



Operation & Maintenance Manual

BOS SAFETAP
Optical Oxygen Sensor
for use with 4401OXY Analyzer

Optical O₂ Products

Operation & Maintenance Manual

BOS SAFETAP Optical Oxygen Sensor

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Receiving & Storage



WARNING!! DO NO DISCARD UV PACKAGING.

Barben oxygen sensors are light sensitive devices. Avoid prolonged exposure to UV light, as this will minimize the effectiveness of the luminophore dye, leading to limited life or failure of the sensor.

Carefully inspect the products immediately upon arrival. If there are missing or damaged items contact the factory or shipping insurance company immediately.

Storage: The storage location should be protected from the elements. Although all components provided are designed to resist corrosion, additional protection from heat (>140°F/ 60°C) and humidity is recommended. Store the sensor caps in factory supplied UV resistant packaging when not in use.

Safety Instructions



Read complete manual to understand operation BEFORE Install & Operation. Please consult factory support for any questions



WARNING: Always wear protective equipment (e.g. face shield, gloves and other protective clothing) and follow safety rules when clearing the line, installing or removing sensor.

Products Covered in this Manual

This product manual provides information about Barben Analytical's BOS SAFETAP oxygen sensor and the replaceable oxygen window cap assembly, B3907-XXXX. The B3907-XXX cap assembly includes a pre-assembled replacement cap and an o-ring replacement for the BOS SAFETAP optical oxygen sensor. The scope of this manual also covers the installation and replacement for the B3907-XXX replacement cap assembly.

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Product Nomenclature and Specifications

Sensor Range	Sensor and Seals	Body Material	Process Connection	Cable Armor	Sensor Length	Lead Length	Agency Approval	
Luminophore								
BOS1	Gas (0 - 4.2% O ₂ , 0 - 41.4 hPa) or Liquid (0 - 1.8 ppm)							
BOS2	Gas (0 - 25% O ₂ , 0 - 250 hPa) or Liquid (0 - 22 ppm)							
BOS3	Gas only (0 - 300 ppm with 1000 ppm over-range)							
Sensor and Seals								
N		BOS FIBERSENSE 4mm wand-style sensor (no integral temperature compensation, sold separately)						
V		Viton O-ring seals (BOS FLEXSENSE & BOS SAFETAP Sensors only)						
E		EPDM O-ring seals (BOS FLEXSENSE & BOS SAFETAP Sensors only)						
K		FFKM (perfluoroelastomer) O-ring seals (BOS FLEXSENSE & BOS SAFETAP Sensors only)						
Body Material								
1		316 Stainless (all versions)						
2		Titanium Gr2 (BOS FLEXSENSE Sensors only)						
3		Hastelloy-C 276 (BOS FLEXSENSE Sensors only)						
Process Connection								
A		4mm Wand (BOS FIBERSENSE Sensors only)						
B		1" Male NPT Assembly Mounting Nut (BOS FLEXSENSE Sensors only)						
C		1/2" Male NPT Assembly Mounting Nut (BOS FLEXSENSE Sensors only)						
D		1/2" Male NPT Ball Valve 750 PSIG Max (BOS SAFETAP sensors only)						
E		1/2" Male NPT Ball Valve 29" Hg Vacuum / 750 PSIG Max. NACE MR0175 (BOS SAFETAP sensors only)						
Fiber Protection								
1		Armor Jacketing Protection						
2		PVC Jacketed Fiber - BOS FIBERSENSE sensors only (Use "N" For PVC Jacket Length)						
BOS Sensor Overall Length (Refer to figures 6 to 11 depending on body style)								
0.7		0.7M (2.3ft) ("N" Standard lead length only)						
2.5		2.5M (8.2ft)						
5.0		5.0M (16.4ft)						
10.		10M (32.8ft)						
XXX		Special Length (If >10M consult factory)						
PVC Jacket Length (fig. 10). Select "N" for BOS FIBERSENSE & SAFETAP Sensors. Options 1, 2, 5, 7 for BOS FLEXSENSE UL Dual Seals sensors ONLY. These options allow PVC jacket fiber length specified separate from the overall jacket fiber length.								
N		Standard - direct connection to 4401OXY Analyzer - Required for BOS FIBERSENSE & SAFETAP Sensors						
1		PVC Jacket Fiber Length 1M (Temperature Compensation separate, with certified 1/2" NPT cable gland)						
2		PVC Jacket Fiber Length 2M (Temperature Compensation separate, with certified 1/2" NPT cable gland)						
5		PVC Jacket Fiber Length 5M (Temperature Compensation separate, includes certified 1/2" NPT cable gland, 10M length only)						
7		PVC Jacket Fiber Length 7M (Temperature Compensation separate, includes certified 1/2" NPT cable gland, 10M length only)						
X		Special PVC Jacket Fiber Length (If >10M consult factory)						
Agency Approval								
ST		Standard						
UL		UL Dual Seal Approval (12mm only, No integral Temperature Compensation available)						
Sensor	Seals	Body	Connection	Armor	Length	Leads	Agency	
BOS1	V	1	B	1	2.5	N	UL	Typical Sensor Configuration

