

7.5.3 Bottom Only Chip Component Terminations Discrete chip components with bottom only terminations **shall** [D1D2D3] meet the dimensional and solder fillet requirements of Table 7-3, see Figure 7-3. The widths of the component and land are (W) and (P), respectively, and the termination overhang describes the condition whereby the smaller extends beyond the larger termination, i.e., (W) or (P). The length of the component termination is (R) and the length of the land is (S).

Criteria for tall profile components with bottom only terminations are in 7.5.12 Tall Profile Components Having Bottom Only Terminations.

Table 7-3 Dimensional Criteria – Bottom Only Chip Component Terminations

Feature	Dim.	Class 1	Class 2	Class 3
Maximum Side Overhang	A	50% (W) or 50% (P), whichever is less, Notes 1, 5		25% (W) or 25% (P), whichever is less, Notes 1, 5
End Overhang	B	Not permitted, Note 5		
Minimum End Joint Width	C	50% (W) or 50% (P), whichever is less, Note 4		75% (W) or 75% (P), whichever is less, Note 4
Minimum Side Joint Length	D	Note 3		
Maximum Fillet Height	E	Note 3		
Minimum Fillet Height	F	Note 3		
Solder Thickness	G	Note 3		
Minimum End Overlap	J	Note 3	50% (R)	75% (R)
Termination Length	R	Note 2		
Land Length	S	Note 2		
Land Width	P	Note 2		
Termination Width	W	Note 2		

- Note 1.** Does not violate minimum electrical clearance.
Note 2. Unspecified parameter or variable in size as determined by design.
Note 3. Wetting is evident.
Note 4. (C) is inspected at the narrowest point of the required fillet.
Note 5. As a function of the component design, the termination may not extend to the component edge, and the component body may overhang the printed board land area.

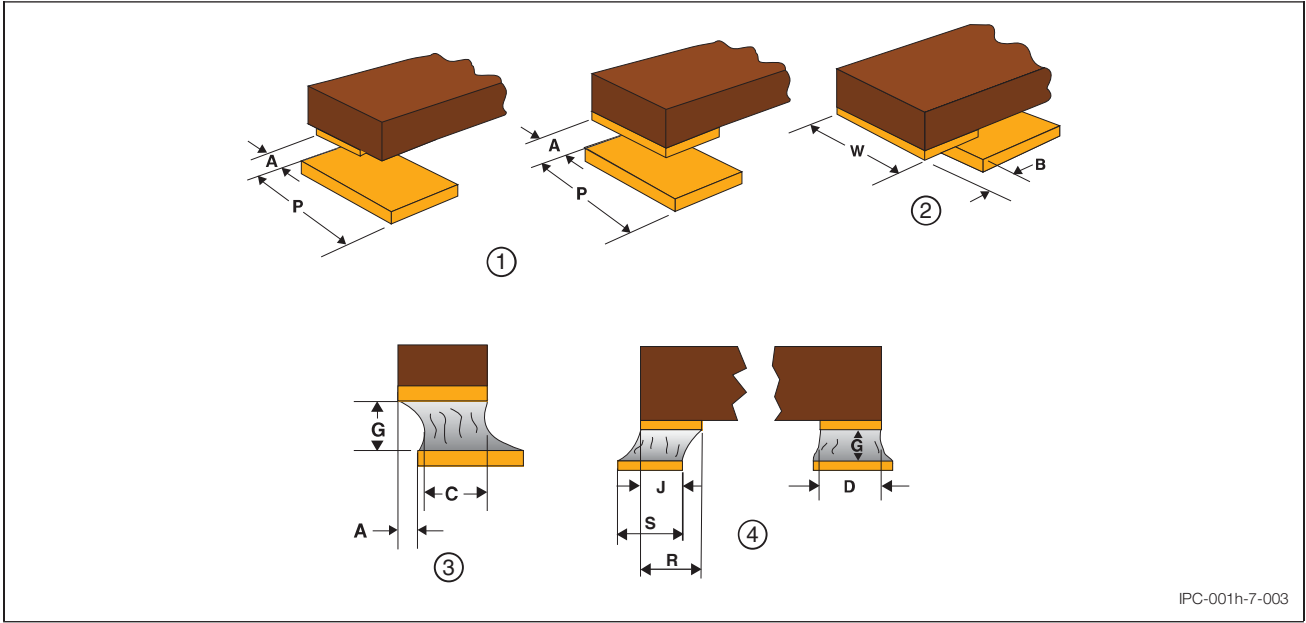


Figure 7-3 Bottom Only Terminations

- 1. Side overhang
- 2. End overhang
- 3. End joint width
- 4. Side joint length, end overlap

7.5.4 Rectangular or Square End Chip Components – 1, 2, 3 or 5 Side Termination(s) These criteria apply to component types such as chip resistor, chip capacitor, square end MELF, and network passive parts (R-NET, etc.) that have this type of termination. Solder connections to components having terminations of a square or rectangular configuration **shall [D1D2D3]** meet the dimensional and solder fillet requirements of Tables 7-4 and 7-4A, see Figures 7-4 and 7-4A. For one side termination, the solderable side is the vertical end face of the component.

Surface deposited electrical elements **shall [A1P2P3]** be mounted away from the board.

