

SEMI E18-91 (Reapproved 0299) GUIDELINE FOR TEMPERATURE SPECIFICATIONS OF THE MASS FLOW CONTROLLER

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1 Purpose

1.1 The purpose of this guideline is to establish a uniform, worldwide means to describe the temperature parameters which are characteristic of mass flow controllers. It is intended to prevent confusion and misunderstanding between manufacturers and users.

2 Scope

2.1 This guideline contains definitions of terms which describe the effects of temperature upon mass flow controllers as used in the semiconductor industry.

3 Definition of Terms (See Figure 1)

3.1 *Units* — Degrees Celsius (C) is used as the temperature unit.

3.2 *Ambient Temperature* — The temperature of the medium surrounding the device.

Note: The ambient temperature assumes that the instrument is not exposed to significant radiant energy sources.

3.3 *Gas Temperature* — The actual temperature of the flowing gas at the primary flow standard.

3.4 *Calibration Temperature* — The ambient temperature at which the mass flow controller was calibrated.

Description Form: ____°C

CAUTION — Calibration Temperature is not to be confused with Gas Temperature or Standard Temperature.

3.5 *Standard Temperature* — The temperature to which a volumetric flow rate (measured at the Gas Temperature) is referenced through the ideal gas law ($PV = nRT$). SEMI E12 defines Standard Temperature as 0.0°C.

CAUTION — Standard Temperature is not the same as the Gas Temperature or Calibration Temperature.

3.6 *Reference Operating Temperature* — The range within which accuracy statements apply without requiring correction for Temperature Effects (see 3.11).

Description Form: ____°C – ____°C

3.7 *Normal Operating Temperature* — The temperature range within which the influence of ambient temperature on the performance is stated.

Description Form: ____°C – ____°C

3.8 *Operating Temperature Limits* — Operation is permitted within this range but performance is not specified beyond the Normal Operating Temperature. If the instrument is operated outside these limits damage may occur.

Description Form: ____°C – ____°C

3.9 *Maximum Baking Temperature* — The highest temperature to which the Mass Flow Controller or its components in contact with the gas can be heated in accordance with a specified baking procedure. The specified baking process will not impair the performance characteristics per the manufacturers specifications. ("Baking" is a process whereby a device is heated to accelerate the removal of adsorbed gases and/or other volatile material.)

Description Form: MAX. ____°C

3.10 *Storage Temperature Limits* — The temperature limits to which the mass flow controller may be subjected in an unpowered condition. No permanent impairment shall take place, however minor adjustments may be needed to restore performance to normal.

Description form: ____°C – ____°C

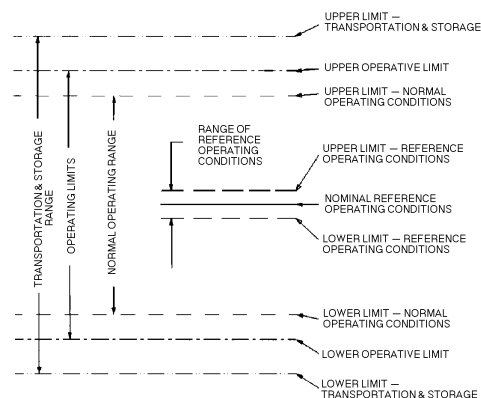


Figure 1

3.11 Temperature Effects — See Figure 2.

NOTE 1: This section requires that Gas Temperature be the same as Ambient Temperature.

3.11.1 *Total Effect* — The change in output, including zero and span, due to a change in Ambient Temperature from one normal operating temperature to a second normal operating temperature. All other conditions must be held within the limits of reference operating conditions.

3.11.2 *Zero Effect* — The change in zero due to a change in ambient temperature from one normal operating temperature to a second normal operating temperature. All other conditions must be held within the limits of reference operating conditions.

The effect of temperature change on zero may be expressed as a coefficient calculated as the ratio of full scale percent change in output to the corresponding change in temperature. The change in ambient temperature should be specified. This coefficient is defined as the “temperature coefficient of zero.”

Example: Temperature coefficient of zero may be expressed as:

$$\frac{2\% \text{ of Full Scale}}{40^{\circ}\text{C} - 20^{\circ}\text{C}} = 0.1\% \text{ of Full Scale}/^{\circ}\text{C}$$

NOTE 2: If the relation between temperature and change in output is linear, one coefficient will suffice.

If the temperature influence is non-linear a different method of expression may be used. Two examples:

1. The percent of full scale change in output will not exceed a specified value for any value of temperature within a specified temperature range.

Example: “± 1.5% of full scale maximum error over 10°C to 50°C”

2. It may be desirable to state a series of coefficients for successive increments of temperature within a specified temperature range.

3.11.3 *Span Effect* — The change in span due to a change in ambient temperature from one normal operating temperature to a second normal operating temperature. All other conditions must be held within the limits of reference operating conditions.

The effect of temperature change on span may be expressed as a coefficient calculated as the ratio of percent of reading change in output to the corresponding change in temperature. The change in ambient temperature should be specified. This

coefficient is defined as the “temperature coefficient of span.”

Example: Temperature coefficient of span may be expressed as:

$$\frac{1\% \text{ of reading}}{40^{\circ}\text{C} - 20^{\circ}\text{C}} = 0.05\% \text{ of reading}/^{\circ}\text{C}$$

NOTE 3: If the relation between temperature and change in output is linear, one coefficient will suffice.

If the temperature influence is non-linear a different method of expression may be used. Two examples:

1. The percent of span change in output will not exceed a specified value for any value of temperature within a specified temperature range.

Example: “± 1.0% of reading maximum error over 10°C to 50°C”

2. It may be desirable to state a series of coefficients for successive increments of temperature within a specified temperature range.

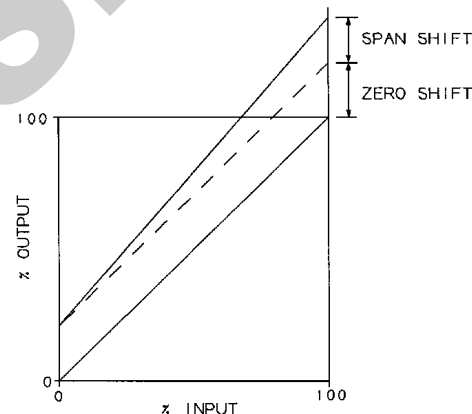


Figure 2
Span and Zero Shift

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