Solderability Testing

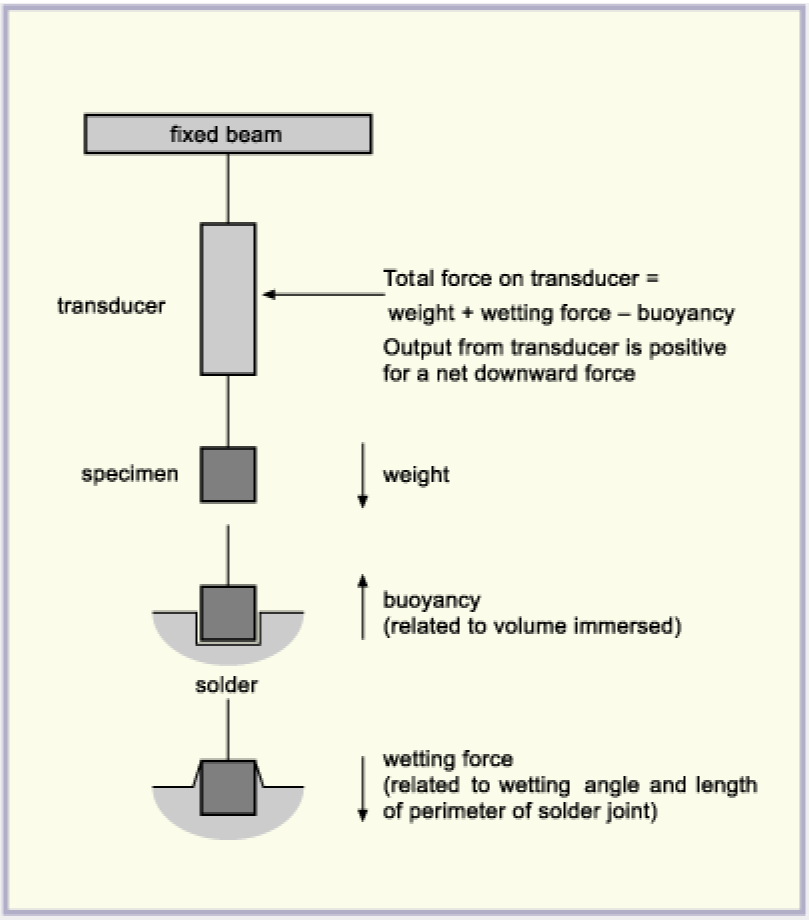
The idea of the process window helps us to explain our observations, particularly in terms of dewetting, but the assessment of solderability goes back to the basic ideas of “how far and how fast”. However, it is just these fundamental measures which are difficult to carry out in production, except one might take a copper coupon with a bead of solder, and watch it spread.

In assembly shops the wettability of individual parts is most likely to be estimated using production equipment and observation. Whilst this helps answer the question “Will the parts work?”, such tests are difficult to replicate and are not suitable as standardised assessments. *Standardised* tests need to have as few variable parameters as possible, and specify tight control of these.

Of the standardised tests available, the wetting balance test method has for long been regarded as the most versatile, and has been used for assessing the efficacy of fluxes as well as the solderability of components. Examination of the results gives information about both the speed and extent of wetting and the behaviour of the surface upon prolonged exposure.

The specimen is fluxed, then suspended from a sensitive balance and held over a solder bath which preheats it by convection. It is then immersed in the bath at a controlled rate and to a set depth. The specimen experiences vertical forces of buoyancy upwards and the surface tension downwards, which are detected by a transducer (Figure 1). The transducer output varies with time and is continuously recorded on a high-speed chart recorder or data acquisition computer: the forces change very rapidly and a fast response time is essential to avoid distorting the test results.

Figure 1: Forces on the transducer, explaining the positive and negative sense of the forces

