ARIZONA DEPARTMENT OF TRANSPORTATION * MATERIALS GROUP

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POLICY AND PROCEDURE DIRECTIVE

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TO: ALL MANUAL HOLDERS	PPD NO. 1
SUBJECT: SAMPLING, TESTING, AND ACCEPTANCE OF REINFORCING BARS	EFFECTIVE DATE: February 27, 2009

1. GENERAL

1.1 This Policy and Procedure Directive supersedes P.P.D. No. 92-2.

1.2 This Policy and Procedure Directive outlines the procedure to be followed for sampling, testing, and acceptance of reinforcing bars.

1.3 This Policy and Procedure Directive modifies the normal certification procedures. It shall be used in conjunction with the requirements of Subsection 106.05 of the Specifications.

2. PROCEDURES

2.1 Samples of reinforcing steel bars taken at the supplier's or fabricator's place of business shall be known as pre-shipment samples, while those samples obtained from stockpile or shipment at the project shall be known as project samples. A shipment should be considered any amount of reinforcement steel bars delivered to a project on any given day, of one transported load.

3. PRE-SHIPMENT SAMPLING FROM SUPPLIERS AND/OR FABRICATORS IN THE PHOENIX OR TUCSON AREAS

3.1 When a supplier or fabricator plans a shipment of reinforcing steel to an ADOT construction project, they should first contact Materials Group, Central Lab, Structural Materials Testing Section to obtain a laboratory number referenced to the project number. Normally the following working day, Structural Materials Testing Section or Regional Materials Laboratory personnel will randomly sample the pre-shipment or receive a pre-shipment sample from the supplier or fabricator at their place of business. For bar size #14, the sample shall be one piece forty-two (42) inches in length, selected at random for each shipment up to thirty (30) tons. For bar size #18, a sample shall be one piece forty-two (42) inches in length, selected at random for each shipment up to fifty (50) tons. For all other bar sizes the sample shall be one piece, seven (7) feet in length, selected at random for each shipment up to twenty (20) tons and one sample for each twenty (20) tons thereafter. Those samples will be submitted for each bar size, grade, heat number, and manufacturer in the shipment. All samples shall be submitted to Structural Materials Testing Section. The pre-shipment bars that are obtained from the supplier

or fabricator must be accompanied by a complete and accurate Certificate of Compliance. The information shown on the certificate must match the bar identification marks. If no Certificate of Compliance is available or the information shown on the certificate is incomplete or inaccurate, the bars should not be accepted for testing. The manufacturer will not be required to submit a Certificate of Analysis (Mill Test Reports).

3.2 When the supplier or fabricator makes a shipment to a project, they will furnish a completed Certificate of Compliance (a blank sample is shown in Attachment #1) stating that the material in the shipment is from the same stock as the pre-shipment sample covered by the laboratory number given to them earlier by the Structural Materials Testing Section. If the pre-shipment sample fails to comply with specification requirements, Structural Materials Testing Section will notify the project by telephone without delay at the completion of testing. In addition, the project shall verify the authenticity of the laboratory number and the reference to the testing of the pre-shipment sample bars, by contacting Structural Materials Testing Section.

3.3 All shipments will be subject to spot sampling upon arrival at the project. The project sample shall consist of one sample bar seven (7) feet in length, regardless of the number of bar sizes. This sample bar should be taken at random from each shipment to the project and submitted to Structural Materials Testing Section for testing. The placement of the reinforcing steel bars shall not be delayed while the project is awaiting test results. However, the concrete placement operation should not begin until satisfactory results of the project sample bar testing are obtained.

