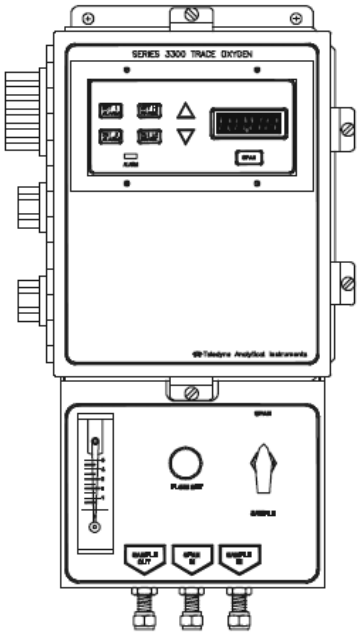
OPERATING INSTRUCTIONS FOR

MODEL 3300TB

Trace Oxygen Analyzer



P/N M70362
1/25/18

DANGER

HIGHLY TOXIC AND OR FLAMMABLE LIQUIDS OR GASES MAY BE PRESENT IN THIS MONITORING SYSTEM.

PERSONAL PROTECTIVE EQUIPMENT MAY BE REQUIRED WHEN SERVICING THIS SYSTEM.

HAZARDOUS VOLTAGES EXIST ON CERTAIN COMPONENTS INTERNALLY WHICH MAY PERSIST FOR A TIME EVEN AFTER THE POWER IS TURNED OFF AND DISCONNECTED.

ONLY AUTHORIZED PERSONNEL SHOULD CONDUCT MAINTENANCE AND/OR SERVICING. BEFORE CONDUCTING ANY MAINTENANCE OR SERVICING CONSULT WITH AUTHORIZED SUPERVISOR/ MANAGER.

DECLARATION OF CONFORMITY

APPLICATION OF COUNCIL DIRECTIVE	: 89/336/EEC 73/23/EEC
STANDARDS TO WHICH CONFORMITY IS DECLARED	: EN55011 Class A Group I EN50082-2 EN61010-1
MANUFACTURER'S NAME	: TELEDYNE ANALYTICAL INSTRUMENTS
MANUFACTURER'S ADDRESS	: 16830 Chestnut Street City of Industry, CA 91748-1020 U.S.A.
TYPE OF EQUIPMENT	: Oxygen Analyzer
EQUIPMENT CLASS	: ISM Class A Group 1
MODEL NUMBER	: 3300P and 3300T

I, THE UNDERSIGNED, HEREBY DECLARE THAT THE EQUIPMENT SPECIFIED ABOVE CONFORMS TO THE ABOVE STANDARD(S) PER 89/336/EEC AND 73/23/EEC.

SIGNATURE: 

FULL NAME: Angel Alegria

POSITION: New Products Manager

DATE: May 30 ,2006

PLACE: City of Industry, California

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. 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 provides measurement readings to its user, and serves as a tool by which valuable data can be gathered. The information provided by the instrument may assist the user in eliminating potential hazards caused by his 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 at the time the order is placed.

Therefore, the purchaser must be aware of the hazardous process conditions. The purchaser 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.

Teledyne Analytical Instruments, 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.

Specific Model Information

The instrument for which this manual was supplied may incorporate one or more options not supplied in the standard instrument. Commonly available options are listed below, with check boxes. Any that are incorporated in the instrument for which this manual is supplied are indicated by a check mark in the box.

Instrument Serial Number: _____

Options Included in the Instrument with the Above Serial Number:

- ❑ **Auto Calibration Valves:**
  Three gas inputs, for sample, zero and span gases, with three solenoid-actuated gas-flow control valves built in. Valves are automatically synchronized to the analyzer's electronic control sequences.

Sensor Options Available for the Instrument with the Above Serial Number:

- ❑ **A2C**
- ❑ **B2C**
- ❑ **L2C**

Important Notice

Model 3300TB complies with all of the requirements of the Commonwealth of Europe (CE) for Radio Frequency Interference, Electromagnetic Interference (RFI/EMI), and Low Voltage Directive (LVD).

The following International Symbols are used throughout the Instruction Manual. These symbols are visual indicators of important and immediate warnings and when you must exercise CAUTION while operating the instrument. See also the Safety Information on the next page.

STAND-BY: Instrument is on Stand-by, but circuit is active

GROUND: Protective Earth

CAUTION: The operator needs to refer to the manual for further information. Failure to do so may compromise the safe operation of the equipment.

CAUTION: Risk of Electrical Shock

Safety Messages

Your safety and the safety of others are very important. We have provided many important safety messages in this manual. Please read these messages carefully.

A safety message alerts you to potential hazards that could hurt you or others. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and inside the instrument. The definition of these symbols is described below:

GENERAL WARNING/CAUTION: Refer to the instructions for details on the specific danger. These cautions warn of specific procedures which if not followed could cause bodily Injury and/or damage the instrument.

CAUTION: HOT SURFACE WARNING: This warning is specific to heated components within the instrument. Failure to heed the warning could result in serious burns to skin and underlying tissue.

WARNING: ELECTRICAL SHOCK HAZARD: Dangerous voltages appear within this instrument. This warning is specific to an electrical hazard existing at or nearby the component or procedure under discussion. Failure to heed this warning could result in injury and/or death from electrocution.

No Symbol

Technician Symbol: All operations marked with this symbol are to be performed by qualified maintenance personnel only.

NOTE: Additional information and comments regarding a specific component or procedure are highlighted in the form of a note.

CAUTION: THE ANALYZER SHOULD ONLY BE USED FOR THE PURPOSE AND IN THE MANNER DESCRIBED IN THIS MANUAL.

IF YOU USE THE ANALYZER IN A MANNER OTHER THAN THAT FOR WHICH IT WAS INTENDED, UNPREDICTABLE BEHAVIOR COULD RESULT POSSIBLY ACCOMPANIED WITH HAZARDOUS CONSEQUENCES.

This manual provides information designed to guide you through the installation, calibration and operation of your new analyzer. Please read this manual and keep it available.

Occasionally, some instruments are customized for a particular application or features and/or options added per customer requests. Please check the front of this manual for any additional information in the form of an Addendum which discusses specific information, procedures, cautions and warnings that may be peculiar to your instrument.

Manuals do get lost. Additional manuals can be obtained from Teledyne at the address given in the Appendix. Some of our manuals are available in electronic form via the internet. Please visit our website at: www.teledyne-ai.com.

DANGER

COMBUSTIBLE GAS USAGE WARNING

This is a general purpose instrument designed for use in a nonhazardous area. It is the customer's responsibility to ensure safety especially when combustible gases are being analyzed since the potential of gas leaks always exist.

The customer should ensure that the principles of operation of this equipment are well understood by the user. Misuse of this product in any manner, tampering with its components, or unauthorized substitution of any component may adversely affect the safety of this instrument.

Since the use of this instrument is beyond the control of Teledyne, no responsibility by Teledyne, its affiliates, and agents for damage or injury from misuse or neglect of this equipment is implied or assumed.

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Introduction

1.1 Overview

The Teledyne Analytical Instruments Model 3300TB Trace Oxygen Analyzer is a versatile microprocessor-based instrument for real-time measurement of the parts per million of oxygen in inert gases, or in a wide variety of gas mixtures. It features simple operation, fast response, and a compact, rugged construction. Typical applications of the Model3300TB are monitoring Nitrogen generators and inert gas blanketing applications.

1.2 Main Features of the Analyzer

The Model 3300B Trace Oxygen Analyzer is sophisticated yet simple to use. The main features of the analyzer include:

- High resolution, accurate readings of oxygen content from 0-10 ppm through 9999 ppm with a large, bright, meter readout.
- Simple push button controls.
- Nylon cell holder.
- Advanced Micro-Fuel Cell for trace analysis. Has six months warranty and an expected lifetime of eight months.
- Unaffected by oxidizable gases.
- Fast response and recovery time.
- Microprocessor based electronics: 8-bit CMOS microprocessor with onboard RAM and 16 kB ROM.
- Two user selectable ranges (from0-10 ppm through 0-9999 ppm) allow best match to users process and equipment.
- Auto Ranging allows analyzer to automatically select the proper preset range for a given measurement. Manual override allows the user to lock onto a specific range of interest.
- Two adjustable concentration alarms.

- Panel mount flowmeter.
- Control valve for the selection of Span gas or Sample gas.
- Sensor failure alarm.
- Three analog outputs: two for measurement (0–10V dc, and negative ground 4–20 mA dc) and one for range identification (0-10 V dc).
- Compact and rugged Control Unit, wallmounted NEMA-4 rated enclosure.
- RS-232 Serial Digital port for output of concentration and data to computer terminals or other digital devices.
- A Sample flow control valve.

