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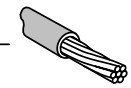
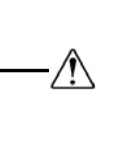
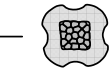
Crimping Instructions

Assembly Instructions

CONTENTS







SCOPE

This document provides general guidelines and procedures for understanding and achieving reliable crimp terminations when using Fischer Connectors closed barrel crimp contacts.

Its contents may slightly differ from individual company guidelines and procedures, and is not intended to replace them.
Given the broad variety of cable sizes, stranding and qualities, it is always recommended to perform trials to verify and if necessary adapt the procedure to the particular situation and application.

If a conflict occurs between this document and Fischer Connectors General Catalogue, this document will take precedence.

INTRODUCTION

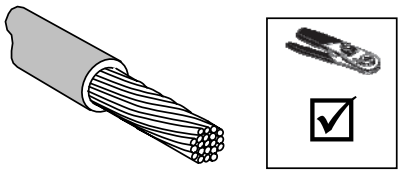
The connection between the wire and the terminal is a critical element of any wire termination.
A good termination is important because it ensures mechanical integrity and electrical performances required for the application.

Crimping is one common method of achieving this connection. It occurs inside the crimp barrel (terminal) of the contact.
There are two types of barrels - open and closed. This specification only deals with closed barrels because all contacts referred in this document are screw-machined which is the usual process for producing this type of barrel.

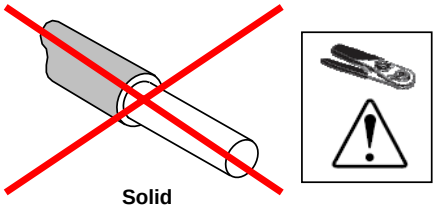
Wire sections are expressed in AWG (American Wire Gauge), mm^2 or CMA (Circular Mil Area). See conversion table in **Appendix 1**.
Because the wire stranding and insulation type or thickness can vary widely within a particular wire size, it is very important to carefully verify the compatibility between the selected wire and the crimp contact by checking the barrel hole dimensions in **Table 1**.

Wire types:

- ☞ Stranded conductors shall be used for crimping.
  Solid round conductors may only be used when their suitability has been proven.



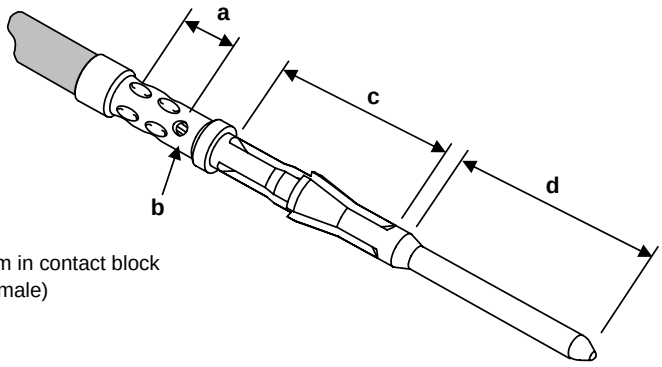
Stranded



Solid

The end result of a properly crimped terminal is a reliable mechanical and electrical connection.

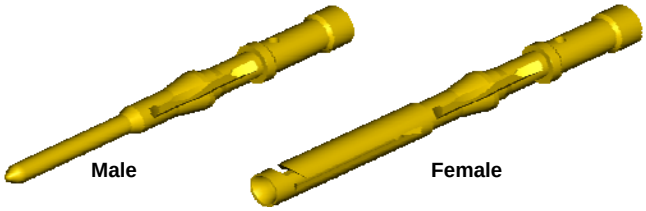
Parts of a machined Fischer Connector crimp contact



a. Conductor crimp area
b. Inspection window
c. Contact retaining mechanism in contact block
d. Mating interface (male or female)

CRIMP CONTACTS

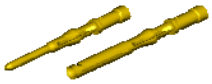
Wire Size and Tool Chart



Crimp style connectors are supplied with the appropriate quantity of crimp contacts. However, replacement contacts may be ordered according to table below.

Crimp contacts can be removed from the contact block by means of extraction tools (see extraction tool section).

