

**NOTE**



All numerical values are in metric units [with U.S. customary units in brackets]. Dimensions are in millimeters. Unless otherwise specified, dimensions have a tolerance of  $\pm 0.13$  [ $\pm .005$ ] and angles have a tolerance of  $\pm 2^\circ$ . Figures and illustrations are for identification only and are not drawn to scale.

## 1. INTRODUCTION

This specification covers the requirements for application of 2.8mm terminal system (sealed and unsealed) for use in the automotive industry. The terminal system consists of a blade terminal and a receptacle terminal. Each terminal features an insulation barrel, wire barrel, and mating end. The serrations inside the wire barrel provide maximum contact and tensile strength after crimping. The orientation tabs prevent the terminal from being inserted into the connector upside-down. The terminal is held in the connector when the internal locking mechanism of the connector engages the locking surface of the terminal.

The sealed terminals are designed for severe environmental conditions and high temperature applications. Sealing is achieved by means of an individual wire seal. The terminals are available in a carrier strip for terminating with semi-automatic machines.

When corresponding with personnel, use the terminology provided in this specification to facilitate your inquiries for information. Basic terms and features of this product are provided in Figure 1.

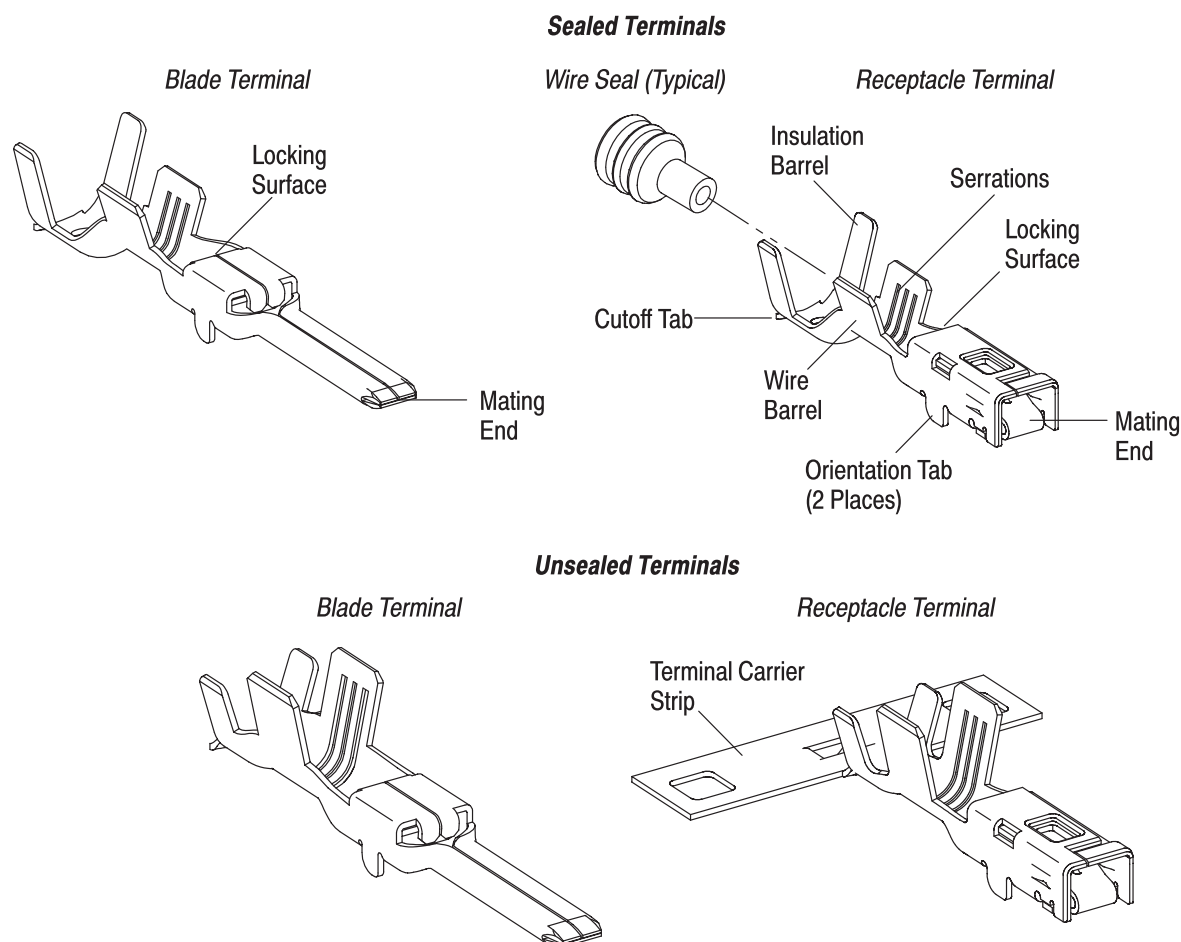


Figure 1

## 2. REFERENCE MATERIAL

### 2.1. Revision Summary

Revisions to this application specification include:

- Updated document to corporate requirements

### 2.2. Customer Assistance

Reference Part Number 1326031 and Product Code 2960 are representative of 2.8mm terminal system (sealed and unsealed). Use of these numbers will identify the product line and expedite your inquiries through a service network established to help you obtain product and tooling information. Such information can be obtained through a local Representative (Field Service Engineer, Field Applications Engineer, etc.) or, after purchase, by calling PRODUCT INFORMATION at the number at the bottom of page 1.

