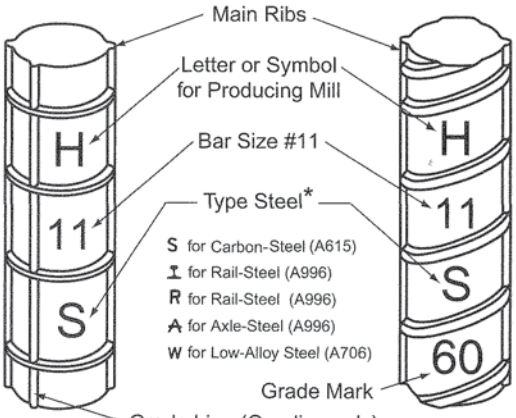
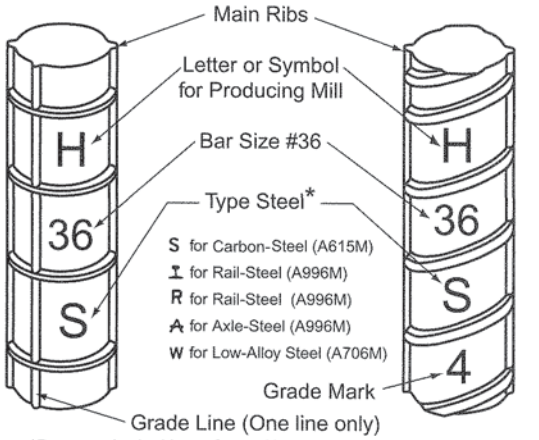
Appendix E

MATERIAL SPECIFICATIONS FOR REINFORCING BARS



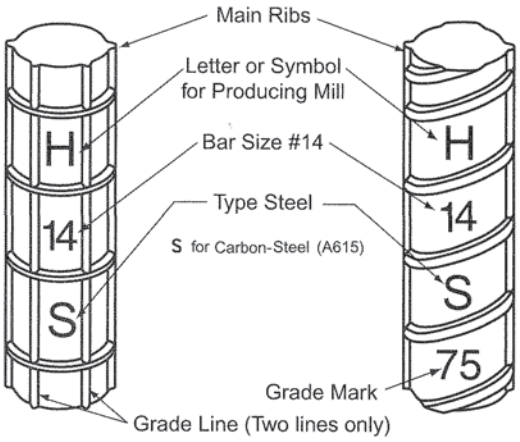
*Bars marked with an **S** and **W** meet both A615 and A706

