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Attn: Wire Harness Suppliers

2.8 mm Apex Terminal Crimp Guidelines
Version 10.4 issued 05/11

To whom it may concern:

The following crimp guidelines for the FCI 2.8 mm Apex Terminal System are being issued by FCI to assist all wiring harness manufacturers in crimping this terminal system.

The purpose of the crimp guidelines is to assist the wire harness manufacturers in producing high quality core and insulation crimps. This comprehensive package includes crimp height and crimp width information, and also the recommended tooling geometry for the working surfaces of the crimp die punches and anvils.

Additional information in this package also shows proper crimp dimensions, and terminal alignment after crimping. This information should assist your personnel in evaluating the quality of your applicator die setup and associated crimp tools. Whether you build or purchase crimp tools, it is recommended the working surfaces of the crimp tools meet the dimensions shown on the respective figures in this package. At FCI, we have spent the past 15 years working with the automotive companies in developing these guidelines. We highly recommend these guidelines be followed for this terminal application.

For any questions regarding the use or interpretation of these guidelines, please contact FCI Product Engineering (248) 592-2700.

How this information is organized:

- Pages 1-6 give explanations and important information on the crimping process, the part numbers these guidelines are associated with and the wire used with these parts.
- Page 7 is an overview of the crimp dimensions information.
- Page 8-11 pertains to the core and insulation crimping of the Male terminal only.
- Page 12-15 pertains to the core and insulation crimping of the Female terminal only.

It is important to note here that all of the DVP&R testing on these terminals has been conducted using the crimp dimensions shown herein *as crimped with the tooling shown herein.*

- Page 16, **Figure 1**, is an overview of cross section areas of representative crimps versus their crimp dimensions.
- Page 17, **Figure 2**, is a print of the conductor tooling in the "B" style.
- Page 18, **Figure 3**, is a print of the insulation tooling in the "D" style.
- Page 19, **Figure 4**, is a print of the insulation tooling in the "B" style.
- Page 20, **Figure 5**, is a view for assessing the setup of the crimping die and the terminal alignment versus the crimp tooling.
- Page 21, **Figure 6**, is a view used to assess the finished crimp for straightness of the terminal. The female terminal is shown, however the view pertains to the male terminal as well.
- Page 22, **Figure 7**, is a view showing the thickness of the crimp tooling as well as the step between the two sets of punches and anvils (core and insulation).
- Page 23, **Figure 8**, is how the finished crimp should look relative to the strands in front of the core crimp. Whether or not a strand compressor is used, the strands of wire coming through the front of the core crimp (these strands are sometimes called "wire brush") must not protrude in a manner which would interfere with the insertion of the terminal into the insulator or would cause damage to the grommet/ end seal of sealed connectors.
- Page 24, **Figure 9**, is a print of the conductor tooling in the "O" style.
- Page 25, **Tooling Table 1**, is a table of Tooling Build Dimensions to be used with Figures 2, 3 and 4 to build the recommended tooling for crimping these terminals. You will note the letters called out in place of the dimensions on the tooling Figures have corresponding letters on the headings of these pages of tooling dimensions.
- Page 26 is the revision list for this document listing the revision level and date of each page and of the whole document.

Since the dimensions in Tooling Table 1 *relate* directly to the finished dimensions of the crimps, both core crimp and insulation crimps (Pages 8-15), the use of tooling NOT built to the attached standards may well result in tensile/ pull-test values and electrical performance values DIFFERENT THAN ARE found in the testing of these systems during the DVP&R Product Validation testing.

ALL dimensions listed herein and attached hereto are in millimeters (mm) unless otherwise specified.

These pages DO NOT supersede the terminal drawing/ blueprints.

Please use the appropriate customer specification for terminal tensile testing. Attachment A of Chrysler specification PF-9600, Revision A, SAE/ USCAR 2 and USCAR-21 were used by the FCI Product Evaluation Lab for terminal tensile requirements.

Shut Height vs. Finished Crimp Height

The Crimp Dimensions Tables (pages 8-15) give the dimensions for crimping terminals. Tooling Table 1 (page 25) gives the dimensions for tool building. The *crimp width* dimensions (core and insulation) given in the Crimp Dimensions Tables directly corresponds to the *shut width* given in Tooling Table 1.

Tooling shut heights as listed in Tooling Table 1 do NOT equal the terminal crimp heights found in the Crimp Dimensions Tables on pages 8-15. The shut height is the distance *inside the crimp area* between the bottom of the anvil and the top of the punch when the tooling is normally closed; meaning no terminal or wire has been placed in the tooling. (See figures 2, 3, 4, or 9 for an example.) The tooling is built to a nominal

shut height to be able to accommodate a range of crimp heights of crimped terminals. This is due to the need for the same tooling to crimp a variety of terminals onto a variety of wires.

For tooling build purposes:

tooling shut height = tooling width x 0.6

The resultant measured crimp width of terminals crimped to crimp heights less than the tooling build shut height will result in finished terminal crimp widths of slightly less than the tooling width.

Conversely, finished crimp heights on terminal crimped to greater than the tooling build shut height will result in measured finished terminal crimp widths of greater than the tooling width. This is due to the angle of the crimp punch working surface and is expected.

Note: The crimp widths listed on pages 8-15 are actually the tooling shut width. When terminals are crimped this width may naturally vary according to the tolerance allowed because of the reasons stated above. The crimp height is the dimension for which the crimping press must be adjusted; the crimp width will generally fall within the tolerance if the correct size tooling is used. However, tooling wear will affect the crimp width. When crimp width exceeds the tolerances, the tooling must be replaced.

Also, the insulation crimp height may need to be adjusted depending on the insulation type used. When this is done it is essential that the crimp is tight enough so that the insulation does not pull out of the crimp when the wire is bent at the crimp and loose enough that the wire strands are not damaged.

2.8 mm Apex Terminal System Part Numbers
0.016" material thickness- males

Terminal Description	Cable Sealed?	FCI	Old FCI/ Interlock	Chrysler	Ford	Other
Male						
22 AWG Grips	No	54002201	LTP-2211-29	4687766-22	-	-
18 AWG Grips	No	54001801	LTP-1811-29	4687766-18	-	-
14 AWG Grips	No	54001401	LTP-1411-29	4687766-14	-	-
13 AWG Grips	No	54001301	LTP-1311-29	4687766-13	-	-
10 AWG Grips	No	54001001	LTP-1011-29	4687766-10	-	-
10 AWG Grips	Yes	54001027	-	-	-	8200955828 †
2.5 Metric	Yes	F808800	-	-	-	243432435R †
Male- Gold						
22 AWG Grips	No	54002228	LTP-2211-58AU	-	-	-
22 AWG Grips	No	54002229	LDP-2211-84AU	-	-	-
22 AWG Grips	No	54002230	LSP-2211-58AU	-	-	-
18 AWG Grips	No	54001804	LTP-1811-58AU	4687818-18	-	-
18 AWG Grips	No	54001819	LDP-1811-84AU	4687818-18	-	-
18 AWG Grips	No	54001818	LSP-1811-58AU	-	-	-
14 AWG Grips	No	54001441	LSP-1411-58AU	-	-	-
						Renault †

The above table lists part numbers which are known to the FCI Product Evaluation Lab as of the current version date of this document. No attempt has or will be made to list all part numbers for all tier suppliers.

2.8 mm Apex Terminal System Part Numbers
0.012" material thickness- females

Terminal	FCI	Old FCI/	Chrysler	Ford	Other
Female- Ungreased					
22 AWG Grips	54002200	JTP-2211-29	4687767-22	XF2T-14474-CA	
18 AWG Grips	54001800	JTP-1811-29	4687767-18	F8VB-14474-BA	
14 AWG Grips	54001400	JTP-1411-29	4687767-14	F8VB-14474-AA	
13 AWG Grips	54001300	JTP-1311-29	4687767-13	YF1T-14474-CA	
12 AWG Grips	54001208	JTP-1211-29	4868298AA		
10 AWG Grips	54001000	JTP-1011-29	4687767-10	XF2T-14474-BA	
Female- Greased					
22 AWG Grips	54002202	JTP-2211-29G	4707172-22		
18 AWG Grips	54001802	JTP-1811-29G	4707172-18		
14 AWG Grips	54001402	JTP-1411-29G	4707172-14		
13 AWG Grips	54001302	JTP-1311-29G	4707172-13		
12 AWG Grips	54001209	JTP-1211-29G			
10 AWG Grips	54001002	JTP-1011-29G	4707172-10		
Female- Gold					
22 AWG Grips	54002203	JTP-2211-66AU	4687819-22		
18 AWG Grips	54001803	JTP-1811-66AU	4687819-18		
14 AWG Grips	54001403	JTP-1411-66AU	4687819-14		
13 AWG Grips	54001303	JTP-1311-66AU	4687819-13		
12 AWG Grips	54001210	JTP-1211-66AU			
10 AWG Grips	54001003	JTP-1011-66AU	4687819-10		
Female- Cable					
22 AWG Grips	54002208	JTC-2211-29			
18 AWG Grips	54001807	JTC-1811-29		XL3T-14474-DA	
14 AWG Grips	54001404	JTC-1411-29		XL3T-14474-AA	
12 AWG Grips	54001202	JTC-1211-29		XL3T-14474-CA	8200955511 †
10 AWG Grips	54001008	JTC-1011-29			
Female- Cable Seal with					
22 AWG Grips	54002209	JTC-2211-29G			
18 AWG Grips	54001810	JTC-1811-29G			
14 AWG Grips	54001409	JTC-1411-29G			
12 AWG Grips	54001205	JTC-1211-29G			
10 AWG Grips	54001009	JTC-1011-29G			
Female- Gold with Cable Seal					
22 AWG Grips	54002210	JTC-2211-66AU			
18 AWG Grips	54001811	JTC-1811-66AU			
14 AWG Grips	54001410	JTC-1411-66AU			
12 AWG Grips	54001206	JTC-1211-66AU			
10 AWG Grips	54001010	JTC-1011-66AU			
					Renault †

The above table lists part numbers which are known to the FCI Product Evaluation Lab as of the current version date of this document. No attempt has or will be made to list all part numbers for all tier suppliers.