### 2.3. Drawings

Customer Drawings for product part numbers are available from the service network. If there is a conflict between the information contained in the Customer Drawings and this specification or with any other technical documentation supplied, call PRODUCT INFORMATION at the number at the bottom of page 1.

### 2.4. Instructional Material

Instruction Sheets (408-series) provide product assembly instructions or tooling setup and operation procedures and Customer Manuals (409-series) provide machine setup and operation procedures. Documents available which pertain to this product are:

408-3295	Preparing Reel of Contacts for Application Tooling
408-7424	Checking Terminal Crimp Height or Gaging Die Closure
408-8040	Heavy Duty Miniature Quick-Change Applicators (Side-Feed Type)
408-8059	General Preventative Maintenance for Applicators
408-9816	Handling of Reeled Products
409-5128	AMP-O-ELECTRIC* Model "K" Terminating Machine 565435-5
409-5842	AMP-O-ELECTRIC Model "G" Terminating Machine 354500-1

## 3. REQUIREMENTS

### 3.1. Storage

#### A. Shelf Life

The terminals should remain in the shipping containers until ready for use to prevent deformation. Terminals should be used on a first in, first out basis to avoid storage contamination that could adversely affect signal transmissions.

#### B. Ultraviolet Light

Prolonged exposure to ultraviolet light may deteriorate the chemical composition used in the terminals.

#### C. Reels

Care must be taken to prevent stretching, sagging, or other distortion that would prevent smooth feeding of the tape through automatic machine feed mechanisms. Store coil wound reels horizontally and traverse wound reels vertically.

#### D. Chemical Exposure

Do not store terminals near any chemical listed below as they may cause stress corrosion cracking in the contacts.

Alkalies	Ammonia	Citrates	Phosphates	Citrates	Sulfur Compounds
Amines	Carbonates	Nitrites	Sulfur	Nitrites	Tartrates

#### NOTE



Where the above environmental conditions exist, phosphor-bronze terminals are recommended instead of brass.

### 3.2. Wire Selection and Preparation

The sealed terminals accept stranded copper wire sizes 22 through 12 AWG. The unsealed terminals will accept a wire size range of 22 through 10 AWG. Wire insulation diameter according to wire size is given in Figure 2.

Proper strip length is necessary to properly insert the wire into the terminal. Strip length is given in Figure 2.

