Chapter 1. Features and Capabilities

1.1 Introduction

This chapter introduces you to the features and capabilities of the GE *XMTC Thermal Conductivity Transmitter.* The following topics are discussed:

- Basic features of the XMTC thermal conductivity transmitter
- Theory of operation
- A system description of the XMTC, available options, and sample systems Information on optional components is also provided, including a 24 VDC power supply, extra cable, and the TMO2D-TC Display.
- A brief discussion of typical XMTC applications

XMTC technical specifications can be found in Chapter 5, *Specifications*. Ordering information can be found in Appendix A, *Supplemental Information*.

1.2 Basic Features

- The XMTC is a transmitter that measures the thermal conductivity of a binary (or pseudo-binary) gas mixture containing hydrogen, carbon dioxide, methane or helium, and provides a 4-20 mA signal proportional to the concentration of one of the gases in the mixture. It offers several unique design features:
- Ultra-stable thermistors and a temperature-controlled measuring cell (55°C/131°F standard, 70°C/158°F optional) provide excellent zero and span stability, as well as tolerance of ambient temperature variations.
- The measuring cell design makes it highly resistant to contamination and flow vibrations. Since it has no moving parts, the transmitter can handle the shock and vibration found in many industrial applications.
- A 2-port version for measurement of zero-based gas mixtures using a sealed reference gas (air or nitrogen) and a 4-port version for measurement of zero-suppressed gas mixtures (and some other special calibrations) using a flowing reference gas are available.
- The XMTC modular construction means that the unit can be field-calibrated quickly and easily. If desired, the plug-in measuring cell can be replaced with a pre-calibrated spare in minutes.
- The XMTC transmitter, with weatherproof or explosion-proof packaging, is designed to be installed as close as possible to the process sample point. It can be located up to 4000 ft (1200 m) from a display or recorder, using inexpensive unshielded cable.

1.3 Theory of Operation

The XMTC measures the concentration of a gas in a binary gas mixture by measuring the thermal conductivity of the sample gas and comparing it to the thermal conductivity of a selected reference gas.

Two ultra-stable, glass-coated thermistors are used: one in contact with the sample gas, and the other in contact with a selected reference gas. The thermistors are mounted so that they are in close proximity to the stainless steel walls of the sample chamber. The entire sensor is heated to 55°C/131°F, (or 70°C/158°F) and the thermistors are heated above the sensor temperature using a constant current source. The thermistors lose heat to the walls of the sample chamber at a rate that is proportional to the thermal conductivity of the gas surrounding them. Thus, each thermistor will reach a different equilibrium temperature. The temperature difference between the two thermistors is detected in an electrical bridge circuit. It is then amplified and converted to a 4-20 mA output proportional to the concentration of one of the constituents of the binary gas mixture. For example:

- To measure 0 to 25% H_2 in N_2, the reference gas would be air (2-port version, sealed reference gas), and for calibration, the zero gas would be 100% N_2 (i.e. 0% H_2) and the span gas would be 25% H_2 in N_2.
- To measure 90-100% H_2 in N_2, the reference gas would be 100% H_2 (4-port version, flowing reference gas), the zero gas would be 90% H_2 in N_2, and the span gas would be 100% H_2 (the same as the reference gas).

Note: *The XMTC has polarity adjustment jumpers which permit the measurement of gases (such as CO_2) that have a relative thermal conductivity less than air/nitrogen.*

Appendix A, *Supplemental Information*, contains a table of *Relative Thermal Conductivity of Common Gases*. *Figure 1* below shows some of these values graphically.

