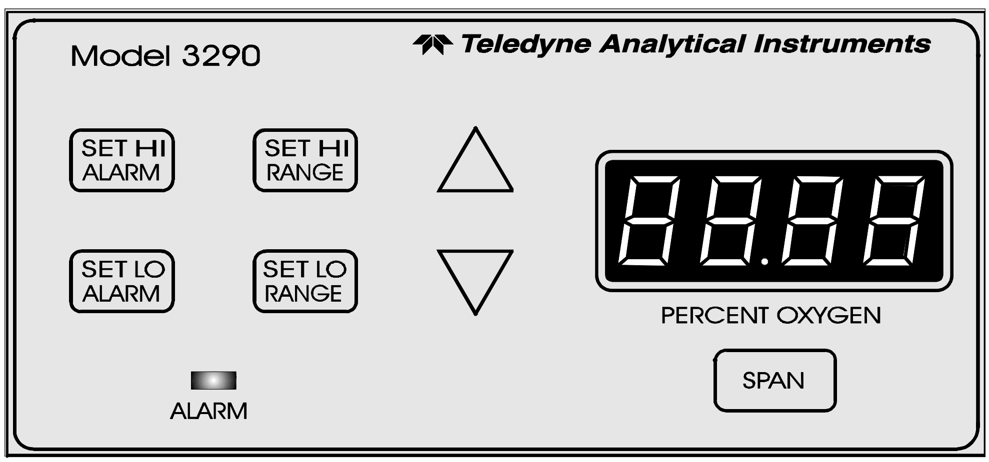
OPERATING INSTRUCTIONS FOR

Model 3290

Percent Oxygen Analyzer



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.

P/N M64643
08/06/99
ECO # 99-0323

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 (TAI), 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

1.1 Overview

The Teledyne Electronic Technologies Analytical Instruments (TETAI) Model 3290 is a microprocessor-based percent oxygen analyzer for real-time measurement of the percent 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 Model 3290 are monitoring nitrogen generators and inert gas blanketing applications.

1.2 Main Features of the Analyzer

The main features of the analyzer include:

- High resolution, accurate readings of oxygen content from 0-1 % through 0-25 %. Large, bright, light-emitting-diode meter readout.
- Simple pushbutton controls.
- Nylon cell holder.
- Advanced Micro-Fuel Cell, for percent analysis, has a two year warranty and an expected lifetime of four years.
- Unaffected by oxidizable gases.
- Fast response and recovery time.
- Microprocessor based electronics: 8-bit CMOS microprocessor with on-board RAM and 16 KB ROM.
- Two user selectable ranges (from 0-1 % through 0-25 %) allow best match to users process and equipment.
- Air-calibration range for convenient spanning at 20.9 %.

- Operator can select Autoranging, which allows the analyzer to automatically select the proper preset range for a given measurement, or he can lock the analyzer onto a single range.
- Two concentration alarms with adjustable setpoints.
- Sensor failure alarm.
- Three analog outputs: two for measurement (0–10 V dc, and negative ground 4–20 mA dc) and one for range identification (0-10 V dc).
- Compact and rugged Control Unit with flush-panel case. Designed for indoor use. Front panel NEMA-4 rated.
- External Probe can be located six feet or more away, depending on the existing electromagnetic noise level.

1.3 Front Panel Description

All controls and displays except the power switch are accessible from the front panel. See Figure 1-1. The front panel has seven pushbutton 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*.

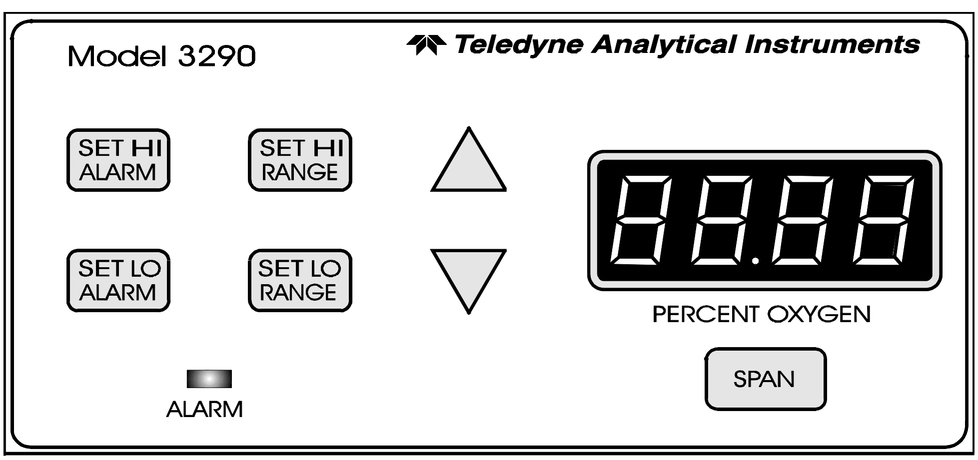

Figure 1-1: Front Panel

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

- **Set HI Alarm** Set the concentration ABOVE which an alarm activates.

