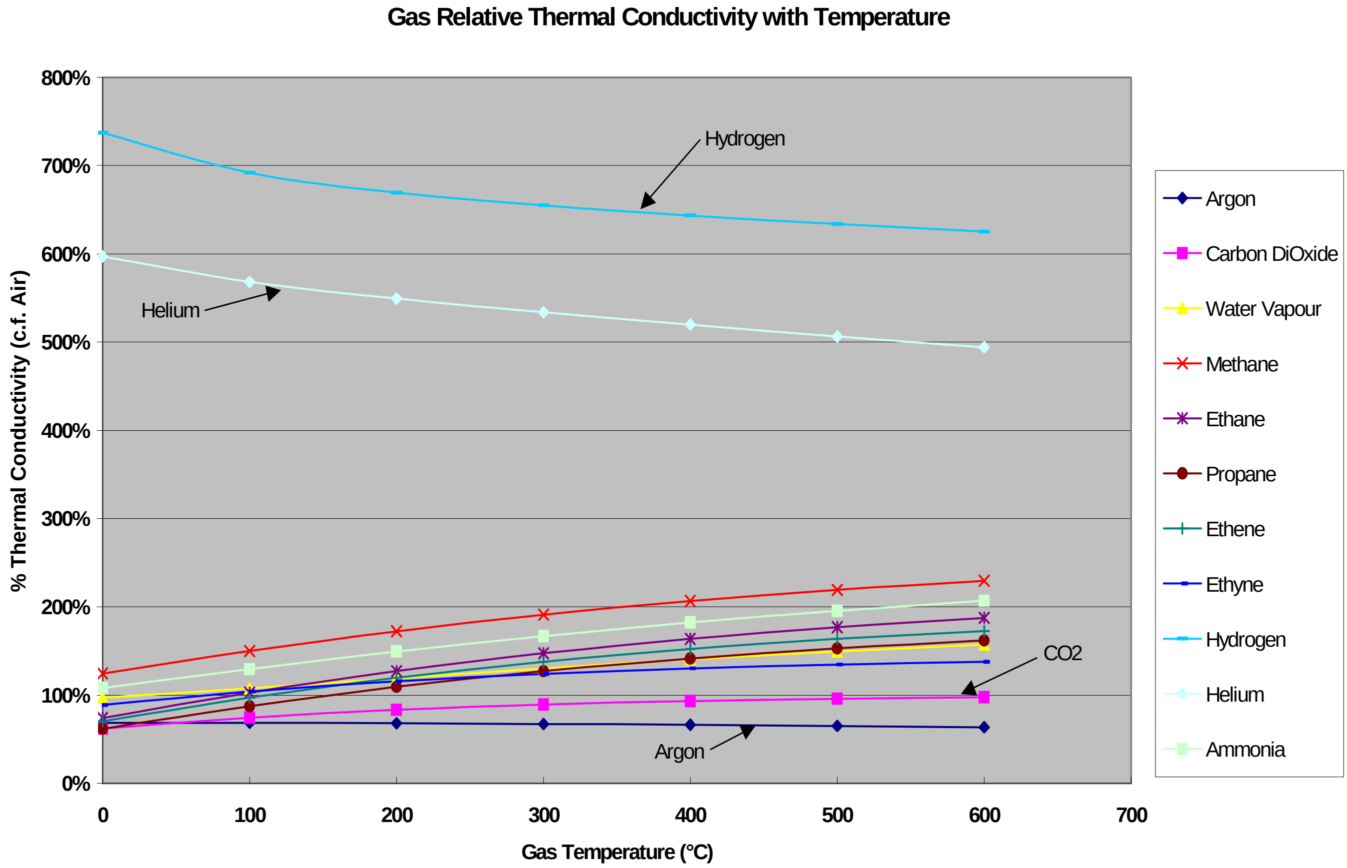
INTRODUCTION

Thermal Conductivity sensors detect and measure between 0 and 100% by volume gases that have thermal conductivities significantly different to a reference gas, usually air. Examples of these gases are: hydrogen, helium and methane. This also means that some gases such as oxygen, nitrogen and carbon monoxide cannot be measured practically as their thermal conductivities are too close to that of air. This difference (or relative thermal conductivity) can vary with the gas temperature (see graph below). This can even result in some gases having lower or greater thermal conductivities than air, depending on the temperature. Sensors that are run at the voltages suggested by SGX will be running at between 400 and 500 °C and the gases in contact with the detecting elements will subsequently be close to this temperature. At this point, most of the detectable gases (apart from argon and carbon dioxide) have relative thermal conductivities greater than that of air.



As shown above, gases with a low density (and high thermal conductivity) such as hydrogen and helium will have much bigger sensor signals compared with other gases. The difference could be up to a factor of 6.

DESCRIPTION

The sensor consists of two matched inert beads, similar to the compensators used in catalytic pellistor sensors. One bead is arranged to allow exposure to the target gas. The other bead is either sealed in a metal can (containing air) fitted to the header on which the beads are welded, or sealed in a chamber within the certified head into which the sensor is eventually fitted.

PRINCIPLE OF OPERATION

The sensors are typically connected in a simple Wheatstone bridge circuit and generally operated at a constant voltage. When the beads are running in air, the beads loose heat at a similar rate resulting in a set difference between the resistances providing a signal to the bridge, which can be zeroed within the bridge circuit. When the sensor is exposed to the target gas, the atmosphere around the detecting element changes, resulting in a greater or lesser amount of heat being lost from the detector bead, leading to a drop or increase in the bead temperature and hence its resistance. The drop or increase is dependent on the target gases thermal conductivity being greater than or less than the thermal conductivity of the reference gas. The reference bead being sealed does not show this effect. The drop or increase in the detecting bead resistance is shown by a negative or positive output of the sensor circuit. This output value is dependent on the sensor type chosen, operating voltage and target gas; it can be of the order 100 mV to 700 mV negative for pure gases such as methane and helium. For pure argon, a typical output would be 50 mV to 100mV positive due to the thermal conductivity being much less than that of air.

LINEARITY

The sensor signal is non-linear with increasing concentrations. This non-linearity can be easily handled using curve fitting (e.g. a quadratic response) or using look-up tables.

RESOLUTION AND ACCURACY

Thermal conductivity sensors work between 0 and 100% by volume. However, the resolution is usually not great enough to cover the 0 - 100% LEL range. The resolution of the sensor depends on the accuracy of the curve fitting, but the instruments containing these sensors can meet the limits specified in EN 61779 Parts 3 and 5.

ADDITIONAL INFORMATION

- Since no catalytic processes are occurring, the sensor does not poison in atmospheres containing poisons such as organic silicones. However, some changes to the sensor response may be seen if decomposition of species onto the detecting bead causes a change in the bead operating resistance/temperature.
- Again, since no catalytic processes are occurring, the sensor does not need oxygen to work.
- Care must be taken to seal the compensating element fully. A loss in signal with exposure time will be seen if the target gas is allowed to reach the compensating element.
- Changes in the humidity and pressure of the target gas will affect the rate of heat loss from the detector bead and hence the sensor zero. In practice, however, the effect is not significant.
- For further information, contact SGX directly.