Making and Instructions for Interpretation of Cross-Sections for F-Crimp Terminals

1. INTRODUCTION

Performance tests such as agency approval testing and/or product qualification testing are normally used to evaluate product performance and to confirm conformance to requirements. For any testing to be valid, it is imperative to crimp the terminal with the correct wire size, use the specified application tooling and crimp height, and ensure conformance to the other parameters as specified in the application specification.

A cross-sectional photograph can be used to further evaluate the crimped termination when additional diagnostics are determined to be necessary. The cross-section should be used as a reference image for comparison to future cross-sections. This reference image should be made with new crimp tooling to ensure that damaged tooling does not provide an incorrect reference image.

NOTE *In the event that there are differences between the information presented in this manual versus the information found in the application specification, the application specification will take precedence.*

2. PROCEDURE FOR MAKING CROSS-SECTIONAL PHOTOGRAPHS

Before making any cross-sectional photographs, it is necessary to ensure that the crimp meets the parameters as listed in the applicable application specification (114 series) or the information provided with the application tooling if an application specification does not exist. These parameter include:

- Verifying that the correct Tyco Electronics application tooling is used to crimp the terminal.
- Verifying that a valid wire or wire combination is being used.
- Verifying that Tyco Electronic components (crimpers and anvils) are being used for the crimp tooling. The components must be in good condition and properly aligned.
- Verifying that the correct crimp height dimension is being used for the particular terminal/wire/tool combination per available documentation.
- Verifying that the other crimp features (bellmouth, flash, no missed, loose or cut wire strands, wire brush, insulation placement, etc.) meet the requirements of the application specification.

Once it has been verified that the crimp meets the requirements as specified in the application specification and/or the documentation provided with the application tooling, the cross-section can be made. Most commercial cross-sectioning equipment consists of several modules: cutting, grinding, etching and imaging. Please refer to the instructions provided with the cross-sectioning equipment for proper technique. The following rules need to be followed when making cross-sections:

- The cross-section must be made perpendicular to the crimp in both the X and Y-axis as shown in Figure 1. Figure 2 shows a terminal that has been cut on an angle.

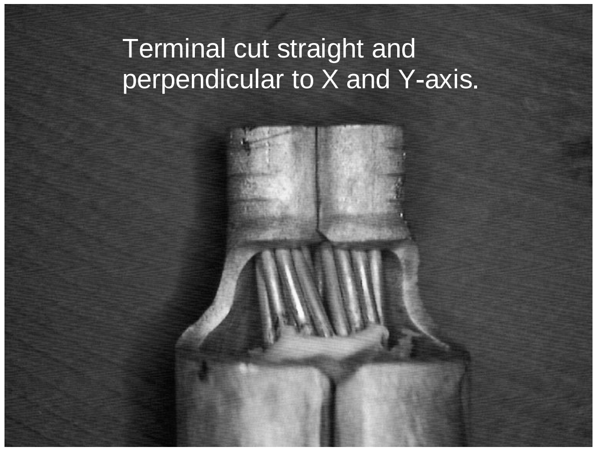

Figure 1

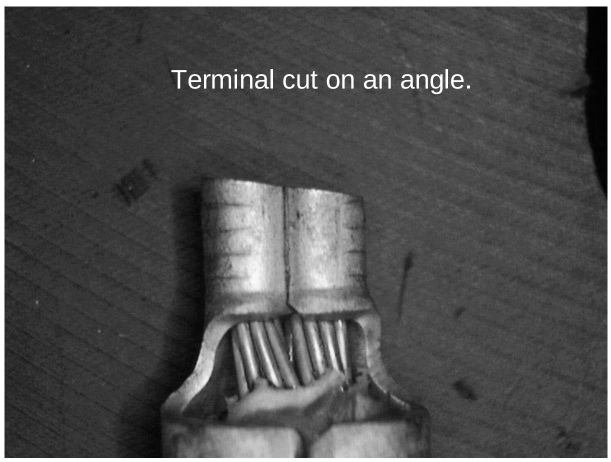

Figure 2

- The cross-section must always be taken in the area where it is recommended to measure crimp height. (Refer to the application specification and instruction sheet 408-7424 for proper crimp-height measurement locations and procedures.)
- The cross-section photograph must clearly show the wire strands and the terminal's material. Figure 3 provides an example of a good cross-sectional photograph made using a curved anvil. Figure 4 provides an example of a good cross-sectional photograph made using a flat anvil.