BOS SAFETAP Retractable Optical Oxygen Sensor Specifications

Valve Options	316 stainless 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 50°C (32 to 122°F) operating, 90°C (194°F) non-continuous
Internal Seal Options	Viton, EPDM, FFKM (Kalrez)

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BOS Range Specifications For All Products

BOS1 Gas or Liquid		
	Dissolved Oxygen	Gaseous & Dissolved Oxygen @ 1atm, 20°C
Measurement Range	0 - 1.8 mg/L (ppm)	0 - 4.2 % O ₂ 0 - 41.4 hPa
Limit of Detection	1 ppb dissolved oxygen	0.002 % O ₂
Resolution @ 20°C and 1013 hPa	± 0.30 at 1 µg/L (ppb) ± 0.41 at 10 µg/L (ppb) ± 0.63 at 200 µg/L (ppb)	± 0.0007 % O ₂ at 0.002 % O ₂ ± 0.007 hPa at 0.023 hPa ± 0.0015 % O ₂ at 0.02 % O ₂ ± 0.015 hPa at 2.0 hPa
Response Time (T ₉₀)	< 30 sec.	< 6 sec.
Accuracy @ 20°C	1 ppb (l), 0.002 % O ₂ (g), or 3% of the measured value whichever is greater	
Drift from Photodecomposition	< 2.0 ppb within 30 days (1 min sample rate)	
Operating Temperature Range	0 to 50°C (32 to 122°F)	
Allowable Sensor Temperature	90°C (194°F) non-continuous	
BOS2 Gas or Liquid		
	Dissolved Oxygen	Gaseous & Dissolved Oxygen @ 1atm, 20°C
Measurement Range	0 - 22 mg/L (ppm)	0 - 25 % O ₂ 0 - 250 hPa
Limit of Detection (LOD)	15 ppb dissolved oxygen	0.03 % O ₂
Resolution @ 20°C and 1013 hPa	± 4.5 at 90 µg/L (ppb) ± 45 at 9060 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 @ 20°C	± 0.4 % O ₂ at 20.9 % O ₂ , ± 0.05 % O ₂ at 0.5 % O ₂	
Drift from Photodecomposition	< 0.03 % O ₂ within 30 days (1 min sample rate)	
Operating Temperature Range	0 to 50°C (32 to 122°F)	
Allowable Sensor Temperature	90°C (194°F) non-continuous	
BOS3 - Gas Phase Only		
	Gas Phase Oxygen Only @ 1atm, 20°C	
Measurement Range	0 - 300 ppm with over-range of 1000 ppm	
Limit of Detection (LOD)	0.5 ppm O ₂	
Resolution @ 20°C & 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 @ 20°C	± 2ppm or ± 5% of measured value whichever is greater (or as partial pressure, +/- 0.002 hPa)	
Drift from Photodecomposition	< 2.0 ppm within 30 days (1 min sample rate)	
Operating Temperature Range	0 to 50°C (32 to 122°F)	
Allowable Sensor Temperature	90°C (194°F) non-continuous	
Cross Sensitivity for BOS1, BOS2, BOS3 Sensors Listed above		
No cross-sensitivity for carbon dioxide (CO ₂), hydrogen sulfide (H ₂ S), ammonia (NH ₃), gaseous sulfur dioxide (SO ₂), no cross-sensitivity to pH (1-14), ionic species like sulfide, sulfate or chloride. Usable in methanol, ethanol-water mixtures, and in pure methanol & ethanol. Avoid organic solvents like chloroform, toluene, acetone, and methylene chloride along with any gaseous chlorine (Cl ₂).		

