
**MODEL
319R
OXYGEN DETECTOR
INSTRUCTION MANUAL**

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Warranty

This equipment is sold subject to the mutual agreement that it is warranted by us free from defects of material and of construction, and that our liability shall be limited to replacing or repairing at our factory (without charge, except for transportation), or at customer plant at our option, any material or construction in which defects become apparent within one year from the date of shipment, except in cases where quotations or acknowledgements provide for a shorter period. The Micro-Fuel Cell warranty period begins on the date of shipment from Teledyne. Components manufactured by others bear the warranty of their manufacturer. This warranty does not cover defects caused by wear, accident, misuse, neglect or repairs other than those performed by Teledyne or an authorized service center. We assume no liability for direct or indirect damages of any kind and the purchaser by the acceptance of the equipment will assume all liability for any damage which may result from its use or misuse.

We reserve the right to employ any suitable material in the manufacture of our apparatus, and to make any alterations in the dimensions, shape or weight of any parts, in so far as such alterations do not adversely affect our warranty.

IMPORTANT NOTICE

This instrument is intended to be used as a tool to gather valuable data. The information provided by the instrument may assist the user in eliminating potential hazards caused by the user's process; however, it is essential that all personnel involved in the use of the instrument or its interface, with the process being measured, be properly trained in the process itself, as well as all instrumentation related to it.

The safety of personnel is ultimately the responsibility of those who control process conditions. While this instrument may be able to provide early warning of imminent danger, it has no control over process conditions, and it can be misused. In particular, any alarm or control systems installed must be tested and understood, both as to how they operate and as to how they can be defeated. Any safeguards required such as locks, labels, or redundancy, must be provided by the user or specifically requested of Teledyne when the order is placed.

The purchaser must be aware of the hazardous process conditions inherent in the process(es) he uses. He is responsible for the training of personnel, for providing hazard warning methods and instrumentation per the appropriate standards, and for ensuring that hazard warning devices and instrumentation are maintained and operated properly.

TBE, the manufacturer of this instrument, cannot accept responsibility for conditions beyond its knowledge and control. **No statement expressed or implied by this document or any information disseminated by the manufacturer or its agents, is to be construed as a warranty of adequate safety control under the user's process conditions.**

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Introduction

The Teledyne Brown Engineering Analytical Instruments (TBE) Model 319R Oxygen Detector measures the percent of oxygen in a wide range of gases and gas mixtures. Modular and compact design provide outstanding performance and reliable on-line monitoring and make the 319R virtually maintenance-free.

A special range on the 319R enables you to calibrate in ambient air. The Micro-Fuel Cell produces an output that corresponds linearly to the oxygen concentration; the absence of oxygen produces zero current. This means you can use ambient air (20.9% oxygen) to calibrate, eliminating the need for special span gases.

The Model 319R contains a main PC board and power supply/inter-connection board housed in a rack mount enclosure. The oxygen probe can be separated from the unit by as much as 6 feet, depending on the level of electromagnetic noise in the operating environment.

Main Features

1. Two Ranges of Analysis. The Model 319R Oxygen Monitor features two analysis ranges: 0–200 PPM and 0–1999 PPM. A 0-25% range is accessible only during calibration to allow calibration in air.

2. Liquid Crystal Display Digital Readout. The digital front panel LCD continuously displays and updates O₂ monitoring levels and displays values when calibrating the instrument and setting the alarms. Note that the display will not read higher than 199.9 on the 200 PPM range and 1999 on the 2000 PPM range.

3. Percent of Range Alarms. Three (3) alarm relays are provided: one high and one low alarm, which are user adjustable, and one low alarm, factory set as a cell fail alarm at 2% of full scale.

4. Proven Sensor. The 319R uses the Class Z-2 Micro-Fuel Cell, warranted for 6 months, with a life expectancy of 6 months.

