SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1442

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(R) High-Strength, Hot-Rolled Steel Bars

Foreword—High-strength steel discussed in this SAE Recommended Practice involves hot-rolled bars only. The strength is achieved through chemical composition and rolling practice; it is not achieved through quenching and tempering or additional rolling operations.

1. ***Scope***—This SAE Recommended Practice covers two levels of high strength structural low-alloy steel bars having minimum Yield Points of 345 MPa (50 ksi) and 450 MPa (65 ksi).

The two strength levels are 345 and 450 MPa or 50 and 65 ksi minimum yield point. Different chemical compositions are used to achieve the specified mechanical properties. In some cases there are significant differences in chemical composition for the same strength level, depending on the fabricating requirements.

It should be noted that although the mechanical properties for a steel grade sourced from different suppliers may be the same, the chemical composition may vary significantly. The fabricator should be aware that certain compositional differences may effect the forming, welding, and/or service requirements of the material. It is therefore recommended that the fabricator consult with the producer to understand the effect of chemical composition.

The products within the scope of this document include bars of the following types and sizes:

Rounds, squares, and hexagons of all sizes (cut length only), flats 5.2 mm (0.203 in) and greater in thickness but not greater than 150 mm (6 in) wide, and flats greater than 5.8 mm (0.229 in) thick and over 150 mm (6 in) to 204 mm (8 in) wide.

This document previously covered plates, structural shapes, and bar size shapes of Grades 290A, 345A, 415A, 450A, 345W, 345F, 415F, 485F, and 550F as well as bars of Grades 290A, 415A, and 345W. These products are no longer covered; requirements for these products and grades can be found in ASTM Specifications as follows in Table 1:

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: http://www.sae.org

TABLE 1—EQUIVALENT ASTM SPECIFICATIONS

Product	Previous SAE Grade	ASTM Specification/Grade
Plates, Structural Shapes, Bar Size Shapes, Bars	290A	A 572/A 572M, Grade 42
Plates, Structural Shapes, Bar Size Shapes	345A	A 572/A 572M, Grade 50
Plates, Structural Shapes, Bar Size Shapes, Bars	415A	A 572/A 572M, Grade 60
Plates, Structural Shapes, Bar Size Shapes	450A	A 57/A 572M, Grade 65
Plates, Structural Shapes, Bar Size Shapes, Bars	345W	A 588/A 588M
Plates	345F	A 656/A 656M, Grade 50
Plates	415F	A 656/A 656M, Grade 60
Plates	485F	A 656/A 656M, Grade 70
Plates	550F	A 656/A 656M, Grade 80

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein.

2.1.1 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 6/A 6M—General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars of Structural Use
ASTM A 370—Standard Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 572/A 572M—Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
ASTM A 588/A 588M—Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in thick
ASTM A 656/A 656M—Specification for Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability

2.2 Related Publications—The following publication is provided for information purposes only and is not a required part of this specification. Unless otherwise indicated, the latest version of SAE publications shall apply.

SAE J450—Use of Terms Yield Strength and Yield Point

***3. General Information*—**The specific grades are identified by the minimum yield point expressed in MPa, that is 345 and 450 or in ksi that is 50 and 65 ksi. Grades 345 and 450 are similar to grades contained in ASTM A 572/A 572M. These Grades were previously covered under this specification as Grades 345A and 450A; the "A" suffix has been dropped in this revision.

Because these steels are characterized by their special mechanical properties obtained in the as-rolled conditions, they are not intended for any heat treatment by the purchaser either before, during, or after fabrication. The fabricator should not subject these steels to such heat treatments without assuming responsibility for the resulting mechanical properties. For certain applications, these steels may be annealed, normalized, or stress relieved with some effect on the mechanical properties; it is recommended that prior to such heat treatments, the purchaser should consult the producer to determine the need for and the effect on mechanical properties.

Both grades and chemical compositions discussed in the practice are weldable despite the differences in carbon, manganese, and alloying addition. Because of the aforementioned variations in composition from one producer to another, it is advisable to discuss with the producers the features of their chemical composition relative to the various types of welding and any special consideration for each application.

These steels, because of their high strength-to-weight ratio, are adapted particularly for use in mobile equipment and other structures where substantial weight savings are generally desirable.

4. ***Mechanical Properties***—The mechanical properties of these steels are shown in Table 2. If thicknesses greater than those shown in the table are required, consultation with the producers regarding availability and characteristics is suggested.

5. ***Chemical Composition***—The chemical composition (heat analysis) of steel furnished to this practice shall conform to Table 3.