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BOS SAFETAP - Dimensions

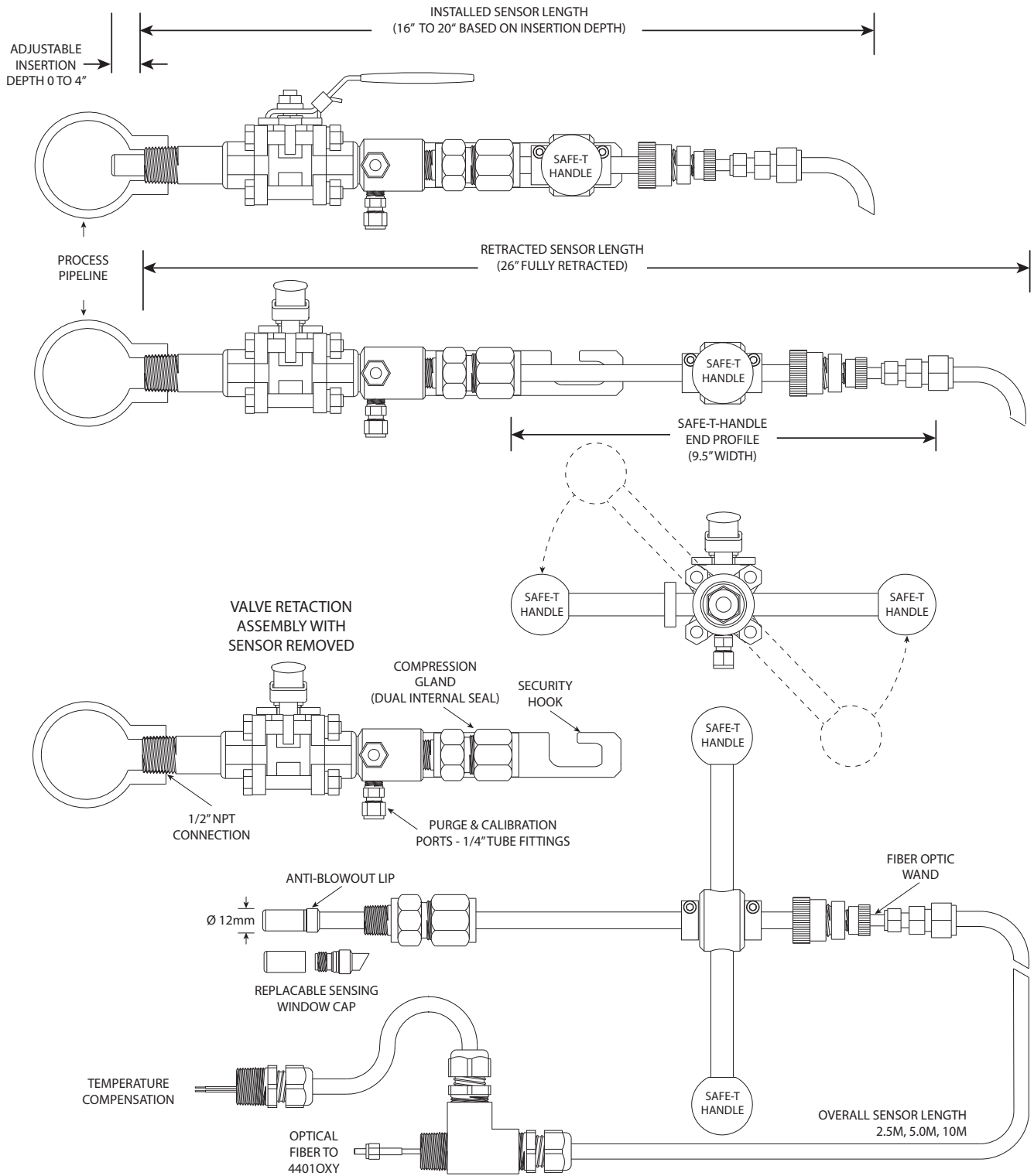


Figure 2

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BOS SAFETAP Optical Oxygen Sensor

Basic Installation And Replacement Guidelines



WARNING!! ALWAYS WEAR PERSONAL PROTECTION EQUIPMENT (PPE)

Use appropriate safety equipment before working on the sensor. Have the proper tools laid out before performing any work.



WARNING!! KEEP THE OPTICAL WINDOW CLEAN. DO NOT TOUCH.