5. Analog Voltage Output. The Model 319R provides customer connections to external devices, such as computers, recorders, alarms, etc., at 0–10 VDC, negative ground, plus contact closures for range identification. Custom voltage outputs, either grounded or isolated, are available as options.

6. Analog Current Output. The Model 319R has a 4–20 mA current output suitable for connection to external devices that use a 4–20 mA input.

7. Over-Range/Cell Failure Visual Indicator. The Model 319R has a LED (Light Emitting Diode) to the left of the Liquid Crystal Display. The LED will blink when the oxygen reading exceeds 105% of scale, or a cell failure alarm is activated.

Micro-Fuel Cell

The Model 319R uses a Class Z-2 Micro-Fuel Cell. The Micro-Fuel Cell measures the concentration of oxygen in a gas stream. The analysis is specific for oxygen; i.e. the measuring cell will not generate an output current unless oxygen is present in the sample gas. Therefore, the analyzer has an absolute zero, and requires no zero gas. Span calibration is performed with atmospheric air as the span gas.

To eliminate any inaccuracies due to the positive temperature coefficient of the Micro-Fuel Cell, a thermistor circuit and network of precision resistors produce a negative coefficient of matching characteristics. The variable element (thermistor) in the compensation network is in the same assembly as the Micro-Fuel Cell, exposing both devices to the same temperature conditions.

Warranty Conditions

Customers having warranty claims must return the cell in question to the factory for evaluation. If it is determined that failure is due to faulty material or workmanship the cell will be replaced free of charge.

CAUTION: Evidence of tampering or abuse will render the warranty null and void.

Installation & Operation

Precautions

1. **Read this chapter in its entirety before installing the unit.**
2. Upon receipt of the instrument, inspect the entire unit for damage. Notify the shipper if any damage is found. Check the unit, probe, and included accessories for broken or loose parts.
3. The sample **must** be free of entrained solids and water. A high humidity sample is ideal since it will prevent water loss from the cell electrolyte.
4. The Micro-Fuel Cell sensor electrolyte is caustic. Do not attempt to open or repair the sensor. Leaking or exhausted sensors should be disposed of in accordance with local regulations. Please refer to the Material Safety Data Sheet in the Appendix to learn about potential hazards and corrective action in case of accident.
5. Do not scratch, puncture, or damage the sensing membrane of the Micro-Fuel Cell sensor. Damage to the membrane will require replacement of the sensor.

Location & Mounting

The unit is designed to be panel-mounted in a general purpose area, away from moisture and the elements. The unit should be installed at viewing level in a sheltered area.

Refer to the Outline diagram (dwg. C-57490) for the physical dimensions of the analyzer.



The analysis unit should be installed in the process at a maximum distance of 6 feet away from the main unit, depending upon the level of electromagnetic noise in the operating environment.

Analysis Unit Connection

The receptacle for the analysis unit cable is located in the lower left-hand corner of the rear panel. The 6-pin Minifit fitting is keyed to fit only one way in the receptacle; do not force it in. The other end of the cable is made of four separate wires; these should be connected to the terminal strip on the analysis unit as follows:

Red:	#1	
Black:	#2	
Green:	#3	} The green and white connectors can be interchanged, but be consistent.
White:	#4	

Refer to the probe interconnection dwg. A-58154.

Sample flow and pressure should not create significant backpressure past the sensor; **2 SCFH** (atmospheric pressure) is nominal.

AC Power (International Ranges)

A 6-foot power cord is supplied with the Model 319R. Plug the female end of the power cord into the receptacle in the upper left-hand corner of the rear panel. The unit is now ready to be plugged into an AC power source (85-264 VAC, 47-440 Hz).

The ON/OFF switch is located to the right of the power cord receptacle.

DC Power

If you have ordered the 10-36 VDC power option, install DC power via the terminal strip on the rear panel of the unit.

Output Signals

Terminals for 4-20 mA, 0-10 VDC, and range identification are labeled on the rear panel of the analyzer, along with high alarm, low alarm, and sensor failure block terminals.

