INSTRUCTION MANUAL

MODEL 212R

THERMAL CONDUCTIVITY 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 M73212
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Teledyne Analytical Instruments

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 acknowledgments 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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1. INTRODUCTION

1.1 Method of Analysis.

The Model 212R compares the thermal conductivity of a sample gas to that of a fixed composition reference gas and produces an electrical output signal that is calibrated to represent the difference between the two gases.

Due to the nonspecific nature of thermal conductivity measurement, standard gases of known composition will be required to calibrate the analyzer. The accuracy of the analysis will be dependent on the accuracy to which the composition of the standard gases is known.

The measuring unit is a four element hot wire cell that forms one-half of an alternating current bridge circuit. Two of the hot wire elements are exposed to the sample gas, and two to the reference gas. The other half of the bridge circuit is formed by the center tapped secondary winding of a transformer.

With reference and zero standardization gas flowing, the bridge circuit is balanced at one end of the measurement range. A span standardization gas containing a known concentration of the component of interest is then introduced into the sample path, and the resulting error signal generated by the now unbalanced bridge circuit is calibrated to represent the span gas mixture. The concentration of the component of interest in the span gas is predicated by the specified ranges of the analysis. After the instrument has been standardized the electrical error signal is directly related to the component of interest content of the sample gas.

The magnitude of the measuring bridge error signal is much too small to drive an indicating or recording instrument. A 100:1 step-up transformer, followed by an electronic amplifier stage, is utilized to amplify the error signal to an acceptable amplitude for demodulation. The signal is then conditioned appropriately to drive recording equipment.

1.2 Sensitivity.

Differences in thermal conductivity that produce a measuring bridge error signal of 0.25 microvolts will be sensed by the analyzer.

1.3 Stability.

Internal variables, other than the sample gas, that could produce variations in the output signal are carefully controlled by the Model 212R. Zero drift is approximately 2% of the fine range in a 24 hour period of operation; furthermore, the drift is bidirectional with a properly installed analyzer and is related to gross changes in ambient temperature. The variables, both internal and external, that can affect the stability of the analyzer will be dealt with in detail in the installation and trouble shooting sections of this manual.

1.4 Special Consideration.

Consideration of Using the 212R to Measure H2, or measure other compounds in H2. H2 in the gas state can be assume of one tow states, para H2, or ortho H2. Each has its own Thermal Conductivity Value. These differ by about 10% from one another.

So this must be taken into consideration when attempting to use the 212R on H2 streams.

We would recommend one consult Wikipedia.com or other sources to learn more about these two states of H2 and how the thermal conductivity of the gas stream varies with the state.

If for instance one is using pure H2 as a reference gas, and this gas is in the para state associated with cryogenic H2 recently vaporized, and this is then compared to cylinder H2 which may be in a different state, then considerable measurement errors can result.

Contact Teledyne for further guidance or information on your specific application.

1.5 Physical Configuration.

The analyzer is housed in a sheet steel case that is designed to flush mount within an equipment panel. Electrical controls, as well as an integral gas control

panel, are located immediately behind a hinged front access door. The analyzer is suitable for installation in a sheltered non-hazardous area.

A recording and/or indicating device will be required to transduce the electrical output signal into readable information.

2. INSTALLATION

2.1 Location.

The analyzer should be panel mounted in an upright position in an area that is not exposed to the following conditions:

1. Direct sunlight.
2. Drafts of air.
3. Shock and vibration.
4. Temperatures other than that one would expect to see in airconditioned, temperature controlled office of lab enviroment.

The 212R should not be mounted outdoors or subject temperature fluctuations beyond 2 or 3 degrees.

The analyzer should be placed as close as possible, subject to the aforementioned conditions, to the sample point.

Outline diagrams of both units will be found in the drawing section. After the cutout has been made in the equipment panel TAI recommends that the analyzer be used as a template to lay out the four mounting holes. Such a procedure will compensate for sheet metal tolerance errors.

2.2 Electrical Requirements and Connections.

Provisions have been made to accommodate the three external circuit connections required by the analyzer. Access holes on one side of the analyzer case (see Outline Diagram) are provided for the installation of the conduit and electrical wiring. All three customer connected circuits are to be terminated on the barrier terminal strip identified "TS1".

To install the conduit and wiring, the inner horizontally hinged panel must be opened (to open the panel, turn the fastener screw at the top of the Panel a 1/4 turn ccw). While installing the conduit and wiring be careful not to disturb the foam insulation lining the interior of the case anymore than is absolutely necessary.

