Operating Manual

Series 23-550-1, -2, -4, & -6
Total Hydrocarbon Gas Analyzer

Series 23-550-1, -2, -4, -6: 120 V, 50/60 Hz
Series 23-552-1, -2, -4, -6: 230 V, 50/60 Hz

November 2007
Rev. 7

READ INSTRUCTIONS BEFORE OPERATING

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IMPORTANT WARNING

THIS MANUAL MUST BE CAREFULLY READ BY ALL INDIVIDUALS WHO HAVE OR WILL HAVE THE RESPONSIBILITY FOR INSTALLING, USING, OR SERVICING THE PRODUCT. Like any piece of complex equipment, the TOTAL HYDROCARBON ANALYZER will perform as designed only if it is installed, used and serviced in accordance with the manufacturer's instructions. OTHERWISE IT COULD FAIL TO PERFORM AS DESIGNED AND PERSONS WHO RELY ON THIS PRODUCT FOR THEIR SAFETY COULD SUSTAIN SEVERE BODILY INJURY OR DEATH.

The warranties made by GOW-MAC Instrument Co. with respect to the product are voided if the product is not installed, used and serviced in accordance with the instructions in this manual.

Please protect yourself and your employees by following these operating instructions. We encourage our customers to write or call for any additional information relative to the use or repair of this instrument.

Technical Support

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GENERAL WARNINGS AND SAFETY

1. The Series 23-550 Total Hydrocarbon Analyzer should be installed, operated and maintained in strict accordance with its labels, cautions, warnings, instructions, and within the limitations stated.

2. The Total Hydrocarbon Analyzer housing must be located in a non-hazardous area.

3. Use genuine GOW-MAC replacement parts when performing any maintenance procedures provided in this manual. Failure to do so may seriously impair instrument performance. Repair or alteration of the Total Hydrocarbon Analyzer, beyond the scope of these instructions or by anyone other than GOW-MAC or a GOW-MAC Representative could cause the product to fail to perform as designed, and persons who rely on this product for their safety could sustain severe bodily injury or death.

4. DISCONNECT the instrument from **ALL** power sources **BEFORE** removing chassis from instrument housing and exposing potentially dangerous voltages.

5. **DO NOT** overload the AC outlet with other electrical equipment.

6. Adhere to the color coding descriptions when hooking up electrical connections.

7. Repair or replace faulty or frayed wiring.

8. Make sure that the actual line voltage is the value for which the instrument was designed. Make sure that the power cord is plugged into the correct voltage source.

9. Perform periodic leak checks on all fitting areas.

10. **DO NOT** allow flammable and/or toxic wastes to accumulate.

11. Keep combustibles away from gas cylinders and eliminate ignition sources.

12. Maintain adequate ventilation around Total Hydrocarbon Analyzer.

13. Dispose of wastes properly.

GENERAL PRECAUTIONS FOR HANDLING AND STORING HIGH PRESSURE GAS CYLINDERS

Compressed gases have properties that can cause serious accidents, injuries, and even death if proper precautions and safety practices are not followed. Therefore, during handling and use of these gases, be certain to use applicable safety precautions described by your local compressed gas supplier, the Compressed Gas Association, and/or O.S.H.A. regulations.

1. Read the label on all cylinders **BEFORE** using to identify the cylinder contents. If the label is illegible, return the cylinder to the supplier. **DO NOT ASSUME THE CONTENTS.**

2. Secure cylinders in storage and in use to an immovable structure to prevent accidental falling or movement. Read the relevant safety codes.

3. Store or move cylinders ONLY in the vertical position. **DO NOT** move or transport cylinders with regulators attached.

4. Store cylinders in a well ventilated area away from heat or ignition sources.

5. When installing tubing, provide ONLY approved, adequate pressure reducing regulators and pressure relief devices to prevent over-pressurizing of tubing and equipment.

6. Never drop cylinders or permit them to strike each other violently.

7. Cylinders may be stored in the open but, in such cases, should be protected against extremes of weather and from damp ground (to prevent rusting). In areas where extreme temperatures are prevalent, store cylinders in the shade.

8. The valve protection cap should be left on each cylinder until cylinder has been secured against a wall or bench, or placed in a cylinder stand and is ready for use.

9. Avoid dragging, rolling or sliding cylinders even for a short distance. Move cylinders by using a suitable hand truck.

10. Never tamper with safety devices in valves or cylinders.

11. Do not store full and empty cylinders together. Serious suck-back can occur when an empty cylinder is attached to a pressurized system.

12. No part of a cylinder should be subjected to a temperature higher than 52 °C (125 °F). Do not permit flame to come in contact with any part of a compressed gas cylinder.

PRINCIPLE OF OPERATION

The Series 23-550 Total Hydrocarbon Gas Analyzers is designed to continuously measure concentrations of hydrocarbons in a gas stream. Various applications include:

- Monitoring ambient air flow for low concentrations of hydrocarbons
- Measuring concentrations of explosive or toxic gases in fuel handling areas
- Measuring off-gases from various chemical processes and converters
- Testing for refrigerant leakage
- Gas manufacturer checking bulk and blended gases
- Gravure printing operation (high speed printing requires large amounts of solvent in the ink to dry the ink quickly); Government regulations require that solvent-in-air recovery operations monitor for total hydrocarbons

This manual contains operating information for Total Hydrocarbon Analyzer Models shown in TABLE 1-1. Identify your model, and disregard those portions that do not apply to your unit.

TABLE 1-1
Total Hydrocarbon Analyzer Models

Model		
115 V	**230 V**	
23-550-1	23-552-1	Total Hydrocarbon Analyzer w/ 4-20mA Converter
23-550-2	23-552-2	Total Hydrocarbon Analyzer w/ 4-20 mA Converter, and High/Low Alarm
23-550-4	23-550-4	Total Hydrocarbon Analyzer w/ 4-20 mA Converter and High Alarm
23-550-6	23-552-6	Total Hydrocarbon Analyzer w/ 4-20mA Converter and RS-232 Output

1.1 Detector

The Series 23-550 utilizes the flame ionization method of detection (FID). Ionized carbon atoms are produced when hydrocarbons are burned in the hydrogen flame. These ionized electrons formed in the flame enter a gap between two electrodes and decrease the gap resistance permitting the current to be measured by an electrometer amplifier. This current is directly proportional to the hydrocarbon concentration in the flame. A current to voltage amplifier circuit (electrometer) provides a dc voltage signal for the digital meter and potentiometric recorder.

The principle components of the detector unit are the base, the flame tip, and the collector.

1.2 Flow System

Individual pneumatic control systems are used to deliver regulated streams of air, fuel and sample to the burner. In addition, the system routes the burner exhaust gas and sample bypass flow out of the analyzer through the corresponding outlet ports.

The pressurized gases which are introduced to the FUEL, AIR and SAMPLE inlet ports are filtered, then routed to the burner through the flow system arrangement described below:

A. Adjustable pressure regulators are used internally for the AIR and FUEL to provide for controlled pressure on the downstream side. A back-pressure regulator on the SAMPLE stream provides controlled pressure at the detector. Excess SAMPLE gas is discharged through the SAMPLE BY-PASS outlet (By Pass feature allows for stable, constant, sample flow rates into the FID while providing high velocity flow through analyzer, to minimize system response time).

