

OPERATING INSTRUCTIONS

FOR

TAI MODEL 307WA

OXYGEN TRACE ANALYZER

SERIAL NUMBER

RANGE

TAG NUMBER

CUSTOMER ORDER NUMBER

SALES ORDER NUMBER

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INTRODUCTION

1.1 Purpose. The TAI Series 300 Oxygen Trace Analyzer measures continuously trace quantities of oxygen in a gas stream. The measurement is specific for oxygen, so the analyzer can be used to monitor the oxygen in a wide variety of gases and gas mixtures.

1.2 Basis of Measurement. The oxygen is measured with an electrochemical cell, which consumes oxygen from the gas stream and generates a proportionate electric current. The cell includes a catalytically active cathode, an anode (which is also consumed in the reaction), and a suitable electrolyte. The terminals of the cell are connected to an amplifier. The output of the cell is amplified to provide an output of 0-1VDC which is directly proportional to the amount of oxygen in the gas stream.

1.3 Method of Operation. The analyzer is operated by attaching it to a supply line leading to the process stream of gas to be analyzed. A sample of this gas is flowed through the analyzer, and the output signal generated by the oxygen cell, is measured by a suitable readout device, such as a meter, millivolt recorder or the output may be converted to drive a current recorder.

The analyzer includes a throttle valve and flowmeter to control the flow of sample, a humidifier to condition the sample for entry to the cell, the measuring cell and its associated load circuitry, and a calibrator to adjust the sensitivity of the analyzer to the desired range of measurement.

1.4 Accessory Equipment Required. For proper operation the analyzer will require accessory equipment, which must be chosen to fit the individual application. In general the analyzer will require the following type of accessory equipment.

1.4.1 Power Source. A source of AC power capable of supplying approximately 150 watts at between 100 and 130 volts, 50 or 60 cycles. (standard).

1.4.2 Output Indicator or Recorder. The analyzer has a millivolt output signal (see Section 7.2) at approximately 100 ohms source impedance. The device used to indicate

and/or record the output of the analyzer cannot require any appreciable power to be supplied by the analyzer signal. The usual type of indicator-recorder is a self-balancing potentiometer.

1.4.3 Sample Conditioning Equipment. The sample entering the analyzer must be free of entrained solids and condensable vapors and be at a relatively constant pressure between 1 and 100 psig. If the sample pressure fluctuates, it should be regulated before entering the analyzer. Pressure fluctuations cause flow rate changes, which may carry fluid from the humidifier column into the cell, impairing its operation. Although the analyzer will accept samples up to 100 psig, more convenient operation is obtained if the sample is regulated to a pressure between 5 and 10 psig. This will reduce the possibility of excessive flow surges while the flow is being adjusted.

In selecting equipment to control and clean the sample the following factors should be considered:

- a) The analyzer requires a sample flow of about 150 cc/min. (0.32 SCFH). Filters, regulators, interconnecting lines, etc., should be kept small to minimize the hold-up time of the sample.
- b) Oxygen from the air will diffuse through most plastic materials. Thus, pressure regulators must have metal diaphragms and interconnecting lines must be metallic tubing. This diffusion with the resultant error in oxygen analysis occurs even though the sample may be at much higher pressure than atmospheric.
- c) Oxygen will diffuse into the sample lines, etc., through tiny leaks also. All of the sample equipment must be free of any measurable leakage.

1.5 Analyzer System Layout. The layout and arrangement of the sample handling equipment, analyzer, and recorder will vary according to the requirements of each individual installation. A typical layout of a simple system is shown in the back of the manual.

2. INSTALLATION

2.1 Case. The Model 307WA Oxygen Trace Analyzer is housed in two sections. The analysis section is an explosion-proof type housing suitable for use where hazardous vapors are present.

The control unit is housed in a non-explosion flush mountable case.

2.2. Location. The analyzer should be installed in a location so that

- a) It is sheltered from direct exposure to the weather.
- b) The ambient temperature remains in the range from 30° to 120° F.
- c) It does not receive excessive shock or vibration.
- d) It is as close as possible to the sampling point of the process.
- e) There is access to the side of the analyzer case for connection of the sample and vent lines and for the electrical connections.

NOTE: The level of the electrolyte in the measuring cell is critical and the water level control system for the humidifier is gravity sensitive. Therefore, THE ANALYZER MUST BE MOUNTED SO THAT THE BOTTOM OF THE CASE IS LEVEL.

2.3 Electrical Connections. A diagram of the necessary electrical connections is included at the back of this manual.

The power connections include a ground terminal for grounding the case and chassis of the analyzer in accordance with standard industrial practice.

The maximum power requirement is less than 1 1/2 amperes at 115 vac (standard).

The output signal leads should be a twisted pair with an insulated electrostatic shield. This cable should run in a conduit separate from the power connections.

2.4 Sample Connections. The outline diagram at the back of this manual shows the location and size of the sample coupling.

2.4.1 Connectors. The use of straight tubing connectors is recommended for connecting the sample line. This will facilitate removal of the analyzer assembly from the case for service if this becomes necessary.

2.4.2 Sample Lines. The sample lines should be metallic tubing. Oxygen can diffuse through plastic tubing and cause errors in analysis.

NOTE: The analyzer measures very small quantities of oxygen. Oxygen can diffuse into the sample line through small leaks, even though the sample pressure is much greater than the atmospheric. Great care should be taken in the installing of the sample line to avoid leaks. The sample line should be of continuous tubing where possible. Splices should be made with tube fittings.

2.4.3 Filters. The sample gas must be clean and free of entrained solids and condensable vapors. If filters, etc., are needed, they should be installed in a convenient location near the analyzer in such a way that they can be easily removed for cleaning.

2.4.4 Scrubbers. If the sample contains small quantities of acidic anhydrides (SO_2 , etc.) or mercaptans (H_2S , etc.) these compounds must be removed before the sample enters the analyzer. Acidic anhydrides react with the electrolyte and mercaptans react with the cathode, impairing the operation of the cell. A caustic scrubber is usually effective in removing these compounds. CO_2 must be scrubbed when the cell electrolyte is KOH or K_2CO_3 . CO_2 must be present when the cell electrolyte is KHCO_3 .

2.4.5 Sample Pressure. The analyzer can accept samples at pressures up to 100 psig. For most convenient operation, however, the sample pressure should be regulated at 5 to 10 psig.

2.4.6 Pressure Surges. If the sample is subject to pressure surges, its pressure must be regulated ahead of the analyzer. Changes in pressure cause changes in the flow rate. If the flow rate exceeds about 300 cc/min., water from the humidifier can be carried over into the cell, upsetting its operation.

2.4.7 Pressure Regulators. Pressure regulators, when used, should be installed as close to the sample point as possible to hold the time required for the sample to travel through the sample line to a minimum. The regulators should have metallic diaphragms to prevent diffusion of oxygen from the atmosphere into the sample.

2.5

2.5.1 Minimum Vent Line. The analyzer should have a vent line of 1/4" diameter tubing at least two feet long, running downward from the vent connection. This is to prevent air from diffusing into the reservoir and dissolving into the humidifier make-up water.

2.5.2 Condensate Trap. If it is not desired to vent the sample into the atmosphere, a vent line to carry the sample to the desired vent area will be required. The sample leaves the vent connection of the analyzer saturated with water vapor at a temperature somewhat above ambient. This means that water will condense in the vent line. A suitable trap to remove the condensate without plugging the vent line will be required. The vent line should be arranged so that it cannot become plugged by dirt or dust.

3. OPERATION

3.1 Start Up. After the analyzer and its associated equipment have been installed in accordance with Section 2 above, it may be placed in operation as follows:

- a) Turn on power.
- b) Fill reservoir. (See Section 3.2).
- c) Add electrolyte to cell. (See Section 3.3).
- d) Install Cell. (See Section 3.3).
- e) Moisten calibrator with electrolyte. (See Section 3.4).
- f) Open throttle valve and start sample flow.

3.2 Reservoir. The reservoir is located in the compartment on the right side of the analyzer case.

3.2.1 Filling. The reservoir is filled through the port at the top of the tank. The reservoir should be filled about 1/2 full (one quart) with distilled water. The water will automatically flow over into the sample humidifier column.

The reservoir cap should be securely replaced after the reservoir is filled. The sample flows back through the reservoir on its way to the vent. Leaving the reservoir cap loose or off will permit the sample to vent into the analyzer case. CHECK TO MAKE CERTAIN THAT THE CAP ON THE RESERVOIR DRAIN SPOUT IS SECURELY TIGHTENED.

3.3 Cell. The cell is located in the thermostated compartment on the left side of the analyzer case. To open the compartment, unscrew the threaded window cover on the cell conduit.

3.3.1 Cell Shipment. The analyzer is shipped with the cell in a separate package. The cell is filled with distilled water to prevent the electrodes from oxidizing from exposure to the atmosphere. The distilled water is sealed into the cell by means of a plastic cover that is held in place with the four cell mounting bolts. The cell should be left filled with the distilled water until the analyzer has been installed and is ready to be placed in operation.

Prior to servicing the cell with electrolyte (Section 3.3.2), the cell's lead electrode should be carefully examined for signs of oxidation. Oxidation of the lead electrode is indicated by redish-brown or yellow discolorations. If the electrode shows evidence of oxidation, the cell must be cleaned before it is serviced with electrolyte.

NOTE: The cell has been carefully prepared by TAI to be ready for immediate use. However, after prolonged periods of storage, it is difficult to guarantee that some oxidation of the lead electrode might not occur. The cell should not be exposed to the atmosphere for a long duration of time under any circumstances.

If there is evidence of oxidation, use the following procedure to clean the cell:

- 1) Either purchase a quart of TAI cleaning solution, or make up a quart of solution. The cleaner is a 10% by weight solution of reagent grade potassium hydroxide (KOH) in distilled water.
- 2) Heat the cleaning solution to almost boiling temperature, and then completely fill the cell cavity with the heated solution.
- 3) Allow the cell to stand with the heated solution for about five minutes, and then dispose of the cleaner.
- 4) Repeat Step 2 and 3 again.
- 5) Wash the cell thoroughly with distilled water, and immediately fill with the recommended electrolyte (see Section 3.3.2). Let it stand for about two minutes, and then dispose of the electrolyte.
- 6) Refill the cell with the recommended electrolyte and install it in the analyzer as prescribed in Section 3.3.3.

3.3.2 Electrolyte. The cell electrolyte is TAI Type "A" for applications where there is a complete absence of CO₂ in the customer's sample. Type "A" Electrolyte is a 10% by weight solution of reagent grade potassium hydroxide (KOH) in distilled water. A bottle, suitably labelled Type "A," containing enough electrolyte to initially service the cell, is furnished with the analyzer. Electrolyte for future service will have to be ordered from TAI or prepared in the field using the proportions specified above.

When re-ordering electrolyte from TAI, be sure to specify the type and quantity.

3.3.3 Installation. To prepare the cell for installation, carefully remove the cell cover.

Pour out the distilled water and fill the cell completely with the furnished electrolyte, so that all the component parts within the cell are wetted by the solution -- then drain this electrolyte from the cell. Repeat this process three times.

Wipe the top of the cell and the O-Ring to remove the electrolyte from the outside of the cell. Do not touch the interior of the cell. Use clean disposable tissues.

Carefully pour in enough electrolyte so that approximately 3/32 of an inch of the bottom edge of the silver screen assembly is immersed in the main pool of electrolyte.

Carefully place the cell under the cell mounting plate with the outer terminal toward the front. (See Figure 5) Clamp in place with the four bolts supplied with the cell.

Connect the red lead to the center terminal, and the black lead to the outer terminal.

IMPORTANT: THE SILVER SCREENS IN THE CELL HAVE BEEN SPECIALLY TREATED TO OBTAIN THE PROPER OPERATING CHARACTERISTICS. THEY MUST BE KEPT CLEAN. DO NOT TOUCH THEM. Even clean fingers have natural skin oil which contaminate the screens. If for any reason the screens need straightening, obtain a small pair of tweezers, wash them thoroughly to remove all grease, rinse in distilled water, and use them to carefully bend the screens back into place.

When the cell is received, the lead electrode may be partially coated with a red or a yellow deposit. (See Section 3.3.1)

3.4 Calibrator. The calibrator is located at the top of the humidifier column. It can be removed by disconnecting the electrical leads attached to the terminal posts, and by removing the two screws that are on the same center line as the terminal posts. (See Figure 7.) Care should be taken not to touch the calibrator wick to anything when removing the assembly.

3.4.1 Moistening. The calibrator is made ready for use by moistening the wick with a suitable electrolyte. The correct electrolyte for this application is a 10% by weight solution of reagent grade potassium hydroxide (KOH) is distilled water (TAI Type "A").

Dip the wick into fresh electrolyte solution. Shake gently to remove excess electrolyte.

3.4.2 Installation. Carefully slide the calibrator assembly back into the humidifier block cavity and clamp firmly in place with the mounting screws. The screws must be turned down firmly to insure a leak-free O-ring seal between the calibrator assembly and the humidifier block. Reconnect the electrical leads to the terminal posts, being careful to observe the correct color code.

IMPORTANT:

The calibrator wick and electrodes must be kept clean. DO NOT TOUCH THEM. If the wick becomes contaminated, it may not produce oxygen in direct proportion to the current flow through it, with consequent errors in calibration.

For cleaning instructions, see Section 4.2. Care should be taken to make sure that the calibration wick is straight when installed.

3.5 Throttle Valve. The throttle valve is located above the resevoir tank.

To start sample flowing, gently open the throttle valve (turn counterclockwise). A stream of bubbles will appear at the base of the humidifier column, and the float of the flowmeter will rise in its tube.

Adjust the throttle so the flowmeter float is centered in the flow rate reference indicator.

The flowmeter indicator has been set at the factory to indicate a flow rate of 150 cc/min. for the sample gas specified for the analyzer.

The analyzer will indicate oxygen content in gases other than the specified sample, but the flowmeter, whose calibration varies with gas density, will not indicate correctly.

If the analyzer is used for gases other than that specified, the sample flow rate should be estimated by observing the bubbles in the humidifier column. For normal operation the analyzer indication is independent of sample flow rate.