1.3 Front panel Description

All controls except the power switch are accessible from the door and gas panel. See Figure1-1.Thefront panel has seven push button membrane switches, a digital meter, and an alarm indicator LED for operating the analyzer.

These features are described briefly here and in greater detail in Chapter 4, *Operation*.

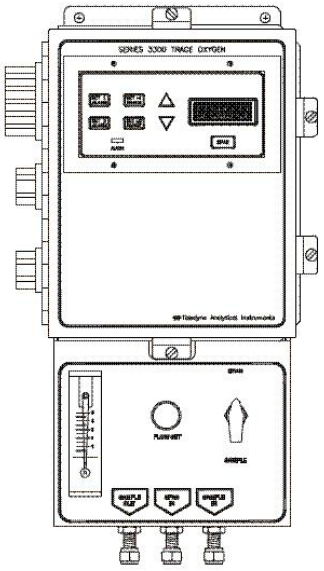

Figure 1-1 Front Panel

Function Keys: Seven push button membrane switches are used to select the function performed by the analyzer:

- **Set Alarm 1:** Set Alarm1 Hi or Low, and the concentration at which alarm 1 activates.
- **Set Alarm 2:** Set the Alarm 2 Hi or Low, and the concentration to which alarm 2 activates.
- **Set HI Range:** Set the high analysis range for the instrument (up to 0-9999ppm).
- **Set LO Range:** Set the low analysis range for the instrument (down to 0-10ppm).
- **Span:** Span calibrate the analyzer.

Data Entry Keys: Two push button membrane switches are used to manually change measurement parameters of the instrument as they are displayed on the LED meter readout:

- **Up Arrow:** Increment values of parameters upwards as they are displayed on the LED readout.
- **Down Arrow:** Increment values of parameters downwards as they are displayed on the LED readout.

Digital LED Readout: The digital display is a LED device that produces large, bright, 7-segment numbers that are legible in any lighting environment. It has two functions:

- **Meter Readout:** As the meter readout, it displays the oxygen concentration currently being measured.
- **Measurement Parameters Readout:** It also displays user definable alarm setpoints, ranges, and span calibration point when they are being checked or changed.

1.4 Rear Panel Description

The rear panel contains the electrical input and output connectors. The connectors are described briefly here and in detail in the *Installation* chapter of this manual.

- **Power Connection:** AC version: 100–240 VAC, at 50/60Hz. The connector housing includes the fuse holder and the power switch.
- **Fuse Holder:** Replacing the fuse is described in Chapter 5, Maintenance.

- **I/O Power Switch:** Turns the instrument power ON (1) or OFF (0).
- **Analog Outputs:** 0–10 V dc concentration output.
  0–10 V dc range ID (or optional over range) output.
  4–20 mA dc concentration output, negative ground.
- **Alarm Connections:** Alarm 1, Alarm 2, and Sensor Failure Alarm connections.
- **Sensor Connector:** Internal Sampling System, Sensor Connector.
- **RS-232 Port:** Serial Digital Output of concentration and range signals.

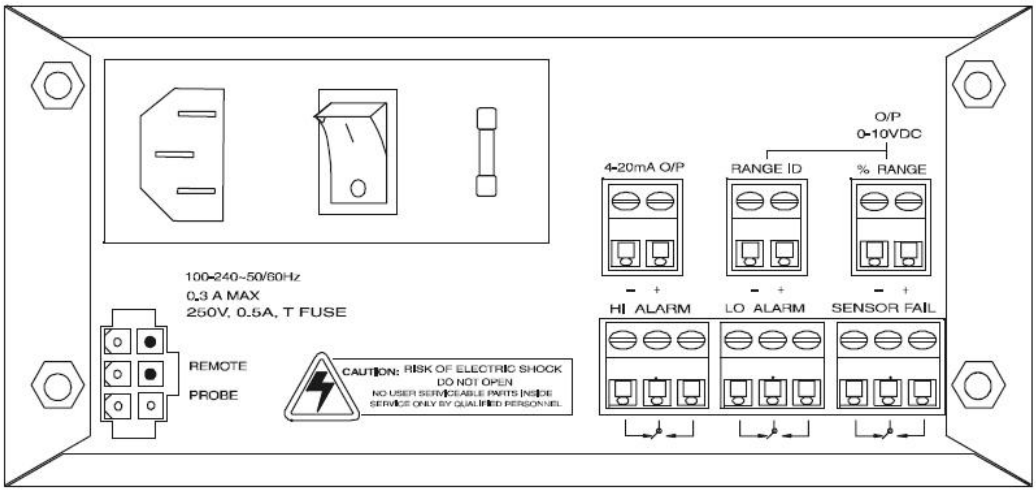

Figure 1-2: Rear Panel

Operational Theory

2.1 Introduction

The analyzer is composed of two subsystems:

1. Analysis Unit with Micro-Fuel Cell Sensor
2. Control Unit with Signal Processing, Display and Controls

The Analysis Unit is designed to accept the sample gas and direct it to the sensitive surface of the Micro-Fuel Cell sensor. The Micro-Fuel Cell is an electrochemical galvanic device that translates the amount of oxygen present in the sample into an electrical current.

The Control Unit processes the sensor output and translates it into electrical concentration, range, and alarm outputs, and a percent oxygen meter readout. It contains a microcontroller that manages all signal processing, input/output, and display functions for the analyzer.

2.2 Micro-Fuel Cell Sensor

2.2.1 Principles of Operation

The oxygen sensor used in the Model 3300TB series is a Micro-Fuel Cell designed and manufactured by Analytical Instruments. It is a sealed plastic disposable electrochemical transducer.

The active components of the Micro-Fuel Cell are a cathode, an anode, and the 15% aqueous KOH electrolyte in which they are immersed. The cell converts the energy from a chemical reaction into an electrical current in an external electrical circuit. Its action is similar to that of a battery.

There is, however, an important difference in the operation of a battery as compared to the Micro-Fuel Cell: In the battery, all reactants are stored within the cell, whereas in the Micro-Fuel Cell, one of the reactants (oxygen) comes from outside the device as a constituent of the sample gas being analyzed. The Micro-Fuel Cell is therefore a hybrid

between a battery and a true fuel cell. (All of the reactants are stored externally in a true fuel cell.)

2.2.2 Anatomy of a Micro-Fuel Cell

The Micro-Fuel Cell is a cylinder only 11/4 inches in diameter and 11/4 inches thick. It is made of an extremely inert plastic, which can be placed confidently in practically any environment or sample stream. It is effectively sealed, although one end is permeable to oxygen in the sample gas. The other end of the cell is a contact plate consisting of two concentric foil rings. The rings mate with spring-loaded contacts in the sensor block assembly and provide the electrical connection to the rest of the analyzer. Figure 2-1 illustrates the external features.

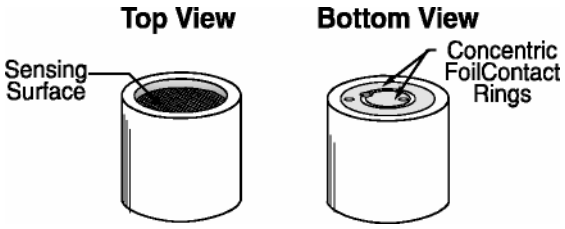

Figure 2-1: Micro-Fuel Cell

Refer to Figure 2-2, *Cross Section of a Micro-Fuel Cell*, which illustrates the following internal description.

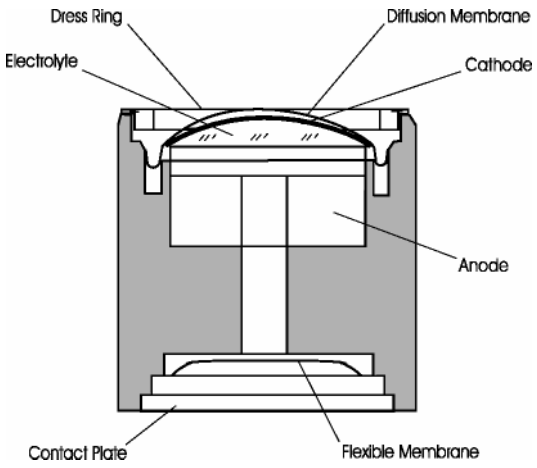

Figure 2-2: Cross Section of a Micro-Fuel Cell (not to scale)

At the top end of the cell is a diffusion membrane of Teflon®, whose thickness is very accurately controlled. Beneath the diffusion membrane lies the oxygen sensing element—the cathode—with a surface area almost 4 cm^2. The cathode has many perforations to ensure sufficient wetting of the upper surface with electrolyte, and it is plated with an inert metal.