   Because the chemical compositions vary significantly among the producers despite the required mechanical properties being the same, it is advisable for the purchaser to discuss specific compositions with each producer, especially if welding, and/or forming are critical factors. The commonly used alloying elements are: chromium, columbium (niobium), copper, molybdenum, nickel, titanium, vanadium, and zirconium. The selection and chemical ranges for any alloying elements not in Table 3, which are considered necessary to attain the required properties, may be specified by mutual agreement between purchaser and producer at the time of ordering. Once specified, they may not be changed without both parties' consent.

6. ***Suggested Bending Practice***—The suggested minimum inside bend radii for cold forming are shown in Table 4. The suggested radii listed in Table 4 should be used as minimums in typical shop fabrication. Material that does not form satisfactorily when fabricated in accordance with Table 4 may be subject to rejection pending negotiation with the steel supplier. When tighter bends are required, the manufacturer should be consulted. the bend radius and the radius of the male die should be as liberal as the finished part will permit. The width across the shoulders of the female die should be at least eight times the plate thickness. Higher strength steels require larger die openings. The surface of the dies in the area of radius should be smooth.

   Since cracks in cold bending commonly originate from the outside edges, shear burrs and gas cut edges should be removed by grinding. Sharp corners on edges and on punched or gas cut holes should be removed by chamfering or grinding to a radius. It should be noted that all steel has a tendency to crack when bent on a sheared or gas cut edge. This is not to be considered a fault of the steel, but rather a function of the induced cold work or heat affected zone. Where bends are to be made on a sheared edge, best performance is attained when the shear burr is located on the inside of the bend.

   If possible, parts should be formed such that the bend line is perpendicular to the direction of final rolling. If it is necessary to bend with the bend line parallel to the direction of final rolling, a more generous radius is suggested (1-1/2 times applicable value given in Table 4 for bend lines perpendicular to the direction of rolling.)

7. ***Dimensional Tolerances***—Standard manufacturing tolerances for dimensions, as shown in the latest edition of ASTM A 6/A 6M shall apply.

TABLE 2—MECHANICAL PROPERTIES[1]

Grade	Nominal Maximum Thickness mm	Nominal Maximum Thickness in	Yield Point[2][3] Minimum MPa	Yield Point[2][3] Minimum ksi	Tensile Strength[3][4] Minimum MPa	Tensile Strength[3][4] Minimum ksi	Elongation[3] Minimum % Minimum 200 mm (8 in)	Elongation[3][5] Minimum % Minimum 50 mm (2 in)	Tensile Strength,[4] Max MPa	Tensile Strength,[4] Max ksi
345	100	4	345	50	450	65	18	21	655	95
450	32	1-1/4	450	65	550	80	15	17	725	105

1. Mechanical testing (location, number of tests, preparation, and method) is to be in accordance with the latest revision of ASTM A 6/A 6M.
2. Yield point may be reported as yield strength as measured by the 0.2% offset or 0.5% extension under load method as agreed upon between the producer and the purchaser.
3. Only one set of units apply to yield and tensile and the reported value should be based on the units of the purchase order. In addition only one set of elongation values 50 mm (2 in) or 200 mm (8 in) need to be met and reported.
4. Some applications may require a maximum tensile strength. In such cases, the following values must be determined from the producer for acceptance prior to issuing a purchase order.
5. Refer to ASTM A 6/A 6M elongation requirement adjustments.

TABLE 3—CHEMICAL COMPOSITION, HEAT ANALYSIS, MAX, % BY WEIGHT

Grade	C	Mn	Si	P	S	Other
345	0.21	1.50	0.40	0.040	0.050	(1)
450	0.26	1.65	0.40	0.040	0.050	(1)

1. Choice and use of alloying elements, combined with carbon, manganese, silicon, phosphorus and sulfur within the limits of Table 3 to give the mechanical properties prescribed in Table 2, shall be made by the manufacturer and included and reported in the heat analysis to identify the type of steel applied. Element commonly added include: chromium, copper, molybdenum, nickel, niobium (columbium), vanadium, titanium, and zirconium.

TABLE 4—SUGGESTED MINIMUM INSIDE RADII FOR 90-DEGREE COLD BENDING—RATIO OF BEND RADIUS TO THICKNESS THICKNESS OF MATERIAL, mm (in)

Grade	to 20 (3/4) incl.	Over 20 (3/4) to 25 (1) incl.	Over 25 (1) to 50 (2) incl.	Over 50 (2)
345	1.5	1.5	2.0	2.5
450	1.5	1.5	3.0	3.5