Microbridge Airflow Sensors

Measuring Low Differential Pressures
Altitude and Gas Density Correction – Note #1

Microbridge mass airflow sensors measure actual mass flow of a gas media (assuming thermal conductivity of the gas is held constant). The actual flow of the gas media is driven by a pressure gradient flowing from a higher pressure region to a lower pressure region. The pressure differential required to drive flow through the microbridge mass flow sensor is considered very low, typically less than two inches water column (less than five mBar) full scale.

As a result, microbridge mass flow sensors are commonly used to measure differential pressures as low as 0.001″ H_2O (0.002 mBar). In these applications, the microbridge sensors actually sense mass gas flow. However, the product is specified and calibrated against differential pressure. To measure differential pressure, the application must be able to provide gas flow through the sensor (gas density remaining constant).

This can be referenced to the Ideal Gas Law which states: PV = nRT. This implies that while measuring differential pressures, the sensor gain will be directly proportional to the absolute pressure (absolute density) of the gas. Microbridge mass flow sensors are calibrated at 850 feet (260 meters) above sea level with the absolute pressure at approximately 740 torr.

At sea level with absolute pressure at 760 torr, the sensor voltage output will be higher by an approximate factor of:

$$1 + \frac{(760\text{-}740)}{740} \text{ or } 1.027$$

Additionally, if located in Salt Lake City - Utah, where the altitude is 4,200 feet (1,270 meters) above sea level, the standard absolute pressure is 650 torr.

This will result in the sensor voltage output being reduced by an approximate factor of:

$$1 + \frac{(650\text{-}740)}{740} \text{ or } 0.8784$$

See Table 1 below for additional approximations for various altitude corrections.

When using microbridge mass flow sensors to measure low differential pressures, the temperature of the gas can also affect the relative gas density. Density changes due to temperature can cause a shift in the sensor output gain. The shift will be proportional to the change in the absolute gas density (referenced to 23°C).

NOTE: When measuring actual mass flow, the microbridge sensor is insensitive to altitude and gas density changes.

Table 2- Approximate Altitude Correction Factors

Altitude	Absolute Pressure Torr	mBar	kPa	Approximate Correction Factors	Representative Cities
0 m (0 ft.)	760	1000	100	1 + (760-740)/740 = 1.027	London (U.K.), New York, NY (US), Tokyo (Japan)
250 m (820 ft.)	740	984	98	1 + (740-740)/740 = 1.000	Minneapolis, MN (US), New Delhi (India), Turin (Italy)
500 m (1,650 ft.)	720	958	96	1 + (720-740)/740 = 0.973	Munich (Germany), Santiago (Chile), Spokane, WA (US)
750 m (2,500 ft.)	694	925	92	1 + (694-740)/740 = 0.938	Ankara (Turkey), Tucson, AZ (US)
1,500 m (5,000 ft.)	632	842	84	1 + (632-740)/740 = 0.854	Denver, CO (US), Johannesburg (S. Africa)
2,250 m (7,500 ft.)	575	766	77	1 + (575-740)/740 = 0.777	Addis Ababa (N.E. Africa), Mexico City (Mexico)
3,000 m (10,000 ft.)	523	697	70	1 + (523-740)/740 = 0.707	La Paz (Bolivia), Leadville, CO (US)