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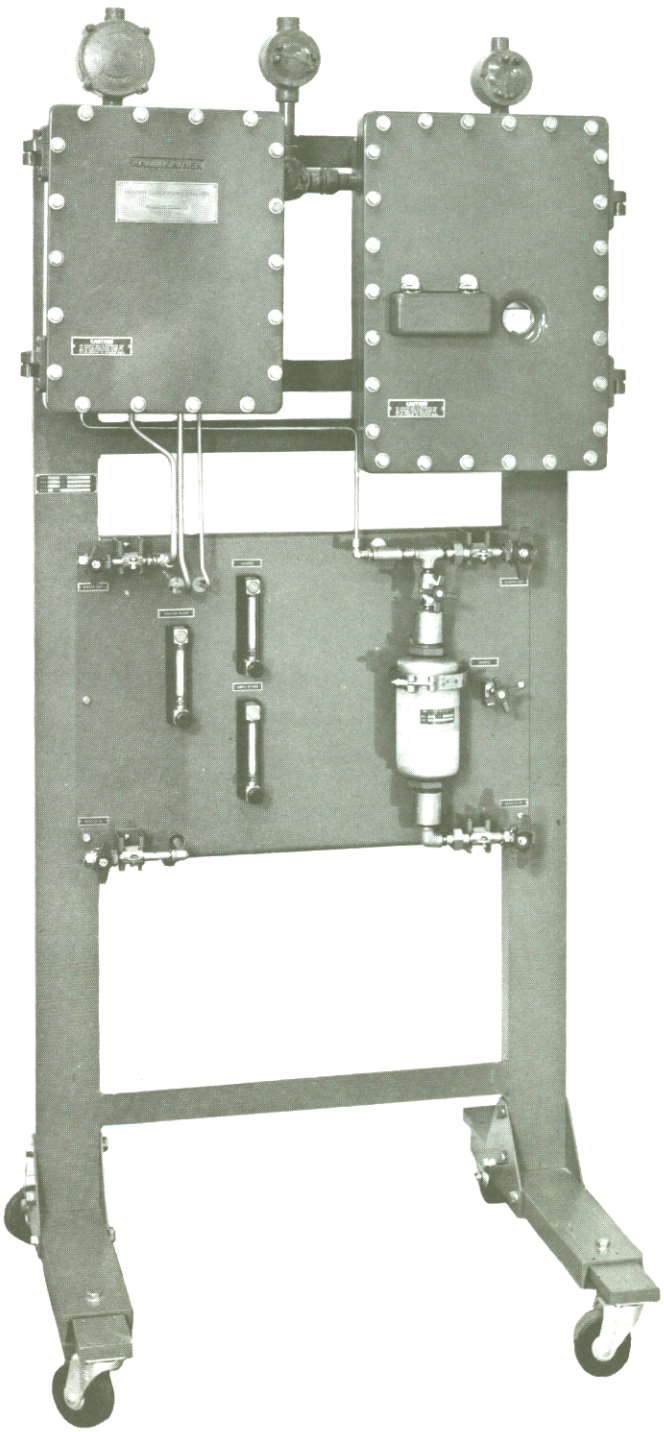
# PROCESS CLOUD POINT ANALYZER

**Model 1466**



**SUMMARY**

The process cloud point analyzer uses a differential temperature technique to detect the cloud point temperature of gas oils and cycle oils which correlates with the ASTM D97-IP 15 method. Detection is not affected by the water content or color of the sample.

The analyzer has a cloud point temperature range from —30°F to +55°F (—35°C to + 15°C) and a repeatability of ±1°F (± ½ °C). The sample cloud point temperature is detected on a cyclic basis, the measuring period depending upon the difference between the temperature of the incoming sample and its actual cloud point. A cloud point trough-picker is built into the analyzer to facilitate automatic control of a process. The analyzer is housed in two lightweight aluminium explosion-proof boxes suitable for use in Class 1, Group D hazardous areas. The left-hand box houses the sample container and cooling unit and is provided with sample and cooling water connections.

The right-hand box contains electronic components. To minimize errors due to ambient temperature variations, significant components are mounted in a small oven, thermostatted at approximately 130°F (55° C).

## PRINCIPLES AND DESCRIPTION OF OPERATION

The instrument has been designed to detect and record the cloud point temperatures of gas oils and cycle oils and the output correlates with the ASTM D97-IP15 results.