Alarm Terminal Connection

SPDT relay contacts are provided for each of the 3 alarms. There are 9 terminals available on the back panel of the system for alarm circuit connection. The explanation for the relay terminals abbreviations is as follows:

NC= Normally closed

C = Common

NO= Normally open

The alarm relay circuits are designed for failsafe operation, meaning that the relays are activated (energized) during normal operation. If power fails, or if an alarm setpoint is exceeded, the relay will become de-energized.

Sensor Installation or Replacement

CAUTION: The sensor electrolyte is caustic. Do not let it come in contact with skin. If it does, immediately flush affected area with water. Consult the Emergency First Aid procedures in the Material Safety Data Sheet in the Appendix.

Do not attempt to open or repair the sensor. Leaking or exhausted sensors should be disposed of in accordance with local regulations. Please refer to the Material Safety Data Sheet in the Appendix to learn about potential hazards and corrective action in case of accident.

To install the cell:

1. Turn the unit off by placing the power switch (on the rear panel of the analyzer) in the OFF position.
2. Disconnect the red and black leads from the terminal strip. Remove the spent cell by pulling up on it and twisting slightly.
3. Remove the new Micro-Fuel Cell from its protective bag.

CAUTION: Do not scratch, puncture, or damage the sensing membrane of the Micro-Fuel Cell sensor. Damage to the membrane will require replacement of the sensor.

4. Attach the red lead of the new cell to terminal #1 and the black lead to terminal #2.
5. Replace the cell on the cell holder by pushing and twisting until it strikes bottom.

Setting Alarms

The alarms can be adjusted over the full scale range, and they are set as a percent of full scale. Thus, an alarm set to indicate 192 on the display while on the 200 PPM O₂ range will activate at 192 PPM O₂ on the 200 PPM O₂ range and at 1920 O₂ on the 2000 O₂ range (96% of full scale). To set the alarms:

1. Place the range switch located below the front panel display in the 2000 PPM range position (or highest range available).
2. Place the power switch in the ON position.
3. To set the high alarm, hold down the SET HI ALARM button while turning the potentiometer to the right of the button until the display reads the desired concentration.
4. To set the low alarm, hold down the SET LO ALARM button while turning the potentiometer to the right of the button until the display reads the desired concentration.
5. Remember, the System/Cell Failure alarm is factory set at 2% of full scale; should this alarm trigger, the LED to the left of the front panel display will blink.

Calibration

To calibrate the 319R:

1. Place the power switch in the ON position.
2. Allow the LCD reading to stabilize.
3. Expose the sensor to ambient air (20.9%) or instrument grade air. If the analyzer goes overrange, the display will go blank and the LED to the left of the display will blink. Hold down the SPAN button until the LED stops blinking.
4. While holding down the SPAN AT 20.9% button, adjust the potentiometer to the right of the button until the display is stable and reads 20.9%.
5. Release the button. The unit is now calibrated.
6. The alarms will be disabled for about 25 seconds after the SPAN button is released. Disabling the alarms allows air to be purged from the sample system without tripping any alarm set below span, or 21%.

NOTE: Do not attempt to adjust any alarm setpoints while the alarms are disabled during the 25-second period.



Maintenance

Replacing the Fuse

If the unit will not turn on when plugged in and switched ON (via the power switch), or you suspect a blown fuse, replace the fuse using the following procedure:

1. Disconnect the AC power and place the power switch located on the rear panel in the OFF position.
2. The fuse is located next to the power cord receptacle in the upper left-hand corner of the rear panel. Remove the power cord from the receptacle.
3. Insert a small flat-blade screwdriver into the slot in the receptacle wall nearest the fuse and gently pry open the fuse receptacle. The fuse holder will slide out. The fuse in use is visible in the clip. To open the spare fuse compartment, push on one end until it slides out.
4. Remove the bad fuse and replace it with a 5X20 mm 1A, 250V fast acting fuse for AC units (TBE P/N F-1189), or 1/2A fast acting fuse for DC units (P/N F-51).

