(PAPERPORT)

TED 60-T

PORTABLE OXYGEN ANALYZER

OPERATOR'S MANUAL

P/N MC40575B.01
7/23/91

TELEDYNE ELECTRONIC DEVICES

Warranty

Teledyne warrants that the goods are free from defects of material and of constuction for a period of 2 years from the date of shipment from Teledyne. The Class T-7 Micro-Fuel Cell is warranted for one year from the date of shipment from Teledyne. The liability of Teledyne, if any, shall be limited solely to the replacement and repair of the goods and shall not include shipping costs or other incidental damages as defined in Section 2-715 of the U.S. Uniform Commercial Code.

This warranty is null and void if any goods are subjected to misuse, negligence, accident, or repairs other than those performed by Teledyne or an authorized service center.

Caution: Federal law restricts this device to sale by or on the order of a physician.

How To Use This Manual

This manual is designed to walk you through the initial set-up of the TED 60T. After you have used it to initially install your analyzer, it becomes a quick reference guide to help you with specific questions or operating problems.

Before you even turn on the instrument, you are advised to read Chapters 1 and 2. These chapters help you to become better acquainted with the monitor and how it works before you actually begin to use it.

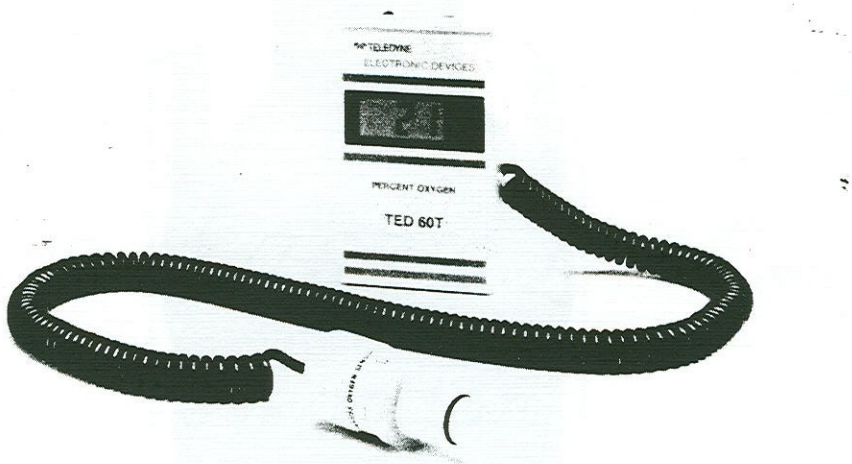
Please read **Chapter 2: Operations** in its entirety before proceeding further with the manual.

Table of Contents

Introduction

The Teledyne Electronics Devices 60T Oxygen Analyzer provides analysis in respirators, incubators, and other medical equipment where specific monitoring of oxygen is vital. The unit is compact, light, fits comfortably in a pocket, and incorporates a belt clip for easy carrying. Its 9-volt battery lasts about one year in normal service.

The TED 60T utilizes the Class T–7 Micro-Fuel Cell specifically designed for medical applications. The sensor is a self-contained galvanic cell with a 90% response time of typically 6–8 seconds at 5 liters/minute and a life expectancy of 10 months in 100% oxygen (continuous). Replacing the sensor is as easy as unclipping the old sensor and snapping on a replacement. The low-cost sensor also has an excellent shelf life that makes keeping spares a sensible proposition.



Front view of the TED 60-T

The TED 60T incorporates a conbination of important features. The liquid crystal display (LCD) provides an easy-to-read indication of the oxygen content of the gas being monitored, with a resolution of 1% oxygen. The upper left-hand corner of the LCD indicates "BAT" when the batteries are low.

1.0 Introduction

Located on the top panel of the monitor are the ON/OFF power switch and the calibration control button. The battery is located in the back beneath a sliding cover.

The Class T–7 Micro-Fuel Cell is the heart of the TED 60T. The sensor is connected to a coiled cable one foot (0.3 meter) long which extends to about five feet (1.5 meters).

