HALLIKAINEN *Instruments*
INDUSTRIAL and SCIENTIFIC
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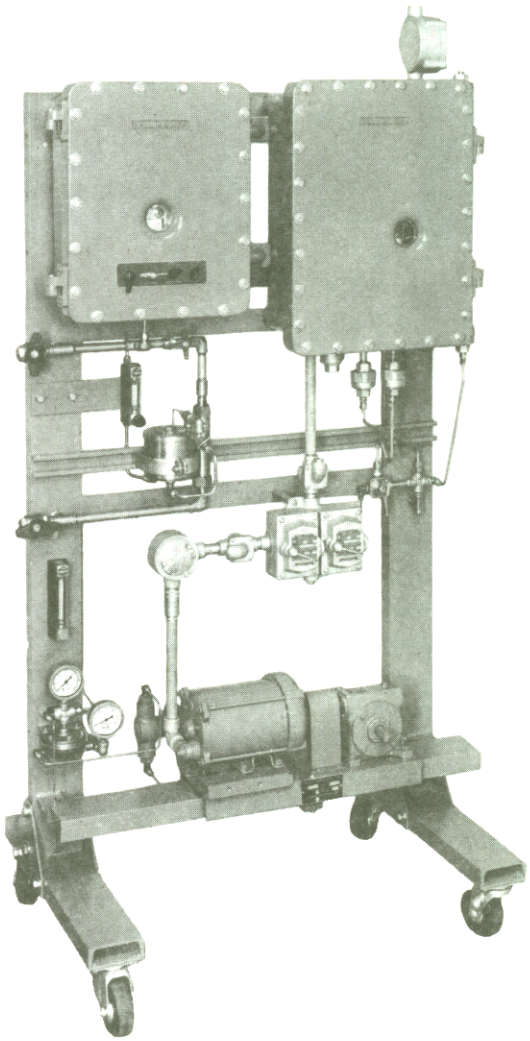
BOILING POINT ANALYZER

END POINT MODEL

MODEL 1238

Shell Development Co. Design



Horizontal Feet and Casters not standard equipment

INTRODUCTION

The Model 1238 Boiling Point Analyzer continuously samples and measures the boiling point (ASTM 85% to 97% recovered) of hydrocarbon samples in the temperature range of 150° to 700°F. Fast response time (about three minutes), excellent repeatability, and low maintenance combine to provide an instrument well suited for routine refinery use with unusual payout potential.

In petroleum refining operations, it is usually necessary to have a knowledge of the boiling range of various products. The ASTM distillation tests have satisfied the needs of the industry for many years; however, refinery routine and normal laboratory delay usually require excessive time between sampling and results. The Model 1238 Analyzer virtually eliminates these delays and provides the operator with a continuous indication of product specifications and quality. The availability of continuous boiling point information allows direct and cascaded automatic control to be applied to further increase payout and provides assurance that the product meets specification.

