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# Gas Media Compatibility and Correction Factors

A Technical Note

## 1.0 Microbridge Wetted Sensor Materials and Gas Media Compatibility

The microbridge mass airflow sensor incorporates a limited number of wetted materials in its construction. The wetted materials in the sensor are fairly non-reactive and are compatible with a wide variety of gaseous media.

Tables 1 and 2 list wetted sensor materials and associated gas media compatibility.

**CAUTION**
**PRODUCT DAMAGE**
Do not use Honeywell microbridge mass airflow sensors to sense liquid flow.
**Failure to comply with these instructions may result in product damage.**

**NOTICE**
Filtering is highly recommended for use in applications that may contain dust particle contamination that can degrade sensor performance over time. See the "Flow Sensor Particle Contamination and Filter Manufacturers" Technical Note for more information.

**Table 1. Microbridge Wetted Sensor Materials**

| Sensor Material | AWM1000 | AWM2000 | AWM3000 | AWM40000 | AWM5000 | Honeywell Zephyr™ |
|---|---|---|---|---|---|---|
| Silicon | X | X | X | X | X | X |
| Silicon nitride | X | X | X | X | X | X |
| Gold | X | X | X | X | X | X |
| Aluminum oxide | X | X | X | X | X | — |
| Epoxy sealant | X | X | X | X | X | X |
| Fluorocarbon | — | — | — | X | X | X |
| Polyester | — | — | — | — | X | — |
| Polyetherimide | X | X | X | 6 SLPM only | X | — |
| 316 stainless steel | AWM1200V | AWM2200V | AWM3200V | — | — | — |
| Glass-reinforced thermoplastic polymer | — | — | — | — | — | X |
| Silicon dioxide | — | — | — | — | — | X |
| PCB epoxy composite | — | — | — | — | — | X |

**Table 2. Microbridge Gas Media Compatibility**

| Sensor Material | AWM1000 | AWM2000 | AWM3000 | AWM40000 | AWM5000 | Honeywell Zephyr™ |
|---|---|---|---|---|---|---|
| Air | X | X | X | X | X | X |
| Nitrogen ($N_2$) | X | X | X | X | X | X |
| Oxygen ($O_2$) | X | X | X | X | X | X |
| Argon (Ar) | X | X | X | X | X | X |
| Helium (He) | 15 Vdc supply | 15 Vdc supply | 15 Vdc supply | 15 Vdc supply | 15 Vdc supply | X |
| Hydrogen ($H_2$)[1] | special listing | special listing | special listing | special listing | special listing | N/A |
| Natural gas | X | X | X | X | X | N/A |
| Nitrous oxide ($N_2O$) | X | X | X | X | X | X |
| Anesthetic gases | N/A | N/A | N/A | N/A (except 6 SLPM) | X | X |
| Carbon dioxide ($CO_2$) | X | X | X | X | X | X |
| Nitric oxide (NO) | dry gas only | dry gas only | dry gas only | dry gas only | dry gas only | N/A |
| Water vapor ($H_2O$) | non-condensing | non-condensing | non-condensing | non-condensing | non-condensing | non-condensing |
| Ammonia gas ($NH_3$) | dry gas only, <1% | dry gas only, <1% | dry gas only, <1% | dry gas only, <1% | dry gas only, <1% | N/A |
| Chlorine gas ($Cl_2$) | <0.1% | <0.1% | <0.1% | <0.1% | <0.1% | N/A |
| Hydrogen sulfide ($H_2S$) | <0.1% | <0.1% | <0.1% | <0.1% | <0.1% | N/A |
| Xenon (Xe)[2] | N/A | N/A | N/A | N/A | N/A | X |

[1]Applications involving hydrogen gas sensing require the use of a sensor identified by the letter "H" in the catalog listing. Current hydrogen stable-catalog listings are: AWM2100VH, AWM2300VH, and AWM42150VH. Other listings may be established as hydrogen-stable devices.

[2]Xenon gas only applies to the Honeywell Zephyr™.