CAUTION:

The throttle valve should be opened carefully. If the flow rate becomes too great, water in the humidifier column may be carried into the measuring cell. If this occurs, the operation of the cell may become erratic, and it will require washing and filling with fresh electrolyte. (See Section 4.1.1).

Excessive flow rate may cause water in the humidifier to be carried to the flowmeter causing moisture to accumulate. This can cause the ball to stick in the flowmeter. To remove moisture, remove flowmeter and allow to air dry or blow dry. Refer to "NOTE" in Figure 8 for removal and installation of the column.

3.5.1 Flow Rate.

While the analyzer is being calibrated, it is necessary to control the sample flow carefully. It should be set so the flowmeter float is within the limits of the flowmeter indicator (see Section 3.8 for calibration procedures).

3.6 Humidity Control. A humidifier control is provided for controlling the humidity of the sample that passes through the measuring cell. The control is located on the front panel of the electrical unit, and is adjusted to maintain a constant electrolyte level in the measuring cell.

When the analyzer is started up, set the control knob to about "30" on the dial. Note the cell electrolyte level, using the bottom of the silver screen assembly as a reference.

Operate the analyzer normally for about 24 hours, and again check the cell electrolyte level.

Wait another 24 hours before making further adjustments. Continue making adjustments at increasingly longer intervals until the electrolyte level remains constant.

3.7 Warm-up and Stabilization. When the analyzer is first put into operation, the air in the lines and the sample passages in the analyzer will drive the output indicator to the top of its scale. The time required to sweep out the air and bring the output indicator to an "on-scale" reading depends on the range of the analyzer, and may be several hours. During this time the cell compartment is heating and coming to its controlled temperature.

Even after the analyzer has "come on scale", it may take several hours more to purge the dissolved oxygen from the cell electrolyte and the humidifier water supply. During this period the analyzer will continuously drift down-scale until it levels out at a stable reading. It is then ready to be calibrated and used to monitor the oxygen in the sample.

3.8 Calibration. The analyzer is calibrated by adding to the sample stream a known amount of oxygen. The span of the analyzer is adjusted until the change in indication due to the added oxygen is equal to the amount of oxygen added. The calibration procedure is as follows:

3.8.1 Adjust the sample flow rate until the flowmeter float is centered in the hole in the flowmeter indicator. Note the output indicator (recorder) reading.

3.8.2 Turn the calibrator power switch to "ON". Adjust calibrator dial to read the amount of oxygen to be added. (The dial is read 0-100 PPM O₂.)

3.8.3 Leave the calibrator power switch on and the calibrator current control as adjusted above. The calibrator current will continue to flow until the calibrator power switch is turned off.

The output indicator (recorder) should move up-scale to indicate the amount of oxygen in the sample (from Paragraph 3.8.1) plus the amount of oxygen added by the calibrator.

3.8.4 If the output indicator (recorder) does not indicate the proper amount of oxygen (sample reading plus oxygen added), turn the span control until it does.

3.8.5 When the output indicator (recorder) reaches the proper equilibrium value as calculated in Section 3.8.3, turn the calibrator power switch off. The output indicator (recorder) will move down-scale to indicate the oxygen content of the sample.

If the output indication required adjustment of more than 10%, the indicated oxygen content of the sample will now differ noticeably from the original indication. The procedure of Sections 3.8.2., 3.8.3, and 3.8.4 should be repeated, using the new value of sample oxygen content as a starting point.

3.8.6 By the above procedures the correct span setting will be reached by a series of successive approximations.

SUGGESTION. The calibration process can be speeded somewhat by estimating the percent correction needed, and "overshooting" the adjustment by the percentage of the original indicated sample oxygen content.

Example:

Original indication of oxygen in sample: 20 ppm

Oxygen added by calibrator: 40 ppm

Indicated oxygen content should be 60 ppm

Assume actual indication is 50 ppm -

therefore, indication must be increased by 10 ppm or indication.

Adjust span so that indication is 4 ppm (20% of original 20 ppm) higher than the calculated indication, 60 ppm; that is, set to read 64 ppm.

A more complete discussion of the calibration procedure is given in Section 6.4.

3.9 Routine Operation. After the analyzer has been placed in operation and calibrated, as described above, the following periodic checks will be required for normal operation.

3.9.1 Sample Flow. The flowmeter and humidifier column should be checked daily to make certain that the sample is flowing properly

3.9.2 Cell Electrolyte Level. The level of electrolyte in the cell should be checked daily. Section 3.6 describes

the adjustments to be made to maintain the proper amount of electrolyte in the cell.

3.9.3 Reservoir Level. The level of water in the reservoir should be checked approximately every two weeks. To check the water level:

Remove the cap from the filler spout.

Obtain a clean glass tube about 4 to 5 inches long and about 1/4 inch O.D.

Lower the tube into the tank through the filler spout until it touches bottom.

Place your finger over the end of the tube, and withdraw the tube from the tank. The height of water in the tube is the height of the water level in the tank.

When the water level in the reservoir gets below one inch, add a quart of distilled water.

Replace the filler spout cap securely after verifying the O-ring seal is in good condition.

3.9.4 Calibration. The span of the analyzer should be checked every two to four weeks. The procedure is described in Section 3.8

4. MAINTENANCE

4.1 Cell. The reaction by which the oxygen in the sample is converted to hydroxyl ion in the cell (to produce the measured current) involves the solution of an equivalent amount of lead into the electrolyte. The lead electrode is eroded, and lead ions accumulate in the electrolyte.

4.1.1 Cell Electrolyte. Approximately every 2 months (or oftener, if there is an undue accumulation of foreign matter in the cell) the cell electrolyte should be replaced.

Remove the cell from the cell compartment.

Drain the old electrolyte.

Prepare fresh electrolyte; rinse, and refill the cell as described in Sections 3.3.2 and 3.3.3

NOTE: Observe the precautions about handling the cell and avoiding contact with the inner parts.

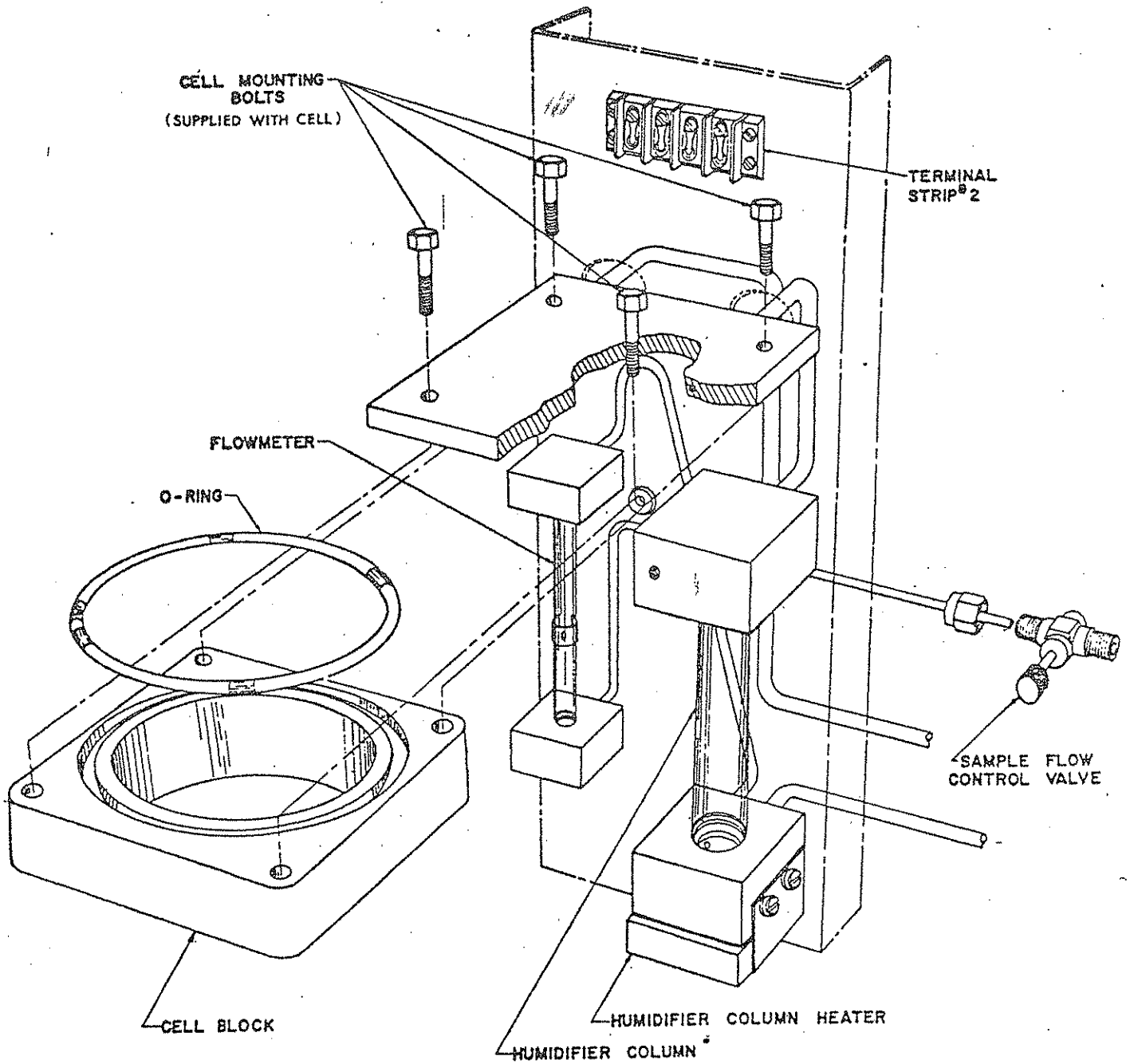
After the cell is replaced and a stable reading obtained, calibrate the analyzer as described in Section 3.8.

4.1.2 Lead Electrode. Each time the cell electrolyte is replaced, the lead electrode should be inspected. When it has become severely eroded, it should be replaced.

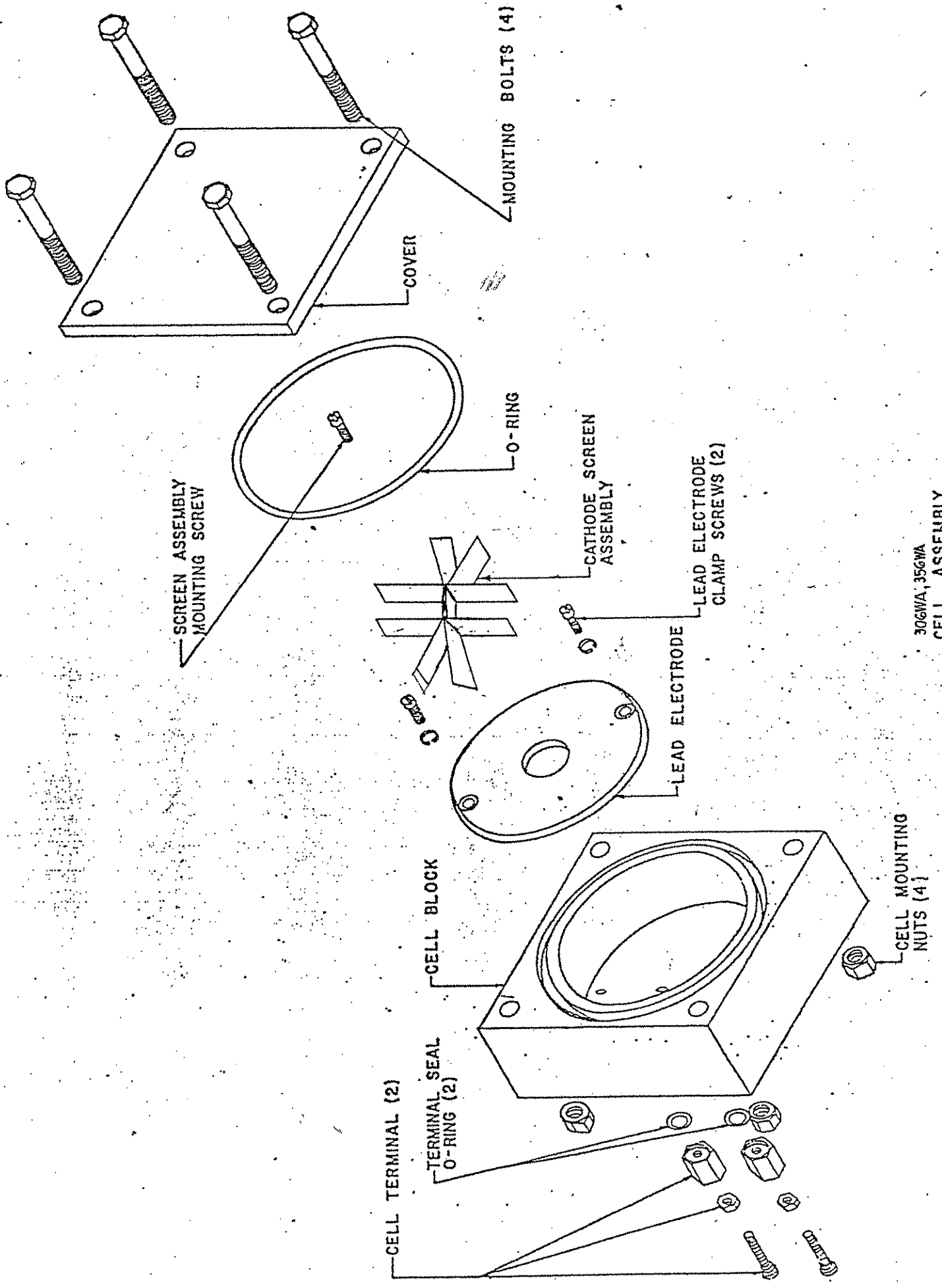
4.1.2.1 Replacement of the lead electrode requires disassembly of the cell. Refer to Figure 6.

Remove the terminal nuts by unscrewing them from the mounting screws.

