

## Solder Fillets of Surface Mounted Connectors

### 1. SCOPE

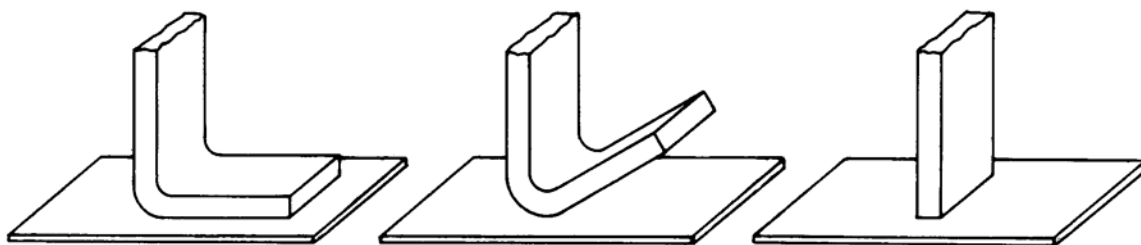
This specification covers the acceptable requirements and the not acceptable conditions for the solder fillets of surface mounted connectors. It is intended to be used for qualitative evaluation of surface mounted connectors. This specification complements existing industry standards and specifications.

### 2. INSPECTION CRITERIA

Figures are at approximately 20X magnification unless otherwise specified. Solder joints shall be viewed at 20X magnification. Connectors shall be viewed at the angles necessary to ensure proper identification of condition. Conditions shown in this specification apply to all types of leads unless otherwise specified.

### 3. IDENTIFICATION OF LEADS

Figures 1 through 3 identify the three basic lead designs. These basic designs are subject to various modifications. Leads may not necessarily be perpendicular to pad.



*Lap or Gulf Wing*

Figure 1

*"J"*

Figure 2

*Butt or "I"*

Figure 1

#### 4. DEFINITION OF TERMS

- 4.1. Bridging  
Direct connection between adjacent conducting pads or leads by solder.
- 4.2. Dewet  
Areas where solder initially wetted the surface but then pulled back, color of base metal not visible.
- 4.3. Non-Wet  
Areas where solder did not wet, color of base metal would be visible.
- 4.4. Solder Balls  
Spherical shaped balls of solder which may or may not have drifted away from the solder joint caused by the nonwetting of the solder to substrate, or by rapid heating of the solder paste in the reflowing process.
- 4.5. Voids  
Voids are spherical cavities usually caused by entrapped flux. They may not always be visible at the surface of the fillet. They are visible in a cross-section of a surface mount solder joint.

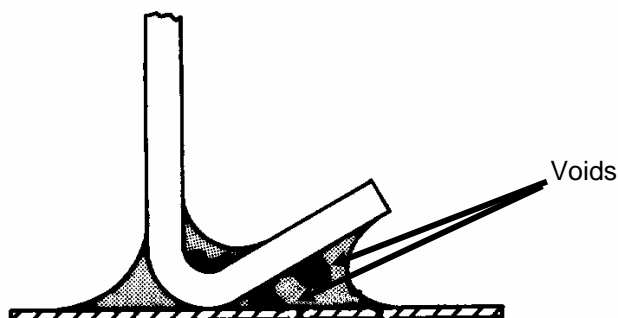


Figure 4

- 4.6. Wetting  
Flow of the molten solder over the surface to be soldered. Good wetting is represented by smooth, even coverage.
- 4.7. Wetting Angle  
The angle where the solder comes in contact with the solderable surface. A low angle, approaching zero, implies good wetting; a high angle, poor wetting, except when solder resist is present, a high angle may be present where the solder contacts the solder resist.

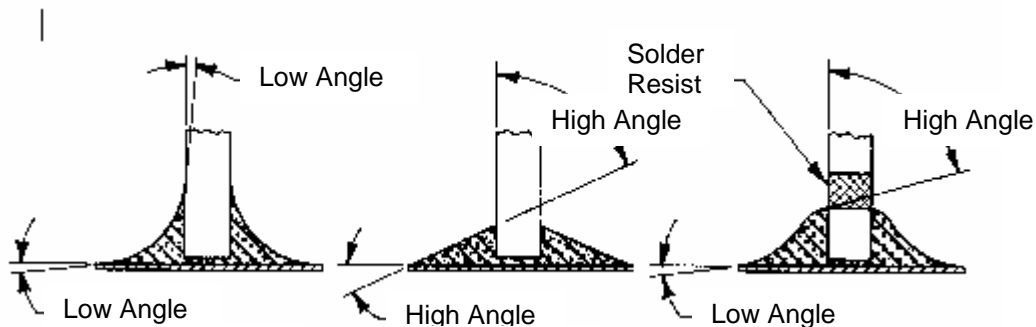


Figure 5

Figure 6

Figure 7

- 4.8. Wicking  
The flow of molten solder away from the solder joint area by a capillary action.

