

**SPECIFICATION FOR STEEL, SHEET, COLD-ROLLED,
CARBON, STRUCTURAL, HIGH-STRENGTH LOW-ALLOY
AND HIGH-STRENGTH LOW-ALLOY WITH IMPROVED
FORMABILITY**



SA-1008/SA-1008M

(Identical with ASTM Specification A1008/A1008M-01a except for the addition of 8.1.1.1 on mechanical properties for pressure vessel design.)

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SA-1008/SA-1008M

(Identical with ASTM Specification A 1008/A 1008M-01a except for the addition of 8.1.1.1 on mechanical properties for pressure vessel design.)

1. Scope

1.1 This specification covers cold rolled structural, high-strength low-alloy, and high-strength low-alloy with improved formability steel sheet, in coils and cut lengths.

1.2 Cold rolled steel sheet is available in the designations as listed in 4.1.

1.3 This specification does not apply to steel strip as described in Specification A 109.

1.4 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other.

2. Referenced Documents

2.1 ASTM Standards:

- A 109 Specification for Steel, Strip, Carbon, Cold Rolled
- A 366/A 366M Specification for Commercial Steel (CS), Sheet, Carbon (0.15 Maximum Percentage), Cold-Rolled
- A 370 Test Methods and Definitions for Mechanical Testing of Steel Products
- A 568/A 568M Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
- A 620/A 620M Specification for Drawing Steel (DS), Sheet, Carbon, Cold-Rolled
- A 941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
- E 517 Test Method for Plastic Strain Ratio r for Sheet Metal
- E 646 Test Method for Tensile Strain-Hardening Exponents (n -Values) of Metallic Sheet Materials

3. Terminology

3.1 Definitions:

3.1.1 For definitions of other terms used in this specification, refer to Terminology A 941.

3.1.2 *stabilization* — the addition of one or more nitride or carbide forming elements, or both, such as titanium and columbium, to control the level of the interstitial elements of carbon and nitrogen in the steel.

3.1.2.1 *Discussion* — Stabilizing improves formability and increases resistance to aging.

3.1.3 *vacuum degassing* — a process of refining liquid steel in which the liquid is exposed to a vacuum as part of a special technique for removing impurities or for decarburizing the steel.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *aging* — loss of ductility with an increase in hardness, yield strength, and tensile strength that occurs when steel that has been slightly cold worked (such as by temper rolling) is stored for some time.

3.2.1.1 *Discussion* — Aging increases the tendency of a steel to exhibit stretcher strains and fluting.

4. Classification

4.1 Cold-rolled steel sheet is available in the following designations:

4.1.1 Commercial Steel (CS Types A, B, and C),

4.1.2 Drawing Steel (DS Types A and B),

NOTE 1 — CS Type B and DS Type B describe the most common product previously included, respectively, in Specifications A 366/A 366M and A 620/A 620M.

4.1.3 Deep Drawing Steel (DDS),

4.1.4 Extra Deep Drawing Steel (EDDS),

4.1.5 Structural Steel (SS grades 25[170], 30[205], 33[230] Types 1 and 2, 40[275] Types 1 and 2, and 80[550]),

4.1.6 High-Strength Low-Alloy Steel (HSLAS, in classes 1 and 2, in grades 45[310], 50[340], 55[380], 60[410], 65[450], and 70[480] in Classes 1 and 2), and

4.1.7 High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F grades 50 [340], 60 [410], 70 [480], and 80 [550]).

4.1.7.1 HSLAS-F steel has improved formability when compared to HSLAS. The steel is fully deoxidized, made to fine grain practice and includes microalloying elements such as columbium, vanadium, zirconium, etc. The steel may be treated to achieve inclusion control.

4.2 Cold-rolled steel sheet is supplied for either exposed or unexposed applications. Within the latter category, cold-rolled sheet is specified either “temper rolled” or “annealed last.” For details on processing, attributes and limitations, and inspection standards, refer to Specification A 568/A 568M.