4. REINFORCING BARS NOT PRE-SHIPMENT SAMPLED

4.1 When the supplier or fabricator makes a shipment to a project from outside the Phoenix or Tucson areas, or not otherwise subjected to pre-shipment sampling, the shipment shall be accompanied by a Certification of Compliance conforming to the requirements of Subsection 106.05 of the Specifications. Before any reinforcing steel from a shipment is to be incorporated into the project work, a project sample shall be taken, tested, and approved. A project sample shall be taken as soon as practical upon arrival at the job site. A different project sample that is representative of each bar size, grade, heat number, and manufacturer from that shipment will be required. The sampling requirements described for pre-shipment sampling for the Phoenix or Tucson areas shall be used.

5. EPOXY COATED REINFORCING BARS

5.1 Epoxy coated reinforcing bars will be sampled and tested in the same manner as uncoated reinforcing bars with the following changes:

5.1.1 The coating thickness and flexibility of epoxy coated reinforcing bars will be tested by Structural Materials Testing Section.

5.1.2 The supplier or fabricator will be required to furnish a Certificate of Compliance, conforming to the requirements of Subsection 106.05 of the Specifications, for the

powdered epoxy resin which properly identifies the batch and/or lot number, material, quantity of batch, date of manufacture, name and address of the manufacturer, and a statement that the powdered epoxy resin is the same composition as the initial sample pre-qualified for use. The Certificate of Compliance shall also state that production bars and pre-qualification bars have been identically prepared and applied with epoxy powders.

5.1.3 The contractor shall furnish a Certificate of Compliance from the coating applicator, in accordance with the requirements of Subsection 106.05 with each shipment of coated steel. The Certificate of Compliance shall (1) verify that the coated items and coating material have been tested in accordance with the requirements of the specifications, (2) state the actual test results for each requirement, (3) state that the test results comply with the requirements, and (4) state that the entire lot is in a fully-cured condition.

6. INFORMATION

6.1 Portions of the January 1990 Concrete Reinforcing Steel Institute "Manual of Standard Practice" are reproduced, with permission, as Attachments #2 through #10 to this Policy and Procedure Directive.

6.1.1 Attachment #2 shows the bar size designation, area, weight, and diameter of ASTM standard reinforcing bars.

6.1.2 Attachments #3 through #5 show the specifications for reinforcing bars, including the significance of the bar markings.

6.1.3 Attachments #6 through #10 provide a listing of the U.S. manufacturers of concrete reinforcing bars with their respective bar markings.

James P. Delton, P.E.
Assistant State Engineer
Materials Group

Attachments (10)

CERTIFICATE OF COMPLIANCE

PROJECT: _____

SUPPLIER: _____

_____

_____

CONTRACTOR: _____

MATERIAL: _____

QUANTITY IN THIS SHIPMENT: _____

LOT NUMBER IDENTIFICATION: _____

APPLICABLE SPECIFICATION: _____

I certify that the material indicated above conforms to all requirements of the project specifications. It is from stock that has been sampled and issued laboratory number _____ by the Arizona Department of Transportation, Materials Group, Central Laboratory, Structural Materials Testing Section.

_____
Signature and Date

_____
Name

_____
Title

ASTM STANDARD REINFORCING BARS

BAR SIZE DESIGNATION	NOMINAL AREA SQ. INCHES	NOMINAL WEIGHT POUNDS PER FT.	NOMINAL DIAMETER INCHES
#3	0.11	0.376	0.375
#4	0.20	0.668	0.500
#5	0.31	1.043	0.625
#6	0.44	1.502	0.750
#7	0.60	2.044	0.875
#8	0.79	2.670	1.000
#9	1.00	3.400	1.128
#10	1.27	4.303	1.270
#11	1.56	5.313	1.410
#14	2.25	7.65	1.693
#18	4.00	13.60	2.257

Current ASTM Specifications cover bar sizes #14 and #18 in A615 Grades 60 and 75 and in A706 only.

CHAPTER 1

MATERIAL SPECIFICATIONS FOR REINFORCING BARS

The specifications for reinforcement published by the American Society for Testing and Materials (ASTM) are generally accepted for construction in the United States. When ASTM revises specifications, most authorities usually accept the latest ASTM specifications even when local codes or independent specifications have not had corresponding revisions incorporated. This lag between changes and the special requirements of some public agencies causes occasional variations.