## 5. ACCEPTABLE REQUIREMENTS

### 5.1. Preferred

- A. There shall be good wetting of solder between lead and pad, indicated by low wetting angles and a concave fillet.
- B. Solder fillet surface shall have a satin luster and be smooth, free from voids and solder balls.
- C. Placement of lead on pad shall allow solder fillets to form on all four sides between lead edges and pads.

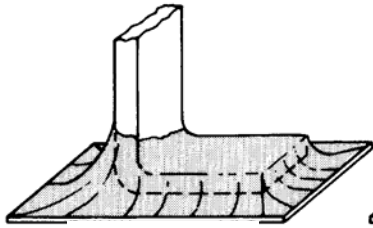


Figure 8

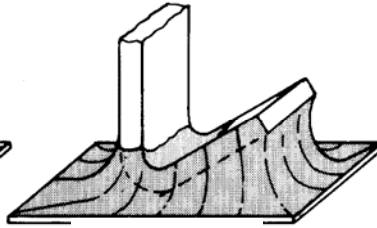


Figure 9

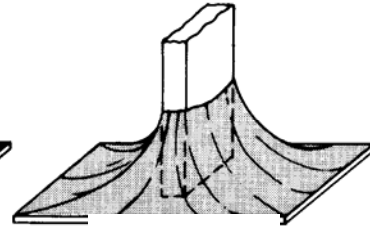


Figure 10

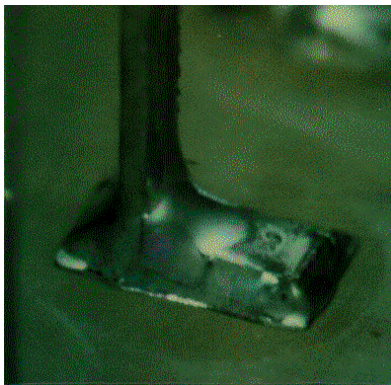


Figure 11

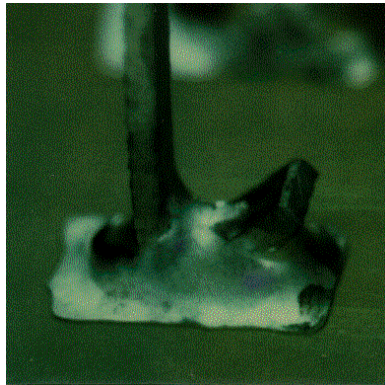


Figure 12



Figure 13

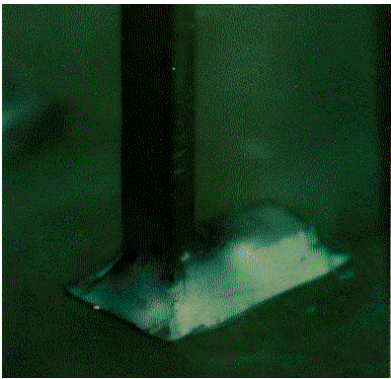


Figure 14

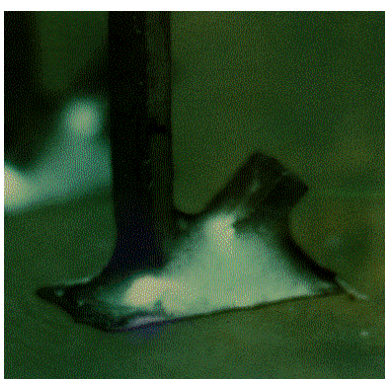


Figure 15

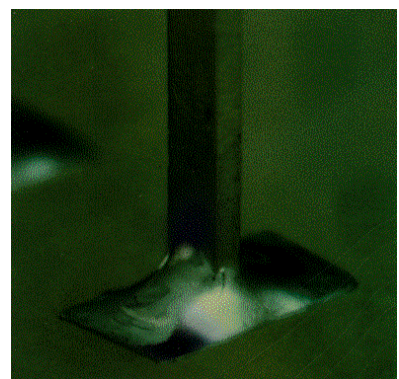


Figure 16

## 5.2. Minimum Solder Fillet

- A. For the lap and "J" leads, the minimum heel fillet shall be to the upper tangent point of the heel bend, Figure 17 and 18.
- B. For the butt lead, the minimum fillet height shall be 0.51 mm [.020 inch] high and the lead should penetrate well into the solder, Figure 19.
- C. For the lap and "J" leads, it is acceptable to have the toe of the lead a non-solderable surface, Figure 20.
- D. For the butt lead, it is acceptable to have two edges of the lead a non-solderable surface. Solder fillets 0.51 mm [.020 inch] high are required on both broad surfaces, Figure 21.