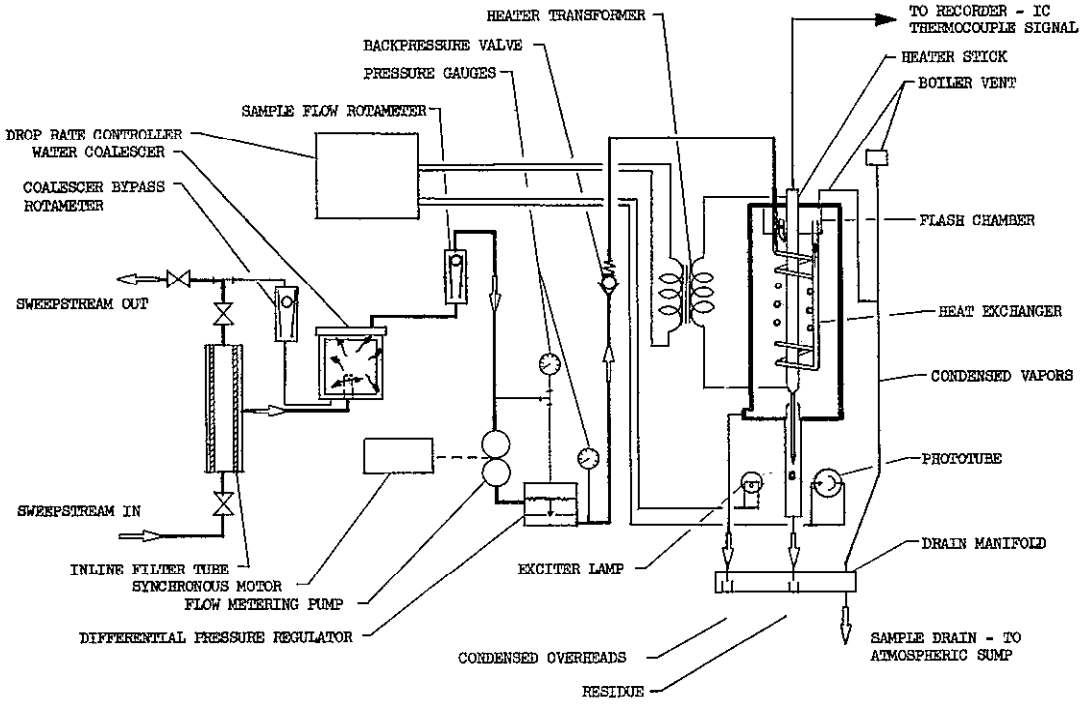
APPLICATIONS

The analyzer has been successfully applied to many plant streams including multi-stream applications. Generally, the instrument may be placed on any stream where the boiling point temperature will be between 150° and 700°F. Several typical applications are listed below:

1. Catalytic Reformer Feed Stocks - For economical operation of catalytic reformers, it is imperative that reformer feed stocks do not contain heavy ends. By continuously monitoring these stocks, profitable operation of the reformer is assured.
2. Jet Fuels - In many refineries, jet fuel production is characterized by production of several different grades. A continuous record of the 95% boiling point temperature allows the fractionating tower output to be changed quickly and profitably.
3. Gasolines - The 85% to 97% recovered point temperatures of stabilized or unstabilized gasolines may be continuously recorded to provide information pertinent to proper column operation and to obtain maximum yield of the product. The analyzer has been used on closed loop control to increase product yield.

4. Intermediate Products - Continuously monitoring the 95% recovered temperature enables maximum yield of the desired product to be obtained. Tower upsets are immediately indicated by a change in analyzer output.

5. Close-Cut Fractions - A boiling point analyzer will monitor close-cut fractions so that specifications can always be met.