2.8 mm Apex Terminal System Part Numbers
0.012" material thickness- males
0.010" material thickness- females

Terminal Description	FCI	Old FCI/ Interlock	Chrysler	Ford
Male				
18 AWG Grips	54001855			
Female- Ungreased				
18 AWG Grips	54001847			

The above table lists part numbers which are known to the FCI Product Evaluation Lab as of the current version date of this document. No attempt has or will be made to list all part numbers for all tier suppliers.

Wire Insulation Types

US wire

Wire Code	Description	Material	Chrysler #	Ford #
SXL	Heavy Wall	Cross-link – 125 °C	MS-5919	ESB-M1L-85A
GXL	Standard Wall	Cross-link – 125 °C	MS-8900	ESB-M1L-85B
TXL	Thin Wall	Cross-link – 125 °C	MS-8288	ESB-M1L-123A
TXL High Temp	Thin Wall	Cross-link – 150 °C	MS-9502	N/A
GPT	Standard Wall	PVC – 85 °C	MS-3450	ESB-M1L-56A
GPT Extra Flex	Standard Wall	PVC – 85 °C	MS-3450F	ESB-M1L-77A
GPT Thin Wall	Thin Wall	PVC – 85 °C	MS-7889	ESB-M1L-120A
GPT Ultra Thin Wall	Ultra Thin Wall	PVC – 85 °C	MS-9532	N/A
Chrysler High Temp	Standard Wall	PVC – 105 °C	MS-5564	N/A
Ford High Temp	Standard Wall	PVC – 105 °C	N/A	ESF-M1L-58A
HDT	Heavy Wall	PVC – 105 °C	MS-3494	ESF-M1L-50A

Metric wire

Wire Code	Description	Material	Chrysler #	Ford #
FLRY-A	Thinwall	PVC – 105 °C	N/A	N/A
FLRY-B	Thinwall	PVC – 105 °C	N/A	N/A

The Wire Code column above directly corresponds to the Wire Code column in the Crimp Dimensions tables on pages 8-13.

Terminal Cable Seals

Terminal Description	Terminal P/N	Cable Seal P/N
Female with 18 AWG TXL wire	54001807	XL3T-14603-FA
Female with 16 AWG TXL wire	54001404	XL3T-14603-EA
Female with 14 AWG TXL wire	54001404	XL3T-14603-DA
Female with 12 AWG TXL wire	54001202	XL3T-14603-CA

Apex 2.8 mm Terminal System Crimp Dimension Information

Plastic Terminal Cavity Constraints for FCI 2.8 mm Apex Connector Systems:
4.50 mm wide by 4.70 mm high UNSEALED (connector opening).
4.40 mm wide by 4.40 mm high SEALED (grommet retainer opening, mat seal application).

Crimp tooling to be constructed according to FCI Table 1 tooling specification (see page 25).

- 2.8 mm Apex Terminal Crimp Guidelines are to FCI specifications. Pull Test specifications are per your client specification.
- Both male and female terminals are subject to the final crimp criteria of Figures 5 and 6.
- Exception to Figures 3, 4, & 5: 5° angle **not** 3° on the tooling at opening to punch **for male only**. (Tool sticking during crimping may be alleviated with 4° punch angles in some cases.)
- Wire strands must be kept below the line of the top of the terminal after crimping in order to minimize mat seal grommet tear. (Reference Figure 8)
- Use of a "Hold Down" device during crimping of the 10 & 12 AWG terminals is necessary to prevent twisting.
- Unless otherwise indicated on the latest 2.8 mm Apex connector system blueprint level, 22, 12, and 10 AWG TXL wire is not recommended for use in any of the 2.8 mm Apex sealed connector systems using a mat seal. Only 20 through 14 AWG TXL wire is approved for use in sealed systems using a mat seal.
- The dimensions listed in Table 1 are for building tooling only. The crimp width and height tables on pages 8-15 are the terminal crimp dimensions.
- These terminals and their associated connector systems were contracted to be optimized to TXL and GPT Thin Wall wire insulation. However, it was also instructed that the terminal insulation grips be able to accommodate GPT and SXL. Therefore, some penetration of the wire insulation of some of the smaller O.D. wire by the insulation crimps is unavoidable. **It is generally accepted that PVC type cable insulation should NOT be used in a sealed application due to compression set on the insulation jacket. FCI cannot be held responsible for any sealing problems which may occur when PVC insulated wire is used in a sealed application.**

It is the responsibility of the harness manufacturing facility to insure proper crimping!

Crimp specifications are subject to change.

Male Core and Insulation Crimp Dimensions and Tooling Set-Up Table

Apex 2.8 mm Terminal System

FCI P/N: 5400xx01, 5400xx04. (Where xx is grip code.)

All crimp dimensions shown are nominal. See Figure 1 for tolerances.

0.016" thick material

US wire

					Male Terminal				Male Terminal			
					Core Crimp		Tooling Design		Insulation Crimp		Tooling Design	
Grip Code	Wire Combination	Wire Code	Max. Wire Insul. O.D.	Sealed System?	Crimp Width	Crimp Height	Crimp Style	Figure No.	Crimp Width	Crimp Height	Crimp Style	Figure No.
10	10	TXL, TXL High Temp	4.09	NR	3.85	2.45	"B"	2 & 7	4.15	3.70	"B"	4 & 7
	10	GPT Thin Wall	4.09	NR	3.85	2.45	"B"	2 & 7	4.15	3.70	"B"	4 & 7
	12	TXL, TXL High Temp	3.35	NR	3.85	2.20	"B"	2 & 7	4.15	3.45	"B"	4 & 7
	12	GPT Thin Wall	3.35	NR	3.85	2.20	"B"	2 & 7	4.15	3.45	"B"	4 & 7
	12	GPT	3.81	NR	3.85	2.20	"B"	2 & 7	4.30	3.90	"B"	4 & 7
	12	GPT Ultra Thin Wall	xxx	NR	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	12	GXL	3.58**	NR	3.85	2.20	"B"	2 & 7	4.30	3.90	"B"	4 & 7
13	20+20	TXL, TXL High Temp, GPT	1.93+1.93	NR	3.25	1.60	"B"	2 & 7	4.30	2.30	"B"	4 & 7
	18+18	TXL, TXL High Temp, GPT	2.13+2.13	NR	3.25	1.80	"B"	2 & 7	4.30	3.00	"B"	4 & 7
	18+20	TXL, TXL High Temp, GPT	2.13+1.93	NR	3.25	1.70	"B"	2 & 7	4.30	2.80	"B"	4 & 7
	16+16	TXL, TXL High Temp, GPT	2.41+2.41	NR	3.25	1.90	"B"	2 & 7	4.30	3.50	"B"	4 & 7
	18+18	GPT	2.54+2.54	NR	3.25	1.80	"B"	2 & 7	4.30	3.70	"B"	4 & 7
	18+20	GPT	2.54+2.41	NR	3.25	1.70	"B"	2 & 7	4.30	3.60	"B"	4 & 7
	18+18	SXL, GPT	2.13+3.05	NR	NR	NR	NR	NR	NR	NR	NR	NR
14	14	TXL, TXL High Temp	2.77	Mat seal	3.05	1.95	"B"	2 & 7	3.60	3.23	"D"	3 & 7
	14	GPT Thin Wall	2.77	NR	3.05	1.95	"B"	2 & 7	3.60	3.23	"D"	3 & 7
	16	TXL, TXL High Temp	2.41	Mat seal	3.05	1.80	"B"	2 & 7	3.60	2.89	"D"	3 & 7
	16	GPT Thin Wall	2.41	NR	3.05	1.80	"B"	2 & 7	3.60	2.89	"D"	3 & 7
	14	GPT	3.18	xxx	3.05	1.95	"B"	2 & 7	3.60	3.30	"D"	3 & 7
	16	GPT	2.92	xxx	3.05	1.80	"B"	2 & 7	3.60	3.20	"D"	3 & 7
	14	GXL	2.97**	xxx	3.05	1.95	"B"	2 & 7	3.60	3.30	"D"	3 & 7
	16	GXL	2.61**	xxx	3.05	1.80	"B"	2 & 7	3.60	3.20	"D"	3 & 7
	14	SXL	3.94	NR	NR	NR	NR	NR	NR	NR	NR	NR
	16	SXL	3.43	xxx	3.05	1.80	"B"	2 & 7	4.15	3.30	"D"	3 & 7
	14	HDT	4.19	NR	NR	NR	NR	NR	NR	NR	NR	NR
	16	HDT	3.81	xxx	3.05	1.80	"B"	2 & 7	4.15	3.35	"D"	3 & 7
	14	GPT Ultra Thin Wall	2.387	NR	3.05	1.95	"B"	2 & 7	3.60	2.70	"D"	3 & 7
	16	GPT Ultra Thin Wall	2.03	NR	3.05	1.80	"B"	2 & 7	3.60	2.54	"D"	3 & 7

** Nominal value only available.

NR Not Recommended

xxx Unknown/ Untested

This version supersedes all previous versions.