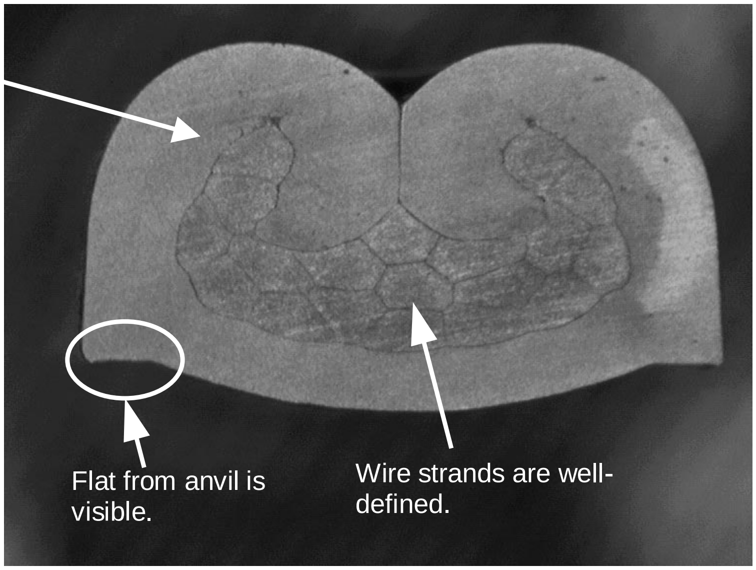

Figure 3

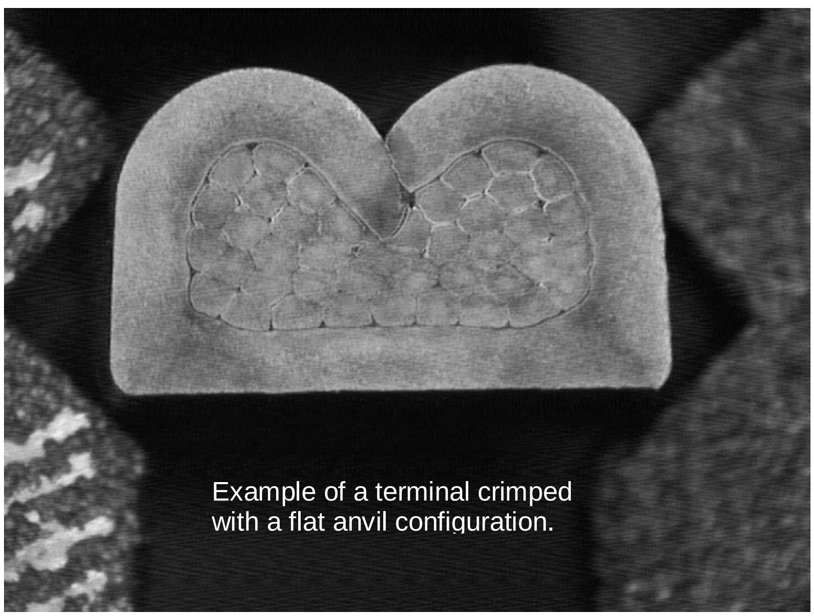

Figure 4

3. COMMON CROSS-SECTION PREPARATION ERRORS

- The cross-section must avoid being made through a serration. Interpreting a cross-section that has been taken through a serration provides an inaccurate view of the crimp. If a cross-section is taken through a serration, part of the terminal will appear to be thicker than the rest of the terminal. Another indication is that there is a gap between the walls of the terminal and the deformed strands. Figure 5 provides an example where the cross-section was taken through a serration.