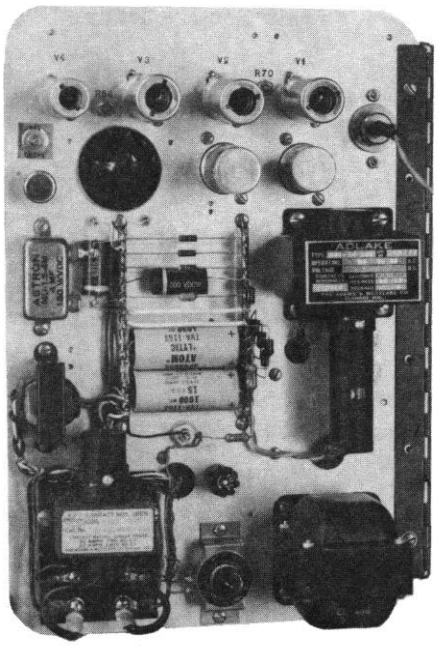


OPERATION

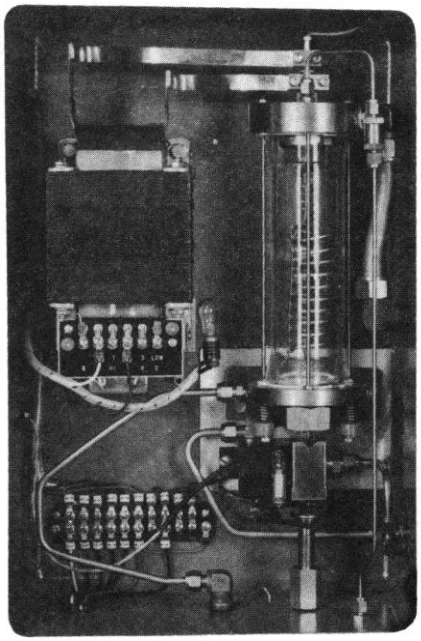
The incoming sample is filtered by an in-line filter element. The sample then passes into a water coalescer which removes all free water from the sample. Coalesced water is continually drained and returned to the process line. A constant sample flow rate is obtained by the use of a metering pump and differential pressure regulator. A back pressure valve which provides a fixed 10 psi back pressure on the system is located after the sample pump and close to the sample inlet to the boiler. The sample passes into the boiler unit which consists of a heater stick and heat exchanger enclosed in a vertical cylinder. The boiler is vented to the atmosphere to duplicate ASTM test conditions. The heat exchanger in the boiler preheats the sample, the sample then flowing into a preflash cup where light hydrocarbons are vented. A spout attached to the cup places the sample onto the heater stick. The heater stick flash evaporates a portion (85% to 97% as required) of the sample. The remaining residue continually drops off the pointed tip of the heater stick where its temperature is measured by a thermocouple located at the tip of the heater stick. The residue falling (in the form of drops) past a phototube interrupts a light source and provides an input signal to a multi-vibrator which regulates the heat input to the heater stick (proportionally) through a special low voltage, high amperage transformer so as to maintain a constant drop rate (residue). The residue is actually the controlled quantity; the evaporated sample being the difference between the feed and the residue. The temperature measured by the thermocouple will thus be the true temperature of a predetermined percentage point. The thermocouple may be connected to either an indicator, a recorder, or to a controller.

To change the percent recovered point within the limits of 85% to 97%, an external screwdriver adjustment is provided. The adjustment changes the multi-vibrator parameters so that a different residue rate is maintained. If a change from 95% to 90% recovered is desired, the residue rate is increased, thus decreasing the amount of sample evaporated since the feed rate is constant.

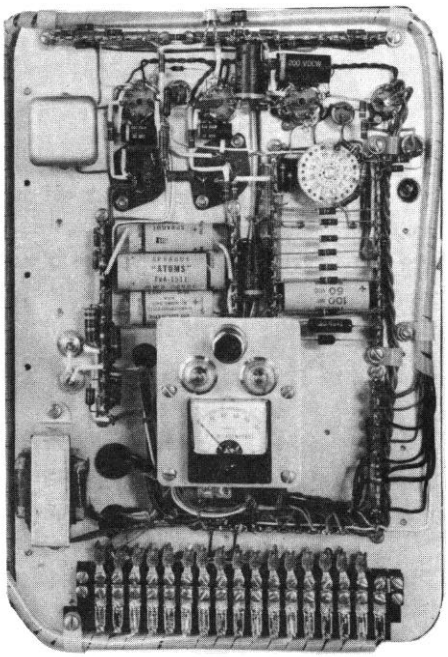
If the 95% recovered temperature of a sample increases, there will be an increased amount of residue falling from the heater tube since less sample will be evaporated. The multi-vibrator senses the increased residue rate in the form of an increased drop rate and, therefore, increases the heater stick temperature. More sample is then evaporated, reducing the residue rate to its previous value. The thermocouple in the tip of the heater stick indicates an increased temperature. The opposite reaction would occur if the 95% temperature of a sample were to decrease.



ELECTRONICS PANEL
(Back)



BOILER ASSEMBLY, TRANSFORMER, Etc.



ELECTRONICS PANEL
(Front)

DESCRIPTION OF COMPONENTS

Housings—The boiler and multi-vibrator controls are each contained in an aluminum alloy, explosion-proof housing designed for use in Class I, Group D, Division 1 hazardous areas. The housings and other components are mounted on a welded steel channel frame. Normally the unit is supplied without the horizontal feet and casters shown in the illustration, but these can be supplied at extra cost.

Motor—A ¼ horsepower, explosion-proof motor drives the metering pump through a gear reducer. The motor is protected from overload by a heater-type circuit-breaker located in the power switch and by an internal over load switch.

Metering Pump—A Hills-McCanna Masterline metering pump, provides a constant flow of sample fluid. The pump delivers about 25 ml/min (approx. ½ gal/hr.)