- **Set LO Alarm** Set the concentration BELOW which an alarm activates.
- **Set HI Range** Set the high analysis range for the instrument (up to 0-25 %).
- **Set LO Range** Set the low analysis range for the instrument (down to 0-1 %).
- **Span** Span calibrate the analyzer.

Data Entry Keys: Two pushbutton 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. Separate rear panel illustrations are shown in Figure 1-2 for the AC and DC powered versions of the instrument. The connectors are described briefly here and in detail in the *Installation* chapter of this manual.

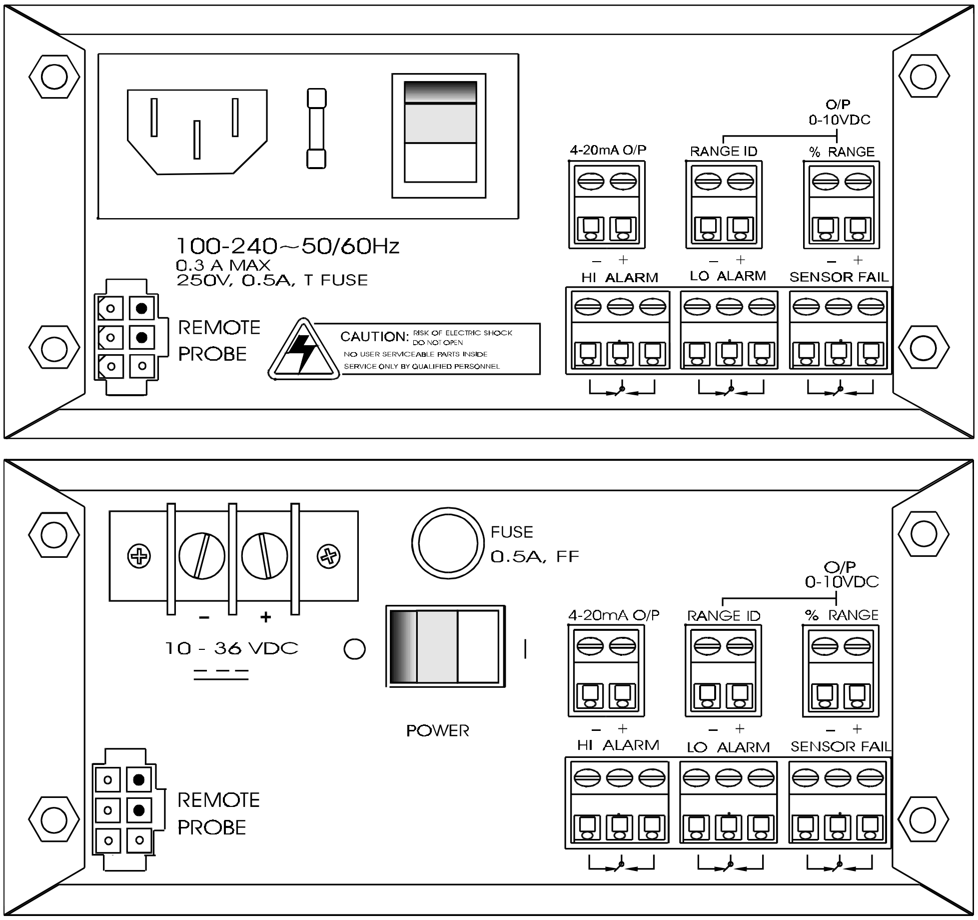

Figure 1-2 Rear Panel (AC and DC versions)

- **Power Connection** — ***AC version:*** 100–240 V ac, at 50/60 Hz. 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 overrange) output.
  4–20 mA dc concentration output, negative ground.
- **Alarm Connections** — HI Alarm, LO Alarm, and Sensor Failure Alarm connections.
- **External Probe** — Connects to the Remote Probe or remote Analysis Unit.

