SAE International™

SURFACE VEHICLE INFORMATION REPORT

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O.D. Coatings for Radial Lip-Type Shaft Seals

1. ***Scope—***This SAE Information Report covers thin coatings of resinous based materials that can be placed on the metallic outer diameter of radial lip-type shaft seals to provide sealing when the mating bore finish is too rough to insure a proper seal (typically when finish exceeds 2.54 µm R_a, or in pressurized applications.)

The coatings will have the following characteristics:

a. Material shall dry to a tough, flexible, and non-tacky film.
b. Thickness typically ranges from 0.005 to 0.076 mm.
c. It shall not crack, flake, or powder when scraped.
d. Coating shall adhere to seal case as noted in text.
e. The sealer shall not show any evidence of peeling, blistering, softening, or dissolution when tested in media to be sealed.

2. ***References—***There are no referenced publications specified herein.

3. ***Coating Thickness***

3.1 **Sub-Coat Thickness—**The metallic O.D. of the seal is often covered with phosphate or similar material and a thin coating of bonding adhesive before the bore sealant is applied. These subcoat(s) have a small but significant thickness, and they must be considered when measuring bore sealant thickness. The thickness of the subcoat(s) can range from 0.003 to 0.018 mm but it depends upon the type of treatment used and the consistency of the cement. When the O.D. subcoat(s) thickness is unknown, an average value of 0.01 mm can be assumed.

3.2 **Coated Seal O.D.—**The coated seal O.D. can be estimated from the following formula:

Coated Seal O.D. = Mean Uncoated Metal O.D.
+2 times 0.01 mm (assumed average subcoat(s) thickness)
+2 times O.D. coating thickness (assumed average)

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3.3 Procedure to Determine Average O.D. Sealant Thickness—To improve the precision of the O.D. sealant thickness measurement, the following procedure is recommended:

a. The subcoat(s) are applied to a given lot of metal cases.
b. Seals are then molded and samples are selected from the given lot before the O.D. sealant material is applied.
c. The seal O.D. with subcoat(s) is determined statistically by measuring the selected samples.
d. The O.D. sealant is then applied to the given lot of seals and additional samples are selected for measurement. It is recommended that the original samples selected in Step B be used.
e. The total seal O.D. with subcoat(s) and O.D. sealant is determined statistically by measuring the selected samples.
f. The O.D. sealant thickness is 1/2 of the difference between the total seal O.D. determined in Step C and the seal O.D. with subcoat(s) determined in Step D.

4. Methods to Measure O.D. Sealant Thickness

4.1 Electronically—This method will work only with carbon steel seal cases. The coating is exposed to a low-frequency magnetic-inductive probe, and three equally spaced readings at the center of the case width are taken around the seal diameter. These readings are then averaged. The results will include the thickness of the O.D. coating and subcoat(s). If desired, the subcoat(s) thickness can be determined and subtracted from the total thickness. The electronic method of measuring thickness is preferred over other methods because it is easy to perform and provides good reproducibility.

4.2 Magnetically—This method will work only with carbon steel seal cases. Magnetic, hand-held gages are available to obtain quick readings. Care must be exercised, since the readings are dependent upon operator skill. The gage must be held perpendicular to the surface. Three equally spaced readings, at the center of the case width, are taken around the seal outer diameter and then averaged to give the total thickness of O.D. sealant and subcoat(s). If desired, the subcoat(s) thickness can be determined and subtracted from the total thickness.

4.3 Mechanically—This method is recommended for use with nonmetallic seal cases. It can also be used with carbon steel cases. The O.D. of the seal is carefully marked and measured. The O.D. coating is removed by soaking the seal in solvent such as MEK. Care must be exercised not to abrade or damage the seal outer diameter. After the O.D. sealant is removed, the seal O.D. measurements are repeated exactly as before. The average difference between the two sets of readings is determined and divided by two to give the average O.D. sealant thickness.

4.4 Correlation of Methods—It is possible that slight dimensional differences may result if different methods are employed. It is recommended that identical measurement methods be used when site-to-site correlation of data is attempted.

5. Method of Measuring Bond Strength of O.D. Coating

5.1 "X" Test (Preferred Method)—An “X” of approximately 6 to 12 mm in height is cut through the coated surface to the metal with a razor blade. Scotch tape (3M 810) is pressed firmly onto this area. After 5 min, the tape is removed by pulling at a tangent to the outside seal diameter. None of the coating other than that disturbed by cutting the “X” shall adhere to the tape, irrelevant of how fast the tape is pulled away.

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5.2 **Cross-Hatch Test—**A segment of the coated O.D. is cross-hatched by cutting through the coated surface to the metal with a razor blade. Sufficient cuts are made in each direction to result in approximately 100 to 150 small squares of about 1 mm on a side. Scotch tape (3M 810) is applied to the cross-hatched surface. After 5 min, the tape is removed slowly, and the number of sections with adhered O.D. coating are counted. If 80% or more of the sections are intact, the bond strength is acceptable.

The cross-hatching operation must be performed with care to prevent loosening the O.D. coating material. If this should occur, it would be difficult to differentiate between poor adhesion and material loosened during cutting. The test would be invalid and should be repeated.

6. O.D. Sealer Fluid Resistance

6.1 Use a fresh test specimen for each fluid.

6.2 Submerge a seal or seal O.D. section coated with the O.D. sealer in the application fluid at a temperature and time agreed upon by the user and supplier.

6.3 Upon completion of the immersion period, remove the specimen, dry it with absorbent paper, and examine the O.D. sealant for evidence of peeling, blistering, softening, or dissolution.

PREPARED BY THE SAE MOTOR VEHICLE COUNCIL

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