Differential Pressure Regulator—This regulator is placed between the inlet and outlet of the pump so that the pressure differential across the pump is nearly zero. The pump thus acts strictly as a metering device whose output is unaffected by sample inlet pressure or viscosity. It should be noted that any back pressure in the remaining part of the flow system must be overcome by the sample inlet pressure.

Sampling System—The sampling system supplied with the instrument consists of a Hallikainen Model 1090 Self-Cleaning IN-LINE Filter, a Hallikainen Model 1336 COALESCER, two rotameters, and associated valves and gauges all piped and mounted. The sample for the analyzer must pass through the walls of the in-line filter element. The high velocity slipstream on the inner walls of the filter tube provides a self-cleaning action by sweeping away stream contaminants. The filter element is rated at 7-14 microns filtering capacity. A separate bulletin fully describes this unit.

COALESCER—The COALESCER is designed to remove free water from the sample fluid. To reduce residence time in the COALESCER and to provide a means for continuously removing the coalesced water, a continuous by-pass system is provided to return the water to the process stream. A rotameter and needle valve are included in the by-pass flow system. Additional details on the COALESCER are available in a separate brochure.

Flow Rotameter—To check the sample flow rate and to detect the presence of air or vapor in the sample line, a rotameter is provided.

Back-pressure Valve—A spring-loaded valve produces a 10 psi back pressure on the flow system to eliminate vapor formation in the sample lines and regulator when low boiling point samples are encountered.

Boiler—The boiler consists of a heavy Pyrex glass cylinder with stainless steel top and bottom. Fitted into the boiler are the heat exchanger and heater stick. The sample evaporated from the heater tube is condensed in several ways: (1) light ends go out a vent in the top of the boiler to a vented condenser; (2) medium and heavy ends condense on the heat exchanger and on the walls of the glass cylinder. Liquid resulting from condensation on the walls of the boiler or the heat exchanger is drained from the bottom of the boiler.

Heat Exchanger—Two heat exchangers are provided for a variety of sample products. The heat exchanger for lower temperature boiling point products utilizes a flash chamber which receives the sample after it has passed through the heat exchanger tubing. The flash chamber acts as a small reservoir to assure a constant flow of sample onto the heater rod and also provides a vent where light-boiling, unstabilized materials may be vented directly to atmosphere through a flame arrester.

The low temperature heat exchanger incorporates seven turns of ⅛" tubing fitted with a solid wire restrictor. The wire restrictor provides an additional system pressure drop and reduces vapor formation in the heat exchanger proper. The seven-turn exchanger is principally designed for gasoline and napthas, but may be used on any product which does not create a pressure drop in excess of available system inlet pressure and if the temperature at the boiling point is within the limits of the heat exchanger.

The second heat exchanger utilizes fourteen turns of ⅛" tubing and does not incorporate the restrictor or flash chamber. It provides a greater degree of sample preheat and is specifically designed for stabilized products such as kerosene, gas oil, etc.

Heater Stick—The heater stick consists of a 3/8 inch diameter stainless steel tube having a wall thickness of 5 mils and a length of about 6½ inches. A helical coil, distorted by winding it on a hexagonal mandrel, is wrapped around the heater tube and promotes uniform distribution of sample on the heater tube. The heater tube is closed and pointed at the lower end. A thermocouple is located in the pointed tip and measures the temperature of the liquid residue as it flows over the tip before dropping off the tube. The thermocouple is not in direct contact with the tip, but is insulated to provide thermal stability and electrical isolation.

Electronic Circuit—The multi-vibrator electronic controller is a five-tube device employing a phototube, a two-stage amplifier switch, a multi-vibrator, a cathode follower, and a thyratron. The pulse created by drops passing by the photocell is amplified and used to trigger a one-shot multi-vibrator. The square wave produced by the multi-vibrator, when added to an adjustable reference voltage, becomes the error signal of the controller, the reference voltage being the set point. The error signal is integrated and buffered by a cathode follower stage. The resulting signal is attenuated by a gain control and feeds directly into another cathode follower section. The signal from the cathode follower biases a thyratron which actuates a mercury plunger relay. The relay controls the power to the heater stick through a stepdown transformer. Modulation of power to the load is accomplished by the time cycle method, wherein the percent "ON" time of the pulsing relay governs the average power delivered to the load. It should not be confused with On-Off control; it is a true two-function controller, proportional and reset, within the limitations imposed by the pulsing nature of the output. The proportional and reset circuits are feedback circuits superimposed on the error signal of the controller. The controller chassis is hinged to the housing door so that accessibility to the rear of the chassis is assured.