All values are in millimeters.

Male Core and Insulation Crimp Dimensions and Tooling Set-Up Table

Apex 2.8 mm Terminal System

FCI P/N: 5400xx01, 5400xx04. (Where xx is grip code.)

All crimp dimensions shown are nominal. See Figure 1 for tolerances.

0.016" thick material

US wire

					Male Terminal				Male Terminal			
					Core Crimp		Tooling Design		Insulation Crimp		Tooling Design	
Grip Code	Wire Combination	Wire Code	Max. Wire Insul. O.D.	Sealed System?	Crimp Width	Crimp Height	Crimp Style	Figure No.	Crimp Width	Crimp Height	Crimp Style	Figure No.
18	18	TXL, TXL High Temp	2.13	Mat seal	2.45	1.50	"B"	2 & 7	2.80	2.50	"D"	3 & 7
	18	GPT Thin Wall	2.13	NR	2.45	1.50	"B"	2 & 7	2.80	2.50	"D"	3 & 7
	20	TXL, TXL High Temp	1.93	Mat seal	2.45	1.35	"B"	2 & 7	2.80	2.30	"D"	3 & 7
	20	GPT Thin Wall	1.93	NR	2.45	1.35	"B"	2 & 7	2.80	2.30	"D"	3 & 7
	20+22	TXL, TXL High Temp, GPT	1.93+1.75	NR	2.45	1.45	"B"	2 & 7	3.45	2.30	"B"	4 & 7
	22+22	TXL, TXL High Temp, GPT	1.75+1.75	NR	2.45	1.40	"B"	2 & 7	3.25	2.35	"B"	4 & 7
	18	GPT	2.54	xxx	2.45	1.50	"B"	2 & 7	3.20	2.60	"D"	3 & 7
	20	GPT	2.41	xxx	2.45	1.35	"B"	2 & 7	3.20	2.45	"D"	3 & 7
	18	GXL	2.38**	xxx	2.45	1.50	"B"	2 & 7	3.20	2.60	"D"	3 & 7
	20	GXL	2.14**	xxx	2.45	1.35	"B"	2 & 7	3.20	2.45	"D"	3 & 7
	18	SXL	3.05	NR	NR	NR	NR	NR	NR	NR	NR	NR
	20	SXL	2.80	NR	NR	NR	NR	NR	NR	NR	NR	NR
	18	HDT	3.42	NR	NR	NR	NR	NR	NR	NR	NR	NR
	20	HDT	3.18	NR	NR	NR	NR	NR	NR	NR	NR	NR
	18	GPT Ultra Thin Wall	1.75	NR	2.45	1.50	"B"	2 & 7	2.80	2.20	"D"	3 & 7
	20	GPT Ultra Thin Wall	1.55	NR	2.45	1.35	"B"	2 & 7	2.80	2.05	"D"	3 & 7
18 Gold	18	TXL, TXL High Temp	2.13	Mat seal	2.45	1.45	"B"	2 & 7	2.80	2.50	"D"	3 & 7
	18	GPT Thin Wall	2.13	NR	2.45	1.45	"B"	2 & 7	2.80	2.50	"D"	3 & 7
	20	TXL, TXL High Temp	1.93	Mat seal	2.45	1.35	"B"	2 & 7	2.80	2.25	"D"	3 & 7
	20	GPT Thin Wall	1.93	NR	2.45	1.35	"B"	2 & 7	2.80	2.25	"D"	3 & 7
22	22	TXL, TXL High Temp, GPT	1.75	NR	2.05	1.40	"B"	2 & 7	2.60	1.96	"D"	3 & 7

** Nominal value only available.

NR Not Recommended

xxx Unknown/ Untested

This version supersedes all previous versions.

All values are in millimeters.

All crimp dimensions shown are nominal. See Figure 1 for tolerances.

0.016" thick material

					Male Terminal				Male Terminal			
Metric wire					Core Crimp		Tooling Design		Insulation Crimp		Tooling Design	
Grip Code	Wire Combination	Wire Code	Max. Wire Insul. O.D.	Sealed System?	Crimp Width	Crimp Height	Crimp Style	Figure No.	Crimp Width	Crimp Height	Crimp Style	Figure No.
10	4.0mm^2	FLRY-B	3.70	NR	3.85	2.3	"B"	2 & 7	4.20	4.35	"B"	2 & 7
14	2.5mm^2	FLRY-B	3.00	NR	3.05	1.80	"B"	2 & 7	3.60	3.25	"D"	3 & 7
	1.5mm^2	FLRY-B	2.40	NR	3.05	1.70	"B"	2 & 7	3.60	3.00	"D"	3 & 7
18	1.0mm^2	FLRY-B	2.10	NR	2.45	1.50	"B"	2 & 7	2.80	2.45	"D"	3 & 7
	0.75mm^2	FLRY-B	1.90	NR	2.45	1.40	"B"	2 & 7	2.80	2.35	"D"	3 & 7
	0.5mm^2	FLRY-A	1.60	NR	2.45	1.30	"B"	2 & 7	2.80	2.20	"D"	3 & 7
22	0.35mm^2	FLRY-A	1.30	NR	2.05	1.30	"B"	2 & 7	2.60	1.95	"D"	3 & 7
25m	2.5mm^2	FLRY-B	3.00	CS	3.45	1.80	"B"	2 & 7	5.20	4.95	"O"	3 & 7

CS= Cable sealed

** Nominal value only available.

NR Not Recommended

xxx Unknown/ Untested

This version supersedes all previous versions.

All values are in millimeters.

Male Core and Insulation Crimp Dimensions and Tooling Set-Up Table

Apex 2.8 mm Terminal System

FCI P/N: 5400xx55. (Where xx is grip code.)

All crimp dimensions shown are nominal. See Figure 1 for tolerances.

0.012" thick material

US wire

					Male Terminal				Male Terminal			
					Core Crimp		Tooling Design		Insulation Crimp		Tooling Design	
Grip Code	Wire Combination	Wire Code	Max. Wire Insul. O.D.	Sealed System?	Crimp Width	Crimp Height	Crimp Style	Figure No.	Crimp Width	Crimp Height	Crimp Style	Figure No.
18	18	TXL, TXL High Temp	2.13	Mat seal	2.05	1.35	"B"	2 & 7	2.60	2.35	"D"	3 & 7
	20	TXL, TXL High Temp	1.93	Mat seal	2.05	1.20	"B"	2 & 7	2.60	2.18	"D"	3 & 7

** Nominal value only available.

NR Not Recommended

xxx Unknown/ Untested

This version supersedes all previous versions.

All values are in millimeters.

Female Core and Insulation Crimp Dimensions and Tooling Set-Up Table

Apex 2.8 mm Terminal System

FCI P/N: 54000xx00, 5400xx03, 5400xx02. (Where xx is grip code.)

All crimp dimensions shown are nominal. See Figure 1 for tolerances.