From the materials listed in this Chapter, or in Chapter 2, the structural engineer should select that grade and type of reinforcement which, in his or her judgment, will best meet the specific design requirements.

Chapters 1 and 2 cover material specifications for reinforcing materials. See Chapter 4 for suggested reinforcement specifications, and see Chapters 5 and 6 for recommended industry practices for estimating and detailing reinforcing materials.

REINFORCING BARS

Specifications for billet-steel, rail-steel, axle-steel and low-alloy steel reinforcing bars are available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

The tables on page 1-2 summarize all pertinent mechanical, deformation, and chemical composition requirements for billet-, rail-, axle-, and low-alloy steel reinforcing bars. The first table also illustrates the grades and bar sizes available in accordance with the four ASTM specifications.

Rolling mill identification marks required by ASTM specifications are shown on page 1-3. The bar marks used by domestic mills known to be commercially producing rebars are illustrated in detail in Appendix A.

CRSI RECOMMENDATION – WELDING OF REINFORCING BARS

The "weldability" of steel established by its chemical analysis limits the applicable welding procedures and sets preheat requirements. Chemical analyses are not ordinarily meaningful for rail and axle bars. The chemical analysis (available upon request) for standard A 615 billet bars is incomplete for determining welding requirements under the "Structural Welding Code Reinforcing Steel" (AWS D1.4-79). Special complete analyses may be secured usually at an extra cost. It should be noted that all standard bar specifications, A 615, A 616, and A 617, specifically note that "The weldability of the steel is *not* part of this specification."

For these reasons, the CRSI recommendation for welding of reinforcing bars is:

"Reinforcing bars conforming to ASTM A 706, 'Low-Alloy Steel Deformed Bars for Concrete Reinforcement,' are recommended for use in all seismic-resistant reinforced concrete structures and wherever important or extensive welding is required. Before specifying A 706 reinforcement, however, local availability should be investigated. Most producers can make A 706 bars, but not in quantities less than one heat of steel for each bar size. (A heat of steel varies in different mills, but may be about 50 to 200 tons.) Thus, A 706 in lesser quantities of single bar sizes may not be immediately available from any single producer. Since the special qualities for seismic-resistant construction are required only for the flexural reinforcement in principal frame members, it will seldom be economical for a user to specify A 706 for small bars, #3, #4, #5, and #6, usually employed for shear or in thin slabs not part of the primary seismic-resistant frame, and which seldom require welding as they can be lap spliced."

SPIRAL REINFORCEMENT

1. STANDARD SIZES

Plain round bars, deformed bars, or wire for spirals are furnished in the following standard sizes and areas as prescribed in the "Simplified Practice Recommendation—Steel Spirals for Reinforced Concrete Columns" in Appendix B. Areas and weights are in accordance with the following table:

STANDARD SIZES

	Area (Sq. in.)	Weight (Lb. per ft.)
3/8" ø or #3	0.11	0.376
1/2" ø or #4	0.20	0.668
5/8" ø or #5	0.31	1.043

2. MATERIAL

Hot-rolled bars for spirals should conform to ASTM A 615, A 616, A 617, or to ASTM A 706, as specified.

Cold-drawn wire for spirals should conform to ASTM A 82 with a minimum yield strength of 70,000 psi.

Deformed wire for spirals should conform to ASTM A 496 with a minimum yield strength of 75,000 psi.

Unless otherwise specified, plain or deformed hot-rolled bars will be furnished.

MATERIAL SPECIFICATIONS FOR REINFORCING BARS (Cont.)

