Compression Forces and Gasket Selection

CHRISTIAN BRULL
Schlegel Systems, Inc., Vise, Belgium*

Closure forces may be multiplied by a factor of 10, depending upon the type of gasket which has been selected.

Introduction

EMI gaskets are conductive materials that fill apertures to provide a continuous, low impedance joint with the chassis. In time, the stress released in the materials, as well as variations in environmental conditions, affect the dimensional stability of the chassis.

In order to maintain good electrical contact in spite of varying conditions, most gaskets are flexible and compress to a certain amount to follow the dimensional variations of the chassis. The compression rate applied on a gasket improves the contact impedance and may result in higher shielding performance. The spring effect of a gasket is therefore a critical characteristic, especially when manufacturers are required to ensure shielding performance throughout the product life cycle as required by the EMC Directive.

Another important characteristic is the total compression force required to close an opening with a mounted gasket. This is a determining factor in the choice of material thickness, locking system, etc. These requirements can make it difficult for design engineers who need to keep the unit's cost as low as feasible. The aim of this article is to propose a tool for the designer to quickly estimate the compression range for a specific gap in a chassis by comparing the compression characteristics of major gasket families.

Gasket Selection

The compression force required by a gasket will depend on its material composition, shape, direction of the force, and directions of deformation. A typical shielding application in a cabinet door was used to compare similar gasket profiles and sizes and evaluate applicable solutions.

Gaskets selected for evaluation

- Conductive fabric over open-cell urethane foam core (UFC) 0.375"/ 0.500" rectangular shape (Figure 1A)
- Beryllium copper fingerstock (BCF) Height: 0.40" thickness: 0.004" (Figure 1B)
- Monel wire mesh over silicone elastomer tubing (SET) Diameter over wire: 0.348" (Figure 1C)
- Monel wire mesh over neoprene sponge (NSP) Diameter over wire: 0.348" (Figure 1D)
- Nickel/graphite loaded d-shape elastomer tubing (DET) Height: 0.312" (Figure 1E)

Averaged Compression

Figure 2 shows the deflection (% from free height) versus the compression force (lbs/linear foot). Although the general aspect of the function remains the same, the slope Y/ X that characterizes the type of material will vary.

Averaged compression =

$$\frac{2Y}{X2 - X1}$$

or lbs-linear ft/% of deflection.

