Shielding Effectiveness of Bal Spring® Canted Coil Springs for EMI

Technical Report
TR-92 (Rev. NC; 9-5-14)
(100-85)

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Bal Seal Engineering is certified to ISO 9001 and TS 16949

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1.0 INTRODUCTION

This report presents the results of shielding effectiveness measurements performed upon Bal Seal Engineering Bal Spring™ BG-series EMI gaskets. The measurements of the gaskets were performed by DNB Engineering, Inc. in Fullerton, California, a fully certified EMC testing laboratory.

Bal Seal Engineering's Bal Spring™ BG-series gaskets are based upon a specific design optimization of its patented canted-coil spring. These gaskets use an all-metallic spring design, manufactured to create a unique canting deflection.

2.0 PURPOSE OF TESTING

The purpose of the test was to measure the shielding effectiveness of Bal Spring™ EMI gaskets. Testing was performed to the requirements of MIL-G-83528, an established procedure for EMI gaskets, the output of which consists of shielding effectiveness measurements.

3.0 SUMMARY

The Bal Spring™ EMI gasket BG25M25 provided greater than 135 dB of shielding at 120 MHz and 105 dB at 1.0 GHz. Additionally, the Bal Seal EMI gaskets provided a consistent 5 to 10 dB of shielding increase to the test interface over a significant portion of the frequency range of 40 MHz to 10GHz.

4.0 BAL SPRING™ EMI GASKET

The Bal Spring™ BG-series EMI gasket is based on a unique canted spring design, with the following benefits and features:

- Long-term durability: high resistance to compression set provided by high deflection and resilience.
- High shielding effectiveness: conductivity across interfaces preserved by highly concentrated forces at numerous contact points.
- Consistent shielding despite surface irregularities and tolerance variations: conformance due to near constant force over a large compression range.
- Fits small package requirements: available in very small ring diameters and cross sections, with various groove options.
- Easy installation: EMI gaskets are self-retained in grooves; no adhesives required.
- Easy assembly: low closure forces from light EMI gasket loads.

Typical forms of Bal Seal EMI gaskets are shown in Figure 1.

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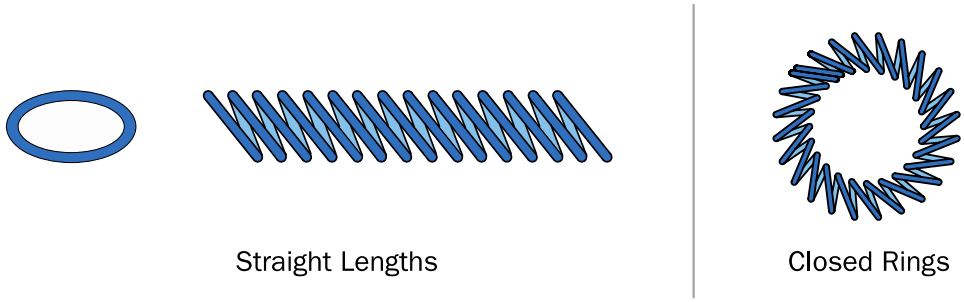

Figure 1
Typical Forms of Bal Seal EMI Gaskets

5.0 TEST PROCEDURE

The MIL-G-83528 specification calls for testing in a radiation configuration, in a modified version of MIL-STD-285, "Military Standard Attenuation Measurements for Enclosures, Electromagnetic Shielding, for Electronic Test Purposes, Method of". The test configuration of MIL-STD-285 is basically that of an enclosure within which is a receiving antenna, and external to it, a transmitting antenna. The shielding effectiveness is determined by taking measurements with and without the enclosure. As MIL-G-83528 is focused upon the shielding characteristics of gasket samples, the enclosure is altered to accommodate a gasket test interface.

The gasket test interface consists of an opening through one of the walls and a cover plate; this interface is sealed with the gasket specimen. The opening is of a square shape, two feet per edge. The enclosure is generally cubic in shape; the overall dimensions are not fixed by the specification. The antennas are aligned and each located one meter away from the opening. Measurements are taken between the antennas, first through the opening, and then with the gasketed plate bolted in place. The ratio between the measurements, expressed in dB, is the "shielding effectiveness" of the gasketed interface. As such, shielding effectiveness increases as the ratio, in dB, increases. The specification cites a test frequency range of 20MHz to 10GHz, which makes a portion of the results susceptible to resonance; resonant modes may occur within the enclosure and opening beyond approximately 175 MHz due to their dimensional relationship with test wavelengths. The basic test configuration is shown in Figure 2.

