Are you **Properly Specifying** Materials?

by Charles J. Carter, S.E., P.E.

The materials and products used in building design and construction are almost universally designated by reference to an appropriate ASTM specification. This simplifies the design and construction process because you can define all the characteristics of a specified product. However, with dozens of ASTM specifications applicable in steel building construction alone and several new ones now available, it can be a challenge to keep the standard designations in contract documents current.

This article provides a summary of the common ASTM specifications used in steel building design and construction, including structural shapes, plate products, fastening products, and other products. This information is based upon similar and more extensive information in the 3rd Edition AISC *LRFD Manual of Steel Construction*. The reader might also find it convenient to have the AISC publication *Selected ASTM Standards for Steel Construction*, which is a compilation of more than 70 steel-related ASTM standards. You will find every ASTM number in this article in that reference. Both the AISC *Manual* and *Selected ASTM Standards* are available for purchase online at **www.aisc.org/bookstore**.

STRUCTURAL SHAPES

See Summary in Table 2-1

W-Shapes

Preferred material specification for W-shapes is ASTM A992 (F_y = 50 ksi and F_u = 65 ksi). The availability of W-shapes in grades other than ASTM A992 should be confirmed prior to their specification. W-shapes with higher yield and tensile strength can be obtained by specifying ASTM A572 grade 60 or 65 or ASTM A913 grades 60, 65 or 70. W-shapes with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A588 grade 50 or ASTM A242 grade 42, 46, or 50. Other material specifications applicable to W-shapes include ASTM A36; ASTM A529 grade 50 and 55, ASTM A572 grade 42 and 50, and ASTM A913 grade 50.

M-Shapes, S-Shapes and HP-Shapes

The preferred material specification for M-shapes is ASTM A36 (F_y = 36 ksi; F_u = 58 ksi), although ASTM A572 grade 50 (F_y = 50 ksi; F_u = 65 ksi) is increasingly very common. The availability of M-shapes in grades other than ASTM A36 should be confirmed prior to their specification. M-shapes with higher yield and tensile strength can be obtained by specifying ASTM A572 grade 42, 50, 55, 60 and 65, ASTM A529 grxade 50 and 55, ASTM A913 grades 50, 60, 65 or 70. M-shapes with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A588 grade 50 or ASTM A242 grade 50.

Channels

The preceding comments for M-shapes apply equally to channels.

Angles

The preferred material specification for angles is ASTM A36 (F_y = 36 ksi; F_u = 58 ksi). The availability of angles in grades other than ASTM A36 should be confirmed prior to their specification. Angles with higher yield and tensile strength can be obtained by specifying ASTM A572 grade 42, 50, 55, 60 or 65, ASTM A529 grade 50 and 55, which cover tensile groups 1 and 2 angles only (see also Table 2-4), or ASTM A913 grade 50, 60, 65 or 70. Angles with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A588 grade 50 or ASTM A242 grade 46 or 50

Structural Tees

Structural tees are split from W-, M- and S-shapes to make WT-, MT- and ST-shapes, respectively. For the preferred material specifications, as well as other suitable material specifications, for structural tees, refer to the preceding sections on W-, M- or S-shapes as appropriate.

Rectangular (and Square) HSS

The preferred material specification for rectangular HSS is ASTM A500 grade B (F_y = 46 ksi; F_u = 58 ksi), although ASTM A500 grade C (F_y = 50 ksi; F_u = 62 ksi) is increasingly very common. The availability of rectangular HSS in grades other than ASTM A500 grade B should be confirmed prior to their specification. Rectangular HSS with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A847. Other material specifications applicable to rectangular HSS include ASTM A501 and ASTM A618.

The Latest Bent on Anchor Rods

ASTM F1554. Have you heard of it? Have you specified it? Are you wondering what it is?

This past summer, AISC's Steel Solutions Center gave presentations on frequently asked questions as part of breakfast seminars in 14 cities across the United States. One topic of interest was anchor rods. While discussion focused on fixes for bent or short rods, the "new" ASTM F1554 anchor-rod specification was a subject that arose repeatedly. Some engineers know of it and specify it regularly, but not all fabricators are aware of it.

Of course, "new" is a relative term—the ASTM F1554 specification was introduced back in 1999. It was the first time that hooked, headed, and threaded and nutted rods were addressed in one specification. The specification also provides for grades 36, 55 and 105. While it is penetrating the market from coast to coast, ASTM F1554 still faces "specification inertia," and many do not know what it has to offer.