Do not introduce dirt, debris, condensate or other foreign contaminants on to the optical window. The Luminophore and optical isolation on the optical window are delicate. **DO NOT SCRATCH OR DAMAGE THE OPTICAL WINDOW.**



WARNING!! DO NOT OVER TIGHTEN THE SENSOR CAP. The sensor cap should be firmly tightened by hand only. Over tightening the cap may result in damage to the cap housing or to the o-ring on the sensor body. Keep the optical window inside the UV resistant bag until the time of installation.

Installation of New BOS SAFETAP Sensor - Analyzer End (figure 3)

1. Installation of the optical fiber and temperature compensation leads may be done prior to mounting the 4401OXY Oxygen Analyzer.
2. The optical fiber should be threaded onto the fiber connector on the bottom of the 4401OXY Analyzer. The fixed knurled nut provides female threads for the BOS SAFETAP Gland and should not be turned.
3. Temperature compensation may be provided directly with the BOS SAFETAP or through a separate PT1000 RTD temperature sensor. If integral temperature compensation is provided separate armor jacketing and a gland are provided for the RTD wiring.
4. Refer to 4401OXY manual for sensor menu setup or any wiring that may need to occur.

BOS SAFETAP - Typical Install at 4401OXY Analyzer



The close-up picture above shows the fiber optic connection on the bottom of the 4401OXY Oxygen Analyzer. The fiber connector protrudes through the middle of the fixed knurled nut. Finger tighten the optical fiber to the connector in the middle of the knurled nut. Once the optical fiber is connected, tighten the armored gland into the female threads on the knurled nut.

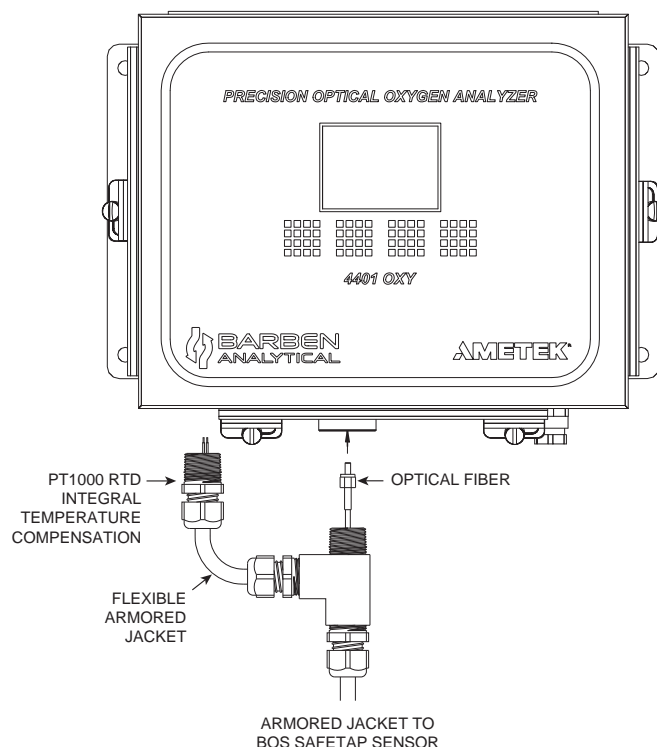


Figure 3

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BOS SAFETAP Optical Oxygen Sensor

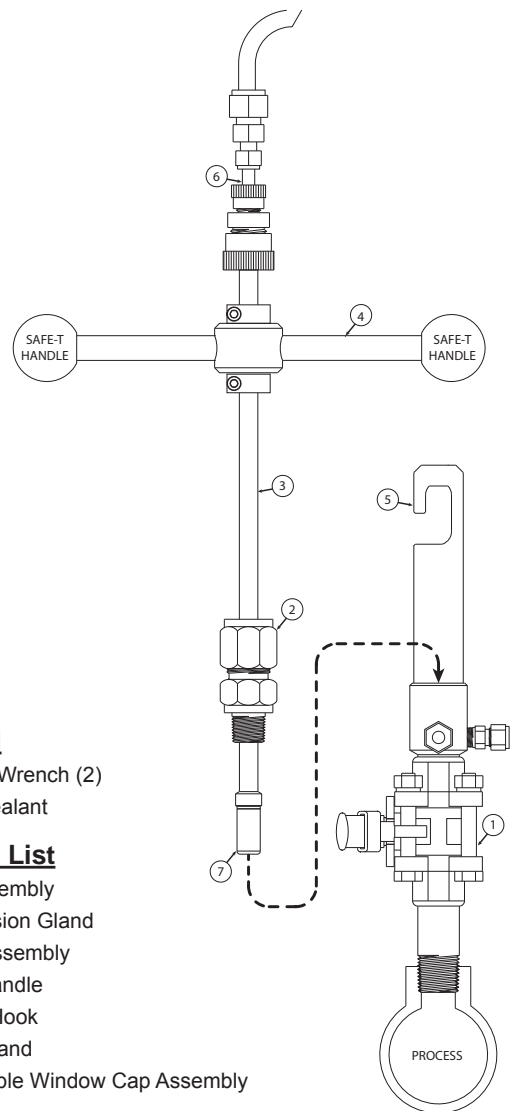
Installation of New BOS SAFETAP Sensor - Process End (figure 4)