B. Porous metal flow restrictors on AIR, FUEL and SAMPLE lines pass the appropriate gas flow when the pressure drop is adjusted to the correct value.

C. Gauges indicate the pressure at the inlet of the corresponding restrictor.

TABLE 1-2
Pressure Gauge Ranges & Location

AIR:	0 - 60 psig	Internal
FUEL:	0 - 60 psig	Internal
SAMPLE:	0 - 5 psig	Front Panel

1.3 Electronics

A. Electrometer: Converts the picoampere signal from the FID to a voltage via a monolithic operational amplifier regulator designed to provide balanced positive and negative supply voltages. Sensitivity of the electrometer output is adjustable by a three step range switch.

B. FID Polarization Power Supply: Provides a constant 160 VDC to the flametip. This sets up an electric field which accelerates the electrons through the flametip collector gap.

C. Flame-Out Detection Circuit: A thermocouple detects the presence of the flame by monitoring the flame temperature and by the solenoid/relay driver which deactivates the solenoid valves on the fuel and sample gas lines when a flame-out condition exists.

SPECIFICATIONS

Detector

- Flame Ionization
- Sensitivity: 0.1 ppm to 1.999% full scale as CH_4 using H_2 or mixed fuel
  (Note: sensitivity decreases with the use of mixed fuel)
- Linearity: 1×10^6

Electrometer Amplifier

- Type: Solid state, FET operational amplifier employing negative feedback; Powered by a dual polarity tracking regulator designed to provide balanced positive and negative supply voltages.
- Sensitivity: 1.5×10^{-12} A
- Dynamic Range: 1×10^6
- Noise: less than 4 μV at maximum sensitivity
- Drift: less than 15 μV/°C under controlled environmental conditions
- Input Ranges: 10^{-10}, 10^{-11}, 10^{-12} A/mV

Sensitivity

	Models -1, -2, -4	Model -6 (RS-232)	
Range 1:	0 ppm to 99.99 ppm	0.0 ppm to 200.0 ppm	Display Reading 0.0 to 9999.9
Range 2:	0 ppm to 999.9 ppm	0.0 ppm to 2000.0 ppm	
Range 3:	0 ppm to 9,999 ppm	0.0 ppm to 10000.0 ppm	

Zero

- Continuously adjustable from -400 mV to 0 to + 400 mV with ten turns of control resolution.

Reproducibility

- ± 1% full scale successive samples

Electrical

- Power: Series 23-550: 115 Watts at 115 V, 60 Hz
  Series 23-552: 230 Watts at 230 V, 50 Hz
- Circuit Breaker: 1 amp
- Output:
- Digital meter, 4-1/2 digit LED (standard)
  Models with Hi/Low Alarm, 4-digit LED display
  Model “-6” with RS232, 5-digit LED display

RS232 Communication

Type: RS232 half duplex
Isolation To Sensor & User Input Commons: 500 Vrms for 1 minute
Working Voltage: 50 V. Not isolated from all other commons.
Baud Rate: 9600
Data Format: 8 bits; no parity; 1 stop

- 100 mV recorder terminal
- Hi/Low Alarm (optional)

Fuel

- 100% H_2 or standard fuel mix; 40/60% H_2/N_2 or H_2/He

Safety

- Flame out indicator
- Fuel and sample automatic shut-off in case of flame out

Mounting

- Bench top or 19” rack panel

Dimensions

W 19”
H 5 1/4”
D 16 1/2”

Weight

Net: 34 lbs.
Shipping: 48 lbs.

OPERATING CONTROLS

The operator should become thoroughly familiar with Figures 3-1 thru 3-4 and the following descriptions of the controls BEFORE continuing.

3.1 Front Panel, Series 23-550

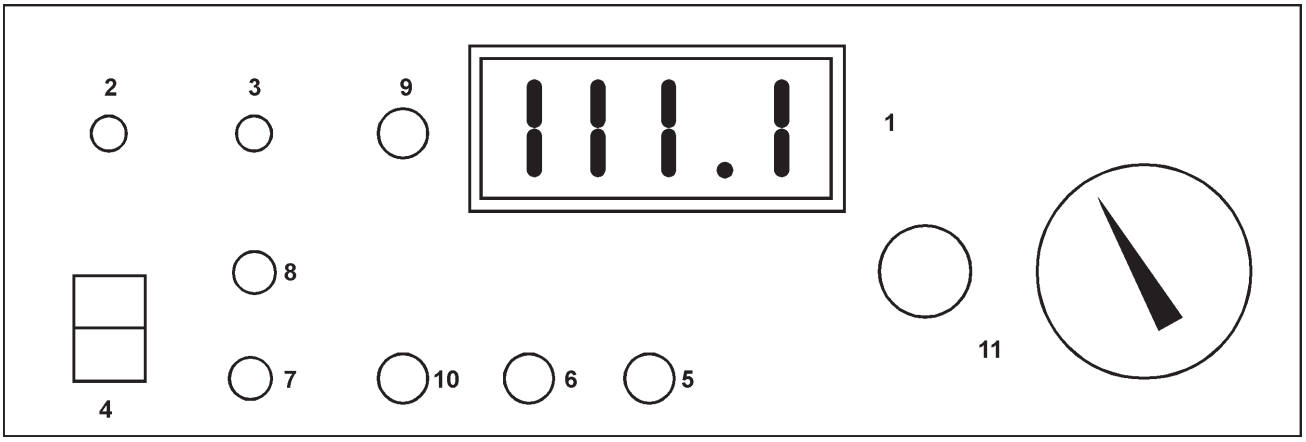

Figure 3-1
Series 23-550 Front Panel

1. ***Meter Display***: Displays sample concentrations in ppm on a 4-1/2 digit LED meter, or on a 4-digit LED Hi/Low Alarm meter,or on a 5-digit LED meter (See Section VIII, part 8.1 for Hi/Low Alarm meter description or 8.4 for RS232 meter description).

2. ***Flame Out Mode Switch***:

   a. By-Pass Mode: Overrides fail-safe circuitry thereby allowing FUEL and SAMPLE to pass through the system enabling ignition of the FID flame.

   b. Operate Mode: Activates fail-safe circuitry. To be engaged after the analyzer has stabilized. If the flame is accidentally extinguished, the “FAIL-SAFE” circuit will sense “flame-out” by an absence of ionization current, thereby deactivating the FUEL and SAMPLE solenoid valves and shutting off the FUEL and SAMPLE supply.

3. ***Ignitor Button***: Activates the glow plug in the FID, thereby igniting the flame. Also activates the Fuel Enrichment Solenoid Valve to make ignition easier.

4. ***Power "ON/OFF" Switch***: Activates or deactivates AC power to the instrument with built-in magnetic circuit breaker.

5. ***Sensitivity Range Switch***: Allows operator to choose the range of sensitivity of the detector output for specific applications.