TABLE 1

Contact 				Core Series						UltiMate		Positioner 	Crimp Tool 	Wire Size
Size [mm]	Polarity	Part Number	Replaces	102	103	1031	104	105	1051	13	18	Part Number	Part Number	AWG
Ø0.5	Male	200.2113	-	•	•							TX00.300	TX00.240	32-28 [1]
	Male	200.2172	-			•	•	•		•		TX00.301		
	Female	200.2114	-	•	•							TX00.302		
	Female	200.2183	-			•	•					TX00.303		
	Female	200.2412	-					•				TX00.324		
	Female	200.2898	-					•		•		TX00.373		
Ø0.7	Male	200.2884	200.1682 200.2698	•	•	•	•	•			•	TX00.304	TX00.240	28-24 [1]
	Male	200.2887	200.2210						•			TX00.307		
	Male	200.2888	200.2384	•	•	•	•	•				TX00.304		
	Female	200.2885	200.1683 200.2760	•	•	•	•					TX00.305		
	Female	200.2886	200.2050					•	•			TX00.306		
Ø0.9	Male	200.2890	200.2248	•	•	•	•					TX00.307	TX00.240	26-22 [1]
	Male	200.2891	200.2350					•	•			TX00.308		
	Female	200.2892	200.1856	•	•	•	•					TX00.309		
	Female	200.2893	200.2143					•	•			TX00.310		
Ø1.3	Male	200.2402	-		•	•	•					TX00.311	TX00.240	24-20 [1]
	Male	200.2403	-					•	•			TX00.338		
	Female	200.2214	-		•	•	•	•	•			TX00.312		
Ø1.6	Male	200.1653	-				•	•	•			TX00.313	TX00.242	18-14 [1]
	Female	200.1654	-				•	•	•			TX00.314		

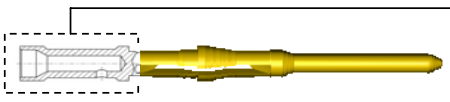
Note 1: Exceptionally for a given AWG, the diameter of some stranded conductor designs could be larger than the hole diameter of the crimp barrel. Make sure that the conductor diameter fits into the hole. See barrel dimensions in **Table 2** on page 4.

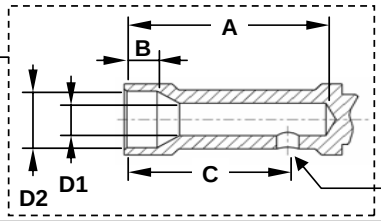
Legend

• = Compatible

CRIMP CONTACTS (Cont.)

Barrel Dimensions and Stripping Length





All contacts listed below are insulation support style machined crimp contacts except Ø1.6 contacts.

⚠ **The wire insulation shall fit into D2.**

TABLE 2

Contact			Barrel dimensions					Stripping length 1)
Size [mm]	Polarity	Part Number	A min	B	C	D1 min	D2 min	
Ø0.5	Male	200.2113	3.0 *(0.118")*	0.5 *(0.020")*	2.5 *(0.098")*	0.43 *(0.017")*	0.83 *(0.033")*	2.5 *(0.098")*
	Male	200.2172						
	Female	200.2114						
	Female	200.2183						
	Female	200.2412						
	Female	200.2898						
Ø0.7	Male	200.1682	3.4 *(0.134")*	0.8 *(0.031")*	3.1 *(0.122")*	0.60 *(0.024")*	1.11 *(0.044")*	2.6 *(0.102")*
	Male	200.2210						
	Male	200.2384						
	Male	200.2698						
	Female	200.1683						
	Female	200.2050						
	Female	200.2760						
	Male	200.2884	3.4 *(0.134")*	0.6 *(0.024")*	3.1 *(0.122")*	0.62 *(0.024")*	1.11 *(0.044")*	2.8 *(0.110")*
	Male	200.2887						
	Male	200.2888						
	Female	200.2885				0.65 *(0.026")*		
	Female	200.2886						
Ø0.9	Male	200.2248	3.3 *(0.130")*	0.7 *(0.028")*	3.1 *(0.122")*	0.82 *(0.032")*	1.56 *(0.061")*	2.6 *(0.102")*
	Male	200.2350						
	Female	200.1856				0.80 *(0.031")*	1.48 *(0.058")*	
	Female	200.2143	3.5 *(0.138")*		3.3 *(0.130")*			2.8 *(0.110")*
	Male	200.2890	3.3 *(0.130")*	0.5 *(0.020")*	3.1 *(0.122")*	0.83 *(0.033")*	1.56 *(0.061")*	2.8 *(0.110")*
	Male	200.2891						
	Female	200.2892						
	Female	200.2893						
Ø1.3	Male	200.2402	3.3 *(0.130")*	0.7 *(0.028")*	3.0 *(0.118")*	1.18 *(0.046")*	1.76 *(0.069")*	2.6 *(0.102")*
	Male	200.2403						
	Female	200.2214	3.6 *(0.142")*		3.5 *(0.138")*			2.9 *(0.114")*
Ø1.6	Male	200.1653	5.0 *(0.197")*	N/A	4.7 *(0.185")*	1.78 *(0.070")*	N/A	6.0 *(0.236")*
	Female	200.1654						