Test Circuits—On the front exterior panel of the electronic explosion-proof housing are several test switches and a test meter visible through a glass window. The test meter is used with the test switch to monitor six critical circuit parameters. The test circuits are valuable in routine maintenance as well as in troubleshooting. A simulator switch provides an artificial test signal for trouble-shooting. Circuit parameters may be easily evaluated with the introduction of the known test signal into the circuit.

Neon Indicators—Neon indicators are placed in several parts of the electronic circuit so that proper operation may be observed. The indicators are also valuable in start-up and maintenance.

Signal Output—The thermocouple used to measure the boiling point temperature is an Iron Constantan Type J thermocouple.

CORRELATION OF RESULTS

Operation of the continuous Boiling Point Analyzer is not a duplication of the ASTM distillation test method and therefore, cannot always be expected to yield temperatures equal to that method. Justification of the instrument lies in the fact that it does have the ability to recognize changes quickly in the ASTM end point (or other boiling points, depending on the set point position). Tests have indicated that the instrument will record changes in the ASTM end point when set in the 95% to 97% recovered range. Corresponding results have been obtained with the instrument set at other percent recovered points.

The instrument has a repeatability of ± 1°F.

GENERAL SPECIFICATIONS

Standard Percent Recovered Range - 85% to 97%

Normal Operating Range - 150° to 700° F.

Response Time (63%) - approx. three minutes (from IN-LINE Filter)

Inlet Sample Pressure Limitations - 30 psig to 150 psig (consult factory for variations of these limits.

Inlet Sample Temperature Limitations - Sample must be below its initial boiling point temperature and, for maximum COALESCER efficiency, should be as cool as possible. Maximum sample temperature out of sample filter - 160°F. (A sample cooler can be supplied as an accessory at extra cost.)

Sample Flow Rate - 25 ml/min (approx. ½ gal/hr)

In-Line Filter Element Rating - 7 to 14 microns

COALESCER Water Removal Ability - All free water at the stream temperature is removed by the coalescer from the volume of sample required in analyzer.

COALESCER Particle Removal Ability - 6 microns and better

Materials of Construction - All metal parts in contact with the sample are stainless steel.

Recommended Installation - Overhead weather protection is desirable. Where freezing temperatures are expected, heating in the shelter is recommended.

UTILITIES

Electrical - 115 Volts AC± 10%, 60 cycle, 1200 watts max., 800 watts normal, 20 amp. Connections are for ½-inch conduit.

Water - Cooling for phototube where conditions warrant. ¼" NPT female connections.

Sweepstream Sample In - ⅜" NPT female connection provided. ½-inch pipe recommended.

Sweepstream Sample Out - ⅜" NPT female connection provided. ½-inch pipe recommended.

Sample Drain from Analyzer - ¼" NPT female connection provided. ¼-inch pipe recommended.

Analyzer Signal Out - Type J Iron Constantan thermocouple. ½" NPT female connection.