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 3290 is a Micro-Fuel Cell designed and manufactured by TAI. It is a sealed, 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 potential that can produce a 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 made of extremely inert plastic (which can be placed confidently in practically any environment or sample stream). It is effectively sealed, though one end is permeable to oxygen in the sample gas. At the permeable end a screen retains a diffusion membrane through which the oxygen passes into the cell. At the other end of the cell is a connector. The connector mates with a miniature phone jack that provides electrical connection to the Control Unit.

Refer to Figure 2-1, *Basic Elements of a Micro-Fuel Cell*, which illustrates the following internal description.

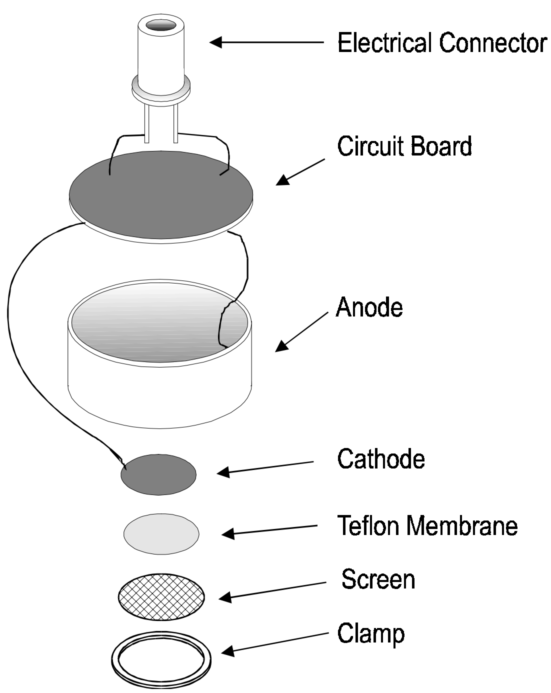

Figure 2-1. Basic Elements of a Micro-Fuel Cell (not to scale)

At the sensing end of the cell is a diffusion membrane, whose thickness is very accurately controlled. Near the diffusion membrane lies the oxygen sensing element—the cathode.

The anode structure is larger than the cathode. It is made of lead and is designed to maximize the amount of metal available for chemical reaction.

The space between the active elements is filled by a structure saturated with electrolyte. Cathode and anode are wet by this common pool. They each have a conductor connecting them, through some electrical circuitry, to one of the external contacts in the connector receptacle, which is on the top 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:

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

(Two electrons are transferred for each atom of lead that is oxidized. TWO ANODE REACTIONS balance one cathode reaction to 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 are present in the sample. The only likely components are the halogens—iodine, bromine, chlorine and fluorine.)

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 as a percentage of the gas mixture, it is necessary that the sample diffuse into the cell under constant pressure.

If the pressure changes, 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 proportion of oxygen has not changed.

Fortunately, Dalton's Law confirms that every gas in a mixture contributes the same pressure to the mixture that it would exert if it were alone in the same amount in that same volume. This means that as long as the total pressure of the sample remains constant, the mixture can change, but the diffusion of the oxygen will be affected only by the concentration of the oxygen.

For this reason, the sample system supplying sample gas to the cell should be designed to keep the pressure on the diffusion membrane constant.

2.2.5 Calibration Characteristics

Given that the total pressure of the sample gas at 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 of constant impedance 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 2-2. Measuring circuits do not have to compensate for nonlinearities.

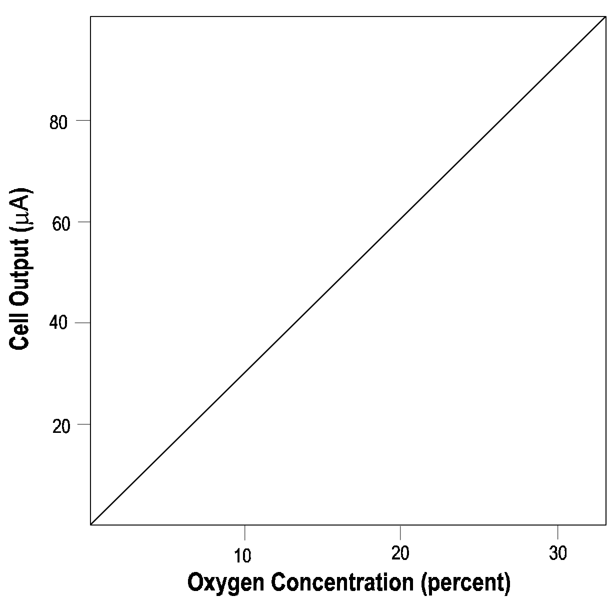

Figure 2-2. Characteristic Input/Output Curve for a Micro-Fuel Cell

In addition, since there is zero output in the absence oxygen, the characteristic curve has an absolute zero. The cell itself does not need to be zeroed.