## 2.0 Effect of Gases on Microbridge Mass Airflow Sensors

Microbridge mass airflow sensors operate by measuring the rate of relative heat transfer from a heater resistor to a temperature sensing resistor located on either side of the heater. The heat transfer is proportional to the mass flow. Offsets in the sensor sensitivity (thermal efficiency) will occur if the thermal properties of the medium change. The dominant factor is the thermal conductivity of the gas being measured. Additionally, heat capacity and gas viscosity cause lesser effects. Heat capacity and gas viscosity are constants for a given gas; however, if the gas composition changes, these properties may also change. Fortunately, air, nitrogen, and oxygen have nearly identical properties.

The 0.5% argon (Ar) in air is not significant, nor is the relative humidity from 0% to 99% at temperatures less than 40°C [104°F]. Humidity levels of 100%, with temperatures greater than 40°C [104°F], indicate that more than 1% of the atmosphere is water. This may cause a measurable increase in sensor output. The actual offsets from argon and 100% humidity are in opposite directions and may partially cancel each other at temperatures less than 40°C [104°F].

Carbon monoxide (CO) and nitric oxide (NO) have properties similar to air. Carbon dioxide ($CO_2$) will have increased sensitivity compared to that of air (roughly 135%, this may vary with flow rate). Gases similar to $CO_2$ are nitrous oxide ($N_2O$) and nitrogen dioxide ($NO_2$).

**NOTICE**

When sensing hydrogen ($H_2$) or helium (He) with the AWM series, it may be necessary to power the mass flow sensors using increased supply voltage: hydrogen, 12 Vdc typical, and helium, 15 Vdc typical.

When using helium with the AWM series sensors an increase supply voltage is required. Helium has such a high thermal conductivity that it will saturate the heater control circuit on the sensor unless supply voltage is increased to 15 Vdc. Helium sensitivity is then reduced to the point where two liters of helium will produce an output equivalent to one liter (1,000 SCCM) mass flow of air or nitrogen. The correction factor will be dependent upon temperature and actual flow rate.

Hydrogen flow measurement requires the use of a special sensor. These devices provide normal operation when sensing hydrogen flow and are designated with an "H" at the end of the catalog listing. Established hydrogen-stable listings include AWM2100VH, AWM2300VH and AWM42150VH.

## 3.0 Application of Gas Correction Factors

To apply a gas correction factor, multiply the sensed flow value by the approximate gas correction factor given in Table 3.

For example, assume a sensor calibrated for nitrogen is being used to sense nitrous oxide, and the sensor is outputting a value of 20 SLPM (of nitrogen). Multiplying 20 SLPM by the nitrous oxide correction factor of 0.7 gives an actual flow of 14 SLPM (of nitrous oxide).

**Table 3. Approximate Gas Correction Factors[1, 2]**

| Gas Type | AWM Series Approximate Gas Correction Factor | Honeywell Zephyr™ Series Approximate Gas Correction Factor Full Scale Less than 1 SLPM | Honeywell Zephyr™ Series Approximate Gas Correction Factor Full Scale Greater than 20 SLPM |
|---|---|---|---|
| Helium (He) | 2.0 | — | — |
| Hydrogen ($H_2$) | 1.4 | — | — |
| Argon (Ar) | 1.1 | — | 1.048 |
| Nitrogen ($N_2$) | 1.0 | 1.0 | 1.0 |
| Oxygen ($O_2$) | 1.0 | — | 1.019 |
| Air | 1.0 | 1.0 | 1.0 |
| Nitric oxide (NO) | 1.0 | — | — |
| Methane ($CH_4$) | 0.9 | — | — |
| Ammonia ($NH_3$) | 0.9 | — | — |
| Nitrous oxide ($N_2O$) | 0.7 | — | 0.569 |
| Nitrogen dioxide ($NO_2$) | 0.7 | — | — |
| Carbon dioxide ($CO_2$) | 0.7 | — | 0.575 |

[1]Gas correction factors are referenced to nitrogen ($N_2$) as the calibration gas type. Approximate gas correction factors are provided as guidelines only. Individual gas types may perform differently at temperature extremes and varying flow rates.
[2]When using alternate gas types, users should verify null before applying correction factors.

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