

*Additional operating instructions and/or information for your **Hydrocarbon Analysis System***

The instruction manual included with your analysis system from Teledyne Electronic Technologies/Analytical Instruments (TET/AI) describes the standard features of the system. It is as accurate as possible in describing the standard theory, operation, maintenance and calibration. Refer to the manual for information regarding all standard features of the model that you have selected.

In addition, your specific system has been designed according to the needs that you specified at the time of purchase. The information contained in this addendum addresses those needs and supersedes any conflicting instructions and descriptions in the standard instruction manual.

NOTE: *All drawings that relate to your system are included in the drawing package at the rear of this manual.*

Overview

Your Model 402REU Hydrocarbon (HC) Analyzer functions as is described in this manual. However, modification have been made and is discussed below.

Area Classification/Enclosure

The Model 402REU Analyzer - Special Stripper System for analysis of VCM in water is mounted in X-Purged NEMA-4W enclosure along with metal Bellows pump. The enclosure is suitable for operation in Class I, Division 1 & 2, Groups B, C and D hazardous locations. For instructions on X-Purge System, please refer to

NOTE: *This equipment is suitable for Class I, Division 2, but not certified to Class I, Division 1 & 2.*

Power Requirements

This instrument operates from a power source of 110VAC @ 60Hz.

Addendum for Model 402REU Hydrocarbon Analysis System

Analysis Range

The 402REU has analysis ranges of 0-10ppm, 0-100ppm VCM in water, when 402R is calibrated as Methane equivalents.

Signal Output

This instrument generates a dual output signal proportional to the HC concentration in the sample (in the selected analysis range). The outputs are 4–20 mA DC (isolated) and 0-1VDC.

Alarm Configuration

This instrument is equipped with two high concentration alarms, both fail-safe. Each alarm has a separate relay with two sets of form "C" contacts rated for 3 amperes resistive load at 120 VAC. The high alarm relays are energized below an operator defined setpoint. When the HC concentration rises above the setpoint, the relays de-energize in an alarm condition.

Sample Selector Module

Your analyzer is equipped with an optional sample selector module that allows you to switch between sample and calibration gases. The module also has a bypass flow valve and flowmeter for controlling the flow through the fast bypass loop. (See Figure 2-1 in this document.)

Addendum for Model 402REU Hydrocarbon Analysis System

MODEL SAMPLE PRE-CONDITIONER

SPECIFICATIONS:

RANGES:	ANALOG METER:	0-10 PPM up to 0.1% HYD gases typical 0-1 PPM up to 0-10 % liquids typical (minimum full scale varies per component and solvent background composition) - X1 to X10 maximum dynamic range - other components and ranges: inquire factory per application
	DIGITAL METER:	SAME AS ABOVE
SENSITIVITY:		better than 100 ppb for most organics (FID)
DETECTOR TYPES:	FID, flame ionization	All Hydrocarbons
	IR, infrared	All IR absorbing gases Specific for hydrocarbon types and example of other components: CO, CO ₂ , NO, NH ₃ , etc. in liquids
	UV, ultraviolet	All UV absorbing gases example of other components: H ₂ S in fuel or natural gas, Cl ₂ /EDC, NH ₃ in liquids or gases
RESPONSE TIME:		FID + 1110 system: 90 % in under 3 minutes: Analyzer: Sample cell volume and/or detector design dependent (path length varies per application, pressure, bypass flow, etc.)
OPERATING TEMPERATURE:		40 to 120 °F (5 to 50 °C), non freezing, single phase
STABILITY:		± 2 % of full scale @ constant temperature
REPEATABILITY:		± 2.0 % or better of full scale
ANALYZER OUTPUT:		0-1v or 4-20 ma isolated current standard
POWER REQUIREMENT:		110/220 vac, 50/60 Hz, specified at time of order
ANALYZER ENCLOSURES:		panel/rack or painted steel as N4F analysis enclosures with General Purpose panel mount control unit or Class I, Division II, Group B, C or D Explosion Proof integral analysis and readout enclosures or with X or Z-purging as appropriate
OPTIONS:		
	ALARM OUTPUT:	per specific analyzer specification
	COMMUNICATION:	per specific analyzer specification

