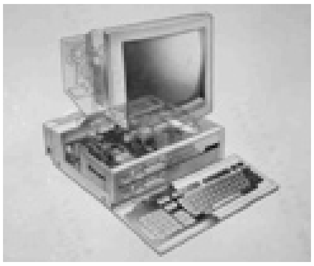
Tooling Introduction to Crimp Technology

Developed to replace the need to solder terminations, crimping technology provides a high quality connection between a terminal and a wire at a relatively low applied cost. The methods for applying crimp terminations depend on the application and volume, and range from hand-held devices to fully-automated systems. The application methods include a basic hand tool, a press and die set, a stripper crimper or a fully automatic wire processing system. But no matter what method is used, the setup of each tool is critical for achieving a quality crimp.



Website: Please visit the Molex website to view the most current Application Tooling information. The Molex website is continuously updated with the latest information. (www.molex.com)

TERMINOLOGY

Bellmouth (Flare)

The flare that is formed on the edge of the conductor crimp acts as a funnel for the wire strands. This funnel reduces the possibility that a sharp edge on the conductor crimp will cut or nick the wire strands. As a general guideline, the conductor bellmouth needs to be approximately 1 to 2x the thickness of the terminal material.*

Conductor Brush

The conductor brush is made up of the wire strands that extend past the conductor crimp on the contact side of the terminal. This helps ensure that mechanical compression occurs over the full length of the conductor crimp. The conductor brush should not extend into the contact area.

Conductor Crimp

This is for the metallurgical compression of a terminal around the wire's conductor. This connection creates a common electrical path with low resistance and high current carrying capabilities.