The benefits of ASTM F1554 are clear: There is no other specification that brings all requirements for anchor rods together into one place—mechanical, chemical, threading, manufacturing, and dimensional. Compared to older "material-only" specifications like ASTM A449, ASTM FI554 eliminates confusion about what product is required.

ASTM F1554 is here to stay, and it's catching on. In an informal poll conducted by Bill Liddy of AISC's Steel Solutions Center, 15 fabricators representing all geographic regions of the United States were asked how often they see ASTM F1554 specified. The results divide at the Rocky Mountains.

East of the Rockies, the respondents indicated that the demand for ASTM F1554 was on the rise—but West of the Rockies, ASTM A449 still is common. Folks out West should keep in mind that ASTM A449 material can be obtained as ASTM F1554 grade 105—and additionally, you get all the specification requirements that make the material into an anchor rod.

Don't let industry growing pains deter you—specify ASTM F1554, and encourage your fabricator to order your anchor rod materials early.

ASTM F1554 is included in the AISC publication *Selected ASTM Standards for Structural Steel Fabrication*, available at www.aisc.org/bookstore. ★

Did You Know...

...that the same nut can be used on both cut and rolled threads?

Why? Because both rolled and cut threads are produced to meet the same threading specification.

Visit www.aisc.org/faq for answers to more technical questions.

10 Important Tidbits

1. **When in doubt, check it out.** Have questions about availability? Call a fabricator or the AISC Steel Solutions Center (866.ASK.AISC or solutions@aisc.org). Either one can keep you swimming in available steel.

2. **Remember that quantity means economy!** Repetitive use of similar shape sizes brings the total cost of steel construction down. Best advice: strive to use enough of any individual shape specified so that the quantity on the job is a mill-order quantity—generally about 20 tons. The small cost of additional weight will be offset easily by the economies of mill ordering cost savings and detailing, fabrication and erection similarity.

3. **Times change.** ASTM A992 originally was introduced covering only W-shapes. A recent revision to this ASTM standard expanded its scope to include other hot-rolled structural cross-sections (channels, angles, M-shapes, etc.), allowing them to be made to ASTM A992. But to date no product other than a W-shape has been offered for sale in ASTM A992. It is expected that this will change, so we'll get back to you later.

4. **Round HSS ≠ Steel Pipe**. Know the difference between ASTM A500 and ASTM A53. ASTM A500 is for HSS (F_y = 42 ksi for grade B; 46 ksi for grade C). ASTM A53 is for steel pipe (F_y = 35 ksi).

5. **Round HSS are similar to steel pipe, though.** Know the similarity between available round HSS (ASTM A500) and steel pipe (ASTM A53). Generally speaking, only round HSS with the same cross-sectional dimensions as steel pipe are stocked and available. So avoid specifying a round HSS with a cross-section that does not match up to one of the steel pipe cross-sections. This is a lot easier than it sounds—just use round HSS with non-zero numbers after the decimal point. For example, HSS 5.562×0.258 has the same cross-section as a Pipe 5 Std. And it generally will be available, while HSS 5.000×0.250 is an HSS-only product and will require a mill order quantity to obtain.

6. **Properly designate your HSS.** A round HSS is designated by nominal diameter and wall thickness, each expressed to three decimal places—for example, HSS 5.563×0.258. A square or rectangular HSS is designated by nominal outside dimensions and wall thickness, each in rational numbers—for example, HSS 5×3×$^3/_8$.

7. **Properly designate your steel pipes.** Use nominal pipe size (NPS) designation through NPS 12—for example, Pipe 5 Std., Pipe 5 x-strong or Pipe 5 xx-strong. Note that this notation has commonly been abbreviated as follows for the examples given: P5, PX5 and PXX5, respectively. Above NPS 12, use the format "Pipe" followed by diameter x nominal wall thickness, each expressed three decimal places—for example, NPS 14 Standard is designated Pipe 14.000×0.375. The latter format also applies to any steel pipe size smaller than NPS 12 that does not have an NPS sizes.

8. **Don't confuse anchor rods with bolts.** Do not specify your anchor rods as ASTM A325 or A490. ASTM A325 and A490 are for headed bolts, with limited threaded length, generally available only up to 8" in length, and governed by provision for steel-to-steel structural joints only. You say you've always specified your anchorage devices this way and it's never been a problem? Well, the reality is your fabricator has been awfully nice to not embarrass you by pointing out that you've specified a product that does not come in the length you likely specified—or as a hooked or longer-threaded rod. Use ASTM F1554, which covers hooked, headed and threaded/nutted rods in three strength grades.

