Swagelok

HF Series Manual Regulator Technical Report

Scope

This technical report provides data on Swagelok® HF series manual regulators. The report covers:

- surface finish
- particle counting
- moisture analysis
- hydrocarbon analysis
- ionic cleanliness
- lab cycle test data.

Particle counting, moisture and hydrocarbon analysis, and ionic cleanliness data show test results from regulators cleaned with deionized (DI) water according to the techniques described in the Swagelok *Ultrahigh Purity Process Specification (SC-01),* MS-06-61.

Surface Finish

Statistical process control (SPC) allows Swagelok to provide consistent surface finishes, as described in SC-01. The roughness average (R_a) specification we have established for the wetted surfaces of HF series regulators is 5 µin. (0.13 µm) R_a on average.

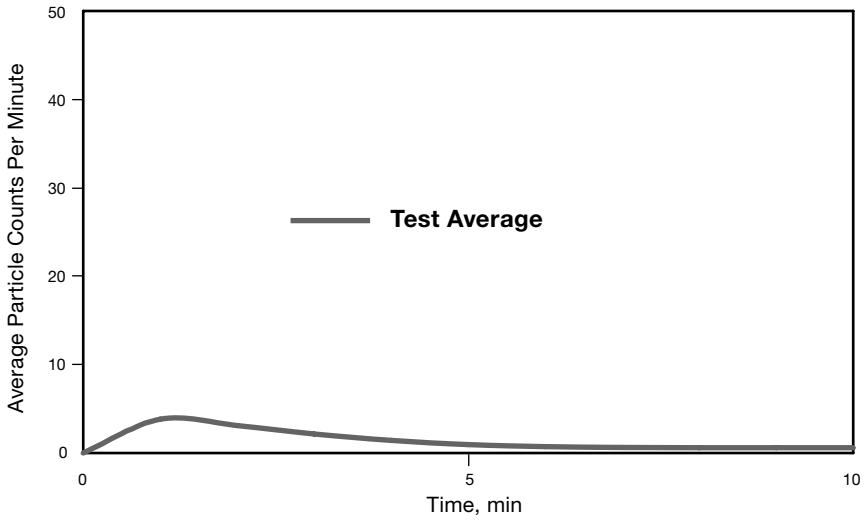
Particle Counting

Static particle counts from HF series manual regulators are very low.

Five regulators, SS-HFM3B-VCR4-P, were tested in accordance with SEMASPEC 93021510A-STD:

- Class 100 cleanroom
- Class 100 laminar-flow bench
- 1.1 std ft^3/min flow rate
- Particles greater than 0.014 µm in size detected. (Typical counters detect particles 0.020 µm and greater in size.)
- Regulators tested in the full open position.

The data represent an average of all five regulators.



Moisture Analysis

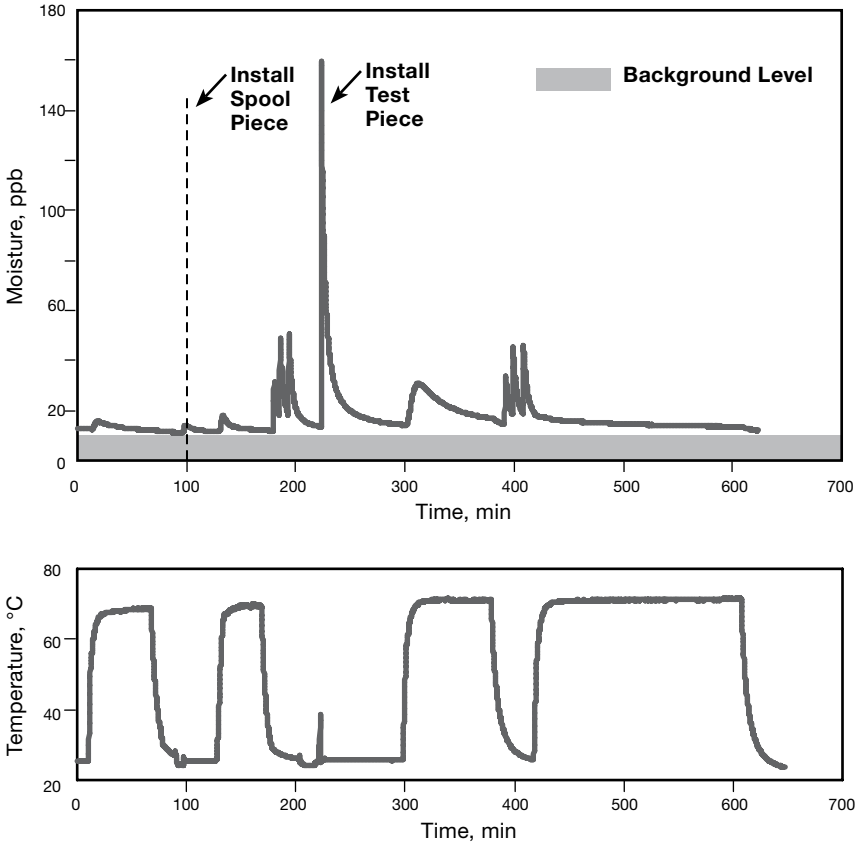
HF series manual regulators were tested at an independent lab in accordance with SEMI E 49.8.