MECHANICAL REQUIREMENTS FOR STANDARD ASTM DEFORMED REINFORCING BARS

Type of Steel and ASTM Designation	Bar Nos. Range	Grade[1]	Minimum[2] Yield, psi	Minimum Tensile strength, psi	Minimum Percentage Elongation in 8 in.	Cold Bend test[3] Pin Diameter (*d* = nominal diameter of specimen)
Billet-Steel A 615	3-6	40	40,000	70,000	#3 . . . . . 11 #4, #5, #6 12	#3, #4, #5 . . . . . 3½*d* #6 . . . . . 5*d*
	3-11, 14, 18	60	60,000	90,000	#3, #4, #5, #6 . . . . . 9 #7, #8 . . . . . 8 #9, #10, #11, #14, #18 7	#3, #4, #5 . . . . . 3½*d* #6, #7, #8 . . . . . 5*d* #9, #10, #11 . . . . . 7*d* #14, #18 (90 deg) 9*d*
	11, 14 18	75	75,000	100,000	#11, #14, #18 6	#11 . . . . . 7*d* #14, #18 (90 deg) 9*d*
Rail-Steel A 616	3-11	50	50,000	80,000	#3, #7 . . . . . 6 #4, #5, #6 . . . . . 7 #8, #9, #10, #11 5	For Grades 50 and 60: #3, #4, #5 . . . . . 6*d* per S1[4] . . . . . 3½*d* #6, #7, and #8 . . . . . 6*d* per S1[4] . . . . . 5*d* #9, #10 . . . . . 8*d* per S1[4] . . . . . 7*d* #11 (90 deg) . . . . . 8*d* per S1[4] 7*d*
	3-11	60	60,000	90,000	#3, #4, #5, #6 . . . . . 6 #7 . . . . . 5 #8, #9, #10, #11 . . . . . 4½	
Axle-Steel A 617	3-11	40	40,000	70,000	#3, #7 . . . . . 11 #4, #5, #6 . . . . . 12 #8 . . . . . 10 #9 . . . . . 9 #10 . . . . . 8 #11 7	#3, #4, #5 . . . . . 3½*d* #6 through #11 . . . . . 5*d*
	3-11	60	60,000	90,000	#3, #4, #5, #6, #7 . . . . . 8 #8, #9, #10, #11 7	#3, #4, #5 . . . . . 3½*d* #6, #7, #8 . . . . . 5*d* #9, #10, #11 . . . . . 7*d*
Low-Alloy Steel A 706	3-11, 14, 18	60	60,000[5]	80,000[6]	#3, #4, #5, #6 . . . . . 14 #7, #8, #9, #10, #11 . . . . . 12 #14, #18 10	#3, #4, #5 . . . . . 3*d* #6, #7, #8 . . . . . 4*d* #9, #10, #11 . . . . . 6*d* #14, #18 . . . . . 8*d*

[1] Minimum yield designation.
[2] Yield point or yield strength. See ASTM specifications.
[3] Test bends 180° unless noted otherwise.
[4] Under supplementary requirements S1 of ASTM A 616 only. ACI 318 requires rail-steel bars (ASTM A 616) to meet Supplementary Requirement S1.
[5] Maximum yield strength 78,000 psi (ASTM A 706 only).
[6] Tensile strength shall not be less than 1.25 times the actual yield strength (ASTM A 706 only).

DEFORMATION REQUIREMENTS FOR STANDARD ASTM DEFORMED REINFORCING BARS

Size No.	Maximum Average Spacing	Minimum Average Height	Maximum[1] Gap
3	0.262″	0.015″	0.143″
4	0.350″	0.020″	0.191″
5	0.437″	0.028″	0.239″
6	0.525″	0.038″	0.286″
7	0.612″	0.044″	0.334″
8	0.700″	0.050″	0.383″
9	0.790″	0.056″	0.431″
10	0.889″	0.064″	0.487″
11	0.987″	0.071″	0.540″
14	1.185″	0.085″	0.658″
18	1.58″	0.102″	0.864″

[1]Chord of 12.5% of nominal perimeter.