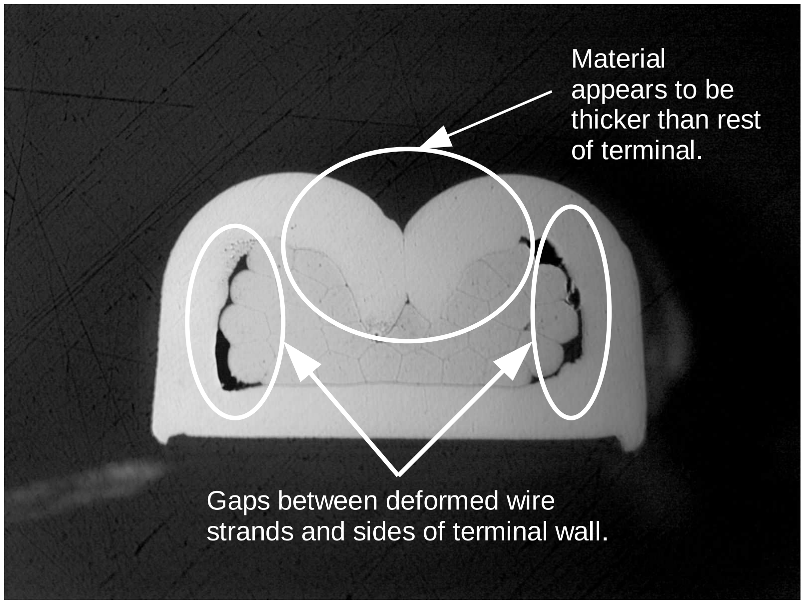

Figure 5

- The cross-section must be properly polished and etched. Improper polishing can give the appearance of cracks. Improper application of the etching solution can also distort the appearance of the cross-section by not sufficiently showing the details. Figure 6 provides an example of a terminal that has been improperly polished and etched. If the terminal is exposed to the etching solution too long, the image becomes very dark and it is difficult to see any details of the wire strands and/or the terminal material. This condition is shown in Figure 7.

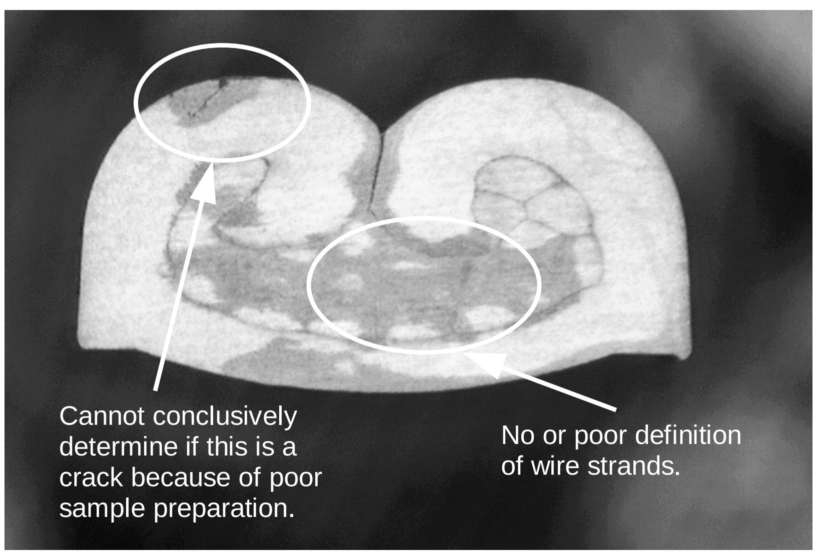

Figure 6

Figure 7

- If the terminal is cut on an angle when the cross-section is being prepared, the terminal will need to be rotated in order for the cross-section to be in focus. When this occurs, the bottom or sides of the terminal will be visible in the cross-sectional photograph. Figure 8 shows an example where the bottom of the terminal is visible instead of just seeing the sectioned portion of the terminal.