5. Ordering Information

5.1 It is the purchaser’s responsibility to specify in the purchase order all ordering information necessary to describe the required material. Examples of such information include, but are not limited to, the following:

5.1.1 ASTM specification number and year of issue,

5.1.2 Name of material and designation (cold-rolled steel sheet) (include grade, type, and class, as appropriate, for CS, DS, DDS, EDDS, SS, HSLAS, or HSLAS-F) (see 4.1),

5.1.2.1 When a type is not specified for CS or DS, Type B will be furnished (see 4.1),

5.1.2.2 When a class is not specified for HSLAS, Class 1 will be furnished (see 4.1),

5.1.2.3 When a type is not specified for SS33 [230] and SS40 [275], Type 1 will be furnished (see 4.1),

5.1.3 Classification (either exposed, unexposed, temper rolled, or annealed last) (see 4.2),

5.1.4 Finish (see 9.1),

5.1.5 Oiled or not oiled, as required (see 9.2),

5.1.6 Dimensions (thickness, thickness tolerance table (see 5.1.6.1), width, and whether cut lengths or coils),

5.1.6.1 As agreed upon between the purchaser and the producer, material ordered to this specification will be supplied to meet the applicable thickness tolerance table shown in Specification A 568/A 568M,

NOTE 2 — Not all producers are capable of meeting all the limitations of the thickness tolerance tables in Specification A 568/A 568M. The purchaser should contact the producer regarding possible limitations prior to placing an order.

5.1.7 Coil size (must include inside diameter, outside diameter, and maximum weight),

5.1.8 Copper bearing steel (if required),

5.1.9 Quantity,

5.1.10 Application (part identification and description),

5.1.11 Special requirements (if required), or supplementary requirement S1 for HSLAS, and

5.1.12 A report of heat analysis will be supplied, if requested, for CS, DS, DDS, and EDDS. For materials with required mechanical properties, SS, HSLAS, and HSLAS-F, a report is required of heat analysis and mechanical properties as determined by the tension test.

NOTE 3 — A typical ordering description is as follows: ASTM A 1008-XX, cold rolled steel sheet, CS Type A, exposed, matte finish, oiled, 0.035 by 30 in. by coil, ID 24 in., OD 48 in., max weight 15 000 lbs, thickness tolerance Table 18 of Specification A 568/A 568M, 100 000 lb, for part No. 4560, Door Panel.

or:

ASTM A 1008M-XX, cold-rolled steel sheet, SS grade 275, unexposed, matte finish, oiled, 0.88 mm by 760 mm by 2440 mm, thickness tolerance Table A1.15 of Specification A 568/A 568M, 10 000 kg, for shelf bracket.

6. General Requirements for Delivery

6.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 568/A 568M unless otherwise provided herein.

7. Chemical Composition

7.1 The heat analysis of the steel shall conform to the chemical composition requirements of the appropriate designation shown in Table 1 for CS, DS, DDS, and EDDS and in Table 2 for SS, HSLAS, and HSLAS-F.

7.2 Each of the elements listed in Table 1 and Table 2 shall be included in the report of the heat analysis. When the amount of copper, nickel, chromium, or molybdenum is less than 0.02%, the analysis may be reported as < 0.02%. When the amount of vanadium, columbium, or titanium is less than 0.008%, the analysis may be reported as < 0.008%.

7.3 Sheet steel grades defined by this specification are suitable for welding if appropriate welding conditions are selected. For certain welding processes, more restrictive composition limits may be desirable and should be requested at the time of inquiry and ordering.

8. Mechanical Properties

8.1 CS, DS, DDS, and EDDS:

8.1.1 Typical nonmandatory mechanical properties for CS, DS, DDS and EDDS are shown in Table 3.

8.1.1.1 For the purposes of pressure vessel design, the following minimum tensile properties may be assumed, 20 ksi [140 MPa] yield strength and 40 ksi [275 MPa] tensile strength.

8.1.2 The material shall be capable of being bent, at room temperature, in any direction through 180° flat on itself without cracking on the outside of the bent portion (see Section 14 of Test Methods and Definitions A 370).

8.1.3 Sheet of these designations except for EDDS may be subject to aging dependent upon processing factors such as the method of annealing (continuous annealing or box annealing), and chemical composition. For additional information on aging, see Appendix X1 of Specification A 568/A 568M.