Note 1: See chapter on **Stripping** on page 7 for definition of stripping length.

All dimensions shown are in millimeters *(inches)* and are for reference only.

RECOMMENDED CRIMP TOOL SETTINGS

These settings are only for use with the adequate crimp tool (see page 6).

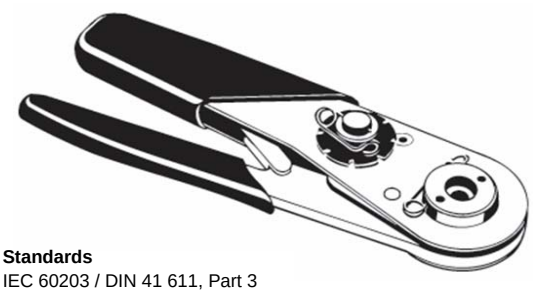
TABLE 3

Contact			Crimp Tool Setting	
Size [mm]	Polarity	Part Number	Wire Size AWG	
Ø0.5	Male	200.2113	32	2
	Male	200.2172	30	3
	Female	200.2114	28 1)	4
	Female	200.2183		
	Female	200.2412		
	Female	200.2898		
Ø0.7	Male	200.1682	28	6
	Male	200.2210	26	6
	Male	200.2384	24 1)	7
	Male	200.2698		
	Female	200.1683		
	Female	200.2050		
	Female	200.2760		
	Male	200.2884	28	5
	Male	200.2887	26	5
	Male	200.2888	24 1)	6
	Female	200.2885		
	Female	200.2886		
Ø0.9	Male	200.2248	26	6
	Male	200.2350	24	7
	Female	200.1856	22 1)	8
	Female	200.2143		
	Male	200.2890	26	5
	Male	200.2891	24	5
	Female	200.2892	22 1)	6
	Female	200.2893		
Ø1.3	Male	200.2402	24	7
	Male	200.2403	22	8
	Female	200.2214	20 1)	8
Ø1.6	Male	200.1653	18	5
	Female	200.1654	16	6
			14 1)	6

Note 1: Exceptionally for a given AWG, the diameter of some stranded conductor designs could be larger than the hole diameter of the crimp barrel. Make sure that the conductor diameter fits into the hole. See barrel dimensions in **Table 2** on page 4.

CRIMPING AND ASSEMBLY TOOLS

Crimp Tool ULTRA PRECISION for closed crimp termination



Standards
IEC 60203 / DIN 41 611, Part 3
MIL-C-22520, Class I, Type 1

Contact Size [mm]	C Crimp Tool	Part Number
Ø0.5	BALMAR 18 - 000 or DANIELS MH - 800	TX00.240
Ø0.7		
Ø0.9		
Ø1.3		
Ø1.6	BUCHANAN 615 708	TX00.242

The best choice of precision crimp tools for highly reliable eight indenter crimping per US-MIL, IEC and DIN Specifications.

These hand tools have an integral mechanism to control the crimping operation to the extend that, once the crimping operation has been started, the crimping tool cannot be opened until the crimping cycle has been completed (full-cycle/ratcheting tool).

Positioners have to be ordered according to contact.
See **Table 1** on page 3.