Five regulators, SS-HFM3B-VCR4-P, recovered to background levels from a 2 ppm moisture spike within 20 minutes, much faster than the 1 hour maximum allowed by SEMI E 49.9.

- The test gas was pure nitrogen.
- The flow rate was 1.28 std L/min at 30 psig (2 bar).

The lower graph shows the pattern of elevated temperatures that were applied to the regulators during testing to enhance the moisture sensitivity of the system.

The data represent the result from one regulator and are typical of the results from all five regulators tested.

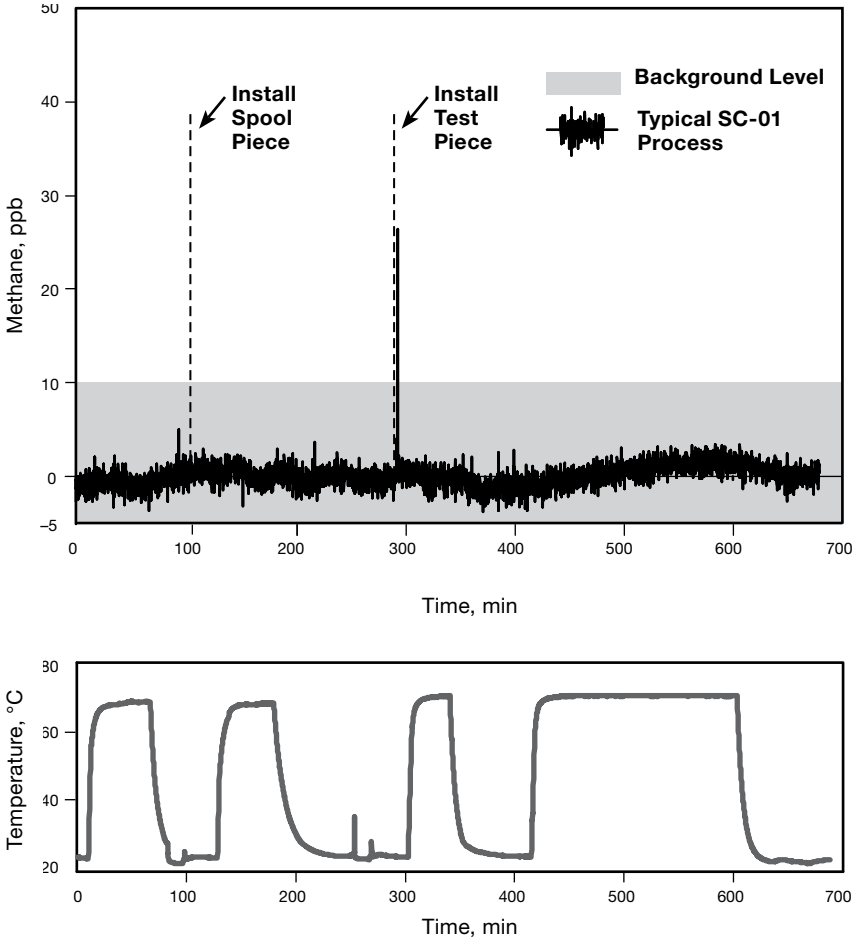


Hydrocarbon Analysis

Hydrocarbon residues in HF series manual regulators fall within the background level produced by the test instrument.

Hydrocarbon analyses of the regulators are conducted in accordance with SEMASPEC 90120396B-STD guidelines.

