Demonstration

Testing the Shielding Quality of EMI Gaskets and Gasketed Joints

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Introduction

The manufacturers of EMI gaskets test their products under ideal conditions, where the conditions are set-up to provide the maximum shielding quality of their products. The testing includes flat parallel plates and sufficient force to guarantee a maximum level of shielding from the gasket under test. The gaskets under actual application will never provide the same level of shielding due to the real conditions and constraints consistent with real design considerations.

There are two accepted methods for testing the shielding quality of EMI gaskets and gasketed joints. These are shielding effectiveness testing (using radiated test methods) and transfer impedance testing (using conducted test methods). This demonstration uses the conducted method because of its low cost and high accuracy. The shielding quality, as illustrated, is defined as:

$$SQ = 20 \log Z_W/Z_T^*$$

where SQ = Shielding Quality (dB)

Z_W = Wave Impedance (ohms) (assumed to be 377 ohms)

Z_T = Transfer Impedance of gasketed joint (ohm-meters)

* The shielding quality as defined is a very close approximation (within 2dB) of the theoretical shielding effectiveness of a gasketed joint. See Kunkel, G.M., "Shielding Effectiveness of EMI Gasketed Joints," Euro-EMC Conference, London England, October 1990.

Demonstration

The purpose of this demonstration is to illustrate some of the real life considerations which must be considered by the design engineer in selecting the gasket as well as the joint surface. The demonstration will evaluate the following:

1. EMI Gasket

   a) Resiliency - Two gaskets are used where the force to compress the gaskets varies by four to one (i.e., one of the gaskets takes 4 pounds per linear inch to compress 10% of its diameter and the other takes 1 pound to compress 10%.

   b) Surface conductivity - Both gaskets are plated with a 90% tin/10% lead composition. However, given the same force, one of the gaskets exhibits about 10 dB more shielding.

2. Joint Surfaces

   a) Surface conductivity - Aluminum plates plated with five different coatings are illustrated. These are: gold, tin, cadmium, nickel and chemical film.

   b) Force - The force on the gasketed joints was varied between ½ and 4 pounds per linear inch.

   c) The flatness of the surfaces was varied from parallel (within .002 inches) to out parallel ¼ degree - out of flatness by .030 inches.

Contents of Illustrations

1. Figure 1 illustrates the shielding quality of the two gaskets under test using gold plated joint surfaces. Both gaskets were compressed 25% of their diameter. This resulted in a force of 10 pounds per linear inch on the moderate force gasket and 2½ pounds per linear inch on the low force gasket.

2. Figures 2 and 3 illustrate the shielding quality of the low force and moderate force gaskets when subjected to ½, 1, 2 and 4 pounds per linear inch of force. As is illustrated, the low force gasket exhibited better shielding. This is due to a lower contact resistance of the tin plating on the gasket. (Note: both gaskets were plated to the same military specification however the surface conductivity is not the same by about 12 dB.)

3. Figures 4, 5, 6 and 7 illustrate the shielding quality of gasketed joints using the ⅜ inch diameter low force gasket against tin, cadmium, nickel and chemical film plated aluminum joint surfaces. The force of the joint surfaces against the gasket varied from ½ pound to 4 pounds per linear inch of the gasket. As is illustrated, the shielding varied by more than 20 dB due to the difference in the surface conductivity of the plated joint surfaces under test.

4. Figure 8 illustrates the difference in the shielding quality of the low force and moderate force gaskets using gold plated joint surfaces, where the surfaces are out of parallel by .030 inches (i.e., the unevenness of the joint is .030 inches). As is illustrated, the low force gasket provides as much as 45 dB better shielding than the moderate force gasket with a force of ½ pound per linear inch. This significant difference is due to the fact that the moderate force gasket did not make electrical contact throughout its circumference. The actual leakage illustrated for the moderate force gasket is a function of the length of the gap. If the test fixture and subsequent gasket length were larger, the length of the gap would have been longer, resulting in a lower level of shielding. At 4 pounds per linear inch, the low force gasket exhibited about 10 dB improved shielding quality at 1 GHz. This difference is principally due to the surface conductivity of the two gaskets (see Figures 2 and 3).