8.1.4 EDDS steel is stabilized to be nonaging and so is not subject to stretcher strains and fluting. Other steels may be processed to be nonaging; please consult your supplier.

8.2 SS, HSLAS and HSLAS-F:

8.2.1 The available strength grades for SS, HSLAS and HSLAS-F are shown in Table 4.

8.2.2 Tension Tests:

8.2.2.1 Requirements — Material as represented by the test specimen shall conform to the mechanical property requirements specified in Table 4. These requirements do not apply to the uncropped ends of unprocessed coils.

8.2.2.2 Number of Tests — Two tension tests shall be made from each heat or from each 50 tons [45 000 kg]. When the amount of finished material from a heat is less than 50 tons [45 000 kg], one test shall be made. When material rolled from heat differs 0.050 in. [1.27 mm] or more in thickness, one tension test shall be made from the thickest and thinnest material regardless of the weight represented.

8.2.2.3 Tension test specimens shall be taken at a point immediately adjacent to the material to be qualified.

8.2.2.4 Tension test specimens shall be taken from the full thickness of the sheet.

8.2.2.5 Tension test specimens shall be taken from a location approximately halfway between the center of the sheet and the edge of the material as rolled.

8.2.2.6 Tension test samples shall be taken with the lengthwise axis of the test specimen parallel to the rolling direction (longitudinal test).

8.2.2.7 Test Method — Yield strength shall be determined by either the 0.2% offset method or the 0.5% extension under load method unless otherwise specified.

8.2.3 Bending Properties:

8.2.3.1 The suggested minimum inside radii for cold bending are listed in Appendix X1 and is discussed in more detail in Specification A 568/A 568M (Section 6). Where a tighter bend radius is required, where curved or offset bends are involved, or where stretching or drawing are also a consideration, the producer should be consulted.

9. Finish and Appearance

9.1 Surface Finish:

9.1.1 Unless otherwise specified, the sheet shall have a matte finish. When required, a controlled surface texture and condition may be specified.

For additional information see “Finish and Condition” section of Specification A 568/A 568M.

9.2 Oiling:

9.2.1 Unless otherwise specified, the sheet shall be oiled.

9.2.2 When required, the sheet may be specified to be furnished not oiled (dry).

10. Retests and Resamples

10.1 Retests — If the results on an original tension test specimen are within 2 ksi [14 MPa] of the required tensile strength, within 1 ksi [7 MPa] of the required yield point, or within two percentage points of the required elongation, a retest shall be permitted for which one test specimen selected at random shall be tested. If the results of this retest specimen satisfy the specified mechanical properties and all other requirements of the applicable specification are satisfied, the material shall be accepted. Retests are permitted in accordance with Specification A 568/A 568M.

10.2 Resamples — Resamples are permitted in accordance with Specification A 568/A 568M.

11. Certification

11.1 A report of heat analysis shall be supplied, if requested, for CS, DS, DDS, and EDDS steels. For material with required mechanical properties, SS, HSLAS, and HSLAS-F, a report is required of heat analysis and mechanical properties as determined by the tension test.

11.2 The report shall include the purchase order number, the ASTM designation number and year date, product designation, grade, type or class, as applicable, the heat number, and as required, heat analysis and mechanical properties as indicated by the tension test.

11.3 A signature is not required on the test report. However, the document shall clearly identify the organization submitting the report. Notwithstanding the absence of a signature, the organization submitting the report is responsible for the content of the report.

11.4 A Material Test Report, Certificate of Inspection, or similar document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifier’s facility. The content of the EDI transmitted document must meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the supplier. Notwithstanding the absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

12. Product Marking

12.1 In addition to the requirements of Specification A 568/A 568M, each lift or coil shall be marked with the designation shown on the order {CS (Type A, B, or C), DS (Type A or B), DDS, EDDS, SS, HSLAS, or HSLAS-F}. The designation shall be legibly stenciled on the top of each lift or shown on a tag attached to each coil or shipping unit.