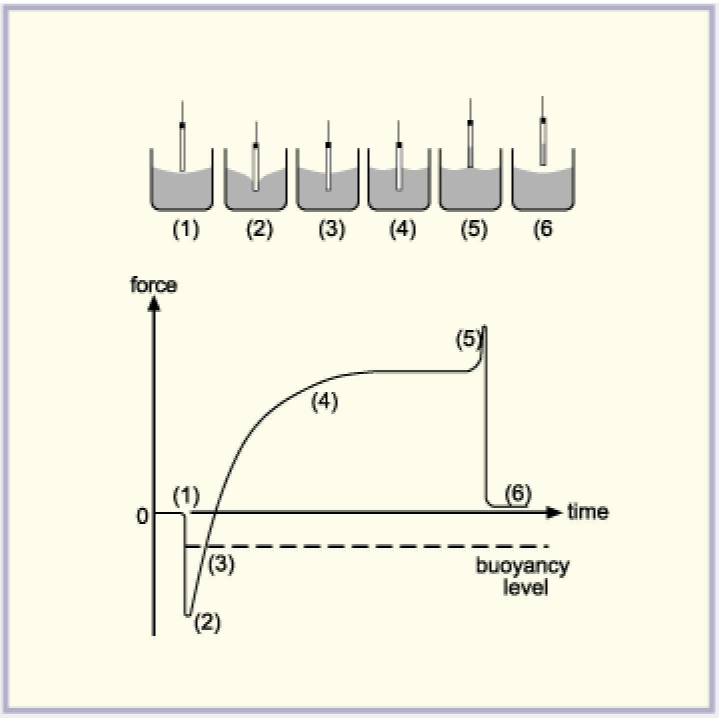


In Figure 2, the six stages of the testing of a readily wettable specimen are shown:

1. just before immersion.
2. immediately after immersion, before wetting has begun and both buoyancy and surface tension forces act upwards.
3. after wetting has begun and the meniscus has risen up the specimen to the point where the vertical force from surface tension is zero and the net force acting in the specimen is that due to its buoyancy.

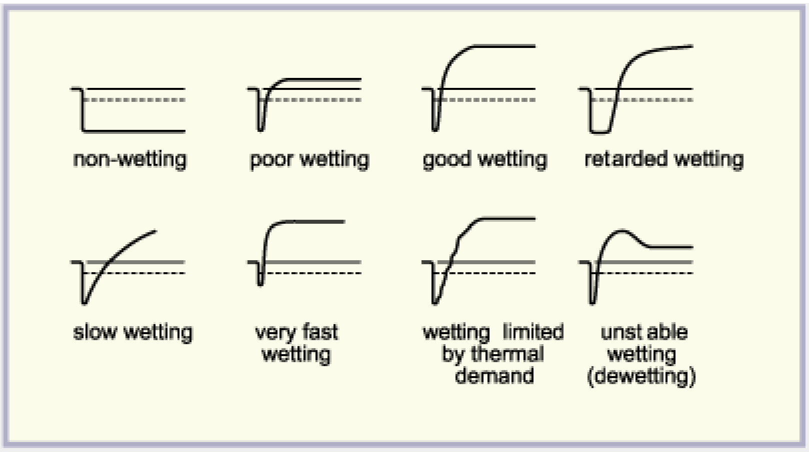
4. when the meniscus is curved upwards and the surface tension force is acting downwards.
5. as the specimen is being withdrawn and surface tension and a possible oxide film on the solder are causing solder to be dragged out.
6. when the specimen has been withdrawn and is heavier than at the start of the test because of the adherent solder coating.

Figure 2: A wetting balance curve



Some representative curves are also shown in Figure 3. In each case the full horizontal line represents the force at the start of the cycle and the dotted horizontal line the buoyancy level at which the wetting force is zero (a calculation based on the weight of solder displaced).

Figure 3: Representative shapes of wetting balance curves



In the globule balance normally used for SM components, the solder bath is replaced by a small globule of molten solder (Figure 4).

Figure 4: Wetting balance of the globule variety

There are several benefits:

- individual leads or pads can be assessed separately
- the curved solder surface increases the transducer output signal

- the small globule reacts to effects such as dissolution of solderable coatings and metallisation which could be swamped in a large bath
- new, uncontaminated solder can be used for each test.

Ceramic plate test

Not everyone accepts that the wetting balance test is suited for determining the solderability of plating materials. The ceramic plate test (CPT), developed at Compaq in 1988, is claimed to evaluate devices under conditions more closely simulating actual surface mount processing. The method consists of printing solder paste onto a ceramic substrate, followed by package placement and reflow. The reflowed solder on the leads is then inspected visually to determine the wetting characteristics, using a rating system for solder appearance (0=best; 10= worst).

Although this test is not universally accepted, the most important point to make is that the test results obtained with the ceramic plate test are not mirrored by the wetting balance test results, tending to be less favourable.

SERA

Solderability testing should ideally reflect the solderability of the surface after typical life. Unfortunately, board fabricators need to have immediate assessments, and other test methods have been proposed to try and give a more real-time test. One of these is Selective Electrochemical Reduction Analysis (SERA), which can be applied to assess the chemical constitution of the through-holes as well as the surface features.

Two test approaches are required to get a complete picture of the finish. The first is a non destructive reduction test which assesses the presence and quantity of surface oxides of tin. The second uses a destructive oxidation test where the electrolyte strips selectively through the layers of tin and the underlying intermetallics. Measuring the amount of free surface tin gives an indication of solderability. Whilst this test is under evaluation, and an interesting laboratory tool, the concern is that it may not be a good predictor of long-term solderability because the growth rates of intermetallic vary with the different types of tin finish.

Source : http://www.ami.ac.uk/courses/topics/0149_stst/index.html