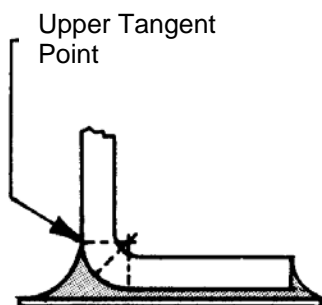


Figure 17

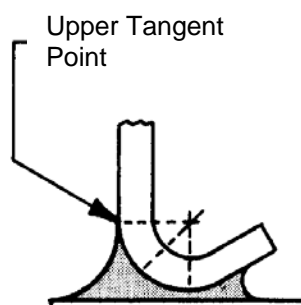


Figure 18

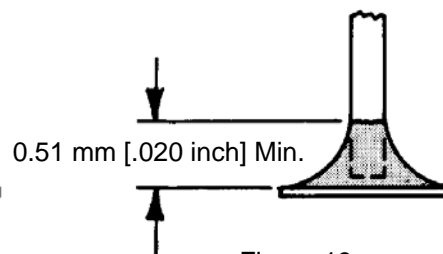


Figure 19

Non-Solderable  
Surface

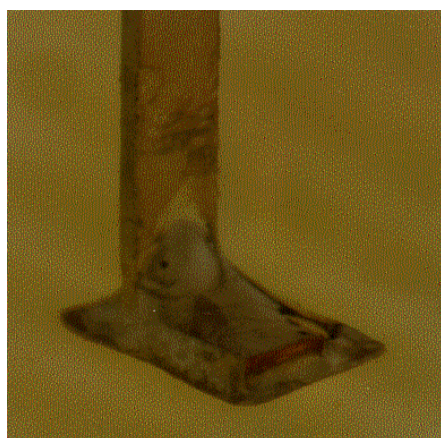


Figure 20

Non-Solderable  
Surface

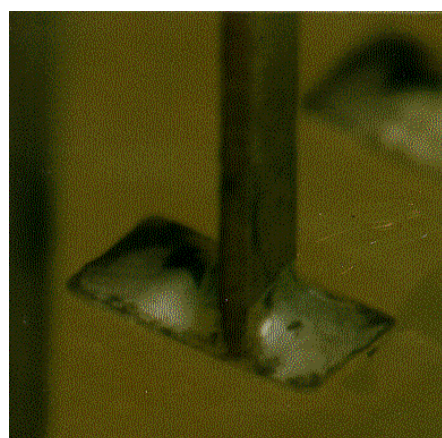


Figure 21



### 5.3. Maximum Solder Fillet

- A. When lead is positioned on pad surface, the solder shall not overhang pad edge.
- B. Lead is wetted and bonded with a straight or slightly convex (rather than concave) solder fillet between lead and pad.
- C. When the solder lies over the top of the lead, the contour of the lead shall be visible, Figure 25.
- D. The maximum height of the heel fillet for the lap and "J" leads shall be no greater than one half the distance between the lower and upper bend, Figure 26.
- E. There is no maximum heel fillet specified for lap and "J" leads with no upper bend in the leg.