1. During initial installation BOS SAFETAP valve assembly (#1) should be installed into the process with the safety nut compression gland (#2) and sensor (#3) removed.
2. Open the valve assembly (#1) (assume no process pressure behind the valve).
3. Use Teflon tape or other suitable sealant on the threads of the compression gland (#2).
4. Thread compression gland (#2) into the valve assembly (#1) using the lower wrench flats to tighten the nut.
5. Once compression gland is installed re-verify that valve is open prior to inserting the sensor assembly (#3).
6. Slowly push down on the Safe-T-Handle (#4) to insert the tip of the sensor into the process. The Safe-T-Handle can rotate 360 degrees during insertion.
7. Maneuver the Safe-T-Handle (#4) into the security hook (#5) to prevent accidental retraction when process pressure is applied.
8. Finger tighten upper nut on the compression gland (#2) then add 1/4 turn using a wrench.
9. Prior to beginning measurement a final check should be made that the optical wand (#6) is fully inserted. The optical wand needs to contact the window cap assembly (#7) at the tip of the sensor to ensure best signal strength.

BOS SAFETAP - Typical Install at Process



The Safe-T-Handle fully inserted and turned into the security hook can be seen above. Once the handle is lodged in the hook the top nut of the compression gland (seen below it) should be tightened to provide additional security against high pressure.



Tools Required

- Crescent Wrench (2)
- Thread sealant

Numbered Part List

1. Valve Assembly
2. Compression Gland
3. Sensor Assembly
4. Safe-T-Handle
5. Security Hook
6. Optical Wand
7. Replaceable Window Cap Assembly

Figure 4

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Removal of BOS SAFETAP Sensor (figure 4)

The BOS SAFETAP Sensor may be periodically removed from the process for cleaning, calibration or window cap assembly replacement. The sensor can be retracted while under pressure by following the steps below. Please remember to use personal protection equipment (PPE) while performing any work on the sensor.

1. Prior to sensor removal make sure that the Safe-T-Handle (#4) is in the security hook (#5) and cannot rotate freely.
2. Loosen the top nut of the compression gland (#2) by 1/4 turn. Push down slowly on the Safe-T-Handle while keeping within the security hook. Process pressure can push the handle back into the hook. This test provides the operator with an understanding of the force needed to ease the sensor out of the process. If a lock-out padlock is used it should be removed prior to this stage.
3. Slowly push down on the Safe-T-Handle (#4) until it can turn freely passed the security hook.
4. Maintain a firm grip on the Safe-T-Handle and let the process pressure push the sensor assembly (#3) back until it can no longer retract.
5. Close the valve assembly to isolate the sensor from the process.
6. Residual process pressure can be bled off through the two 1/4" tubing fittings on the valve assembly. Please use proper precautions if hazardous or toxic gases are present. These tubing fittings can also be used for insitu calibration.

Regular Maintenance

- Ensure that the sensor is clean and free of debris. Clean the sensor window cap assembly with clean water (tap or distilled). Heavier accumulations can be cleaned by soaking the sensor in water and cleaning with a cotton swab.
- Ensure that the soft, black portion of the window cap assembly is free of damage. Damage to the cap may render the sensor inoperable or may affect the accuracy of the readings from the analyzer.
- Ensure that the window cap assembly of the sensor is secured to the sensor housing. An accumulation of moisture inside the sensor may create errors..
- **DO NOT attempt to clean the window cap assembly with the use of a wire brush, screwdriver, sand paper or other method that may damage the tip of the sensor.**

Replacement of Window Cap Assembly (figure 5)