9. **Have all the information at your fingertips.** More extensive information can be found in the 3rd Edition AISC *LRFD Manual of Steel Construction* and the AISC publication *Selected ASTM Standards for Steel Construction*, which are available at www.aisc.org/bookstore.

10. **When in doubt, check it out.** Oh, wait, this is number 1. Well, it *is* important.

Round HSS

The preferred material specification for round HSS is ASTM A500 grade B (F_y = 42 ksi; F_u = 58 ksi), although ASTM A500 grade C (F_y = 46 ksi; F_u = 62 ksi) is increasingly very common. The availability of round HSS in grades other than ASTM A500 grade B should be confirmed prior to their specification. Round HSS with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A847. Other material specifications applicable to round HSS include ASTM A501 and ASTM A618.

Steel Pipe

The sole material specification for steel pipe is ASTM A53 grade B (F_y = 35 ksi; F_u = 60 ksi).

PLATE PRODUCTS

See Summary in Table 2-2

Structural Plates

The preferred material specification for structural plates is ASTM A36 (F_y = 36 ksi for plate thickness is equal to or less than 8", F_y = 32 ksi otherwise; F_u = 58 ksi). The availability and cost effectiveness of structural plates in grades other than ASTM A36 should be confirmed prior to their specification. Note also that the availability of grades other than ASTM A36 varies through the range of thickness as shown in Table 2-2 (see also Table 2-4). Structural plates with higher yield and tensile strength can be obtained by specifying ASTM A572 grade 42, 50, 55, 60 or 65, ASTM A529 grade 50 or 55, ASTM A514 grade 90 or 100, or ASTM A852. Structural plates with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A588 grade 42, 46 or 50 or ASTM A242 grade 42, 46 or 50.

Structural Bars

The preceding comments for structural plates apply equally to structural bars, except that neither ASTM A514 nor A852 is applicable.

Raised-Pattern Floor Plates

ASTM A786 is the standard specification for rolled steel floor plates. As floor-plate design is seldom controlled by strength considerations, ASTM A786 "commercial grade" commonly is specified. If so, per ASTM A786 Section 5.1.2, "the product will be supplied 0.33 percent maximum carbon and without specified mechanical properties." Alternatively, if a defined strength level is desired, ASTM A786 raised-pattern floor plate can be ordered to a defined plate specification, such as ASTM A36, A572, or A588; see ASTM A786 Sections 5.1.2, Section 8 and Appendix Table X1.1.

Sheet and Strip

Sheet and strip products, which generally are thinner than structural plate and bar products, are produced to such ASTM specifications as A570, A606 or A607.

Table 2-1.
Applicable ASTM Specifications for Various Structural Shapes

Steel Type	ASTM Designation		F_y Min. Yield Stress (ksi)	F_u Tensile Stress[a] (ksi)	Applicable Shape Series									
					W	M	S	HP	C	MC	L	HSS Rect.	HSS Round	Steel Pipe
Carbon	A36		36	58–80[b]	■	■	■	■	■	■	■			
	A53 Gr. B		35	60										■
	A500	Gr. B	42	58									■	
			46	58								■		
		Gr. C	46	62									▒	
			50	62								▒		
	A501		36	58								▒	▒	
	A529[c]	Gr. 50	50	65–100	▒	▒	▒	▒	▒	▒	▒			
		Gr. 55	55	70–100	▒	▒	▒	▒	▒	▒	▒			
High-Strength Low-Alloy	A572	Gr. 42	42	60	▒	▒	▒	▒	▒	▒	▒			
		Gr. 50	50	65[d]	▒	▒	▒	▒	▒	▒	▒			
		Gr. 55	55	70	▒	▒	▒	▒	▒	▒	▒			
		Gr. 60[e]	60	75	▒	▒	▒	▒	▒	▒	▒			
		Gr. 65[e]	65	80	▒	▒	▒	▒	▒	▒	▒			
	A618[f]	Gr. I & II	50[g]	70[g]								▒	▒	
		Gr. III	50	65								▒	▒	
	A913	50	50[h]	60[h]	▒	▒	▒	▒	▒	▒	▒			
		60	60	75	▒	▒	▒	▒	▒	▒	▒			
		65	65	80	▒	▒	▒	▒	▒	▒	▒			
		70	70	90	▒	▒	▒	▒	▒	▒	▒			
	A992		50–65[i]	65[i]	■									
Corrosion Resistant High-Strength Low-Alloy	A242		42[j]	63[j]	▒									
			46[k]	67[k]	▒			▒				▒		
			50[l]	70[l]	▒	▒	▒	▒	▒	▒	▒	▒		
	A588		50	70	▒	▒	▒	▒	▒	▒	▒	▒		
	A847[f]		50	70								▒	▒	

■ = Preferred material specification.
▒ = Other applicable material specification, the availability of which should be confirmed prior to specification.
□ = Material specification does not apply.