IMPORTANT: The foam lining the interior of the analyzer is an integral part of the environmental temperature control system. Removal or destruction of this lining will result in erratic instrument performance.

2.2.1 Primary Power.

A source of single phase, 105 to 125 volt, 60 cycle power will be required to operate the analyzer. The maximum power consumption of the analyzer is 500 watts.

NOTE: The analyzer is also available for 50 cycle operation with special modifications and accessories.

Refer to the Interconnection Diagram in the drawing section of the manual and connect the power and ground wiring as shown. Be sure to polarize the power service connections as indicated. When connecting the wires, do not leave an excessive amount of slack within the analyzer. Two vacuum tubes are located just below the wiring area and the wiring should be installed to be well clear of them.

2.2.2 Signal Output.

Connect a two conductor shielded cable between the analyzer and recording equipment. Be sure to observe the proper polarity at both instruments. Connect the shield of the cable on the indicated terminal at the analyzer only, and cut back and insulate the shield at the recorder.

NOTE: Connecting the shield at both ends of a cable when dealing with low level circuits can create a ground loop between two instruments. Improperly installed shielding can produce more noise in a low level circuit than no shielding at all.

2.2.3 Regulating Transformer.

Run the cable attached to the transformer unit in through the access hole that is equipped with the cable clamp and terminate it as specified on the interconnection diagram.

2.2.4. Completion and Inspection.

After the electrical connections have been completed, slide any excess slack back into the conduits so that the installed wiring is not in contact with the components mounted on the analyzer chassis.

Remove the three foam strips that are taped to the inside of the analyzer door and use them to stuff the conduit openings. It is important that these openings be as well sealed as possible.

Check to see that the temperature control printed circuit board, and all vacuum tubes are firmly seated in their respective sockets.

Close and latch the control panel. There should be no further need to have access to the interior of the analyzer. All controls and adjustments are arranged so that they can be manipulated without disturbing the delicate temperature equilibrium of the instrument interior.

2.3 Gas Requirements and Connections.

Before attempting installation of the sample and supporting gas lines and accessories give careful consideration to the following important installation notes.

Note #1: It is absolutely necessary that all connections and components in the gas control system ahead of the measuring cell be leak free. Toward that end TAI has tested the integral sampling system under pressure with a sensitive leak detector and certifies that the analyzer is leak free.

Note #2: Use no solder connections in the system. Soldering fluxes outgas into the sample lines and produce erratic output readings. Acid type soldering fluxes actually attack and permanently change the characteristics of the detector cell measuring elements.

Note #3: All sample system tubing should be new and clean. Many gases and vapors are absorbed by dirt or oxide coatings on tubing walls. These gases and vapors are released as the ambient temperature rises. Because of the high sensitivity of the analyzer, this absorption-desorption phenomenon can

cause a large fluctuation in output signal. For best results, use electropolished SS tubing

Note #4: Because of the diffusion of air through composition materials, only dual stage SS regulators with metallic diaphragms should be used in conjunction with the sample and supporting gas supplies.

Note #5: Regulators must be thoroughly purged (burped) prior to use.

2.3.1 Reference Gas.

A cylinder of gas of fixed composition is required as the reference for comparison with the sample gas. A total lack of impurities in the reference would be ideal but is not necessary. An impurity concentration of up to 50% of the narrowest range of interest is tolerable. The exact composition of the reference gas is academic as long as the user is certain that it falls within the limits specified in Section 7 of the manual. The important consideration is that the composition of the reference gas remain unchanged when in use.

NOTE: When it becomes necessary to replace the reference gas, the analyzer will have to be recalibrated.

2.3.2 Zero Gas.

A supply of gas, composed of the background gas of the analysis and the lowest attainable concentration of impurity, will be required to standardize one end of the ranges of interest. The composition of the zero gas must be known to the same exactitude expected of the analysis. TAI suggests that the gas be obtained from a supplier that will certify its composition. Recommendations as to the composition of the gas will be found in Section 7 of the manual.

2.3.3 Span Gas.

A supply of gas, composed of the background of the analysis plus a known concentration of the component of interest, will be required to standardize the sensitivity of the analyzer. Again, the composition of the gas must be known to the same order of accuracy expected of the analyzer. Analysis and certification of the composition is desirable. Specific recommendations governing the composition of the span gas will be found in Section 7 of the manual.