**CAUTION**

*Reasonable care must be taken not to nick, scrape, or cut any strands during the stripping operation.*



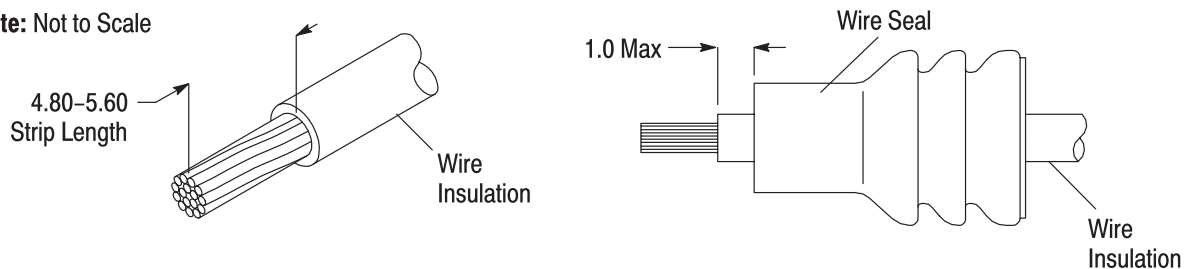
The wire seal must be inserted onto the wire (prior to termination) and crimped in the insulation barrel of the terminal simultaneously with the terminal. The appropriate wire seal must be selected which will accommodate the insulation diameter of the wire (contact PRODUCT INFORMATION at the number at the bottom of page 1 for appropriate wire seal part number). The wire seal must be installed onto the wire as shown in Figure 2.

**CAUTION**

*The wire seal must not be damaged when placing it over the wire.*



**Note:** Not to Scale



WIRE SIZE <sup>(1)</sup>		WIRE INSULATION DIAMETER RANGE
mm <sup>2</sup>	AWG	
0.35	—	1.33-1.49
—	22	1.19-1.65
0.50	—	1.61-1.76
—	20	1.40-1.85
0.75	—	1.81-1.97
—	18	1.60-2.06
1.0	—	1.98-2.14
—	16	1.88-2.34
1.5	—	2.24-2.40
—	14	2.34-2.69
2.5	—	2.68-2.85
—	12	3.10-3.30
4.0	—	3.34-3.50
—	10	3.84-4.04

<sup>(1)</sup>Wire size given in mm<sup>2</sup> is not equivalent to wire size given in AWG

Figure 2

### 3.3. Crimp Requirements

A sealed and unsealed terminal as it should appear after crimping is shown in Figure 3.

**NOTE**

Periodic inspections must be made to ensure crimped contact formation is consistent as shown.



#### A. Crimp Height and Width

The crimp applied to the wire portion of the terminal is the most compressed area and is most critical in ensuring optimum electrical and mechanical performance of the crimped terminal. The crimp height and width must be within the dimensions provided in Figure 3.

**NOTE**

The developed crimp configurations result from using the specific tooling described in Section 5, TOOLING.



WIRE SIZE <sup>(1)</sup>		WIRE BARREL		INSULATION BARREL (Ref)			
		CRIMP HEIGHT	CRIMP WIDTH	SEALED TERMINALS <sup>(2)</sup>		UNSEALED TERMINALS	
mm <sup>2</sup>	AWG			CRIMP HEIGHT ±0.10	CRIMP WIDTH ±0.10	CRIMP HEIGHT ±0.10	CRIMP WIDTH ±0.10
0.35	—	0.99–1.09	1.50–1.70	3.45	3.85	1.50	1.90
—	22	0.99–1.09		3.45		1.70	
0.50	—	1.07–1.17	2.05–2.25	3.50		1.80	2.30
—	20	1.16–1.26		3.50	4.25	1.89	
0.75	—	1.17–1.27		3.60		1.90	
—	18	1.32–1.42		3.60		2.07	
1.0	—	1.25–1.35	2.55–2.75	3.70		1.95	3.00
—	16	1.54–1.44		3.70	4.80	2.32	
1.5	—	1.50–1.60		4.30		2.35	
—	14	1.64–1.74		4.30		2.73	
2.5	—	1.75–1.85	3.70–3.90	4.35		2.70	
—	12	1.70–1.80		4.85	5.15	3.30 <sup>(2)</sup>	3.80±0.15 <sup>(2)</sup>
4.0	—	1.85–1.95		—	—	3.30 <sup>(2)</sup>	
—	10	2.05–2.15		—	—	3.90 <sup>(2)</sup>	

<sup>(1)</sup> Wire size given in mm<sup>2</sup> is not equivalent to wire size given in AWG

<sup>(2)</sup> Sealed terminals and indicated unsealed terminals shall have an “O” crimp on the insulation barrel. The crimp shall be snug against the wire seal or wire insulation and never exceed the tolerance given. All other unsealed terminals shall have an F-crimp for the insulation barrel.

