MODEL 275R

PORTABLE TURBINE GENERATOR PURGE GAS ANALYZER

INSTRUCTION MANUAL

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 M51353
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ECO # 01-0115

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 sale, 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, or neglect. We assume no liability for direct or indirect damages of any kind and the purchaser by the acceptance of the equipment will assume all liability for any damage which may result from its use or misuse.

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

Important Notice

This instrument is intended to be used a tool to gather valuable data. The information provided by the instrument may assist the user in eliminating potential hazards caused by the process that the instrument is intended to monitor; 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 can be misused. In particular, any alarm or control system installed must be tested and understood, both as they operate and as they can be defeated. Any safeguards required such as locks, labels, or redundancy must be provided by the user or specifically requested of Teledyne.

The purchaser must be aware of the hazardous conditions inherent in the process(es) he uses. He is responsible for training his 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.

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 his agents is to be construed as a warranty of adequate safety control under the user's process conditions.**

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CAUTION

- Do not connect the instrument to a pressure source greater than **30 psig**.
- This is a measurement instrument, **NOT** a safety instrument.
- This instrument is **NOT** explosion-proof or intrinsically safe and **MUST NOT** be used in hazardous areas.

Introduction

In order to help you make maintenance purging of turbine generators safer, Teledyne Analytical Instruments has developed the 275R Turbine Generator Purge Gas Analyzer. During maintenance of hydrogen-cooled turbine generators, the cooling gas (H_2) is systematically replaced with carbon dioxide (CO_2) and then air. The 275R accurately measures H_2 concentrations during the replacement process by comparing the difference in thermal conductivities between a sealed reference gas (helium) and the atmosphere undergoing replacement.

Since air leaks reduce the purity of H_2 used in cooling, which increases viscosity and reduces heat conduction, the 275R has a H_2-in-air range in order to assist in monitoring H_2 and impurity concentrations for optimum efficiency during normal operations.

1.1 Features

The Model 275R analyzer has three ranges for purge and normal generator operation, with zero and span potentiometers for each. Each range also has its own scale on the meter face. Efficient insulation around the cell block enables quick restarts so that the instrument can be carried from one generator to the next without a lengthy warm-up period.

Periodic calibration is all the maintenance necessary. Installation is just a matter of connecting sample inlet and outlet lines. The reference cell is sealed; thus, no other gas connections are necessary. Electronic temperature control in the cell block insures optimum accuracy in measurement.

1.0 Introduction

Operational Theory

The Model 275R Turbine Generator Purge Gas Analyzer can measure either the concentration of one component in a binary stream of gas, or the purity of a sample stream containing a composite mixture of impurities.

2.1 Thermal Conductivity

The ability of a substance to conduct heat is called *thermal conductivity*. A good heat conductor has a large thermal conductivity (as in the case of hydrogen and helium, which have nearly identical thermal conductivities); a small thermal conductivity (as in chlorine and carbon dioxide gas) indicates that the substance may be a better insulator than conductor. Operation of the 275R analyzer is based on being able to detect the difference in thermal conductivity between the gas being monitored and the known reference (which, in this case, is helium).

Thermal conductivity measurements are non-specific by nature, which imposes certain limitations and requirements. If the analyzer is to detect a specific component in a sample stream, the sample must be composed of the component of interest and one other gas in order to be accurate.

If, on the other hand, the user is primarily interested in the purity of a process stream, and does not require specific identification of the impurity, the analyzer can be used on more complex mixtures.

Because analysis by thermal conductivity is not an absolute measurement, standardizing gases of known compositions will be required to zero and span the analyzer.

The detector cell is divided into two halves, with the reference gas (helium) sealed into one chamber, and the other through which the sample flows. The difference in thermal conductivity between the reference gas and the sample is sensed by hot wire elements, which protrude into the chambers. Each pair of elements is wired into an electrical circuit known as a Wheatstone bridge.

During calibration, the bridge circuit is balanced with the reference gas; the zero of each range is set with its zero gas and the high end of the range is adjusted with span gas. The intervening points along the range (or ranges) of interest will produce a DC electrical signal representative of the analysis.

2.2 Electronic Components

The temperature of the measuring and reference cell block is regulated to within 0.1°C by means of an electronic proportional controller circuit. The cell block is mounted on an aluminum heater block and insulated. A thermistor is used in the circuit to keep the heater block at a predetermined temperature.