	Models -1, -2, -4	Model -6 (RS-232)	
Range 1:	0 ppm to 99.99 ppm	0.0 ppm to 200.0 ppm	Display Reading 0.0 to 9999.9
Range 2:	0 ppm to 999.9 ppm	0.0 ppm to 2000.0 ppm	
Range 3:	0 ppm to 9,999 ppm	0.0 ppm to 10000.0 ppm	

6. ***Span Adjustment***: 10 turn potentiometer with turn counting dial configured as a voltage divider so that the user may calibrate the instrument using a known standard gas mixture.

7. ***Flame Out Indicator Light***: Illuminates when flame is not ignited.

8. ***Flame On Indicator Light***: Illuminates when the flame is on.

9. ***Fine Zero Adjustment***: Permits fine adjustment of voltage offset within the amplifier.

10. ***Coarse Zero Adjustment***: Permits coarse adjustment of voltage offset within the amplifier.

11. ***Sample Pressure Regulator and Gauge***: Adjusts/displays SAMPLE pressure drop across the SAMPLE restrictor to 0-5 psig.

3.2 Back Panel of the Model 23-550

1. ***Air Inlet Connection*** (1/8” compression fitting)
2. ***Fuel Inlet Connection*** (1/8” compression fitting)
3. ***Sample Inlet Connection*** (1/8” compression fitting)
4. ***Sample By-Pass Outlet*** (1/8” compression fitting)
5. ***FID Exhaust***
6. ***Recorder Jack: 0-100 mVDC*** except 4-20 mA in “-2” Model
7. ***Power Cord Jack***
8. ***4-20 mA Output*** (standard in “-1” & “-6” Models)

NOTE The 4-20 mA output is fixed over a single range which is selected at time or order.

9. ***High/Low Alarm Cable*** (“-2” Model)
10. ***RS232 Output*** (“-6” Model)

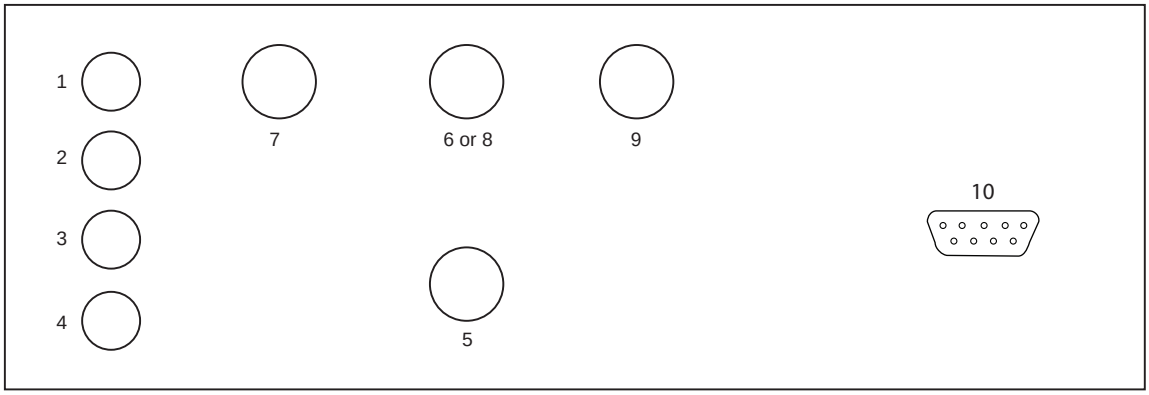

Figure 3-2
Series 23-550 Back Panel

4

INSTALLATION

The Total Hydrocarbon Analyzer needs a source of fuel and combustion air for the flame ionization detector (FID).

4.1 Additional Equipment Required

A. Combustion Gas: Air cylinder UPC or zero grade having a maximum total hydrocarbon content less than 1.0 ppm.

B. FUEL Gas: 100% hydrogen or a pre-mixed fuel mixture containing 40% hydrogen 60% nitrogen or 40% hydrogen/60% helium may be used. Whatever fuel gas is selected, be certain that the maximum total hydrocarbon content is less than 0.5 ppm. 100% hydrogen provides maximum sensitivity and the cylinder will last longer due to lower flowrate. 40%/60% hydrogen/helium provides more linear performance than 40%/60% hydrogen/nitrogen.

C. SAMPLE: Prior to using the instrument for an analysis of a sample, it is recommended that a three-way valve be installed between cylinders of known CALIBRATION gas, ZERO gas, and the SAMPLE inlet port of the analyzer. Refer to Figure 4-1. The ZERO gas should be a “zero grade” of the major component of your SAMPLE with a total hydrocarbon content less than 0.5 ppm. The CALIBRATION gas should be a mix of the SAMPLE components at about 100% to 125% of SAMPLE hydrocarbon concentration.

D. All support gases should have certificates of analysis. Regulators should have non-contaminating stainless steel diaphragms. They can be single stage with relief valves sized to protect the analyzer. Refer to Table 4-1.

Table 4-1
Inlet Gas Pressures, psig

GAS	RECOMMENDED	MAXIMUM
SAMPLE	5 - 11	50
FUEL	75	250
AIR	75	250

E. AC power source:

Model 23-550: 115 Watts at 115 V, 60 Hz
Model 23-552: 230 Watts at 220 V, 50 Hz

WARNING

OPERATING INSTRUCTIONS FOR ALL MODELS ARE THE SAME, EXCEPT FOR LINE VOLTAGE REQUIREMENTS. TO PREVENT DAMAGE TO THE INSTRUMENT, MAKE SURE THAT THE AC ELECTRICAL OUTLET IS THE CORRECT VOLTAGE FOR YOUR INSTRUMENT BEFORE PLUGGING IT INTO THE OUTLET.

F. Potentiometric recorder with 100 mV span, <1 sec. response

G. Several pieces of 1/8" stainless steel tubing cleaned as described later in this section.

4.2 Unpacking and Inspection

A. When unpacking the instrument, check it carefully for evidence of shipping damage or rough handling. Check to ensure that all components ordered have either been supplied or back-ordered.

B. Remove all plastic and/or paper shipping caps and restraints before operating.

C. Fill out and return the yellow WARRANTY-REGISTRATION card (included in this manual) to ensure that the WARRANTY will be validated and that you will be kept informed of any improvements or other items of interest.

4.3 Location

A. The Total Hydrocarbon Analyzer should be placed in a location that is secure, vibration free, and protected from abrupt temperature changes and drafts (ambient operating air temperature range should be between 20-30 °C (68-86 °F) for optimum results). Irregular changes in the instruments' location may upset the temperature stability in the course of an analysis or preparation.

WARNING

THE ANALYZER MUST *NOT* BE PLACED IN AN EXPLOSIVE OR HAZARDOUS ENVIRONMENT; OTHERWISE, AN *EXPLOSION* MAY OCCUR.

B. Enough adjacent table-top space should be allowed for the installation of recorders, integrators, etc. Allow sufficient space on all sides of the analyzer for easy access.

C. Make sure that there is adequate space for the installation of the necessary gas cylinders. Cylinders should be securely fastened to the wall or table.

WARNING

FOLLOW THE "GENERAL WARNINGS AND CAUTIONS" AND "GENERAL PRECAUTIONS FOR HANDLING AND STORING HIGH PRESSURE GAS CYLINDERS" LOCATED AT THE FRONT OF THIS MANUAL; CONTACT YOUR LOCAL GAS SUPPLIER TO ENSURE PROPER HANDLING OF CYLINDERS.