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 temperature compensated 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.

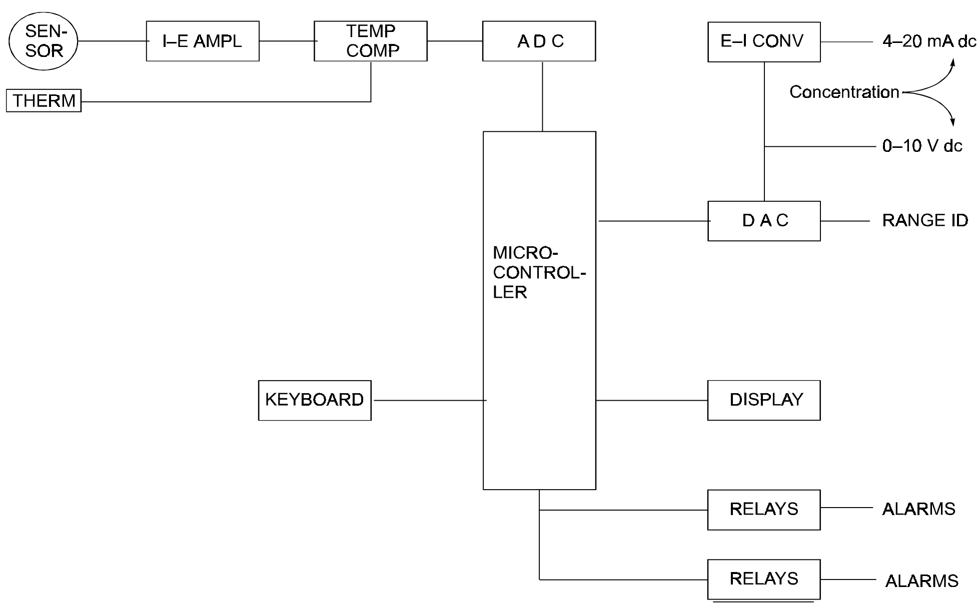

Figure 2-3: Block Diagram of the Signal Processing Electronics

In the presence of oxygen the cell generates a current. A current to voltage amplifier (I–E AMPL) converts this current to a voltage.

The second stage amplifier (TEMP COMP) supplies temperature compensation for the oxygen sensor output. The temperature compensation amplifier incorporates a thermistor (THERM) that is physically located in the cell block. The thermistor is a temperature dependent resistance that changes the gain of the amplifier in proportion to the temperature changes in the block. This change is inversely proportional to the change in the cell output due to the temperature changes. As a result there is negligible net change in the signal due to temperature changes once the sensor comes to equilibrium. See *Specifications* in the Appendix.

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 current to voltage converter (E–I CONV) produces the 4-20 mA dc analog concentration signal.

Installation

Overvoltage Category II

Installation of the analyzer includes:

1. Unpacking the system.
2. Mounting the Control Unit, External Sample Block, and Micro-Fuel Cell sensor.
3. Making the electrical connections.
5. Making the gas connections.
6. Testing the installation.

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

For indoor use only.

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 Control Unit, External Probe, 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 3290 Control Unit is designed to be panel-mounted in a general purpose, indoor area, away from moisture and the elements. The unit should be installed at viewing level in a sheltered area.

CAUTION: For the DC powered version, the control unit chassis must be isolated from the input power ground.

Refer to the Outline diagram C-64771 for the physical dimensions of the analyzer.

3.2.2 External Probe Installation

The External Probe can be installed in the process any reasonable distance from the Control Unit. The nominal maximum is 6 ft, but the distance can be more, depending on the level of electromagnetic noise in the operating environment.

The standard Model 3290 includes the External Probe unit depicted in the Final Assembly, Dwg C-64643, and the Analysis Unit (probe) Outline, Dwg B-57335. Dimensions are also given in *Specifications* in the Appendix.

For special applications, the type of External Probe unit supplied may vary depending on the specific process. With these systems, specific installation and interconnect information is given in a separate probe manual or in an addendum to this manual depending on the model External Probe used. The addendum will reference the specific Outline and Interconnection Drawings in the Drawings section of this manual, and provides any other appropriate information.

