



CRSI Standard on

Bend Diameters, Measuring Points and Fabrication Tolerances for Steel Reinforcing Bars

1. Scope

- 1.1. This Standard covers fabrication requirements for steel reinforcing bars for concrete reinforcement.
 - 1.1.1. This Standard applies to uncoated reinforcing bars conforming to the ASTM reinforcing-bar material standards listed in Section 4.2.1, including:
 - 1.1.1.1. ASTM A615 carbon-steel reinforcing bars, including Grade 40 where permitted by ASTM A615, and Grades 60, 80, and 100.
 - 1.1.1.2. ASTM A706 low-alloy reinforcing bars, Grades 60, 80, and 100.
 - 1.1.1.3. ASTM A955 stainless-steel reinforcing bars, Grades 60, 75, and 80.
 - 1.1.1.4. ASTM A996 rail-steel and axle-steel reinforcing bars, including rail-steel Grades 50 and 60 and axle-steel Grades 40 and 60.
 - 1.1.1.5. ASTM A1035 low-carbon, chromium steel reinforcing bars, Grades 100 and 120.
 - 1.1.2. This Standard also applies, where specified, to coated reinforcing bars conforming to the ASTM coating/product standards listed in Section 4.2.2, including ASTM A767, ASTM A1094, ASTM A775, ASTM A934, ASTM A1124, and ASTM A1055.
- 1.2. Fabrication of epoxy-coated steel reinforcing bars must also comply with the requirements provided by ANSI/CRSI Standard CG2.1, *Epoxy-Coated Steel Reinforcing Bar Fabrication Facilities*.
- 1.3. Fabrication of stainless-steel reinforcing bars must also comply with the requirements provided by ANSI/CRSI Standard IPG4.1, *Stainless Steel Reinforcing Bar Fabrication Facilities*.
- 1.4. This Standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.



- 1.5. The text of this Standard references notes and footnotes, which provide explanatory material. These notes and footnotes (excluding those in tables) shall not be considered as requirements of this Standard.
- 1.6. The figures shown in this Standard are illustrative and do not represent all possible conditions.

2. Keywords

- 2.1. fabrication, shop fabrication, steel reinforcing bars, bend diameters, standard hooks, bend test diameter, minimum bend diameter, finished bend diameter, bending pins, measuring points, tolerances, bend curvature, typical fabrication, special fabrication, inspection, finished bent bars.

3. Definitions

- 3.1. Finished bend diameter—the inside bend diameter measured after the bar is bent around a pin, including spring-back.
- 3.2. Special fabrication—fabrication tolerances tighter than those in accordance with Section 12 of this Standard.
- 3.3. Typical fabrication—fabrication tolerances in accordance with Section 12 of this Standard.

4. Referenced Standards and Documents

- 4.1. American Concrete Institute (ACI)
 - 4.1.1. ACI CODE-318-25: Building Code for Structural Concrete—Code Requirements and Commentary
 - 4.1.2. ACI SPEC-117-10: Specification for Tolerances for Concrete Construction and Materials (ACI 117-10) and Commentary-Reapproved 2015
- 4.2. ASTM International (ASTM)
 - 4.2.1. Reinforcing Bar Material Standards
 - 4.2.1.1. ASTM A615
 - 4.2.1.2. ASTM A706
 - 4.2.1.3. ASTM A955



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- 4.2.1.4. ASTM A996
- 4.2.1.5. ASTM A1035
- 4.2.2. Coated / Specialty Reinforcing Bar Product Standards
 - 4.2.2.1. ASTM A767
 - 4.2.2.2. ASTM A1094
 - 4.2.2.3. ASTM A775
 - 4.2.2.4. ASTM A934
 - 4.2.2.5. ASTM A1124
 - 4.2.2.6. ASTM A1055
- 4.3. Concrete Reinforcing Steel Institute (CRSI)
 - 4.3.1. Manual of Standard Practice, 31st Edition
 - 4.3.2. ANSI/CRSI CG2.1, Epoxy-Coated Steel Reinforcing Bar Fabrication Facilities
 - 4.3.3. ANSI/CRSI IPG4.1, Stainless Steel Reinforcing Bar Fabrication Facilities

5. Typical Bend Shapes

- 5.1. Typical bend shapes for reinforcing bars shall be in accordance with CRSI Manual of Standard Practice Section 7.2.

6. Leg Names and Dimensions for Bend Shapes

- 6.1. Leg names and dimensions for bend shapes of reinforcing bars shall be in accordance with CRSI Manual of Standard Practice Section 7.3.5.

7. ACI Standard Hooks

- 7.1. ACI standard hooks are designated on bend shapes with leg names "A" and/or "G".
- 7.2. ACI standard hooks shall be fabricated in accordance with Sections 7.2.1 and 7.2.2 of this Standard.
 - 7.2.1. Standard hook geometry
 - 7.2.1.1. Minimum inside bend diameters and hook geometry for 90-degree hooks and 180-degree hooks are defined in ACI 318 Section 25.3.1.
 - 7.2.1.1.1. Dimensions for 90-degree and 180-degree standard hooks, including finished bend diameters, for uncoated reinforcing bars and for all coated reinforcing bars except ASTM A767



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galvanized reinforcing bars, shall be in accordance with Table 7-1 of this Standard.

7.2.1.1.2. Dimensions for 90-degree and 180-degree standard hooks for reinforcing bars galvanized in accordance with ASTM A767 shall be in accordance with Table 7-2 of this Standard.