5. Figure 9 illustrates the lack of accuracy that is experienced in performing radiating testing.

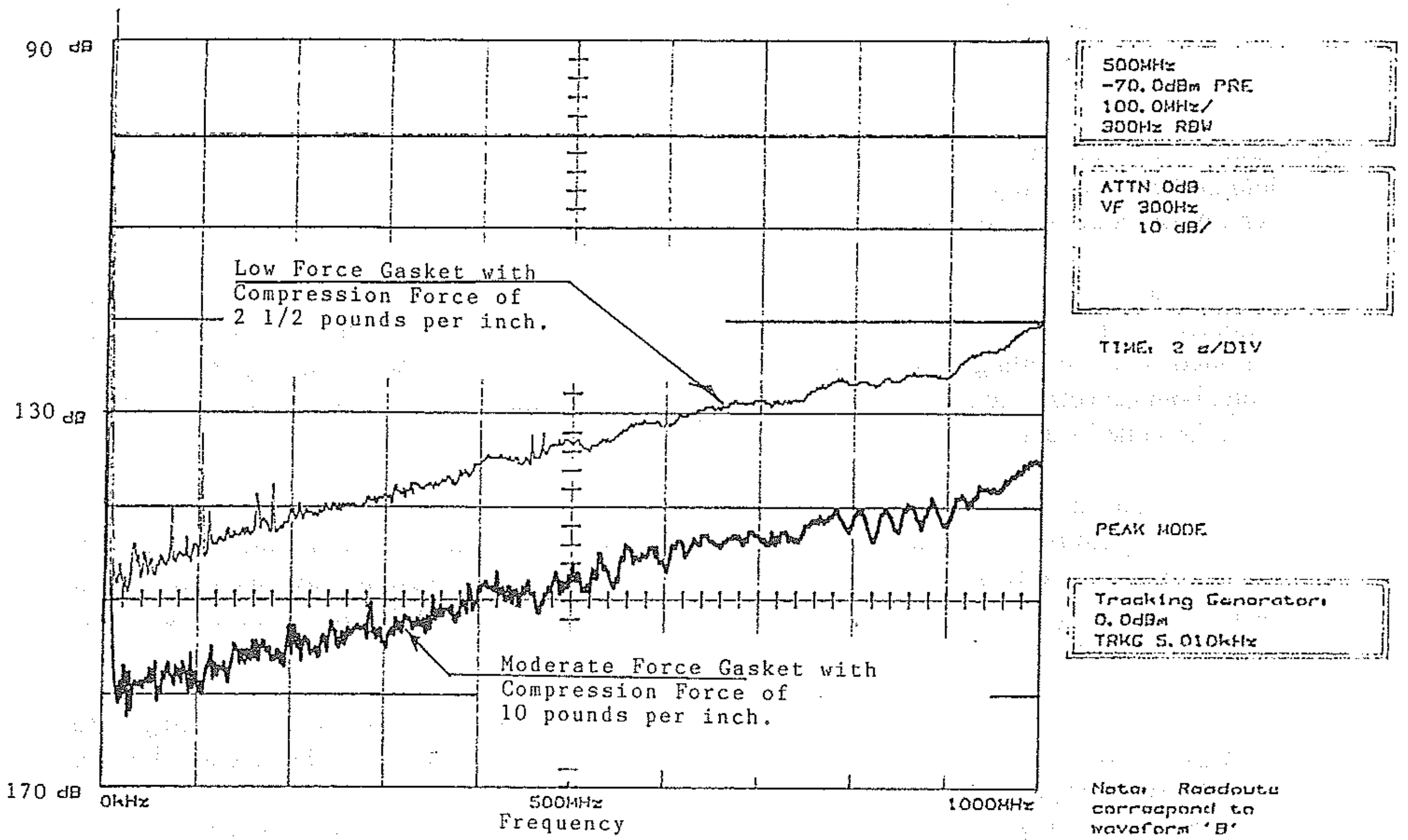

Figure 1. Shielding Quality of Low Force and Moderate Force, 3/8 inch Diameter Gaskets compressed 25% of their Diameter.