CHEMICAL COMPOSITION REQUIREMENTS FOR STANDARD ASTM DEFORMED REINFORCING BARS

Type of Steel and ASTM Designation	Condition[1]	Element									
		Carbon (C)	Manganese (Mn)	Phosphorus (P)	Sulfur (S)	Silicon (Si)	Copper (Cu)	Nickel (Ni)	Chromium (Cr)	Molybdenum (Mo)	Vanadium (V)
Billet-Steel A 615	1	X	X	X	X						
	2			0.06%							
	3			0.075%							
Low-Alloy Steel A 706	1	X	X	X	X	X	X	X	X	X	X
	2	0.30%	1.50%	0.035%	0.045%	0.50%					
	3	0.33%	1.56%	0.043%	0.053%	0.55%					

[1] CONDITION DEFINITIONS: [1] Analysis required of these elements for each heat.
[2] Maximum allowable chemical content for each heat.
[3] Maximum allowable chemical content for finished bar.

CHAPTER 1

MATERIAL SPECIFICATIONS FOR REINFORCING BARS (Cont.)

IDENTIFICATION MARKS*—ASTM STANDARD REBARS

The ASTM specifications for billet-steel, rail-steel, axle-steel and low-alloy reinforcing bars (A 615, A 616, A 617 and A 706, respectively) require identification marks to be rolled into the surface of one side of the bar to denote the producer's mill designation, bar size, type of steel, and minimum yield designation. Grade 60 bars show these marks in the following order.

1st – Producing Mill (usually a letter)

2nd – Bar Size Number (#3 through #18)

3rd – Type of Steel: **S** for Billet (A 615)

I for Rail (A 616)

I R for Rail meeting Supplementary Requirements S1 (A 616)

A for Axle (A 617)

W for Low-Alloy (A 706)

4th – Minimum Yield Designation

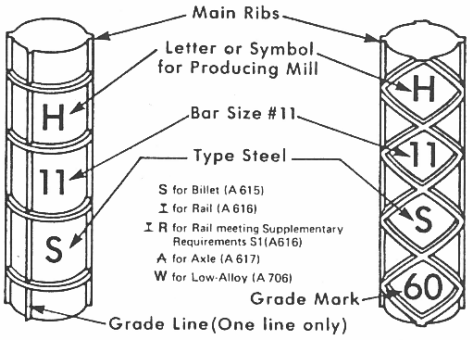
Minimum yield designation is used for Grade 60 and Grade 75 bars only. Grade 60 bars can either have one (1) single longitudinal line (grade line) or the number 60 (grade mark). Grade 75 bars can either have two (2) grade lines or the grade mark 75.

A grade line is smaller and is located between the two main ribs which are on opposite sides of all bars made in the United States. A grade line must be continued through at least 5 deformation spaces, and it may be placed on the side of the bar opposite the bar marks. A grade mark is the 4th mark on the bar.

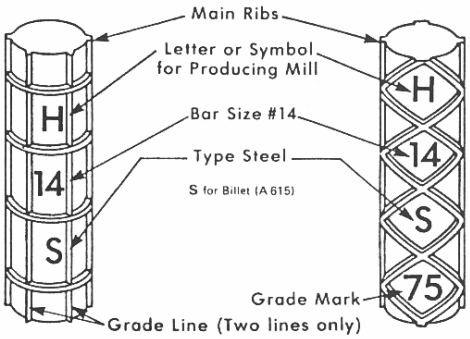
Grade 40 and 50 bars are required to have only the first three identification marks (no minimum yield designation).

VARIATIONS: Bar identification marks may also be oriented to read horizontally (at 90° to those illustrated).

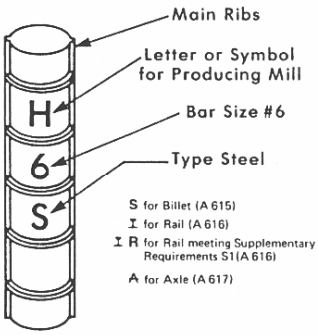
Grade mark numbers may be placed within separate consecutive deformation spaces to read vertically or horizontally.