Applications

The TED-60T is designed to analyze oxygen concentrations in a variety of medical gas mixtures. It is recommended that the instrument **only be used as a secondary measuring device** to verify the concentration of oxygen in gas mixtures prepared using a gas blender, anesthesia gas machine, or similar apparatus. The use of this instrument as a primary or only means of preparing gas mixtures for human consumption is **not** advised.

The unit may be used for verifying oxygen concentrations in gas mixtures used in:

- Anesthesia
- Respiratory Therapy
- Neonatal Care
- Intensive Care

Operations

NOTE: UPON RECEIPT, INSPECT THE ENTIRE UNIT FOR DAMAGE. CHECK UNIT AND INCLUDED ACCESSORIES FOR BROKEN OR LOOSE PARTS. IF DAMAGED, DO NOT USE; NOTIFY THE SHIPPER; AND CONSULT TELEDYNE ELECTRONIC DEVICES.

Set-Up

To set up and use your TED 60T:

- Install the battery.
- Install the sensor.
- Calibrate the unit.

Battery Installation or Replacement

NOTE: A 9-volt alkaline battery must be installed in the unit before the TED 60T can operate.

1. Turn the unit off (if it is on).

2. Below the belt clip on the rear of the unit is the battery compartment. The door slides downward in the direction of the arrow.

3. Unclip the old battery and replace. The battery snap connector will only accept a battery one way, so do not force it.

NOTE: Use alkaline batteries only. Other types may give erroneous readings.

If "BAT" appears in the upper left-hand corner of the LCD, the battery needs replacing.

2.0 Operations

Sensor Installation or Replacement

NOTE: The T-7 oxygen sensor must be installed before the TED 60T will operate.

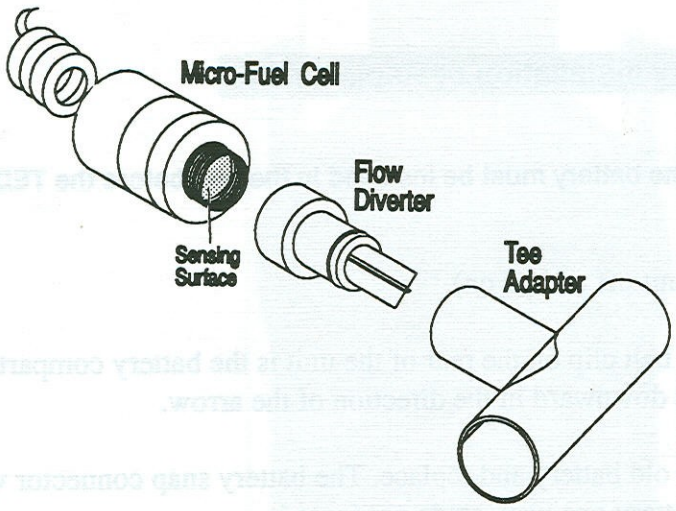
CAUTION: Do not autoclave the sensor. See page 2.4, Sterilization.

1. Remove the new sensor from its protective bag. Inspect the sensor for damage or electrolyte leakage. If the sensor is damaged, obtain a replacement. Do not use the defective sensor as it may damage the unit.

CAUTION: The T–7 sensor electrolyte is caustic. Do not let it come in contact with skin. If it does, flush affected area with water. Do not attempt to open or repair the sensor. Check the sensor regularly for leaks. Leaking or exhausted sensors should be disposed of in accordance with local regulations. Consult the Material Safety Data Sheet in the Appendix.

2. Plug the end of the coiled cable into the telephone jack receptacle on the end of the T-7 sensor, observing proper key orientation. The jack will only fit one way, so if it does not fit, rotate it until it slides in easily.

NOTE: If the TED 60T is used for diffusion sampling (i.e., incubators, tents, etc.), the plastic flow diverter must be removed from the T-7 sensor. If the sensor is used in breathing circuits, etc., the diverter must be used.



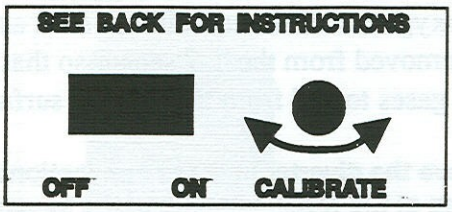
Calibration

NOTE: Never expose the sensor to varying temperatures (i.e., hold the sensor in your hand) while calibrating.