Table 7-4 Dimensional Criteria – Rectangular or Square End Chip Components – 1, 2, 3 or 5 Side Termination(s)

Feature	Dim.	Class 1	Class 2	Class 3
Maximum Side Overhang	A	50% (W) or 50% (P), whichever is less, Note 1		25% (W) or 25% (P), whichever is less, Note 1
End Overhang	B	Not permitted		
Minimum End Joint Width	C	50% (W) or 50% (P), whichever is less, Note 5		75% (W) or 75% (P), whichever is less, Note 5
Minimum Side Joint Length	D	Note 3		
Maximum Fillet Height	E	Note 4		
Minimum Fillet Height	F	Wetting is evident on the vertical surface(s) of the component termination		(G) + 25% (H) or (G) + 0.5 mm [0.02 in], whichever is less
Solder Thickness	G	Note 3		
Termination Height	H	Note 2		
Minimum End Overlap	J	Required		25% (R)
Width of Land	P	Note 2		
Termination Length	R	Note 2		
Termination Width	W	Note 2		
Side Mounting/Billboarding, Notes 6, 7				
Width to Height Ratio		Does not exceed 2:1		
End Cap and Land Wetting		100% wetting land to end metallization contact areas		
Minimum End Overlap	J	100%		
Maximum Side Overhang	A	Not permitted		
End Overhang	B	Not permitted		
Maximum Component Size		No limits		1206, Note 8

Note 1. Does not violate minimum electrical clearance.

Note 2. Unspecified parameter or variable in size as determined by design.

Note 3. Wetting is evident.

Note 4. The maximum fillet may overhang the land and/or extend onto the top or side metallization but does not touch the top or side of the component.

Note 5. (C) is inspected at the narrowest point of the required fillet.

Note 6. These criteria are for chip components that may flip (rotate) onto the narrow edge during assembly, and only apply to components with 3 or 5 side terminations.

Note 7. These criteria may not be acceptable for certain high frequency or high vibration applications.

Note 8. Component size may be larger than 1206 if the component is less than a 1.25:1 width to height ratio and has 5 termination faces.

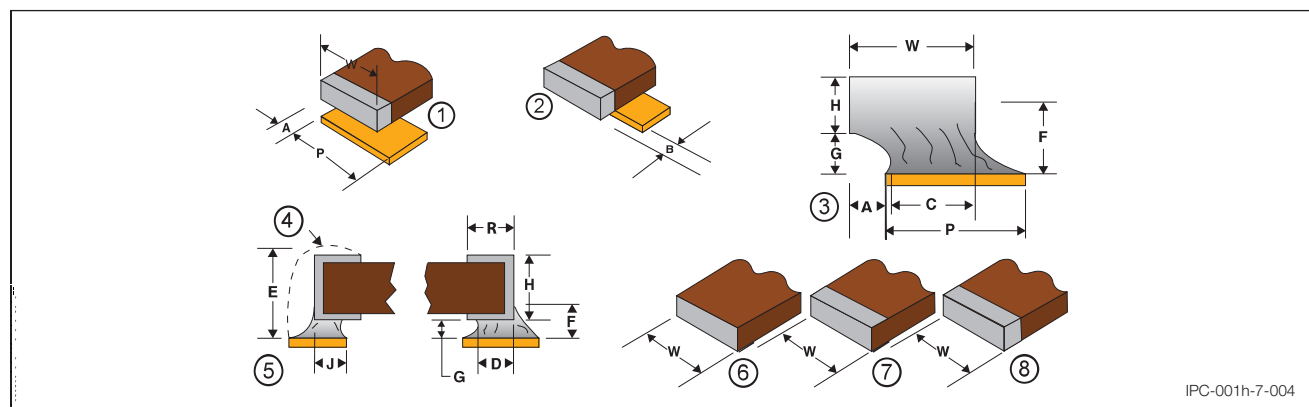


Figure 7-4 Rectangular or Square End Chip Components

1. Side overhang
2. End overhang

3. End joint width
4. See Note 4, Table 7-4

5. Side joint length, end overlap
6. One or two side termination

7. Three side termination
8. Five side termination

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Table 7-4A Dimensional Criteria – Center Termination (When Present) – Rectangular or Square End Chip Components – 1, 2, 3 or 5 Side Termination(s)

Feature	Dim.	Class 1	Class 2	Class 3
Maximum Side Overhang		50% (Cw) or 50% (Cp), whichever is less, Note 1		25% (Cw) or 25% (Cp), whichever is less
Minimum Side Joint Length		50% (Cw) or 50% (Cp), whichever is less, Note 5		75% (Cw) or 75% (Cp), whichever is less
Maximum Fillet Height		Note 4		
Minimum Fillet Height (F)	F	Note 3		
Solder Thickness	G	Note 3		
Termination Width	Cw	Note 2		
Termination Height	Ch	Note 2		
Land Width	Cp	Note 2		

Note 1. Does not violate minimum electrical clearance.

Note 2. Unspecified parameter or variable in size as determined by design.

Note 3. Wetting is evident.

Note 4. The maximum fillet may overhang the land and/or extend onto the top or side metallization but does not touch the top or side of the component.

Note 5. (C) is inspected at the narrowest point of the required fillet.

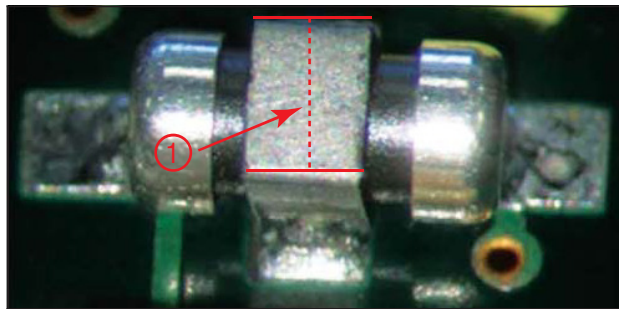


Figure 7-4A Rectangular or Square End Chip Components – 1, 2, 3 or 5 Side Termination(s) Center Termination (When Present)

1. Center Termination

7.5.5 Cylindrical End Cap Terminations This component is sometimes referred to as MELF (metal electrode leadless face). Solder connections to components having cylindrical end cap terminations **shall [D1D2D3]** meet the dimensional and solder fillet requirements of Tables 7-5 and 7-5A, see Figures 7-5 and 7-5A.