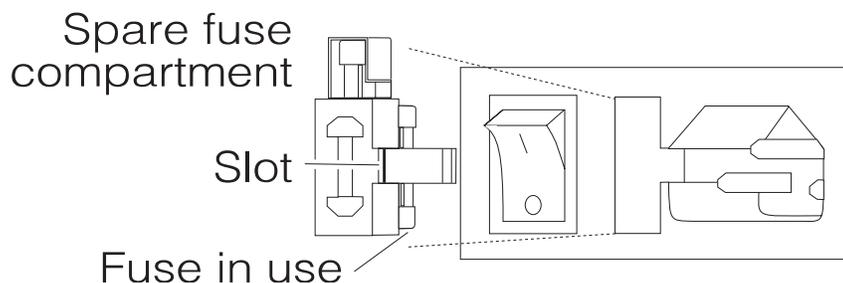


Figure 5-1: Replacing the fuse (AC power).

5. Replace the fuse holder into its receptacle, pushing in firmly until it clicks.

In units with DC power, the fuse is located on the rear panel above the ON/OFF switch. Open the fuse holder by unscrewing and removing the knob marked FUSE. The fuse will be located inside the knob.

Replacing the Sensor

The characteristics of the Micro-Fuel Cell are similar to those of a mercury battery in that both provide an almost constant output through their useful life, and then fall off sharply towards zero at the end. If the sample being analyzed has a low oxygen concentration, cell failure will probably be indicated by the inability to properly calibrate the analyzer. You will find that very little adjustment of the span potentiometer will be required to keep the analyzer calibrated properly during the duration of a given cell's useful life. If large or many turn adjustments (clockwise) are required to calibrate the instrument, or calibration cannot be achieved within the range of the control, the cell needs replacing. Read the following section (Cell Warranty) before replacing the cell. Cell installation instructions are in Chapter 2: Cell Installation.

In addition, if the LCD displays "00.0" when the unit is plugged in, and the power switch is in the ON position, the sensor needs to be replaced.

IMPORTANT: After replacing the Micro-Fuel Cell, proceed to Chapter 2: Calibration.

To offset the possibility of not having a replacement cell available when needed, a spare cell can be ordered shortly after the instrument is in service, and each time after cell replacement thereafter.

NOTE: Do not stockpile cells, as the cell warranty begins on date of shipment.

Only one cell per instrument should be in reserve. The spare cell should be carefully stored in an area not subject to large variations in ambient temperature (75° F nominal), and in such a way to eliminate any possibility of damage. Under no circumstance should you disturb the integrity of the cell package until the cell is to be used. If the cell package is punctured and air permitted to enter, the cell will immediately start to react to the presence of oxygen.

Warranty Conditions

The Class Z-2 cell used in the 319R is warranted for six (6) months of service from the date of shipment. Customers having warranty claims must return the cell in question to the factory for evaluation. If it is determined that failure is due to faulty material or workmanship, the cell will be replaced free of charge.

CAUTION: Evidence of tampering or abuse will render the warranty null and void.

Appendix

Specifications

Ranges:	0–200 PPM, 0–1999 PPM O ₂ , and 0–25% calibration range
Sensitivity:	1% of full scale
Signal Output:	Standard: 0–10 VDC, negative ground 4–20 mA, negative ground plus contact closures for range identification.
Display:	Digital 7 segment, 3½-digit LCD with over range indicator.
Alarms:	One high alarm, adjustable & fail-safe. One low alarm, adjustable & fail-safe. One low alarm, fixed at 2% full scale and fail-safe.
Accuracy:	±2% of full scale at constant temperature and pressure of calibration ±5% of full scale throughout operating temperature range (once temperature equilibrium has been reached).
Response:	90% of full scale in 35 seconds.
Operating Temp. Range:	32 °F to 122 °F (0°C to 50°C)
Power:	85-264 VAC, 47-440 Hz or 10-36 VDC, user specified, 10 W max.
Enclosure:	General purpose, panel mount
Cell Type:	Z-2
Cell Warranty:	6 months
Cell Life (Expected):	6 months
Dimensions:	2.75 "H × 6.0 "W × 2.75 "D (63.5 mm × 152.4 mm × 63.5 mm) Faceplate: 3.75 "H × 7.0 "W (95.25 mm × 177.8 mm) Probe unit: 4.0 "H × 6.0 "W × 3 "D (101.6 mm × 152.4 mm × 76.2 mm)