For special applications the Micro-Fuel Cell may also be of a different type than the standard E-2 unit. If this is the case, the pertinent cell specifications will be given in the addendum.

3.2.3 Installing the Micro-Fuel Cell

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.

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

3.3 Electrical Connections

Figure 3-1 shows the two alternate Model 3290 rear panels. The difference between them is the power connections. The first illustration shows the AC powered version, and the second illustration shows the DC powered version. Both versions have identical connections for the External Probe, the alarms, and for both digital and analog concentration outputs. For detailed pinouts, see the wiring/interconnection drawings in the Drawings section at the rear of this manual.

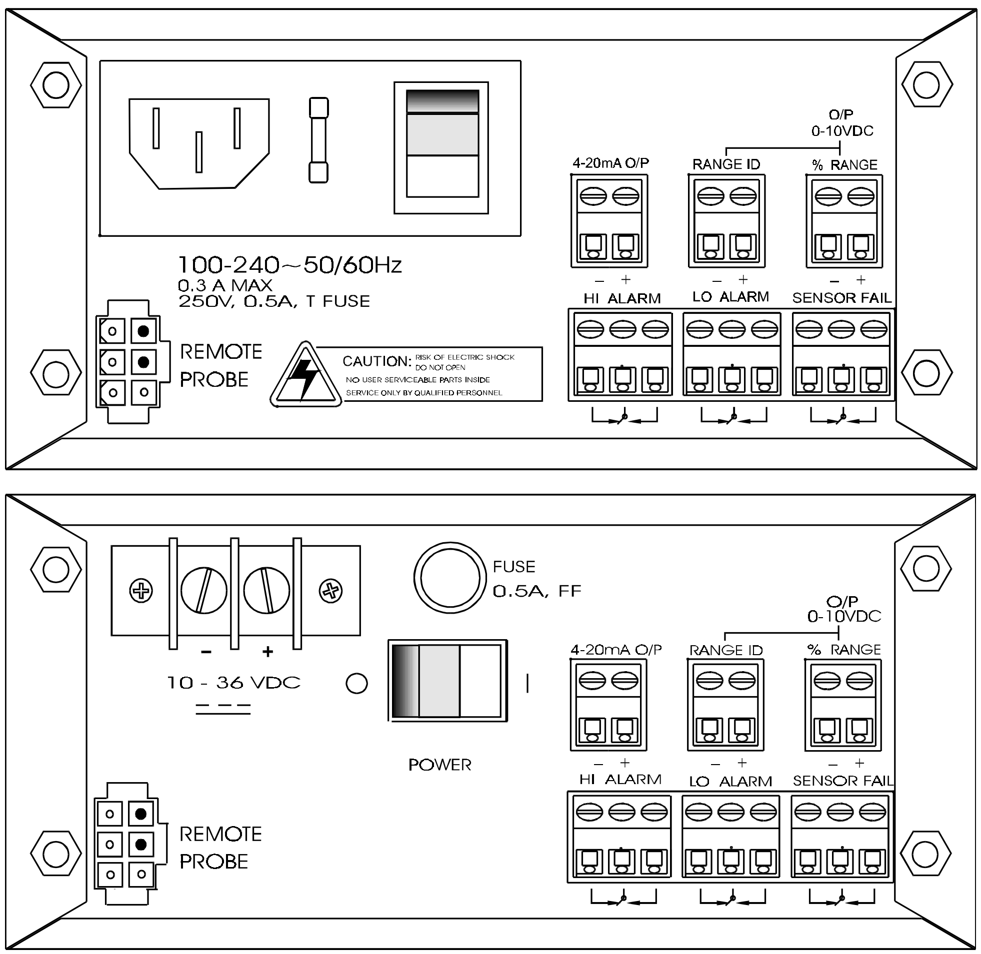

Figure 3-1 Rear Panel Electrical Connectors for AC and DC Units

Primary Input Power (AC version): The power cord receptacle, fuse block and Power switch are located in the same assembly. A 6-foot, standard AC power cord is supplied with the Control Unit. Insert the female plug end of the power cord into the power cord receptacle.

The universal power supply allows direct connection to any 100-240 V ac, 50/60 Hz power source. The fuse block, to the right of the power cord receptacle, accepts a 5 × 20 mm, 0.5 A, 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.