Contact Insertion Tool

Material
- Handle: POM (black Delrin®)
- Fork: Tool Steel, chrome plated

Contact Size [mm]	Part Number
Ø0.5	TX00.214
Ø0.7	TX00.210
Ø0.9	TX00.211
Ø1.3	TX00.273

Tool for inserting male and female removable crimp contacts into the contact block.

Especially recommended for small gauge and fragile wires.

Contact Extraction Tool

Material
- Housing and Plunger: POM (black Delrin®)
- Sleeve: Stainless Steel
- Slide: Tool Steel

Contact Size [mm]	Part Number
Ø0.5	TX00.213
Ø0.7	TX00.200
Ø0.9	TX00.205
Ø1.3	TX00.212
Ø1.6	TX00.201

Tool for extracting male and female removable crimp contacts from the contact block.

The sleeve of this tool is pushed over the contact, thereby releasing the contact retaining mechanism. The tool plunger is then pushed to eject the contact.

CRIMP PROCESS

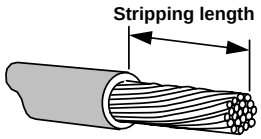
Stranded conductors shall not be soldered/tin dipped in that part which is intended to be crimped.
After crimping, no additional soldering should take place.

Some reasons for failure of crimped joints to meet minimum tensile requirements include nicked wires, nicked or ruptured strands, strand turn back at crimp joint, and ruptured wires outside of the crimped terminal. To avoid these problems, use the correct size wire for the barrel, prepare your wire carefully, and use the proper crimping tool.

PREPARATION

Stripping:

Wire insulation may be removed using chemical, thermal or mechanical strippers. Chemical insulation stripping agent shall be used only for solid wires.
In order to obtain a good and stable crimped connection, it is necessary to strip the wire correctly, i.e. the required stripping length depends on the type and size of the crimp barrel used as described below.
See **Table 2** on page 4 for barrel dimensions **A** and **B**, position of inspection hole **C**, and stripping length.

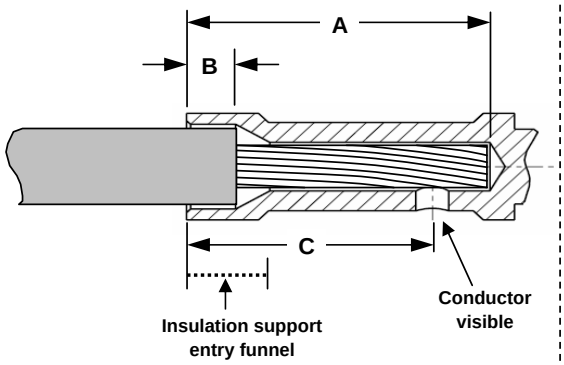


Insulation support style contact:

The wire insulation shall be inserted into the support barrel of the contact, i.e. no insulation clearance is allowed.

Stripping length = **A** - **B**

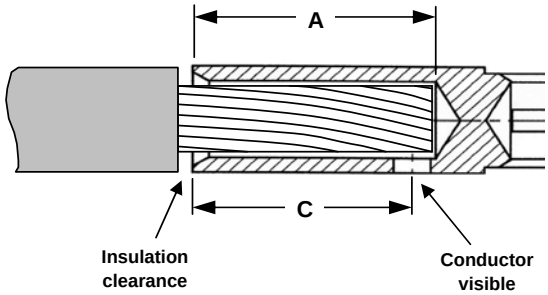
If the insulation diameter is larger than the entry funnel, then apply rule below for contact without insulation support.



Contact without insulation support:

As rule of thumb:
Stripping length = **A** + 1 mm (up to 1 mm^2)

If the insulation clearance is too large, then there is a danger of short circuit.



CRIMP PROCESS (Cont.)

Strand damage and end cuts:

The strands stripped part of the conductor shall not be damaged, for example partly or totally broken, as it can lead to degraded performance.
Tools utilized to accomplish wire cut shall be selected and used to provide repetitive and consistent wire cut terminations.
The process of wire cutting shall be performed such that the cut ends are uniform and all strands are the same length.