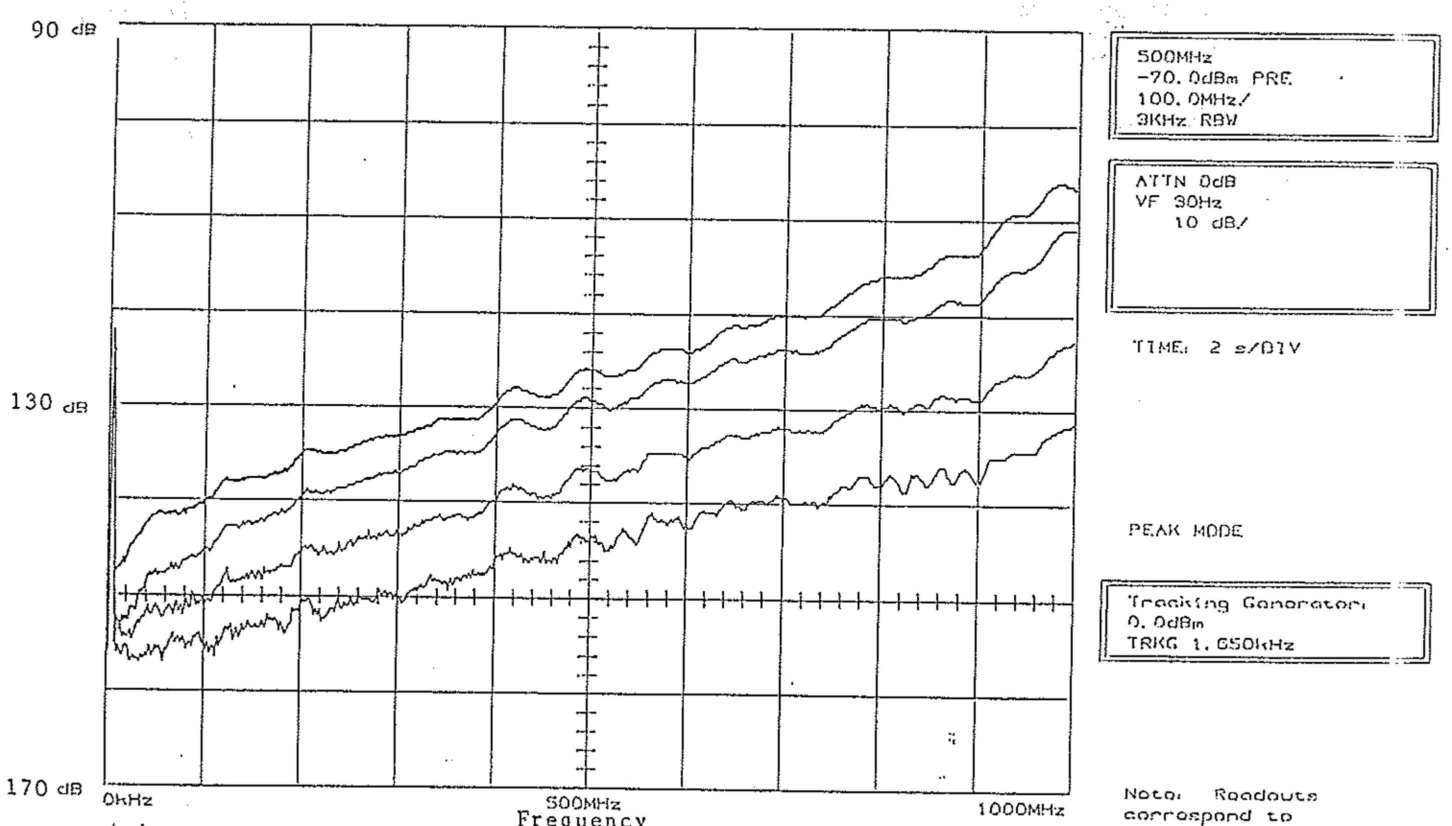

Figure 2. Shielding Quality of Low Force Gaskets against Gold-Plated Joint Surfaces with Compression Force of 1/2, 1, 2 and 4 pounds per inch.