1. Switch the unit ON.

2. Place the sensor in 100% oxygen.

NOTE: The flow diverter should only be used with flowing gas circuits.



3. The CALIBRATE button is located on the top of the unit. Turn the button by pressing down on it and twisting. Rotate until the display reads 100%.

4. Remove the sensor from 100% oxygen. If the flow diverter is attached, remove it and expose the sensor to room air. The LCD should display 20–22%.

5. A calibration check may be conducted at any time to assure proper operation. Remove the diverter and expose the sensor to room air, and verify that the reading is 20–22%. Expose the sensor to 100% oxygen (preferably using the diverter and tee adapter in a flow circuit) and verify that the reading is 99–101%.

NOTE: Never calibrate the unit in humidified gas, as water vapor dilutes the calibration gas and makes the oxygen concentration appear lower than it really is.

Use

NOTE: Prior to use, check the calibration and check the sensor for leaks or damage.

The TED 60T can be used to analyze gas mixtures for oxygen in two basic modes:

1.) In breathing circuits or other instances where gases are flowing in tubing circuits.
2.) In confined volumes such as incubators or tents.

When measuring for oxygen in breathing circuits, the diverter **must** be used. The diverter should be screwed onto the threaded front end of the T-7 sensor. A tee adapter (either plastic, P/N A268, or metal, P/N A283) should be placed into the circuit, and the above sensor assembly plugged into the tee adapter.

CAUTION: Check the breathing circuit for leaks. Be certain that the circuit downstream of the sensor does not produce any back-pressure or restriction to flow, or errors in readings will result.

When measuring for oxygen in confined volumes such as incubators, hoods, etc., the flow diverter must be removed from the T-7 sensor so that it does not interfere with the rapid exchange of gases to and from the sensing surface of the T-7.

CAUTION: Failure to remove the diverter in these application areas will result in a marked lowering of the response time of the sensor.

The T-7 sensor can be placed inside incubators, tents, etc. When it is necessary to thread the cable through a small hole in order to gain access to the inside of a chamber, the cable should be disconnected at the sensor, threaded through the hole, and reconnected inside the chamber.

Sterilization

The T-7 sensor and interconnecting cable may be gas sterilized using low temperature ethylene oxide. A vacuum must not be drawn on the sensor during the sterilization process.

CAUTION: The sensor must never be immersed in any sterilizing or other solutions, autoclaved, or subjected to high temperatures or vacuums.

The TED 60T itself should never be liquid sterilized or autoclaved. The surface of the case may be wiped with isopropyl alcohol and allowed to air dry. In extreme cases, a mild detergent may be used.

Anesthetic Gases

When using the T-7 sensor in the presence of anesthetic gases such as Halothane, the oxygen reading may fall (see the table on the following page). The magnitude of this error will depend upon the level of oxygen and the duration of exposure.

The anesthetic agents listed in the table (Halothane, Enflurane, Isoflurane, and Methoxyflurane) were vaporized into a stream of 100% oxygen, and the resulting drops in oxygen level after an exposure of approximately two hours were noted. A level of 50% oxygen would be expected to have only half the error.

Exposures in excess of two hours will produce slightly greater error. The errors listed are typical for all oxygen sensors such as the T-7. Exposing the sensor to air or gases that do not contain anesthetic agents for a period of time equal to or greater than the exposure interval will eliminate the reading error in most cases.

Gas or Vapor	Test Level (balance oxygen)	Oxygen Reading Error *
Nitrogen	80%	0%
Helium	80%	0%
Nitrous Oxide	80%	0%
Carbon Dioxide	10%	0%
Halothane	5%	-2%
Enflurane	3%	-1%
Isoflurane	5%	-2%
Methoxyflurane	2%	-.5%

*Errors are approximate and may vary based on exposure times and concentrations.

CAUTION: The TED 60T should not be used in the presence of flammable anesthetics such as diethyl ether or cyclopropane.