D. An electrical outlet (AC) should be near the location where the analyzer is to be installed. If the outlet is not a 3-pin type, make sure that a good ground connection is available, since a good ground is necessary for proper operation.

The AC outlet should be connected to a circuit that is not heavily loaded with other electrical equipment. Input voltage to the instrument should be steady for optimum operating stability.

If the AC line voltage varies, consideration should be given to the installation of a stabilizing transformer at the AC outlet.

NOTE

BOTH RECORDER AND TOTAL HYDROCARBON ANALYZER SHOULD BE CONNECTED TO THE SAME DUPLEX SERVICE OUTLET TO PREVENT GROUND LOOPS.

4.4 Electrical Connections

CAUTION

ALL SWITCHES SHOULD BE IN THE "OFF" POSITION BEFORE ANY ELECTRICAL CONNECTIONS ARE MADE.

A. Potentiometric Recorder Cable Connection

1. The recorder cable is connected to the 16 pin terminal strip located inside the analyzer as follows:

Terminal 12.....	green.....	4-20 mA Output (external)
Terminal 13.....	white.....	4-20 mA Output (external)
Terminal 14.....	black (-).....	Recorder Cable (external)
Terminal 15.....	red (+)	Recorder Cable (external)
Terminal 16.....	orange (GND)	Recorder Cable (external)

B. Hook up the other end of the recorder cable to the recorder, making sure to follow the color convention:

Ground.....	Silver
Negative.....	Black
Positive.....	Red

C. RS232 Connection

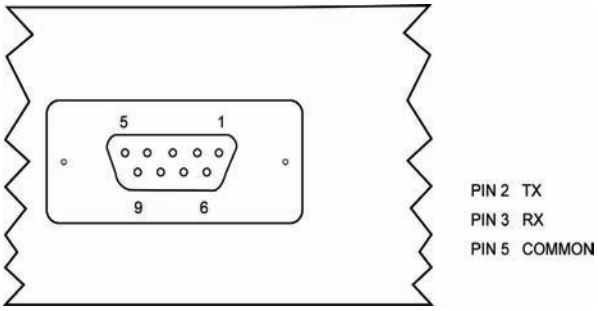

Figure 4-1: Extended Comms Connection

D. Power Cable Connection

The power cord is connected to the 16 pin terminal strip as follows:

115 Volt	Terminal 1	Ground
	Terminal 3	115 Volt neutral
	Terminal 8	115 Volt power
230 Volt	Terminal 1	Ground
	Terminal 3	230 Volt neutral
	Terminal 8	230 Volt power

4.5 Gas Connections

The use of 1/8” diameter stainless steel tubing is strongly recommended for all external gas lines. Stainless steel tubing may contain hydrocarbon contaminants which should be cleaned out as described below.

NOTE

PLASTIC TUBING IS *NOT* RECOMMENDED, SINCE ALL PLASTICS ARE PERMEABLE TO AIR.

All gas connections to the cylinder regulators and inlet ports should be made as follows:

A. Remove all protective packaging plugs and/or caps from gas INLET and OUTLET PORTS if not already done.

B. To prevent contamination of the analyzer by grease, oil, or chemical residue, the following cleaning procedure should be followed for purging tubing prior to connecting it to the analyzer:

   i. Clean tubing pieces by flushing with acceptable solvent, such as acetone, to remove any oil residue that may be present.

WARNING

CLEANING SOLVENTS ARE EXTREMELY FLAMMABLE. USE CARE WHEN USING THESE MATERIALS. *DO NOT* EXPOSE THEM TO OPEN FLAMES OR OTHER POTENTIAL IGNITION SOURCES OTHERWISE, AN *EXPLOSION* OR FIRE MAY OCCUR.

   ii. After washing, let tubing drain and dry. Apply a flow of dry nitrogen for a few minutes to aid drying.
   iii. All external tubing should be clean and free of moisture before connecting to gas cylinders and the total hydrocarbon analyzer.

C. Connect one end of the pre-cleaned tubing to the gas cylinder regulator (Figure 4-1).

D. Purge tubing with a flow of gas from the cylinder.

E. Connect the free end to the analyzer. Repeat C and D for the remaining gas connections.

F. After all connections have been made, it is important to check for leaks. Refer to Section 4.6.

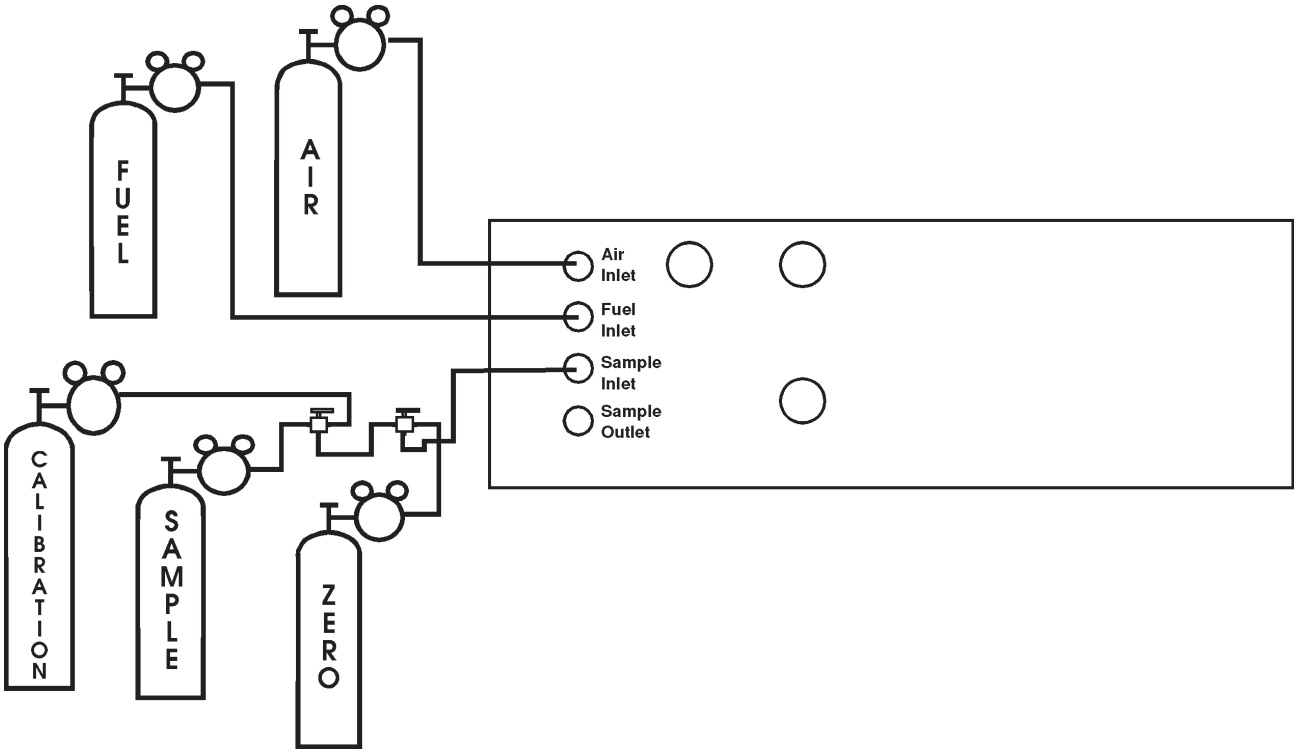

Figure 4-1
Series 23-550 Gas Cylinder Connections

4.6 Leak Testing

After all connections have been made, it is **IMPORTANT** that they be tight and free from leaks. Leaks in the system will cause baseline drift, noise, and may reduce sensitivity.