The principle of the method is based on the phenomenon that, upon cooling the sample, a crystal lattice is formed and that the forming of this lattice impedes convection currents. The temperature at which the lattice structure develops coincides essentially with the temperatures at which a visible cloud appears.

A thermoelectric cooling unit surrounds the sample container, the bottom of which protrudes from the cooling unit. Two thermistors, protruding into the sample at either end of the sample container, are connected into the opposite arms of a Wheatstone Bridge circuit for differential temperature measurement, while a thermocouple located approximately in the center of the sample container measures the sample temperature. When the power to the cooling unit is switched on the sample cools and convection currents fall down the walls of the sample container and rise along the axis. The lower thermistor becomes colder than the upper thermistor and the bridge becomes unbalanced. At the cloud point temperature, or wax precipitation temperature, convection ceases; the lower thermistor no longer receives the cold stream falling from the walls and the upper thermistor no longer receives the relative warmth of the ascending convection stream. On the contrary the upper thermistor is cooled by heat conduction to the cooling unit. The differential temperature between the two thermistors is suddenly reduced and, when zero, the detector bridge balances and a transistorized Schmitt trigger operates. The sample temperature, as detected by the thermocouple, is then at the cloud point temperature and is indicated on a recording potentiometric millivoltmeter or similar instrument.

The sequence of events during a cycle may be summarized with reference to Fig. 1 as follows:

1. The 3-minute time delay No. 1 is initiated. The two-way solenoid valve is energized so that the sample container is purged by the sample. Power to the cooling unit is isolated during this period.

2. At the end of the delay period, the solenoid valve is de-energized, thus trapping a sample in the container and allowing the sample stream to by-pass the sample container. Power is supplied to the cooling unit, the trapped sample begins to cool and time delay No. 2 is initiated. This delay is included to mute the Schmitt trigger for approximately 90 seconds in order that the trigger does not operate at the beginning of the test.

3. At the cloud point temperature the Schmitt trigger operates and time delay No. 3 is initiated.

4. After approximately 5 seconds time delays Nos. 1 and 2 reset, then time delay No. 3 re-sets, time delay No. 1 is initiated and the cycle is repeated.

The time required for a complete cycle is about 10 minutes but this period depends on the sample inlet temperature and also on the cloud point temperature.

A cloud point trough-picker is built into the analyzer. This enables the instrument to be used for the automatic control of a process.

The differential temperature technique for cloud point detection is not influenced by the water content or color of the sample and is applicable to any oil which has a wax precipitation temperature provided that its viscosity at this temperature is not greater than about 10 poise.

## SAFETY FEATURES

Two safety devices are incorporated in the analyzer. One is a miniature thermostat fixed to one of the heat sinks of the cooling unit and set at approximately 95°F (35°C). The other is a miniature thermostat fixed to the base of the solenoid valve and set to operate should the sample temperature reach 140° F (60°C). Both circuits serve to protect the cooling unit in the event of cooling water failure. When this happens the analyzer will be isolated from the power supply and the sample will by-pass the sample container.