GRADE 60 AND A 706



GRADE 75



GRADE 40 AND 50

ACI BUILDING CODE – REQUIREMENTS FOR REINFORCING BARS

The current ACI Building Code requires billet-steel reinforcing to conform to the ASTM A 615 specification.

Rail-steel reinforcing bars must meet A 616 including supplementary requirement (S1). As shown in the mechanical requirements table on page 1-2, the supplementary requirement (S1) prescribes more-restrictive bend tests. S1 also requires that A 616 reinforcing bars furnished to these supplementary requirements must be designated for type of steel by the symbol "R", in addition to the rail symbol.

The ACI Code does not have special requirements for axle-steel (A 617) and low-alloy (A 706) reinforcing bars, nor take any exceptions to the ASTM specifications for these bars.

*See Appendix A for complete identification marks of concrete reinforcing bars produced by all U.S. manufacturers. The marks, listed alphabetically by producing mill, include the identification requirements of ASTM and the deformation pattern used by each mill.

APPENDIX A

U.S. MANUFACTURERS OF CONCRETE REINFORCING BARS

IDENTIFICATION OF U.S. REINFORCING BARS

ASTM and AASHTO Specifications require that all reinforcing bars be identified by permanent, mill imprinted markings. See page 1-3.

1 A.B. STEEL MILL, INC.

A

#3 and #4 bars only
Grade mark line used for #3

1 A.B. STEEL MILL, INC.

A

Bars #5 through #10 only

2 ARMCO INC.
(Midwestern Steel Division)

S

#3 and #4 bars only
Grade mark line on opposite side

3 ATLANTIC STEEL COMPANY

S

Coiled bars (#3 through #5 only)

3 ATLANTIC STEEL COMPANY

S

Straight bars (#3 through #11 only)

3 ATLANTIC STEEL COMPANY

MILL	BAR SIZES
Cartersville	#3 through #7 only
Atlanta	#8 through #11 only

4 AUBURN STEEL COMPANY, INC.

S

Bars #3 through #5 only

4 AUBURN STEEL COMPANY, INC.

S

Bars #6 through #11 only

5 BAYOU STEEL CORPORATION

S

Bars #4 through #6 only
Grade mark line on opposite side

6 BIRMINGHAM STEEL CORPORATION
(Barbary Coast Steel Corporation)

S

6 BIRMINGHAM STEEL CORPORATION
(Illinois Division)

S

Bars #4 through #11 only

6 BIRMINGHAM STEEL CORPORATION
(Mississippi Steel Division)

S

6 BIRMINGHAM STEEL CORPORATION
(Norfolk Steel Corporation)

S

Bars #4 through #11 only

6 BIRMINGHAM STEEL CORPORATION
(Salmon Bay Steel Division)

S

Bars #3 through #9 only

6 BIRMINGHAM STEEL CORPORATION
(Salmon Bay Steel Division)

S

Bars #10 through #18 only

6 BIRMINGHAM STEEL CORPORATION
(Southern United Steel Division)

S

Bars #5 through #11 only

7 BORDER STEEL MILLS, INC.

S

APPENDIX A (Cont.)

U.S. MANUFACTURERS OF CONCRETE REINFORCING BARS

IDENTIFICATION OF U.S. REINFORCING BARS

ASTM and AASHTO Specifications require that all reinforcing bars be identified by permanent, mill imprinted markings. See page 1-3.