Spare Parts List

QTY.	P/N	DESCRIPTION
1	C57304	PC board, main
1	A33748	Thermistor assembly
1	C6689-Z2	Micro-Fuel Cell, Z-2
4	F1189	Fuse, 1A (AC)
4	F51	Fuse, ½A (DC)
1	A59264	Probe to analyzer cable, 6 feet

A minimum charge of US \$20.00 is applicable to spare parts orders.

IMPORTANT: Orders for replacement parts should include the part number and the model and serial number of the system for which the parts are intended.

Send orders to:

TELEDYNE BROWN ENGINEERING
Analytical Instruments
16830 Chestnut Street
City of Industry, CA 91749-1580
Telephone: (818) 961-9221
TWX: (910) 584-1887 TDYANYL COID
Fax: (818) 961-2538
or your local representative

Drawing List

C-57490	Outline diagram
A-58154	Probe interconnection diagram
D-57302	Electronic PCB schematic diagram
C-57305	Power supply PCB schematic diagram
C-57307	Power supply PCB assembly diagram
B-58123	Analysis unit (probe) outline

Note: 319R analyzers with 25% and 100% range modifications incorporate the following changes:

100% range modified circuit changes:

1. JP2 - connects pins 1 and 2
2. R52 is 12.5K
3. R30 is 7.5K
4. R35 is 1.5K

25% range modified circuit changes:

1. JP2 - connects pins 1 and 2
2. R52 is 50K
3. R30 is 28K
4. R35 is 11K

Material Safety Data Sheet

Section I – Product Identification

Product Name: Micro-Fuel Cells and Super Cells, all classes except A-2C, A-3, and A-5.

Electrochemical Oxygen Sensors, all classes except R-19.

Mini-Micro-Fuel Cells, all classes.

Manufacturer: Teledyne Brown Engineering Analytical Instruments

Address: 16830 Chestnut Street, City of Industry, CA 91749

Phone: (818) 961-9221

Customer Service: Extension 222

Environmental Health

and Safety: Extension 230

Date Prepared : 04/26/95

Section II – Hazardous Ingredients/Composition

Material or Component TLV	C.A.S. #	Quantity	OSHA PEL	ACGIH
Lead (Pb)	7439-92-1	3–20 gms	0.05 mg/m ³	0.15 mg/m ³
Potassium Hydroxide Solution 15% (KOH)	1310-58-3	1–5 ml	None	2 mg/m ³

Section III – Physical/Chemical Characteristics

Material Appearance or Component	Boiling Point (°C)	Specific Gravity	Vapor Pressure	Melting Point (°C)	Density	Evap. Rate	Solubility in Water	Odor
Lead	1744	11.34	na	328	na	na	Insoluble	Solid, silver gray, odorless
Potassium Hydroxide	1320	2.04	na	360	na	na	Complete	White or slightly yellow, no odor

Section IV – Fire and Explosion Hazard Data

Flash Point:	na	Flammable Limits:	na	LEL:	na	UEL:	na
Extinguishing Media:	Use extinguishing media appropriate to surrounding fire conditions. No specific agents recommended.						
Special Fire Fighting Equipment:	Wear NIOSH/OSHA approved self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.						
Unusual Fire and Explosion Hazards:	Emits toxic fumes under fire conditions.						