7.2.2. Stirrup, tie, and hoop hook geometry

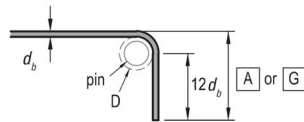
7.2.2.1. Minimum inside bend diameters and hook geometry for 90-degree hooks, 135-degree hooks, and 180-degree hooks are defined in ACI 318 Section 25.3.2.

7.2.2.1.1. Dimensions for 90-degree, 135-degree, and 180-degree hooks for stirrups, ties, and hoops, including finished bend diameters, for uncoated reinforcing bars and for all coated reinforcing bars except ASTM A767 galvanized reinforcing bars, shall be in accordance with Table 7-3 of this Standard.

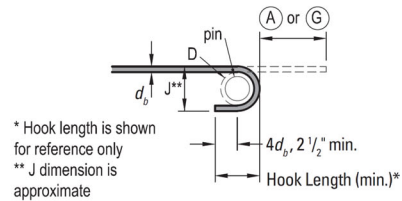
7.2.2.1.2. Dimensions for 90-degree, 135-degree, and 180-degree hooks for stirrups, ties, and hoops for reinforcing bars galvanized in accordance with ASTM A767 shall be in accordance with Table 7-4 of this Standard.

Table 7-1 Dimensions for Standard Hooks

Bar Size	D (in.)	90°	180°		
		A or G (ft-in.)	A or G (ft-in.)	J** (ft-in.)	Hook Length* (ft-in.)
#3	2 ¹ / ₄	0–6	0–5	0–3	0–4
#4	3	0–8	0–6	0–4	0–4 ¹ / ₂
#5	3 ³ / ₄	0–10	0–7	0–5	0–5
#6	4 ¹ / ₂	1–0	0–8	0–6	0–6
#7	5 ¹ / ₄	1–2	0–10	0–7	0–7
#8	6	1–4	0–11	0–8	0–8
#9	9 ¹ / ₂	1–7	1–3	0–11 ³ / ₄	0–10 ¹ / ₂
#10	10 ³ / ₄	1–10	1–5	1–1 ¹ / ₄	0–11 ³ / ₄
#11	12	2–0	1–7	1–2 ³ / ₄	1–1
#14	18 ¹ / ₄	2–7	2–3	1–9 ³ / ₄	1–5 ¹ / ₂
#18	24	3–5	3–0	2–4 ¹ / ₂	1–11 ¹ / ₄



Standard 90° Hooks



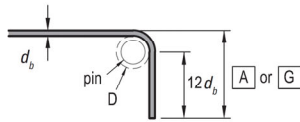
Standard 180° Hooks

Notes:

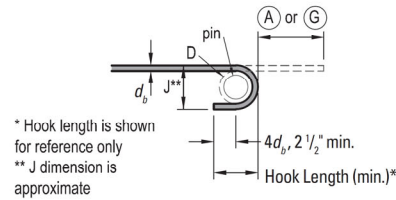
1. D = Finished bend diameter
2. All coated reinforcing bars except ASTM A767 galvanized reinforcing bars
3. For reinforcing bars that are not subject to ASTM A767 special galvanized finished-bend requirements, the finished bend diameters and hook dimensions published in this Standard shall apply to all applicable grades covered by the referenced ASTM bar specifications, including ASTM A615 Grade 100, ASTM A706 Grade 100, and ASTM A1035 Grades 100 and 120.
4. Due to potential safety concerns with shop fabrication, CRSI does not recommend bending reinforcing bars larger than #11 with a grade designation of Grade 75 or higher.
5. A or G dimensions for 180° hooks shown in Table 7-1 are **minimum** allowable lengths. Not all bend tooling can safely produce bends with these minimum A or G dimensions. For safety reasons, it is acceptable for A or G dimensions and hook lengths to be longer than values shown in the Table.

Table 7-2 Dimensions for Standard Hooks – ASTM A767 Galvanized¹

Bar Size	D (in.)	90°	180°		
		A or G (ft-in.)	A or G (ft-in.)	J** (ft-in.)	Hook Length* (ft-in.)
#3	2 ¹ / ₄	0–6	0–5	0–3	0–4
#4	3	0–8	0–6	0–4	0–4 ¹ / ₂
#5	3 ³ / ₄	0–10	0–7	0–5	0–5
#6	4 ¹ / ₂	1–0	0–8	0–6	0–6
#7	7	1–3	1–0	0–8 ³ / ₄	0–8
#8	8	1–5	1–2	0–10	0–9
#9	9 ¹ / ₂	1–7	1–3	0–11 ³ / ₄	0–10 ¹ / ₂
#10	10 ³ / ₄	1–10	1–5	1–1 ¹ / ₄	0–11 ³ / ₄
#11	12	2–0	1–7	1–2 ³ / ₄	1–1
#14	18 ¹ / ₄	2–7	2–3	1–9 ³ / ₄	1–5 ¹ / ₂
#18	24	3–5	3–0	2–4 ¹ / ₂	1–11 ¹ / ₄



Standard 90° Hooks



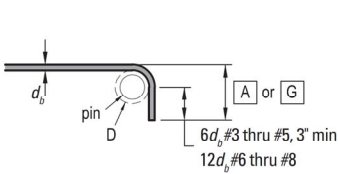
Standard 180° Hooks

Notes:

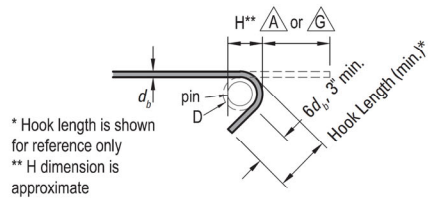
1. Bend diameters larger than ACI 318 Code are shown in blue shading.
2. D = Finished bend diameter
3. ASTM A767 galvanized reinforcing bars only
4. Due to potential safety concerns with shop fabrication, CRSI does not recommend bending reinforcing bars larger than #11 with a grade designation of Grade 75 or higher.
5. A or G dimensions for 180° hooks shown in Table 7-2 are **minimum** allowable lengths. Not all bend tooling can safely produce bends with these minimum A or G dimensions. For safety reasons, it is acceptable for A or G dimensions and hook lengths to be longer than values shown in the Table.
6. Tables 7-2, 7-4, and 8-2 apply only to reinforcing bars galvanized in accordance with ASTM A767. ASTM A767 does not cover ASTM A1035 bars; therefore, ASTM A1035 Grade 100 and Grade 120 bars are not applicable to Tables 7-2, 7-4, and 8-2.

Table 7-3 Dimensions for Stirrup, Tie, and Hoop Hooks

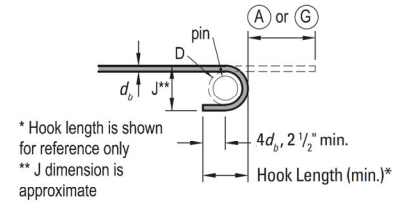
Bar Size	D (in.)	90°	135°			180°		
		A or G (ft-in.)	A or G (in.)	H** (in.)	Hook Length* (in.)	A or G (in.)	J** (in.)	Hook Length* (in.)
#3	2	4 $\frac{1}{2}$	4 $\frac{1}{2}$	2 $\frac{3}{4}$	4 $\frac{1}{4}$	5	2 $\frac{3}{4}$	3 $\frac{3}{4}$
#4	2 $\frac{1}{2}$	4 $\frac{3}{4}$	5	3	4 $\frac{3}{4}$	5 $\frac{1}{2}$	3 $\frac{1}{2}$	4 $\frac{1}{4}$
#5	3 $\frac{1}{4}$	6	6	3 $\frac{3}{4}$	6	6 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{3}{4}$
#6	4 $\frac{1}{2}$	1-0	8	4 $\frac{1}{2}$	7 $\frac{3}{4}$	8	6	6
#7	5 $\frac{1}{4}$	1-2	9	5 $\frac{1}{4}$	8 $\frac{3}{4}$	10	7	7
#8	6	1-4	10 $\frac{1}{2}$	6	10	11	8	8



90° Stirrup/Tie Hooks



135° Stirrup/Tie Hooks



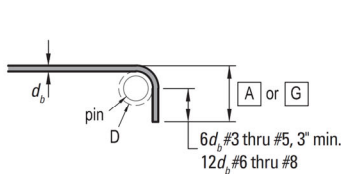
180° Stirrup/Tie Hooks

Notes:

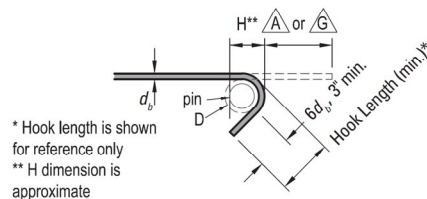
1. D = Finished bend diameter
2. All coated reinforcing bars except ASTM A767 galvanized reinforcing bars.
3. A or G dimensions for 180° hooks shown in Table 7-3 are **minimum** allowable lengths. Not all bend tooling can safely produce bends with these minimum A or G dimensions. For safety reasons, it is acceptable for A or G dimensions and hook lengths to be longer than values shown in the Table.
4. For reinforcing bars that are not subject to ASTM A767 special galvanized finished-bend requirements, the finished bend diameters and hook dimensions published in this Standard shall apply to all applicable grades covered by the referenced ASTM bar specifications, including ASTM A615 Grade 100, ASTM A706 Grade 100, and ASTM A1035 Grades 100 and 120.

Table 7-4 Dimensions for Stirrup, Tie, and Hoop Hooks – ASTM A767 Galvanized¹

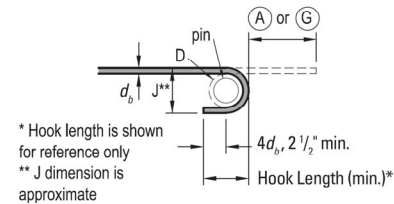
Bar Size	D (in.)	90°	135°			180°		
		A or G (ft-in.)	A or G (in.)	H** (in.)	Hook Length* (in.)	A or G (in.)	J** (in.)	Hook Length* (in.)
#3	2 ¹ / ₄	0–4 ¹ / ₂	4 ¹ / ₂	2 ³ / ₄	4 ¹ / ₂	5 ¹ / ₄	3	4
#4	3	0–5	5	3	5	6	4	4 ¹ / ₂
#5	3 ³ / ₄	0–6 ¹ / ₄	6 ¹ / ₂	3 ³ / ₄	6 ¹ / ₄	7	5	5
#6	4 ¹ / ₂	1–0	8	4 ¹ / ₂	7 ³ / ₄	8 ¹ / ₄	6	6
#7	7	1–3	10	5 ¹ / ₂	9 ³ / ₄	1–0	8 ³ / ₄	8
#8	8	1–5	11 ¹ / ₂	6 ¹ / ₂	11	1–2	10	9