8 CALUMET STEEL COMPANY

S

Bars #4 through #10 only

9 CASCADE STEEL ROLLING MILLS, INC.

S

10 CF&I STEEL CORPORATION

S

Bars #3 through #7 only

10 CF&I STEEL CORPORATION

S

#8 bar only

10 CF&I STEEL CORPORATION

S

Bars #9 through #11 only

11 CHAPARRAL STEEL COMPANY

S

Grade mark line on opposite side

12 CHICAGO HEIGHTS STEEL

I

Bars #4 through #8 only

13 COMMERCIAL STEEL CORPORATION

I

Bars #3 through #6 only

14 CONNECTICUT STEEL CORPORATION

S

Bars #3 through #11 only
Grade mark line on opposite side

15 FLORIDA STEEL CORPORATION
(Charlotte Steel Mill Division)

S

Bars #4 through #11 only

15 FLORIDA STEEL CORPORATION
(Jacksonville Steel Mill Division)

S

Bars #3 through #11 only

15 FLORIDA STEEL CORPORATION
(Knoxville Steel Mill Division)

S

Bars #3 through #11 only

15 FLORIDA STEEL CORPORATION
(Tampa Steel Mill Division)

S

Bars #4 through #11 only

15 FLORIDA STEEL CORPORATION
(West Tennessee Steel Mill Division)

S

Bars #4 through #18 only

16 FRANKLIN STEEL COMPANY

I

Bars #4 through #11 only

17 GEORGETOWN STEEL CORPORATION

N

Bars #3 through #5 only

18 HAWAIIAN WESTERN STEEL, LTD.

S

APPENDIX A (Cont.)

U.S. MANUFACTURERS OF CONCRETE REINFORCING BARS

IDENTIFICATION OF U.S. REINFORCING BARS

ASTM and AASHTO Specifications require that all reinforcing bars be identified by permanent, mill imprinted markings. See page 1-3.

19 INLAND STEEL COMPANY

S

20 LACLEDE STEEL COMPANY

S

Straight bars

20 LACLEDE STEEL COMPANY

S

Bars #3 and #4 only, coiled bars

21 LTV STEEL COMPANY

S

Bars #5 through #11 only

22 MARION STEEL COMPANY

S

Bars #4 through #11 only

23 NEW JERSEY STEEL CORPORATION

S

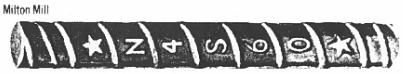
Bars #3 through #11 only

24 NORTH STAR STEEL COMPANY
(Beaumont Mill)

S

Bars #3 and #4 only

24 NORTH STAR STEEL COMPANY
Milton Mill

S 

Bars #3 through #9 only

24 NORTH STAR STEEL COMPANY
Milton Mill

S

Bars #10 through #18 only

24 NORTH STAR STEEL COMPANY
(Monroe Mill)

S

Bars #4 through #18 only
Grade mark line on opposite side

24 NORTH STAR STEEL COMPANY
(St. Paul Mill)

S

Bars #4 through #11 only
Grade mark line on opposite side

24 NORTH STAR STEEL COMPANY
(St. Paul Mill)

S

#14 and #18 bars only
Grade mark line on opposite side

24 NORTH STAR STEEL COMPANY
(St. Paul Mill)

N

Bars #6 through #18 (Patented)–Longitudinal groove on one side only
Marking system not in conformance with ASTM Specifications

24 NORTH STAR STEEL COMPANY
(Wilton Mill)

S

Mill symbol "I" either appears as first mark (shown) or as last mark (under S)

25 NORTHWESTERN STEEL & WIRE CO.

S

Bars #3 through #10 only

26 NUCOR CORPORATION
(Nebraska Mill)

S

Bars #4 through #11 only

26 NUCOR CORPORATION
(Utah Mill)

S

Bars #4 through #18 only

APPENDIX A (Cont.)

U.S. MANUFACTURERS OF CONCRETE REINFORCING BARS

IDENTIFICATION OF U.S. REINFORCING BARS

ASTM and AASHTO Specifications require that all reinforcing bars be identified by permanent, mill imprinted markings. See page 1-3.