Table 7-5 Dimensional Criteria – Cylindrical End Cap Terminations

Feature	Dim.	Class 1	Class 2	Class 3
Maximum Side Overhang	A	25% (W) or 25% (P), whichever is less, Note 1		
End Overhang	B	Not permitted		
Minimum End Joint Width, Note 2	C	Note 4	50% (W) or 50% (P), whichever is less	
Minimum Side Joint Length	D	Note 4, 6	50% (R) or 50% (S), whichever is less, Note 6	75% (R) or 75% (S), whichever is less, Note 6
Maximum Fillet Height	E	Note 5		
Minimum Fillet Height (end and side)	F	Note 4		(G) + 25% (W) or (G) + 1.0 mm [0.04 in], whichever is less
Solder Thickness	G	Note 4		
Minimum End Overlap	J	Notes 4, 6	50% (R) Note 6	75% (R) Note 6
Land Width	P	Note 3		
Termination Length	R	Note 3		
Land Length	S	Note 3		
Termination Diameter	W	Note 3		

Note 1. Does not violate minimum electrical clearance.

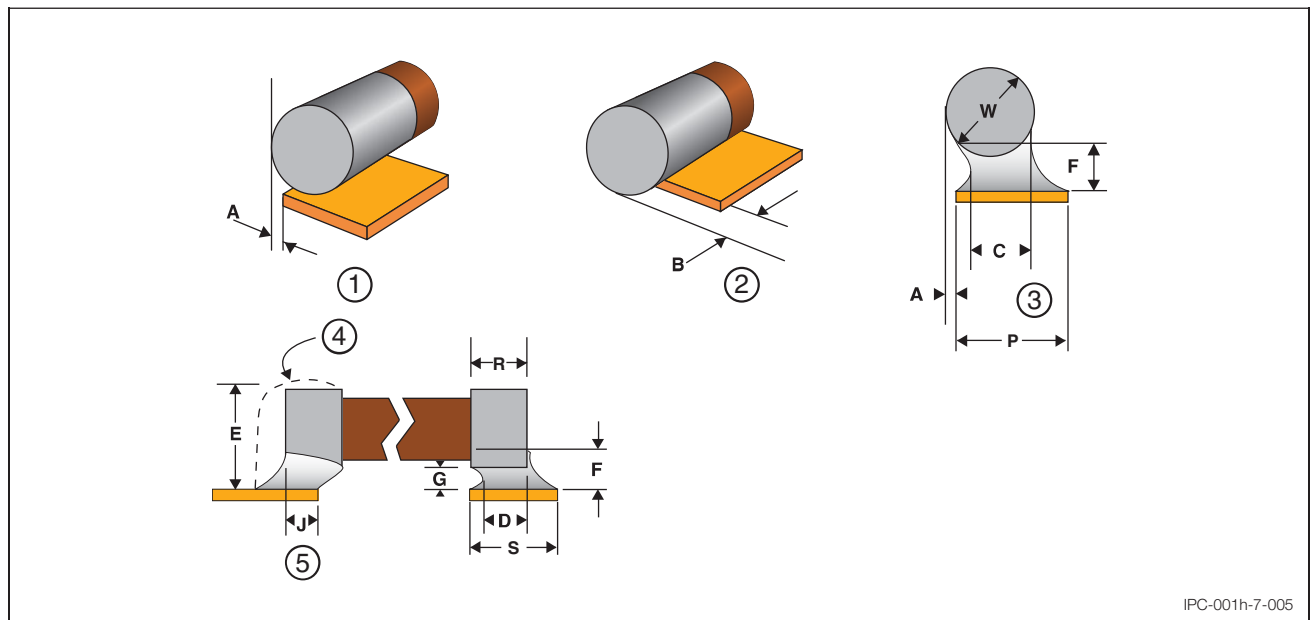
Note 2. (C) is inspected at the narrowest point of the required fillet.

Note 3. Unspecified parameter or variable in size as determined by design.

Note 4. Wetting is evident.

Note 5. The maximum fillet may overhang the land or extend onto the top metallization but does not touch the top of the component. Solder may touch the bottom half of the component body.

Note 6. Does not apply to components with end-only terminations.



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Figure 7-5 Cylindrical End Cap Terminations

1. Side overhang

2. End overhang

3. End joint width

4. See Note 5, Table 7-5

5. Side joint length and end overlap

**Table 7-5A Dimensional Criteria – Center Termination
(When Present) – Cylindrical End Cap Terminations**

Feature	Dim.	Class 1	Class 2	Class 3
Maximum Side Overhang		50% (Cw) or 50% (Cp), whichever is less, Note 1		25% (Cw) or 25% (Cp), whichever is less
Minimum Side Joint Length		50% (Cw) or 50% (Cp), whichever is less, Note 5		75% (Cw) or 75% (Cp), whichever is less
Maximum Fillet Height		Note 4		
Minimum Fillet Height (F)	F	Note 3		
Solder Thickness	G	Note 3		
Termination Width	Cw	Note 2		
Termination Height	Ch	Note 2		
Land Width	Cp	Note 2		

Note 1. Does not violate minimum electrical clearance.

Note 2. (C) is inspected at the narrowest point of the required fillet.

Note 3. Unspecified parameter or variable in size as determined by design.

Note 4. Wetting is evident.

Note 5. The maximum fillet may overhang the land or extend onto the top metallization but does not touch the top of the component. Solder may touch the bottom half of the component body.