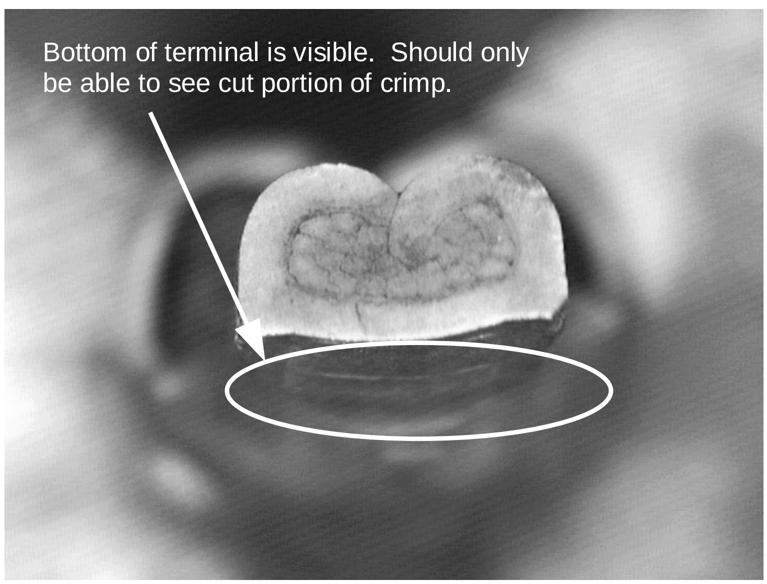

Figure 8

4. INTERPRETATION OF CROSS-SECTIONAL PHOTOGRAPHS FOR TOOLING ISSUES

The following cross-sectional photographs provide representative examples of various conditions that are related to worn/damaged tooling or applicator adjustments.

Variations in feed and/or variations in setting of feed lengths can result in flash. Flash is formed when the terminal's base material extrudes into the clearance between the anvil and wire crimper. Variations of this nature typically result in the tips of the terminal not being symmetric. Figure 9 shows an example of this condition.

