Data Sheet
SS/6517_4

Katharometers

Series 6517

- **Designed for continuous industrial use**
- **Long working life**
- **Suitable for flammable gases**
- **CENELEC certified (ATEX)**
  – to EExia IIC T4.T_{amb} –20 to 55°C (–4 to 131°F)
- **Robust – no moving parts**
- **Suitable for corrosive gases**
- **No routine span checks**
- **Accurate levelling unnecessary**

The ideal equipment for Process Monitoring and Control

General Introduction

The Katharometer is a device which provides a change in an electrical output signal in response to a change in the thermal conductivity of a gas passing through it. If a gas mixture of known constituents is passed through a Katharometer by means of a suitable gas sampling system, then any changes in output signal are related to changes in the composition of the gas stream.

The Katharometer is non-specific but, for binary, and many complex mixtures, details of the concentration of one of the gases in a mixture can be provided.

All gases and vapours have a characteristic thermal conductivity which can differ considerably from one gas to another. For example, the thermal conductivity of air is approximately three times that of sulphur dioxide and only one-seventh that of hydrogen.

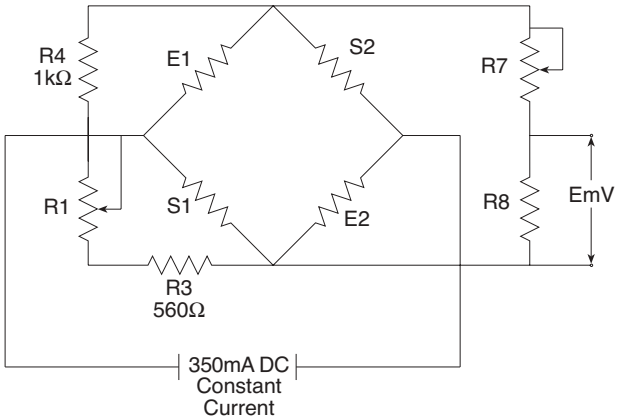
The analysis equipment is simple, robust and correspondingly easy to install and maintain. It is accurate and reliable in service and, since sampling is continuous and automatic, is ideal for process monitoring and control.

The Principle

If a current is passed through an electrical conductor surrounded by gas in a chamber, the temperature of that conductor rises until a point of thermal equilibrium is reached. At this point, the electrical energy supplied to the conductor is equal to the thermal energy lost to its surroundings. Provided that radiation, convection and end-conduction losses are minimized, the temperature of the conductor can be assumed to depend upon the heat loss by conduction through the gas.

Since the change of electrical resistance of the conductor is a function of its change in temperature, measurement of the former determines the latter.

The Katharometer comprises matched platinum-wire filaments, finely coated with glass, and forming a Wheatstone bridge network. The filaments are enclosed in separate cells in a comparatively massive block. Thermal conductivity differences between the reference gas and the measured gas cause imbalance of the bridge and hence an output (EmV) which may be calibrated directly in terms of the gas being measured.



The Choice of Katharometer

There are many circumstances in industry where it is necessary to monitor the variations in a gas stream for process control, safety monitoring or economic operation. Where the Katharometer is capable of carrying out the required measurements it offers several advantages over other systems. These are:

a) Designed to operate continuously – no moving parts

b) Under favourable conditions has a working life of many years

c) Can be adapted to operate in hazardous areas

d) Is highly stable

e) Is compact and does not interfere with the process being monitored.

Katharometers are available in standard or corrosion-resistant forms, some of these being available thermally lagged for indoor applications or for use with flammable gases. Both the standard and corrosion-resistant versions may be thermostatically controlled where ambient conditions are usually variable or where the highest level of accuracy and stability are required. In theory the Katharometer is suitable only for use with binary gas mixtures. The Katharometer incorporates sealed reference cells and this method is called 'The Direct Measurement Technique' – see Fig. 1.

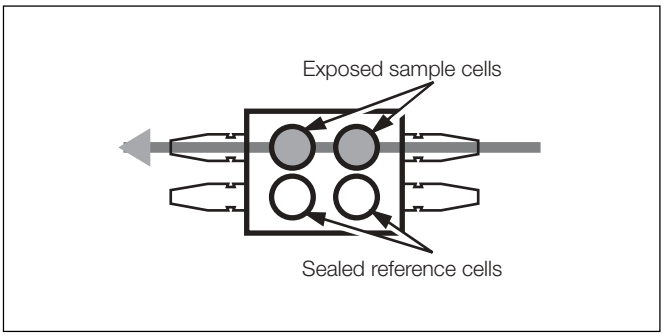


Fig. 1 Direct Measurement Technique – Dry Gases

However, the use of Katharometers may be considerably extended by:

a) Comparing the thermal conductivity of a stream before and after a reaction to promote the effect of variations in the measured variable. This is the Differential Measurement Technique – see Fig. 2.