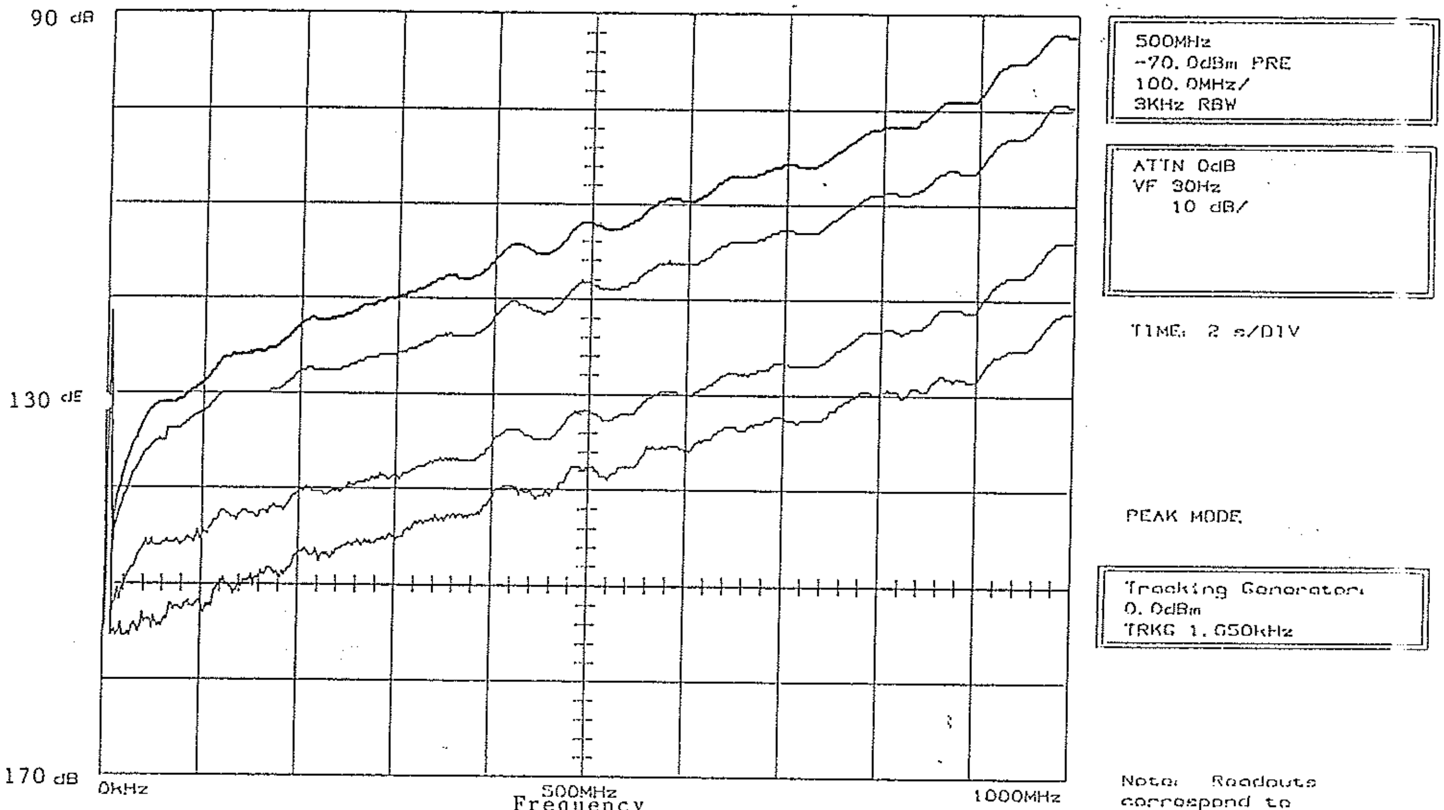

Figure 3. Shielding Quality of Moderate Force Gasket (using Gold-Plated Joint Surfaces) with Compression Force of 1/2, 1, 2 and 4 pounds per inch.