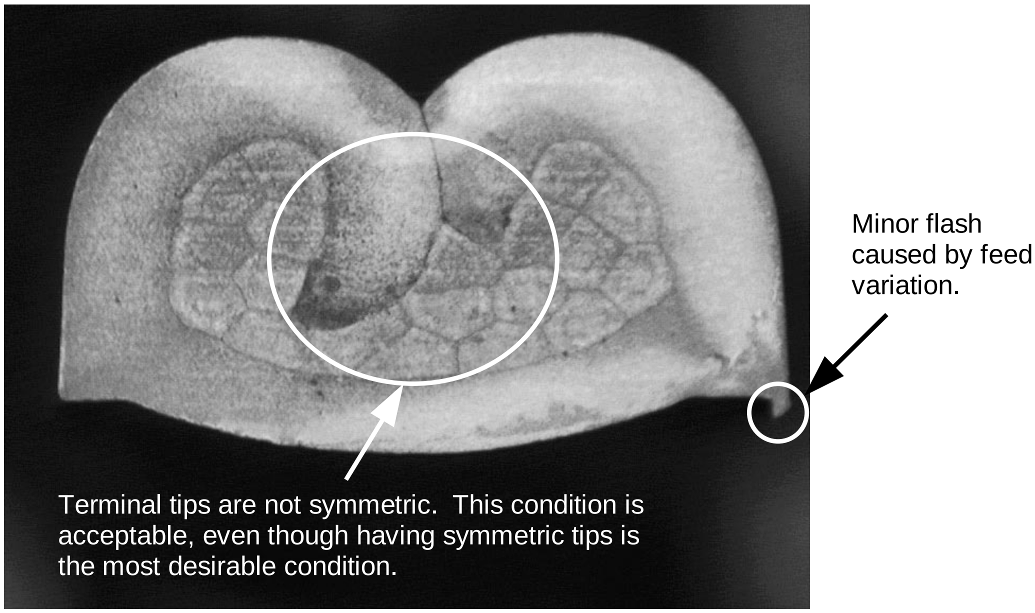

Figure 9

NOTE *While symmetry of terminal tips is a desirable condition, a condition of this nature is acceptable. Symmetry variations are common with end feed terminals since the terminal is susceptible to twisting once it leaves the strip guides.*

Misalignment of crimp tooling can result in variations regarding the shape. Common variations include significant flash without having any signs of anvil damage and irregular curvature of the crimp profile. Figure 10 shows an example of these conditions.

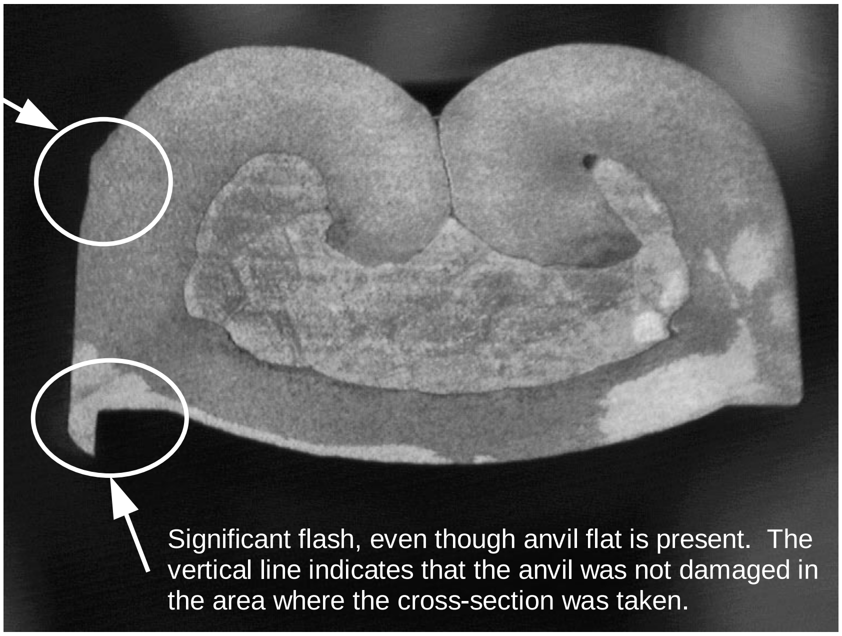

Figure 10

Damaged anvils result in excessive flash. One way to identify a damaged anvil is the lack of a distinctive flat at the bottom corners of the crimp profile. This condition is shown in Figure 11. Damage to the anvil can also result in cracks being formed in the bottom corner of the crimp. This condition is shown in Figure 12.

