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## TITLE

Summary of Vibration Test Performance Data Using a Shaker Table for 316 Stainless Steel 1/4, 1/2, 3/4, and 1 Inch Swagelok® Tube Fittings With 316 Stainless Steel Tubing

## PRODUCT TESTED

| Ordering Number | Tubing Size OD × Wall in. | Tubing Hardness HRB | Samples Tested |
|---|---|---|---|
| SS-400-6 | 1/4 × 0.035 | 90 max | 2 |
| SS-400-6 | 1/4 × 0.065 | 90 max | 2 |
| SS-810-6 | 1/2 × 0.065 | 90 max | 5 |
| SS-1210-6 | 3/4 × 0.095 | 90 max | 5 |
| SS-1610-6 | 1 × 0.109 | 90 max | 1 |

## PURPOSE

These assemblies were tested to observe the vibration performance of selected Swagelok tube fittings using a shaker table under laboratory conditions.

## TEST CONDITIONS

Original test date: April 2005

Room temperature laboratory conditions

## TEST METHOD

### Vibration Test

1. The samples were filled with hydraulic oil and installed into the vibration test apparatus.
2. The samples were pressurized to the vibration test pressures, as listed in the Test Results section.
3. The tests were conducted in accordance with MIL-STD-167 Type 1.
4. The tests were conducted in the axial (X), transverse (Y), and transverse rotated 90° (Z) axes.
5. Sample testing was conducted in the following conditions:
    a. X-Axis – Exploratory Vibration
    b. X-Axis – Variable Frequency
    c. X-Axis – Endurance Test
    d. Y-Axis – Exploratory Vibration
    e. Y-Axis – Variable Frequency
    f. Y-Axis – Endurance Test
    g. Z-Axis – Exploratory Vibration
    h. Z-Axis – Variable Frequency
    i. Z-Axis – Endurance Test

6. Exploratory vibration tests were conducted in frequencies from 4 to 50 Hz for 1/4 and 1 in. samples; from 4 to 60 Hz for 1/2 and 3/4 in. samples at the displacement amplitudes listed in the table below in discrete frequency intervals of 1 Hz. At each frequency interval, the vibration was maintained for a period of 15 seconds to determine the frequency at which the presence, location and frequency of resonance occurs.

| **Exploratory Vibration Test Parameters** | |
|---|---|
| **Frequency Range,** Hz | **Peak Displacement Amplitude,** in. |
| 4 to 33 | 0.010 ± 0.002 |
| 34 to 50① | 0.003 + 0.000<br>– 0.001 |
| 34 to 60② | 0.003 + 0.000<br>– 0.001 |

Notes:
① 1/4 and 1 in. samples
② 1/2 and 3/4 in. samples: MIL-STD-167 Type 1 requires testing to 50 Hz; Testing was extended to 60 Hz.

Variable frequency tests were conducted in frequencies from 4 to 50 Hz for 1/4 and 1 in. samples; from 4 to 60 Hz for 1/2 and 3/4 in. samples at the displacement amplitudes listed in the table below in discrete frequency intervals of 1 Hz. At each integral frequency, the vibration was maintained for a period of 5 minutes.

| **Variable Frequency Parameters** | |
|---|---|
| **Frequency Range,** Hz | **Peak Displacement Amplitude,** in. |
| 4 to 15 | 0.030 ± 0.006 |
| 16 to 25 | 0.020 ± 0.004 |
| 26 to 33 | 0.010 ± 0.002 |
| 34 to 40 | 0.005 ± 0.001 |
| 41 to 50① | 0.003 ± 0.000 |
| 41 to 50② | 0.003 + 0.000<br>– 0.001 |
| 51 to 60③ | 0.002 ± 0.000 |

Notes:
① 1/2 and 3/4 in. samples
② 1/4 and 1 in. samples
③ 1/2 and 3/4 in. samples: MIL-STD-167 Type 1 requires testing to 50 Hz. Testing was extended to 60 Hz.

With the 1/4 and 1 in. samples, the resonant frequency occurred at 4 Hz. Therefore, the endurance tests with 1/4 and 1 in. samples were conducted at 4 Hz for a period of 2 hours. With 1/2 and 3/4 in. samples, no resonant frequency was detected during the exploratory vibration tests. Therefore, the endurance tests were conducted at 60 Hz for a period of 2 hours.

7. Upon successful completion, all samples underwent a 5-minute hydrostatic proof test at 150% (+/- 5%) of the vibration test pressure.

## TEST RESULTS

### Vibration Test

| Ordering Number | Tubing Size in. | Samples Tested | Resonant Condition | Vibration Test Pressure psig (bar) | Post-Vibration Proof Pressure psig (bar) | Hydrostatic Proof After Vibration |
|---|---|---|---|---|---|---|
| SS-400-6 | 1/4 × 0.035 | 2 | 4 Hz Endurance tested at 4 Hz | 3750 (258) | 5625 (387) | No visible leakage 2/2 samples |
| SS-400-6 | 1/4 × 0.065 | 2 | 4 Hz Endurance tested at 4 Hz | 3750 (258) | 5625 (387) | No visible leakage 2/2 samples |
| SS-810-6 | 1/2 × 0.065 | 5 | None to 60 Hz Endurance tested at 60 Hz | 5100 (351) | 7650 (527) | No visible leakage 5/5 samples |
| SS-1210-6 | 3/4 × 0.095 | 5 | None to 60 Hz Endurance tested at 60 Hz | 4900 (337) | 7350 (506) | No visible leakage 5/5 samples |
| SS-1610-6 | 1 × 0.109 | 1 | 4 Hz Endurance tested at 4 Hz | 3750 (258) | 5625 (387) | No visible leakage 1/1 sample |

**The tests were conducted beyond the product's recommended operating parameters and do not modify the published product ratings.**

These tests were performed to consider a specific set of conditions and should not be considered valid outside those conditions. Swagelok Company makes no representation or warranties regarding these selected conditions or the results attained. Laboratory tests cannot duplicate the variety of actual operating conditions. Test results are not offered as statistically significant. See the product catalog for technical data.

## SAFE PRODUCT SELECTION

When selecting a product, 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.

### Referenced Documents

MIL-STD-167*, Mechanical Vibrations of Shipboard Equipment (Type 1—Environmental and Type II— Internally Excited),* Department of Defense, Documentation Automation and Productions Services, 5450 Carlisle Pike Bldg., 09, P.O. Box 2020, Mechanicsburg, PA 17055-0788