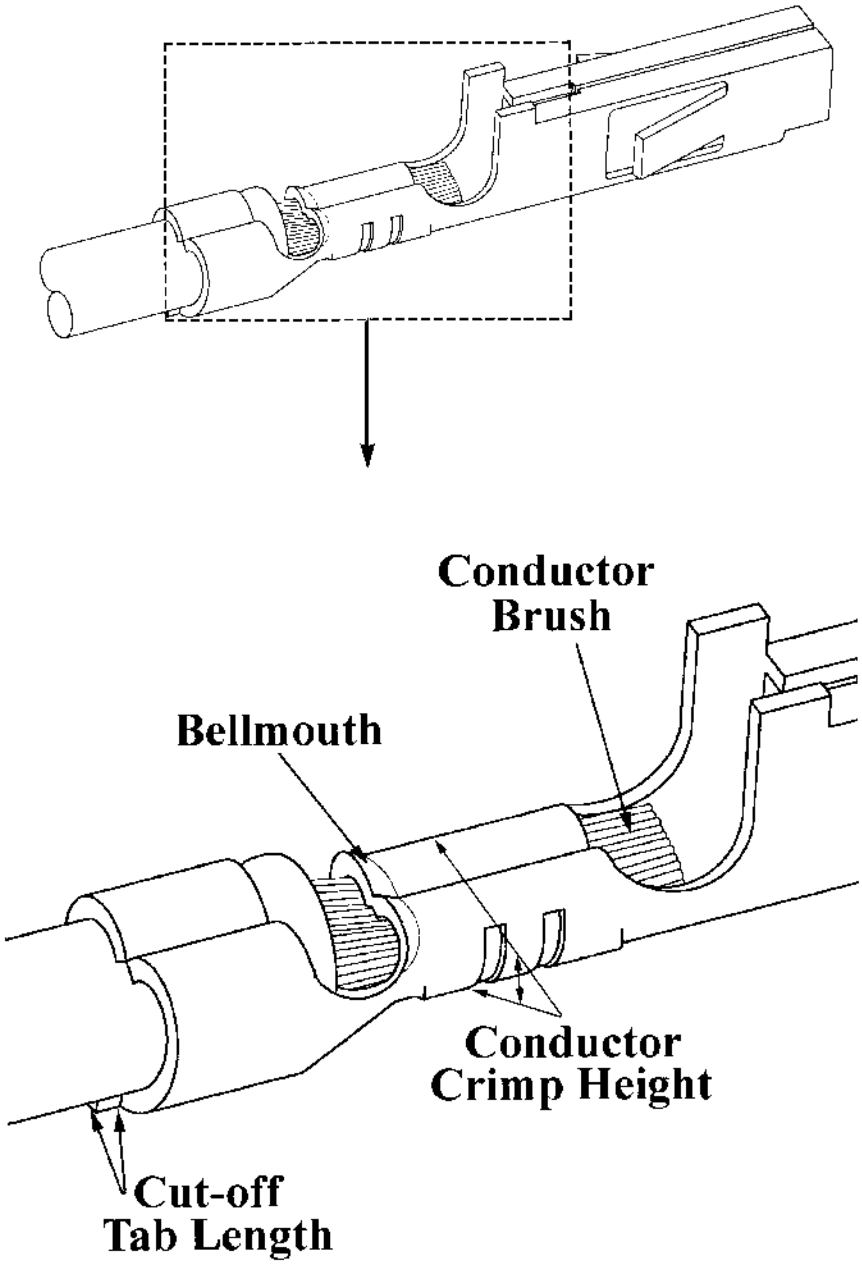
Conductor Crimp Height

The conductor crimp height is measured from the top surface of the formed crimp to the bottom most radial surface. Do not include the extrusion points in this measurement (See Figure 2). Measuring crimp height is a quick, non-destructive way to help ensure the correct metallurgical compression of a terminal around the wire's conductor and is an excellent attribute for process control. The crimp height specification is typically set as a balance between electrical and mechanical performance over the complete range of wire stranding and coatings, and terminal materials and platings. Although it is possible to optimize a crimp height to individual wire strandings and terminal platings, one crimp height specification is normally created.

Cut-off Tab Length

This is the material that protrudes outside the insulation crimp after the terminal is separated from the carrier strip. As a general rule, the cut-off tab is approximately 1.0 by 1.5x terminal material thickness.* A cut-off tab that is too long may expose a terminal outside the housing or it may fail electrical spacing requirements. In most situations, a tool is setup to provide a cut-off tab that is flush to one material thickness.

*Consult individual terminal specifications



TERMINOLOGY (CONTINUED)

Extrusions (Flash)

These are the small flares that form on the bottom of the conductor crimp resulting from the clearance between the punch and anvil tooling. If the anvil is worn or the terminal is over-crimped, excessive extrusion results. An uneven extrusion may also result if the punch and anvil alignment is not correct, if the feed adjustment is off, or if there is insufficient/excessive terminal drag.

Insulation Crimp (Strain Relief)

This is the part of the terminal that provides both wire support for insertion into the housing and allows the terminal to withstand shock and vibration. The terminal needs to hold the wire as firmly as possible without cutting through to the conductor strands. The acceptability of an insulation crimp is subjective and depends on the application. A bend test is recommended to determine whether or not the strain relief is acceptable for each particular application.

Insulation Crimp Height

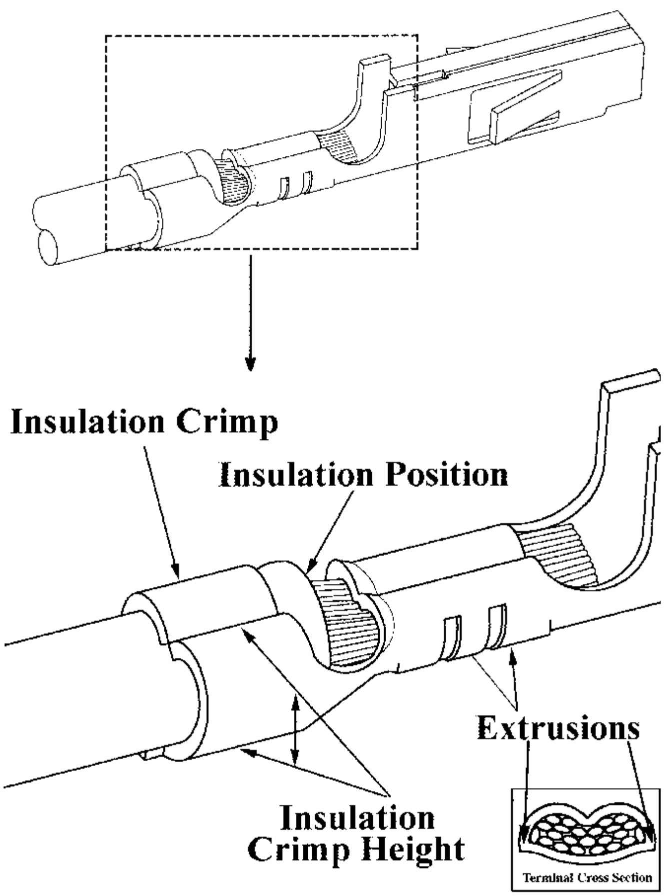
Molex does not specify insulation crimp heights because of the wide variety of insulation thickness, material, and hardness. Most terminals are designed to accommodate multiple wire ranges. Within the terminals range, an insulation diameter may not completely surround the wire or fully surround the diameter of the wire. This condition will still provide an acceptable insulation crimp for most applications.

- A large insulation should firmly grip at least 88% of the wire
- A smaller insulation should firmly grip at least 50% of the wire and firmly hold the top of the wire

To evaluate the insulation section cut the wire flush with the back of the terminal. Once the optimum setting for the application is determined it is important to document the insulation crimp height. Then, as part of the setup procedure the operator can check the crimp height.