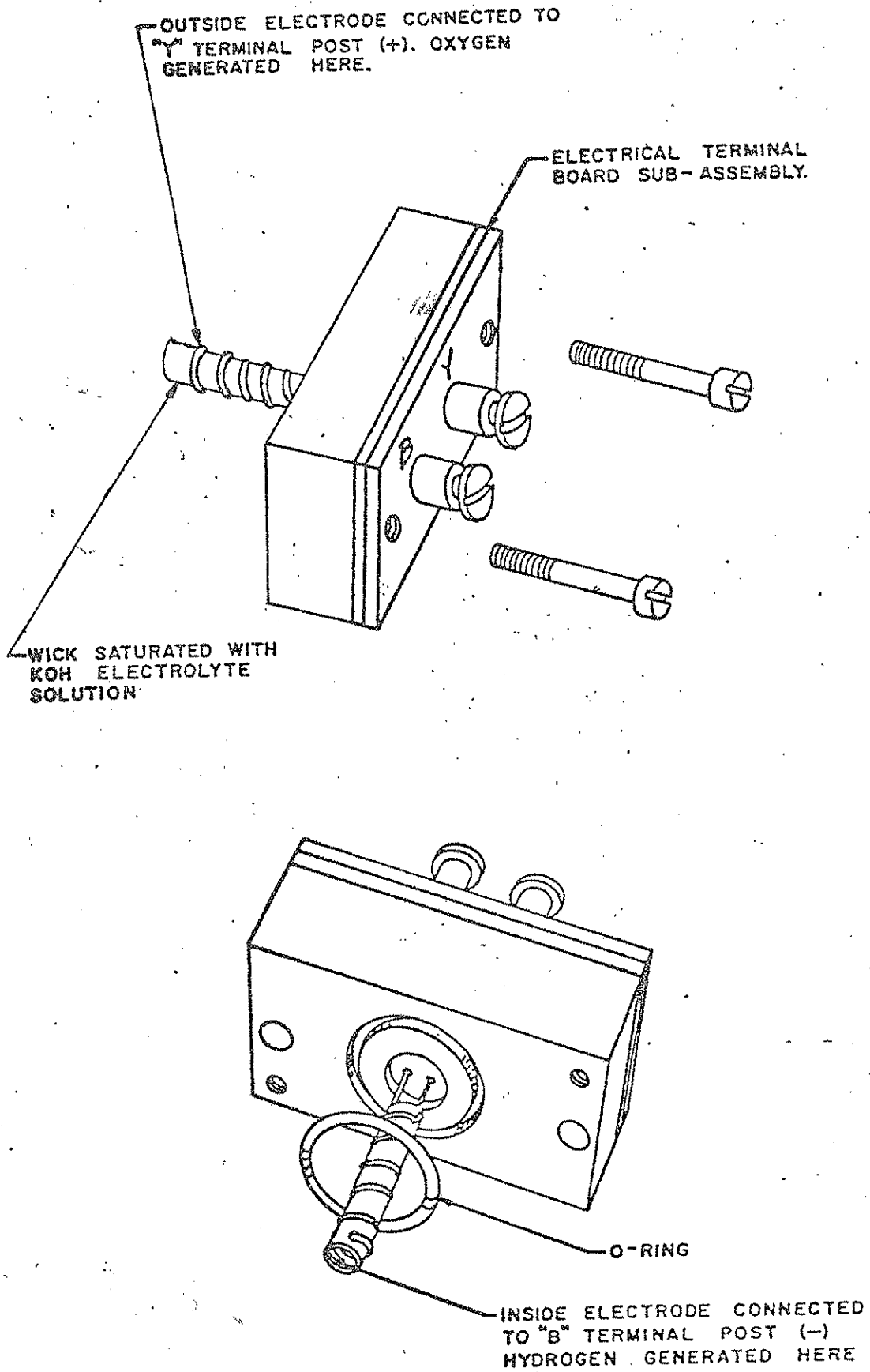
Carefully remove the screw holding the screen assembly in place. The screen assembly is delicate and easily contaminated. Place it in a clean glass or plastic container with a tight cover. Handle it only with clean tweezers, NOT with the fingers.



CELL COMPARTMENT COMPONENTS
FIGURE 5



306WA, 356WA
 CELL ASSEMBLY
 FIGURE 6 CLASS 2



CALIBRATOR ASSEMBLY
 T.A.I. P/N A-4616
 FIGURE 7

Remove the screws holding the lead electrode in place.

4.1.2.2 Wash the cell body out thoroughly and rinse with distilled water. Dry it carefully with clean, disposable tissue.

4.1.2.3 After washing it thoroughly in electrolyte (KOH) solution, place the new lead electrode inside the cell body and clamp it firmly in place with the mounting screws. Be sure to use the lockwashers. Avoid handling the electrode with the fingers.

4.1.2.4 Install the screen assembly carefully, and replace the terminal nuts.

4.1.2.5 Wash the cell thoroughly in hot KOH solution.

4.1.2.6 Rinse the cell assembly with distilled water, and add electrolyte as described in Section 3.3.2 and 3.3.3.

4.1.3 Screen Assembly. The screen assembly may become discolored after prolonged use, by contamination from various sources. If this occurs, and if the cell no longer has adequate sensitivity, the entire cell assembly should be replaced. It is not usually possible to rehabilitate the silver screens.

4.2 Calibrator. The calibrator must be clean and free of contaminants in order to generate oxygen properly. It should be removed and inspected each time the cell electrolyte is replaced. If there is any dark deposit on the calibrator wick (See Figure 7), the calibrator should be replaced.

4.3 Reservoir and Humidifier Column. About once per year the tank and humidifier column should be drained and cleaned. This can be done as follows:

- 4.3.1 Turn sample flow down to approximately 50 cc/min.
- 4.3.2 Place a small funnel with attached tubing beneath the drain spout that is located on the underside of the reservoir, and remove the drain spout cap. Allow the reservoir and humidifier column to drain thoroughly.
- 4.3.3 Replace the drain spout cap, turn sample flow off, and remove the reservoir filling cap.
- 4.3.4 Add a small amount of KOH to a pint of warm distilled water. Pour the solution into the reservoir and replace the filler cap.
- 4.3.5 Gently open the throttle valve and permit the sample to flow for 5 to 10 minutes.
- 4.3.6 Reduce sample flow to 50 cc/min. and drain the solution from the reservoir, and then turn sample flow off.
- 4.3.7 Rinse by filling and draining the reservoir several times with distilled water.
- 4.3.8 If the humidifier column still has deposits on the walls, the column should be removed and cleaned with a brush and a suitable cleaner, (follow the instructions listed on Figure 8 when removing or installing the humidifier column). After cleaning, the humidifier column should be thoroughly rinsed in distilled water before reinstallation.
- If electrolyte has dripped down into the humidifier column, the column walls may be severely etched. If this is the case, the humidifier column should be replaced.
- 4.3.9 After the reservoir and humidifier column have been cleaned, refill the reservoir as directed in Section 3.2.

5. SERVICE

This section includes a list of suggested procedures to be followed in case the analyzer does not function properly. If these procedures do not correct the difficulty, a factory field representative should be called.

5.1 No Response to Oxygen.

5.1.1 Verify that the connections from the cell through the control unit to the recorder are properly made, and that the electrolyte level is correct. (See Section 3.3.3)

5.1.2 Remove the cell and wash thoroughly. Check for shorts between cathode assembly and lead anode. Refill with fresh electrolyte. (See Section 4.1.1)

If this corrects the difficulty, it indicates that the cell had been poisoned, probably by fluid from the humidifier column being carried into the cell. Check the sample flow rate and also check whether there is excessive foaming in the humidifier column. If so, drain and clean the reservoir system as described in Section 4.3.

5.1.3 If neither of the above procedures makes the cell respond, it must be replaced by a new one.

The indication is that the cell has been poisoned by some constituent of the sample. If there has been no possibility of change in the normal sample composition, it may be necessary to provide a scrubber ahead of the analyzer to remove the offending component. (See Section 2.4.4)

5.2 Cell Sensitivity Problems.

5.2.1 Verify that the electrolyte in the cell covers no more than 3/32 inch of the bottom of the screens.

TO REMOVE THE HUMIDIFIER COLUMN THE FOLLOWING PROCEDURE MUST BE FOLLOWED:

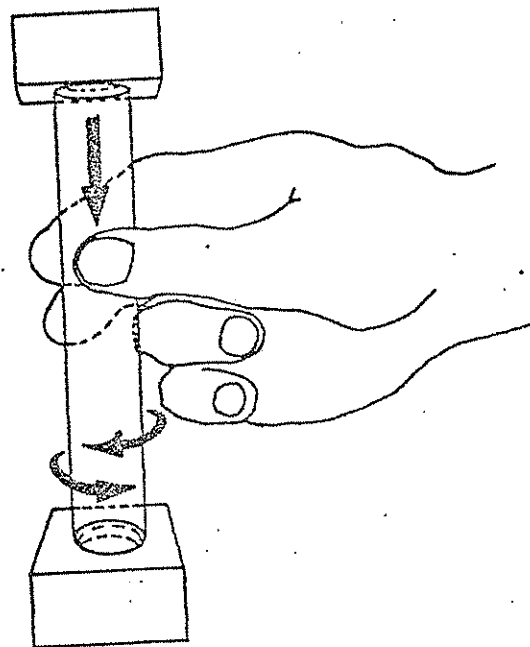
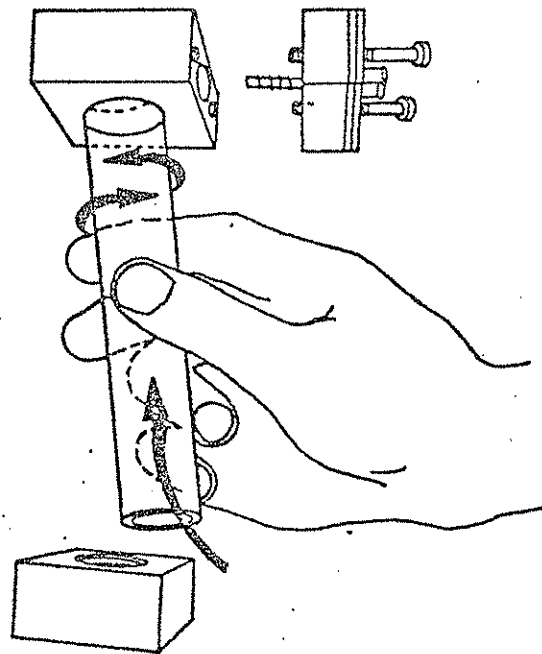
- 1: REMOVE THE CALIBRATOR ASSEMBLY FROM THE TOP HUMIDIFIER BLOCK.
- 2: GRASP THE TUBE, AND WITH A TWISTING MOTION, WORK IT UP INTO THE TOP HUMIDIFIER BLOCK UNTIL IT CLEARS THE BOTTOM BLOCK COMPLETELY.
- 3: ANGLE THE BOTTOM OF THE TUBE TOWARDS YOU AND TWIST IT FREE OF THE TOP BLOCK.
- 4: THE TOP AND BOTTOM O-RINGS WILL REMAIN CAPTIVE IN THEIR BLOCKS.

TO REINSTALL:

- 1: ENGAGE THE TOP OF THE TUBE IN THE TOP BLOCK, AT AN ANGLE, AND TWIST UP INTO THE CALIBRATOR CAVITY OF THE TOP BLOCK UNTIL THE BOTTOM OF THE TUBE CLEARS THE BOTTOM BLOCK.
- 2: SWING THE TUBE INTO LINE, AND TWIST DOWN INTO THE BOTTOM BLOCK UNTIL THE TUBE SEATS.
- 3: REINSTALL THE CALIBRATOR ASSEMBLY AS DESCRIBED IN PARAGRAPH 3.4.2.

NOTE: THE FLOWMETER IS SIMILARLY CONSTRUCTED AND CAN BE REMOVED AND REINSTALLED FOLLOWING THE SAME PROCEDURE OUTLINED ABOVE.

Refer to your Spare Parts List for replacement of flowmeter column or humidifier column.



HUMIDIFIER COLUMN

FIGURE 8

5.2.2 Verify that the cell compartment is at the proper temperature. The thermoswitch used to control the temperature is essentially a mercury thermometer. The mercury column should reach up to or just below the upper contact. If the temperature is too low;

5.2.2.1 Verify that the power switch is on.

5.2.2.2 Check the 2 ampere fuse.

5.2.2.3 Check the operation of the heater control circuit in the following manner:

- 1) Remove the cell compartment cover.
- 2) Connect an AC Voltmeter that has been set to read in the 115 volt region to terminals 7 and 9 of terminal strip TS6.
- 3) Remove one of the thermoswitch wires from TS6, terminals 1 and 2. With the thermoswitch now disconnected, the meter should indicate voltage.
- 4) If voltage is indicated, shunt terminals 1 and 2 on terminal strip TS6 with test jumper. The meter reading should drop to zero.
- 5) If the power fails to go on and off as the jumper is alternately installed and removed between terminals 1 and 2 on TS6, a faulty triac in the heater control circuit is the probable cause.

5.2.3 Remove the cell, carefully rinse with electrolyte, and replace with the proper level of electrolyte as described in Section 4.1.1.

5.2.4 If none of the above procedures improves the cell sensitivity enough to obtain the proper calibration, the cell must be replaced.

The indication is that the cell has been poisoned by some constituent of the sample. If there has been no possibility

of change in the normal sample composition, it may be necessary to provide a scrubber ahead of the analyzer to remove the offending component. (See Section 2.4.4)

5.3 Calibration Difficulties.

5.3.1 Cell Slow to Respond to Added Oxygen.

5.3.1.1 Remove Calibrator assembly (See Section 3.4)

5.3.1.2 Inspect calibrator assembly as outlined in Section 4.2.

5.3.1.3 Rinse calibrator carefully with distilled water, moisten wick with fresh electrolyte, and re-install.

5.3.2 No Calibrator Indication.

5.3.2.1 Verify that power switch is on.

5.3.2.2 Check the connections to the calibrator.

5.3.2.3 Remove the calibrator and moisten the wick with electrolyte as described in Section 3.4.

When the calibrator circuit is energized, the current flow through the circuit should produce a voltage drop across the calibrator electrodes of between 1 to 3 volts. If the calibrator wick is dry, this voltage will be much higher, ranging up to 24 volts.

The calibrator electrode voltage can be measured between terminals 5 and 6 of terminal strip TS6, or at the calibrator assembly itself. Terminal 6 at TS6 and the yellow wire at the calibrator are the positive side of the calibrate circuit.

