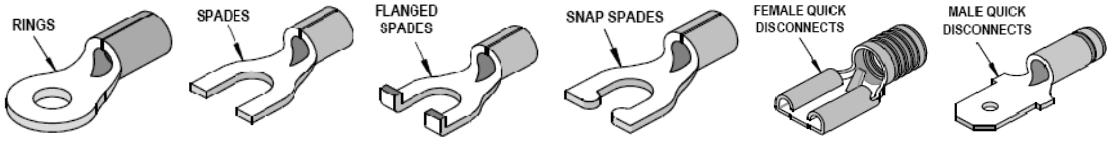
Solderless Crimp Terminals and Splices Nylon Insulated, Double Crimp, Yellow-Blue-Red

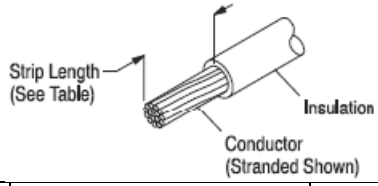
The Molex Avikrimp, AMP PIDG, Panduit Pan-Term PNF, Hollingsworth Funnel FIIG and 3M MNG Terminals, are tin plated copper for corrosion resistance, have grooved barrels for maximum wire holding strength, a chamfered or funnel barrel openings for easy wire insertion, a tin-plated copper or brass sleeve insulation grip and a color coded nylon sleeve, which provides insulation. The copper or brass sleeve is crimped around the wire insulation providing a strain relief, so the wire does not vibrate, loosen, fray, or break, it also helps to prevent the wire from being exposed due to the insulation receding and to keep the terminal from spreading apart at the seam when crimped. They are available in 10 to 26 AWG.

The “tongue” is the end of the terminal that attaches to other components (switch, stud, etc.). These tongue configurations vary.



Wire Selection and Preparation

Terminals and splices accept solid and/or stranded wire sizes 26 through 10 AWG. The wire size used must be within the range stamped on the underside of the terminal tongue or on the center of the splice. Generally, the strip length of the wire should be equal to the wire barrel length plus .030 (1/32”). If the strip length is too short or if a wire is not fully inserted into the conductor Crimp Section, the termination may not meet the specified pull force because the metal-to-metal contact between the wire and the terminal is reduced.

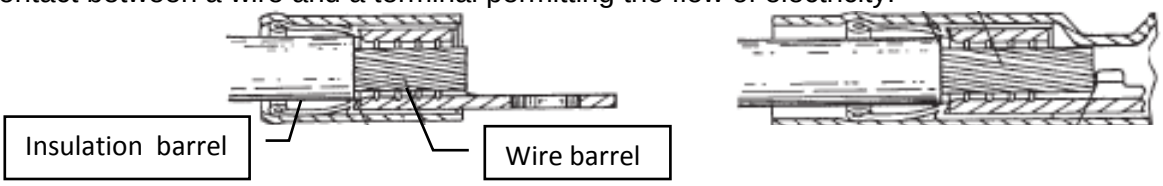


Wire	Insulation Color	Ring Term wire Strip Lg (Amp)	Ring Term wire Strip Lg (Panduit)	Ring Term wire Strip Lg (3M)	Ring Term wire Strip Lg (Molex)
22-18	Red	.203-.234	7/32	9/32?	.25
16-14	Blue	.203-.234	7/32	9/32?	.25
12-10	Yellow	.312-.343	9/32	?	.375

Wire	Insulation Color	Butt Splice wire Strip Lg Amp	Butt Splice wire Strip Lg Panduit	Butt Splice wire Strip Lg 3M	Butt Splice wire Strip Lg Molex
22-18	Red	.250-.281	9/32	.312?	.312
16-14	Blue	.250-.281	9/32	.312?	.312
12-10	Yellow	.343-.375	3/8	.312?	.312

Wire Placement

The stripped wire must be inserted into the wire barrel where the bare wire contact area will be crimped and the insulation is against the wire barrel but not inside it. The wire insulation must be inside the metal sleeve or Insulation barrel. A gap between the insulation and wire barrel is allowed. The Contact Area is the area in contact between a wire and a terminal permitting the flow of electricity.



Another crimping problem that relates to a too short strip length occurs when the wire is inserted too far into the crimp sections, and the insulation protrudes into the wire barrel. A metal-to-plastic contact isn't as strong, nor does it conduct electricity, as well as metal-to-metal. If the wire protrudes to far forward the tip of the mating terminal hits against the wire, it may prevent the connectors from fully seating or it may bend the male or female terminals. This condition is known as "terminal butting".