## GENERAL SPECIFICATIONS

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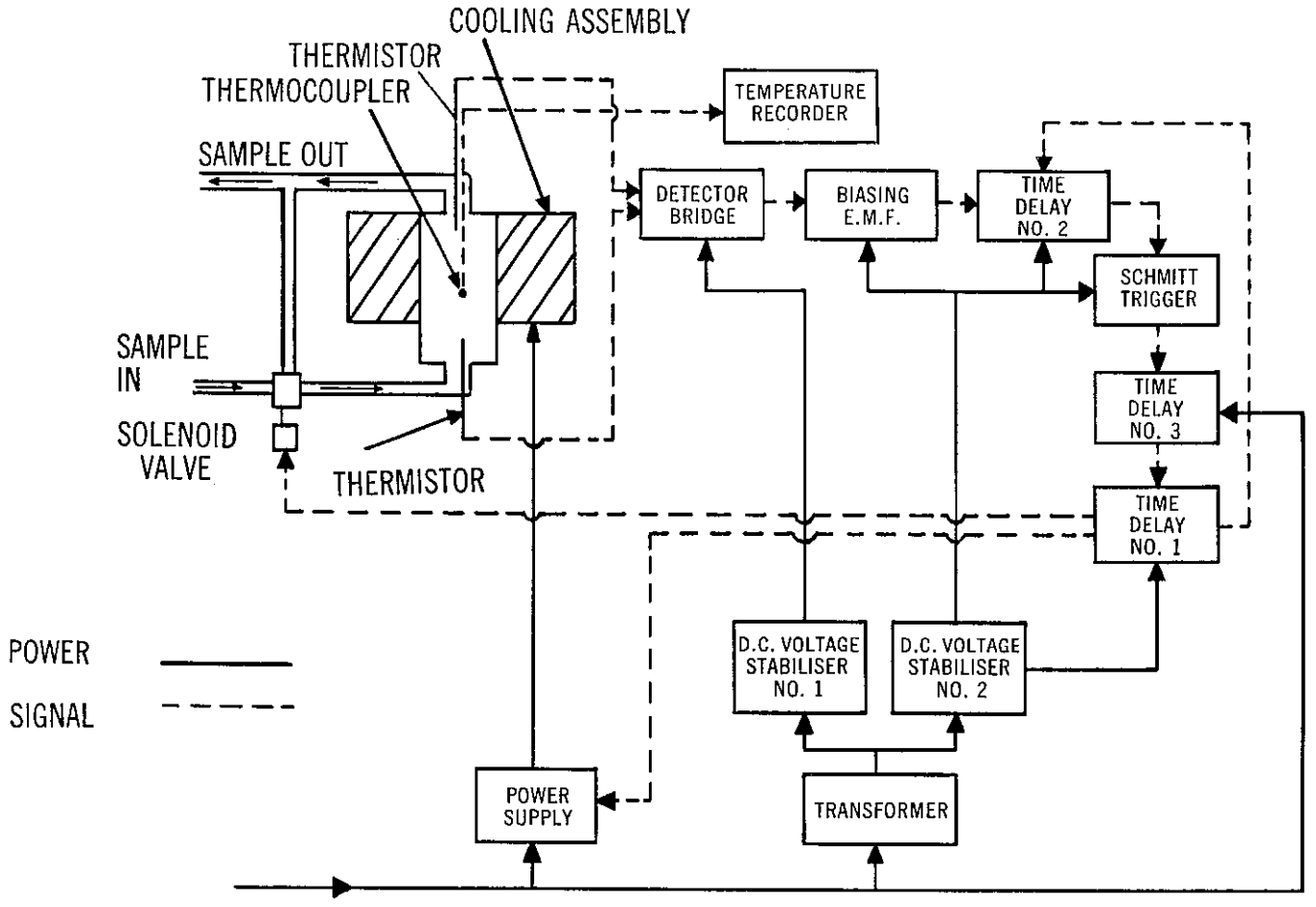
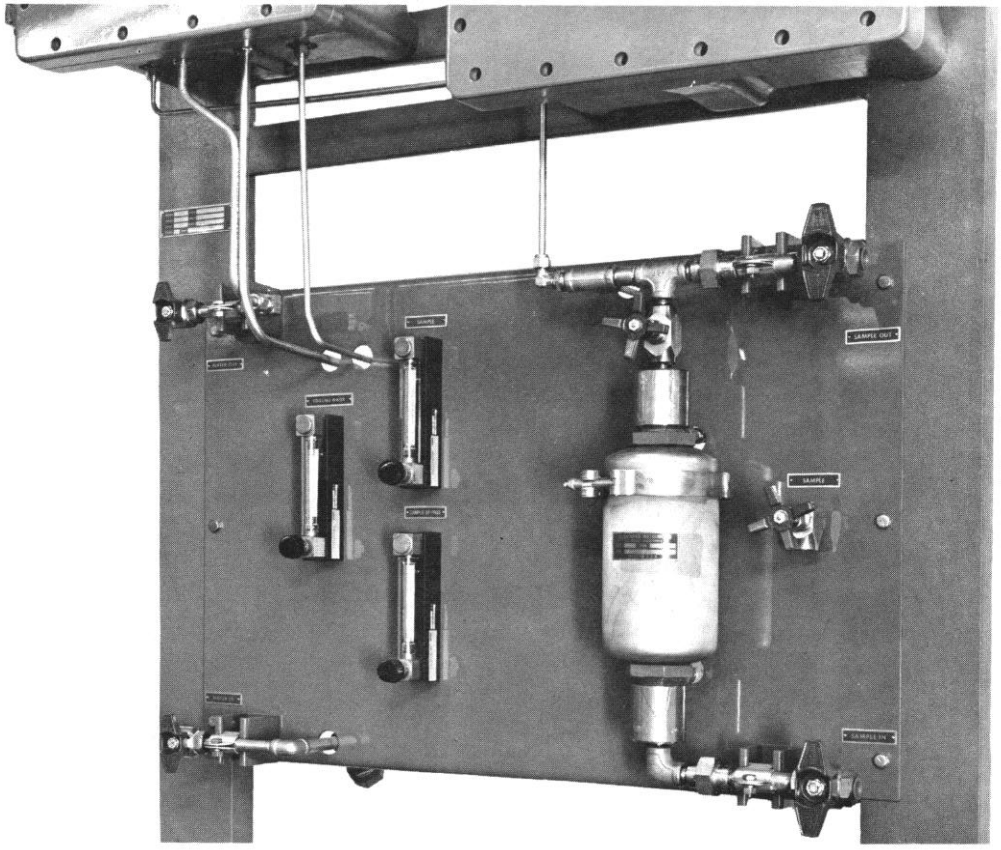
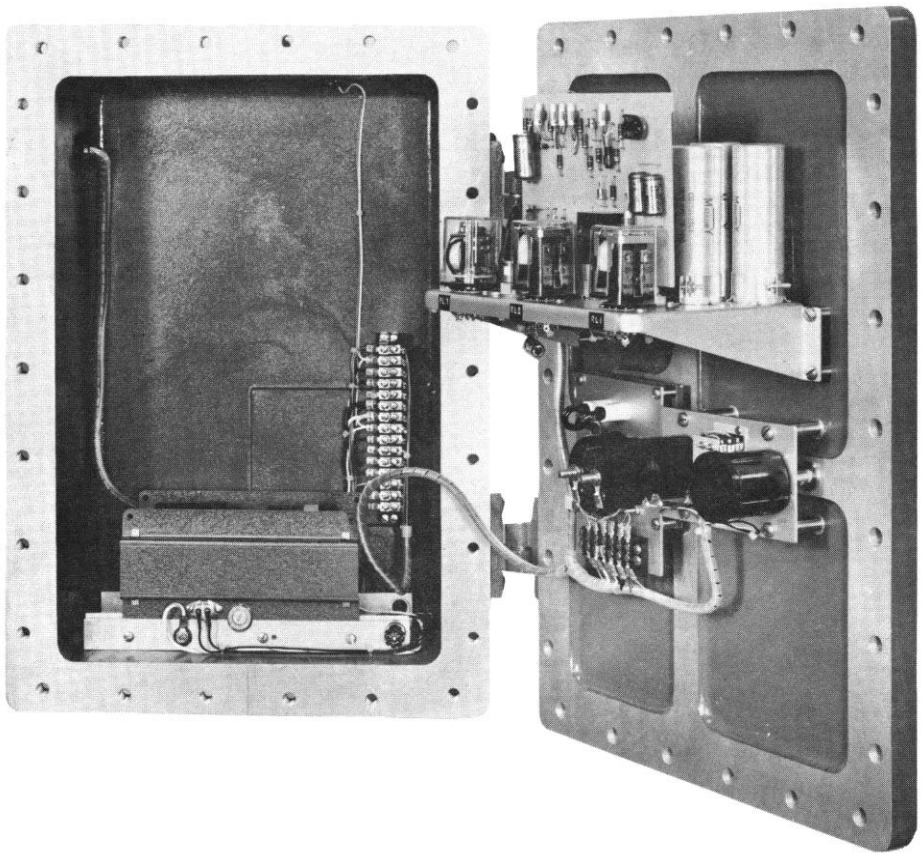
|---|---|
| Cloud point temperature range | —30°F to +55°F (—35°C to +15°C) |
| Repeatability | ±1°F (± ½°C) |
| Analysis time | Approximately 10 minutes (depending on cloud point of sample) |
| Sample pressure at inlet to sample container | 20 psig minimum<br>95 psig maximum |
| Sample temperature at inlet to sample container | At least 50°F (10°C) above expected cloud point. Maximum temperature of 140°F (60°C) |
| Sample flow rate | 200 - 250 ml/min |
| Ambient temperature | 120°F maximum (50°C) |
| Sample filter particle removal rating | 14 micron |
| Materials in contact with sample | Stainless steel |
| Recommended installation | Overhead weather protection is desirable. |
| Utilities: Electrical | 115 A.C. 60 c.p.s. 0.6 KVA |
| Cooling Water (Fresh) | 80°F maximum (25°C), 10 gal/hr nominal |
| Sweepstream sample in and out | 1 gal/min. |
| Analyzer output signal | 1. Type J iron-construction thermocouple<br>2. 115V A.C. to recorder for trough-picking |

**Figure 1**





Sampling Panel



Control Unit