13. Keywords

13.1 carbon steel sheet; cold-rolled steel sheet; steel sheet; commercial steel; drawing steel; deep drawing steel; extra deep drawing steel; high-strength low-alloy steel; high-strength low-alloy steel with improved formability; structural steel

**TABLE 1 CHEMICAL COMPOSITION^A
FOR COLD ROLLED STEEL SHEET DESIGNATIONS CS, DS, DDS, AND EDDS**

Designation	Composition, % Heat Analysis (Element Maximum Unless Otherwise Shown)													
	C	Mn	P	S	Al	Si	Cu ^B	Ni ^B	Cr ^{B, C}	Mo ^B	V	Cb	Ti	N
CS Type A ^{D, E, F, G}	0.10	0.60	0.030	0.035	...	...	0.20 ^H	0.20	0.15	0.06	0.008	0.008	0.008 ^I	...
CS Type B ^D	0.02 to 0.15	0.60	0.030	0.035	...	...	0.20 ^H	0.20	0.15	0.06	0.008	0.008	0.008 ^I	...
CS Type C ^{D, E, F, G}	0.08	0.60	0.10	0.035	...	...	0.20 ^H	0.20	0.15	0.06	0.008	0.008	0.008 ^I	...
DS Type A ^{E, J}	0.08	0.50	0.020	0.030	0.01 min	...	0.20	0.20	0.15	0.06	0.008	0.008	0.008 ^I	...
DS Type B	0.02 to 0.08	0.50	0.020	0.030	0.02 min	...	0.20	0.20	0.15	0.06	0.008	0.008	0.008 ^I	...
DDS ^{F, G}	0.06	0.50	0.020	0.025	0.01 min	...	0.20	0.20	0.15	0.06	0.008	0.008	0.008 ^I	...
EDDS ^K	0.02	0.40	0.020	0.020	0.01 min	...	0.10	0.10	0.15	0.03	0.008	0.10	0.15	...

^A Where an ellipsis (. . .) appears in the table, there is no requirement, but the analysis result shall be reported.
^B The sum of copper, nickel, chromium, and molybdenum shall not exceed 0.50% on heat analysis. When one or more of these elements is specified by the purchaser, the sum does not apply, in which case only the individual limits on the remaining elements shall apply.
^C Chromium is permitted, at the producer’s option, to 0.25% maximum when the carbon content is less than or equal to 0.05%. In such case the limit on the sum of the four elements in Footnote B does not apply.
^D When an aluminum deoxidized steel is required for the application, Commercial Steel (CS) may be ordered to a minimum of 0.01% total aluminum.
^E Specify Type B to avoid carbon levels below 0.02%.
^F May be furnished as a vacuum degassed or chemically stabilized steel, or both, at the producer’s option.
^G For carbon levels less than or equal to 0.02%, columbium or titanium, or both, may be used as stabilizing elements at the producer’s option. In such cases, the applicable limit for columbium shall be 0.10% max. and the limit on titanium shall be 0.15% max.
^H When copper steel is specified, the copper limit is a minimum requirement. When copper steel is not specified, the copper limit is a maximum requirement.
^I Except for EDDS, titanium is permitted, at producer’s option, to 0.025% provided the ratio of % titanium to % nitrogen does not exceed 3.4.
^J DS Type A may be furnished as a vacuum degassed steel, at the producers option.
^K Shall be furnished as a vacuum degassed and stabilized steel.