GRADE 60

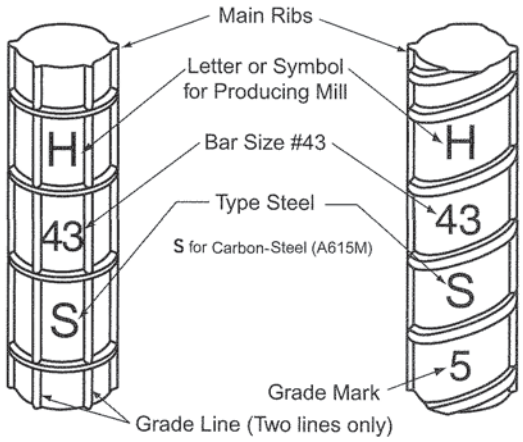


*Bars marked with an **S** and **W** meet both A615M and A706M

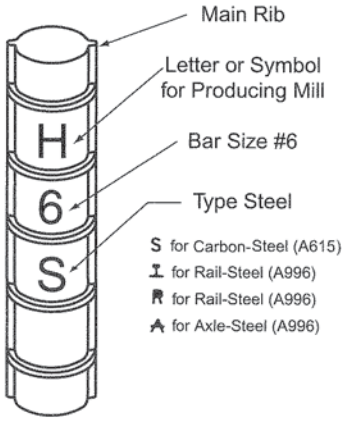
GRADE 420



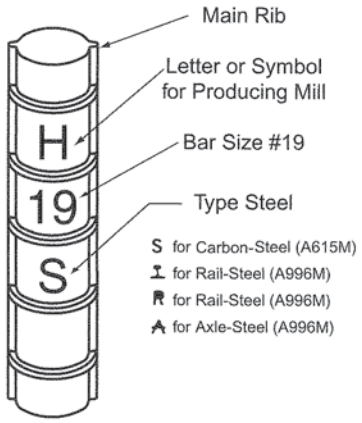
GRADE 75



GRADE 520



GRADE 40 AND 50



GRADE 280 AND 350

MATERIAL SPECIFICATIONS FOR REINFORCING BARS

ASTM SPECIFICATIONS – BAR SIZES, GRADES, TENSILE AND BENDING REQUIREMENTS

Type of Steel and ASTM Specification	Bar Sizes	Grade	Minimum Yield Strength, psi [MPa]	Minimum Tensile Strength, psi [MPa]	Minimum Percentage Elongation in 8 in. [203.2 mm]	Bend Test Pin Diameter (*d* = nominal diameter of bar)
Carbon-Steel A615/A615M	#3 - #6 [#10 - #19]	40 [280]	40,000 [280]	60,000 [420]	#3 [#10] .....11 #4, #5, #6 [#13, #16, #19] 12	#3, #4, #5 [#10, #13, #16] ....3½*d* #6 [#19] 5*d*
	#3 - #18 [#10 - #57]	60 [420]	60,000 [420]	90,000 [620]	#3, #4, #5, #6 [#10, #13, #16, #19] .....9 #7, #8 [#22, #25] .....8 #9, #10, #11, #14, #18 [#29, #32, #36, #43, #57] 7	#3, #4, #5 [#10, #13, #16] ....3½*d* #6, #7, #8 [#19, #22, #25] .....5*d* #9, #10, #11 [#29, #32, #36] .....7*d* #14, #18 (90°) [#43, #57 (90°)] 9*d*
	#3 - #18 [#10 - #57]	75 [520]	75,000 [520]	100,000 [690]	#3, #4, #5, #6, #7, #8 [#10, #13, #16, #19, #22, #25] .....7 #9, #10, #11, #14, #18 [#29, #32, #36, #43, #57] 6	#3, #4, #5, #6, #7, #8 [#10, #13, #16, #19, #22, #25] .....5*d* #9, #10, #11 [#29, #32, #36] .....7*d* #14, #18 (90°) [#43, #57 (90°)] 9*d*
Low-Alloy Steel A706/A706M	#3 - #18 [#10 - #57]	60 [420]	60,000 [420]	80,000 [550]	#3, #4, #5, #6 [#10, #13, #16, #19] .....14 #7, #8, #9, #10, #11 [#22, #25, #29, #32, #36] ....12 #14, #18 [#43, #57 10	#3, #4, #5 [#10, #13, #16] .....3*d* #6, #7, #8 [#19, #22, #25] .....4*d* #9, #10, #11 [#29, #32, #36] .....6*d* #14, #18 [#43, #57] 8*d*
Stainless-Steel A955/A955M	#3 - #6 [#10 - #19]	40 [280]	40,000 [280]	70,000 [500]	#3, #4, #5, #6 [#10, #13, #16, #19] 20	#3, #4, #5 [#10, #13, #16] ....3½*d* #6 [#19] 5*d*
	#3 - #18 [#10 - #57]	60 [420]	60,000 [420]	90,000 [620]	#3 - #18 [#10 - #57] 20	#3, #4, #5 [#10, #13, #16] ....3½*d* #6, #7, #8 [#19, #22, #25] .....5*d* #9, #10, #11 [#29, #32, #36] .....7*d* #14, #18 (90°) [#43, #57 (90°)] 9*d*
	#6 - #18 [#19 - #57]	75 [520]	75,000 [520]	100,000 [690]	#6 - #18 [#19 - #57] 20	#6, #7, #8 [#19, #22, #25] .....5*d* #9, #10, #11 [#29, #32, #36] .....7*d* #14, #18 (90°) [#43, #57 (90°)] 9*d*

For low-alloy steel reinforcing bars, ASTM A706/A706M prescribes a maximum yield strength of 78,000 psi [540 MPa] and tensile strength must be 1.25 times the actual yield strength.

Bend tests are 180° except ASTM A615/A615M permits 90° for bar sizes #14 and #18 [#43 and #57].

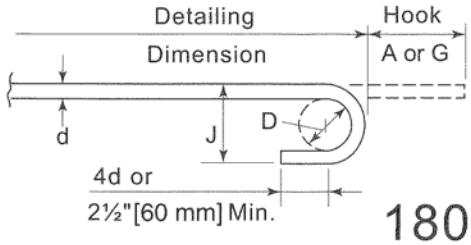
RECOMMENDED INDUSTRY PRACTICE FOR DETAILING CONCRETE REINFORCING STEEL

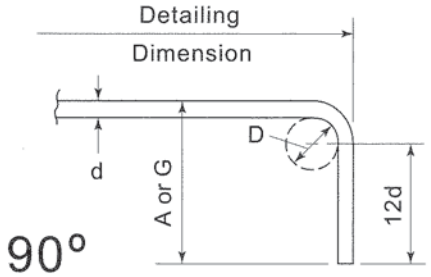
STANDARD HOOKS

All specific dimension recommended by CRSI below meet minimum requirements of ACI 318 [318M]. Galvanized bars that are bent cold prior to galvanizing may have finished bend diameters larger than those shown below. See ASTM A767/A767M, Section 7.