b) Exploiting common factors between two or more sample constituents, for example, air is comprised principally of nitrogen and oxygen. Reference to Fig. 3 shows a similarity in thermal conductivity that enables air to be treated as one gas

c) Treating the gas prior to measurement, for example, absorbing out an interfering constituent

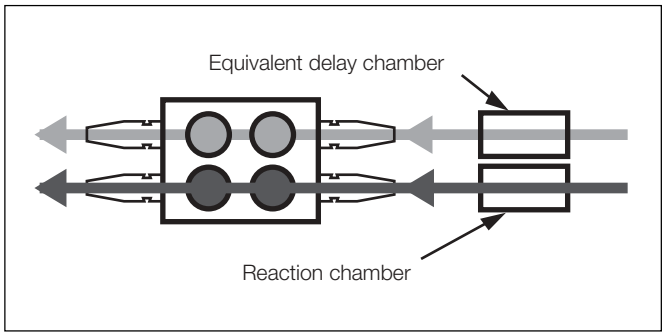


Fig. 2 Differential Measurement Technique

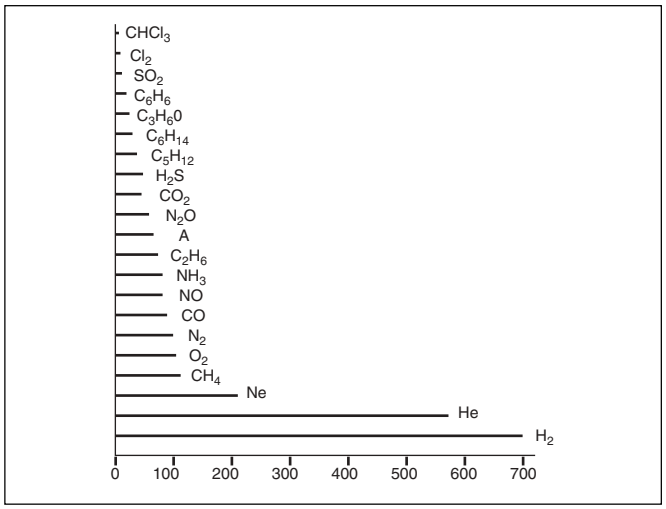


Fig. 3 Thermal conductivities relative to air at 0°C where air is 100

Katharometer Types Available

All Katharometers in this series are housed in a steel case of common size and presentation. The Katharometer is usually supplied mounted on a steel panel, also containing the associated sample control accessories, for example, flow control valve and flow gauge, drying chambers and sample aspirators; of which there is a choice of types available. The following Katharometers are within the standard range:

For Non-Corrosive Gases

6517-000	Thermally-lagged direct-acting type
6539-960K	As 6517-000 but with protective diodes for flammable gases CENELEC Certificate EExia IIC T4 (Zone 0)
6548-001	As 6539-960K but pressure tested to 10 bar
6518-000	Thermostatically controlled direct-acting type
6520-000	Thermostatically controlled differential type
6521-000	Thermally lagged differential type
6539-970K	As 6521-000 but with protective diodes for flammable gases CENELEC Certificate EExia IIC T4 (Zone 0)

For Corrosive Gases

All parts in contact with the gas are either glass, PVC or Viton

6522-000	Thermally lagged direct-acting type
6523-000	Thermally lagged differential type
6524-000	Thermostatically controlled direct-acting type

Installation

The Katharometer is not a complete gas analyzer but is the detector within a gas analysis system. The minimum additional requirements are for a constant current power supply unit for the bridge circuit and an indicator. These items can be mounted remotely from the Katharometer and must be mounted in a safe area. Using suitable accessories the Katharometer can then be mounted in a hazardous area.

Fig. 4 shows the simplest form of installation which is suitable for a direct measurement where a clean and dry sample is available at the correct pressure and flow.

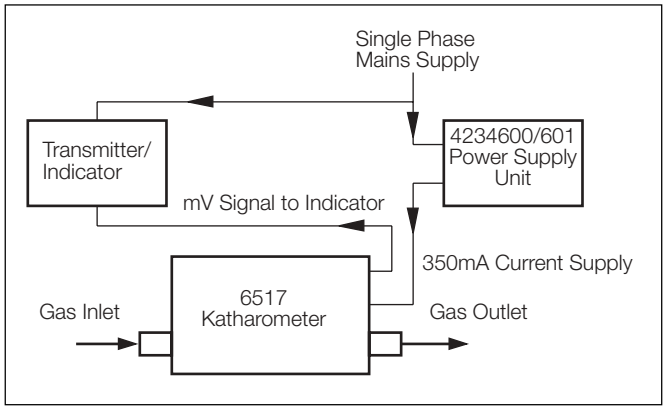


Fig. 4 Simple Katharometer System

Fig. 5 shows a more complex installation in which the Katharometer is mounted on a panel from the 6540 Series and includes a flow control facility and a small drying chamber. A local indicator or remote recorder is also coupled to the Katharometer output.