Figure 3

#### B. Wire Seal

The wire seal may not extend beyond the dimensions shown in Figure 4.

**CAUTION**

The wire seal shall NOT be cut or broken during the crimping operation.



#### C. Crimp Length

Effective crimp length shall be defined as that portion of the wire barrel, excluding bellmouth(s), fully formed by the crimping tool. For optimum crimp effectiveness, the crimp must be within the area shown in Figure 4.

**D. Wire Barrel Seam**

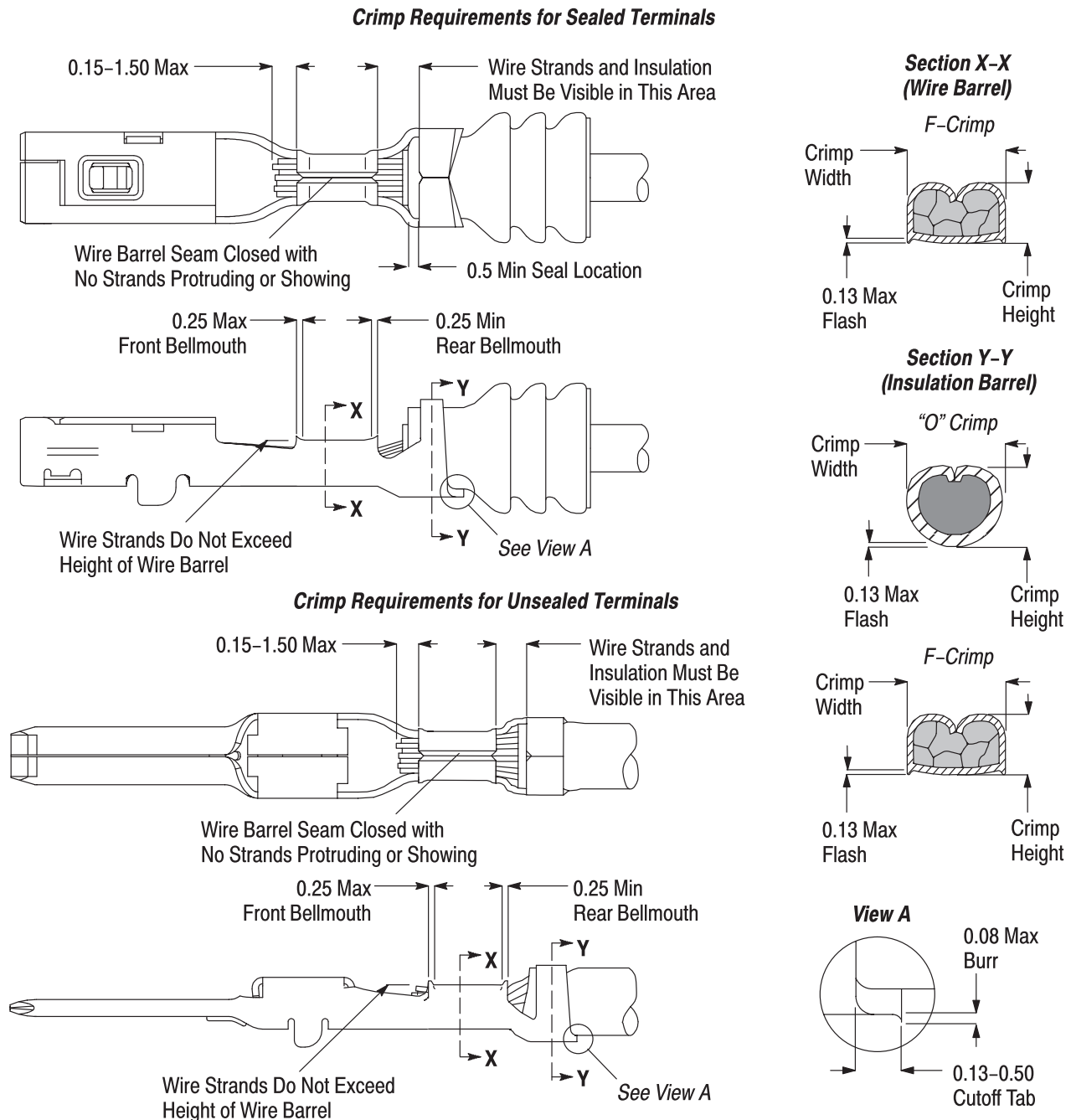
The wire barrel seam must be closed with no evidence of loose wire strands visible in the seam as shown in Figure 4.