Addendum for Model 402REU Hydrocarbon Analysis System

<u>SPECIFICATION</u>	<u>PARAMETER/TOLERANCE</u>	<u>METHOD OF COMPLIANCE</u>
Ranges: 402REU General Purpose	0-10 to 0-1000ppm Total Hydrocarbon (THC) or	gas and/or liquid test
Analog meter, triple range attenuator	calibrated as application dependent HYD.	
Division I to General purpose	Hydrocarbon equivalent (standard is usually	
402REU, X-purged versions	Methane equivalent)	gas and/or liquid test
FID, (flame ionization detection)	0-10, 0-100, 0-1000 ppm methane equiv std.	
Output:	0-5 mVDC std, others available	electrical test
Accuracy: GAS phase	±2% full scale (fs) per single HYD gas mixture	gas tested, minimum 24 hrs
Accuracy: Liquid phase, stripping	±5% full scale (fs) per single HYD liquid mixture	Liquid tested, minimum 24 hrs
Flow rate: Gas phase	100-400 ccm sample, 40-50 ccm fuel	qualification tested, not tested
Flow rate: Liquid analysis	10-200 ccm stripped, dried, then gas analyzed	Gas/liquid tested
Stability: Gas phase	≤ 1% fs in 24 hours (most applications)	qualification tested on gas, minimum 24 hrs
Stability: Liquid phase	≤ 2% fs in 24 hours (most applications)	qualification tested on gas, minimum 24 hrs
Noise:	≤ ±0.5% fs	recorded from gas test
Response time: Gas phase	Analysis= ≤ 1 minute for 90% full scale deflec	Engineering analysis, not tested
Liquid Phase at 100ccm	Analysis= ≤ 5 minutes for 90% full scale deflec	qualification tested for the liquid/gas system
Liquid analysis by stripping HYD from H2O		
Operating temperature range:	5-43 °C (40-100 °F)	qualification tested from initial design
Power:	140 watts, 115 VAC, 60Hz single phase, Others available	Engineering design
System leak check (on noncritical components)	He leak test if toxic/flammable gases to 10 ⁻⁵ torr	gas test using Helium or Nitrogen
	panel or rack	for low pressure applications use bubble test
Mounting:		
Dimensions:	8.75 in HT x 19.0 in W x 15.5 in D	
	222 mm x 483 mm x 394 mm	
ADDENDUM:		
System accuracy from pressure	±1% adder due to the Pressure regulator	Vendor specified, Eng design

CUSTOMER MUST REFER TO FEASIBILITY CAVEATS FOR ANY SAMPLE CONDITIONING, CALIBRATION OR INTERFERENCES

CUSTOMER MUST PROVIDE A SAMPLE IN SINGLE PHASE, BELOW 45 °C (NON-FREEZING), ≤100PSIG, AND PARTICULATE FREE.

SAMPLE PRE-CONDITIONER

for Hydrocarbons in water analysis

Introduction:

We all know how important Oil in water analysis has become with the increasing concern of our environment. To supplement our 660 oil in water technology, a very flexible approach to measuring many different contaminants in water has been developed here at Teledyne Analytical Instruments. Besides crude oil sources containing aromatics, our sample preconditioning system can now remove many classes of hydrocarbons that are dissolved in water and present them usually in concentrated form to our 402REU FID total hydrocarbon analyzer with ppb sensitivities. Indeed, our analytical approach lends itself to more specificity when we incorporate other specific Teledyne detections systems (IR, UV, TC, etc.) with the stripped analyte vapors. Keep in mind, the analyte(s) do not have to be hydrocarbons, but other water contaminating compounds of interest such as: CO, NH₃, CO₂, SO₂, NO, Cl₂, H₂S, CS₂, CCL₄, to name a few.

Hydrocarbon analysis:

Detection of contaminants in water remains important both because of the economics involved (contaminants usually are costly chemicals lost or environmental pollutants) as well as environmental requirements which are becoming more stricter. There are many parameters of interest; PH, conductivity, temperature, dissolved oxygen, suspended solids, to name only a few. Of primary value is the ability to detect and identify when possible specific water pollutants, particularly for the case of hydrocarbons in water are present.

There are related analytical methods which could apply to this type of water measurements that cannot be covered in this brief presentation: (Total carbon analyzers (TCA's), total organic carbon analyzers (TOCA'S), chemical oxygen demand (COD), biological oxygen demand (BOD) and total oxygen demand (TOD) to name a few.