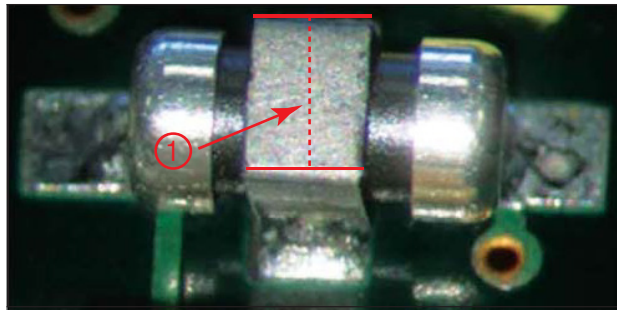


Figure 7-5A Cylindrical End Cap Terminations Center Termination (When Present)

1. Center Termination

7.5.6 Castellated Terminations Connections formed to castellated terminations shall [D1D2D3] meet the dimensional and solder fillet requirements of Table 7-6, see Figure 7-6.

Table 7-6 Dimensional Criteria – Castellated Terminations

Feature	Dim.	Class 1	Class 2	Class 3
Maximum Side Overhang	A	50% (W), Note 1		25% (W), Note 1
End Overhang	B	Not permitted		
Minimum End Joint Width	C	50% (W), Note 5		75% (W), Note 5
Minimum Side Joint Length	D	Note 3	Depth of castellation	
Maximum Fillet Height	E	Notes 1, 4		
Minimum Fillet Height	F	Note 3	(G) + 25% (H)	(G) + 50% (H)
Solder Thickness	G	Note 3		
Castellation Height	H	Note 2		
Land Length	S	Note 2		
Castellation Width	W	Note 2		

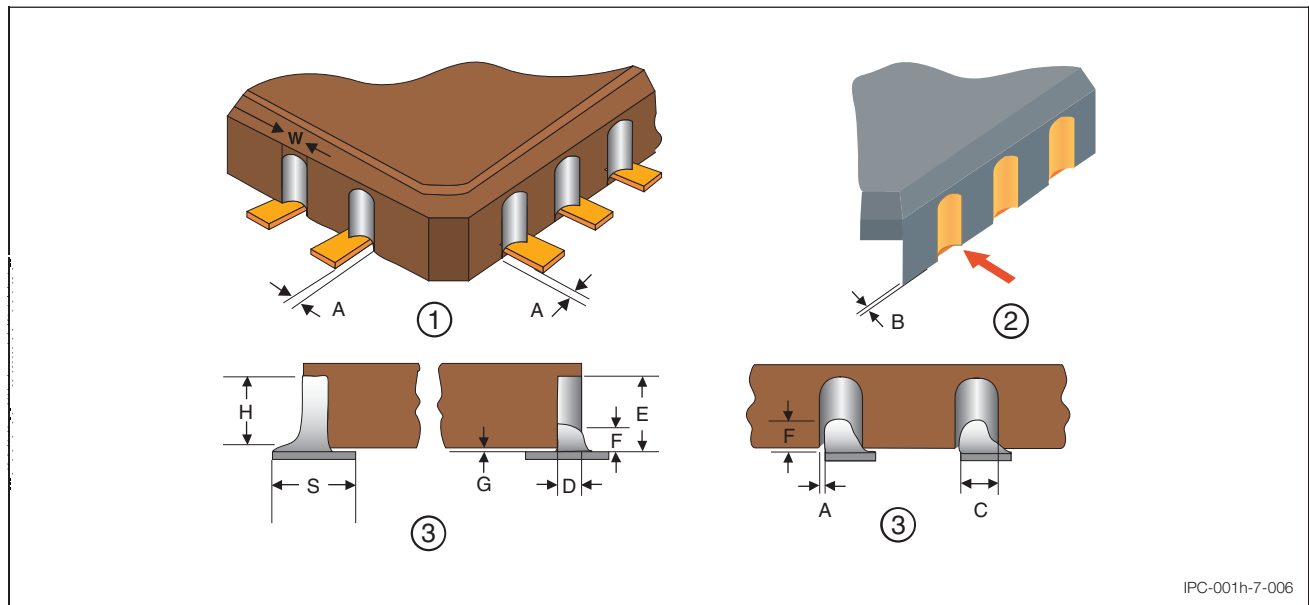
Note 1. Does not violate minimum electrical clearance.

Note 2. Unspecified parameter or variable in size as determined by design.

Note 3. Wetting is evident.

Note 4. The maximum fillet may extend past the top of the castellation if it does not contact the body.

Note 5. (C) is inspected at the narrowest point of the required fillet.



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Figure 7-6 Castellated Terminations

1. Side overhang
2. End overhang
3. Side overhang/end joint width

7.5.7 Flat Gull Wing Leads Connections formed to flat gull wing shaped leads **shall [D1D2D3]** meet the dimensional and solder fillet requirements of Table 7-7, see Figure 7-7.

Toe down is the formed condition of the foot where the heel and the toe are not planar to the board, with the toe biased downward. The angle can be from a few degrees up to 45 degrees, see Figure 7-7.