90° Stirrup/Tie Hooks



135° Stirrup/Tie Hooks



180° Stirrup/Tie Hooks

Notes:

1. Bend diameters larger than ACI 318 Code are shown in blue shading.
2. D = Finished bend diameter
3. ASTM A767 galvanized reinforcing bars only
4. Due to potential safety concerns with shop fabrication, CRSI does not recommend bending reinforcing bars larger than #11 with a grade designation of Grade 75 or higher.
5. A or G dimensions for 180° hooks shown in Table 7-4 are **minimum** allowable lengths. Not all bend tooling can safely produce bends with these minimum A or G dimensions. For safety reasons, it is acceptable for A or G dimensions and hook lengths to be longer than values shown in the Table.
6. Tables 7-2, 7-4, and 8-2 apply only to reinforcing bars galvanized in accordance with ASTM A767. ASTM A767 does not cover ASTM A1035 bars; therefore, ASTM A1035 Grade 100 and Grade 120 bars are not applicable to Tables 7-2, 7-4, and 8-2.

8. Finished Bend Diameter

8.1. Finished bend diameter is the inside bend diameter measured after the bar is bent around a pin, including spring-back. Finished bend diameter is not the pin diameter around which the bar was bent.

8.2. Finished bend diameter shall be equal to or larger than the minimum bend diameter specified by ACI 318 in accordance with the following sections:

8.2.1. Section 25.3.1 for standard bend shapes and special bend shapes as well as 90-degree and 180-degree standard hooks.

8.2.2. Section 25.3.2 for stirrup and tie bend shapes, and special bend shapes, as well as 90-degree, 135-degree and 180-degree standard hooks for stirrups, ties, and hoops.



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8.3. Finished bend diameters:

8.3.1. Finished bend diameters shall be in accordance with Table 8-1 for uncoated reinforcing bars and for all coated reinforcing bars except ASTM A767 galvanized reinforcing bars.

8.3.2. Finished bend diameters shall be in accordance with Table 8-2 for reinforcing bars galvanized in accordance with ASTM A767.

Table 8-1 Minimum Inside Bend Diameters and Finished Bend Diameters¹

Bar Size	Nominal Diameter	Minimum Inside Bend Diameter				Finished Bend Diameter	
		ACI 318 Code				CRSI Manual of Standard Practice	
		Standard		Stirrup/Tie		Standard	Stirrup/Tie
value	inches	bar dia.	inches	bar dia.	inches	inches	inches
#3	0.375	6	2.25	4	1.50	2.25	2.00
#4	0.500	6	3.00	4	2.00	3.00	2.50
#5	0.625	6	3.75	4	2.50	3.75	3.25
#6	0.750	6	4.50	6	4.50	4.50	4.50
#7	0.875	6	5.25	6	5.25	5.25	5.25
#8	1.000	6	6.00	6	6.00	6.00	6.00
#9	1.128	8	9.024	—	—	9.50	—
#10	1.270	8	10.16	—	—	10.75	—
#11	1.410	8	11.28	—	—	12.00	—
#14	1.693	10	16.93	—	—	18.25	—
#18	2.257	10	22.57	—	—	24.00	—

Notes:

1. Bend diameters larger than ACI 318 Code are shown in blue shading.
2. For reinforcing bars that are not subject to ASTM A767 special galvanized finished-bend requirements, the finished bend diameters and hook dimensions published in this Standard shall apply to all applicable grades covered by the referenced ASTM bar specifications, including ASTM A615 Grade 100, ASTM A706 Grade 100, and ASTM A1035 Grades 100 and 120.



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Table 8-2 Minimum Finished Bend Diameters for Reinforcing Bars That Are Galvanized in Accordance with ASTM A767¹

Bar Size	Nominal Diameter	Standard		Stirrup/Tie	
		bar diameter	inches	bar diameter	inches
#3	0.375	6	2.25	6	2.25
#4	0.500	6	3.00	6	3.00
#5	0.625	6	3.75	6	3.75
#6	0.750	6	4.50	6	4.50
#7	0.875	8	7.00	8	7.00
#8	1.000	8	8.00	8	8.00
#9	1.128	8	9.024	—	—
#10	1.270	8	10.16	—	—
#11	1.410	8	11.28	—	—
#14	1.693	10	16.93	—	—
#18	2.257	10	22.57	—	—

Notes:

1. Bend diameters larger than ACI 318 Code are shown in blue shading.
2. This is the only ASTM specification that defines a minimum finished bend diameter for each bar size. All other specifications define the pin size for bend tests. Based on the values contained in ASTM A767, the standard hooks for certain bar sizes of galvanized bars are different than uncoated bars.
3. ASTM A1094 continuous hot-dip galvanized reinforcing bars follow the bend requirements of the substrate reinforcing bar specification and do not require the larger finished bend diameters prescribed by ASTM A767.
4. Tables 7-2, 7-4, and 8-2 apply only to reinforcing bars galvanized in accordance with ASTM A767. ASTM A767 does not cover ASTM A1035 bars; therefore, ASTM A1035 Grade 100 and Grade 120 bars are not applicable to Tables 7-2, 7-4, and 8-2.

9. Bending Pins

- 9.1. The diameter of bending pins used for fabrication shall be equal to or larger than the pin diameter specified for qualification to the applicable ASTM standard to ensure the bending operations are compliant with the applicable ASTM specification and do not damage the reinforcing bars during fabrication.