Wire Barrel Crimp Profile and Location

The wire barrel where the bare wire will be crimped by the tooling must be either a confined crescent crimp which appears as a depressed oval shape or a flat rectangular crimp over the center of the wire barrel. The crimp must be evenly formed. This is 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. A crimp height that is either too small or too large will not provide the specified crimp strength (terminal retention to the wire), will reduce the wire pull out force and current rating, and may generally cause the crimp to underperform in otherwise normal operating conditions. A crimp height that is too small also may cut strands of the wire or fracture the metal of the conductor crimp section. A crimp height that is too large will not compress the wire strands properly, causing excessive voids in the Crimp Section because there is not enough metal-to-metal contact between the wire strands and the metal of the terminal.

Bellmouth

This is the undisturbed portion of the conductor barrel nearest the insulation crimp. It is the result from the actual crimping, which acts as a funnel for the wires and reduces the possibility of a sharp edge on the barrel cutting or nicking the wires. There shall be no rear bellmouth. The front bellmouth shall be evident on the top and bottom of the wire Barrel. If the bellmouth is missing, there is a risk of cutting the wire strands. To correct the problem, make sure the punch and anvil on the crimping equipment and the terminal are properly aligned. There is also a problem if the bellmouth is oversized, because this reduces the total area that the crimp section of the terminal has in contact with the wire. The less the wire-to-terminal interface, the lower the wire pull out force.

Flash

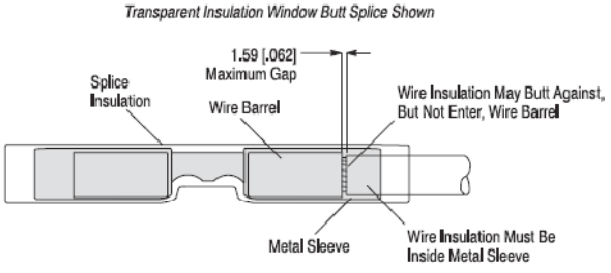
There shall be no flash (abnormal protrusion on the wire barrel) or extruded nylon insulation material visible in the most compressed area of the wire crimp. These small flares form on the bottom wire barrel resulting from the clearance between the punch and anvil tooling. If the terminal is over-crimped an excessive extrusion results.

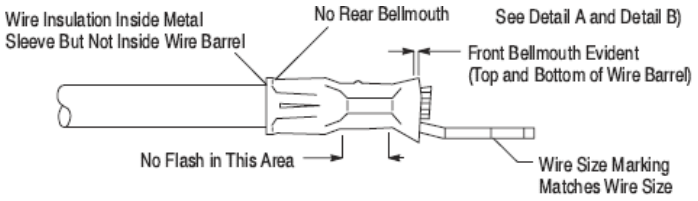
Terminal, Splice Insulation

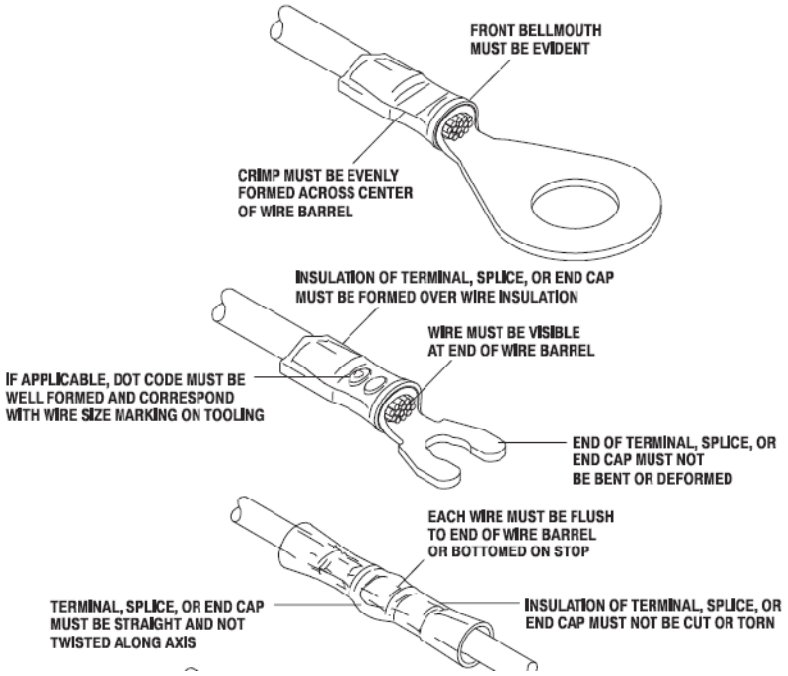
The nylon insulation of the terminal or splice must not be cut or show uneven stress marks or highlighted marks on the insulation.

Wire Location

Terminals shall have the wire ends flush or extended slightly beyond the end of the wire barrel. Splices shall have the end of the wire located against the wire stop inside the center of the splice.