2.3.4 Installation of Cylinder Supplies.

The reference and standard gas cylinders should be installed as close to the analyzer as possible. Each cylinder should be provided with a dual stage, metallic diaphragm, pressure reducing regulator. When installing the regulators, crack the cylinder valve open so that gas is flowing. This procedure will prevent air from being entrapped in the regulator, and eliminate a common source of supporting gas contamination. Improper installation of a cylinder regulator can appreciably change the composition of a standard gas. Air trapped in the regulator will diffuse back into the cylinder, and the impurity concentration of the composition will be altered. When dealing with the zero gas, the alteration of the composition can be significant.

Once installed, prior to use, the regulators for reference, span and zero gases must be purged by alteratively pressuring the first stage, with the second stage off, then bleeding out the first stage by opening the second stage, back and forth several times.
Note: *Make sure to close the cylinder prior to bleeding the first stage through the second.*

2.3.5 Sample Pressure.

The sample point should be equipped with a metallic diaphragm pressure regulator and the pressure reduced to between 10 and 50 psig. The regulator should be installed as close to the sample point as possible to minimize sample line lag time.

2.3.6 Interconnecting Lines.

The inlet and vent connections are identified on the analyzer outline diagram. The connections are stainless steel 1/8" female pipe couplings that are braised into a gas connector bar mounted within the analyzer. The braised pipe coupling was selected as a transition so that the torque generated during installation of the external system would be isolated from the internal system. Bulkhead type fittings can be accidently twisted, and leaks promoted in hard to reach areas within the analyzer. TAI suggests that 1/4" tubing and adapter fittings be used throughout the external sampling and supporting gas system.

2.3.7 Vent Lines.

The sample path, reference path, and an integral bypass system vent from separate ports at the rear of the analyzer. Wherever possible, TAI recommends that the gases be permitted to vent directly to the atmosphere. If it is necessary to carry these gases to a remote area the following precautions must be observed when installing the vent lines:

1) The vent lines must be 1/4" tubing or larger so that no back pressure resulting from restricted flow is experienced by the measuring cell.

2) The sample and reference paths must vent into an area that experiences the same ambient pressure conditions.

3) The ambient pressure at the vent location should undergo no more than normal barometric pressure fluctuations.

4) The vent lines must be installed so that water and dust cannot accumulate in them.

A pressure differential existing at the cell between the reference and sample will result in a corresponding change in output signal. The reference and sample path flowmeters are located upstream from the cell so that both cell paths can vent directly to atmosphere. The random bounce of the floats in the flowmeters, when located downstream from the measuring cell, can produce up to 5% noise on the output signal.

3.0 STARTUP

3.1 Preliminary.

The following preliminary steps should be accomplished before applying power or starting gas flow.

1. Check the integral gas control panel and be sure that all valves are closed (fully cw). Do not jam the sample, reference, and bypass metering valves.
2. Place the “RANGE” switch on the #2 position.
3. Set the “SPAN” control to the reading recorded in Section 7 of the manual.

4. Determine what the sample pressure is and set the output pressure of the cylinder gas supplies to agree with the sample pressure. This procedure, although not absolutely necessary, will minimize flow adjustments when the sample path is switched to the various inputs.
5. Turn the analyzer and recorder power switches to "ON".

3.2 Reference Gas Flow.

Open the reference gas throttle valve adjacent to the "Ref. Flow" meter, and set the valve for an indicated flowrate of between 0.1 and 0.3 scfh. Since the actual setting is not critical, TAI suggests that the flow be set at 0.1 scfh to conserve the reference gas supply.

3.3 Zero Gas Flow.

Open the "ZERO" valve (ccw until a release in tension is felt), and adjust the throttle valve to the right of the "SAMPLE FLOW' flowmeter for an indicated flowrate of 0.3 scfh.

3.4 Warmup.

A warm-up period of twenty-four (24) hours is recommended to stabilize the interior of the analyzer at the control temperature level. Until the measuring cell temperature has equilibrated with the control temperature, the output signal will drift.

During the warmup period, check the recorder periodically. As the drift rate decreases, increase the sensitivity by moving the range switch towards Range #1.