0.012" thick material

US wire

					Female Terminal				Female Terminal			
					Core Crimp		Tooling Design		Insulation Crimp		Tooling Design	
Grip Code	Wire Combination	Wire Code	Max. Wire Insul. O.D.	Sealed System?	Crimp Width	Crimp Height	Crimp Style	Figure No.	Crimp Width	Crimp Height	Crimp Style	Figure No.
10	10	TXL, TXL Thin Wall	4.09	NR	3.45	2.25	"B"	2 & 7	4.20	3.65	"B"	4 & 7
	10	GPT Thin Wall	4.09	NR	3.45	2.25	"B"	2 & 7	4.20	3.65	"B"	4 & 7
12	12	TXL, TXL Thin Wall	3.35	NR	3.45	1.95	"B"	2 & 7	3.80	3.05	"B"	4 & 7
	12	GPT Thin Wall	3.35	NR	3.45	1.95	"B"	2 & 7	3.80	3.05	"B"	4 & 7
	12	TXL	3.35	Cable Seal	3.45	1.95	"B"	2 & 7	4.30	4.80	"O"	9 & 7
13	20+20	TXL, TXL High Temp, GPT	1.93+1.93	NR	3.05	1.30	"B"	2 & 7	4.30	2.40	"B"	4 & 7
	18+18	TXL, TXL High Temp, GPT	2.13+2.13	NR	3.05	1.45	"B"	2 & 7	4.30	2.70	"B"	4 & 7
	18+20	TXL, TXL High Temp, GPT	2.13+1.93	NR	3.05	1.35	"B"	2 & 7	4.30	2.55	"B"	4 & 7
	16+16 *	TXL, TXL High Temp, GPT	2.41+2.41	NR	3.05	1.65	"B"	2 & 7	4.30	2.90	"B"	4 & 7
	18+18	GPT	2.54+2.54	NR	3.05	1.60	"B"	2 & 7	4.30	3.60	"B"	4 & 7
	18+20	GPT	2.54+2.41	NR	3.05	1.50	"B"	2 & 7	4.30	3.50	"B"	4 & 7
	18+18	SXL, GPT	2.13+3.05	NR	NR	NR	NR	NR	NR	NR	NR	NR
14	14	TXL, TXL High Temp	2.77	Mat seal	2.45	1.60	"B"	2 & 7	3.20	2.72	"D"	3 & 7
	16	TXL, TXL High Temp	2.41	Mat seal	2.45	1.50	"B"	2 & 7	3.20	2.60	"D"	3 & 7
	14	GPT Thin Wall	2.77	NR	2.45	1.60	"B"	2 & 7	3.20	2.72	"D"	3 & 7
	16	GPT Thin Wall	2.41	NR	2.45	1.50	"B"	2 & 7	3.20	2.60	"D"	3 & 7
	14	GPT	3.18	xxx	2.45	1.60	"B"	2 & 7	3.40	2.90	"D"	3 & 7
	16	GPT	2.92	xxx	2.45	1.50	"B"	2 & 7	3.20	3.00	"D"	3 & 7
	14	GXL	2.97 **	xxx	2.45	1.60	"B"	2 & 7	3.40	2.90	"D"	3 & 7
	16	GXL	2.61 **	xxx	2.45	1.50	"B"	2 & 7	3.20	3.00	"D"	3 & 7
	14	SXL	3.94	NR	NR	NR	NR	NR	NR	NR	NR	NR
	16	SXL	3.43	NR	NR	NR	NR	NR	NR	NR	NR	NR
	14	HDT	4.19	NR	NR	NR	NR	NR	NR	NR	NR	NR
	16	HDT	3.81	NR	NR	NR	NR	NR	NR	NR	NR	NR
	14	GPT Ultra Thin Wall	2.387	NR	2.45	1.60	"B"	2 & 7	3.20	2.40	"D"	3 & 7
	16	GPT Ultra Thin Wall	2.03	NR	2.45	1.50	"B"	2 & 7	3.20	2.25	"D"	3 & 7
	14	TXL	2.77	Cable Seal	2.45	1.60	"B"	2 & 7	4.10	4.40	"O"	9 & 7
	16	TXL	2.41	Cable Seal	2.45	1.50	"B"	2 & 7	4.10	4.25	"O"	9 & 7

* This crimp combination not recommended. Wire strand capture is difficult and cannot be optimized.

** Nominal value only available.

NR Not Recommended

xxx Unknown/ Untested

This version supersedes all previous versions.

All values are in millimeters.

Female Core and Insulation Crimp Dimensions and Tooling Set-Up Table

Apex 2.8 mm Terminal System

FCI P/N: 54000xx00, 5400xx03, 5400xx02. (Where xx is grip code.)

All crimp dimensions shown are nominal. See Figure 1 for tolerances.

0.012" thick material

US wire

					Female Terminal				Female Terminal			
					Core Crimp		Tooling Design		Insulation Crimp		Tooling Design	
Grip Code	Wire Combination	Wire Code	Max. Wire Insul. O.D.	Sealed System?	Crimp Width	Crimp Height	Crimp Style	Figure No.	Crimp Width	Crimp Height	Crimp Style	Figure No.
18	18	TXL, TXL High Temp	2.13	Mat seal	2.05	1.35	"B"	2 & 7	2.60	2.35	"D"	3 & 7
	20	TXL, TXL High Temp	1.93	Mat seal	2.05	1.20	"B"	2 & 7	2.60	2.18	"D"	3 & 7
	18	GPT Thin Wall	2.13	NR	2.05	1.35	"B"	2 & 7	2.60	2.35	"D"	3 & 7
	20	GPT Thin Wall	1.93	NR	2.05	1.20	"B"	2 & 7	2.60	2.18	"D"	3 & 7
	20+22	TXL, TXL High Temp, GPT	1.93+1.75	NR	2.05	1.35	"B"	2 & 7	3.45	1.80	"B"	4 & 7
	22+22	TXL, TXL High Temp, GPT	1.75+1.75	NR	2.05	1.35	"B"	2 & 7	3.25	1.95	"B"	4 & 7
	18	GPT	2.54	xxx	2.05	1.35	"B"	2 & 7	2.60	2.50	"D"	3 & 7
	20	GPT	2.41	xxx	2.05	1.20	"B"	2 & 7	2.60	2.30	"D"	3 & 7
	18	GXL	2.38**	xxx	2.05	1.35	"B"	2 & 7	2.60	2.50	"D"	3 & 7
	20	GXL	2.14**	xxx	2.05	1.20	"B"	2 & 7	2.60	2.20	"D"	3 & 7
	18	SXL	3.05	NR	NR	NR	NR	NR	NR	NR	NR	NR
	20	SXL	2.80	xxx	2.05	1.20	"B"	2 & 7	3.20	2.60	"D"	3 & 7
	18	HDT	3.42	NR	NR	NR	NR	NR	NR	NR	NR	NR
	20	HDT	3.18	xxx	2.05	1.20	"B"	2 & 7	3.20	2.60	"D"	3 & 7
	18	GPT Ultra Thin Wall	1.75	NR	2.05	1.35	"B"	2 & 7	2.60	1.85	"D"	3 & 7
	20	GPT Ultra Thin Wall	1.55	NR	2.05	1.20	"B"	2 & 7	2.60	1.68	"D"	3 & 7
	18	TXL	2.13	Cable Seal	2.05	1.35	"B"	2 & 7	3.30	4.05	"O"	9 & 7
18 Gold	18	TXL	2.13	Mat seal	2.05	1.35	"B"	2 & 7	2.60	2.35	"D"	3 & 7
	20	TXL	1.93	Mat seal	2.05	1.25	"B"	2 & 7	2.60	2.18	"D"	3 & 7
	18	GPT Thin Wall	2.13	NR	2.05	1.35	"B"	2 & 7	2.60	2.35	"D"	3 & 7
	20	GPT Thin Wall	1.93	NR	2.05	1.25	"B"	2 & 7	2.60	2.18	"D"	3 & 7
22	22	TXL, TXL High Temp, GPT	1.75	NR	1.85	1.10	"B"	2 & 7	2.60	1.75	"D"	3 & 7

** Nominal value only available.

NR Not Recommended

xxx Unknown/ Untested

This version supersedes all previous versions.

All values are in millimeters.

Female Core and Insulation Crimp Dimensions and Tooling Set-Up Table

Apex 2.8 mm Terminal System

FCI P/N: 54000xx00, 5400xx03, 5400xx02. (Where xx is grip code.)

All crimp dimensions shown are nominal. See Figure 1 for tolerances.

0.012" thick material

Metric wire

					Female Terminal				Female Terminal			
					Core Crimp		Tooling Design		Insulation Crimp		Tooling Design	
Grip Code	Wire Combination	Wire Code	Max. Wire Insul. O.D.	Sealed System?	Crimp Width	Crimp Height	Crimp Style	Figure No.	Crimp Width	Crimp Height	Crimp Style	Figure No.
10	4.0mm^2	FLRY-B	3.70	NR	3.45	2.05	"B"	2 & 7	4.20	3.90	"B"	2 & 7
14	2.5mm^2	FLRY-B	3.00	xxx	2.45	1.90	"B"	2 & 7	3.20	3.10	"D"	3 & 7
	1.5mm^2	FLRY-B	2.40	NR	2.45	1.50	"B"	2 & 7	3.20	2.65	"D"	3 & 7
18	1.0mm^2	FLRY-B	2.10	NR	2.05	1.40	"B"	2 & 7	2.60	2.30	"D"	3 & 7
	0.75mm^2	FLRY-B	1.90	NR	2.05	1.30	"B"	2 & 7	2.60	2.10	"D"	3 & 7
	0.5mm^2	FLRY-A	1.60	NR	2.05	1.25	"B"	2 & 7	2.60	2.00	"D"	3 & 7
22	0.35mm^2	FLRY-A	1.30	NR	1.85	1.10	"B"	2 & 7	2.60	1.65	"D"	3 & 7
12	2.5mm^2	FLRY-B	3.00	CS	3.45	1.95	"B"	2 & 7	4.30	4.80	"O"	2 & 7

CS= Cable sealed

**	Nominal value only available.	**This version supersedes all previous versions.**
NR	Not Recommended	**All values are in millimeters.**
xxx	Unknown/ Untested	

Female Core and Insulation Crimp Dimensions and Tooling Set-Up Table
Apex 2.8 mm Terminal System
FCI P/N: 5400xx47. (Where xx is grip code.)
All crimp dimensions shown are nominal. See Figure 1 for tolerances.
0.010" thick material

US wire

					Female Terminal				Female Terminal			
					Core Crimp		Tooling Design		Insulation Crimp		Tooling Design	
Grip Code	Wire Combination	Wire Code	Max. Wire Insul. O.D.	Sealed System?	Crimp Width	Crimp Height	Crimp Style	Figure No.	Crimp Width	Crimp Height	Crimp Style	Figure No.
18	18	TXL, TXL High Temp	2.13	Mat seal	2.05	1.15	"B"	2 & 7	2.60	2.15	"D"	3 & 7
	20	TXL, TXL High Temp	1.93	Mat seal	2.05	1.05	"B"	2 & 7	2.60	2.00	"D"	3 & 7

** Nominal value only available.
NR Not Recommended
xxx Unknown/ Untested

This version supersedes all previous versions.
All values are in millimeters.