Table 7-7 Dimensional Criteria – Flat Gull Wing Leads

Feature		Dim.	Class 1	Class 2	Class 3
Maximum Side Overhang		A	50% (W) or 0.5 mm [0.02 in], whichever is less, Note 1		25% (W) or 0.5 mm [0.02 in], whichever is less, Note 1
Maximum Toe Overhang	when (L) is ≥ 3 (W)	B	Note 1	Note 1	
	when (L) is < 3 (W)			Not permitted when (L) is less than 1 (W), Note 1	
Minimum End Joint Width		C	50% (W), Note 6		75% (W), Note 6
Minimum Side Joint Length	when (L) is ≥ 3 (W)	D	1 (W) or 0.5 mm [0.02 in], whichever is less, Note 7	3 (W) or 75% (L), whichever is longer, Note 7	
	when (L) is < 3 (W)			100% (L), Note 7	
Maximum Heel Fillet Height		E	Note 4		
Minimum Heel Fillet Height		F	Note 3	(G) + 50% (T), Note 5	
Solder Thickness		G	Note 3		
Formed Foot Length		L	Note 2		
Lead Thickness		T	Note 2		
Lead Width		W	Note 2		

- Note 1.** Does not violate minimum electrical clearance.
Note 2. Unspecified parameter or variable in size as determined by design. When lead forming is required, see 7.1.2 Forming.
Note 3. Wetting is evident.
Note 4. Solder does not touch package body or end seal, see 7.1.1 Plastic Components for exceptions.
Note 5. In the case of a toe-down lead configuration, the Minimum Heel Fillet Height (F) extends at least to the mid-point of the outside lead bend.
Note 6. (C) is inspected at the narrowest point of the required fillet.
Note 7. If Side Overhang (A) is present, then the Side Joint Length (D) on the overhanging portion of the lead may not be inspectable.

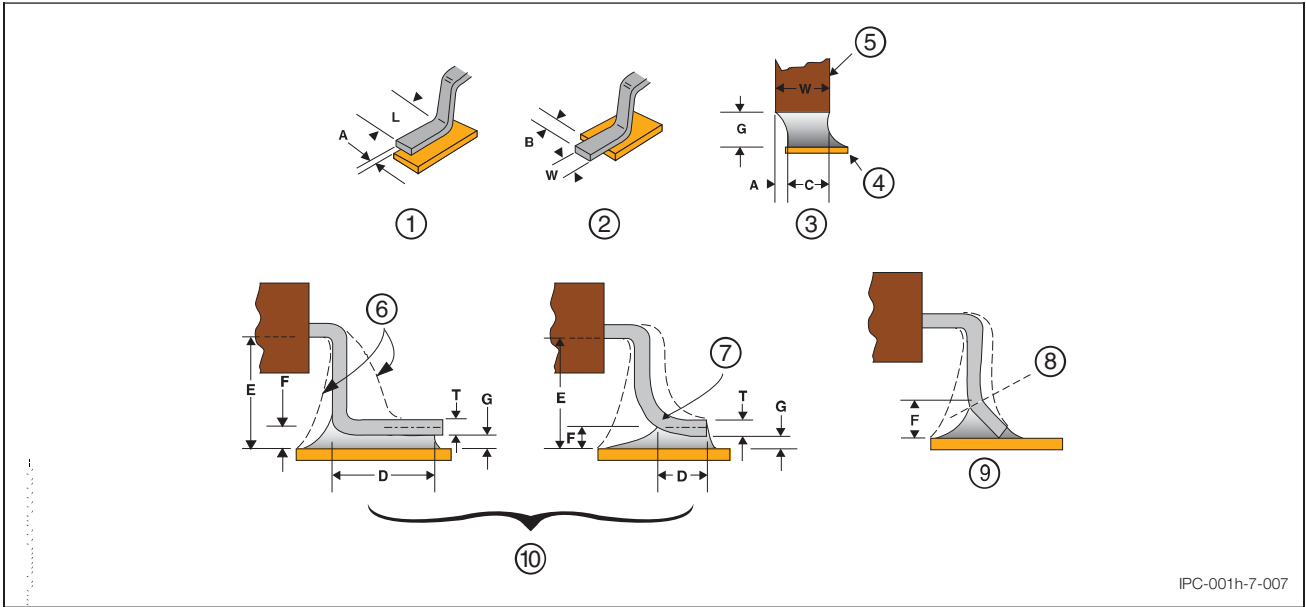


Figure 7-7 Flat Gull Wing Leads

- 1. Side overhang
- 2. Toe overhang
- 3. End joint width
- 4. Land
- 5. Lead
- 6. Solder fillet may extend through the top bend.
- 7. Center line of (T)
- 8. Line bisecting lower bend
- 9. Toe down heel fillet height
- 10. Side joint length

7.5.8 Round or Flattened (Coined) Gull Wing Leads Connections formed to round or flattened (coined) leads **shall** [D1D2D3] meet the dimensional and fillet requirements of Table 7-8, see Figure 7-8.

Table 7-8 Dimensional Criteria – Round or Flattened (Coined) Gull Wing Leads

Feature	Dim.	Class 1	Class 2	Class 3
Maximum Side Overhang	A	50% (W) or 0.5 mm [0.02 in], whichever is less, Note 1		25% (W) or 0.5 mm [0.02 in], whichever is less, Note 1
Maximum Toe Overhang	B	Not permitted when (L) is less than (W), Note 1		Not permitted when (L) is less than 1.5 (W), Note 1
Minimum End Joint Width	C	Note 3		75% (W)
Minimum Side Joint Length	D	100% (W), Note 6		150% (W), Note 6
Maximum Heel Fillet Height	E	Note 4		
Minimum Heel Fillet Height	F	Note 3	(G) + 50% (T), Note 5	
Solder Thickness	G	Note 3		
Formed Foot Length	L	Note 2		
Minimum Side Joint Height	Q	Note 3, 6	(G) + 50% (T), Note 6	
Thickness of Lead at Joint Side	T	Note 2		
Flattened Lead Width or Diameter of Round Lead	W	Note 2		

Note 1. Does not violate minimum electrical clearance.

Note 2. Unspecified parameter or variable in size as determined by design. When lead forming is required, see 7.1.2 Forming and/or 7.1.6 Flattened Leads.

