TEST PROCEDURE SUMMARY

1. Compressive Strength - ASTM D695

The compressive strength of a product is determined by subjecting a solid cylinder of material whose length is equal to twice its diameter to a uniformly increasing load. The load is applied to each end of the cylinder, perpendicular to the longitudinal axis. The load is increased until the specimen fails (ruptures) and the load at which failure occurs is noted. The compressive strength is then calculated by dividing the load applied by the cross sectional area of the specimen.

2. Flexural Strength-ASTM D790

Flexural Strength is determined by subjecting a rectangular bar of material to load. Test specimens measuring 160 mm x 6 mm x 12 mm are supported flatwise on pivots 127 mm apart with a load applied centrally across the width of the bar and the load is increased at a constant rate until the bar yields and the maximum load is recorded. The flexural strength is then calculated by reference to the load applied, the cross sectional area, and the span between the pivots.

3. Heat Distortion Temperature - ASTM D648

Heat distortion temperatures is determined by subjecting a rectangular bar of material to a constant load at increasing temperature. Test specimens measuring 160 mm x 12mm x 6 mm are supported on pivots 150 mm apart and a load of 1 kg is applied to the centre of the bar. The test rig is immersed in a bath of oil which can then be heated to give a temperature increase of 2° per minute. The temperature at which the bar bends by 0.25 mm is then recorded as the heat distortion temperature

4. Tensile Strength - ASTM D 412

Tensile strength uses a cast dumbbell of material of a nominal thickness of 3 mm clamped freely between two sets of jaws, which can be pulled apart with increasing load applied. The load is increased until the dumbbell breaks and this load is noted and the tensile strength can then be calculated.

5. Flexibility - ASTM D412

Dumbbells of the product under test are cast at a nominal thickness of 3 mm. After full cure the dumbbells are clamped into jaws which can be pulled apart at a constant rate, and constant load. The original length of the dumbbell is measured, and the increase in length is monitored with the length at which the dumbbell breaks being recorded. The increase in length is then expressed as a percentage of the original length which is the flexibility of the product.

6. Salt Fog Resistance - ASTM B117

Test panels 150mm x 100mm coated with the appropriate coating system are exposed to a continuous salt fog at a constant temperature of 35°C in a closed cabinet. The salt fog is an atomised salt solution consisting of 5% salt by weight dissolved in distilled water. Panels are positioned vertically within the cabinet, but not in contact with each other, and droplets of solution which collect on the roof of the cabinet are prevented from falling onto the panels. Panels are examined periodically for degradation, including blistering, corrosion and cracking.

7. Tensile Shear Adhesion - ASTM D 1002

Tensile shear adhesion is determined by measuring the load at which an overlapping bond fails. The material under test is applied to a blast cleaned surface of metal strips measuring 25mm x 100mm. The material is applied at the end of the strip over an area of 10mm x 25mm and two strips are bonded together by overlapping the treated area. The strips are clamped together and the product allowed to cure. After curing the strips are clamped into jaws which are pulled apart at a constant speed, increasing the load until the bond breaks. The shear adhesion can then be calculated from this load and the area of the bond.

8. Abrasion Resistance - ASTM D4060

The material under consideration is applied to a 100mm square panel with a hole drilled centrally. When fully cured the panel is then clamped onto the test rig, which rotates at a given rpm. Abrasive wheels of a designated hardness are lowered onto the specimen surface with a load applied (usually 1 kg). After a specified number of revolutions (cycles) the test piece is examined and the amount of product removed can be measured to determine the abrasion resistance.

9. Humidity Resistance - BS 3900 Part F.2

Test panels 150mm x 100mm coated with the appropriate system are exposed in a closed cabinet containing 100% humidity operating in a cyclic temperature of 42°C to 48°C which ensures that condensation always forms on coated surfaces. Panels are positioned in a vertical position in the test chamber. Panels are examined regularly and assessed for blistering, corrosion and other degradation.

10. Scratch Resistance - BS 3900 Part E2

A scratching needle which has a 1mm diameter hemispherical hardened steel tip, which can be loaded with increasing weight is passed over the cured coating surface. The loading on the needle is increased until the needle penetrates the coating through to the substrate, and the minimum weight, which penetrates the coating is recorded as the scratch resistance.

11. Tensile Strength-ASTM D638

Dumbbells of the product under test are cast at a known thickness of a minimum of 4mm, from which the cross sectional area can be calculated. After full cure the dumbbells are clamped into jaws which can be pulled apart at a constant rate, until the dumbbell breaks. The load applied to the dumbbells is monitored and the maximum load prior to the break is recorded, from which the tensile strength can be calculated.

12. Water Vapour Permeability - ASTM D1653

A free film of the coating under test, of a known film thickness is clamped over the top of a small dish. This dish contains a measured weight of water. The dish is then stored at a constant temperature and pressure, in a sealed vessel containing a desiccant, for a specified period of time. The desiccant draws moisture through the coating film. After the specified time the test samples are removed and the amount of water remaining in the dish is measured. The weight loss is the amount of water vapour that has passed through the coating, which allows the water vapour permeability to be calculated in relation to the exposed surface area and thickness

13. Impact Resistance - ASTM D256

Test bars measuring at 10mm x 12.5 mm x 62mm of the material under test are cast and a 'V' notch at an angle of 22° and a depth of 2.5 mm is cut into the centre of the narrow side. A minimum of specimens are tested. The specimen is fixed in the test rig. A pendulum with a striking head of a cylindrical bar is then swung so that the striking head hits the notch with an energy of 2.7 joules. The test rig is fitted with a dial, which measures the distance the pendulum swings after the specimen has broken. This equates to the energy retained by the pendulum, which allows the energy loss to be expressed as the impact resistance of the test material.