WARNING

LEAKS IN THE HYDROGEN LINE (FUEL) ARE HAZARDOUS.
HYDROGEN IS AN EXTREMELY EXPLOSIVE GAS.

The lower explosive limit (LEL) in air is 4% and the upper explosive limit (UEL) in air is 75%. When oxygen is used, the LEL remains the same but the UEL increases to 94%. **CARE MUST BE EXERCISED** in handling this gas and the system must be free of leaks.

WARNING

HYDROGEN SHOULD BE TURNED OFF AT
THE CYLINDER WHEN NOT IN USE.

The instrument should **NOT** be left unattended until the flame has been ignited and the “FLAME-OUT MODE” switch is confirmed to be in the “OPERATE” position.

This instrument has been completely leak-tested and checked out prior to shipping. It is possible, but unlikely, that leaks have developed during shipment. The most likely source of leaks will be is subsequent connections or reconnections made by the user.

NOTE

ALL CONNECTIONS SHOULD BE LEAK-TESTED, WITH THE GASES FLOWING, BEFORE THE INSTRUMENT IS OPERATED.

Each gas must be flowing to check for leaks. Use Table 4-1 to set pressures on the cylinders or the external pump (if so equipped). The use of soap or other organic substances to check for leaks **IS NOT** recommended. They will contaminate the system. The easiest way to locate leaks in the system is with either the GOW-MAC Model 21-050 Mini Gas Leak Detector or the Model 21-250 Gas Leak Detector.

NOTE

LEAK CHECKS SHOULD BE RUN PERIODICALLY AND ARE A *MUST* WHEN NEW TUBING AND FITTINGS ARE INSTALLED.

WARNING

DO NOT ATTEMPT TO PRESSURIZE THE SYSTEM BY PLUGGING OFF THE EXHAUST PORT ON THE FID. THE FID IS NOT GAS TIGHT UNDER PRESSURE.

INITIAL START-UP PROCEDURE

5.1 Start-up Procedure When Using 100% Hydrogen For Fuel

A. Make the necessary AIR, FUEL, and SAMPLE gas connections to the respective bulkhead fittings on the rear of the analyzer. Refer to Section 4.5, “Gas Connections”.

B. The gas regulators on the cylinders for the AIR and FUEL are to be set to approximately 75 psig.

C. Gas regulators on ZERO, SAMPLE, and CALIBRATION gases should be set to approximately 10 psig. (These gases are connected to the SAMPLE INLET by using a 3-way valve and toggle valves in a manifold arrangement. See Figure 4-1or 4-2. Set 3-way valve so that ZERO GAS will enter the analyzer.

D. Turn Power “ON” and allow about 30 minutes for detector warm up. It is easier to ignite the flame in a hot detector.

E. In order to set fuel and sample pressures and light the flame, hold the “FLAME OUT MODE” switch in the “BY-PASS” position. This will allow the fuel and sample to flow into the system.

F. The FUEL and AIR flows are preset a the factory to your specified fuel and should not need adjustment.

WARNING

TO AVOID EXPLOSION, CONTROL PRESSURE WITHIN THE MAXIMUM RECOMMENDED FUEL PRESSURE. IGNITE FLAME PROMPTLY. KEEP CASE VENTS CLEAR.

G. Set the SAMPLE Regulator on the instrument to obtain 2.0 psi.

H. Allow five to ten seconds for fuel and air to fill the detector, then press the IGNITOR button to light the flame. Ignition is indicated by an audible “pop”, deflections on the digital meter and chart recorder, water vapor exiting the FID exhaust (indicates hydrogen burning in air), and change from red FLAME OUT light to amber FLAME ON light.

I. The FLAME OUT OPERATE-BYPASS switch may be released to the OPERATE mode upon illumination of the amber FLAME ON light.

J. Use the following procedure in case the FID fails to ignite: Press and hold the IGNITOR button for two to three seconds at intervals of five to ten seconds. Check fuel, air, and sample pressures.

CAUTION

TAPERS, PAPERS, OR MATCHES SHOULD NOT BE INSERTED INTO THE EXHAUST. THEY WILL EXTINGUISH THE FLAME IF IGNITED.

5.2 Instrument Zeroing

After the initial start-up has been completed and the flame is lit, set the Range and zero the instrument.

A. Refer to Table 5-1 for range designations and set RANGE switch accordingly. THE ANALYZER REQUIRES RE-ZEROING UPON CHANGE OF RANGE. I

Table 5-1
Range Designations

	Models -1, -2, -4	Model -6 (RS-232)	
Range 1:	0 ppm to 99.99 ppm	0.0 ppm to 200.0 ppm	Display Reading 0.0 to 9999.9
Range 2:	0 ppm to 999.9 ppm	0.0 ppm to 2000.0 ppm	
Range 3:	0 ppm to 9,999 ppm	0.0 ppm to 10000.0 ppm	

B. Make sure that the ZERO GAS is flowing in the SAMPLE INLET.

C. Allow the analyzer to warm-up until the meter display stabilizes.

D. Use the COARSE and FINE ZERO controls to zero the digital meter.

E. If a recorder is being used, zero it at this time.

5.3 Instrument Calibration

A. Introduce known CALIBRATION GAS into the SAMPLE INLET via a 3-way valve or manifold (Fig. 4-1). The valving should allow for selection of CALIBRATION GAS, ZERO GAS, and SAMPLE GAS.

B. Adjust SPAN CONTROL so the meter displays the CALIBRATION GAS hydrocarbon concentration. LOCK the control.

C. The recorder output has been adjusted at the factory for a 0 - 100 mV full scale output. Contact GOW-MAC Instrument Co. if adjustment is necessary.

D. Introduce the ZERO GAS into the system.

E. Meter and recorder should return to zero references.

F. REPEAT steps A-D to verify readings.

5.4 Shut Down Procedure

A. Turn the SAMPLE regulator so gauge fall to zero. Close the valve on the FUEL cylinder. The amber “FLAME ON” indicator light should go off and the red “FLAME OUT” indicator should illuminate.

B. Turn “POWER” switch “OFF”.

C. Turn recorder “OFF”.

D. Close valves on support gas cylinders.

WARNING

ALWAYS SHUT FUEL GAS OFF BEFORE TURNING THE AIR FLOW OFF.

6

GENERAL OPERATION

6.1 Notes on Flame Operation in FID Instruments

A. At start-up, some operators use a much higher FUEL flow to ensure ignition. THIS IS A DANGEROUS PROCEDURE AND **IS NOT NECESSARY** WITH THIS INSTRUMENT.