A regulated current supply of approximately 100 milliamperes supplies stable temperature-independent power to the sensor elements in the chambers. Since the elements are connected to the four arms of the Wheatstone bridge, a gas with a thermal conductivity different from the reference creates an imbalance in the bridge in proportion to the thermal conductivity of the sampled gas. This signal is amplified and displayed.

The output of the final buffer amplifier is normally 1 volt full scale, and is powered by a standard TAI power supply unit of +15V and -15V.

Operations

3.1 Front Panel

3.1.1 Function Switch

This switch is used to select the gas mixture range to agree with the composition of the sample. Gas compositions for which your analyzer is intended are hydrogen and carbon dioxide (0-100% H_2 in CO_2), or air and carbon dioxide (0-100% air in CO_2), or purity of hydrogen (e.g. 90-100% H_2 with 0-10% impurities).

3.1.2 Zero Control

The zero control potentiometers are used to adjust the zero reading for each range when a zero gas is introduced into the analyzer. See **Appendix: Specifications** for the recommended zero gas.

3.1.3 Span Control

The span control potentiometers are used to adjust the meter to read the known concentration of a span gas present in the measuring chamber. See **Appendix: Specifications** for the recommended span gas.

3.1.4 Cell Temperature

Generally the cell temperature is stable within 30 minutes of switching on the analyzer. The indicator lamp on the front panel shows when the heater is on, and when it is flashing the cell is up to its operating temperature.

3.1.5 Flowmeter

The flowmeter is used to control and adjust the sample (or span or zero) gas flow through the measuring chamber.

3.1.6 Analog Meter

The meter has three scales:

- 0-100% H_2 in CO_2 (green).
- 0-100% air in CO_2 background (black).
- 90-100% H_2 in air (red).

The output of the circuitry for the 0-100% H_2 in CO_2 scale is nonlinear with the most sensitive area being at the low end. The other two scales are almost linear. A special meter dial is provided with markings located to accommodate these non-linearities so that extrapolation is not required.

3.1.7 Analog Output

A 0-1 VDC output is provided. This output is non-linear and must be interpreted using the curves in the Appendix. The load on this signal must be less than 10,000 Ω to ensure that it will not cause error in the output signal.

3.2 Start-Up

3.2.1 Preliminary

1. Check that the inlet and outlet lines have been connected to the proper ports in the rear of the analyzer, and that all the lines are leak-free.
2. Plug the power cord in.
3. Turn the analyzer power switch ON. The switch is located on the lower left-hand corner of the front panel.
4. Allow the analyzer to warm up until the lamp starts flashing. Allow 15 more minutes of warm-up.

3.2.2 Flowrate

The gas flowrate should be approximately **0.1 SCFH**, at **10 psi** pressure.

3.2.3 Calibration

1. With 100% CO_2 flowing through the cell, adjust the zero control potentiometer so that the meter reads zero for Range 1 and Range 2 of the analyzer.

2. With a mixture of 90% H_2 and 10% N_2 flowing through the analyzer, adjust the zero control potentiometer to read zero on the meter for Range 3.
3. With 100% H_2 flowing through the cell, adjust the span controls to read full scale output in Ranges 1 and 3.
4. With air flowing through the cell, adjust the span control to read full scale output in Range 2.

After calibration has been successfully concluded, connect the sample gas to the analyzer, and adjust the flow to approximately **0.1 SCFH**.

3.0 Operations

Installation

4.1 Location

WARNING: This instrument is not explosion-proof or intrinsically safe, and MUST NOT be used in hazardous areas.

The instrument should be installed where it will not be subjected to:

- direct sunlight.
- drafts.
- shock and vibration.
- temperatures below 30 °F or above 110 °F.

The analyzer should be placed as close as possible, subject to the above conditions, to the sample point, to minimize the effects of sample line lag time on the analysis.

An outline diagram showing the location and identification of the gas and electrical connections, as well as the physical dimensions of the analyzer case, is included in the drawings at the rear of the manual.

4.2 Electrical Connections.

A source of single phase, 50 or 60 Hz, 110 to 120 volt power, capable of delivering 1 ampere of current continuously, is required to operate the analyzer. 220 volt is available upon special order.

The primary power connection is made by connecting the line cable to the receptacle at the back of the instrument.

Use 2-conductor shielded cable (nominally #22 ga. wire size) to interconnect the analyzer output signal with any recording equipment. The shield should be terminated on the appropriate terminal (see interconnection diagram) at the analyzer, and be left disconnected at the recorder.

4.3 Gas Connections

The gas inlet and outlet connections are 1/8" tube fittings located on the upper left-hand corner of the rear panel.

NOTE: Reducing-type pressure regulators will have to be installed at all gas supply sources.