The anode structure is below the cathode. It is made of lead and has a proprietary design which is meant to maximize the amount of metal available for chemical reaction.

At the rear of the cell, just below the anode structure, is a flexible membrane designed to accommodate the internal volume changes that occur throughout the life of the cell. This flexibility assures that the sensing membrane remains in its proper position, keeping the electrical output constant.

The entire space between the diffusion membrane, above the cathode, and the flexible rear membrane, beneath the anode, is filled with electrolyte. Cathode and anode are submerged in this common pool. They each have a conductor connecting them to one of the external contact rings on the contact plate, which is on the bottom of the cell.

2.2.3 Electrochemical Reactions

The sample gas diffuses through the Teflon membrane. Any oxygen in the sample gas is reduced on the surface of the cathode by the following HALF REACTION:

$$O_2 + 2H_2O + 4e^- \rightarrow 4OH^- \qquad \text{(cathode)}$$

(Four electrons combine with one oxygen molecule—in the presence of water from the electrolyte—to produce four hydroxyl ions.)

When the oxygen is reduced at the cathode, lead is simultaneously oxidized at the anode by the following HALF REACTION:

$$Pb + 2OH^- \rightarrow Pb^{+2} + H_2O + 2e^- \qquad \text{(anode)}$$

(Two electrons are transferred for each atom of lead that is oxidized. Therefore it takes two of the above anode reactions to balance one cathode reaction and transfer four electrons.)

The electrons released at the surface of the anode flow to the cathode surface when an external electrical path is provided. The current is proportional to the amount of oxygen reaching the cathode. It is measured and used to determine the oxygen concentration in the gas mixture.

The overall reaction for the fuel cell is the SUM of the half reactions above, or:

$$2Pb + O_2 \rightarrow 2PbO$$

(These reactions will hold as long as no gaseous components capable of oxidizing lead—such as iodine, bromine, chlorine and fluorine—are present in the sample.)

The output of the fuel cell is limited by (1) the amount of oxygen in the cell at the time and (2) the amount of stored anode material.

In the absence of oxygen, no current is generated.

2.2.4 The Effect of Pressure

In order to state the amount of oxygen present in the sample in parts-per-million or a percentage of the gas mixture, it is necessary that the sample diffuse into the cell under constant pressure.

If the total pressure increases, the rate that oxygen reaches the cathode through the diffusing membrane will also increase. The electron transfer, and therefore the external current, will increase, even though the oxygen concentration of the sample has not changed. It is therefore important that the sample pressure at the fuel cell (usually vent pressure) remain relatively constant between calibrations.

2.2.5 Calibration Characteristics

Given that the total pressure of the sample gas on the surface of the Micro-Fuel Cell input is constant, a convenient characteristic of the cell is that the current produced in an external circuit is directly proportional to the rate at which oxygen molecules reach the cathode, and this rate is directly proportional to the concentration of oxygen in the gaseous mixture. In other words it has a linear characteristic curve, as shown in Figure 2-3. Measuring circuits do not have to compensate for nonlinearities.

In addition, since there is zero output in the absence oxygen, the characteristic curve has close to an absolute zero (within ± 1 ppm oxygen). In practical application, zeroing may still used to compensate

for the combined zero offsets of the cell and the electronics. (The electronics is zeroed automatically when the instrument power is turned on.)

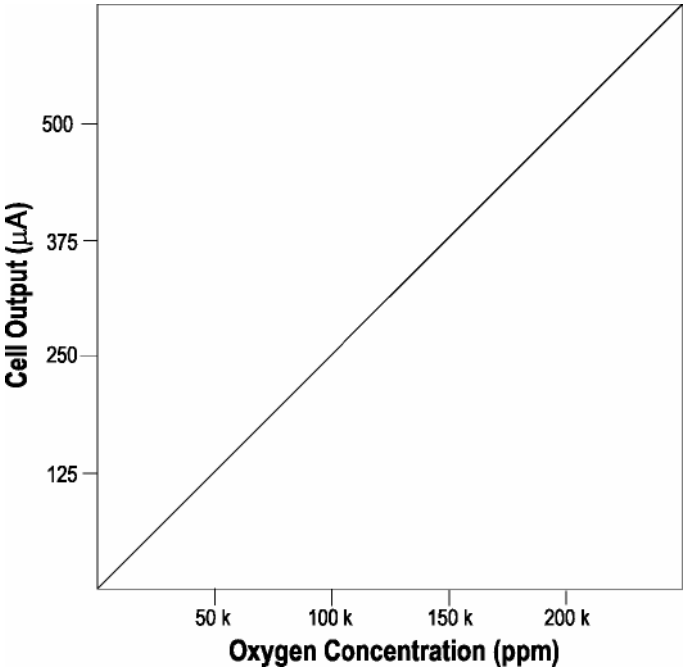

Figure 2-3: Characteristic Input/Output Curve for a Micro-Fuel Cell

2.3 Electronics

2.3.1 General

The signal processing uses an Intel® microcontroller with on-board RAM and ROM to control all signal processing, input/output, and display functions for the analyzer. System power is supplied from a universal power supply module designed to be compatible with most international power sources.

The power supply circuitry is on the Power Supply PCB, which is mounted vertically, just behind the rear panel of the Control Unit.

The signal processing electronics including the sensor amplifier, microcontroller, analog to digital, and digital to analog converters are

located on the Main PCB, which is mounted vertically, just behind the front panel of the Control Unit.

2.3.2 Signal Processing

Figure 2-3 is a block diagram of the signal processing electronics described below.

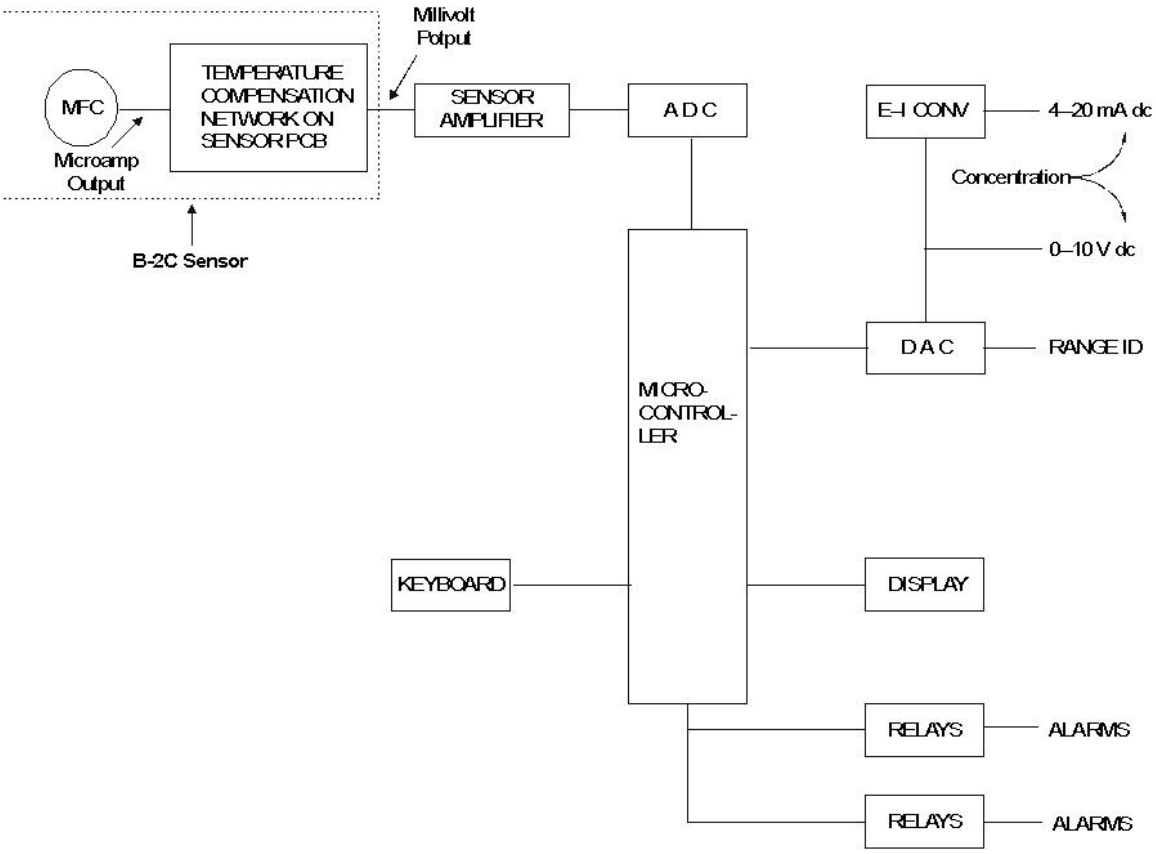

Figure 2-3: Block Diagram of the Signal Processing Electronics

In the presence of oxygen the cell generates a current. The sensor has an internal thermistor compensation network.