1. Inspect the sensor window cap (#1). Look for visible damage (e.g. deformation, cuts, corrosion) on the metal housing of the cap. Inspect the optical luminophore on the tip of the sensor for damage (e.g. scratches) to ensure the integrity of the reading.
2. Clean the sensor assembly (#2) with a damp cloth to remove residual process material.
3. Unscrew the sensor window cap (#1) from the tip of the sensor.
4. Inspect the o-ring seal (#3) on the sensor stem for damage. Replace the o-ring if necessary.
5. Loosen the knurled compression fitting (#4) until the optical wand (#5) can slide freely inside of the sensor assembly (#2).
6. Slide the optical wand forward, through the sensor assembly (#2), towards the direction of the cap. NOTE: The wand tip should protrude from the open end of the sensor assembly (#2).
7. Hand tighten the replacement window cap assembly (#1) on to the sensor assembly (#2). The cap assembly will contact the optical wand (#5) tip. They should be in contact.
8. Fasten the sensor window cap "hand-tight". Avoid using pliers or other tools.
9. Keep the optical wand (#5) in contact with the window cap assembly (#1) and tighten the knurled compression fitting (#4) "hand-tight". NOTE: Avoid swaging or over-tightening the knurled compression fitting (#4).
10. Carefully reinstall the sensor assembly into the valve assembly. Use care during installation to avoid contact with tip.

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BOS SAFETAP - Window Cap Assembly Replacement

Numbered Part List

1. Replaceable Window Cap Assembly
2. Sensor Assembly
3. O-ring seal
4. Knurled Compression fitting
5. Optical Wand

Tools Required

- Spare Window Cap Assembly
- Damp Cloth
- O-ring seal

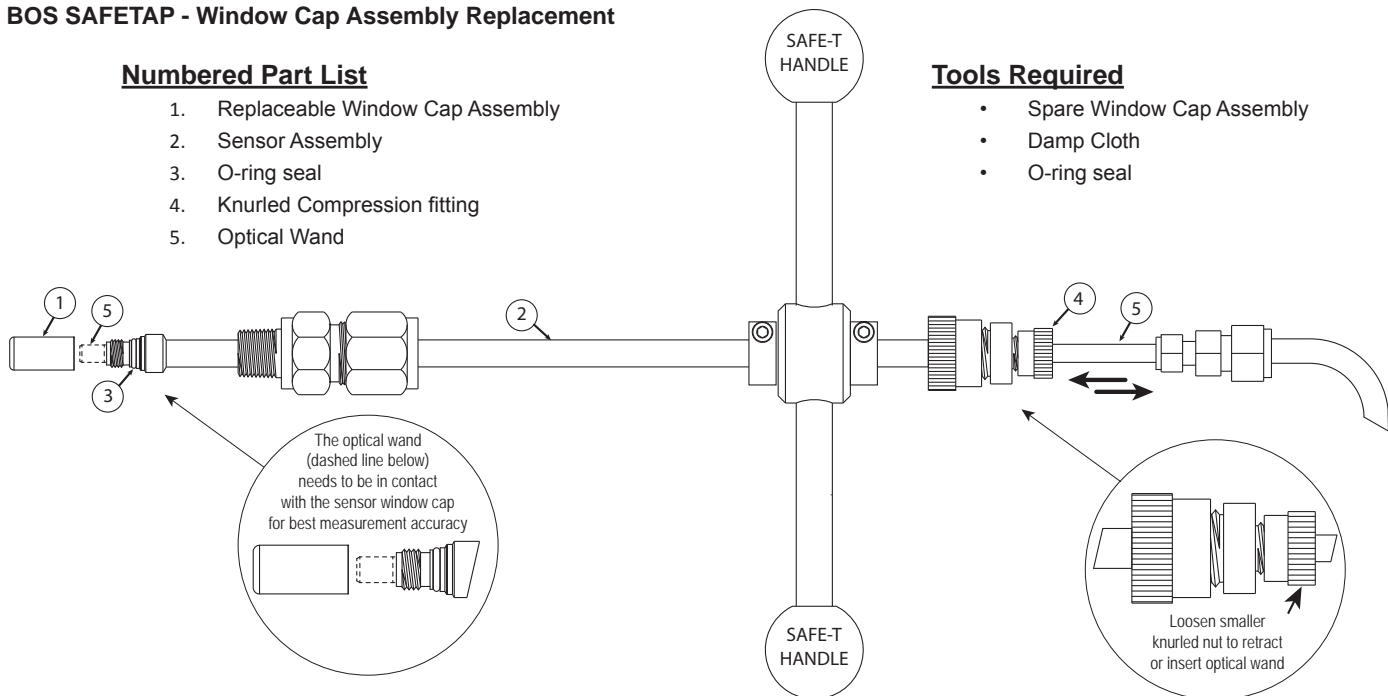


Figure 5

BOS SAFETAP - Insitu Purge & Calibration

The valve assembly of the BOS SAFETAP provides two 1/4" tubing fittings. When the sensor assembly is retracted from the process these tubing fitting can be used to expose the luminophore sensing window to external (customer supplied) purge and calibration gas without removal of the sensor assembly.