Primary Input Power (DC version): The 10–36 V dc power is connected via the + and – terminals in the upper left corner of the panel. The fuse receptacle, to the right of the power terminal strip, holds a 0.05 A, very quick acting fuse. (See *Fuse Replacement* in chapter 5, *Maintenance*.)

The Power switch is located below the fuse receptacle.

WARNING: Insert the stripped tips of wires entirely into the terminal blocks. Do not leave exposed wire outside of the holes in the blocks.

CAUTION: The control unit chassis must be isolated from the grounding system of the DC input power.

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 V ac into a resistive load.

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.

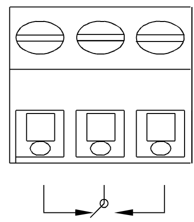

Figure 3-2: Contact ID for FAILSAFE Relay Operation

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

HI Alarm Configured as high alarm (actuates when concentration is above threshold). Can be set anywhere between 1 and 25 %, but must be set ABOVE the threshold set for the LO Alarm.

LO Alarm Configured as low alarm (actuates when concentration is below threshold). Can be set anywhere from 1 to 25 %, but must be set BELOW the threshold set for the HI Alarm.

Sensor Fail Actuates when the output of the Micro-Fuel Cell sensor falls below the acceptable level.

External Probe: The receptacle for the analysis unit cable is located in the lower left-hand corner of the rear panel. The 6-pin Minifit connector is keyed to fit only one way into 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 Final Assembly, Dwg. C-64643.

3.4 Gas Connections

Gas connection instructions depend on the specific External Probe used and any special requirements of the process being monitored.

The standard Model 3290 External Probe has inlet and outlet fixtures only. Calibration gasses must be tee'd into the sample inlet through appropriate valves. ¼ inch tube fittings are used. For metric installations, ¼ inch to 6 mm adapters are supplied.

In general, sample flow and pressure must not create significant backpressure past the sensor. For the standard probe, 2 scfh is the nominal recommended flowrate.

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.

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
- Opened the isolation valves
- Checked for leaks
- Set the sample pressure to 5–10 psig, nominal

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 percent 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 Analyzer is analyzing.

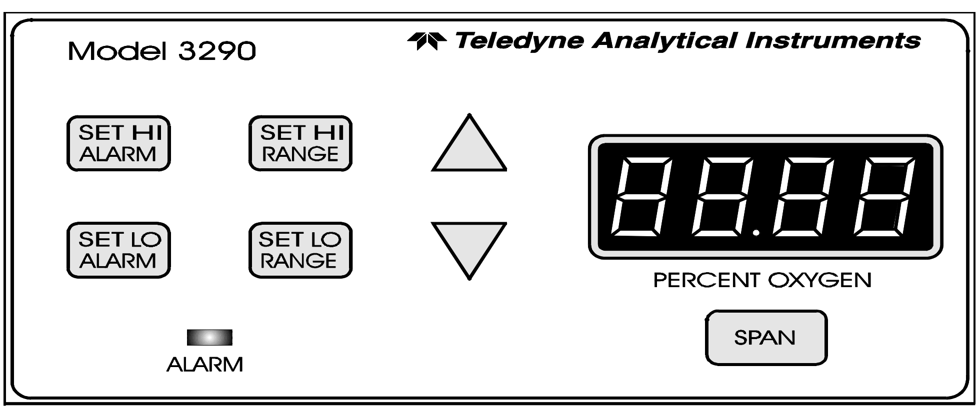

Figure 4-1: Front Panel Controls and Indicators

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 percent of oxygen in the sample gas that is flowing through the Remote Probe.

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 (Δ and ∇) increment the values displayed on the PERCENT OXYGEN meter while one of the Function buttons is being held down.

- Δ : 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 0-1% to 0-25% oxygen concentration. Whatever values are selected, the analyzer automatically switches from the LO range to the HI range when the oxygen concentration reaches 100% of the LO range fullscale value, and it switches back to the LO range when the oxygen concentration reaches 85% 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 Δ 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 Δ or ∇ 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 (0-25% oxygen content). They are set as a percent of oxygen content, so that an alarm set to indicate 9.6 on the display will activate at 9.6% O_2 on any O_2 range.

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

4.4.1 Set Alarm 1

Setting the HI Alarm sets the value ABOVE which the HI Alarm will activate. To Set the HI Alarm:

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

4.4.2 Set Alarm 2

Setting the LO Alarm sets the value BELOW which the LO alarm will activate. To set the LO Alarm:

1. Press the SET LO ALARM Function button once.
2. Immediately press either the Δ or ∇ button to raise or lower the displayed value, as required, until the display reads the desired percent concentration.