The output of the sensor is converted to voltage millivolt range. This output is fed to a voltage amplifier. The internal thermistor network provides temperature compensation of the sensor output. The resistance of the network changes with temperature, compensating for the changes of the micro-fuel cell output to temperature.

The output from the temperature compensation amplifier is sent to an analog to digital converter (ADC), and the resulting digital concentration signal is sent to the microcontroller.

The digital concentration signal along with input from the front panel buttons (KEYBOARD) is processed by the microcontroller, and appropriate output signals are directed to the display and alarm relays. The same digital information is also sent to a 12-bit digital to analog converter (DAC) that produces the 0-10 V dc analog concentration signal and the 0-10 V dc analog range ID output. A voltage current converter (E–I CONV) produces the 4-20 mA dc analog concentration signal.

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Installation

Installation of the Model 3300TB Analyzer includes:

1. Unpacking the system.
2. Mounting the Control Unit to a wall
3. Installing the Micro-Fuel Cell
4. Making the electrical connections.
5. Making the gas connections.
6. Testing the installation.

CAUTION: Read this chapter in its entirety before installing the units.

The Sample must be free of entrained solids or water. However, a high humidity sample is ideal, since it will prevent water loss from the cell electrolyte.

The Micro-Fuel Cell sensor electrolyte is caustic. Do not attempt to open it. Leaking or exhausted cells should be disposed of in accordance with local regulations. Refer to the Material Safety Data Sheet in the Appendix.

Any damage or scarring of the delicate permeable membrane on the sensing end of the cell will require cell replacement. Prevent contact with membrane by any solid object.

3.1 Unpacking the Analyzer

As soon as you receive the instrument, carefully unpack and inspect the Unit, and any included accessories for damage. Immediately report any damage to the shipping agent. The analyzer is shipped with all the materials you need to install and prepare the system for operation.

CAUTION: Do not disturb the integrity of the cell package until the cell is to actually be used. If the cell package is punctured and air is permitted to enter, cell-life will be compromised.

3.2 Location and Mounting

3.2.1 Control Unit Installation

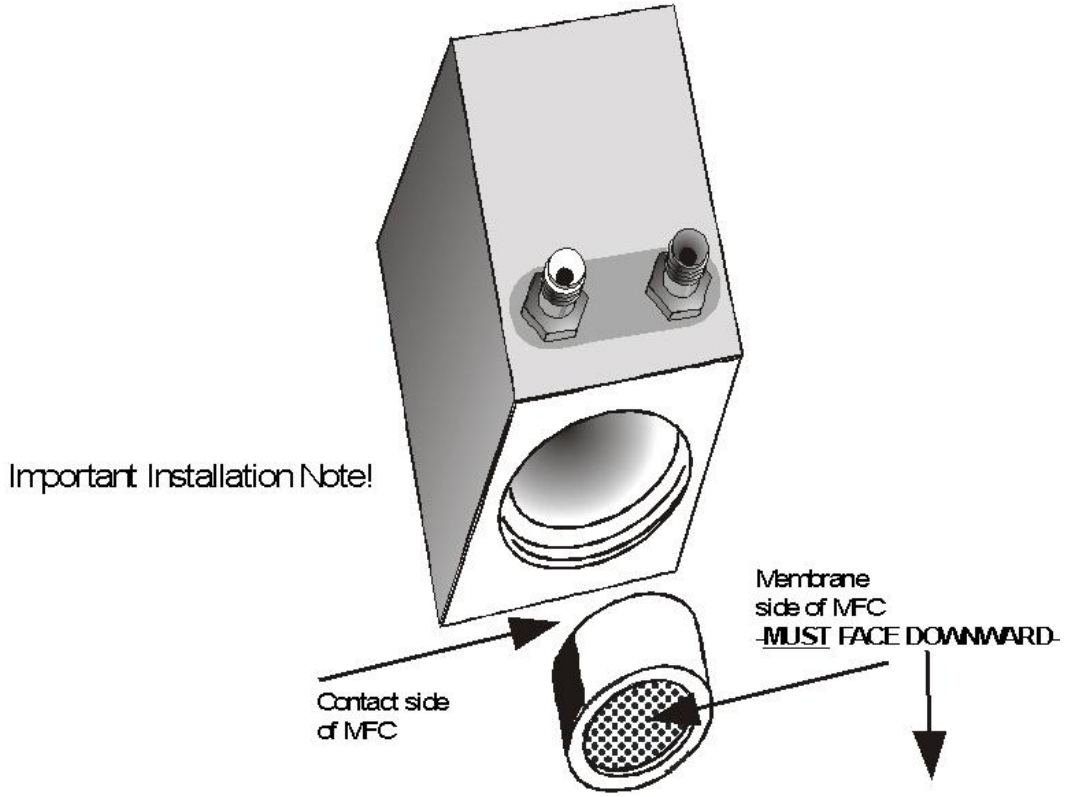
The 3300TB Control Unit is designed to be wall-mounted, in a general purpose, area. The unit should be installed at viewing level in a sheltered area.

Refer to the Outline diagram D-70361 for the physical dimensions of the analyzer.

3.2.2 Installing the Micro-Fuel Cell/Cell Block Orientation

A Micro-Fuel Cell is included as a separate item. It must be installed prior to instrument use.

Also, once it is expended, or if the instrument has been idle for a lengthy period, the Micro-Fuel Cell will need to be replaced.



During the installation and/or replacement of the MFC, the membrane surface MUST ALWAYS FACE DOWNWARD, and the contact side of the membrane, must be placed FIRST into Analysis Unit.

The reason for proper installation/replacement is, if any bubble that develops as the electrolyte dries out it will be directed by gravity away from the membrane.

To install or replace the Micro-Fuel Cell, follow the procedures in Chapter 5, *Maintenance*.

3.3 Electrical Connections

Figure 3-1 shows the Model 3300TB rear panel of the control unit. For detailed pinouts, see the wiring/interconnection drawings in the Drawings section at the rear of this manual. To gain access to the terminal blocks, the analyzer door screws must be loosened, and the door opened.

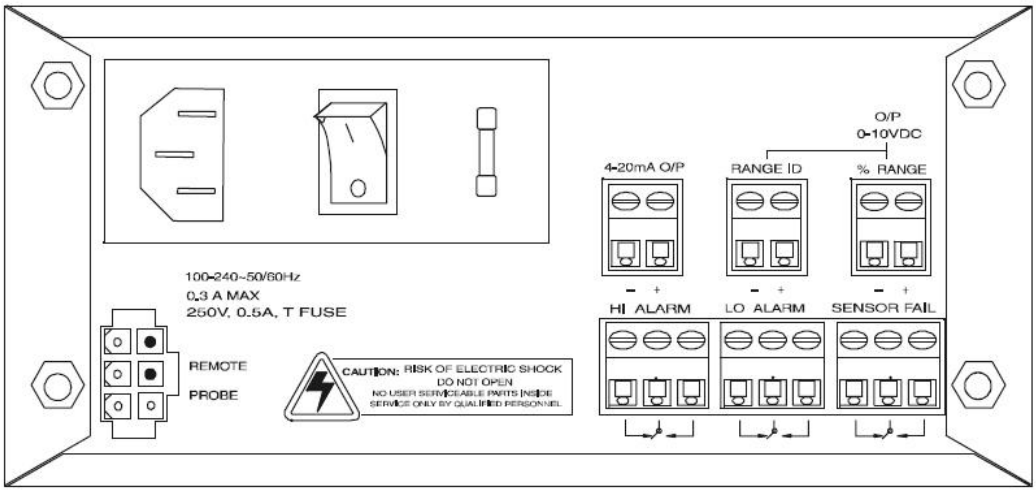
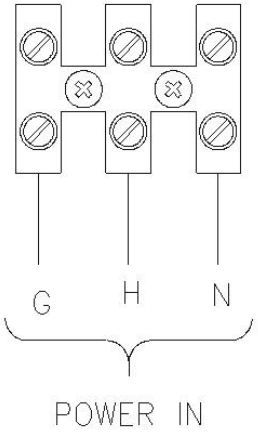


Figure 3-1 Electrical Connectors for AC Control Unit

Primary Input Power: The power strip is installed inside the analyzer. Connect ground to terminal 1, neutral to terminal 3, and hot to terminal 2. Make sure female plug end is inserted in the control unit power receptacle.

