



IPC-TM-650 TEST METHODS MANUAL

1.0 Scope

1.1 Purpose This test method establishes a procedure for determining the amount of surface ionic soil on a printed board or printed board assembly. The soil must be soluble in water, alcohol or some mixture of both. The determination can be made on either a quantitative or a qualitative basis.

1.2 Restrictions The equipment used does not differentiate between specific ionic specie. It determines their presence and ranks them according to their ionic mobilities. Salts with higher ionic mobilities are weighed heavier than salts with lower ionic mobilities.

1.3 Application This method has application as a quality control tool and as a method for developing and evaluating cleaning process parameters. As a quality control tool, it can be used to inspect parts to determine if they conform to pre-determined levels of cleanliness. In process development this procedure can be used to evaluate solvent and process efficiency and also to set levels of acceptable cleanliness.

2.0 Applicable Documents None

3.0 Test Specimen Any preproduction or production bare printed board or printed board assembly.

4.0 Test Equipment A dynamic measurement device which extracts the ions from the surface being measured and checks conductivity of a rinse solution. Solvent is pumped through a recirculating loop which includes a plastic tank, conductivity cell and ion exchange column to remove all traces of ions from the solvent before entering the tank. The conductivity cell used is temperature compensated to avoid reading variations caused by temperature changes. A metering pump pumps the solution through the loop at a constant rate. A recorder is used to follow the change of conductivity with time. (See notes).

5.0 Procedure

5.1 Solvent Systems The equipment can be used with either pure water or water/alcohol mixtures. Water is used when only water soluble salts such as plating salts are to be measured. The use of pure water results in a measuring fluid

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with an initial conductivity of about 0.1 micromhos (10 megohms).

Water/alcohol systems are used when nonpolar soils might encapsulate or otherwise mask the water soluble ionic soils. Various alcohols have been used successfully. The preferred systems use either N-propanol or isopropanol as the alcohol solvent. Because of the high dielectric constant of the alcohols, excessive alcohol in the mixture will generally degrade the sensitivity of the measurement. To obtain maximum sensitivity and to insure sufficient alcohol to readily remove all nonpolar residue, the recommended mixtures are 40% (by volume) N- propanol and 60% water or 50% (by volume) isopropanol and 50% water. Mixtures with as high as 75% by volume is isopropanol have been successfully used.

5.2 Calibration Once the fluid in the system has established a stable level of conductivity, a precise quantity of calibration solution is injected into the test solution. The system then integrates the variables of test solution conductivity, pumping rate, sample area and time into a contamination level specified as equivalent micrograms of sodium chloride (per sq.) of the sample.

5.3 Testing Once the system has been calibrated in accordance with 5.2, the test specimen is immersed in the sample tank. Care must be taken not to handle the sample or any of the appliances used to insert it into the tank. Finger dirt contains highly mobile ionic soils and may give spurious readings.

During the course of the measurement, the conductivity of the solution will depart from the baseline of conductivity and then gradually return. When it has returned to the baseline, no additional soil can be removed and the measurement is complete.

The curve for that sample is then integrated as per section 5.2 and the calibration curve is used to determine the amount of contamination on the part.

5.4 Evaluation Without a sample in the tank, a condition will be established in which the conductivity of the solvent, as measured by the conductivity cell, will attain a constant low value. With the introduction of a contaminated sample into the tank, the conductivity reading measured at the cell will rise rapidly. The sample remains immersed in the solvent until the conductivity of the solvent returns to its original equilibrium

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level. At that point, no further ionic material can be removed from the sample.

5.4.1 Theory of Measurement Technique The entire amount of ionic material removed from the sample can be related to the integral of the conductivity readings over the period of time required to dissolve the material and purge it through the system as follows: At any instant, t , the number of moles, n_t , of ionic material within the conductivity cell is $n_t = V_c \times C_t$ where C_t is the concentration of ions and V_c is the cell volume which is constant. Over an infinite amount of time, the total number of moles of ions passing through the cell, N , will be:

$$N = \int_0^{\infty} n_t dt = V_c \int_0^{\infty} C_t dt$$

Since we are dealing with very low concentrations ($10^{-4}N$), we can assume complete ionization, therefore:

$$\text{Conductivity} = L = kC$$

(assuming one salt to be present). Of course, different ionic salts with different ionic mobilities will give different conductivities for a given concentration.

$$N = kV_c \int_0^{\infty} L_t dt$$

If the monitor and recorder responses are linear with respect to L , then according to the last equation, the area under the conductivity-time curve which is charted on the recorder is a linear function of N , the total amount of ions removed from the sample.

5.4.2 Treatment of Test Data The number obtained from section 5.3 will be the ionic contamination on the surface of

the board in terms of equivalent micrograms of sodium chloride. (If the calibration solution contained a different salt than sodium chloride the number will be in term of equivalent micrograms of that salt). It is common practice to divide this figure by the total area on both sides of the printed board or printed board assembly and present the data in terms of equivalent micrograms of salt per unit of area.

By using a scale of measurement based on only one salt, i.e. sodium chloride, the ionic contaminants are being measured in terms of their ionic mobility. The more mobile or active an ion is, the more likely it is to cause a problem. Thus, while this test method will not differentiate between specific ions, it is an effective way of quantifying the presence of many ions.

6.0 Notes

6.1 Other Uses The equipment measures the ionic activity of any part or solution which contains ionic material, it may be used for various other purposes. A partial list appears below:

- A. Incoming inspection of reflowed tin/lead boards to determine if residues have been completely removed.
- B. Measurements of purity of incoming and redistilled solvents.
- C. Measurement of amount of activated rosin flux dissolved in the boiling sump of a vapor degreaser.
- D. Measurement of activity level of activated rosin fluxes.

6.2 Availability The equipment specified, or its equivalent, may be procured commercially. Source is Alpha Metals Inc. (Equipment name is Ionograph™).