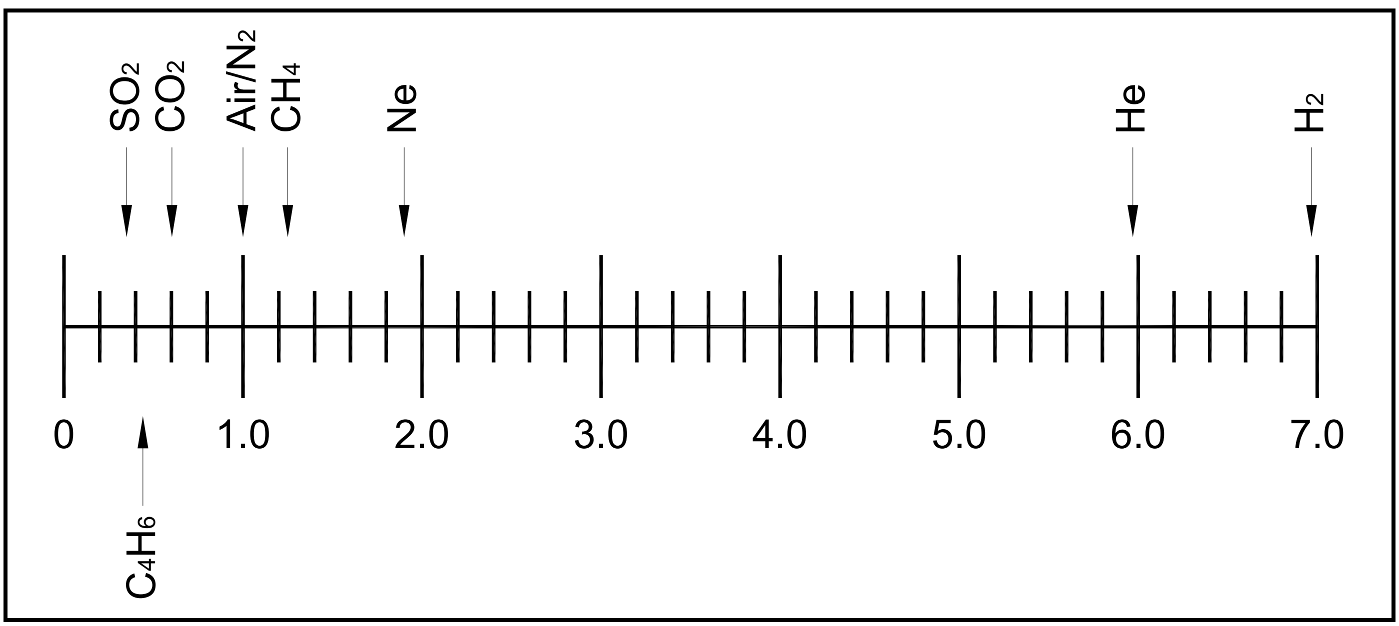

Figure 1: Relative Thermal Conductivity of Some Common Gases

1.4 System Description

The basic XMTC measurement system consists of an XMTC Transmitter mounted in a sample system. The sample system is mandatory, and can either be provided by GE or constructed according to GE recommendations. The XMTC is supplied with a standard 10 ft (3 m), 4-wire cable for power and output connections, with lengths up to 4000 ft (1200 m) available. Optionally available from GE are a 24-VDC power supply to power the XMTC, a remote display with programming and control capabilities, and several analyzers which can be interfaced with the XMTC.

1.4.1 Packaging and Temperature Rating

The XMTC transmitter is self-contained, consisting of the thermal conductivity sensor and associated electronics. It requires 24 VDC power (1.2 A maximum at power-up), and provides a 4-20 mA output signal proportional to the concentration of one of the gases in the binary sample gas mixture.

The XMTC is designed to be installed in a sample system as close as possible to the process sample point. Thus, it is available in two environmental packages:

- Weatherproof
- Explosion-proof (with the addition of flame arrestors to the sample/reference gas inlet and outlet)

Each environmental package is available in a standard 2-port (sealed reference gas) version, or an optional 4-port (flowing reference gas) version.

The XMTC is supplied with a standard measurement cell operating temperature of 55°C (131°F). An optional 70°C (158°F) cell operating temperature is available.

Note: *The 70°C (158°F) operating temperature should be selected only for high temperature applications, because it results in reduced sensitivity.*