TABLE 2
CHEMICAL COMPOSITION^A
FOR COLD ROLLED STEEL SHEET DESIGNATIONS SS, HSLAS, AND HSLAS-F

Designation	% Heat Analysis, Element Maximum unless otherwise shown												
	C	Mn	P	S	Al	Si	Cu ^{B, C}	Ni ^B	Cr ^B	Mo ^B	V	Cb	N
SS:													
Grade 25 [170]	0.20	0.60	0.035	0.035	...	...	0.20	0.20	0.15	0.06	0.008	0.008	...
Grade 30 [205]	0.20	0.60	0.035	0.035	...	...	0.20	0.20	0.15	0.06	0.008	0.008	...
Grade 33 [230] Type 1	0.20	0.60	0.035	0.035	...	...	0.20	0.20	0.15	0.06	0.008	0.008	...
Grade 33 [230] Type 2	0.15	0.60	0.20	0.035	...	...	0.20	0.20	0.15	0.06	0.008	0.008	...
Grade 40 [275] Type 1	0.20	0.90	0.035	0.035	...	...	0.20	0.20	0.15	0.06	0.008	0.008	...
Grade 40 [275] Type 2	0.15	0.60	0.20	0.035	...	...	0.20	0.20	0.15	0.06	0.008	0.008	...
Grade 80 [550]	0.20	0.60	0.035	0.035	...	...	0.20	0.20	0.15	0.06	0.008	0.008	...
HSLAS:^D													
Grade 45 [310] Class 1	0.22	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	...
Grade 45 [310] Class 2	0.15	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	...
Grade 50 [340] Class 1	0.23	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	...
Grade 50 [340] Class 2	0.15	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	...
Grade 55 [380] Class 1	0.25	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	...
Grade 55 [380] Class 2	0.15	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	...
Grade 60 [410] Class 1	0.26	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	...
Grade 60 [410] Class 2	0.15	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	0.020
Grade 65 [450] Class 1	0.26	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	0.012
Grade 65 [450] Class 2	0.15	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	0.020
Grade 70 [780] Class 1	0.26	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	0.012
Grade 70 [780] Class 2	0.15	1.65	0.04	0.04	...	...	0.20	0.20	0.15	0.06	0.01 min	0.005 min	0.020
HSLAS-F:^E													
Grade 50 [340], 60 [410], 70 [480], and 80 [550]	0.15	1.65	0.020	0.025	...	...	0.20	0.20	0.15	0.06	...	...	...

^A Where an ellipsis (. . .) appears in the table, there is no requirement but, the analysis shall be reported.

^B The sum of copper, nickel, chromium, and molybdenum shall not exceed 0.50%. When one or more of these elements are specified by the purchaser, the sum does not apply, in which case, only the individual limits on the remaining unspecified elements will apply.

^C When copper is specified, the copper limit is a minimum requirement. When copper steel is not specified, the copper limit is a maximum requirement.

^D For HSLAS steels, columbium and vanadium may be added singly or in combination.

^E These steels shall also contain one or more of the following elements: vanadium, titanium, and columbium. Other alloying elements may be present, but are not required.

TABLE 3
TYPICAL RANGES OF MECHANICAL PROPERTIES^A (NONMANDATORY)^B
FOR COLD ROLLED STEEL SHEET DESIGNATIONS CS, DS, DDS, AND EDDS

Designation	Yield Strength ^C		Elongation in 2 in. [50 mm] % ^C	r_m Value ^D	n -Value ^E
	ksi	MPa			
CS Types A, B, and C	20 to 40	[140 to 275]	≥ 30	<i>F</i>	<i>F</i>
DS Types A and B	22 to 35	[150 to 240]	≥ 36	1.3 to 1.7	0.17 to 0.22
DDS	17 to 29	[115 to 200]	≥ 38	1.4 to 1.8	0.20 to 0.25
EDDS	15 to 25	[105 to 170]	≥ 40	1.7 to 2.1	0.23 to 0.27

^A These typical mechanical properties apply to the full range of steel sheet thicknesses. The yield strength tends to increase, the elongation decreases, and some of the formability values tend to decrease as the sheet thickness decreases.

^B The typical mechanical property values presented here are nonmandatory. They are provided to assist the purchaser in specifying a suitable steel for a given application. Values outside of these ranges are to be expected.

^C Yield Strength and elongation are measured in the longitudinal direction in accordance with Test Methods A 370.

^D Average plastic strain ratio (r_m value) as determined by Test Method E 517.

^E The strain hardening exponent (n -value) as determined by Test Method E 646.

^F No typical properties have been established.