4.3.1 Gases

Air, hydrogen, carbon dioxide and a mixture of 10% nitrogen in hydrogen are needed to calibrate the unit. *

WARNING: Hydrogen is a highly flammable gas. Care should be taken not to store it near flames or flammmable materials. The output from the analyzer should be purged to a remote space, away from ignition and ignitable sources.

4.3.2 Vent Lines

The selected gas introduced into the sample path of the cell is vented through the gas outlet fitting.

If it is desirable to carry the outlet gas to an area remote from the analyzer to vent it, the following precautions must be observed in vent line installation:

a) The vent line should be constructed of tubing of sufficient diameter so that no appreciable back pressure resulting from restricted flow is experienced by the analyzer.

b) The sample line must be vented into an area where the ambient pressure is the same as that of the analyzer.

c) The ambient pressure in the vent area must undergo no more than normal barometric pressure changes.

d) The vent line must be installed so that water cannot accumulate in it.

4.4 Pressure Regulation

The following precautions must be observed for the incoming gas lines:

a) The incoming gas line should be equipped with a pressure regulator.

b) The sample line pressure regulator should be installed as close to the sample point as possible, to minimize sample line lag time.

c) Sample pressure should be set somewhere between **5 and 30 psig**; 10 psig is nominal.

d) To minimize flowrate adjustments, the pressure regulators on the supporting gas supply cylinders should be adjusted to provide the same output pressure as the sample line regulator.

NOTE: When installing pressure regulators on supply cylinders, open the cylinder valves slightly so that gas is flowing during installation.

Using this procedure will eliminate the diffusion of air trapped during assembly back into the cylinder, the most common cause of standardization gas contamination.

4.0 Installation

Maintenance & Troubleshooting

Since no moving parts are used in the analyzer, no routine maintenance is required, other than checking the gas flow rate periodically.

Symptom	Cause	What To Do
1. No output.	a) Bad fuse.	a) Check and replace fuse.
	b) The power supply of +15V and -15V may be defective.	b) If faulty, change the power supply board.
	c) The bridge power supply (100 mA) may be defective.	c) Measure it, and if faulty, change the voltage regulator/amplifier board.
2. Output drifting very slowly.	a) Blocked vent may be causing back-pressure in the measurement cell, resulting in high cell pressure, erratic readings, and a constricted flow.	a) Clean the vent.
3. Output goes high slowly when the instrument is first turned on.	a) The temperature controller may not be working.	a) Check that the bulb above the power switch is flashing, and if the bulb is not flashing, change the temperature controller board.
		b) If the temperature controller is working, perform the same checks as in #2 above.

5.0 Maintenance & Troubleshooting

Appendix

Specifications

Ranges: 0–100% H_2 in CO_2
0–100% air in CO_2
90–100% H_2 in air

Sealed reference gas: Helium

Zero drift: <1% per day

Accuracy: ±5% of full scale or better, depending on the range selected.

Response time: 90% in 50 seconds.

Sample flowrate: 0 to 0.5 SCFH.

Area classification: General purpose (non-hazardous) areas.

Signal output: 0 to 1 VDC.
mVDC output also available.

Meter readout: Integral analog meter.

Operating temperature: +32 to +125 °F (0 to +52 °C).

Electrical requirements: 115 VAC, 60 Hz, 115 Watts.
100 or 220 VAC, 50/60 Hz also available.

Approximate dimensions: H × W × D
9 " × 10 " × 14 "
230 mm × 250 mm × 360 mm

Approximate weight: analyzer: 10.5 lbs. (4.8 kg).
power cord: 0.7 lbs. (0.3 kg).

Calibration Data

Serial Number:

Ranges: 0-100% H_2 in CO_2
0-100% air in CO_2
90-100% H_2 in air

Output Signal: 0-1 VDC

Recommended Zero Gases: 100% CO_2
90% H_2 with 10% N_2

Recommended Span Gases: 100% H_2
100% air

Reference Gas: Sealed helium reference

Recommended Spare Parts List

P/N	QTY.	DESCRIPTION
C-51407	1	PC board, measurement
B-30927	1	PC board, amplifier
A-9306	1	PC board, power supply
B-73363	1	Cell block assembly
F9	5	Fuse, 1 amp
H158	1	Heater, 18 watt cartridge type

A minimum charge of $150.00 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:

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16830 Chestnut Street

City of Industry, CA 91748-1580

Telephone: (626) 961-9221

TWX: (910) 584-1887 TDYANYL COID

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or contact your local representative