Solder iron

Do NOT tin the wire with solder before crimping

Wire insulation damage:

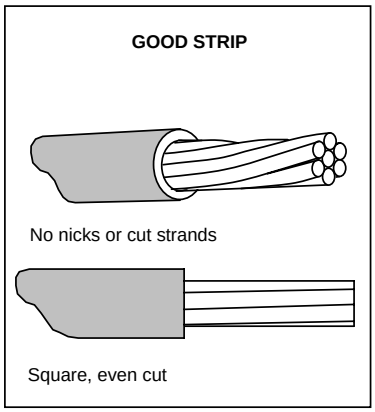
Indents on the wire insulation caused by the stripping tool which do not damage the insulation are permitted if there are no cuts, breaks, cracks or splits in insulation. Coatings added over insulation base material such as resin coatings over polyimide are not considered to be part of the insulation.

Cleanliness:

The stripped part of the conductor shall be clean and free of heavy, non-conductive films such as oxides, sulfides, and similar substances., and free from particles of insulation.

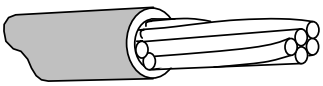
Conductor deformation/birdcaging:

The strands shall not be flattened, untwisted, buckled, kinked or otherwise deformed.
The lay of the strands shall be correct. If the lay has been disturbed, it may be restored by a light twist to approximate the original spiral lay of the wire. Care should be taken not to over-twist the strands.



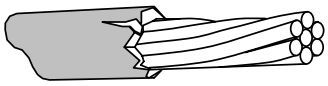
CRIMP PROCESS (Cont.)

Examples of Stripping Faults

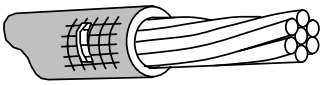


Distance between stripping blades too small:
Strands damaged or removed

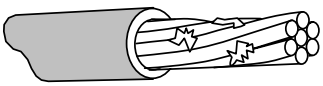
Not appropriate stripping tool:
Cut at angle



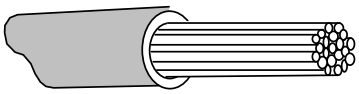
Blunt stripping blades or incorrect
distance between the blades:
Tapered, torn, split or burred insulation



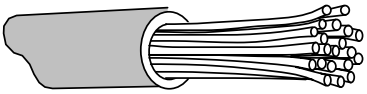
The grip of the stripping tool is damaged or
there are metal shavings within the grip:
Insulation is damaged.



Stripping blades either blunt or not correctly adjusted:
Particles of insulation left on the stripped part of the wire

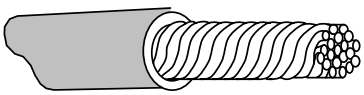


Inappropriate handling of stripped wire:
Strands untwisted



Inappropriate handling of stripped wire:
Strands untwisted and wire bundle splayed

Inappropriate handling of stripped wire:
- **Wire strands extend beyond wire insulation outside diameter.**
- **Wire strands are kinked.**



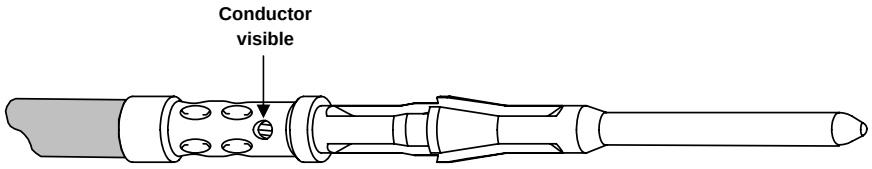
The strands are overtwisted; therefore the distribution
of strands within the crimp barrel is not assured
(increase of the wire cross-section)

CRIMP PROCESS (Cont.)