Section V – Reactivity Data

Stability:	Stable
Incompatibilities:	Aluminum, organic materials, acid chlorides, acid anhydrides, magnesium, copper. Avoid contact with acids and hydrogen peroxide > 52%.
Hazardous Decomposition of Byproducts:	Toxic fumes
Hazardous Polymerization:	Will not occur.

Section VI – Health Hazard Data

Routes of Entry:	Inhalation:	Highly unlikely
	Ingestion:	May be fatal if swallowed.
Skin:	The electrolyte (potassium hydroxide) is corrosive; skin contact may cause irritation or chemical burns.	
Eyes:	The electrolyte (potassium hydroxide) is corrosive; eye contact may cause irritation or severe chemical burns.	
Acute Effects:	The electrolyte is harmful if swallowed, inhaled or adsorbed through the skin. It is extremely destructive to tissue of the mucous membranes, stomach, mouth, upper respiratory tract, eyes and skin.	
Chronic Effects:	Prolonged exposure with the electrolyte has a destructive effect on tissue.	
	Chronic exposure to lead may cause disease of the blood and blood forming organs, kidneys and liver, damage to the reproductive systems and decrease in fertility in men and women, and damage to the fetus of a pregnant woman. Chronic exposure from the lead contained in this product is extremely unlikely.	

Signs and Symptoms of Exposure:	Contact of electrolyte with skin or eyes will cause a burning sensation and/or feel soapy or slippery to touch. Other symptoms of exposure to lead include loss of sleep, loss of appetite, metallic taste and fatigue.
Carcinogenicity:	Lead is classified by the IARC as a class 2B carcinogen (possibly carcinogenic to humans)
OSHA:	Where airborne lead exposures exceed the OSHA action level, refer to <i>OSHA Lead Standard 1910.1025</i> .
NTP:	na
Medical Conditions Generally Aggravated by Exposure:	Lead exposure may aggravate disease of the blood and blood forming organs, hypertension, kidneys, nervous and possibly reproductive systems. Those with preexisting skin disorders or eye problems may be more susceptible to the effects of the electrolyte.
Emergency First Aid Procedures:	In case of contact with the skin or eyes, immediately flush with plenty of water for at least 15 minutes and remove all contaminated clothing. Get medical attention immediately. If ingested, give large amounts of water and DO NOT INDUCE VOMITING. Obtain medical attention immediately. If inhaled, remove to fresh air and obtain medical attention immediately.

Section VII – Precautions for Safe Handling and Use

NOTE: The oxygen sensors are sealed, and under normal circumstances, the contents of the sensors do not present a health hazard. The following information is given as a guide in the event that a cell leaks.

Protective measures during cell replacement:	Before opening the bag containing the sensor cell, check the sensor cell for leakage. If the sensor cell leaks, do not open the bag. If there is liquid around the cell while in the instrument, wear eye and hand protection.
Cleanup Procedures:	Wipe down the area several times with a wet paper towel. Use a fresh towel each time. Contaminated paper towels are considered hazardous waste.

Section VIII – Control Measures

Eye Protection:	Chemical splash goggles
Hand Protection:	Rubber gloves
Other Protective Clothing:	Apron, face shield
Ventilation:	na

Section IX – Disposal

Both lead and potassium hydroxide are considered poisonous substances and are regulated under TSCA and SARA Title III.

EPA Waste Number:	D008
California Waste Number:	181
DOT Information:	RQ Hazardous Waste Solid N.O.S. (Lead), 9, UN3077, PG III

Follow all Federal, State and Local regulations.

Section X – References

Material Safety Data Sheets from J.T. Baker Chemical, Aldrich, Malinckrodt, ASARCO
U.S. Department of Labor form OMB No. 1218-0072
Title 8 California Code of Regulations
TSCA
SARA Title III
CFR 49
CFR 29
CFR 40

NOTE: The above information is believed to be correct and is offered for your information, consideration, and investigation. It should be used as a guide. Teledyne Brown Engineering Analytical Instruments shall not be held liable for any damage resulting from handling or from contact with the above product.