As with all galvanic-type oxygen sensors, the T-7 should not be left in nitrous oxide mixtures any longer than absolutely necessary. After exposure to nitrous oxide mixtures, the sensor should be left in 100% oxygen overnight (e.g., left in a breathing circuit that has been flushed with pure oxygen). If this is not practical, the plastic flow diverter should be removed and the sensor left in room air. If the oxygen reading continues to drop after each use in nitrous oxide the sensor should be removed from service. If the sensor can no longer be calibrated or if there is any sign of electrolyte leakage, the sensor should be disposed of in accordance with local regulations and the Material Safety Data Sheet (MSDS) located in the Appendix.

Pressure

Virtually all oxygen analyzers measure the partial pressure, not the precentage, of the gas that they sense. The only time that these instruments can accurately read percentages is when the total pressure does not vary over time between calibration and use. This is why it is important to calibrate the TED 60T oxygen sensor at regular intervals. **It is recommended that the unit be calibrated prior to each use or every 8 hours.**

When the sensor is connected to a ventilator circuit, the alternating "breathing" pressure cycles generated by the ventilator will be sensed as an increase in the oxygen percentage (especially if the sensor is fast enough to sense the changes, as is the T-7). In reality, the percentage of oxygen is not changing; it is the total pressure that is increasing, producing a corresponding increase in the partial pressure of oxygen. A hundred-centimeter water pressure pulse will produce a .11 atmosphere, or an 11% increase in the total and therefore partial pressure of oxygen. Assuming that the sensor is fast enough to track this pressure pulse, an unpressurized reading of 50% oxygen

will increase to 55.5% if the sensor is subjected to a pressure cycle of 100 cm H_2O. The reading will rise proportionally less for smaller pressures.

Humidity

Humidity does not directly affect the accuracy of the sensor's measurement. However, when a nebulizer or other device is used to increase moisture levels in gas mixtures, the moisture actually dilutes the mixture. This dilution effect decreases the oxygen concentration.

For example, if an 80% oxygen gas mixture is humidified to saturation at room temperature, the resulting gas mixture will contain only 77.5% oxygen. Your TED 60T oxygen analyzer accurately measures decreases in the oxygen concentration due to the dilution effects of moisture added to gas mixtures.

Caution: As with all oxygen sensors, excessive condensation on the sensing surface of the T-7 will block the diffusion of oxygen to the sensor, rendering it inoperative.

Should this occur, gently wipe the sensing surface of the T–7 with a cotton swab and allow to air dry. To prevent this, TED recommends installing the sensor on the dry side of the breathing circuit at all times.

Water condensate on the exposed cable contacts at the rear of the sensor may affect the oxygen reading and should be removed by shaking out the condensed water and allowing the sensor to air dry.

Temperature

A thermistor circuit in the T-7 oxygen sensor adjusts for ambient temperature changes in the range of 0–40°C (32–106°F). Since the thermistor that compensates for these changes is located in the rear of the sensor assembly, it is important that gas mixtures, flowing over the front of the sensor, be at room temperature. Reading errors may occur if hot gases from a heated humidifier are directed past a sensor teed into a breathing circuit.

A small thermal tracking error may be encountered in application areas where the entire sensor assembly is placed in the gas mixture to be analyzed (e.g., incubators). No adjustments should be made during this period (about 1 to 2 hours), since this error will be eliminated when both the thermistor and sensing electrode have had sufficient time to come to thermal equilibrium.

Discrepancy in Readings

The TED 60T is intended to be used as a **secondary** means to verify the

accuracy of and check the oxygen concentration leaving another oxygen mixing device or primary life support system (i.e., a blender or respirator). Whenever there is a significant difference in the oxygen readings between the primary support system and the analyzer, the discrepancy must be resolved immediately. The information obtained from the TED 60T should never be used to make adjustments to the primary life-support system, but should only be used as an indication that the primary device **may** require service and/or calibration.

Do's and Don'ts

DO:

- Read all of the directions before using for the first time.
- Calibrate every 8 hours or before every use.
- Keep the unit, sensor and connections dry, or on the dry side of the breathing circuit.
- Recalibrate after replacing the batteries.
- Recalibrate after replacing the sensor.
- Use properly installed **alkaline** batteries only.
- Make sure the T-7 sensor is properly attached.
- Visually inspect the sensor for leakage or water condensation on the sensing surface before each use.
- Use the plastic flow diverter only when using the tee adapter.
- Remove and save the plastic flow diverter when using the unit in chamber applications (incubators, tents, etc.)
- Clean the case with isopropyl alcohol or mild detergent only.
- Remove the batteries prior to storage.