The universal power supply allows direct connection to any 100-240 VAC, 50/60Hz power source. The fuse block, to the right of the power cord receptacle, accepts two 5x20mm 0.5 A, 250V, IEC time-lag (T) fuse. (See *Fuse Replacement* in chapter 5, *Maintenance*.)

The power switch is located on the right-hand end of the power source input receptacle assembly.



AC Power Terminal Strip

Analog Outputs: There are three DC output signal connectors with screw terminals on the panel. There are two wires per output with the polarity noted. See Figure 3-3. The outputs are:

0–10 V % Range:	Voltage rises with increasing oxygen concentration, from 0 V at 0 percent oxygen to 10 V at full scale percent oxygen. (Full scale = 100% of programmed range.)
0–10 V Range ID:	03.33 V = Low Range, 06.66 V = High Range, 10 V = Air Cal Range.
4–20 mA % Range:	Current increases with increasing oxygen concentration, from 4 mA at 0 percent oxygen to 20 mA at full scale percent oxygen. (Full scale = 100% of programmed range.)

Alarm Relays: The three alarm-circuit connectors are screw terminals for making connections to internal alarm relay contacts. There is one set of contacts for each type of alarm. Contacts are Form C, with normally open and normally closed contact connections capable of

switching up to 0.5 ampere at 125 VAC into a resistive load (2A for 30 VDC).

The alarm relay circuits are designed for failsafe operation, meaning the relays are energized during normal operation. If power fails the relays de-energize (alarms activated).

The contact connections are indicated diagrammatically on the rear panel as Normally Closed, Common, and Normally Open. Figure 3-2 explains how these act in failsafe operation.

Alarm 1 and Alarm 2 can both be configured as either HI or LO. A HI alarm will activate when concentration is above threshold, while a LO alarm will activate concentration is below threshold.

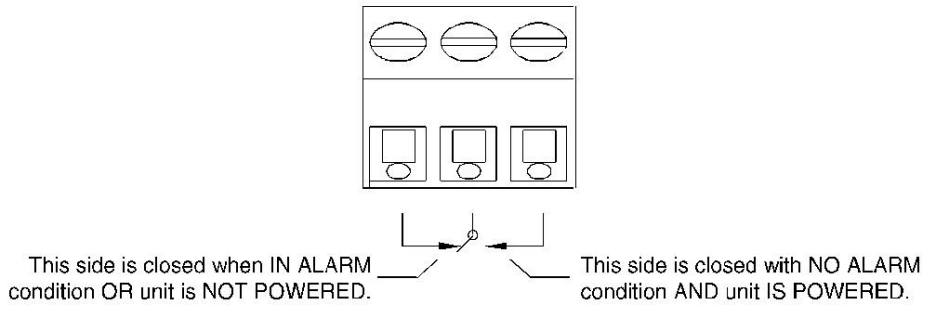


Figure 3-2: Contact ID for FAILSAFE Relay Operation

The specific descriptions for each type of alarm are as follows:

Alarm #1	Programmable as high or low alarm (actuates when concentration is above threshold). Can be set anywhere between 0 and 9999ppm, but must be set ABOVE the threshold set for the LO Alarm.
Alarm #2	Programmable as high or low alarm (actuates when concentration is below threshold). Can be set anywhere from 0 to 9999ppm.
Sensor Fail	Actuates when the output of the Micro-Fuel Cell sensor falls below the acceptable level.

CAUTION: There could be hazardous voltage at the alarms terminals, even when power is removed from the instrument.

3.4 Gas Connections

The standard Model 3300TB has two inlets and one outlet fixture only. Calibration gasses can be connected into the "Span" inlet. All of the gas connections are 1/4 inch brass fittings.

A switching valve is provided to feed the analysis unit with either sample or gas.

A flowmeter and flow controller valve are part of the system and will assist in setting the flow of the gas.

Sample flow should be adjusted to 2 SCFH. The sample vent connection should not restrict the sample flow. The sensor is designed to operate at atmospheric pressure. Restricting the sample vent line will result in pressurizing the sensor and altering the O2 reading.

The pressure required will depend on the sampling system. When venting into a constant pressure, such as the atmosphere, controlling input pressure is simple. If you are venting into a system of varying pressure, then some form of pressure regulation is required to maintain a constant pressure across the sensor.

The Sample and Span pressure is not to exceed 50 psig (345 kPa).

3.4.1 Vacuum Service Option

For vacuum service pluming reference Figure 3-4. The vacuum service option is recommended for applications in which the sample source is not pressurized. The customer must supply a pump and by-pass system to complete the sample system. The sample inlet and outlet pressure must be maintained at a constant pressure for proper performance. If the sample inlet or vent pressure will not be held constant during the process, a pressure regulator must be used to regulate the pressure across the cell.

Adjust the flow rate on a vacuum service system as follows:

Select Sample with the three-way control valve and open the flow control valve on the analyzer to full flow (located on the analyzer flow meter). Open the pump by-pass valve, and turn on the pump. Readjust the pump by-pass valve to limit the maximum flow rate to full scale on the flowmeter with the flowmeter valve fully open. Adjust the analyzer flow control valve (flowmeter valve) to a flow-rate of approximately 2 SCFH). Select Span and verify that the span and Sample gas are at different pressures. The calibration accuracy will be adversely affected if the Span and Sample gases are at differing pressures.

If the span gas is provided from pressurized source, a control valve must be added between the analyzer and the span gas source. This valve is used to adjust the span flow rate to match the sample flow rate. Do not adjust the span flow rate with the flow control valve located on the analyzer for units with vacuum service options.

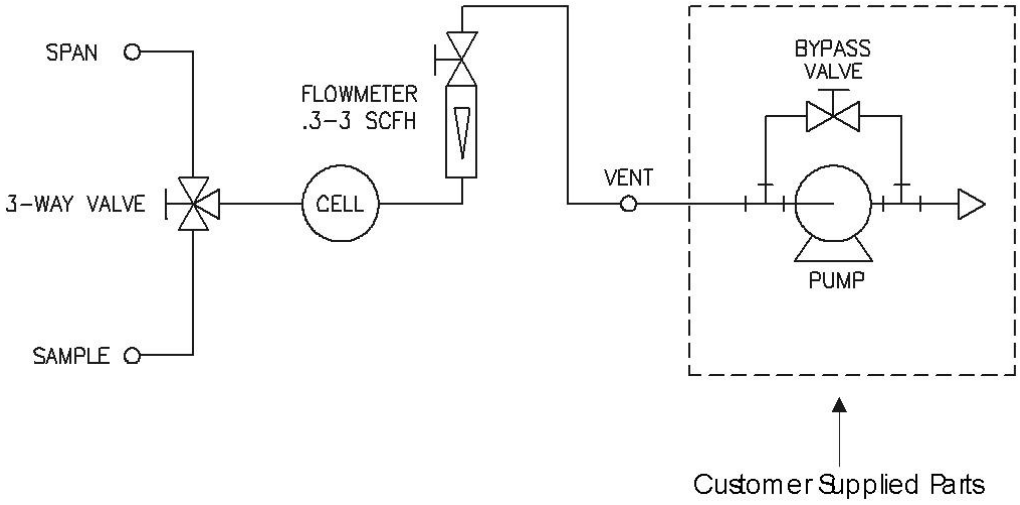


Figure 3-4: Piping Diagram for Vacuum Service Option

3.5 Installation Checklist

Before connecting the instrument to the power source and turning it on, make sure you have:

- Correctly installed the Sample and Exhaust gas lines
- Checked for leaks

- Set the sample pressure to 5–10 psig (34.5 - 68.9 kPa), nominal (for non-vacuum service units)
- Set the flow

Once the above checks have been made, you can connect to the power source. The instrument is now ready for operation.

Operation

4.1 Introduction

- Once the analyzer has been mounted, the gas lines connected and the electrical connections made, the Analyzer can be configured for your application. This involves setting the system parameters:
- Defining the user selectable analysis ranges.
- Setting alarm setpoints.
- Calibrating the instrument.
  - All of these functions are performed via the front panel controls, shown in Figure 4-1.

