Inspection & Replacement Criteria of Rubber/Metal Composites

Rubber Creasing

Following installation of rubber product, and operational use, creasing may occur between the metal and rubber parts. Creasing is partly a consequence of the anti-ageing wax inherent in rubber that protects it from ozone and other environmental factors. It can become especially noticeable on bulging rubber.

Creases may falsely appear like cracks or tears in the rubber. Creasing in rubber during or after loading is harmless and does not affect the integrity of rubber springs.

Refer to Figures 1 through 3 below for examples of rubber creasing.

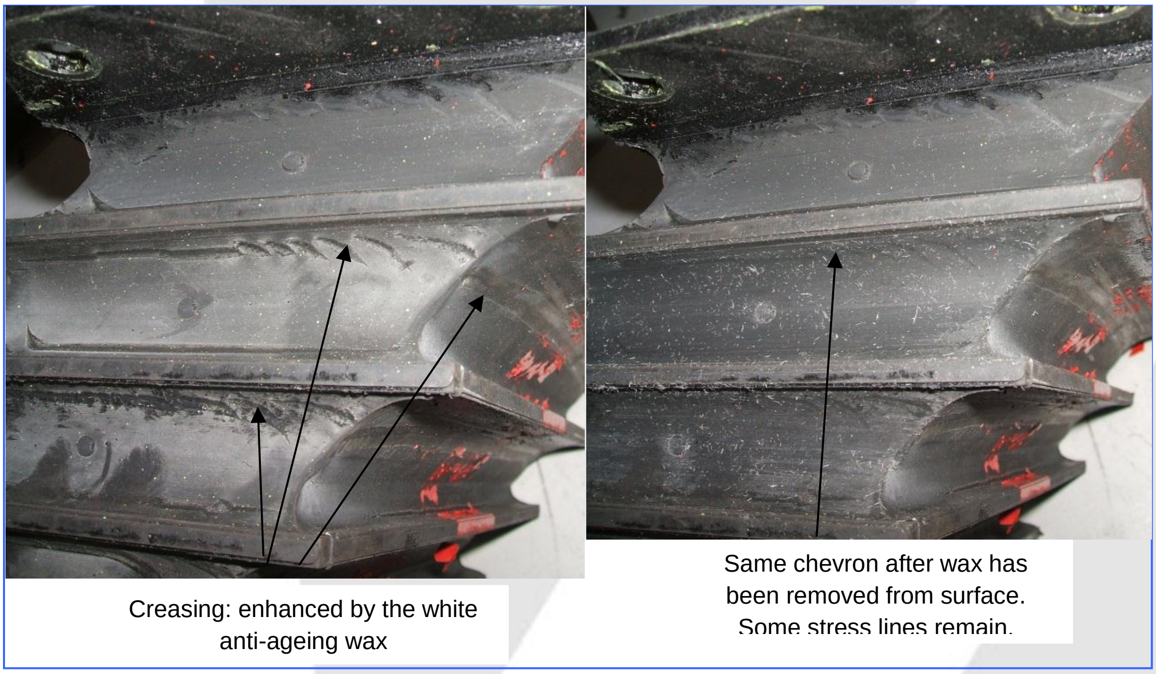

Figure 1: Creasing on rubber surface after 3 million cycle fatigue test

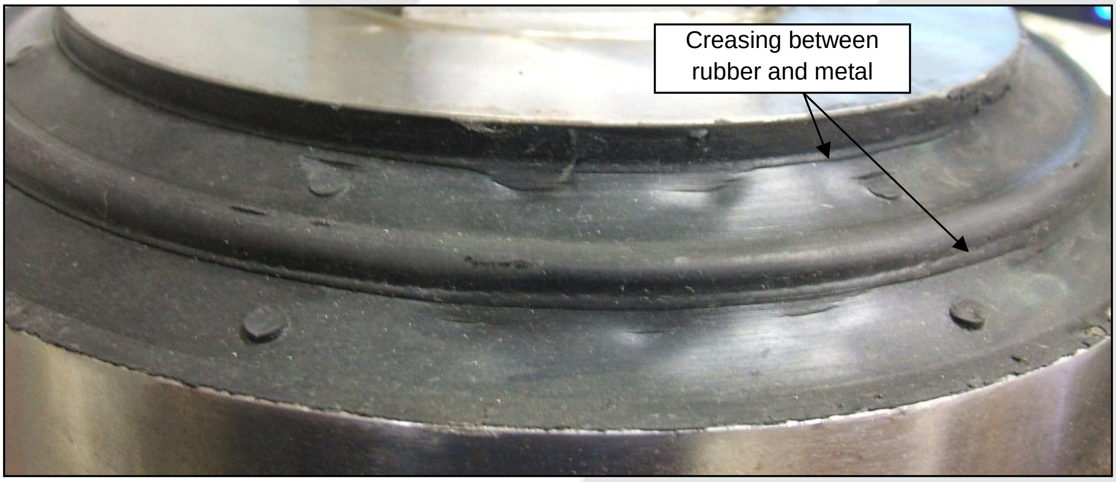

Figure 2: Rubber creasing in a bush after 200,000 km service

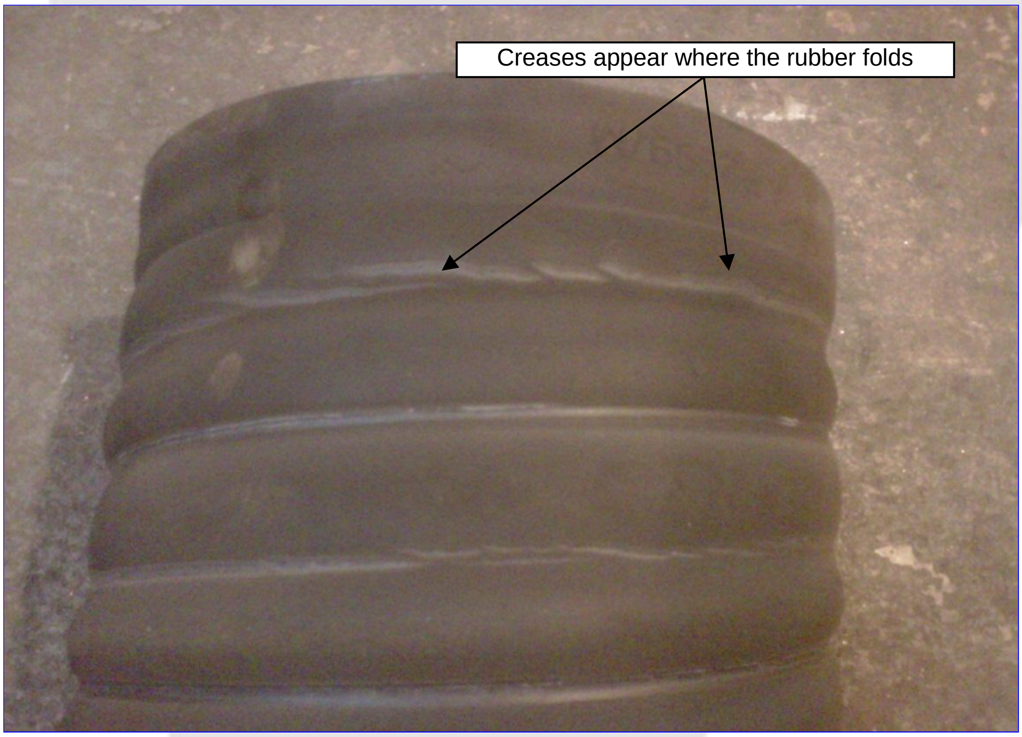

Figure 3: Rubber creasing on a primary suspension spring after 3 years service

Rubber Cracking

After 1 year of service, routine checks should be conducted to inspect for cracks and de-bonding in areas where creasing appears. This check should be repeated as part of a regular inspection approximately once per year.

Cracks are critical whenever rubber is subjected to tensile stress, i.e., pure shear, pure tension, pure torsion, where the crack can propagate rapidly. The presence of compressive loads in some elastomers attenuates the effects of these tensile stresses and the likelihood of cracks to propagate.

Figure 4 shows an example of a fatigue crack growing in rubber as a result of an applied cyclic load.

Shear elastomer subjected to 50% shear strain.
A 5 mm deep crack has grown after 750,000 cycles.

Same elastomer after 1.6 million cycles. The crack has grown to 15 mm deep and the stiffness value decreased 30% from its starting value. This product continued operating for a further 400,000 cycles before failure.

Figure 4: Crack growth in rubber of a shear elastomer

After several years of operation, the part may develop small surface cracks due to ozone attack and cyclic loading. Generally, ozone cracking is cosmetic only and only becomes an issue if cracks propagate inside the rubber surface.

Replacement of the part is recommended if there are more than 10 cracks per square centimetre on the rubber surface.

Figure 5 shows two examples of ozone cracking on the surface of rubber.