[a] Minimum unless a range is shown.
[b] For shapes over 426 lb/ft, only the minimum of 58 ksi applies.
[c] Groups 1 and 2 shapes only. To improve weldability a maximum carbon equivalent can be specified (per ASTM Supplementary Requirement S78). If desired, maximum tensile stress of 90 ksi can be specified (per ASTM Supplementary Requirement S79).
[d] If desired, minimum tensile stress of 70 ksi can be specified (per ASTM Supplementary Requirement S81).
[e] Groups 1, 2 and 3 shapes only.
[f] ASTM A618 can also be specified as corrosion-resistant; see ASTM A618.
[g] Minimum applies for walls nominally 3/4-in. thick and under. For wall thicknesses over 3/4 in., F_y = 46 ksi and F_u = 67 ksi.
[h] If desired, maximum yield stress of 65 ksi and maximum yield-to-tensile strength ratio of 0.85 can be specified (per ASTM Supplementary Requirement S75).
[i] A maximum yield-to-tensile strength ratio of 0.85 and carbon equivalent formula are included as mandatory in ASTM A992.
[j] Groups 4 and 5 shapes only.
[k] Group 3 shapes only.
[l] Groups 1 and 2 shapes only.

Table 2-2.
Applicable ASTM Specifications for Plates and Bars

Steel Type	ASTM Designation		F_y Min. Yield Stress (ksi)	F_u Tensile Stress[a] (ksi)	Plates and Bars									
					to 0.75 incl.	over 0.75 to 1.25	over 1.25 to 1.5	over 1.5 to 2 incl.	over 2 to 2.5 incl.	over 2.5 to 4 incl.	over 4 to 5 incl.	over 5 to 6 incl.	over 6 to 8 incl.	over 8
Carbon	A36		32	58–80										■
			36	58–80	■	■	■	■	■	■	■	■	■	
	A529	Gr. 50	50	70–100		[b]	[b]	[b]	[b]					
		Gr. 55	55	70–100		[b]	[b]							
High-Strength Low-Alloy	A572	Gr. 42	42	60										
		Gr. 50	50	65										
		Gr. 55	55	70										
		Gr. 60	60	75										
		Gr. 65	65	80										
Corrosion Resistant High-Strength Low-Alloy	A242		42	63										
			46	67										
			50	70										
	A588		42	63										
			46	67										
			50	70										
Quenched and Tempered Alloy	A514[c]		90	100–130										
			100	110–130										
Quenched and Tempered Low-Alloy	A852[c]		70	90–110										

■ = Preferred material specification.

= Other applicable material specification, the availability of which should be confirmed prior to specification.

= Material specification does not apply.

[a] Minimum unless a range is shown.
[b] Applicable to bars only above 1-in. thickness.
[c] Available as plates only.

FASTENING PRODUCTS

See Summary in Table 2-3

Conventional Bolts

The preferred material specification for conventional (heavy-hex) high-strength bolts in steel-to-steel structural connections is ASTM A325, although ASTM A490 can be specified when higher strength is desired. In either case, Type 1 (medium-carbon steel) is most commonly specified. When atmospheric corrosion resistance is desired, Type 3 can be specified. While still formally permitted in the *LRFD Specification*, the use of other material specifications in steel-to-steel structural bolting applications has become quite uncommon. ASTM A307 bolts are almost as infrequently specified today as are ASTM A501 and A502 rivets.

Twist-Off-Type Tension-Control Bolt Assemblies

The preferred material specification for twist-off-type tension-control bolt assemblies is ASTM F1852, which offers a strength level that is equivalent to that of ASTM A325 bolts. When a higher strength is desired, twist-off-type tension-control bolt assemblies can be obtained in a strength level that is equivalent to that of ASTM A490 bolts using the provisions for alternative-design fasteners in *RCSC Specification* Section 2.8. In either case, Type 1 (medium-carbon steel) is most commonly specified. When atmospheric corrosion resistance is desired, Type 3 can be specified. The use of these devices must conform to the requirements in the *RCSC Specification*, which provides detailed requirements for pre-installation verification (Section 7), installation (Section 8) and inspection (Section 9).