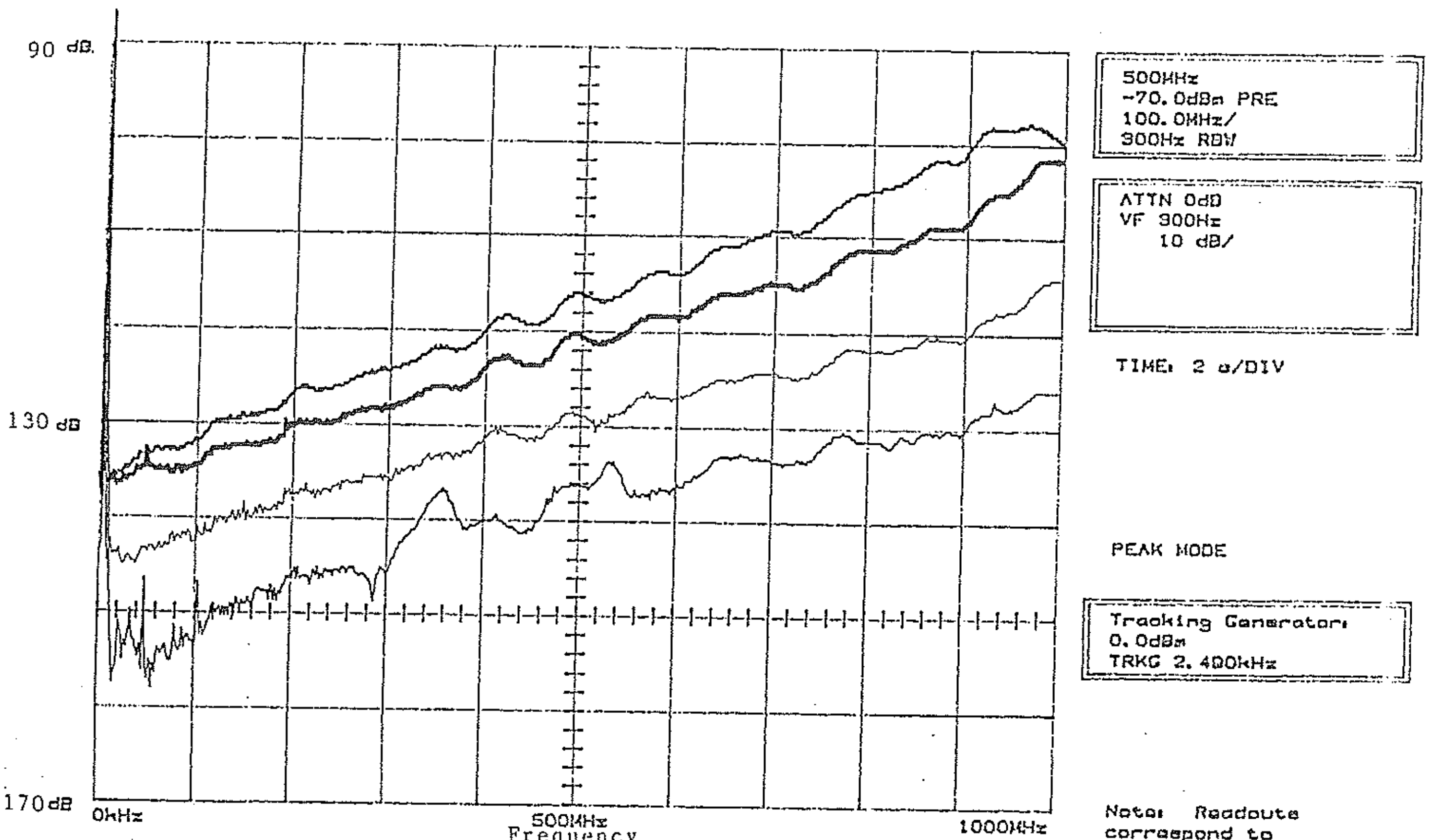

Figure 4. Shielding Quality of Low Force gasket against Cadnium-Plated Aluminum Joint Surfaces with Compression Force of 1/2, 1, 2 and 4 pounds per inch.