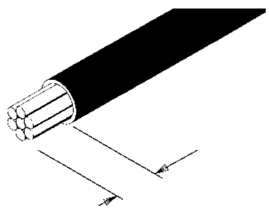
Insulation Position

This is the location of the insulation in relation to the transition area between the conductor and insulation crimps. Equal amounts of the conductor strands and insulation need to be visible in the transition area. The insulation position ensures that the insulation is crimped along the full length of the insulation crimp, and that no insulation gets crimped under the conductor crimp. The insulation position is set by the wire stop and strip length for bench applications. For automatic wire processing applications the insulation position is set by the in/out press adjustment.



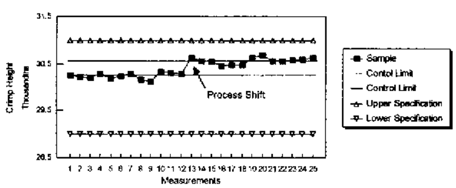
Strip Length

The strip length is determined by measuring the exposed conductor strands after the insulation is removed. The strip length determines the conductor brush length when the insulation position is centered.



Process

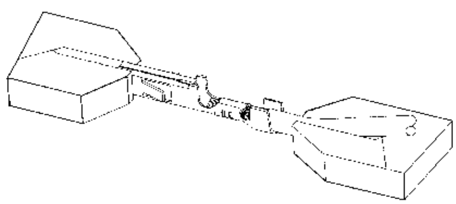
The combination of people, equipment, tooling, materials, methods and procedures needed to produce a crimp termination. Process control is used to track attributes over time to aid in the detection of change to the process. Detecting a process change when it happens helps prevent many thousands of bad crimps.



Pull Force Testing

Pull Force Testing is a quick, destructive way to evaluate the mechanical properties of a crimp termination. When making a crimp, enough pressure must be applied to breakdown the oxides that build up on the stripped conductor and the tin plating on the inside of the terminal grip. This is necessary to provide a good metal-to-metal contact. If this does not occur, resistance can increase. Over crimping a crimp termination will reduce the circular area of the conductor and increase resistance.

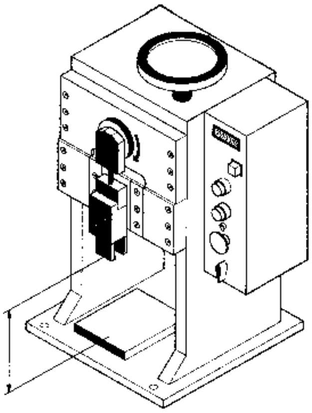
Pull Force Testing is also a good indicator of problems in the process. Cut or nicked strands in the stripping operation, lack of bellmouth or conductor brush, or incorrect crimp height or tooling will reduce pull force. Wire properties and stranding, and terminal design (material thickness and serration design), also can increase or decrease pull force levels.



TERMINOLOGY (CONTINUED)

Shut Height

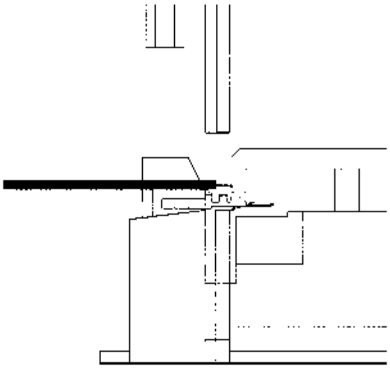
The distance, at bottom dead center on a press, from the tooling mounting base plate to the tooling connection point on the ram of the press.



Terminal Position

The terminal position is set by the alignment of the terminal to the forming punch and anvils, and the carrier strip cut-off tooling. The tool set-up determines conductor bellmouth, cut-off tab length, and terminal extrusions.

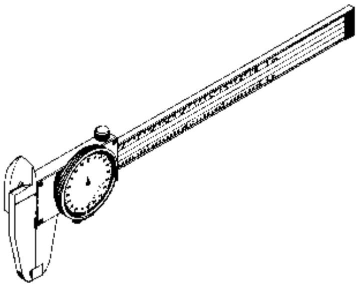
*Consult individual terminal specifications



ASSOCIATED MATERIALS

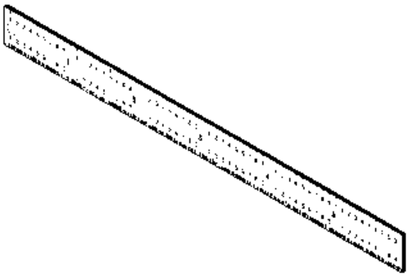
Caliper

A gauge, consisting of two opposing blades, for measuring linear dimensional attributes.