Insitu calibration should be done with the sensor assembly fully retracted and the isolation valve closed. Calibration gas should be run for several minutes to purge the valve assembly of any residual oxygen from the process. In liquid applications orientation of the outlet port should allow for residual process liquid to drain prior to calibration.

A typical flow schematic for insitu calibration is shown to the right. Please consult Barben Analytical for additional support for these types of installations.

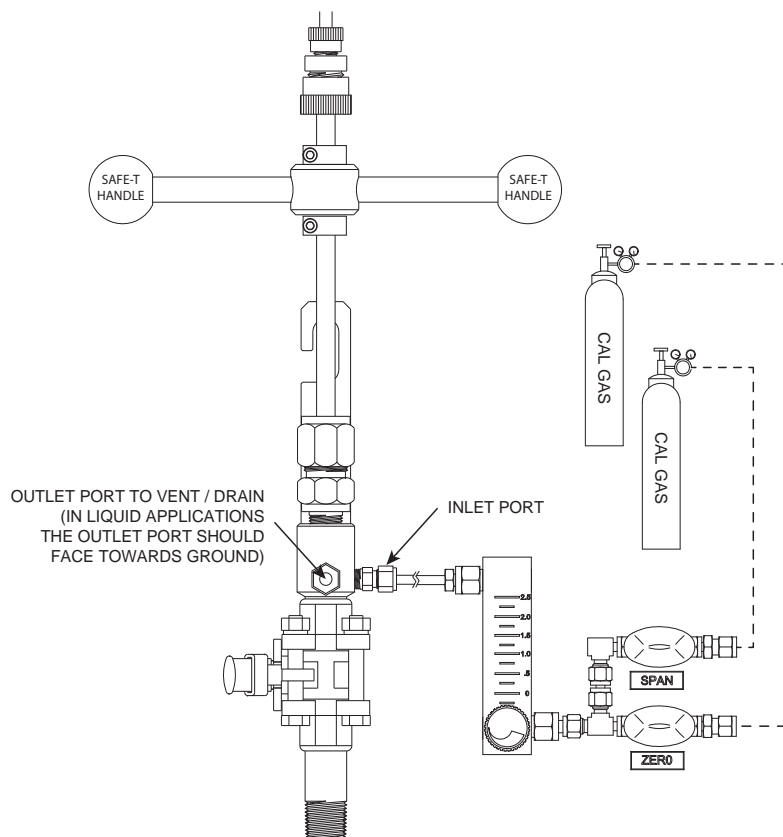


Figure 6

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BOS SAFETAP Optical Oxygen Sensor

Spare Parts

Listed below are the most common recommended spare parts. Replacement window cap assemblies include the lumino-phore sensing element and can be ordered as new with the part numbers listed below. Call factory support for additional details on other spare parts that may be required for your installation.

Recommended Spare Parts - Replacement Window Cap Assembly (Reference figure 7)			
Part #	Optode	Body Material (Wetted)	O-Ring Seals (Wetted)
B3907-1101	BOS1	316 Stainless	Viton
B3907-1100	BOS1	316 Stainless	EPDM
B3907-1102	BOS1	316 Stainless	FFKM (perfluoroelastomer)
B3907-1104	BOS2	316 Stainless	Viton
B3907-1103	BOS2	316 Stainless	EPDM
B3907-1105	BOS2	316 Stainless	FFKM (perfluoroelastomer)
B3907-1107	BOS3	316 Stainless	Viton
B3907-1106	BOS3	316 Stainless	EPDM
B3907-1108	BOS3	316 Stainless	FFKM (perfluoroelastomer)

Optional Spare Parts - (Reference figure 7)	
Part #	Description and Materials (wetted)
B4904K-1017	Replacement Seal Kit, Viton Extreme
B4904K-1015	Replacement Seal Kit, EPDM
B4904K-1016	Replacement Seal Kit, FFKM (perfluoroelastomer)
B5102-1000	Lock-out padlock (can be used for Safe-T-Handle or for valve lockout)