Nuts

The preferred material specification for heavy-hex nuts is ASTM A563. The appropriate grade and finish is specified per ASTM A563 Table X1.1 according to the bolt or threaded part with which the nut will be used. For steel-to-steel structural bolting applications, the appropriate grade and finish is summarized in *RCSC Specification* Section 2.4. If its availability can be confirmed prior to specification, ASTM A194 grade 2H nuts are permitted as an alternative, as indicated in *RCSC Specification* Table 2.1.

Washers

The preferred material specification for hardened steel washers is ASTM F436. This specification provides for both flat and beveled washers. While standard ASTM F436 washers are sufficient in most applications, there are several specific applications when special washers are required. The special washer requirements in *RCSC Specification* Section 6 apply when oversized or slotted holes are used in the outer ply of a steel-to-steel structural joint. In anchor rod and other embedment applications, hole sizes generally are larger than those for steel-to-steel structural bolting applications (see Table 14-2 for maximum anchor-rod hole sizes). Accordingly, washers used in such applications generally are larger and might require design consideration for proper force transfer, particularly when the anchorage is subject to tension.

Compressible-Washer-Type Direct-Tension Indicators

When bolted joints are specified as pretensioned or slip-critical and the direct-tension-indicator pretensioning method is used, ASTM F959 compressible-washer-type direct-tension indicators are specified. Type 325 is used with ASTM A325 high-strength bolts and type 490 is used with ASTM A490 high-strength bolts. The use of these devices must conform to the requirements in the *RCSC Specification*, which provides detailed requirements for pre-installation verification (Section 7), installation (Section 8) and inspection (Section 9). The *RCSC Specification* also permits alternative washer-type indicating devices subject to the provision the *RCSC Specification* Section 2.6.2.

Anchor Rods

The preferred material specification for anchor rods is ASTM F1554, which covers hooked, headed, threaded and nutted anchor rods in three strength grades: 36, 55 and 105. ASTM F1554 grade 36 is most commonly specified, although grades 55 and 105 are normally available. ASTM F1554 grade 36 or ASTM F1554 grade 55 with weldability supplement S1 and the carbon equivalent formula in ASTM F1554 Section S1.5.2.1 can be specified to allow welded field correction should the anchor rods be placed incorrectly in the field. ASTM F1554 grades 36, 55 and 105 are essentially the anchor-rod equivalents of the generic rod specifications ASTM A36, ASTM A572 grade 55 and A193 grade B7, respectively. Several other ASTM specifications also can be used. For applications involving unheaded rods, ASTM A36, A193, A307, A354, A449, A572, A588 and A687 can be specified. For applications involving headed rods, ASTM A307, A354 and A449 can be specified.

Threaded Rods

The preferred material specification for threaded rods, whether provided with plain or upset ends, is ASTM A36. Other material specifications that can be specified include ASTM A193, A307, A354, A449, A572, A588, and A687.

Forged Steel Structural Hardware

Forged steel structural hardware products, such as clevises, turnbuckles, eye nuts, and sleeve nuts, are occasionally used in building design and construction. These products are generally provided to AISI material specifications. AISI C-1035 material commonly is used in the manufacture of clevises and turnbuckles. AISI C-1030 material commonly is used in the manufacture of steel eye nuts and steel eye bolts. AISI C-1018 grade 2 material commonly is used in the manufacture of sleeve nuts. Other products, such as steel rod ends, steel yoke ends and pins, cotter pins and coupling nuts commonly are provided generically as "carbon steel." The dimensional and strength characteristics of these devices are described in the literature provided by their manufacturer. Note that such information usually is provided as a safe working load and based upon a factor of safety as high as 5, assuming that the product will be used in rigging or similar applications subject to dynamic loading. If so, the tabular value might be overly conservative for permanent installations and similar applications subject to static loading only. In these applications, a factor of safety of 3 is used more commonly.