DON'T:

- Use the TED 60T if you suspect any malfunction.
- Use the TED 60T in the presence of flammable gases.
- Use anything but alkaline batteries.
- Autoclave or freeze the T-7 sensor or TED 60T unit.
- Open or try to repair a leaking or broken sensor.
- Immerse the unit or sensor in any liquid.
- Pass hot or cold gas mixtures over the sensor.
- Expose the unit to devices that produce high levels of radio, short wave, microwave, x-ray, or high frequency interference.
- Use cleaning agents or liquids in the cable receptacles or around the battery compartment.
- Place the TED 60T unit itself in a water vapor-saturated environment.
- Expose the LCD to excessive sunlight.
- Expose the TED 60T to a condensing water environment such as a mist tent.

Symptom	Why	What to Do
A new sensor will not calibrate in air.	A new sensor must be allowed to stabilize prior to calibration.	A) Wait 1–2 minutes or until the O_2 reading is stable and try again. B) Oxygen concentration at the sensor is significantly higher than 21%. Take the instrument to a well-ventilated area and repeat the calibration. C) Try calibrating with a known good sensor.
The TED 60T does not react to changes in oxygen concentration, or the readings are unstable and drifting.	A) This is typical of all O_2 sensors when they become flooded. See Chapter 2.0: Humidity. B) Radio frequency interference (RFI).	A) Remove T-7 sensor from tee adapter and unscrew the plastic flow diverter. Using absorbent tissue or cotton swab, gently wipe off sensing surface inside threaded portion of sensor assembly. B) Relocate unit away from sources of RFI.

3.0 Troubleshooting

Symptom	Why	What to Do
The oxygen reading fluctuates or appears to be incorrect.	Like all O_2 sensors, the T-7 detects the changes in the partial pressure of O_2. See Operations: Pressure.	A) During calibration, make sure there are no restrictions on exhaust side of sensor. If the reading changes with flow, the sensor is pressurized or there may be a leak in the system. B) If a high degree of accuracy is desired, or the concentration of O_2 is in excess of 40%, calibration with 100% is recommended.
	Quick changes in temperature can produce temperature tracking errors.	C) Do not hold sensor or subject it to changes in temperature during calibration. D) If humidified gas is used to ventilate the patient, water vapor actually dilutes the gas. See Chapter 2.0: Humidity, Temperature. E) If a blender is used, check its calibration. See Chapter 2.0: Discrepancy in Readings.
No display.	A) Batteries expired. B) Bad battery connection.	A) Check/replace batteries. B) Check battery connections.
Unit reads 00.	A) Sensor not plugged in.	A) Check and reconnect, then calibrate.

NOTE: In the event that none of these procedures produce desired results, remove the batteries and return the unit to Teledyne for repair.

Appendix

Specifications

Range:	0-100% oxygen
Accuracy:	±2% of full scale for 8 hours at constant temperature and pressure
Response Time:	90% in less than 10 seconds (typically 4–6 sec.)
Display Resolution:	Nearest whole number
Battery Type:	9-volt alkaline
Battery Life:	12 months (typical)
Sensor Type:	Class T–7 (Galvanic)
Expected Sensor Life:	Up to 10 months in 100% oxygen (48 months in room air)
Dimensions:	2.5"W × 1.25"D × 4.25"H (63.5 mm × 31.75 mm × 108 mm)
Weight:	9 oz.
Cable Length:	Retracted: 1 ft. Extended: 5 ft.
Storage Temp.:	0-50°C (Recommended Temp. 10-30°C)
Operating Temp.:	0-40°C

4.0 Appendices

Spare Parts List

QTY	PART NO.	DESCRIPTION
1	A51327	Micro-Fuel Cell T-7
1	B326	9-volt alkaline battery
1	A268	Tee adapter (22 mm)
1	B50057	Flow-Thru adapter

Optional Accessories

1	A51589	T–7 adapter cap, female (22 mm)
1	A51588	T–7 adapter cap, male (22 mm)
1	A283	Universal adapter for pediatric circuits (15 mm)
1	A274	Tee adapter (22 mm male/female), autoclavable
1	B34102	Mounting clamp

Repair Service

PLEASE READ CAREFULLY

In the event that your TED 60T Portable Oxygen Analyzer needs servicing, the following steps will help to ensure that the repair request is processed promptly.