Note 3. Wetting is evident.

Note 4. Solder does not touch package body or end seal, see 7.1.1 Plastic Components for exceptions.

Note 5. In the case of a toe-down lead configuration, the Minimum Heel Fillet Height (F) extends at least to the mid-point of the outside lead bend.

Note 6. A Side Fillet (and corresponding Dimensions (D) & (Q)) may not be inspectable on a side where acceptable Side Overhang (A) is present.

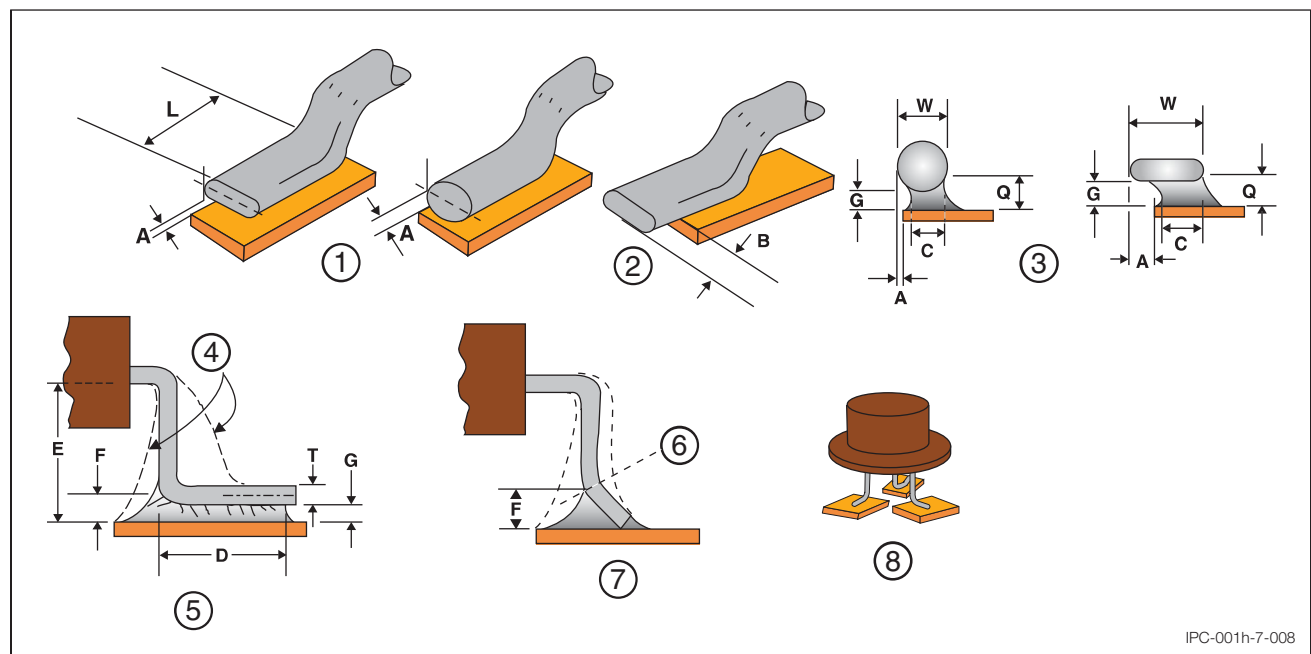


Figure 7-8 Round or Flattened (Coined) Gull Wing Leads

- | | |
|--|--------------------------------|
| 1. Side overhang | 5. Side joint length |
| 2. Toe overhang | 6. Line bisecting lower bend |
| 3. End joint width | 7. Toe down heel fillet height |
| 4. Maximum heel fillet height, Note 4 of Table 7-8 | 8. Other land configurations |

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7.5.9 J Lead Terminations Connections formed to leads having a “J” shape at the connection site **shall [D1D2D3]** meet the dimensional and fillet requirements of Table 7-9, see Figure 7-9.

Table 7-9 Dimensional Criteria – J Leads

Feature	Dim.	Class 1	Class 2	Class 3
Maximum Side Overhang	A	50% (W), Note 1		25% (W), Note 1
Maximum Toe Overhang	B	Note 1		
Minimum End Joint Width	C	50% (W), Note 5		75% (W), Note 5
Minimum Side Joint Length	D	Note 3	150% (W)	
Maximum Heel Fillet Height	E	Note 4		
Minimum Heel Fillet Height	F	(G) + 50% (T)		(G) + (T)
Solder Thickness	G	Note 3		
Lead Thickness	T	Note 2		
Lead Width	W	Note 2		

- Note 1.** Does not violate minimum electrical clearance.
Note 2. Unspecified parameter or variable in size as determined by design.
Note 3. Wetting is evident.
Note 4. Solder does not touch package body or end seal, see 7.1.1 Plastic Components for exceptions.
Note 5. (C) is inspected at the narrowest point of the required fillet.