Amplifiers, or digital indicators, are available to convert the millivolt signal from the Katharometer to a current signal, e.g. 0 to 10mA, 0 to 20mA, 4 to 20mA. The output signal is preset to the user's choice. Alarms are integral with the digital displays.

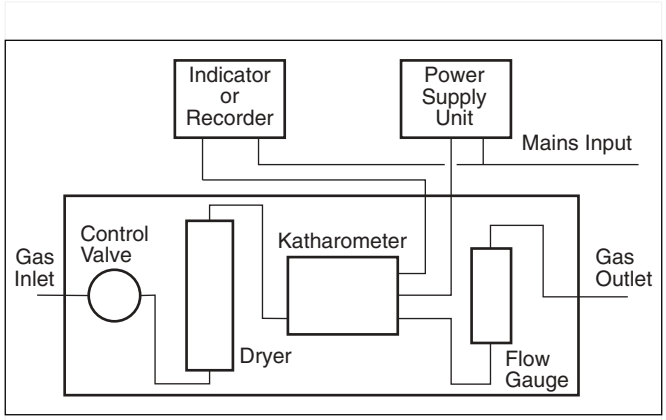


Fig. 5 Typical Katharometer Installation

Monitoring Flammable Gases

When it is required to monitor explosive mixtures such as hydrogen or methane in air and also in some potentially dangerous areas, precautions are necessary to ensure that the gas analyzer does not cause an explosion. The main difference between the standard and the 'certified' apparatus is the use of a certified I.S. power supply unit for the Katharometer bridge circuit and the fitting of the protective diodes within the Katharometer. Additionally the output signal from the Katharometer must be connected via shunt diode safety barriers to any mains-operated display equipment or amplifier which must be mounted in a safe area.

Equipment of the above type conforms with the requirements of CENELEC Standard EExia IIC (Zone 0) T4. T_{amb} –20°C/+55°C, Groups IIA, IIB and for hydrogen in Group IIC. It must be noted that for the safety certification to be effective the equipment must be installed exactly in accordance with the instructions supplied and that:

a) It is not possible to use a Katharometer to measure some of the gases/vapors covered by Group IIC of the BASEEFA standard and

b) The certificate refers to the mixture of these gases with air and not oxygen, although certain oxygen ranges are permitted.

Fig. 4 shows the layout of a simple system conforming to the relevant BASEEFA requirements.

Shunt Diode Safety Barriers

The action of the barrier unit is to allow a signal to be passed with negligible distortion up to the avalanche voltage of the zener diodes. Above this voltage the diodes conduct and hold down the potential across the terminals to a safe level. Further installation details are available from BASEEFA standards.

Sampling Accessories

A full range of filters, aspirators, flow control accessories etc. are available for use with this Series of Katharometers. They are usually mounted on a panel, together with the Katharometer, with all interconnecting pipework. Careful selection of the sampling accessories enables a wide variety of industrial gases to be presented to the Katharometer under optimum conditions for stable readings and long instrument life.

Indicators, Recorders and Controllers

The Katharometer supplies an output signal that is most suitable for a potentiometric receiver; the ABB range of indicators and recorders being particularly recommended. The output signal may also be made suitable for galvanometer indicators provided that they are of a suitable sensitivity and resistance.

Power Supply Unit Type 4234

The accuracy of a Katharometer system is dependent upon the accuracy and stability of the current supplied to the Katharometer bridge. An error of 1% in the bridge current can cause an error of up to 3% in the final reading and for this reason a specially developed constant current unit is available.

Series 4234 Power Supply

Specification – Katharometer

6517 Series

Approximate volume

5ml (0.169 fl ozs.) (differential Katharometers 10ml [0.338 fl ozs.])

Optimum sample flow rate

50 to 200ml/min. (1.691 to 0.6.763 fl ozs.)

Bridge current

350mA standard
Some special applications require a different current

Thermostat temperature (when fitted)

47°C ±0.5° (116.6°F ±1°F) (55°C [131°F] for some applications)

Accuracy

Better than 1% FSD at time of calibration

Output signal

0 to 1mV to 0 to 50mV depending on range and requirements
Preferred standard outputs 0 to 5mV or 0 to 10mV

Pipe connections

4mm compression fitting, in 1/8 in. BSP female mount

Specification – Power Supplies

Series 4234-600 and 4234-601

Supplies 1 or 2 Katharometers with a preset current (normally 350mA)

Maximum load

21Ω, including connecting cable

Supply voltages

Series 4234-601 115V 50/60Hz

Series 4234-600 230V 50/60Hz

Ambient temperature range

–20 to 55°C (–4 to 131°F)

Stability

Within ±0.7% of initial setting over one month

Dimensions

160mm high x 170mm width x 111mm deep
(6.3 in. high x 6.7 in. width x 4.4 in. deep)

Cable entries

Three separate glands suitable for cables 6.5 to 10.5mm
(0.256 to 0.413 in.)