CRIMPING

Conductor location:

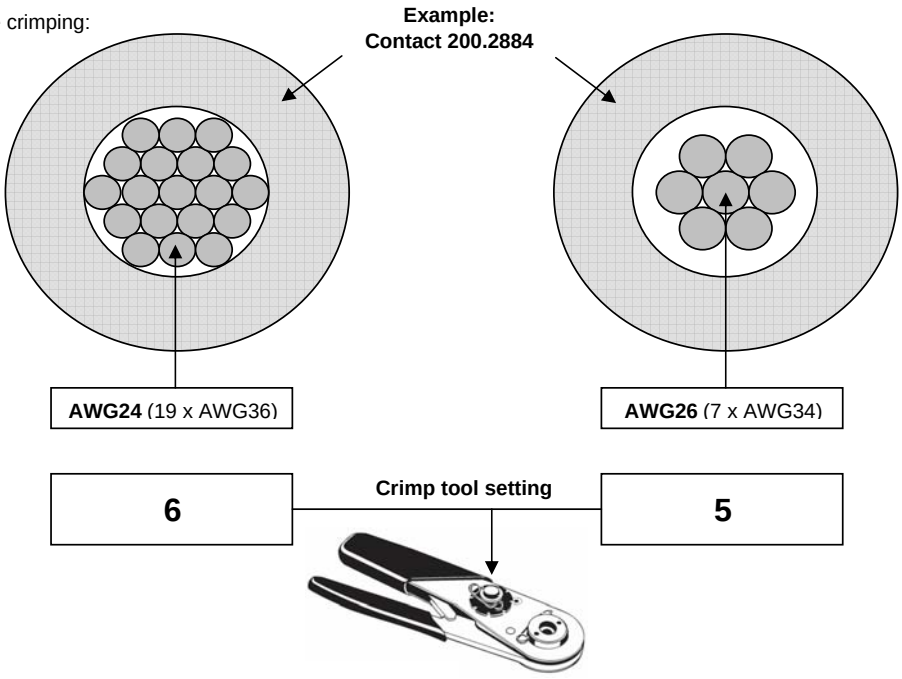
The conductor shall be correctly located in the barrel, i.e. to the correct depth. It must be visible inside the inspection window.
All conductor strands shall be within the barrel. There shall be no damaged strands.



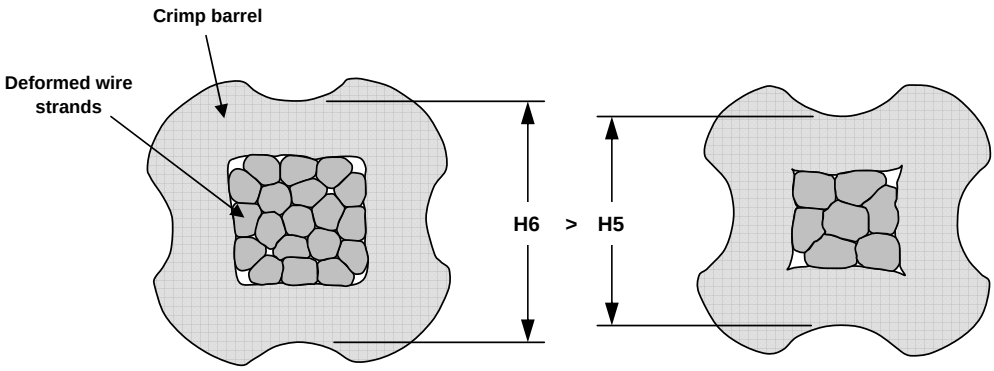
Deformation of the crimp barrel:

The figures below show the crimping of the same contact but with two different wire sizes.
The smaller wire requires a deeper deformation of the crimp barrel which is achieved by selecting the recommended crimp tool setting in **Table 3** on page 5.

Cross-sections before crimping:



With the aid of cross-section equipment it is possible to verify the quality of the crimp.
Each strand should be compressed and deformed, crimp settings may be adjusted to get void free strand compression.



CRIMP PROCESS (Cont.)

Mechanical Properties of the Crimped Connection

For each contact and compatible wire combination, a proper crimp requires a crimp dimension (or height) that offers the highest performance.
The tensile test or pull test is the most widely used field test for evaluating the mechanical properties of the crimped connection. The chart on the existing page shows the requirements of the IEC 60352-2 for various wire sizes. The force indicates the minimum acceptable force to break or separate terminal from the conductor.

- If the crimp dimension is too small, then the conductor is over-crimped and the wire strands could be damaged. This could also create a heat rise across the termination because of increased resistance.

- If this dimension is too large, then the conductor is under-crimped and the wire strands will not be deformed enough.

In both cases the result will be a lower pull out force.