5.3.3 Erratic Calibrator Current.

5.3.3.1 Check the connections from the control unit through to the calibrator.

5.3.3.2 Remove the calibrator assembly and moisten the wick, as described in Section 3.4.

5.3.3.3 Check to make sure that the brown wire is going to the post marked brown on the calibrator and the yellow wire to the post marked yellow.

5.3.4 Proper Calibrator Current - No Cell Response.

5.3.4.1 Verify that the cell responds to oxygen by loosening the calibrator assembly momentarily to let in air, then bolting it back in place.

The recorder should indicate an increase in oxygen due to the air allowed into the sample stream.

If the recorder does not respond, proceed as in Section 5.1.

5.3.4.2 If the above tests show the cell to be operating, remove the calibrator assembly. If there are not obvious short circuits which can be easily repaired, the calibrator assembly should be replaced.

5.4 Leak Detection. One of the most frequent sources of trouble in trace measurements is leaks. Tiny leaks which ordinarily would go unnoticed can cause serious errors in trace measurements. One of the main problems is that air can diffuse into a gas line through a small leak, even though the gas pressure in that line is many times atmospheric pressure.

When a leak occurs in which the mass flow velocity is less than the molecular velocity, gas molecules move both directions through the leak. The net flow of any particular kind of gas, e.g. oxygen, will depend on the relative partial pressures of that gas on each side of the leak. In the case of samples having only a few parts per million of oxygen, there will be a net flow of oxygen inward unless the sample pressure is many thousands of pounds (enough to bring the oxygen partial pressure up to approximately 1/5 atmosphere).

NOTE: A leak in the reservoir drain cap will permit air to dissolve into the make-up water and diffuse into the humidifier column, where it would be "scrubbed out" by the sample as it bubbled through. Indication of a leak here could mean either a leak in the humidifier column itself, or in the reservoir system.

5.4.1 Measuring Cell Leak. The measuring cell should be checked for leaks. The two most likely places are the two O-ring locations at the terminals, and the mounting plate.

Check that the terminals are screwed tightly into place. Frequently when a leak occurs at a terminal connection, there will be greenish crystalline deposit inside the cell around the terminal mounting screw. This is lead carbonate, formed by the action of carbon dioxide from the air reacting with lead ions in the electrolyte.

If the large O-ring at the mounting plate is leaking, the analyzer oxygen indication will usually start to rise almost immediately after the sample flow is stopped, and continue to rise until the sample flow is restarted, when it will gradually decrease again.

6. PRINCIPLES OF OPERATION

6.1 Measuring Cell. The measuring cell of this analyzer is one of a class of electrochemical devices known as fuel cells. The fuel in this case is the lead electrode. The "combustion rate" is limited by the available oxygen. Thus, the output current resulting from the combustion becomes a measure of the oxygen present in the sample stream.

Chemically the reaction can be represented by the equation:

At silver electrode



This represents the catalytic conversion of the oxygen to hydroxyl ion by the silver.

At lead electrode



This represents the "combustion" of the lead to lead oxide.

The electrons liberated by the combustion of the lead flow through the external load circuit and become the electrons needed to convert the O_2 to $(\text{OH})^-$.

Physically, the measuring cell consists of the silver electrode in the form of screens covered with a film of electrolyte; the main body of electrolyte, and the lead electrode, also covered by electrolyte. The silver electrode and the lead electrode are each connected to a terminal to which the external load is connected.

The sample stream enters the cell from the top into a chamber where the silver screens are located. Oxygen from the sample dissolves into the electrolyte covering the screens and diffuses through to the silver surface, where it reacts to form the hydroxyl ions. Simultaneously, because of the external connection and the electrochemical potentials involved, lead is oxidized by reaction with hydroxyl ions in the electrolyte surrounding it. The reaction is completed by the movement of the hydroxyl ions produced at the silver electrode through the electrolyte to replace the hydroxyls used up by the "combustion" of the lead.

The electrolyte covering the silver screens constitutes a "diffusion barrier" to the oxygen on its way to be reacted. There is a dissolved-oxygen concentration gradient across the thickness of the film of electrolyte, ranging from essentially zero at the silver surface up to the equilibrium concentration determined by the partial pressure of oxygen in the sample gas at the outer surface of the electrolyte. The rate at which oxygen molecules travel along this gradient and are reacted will, therefore, depend on a) the area of the silver electrode, b) the thickness of the film of electrolyte, and c) the equilibrium concentration of oxygen dissolved at the surface of the electrolyte. Oxygen will leave the sample stream and dissolve into the electrolyte at this same rate. The sample flow rate must be adequate to provide enough oxygen molecules to replace those dissolved into the electrolyte and keep the oxygen concentration next to the electrodes representative of the entire sample. At higher flow rates there will be no increase in oxygen reacted (cell output current per ppm) because the rate of reaction is limited by the diffusion rate through the electrolyte.

The above consideration concerning the diffusion of the oxygen through the electrolyte to the silver are valid regardless of the concentration of oxygen in the sample stream. As the oxygen concentration increases, however, the number of hydroxyl ions produced at the silver surface increases. If these are permitted to remain there, the reaction which converts the Ag_2O to Ag and OH^- (equation 2 above) is

deterred, and the output current is no longer directly proportional to the oxygen concentration; i.e., the analyzer response becomes non-linear. To assure linear response it is necessary to provide a sufficiently large channel of electrolyte for the hydroxyl ions to move down into the main body of electrolyte; but this channel cannot be made too large or the analyzer will require an undue length of time to respond to changes in oxygen concentration. An optimum balance between speed of response and linearity is achieved for each range of measurement by constructing and treating the silver screen to have the proper amount of electrolyte surrounding it. The screen electrode area and the load resistance is chosen to provide a suitable millivolt output signal for the specific range of the analyzer.

6.2 Humidifier. As can be seen from the above discussion of the operation of the measuring cell, it is necessary to maintain a film of electrolyte on the screens of the electrode assembly. This means that the humidity of the sample as it flows through the cell must be such that the water vapor pressure of the electrolyte is equal to the water vapor pressure in the sample gas. If the humidity of the sample is too low, water will be evaporated from the electrolyte, drying the cell. If the sample humidity is too high, water will condense out into the electrolyte, flooding the cell.

The sample is humidified by bubbling it through water (in the humidifier column) just before it enters the cell. The humidifier column is in the same heated compartment as the cell and so is held at the same temperature. The water in the column, however, is cooled by the evaporation into the sample gas. Thus the sample gas will normally have a humidity that is too low for equilibrium with the cell. It is assumed here, of course, that since the cell component is heated above ambient temperature, the sample gas is less than saturated at the compartment temperature when it enters the analyzer.

The humidity of the sample is increased to be in equilibrium with the cell electrolyte by heating the water in the humidifier column. The humidifier heater is in the base of the column, and the amount of heating is adjusted with the humidity control that is located on the panel of the electrical control unit.

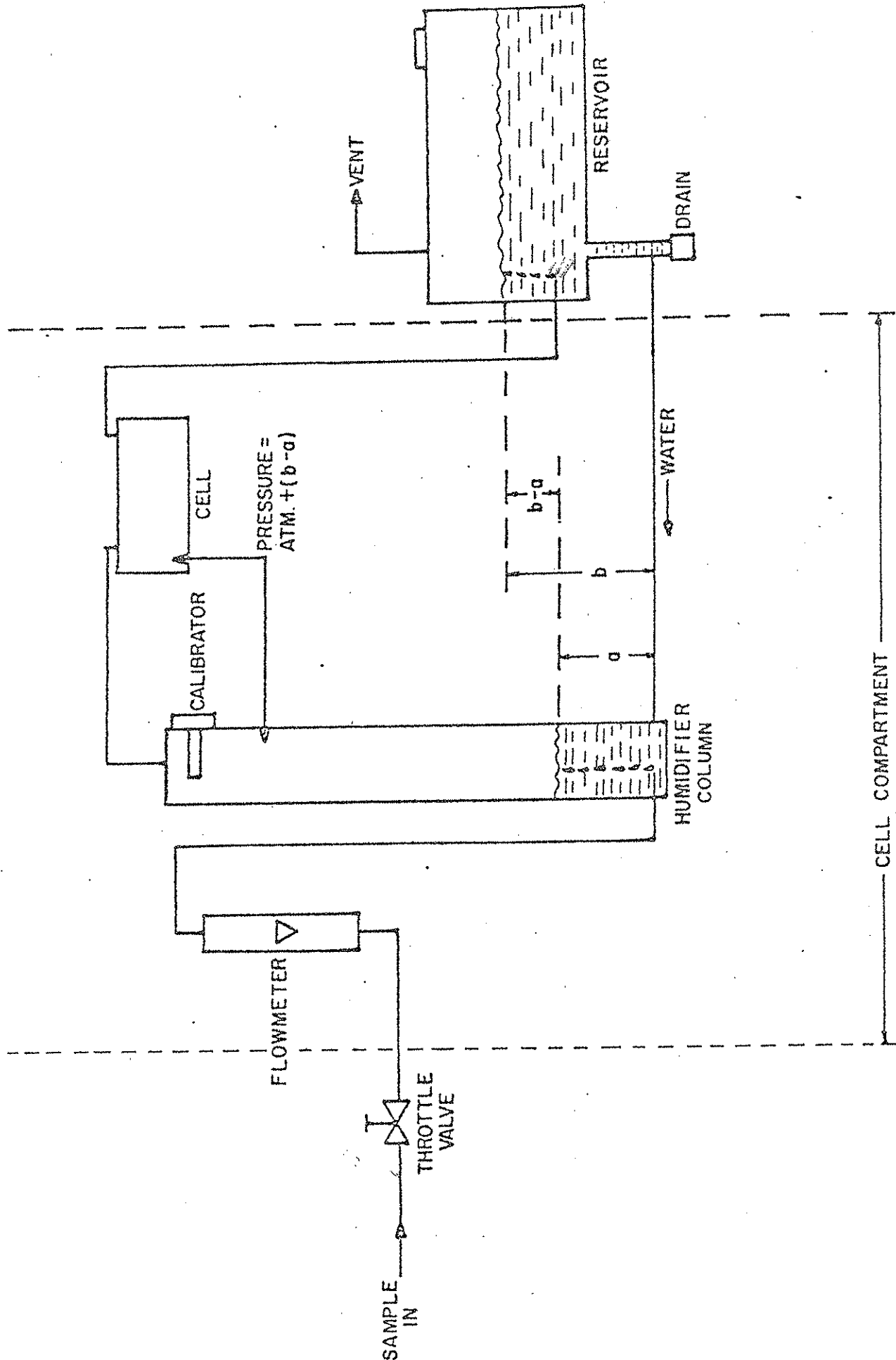
The amount of heating required depends on the sample flow rate, the sample humidity, and the specific heat of the sample. The correct adjustment for the operating conditions of any particular installation is obtained by checking the cell electrolyte level periodically as described in Section 3.6.

The humidifier column also contains baffles. This is intended to stop water from splashing up into the line to the sample cell at high flow rates.

6.3 Flow System. The analyzer flow system is shown schematically in Figure 9. It includes a needle valve for adjusting the sample flow rate, a flowmeter to indicate the sample flow required for calibration, the humidifier, the calibrator, the measuring cell, and an automatic level control system for the water in the humidifier.

As can be seen from Figure 9, the sample enters the humidifier column against the pressure of a water column from the base of the humidifier to the water level in the reservoir - approximately 4 inches. This determines the minimum sample pressure at which any sample can flow through the analyzer. In practice the sample pressure must be somewhat greater than this in order to have an adequate flow rate.

The automatic level control in the humidifier column is accomplished by connecting the sample outflow from the cell to the bottom of the reservoir. This puts a back pressure on the sample in the cell and upper portion of the humidifier column equal to the water column from the bottom of the reservoir to the water level in the reservoir. Thus, the water level in the humidifier column is held even with the sample connection at the bottom of the reservoir. There will be a slight additional pressure in the top of the humidifier column depending on the flow rate (the pressure needed to push the sample through the cell and associated tubing), but at normal flow rates this merely slightly lowers the level in the humidifier column.



ANALYZER FLOW SYSTEM

FIGURE 9

The sample bubbles through the water in the reservoir on its way to the outlet port. Some of the water vapor will recondense, so that the sample flows out of the outlet port saturated at the reservoir temperature - slightly above ambient. The sample bubbling through the make-up water will scrub out any oxygen which may be dissolved in it. This assures that the sample will not pick up any oxygen as it passes through the humidifier column.

6.4. Calibration. As can be seen from the chemical equations in the preceding section, the number of electrons flowing through the measuring cell's load resistance (the output current) is directly proportional to the amount of oxygen reacted. If no oxygen is present, no output current flows. Thus, the analyzer has an "absolute" zero, and no zero adjustment is required. The analyzer can be completely calibrated with only one "standard" sample, instead of the two usually required for process analyzers.

The analyzer can be calibrated by flowing through it a sample gas containing a known amount of oxygen and setting the span so that the output indicator reads this amount. However, it has been found to be impractical in most cases to obtain a reliable and stable standard gas which contains oxygen in the parts per million range. Standard gases are usually contained in cylinders for convenience. It has been found that the oxygen will adhere to the walls of the cylinder, and the amount of oxygen which comes out with the background gas will vary with the ambient temperature. The length of time since the cylinder was filled, and the amount of gas remaining in the cylinder, among other things. It is desirable to have a more reliable means of calibration.

If the oxygen content indicated by the analyzer is plotted as ordinate against the actual oxygen content as abscissa on a simple graph, the condition of proper calibration is represented by a straight line starting at the origin with a slope of 1. (See Figure 10). If the analyzer has a low sensitivity, the slope will be less than 1; and if the sensitivity is high, the slope will be greater than 1. In each case, however, the line passes through the origin because of the absolute zero, and the slope is determined by the sensitivity adjustment. Thus, the analyzer can be completely calibrated by adjusting

the slope of this curve; i.e., by adjusting the span so that the change in output indication is equal to a known change in actual oxygen content of the sample. This can be done by adding a known amount of oxygen to the sample flowing through the analyzer, even though the amount of oxygen in the sample is not known.

Example:

Analyzer range: 0-10, 0-100, 0-1000 (Standard)

Sample reading: 18 ppm

Check calibration:

Adjust analyzer calibrator circuits so that 50 ppm of oxygen is being added to the sample. This is the change in actual oxygen content of the sample.