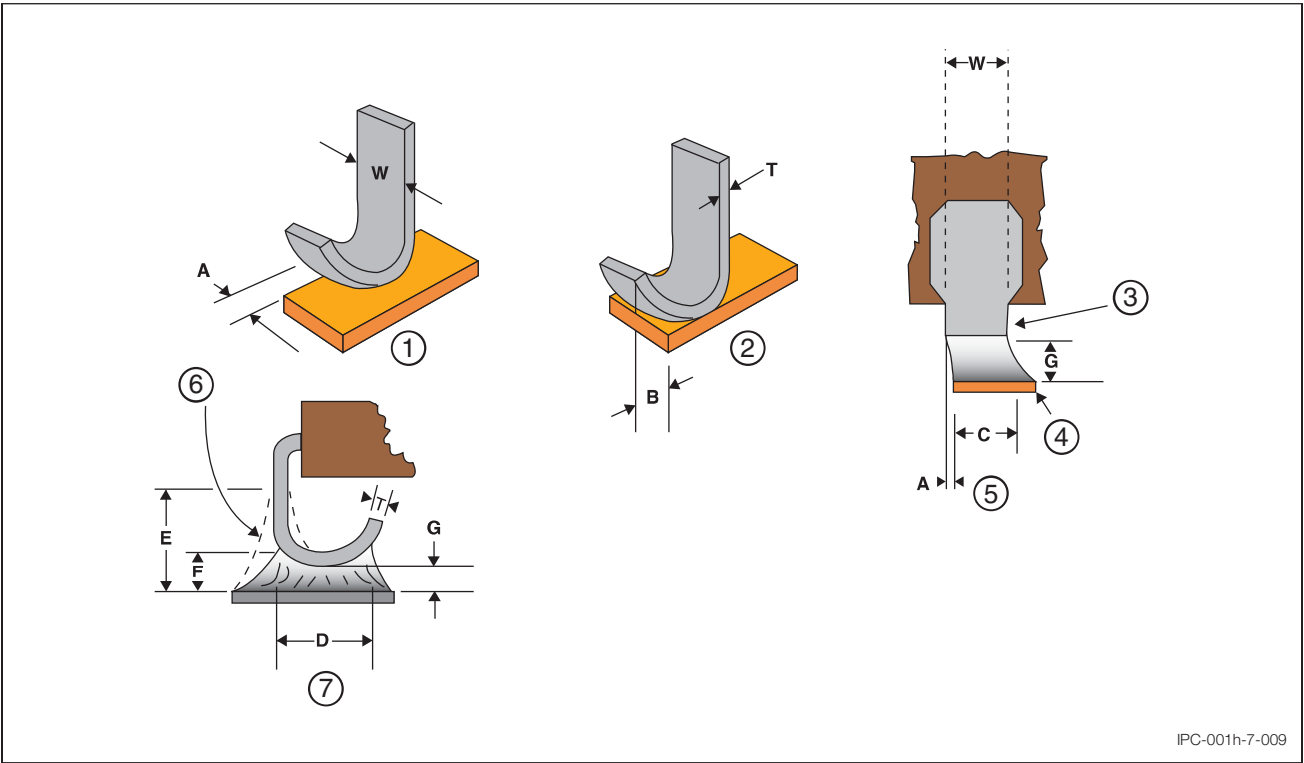


Figure 7-9 J Leads

1. Side overhang

2. Toe overhang

3. Lead

4. Land

5. End joint width

6. Maximum heel fillet height, Note 4, Table 7-9

7. Side joint length

7.5.10 Butt/I Terminations

7.5.10.1 Butt/I Terminations – Modified Through-Hole Terminations Components designed for pin-in-hole application and modified for butt connection attachment, or stiff-leaded dual-inline packages, e.g., Alloy 42, brazed or tempered leads, may be modified for use on Class 1 and 2 products but **shall not** [N1N2D3] be used on Class 3 products. Connections formed to leads positioned perpendicular to a circuit land in a butt/I configuration **shall** [D1D2D3] meet the dimensional and solder fillet requirements of Table 7-10, see Figure 7-10.

Table 7-10 Dimensional Criteria – Butt/I Connections

Feature	Dim.	Class 1	Class 2
Maximum Side Overhang	A	25% (W), Note 1	Not permitted
Toe Overhang	B	Not permitted	
Minimum End Joint Width	C	75% (W), Note 5	
Minimum Side Joint Length	D	Note 3	
Maximum Fillet Height	E	Note 4	
Minimum Fillet Height	F	0.5 mm [0.02 in]	
Solder Thickness	G	Note 3	
Lead Thickness	T	Note 2	
Lead Width	W	Note 2	

Note 1. Does not violate minimum electrical clearance.

Note 2. Unspecified parameter or variable in size as determined by design.

Note 3. Wetting is evident.

Note 4. Solder does not touch package body or end seal, see 7.1.1 Plastic Components for exceptions.

Note 5. (C) is inspected at the narrowest point of the required fillet.