10. Dimensions

- 10.1. All dimensions related to fabrication of reinforcing bars and inspection of finished bent bars shall be measured out-to-out of bar except for the cases in Sections 10.1.1 and 10.1.2.
- 10.1.1. “A” and “G” legs on standard 180-degree hooks.
- 10.1.2. “A” and “G” legs on standard 135-degree hooks.

10.2. All placing drawings, bar-lists and/or bill-of-materials shall report out-to-out dimensions.

11. Measuring points

- 11.1. Measuring points shall be used for both fabrication of reinforcing bars and inspection of finished bent bars.
- 11.2. Measuring points are described for bend conditions, not individual bend shapes, and are to be applied to both typical bend shapes and special bend shapes.
- 11.3. Measuring points shall be in accordance with Figures 1, 2, and 3.

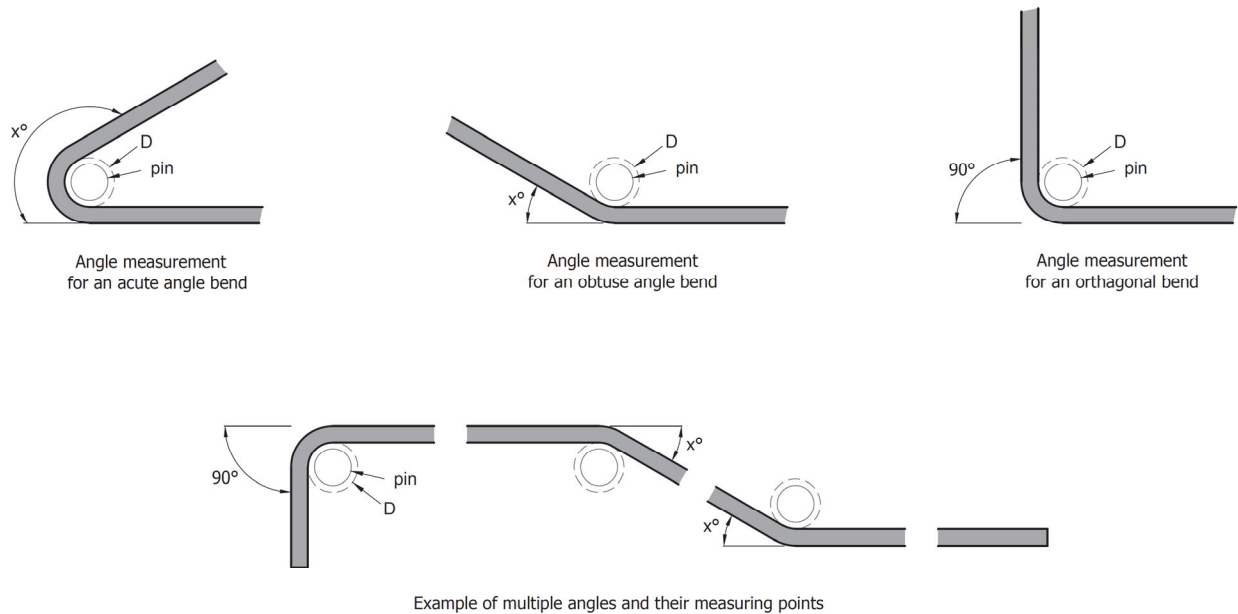


Figure 1. Measuring points for fabrication and inspection of reinforcing bars

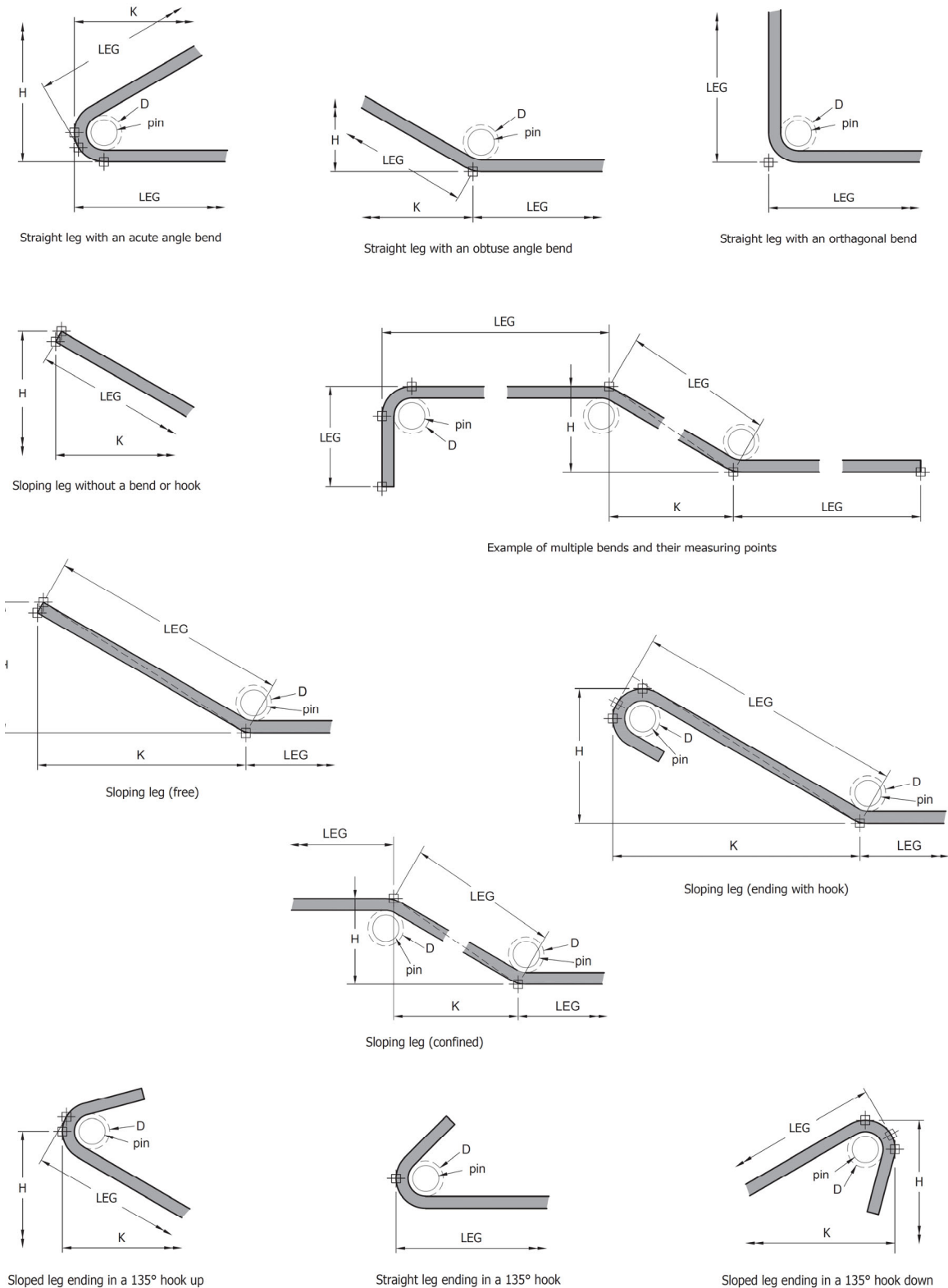


Figure 2. Measuring points for fabrication and inspection of reinforcing bars

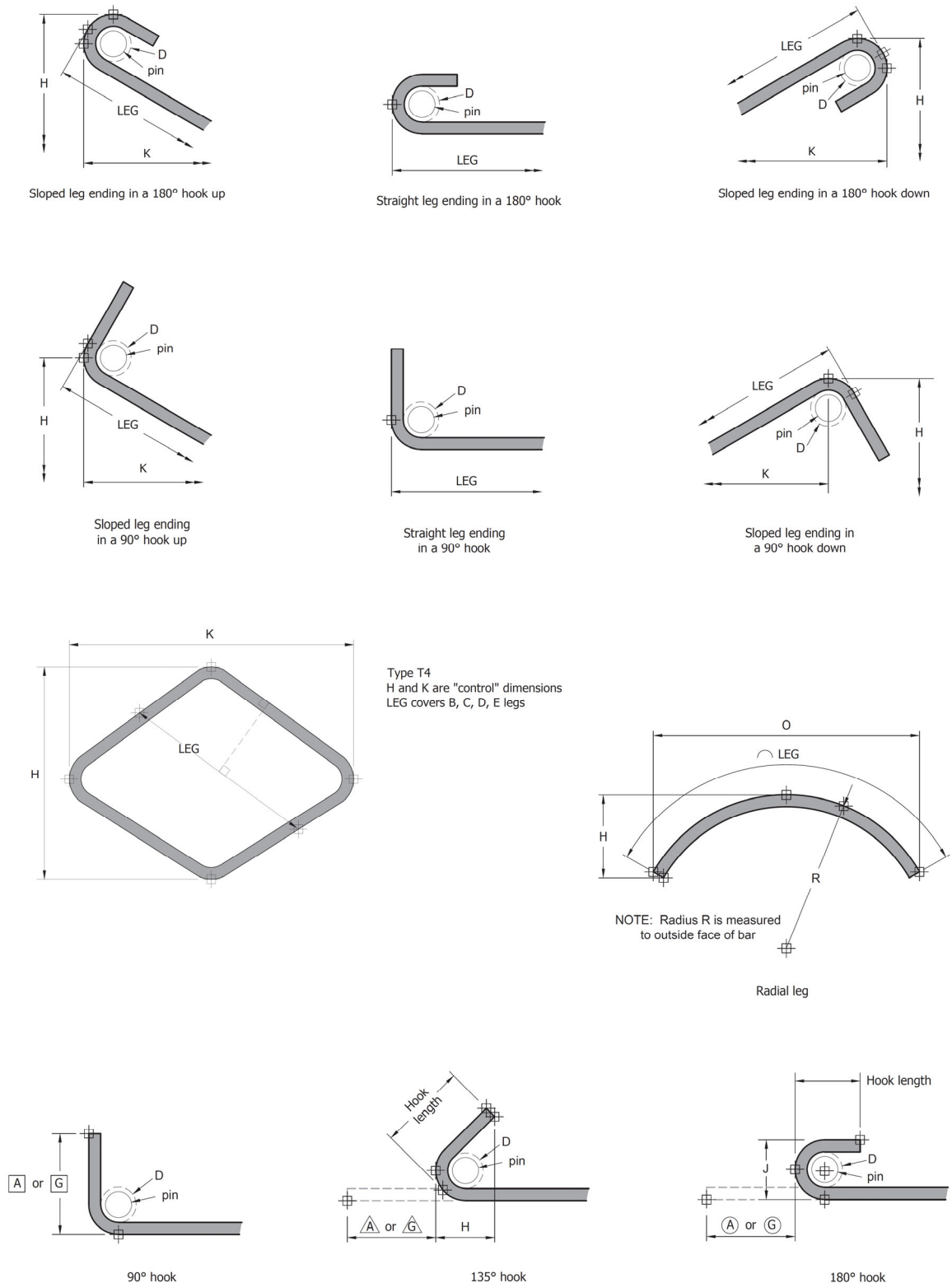


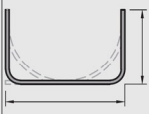
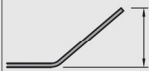
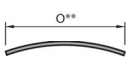
Figure 3. Measuring points for fabrication and inspection of reinforcing bars