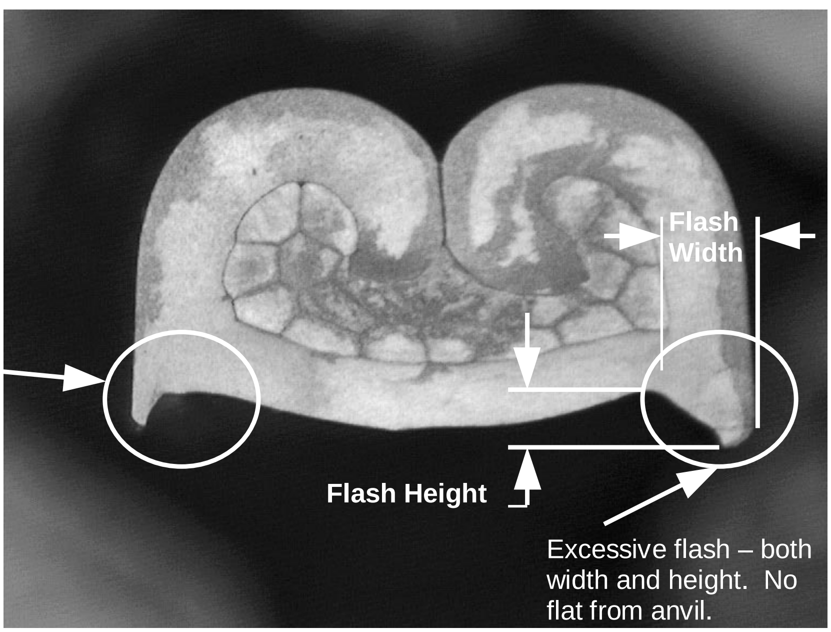

Figure 11

NOTE *Refer to the application specification to determine the amount of flash that is permissible.*

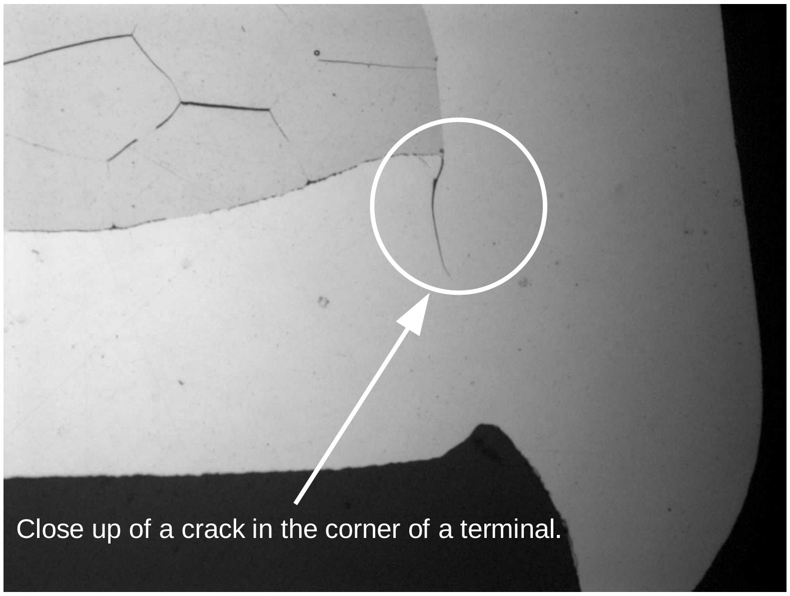

Figure 12

Collisions between the crimper and anvil can damage both pieces of tooling. Figure 13 shows a crimp that was made by tooling that was damaged by colliding with one another.