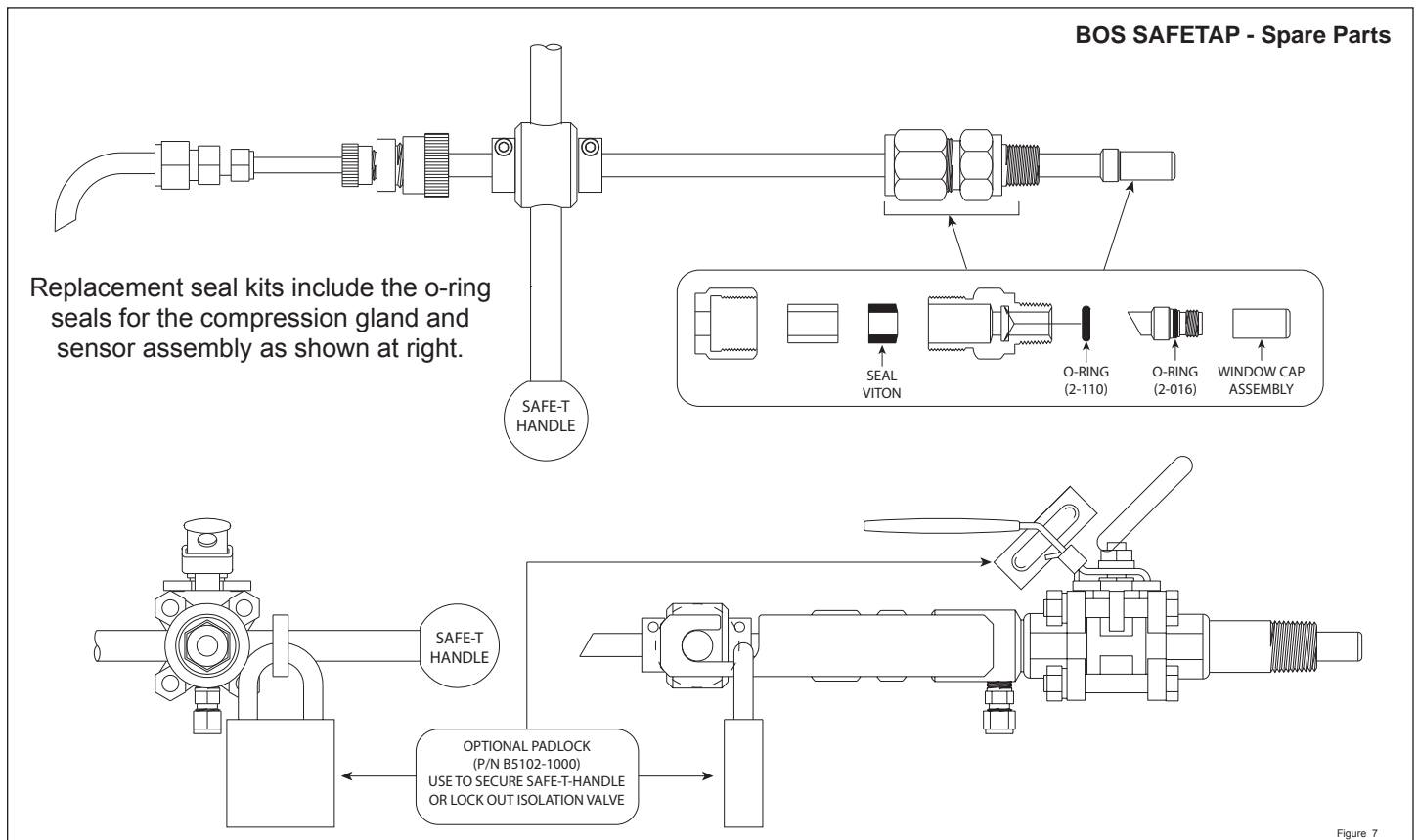


Figure 7

Operation & Maintenance Manual BOS SAFETAP Optical Oxygen Sensor

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BOS SAFETAP Optical Oxygen Sensor

Contact Us

Barben Analytical is a leading supplier of analytical measurement technology targeting the industrial marketplace. It is a wholly owned subsidiary of Ametek.

Ametek has nearly 14,000 colleagues at over 120 manufacturing locations around the world. Supporting those operations are more than 80 sales and service locations across the United States and in more than 30 other countries around the world.

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