27 OWEN ELECTRIC STEEL CO. OF S.C.

S

Bars #3 through #14 only

28 ROANOKE ELECTRIC STEEL CORP.

S

Bars #3 through #11 only

29 SEATTLE STEEL, INC.

S

Bars #3 through #11 only

29 SEATTLE STEEL, INC.

S

#14 and #18 bars only

30 SHEFFIELD STEEL CORPORATION

S

Bars #3 through #14 only

31 SILVER, INC., W.

I

Bars #3 through #6 only

31 SILVER, INC., W.

I

Bars #3 through #6 only

31 SILVER, INC., W.

I

Bars #3 through #6 only
Grade mark line on opposite side

32 SMI STEEL - ARKANSAS

I

Bars #3 through #11 only

32 SMI STEEL - ARKANSAS

I

Bars #3 through #6 only

33 STRUCTURAL METALS, INC.

S

Bars #3 through #11 only

33 STRUCTURAL METALS, INC.

S

#14 and #18 bars only

34 TAMCO

S

34 TAMCO

S

Bars #4 and #5 only

34 TAMCO

S

Bars #6 through #18 only

35 THOMAS STEEL CORPORATION

S

36 USX CORPORATION

S

APPENDIX A (Cont.)

U.S. MANUFACTURERS OF CONCRETE REINFORCING BARS

NUMBERS REFER TO BAR MARK PHOTOS

1. A.B. STEEL MILL, INC.
   Cincinnati, Ohio
2. ARMCO, INC.
   Kansas City, Missouri
3. ATLANTIC STEEL COMPANY
   Atlanta, Georgia
4. AUBURN STEEL COMPANY
   Auburn, New York
5. BAYOU STEEL CORPORATION
   La Place, Louisiana
6. BIRMINGHAM STEEL CORPORATION
   Birmingham, Alabama
7. BORDER STEEL MILLS, INC.
   El Paso, Texas
8. CALUMET STEEL COMPANY
   Chicago Heights, Illinois
9. CASCADE STEEL ROLLING MILLS, INC.
   McMinnville, Oregon
10. CF & I STEEL CORPORATION
    Pueblo, Colorado
11. CHAPARRAL STEEL COMPANY
    Midlothian, Texas
12. CHICAGO HEIGHTS STEEL
    Chicago Heights, Illinois
13. COMMERCIAL STEEL CORPORATION
    Glassport, Pennsylvania
14. CONNECTICUT STEEL CORPORATION
    Wallingford, Connecticut
15. FLORIDA STEEL CORPORATION
    Tampa, Florida
16. FRANKLIN STEEL COMPANY
    Franklin, Pennsylvania
17. GEORGETOWN STEEL CORPORATION
    Georgetown, South Carolina
18. HAWAIIAN WESTERN STEEL, LTD.
    Ewa Beach, Hawaii
19. INLAND STEEL COMPANY
    Chicago, Illinois
20. LACLEDE STEEL COMPANY
    St. Louis, Missouri
21. LTV STEEL COMPANY
    Cleveland, Ohio
22. MARION STEEL COMPANY
    Marion, Ohio
23. NEW JERSEY STEEL CORPORATION
    Sayreville, New Jersey
24. NORTH STAR STEEL COMPANY
    Minneapolis, Minnesota
25. NORTHWESTERN STEEL & WIRE CO.
    Sterling, Illinois
26. NUCOR STEEL CORPORATION
    Norfolk, Nebraska
27. OWEN ELECTRIC STEEL COMPANY OF S.C.
    Cayce, South Carolina
28. ROANOKE ELECTRIC STEEL CORP.
    Roanoke, Virginia
29. SEATTLE STEEL, INC.
    Seattle, Washington
30. SHEFFIELD STEEL CORPORATION
    Sand Springs, Oklahoma
31. SILVER, INC., W.
    El Paso, Texas
32. SMI STEEL—ARKANSAS
    Magnolia, Arkansas
33. STRUCTURAL METALS, INC.
    Seguin, Texas
34. TAMCO
    Etiwanda, California
35. THOMAS STEEL CORPORATION
    Lemont, Illinois
36. USX CORPORATION
    Pittsburgh, Pennsylvania