IMPORTANT:

The zero control will have little or no effect until Range #1 is reached. If the recorder is off scale towards electrical zero (negative signal) after 24 hours of running on zero gas, use the procedure outlined in Section 6.2. The drift rate will decrease exponentially. When the rate of change slows to approximately 1% per hour, place the "RANGE" switch on position #1 and readjust the "ZERO" control so that the recorder is reading midscale. Do not attempt to calibrate the analyzer until the recorder indication stabilizes.

3.5 Zero Standardization.

After the analyzer stabilizes adjust the "ZERO" control until the recorder indicates the impurity concentration of the zero gas composition. Be sure that the range switch is on position #1 and that the sample path flowrate is 0.3 scfh.

NOTE if the"ZERO" or "FINE ZERO" pot runs out of adjustment and the analyzer can not be calibrated, set this pot back to mid-scale. Then use the "COURSE ZERO" pot to readjust the zero calibration as close as possible to zero calibration. And last use the "ZERO" ot "FINE ZERO" pot to fine adjust the zero calibration.

3.6 Span Standardization.

After the zero has been standardized, switch the selector valve to "Span", and reset the sample path flowrate to 0.3 scfh. The recorder should come to balance on, or close to, the composition of the span gas.

The analyzer is factory calibrated to make sure that the output is linear over all three ranges of interest. Calibration is achieved with mixing block technique and the span setting recorded in Section 7 is derived at that time.

If the analyzer performed as described in the warm-up procedure (Section 3.4), and fails to closely approximate the composition of the span gas, there is grounds for doubting the span gas mixture. Because of the difficulty involved in obtaining precise analysis of small amounts of impurities in cylinder gas, and because of the ease with which the gas can be contaminated subsequent to analysis, any large error in response to the span gas should be suspect. In such a case TAI recommends that the analyzer be operated at the recommended span setting until the span gas is reanalyzed.

If adjustment of the span control is necessary to compensate for minor discrepancies between the recorded setting and the span gas reading, TAI suggests that the zero and span procedures be repeated until no further adjustment is required.

3.7 Bypass.

The integral gas control panel features a bypass flowmeter and throttle valve that is located downstream from the input manifold (see the analyzer piping schematic in the drawing section). The bypass system can be used to speed the response of the analyzer to changes in the process. The bypass flowmeter will indicate flowrates that are a factor of ten greater than the sample path flowmeter. TAI recommends that the bypass system be used whenever the sample path is switched and particularly after using the span gas. The time required for the analyzer to stabilize on an impurity concentration within the limits of Range #1, after having been exposed to a concentration within the limits of Range #3, is not a function of cell response which is

virtually instantaneous. Recovery is a function of how long it takes to purge the sampling system upstream from the cell. Accelerating the sample path flowrate will speed the response.

NOTE: TAI recommends that some bypass flow be permitted at all times. The bypass throttle meter is a part of the input manifold. Being so located means that the throttle valve lies between the sample side of the cell and atmosphere.

Without some bypass flow it is possible that atmosphere could diffuse into the sample line. Do not attempt to use the throttle valve as a shut off valve. Jamming the valve will damage the metering needle.

3.8 Sample Mode.

After the analyzer has been standardized, switch the selector valve to "Sample". Set the bypass flow so that the float is visibly elevated from the bottom of the tube and then readjust the sample flowrate to 0.3 scfh. No further adjustments are required.

NOTE: Although the bellows type valves used in the input manifold are among the best available, TAI suggests that the span gas be turned OFF at the cylinder when not in use, and the span line relieved of pressure before closing the analyzer span valve. Such a procedure will eliminate any possibility of the span gas diffusing into the sample path of the analyzer. Normally, the recommended span gas composition contains a component of interest content of 3/4 the coarsest range of analysis. The component of interest

content of the sample gas, on the other hand, is usually well within the finest range of analysis. Instrument sensitivity in Range #1 is 100 times greater than in Range #3. The user can readily see what even a minute rate of span gas diffusion would do to the validity of a Range #1 analysis.

4. ROUTINE OPERATION

4.1 Flowrates.

The reference and sample flowrates should be checked daily. The instrument is somewhat flow sensitive. Operating on Range #1 a change in flowrate of 0.1 scfh will cause a corresponding change in sensitivity of from 1 to 20% of scale. On the coarser ranges, the change in sensitivity would be undetectable.

The sample path flowrate should be maintained at 0.3 scfh, the reference path flowrate at 0.1 scfh, and the bypass flowmeter float should be slightly above the bottom of the indicator glass.