B. Improper Ignition: Upon ignition, if excessive FUEL is present, the flame will burn above the collector rather than on the flame tip. This will be evidenced by lack of response and/or sensitivity of the instrument, even through the flame appears to be burning. Allow the flame to go out by shutting off the fuel and reignite. An upscale deflection of the meter will indicate flame ignition.

C. If a flame out failure occurs due to a depletion of the AIR supply, it is important that the FUEL be turned off for 10-15 minutes before reigniting the flame. The FID is not gas tight so allow time for the hydrogen to vent from the case.

WARNING

DO NOT PERMIT FUEL TO ACCUMULATE IN THE INSTRUMENT. AN EXPLOSION MAY OCCUR. KEEP CASE VENTS CLEAR.

6.2 Routine Operation

After the instrument has been calibrated as per Section 5, proceed as follows:

A. Supply the SAMPLE gas to the SAMPLE INLET. Adjust the SAMPLE back pressure regulator to obtain the recommended pressure.

Refer to Table 6-1 and Chart 6-1.

B. Adjust the RANGE switch to the desired position. The METER and RECORDER (if connected) will now and continuously read the hydrocarbon content of the sample.

NOTE

READINGS ACQUIRED DURING OPERATION ARE DEPENDENT UPON THE TYPE AND CONCENTRATION OF HYDROCARBONS IN THE SAMPLE.

6.3 Calibration Frequency

The Total Hydrocarbon Analyzer requires calibration under the following conditions:

- After initial start-up
- After prolonged shutdowns
- Daily calibrating is recommended. Thereafter, frequency can be reduced as experience and application requirements dictate.

6.4 Flame Out Circuit

The FLAME OUT CIRCUIT detects the presence of the ionization current flow (only present when flame is lit). When the ionization current is not present (FLAME OUT), the circuit automatically deactivates two solenoid valves; one to shut off the SAMPLE IN and the other to shut off the FUEL.

6.5 Maximum Sensitivity

To acquire maximum sensitivity, it is necessary to find the optimum combination of settings on the SAMPLE, FUEL, and AIR pressure regulators. Settings must be experimentally determined. Determine the response at a given FUEL pressure from the difference between the CALIBRATION gas response and the ZERO gas response. Incrementally adjust the FUEL pressure over the recommended range. Record the CALIBRATION and ZERO response at each FUEL pressure setting. A plot of the difference between the CALIBRATION and ZERO response versus FUEL pressure will be a curve similar to Figure 6-1.

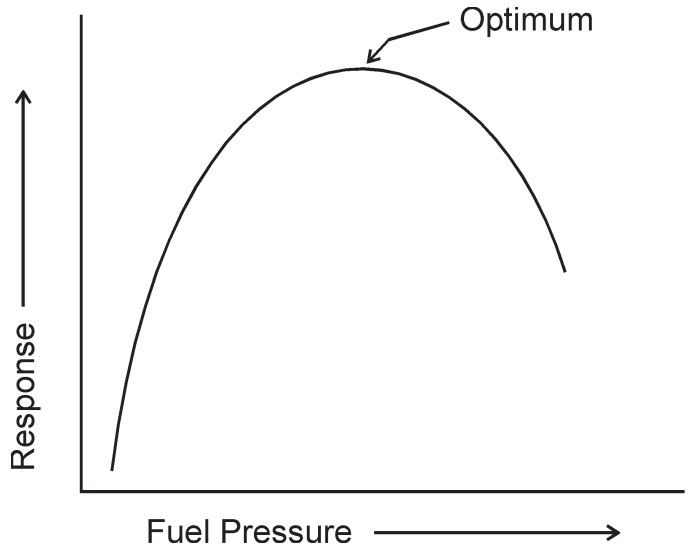

Figure 6-1
Response vs. Fuel Pressure

Table 6-1
Pressure Settings, psig

Fuel	FID Gas	Sample Gas						
		Oxygen	**Nitrogen**	**Argon**	**Hydrogen**	**Helium**	**Air**	**Carbon Dioxide**
100% H_2	Fuel (Note 1)	Use fuel mix for oxygen sample	10	11	0	12	11	11
	Air		23	23	23	20	23	23
	Sample		1.0	1.4	0.7	1.2	1.5	1.5
40/60% H_2/He	Fuel (Note 1)	21	21	21	18	18	20	20
	Air	12	22	22	23	22	22	22
	Sample	1.1	1.0	1.4	0.5	1.2	1.1	1.1
40/60% H_2/N_2	Fuel (Note 2)	23	24	24	22	23	23	23
	Air	12	22	22	23	22	22	22
	Sample	1.0	0.9	1.1	0.5	0.8	1.1	1.1

Note 1: With 100% hydrogen fuel tee installed
Note 2: WIth fuel mix tee installed

7
MAINTENANCE & SERVICE

7.1 FID Cleaning & Servicing

NO ATTEMPT should be made to take the FID apart for repair or cleaning.

Call our Repair Department at (610) 954-9000 to receive estimate for cleaning or repair, as well as an RMA number to send the detector back to us.

Display the RMA number on your shipping label to insure prompt attention upon arrival at GOW-MAC.

GOW-MAC Instrument Co.
Attn: Repair Dept, RMA# _____
277 Brodhead Road
Bethlehem, PA 18017-8600

Please include a contact person, phone number, service required and a P.O. number. We are also able to furnish an estimate prior to repairs if this is required.

8
OPTIONS

The Total Hydrocarbon Analyzers are available with the following options:

8.1 4-Digit Digital Meter w/ High/Low Setpoint Controller Board

The meter features two internal electromechanical-relays controlled by HI/LO setpoint adjustments accessible through the front lens. These setpoints, adjustable with a screwdriver, can be used for limit alarm functions, ON/OFF control, two-position differential control, three-position control and limit-cycle control.

The setpoints on the meter are adjustable over the entire -9999 to +9999 display range. The HI setpoint may be changed to the lower setpoint allowing adjustment in the range between the selected LO setpoint and the HI setpoint. Either setpoint may be displayed by pressing the LO or HI Setpoint Push Button Switch on the front panel.

As shipped, both relays are de-energized when the input value is between the LO and HI setpoints. When the input value falls below the LO setpoint, the LO relay energizes. When the input rises above the HI setpoint, the HI relay energizes.

Red “LO” and “HI” lamps on the front panel light when their respective relays are energized. A six wire cable on the rear panel of the instrument contains the alarm signals. The color code for the alarms are as follows:

BLACK.....	Low Alarm, normally open
BROWN.....	Low Alarm, normally closed
RED.....	Common (low)
ORANGE.....	High Alarm, normally open
YELLOW.....	High Alarm, normally closed
GREEN.....	Common (high)

8.2 Sample Pump (external)

A. Features

- Contamination - free pumping of gas via reciprocating diaphragm
- Available head materials: polypropylene, polycarbonate, aluminum, stainless steel, Hastelloy
- Available diaphragm materials: Neoprene®, Teflon®, Viton®

B. Installation

Attach the sample pump to the SAMPLE INLET on the total hydrocarbon analyzer by using Teflon® tubing, or clean copper or stainless steel tubing. See Section 4.5.

