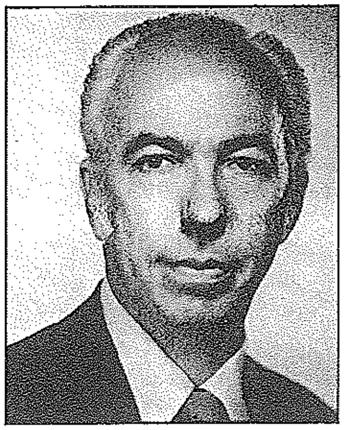
Guest Editorial

by George Kunkel
Spira Manufacturing Corporation
North Hollywood, CA 91605

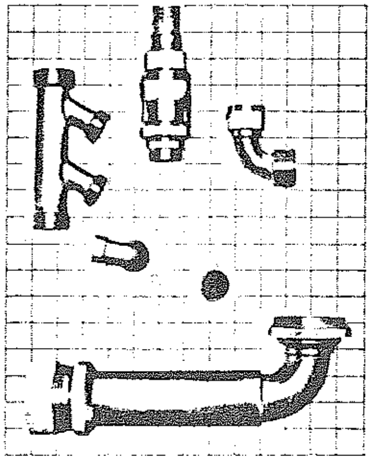


The testing of EMI gaskets, as utilized by EMI gasket manufacturers to determine the shielding quality of the gasket under test, leaves much to be desired. EMI gaskets are very complex devices. They are used by the electrical/electronics industry to obtain a highly conductive path across joint surfaces of shielded barriers for the purpose of obtaining a specific level of shielding effectiveness of the barrier. The requirement of the gaskets is to provide a consistent conductive path across the joint surface throughout the life of the equipment. Efforts have been made by the EMC professional community to provide a reliable measure of the shielding quality of EMI gaskets. The manufacturers of the gaskets have, however, refused to use the calibrated EMC approved test methods to ensure the shielding quality of their products.

In 1975 the SAE AE-4 EMC Committee issued ARP 1173 as a radiated procedure to measure shielding characteristics of EMI gaskets. The procedure was used by some EMI gasket manufacturing companies, but it quickly fell into disuse due to the lack of a requirement by the users and poor EM bonding results of the gaskets under test obtained by the manufacturing companies. In 1981 ARP 1705 was issued as a coaxial (conducted) procedure to measure the shielding characteristics of EMI gaskets. Again the major manufacturers of EMI gaskets refused to use the test method.

The major EMI gasket manufacturers have an extremely strong lobby and are using the lobby to legitimize the uncalibrated procedures which they like to use for their promotional purposes. These procedures are the same ones they have lobbied into MIL-G-83528 and are called "modified MIL-STD-285 testing." The shielded enclosures used to do the testing resonate at about 50 MHz. Because the testing can be done at spot frequencies, almost any results at or above 50 MHz can be obtained by varying the test frequency slightly. More perverse is the testing above 500 MHz. The wavelength of a 500 MHz signal is approximately 24 inches (61 cm), which is the size of the test opening. As a result, the wave impinged on the plate at frequencies above 500 MHz will have equal and opposite current vectors where the actual current flowing across the gasketed joint can approach zero. This will allow a gasket manufacturer to claim exceedingly good RF bonding capability with a specific gasket where, in fact, the results are simply a function of the method and care used in performing the testing.

Unless the EMI gasket users take a stand on the testing of EMI gaskets and insist on the use of qualified calibrated testing, such as the SAE ARPs, by the major EMI gasket manufacturers, the market will be that which the gasket manufacturers want to sell instead of what the industry needs. With the advent of microwave warfare and fly-by-wire airplanes, this can significantly jeopardize the ability of the United States to protect itself from its enemies.



Guest Editorial: A Rebuttal

by Joseph E. Butler
Chomerics, Inc.
Woburn, MA 01888

In his "guest editorial" in the January/February 1989 issue of *EMC Technology*, George Kunkel suggests that coaxial (conducted) measurement per ARP 1705, issued in 1981 by the SAE AE-4 EMC Committee, is the superior method for determining EMI shielding gasket effectiveness. It should be stated that ARP-1705 was developed by the SAE AE-4 EMC Committee in part to provide members of the EMP engineering community a method for obtaining transfer impedance data on shielding mechanisms. Such data makes possible free field-to-system coupling calculations necessary to assess system EMP vulnerability. It was also developed to address concerns over radiated types of measurements.

For two key reasons, the MIL-G-83528 specification for conductive elastomer gaskets (and soon to be released DESC 86129 specification for wire mesh gaskets) cite the "modified MIL-STD-285" radiated EMI measurement. First, this technique addresses the **complete frequency range** of interest to engineers faced with meeting MIL-STD-461 shielding requirements, which extend up to 40 GHz. In contrast, the transfer impedance technique is well understood within the EMP community, where the frequency range of concern extends only up to 100 MHz. To verify system compliance, additional calculations are required.

Second, transfer impedance information is generally not useful to engineers concerned with assessing shielding effectiveness of various materials. EMI design engineers typically need shielding effectiveness information to guide material selection for shielding a system from radiated EMI fields impinging on the equipment. These engineers operate within equipment design guidelines which express shielding requirements in terms of decibels of attenuation. Hence, the modified MIL-STD-285 measurement technique, which quantifies shielding effectiveness in dB, is more meaningful than the transfer impedance method. Simply stated, the average "consumer," in this case the EMI design engineer, is not particularly interested in or, more importantly, knowledgeable about transfer impedance.