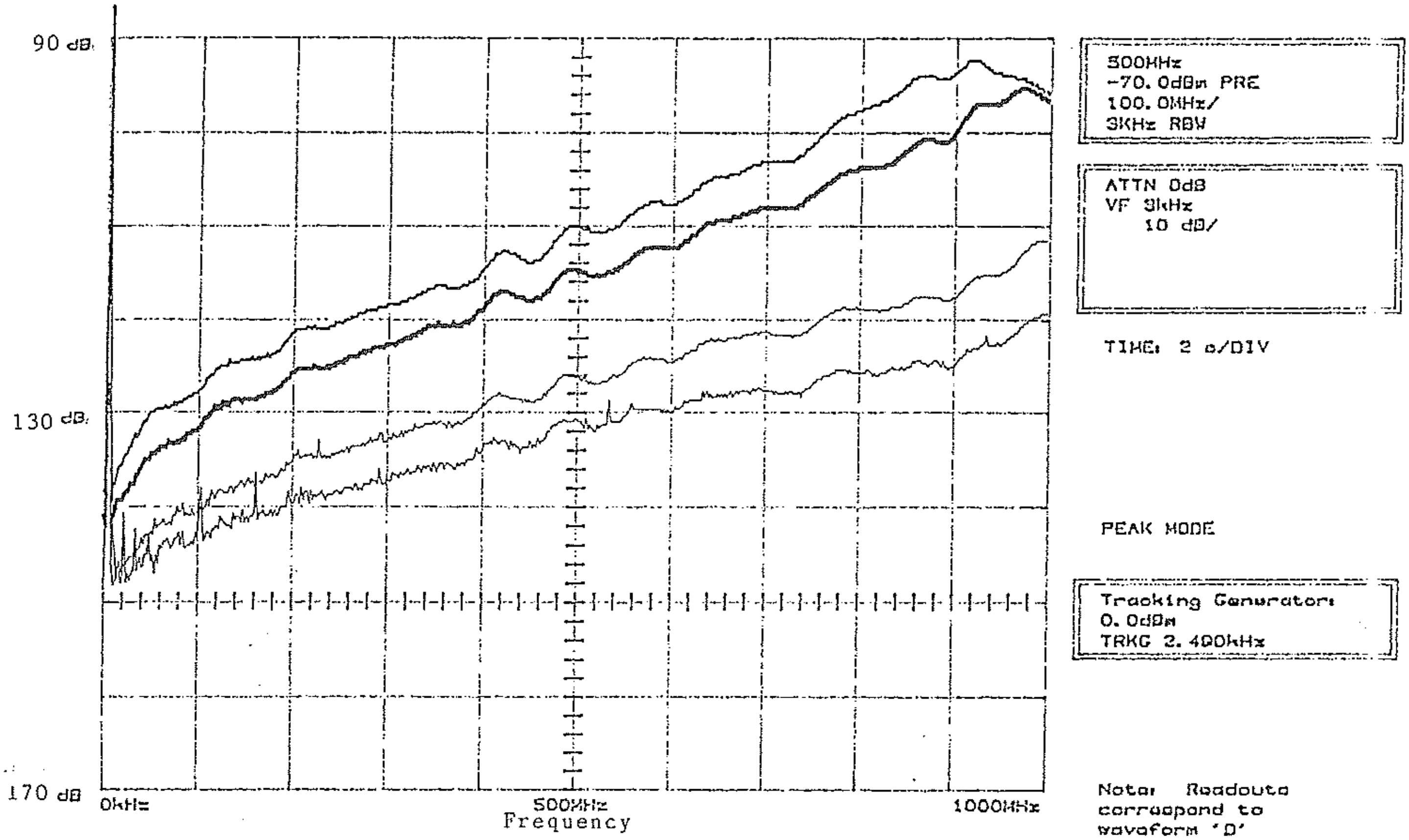

Figure 5. Shielding Quality of Low Force Gasket against Tin-Plated Aluminum Joint Surfaces with Compression Force of 1/2, 1, 2 and 4 pounds per inch.