For dirty waters and salt waters, high sensitivity is desired and the measuring solution has not been so easy. Early applications using Gas Chromatographs (GC's) were hampered by the sampling trains, microliter injection and the water vapor interference in the GC columns causing long semi - continuous analysis cycle times. Particulate plugging, column overloading and low sensitivities often resulted. An early attempt to overcome the deficiencies of the various systems was discussed by Hill.

In the Teledyne approach using the model 1110 Pre-Conditioner, with the 402REU FID total hydrocarbon analyzer continuous on-line analysis is obtained with 10 to 1000 times increase in sensitivity (down to ppb), specificity to hydrocarbons only, high particulate discrimination without fear of plugging (can handle up to 100 micron particulate sizes) and has a high system response typical less than 3 minutes with a fast flow loop built-into the sampling train inlet.

System Piping:

The flow diagram here depicts the flexibility and capability of the Model 1110 pre-conditioner. The water sample enters the system containing dissolved compounds of interest. Water flow rates are: bypass flow = 2 to 30 Gallons per Hour (but can be designed for more depending upon the takeoff distance); sample flow = 10 to 200 ml/minute through the stripper. A Stripper gas usually Nitrogen (N₂) also flows into a Teflon or metal column in a countercurrent direction through a fine sintered sparger (this gives a high surface contact between gas and liquid) of the incoming water sample. The N₂ residence time is maximized up through the column to pull the hydrocarbons out of the

Addendum for Model 402REU Hydrocarbon Analysis System

Sampling schemes:

Water/solvent applications:

The pre-conditioner in front of the instrument is designed to accommodate many types of water samples from many sources: wastewater, drinking water, cooling water, boiler condensate, sea water, plant water, feedwater, offshore effluent, and even other types of solvents if necessary, since the stripper is made of corrosion resistant teflon materials where desired (applications like chlorine (CL2) in EDC are also possible using monel and/or hastelloy C materials); wherein the stripped N2 or air is delivered to another specific Teledyne instrument for chlorine analysis (UV analyzer).

Fuel gas/Natural gas applications:

The pre-conditioner when used in the reverse mode can scrub process gases into the liquid phase (most commonly water) for analysis. A good example of this is 0-1ppm up to 2% H2S in fuel or natural gas. Clean H2S free plant water made basic (5 times excess using ammonia gas) converts in the pre-conditioner the trace ppm H2S in the process gas to ammonium sulfide (NH4)2S in the liquid phase. The analysis of the water is 36 times more sensitive in the liquid than in the gas for the same concentration. Also, the aromatic, mercaptan, olefin and COS interferences are drastically or insignificantly reduced or eliminated in most cases based upon their normal levels.

Sensitivity:

How, then does one go about determining the sensitivity for various compounds? The following table lists only a few of many of the potentially important pollutants:

The following results were obtained for the Model 402REU sensitivity when various hydrocarbons were stripped from water at a concentration of 2 ppm volume to volume.

PARTITIONING COEFFICIENT TABLE FOR HYDROCARBONS FROM WATER

SET UP CONDITIONS:

		0-10,100,1000ppm ACETONE
Sample water liquid flow rate into stripper=	50 cc/minute; (range is 10-200 ccm)	160 ccm
N2 stripping purge flow rate into stripper	0.4 liter/minute; (range is .4 to 2 lpm)	1.6 LPM
Dryer back purge N2 flow rate	approx. 1 liters/minute	8-10SCFH (4LPM)
Temperature of stripper zone	45.0 ±1 °C	45°C
Approximate response time to 90% FSD	under 3 minutes (can be increased with liquid and N2 or air flow rate)	

<u>Hydrocarbon</u>	<u>Concentration in H₂O</u>	<u>402R calibrated on CH₄</u> <u>Methane equivalents</u>	<u>Partitioning</u> <u>coef's, 50 ccm</u>	<u>200 ccm</u>
Hexane	2 ppm	20 ppm as Methane	10:1	40:1
Cyclohexane	2 ppm	93 ppm	46.5:1	186:1
Benzene	2 ppm	276 ppm	138:1	552:1 (.0018)
Toluene	2 ppm	190 ppm	95:1	380:1
Acetone	2 ppm	16 ppm	8:1	32:1
EDC	2 ppm	37.8 ppm	18.9:1	76:1
DMF	2 ppm	7.0 ppm	3.5:1	14:1
Methanol	2 ppm	3.75 ppm	1.87:1	7.5:1
Methylene dichloride	2 ppm	28.7 ppm	14.3:1	57:1
N,N DMAC	2 ppm	4.7 ppm	2.4:1	9.6:1
1- Hexene	2 ppm	37.9 ppm	19:1	76:1
THF	2 ppm	13.7 ppm	6.8:1	27:1
H ₂ O, Tap	0 ?	< 1ppm	-	-

