

## **2.9 LAMINATED VIBRATION DAMPING STEELS (LVDS)**

### **2.9.1 INTRODUCTION**

The term “laminated steel” generally applies to products consisting of two layers of steel bonded to a plastic core. In this discussion, the term “laminated vibration damping steels” (LVDS) refers to a product consisting of steel outer skins bonded together by a 0.025 mm (0.001”) thick viscoelastic material. The total thickness of available product currently ranges from 0.8 to 3.0 mm (0.032 to 0.120”). Caution should be exercised in the designing with laminated steels, because laminated steel panels of same thickness possess lower section modulus than those with solid steel panels.

When a component made from LVDS is subjected to structure-borne excitation, the amplitudes of resonant vibrations are much lower than for a similar component made from conventional sheet steel. The amplitude reduction normally leads to less radiation of airborne noise. Extensive laboratory and vehicle tests have quantified the performance characteristics of LVDS for vehicle noise, vibration and harshness (NVH). Studies have shown that LVDS can benefit vehicle level performance not only for structure-borne noise, but also for the higher frequency ranges that cause speech interference inside the passenger compartment.

The viscoelastic materials used in LVDS are currently formulated to optimize damping performance at 27C (80F), 54C (130F), 77C (170F) and 99C (210F). This latitude has been helpful in optimizing structural damping in various stamped sheet steel body and chassis components including oil pans, valve covers, engine accessory drive covers, transmission pans, heat shields and sheet steel body members.

### **2.9.2 MECHANICAL PROPERTIES**

The mechanical properties of LVDS (yield strength, ultimate strength, % elongation, strain hardening, etc.) are totally determined by the properties of the steel. These and the forming characteristics of LVDS allow vehicle programs the flexibility of either adding it into the vehicle to improve NVH performance, or designing it into the vehicle to optimize the NVH system performance.

### **2.9.3 FORMING CHARACTERISTICS**

Formability of LVDS is totally determined by the draw quality of the steel. They can therefore be processed using tools designed for standard metal fabricating operations such as slitting, roll forming, brake forming, stamping, drawing and punching. It is suggested that hold down or clamp pressures be increased, tighter die clearances be utilized and radii kept as generous as possible. In some instances the use of a pre-applied dry lube can greatly enhance formability. When holes other than pilot are to be punched, expanding the die progression to reduce individual drawing stages, making the center of the material first during drawing stages, and punching holes last helps to prevent misalignment of hole centers on the skins.

## 2.9.4 POST-FORMING PROCESSING AND TREATING

LVDS can survive paint bake ovens, E-Coat cycles, vapor degreasing, standard cleaning and treating operations, etc. The following treatments typically have no effect on the physical properties:

- Heat treatment at 232C (450F) for 40 minutes
- Oil soak at 150C (300F) for 1 hour
- Environmental cycling from -31C (-25F) to 107C (225F) for 5 cycles
- ASTM-D-117-64 salt spray for 250 hours
- ASTM-D-2247-68 humidity cabinet for 250 hours
- Exposure to forming lubricants
- Heat-stability testing from 38C (100F) to 205C (400F) in 14C (25F) increments.

## 2.9.5 FASTENING SYSTEMS

The LVDS viscoelastic core is thin and weldable. Therefore the product can be spot welded, projection welded, MIG welded and seam welded without shunting. Welding parameters are similar to those for solid metal substrates.

Adhesive bonding and lock seaming have also been performed successfully. LVDS can be used in multiple configurations with other sealers and adhesives.

Bolted joints that sandwich the material between the bolt head and nut may encounter torque retention problems because of the potential for relaxation in the 0.04 mm (0.001") thick viscoelastic layer. Steps to reduce the torque loss are as follows:

- During stamping, coin the area to be torqued.
- Automatic torque equipment should allow for torque/re-torque.
- After final assembly, re-torque.