Table 2-3.
Applicable ASTM Specifications for Various Types of Structural Fasteners

ASTM Designation		F_y Min. Yield Stress (ksi)	F_u Tensile Stress[a] (ksi)	Diameter Range (in.)	High-Strength Bolts	Common Bolts	Nuts	Washers	Direct-Tension-Indicators	Threaded Rods	Anchor Rods		
											Hooked	Headed	Threaded & Nutted
A325		–	105	over 1 to 1.5 incl.	■								
		–	120	0.5 to 1, incl.	■								
A490		–	150	0.5 to 1.5	■								
F1852		–	105	1.125	■								
		–	120	0.5 to 1, incl.	■								
A194 Gr. 2H		–	–	0.25 to 4			▭						
A563		–	–	0.25 to 4			■						
F436[b]		–	–	0.25 to 4				■					
F959		–	–	0.5 to 1.5					■				
A36		36	58–80	to 10						■	▭		▭
A193 Gr. B7		–	100	over 4 to 7						▭	▭		▭
		–	115	over 2.5 to 4						▭	▭		▭
		–	125	2.5 and under						▭	▭		▭
A307	Gr. A	–	60	0.25 to 4		■						▭	
	Gr. C	–	58–80	0.25 to 4						▭	▭		▭
A354 Gr. BD		–	140	2.5 to 4 incl.						▭	▭	▭	▭
		–	150	0.25 to 2.5, incl.						▭	▭	▭	▭
A449		–	90	1.5 to 3 incl.	[c]					▭	▭	▭	▭
		–	105	1.125 to 1.5, incl.	[c]					▭	▭	▭	▭
		–	120	0.25 to 1, incl.	[c]					▭	▭	▭	▭
A572	Gr. 42	42	60	to 6						▭	▭		▭
	Gr. 50	50	65	to 4						▭	▭		▭
	Gr. 55	55	70	to 2						▭	▭		▭
	Gr. 60	60	75	to 1.25						▭	▭		▭
	Gr. 65	65	80	to 1.25						▭	▭		▭
A588		42	63	Over 5 to 8, incl.						▭	▭		▭
		46	67	Over 4 to 5, incl.						▭	▭		▭
		50	70	4 and under						▭	▭		▭
A687		105	150 max.	0.625 to 3						▭		▭	
F1554	Gr. 36	36	58–80	0.25 to 4							■	■	■
	Gr. 55	55	75–95	0.25 to 4							▭	▭	▭
	Gr. 105	105	125–150	0.25 to 3							▭	▭	▭

■ = Preferred material specification.

▭ = Other applicable material specification, the availability of which should be confirmed prior to specification.

□ = Material specification does not apply.

– indicates that a value is not specified in the material specification.
[a] Minimum unless a range is shown or maximum (max.) is indicated.
[b] Special washer requirements may apply per RCSC Specification Table 6.1 for some steel-to-steel bolting applications and per Part 14 for anchor-rod applications.
[c] See LRFD Specification Section A3.3 for limitations on use of ASTM A449 bolts.

Filler Metal

The appropriate filler metal for structural steel is as summarized in ANSI/AWS D1.1-2000 Table 3.1 for the various combinations of base metal specification and grade and electrode specification. A tensile

strength level of 70 ksi is indicated for the majority of the commonly used steels in building construction.

Shear-Stud Connectors

As specified in ANSI/AWS D1.1-2000 Chapter 7 (Section 7.2.6 and Table 7.1), Type B shear stud connectors made from ASTM A108 material are used for the interconnection of steel and concrete elements in composite construction (F_u = 60 ksi).

OTHER PRODUCTS

Steel Castings and Forgings

Steel castings are specified as ASTM A27 grade 65-35 or ASTM A148 grade 80-35. Steel forgings are specified as ASTM A668.

Crane Rails

Crane rails are furnished to ASTM A759, ASTM A1 and/or manufacturer's specifications and tolerances. Most manufacturers chamfer the top and sides of the crane-rail head at the ends unless specified otherwise to reduce chipping of the running surfaces. Often, crane rails are ordered as end-hardened, which improves the crane-rail ends' resistance to impact from contact with the moving wheel during crane operation. Alternatively, the entire rail can be ordered as heat-treated. When maximum wheel loading or controlled cooling is needed, refer to manufacturers' catalogs. Purchase orders for crane rails should be noted "for crane service." Light 40-lb rails are available in 30′ lengths, 60-lb rails in 30′, 33′ or 39′ lengths, standard rails in 33′ or 39′ lengths and crane rails up to 80′. Consult manufacturer for availability of other lengths. Rails should be arranged so that joints on opposite sides of the crane runway will be staggered with respect to each other and with due consideration to the wheelbase of the crane. Rail joints should not occur at crane girder splices. Odd lengths that must be included to complete a run or obtain the necessary stagger should be not less than 10′ long. Rails are furnished with standard drilling in both standard and odd lengths unless stipulated otherwise on the order.

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