SPARK TESTING OF THICK FILM COATINGS MANUFACTURED BY CORROCOAT LTD

NB: This information should not be used for holiday detection on coatings having a total dft of less than 300 microns or which have dielectric strengths below 200 volts per 25 microns (Thou).

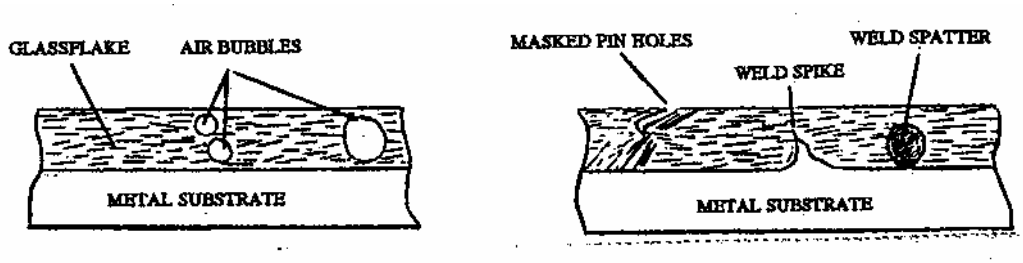
Spark testing is carried out to ensure that there are no pinholes or holidays within the coating system, which could lead to direct corrosion of the substrate and premature failure in aggressive environments.

Although this specification may be applied to other materials it is primarily intended for Corrocoat/Polyglass coatings which are generally described as thick film coatings. They are normally applied to dft's in excess of 300 microns but are often applied in the range of 800 to 3000 microns.

Corroglass/Polyglass materials contain flaked glass in a resin system and the resultant compound has a high dielectric strength. Because of this the use of certain types of holiday detector e.g. wet sponge, is inadvisable due to their inability to detect partial flaws in the coating system.

In order to pass an electric current across an air gap a potential of approximately 1,800 volts is required per mm. Because there would be insufficient voltage to bridge the gap in dry air, it would be useless to test a 1500 micron thick coating with a test voltage of 2 kV, as a pin hole may not be detected at this voltage, even if the pin hole existed from the surface right through to the metal substrate.

Much higher voltages are therefore required to test this type of coating for defects. It is also possible for partial defects to occur which can be detrimental to the coating system's integrity but which would not be detected with relatively low voltages and which are not detectable by visual means. For instance, it is possible, in a film applied at 500 microns in a single coat, to have a bubble in that film of 450 microns in diameter (see sketch). This defect would not be picked up at a voltage which was lower than the dielectric strength of the 50 microns of material plus the air gap.



In order to overcome these problems and obtain high integrity in the coating, Corrocoat recommend a high frequency AC tester used at high voltages. This equipment gives a highly visual indication of a leak path. DC testing equipment can be used but the DC test is more aggressive and likely to break down of films more readily if incorrectly used. On thick film coatings of the Polyglass/Corroglass type, the visual spark indication of DC equipment at a holiday is poor, also, at high DC voltages the equipment becomes dangerous to personnel. When using DC equipment it is necessary to reduce the test voltage compared with that for AC testing. Where concrete or masonry is being tested, the high frequency AC tester recommended in normal use will not function well and the DC tester should be used as a preference(Consult UK Technical Service).

Because of capacitance effect, it is unnecessary to earth a metal component when testing with a high frequency AC unit. This obviates one of the problems in using a DC tester, that of ensuring a good integrity earth from component to testing equipment.

The dielectric strength of Polyglass/Corroglass materials varies dependent upon grade, age of coating and moisture content, but in general it can be said that the dielectric strength is in excess of 450 volts per 25 microns, therefore, in order to pass current through a 1mm film, a voltage of circa 18 kV is required. As dielectric strengths are generally much higher than the figure quoted when the coating material is new and because the AC current is less likely to break down the coating at the frequencies used, voltages up to than 25 kV per mm can generally be used without damage to the coating. This may be desirable to 'blow' a pinhole that is covered (bubble), for coatings

seeing service in aggressive environments, such as high concentration acidic duty. However, it is **not** necessary in most environments to use such high voltages and for many service duties, a voltage per mm of 12kV AC and with leak alarm 6kV DC, is perfectly adequate.