Addendum for Model 402REU Hydrocarbon Analysis System

Notes:

- 1 Sensitivity full scale can be increased by increasing water sample flow.
- 2 Response can be increased by increasing N₂ stripping flow as well as sample flow rate.
- 3 -The more polar the solvent (more soluble in water) the less stripping efficiency, the lower the sensitivity.
-Conversely, the less polar the solvent (less soluble in water) the more easily it is to strip from water, the higher the sensitivity.
- 4 In general, the higher the number of carbon-hydrogen atoms per compound the more sensitive the FID detection is.

The table above shows values of tested/obtained partitioning coefficients for each hydrocarbon at the set up conditions given. If, for example, one is interested in detecting benzene in water. What would be the lowest detectable concentration we could see on a 0-10 ppm methane equivalent calibrated range? Benzene has 6 carbon-hydrogen bonds and is quite nonpolar or non-soluble in water and should be very sensitive after stripping from water:

Given the fact that at .4 lpm N₂ and 200 ccm sample flow one can detect methane as low as 0.5 ppm methane (CH₄) equivalent² with confidence in N₂ using the model 402REU. Therefore, 1 ppm benzene stripped from water = 552 methane equivalent counts in N₂. This equates to 0.0018 ppm benzene = 1 ppm methane equivalents in N₂ (See table). Then 0.5 ppm methane = 0.00091 ppm benzene sensitivity as methane equivalents² or 0.91 ppb benzene sensitivity.

Another example is: Acetone, a 3 carbon-hydrogen bonded, polar compound has a partitioning coefficient of 32 for the same sample/N₂ or air flow conditions, then, 1 ppm Methane = 1/32 as acetone or .031 ppm acetone; therefore, 0.5 ppm methane = .0155 ppm acetone or 15.5 ppb acetone sensitivity.

Normally, you would expect acetone to respond with 1/2 the sensitivity as benzene due to the 1:2 carbon-hydrogen ratio when in actuality it was determined to be a 1:17 ratio in sensitivity. The decrease in expected sensitivity is due to the more polar nature of acetone and its related solubility in water which makes it more difficult to strip out into the N₂ or air phase. Indeed, observation of the listed compounds given in the table one can relate their number of C-H bonds and polarities to sensitivities. Based upon these observations, one might estimate relative sensitivities for other simple hydrocarbon compounds.

Teledyne Detection Systems:

As indicated earlier, Teledyne with its vast knowledge in custom systems, can provide other detection systems that will link to the Model 1110 pre-conditioner for more specific contaminants in water or other solvents, for example:

Applications	Range
- a specific hydrocarbon in water with an IR detector	10 ppm to %
- CO, NO, CS ₂ , CO ₂ , SO ₂ , NH ₃ in water with an IR/UV/ elec. chem detector or many other gases that absorb specifically in the IR or UV region (contact Teledyne)	10 ppm to %
- O ₂ in water with an O ₂ gas sensor	ppb to %
- free Cl ₂ in water or EDC (1,2-dichloroethane)	ppm to %
- H ₂ S in fuel/natural gas using UV analyzer (Model 1110 used in reverse mode)	ppm to %
- Benzene/Water with 1110/IR7000	0-200 ppb

Stripper Sample System Assembly

The layout of the components for the stripper assembly on a backpanel is indicated on the assembly D-sk8697, C-71485 rev 2. The assembly can be linked to any of several analysis instrumentation provided by Teledyne Analytical Instruments, for example: FID using the 402REU) GP or X-Purged (gas pump required); GP or XP 6110 UV analyzer; GP or XP Infrared 500 series, 730 series or 7000 series analyzers (gas pump typically not required).

Operation of the stripper assembly is performed by observing sample flow and settings, etc., according to the piping diagram C-71485. Please see calibration settings (gas stripping flow, sample liquid flow, temperature stripper control value and analyte partitioning coefficients in the addendum) at the beginning of the manual pertaining to your particular application.