Mr. Kunkel suggests various errors which might be associated with radiated EMI measurement methods. To be fair, equally significant (or more serious) concerns exist with respect to using transfer impedance measurements for determining shielding effectiveness. Two critical areas are adequate representation of gasketed joints and the technique's questionable accuracy as the testing approaches 1 GHz. In light of these factors, Mr. Kunkel's indictment of the EMI gasket manufacturing industry as one which asks the consumer to accept less than adequate information on gasket performance is misguided. When one considers the errors associated with the alternative measurement technique, the "threats to national security" suggested in his editorial appear to be in the frequency ranges where that technique is most suspect.

Guest Editorial: The Final Word

by Louis A. Messer
Teledyne Ryan
Electronics
San Diego, CA

This is in response to Joseph Butler's (Chomerics, Inc.) guest editorial in your May/June issue. Mr. Butler rebutted George Kunkel's (Spira Manufacturing) guest editorial in the January/February issue.

Eleven years ago[1] I faced a particularly severe gasketing problem in trying to achieve a high degree of isolation across a gasketed cover joint. It was the type of application that classically would have used nested shields and filters, rather than trying to extend the capability of a single enclosure. I spent several fruitless weeks of testing in trying to achieve the required isolation to a sensitive receiver compartment. The cover gaskets limited the isolation I was able to achieve. I tried most conventional gasket types. These were purchased from vendors who advertised large shielding effectiveness numbers. The candidate gaskets included Chomerics silver loaded elastomers. According to the vendors' literature, all of the gaskets should have performed about equally well. In reality, there were significant differences but none of them were adequate in the region of 30 to 1,000 MHz. I was rather discouraged because I was facing the prospect of a mechanical design that would have imposed severe weight and recurring cost penalties on my company's new product for a military helicopter.

The breakthrough came when I noticed lying on a desk, a folder produced by a consultant by the name of George Kunkel, who at that time was starting a new gasket company. The folder contained extracts from two interesting papers by Peter Madle[2] and Earl Grosshart[3] on transfer impedance of gasketed joints. The folder had been brought back by a technician in the test lab who had just attended a class at ICT. George was a guest instructor for the course. In reading the folder and later the entire papers, I finally gained insight on the limitations of gasketed joints. **There really is an intrinsic parameter of the joint which is independent of the artifacts of the test set up (geometry, etc.).** What was exciting was that the test data in the papers supported my findings on differences in achievable isolation between gasket types. The papers also showed that **loaded elastomer gaskets had significantly higher transfer impedance than other types.** Mr. Butler's company is one of the main suppliers of this gasket type. The papers also showed that transfer impedance was largely a function of surface state physics and that the types of metal in contact had the dominant effect. Environmental conditions and aging significantly degraded some gasket performance. Gold vs gold was ideal, tin vs tin was nearly as good and even tin vs aluminum did quite well. The papers also contained comparative test data on a new gasket type consisting of a very compliant tin plated beryllium copper spiral.

I immediately hired George as a one day consultant and asked him to bring a sample of his new gasket. He did this. The very first test we ran was completely free from receiver contamination. Today, various forms of tin or gold plated BeCu spiral are my company's gasket of choice in new applications. This choice minimizes the risk for any new design. The value of that reduced risk far exceeds any actual difference in material costs.

That experience introduced me to both George and Peter and started a relationship that increased my contributions in the EMC community. Today I am professionally associated in EMC activity with both of the above as well as Joseph Butler. I support the position of both Messrs. Kunkel and Madle that the conducted measurement is superior to shielding effectiveness, for the reasons cited in George's editorial.

Mr. Butler is concerned that transfer impedance measurement would be vulnerable to large errors above 100 MHz. Over the VHF and UHF bands, I found good correlation between the results in the papers and isolation limitations in a real application. My product had no trouble up through 10 GHz, the maximum test frequency required.

Mr. Butler states that the radiated method (shielding effectiveness) relates more closely to a designer's application than transfer impedance. My experience is exactly the opposite. Advertised shielding effectiveness values are too colored by the testing artifacts and usually give very optimistic results with respect to how they will perform in a demanding (high isolation) application. On the other hand, the relative transfer impedance values for different gasket types will pretty much be demonstrated in relative leakage when substituting the same gasket types in a real high isolation application.

The real performance challenge is achieving very high isolation across a single joint without the use of nested shields. I am a Systems Engineer and EMC is but one of the competing factors I have to balance in a new design. Doing something in the most cost effective way should be an objective for all of us in EMC, or any other business.

In retrospect, there probably is a way I could have cost effectively applied the silver loaded elastomer gasket. Because it provides both EMC and environmental sealing in a single retaining groove, nesting two of them concentrically would probably have done the job in no more space than I used for the environmental and EMC gaskets. This is equivalent to connecting two attenuators in series. However, the question raised by the two referenced editorials is: which testing method provides the most useful data to applications engineers? As both a gasket consumer and an experienced contributor to the EMC community, I am motivated to speak out for a method that will not mislead the consumer. The conducted method comes far closer to describing the relative achievable isolation limits between different gasket types in a real high isolation application. For modest requirements, the silver loaded elastomer gasket provides EMC and environmental sealing in a single groove.

References

1. Messer, L. A. "Applied EMC Control in a High Dynamic Range Environment." 1988 EMC Symposium Record, pp. 169-74.
2. Madle, P. J. "Transfer Impedance and Transfer Admittance Measurements on Gasketed Panel Assemblies and Honeycomb Air Vent Assemblies." 1976 IEEE Symposium Record.
3. Grosshart, E. "Corrosion Control in EMI Design." 1977 IEEE EMC Symposium Record.