12. Standard Fabrication Tolerances

- 12.1. Standard fabrication tolerances permitted for leg lengths and dimensions of finished bent bars are provided in Sections 12.2, 12.3, 12.4, and 12.5.
- 12.2. Tolerances for standard pin bending shall comply with Tables 12-1a and 12-1b.
- 12.3. Tolerances for stirrup/tie pin bending shall comply with Tables 12-2a and 12-2b.
- 12.4. Tolerances for round spirals shall comply with Table 12-3a.
 - 12.4.1. The tolerances that are shown in Table 12-3a are for fabricated round spiral reinforcing steel only and should not be used to measure final field tolerance for an assembled unit. The final tolerance for the diameter of an assembled unit is $\pm \frac{1}{2}$ in. for a diameter ≤ 30 in. and ± 1 in. for a diameter > 30 in.
- 12.5. Tolerances for square spirals shall comply with Table 12-3b.
 - 12.5.1. The tolerances that are shown in Table 12-3b are for fabricated square spiral reinforcing steel and are also used to measure final field tolerance for an assembled unit.
- 12.6. All tolerances shown are single plane.

Table 12-1a Tolerances for Standard Pin Bending

Condition	Illustration	#3 - #11	#14*	#18*
Length of straight bar		±1"	±2"	±2"
Length of leg / dimension with adjacent leg on one or both ends		±1"	±2 1/2"	±3 1/2"
Rise of a confined sloping leg		+0", -1/2"	±2 1/2"	±3 1/2"
Rise of a free sloping leg		±1"	±2 1/2"	±3 1/2"
Overall length of multiple legs		±1"	±2 1/2"	±3 1/2"
Radius		±1"	±2 1/2"	±3 1/2"
Chord length		Larger of ±2" or 1.5% x O	Larger of ±2 1/2" or 1.5% x O	Larger of ±3 1/2" or 1.5% x O
Angular deviation on 90° hooks and 90° bent legs		Maximum of ±2 1/2° or ±1/2" per foot, but not less than 1/2"		
Standard 90° hook length		±1"	±2 1/2"	±3 1/2"
Standard 180° hook depth J		±1/2"	±1 1/2"	±2"

*Due to potential safety concerns with shop fabrication, CRSI does not recommend bending reinforcing bars larger than #11 with a grade designation of Grade 75 or higher.

**If application of positive tolerance to Bend Type 109 results in a chord length not less than the arc or bar length, the bar may be shipped straight.

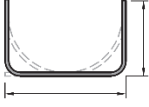
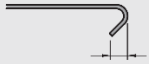
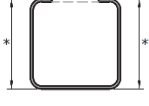


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Table 12-1b Tolerances for Standard Pin Bending

Condition	Illustration	#3 - #11
Truss bar overall length	 A schematic diagram of a truss bar with three downward-pointing bends. A horizontal dimension line with arrows at both ends spans the entire length of the bar, from the start of the first bend to the end of the last bend.	$\pm 1"$
Truss bar depth	 A schematic diagram of a truss bar with three downward-pointing bends. A vertical dimension line with arrows at both ends is positioned over the first downward bend, indicating the depth of the bar at that point.	$+0", -1/2"$

Table 12-2a Tolerances for Stirrup/Tie Pin Bending

Condition	Illustration	#3 - #5		#6 - #8
Length of leg / dimension with adjacent leg on one or both ends		Total Length < 12'-0"	Total Length ≥ 12'-0"	
		± 1/2"	± 1"	± 1"
Angular deviation on 90° hooks and 90° bent legs		Maximum of ± 2 1/2° or ± 1/2" per foot, but not less than 1/2"		
Rise of a confined or free sloping leg		± 1/2"	± 1"	± 1"
Hoop diameter		± 1/2"	± 1/2"	± 1/2"
Standard 90° hook length		± 1/2"	± 1/2"	± 1/2"
Standard 135° hook width		± 1/2"	± 1/2"	± 1/2"
Standard 180° hook depth J		± 1/2"	± 1/2"	± 1/2"
Lap length (with or without hooks present)		-1"	-1"	-1"
Opposite parallel leg lengths / dimensions		± 1/2"	± 1"	± 1"

*Leg lengths / dimensions are to be within tolerance shown but are not to differ from the opposite parallel length / dimension by more than 1/2". This applies to all stirrups and ties, open and closed, with or without hooks present.

Table 12-2b Tolerances for Stirrup/Tie Pin Bending

Condition	Illustration	#3 - #5		#6 - #8
Standee height		Total Length <12'-0"	Total Length ≥12'-0"	
		±1/2"	±1"	±1"

Notes:

- Dimensions are to be within tolerance shown but are not to differ from the opposite parallel dimension more than 1/2".

