Improved EMI Shielding Gasket Design for Cards/Cage Applications

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Cards/cage type of equipment is becoming very popular, especially in the telecommunication industry. The main reason for this trend is the standardization of a platform that will provide substantial savings for the OEM's in the development process and reducing the time of introducing new products to the market.

Advanced Telecom Computing Architecture (ATCA) is the latest series of standard specifications written by PICMG for the next generation of carrier grade communication equipment.

Each module within this framework is shielded by means of an EMI gasket mounted on the side of the module face plate. ATCA EMI shielding gasket requirements are as follows:

- Shall be 2.54 mm high + 0 mm, -0.5 mm
- Shall be less or equal to 12 mm wide
- Shall be UL94-V0 recognized (Bellcore Nebs GR63)
- Shall perform a minimum of 200 insertion/extraction cycles with no significant change in effectiveness.

This type of environment is rather challenging for the EMI shielding gaskets due to the wide variation of compression that the gasket must withstand. This is mainly due to the cumulative tolerance on blade location which is a common problem in card/cage applications. In the ATCA environment, the nominal gap between compact modules is 1.2 mm with a tolerance of +0.87mm, -0.21 mm. Therefore, the EMI shielding gaskets must ensure attenuation at low compression when at the maximum gap and also provide a workable compressibility when at the minimum gap.

The main technology used in the past for the shielding of cards/cage applications was metal fingerstocks - mainly Beryllium Copper (BeCu). This alloy is well known for its high conductivity at low compression. Half or a quarter hard alloy is stamped, formed in a progressive die and finally heat treated to ensure resiliency and minimum memory when compressed. The heat treatment often requires a fixture to hold dimensions and shapes due to the stress released in the metal after forming. This process impacts greatly on the costs. The force required at high level of compression is important and softer versions are available on the market and can be obtained by either processing thinner sheet metal or by etching techniques after the heat treatment. These thinner metals may affect the compression set, the shielding efficiency and increase the cost.

There are also environmental concerns with BeCu fingerstocks due to the presence of beryllium in the gasket. This becomes an issue during the recycling process at the end of the product life. Beryllium is classified as a carcinogenic material (European REACH regulation). The ever increasing bandwidths of systems also puts some more constraints on this technology due to the slot in between the fingers which may start to leak at shorter wavelengths.

For all these reasons, conductive fabric-over-foam has been considered for this type of environment. This technology was introduced to the market in the late 1980's. A metal plated polyester fibre is woven to create a highly flexible conductive fabric (fig.1). The fabric is protected by a special conductive coating on its surface to enhance abrasion resistance and galvanic compatibility. The fabric is then shaped around foam to provide the necessary resiliency. The cell structure of the foam allows pressure equalization between cells and limited compression set. Special configurations in the type of weaving and the use of coating ensure mechanical stability with no risk of loose fibres after the cut-to-length operation. Although, Fabric-over-foam is a proven technology used in most fields in today's Electronics, further important modifications must be considered to address ATCA or Card Cages specific characteristics.

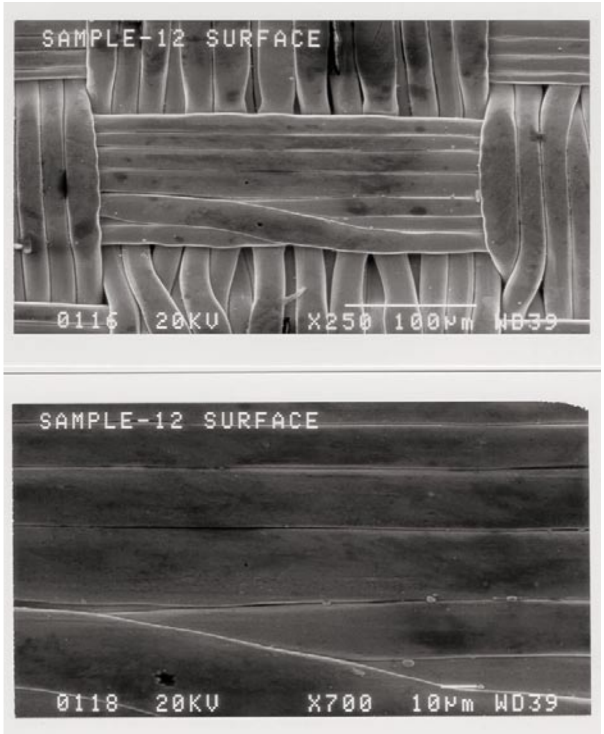

Figure 1.

Soft and low memory foam must be used to ensure low insertion force even when maximum compression configuration is met. Figure 2 shows for an ATCA compliant gasket the Compression Load Deflection (CLD) versus contact resistance.