**E. Bellmouths**

Front and rear bellmouths shall be evident and conform to the dimensions given in Figure 4.

**F. Wire Location**

The wire conductor and insulation must be visible in the transition area between the wire and insulation barrels. Refer to Figure 4.



### G. Wire Barrel Flash

The wire barrel flash shall not exceed the dimensions shown in Figure 4.

### H. Conductor Location

The conductor may extend beyond the wire barrel to the maximum shown in Figure 4.

### I. Cutoff Tab and Burr

The cutoff tab and burr shall not exceed the dimensions shown in Figure 4.

## 3.4. Twist and Roll

There shall be no deformation or other damage to the mating portion of the crimped contact that will prevent proper mating. The twist and roll shall not exceed the limit shown in Figure 5.

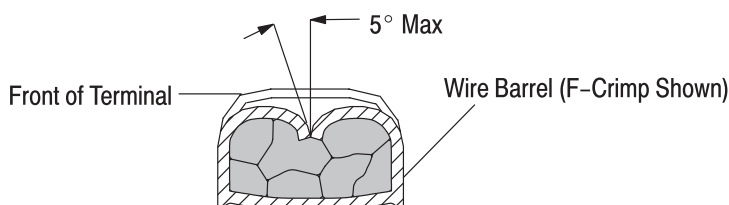


Figure 5

## 3.5. Tensile

Crimped terminals should hold the wire firmly and have a pull-test tensile value meeting that specified in the table in Figure 6.

#### NOTE



Adjust tensile testing machine for head travel of 25.4 per minute. Force must be applied directly and gradually for 1 minute.

CRIMP PULL-OUT TEST

WIRE SIZE <sup>(1)</sup>		MINIMUM FORCE <sup>(2)</sup>		WIRE SIZE <sup>(1)</sup>		MINIMUM FORCE <sup>(2)</sup>	
mm <sup>2</sup>	AWG	NEWTONS (N)	POUNDS (lb)	mm <sup>2</sup>	AWG	NEWTONS (N)	POUNDS (lb)
0.35	—	52.60	11.90	—	16	176.60	39.95
—	22	61.20	13.85	1.5	—	223.65	50.60
0.50	—	61.65	13.95	—	14	277.60	62.80
—	20	84.00	19.00	2.5	—	281.55	63.70
0.75	—	117.60	26.60	—	12	353.15	79.90
—	18	167.30	37.85	4.0	—	348.30	78.80
1.0	—	138.55	31.35	—	10	405.50	91.75

CRIMP tensile does not include insulation grip. Crimp tensile values may vary with wire construction and style.

<sup>(1)</sup> Wire size given in mm<sup>2</sup> is not equivalent to wire size given in AWG

<sup>(2)</sup> The minimum force is calculated by an average value minus three standard deviations ( $\bar{x} - 3\sigma$ ) which is the result of statistical data sampling using crimp terminations at minimum, nominal, and maximum crimp geometry.

Figure 6

### 3.6. Straightness

The force applied during crimping may cause some bending between the crimped wire barrel and the mating portion of the terminal. Such deformation is acceptable within the following limits.

1. Up and Down

The crimped terminal, including cutoff tab and burr, shall not be bent above or below the datum line more than the amount shown in Figure 7.

2. Side to Side

The side-to-side bending of the terminal may not exceed the limits provided in Figure 7.