Analyzing for the trace oxygen level in the gas passing through the cell block is the default mode of operation. As long as no front panel buttons are being pressed the Unit is analyzing.

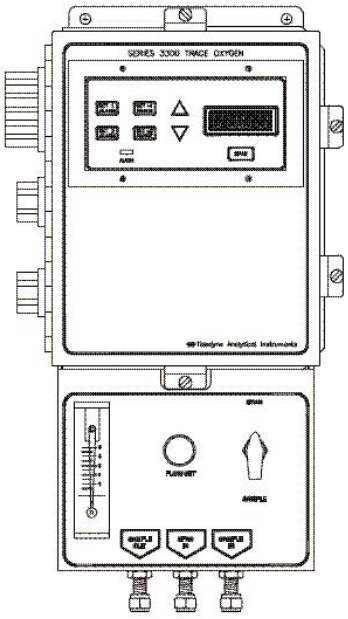


Figure 4-1: Front Panel Controls and Indicators

4.2 Using the Function and Data Entry Buttons

When no buttons on the Analyzer are being pressed, the instrument is in the Analyze mode. It is monitoring the amount of oxygen in the sample gas that is flowing through the sampling system.

When one of the Function Buttons is being pressed, the Analyzer is in the Setup mode or the Calibration mode.

The 4 Setup function buttons on the analyzer are:

- SET ALARM 1
- SET ALARM 2
- SET HI RANGE
- SET LO RANGE

The Calibration mode button is:

- SPAN

The Data Entry buttons (▲ and ▼) increment the values displayed on the TRACE OXYGEN meter while one of the Function buttons is being held down.

▲: Increments the displayed value upwards.

▼ : Increments the displayed value downwards.

Any of the functions can be selected at any time by holding down the appropriate button.

Each function will be described in the following sections. Although the operator can use any function at any time, the order chosen in this manual is appropriate for an initial setup.

4.3 Setting the Analysis Ranges

The two user definable analysis ranges are both capable of being adjusted for from 0-10 ppm to 0-9999 ppm oxygen concentration. Whatever values are selected, the analyzer automatically switches from the LO range to the HI range when the oxygen concentration reaches the LO range fullscale value, and it switches back to the LO range when the oxygen concentration falls below of the LO range fullscale value

Note: The HI Range setpoint MUST be set at a higher concentration percentage than the LO Range setpoint.

4.3.1 HI Range

Setting the HI Range fullscale value defines the LEAST sensitive analysis range to be used. To set the HI Range:

1. Press the SET HI RANGE Function button once.
2. Immediately (within 5 seconds) press either the ▲or ▼button to raise or lower the displayed value, as required, until the display reads the desired fullscale percent concentration.

4.3.2 LO Range

Setting the LO Range fullscale value defines the MOST sensitive range to be used. To set the LO Range:

1. Press the SET LO RANGE Function button once.
2. Immediately (within 5 seconds) press either the D or Ñ button to raise or lower the displayed value, as required, until the display reads the desired fullscale percent concentration.

4.4 Setting the Alarm Setpoints

The alarm setpoints can be adjusted over the full range of the analyzer (0-9999 ppm oxygen content). The set point values are expressed in ppm only.

4.4.1 Set Alarm 1

Alarm 1 can be set either as a high or low alarm. To configure this alarm to your preferences:

1. Press the SET ALARM 1 function button once.
2. The display will flash either HI or LO depending on what the alarm was configured in the last time. If the alarm configuration must be changed, use the Up or Down keys to toggle the alarm from HI to LO or viceversa (if within 5 seconds no key is pressed, the instrument will return to the sample mode and display oxygen concentration).
3. To change the setting at which the alarm will be actuated, press the SET ALARM 1 function button once more. The alarm setpoint will flash on the LED display. Press either the Up or Down keys to raise or lower the displayed value, as required, until the display reads the desired percent

concentration. (if within 5 seconds no key is pressed, the instrument will return to the sample mode and display oxygen concentration).

After setting the value wait for the unit to time out of this mode (approximately 5 seconds) and return to displaying oxygen concentration.

4.4.2 Set Alarm 2

Alarm 2 can be set either as a high or low alarm. To configure this alarm to your preferences:

1. Press the SET ALARM 2 function button once.
2. The display will flash either HI or LO depending on what the alarm was configured in the last time. If the alarm configuration must be changed, use the Up or Down keys to toggle the alarm from HI to LO or viceversa (if within 5 seconds no key is pressed, the instrument will return to the sample mode and display oxygen concentration).
3. To change the setting at which the alarm will be actuated, press the SET ALARM 2 function button once more. The alarm setpoint will flash on the LED display. Press either the Up or Down keys to raise or lower the displayed value, as required, until the display reads the desired percent concentration. (if within 5 seconds no key is pressed, the instrument will return to the sample mode and display oxygen concentration)

After setting the value wait for the unit to time out of this mode (approximately 5 seconds) and return to displaying oxygen concentration.

4.4.3 Sensor Fail Alarm

The SENSOR FAIL alarm has fail safe contacts that are triggered only when power to instruments is turned off.

4.5 Selecting a Fixed Range or Autoranging

The Model 3300TB can operate in fixed high, fixed low, or autoranging mode. To change modes:

1. Press and then release the SET HI RANGE and the SET LO RANGE buttons simultaneously.
2. Within 5 seconds, press either the D or Ñ button until Auto, Lo, or Hi displays on the LCD, as desired.

After about three seconds, the analyzer resumes monitoring in the selected range mode.

Note: If the concentration exceeds 9999 ppm oxygen, the analyzer will automatically switch to the Calibration Range, EVEN THOUGH INSTRUMENT IS IN THE FIXED RANGE MODE.

4.6 Calibration

Preliminary—If not already done: Power up the Analyzer and allow the LED reading to stabilize. Set the Alarm setpoints and the fullscale ranges to the desired values.

Procedure:

1. Expose the sensor to ambient air or instrument grade air (20.9 % oxygen). Allow time for the sampling system to purge and the analyzer to achieve equilibrium.

Note: If the analyzer output goes above the high alarm setpoint or below the low alarm setpoint, the display will go blank and the front panel ALARM Indicator, beneath the SET Function buttons, will blink. Hold down the SPAN button until the ALARM Indicator stops blinking.

2. Press the SPAN button once.
3. Within 5 seconds press either the D or Ñ button until the display is stable and reads 20.9 %.

The unit is now calibrated.

Note: If you use a span gas other than air, do not span in the 0-10 ppm range. Calibration at this level is not dependable.

Note: If you use a span gas other than air, and the span gas oxygen concentration is less than 10,000 ppm, the analyzer could take up to 65 seconds to to settle. The lag is caused by a digital filter that is active only below 10,000 ppm (1%) oxygen.

4.7 Displaying Percent & PPM on the LED Display

The analyzer displays the concentration in percent whenever the reading is over 9999 ppm. When the reading changes to percent, the LED display will alternate between flashing "PC" and the oxygen concentration. On the other hand, if the instrument is displaying ppm, only the concentration reading will be shown.

4.8 Supplementary Information

If, during the Span Procedure, you pressed the SPAN button by mistake, you must wait five minutes for the analyzer to resume analisis or you can press the UP button and then the DOWN button. (Pressing the UP and DOWN buttons causes the analyzer to time-out in five seconds instead of five minutes).

If during the span procedure, you press the RANGE or ALARM buttons:

- either the range or alarm routine will be activated.
- any changes to span will be rejected.
- the 60 second alarm delay will not occur, i.e., the alarms will be responsive immediately.

CAUTION: TAI considers the action of pressing the ALARM or RANGE buttons to be at your (the user's) discretion. The user should be aware that the alarms will become active within 5 (five) seconds if the Range or Alarm bottons are pressed during Span. This may result in false alarms if the Span gas has not been fully purged from the Cell and Sample lines.

Maintenance

Aside from normal cleaning and checking for leaks at the gas connections, the Model 3300TB should not require any maintenance beyond replacement of expended Micro-Fuel Cells, and perhaps a blown fuse. Routine maintenance includes occasional recalibration, as described in chapter 4, *Operation*.

5.1 Replacing the Fuse

CAUTION: Remove power to the unit before replacing the fuse.

When a fuse blows, check first to determine the cause, then replace the fuse using the following procedure:

1. Disconnect the AC power and place the power switch located on the rear panel in the O position. Remove the power cord from the receptacle.
2. The fuse receptacle is located in the power cord receptacle assembly in the upper left-hand corner of the rear panel. See Figure 5-1.