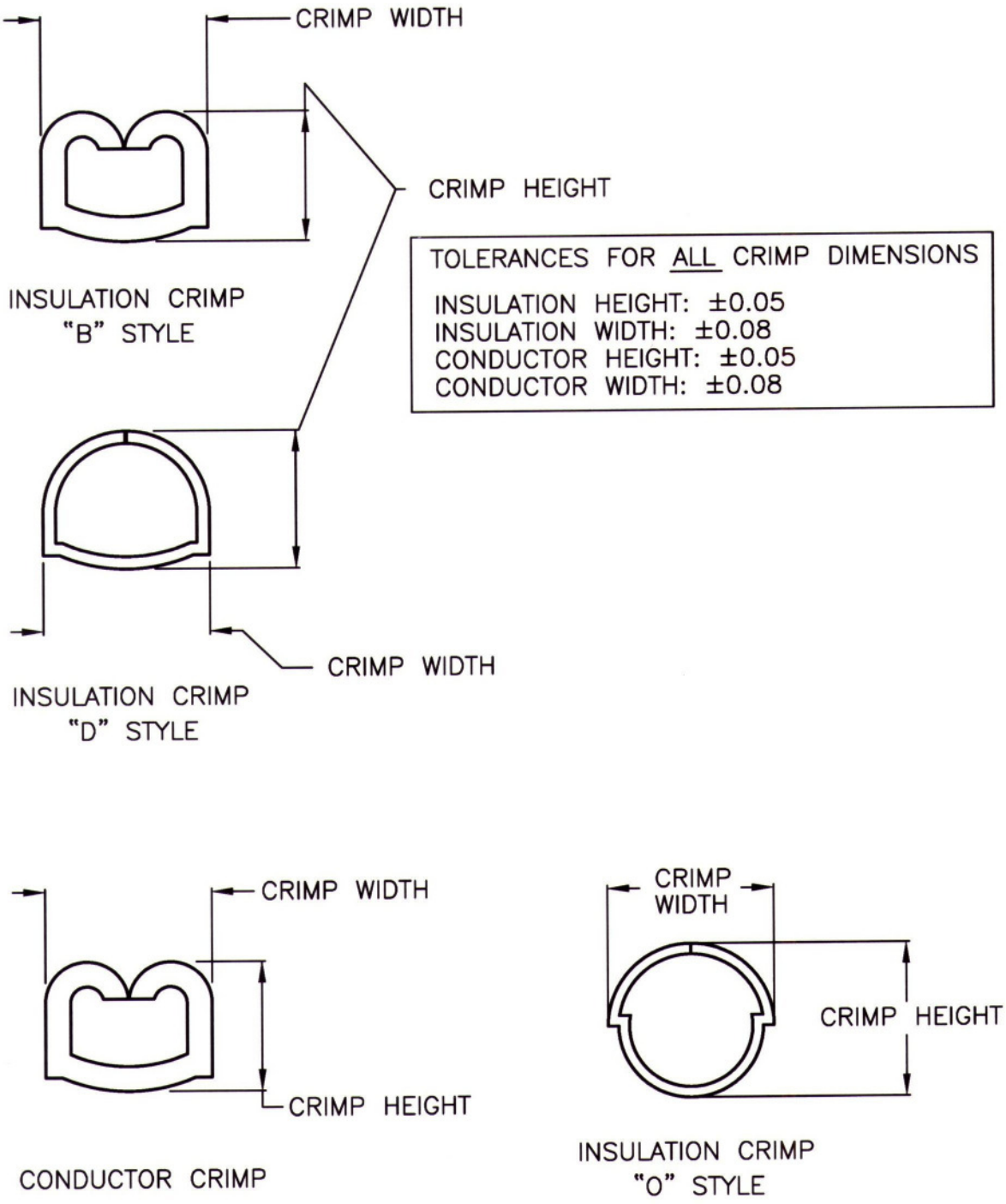
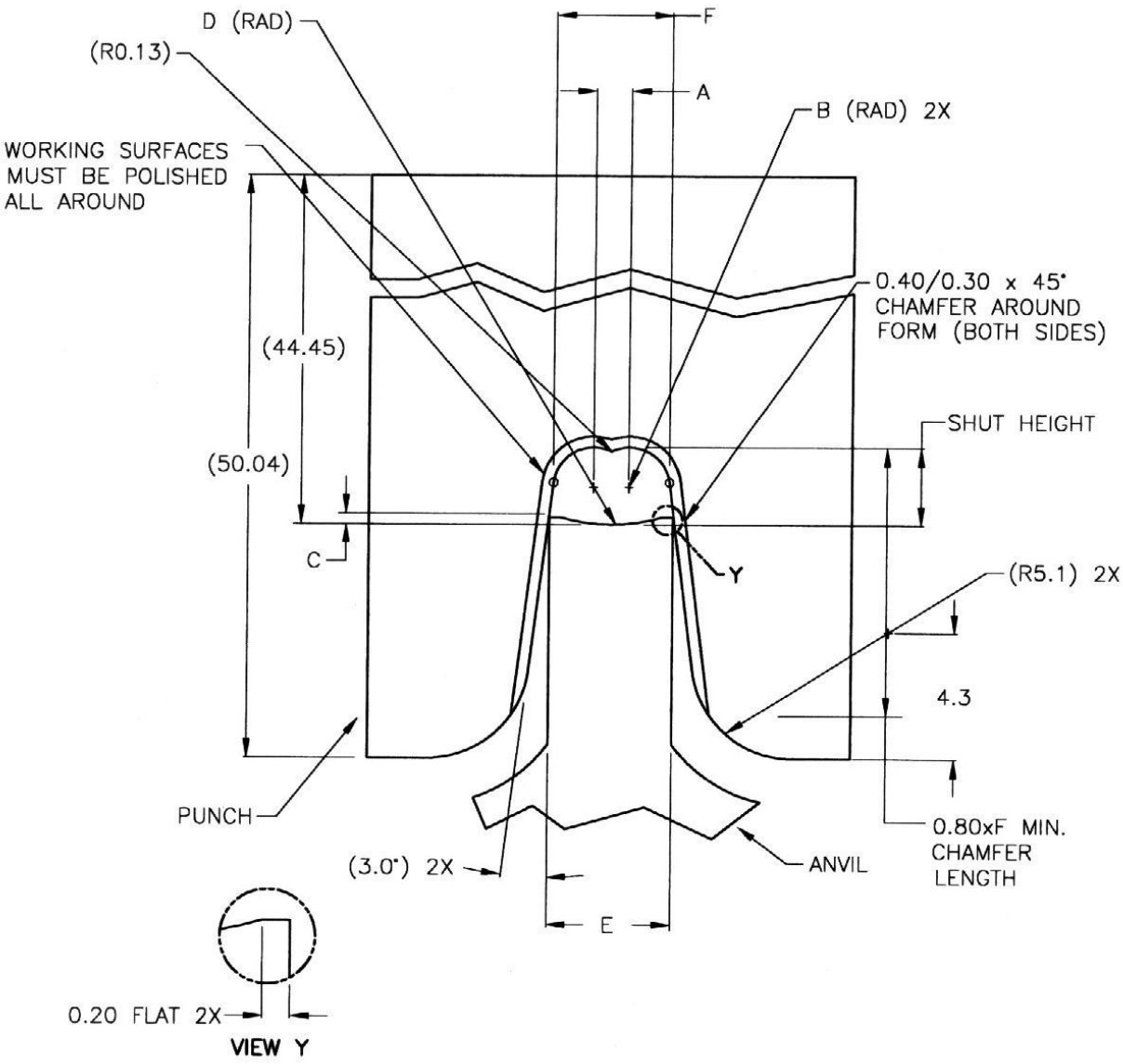