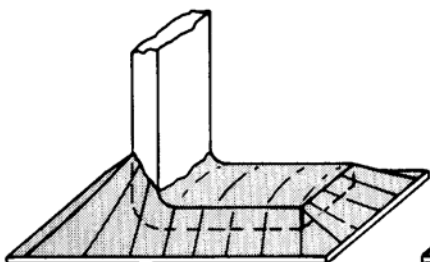


Figure 22

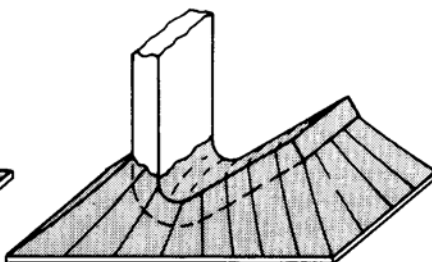


Figure 23

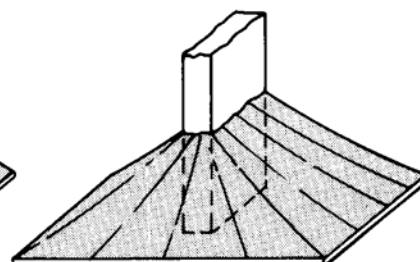


Figure 24

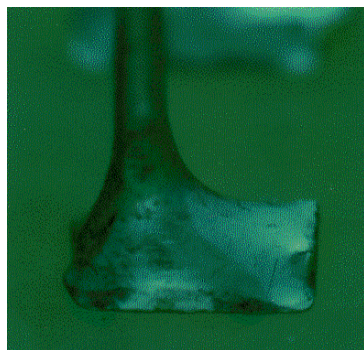


Figure 25

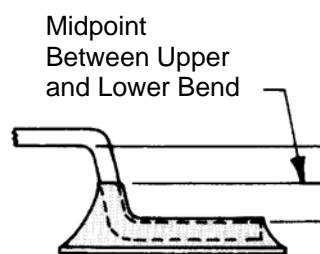


Figure 26

#### 5.4. Maximum Misalignment

- A. Lap and "J" leads may extend off of side of pad by 25% of lead width or 0.51 mm [.020 inch], whichever is smaller, providing solder completely fills dimension X and minimum spacing requirements are not violated, Figure 27.
- B. Lap and "J" leads may extend off of front of pad by 25% of lead width or 0.51 mm [.020 inch], whichever is smaller, providing solder completely fills dimension Y and minimum spacing requirements are not violated, Figure 28.
- C. Butt lead shall not extent off the pad in any direction.

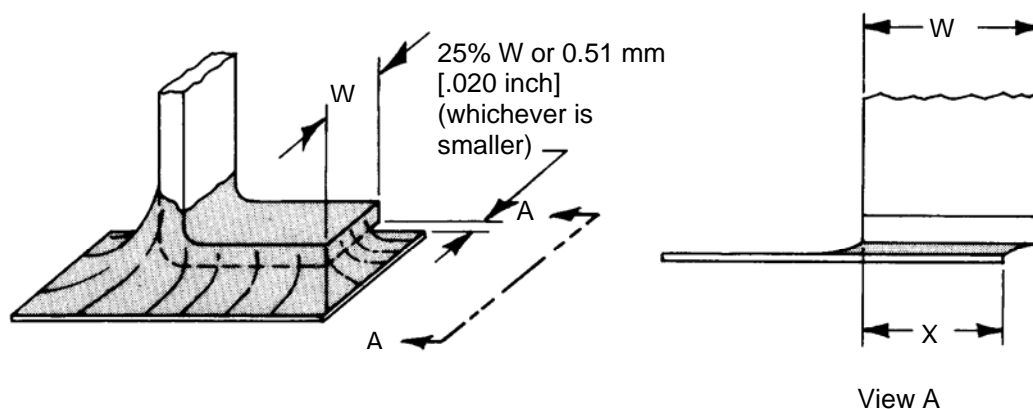


Figure 27

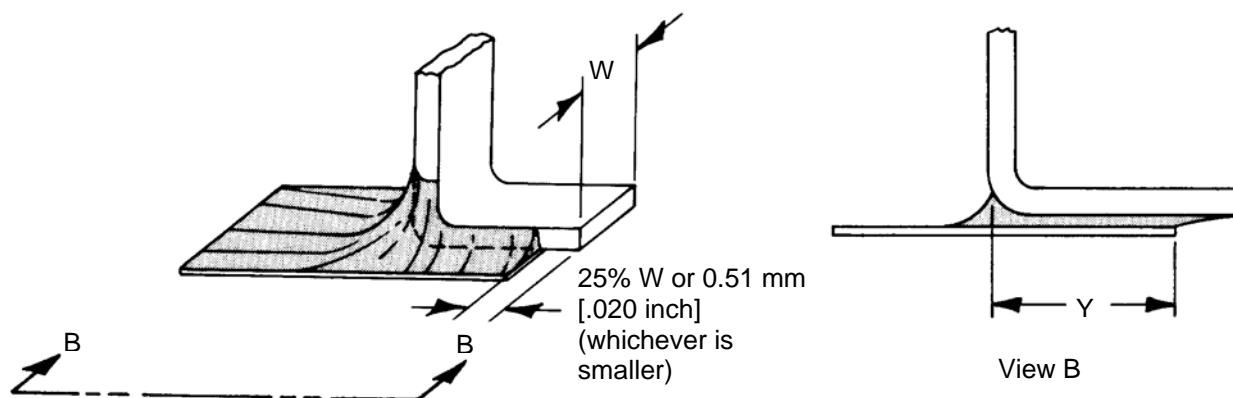
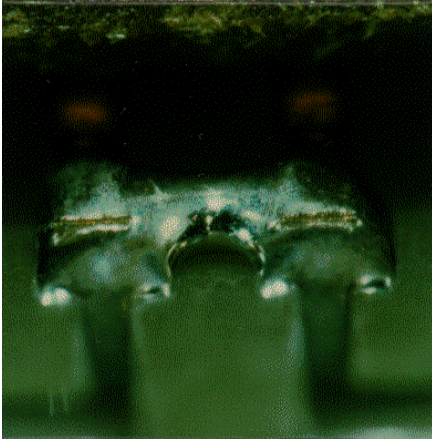