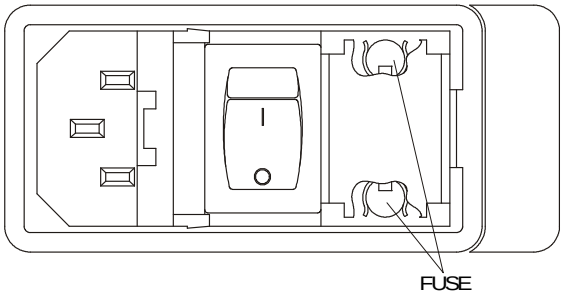


Figure 5-1: AC Fuse Replacement

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. There are two fuses in use and are visible in the clip.
4. Remove the bad fuse and replace it with a 5x20mm 0.5 A, 250 VAC, IEC time lag (T) fuse (P/N F1128).

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

5.2 Sensor Installation or Replacement

5.2.1 When to Replace a Sensor

On the trace analyzers, the Micro-fuel Cell will typically fail due to excessive zero offset caused by loss of water. Large zero offsets will result in inaccurate SPAN settings. To test for this condition, purge the sensor and sample system with ZERO gas (typically nitrogen with less than 1 ppm O2). It may take several hours for the sample system and cell to return to a stable low level of O2 if it has been exposed to higher levels of O2. If the instrument will not come down to an acceptably low reading on zero gas, then a depleted cell or a sample system leak should be suspected. Typically offsets of 1.0 ppm or less are acceptable. A Cell failure may also be indicated by an inability to SPAN, or slow response to changes in O2 concentration at levels below 100 ppm.

CAUTION: Read the section Cell Warranty Conditions, below, before replacing the cell.

CAUTION: After replacing the Micro-Fuel Cell, the analyzer must be recalibrated. See Calibration in Chapter 4.

5.2.2 Ordering and Handling of Spare Sensors

To have a replacement cell available when it is needed, TAI recommends that one spare cell be purchased when the current cell 's warranty period is approximately two thirds over.

CAUTION: Do not stockpile cells. The warranty period starts on the day of shipment. For best results, do not order a new spare cell too soon.

The spare cell should be carefully stored in an area that is not subject to large variations in ambient temperature (75 °F nominal), and in such a way as to eliminate the possibility of incurring damage.

CAUTION: Do not disturb the integrity of the cell package until the cell is to actually be used. If the cell package is punctured and air is permitted to enter, cell-life will be compromised.

WARNING: THE SENSOR USED IN THE MODEL 3300TB CONTAINS AN ELECTROLYTE WHICH INCLUDES SUBSTANCES THAT ARE EXTREMELY HARMFUL IF TOUCHED, SWALLOWED, OR INHALED. AVOID CONTACT WITH ANY FLUID OR POWDER IN OR AROUND THE UNIT. WHAT MAY APPEAR TO BE PLAIN WATER COULD CONTAIN ONE OF THESE TOXIC SUBSTANCES. IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH EYES WITH WATER FOR AT LEAST 15 MINUTES. CALL A PHYSICIAN. (SEE APPENDIX, MATERIAL SAFETY DATA SHEET—MSDS).

5.2.3 Removing the Micro-Fuel Cell

Refer to Figure 5-2 for an exploded view of the cell block and cell. To remove a spent or damaged Micro-Fuel Cell:

1. Disconnect the Power Source from the Control Unit.
2. Open the analyzer door.
3. Unscrew the cell-retainer cap from the cell block by turning it counterclockwise until it is free.

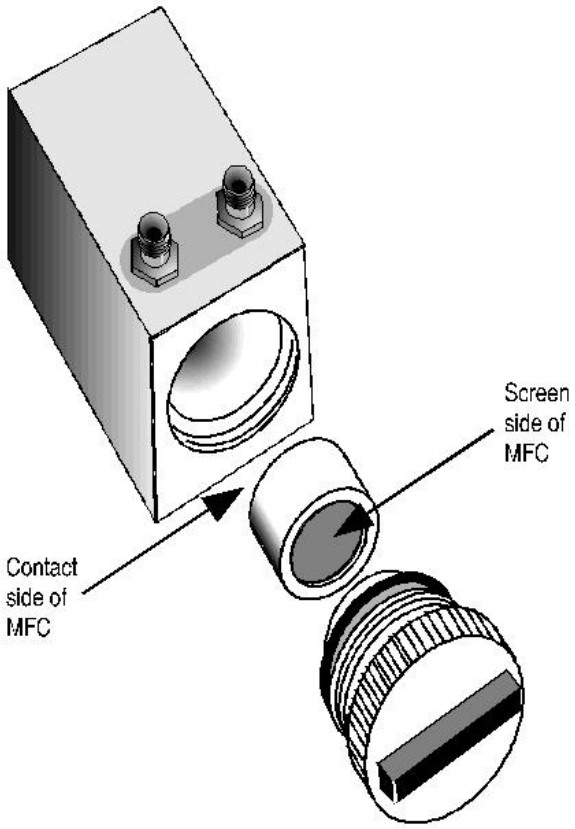


Figure 5-2: Exploded View of MFC and Cell Block

4. Slowly withdraw the cap from the block. The cell should come out with the cap.
5. Carefully pull the cell off of the cap. DO NOT TOUCH THE SCREENED END OF THE CELL OR ANY FLUID THAT MAY BE LEAKING FROM IT.
6. Dispose of the cell in a safe manner, in accordance with all applicable ENVIRONMENTAL AND SAFETY laws.

5.2.4 Installing a Micro-Fuel Cell

To install a new Micro-Fuel Cell:

CAUTION: Do not scratch, puncture, or otherwise damage the sensing membrane of the Micro-Fuel Cell. If the membrane is damaged, the cell must be replaced.

1. Disconnect the Power Source from the Control Unit.
2. Remove the new Micro-Fuel Cell from its protective bag.
3. Examine the O-ring at the base of the threaded portion of the cell-retainer cap, and replace it if it is worn of damaged.
4. Replace the cell on the end of cell-retainer cap, which is designed to fit snugly into the rim on the screen side of the cell.
5. Careful insert the cap and cell into the block, and screw the cap clockwise into the cell block until it is held firmly in the cell.
6. Reconnect the cell block electrical connector plug.

5.2.5 Cell Warranty Conditions

The B-2C Class Micro-Fuel cell is used in the Model 3300TB. These cells are warranted for 6 months, with an expected life of 8 months from the date of shipment (under specified operating conditions—see Appendix). Note any Addenda attached to the front of this manual for special information applying to your instrument.

Note that the warranty period begins on the date of shipment. The customer should stock only one spare cell per instrument at a time. Do not attempt to stockpile spare cells.

If a cell was working satisfactorily, but ceases to function before the warranty period expires, the customer will receive credit toward the purchase of a new cell.

If you have a warranty claim, you must return the cell in question to the factory for evaluation. If it is determined that failure is due to faulty workmanship or material, the cell will be replaced at no cost to you.

Note: Evidence of damage due to tampering or mishandling will render the cell warranty null and void.

Appendix

A-1 Model 3300TB Specifications

Ranges: Two user selectable ranges can be set between 0-10 ppm and 0-9999 ppm oxygen, and a 0-25 % (nominal) Air Calibration Range.

Signal Output: Voltage: 0–10 VDC, negative ground
Current: 4-20 mA, negative ground

Range ID: 0-10 VDC.

Display: Light emitting diode (LED) display.

Alarms: One high alarm relay, adjustable; one low alarm relay, adjustable; one sensor failure relay. (All are failsafe.)

System Operating Temp: 0-50 °C

Accuracy: ±2 % of full scale at constant temperature
±5 % of full scale through operating temperature range (At 100 ppm and higher user defined ranges) once temperature equilibrium is reached.
±1 ppm for 10 ppm range under above conditions.

Response Time: 90 % in less than 65 seconds at 25 °C (68 °F).

System Power Requirement: AC (100-240 VAC, 50/60Hz), or
DC (10-36 VDC); user specified.

System Enclosure: Wall Mount, NEMA -4 Enclosure:

16.40" H × 8.0" W × 6.0" D (416.56 mm × 203.2 mm × 152.40 mm).

A-2 Spare Parts List

Qty	Part Number	Description
1	C-65220-A	PC Board, Main
1	C-64586	PC Board, Power Supply
1	C-6689-B-2C	Micro-Fuel Cell, class B-2C
2	F-1130	Fuse (AC), ½A, 250 VAC Type "T" (IEC), 5 x 20mm

Note: Orders for replacement parts should include the part number (if available) and the model and serial number of the instrument for which the parts are intended.