4.2 Supporting Gas Supplies.

Supporting cylinder gas supplies should be checked frequently on a routine basis with particular attention focused on the reference gas. A spare cylinder of reference gas should be available at all times. When the cylinder pressure drops below 100 psig the reference supply should be replaced as the operation of the regulator is questionable at pressures below this point.

When replacing supply cylinders, be sure to bleed the gas through the cylinder valve while installing the pressure regulator (see Section 2.3.4). It is also advisable to check the connections with soap water whenever a supply cylinder is changed.

4.3 Standardization.

The analyzer must be completely restandardized whenever the reference gas supply is replaced. Barring unforeseen difficulties with the analyzer, re-standardization should not be necessary between reference cylinder replacement periods if the analyzer is run continuously. If the analyzer is shut down for long period of time use the startup procedure (in its entirety) when operation is to be resumed.

NOTE: TAI strongly recommends that the analyzer run continuously with gas flowing in both the sample and reference paths. During inactive periods arrange the input manifold so that zero gas is flowing. Gas supplies can be conserved by reducing the sample and reference path flowrates to less than 0.1 scfh and closing off the bypass flow completely.

Due to the delicate balance of the thermal conductivity cell employed in the analyzer, exposure to the atmosphere in an uncontrolled temperature environment is undesirable. After extended shutdown periods many days of operation may be required for the analyzer to re-stabilize.

5. PERIODIC MAINTENANCE

5.1 Heater Fan.

The heater fan is the only component within the analyzer that requires periodic attention. Whenever the reference gas is replaced the motor bearings will require a few drops of light machine oil. Since oiling the fan motor necessitates opening the inner door of the analyzer, the instrument will require the necessary temperature equilibrating time after the door is closed. With zero gas flowing be sure that the analyzer has stabilized on the Range #1 position before re-standardization is attempted.

6. TROUBLE SHOOTING

6.1 Preliminary.

If the analyzer is suspected of incorrect operation, as a preliminary to evaluation, always arrange the input manifold so that zero gas is flowing through the sample path of the analyzer. Never attempt to evaluate the performance of the instrument with sample gas flowing.

Analysis by thermal conductivity is nonspecific in nature. A thermal conductivity analyzer with the fine range sensitivity of the Model 212R will respond to many influencing factors other than the component of interest; particularly when operated at Range #1 sensitivity.

It is necessary, therefore, to eliminate as many external variables as possible if the performance of the analyzer is to be assessed. Programming the analyzer for zero gas places both paths of the measuring cell on relatively reliable cylinder gas sources.

6.1.1 Electrical Checks.

Check to see that both the analyzer and recorder are being furnished electrical power. Check to see that the analyzer and recorder fuses are intact. Check all electrical connections outside of the analyzer.

6.1.2 Sampling System Checks.

Be sure that there is an adequate supply of reference gas and that the sample and reference path flowrates are correct. Check to see that there are no obstructions in the vent paths from the analyzer. Check all external plumbing connections for leaks with soap water.

6.1.3 Summary of Preliminary Checks.

The analyzer inner door should not be opened and no adjustments, beyond manipulation of the normally used controls, should be made until all the afore-mentioned preliminaries have been completed and any necessary remedial repairs effected.

6.2 Loss of Zero Control.

If loss of zero control on Range #1 is experienced during initial startup or after the reference gas supply has been changed, the dynamic balance procedure must be repeated.

Loss of zero control, under such circumstances, indicates that the impurity concentration within the reference gas is different than that of the gas used during factory checkout (or the previous cylinder) and does not in itself indicate a defective analyzer.

The analyzer was adjusted at the factory to have a zero balance at close to the midpoint of the zero control potentiometer (dual dial reading of 500) with a common source of high purity cylinder gas supplying both the sample and reference paths of the cell. If the recorder is off scale and cannot be returned with the zero control, the dynamic balance procedure must be employed to restore control before further conclusions as to instrument performance can be made.

6.2.1 Dynamic Balance Procedure.

The measuring bridge circuit (see schematic) incorporates two 10 turn potentiometers that are utilized to compensate for minute differences in the resistive and reactive properties of the hot wire elements and the center tapped secondary of the bridge transformer in the reference and zero gas related to the application.

The potentiometers are of the screw driver adjustment type and are equipped with shaft locking assemblies that have been factory adjusted to create enough friction so that the shaft will not change position in shipment. The potentiometers are located on the amplifier chassis, and are controlled through two holes identified "RESISTIVE" and "REACTIVE" on the inner control panel.