FIGURE 1

REV: D
6/01

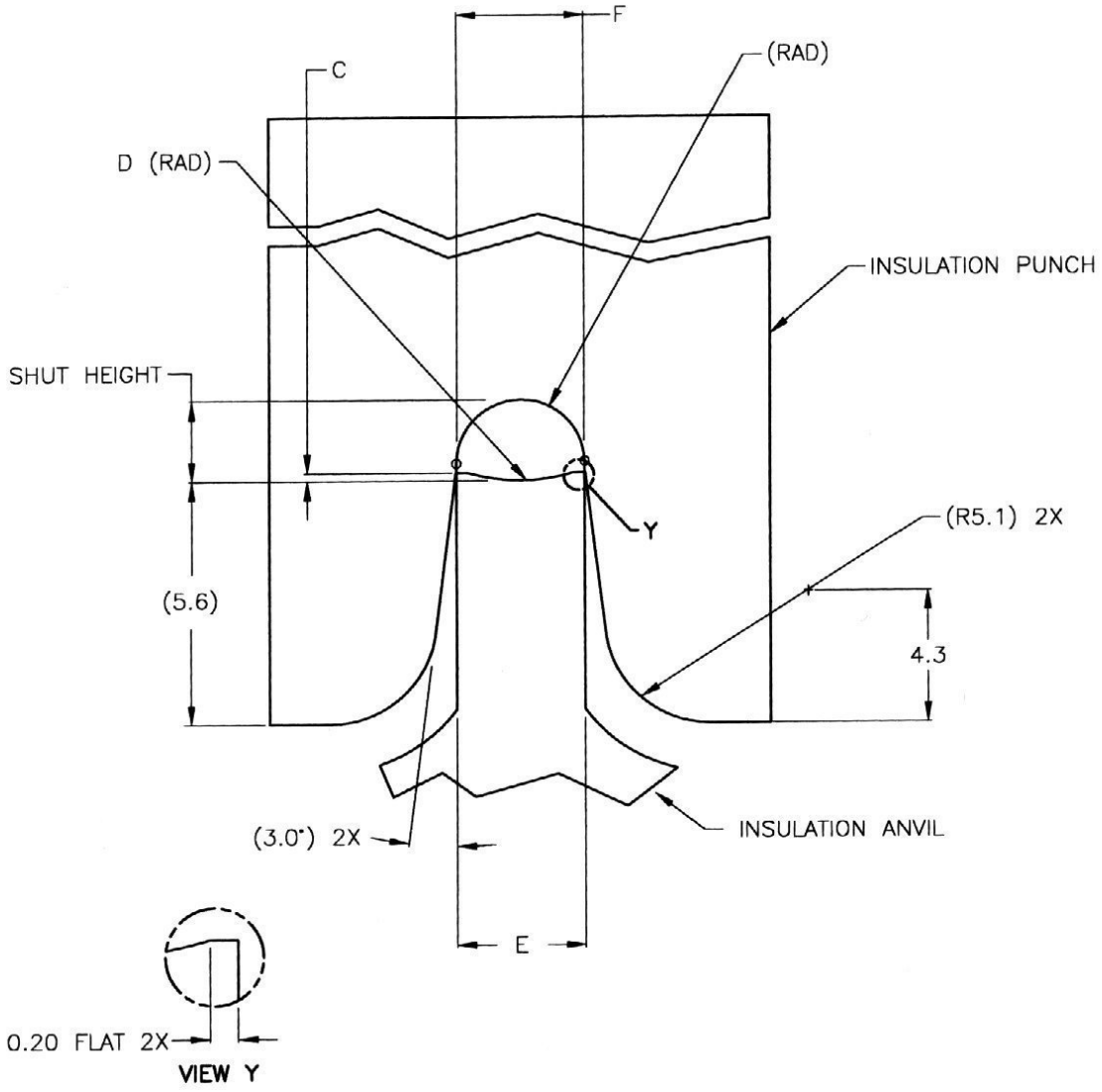


SEE TOOLING TABLE 1 FOR DIMENSIONS

STANDARD "B" FORM TOOLING DESIGN
CONDUCTOR ONLY

FIGURE 2

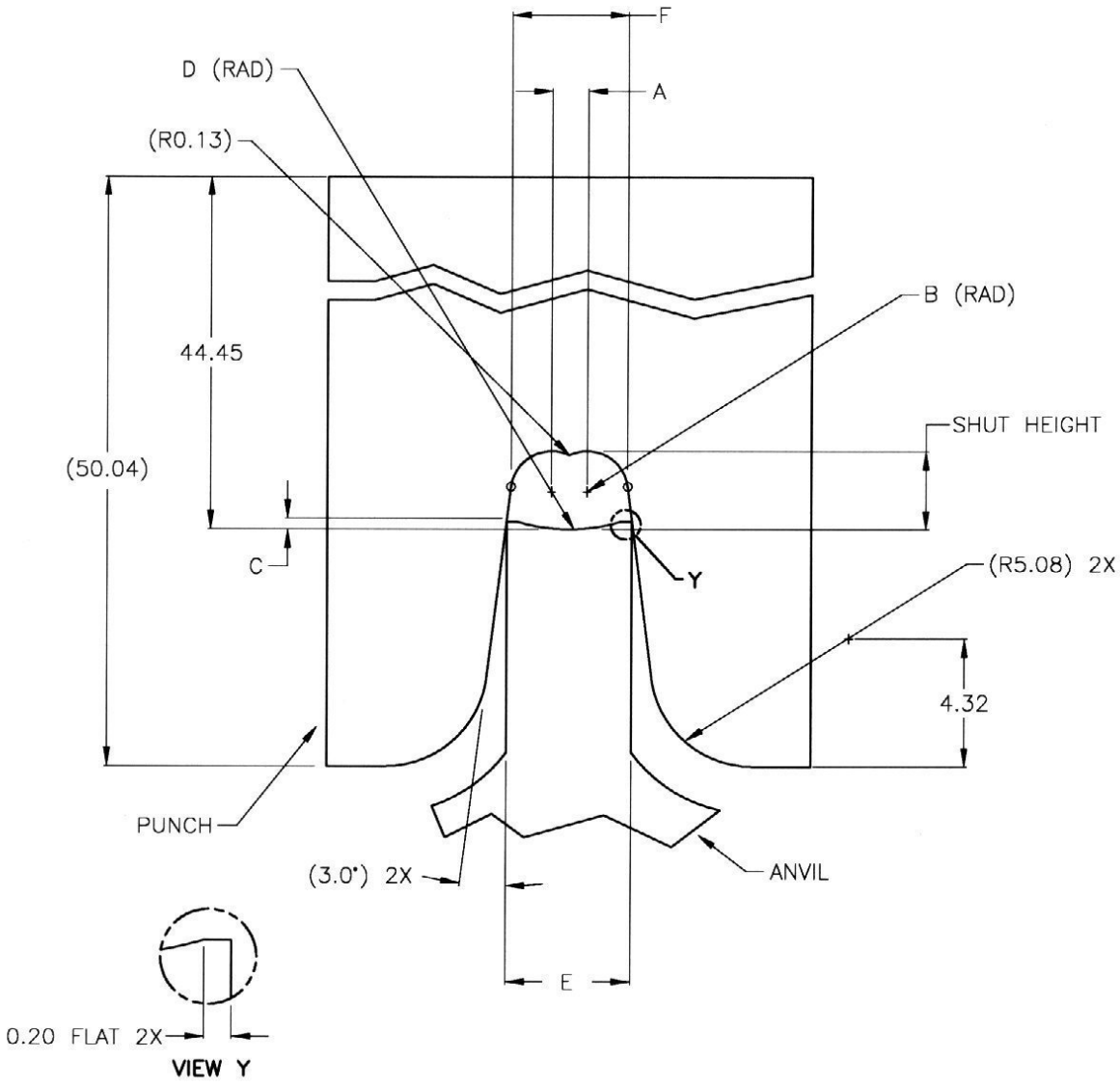
REV: C
3/99



SEE TOOLING TABLE 1 FOR DIMENSIONS

PUNCH AND ANVIL DESIGN
FOR STD "D" INSULATION TOOLING ONLY

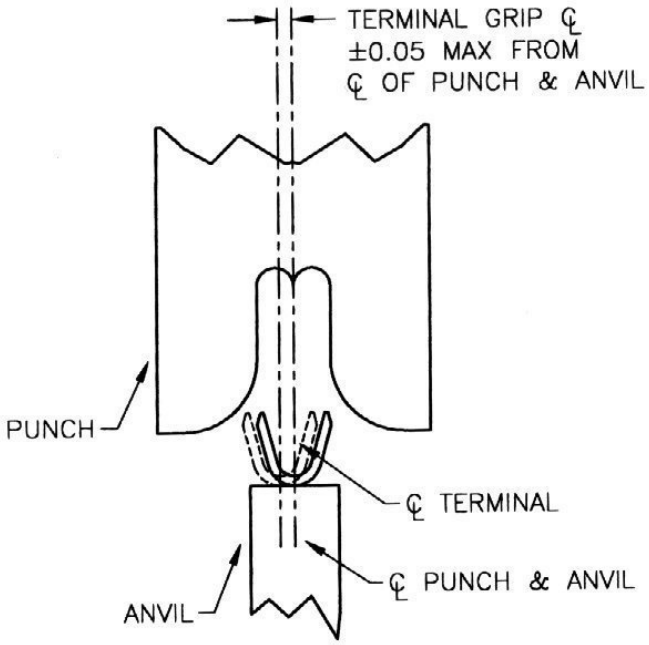
FIGURE 3
REV: C
3/99



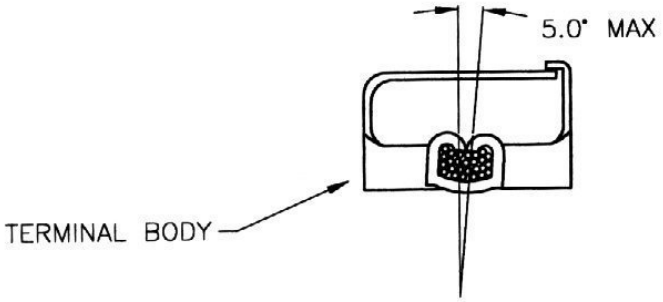