8.3 Voltage to Current Converter, 4-20 mA

The Voltage to Current Converter has been specifically designed for high accuracy applications in process control and monitoring systems. It offers complete galvanic isolation and protection against damage from transients and fault voltages in transmitting information between sub-systems or separate system elements.

The unit is a high performance, compact voltage to current converter offering 1500 volt DC input to output isolation in interfacing standard process signals. The isolated output current range is 4 to 20 milliamps which is capable of delivering rated current to an external 0-1000 ohm grounded or floating load.

In the industrial environment, the converter can serve as a transmission link between such system elements as transmitters, indicators, controllers, recorders, computers, actuators, and signal conditioners.

The 4 - 20 mA cable connection is to be made to the 16 pin terminal strip located inside the analyzer back panel in the following manner:

For “-1” and “-2” Models:

Terminal 13	Positive
Terminal 12.....	Negative
Terminal 16.....	Ground

Connect the other end of the cable according to the following color convention:

Silver	Ground
Black.....	Negative
Red.....	Positive

NOTE

THE 4 - 20 mA INPUT DEVICE LOAD IS NOT TO EXCEED 500 Ω.

8.4 Meter, 5-digit LED (Model “-6” with RS232 Output)

A. Factory Service Operations - “Parameter Key”

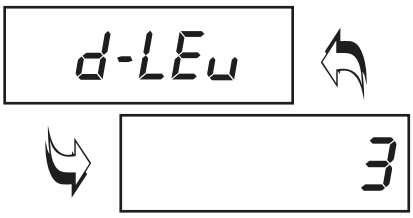

Figure 8-1: Display Intensity Level

Enter the desired Display Intensity Level (0-15) by using the arrow keys. The display will actively dim or brighten as the levels are changed.

Note: If “CODE” is displayed, press “PAR” to end.

B. RS232 Communication

1. Specifications

Type: RS232 half duplex
Isolation To Sensor & User Input Commons: 500 Vrms for 1 minute
Working Voltage: 50 V. Not isolated from all other commons.
Baud Rate: 9600
Data Format: 8 bits; no parity; 1 stop

2. Wiring Connections

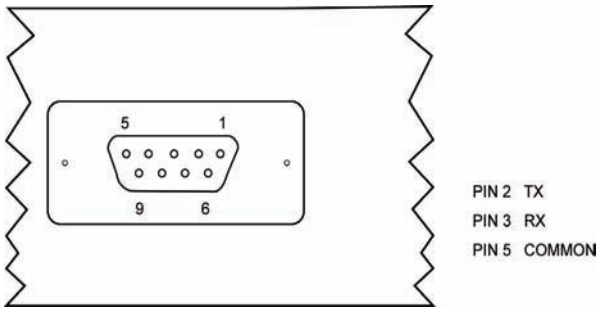

Figure 8-2: Extended Comms Connection

Some devices cannot accept more than two or three characters in succession without a pause in between. In these cases, the instrument employs a busy function.

As the instrument begins to transmit data, the RXD line (RS232) is monitored to determine if the receiving device is “busy”. The receiving device asserts that it is busy by setting the RXD line into a space condition (logic 0). The instrument then suspends transmission until the RXD line is released by the receiving device.

3. Receiving Data

Data Block Format (14 bytes)	
Byte	**Description**
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> carriage return
14	<LF> line feed

4. Communication Format

Data is transferred from the instrument through a serial communication channel. In serial communications, the voltage is switched between an high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

The voltage level conventions depend upon the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485
1	mark (idle)	TXD, RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD, RXD; +3 to +15 V	a-b > +200 mA
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is “framed” with a beginning start bit, an optional error detection parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures lists the data formats employed by the instrument.

Start Bit and Data Bit

Data transmission always begins with the *start bit*. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted. Since the sending and receiving devices operate at the same

transmission speed (baud rate), the data is read without timing errors.

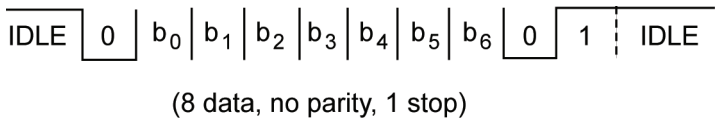

Figure 8-3: Character Frame

Parity Bit

After the data bits, the *parity bit* is sent. The transmitter set the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The instrument ignores the parity bit of incoming data and sets the parity bit to none (mark parity) for outgoing data.

Stop Bit

The last character transmitted is the *stop bit*. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit.

TROUBLESHOOTING

PROBLEM	CAUSE	REMEDY
Burner will not ignite	Fuel gas emerging. FLAME TIP diluted with other gases because fuel system insufficiently purged	Purge FUEL pressure regulator by allowing gas to flow for several minutes.
	AIR and/or FUEL pressure regulator improperly adjusted	Check readings on AIR & FUEL pressure gauges.
	No flow, or reduced flow, of FUEL and/or AIR into burner	Blockage in FUEL and/or AIR passage in burner jet, combustion chamber restrictor, etc. Find cause of blockage and remove. Adjust flows.
	Ignitor circuit malfunction	Activate IGNITOR button. Ignitor wire should glow orange. If not, check the following:
	a. ignitor leads improperly connected	Check ignition wires for proper contact at terminal and plug.
	b. ignitor assembly burned out	Call GOW-MAC.
	c. transformer circuit open	Check voltage.
	d. IGNITOR button defective	Call GOW-MAC.

PROBLEM	CAUSE	REMEDY
Sample pressure fluctuation	Valve in sample pump malfunctioning	Examine valve. Replace valve.
	Obstruction in by-pass outlet.	Examine by-pass outlet. Remove obstruction.
Noise	Contamination of flow system. FUEL and AIR supplies, external pressurere regulators, connecting tubing	Replace FUEL and/or AIR supply; clean or place tubing & regulators.
No output	Electrical connection malfunction. Detector flame out	Check connections. Ignite flame. Check FUEL and/or AIR flow. Check for plugged FLAME TIP. Call GOW-MAC.
	Recorder not properly connected. Recorder defective.	Check recorder connections. See recorder manual for troubleshooting procedure.
Poor sensitivity	Sensitivity range too low or attenuation too high	Adjust span control for correct sensitivity and change electrometer RANGE switch if necessary.
	Insufficient sample	Increase sample flow rate.
	FUEL or AIR flow rate incorrect	Adjust flow rate.
	Obstruction in FLAME TIP or incorrect FLAME TIP orifice	Call GOW-MAC.
Negative output signal	Recorder leads reversed	Check recorder connections.

PROBLEM	CAUSE	REMEDY
Irregular baseline drift	Poor instrument location	Move instrument to a location where it is not subject to drafts and/or ambient air changes.
	Instrument not grounded	Make sure instrument and recorder are connected to a good earth ground.
	Recorder defective	See recorder manual.
	Detector base contaminated	Call GOW-MAC.
	Leaks in system	Locate & correct leak
	Poor FUEL and/or AIR regulator	Check FUEL and AIR supplies. Check gas regulators to ensure proper operation.
Short spikes or peaks at regular intervals	Condensation in lines causing gases to bubble through	Heat gas lines.
High background noise	Contaminated detector	Call GOW-MAC.
	Water condensation inside FID	Detector heater defective, replace.
	Defective FLAME TIP	Call GOW-MAC.
	Defective recorder	Check recorder manual.
	Recorder slideware dirty	Clean recorder slideware per recorder manual.
	AIR and/or FUEL flow rate(s) incorrect	Adjust flow rates to proper levels.
	Leak(s) in system	Locate & correct leak(s)
	Bad ground connection	Make sure all instruments are connected to a good earth ground.