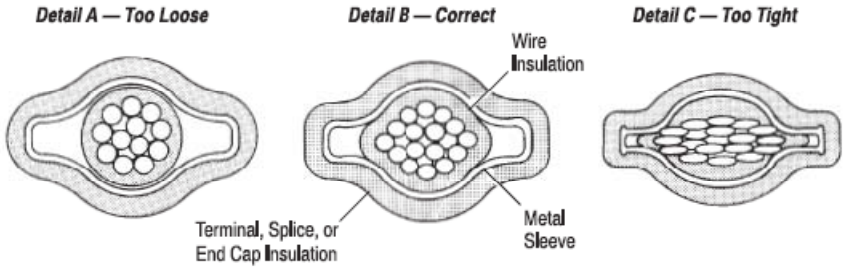






Insulation Crimp Check

The nylon insulation crimp must capture the wire insulation. The wire insulation must not be crimped inside the wire barrel of the terminal or splice. The wire insulation must be inside the metal sleeve to provide strain relief for the wire. This crimp provides a strain relief for the conductor Crimp Section so that as the wire flexes, the wire strands do not break. An insulation crimp section that is too small may overstress the metal in the insulation Crimp Section, weakening the strain relief function. The correct adjustment allows the terminal to grip the insulation without piercing the insulation.



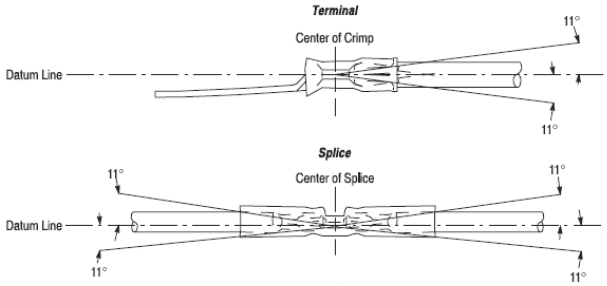
Tensile Strength

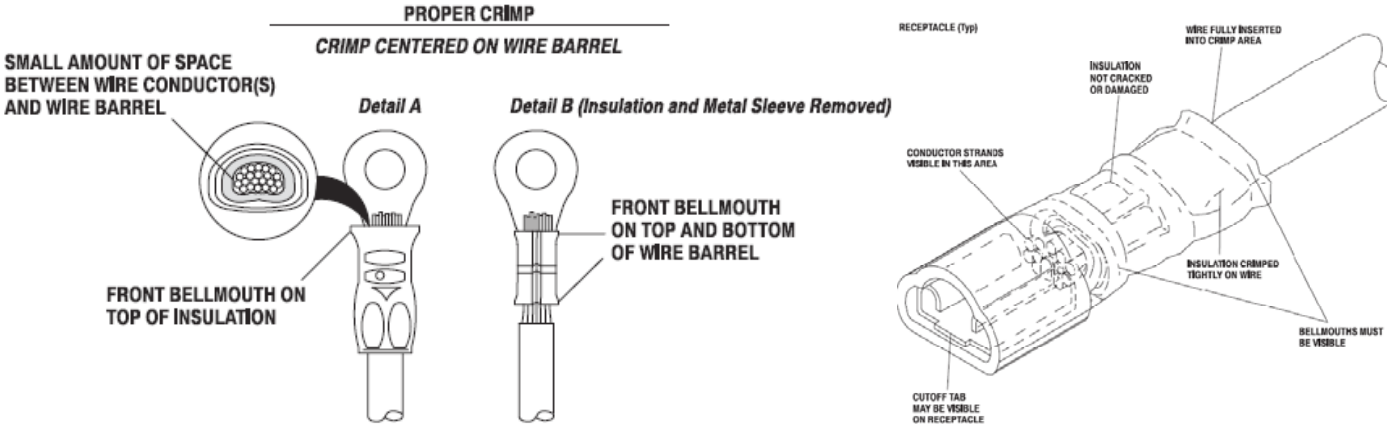
Crimped terminals or splices should hold the wire conductor(s) firmly and have a pull–test tensile value meeting that specified in the table. The following charts show the UL specifications for wire pull-out forces of various wire sizes. The tensile strength is shown in lbf (pound-force). It indicates the minimum acceptable force to break or separate the terminal from the conductor. If results of a pull force tests are within an allowed range, it assures that proper crimp force has been applied during crimping. It is crucial as, when making a crimp, enough force must be applied to break down the layer of non-conductive oxides that may 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.