14. Direct Pull Adhesion - ASTM 4541

Special studs with a 121/2mm diameter are bonded onto the coated test panel with a suitable adhesive. A suitable clamp is fixed to the stud once the adhesive is cured so that a force can be exerted at 90° to the coating surface. The force at which the bond breaks is noted and the type of failure (cohesive split in the coating, coating pulled from the substrate, adhesive failure) is noted.

The ratio of force to surface area gives the adhesion of the system.

15. Pencil Hardness - ASTM D3363

Standard lead (graphite) pencils with harnesses varying from 9H to 6B are used. The pencils are sharpened and the end of the lead is squared off using a fine abrasive pad. The pencil is held at an angle of 45° and pushed over the surface of the coating under test.

The coating surface is now examined for marring, and the hardness of pencil which just marrs the coating is noted and the hardness of the coating is expressed as the next softest pencil.

16. Scrub Resistance - ASTM D2486

Test panels coated with the system under test are fixed to the test bed of the testing apparatus which consists of a brush attached to a motor by a connecting rod mechanism. A special detergent medium is used to wet the brush, this medium is renewed every 400 cycles and the surface of the system is assessed for loss of gloss and erosion after a specified period.

17. Dry Heat Resistance - ASTM D2485

Test panels of the system under test are exposed for 24 hours in a muffle furnace at an agreed temperature. At the end of the test period the panel is allowed to cool to ambient temperature then if the coating system is designed for interior use the panel is bent over a ½" mandrel and the coating film is examined for deterioration. When a coating system is designed for exterior use, panels are removed from the furnace and examined, and if no deterioration is evident, the panels are exposed in a salt spray for 24 hours, then re-examined.

18. Heat Resistance – ASTM D573

Samples are heat aged in an oven at specified temperatures for the specified time, samples are then removed and subjected to physical testing and results compared against none heated sample to establish if any deterioration occurs.

19. Ozone Resistance – ASTM D1149

Samples of elastomers are exposed under constant surface tensile strain to an ozone euriched atmosphere under partial pressure and examined for cracking and degradation.

20. Tear Strength – ASTM D624

Dumbbells of elastomers are clamped in the jaws of a tensile test apparatus and an increasing load is applied to pull stretch the sample. The force at which the sample begins to tear is noted and recorded as the tear strength.

21. Flexibility – ASTM D624

Coatings under test are applied to prepared thin gauge steel or other specified metal panels and allowed to cure. When cured for the appropriate period the panel is bent over the specified mandrel.

Method A uses cylndrial mandrels of different diameter ranging from 3 mm up to 25 mm, on these mandrels the panel is bent through 180° under slow deformation.

Method B uses a conical mandrel and again the panel is bent through 180° over the mandrel.

After bending, the coating is examined for cracking, flaking etc. The diameter at which the coating does not show defects is reported using Method A whilst Method B expresses the point of failure furthest from the point of the come as a % figure.

22. Water Absorption – ASTM D570

Solid discs of the coating/material under test are allowed to fully cure. The samples are weighed then immersed in water for the specified time, then removed, wiped dry then again weighed. The change in weight is then expressed as a % weight gain.

23. Cathodic Disbondment – ASTM G95

Cells comprising either a plastic or glass cylinder filled with electrolyte are bonded onto coated pipe sections, the electrolyte is 3% solution of salt in deionised water. A current of 3 volts DC is passed through the cell for the test period with the electrolyte topped up to a consistent level as required.

At the end of the test period the coating is examined for holidays and loosening. A holiday is cut in the coating in the test area, radial cuts at 45° are made through the coating intersecting at the centre of the holiday. The adhesion of the coating is then checked by lifting with a knife and the amount of disbondment is measured.

24. Impact Resistance – ASTM G14

A sample of coated pipe is clamped in the test apparatus. A weight of 1.361 kg with a hemispherical contact head of 15.875mm diameter is dropped from various heights until the coating fails. The height at which failure occurs is noted and this is then reported as the impact resistance by converting the units to inch or lbs or joules.

25. Bacteria Resistance – BS 4618 Section 4.5

This test measures the effect of soil burial and biological attack on plastic materials and coatings. Coated samples are buried in a standard 'soil' composition for a prescribed period of usually 12 months and the effect of the burial on the coating is noted.

26. Mould Resistance – BS 3900 Part G6

Coated panels are exposed to a mixed inoculum of fungal species normally found in contact with painted surfaces and exposed for an agreed time, usually up to 6 months, and the effect of these fungal species on the coating are assessed.

27. Hardness – ASTM D 2240

Cured discs of product of a minimum thickness of 6 mm are tested for penetration resistance using a pointed probe. Two different probes are used, Shore A for soft flexible materials and Shore D for hard plastic materials.

28. Accelerated Weathering – ASTM G53

Coated panels are exposed in a chamber where cyclic exposure to water spray (to simulate rain) and UV light (to simulate sunlight) occurs. Panels are examined for colour change, cracking etc. after the specified exposure period.

29. Chemical Resistance – ASTM D 543

Solid samples or coated rods are exposed to specified chemicals for a prescribed times. Weight of samples are checked before and after exposure and any change in weight recorded.