Pull out force of crimped connections 1)

Conductor cross-section		Pull out force
[mm^2]	AWG 2)	[N]
0.05	30	6
0.08	28	11
0.12	26	15
0.14	-	18
0.22	24	28
0.25	-	32
0.32	22	40
0.5	20	60
0.75	-	85
0.82	18	90

Note 1: Source: IEC 60352-2, § 5.2.2.1
Note 2: For information only

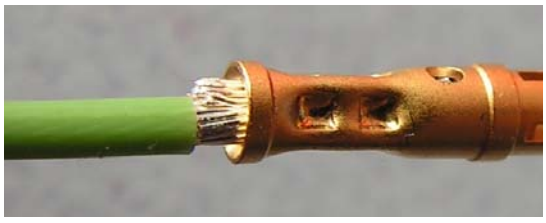
Methods for Building up Conductor Cross-Section

⚠ **In some industries, the use of the methods described below is not recommended.**

Normally, crimped connections are made with one wire in a crimp barrel. However under certain circumstances, when the wire size is smaller than the acceptable range of the crimp barrel, one of the following methods or a combination of both can be used to buildup the correct cross-section :

- The conductor is folded or bent back:

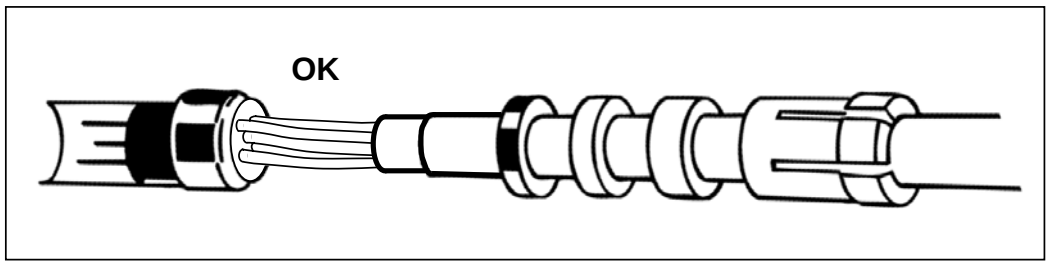
- The conductor area is increased by the use of bare (non-insulated) filler conductors as needed:

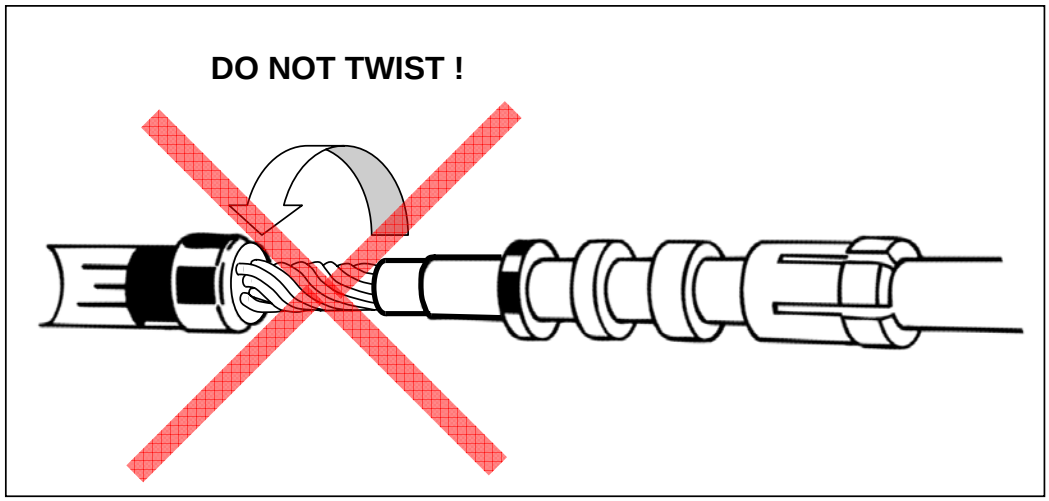


☞ Attention should be paid to the following items:
- The filler shall be visible at the wire entry end of the barrel.
- The filler conductors and/or the wire conductor are visible in the inspection window of the contact.
- The filler conductor is of the same type conductor as the wire being crimped into the contact. (Gauge can be different as needed but the base metal and the plating, if any, need to be the same).