DO NOT OPEN THE INNER PANEL OF THE ANALYZER TO GAIN ACCESS TO THESE CONTROLS. The balance adjustments should not be disturbed if the analyzer is not up to operating temperature. Correct bridge balance can only be achieved at operating temperature because of the inherent thermal junctions within the potentiometers themselves. The minute voltages produced by contact between the dissimilar materials within the potentiometers are effectively balanced out in the procedure when it is accomplished at operating temperature. Because the voltage generated by these junctions varies with temperature, and because the analyzer will resolve a 0.25 microvolt change in bridge voltage, temperature stability is a mandatory prerequisite to the dynamic balance procedure.

To restore zero control within the limits of Range *# 1*, employ the following Procedure:

1) With zero gas flowing, adjust the sample and reference gas flowmeters to the same value between 0.1 and 0.3 scfh.
2) Set the ZERO potentiometer to 500.
3) Connect a voltmeter to the instrument signal output. Connect an oscilloscope to the probe point an d set the sweep rate to 5 milliseconds. Set the voltage level so ± 15 volts can be read.
4) If a reading of +15 or –15 volts is indicated on the oscilloscope with the RANGE switch set to Range # 1 the instrument is significantly unbalanced. Set to Range #2 and proceed to step 4). If the voltage is lower in magnitude than + or – 15 skip down to step 6).

5) Using a screwdriver that has a shaft diameter of 1/8" and a shaft length of at least 6", turn the "Reactive" balance adjustment all the way counterclockwise (CCW) until the potentiometer stop point is reached. Turn the adjustment back clockwise (CW) 5 full turns to center the adjustment.
6) Turn the "Resistive" balance adjustment all the way clockwise (CW) until the potentiometer stop point is reached.
7) Slowly turn the "Resistive" adjustment until the output reaches its lowest value. If the reading is negative adjust to the most negative value possible.
8) Turn the "Reactive" balance adjustment slowly CW and CCW to obtain the lowest possible output value. Again, if the reading is negative adjust to the most negative value possible.
9) Repeat steps 6) and 7) until the output value is as low as these adjustments can make it.
10) Detune the instrument by turning the "Resistive" balance adjustment ½ turn CW. This will bring the signal out of the baseline noise, which could otherwise cause non-linear response at the low concentration end.

NOTE: ***Due to minute differences between measuring cells and the electronics in the bridge circuit found in various instruments, some analyzers will have to be balanced at a point higher than 10% of scale while others can be balanced even closer to electrical zero. The 10% of scale recommended in step 6 of the procedure is an arbitrary starting point. If the bridge circuit can be easily balanced at this signal level, the procedure should be repeated at a point even closer to electrical zero. Conversely, if balance cannot be accomplished at 10% of scale, the operator will have to select a higher recorder set point for the procedure. In any case, the object is to accomplish dynamic balance with the lowest magnitude of analyzer cutout signal attainable with the analyzer at Range #1 sensitivity.***

6.3 Correct Operation.

If a stable recording is achieved when the analyzer is operated on zero gas, erratic performance must be attributed to the customers sampling system

or incorrect instrument installation. The following conditions can produce an erratic output from the analyzer:

1) Installation in an area that is subject to large changes in ambient temperature, direct sunlight, drafts from wind, blowers, or air conditioners. Any of the foregoing conditions will produce a bidirectional (diurnal) variation in output signal.

2) Sample gas with a moisture content of 10 ppm or greater. Again, the output will vary bi-directionality with ambient temperature changes. If the sample gas is known to have a fairly high moisture content a dryer should be installed in the sample line.

3) Even the smallest leak anywhere in the sampling system upstream from the analyzer, a small leak at a fitting, valve, or regulator, will cause almost constant variation in analyzer output. The resulting signal drift would be erratic and could be either bi-directional or unidirectional.

4) Acid in the sampling system (soldering fluxes) will produce continuous, uncontrollable, unidirectional output signal drift. Sample tubing that has been treated with descaling chemicals, if subject to above ambient temperatures, will outgas continuously. Any form of acid in the sampling system will outgas at high temperatures and attack the hot wire elements of the cell.