Assume the analyzer changes its output to read 52.

The change in output indication is $52 - 18 = 34$. Therefore the analyzer does not have enough sensitivity and the span must be turned to read $52/34$ or 1.53 times the original span setting which should now read 77.5 ppm.

The calibrator provided in this analyzer is an electrolysis cell in which water is converted to hydrogen and oxygen by an electric current. The calibrator is mounted so that it is swept by the sample flowing through the analyzer. Thus, oxygen is added directly to the sample.

The concentration of oxygen added to the sample can be calculated from the amount of current passing through the calibrator and the sample flow rate.

Faraday's Law states that 96,500 coulombs of electric charge will displace 1 gram equivalent of an element from a compound. For oxygen 1 gram equivalent is 8 grams. One ampere of current is one coulomb per second. Thus, 1 ampere of current will release

$$\frac{8}{96,500} \times 60 \text{ grams of oxygen per minute}$$

This is equivalent to 3.75 cubic centimeters per minute of oxygen per ampere of current. Expressing this in parts per million per milliampere of current. We find that the oxygen

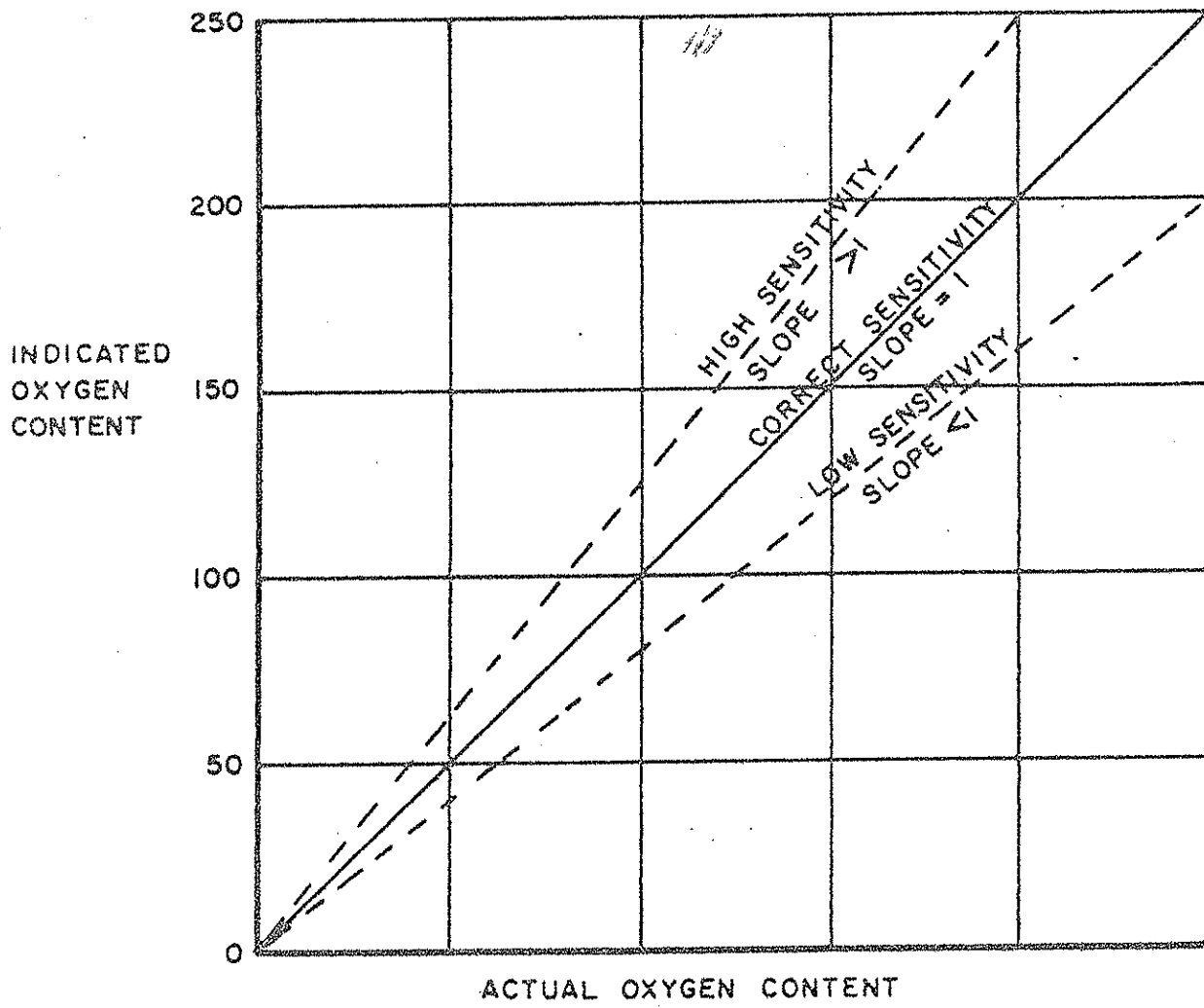


FIGURE 10

added to the sample by the calibrator becomes

$$O_2 \text{ added} = \frac{3750}{\text{flow rate}} \quad \text{ppm per ma}$$

Thus, at a sample flow rate of 150 cc per minute we add 25 ppm oxygen per milliampere of current through the calibrator.

The three ranges of the analyzer are intended primarily to make calibration convenient. It is expected that the oxygen content of the sample being analyzed will be within the narrow range (Range No. 1) of the analyzer. Then when the analyzer is switched to Range No. 2, a sufficiently large amount of oxygen can be added by the calibrator to give a reliable calibration. Since the calibration is dependent on adjusting the change in indication, this change should be as large as possible at least 50% of the wider range.

Ser. No.:

S.O. No.:

7. CALIBRATION DATA

7.1 Range: The ranges of this analyzer are

Range Switch Position No. 1:

Range Switch Position No. 2:

Range Switch Position No. 3~~2~~

7.2 Output Signal: The output signal is

7.3 Background Gas: This analyzer is intended to measure oxygen in a background of

The flowmeter has been set to indicate a flow of 150 cc/min. of this gas. If any other type of gas is to be analyzed, the flowmeter must be reset for that gas, using a displacement type flowmeter.

7.4 Calibration Table: Your calibrator will generate 0-100 ppm of oxygen.

To set calibration: Turn calibrator switch to ON position, turn calibrator dial to read the amount of oxygen to be added.

To Add:

10	ppm	set	calibrator	dial	to	read	100
20	"	"	"	"	"	"	200
30	"	"	"	"	"	"	300
40	"	"	"	"	"	"	400
50	"	"	"	"	"	"	500
60	"	"	"	"	"	"	600
70	"	"	"	"	"	"	700
80	"	"	"	"	"	"	800
90	"	"	"	"	"	"	900
100	"	"	"	"	"	"	1000

307WA

RECOMMENDED SPARE PARTS LIST

MODEL ~~306WA~~, 307WA, 308WA TRACE OXYGEN ANALYZER

<u>QTY.</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>
1*	B-29600	PC BOARD - E/I CONVERTOR, ISOLATED ("O" OPTION)
1*	B-14702	PC BOARD - E/I CONVERTOR, NEG. GND ("I" OPTION)
1*	A-9309	PC BOARD - ALARM COMPARTOR, DUAL (-2 OPTION)
1*	A-10045	PC BOARD - ALARM COMPARTOR, SINGLE (-1 OPTION)
1	C-14449	PC BOARD - PROPORTIONAL TEMP. CONTROL (220V USES C-41274) (FOR APPLICATIONS LESS THAN 10 PPM)
1	B-30868	PC BOARD - TEMP. CONTROL (220V USES B-36026) (FOR APPLICATIONS 10 PPM OR HIGHER)
1	C-1372	CELL ASSEMBLY (SPECIFY RANGE, CLASS)
1	B-1473	LEAD ELECTRODE
2	O-5	O-RING, CELL TERMINAL
1	O-25	O-RING, CELL SEAL
1	A-4616	CALIBRATOR ASSEMBLY
2	O-26	O-RING, CALIBRATOR
1	A-3042	HUMIDIFIER COLUMN ASSEMBLY
1	R-991	HUMIDIFIER COLUMN HEATER (220V USES R-1211)
2	O-9	O-RING, HUMIDIFIER COLUMN
1	A-5267	RESERVOIR CAP
2	O-8	O-RING, RESERVOIR CAP
5	F-10	FUSE, 2 AMP, SLO-BLO (220V USES F-9)
5	F-6	FUSE, 1/4 AMP, SLO-BLO
2	H-68	HEATER (USED IN 307WA/308WA)
2	H-2	HEATER (USED IN 306WA) ok
2	O-204	O-RING, FLOWMETER
1	A-33748	THERMISTOR ASSEMBLY
1	B-6274	FLOWMETER ASSY. (SPECIFY BACKGROUND GAS)

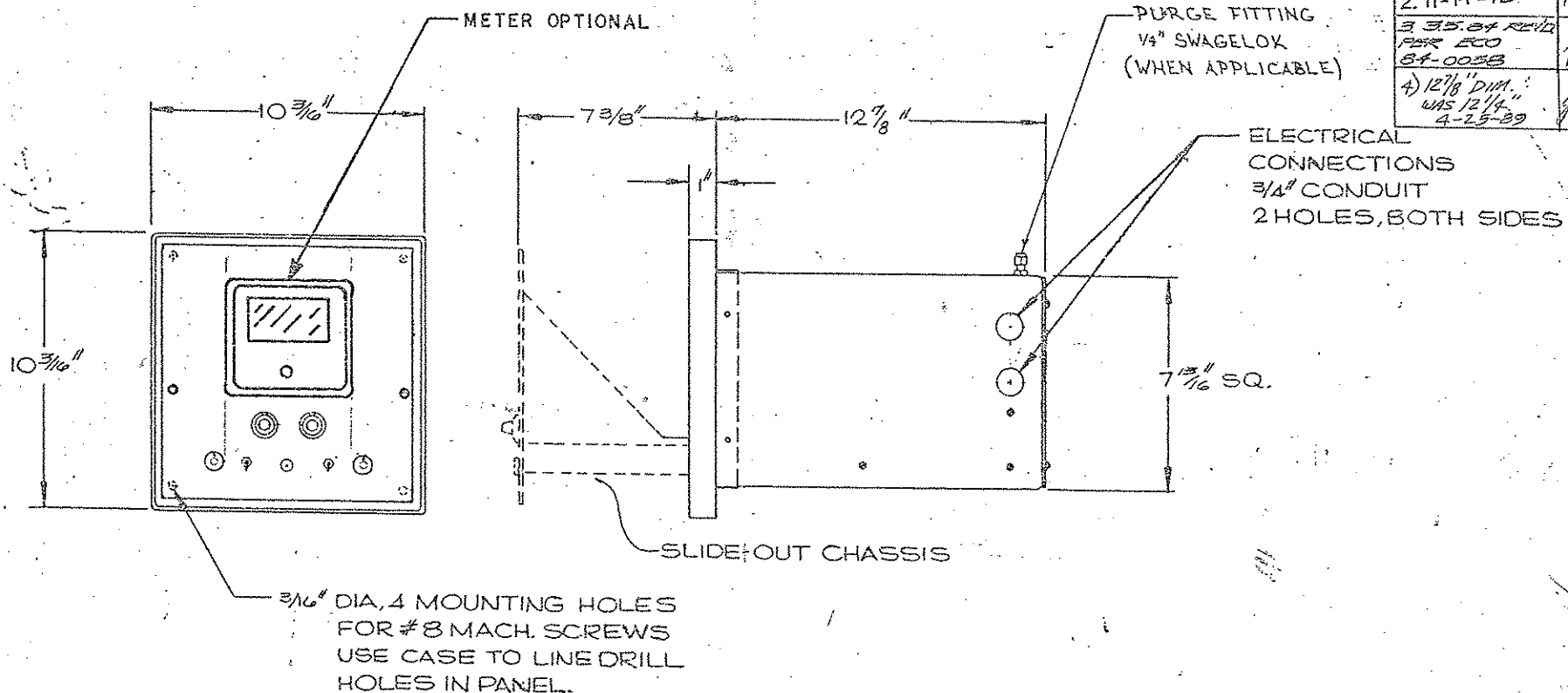
* - THESE ITEMS ARE OPTIONS TO THE STANDARD INSTRUMENT, AND UNLESS ORDERED, WILL NOT BE PRESENT.

A MINIMUM CHARGE OF \$ 20.00 IS APPLICABLE TO SPARE PARTS ORDERS.