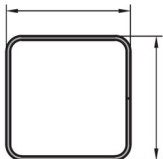
Table 12-3a Tolerances for Round Spirals

Condition	Bar Size	≤18"	>18" ≤30"	>30" ≤48"	>48" ≤66"	>66" ≤84"	>84" ≤102"	>102"
Round spiral diameter 	#3	±1/2"	±1/2"	Not Recommended				
	#4	±1/2"	±1/2"					
	#5	±1/2"	±1/2"	+1", -0"	+2", -0"	+3", -0"	+4", -0"	+5", -0"
	#6	Not Available	±1/2"	+1", -0"	+2", -0"	+3", -0"	+4", -0"	+5", -0"
	#7		+1", -0"	+2", -0"	+3", -0"	+4", -0"	+5", -0"	
	#8		+2", -0"	+3", -0"	+4", -0"	+5", -0"		

Notes:

- #3 bars are not recommended for use in round spirals larger than 30 in.
- #4 bars are not recommended for use in round spirals larger than 48 in.
- Special consideration must be used when loading/unloading, and handling large diameter round spirals and ties to prevent misshaping the fabricated diameter.
- The Fabricator must take the number of turns in the round spiral into consideration to ensure that on large diameter spirals there is enough material to complete the finished length of the spiral.
- The Contractor, Fabricator, and Placer must coordinate and make arrangements for additional material required for bracing and supporting the assembled unit to maintain the required diameter.

Table 12-3b Tolerances for Square Spirals

Condition	Illustration	#3 - #5		#6 - #8
Square spiral leg length		Total Length < 12'-0"	Total Length ≥ 12'-0"	
		±1/2"	±1"	±1"

Notes:

- Special consideration must be used when loading/unloading, and handling large square spirals and ties to prevent misshaping the fabricated dimension.
- The Fabricator must take the number of turns in the square spiral into consideration to ensure that on large square spirals there is enough material to complete the finished length of the spiral.
- The Contractor, Fabricator, and Placer must coordinate and make arrangements for additional material required for bracing and supporting the assembled unit to maintain the required dimensions.



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13. Bend Curvature

- 13.1. Imperfections with bend diameter, which affect curvature of the bend (out-of-roundness) are permitted provided the finished bend diameter is equal to or larger than the minimum bend diameter required by the ACI 318 Code.

14. Inspection of Finished Bent Bars

- 14.1. Inspection of fabricated reinforcing bars shall only be conducted on finished bent bars.
- 14.2. Inspection of finished bent bars shall ensure that the finished bend diameter is equal to or larger than the required minimum bend diameter, as prescribed in Section 8.
- 14.3. Inspection of finished bent bars shall ensure that the finished leg dimensions are in compliance with the associated placing drawings, bar-lists, and/or bill-of-materials, and are within the permitted tolerances defined in Section 12 and in ACI 117.



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APPENDIXES**(Nonmandatory Information)****Table X.1. Uncoated Reinforcing Steel Types and Applicable Grades Covered by this Standard**

Reinforcing Steel Type	ASTM Standard	Applicable Grades
Carbon-steel reinforcing bars	ASTM A615	Grade 40 ¹ ; Grade 60; Grade 80; Grade 100
Low-alloy reinforcing bars	ASTM A706	Grade 60; Grade 80; Grade 100
Stainless-steel reinforcing bars	ASTM A955	Grade 60; Grade 75; Grade 80
Rail-steel reinforcing bars	ASTM A996	Grade 50; Grade 60
Axle-steel reinforcing bars	ASTM A996	Grade 40; Grade 60
Low-carbon, chromium steel reinforcing bars	ASTM A1035	Grade 100; Grade 120

Notes:

1. Grade 40 reinforcing bars are included only where permitted by ASTM A615.
2. ASTM A955 covers Grade 60, Grade 75, and Grade 80 stainless-steel reinforcing bars.
3. ASTM A996 covers rail-steel Grades 50 and 60 and axle-steel Grades 40 and 60. Users should be aware that rail-steel and axle-steel reinforcing bars may not be readily available in all regions and local availability should be verified before specification.

Table X.2. Coated Reinforcing Steel Product Types Covered by this Standard and Permitted Substrate Bar Specifications

Coated Reinforcing Steel Product Type	ASTM Standard	Permitted Substrate Reinforcing Bar Specifications
Zinc-coated (galvanized) reinforcing bars	ASTM A767	ASTM A615; ASTM A706; ASTM A996
Epoxy-coated reinforcing bars	ASTM A775	ASTM A615; ASTM A706; ASTM A996; ASTM A1035
Epoxy-coated prefabricated reinforcing bars	ASTM A934	ASTM A615; ASTM A706; ASTM A996; ASTM A1035
Zinc-and-epoxy dual-coated reinforcing bars	ASTM A1055	ASTM A615; ASTM A706; ASTM A996; ASTM A1035
Continuous hot-dip galvanized reinforcing bars	ASTM A1094	ASTM A615; ASTM A706; ASTM A996; ASTM A1035
Textured epoxy-coated reinforcing bars	ASTM A1124	ASTM A615; ASTM A706; ASTM A996; ASTM A1035

Notes:

1. For coated reinforcing steel products, the applicable grades are the grades of the permitted substrate reinforcing bars listed in Table X.1 and permitted by the applicable ASTM product standard.
2. ASTM A767 applies only to reinforcing bars conforming to ASTM A615, ASTM A706, or ASTM A996. Therefore, ASTM A1035 Grade 100 and Grade 120 bars are not applicable to ASTM A767 product requirements.
3. ASTM A1094, ASTM A775, ASTM A934, ASTM A1124, and ASTM A1055 may apply to ASTM A1035 substrate bars, as permitted by those standards.

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