SEE TOOLING TABLE 1 FOR DIMENSIONS

STANDARD "B" FORM TOOLING DESIGN
INSULATION ONLY

FIGURE 4
REV: C
3/99

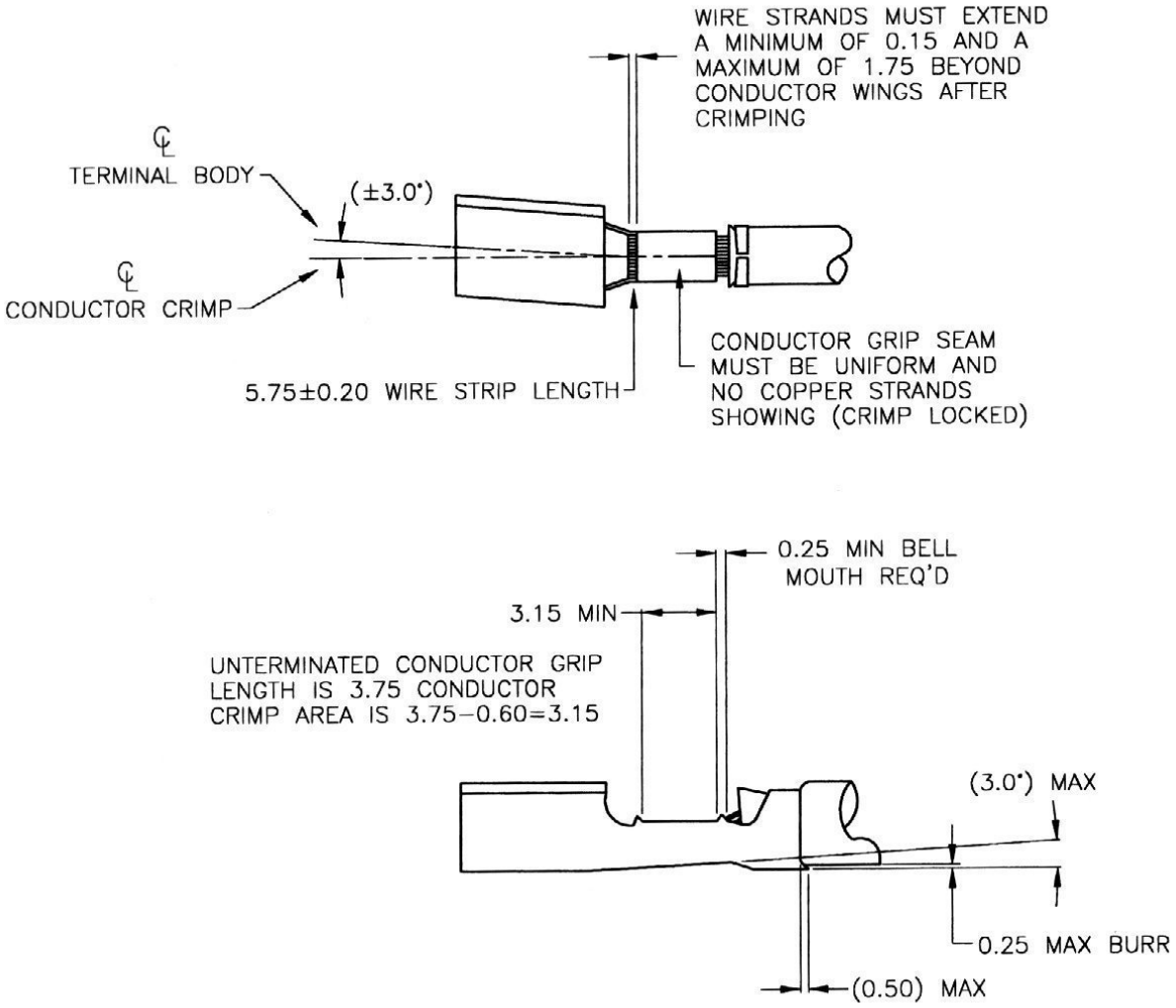


TERMINAL ALIGNMENT TO PUNCH & ANVIL



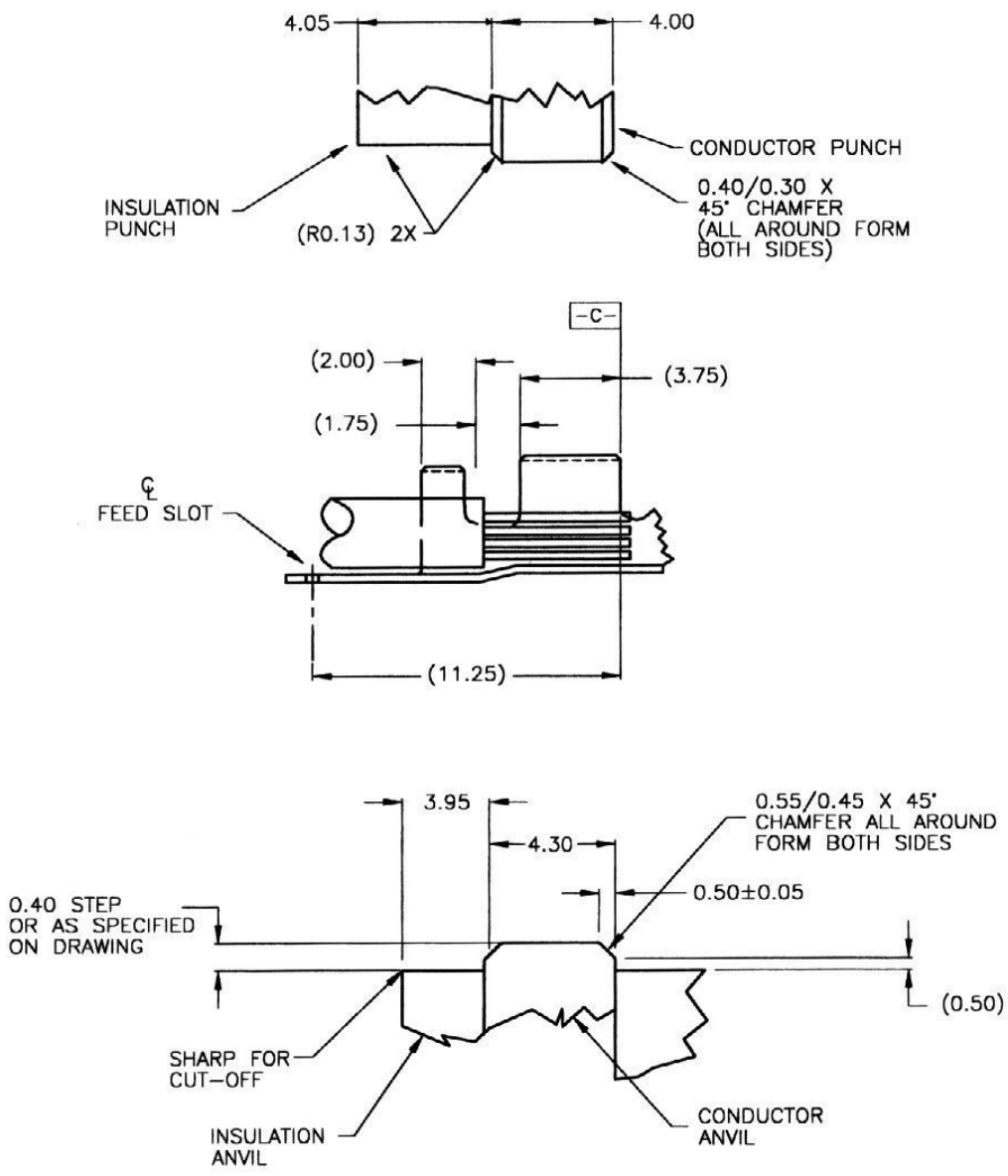
CONDUCTOR CRIMP ROLL

FIGURE 5
REV: C
3/99



(FINISH CRIMP QUALITY)
CONDUCTOR CRIMP DESIGN & ALIGNMENT

FIGURE 6
REV: C
3/99



PUNCH AND ANVIL THICKNESS (DESIGN)

