Package cushioning systems

The term *packaging cushioning systems* covers a wide variety of techniques and materials for protecting goods from the effects of impacts and vibration in transit. They range from the traditional application of straw and woodwool in the packaging of glassware, pottery and ceramics, to the highly sophisticated shock isolation systems, incorporating springs and hydraulic shock absorbers, used in packages for aero-engines and space satellites.

Goods can be protected against impact in three ways.

1. By spreading the forces on impact over a large area so that the force per unit area is reduced and no part of the product is subjected to concentrated forces.
2. By supporting the product at its stronger points so that the forces on impact are directed to those points and not to the weaker ones.
3. By reducing the forces and hence the deceleration on impact by using materials which compress on impact and cushion the product by absorbing the energy of the impact and converting the short duration/high intensity forces to lower intensity/longer duration forces which are less damaging.

Methods 1 and 2 do not require a compressible material or system to reduce damage to the exterior of a product but will not necessarily prevent internal damage for example in electronic equipment or a complex mechanical assembly. In practice, cushioning systems combine method 3 with load spreading or directing forces through the area of contact and the placing of the system in contact with the goods.

Cushioning systems fall into three main groups: substantially elastic material, less elastic materials and load spreaders. Most of the materials and devices used fall into one of these categories (Figure 23.1). However, most bulk cushioning materials also act as load spreaders due to the often quite large area in contact with the packaged article and most load spreaders are often more or less compressible so that they too reduce the forces on impact to some extent.

Some load spreaders are loose fill materials often called space fillers, used as the name implies to fill the space around an irregularly shaped article placed in a regularly shaped container. They permit the controlled movement which is essential to reduce the shock transmitted to the contents.
when the package receives an impact, but the level of shock protection is not easily predicted because of the non-homogeneous nature of these materials, and the difficulty of ensuring a uniform density throughout the space filled. This is not important in the bulk packaging of glassware and pottery, where the main function of a space filler is to prevent the pieces from making contact with one another, or with the walls of the container, but it is important in packaging more shock-sensitive products. For this reason, space fillers are normally used for fairly robust or low-value articles.

Less elastic systems cover a wide range of materials from corrugated boards and rigid foams which crush on impact and provide one drop protection to those such as expanded polystyrene which provide protection by a combination of crushing of the polymer matrix and mainly elastic compression of the air entrapped in the closed cell structure of the material. The level of shock protection is predictable although it deteriorates with repeated impacts due to crushing of the material’s structure.

There are two distinct types of elastic system: bulk cushioning materials and cushioning devices. Expanded plastics and bonded foams are typical of the first type. Their performance is predictable, and simple engineering design techniques can be applied to the package design, provided suitable performance data are available. Such data can often be obtained from the material manufacturers. The term cushioning device includes a wide variety of rubber and steel springs. In general, resilient systems are more expensive, and their use in consumer packaging is restricted to higher value fragile goods, although they are sometimes employed in re-usable packages where the high cost can be justified. They are also widely used in the packaging of