4.4.3 Sensor Fail Alarm

The SENSOR FAIL alarm is factory set to a reading less than 0.05% O_2. Should this alarm trigger the ALARM Indicator below the SET Function buttons will blink, and the alarm relay contact dedicated to this function will change state.

4.5 Selecting a Fixed Range or Autoranging

The Model 3290 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. Immediately (within 5 seconds) press either the Δ or ∇ 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.

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 goes overrange, 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. Immediately (within 5 seconds) press either the Δ or ∇ button until the display is stable and reads 20.9%.

The unit is now calibrated.

Note: 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 (20.9%). Do not attempt to adjust any alarm setpoints while the alarms are disabled during the 25-second period.

Maintenance

Overvoltage Category II

Aside from normal cleaning and checking for leaks at the gas connections, the Model 3290 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

5.1.1 AC Powered Units

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.

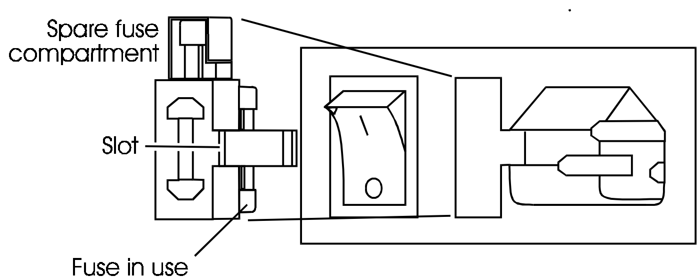

Figure 5-1: AC Fuse Replacement

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. 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 5×20 mm 0.5 A, 250 V ac, time lag (T) fuse (P/N F1128) for AC units.

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

5.1.2 DC Powered Units

In units with DC power, the fuse is located on the rear panel above the ON/OFF switch.

1. Open the fuse holder by unscrewing and removing the cap marked FUSE.

2. The fuse is located inside the receptacle, not inside the cap. Both terminals are on the same end of the fuse. Pull straight out without twisting to remove the old fuse from the receptacle, and replace it with a 0.5 A, 125 V dc, very quick acting (FF) microfuse (P/N F51).

3. Replace the cap by screwing it back into the receptacle.

5.2 Sensor Installation or Replacement

5.2.1 When to Replace a Sensor

The characteristics of the Micro-Fuel Cell show an almost constant output through their useful life, and then fall off sharply towards zero at the end. You will find that very little adjustment will be required to keep the analyzer calibrated properly during the duration of a given cell's useful life.

If the sample being analyzed has a low oxygen concentration, cell failure will probably be indicated by the inability to properly calibrate the analyzer. If large adjustments are required to calibrate the instrument, or calibration cannot be achieved within the range of the Δ∇ buttons, the cell may need replacing. Read the section *Cell Warranty Conditions*, below, before replacing the cell.

In addition, if the front panel Percent Oxygen Meter 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, 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 shortly after the instrument is placed in service, and each time the cell is replaced.

CAUTION: Do not stockpile cells. The warranty period starts on the day of shipment. For best results, order a new spare cell when the current spare is installed.

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 3290 uses electrolytes which contain 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 physician. (See Appendix, Material Safety Data Sheet—MSDS).

5.2.3 Removing the Micro-Fuel Cell

To remove a spent or damaged Micro-Fuel Cell:

1. **Disconnect the Power Source from the Unit.**
2. Unplug the connector from the spent cell.
3. Remove the spent cell by unscrewing it, counterclockwise, from the cell block.
4. Dispose of the cell in a safe manner, and in accordance with local laws.

5.2.4 Installing a Micro-Fuel Cell

To install a new Micro-Fuel Cell:

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.

1. **Disconnect the Power Source from the Unit.**

2. Remove the new Micro-Fuel Cell from its protective bag, being careful not to lose the O-ring at the base of the threaded portion of the cell.

3. Replace the cell on the cell holder by screwing it clockwise into the cell block until it is held firmly in the socket.

4. Insert the cell block electrical connector plug into the socket in the sensor.

5.2.5 Cell Warranty Conditions

The Class E-2 Micro-Fuel cell is used in the Model 3290. This cell is a long life cell and is warranted for 2 years (under specified operating conditions—see Appendix) from the date of shipment. Note any Addenda attached to the front of this manual for special information applying to your instrument.

With regard to spare cells, 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 the customer.