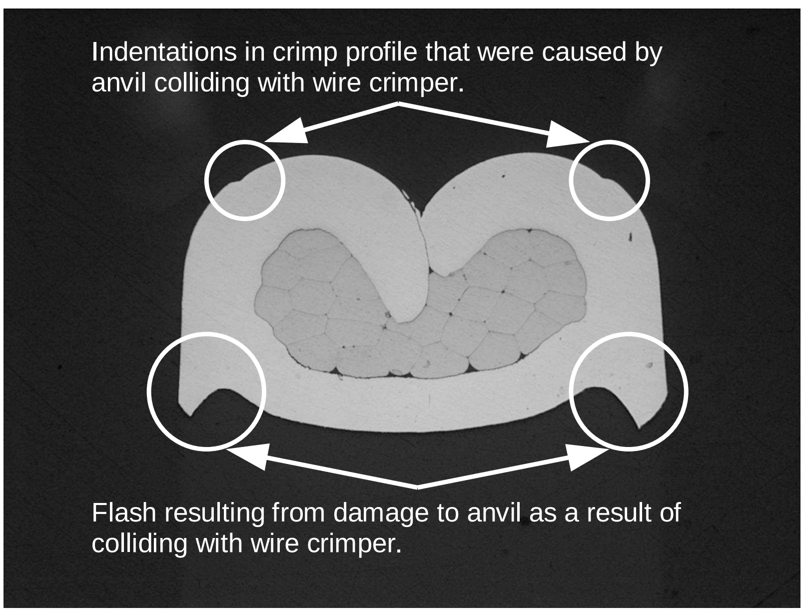

Figure 13

5. INTERPRETATION OF COMMON CROSS-SECTION CHARACTERISTICS

A cross-sectional photograph is a diagnostic tool that can be used to evaluate a crimped termination as previously stated in Sections 1 and 2. In order for a cross-sectional photograph to be of value, the crimp must be made using the correct combination of terminal, wire and application tooling and that the crimp is made to the crimp height specified for this combination. The crimp must also meet all other crimp parameters as specified in the applicable application specification. The following cross-sectional photographs are representative of various conditions typically seen.

Figure 14 is an example of a cross-sectional photograph of a good crimp. The wires are deformed, the terminal tips are symmetric and the anvil flats are visible.

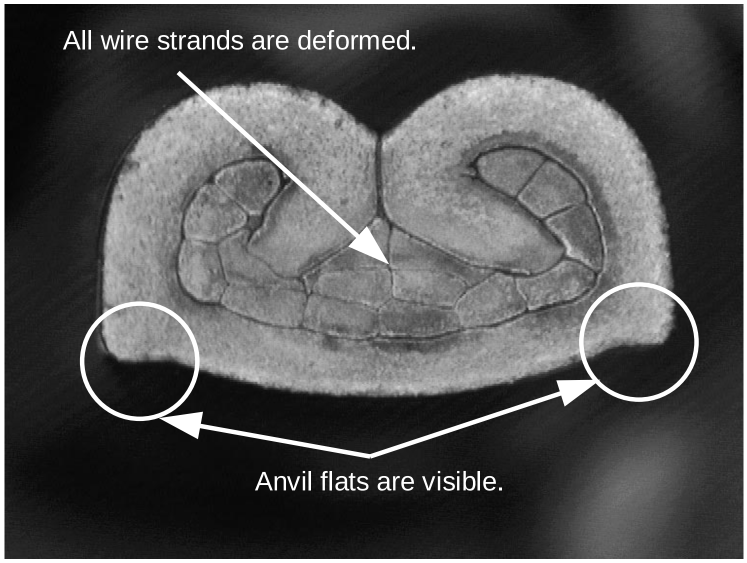

Figure 14

Figure 15 shows a crimp where one of the terminal tips touches the bottom of the crimp. This condition is permissible if all other specified crimp parameters are met.

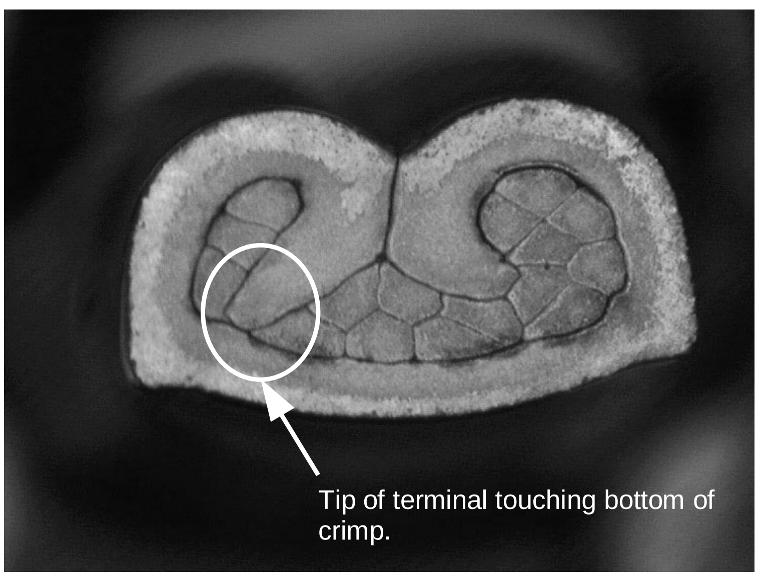

Figure 15

Figure 16 shows a crimp where both tips of the terminals are touching the sides of the crimp. A wire strand is trapped in the upper left corner of the crimp, but it is thoroughly deformed. This condition is permissible if all other specified crimp parameters are met.