5) Composition materials (diaphragms, tubing, etc.) in the sampling system will produce erratic, unpredictable changes in output signal level because of their permeability to gases other than the sample. The nylon tubing normally used in quick disconnect type sampling systems will produce diurnal output signal excursions in the order of 10 to 20% of the fine range of analysis.

6.4 Incorrect Operation.

If the analyzer is not stable on zero gas, and the supporting gas installation has been made and checked in accordance with sections 2 and 3, the following procedures should be employed.

6.4.1 Analyzer Leak

Check as previously stated, the analyzers entire sampling system has been checked under pressure with a leak detector. However, if the external system checks out and the instrument is displaying a large diurnal or uni- directional drift, the interior sampling system should be checked for leaks. Do not open the analyzer inner door. Use the following procedure:

1) Acquire a source of cylinder helium and through a dual stage regulator connect it to a length of 1/8" tubing.
2) Open the outer door of the analyzer and insert the tubing between the edge of the sample control panel and the outer case.

CAUTION: ***Do not insert the tubing along the edges of the larger swing-down control panel as there is danger of obstructing the fan or short circuiting the electronics. The end of the tubing should be shaped into a curve so that the foam lining is not overly disturbed and the tubing should only be inserted a couple of inches into the interior.***

3) Start the helium flowing. Keep the flowrate low so as not to disturb the temperature equilibrium of the analyzer interior.
4) Observe the recorder. If any leaks are present in the interior sampling system, the recorder will be driven off scale in one direction or the other. NOTE: The analyzer should be on Range #1 and the zero control adjusted so that the recorder is reading mid-scale. The direction the recorder indication moves is a function of the type of zero and reference gas being used (which varies per application) and which path of the sampling system (sample or reference) the leak is located in. If the recorder responds to an atmosphere of helium within the analyzer, all connections inside the analyzer must be checked.

6.4.2 Temperature Control Check.

The interior temperature of the analyzer is regulated to a constant value to within .002 degrees centigrade. The actual temperature control point varies slightly per application and is a function of the components used in the proportional temperature control circuit.

If the recorder is displaying a large diurnal recording that is related to the time of day in terms of the differential between day and night ambient temperature, trouble in the temperature control circuitry is indicated. Again, this symp-

tom must be evident with zero gas flowing. If this symptom is displayed only when the sample is flowing, the problem is related to one (or more) of the five (5) points outlined in section 7.3.

To check the temperature control circuit, use the following procedures:

1) With the power switch ON, open the control panel door and check to see if the fan is running. If it is not, check the left hand fuse. This fuse protects the entire temperature control circuit (see schematic). If the fuse will not hold, a short circuit is indicated. Disconnect the printed circuit card and replace the fuse. If the fuse holds (as indicated by the fan running) the printed circuit card will have to be replaced.

NOTE: Unless competent electronic technicians are available, TAI recommends that a replacement printed circuit card be ordered and the existing board returned to the factory for repair. Repair charges (out of warrantee) will be based on time and material. A schematic of the proportional temperature control card is included among the drawings at the rear of the manual.

2) If the fuse will not hold with the board removed, a short is indi cated in the fan, the heater resistors, or the interconnecting wiring. With the board removed, check wiring and components for short circuits.

3) If the fan is running, connect an AC volt meter across anyone of the heater resistors on the fan assembly (the meter should be set to read 50 VAC). In a properly operating circuit, the meter should read approximately 47 volts (heater control full on) as the control panel is open and the thermistor should be demanding maximum heater voltage. If no voltage is present, either the circuit card or the thermistor probe is faulty. Isolate the problem by first disconnecting the circuit board from its socket and with an ohmmeter check between terminals 5 and 6 of terminal strip TS2. If a reading is obtained (disregard actual resistance) the thermistor is intact and a new circuit card will be necessary. If no reading is obtained, a new probe assembly will be required.

4) If approximately 47 VAC is measured across the heater resis- tors, a runaway, or correct, circuit is indicated. To determine which is the case, hold a soldering iron in close proximity (1/2") to the end of the thermistor probe and observe the meter.

CAUTION: Do not touch the thermistor probe with the iron. The end of the probe is tied and taped to the sample tubing below the cell cover. If the meter reading suddenly drops to zero, remove the soldering iron immediately. After the area around the thermistor cools, the voltage across the heater resistors should again climb to 47 volts. Such action indicates a properly functioning heater circuit. If the meter stays in the 47 volt region, the circuit card will have to be replaced.