PROBLEM	CAUSE	REMEDY
	Electronic circuiting defective	Consult GOW-MAC SERVICE DEPARTMENT
Constant, upward baseline drif	Leak in FID base	Call GOW-MAC.
Baseline cannot be zeroed	Adjustable zero on recorder not properly set	Adjust ZERO on recorder.
	Recorder improperly connected	Check recorder connections. Remove any connections between recorder inputs and ground or shield
	Recorder defective	See recorder manual.
Sharp spiking at irregular intervals	Quick atmospheric pressure changes from opening & closing doors, blowers, etc.	Relocate instrument to minimize problem. **DO NOT** locate under heating or air conditioning blowers.
	Dust particles or other foreign material being burned in flame	Keep detector chamber free of dust particles.
FID Only-Sudden drop-off of otherwise normal signal output. Recorder pen returns to level below previous baseline. FID flame becomes extinguished.	Sample size too large	Reduce sample size. Reignite flame.
	FLAME TIP orifice too small	Call GOW-MAC.
	FLAME TIP plugged	Call GOW-MAC.
	Loss of AIR/FUEL	Check FUEL/AIR supplies. Re-establish proper flow rates.
FLAME ON indication exists while flame is out	The flame out circuit threshold voltage is low compared to the FID voltage.	Consult GOW-MAC Service Department.

10
REPLACEMENT PARTS

Electrometer Amplifier PCB	123-147-3
Electrometer Power Supply PCB	123-148
Polarization Power Supply	123-121
Flame-out Detection with Thermocouple PCB	123-302
Transformer (Ignitor)	118-112
Switch, rotary	120-127
Switch, circuit breaker/illuminated (1 amp)	120-166
Switch, toggle (Flame-out)	120-185
Switch, momentary (Ignitor)	120-206
Proportional Controller (120 VAC)	124-201
Proportional Controller (240 VAC)	124-202
Cord Set, 8’ grey	127-131
Panel Indicator, red neon	127-329
Panel Indicator, amber neon	127-375
Knob, range	127-325
Turn Counting Dial (Span & Zero)	127-497
Meter, 4 1/2 Digit LED, 120 VAC (23-550-1)	128-159
Meter, 4 Digit LED w/ Hi/Lo Alarms & 4 - 20 mA, 120 VAC (23-550-2)	128-228
Meter, 4 Digit LED w/High Alarm, 120 VAC (23-550-4)	128-195
Meter, 5 Digit LED w/ 4-20 mA & RS232, 120 VAC (23-550-6)	128-124
Gauge, 0-5 psi (Sample)	128-160
Gauge, 0-60 psi (Air & Fuel)	128-202
Back-pressure Regulator, lo temp.	180-603
Pressure Regulator, 0-60 psi (Air & Fuel)	180-639
Solenoid Valve, 120 VAC	180-850
Solenoid Valve, 240 VAC	180-851
Heater, 60 Watts, 120 VAC	124-152
Heater, 60 Watts, 240 VAC	124-153
Heater, 30 Watts, 120 VAC	124-234
Heater, 30 Watts, 240 VAC	124-235
Flame Ionization Detector (FID), standard	12-550-F
Flow Restrictor, 1/8 (10 scc)	181-601-10
Flow Restrictor, 1/8 (100 scc)	181-601-100
Flow Restrictor, 1/8 (25 scc)	181-601-25
Flow Restrictor, 1/8 (50 scc)	181-601-50
Flow Restrictor, 1/8 (500 scc)	181-601-500
Flow Restrictor, 1/4 (1K scc)	181-602-1K
Flow Restrictor, 1/4 (500 scc)	181-602-500

11
DRAWINGS

Model 23-550-1

Flow Diagram	B-18220
Detector	B-20556
Wiring Schematic, 115 V	C-18605
Wiring Schematic, 230 V	C-20012

Model 23-550-2

Flow Diagram	B-18220
Detector	B-20556
Wiring Schematic, 115 V	C-18589
Wiring Schematic, 230 V	C-19516

Model 23-550-4

Flow Diagram	B-18220
Detector	B-20556
Wiring Schematic, 115 V	_____
Wiring Schematic, 230 V	_____

Model 23-550-6

Flow Diagram	B-18220
Detector	B-20556
Wiring Schematic, 115 V	_____
Wiring Schematic, 230 V	C-20713

Health And Safety Declaration for the Return of GOW-MAC Instrument Co. Equipment

In order to protect our employees from exposure to various hazards, the following statements and or questions **MUST** be answered. This document **MUST** be filled out and returned to GOW-MAC Instrument Co. before the instrument and or device / part can be accepted into GOW-MAC Instrument Co.'s repair and service facility. After the instrument and or device / part have been approved for return, an acknowledgement will be promptly issued with notification of the procedure for return.

If this form is not accepted or submitted the instrument and or device will not be allowed into the facility and or serviced.

Record the Following:

Return Authorization No: _____

Model # / Part #: _____

Serial #: _____

Service Technician spoken to: _____

Date: _____

Is there the possibility of internal or external contamination on this instrument and or device from any of the following?
Please check the appropriate box.

- ❑ Blood, Body Fluids, (e.g. Urine, Secretions), Pathological Specimens
- ❑ Infectious Substances or other Bio-Agents (e.g. Protein, Enzymes, Antibodies)
- ❑ Regulated Medical Wastes
- ❑ Radioactive Isotopes used in the area. Detail type (ECD, Isotopic Labels, etc) and Activity in Micro Curies
- ❑ Chemicals Or Substances That Are Hazardous To Health
- ❑ Biodegradable Material That Could Become Hazardous
- ❑ Other Hazards _____

If any of the above boxes are checked the following statements and or questions must be answered.

1. Specifically describe where (on or an) the instrument, device / part there might be any residual contamination (for example, blood spill on the surface). _____
   _____

2. Provide details of these hazards. Include names, Material Safety Data Sheets (MSDS), and concentration of contaminants, where possible. _____
   _____

3. Describe the method of decontamination used. **Attach Procedure.** _____
   _____

I declare that the above information is true and complete to the best of my knowledge and belief.

Authorized signature _____ Date: _____

Name (Printed)_____ Phone Number: _____

Company Name: _____ Fax Number: _____

Shipping Address: _____

City: _____ State/Country: _____ Zip: _____

All applicable regulations should be followed when returning instrumentation, devices and or parts.

Fax this form back to: (610) 954-0599 or
e-mail this form to: repairs@gow-mac.com

For GOW-MAC Use Only: Signed: _____ Date ___/___/___

- ❑ **Passed** Safety Inspection. OK to proceed to Repair Dept. Chem. Sfty Off. Comments: ( ) None
- ❑ **Failed** Safety Inspection. DO NOT proceed to Repair Dept. ( ) On Back >>>>>

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