Contact your authorized TED distributor or factory for return instructions. Do not ship your instrument without first obtaining authorization.

Include a copy of the sales invoice or other proof of purchase date. Warranty service may be denied if no proof of purchase is included.

It is your responsibility to pay shipping charges to Teledyne Electronic Devices. If the unit is under warranty, the serviced or replaced instrument will be returned to you postage prepaid.

Instruments and sensors damaged by accident or misuse are not covered by the warranty. In these situations, service charges will be based on time and materials.

Material Safety Data Sheet

Section I – Product Identification

Product Name: Micro-Fuel Cells
Mini-Micro-Fuel Cells, all classes
Super Cells, all classes except T–5x
Oxygen Sensors, all classes.

Manufacturer: Teledyne Electronic Devices
Address: 16830 Chestnut Street, City of Industry, CA 91749
Phone: (818) 961-9221
Date Prepared or Last Revised: 08/08/91
Emergency Phone Number: (818) 961-9221

Section II – Physical and Chemical Data

Chemical and Common Names: Potassium Hydoxide (KOH), 15% (w/v)
Granular Lead (Pb), pure
CAS Number: KOH 1310–58–3
Pb 7439–92–1

	KOH	Pb
Melting Point/Range:	10 to 0 °C	328 °C
Boiling Point/Range:	100 to 115 °C	1744 °C
Specific Gravity:	1.09 @ 20 °C	11.34
pH:	>14	N/A
Solubility in Water:	Completely soluble	Insoluble
Percent Volatiles by Volume:	None	N/A
Appearance and Odor:	Colorless, odorless solution	Grey metal, odorless

Section III – Physical Hazards

Potential for fire and explosion: The electrolyte in the Micro–Fuel Cells is not flammable. There are no fire or explosion hazards associated with Micro–Fuel Cells.

Potential for reactivity: The sensors are stable under normal conditions of use. Avoid contact between the sensor electrolyte and strong acids.

Section IV – Health Hazard Data

Primary route of entry:	Ingestion, eye/skin contact
Exposure limits:OSHA PEL:	.05 mg/cu.m. (Pb)
ACGIH TLV:	2 mg/cu.m. (KOH)
Effects of overexposure	
Ingestion:	The electrolyte could be harmful or fatal if swallowed. Oral LD50 (RAT) = 3650 mg/kg
Eye:	The electrolyte is corrosive; eye contact could result in permanent loss of vision.
Dermal:	The electrolyte is corrosive; skin contact could result in a chemical burn.
Inhalation:	Liquid inhalation is unlikely.
Signs/symptoms of exposure:	Contact with skin or eyes will cause a burning sensation and/or feel soapy or slippery to touch.
Medical conditions aggravated by exposure:	None
Carcinogenity:	NTP Annual Report on Carcinogens: Not listed LARC Monographs: Not listed OSHA: Not listed
Other health hazards:	Lead is listed as a chemical known to the State of California to cause birth defects or other reproductive harm.

Section V – Emergency and First Aid Procedures

Eye Contact: Flush eyes with water for at least 15 minutes and get immediate medical attention.

Skin Contact: Wash affected area with plenty of water and remove contaminated clothing. If burning persists, seek medical attention.

Ingestion: Give plenty of cold water. Do not induce vomiting. Seek medical attention.

Inhalation: Liquid inhalation is unlikely.

Section VI – Handling Information

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 clothing: Rubber gloves, chemical splash goggles.

Clean-up procedures: Wipe down the area several times with a wet paper towel. Use a fresh towel each time.

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, put on gloves and eye protection before removing the cell.

Disposal: Should be in accordance with all applicable state, local and federal regulations.

NOTE: The above information is derived from the MSDS provided. The information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. Teledyne Electronic Devices shall not be held liable for any damage resulting from handling or from contact with the above product.