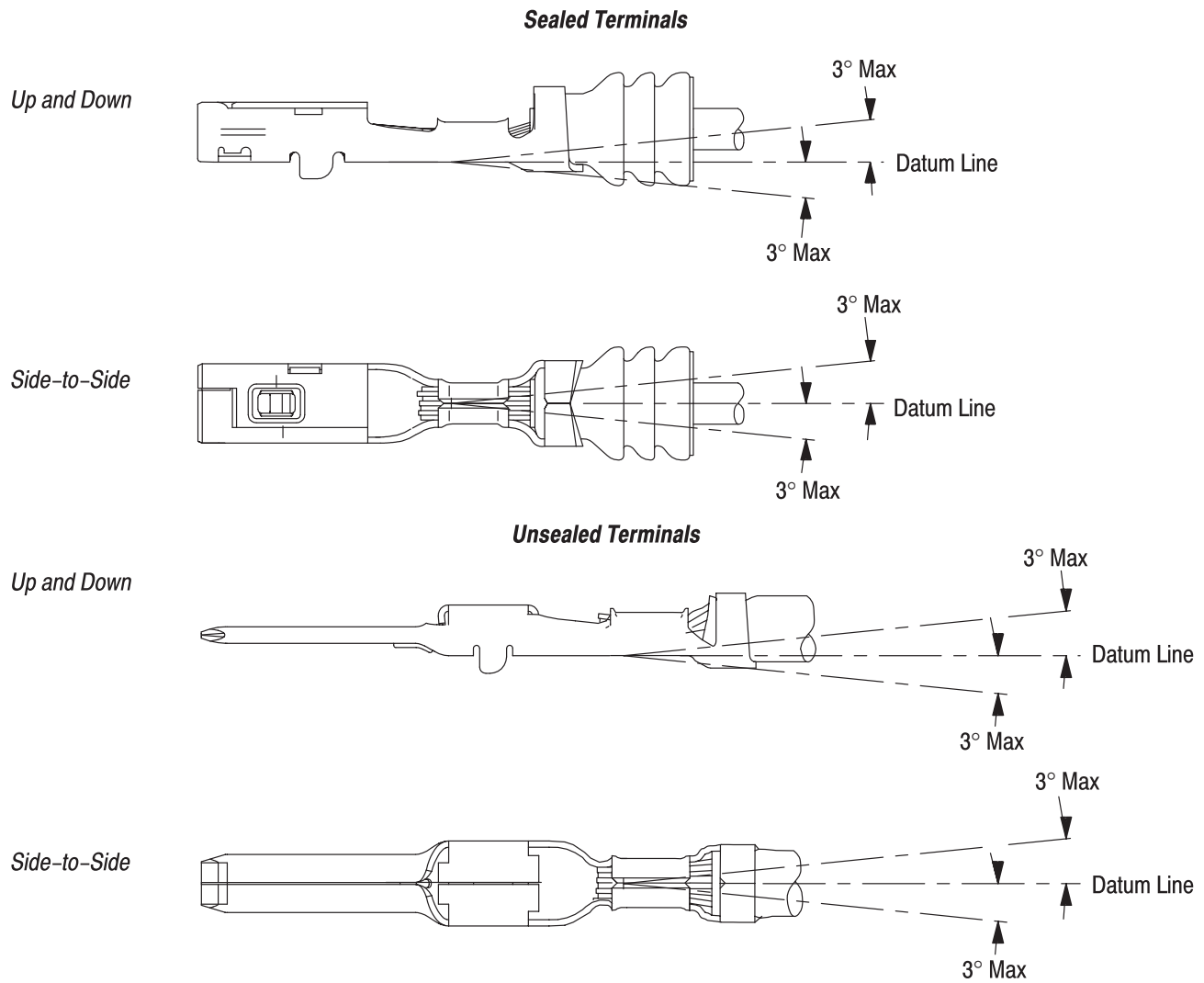


Figure 7

### 3.7. Repair and Replacement

These terminals are not repairable. Damaged terminals must be removed from the connector and replaced with new ones. Terminals **MUST NOT** be re-used by removing the wire.

## 4. QUALIFICATIONS

Terminals in the 2.8mm terminal system (sealed and unsealed) are not required to be listed or recognized by Underwriters Laboratories Inc. (UL) or certified to the Canadian Standards Association (CSA).

5. TOOLING

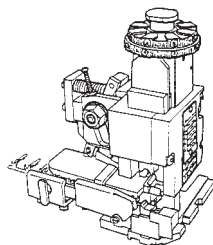
Semi-automatic machines for power assisted application of tape-mounted terminals are available to cover the full wire size range. Modified designs and additional tooling concepts may be available to meet application requirements. Tooling part numbers and instructional material packaged with the tooling are shown in Figure 8.