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

SEND ORDERS TO:

TELEDYNE ANALYTICAL INSTRUMENTS
16830 CHESTNUT STREET
CITY OF INDUSTRY, CALIF., 91748
TELEPHONE (818) 961-9221
TWX: (910) 584-1887 TDYANYL COID
OR YOUR LOCAL REPRESENTATIVE

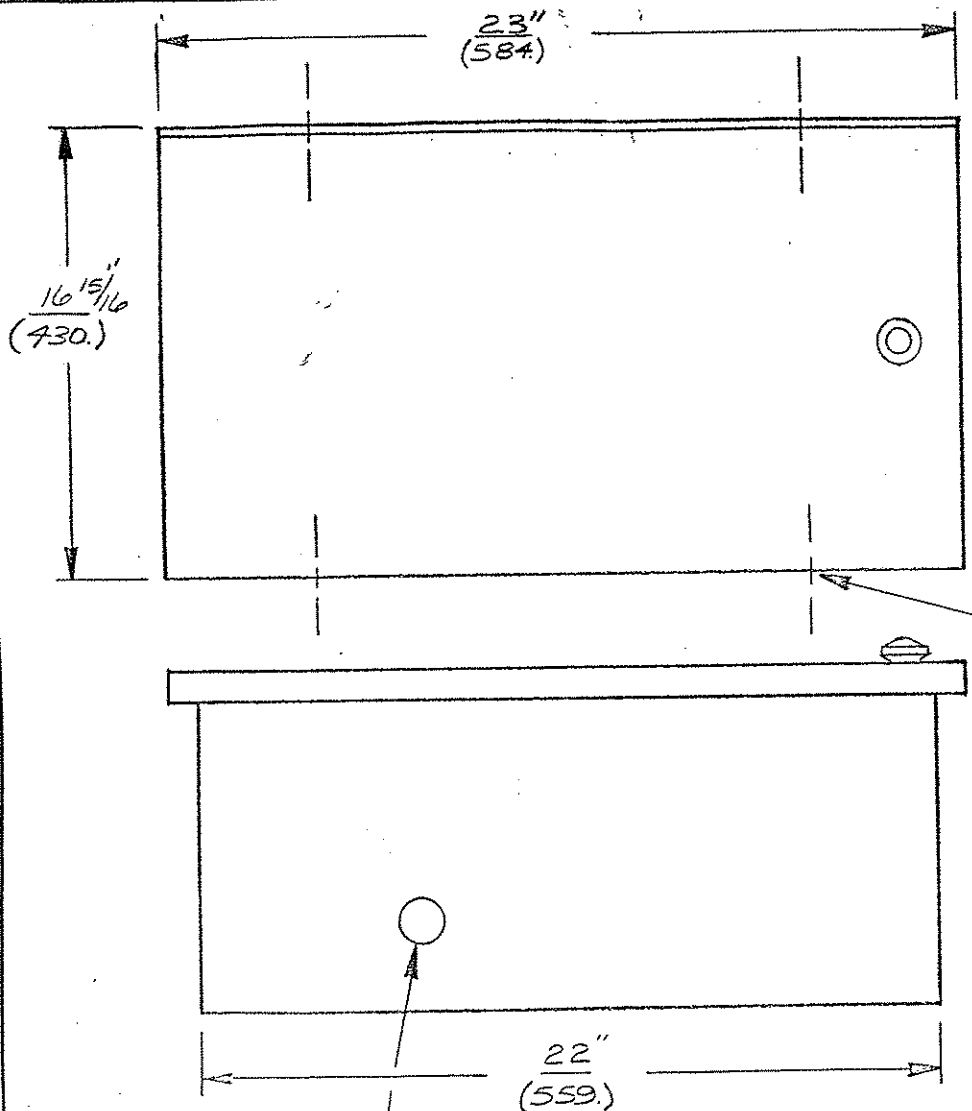


NOTE: RECOMMENDED PANEL CUT-OUT
DIMENSIONS 8 1/4" x 8 1/4"

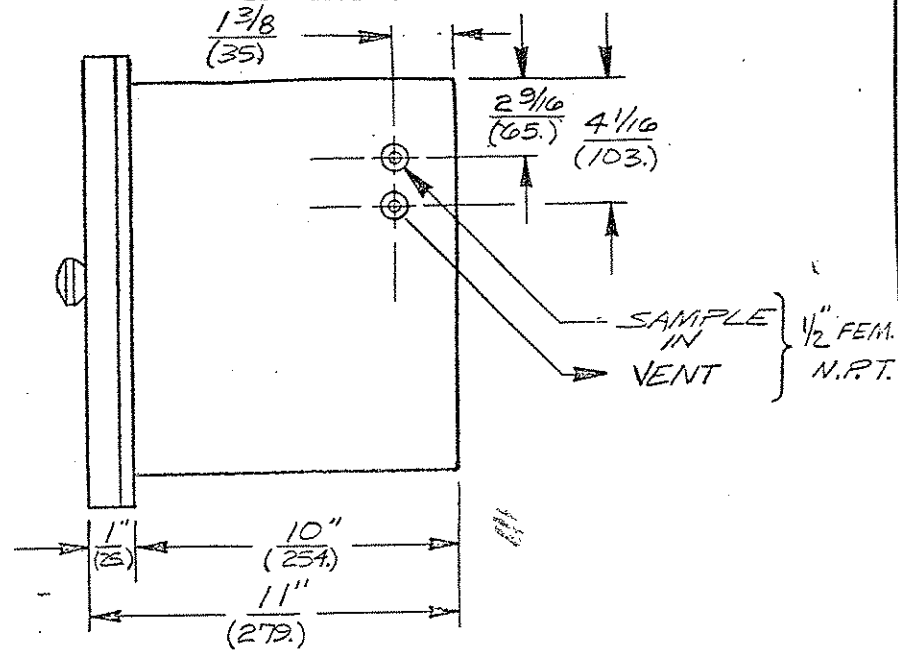
ISSUE NO.	REV.
1. 7-14-78	1
ADDED METER	
2. 11-14-78	1
3. 3.5.84 REV'D FOR ECO	1
84-0058	
4) 12 7/8" DIM. WAS 12 1/4"	
4-25-89	

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TOLERANCE UNLESS OTHERWISE SPECIFIED	FRACT. ± 1/32	DEC. ± .005	ANGLES ± 1/2°
TELEDYNE ANALYTICAL INSTRUMENTS SAN GABRIEL, CALIFORNIA		SCALE	DATE 7-14-78
MODEL 307 WA/357 WA CONTROL UNIT OUTLINE DIAGRAM		MATL.	
		DR HU	CHK
		B-19026	

1-5227



QA	ISSUE NO.	DATE	REVISION / ECO NUMBER	APP
	5	4-26-89	REDRAWN: 16 9/16" DIA WAS: 16 7/8" DEL: 1 1/4" HOLES DIA	J.A.P.



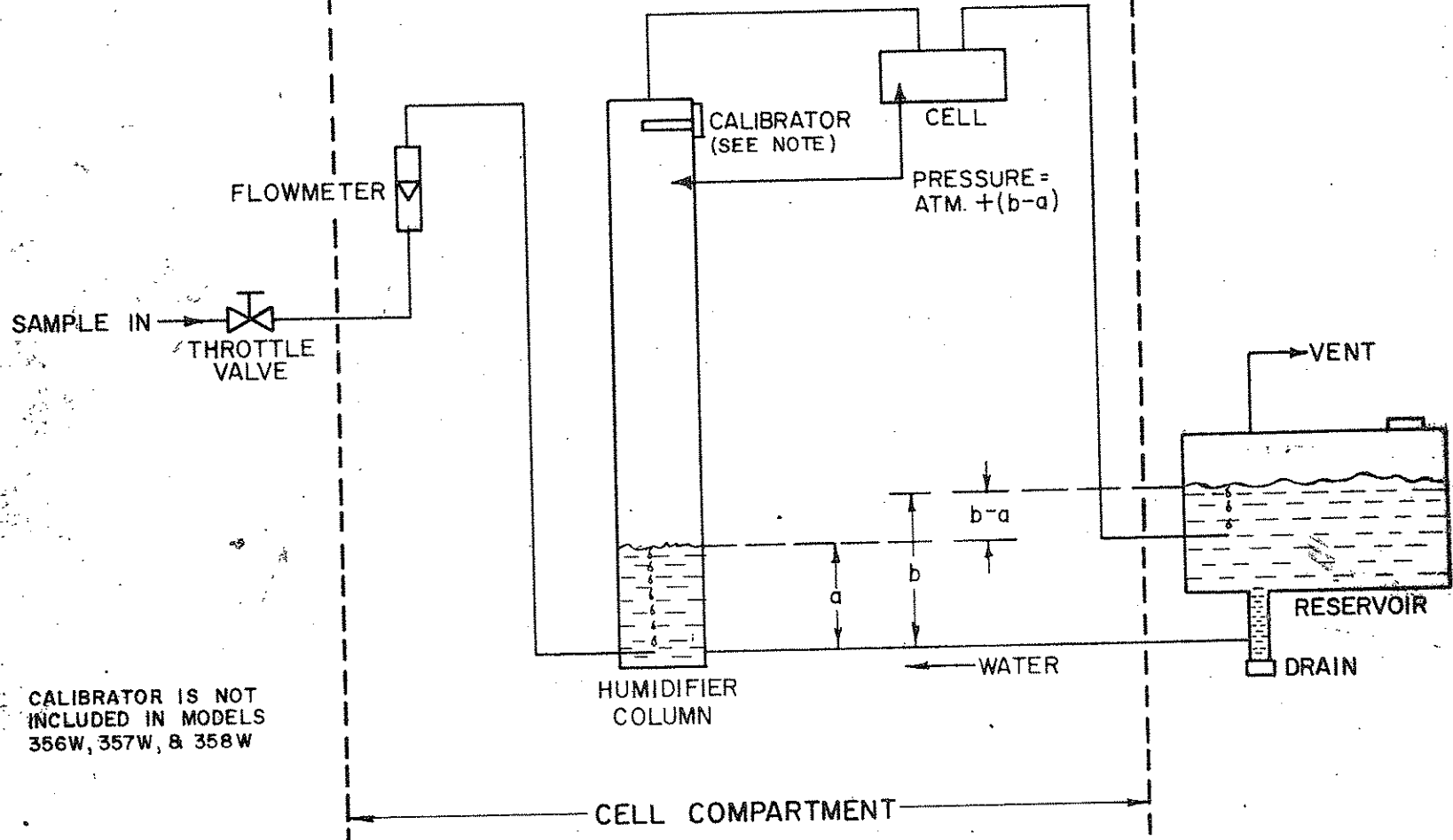
4 MTG. HOLES FOR #10 FLT. HD.
USE CASE TO LINE DRILL HOLES IN PANEL.

NOTE:

- 1). DIMENSIONS ARE IN INCHES ($\pm 1/16$) OR MILLIMETERS (± 1) INCHES
- 2). CUT OUT FOR PANEL MOUNTING (M/A) 15 7/8" X 22 1/8"

1 1/4" HOLES TOP & BOTTOM OF CASE FOR ELECTRICAL CONNECTIONS (3/4" FEM. N.P.T.)

ITEM	PART NO.	REQ	DESCRIPTION
TOLERANCE UNLESS OTHERWISE SPECIFIED			
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FRAC. $\pm 1/64"$	TELEDYNE ANALYTICAL INSTRUMENTS		SCALE N.T.S. DATE 4/25/89
DEC. $\pm .005"$	CITY OF INDUSTRY, CALIFORNIA 91748		MAT'L
ANGULAR $\pm 1/2'$	OXYGEN TRACE ANALYZER		FINISH
	MDL. 307/357WA OUTLINE DIAG.		DR. ENGR. APP. 1/1
S.O.	B-3156		



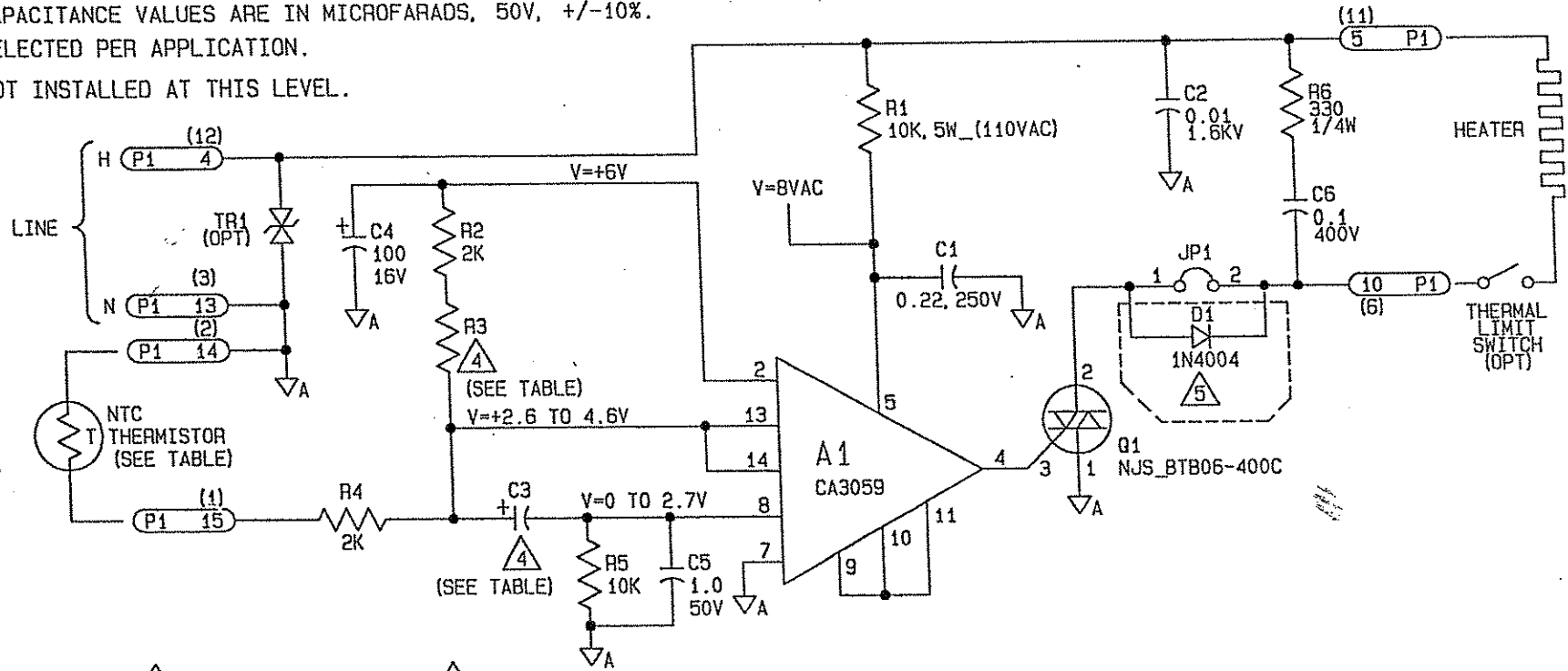
NOTE: CALIBRATOR IS NOT INCLUDED IN MODELS 356W, 357W, & 358W

TOLERANCE UNLESS OTHERWISE SPECIFIED	FRACT. ± 1/64	DEC. ± .003	ANGULAR ± 1/1°
TELEDYNE ANALYTICAL INSTRUMENTS A DIVISION OF TELEDYNE INC. PASADENA, CALIFORNIA		SCALE	DATE 11-10-67
		MATL:	
OXYGEN TRACE ANALYZER SERIES 300 FLOW SYSTEM SCHEMATIC		FINISH:	
		DR S	<i>g</i>
		DWG No. A-8704	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	10	INC ECD 93-418	12-23-93	SB