TABLE 4
MECHANICAL PROPERTY REQUIREMENTS^A
FOR COLD ROLLED STEEL SHEET DESIGNATIONS SS, HSLAS, AND HSLAS-F

Designation	Yield Strength, min.		Tensile Strength, min.		Elongation in 2 in. or 50 mm, min., %
	ksi	[MPa]	ksi	[MPa]	
SS:					
Grade 25 [170]	25	[170]	42	[290]	26
Grade 30 [205]	30	[205]	45	[310]	24
Grade 33 [230] Types 1 and 2	33	[230]	48	[330]	22
Grade 40 [275] Types 1 and 2	40	[275]	52	[360]	20
Grade 80 [550]	80 ^B	[550]	82	[565]	^C
HSLAS:					
Grade 45 [310] Class 1	45	[310]	60	[410]	22
Grade 45 [310] Class 2	45	[310]	55	[380]	22
Grade 50 [340] Class 1	50	[340]	65	[450]	20
Grade 50 [340] Class 2	50	[340]	60	[410]	20
Grade 55 [380] Class 1	55	[380]	70	[480]	18
Grade 55 [380] Class 2	55	[380]	65	[450]	18
Grade 60 [410] Class 1	60	[410]	75	[520]	16
Grade 60 [410] Class 2	60	[410]	70	[480]	16
Grade 65 [450] Class 1	65	[450]	80	[550]	15
Grade 65 [450] Class 2	65	[450]	75	[520]	15
Grade 70 [480] Class 1	70	[480]	85	[585]	14
Grade 70 [480] Class 2	70	[480]	80	[550]	14
HSLAS-F:					
Grade 50 [340]	50	[340]	60	[410]	22
Grade 60 [410]	60	[410]	70	[480]	18
Grade 70 [480]	70	[480]	80	[550]	16
Grade 80 [550]	80	[550]	90	[620]	14

^A For coil products, testing by the producer is limited to the end of the coil. Mechanical properties throughout the coil shall comply with the minimum values specified.

^B On this full-hard product, the yield strength approaches the tensile strength, and since there is no halt in the gage or drop in the beam, the yield point shall be taken as the yield stress at 0.5% extension under load.

^C There is no requirement for elongation in 2 in. for SS Grade 80.

SUPPLEMENTARY REQUIREMENTS FOR COLD ROLLED HSLAS STEEL SHEET

The following supplementary requirements shall apply when specified in the order or contract:

S1. Elements

S1.1 When a purchaser prefers to designate the specific elements (columbium, vanadium, nitrogen, or combinations thereof), one of the types listed below shall be specified. The type, in addition to the grade, must be shown on the order:

Type 1 — Columbium

Type 2 — Vanadium

Type 3 — Columbium and Vanadium

Type 4 — Vanadium and Nitrogen

S1.2 The composition limits of Section 7 shall apply for any of these elements.

APPENDIX

(Nonmandatory Information)

X1. BENDING PROPERTIES

TABLE X1.1
SUGGESTED MINIMUM INSIDE RADIUS FOR COLD BENDING

Product	Grade	Minimum Inside Radius for Cold Bending	
Structural Steel	25[170]	$\frac{1}{2} t$	
	30[205]	1 t	
	33[230]	$1\frac{1}{2} t$	
	40[275]	2 t	
	80[550]	not applicable	
High-Strength Low-Alloy Steel		<u>Class 1</u>	<u>Class 2</u>
	45[310]	$1\frac{1}{2} t$	$1\frac{1}{2} t$
	50[340]	2 t	$1\frac{1}{2} t$
	55[380]	2 t	2 t
	60[410]	$2\frac{1}{2} t$	2 t
	65[450]	3 t	$2\frac{1}{2} t$
	70[480]	$3\frac{1}{2} t$	3 t
High-Strength Low-Alloy Steel with Improved Formability	50[340]	1 t	
	60[410]	$1\frac{1}{2} t$	
	70[480]	2 t	
	80[550]	2 t	

NOTE 1 — (t) Equals a radius equivalent to the steel thickness.

NOTE 2 — The suggested radius should be used as a minimum for 90° bends in actual shop practice.

NOTE 3 — Material which does not perform satisfactorily, when fabricated in accordance with the requirements, may be subject to rejection pending negotiation with the steel supplier.