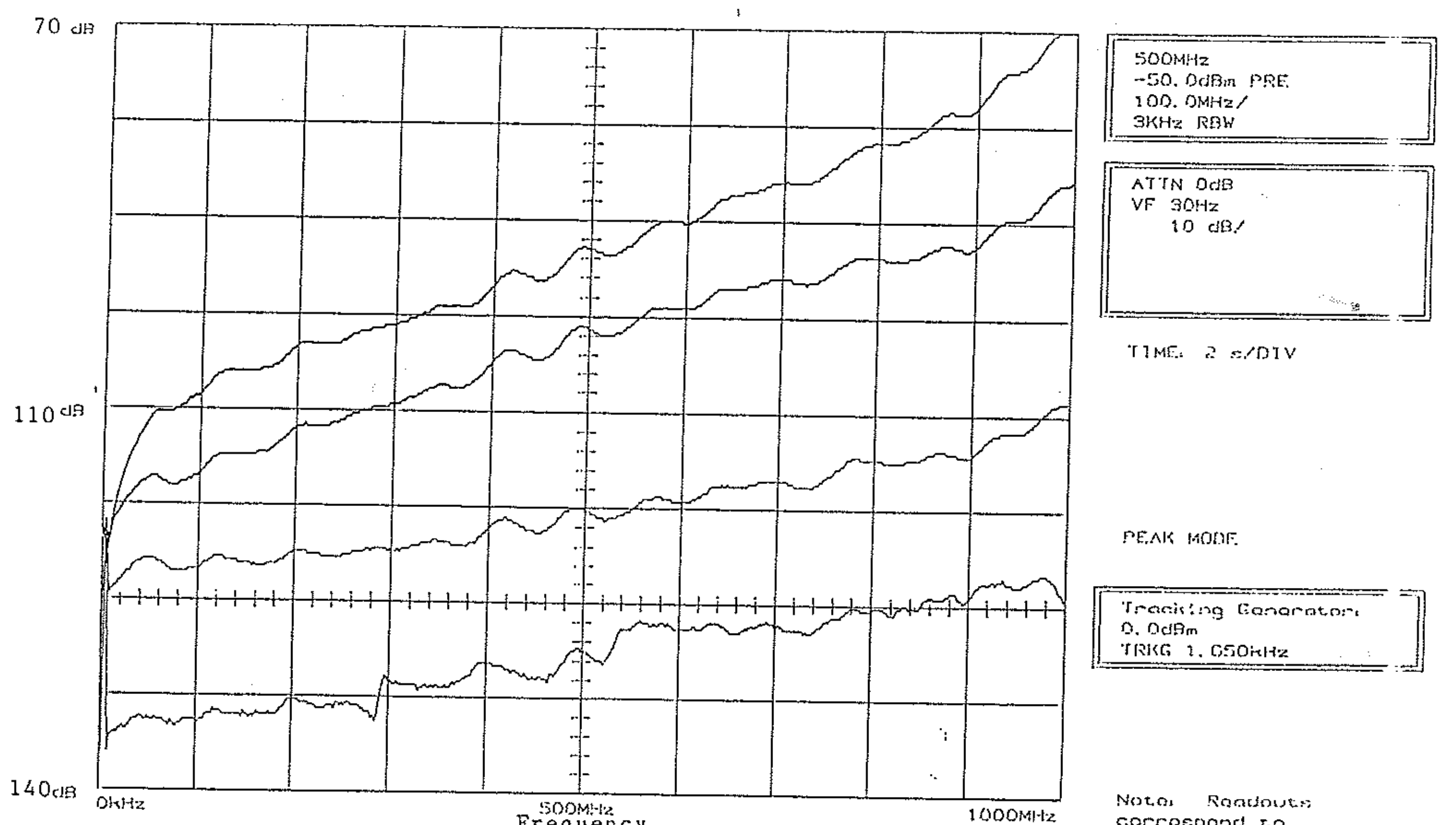

Figure 6. Shielding Quality of Low Force Gasket Against Chemical Film-Plated Aluminum Joint Surfaces with Compression Force of 1/2, 1, 2 and 4 pounds per inch.