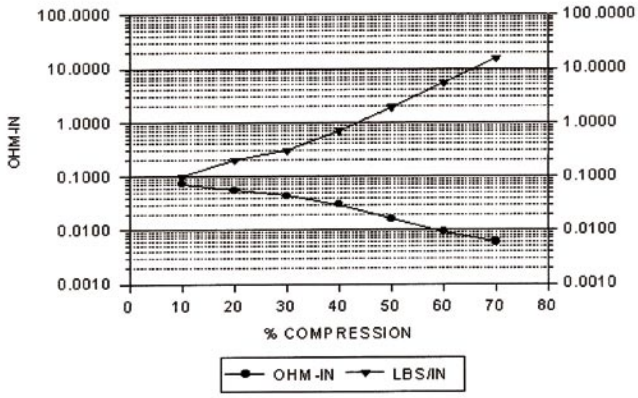

Figure 2.

For cost reasons and ease of mounting, pressure sensitive adhesive (PSA) is used on the base of the gasket. Non-conductive adhesive featuring excellent shear strength value should be preferred. The use of conductive adhesive is not recommended. Trials indicated that conductive particles affect the adhesion characteristics of the PSA and the forces exerted on the gasket during the blade insertion pushed the gasket from its original mounting.

It is therefore necessary to modify the gasket design to ensure stable shielding effectiveness when compression is at minimum levels so to overcome the isolated barrier of the non conductive adhesive. This is achieved by utilizing a centre base-bump gasket design. The design enhances continuous contact in spite of the minimal compression exerted on the gasket (see profile on fig. 3).

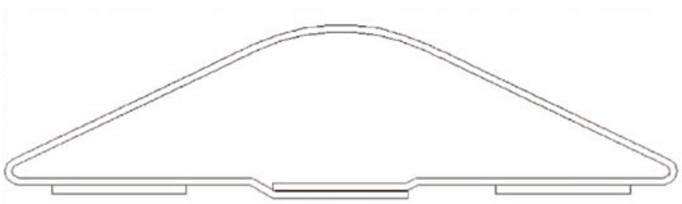

Figure 3.

In order to measure the efficiency of this modification, testing has been carried out using TEM H-t cell (see fig. 4) as described in IEEE Std 1302. Tem T and H-t cells have been designed by Prof. ir.J. Catrysse from the University of Oostend in Belgium. The H-t cell is a coaxial line with a rectangular cross section terminated by two small loop antennas simulating magnetic near field conditions. Tests were carried out from 0 to 500 MHz.

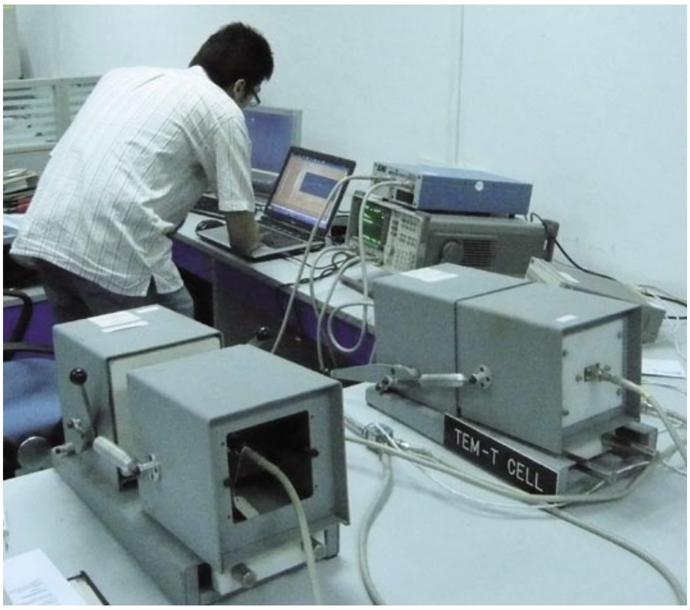

Figure 4.

By inserting a gasket holder (see fig.5), both the absolute shielding effectiveness obtained with the gasket holder and a gasket in place, and the difference in between an open gap and the gap of the gasket holder filled with the gasket may be obtained and displayed. The conductivity of the gasket, and the value of the contact impedance between gasket and holder, will directly influence the shielding effectiveness obtained. This set-up reproduces a gasket in-situ. The loops are very close to the holder so that the obtained shielding values are small to compare with other methods. However, the repeatability is excellent (+/- 3 dB) which makes this fixture a good tool to isolate specific parameter under study.