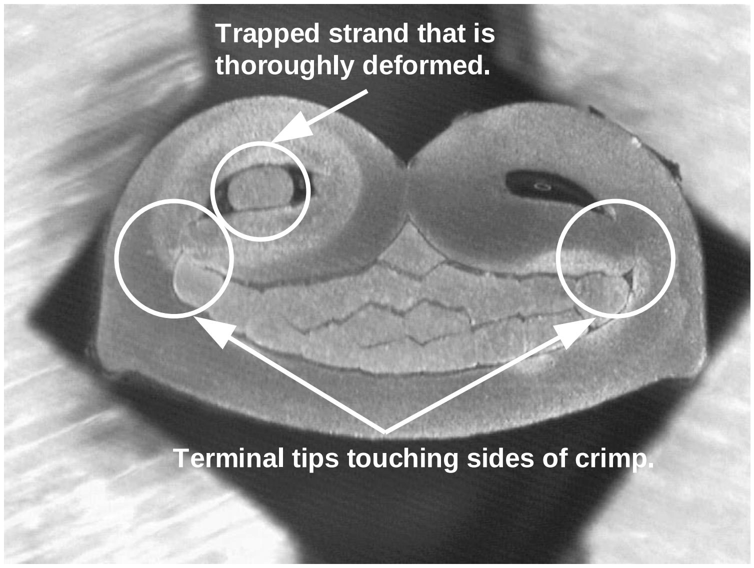

Figure 16

Voids are acceptable in a crimp since a successful crimp is dependent on the generation of “adhesion” between the wire strands and between the strands and the body of the terminal. Adhesion occurs through the disruption of the surface films due to the deformation of two metal surfaces in contact and as they move relative to one another. Metallic bonding occurs across this interface and the combination becomes a homogeneous mass in an electrical sense. Voids may be present in the crimp since full interface contact will be obtained at deformations that are far less than required to form a void-less, homogeneous mass. Figure 17 shows a crimp that has several voids present.

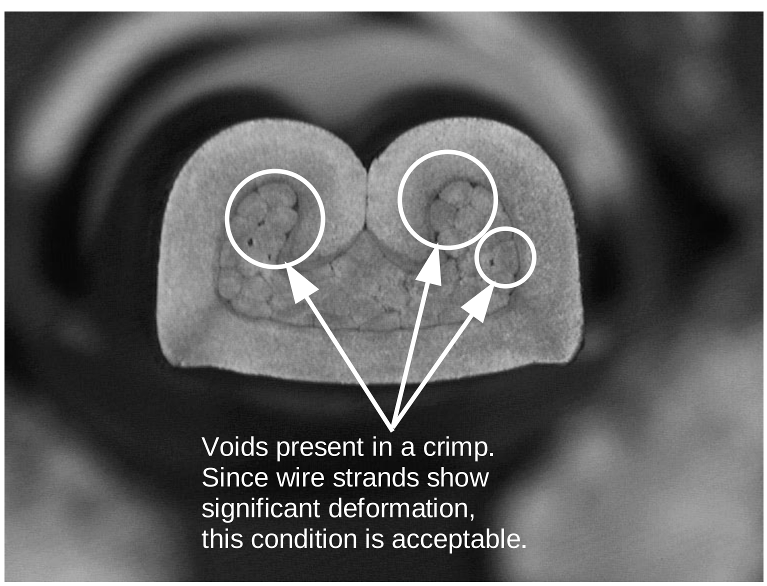

Figure 17