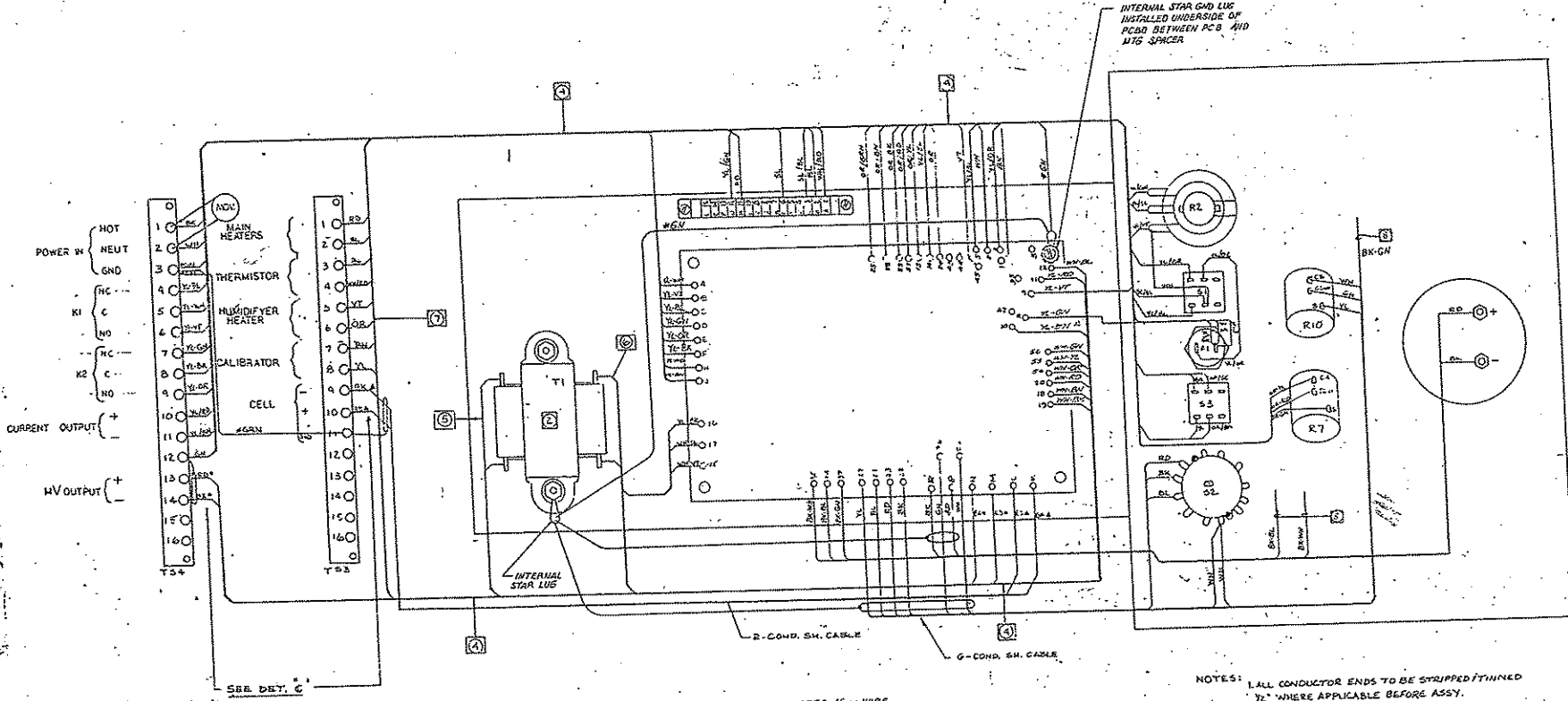
NOTES: UNLESS OTHERWISE SPECIFIED

- FOR ASSEMBLY SEE B-30868.
 - RESISTANCE VALUES ARE IN OHMS, 1/8W, +/- 1%.
 - CAPACITANCE VALUES ARE IN MICROFARADS, 50V, +/-10%.
- 4 SELECTED PER APPLICATION.
5 NOT INSTALLED AT THIS LEVEL.



CONT. TEMP. °C +/- 3 °C	16K CONTROL THERMISTOR (PN T-722) -TR1		10K CONTROL THERMISTOR PN (T-174) -TR1	
	R3 (K OHMS)	C3	R3 (K OHMS)	C3
20	21K	10	12.7	10
30	13	10		
41	8.25	10	5.62	22
43	7.50	10	5.23	22
46	6.81	22	4.64	22
50	5.90	22	4.02	56
55	4.75	22	3.40	56
60	4.02	56	2.94	56
64	3.57	56	2.49	56
70	2.94	56		

TOLERANCE UNLESS OTHERWISE SPECIFIED DO NOT SCALE DRG DEC .X + .XX - .1 .XXX + BREAK EDGES .02	THIS DRAWING IS THE PROPERTY OF TELEDYNE BROWN ENGINEERING ANALYTICAL INSTRUMENTS AND CONTAINS CONFIDENTIAL INFORMATION. IT IS NOT TO BE COPIED, REPRODUCED OR USED WITHOUT WRITTEN PERMISSION. TELEDYNE BROWN ENGINEERING ANALYTICAL INSTRUMENTS CITY OF INDUSTRY, CALIFORNIA 91748 SCHEMATIC DIAGRAM - PROPORTIONAL TEMP CONTROL (PLUG IN) BD.	SCALE NONE DR T.MCINTYRE ENGR APP MATERIAL FINISH B-30974 REV 10 DATE 10/22/93 SHEET 1 OF 1
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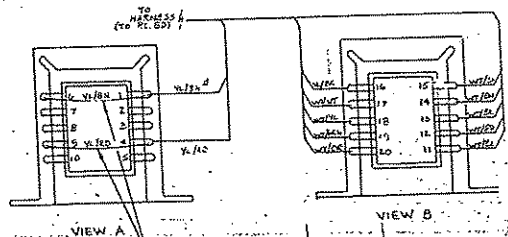
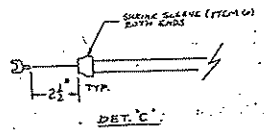


INTERNAL STAR GND LUG
INSTALLED UNDERSIDE OF
PCB BETWEEN PCB AND
MTG. SPACER

SEE DET. C

* DENOTES 16 GA WIRE

- NOTES:
1. ALL CONDUCTOR ENDS TO BE STRIPPED/TINNED "L" WHERE APPLICABLE BEFORE ASSY.
 2. TRANSFORMER WIRED PER APPLICATION. REFERENCE DRAWING B-17963-1
 3. REFERENCE SCHEMATIC D-19722
 4. HARNESS, SPDT TIE AIR
 5. SEE VIEW A
 6. SEE VIEW B
 7. SEE DET. C
 8. LEAVE "A" PIGTAIL & TIE INTO HARNESS



SEE B-17963 FOR OTHER THAN
STANDARD VOLTAGES

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TELETYPE ANALYTICAL INSTRUMENTS SAN CARLOS, CALIFORNIA	MODEL AND SERIAL NO. DATE
MDL 307 WA OXYG. ANALYZER CONTROL UNIT	DATE B. 8. 82
WIRING DIAGRAM	NAME: NOTED. PART: _____ DRAWN: _____ APP: _____
	D-29555

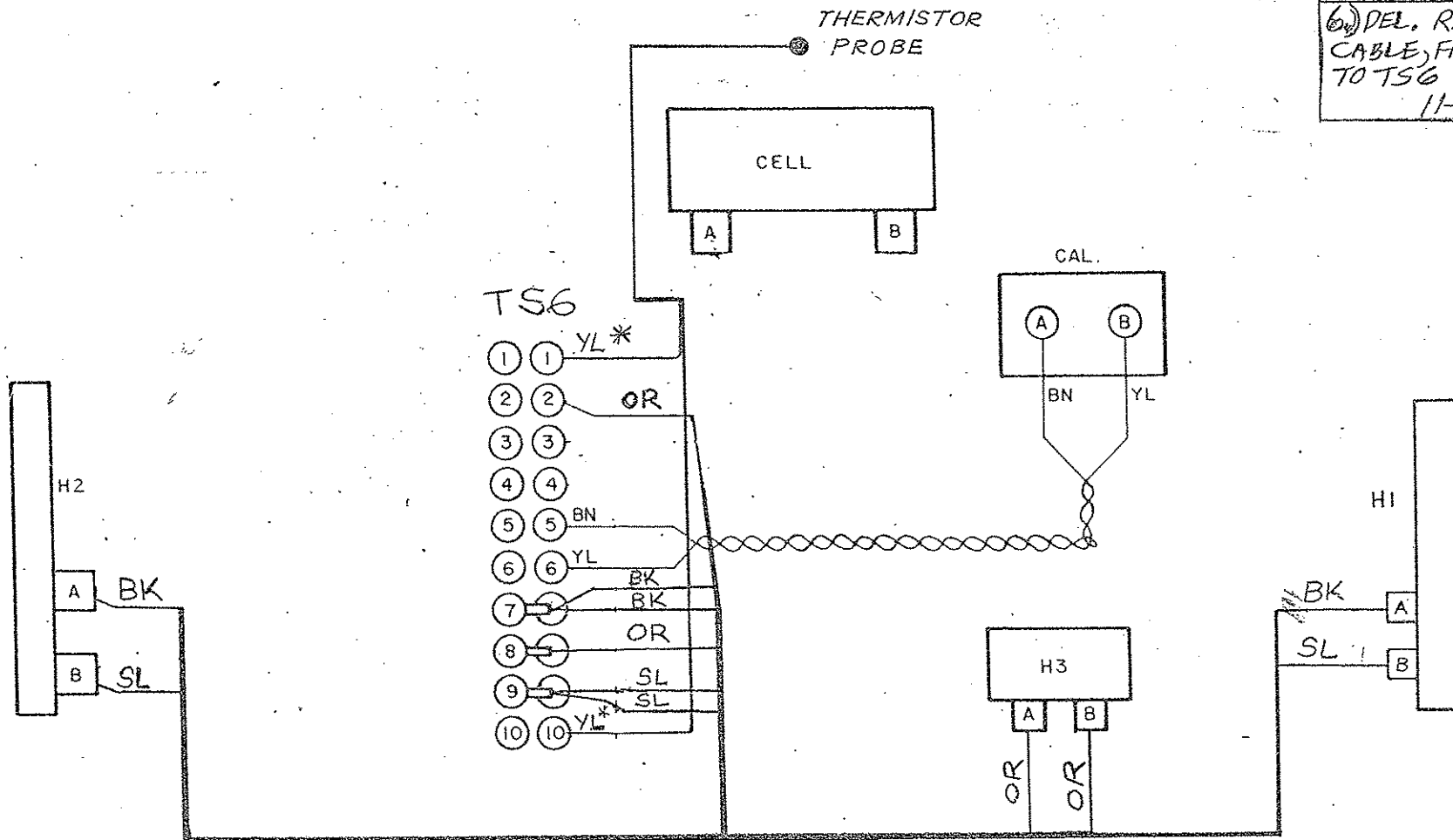
REVID DWG ADDED
WIRE COLOR'S

5) 7-30-85

6) DEL. RD-BK
CABLE, FROM CELL
TO TSG

11-11-88

J.A.R.



NOTE: * THERM. PROBE WIRES

WIRING SHOWN ON TERMINALS 7, 8 & 9
SOLDERED TO "Y" CONNECTORS.

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SAN GABRIEL, CALIFORNIA

SCALE

DATE 2-23-73

MATL:

FINISH:

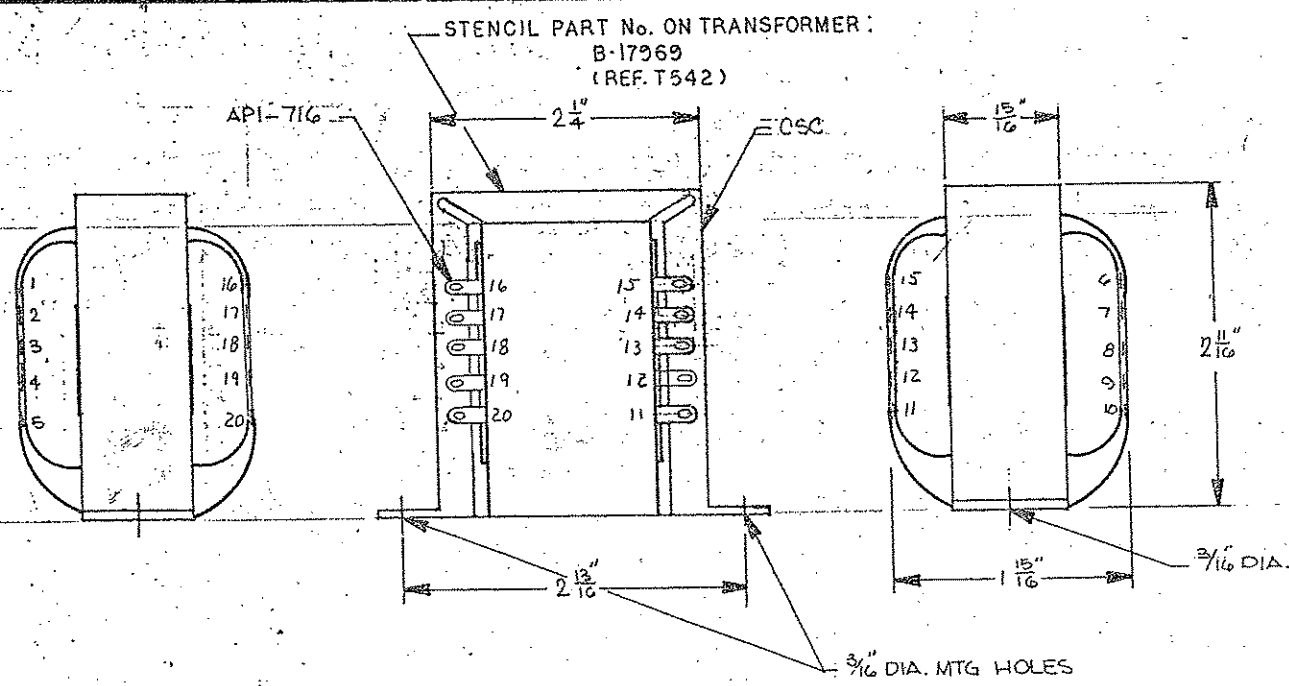
DR

ENGR

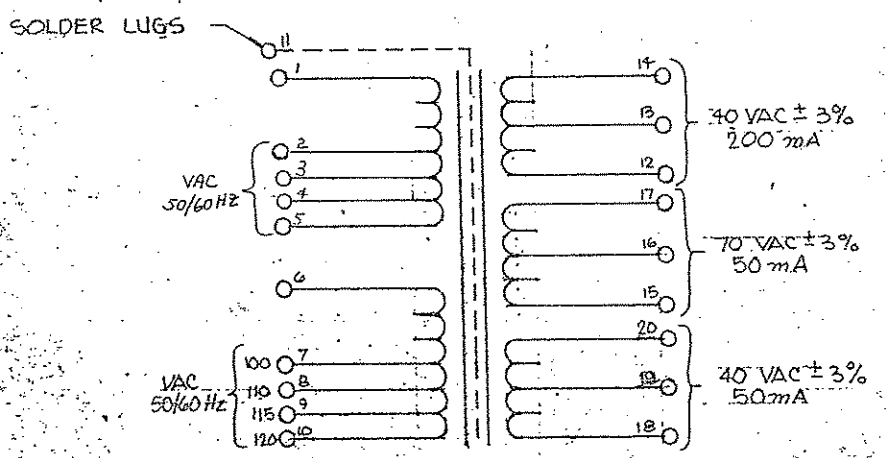
APP

MDL. 307 WA, 308 WA
ANALYSIS UNIT WIRING

A-20199



INPUT VOLTAGE 50-60 HZ	WIRE		
	HOT	NEUT	JUMPER
100 VOLTS	1-6	2-7	↗
110 VOLTS	1-6	3-8	↗
115 VOLTS	1-6	4-9	↗
120 VOLTS	1-6	5-10	↗
200 VOLTS	1	7	2-6
220 VOLTS	1	8	3-6
230 VOLTS	1	9	4-6
240 VOLTS	1	10	5-6