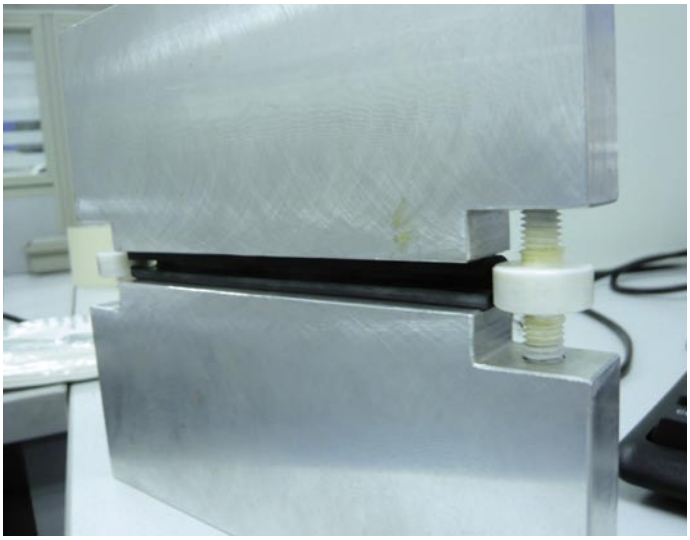

Figure 5.

The test was to measure the influence of non-conductive PSA on shielding between a standard flat D gasket and a modified shape as described under low compression (0%-10%-20%). The gasket holder is made of Aluminium. Both gaskets were identical in dimensions, fabric and foam.

As you can see on figure 6 (DYNASHEAR: Flat –D with centre base bump), at 0% compression and with just a few contact points with the gasket holder, the centre base-bump gasket design already provided attenuation close to the expected one under higher compression. Meanwhile, the standard flat base gasket (fig. 7) needed 20 % compression to cross the isolated barrier represented by the non-conductive PSA. The tests indicate that modified gaskets ensure good efficiency in low compression environment with non-conductive adhesive.

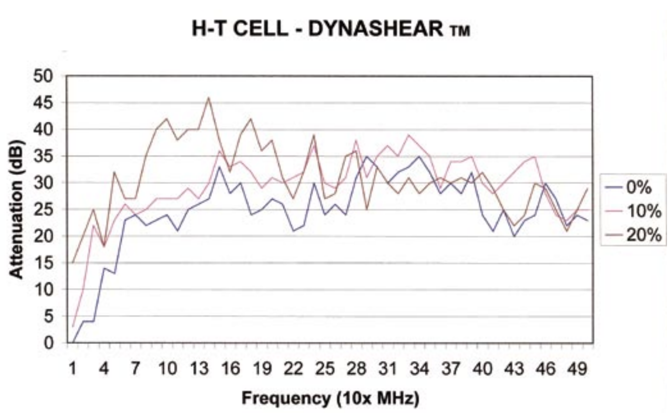

Figure 6.

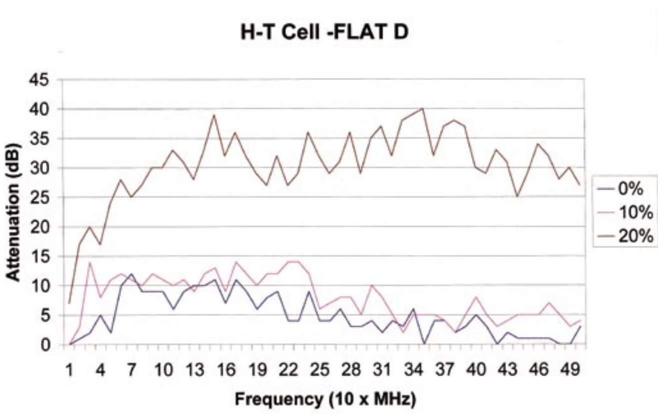

Figure 7.

ATCA shielding EMI gaskets are required to perform a minimum of 200 insertion/extraction cycles with no significant change in shielding effectiveness. A test fixture has been built to reproduce the wiping actions exerted on the modified gasket at the ATCA nominal compression. The gasket was submitted to 400 cycles with dimensional control on height directly after the cycling was completed and results were compared with unaged values. Tests were carried out on 10 different samples. There were no significant variations to be reported.

In conclusion, with small modifications, fabric-over-foam EMI shielding gaskets offer cost effective alternatives and technical benefits over Beryllium Copper fingerstocks in ATCA and card cage environments. Due to the tolerances on gaps between modules, it is necessary to consider the worst case scenarios to avoid surprises during the final compliance testing of the cabinets and the related costly design retrofits.

Schlegel Electronic Material's DYNASHEAR TM product family is especially effective for card cage applications. DYNASHEAR TM consists of 15 different standard flat D profiles (3 widths x 5 heights) with center base-bump. This includes an ATCA/μTCA compliant gasket.

References :

1. IEEE STD 1302 – rev 2007: Guide for the electromagnetic characterization of conductive gaskets in the frequency range of DC to 18 GHz
2. Prof. ir.J.Catrysse/Ing.G.Vandecasteele:A comparative stu-dy of different methods for the characterization of shielding gaskets.