5.1. Applicators

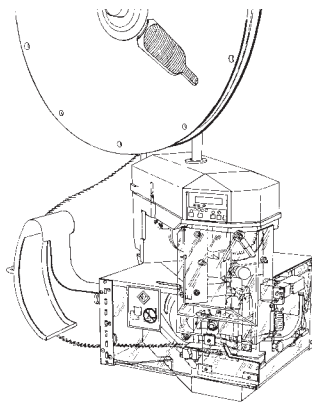
The applicator is designed to crimp tape-mounted terminals onto pre-stripped wire, and provides for high volume, heavy duty production requirements. The applicator must be installed onto a power unit.

5.2. Power Units

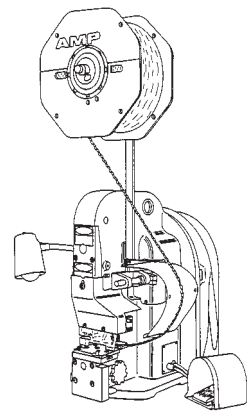
The power unit provides the force required to drive the applicator for crimping tape-mounted terminals. These power units are designed to be bench mounted.



Typical Heavy Duty Miniature Quick-Change Applicator (Side-Feed Type) (Refer To Table) (408-8040)



AMP-O-LECTRIC Model "G" Terminating Machine 354500-1 (409-5842)



AMP-O-LECTRIC Model "K" Terminating Machine 565435-5 (409-5128)  
No Longer Manufactured New

TERMINAL	WIRE SIZE-		APPLICATOR
	mm <sup>2</sup>	AWG	
Sealed	0.35	22	680815-2
	0.50	20	680816-2
	0.75-1.0	18	680850-2
	—	16	680851-2
	1.5	14	680817-2
	2.5		
	—	12	680818-2
Unsealed	0.35	22	680811-2
	0.50	20	680812-2
	0.75-1.0	18	
	1.5	16	680813-2
	2.5	14	
	4.0	12	680814-2
	—	10	