The liquid water (or other solvent) sample must enter at greater than 25 psig, preferably 30 psig otherwise a liquid pump is required to drive and control properly the liquid flow through the system. Immediately at the inlet, a bypass sample return tee's-off through a flowmeter (typically 3-30 GPH) occurs. This minimizes lag-time from the process sample tap up to the analysis system. The sample then flows through a 20 mesh particulate strainer, than into a 3-way sample/cal selector valve through which a zero or span liquid fluid can also be introduced for calibration purposes through the stripper and/or analyzer. Following the sample/cal valve and pump if provided, a tee-off into a 2-way needle valve will bypass the liquid sample (0-25 psig) around a 2-way solenoid, 140 micron tee-type filter flow control regulator in series with a sample flowmeter (0-200 ccm). The normally closed 2-way solenoid is power controlled by relay contact from the fiber optic sensor (CP-1808) located after the stripper but before the dryer. Its electronics control circuitry (CP1806) is located in the control box (B139). The intrinsically safe fiber optic sensor detects solvent condensate (usually liquid water or condensate) and shuts down the sample liquid flow by closing the 2-way solenoid (P/N S1143). This protects the dryer, pump and analyzer from seeing liquid fluids. Also in the event of power failure, the solenoid closes off the sample liquid flow into the stripper. Although the liquid flow is stopped, the air purge flowing through the water in the column still occurs and could carry excess water or solvent condensate into and through the dryer/analyzer(s) in the event of a temperature controller (T-1088) failure. Please, refer to the Levelite Fiberoptic Sensor and Controller operation and maintenance in the manual attached. The heater in the enclosure (GP or XP) maintains the stripper compartment temperature at the prescribed dew point set point (typically 45 ± 5 °C).

The sample continues through a pressure regulator preceding a sample flowmeter which allows precise flow control of sample through the heat exchanger coil (1/8" OD tubing) located slightly above the heater into the stripper section then out of the dryer. Sample liquid flow control is critical to maintaining the proper calibration and thereby delivery of the correct stripped concentration of hydrocarbon (with its fixed partitioning coefficient based upon air stripping gas and sample liquid flows at constant zone stripping temperature) into the dryer and analyzer(s). The sample passes up through the bottom teflon male-run tee into a stripping chamber partially filled with glass beads. These beads serve to create high surface area contact of the liquid sample entering the bottom with the air purge stripping gas also entering at the bottom of the stripper. Higher surface contact of the air purge gas with the sample promotes efficient "stripping-out" of the intended hydrocarbon(s) for measurement (thereby increasing their partitioning coefficients). The beads also serve to reduce the dead-volume in the chamber thereby allowing faster response through the system of both sample liquid and air purge gas. The beads are held into place by glass-fiber packing above and below to eliminate any carry-over due to a high N₂ purge gas flow entering the bottom of the stripper. About 1-2" above the upper bead level a 3/8" OD teflon tube is also placed up through the bottom male-run

Addendum for Model 402REU Hydrocarbon Analysis System

tee. This allows a controlled height for the incoming sample to reach before draining out through the bottom to the right into a elbow containing a 2" vent head which gravity feeds to a suitable collection drain provided by the customer. Also from this 2" head an overflow vent is provided for any residual gas bubbles carried over or remaining in the water/solvent sample going to drain. This vent could also be tied in to the analyzer bypass safe vent (no back pressure allowed). In some applications, the water or solvent sample may be gravity fed into a liquid analyzer for a different liquid analysis of a scrubbed process gas instead of a gas stripped analyzed liquid sample.

The air purge gas containing stripped hydrocarbons leaving the water sample exit at the top of the chamber through another teflon male-run tee. The top portion of the male-run tee is where the air purge gas enters through 1/4" teflon tubing which extends down into the liquid sample all the way toward the bottom of the teflon stripper assembly. At its bottom tip is fastened a 5-10 micron sintered sparging element (made of Stainless/Monel or Hastelloy C material) to distribute the incoming airgas into a homogeneous dispersing scrubbing/stripping action up through the sample water column. This gas then passes up through the male-run tee but exits 90 degrees before continuing through the fiber-optic sensor then on into a dryer which removes condensable water (no dryer is used if other solvents are stripped for analysis). Once the dryer removes the water to a dew point typically below 0 °C (dew point depends upon the dryer used), the sample can proceed in a normal dry state for analysis without any concern for further condensation. The dryer back-purge air or clean air gas flow must be set to at least twice the sample flow used in the stripping operation. Its dew point of the back-purge gas should be typically -40 °C or lower.