FIGURE 7
REV: C
3/99

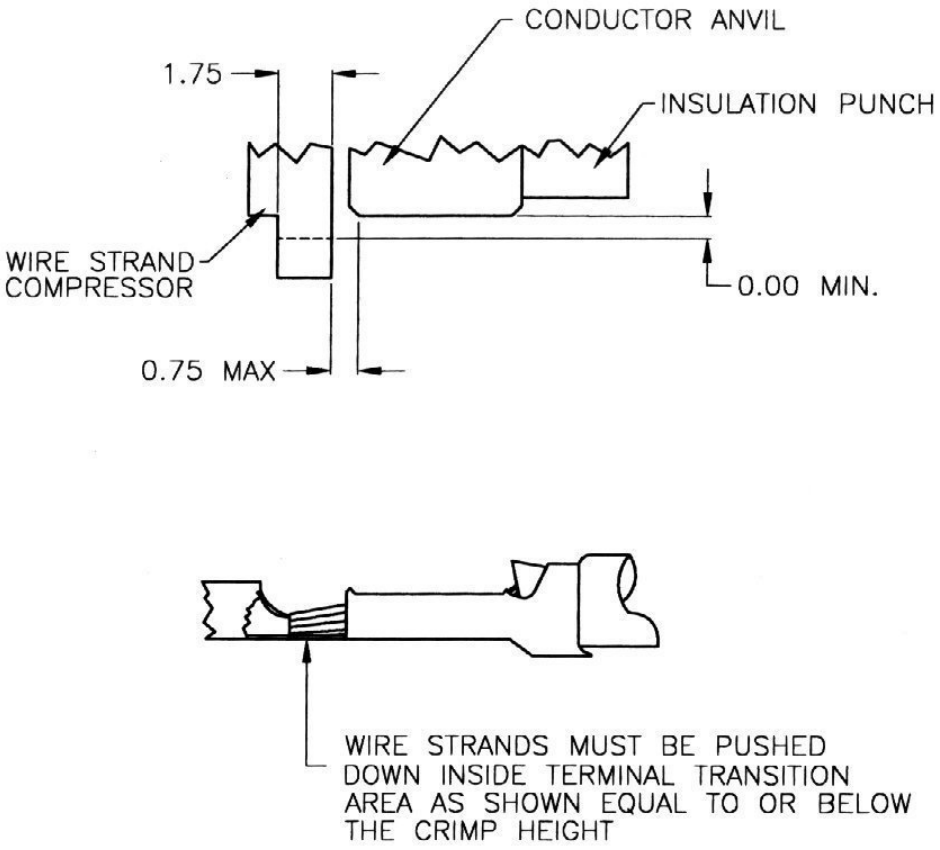
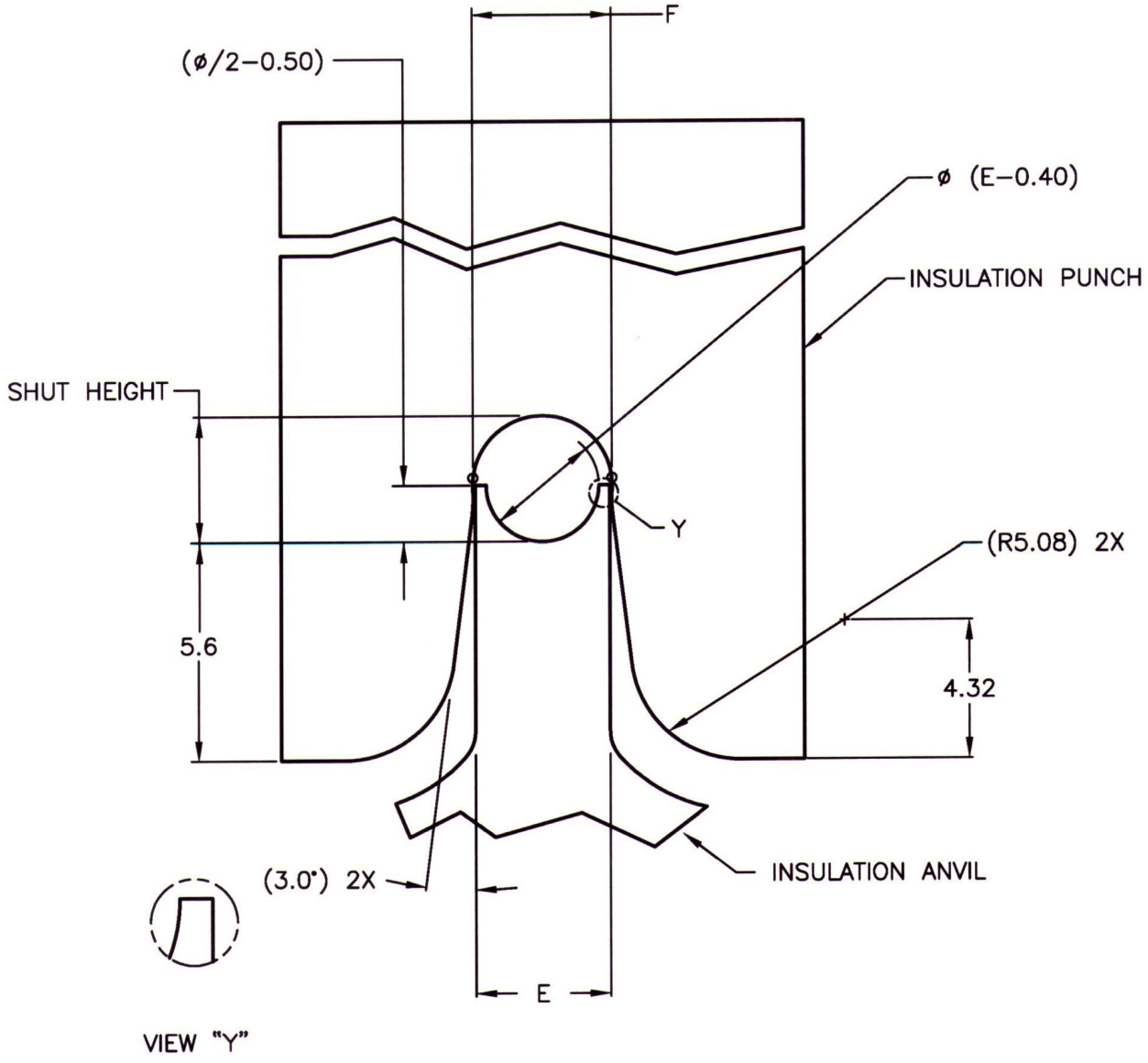


FIGURE 8
REV: C
3/99



SEE TOOLING TABLE 1 FOR DIMENSIONS

PUNCH AND ANVIL TOOLING DESIGN
FOR ROUND INSULATION ("O") CRIMP ONLY

FIGURE 9
REV: A
6/04

Tooling Table #1

These dimensions are for **building tooling only**.

Punch Shut Width	Shut Height	A	B	C	D	E	F
1.85	1.11	0.826	0.477	0.106	2.313	1.79	1.779
2.00	1.20	0.892	0.515	0.121	2.500	1.94	1.923
2.05	1.23	0.915	0.528	0.125	2.563	1.99	1.971
2.15	1.29	0.959	0.554	0.135	2.688	2.09	2.067
2.45	1.47	1.093	0.631	0.163	3.063	2.38	2.356
2.60	1.56	1.160	0.670	0.178	3.250	2.53	2.500
2.80	1.68	1.249	0.721	0.197	3.500	2.72	2.692
3.05	1.83	1.361	0.786	0.220	3.813	2.96	2.933
3.20	1.92	1.428	0.824	0.235	4.000	3.11	3.077
3.25	1.95	1.450	0.837	0.240	4.063	3.16	3.125
3.30	1.98	1.473	0.850	0.244	4.125	3.20	3.173
3.40	2.04	1.517	0.876	0.254	4.250	3.30	3.269
3.45	2.07	1.539	0.889	0.259	4.313	3.35	3.317
3.60	2.16	1.606	0.927	0.274	4.500	3.50	3.461
3.85	2.31	1.718	0.992	0.298	4.813	3.74	3.702
4.00	2.40	1.785	1.031	0.311	5.000	3.88	3.846
4.05	2.43	1.807	1.043	0.317	5.063	3.93	3.894
4.10	2.46	1.830	1.056	0.322	5.125	3.98	3.942
4.15	2.49	1.852	1.069	0.327	5.188	4.03	3.990
4.20	2.52	1.874	1.082	0.332	5.250	4.08	4.038
4.30	2.58	1.919	1.108	0.340	5.375	4.17	4.134
4.50	2.70	2.008	1.159	0.361	5.625	4.37	4.327

The lettered dimensions in the table above (A, B, C, etc…) correspond to the lettered dimensions on figures 2, 3, & 4.

All dimensions are in millimeters.

Revision List for 2.8 mm Apex Crimp Specification Guidelines

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Overall Document Version: 10.4, issued 5/11