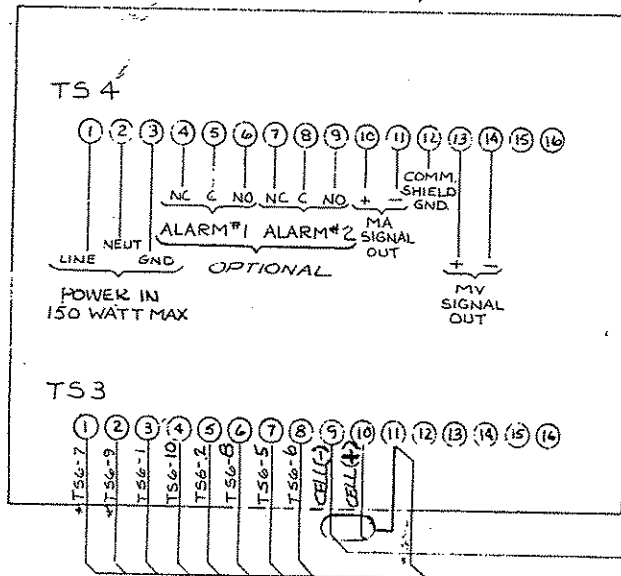
- NOTES:
- 1) LOAD REG. ON SECONDARY TO BE LESS THAN 10 %
 - 2) PRIMARY WINDINGS 100, 110, 115, 120, 200, 220, 230, 240 VAC 50/60 Hz
 - 3) INSULATION MATERIALS TO BE CLASS H.
 - 4) 2500V MINIMUM INSULATION (HI POT.)

(T.A.I P/N T542)

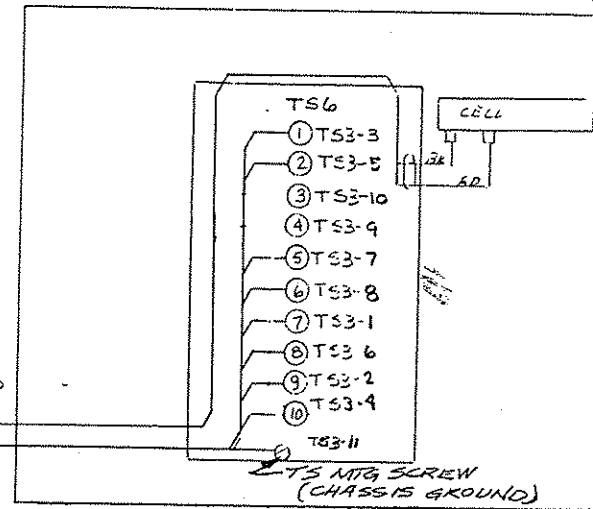
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TOLERANCE UNLESS OTHERWISE SPECIFIED	FRACT. ± 1/64	DEC. ± .008	ANGULAR ± 1/2°
TELEDYNE ANALYTICAL INSTRUMENTS SAN GABRIEL, CALIFORNIA		SCALE FULL	DATE 1-4-78
MDL. 306WA TRANSFORMER SPEC. WIRING DIAGRAM		FINISH L.T. GEN. # 50065514	DR <i>THB</i> ENGR <i>VP</i> APP <i>VP</i>
		B-17969	

MODEL 307WA
CONTROL UNIT
(REAR VIEW)



ANALYSIS UNIT



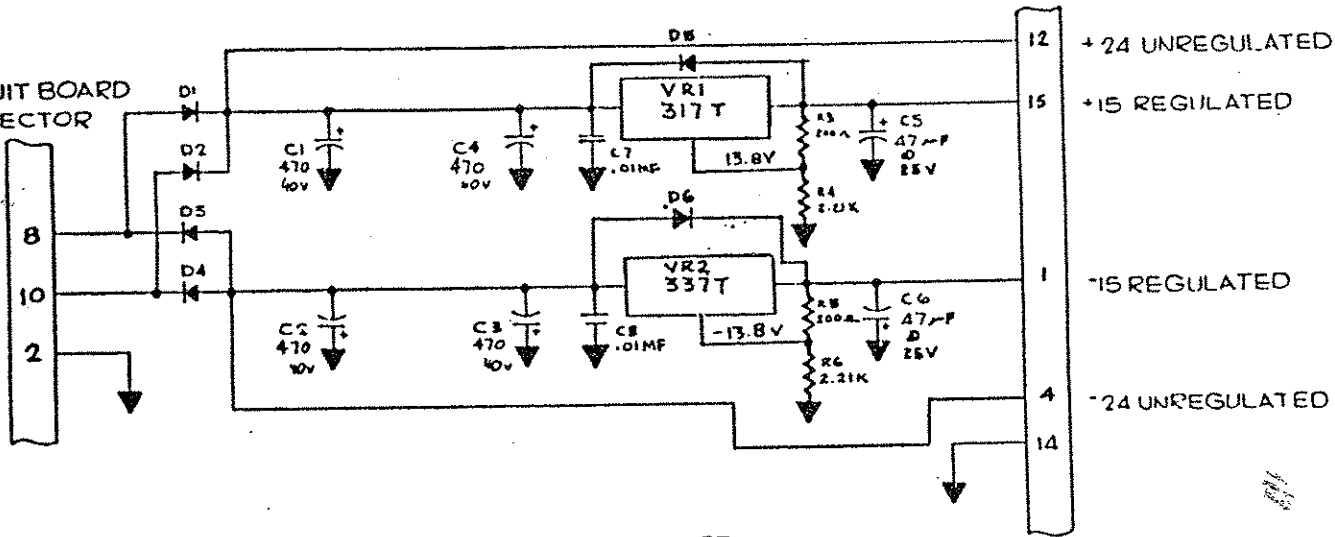
2 COND.
22 GA. SHIELDED
CABLE

* DENOTES
10 GA MIN

ISSUE NO.	APP.
43-22-79	W. J. R.
2-4-1-81	REVISED AIC
3) BK-FD CABLE WAS CONNECTED TO TS6-3 & -4 11-11-66	JAR
4) REF. INT. 11 TS3-9 & -10 WAS: TS6-4 AND TS6-3 10/9/61	JAR.

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TOLERANCE UNLESS OTHERWISE SPECIFIED	FRACT. ± 1/64	DEC. ± .005	ANGUL. R ± 1/2°
 TELEDYNE ANALYTICAL INSTRUMENTS SAN GABRIEL, CALIFORNIA		SCALE	DATE 3 22 79
MODEL 307 WA X INTERCONNECTION DIA. (FRONT REAR CONTROL)		MATL	
		FINISH	
DRAWN	ENGR	APP	
		B-20282	

CIRCUIT BOARD CONNECTOR



NOTE: UNLESS OTHERWISE SPECIFIED,
 ALL RESISTANCE VALUES ARE IN OHMS.
 ALL CAPACITANCE VALUES ARE IN MICRO-
 FARADS.
 ALL DIODES ARE IN4004.

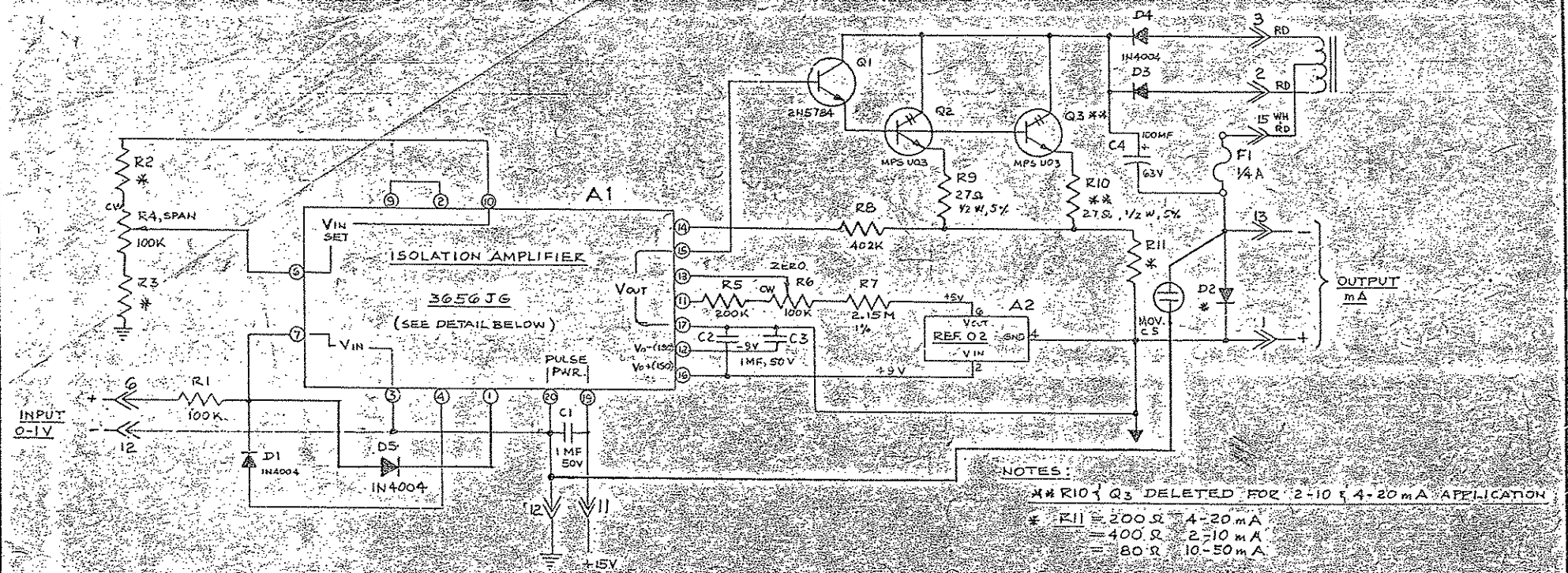
CIRCUIT BOARD CONNECTOR

ISSUE NO	APP
2) 83-0125	jsa
12. 10 - 83	
SEE REV CARD	
3) 1-25-84	JK
TERM 10, WAS 6	
4) 6-29-84	
ADDED NOTES	
5) 4-1-85	JK
ECO# 85-0178	
6) 10-23-85	JK

TOLERANCE UNLESS OTHERWISE SPECIFIED			
FRAC. ± 1/100	DEC. ± 0.08	ANGULAR ± 1/2°	
TELEDYNE ANALYTICAL INSTRUMENTS SAN GABRIEL, CALIFORNIA		SCALE	DATE 8-22-83
REGULATED POWER SUPPLY SCHEMATIC		FINISH	
DR	ENGR	APP	
			B-33129

ASSY/A9306

ISSUE NO.	DATE	REVISION / RECONSTRUCTED	APP
2	8-8-83	ECO 83-0119	CS



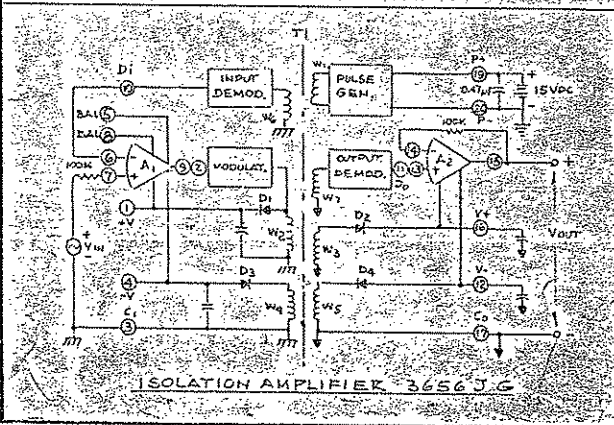
NOTES:

* R10 & Q3 DELETED FOR 2-10 & 4-20 mA APPLICATION

* R11 = 200 Ω 4-20 mA
 = 400 Ω 2-10 mA
 = 80 Ω 10-50 mA

* D2 = ZENER DIODE 27V @ 1W FOR INTRINSIC SAFETY BARRIER OPTION

INPUT: 0-1VDC



ASSY.: B-29600 4-20mA, 2-10mA
 B-29811 10-50mA
 SCH.: B31640 0-20mA

ITEM	PART NO.	REQ	DESCRIPTION
TOLERANCE UNLESS OTHERWISE SPECIFIED			
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FRAC	1764		TELEDYNE ANALYTICAL INSTRUMENTS CITY OF INDUSTRY, CALIFORNIA 91748
DEC	1983		
ANGULAR	c 1/2		
ISOLATED I/I CONVERTER			SCALE: _____ DATE: 8-11-82
P.C. BOARD, 2-10, 4-20, 10-50 mA			MAT'L: _____
SCHEMATIC, FOR MDR'S, 506, 507			FINISH: _____
514			DR: [Signature] APP: [Signature]
			B-30364

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