Shielding effectiveness measurements were performed to the requirements of MIL-G-83528. The output of this test consists of measurements in units of dB over a frequency range. As a general specification, MIL-G-83528 also includes a comprehensive list of quality assurance tests to qualify material lots of the gaskets. These include operating temperature range, hardness, tensile strength, stability through vibration, volume resistivity after life testing, and fluid immersion, among others.

The fixture employed by the testing laboratory has a designed range of DC to 10 GHz. The testing of the Bal Spring™ EMI gaskets was performed over the frequency range of 40 MHz to 1 GHz, in 25 MHz or smaller increments, and over the range of 1 GHz to 10 GHz in 0.25 GHz increments.

Bal Spring™ EMI gaskets from the BG25 series were tested. These are of 0.125 in. (3,18 mm) nominal height. Different configurations of the gaskets were evaluated, including variations of base materials, plating materials, compression forces, and groove types.

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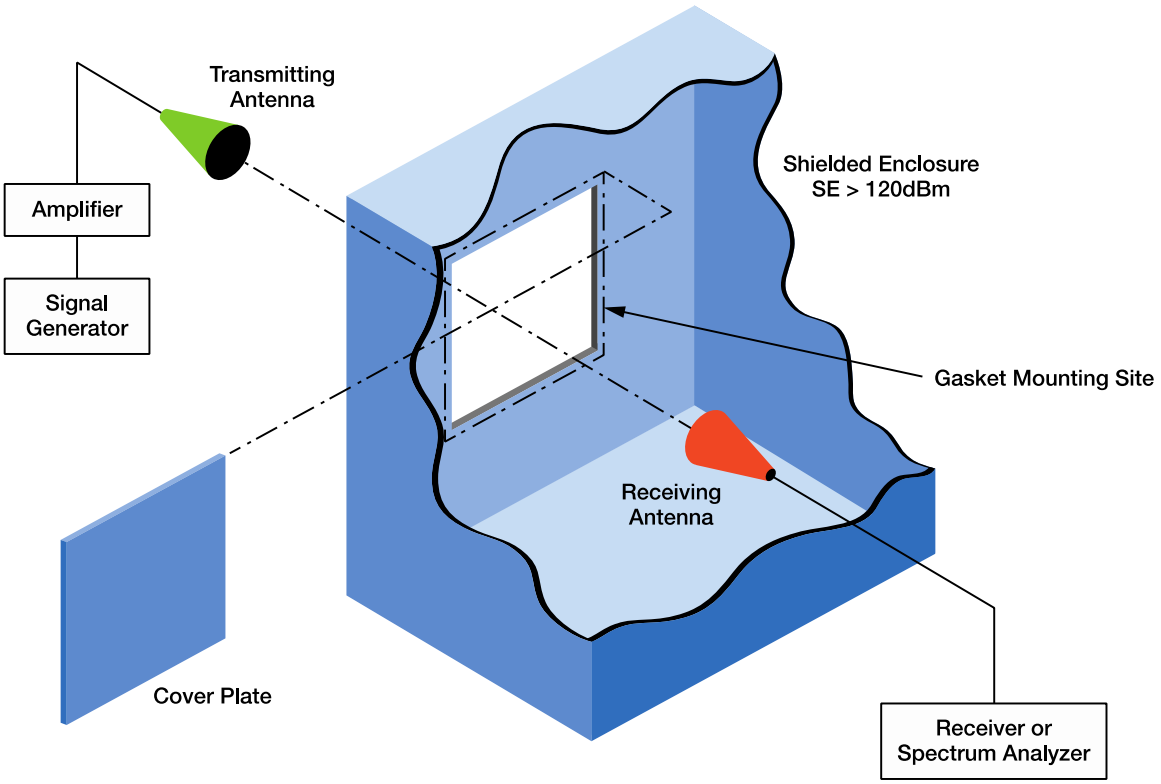

Figure 2
MIL-G-83528 Test Fixture

6.0 TEST RESULTS

The Bal Spring™ EMI gaskets were evaluated in terms of the shielding improvement they provide over an ungasketed configuration. In the data presented in Figure 3, the 'plate' curve is the shielding performance of an ungasketed plate fastened to the wall, and the 'BG25' curves represent that of the plate using the particular springs gasket and groove types. The three configurations generally provided an increase in shielding across the entire test frequency band. The 'BG25M5-SBB Angled' and 'BG25M5-TBB Dovetail' configurations, in particular, showed shielding increases of 5 to 10 dB over a significant portion of the test frequency band. The greatest absolute shielding value was provided by the 'BG25M5-SBB Angled' configuration at approximately 120 MHz; this value was in excess of 135 dB. All of the curves display a trend toward reduced average shielding with respect to increasing frequency. There are numerous spikes in the curves over the test frequency range, and they all share the same general pattern of shielding contribution with respect to that of the unshielded interface.