Figure 28

## 6. NOT ACCEPTABLE CONDITIONS

### 6.1. Bridging

Solder is evident between adjacent pad or lead surfaces.

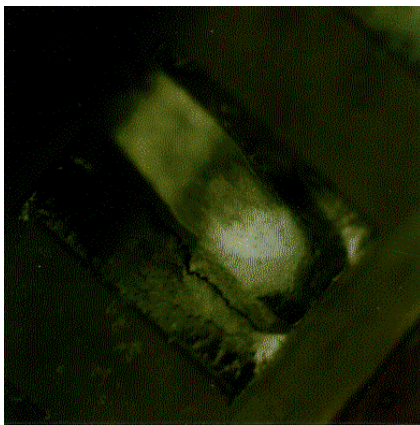


**NOT ACCEPTABLE**

Figure 29

### 6.2. Cracks

Cracks are evident in the solder fillet.

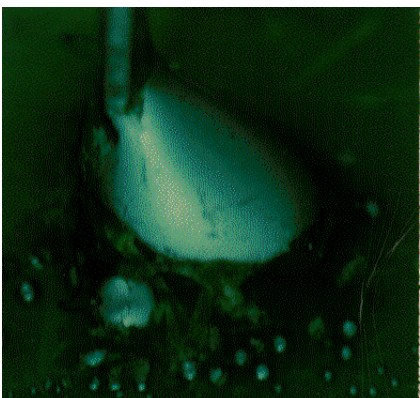


**NOT ACCEPTABLE**

Figure 30

### 6.3. Solder Balls

Solder balls are evident in and around the solder fillet.



**NOT ACCEPTABLE**

Figure 31

6.4. Wicking Causing Insufficient Solder at Joint

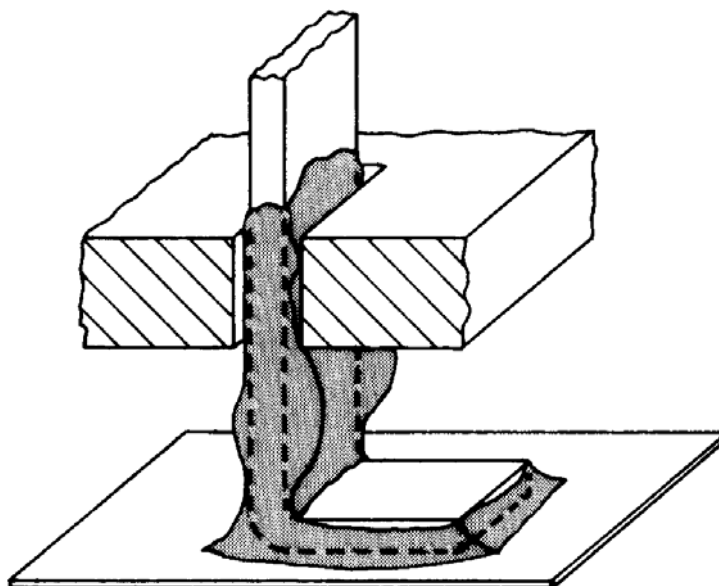


Figure 32

6.5. Misalignment  
Heel extends off pad.

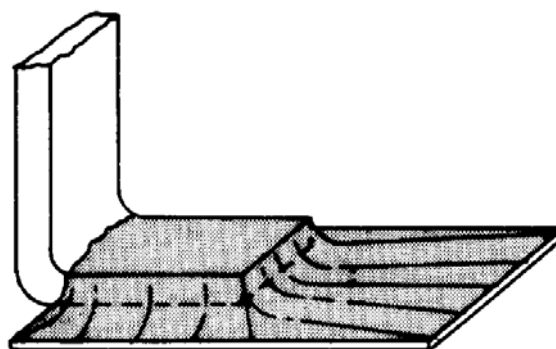


Figure 33