The lower graph shows the pattern of elevated temperatures that were applied to the regulators during testing to drive off any hydrocarbon residues in the system.



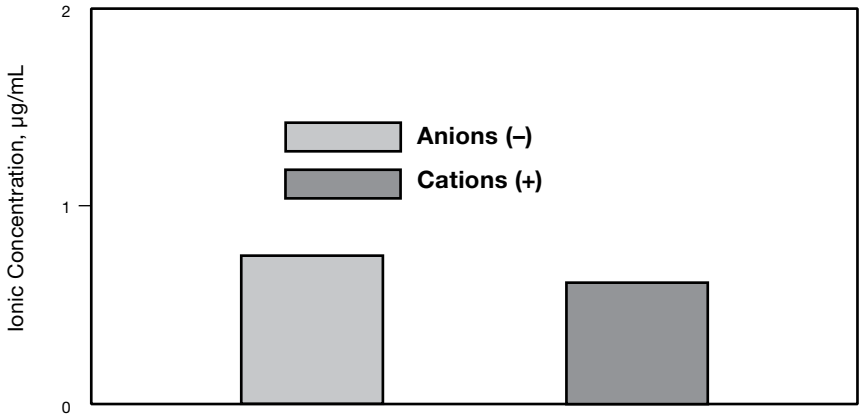
Ionic Cleanliness

Residual ionic contamination is very low for HF series manual regulators. Five regulators, SS-HFM3B-VCR4-P, were tested in accordance with ASTM F1374:

- Each regulator was filled with deionized (DI) water.
- After 24 h, the sample was extracted and analyzed.

The data represent an average of all five regulators.

Anions (–)	Cations (+)
Fluoride	Lithium
Chloride	Sodium
Nitrate	Ammonium
Phosphate	Potassium
Sulfate	Magnesium
	Calcium



Lab Cycle Testing

The HF series manual pressure regulator was tested to determine an estimated cycle life of the diaphragm under laboratory conditions (table at right).

Five regulators, SS-HFM3B-VCR4-P, with standard alloy 625 diaphragms were tested.

- Each regulator was set to deliver 30 psig (2.0 bar) outlet pressure at 1 std L/min flow rate with 80 psig (5.5 bar) inlet pressure.
- The regulator inlet was connected to the nitrogen supply, and the outlet was connected to a pneumatically actuated valve.
- The regulator was cycled at a rate of 30 cpm.
- As the regulator was cycled, flow rate through the regulator varied between 0 and 30 std L/min.

Diaphragm cycle life was evaluated at regular intervals. Failure was defined as an envelope leak rate greater than 1×10^{-9} std cm^3/s.

All HF series manual regulators have exceeded 3.5 million cycles without failure.

Test Data

Quantity	5 HF series manual regulators
Gas	Dry, filtered nitrogen
Temperature, °F (°C)	70 (20) ambient
Inlet Pressure, psig (bar)	80 (5.5) constant
Outlet Pressure psig (bar)	30 (2.0) with no flow to 0 psig with flow
Cycle Rate, cpm	30
Cycles Complete	> 3.5 million

These tests are not a guarantee of a minimum number of cycles in service. Laboratory tests cannot duplicate the endless variety of actual operating conditions and cannot promise that the same results will be realized in service.

Referenced Documents

SEMATECH SEMASPECS [1]

93021510A-STD Test Method for Determination of Particle Contribution by Low-Pressure Regulators in Gas Distribution Systems

90120396B-STD Standard Test Method for Determination of Total Hydrocarbon Contribution by Gas Distribution Systems Components

ASTM Standards [2]

F1374 Standard Test Method for Determination of Ionic/Organic Extractables of Internal Surfaces—IC/GC/FTIR for Gas Distribution Systems Components

SEMI Standard [3]

E49.8 Guide for Ultra High Purity Gas Distribution Systems in Semiconductor Manufacturing Equipment

Swagelok Specification

Ultrahigh Purity Process Specification (SC-01), MS-06-61

1. SEMATECH, Inc., 2706 Montopolis Dr., Austin, TX 78741.
2. American Society for Testing and Materials, 100 Barr Harbor Dr., West Conshohocken, PA 19428.
3. Semiconductor Equipment and Materials International, 3801 Zanker Rd., San Jose, CA 95134.

Safe Product Selection
When selecting products, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

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