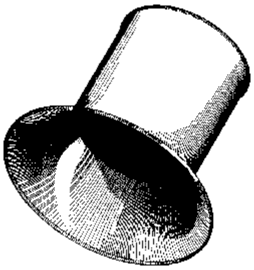
Ruler (Pocket Scale)

This is used to estimate the five piece measurement of bellmouth, cut-off tab, conductor brush, wire position, and strip length. The recommended maximum resolution is .5mm (.020 in).



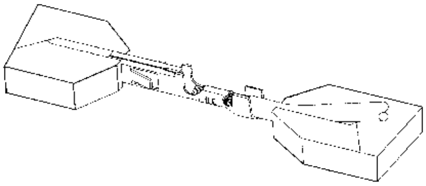
Eye Loop

A magnification tool, normally 10x power or greater, which is used to aid visual evaluation of a crimp termination.



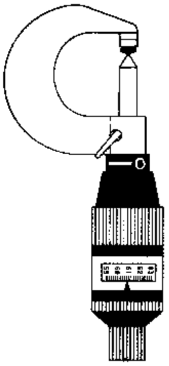
Pull Tester (Reference Figure 5)

A device used to determine the mechanical strength of a crimp termination. Most pull testing is done with a device that clamps the wire, pulls at a set speed, and measures force by means of a load cell. A pull tester also can be as simple as hanging fixed weights on the wire for a minimum of one minute.



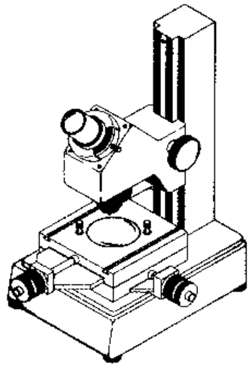
Crimp Micrometer

This is a micrometer specifically designed to measure crimp height. The measurement is taken in the center of the crimp so it is not influenced by the conductor bellmouth. It has a thin blade that supports the top of the crimp while a pointed section determines the bottom most radial surface.



Toolmaker's Microscope

This is used for close visual evaluation and statistical measurement of bellmouth, cut-off tab, conductor brush, wire position, and strip length.



IDT TOOLING INTRODUCTION

Insulation Displacement Technology, IDT, is a wire termination technique in which an insulated wire is pressed into a terminal slot smaller than the conductor diameter, displacing the insulation and forming an electrical contact between the terminal and conductor.

Insulation displacement offers 3 major advantages over other termination techniques:

- Electrical connectors are supplied to the customer with the terminals loaded into their final positions. This feature results in customer labor savings as additional operations are not required to complete the assembly.
- Hourly production rates are maximized through the simultaneous mass insertion of wires into multiple connectors.
- IDT allows for multiple connectors to be placed along a harness assembly (daisy chain) without the need to double terminate circuits.

Molex offers a full line of IDT terminating equipment ranging from simple hand tools to fully automatic cable and discrete wire harness assembly machines. All tools are designed and manufactured using the latest technologies to ensure high quality in tool performance and in the product they produce.

IDT TERMINATING EQUIPMENT

Hand Tools

Low volume users can choose from a range of snap-on modules that mount to a common pistol or bench mounted holder. These modules can be easily changed to accommodate various connector styles. Typically, these tools yield production rates of approximately 300 terminations per hour.

Manual Press Tools

For medium production volumes, Molex offers a variety of manual press bench tools designed to process cable or discrete wire to further increase productivity. For tools in this category, production rates of up to 250 assemblies per hour for cable or 500 terminations per hour for discrete wire are not uncommon.

Semi-Automatic Bench Tools

For higher production volumes, Molex offers a variety of semi-automatic bench tools to increase the end users' productivity. For tools in this category, production rates of up to 900 assemblies per hour for cable or 1200 terminations per hour for discrete wire are normally realized. In addition to inserting wires into terminals, selected machine models are already equipped to:

- Automatically unload connectors from packaging such as extruded tubes, mylar film, etc.
- Perform secondary operations, for example, carrier strip breakoff, terminal insertion, product marking, etc.

Fully Automatic Machines

For large production requirements, Molex offers its customers fully automatic modular assembly machines. This modular concept allows machines to be designed and built to meet exact customer requirements. Additionally, this concept enables customers to add options at a future date as production needs change. In general, machines in this category produce 10,000 terminations per hour or better. All machines are designed with fully-integrated PLC controls that include "user friendly" self-diagnostic software features to minimize set-up time and maximize machine uptime and system utilization.

Special Machines

Molex can quote special machines upon request with optional features that parallel the Phoenix™/Eagle™ Series. In general, these machines differ by the manner in which connector termination and wire handling is accomplished. Additionally, daisy chain and different connector orientations can be accomplished.