Orders should be sent to:

TELEDYNE Analytical Instruments

16830 Chestnut Street
City of Industry, CA 91748

Phone (626) 934-1500, Fax (626) 961-2538

Web: www.teledyne-ai.com
or your local representative.

A-3 Drawing List

D70361	Outline Drawing
D70362	Final Assembly

Note: The MSDS on this material is available upon request through the Teledyne Environmental, Health and Safety Coordinator. Contact at (626) 934-1592.

A-5 Material Safety Data Sheet

Section I - Product Identification

Product Name:	Micro-fuel Cells
	Mini-Micro-fuel Cells
	Super Cell, all classes except T-5F
	Electrochemical Oxygen Sensors, all classes
Manufacturer:	Teledyne Electronic Technologies
	Analytical Instruments
Address:	16380 Chestnut Street,
	City of Industry, CA 91749
Phone:	(626) 961-9221
Technical Support:	(626) 934-1673
Environment, Health and Safety:	(626) 934-1592
Date Prepared:	11/23/98

Section II - Physical and Chemical Data

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

	KOH (15% w/v)	Pb (pure)
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 Vol.:	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:	0.05 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
Carcinogenicity:	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. Do not administer liquids to an unconscious person.

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.

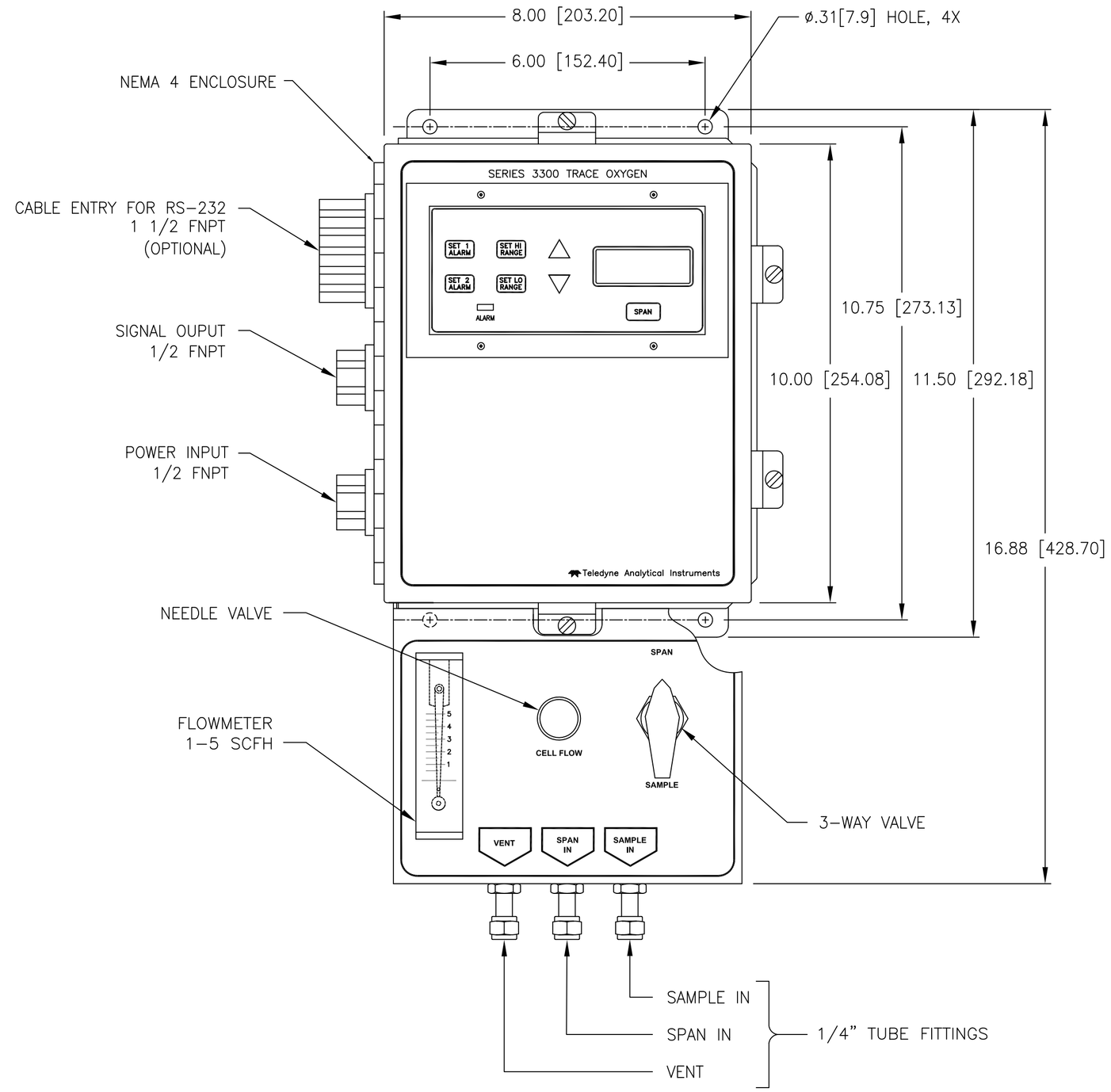
Disposal: Should be in accordance with all applicable state, local and federal regulations.

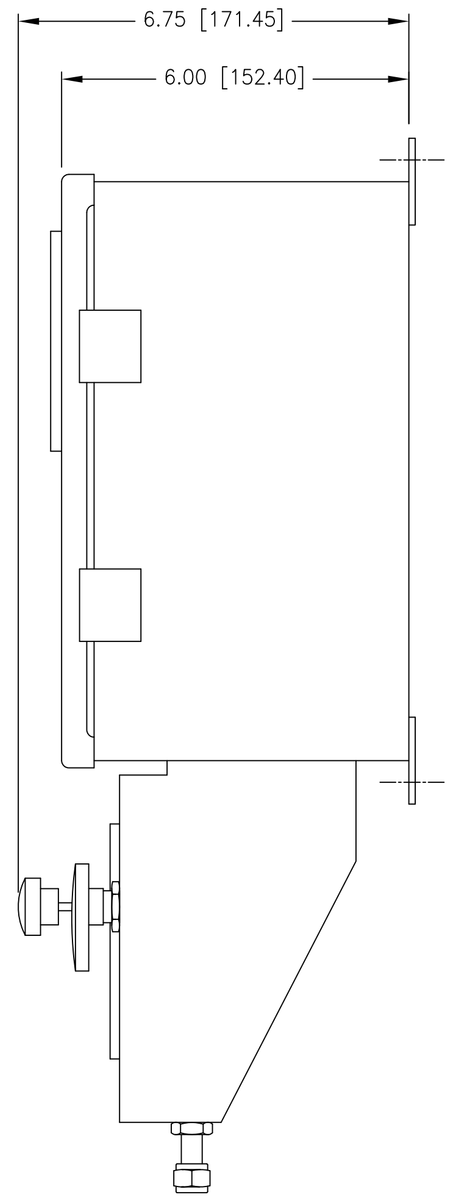
Note: The above information is derived from the MSDS provided by the manufacturer. The information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. Teledyne Analytical Instruments shall not be held liable for any damage resulting from handling or from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

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL DIMENSIONS ARE IN INCHES (±.06) AND MILLIMETERS (±1.), INCHES[mm].

REVISIONS				
REV	DESCRIPTION	DATE	APP.	REV. BY
0	REL PER ECO# 98-0585	12/17/98	WTC	--





ITEM	QTY	PART NO.	DESCRIPTION

BILL OF MATERIAL

DO NOT SCALE DWG

TOLERANCE UNLESS OTHERWISE SPECIFIED: ANGULAR ±1/2° LINEAR .X = ±.1, .XX = ±.02, .XXX = ±.010

TELEDYNE INSTRUMENTS
Analytical Instruments
A Teledyne Technologies Company
City of Industry, California, 91748, USA

	SIGNATURES	DATE
N/	DRFT: WING T. CHOW	12/02/98
I/	CHK:	
O/	APPR:	
P/ B-70351	ENGR: WING T. CHOW	
F/ D-70362	C.O. STANDARD	
REFERENCE	CAD ID D70361-0	

TITLE: OUTLINE DIAGRAM
TRACE OXYGEN ANALYZER
MODEL 3300TB

SCALE 1:2 | SIM NONE | SHEET 1 OF 1

MATL. NONE | DWG NO. **D-**70361 | REV 0