■ Wire size given in mm<sup>2</sup> is not equivalent to wire size given in AWG

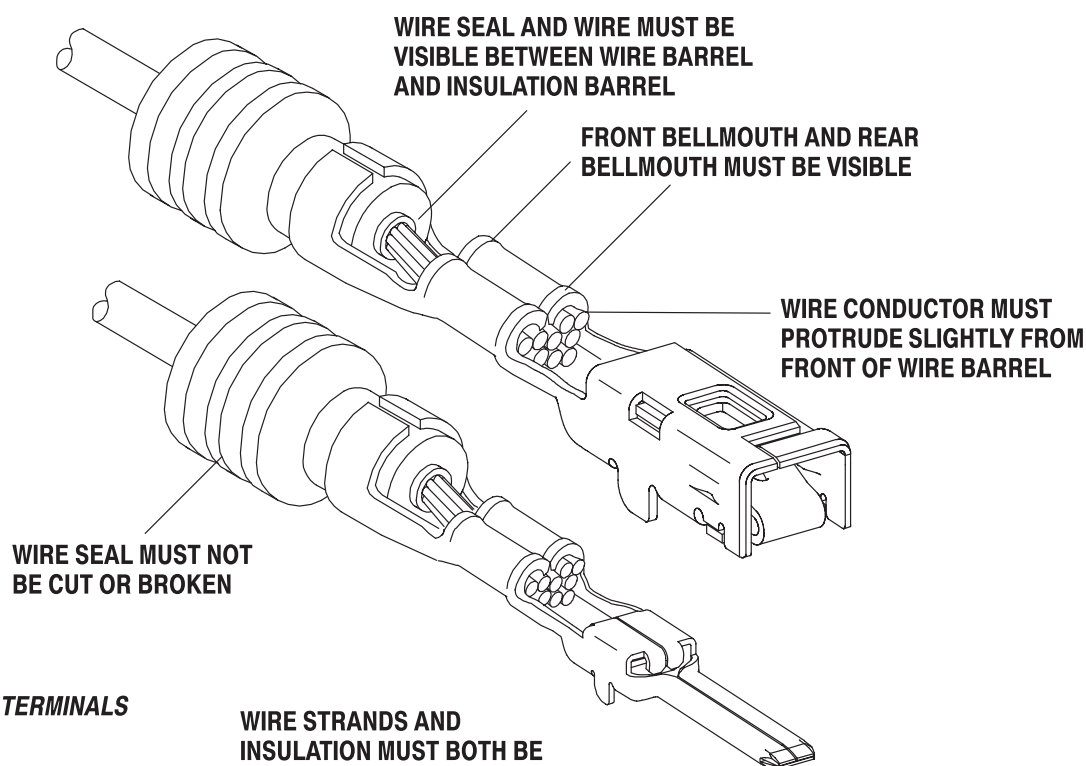
Figure 8



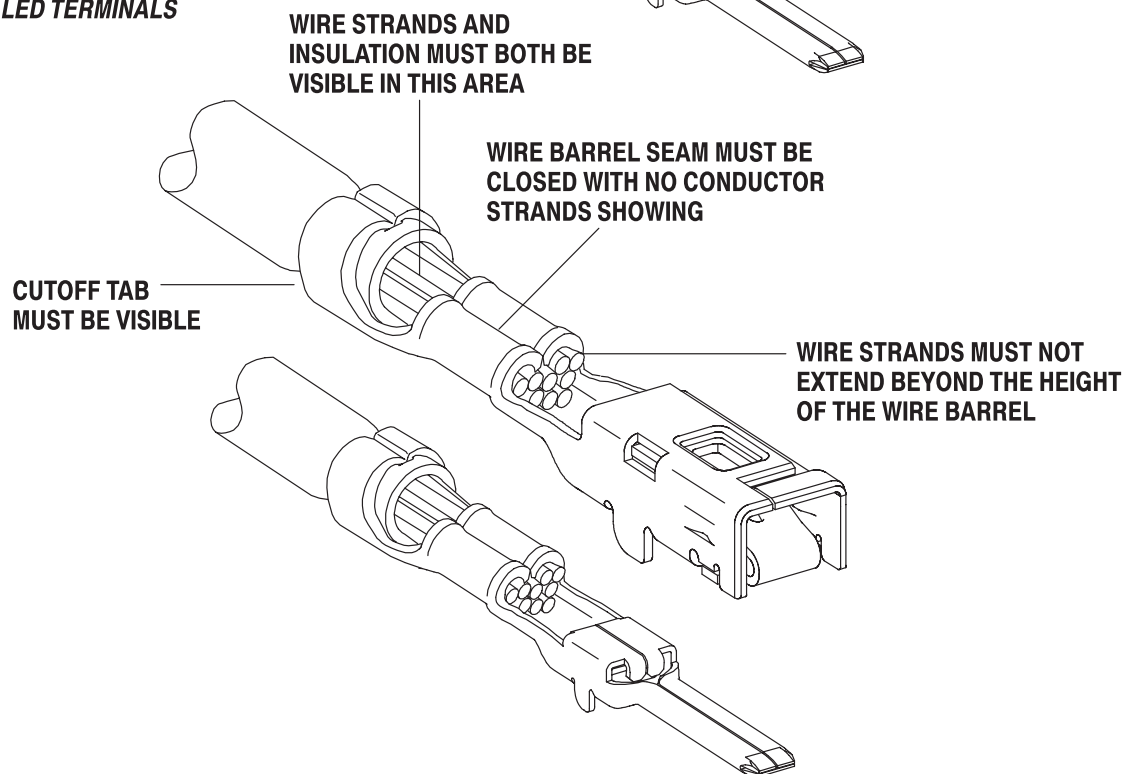
## 6. VISUAL AID

The illustration below shows a typical application of 2.8mm terminal system (sealed and unsealed). This illustration should be used by production personnel to ensure a correctly applied product. Applications which DO NOT appear correct should be inspected using the information in the preceding pages of this specification and in the instructional material shipped with the product or tooling.

### SEALED TERMINALS



### UNSEALED TERMINALS



**FIGURE 9. VISUAL AID**