Wire Size	Terminals & Quick Disconnects Tensile Force (Pull Test) Lb Force UL-486 A & UL 310	Butt Splices Tensile Force (Pull Test) Lb Force UL-486 C
22	8	8
20	13	10
18	20	10
16	30	15
14	50	25
12	70	35
10	80	40

Bend allowance

Upward and downward bend of the terminated terminal, splice, or end cap must be within the tolerance. One of the most descriptive crimping problems is known as a "banana" crimp, because the crimped terminal takes on a banana shape. This makes it difficult to insert the terminal into the housing and may cause terminal butting. This problem is easy to solve by adjusting the position of the terminal in the crimp press. During crimping, a significant amount of metal on one end of the terminal (in the crimp section) moves. These high forces tend to force the front of the terminal upwards.





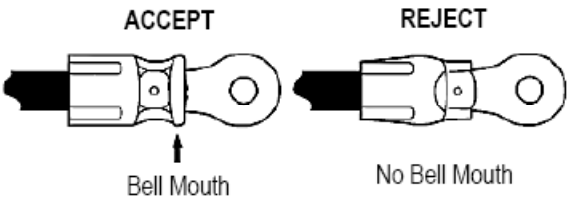
1. Choose the right connector for your application requirements.

2. Use the crimp tooling specified by the terminal manufacturer.

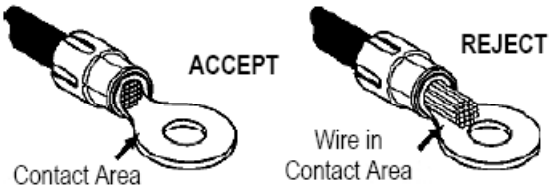
3. Properly adjust and maintain the crimp tooling in good working order.

4. If using a generic crimp tool position the terminal in the die for proper wire and insulation crimp. (Generic tools DO NOT have terminal and wire locators built in to help in positioning the terminal.)

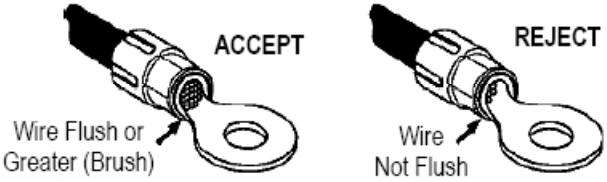
Crimp to be Centered: On all crimped terminals, the conductor crimp should be centered on the conductor barrel. This insures even pressure on the entire length of the barrel. Be sure that a good bell mouth is present on the wire barrel.



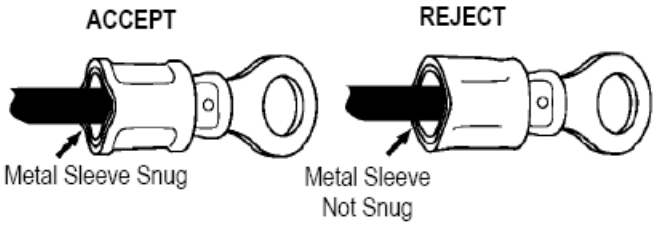
No Wire Strands in the Contact Area: Be sure that wire strands do not exceed into the tongue area of the lug or terminal.



Wire Flush or Greater: Be sure that the wires are either flush with the end of the conductor barrel or extend past the barrel. This “brush” extension should be approximately 1/32”.



Insulation Support Crimp: Wire sizes 18 thru 10 AWG require an insulation crimp to securely hold the wire. On closed barrel terminals that have a secondary metal sleeve, the metal sleeve should be formed snugly around the wire.



Recommended Tooling

Pliers Type

Very hard to get repeatable crimp results, especially with different users. Hand strength of user effects crimp quality. Cannot predict longevity of the crimp. Best for when the user can tolerate short crimp life and the downtime of potential multiple repairs due to failing crimps.

Ratchet Type Hand Crimp Tools

Repeatable crimp results especially with different operators. The crimp quality is not affected by the hand strength of the operator. Predictable, long lasting crimp life. Many different die sets available for other terminals. The following is a list of some of the available tools from different manufactures. In their line of tools you can get lower cost or higher cost one. All these tools come with die sets.

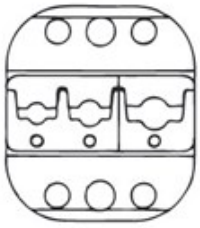
Generic Crimp Tools (no terminal and wire locators)

Paladin CrimpAll 8021

Sargent Super Crimp 4140CT

Ideal Crimp Master 30-500

Paladin 2035



Sargent 4100-40

Ideal Crimp Master 30-579

Manufactures Crimp tools with terminal and wire locators built in for specific terminals

T & B Sta-Kon ERG 4001

Molex 64001-0100

Amp Pro Crimper III 58433-3

REFERENCES for this paper

Pic Wire and Cable “Making Connections”
Molex “Industrial Crimp Quality Handbook”
Tyco/AMP “Application Specification of PIDG Terminals”
Molex “Good Crimps and How to Recognize Them”
Crimping 101 “Understanding and making crimp connection that last”
3 Feb 2011