7.0 CALIBRATION DATA FOR MODEL 212R

SERIAL NUMBER: 195929

7.1 Ranges.

The ranges of the analyzer are:

Range Switch Position #1:	0-50,000 ppm N_2 in H_2
Range Switch Position #2:	0-5000 ppm N_2 in H_2
Range Switch Position #3:	0-500 ppm N_2 in H_2

7.2 Output Signal:

Output coincides with 100% analysis.

4mA	=	0 ppm N_2 in H_2	
20mA	=	50,000 ppm	N_2 in H_2 - Range #1
	=	5000 ppm	N_2 in H_2 - Range #2
	=	500 ppm	N_2 in H_2 - Range #3

7.3 Span Setting: 555

7.4 Recommended Accessory Gases.

H_2 Purity	Zero Gas	99.999
H_2 Purity	Reference Gas	99.999
	Span Gas	350-450 ppm N_2 in H_2

7.4.1 Reference Gas.

With a equivalent impurity of less than 3% of range 1. The impurity ratio must remain constant. When the reference gas supply is replaced, the analyzer must be re-standardized.

7.4.2 Zero Gas.

Because of the difficulties involved in obtaining a gas in pure form, the zero gas must be purchased from a supplier who will certify the cylinder as to its content. The equivalent impurity concentration of the gas must be less than 3% of range 1. When the zero gas is introduced for standardization, the range switch must be in Range 1, and the zero control set such that the recorder indicates the zero gas impurity.

IMPORTANT: At startup, be sure that the span control dial is set to the number recorded in Section 7.3.

7.4.3 Span Gas.

Containing an equivalent impurity. Again, the span gas must be procured from a supplier who will certify its composition. The range switch must be in range 3 when the span gas is introduced.

IMPORTANT: The accuracy of the analysis is directly related to the users knowledge of the span gas composition.

Reference and Sample Flowrates 0.3 SCFH

Bypass Flowrate 3.0 SCFH

NOTE: ***Cylinder and sample stream pressure settings must be adjusted in order to maintain the above flowrates when switching from one sample to another.***

RECOMMENDED SPARE PARTS LIST

QUANTITY	PART NO.	DESCRIPTION
1	A-6251	Measuring Cell Block Assembly
1	A-6981	Proportional Temperature Control
1	F-45	Sample Flowmeter Tube
1	F-22	Sample Flowmeter Bypass Tube

A minimum charge applies to all spare part orders.

IMPORTANT: Orders for replacement parts should include the part number, the model and serial number of the analyzer in which they are to be used.

Orders should be sent to:

TELEDYNE Analytical Instruments

16830 Chestnut Street
City of Industry, CA 91749-1580

Phone (626) 934-1500, Fax (626) 961-2538
TWX (910) 584-1887 TDYANYL COID

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

Drawing List

B-73356	Outline Diagram
D-73212	Final Assembly
A-72035	Piping Diagram
C-73085	Main PCB Schematic
C-73088	Power Supply PCB Schematic

Replacement Parts Order Information

A minimum charge of $150.00 is application to all spare parts orders.

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

Teledyne Analytical Instruments
16830 Chestnut street
City of Industry, Ca 91748-1580

Telephone: (626) 961-2538
(626) 934-1500

Fax: (626) 961-2538
(626) 934-1651

APPENDIX

Specifications:

Ranges: Three decade ranges: Minimum Full scale(ppm)
20 ppm Hydrogen balance Argon
25 ppm Hydrogen balance Nitrogen, Air
100 ppm Nitrogen balance Argon, Helium
100 ppm Helium balance Air
150 ppm Nitrogen, Carbon Monoxide balance Hydrogen
200 ppm Oxygen balance Argon

Range ID: 3 range ID contacts
Local Range ID LED'S

Detector: Thermal conductivity sensor

Signal Output: 0-1VDC negative ground
4-20maDC Isolated ground

Accuracy: ±2% full scale for most binary mixture at constant temperature. ± 5% of Full Scale over operating temperature (once temperature equilibrium has been achieved)

Operating Temperature: 20 – 30°C (68° F to 85° F)

Sample Requirement: Sample: 0.3SCFH
Reference: 0.1SCFH

Display: Digital LED read out (3½ Digit)

Mounting: Flush panel mount.

Response Time: 90% of full scale less then 60 seconds. For most application.

Stability: Less then 2% full scale drift over 24 hours

Power requirement: 110VAC, 50/60Hz (220VAC optional)