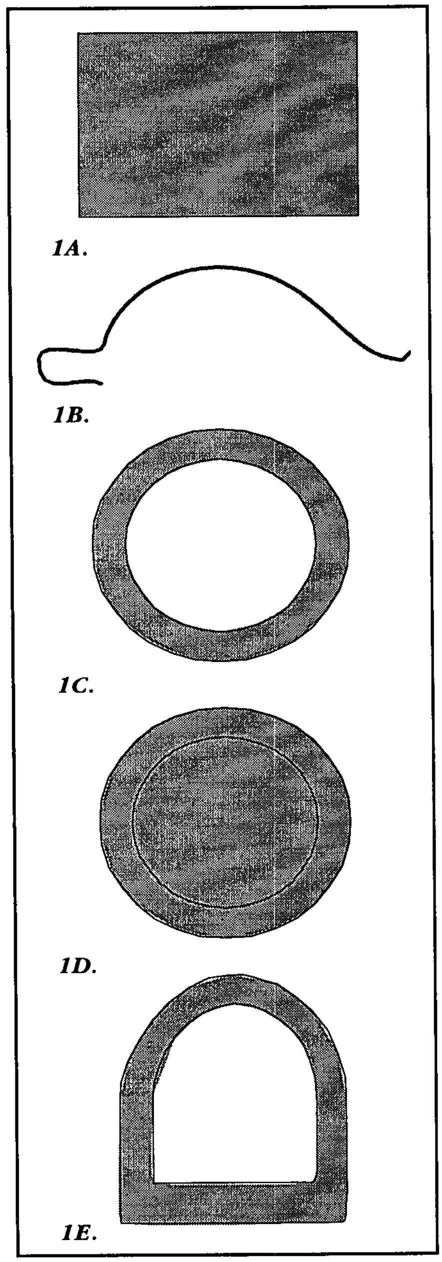

Figure 1. *Gasket Types.*

*See advertisement on page 197

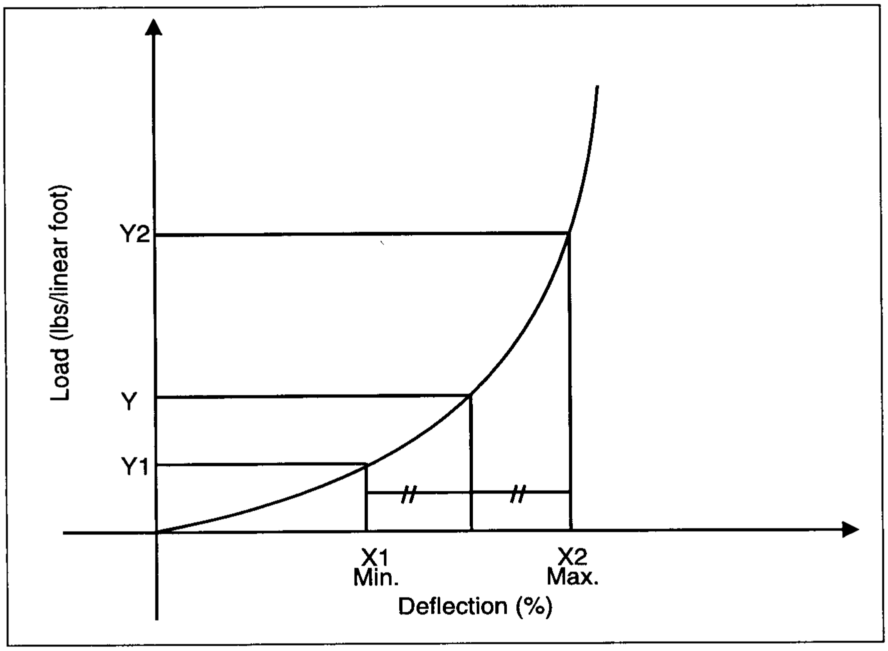

Figure 2. Deflection Versus Compression Force.

The calculations were based on data provided by gasket manufacturers. To evaluate the recommended compression forces for each gasket, the minimum and maximum recommended compression were averaged. For comparison purposes, values are expressed in lbs-linear ft/% of deflection.

Table 1 shows the load at the average recommended compression for each type of gasket.

Type	Load (lb/ft)	Compression (%)
UFC	4.83	30
BCF	25.00	30
SET	42.00	30
NSP	49.50	30
DET	7.50	30

Table 1. Load at Recommended Compressions.

The values obtained in Table 2 provide the compression force required to compress a 1-foot length of the specified gasket a total of 1% from its free height. Therefore, these values must be multiplied by the length (feet) needed for the application and by the recommended compression rate (30 %).

Lbs. -lin. ft/%	
UFC	0.16
BCF	0.83
SET	1.40
NSP	1.65
DET	0.25

Table 2. Force Required to Compress a 1-foot Length of the Specified Gasket.

Conclusions

Conductive fabric over open-cell urethane foam (UFC) offers the lowest compression force due to its open-cell structure and flexible conductive fabric (Figure 3). Moreover, the contact resistance with the mating surface is minimally affected by the compression variations that maintain the original shielding effectiveness. A protective coating over the conductive fabric provides abrasion resistance and allows wiping actions. The manufacturing process creates a fusion of core and fabric making this type of material available in various shapes. Leaf seal gasket designs, such as C-folds, provide an even lower compression rate.

DET, loaded elastomer over D-shaped tubing, also shows a very low compression rate. This is mainly due to the geometry of the proposed design. However, small variations in compressions may influence the shielding effectiveness in very large proportions.

BCF, beryllium copper fingerstock, requires approximately five times more compression force than UFC. The shielding effectiveness of fingerstock gaskets does not vary significantly with compression. Mechanical vulnerability (damaged fingers) may be a concern, especially for long lengths.

SET, monel wire mesh over silicone elastomer tubing, has a high compression rate (8.75 times UFC). Compression set may also be a concern and

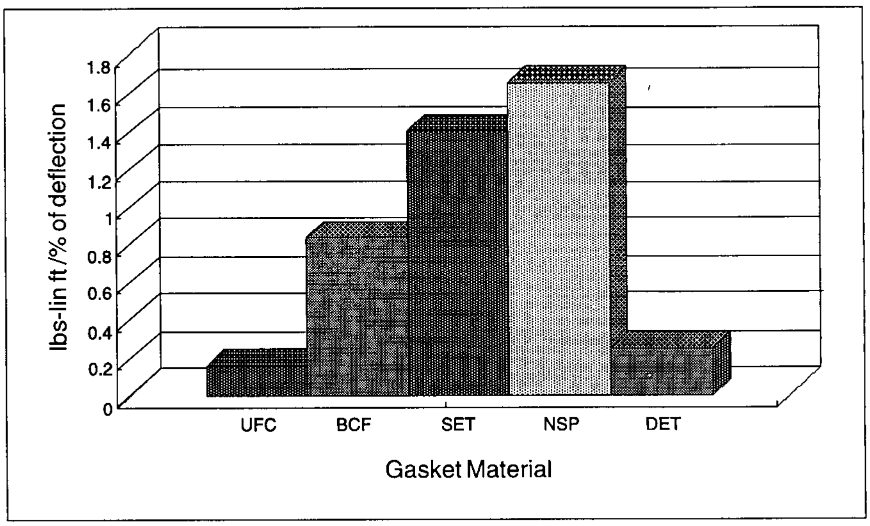

Figure 3. Required Closure Forces.

may influence shielding effectiveness. NSP with neoprene sponge (more than 10 times UFC) presents the same concerns.

A fact which also must be considered is that the required closure forces may be multiplied by a factor of 10 depending upon the type of gasket that has been selected and therefore will become a concern especially for large enclosures.

Summary

Each of these gaskets have advantages and disadvantages within a specified range of use. For compression, a comparison of each gasket versus the best solution (conductive fabric over open-cell urethane foam-UFC) demonstrates the importance of the right gasket selection with regard to the application. Closure forces must also be considered.

CHRISTIAN BRULL *received a degree in electronic engineering in 1981 from St. Laurent Institute, Liege, Belgium. He spent several years in research, development and application engineering areas in the nondestructive testing department of Schlumberger. He began his EMC work in 1990 in the gasket industry as an applications engineer. Since 1997, Christian has been EMC product manager for Schlegel Systems, Inc. in Europe. (800) 204-0863, ext.1216.*