ASSEMBLY IN CONNECTOR

A certain play in the bloc is necessary for the crimp contacts.
Never twist the cable and wires during the cable assembly.





APPENDIX 1 - WIRE SIZE

This chart is intended for reference only.

AWG	Stranding	Diameter		Effective Cross-Sectional Area	
		Inches	mm	CMA 1)	mm^2
44	Solid	0.0020	0.050	3.9	0.002
42	Solid	0.0025	0.063	6.2	0.003
40	Solid	0.0031	0.080	9.9	0.005
39	Solid	0.0035	0.090	12.5	0.006
38	Solid	0.0040	0.10	15.7	0.008
37	Solid	0.0045	0.11	19.8	0.010
36	Solid	0.0050	0.13	25.0	0.013
35	Solid	0.0056	0.14	31.5	0.016
34	Solid	0.0063	0.16	39.8	0.020
33	Solid	0.0071	0.18	50.1	0.025
32	Solid	0.0080	0.20	63.2	0.032
32	7/40	0.0090	0.23	69.2	0.035
32	19/44	0.0080	0.20	74.3	0.038
31	Solid	0.0089	0.23	79.7	0.040
30	Solid	0.010	0.25	101	0.051
30	7/38	0.012	0.30	110	0.056
30	19/42	0.013	0.33	118	0.060
29	Solid	0.011	0.29	127	0.064
28	Solid	0.013	0.32	160	0.081
28	7/36	0.015	0.38	175	0.089
28	19/40	0.016	0.41	188	0.095
27	1/27	0.014	0.36	202	0.102
27	7/35	0.017	0.43	221	0.112
27	65/44	0.018	0.46	254	0.129
26	Solid	0.016	0.40	254	0.129
26	7/34	0.019	0.48	278	0.141
26	10/36	0.020	0.51	250	0.127
26	19/38	0.020	0.51	299	0.151
25	Solid	0.018	0.45	320	0.162
24	Solid	0.020	0.51	404	0.205
24	7/32	0.024	0.61	442	0.224
24	10/34	0.023	0.58	398	0.201
24	19/36	0.025	0.64	475	0.241
24	41/40	0.024	0.61	405	0.205

AWG	Stranding	Diameter		Effective Cross-Sectional Area	
		Inches	mm	CMA 1)	mm^2
23	Solid	0.023	0.57	509	0.258
22	Solid	0.025	0.64	642	0.326
22	7/30	0.030	0.76	704	0.356
22	19/34	0.032	0.81	755	0.383
22	26/36	0.029	0.74	650	0.329
21	Solid	0.028	0.72	810	0.410
20	Solid	0.032	0.81	1022	0.518
20	7/28	0.038	0.97	1119	0.567
20	10/30	0.036	0.91	1005	0.509
20	19/32	0.038	0.97	1201	0.609
20	26/34	0.040	1.02	1034	0.524
20	41/36	0.038	0.97	1025	0.519
19	Solid	0.036	0.91	1288	0.653
18	Solid	0.040	1.02	1624	0.823
18	7/26	0.046	1.17	1779	0.901
18	16/30	0.046	1.17	1608	0.815
18	19/30	0.048	1.22	1910	0.968
18	41/34	0.046	1.17	1630	0.826
18	65/36	0.048	1.22	1625	0.823
17	Solid	0.045	1.15	2048	1.038
16	Solid	0.051	1.29	2583	1.309
16	7/24	0.060	1.52	2828	1.433
16	19/29	0.054	1.37	2408	1.220
16	26/30	0.058	1.47	2613	1.324
16	65/34	0.059	1.50	2584	1.309
16	105/36	0.059	1.50	2625	1.330
15	Solid	0.057	1.45	3257	1.650
14	Solid	0.064	1.63	4107	2.081
14	7/22	0.073	1.85	4497	2.279
14	19/27	0.068	1.73	3829	1.940
14	41/30	0.070	1.78	4121	2.088
14	105/34	0.086	2.18	4174	2.115

Number of strands — Size of each strand in AWG

Note 1: Circular Mil Area (CMA):
A circular mil is the cross-sectional area of a wire one mil (0.001 inches) in diameter.