Weight

2.12kg (4.7 lb)

Series 4234-500 and 4234-501

For intrinsically safe applications. Must be installed in a safe atmosphere and are for use with a Katharometer measuring a potentially inflammable gas in air. Supplies one Katharometer only.

Maximum load

Katharometer 13Ω max. Cable 2Ω max.

Supply voltage

Series 4234-501 115V 50/60Hz

Series 4234-500 230V 50/60Hz

Ambient temperature range

–20 to 55°C (–4 to 131°F)

Stability

Within ±0.7% of initial setting over one month

Dimensions

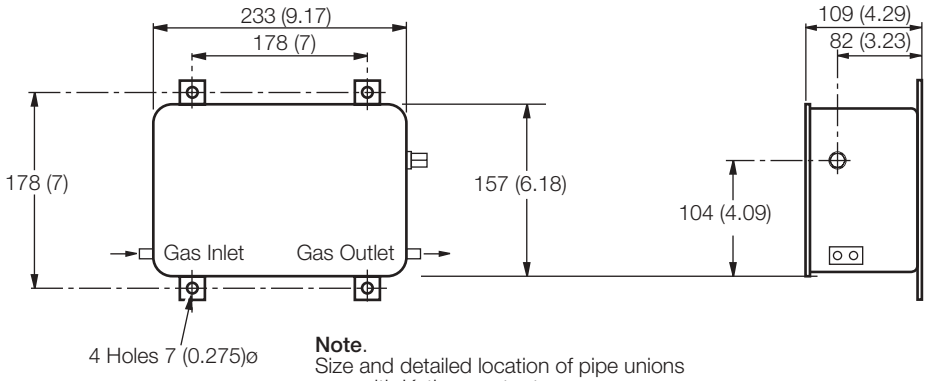
160mm high x 170mm width x 111mm deep
(6.3 in. high x 6.7 in. width x 4.4 in. deep)

Weight

2.12kg (4.7 lb)

Overall Dimensions

Dimensions in mm (in.)

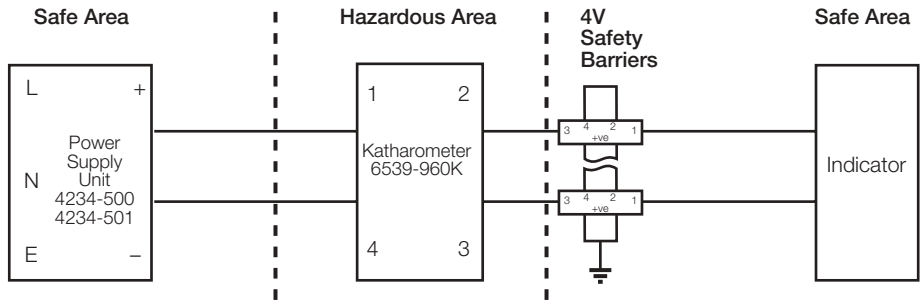


Note.
Size and detailed location of pipe unions vary with Katharometer type.
Data shown is for type 6517.

Katharometer

Electrical Connections

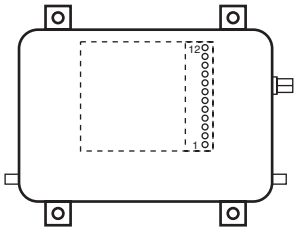
Electrical connections are made to the 12-way screw terminal block inside the Katharometer unit via the 20mm cable gland on the right side of the unit casing. The gland is suitable for cables 6.5mm to 10.5mm (0.256 to 0.413 in.) diameter.



Cable used as specified in latest BASEEFA standard

Typical wiring schematic

Katharometer Terminal Connections



Terminal Connections

1. Power supply (+ve)(350mA)
2. +ve } Bridge Output
3. –ve } (Range 1)
4. Power Supply (–ve)(350mA)
5. +ve } Bridge Output
6. –ve } (Range 2 if supplied)
7. +ve } Power supply to Temperature Control
8. –ve } Circuit (Models 6518 & 6520 only)
9. } Provision for external zero control
10. } (1kΩ variable resistor)
11. Allocated for special purposes as required
12. Allocated for special purposes as required

Ordering Information

Due to the extremely wide and varied range of Katharometers that can be supplied a questionnaire is available on application to assist in fulfilling the requirements for all the process details needed before a quotation can be provided.

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