Vitronics Soltec

Information Sheet 123

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Wetting or joint shape in relation to the surface dimensions

Introduction

One of the inspection criteria to judge joint quality is the so-called wetting angle.

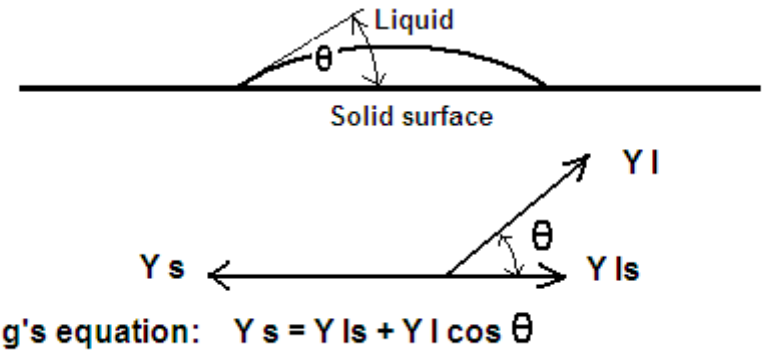
The angle that exists between the surfaces of a joint and the solder should be in general < 30°. There are however situations that will create larger wetting angles but still create sound joints. The reason for those types of joints will be elucidated

The mechanisms of wetting

If a liquid comes in contact with a surface the total system tends to a minimal of free energy.
This means that the surface tension forces involved between the liquid and the surface are counteracting one another until they find a balance of forces.
The surface tensions involved at the interface between the parts and the environment will finally balance and can be expressed in Young's formula:

$\gamma_s = \gamma_{ls} + \gamma_l \cos \Theta$. (See Figure 1).

Figure 1 Wetting forces acting on a surface



Note: See for more information on solder wetting and related aspects the book Soldering in Electronics SE ,Chapter 2.1.2, by R. J. Klein Wassink

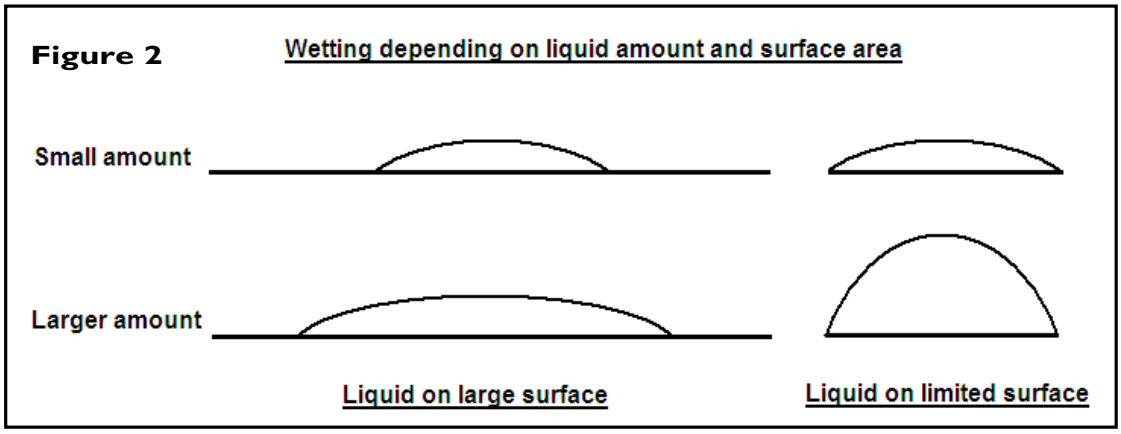
The effect of limited surface dimensions

If the liquid contacts an "infinitive" surface, the surface tension force γs can freely act on the system. However when the surface comes to an end, e.g. at an edge, this force γs can not be active anymore because there is no more surface available in the plain where the force is acting when it comes to the edge. There may be a surface over the edge as with plated through holes, but that is a new story, because that surface is not in the same plain as the original wetted surface. The liquid will not pass a sharp corner towards a surface in another dimension, unless there are capillary gaps at the edge so that it is not a real sharp edge. It simply stops wetting at the edge of a surface. It will in fact withdraw from the edge.

If a liquid film becomes however thicker the wetting angle Θ at such an edge will increase. When this angle Θ becomes larger than 90° the liquid will finally flow over the edge.

Various wetting examples

In Figure 2 we see several examples of wetting. Both on large surfaces and on surfaces which are limited. In one example we see the effect of full wetting at a given amount of liquid, giving on both surfaces the same wetting angle. The next example shows the effect of an increase in the liquid amount. On the large surface this extra amount will result in a larger area of spread of the liquid still giving the same wetting angle as in the previous model. On the limited surface this same extra amount of liquid will now result in a build up of liquid at that surface, resulting in a larger wetting angle.



The effect of limited surfaces on the shape of a solderjoint

On most solderjoints we have to deal with limited surfaces where the solder has no possibility to drain off by other means than just the lead end. Since the tracks are covered by solder resist there is no connection to the joint that could assist the solder to get rid of solder excess.

So in case that more solder is left at the joint when it is separated from the solderwave there is no other way for the solder than to stay on the joint. This will however inevitable result in a joint shape with a larger wetting angle. Although such a joint does not meet the small wetting angle qualification it is still a perfect joint since all parts involved in that joint did wet well.