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

Appendix

A.1 Specifications

Ranges:	0-3 % and 0-10 % oxygen (Standard Ranges), and 0-25 % (nominal) Calibration Range. User selectable % Ranges can be set between 1% and 25 % oxygen
Signal Output:	Voltage: 0–10 V dc, negative ground Current: 4-20 mA, negative ground
Range ID:	0-10 V dc.
Display:	Light emitting diode display.
Alarms:	Two customer selectable high or low fully adjustable alarms. One cell failure alarm. Alarm relays "C" contacts dry contacts rated at 2A for 30VDC, 0.5A for 115VAC.
System Operating Temp:	0-50 °C
Accuracy:	±2% of full scale at constant temperature ±5% of full scale through operating temp. range once temp. equilibrium is reached. (At 3 % and 5 % user defined ranges.)
Response Time:	90% in less than 20 seconds at 25 °C.
System Power Requirements:	AC (100 to 240 V ac, 50/60 Hz).
System Enclosure:	Rack mount with handles. Dimensions (Approx.) 19 W x 5 H x 5 D.
Sensor Type:	Micro Fuel Cell Class R-22..
Analysis Unit:	4.0" H × 6.0" W × 2.5" D (101.6 mm × 152.4 mm × 63.5 mm)

A.2 Spare Parts List

QTY.	P/N	DESCRIPTION
1	C-65220	PC Board, Main
1	C-64586A	PC Board, Power Supply, AC Version
1	C64586B	PC Board, Power Supply, DC Version
1	C-57283-E2	Micro-Fuel Cell, E-2
1	A33748	Thermistor Assembly
4	F-1128	Fuse (AC), ½A, 250 V ac
4	F-51	Fuse (DC), ½A, 125 V dc
1	A-64678A	Probe to Analyzer Cable, 6 ft

A minimum charge 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 ELECTRONIC TECHNOLOGIES
Analytical Instruments
16830 Chestnut Street
City of Industry, CA 91749-1580

Telephone: (626) 934-1500
TWX: (910) 584-1887 TDYANYL COID
Fax: (626) 961-2538

Web: www.teledyne-ai.com

or your local representative.

A.3 Reference Drawing

C-64643 Final Assembly (and interconnection diagram)
C-64771 Outline Diagram

A.4 Miscellaneous

The symbol: ~ is used on the rear panel of the model 3290 to signify volts alternating current (V ac).

Model 3290PA AL Options

Model 3290 AL option is used by AIR LIQUIDE, MEDAL, INDECOR and others.

The special features include:

Analysis Unit and Cable Assembly

The standard oxygen analysis unit (AU) has been replaced with a special AU (P/N B61178). The cable assembly (P/N A61177) supplied for use with the AU is ten feet in overall length.

NOTE: The AU does not have a mounting plate or terminal strip. However, the manifold block of the AU contains two screw holes tapped for 10-32 UNF-2B x .500" that are suitable for mounting purposes. (See drawing C-64643 for a sample interconnection.)

NOTE: The micro-fuel cell used in this instrument is not orientation dependent. However, to minimize the possibility of contamination from particulates or moisture, TET/AI recommends that the cell assembly be kept in an upright position as is shown in drawing C-64643.

Out-Of-Range Indicator

An IC on the Power Supply PCB (C-64586) has been installed for the out-of-range identification feature.

When the high analysis range is set, an output of ≈15VDC (45mA maximum) is available at the rear panel "RANGE ID" terminal block. (This output can be used to drive a relay or some other indicator.) When the low analysis range is set, the output at the terminal block drops to ≈0VDC. (To set the high or low ranges, see paragraph 4.3 in this manual.)

NOTE: When the instrument is in the "AUTO" mode, the output at the "RANGE ID" terminal block will be as follows:

HI ≈ 15VDC

LO ≈ 0VDC

CAL ≈ 15VDC

Drawing Changes

The following drawings should be used with Model 3290 AL:

C-65676 Final Assembly/Interconnection

C-66095 Outline Diagram, Model 3290 Oxygen Analyzer

B-61176 Outline Diagram, Probe Analysis Unit

A.5 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–5F Electrochemical Oxygen Sensors, all classes.
Manufacturer:	Teledyne Analytical Instruments
Address:	16830 Chestnut Street, City of Industry, CA 91749
Phone:	(626) 961-9221
Date Prepared or Last Revised:	08/08/91
Emergency Phone Number:	(626 961-9221

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 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
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.