7.0 CONCLUSIONS

The results of shielding effectiveness testing show that the Bal Spring™ EMI gaskets provided a consistent measure of shielding across a frequency range of 40 MHz to 10 GHz. The shielding behavior of the spring gaskets is correspondent to that of the unshielded plate, and for the bulk of the frequencies, added on the order of 5 to 10 dB of shielding increase to the interface.

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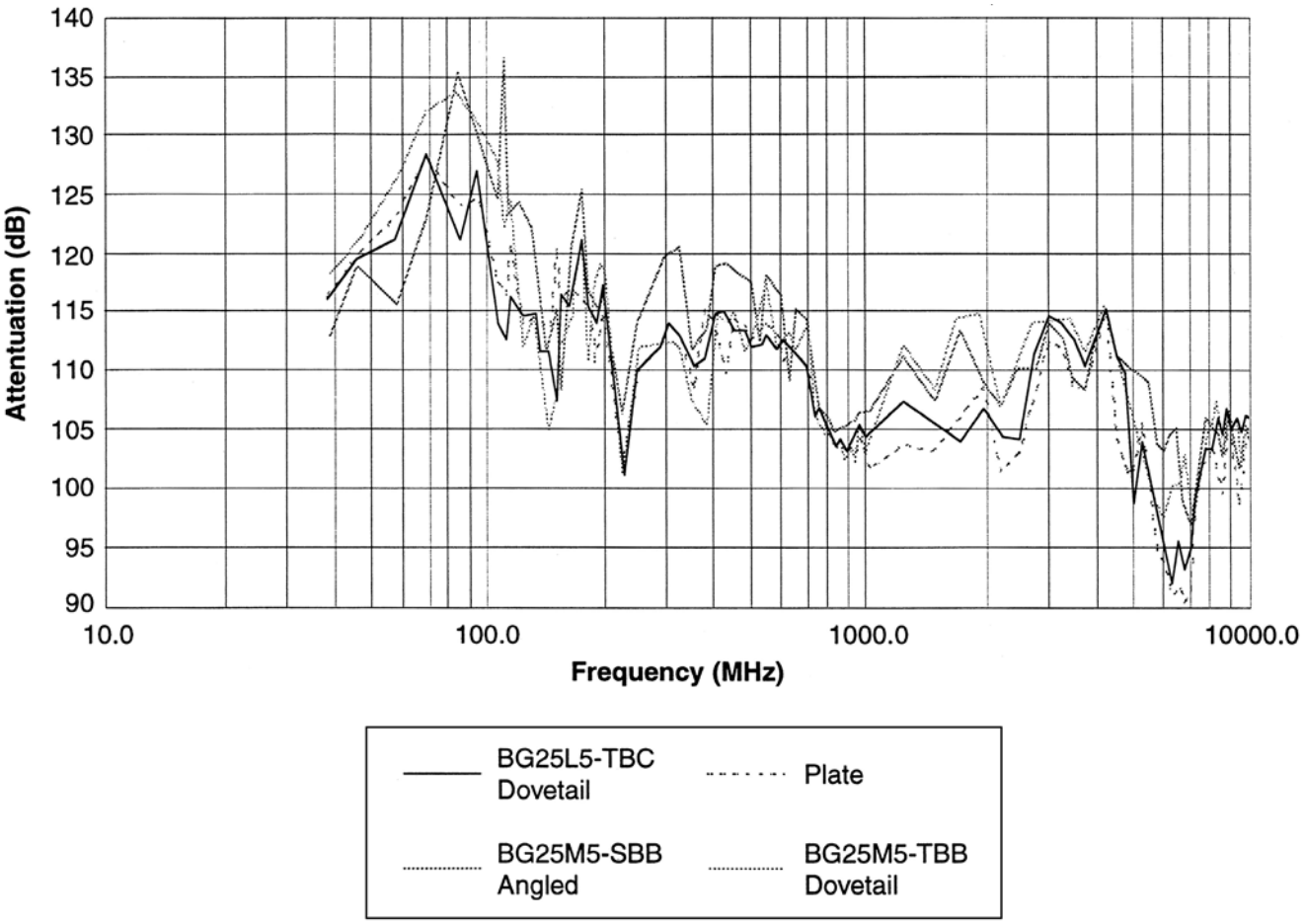

Figure 3
BG25 Measurements - Shielding Effectiveness

8.0 REFERENCES

1. MIL-G-83528 – "Gasketing Material, Conductive, Shielding Gasket, Electronic, Elastomer, EMI/RFI", 4 June 1993, United States Department of Defense
2. MIL-STD-285 – "Attenuation Measurements for Enclosures, Electromagnetic Shielding, for Electronic Test Purposes, Method of", 25 June 1956, United States Department of Defense

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