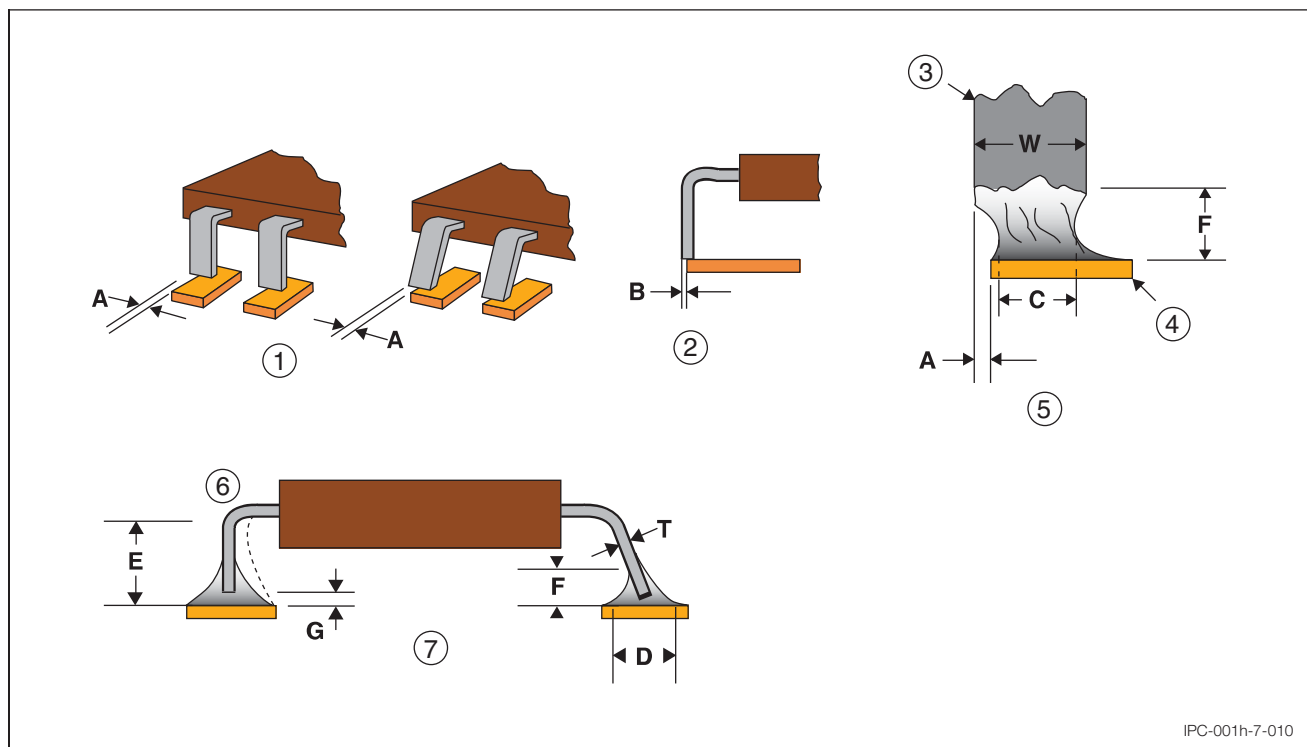


Figure 7-10 Butt/I Terminations for Modified Through-Hole Leads

1. Side overhang
2. Toe overhang
3. Lead
4. Land

5. End joint width
6. See Note 4, Table 7-10
7. Side joint length

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7.5.10.2 Butt/I Terminations – Solder Charged Terminations These criteria are for components designed with a hole or holes in the lead, a bump on the bottom to assure a good (G) fillet thickness across most of the bottom, and an attached solder slug to control the amount of solder. Connections formed to solder-charged leads positioned perpendicular to a circuit land in a butt/I configuration **shall [D1D2D3]** meet the dimensional and solder fillet requirements of Table 7-11, see Figure 7-11. The top hole of a solder charge termination with two holes is not required to be filled. Additional testing such as shock and vibration may be required depending on the end-use environment.

Table 7-11 Dimensional Criteria – Butt/I Terminations – Solder Charged Terminations

Feature	Dim.	Class 1	Class 2	Class 3
Lead Side Overhang	A	Not permitted		
Lead Toe Overhang	B	Not permitted		
Minimum End Joint Width	C	100% of (W), Note 2		
Minimum Fillet Height	F	Completely wets and fills bottom hole on the termination		
Lead Width	W	Note 1		
Land Width	P	Note 1		

Note 1. Unspecified parameter or variable in size as determined by design.

Note 2. (C) is inspected at the narrowest point of the required fillet.

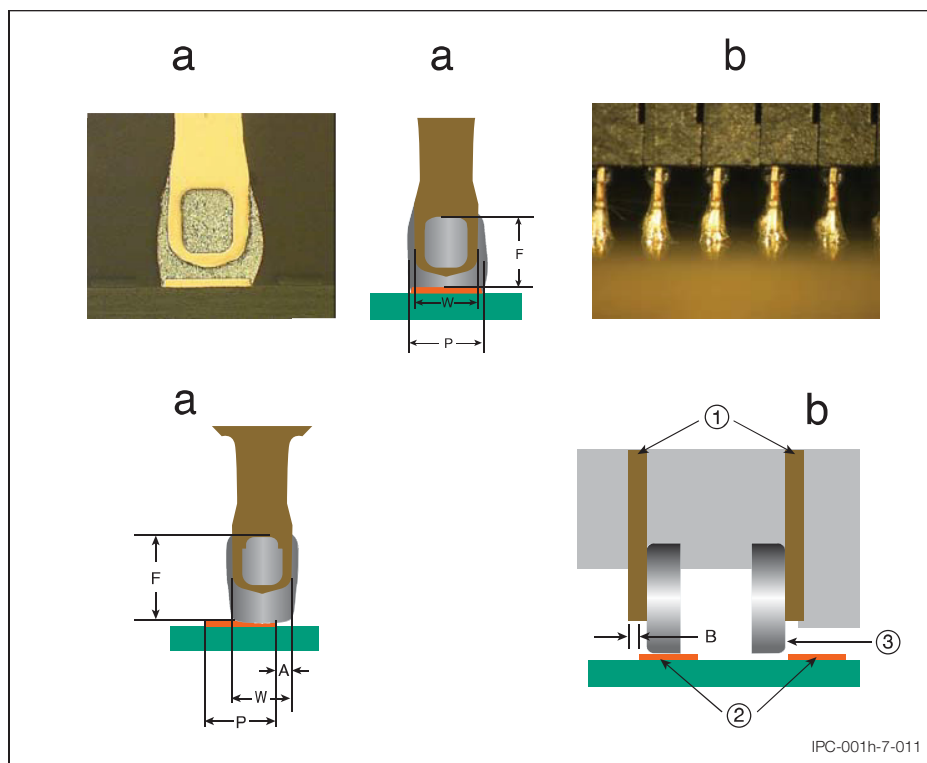


Figure 7-11 Butt/I Terminations for Solder Charged Leads

- | | |
|--------------------------------|---------------|
| 1. Connector lead | a. Side View |
| 2. Land | b. Front View |
| 3. Solder charge (solder slug) | |