DIMENSIONS

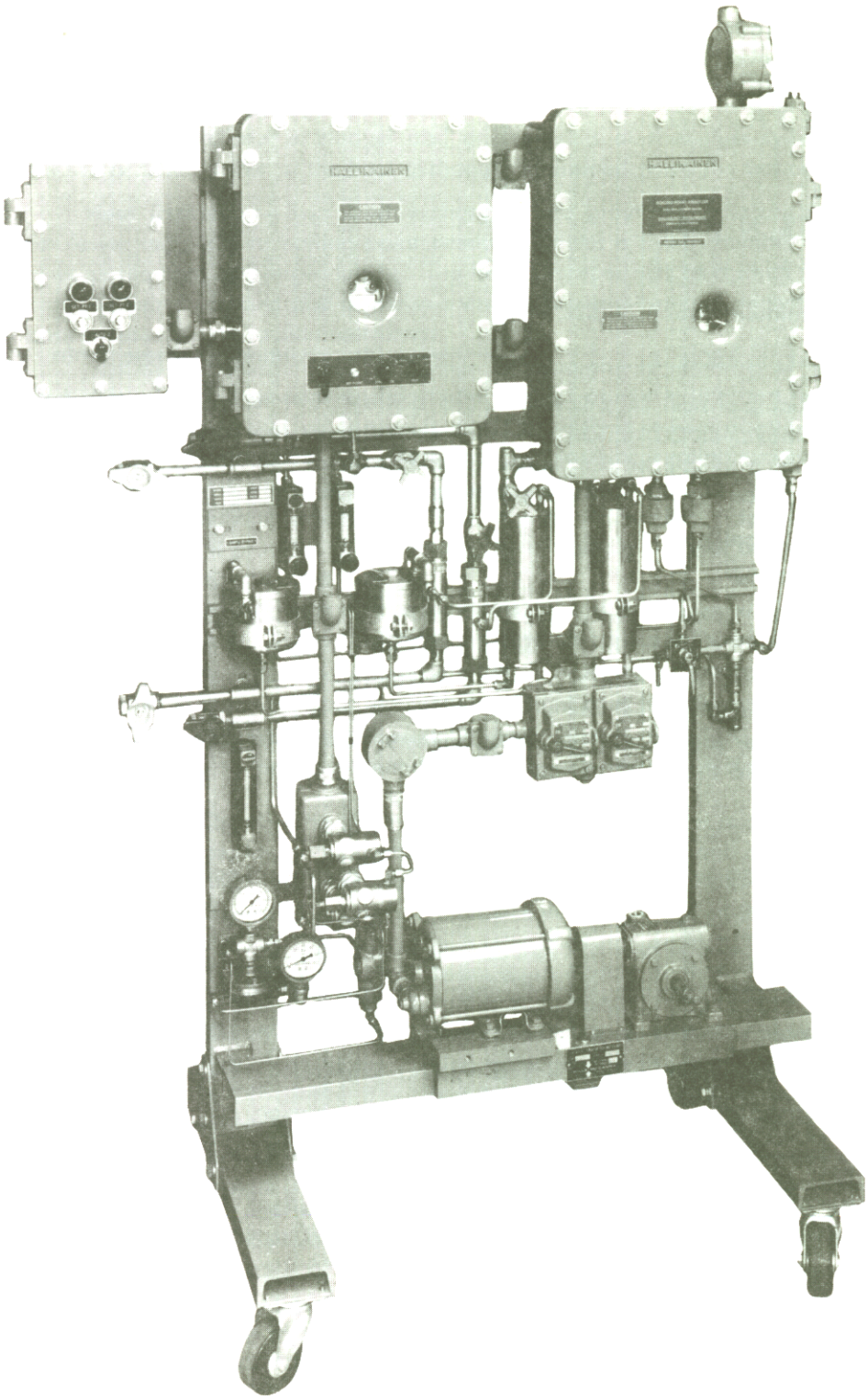
Model 1238 - (approx) 37" wide x 24" deep x 70" high - with horizontal feet and casters.
(approx) 37" wide x 16" deep x 62" high - without horizontal feet and casters.

NET WEIGHT

Model 1238 - (approx) 400 lbs., without horizontal feet or casters.
(approx) 425 lbs., with horizontal feet and casters.

STANDARD EQUIPMENT

Complete instrument as described including IN-LINE Filter, COALESCER, rotameters and gauges indicated in Fig. 1, piped and mounted on frame, but not including temperature recorder or horizontal feet and casters.



MODEL 1238S22

A special model for multi-stream application is also available. Illustrated, is an instrument for use on two streams. The IN-LINE Filters, COALESCERS, and by-pass equipment are included to minimize instrument response time. A timer with a fixed cycle energizes three 3-way solenoid valves for switching from one stream to another. A manual override allows full flexibility in selecting stream flows. The actual stream flowing indicated by a pilot light. Separate set point controls and heater power connections are provided so that streams of different characteristics may be analyzed at different boiling points, if desired. Cycle time varies with different products, but may be between fifteen minutes and several hours depending on product and customer preference. Analyzers for three streams and more can also be supplied. For these units, the sampling systems for each stream are not mounted on the analyzer frame but on a separate frame adjacent to and attached to the left side of the analyzer frame.