The sample exiting the dryer is split at a tee. One portion vents through a flowmeter (.2-2 scfh) the stripped sample to the analyzer atmospheric sample bypass vent, whereas the other portion feeds the richer stripped hydrocarbon sample through a 3-way manual ball valve. This valve allows sample or zero air gas to enter before the 402REU sample pump. Zero air/N₂ entrance here checks the efficiency of the sample pump delivery into the 402REU FID detection system. Following this 3-way calibration entrance valve, the sample is flow and pressure controlled into the suction side of the 402REU pump required to deliver a pressurized sample for analysis. A flowmeter (.2-2 scfh) indicates the sample portion drawn into the sample pump. A needle valve located after the 3-way manual calibration gas valve is used in conjunction with a subatmospheric back-pressure regulator (SBP, set at a slight vacuum of about 4 to 30 " of water column). Use air or at the calibration 3-way manual valve inlet to adjust the sub atmospheric back-pressure regulator. To do this, open the regulator needle valve which extends to the fine adjustable "inches of water" gauge. While turning slowly clockwise the coarse adjustment knob on the regulator, observe the fine indicating vacuum pressure on the gauge. Adjust the vacuum of the regulator to the slight 4-30" vacuum needed on N₂ or air. Next, close the needle valve which extends to the fine gauge. This will protect the brass gauge from any corrosive gases that may purge out of the sample liquid fluid. A coarse stainless gauge is also available to view any possible upsets in the system should the SBP regulator fail.

The needle valve and regulator (with the flowmeter open to maximum flow for observation only) is adjusted for the proper flow into the pump. The pressure of 4-30" water column allows the stripper to work effectively and drain properly. Should the pump demand or create a high vacuum, the subatmospheric back pressure regulator will not allow a high suction back into the stripper chamber which would otherwise cause the sample water level to rise in the chamber above the required "head" level for proper draining out the bottom exit port. The pump then can only pull sample on what the regulator will allow (a few inches of water). Any increased pump suction then occurs and the pump also relieves any deadhead action out through the pressure relief valve (set at 10 psig which is higher than the 402REU system requires) located across the pump. A needle valve also installed across the pump can be use to increase/decrease the pressure of the sample and thereby sample

Addendum for Model 402REU Hydrocarbon Analysis System

flow delivery to the 402REU also regulated by the inlet 402REU back-pressure bypass regulator set at 3 psig. For operation of the 402REU, follow the standard operating procedures located in the 402REU manual.

Calibration Method

1. The 402REU was factory calibrated using ppm methane in nitrogen for the three ranges: 0-10, 0-100 and 0-1000ppm.
2. Calibration solution for checking the sampling system partitioning coefficient of Acetone in water versus methane equivalent is prepared as follows: each 100 microliters of Acetone in 5 gallons of hydro carbon free water equals a 5.3 ppm (vol./vol.) Acetone in water solution.
3. The Acetone to methane equivalent factor for this system is recorded.
4. 1 ppm Acetone in water equals 1 ppm methane in nitrogen.
N2 stripper flow = 1.6 LPM
Sample liquid flow = 160 CCM
Temperature of stripper = 45°C
402REU backpressure regulator set at 3 psig
N2 dryer back purge flow = 8-10 SCFH minimum (Inlet Regulator of 402R set to maintain 3 psig on Zero air inlet for backpressure).
Zero of 402REU = 490
Span of 402REU = 300
PR 1 for N2 strip gas = 15 psig
PR 7 for sample flow liquid = 30 psig
SBPR = (-30" water) max with inlet flow off

Reference Drawings

The following drawings are included at the rear of this document.

D-71878	Outline Diagram
B-67698	Piping Diagram
C-71900	Piping Diagram
D-71911	Schematic Diagram
B-30719	Schematic Diagram
B-18823	Schematic Diagram
B-30974	Schematic Diagram
B-29602	Schematic Diagram
B-34436	Schematic Diagram
D-67923	Wiring Diagram
C-67792	Wiring Diagram
C-65358	Wiring Diagram
C-71909	Wiring Diagram
D-71910	Wiring Diagram
D-71901	Interconnection Diagram

Project Engineer _____

Date _____

Addendum for Model 402REU Hydrocarbon Analysis System