PROCEDURE

The tester should be operated by connecting to the mains using a suitable earthed plug and the mains voltage selected on the tester to match with the supply voltage. The output control should be adjusted for the required voltage, dependent upon the thickness of coating. It is recommended that a voltage of (thickness in microns x dielectric strength per micron x 0.75 constant) is used. Where aggressive environments are encountered, e.g. acid tank linings, it is recommended that the constant used is 0.9. The test voltage used may be limited for safety purposes but should always exceed the air gap value plus 10%.

After switching on the tester it should be checked for operation by bringing the probe tip near to a metal surface and checking that an arc occurs. It should be noted that at the higher voltages, establishment of an arc should be possible at some distance from the metal, whereas at the lower voltage this will only be possible in close proximity to it. An air gap standard should be used for calibration and to check output voltage.

The surface of the object to be tested should be thoroughly swept by the probe. This can be achieved by marking out (with a non-conductive marker) into a grid section on each component and systematically working from square to square using the largest brush practical. On small components it will be relatively easy to ensure full coverage using a soft fan tail brush probe. It should be noted that passing over the same area more than once will not damage the coating provided that the probe is not allowed to be kept stationary for more than a few seconds (see note). However, constant arcing in one position or repeated testing may cause carbonisation of the coating and actually generate a defect.

Voids or defects in the coating will be readily recognised by the passage of a bright spark. This can be confirmed by moving away from the area and noting that the arc remains established at the same point until the probe has been moved too far away from the defect to maintain the arc, at the same time a hissing, rather than crackling noise will be observed. The site of the defect, once located, should be marked and repaired in accordance with the defect repair procedure for each particular material. After repair and cure a further test should be carried out to ascertain that the repair has been successful.

The AC tester cannot be used on concrete without earthing and even so is generally not effective. Where concrete or masonry is to be tested the DC type tester must be used. Testing should be carried out by earthing the tester (usually by driving a masonry nail into the substrate in convenient locations or attaching to exposed re-bar) and operating with the probe voltage set at the 12 kV, or greater, position.(**Be aware of safety considerations**). Where concrete substrate has a very low moisture content spark testing may be impractical and it may not, therefore, be possible to check for integrity of the film without a conductive under-film (Polyglass Graphite S) has been applied first, in which case both AC and DC may be used.

DC TESTING

Previously AC spark testing using capacitance effect was the only recommended procedure for Corrocoat or Corroglass thick film coatings applied on steel. The reason for this is that the AC equipment does not need grounding, the park is highly visible and it is less dangerous than the DC equipment from a health and safety point of view.

Advances in DC equipment means that this equipment can now be utilised satisfactorily, provided the equipment is fitted with a current leakage alarm so that even when a spark is not produced or is not visible, the alarm will notify the tester that a voltage leak has occurred and that a pinhole or holiday is being encountered. It is essential that only DC equipment fitted with a leakage alarm facility be used and equipment plus test piece is well earthed.

Suggested **voltages for DC testing** are as the previous calculation but because of the ability of DC to cause damage at lower voltages the constant **values used should be between** 0.5 and 0.7 respectively.

NOTE

No spark testing should be carried out **on damp surfaces** or **before a tack free** cure is attained. Surface contamination by conductive particles (such as metal grinding) or films (such as carbon smoke) may give rise to false indications.

Where product has been in service for some time it's dielectric strength may have been affected and spark testing could be inadvisable. If the coating has been in service and does not show signs of pin holing or breakdown a good visual inspection is preferable. Where testing of after service coating is to be carried out, a DC tester set at low voltage (25% of the norm) with the leakage alarm activated is suggested. Further, it is recommended that the coating is not only surface dry but dry throughout the film thickness. This may only occur after some days out of service or after dehumidification.

A phenomenon called **Dielectric Fatigue** can occur and is more prevalent with some types of coating and polymer than others. This phenomenon occurs when the material is subject to repeated high voltage conditions. The condition is relevant to spark testing and particularly where high voltages are used. Therefore, it is **not recommended** that testing be carried out over and over again. Where pin holes or holidays are found and high voltages have been used it is preferable that testing is carried out no more than twice. Preferably the defects should be repaired on the first occasion and the whole surface area retested but then, should further defects be found, these should be repaired and the defects only tested. **Repeated testing of the whole area may result in generating new defects** on each occasion**.**

Safety is paramount and operators should wear rubber soled boots and insulative gloves. Testing should not be carried out in flammable atmospheres or intrinsically safe areas.

All values are approximate. Physical data is based on the product being in good condition before polymerisation, correctly catalysed and full cure being attained. Information regarding application of the product is available in the Corrocoat manual. Should further information be required, please consult Corrocoat Technical Services.

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