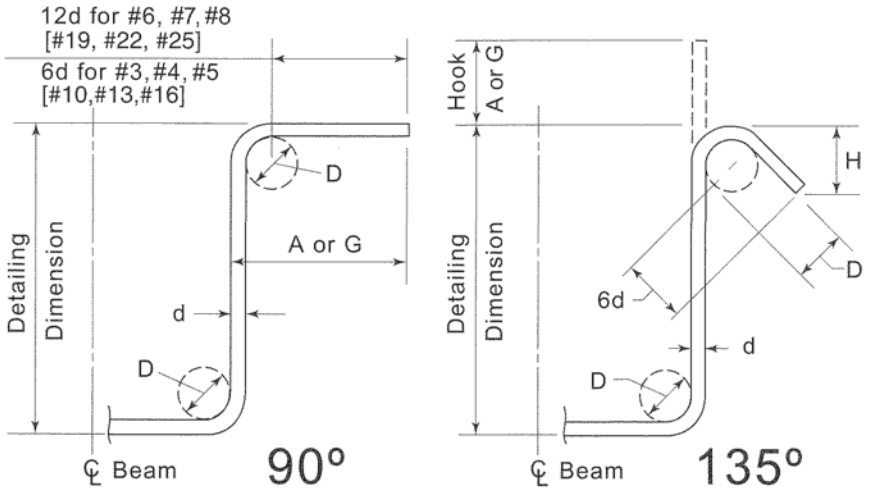
RECOMMENDED END HOOKS
ALL GRADES OF STEEL
D = Finished bend diameter

Bar Size	D, in. [mm]	180° Hooks, ft-in. [mm]		90° Hooks, ft-in. [mm]
		A or G	J	A or G
#3 [#10]	2¼ [60]	0-5 [125]	0-3 [80]	0-6 [150]
#4 [#13]	3 [80]	0-6 [150]	0-4 [105]	0-8 [200]
#5 [#16]	3¾ [95]	0-7 [175]	0-5 [130]	0-10 [250]
#6 [#19]	4½ [115]	0-8 [200]	0-6 [155]	1-0 [300]
#7 [#22]	5¼ [135]	0-10 [250]	0-7 [180]	1-2 [375]
#8 [#25]	6 [155]	0-11 [275]	0-8 [205]	1-4 [425]
#9 [#29]	9½ [240]	1-3 [375]	0-11¾ [300]	1-7 [475]
#10 [#32]	10¾ [275]	1-5 [425]	1-1¼ [335]	1-10 [550]
#11 [#36]	12 [305]	1-7 [475]	1-2¾ [375]	2-0 [600]
#14 [#43]	18¼ [465]	2-3 [675]	1-9¾ [550]	2-7 [775]
#18 [#57]	24 [610]	3-0 [925]	2-4½ [725]	3-5 [1050]

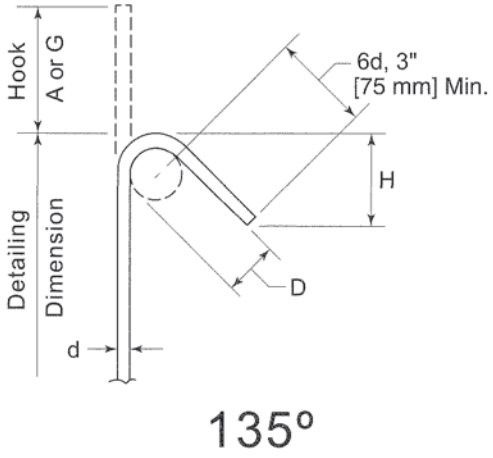




90° AND 135° STIRRUP AND TIE HOOKS



135° SEISMIC STIRRUP/TIE HOOKS



STIRRUP (TIES SIMILAR)
STIRRUP/TIE HOOK DIMENSIONS
ALL GRADES OF STEEL

Bar Size	D, in. [mm]	90° Hook, ft-in. [mm]	135° Hook, in. [mm]	
		Hook A or G	Hook A or G	H (Approx.)
#3 [#10]	1½ [40]	0-4 [105]	4 [105]	2½ [65]
#4 [#13]	2 [50]	0-4½ [115]	4½ [115]	3 [80]
#5 [#16]	2½ [65]	0-6 [155]	5½ [140]	3¾ [95]
#6 [#19]	4½ [115]	1-0 [305]	8 [205]	4½ [115]
#7 [#22]	5¼ [135]	1-2 [355]	9 [230]	5¼ [135]
#8 [#25]	6 [155]	1-4 [410]	10½ [270]	6 [155]

135° SEISMIC STIRRUP/TIE HOOK DIMENSIONS
ALL GRADES OF STEEL

Bar Size	D, in. [mm]	135° Hook, in. [mm]	
		Hook A or G	H (Approx.)
#3 [#10]	1½ [40]	4¼ [110]	3 [80]
#4 [#13]	2 [50]	4½ [115]	3 [80]
#5 [#16]	2½ [65]	5½ [140]	3¾ [95]
#6 [#19]	4½ [115]	8 [205]	4½ [115]
#7 [#22]	5¼ [135]	9 [230]	5¼ [135]
#8 [#25]	6 [155]	10½ [270]	6 [155]