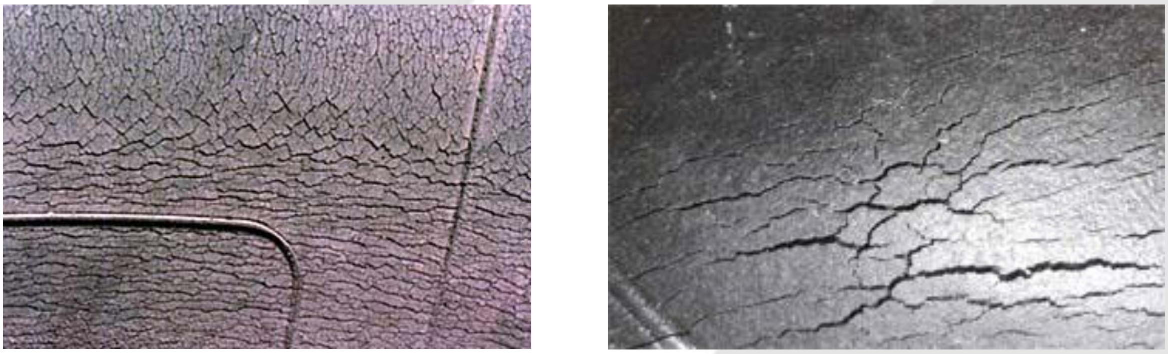

Figure 5: Examples of ozone cracking in rubber

Deformed Rubber Due to Metal Contact

Cyclic or permanent contact with foreign objects (i.e., fasteners, washers, etc.) can induce surface damage on rubber products (see Figure 6 below). This damage appears to remain confined by the shape and geometry of the impacting object, and is not likely to propagate. However, this continued contact might promote bond failure if it occurs close to the metal/rubber interface.

The installation of the rubber product and the fastening technique should be reviewed and revised to prevent and/or stop this condition wherever possible.

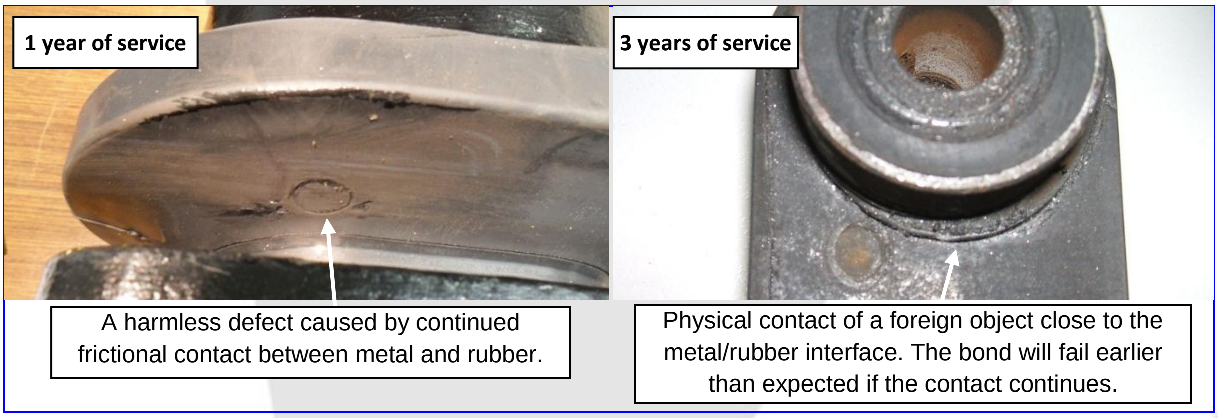

Figure 6: Deformed rubber due to contact with foreign objects

Debonding or Delamination Between Rubber & Metal

Generally speaking, rubber to metal bonds are as strong or stronger in dry conditions than the rubber itself. Thus when failure does occur, it typically occurs through the rubber.

With most rubbers, the occurrence of dry rubber-metal bond failure usually indicates a manufacturing process error, but in some cases, the bond strength may be moderate only. In such cases, a product shall be evaluated carefully and replaced if there is a defect of the bond larger than 10 mm of depth. Figure 7 shows an example of a debond between the rubber and metal surface.

Figure 7: Failure of bond between rubber and metal

Changing Stiffness/Deflection Characteristics

In some cases, where the loads applied are mainly compressive, the product might fail due to compression set or creep. The part dimensions and/or stiffness characteristics may fall outside the original specification over a period of time.

It is recommended that the part be replaced when the mechanical characteristics (stiffness and/or deflection) fall outside a ±30% window from the original target values.