Standard Specification for
Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength
Low-Alloy, High-Strength Low-Alloy with Improved
Formability, Solution Hardened, and Bake Hardenable

This standard is issued under the fixed designation A 1008/A 1008M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers cold-rolled, carbon, structural, high-strength low-alloy, high-strength low-alloy with improved formability, solution hardened, and bake hardenable 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/A 109M.

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/A 109M Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled
A 366/A 366M Specification for Commercial Steel (CS) Sheet, Carbon (0.15 Maximum Percent) Cold-Rolled
A 370 Test Methods and Definitions for Mechanical Testing of Steel Products
A 568/A 568M Specification for Steel, Sheet, Carbon, Structural, 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 18 Test Methods for Rockwell Hardness of Metallic Materials
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 of Terms Specific to This Standard:

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

3.1.2 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.

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

3.1.3 bake hardenable steel—steel in which significant aging is realized when moderate heat treatment, such as that used for paint baking, follows straining or cold working.

3.1.4 solid-solution hardened steel or solution hardened steel—steel strengthened through additions of elements, such as Mn, P, or Si, that can be dissolved within the crystalline structure of steels.

3.1.4.1 Discussion—Alloying elements that form a solid-solution with iron provide strengthening as a result of local distortions in atomic arrangements, which arise as a result of the mismatch between the atomic sizes of such elements and that of iron.

3.1.5 stabilization—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.

3.1.5.1 Discussion—Stabilizing improves formability and increases resistance to aging.

3.1.6 vacuum degassing—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.

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),
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, HSLAS-F, SHS, or BHS) (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 SS 33 [230] and SS 40 [275], Type 1 will be furnished (see 4.1);
5.1.3 Classification (either exposed, unexposed, temper rolled, or annealed last) (see 4.3);
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;

5.1.6.2 When a grade is not specified for HSLAS and HSLAS-F steels, limits on the use of one or more of the microalloy elements shall be specified on the order.
5.1.6.3 High-Strength Steel (HSLAS-F grades 50, 60, 70, and 80).

5.1.6.4 When ordered for HSLAS and HSLAS-F steels, limitations on the use of one or more of the microalloy elements shall be specified on the order.
5.1.6.5 Cold-rolled steel sheet is supplied for either exposed or unexposed applications. Within the latter category, cold-rolled sheet shall be specified either “temper rolled” or “annealed last.” For details on processing, attributes and limitations, and inspection standards, refer to Specification A 568/A 568M.

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

5.2 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.

6. Chemical Composition

6.1 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, HSLAS-F, SHS, and BHS.

6.2 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 %, report the analysis as <0.02 % or the actual determined value. When the amount of vanadium, columbium, or titanium is less than 0.008 %, report the analysis as <0.008 % or the actual determined value. When the amount of boron is less than 0.0005 %, report the analysis as <0.0005 % or the actual determined value.

7. Mechanical Properties

7.1 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). The bend test is not a requirement of delivery. However, if testing is performed by

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.

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), 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, HSLAS-F, SHS, and BHS, 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.

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.
Consideration should be made for the use of nitrogen binding elements (for example, vanadium, titanium).

The producer, nitrogen may be a deliberate addition. 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.

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

For carbon levels less than or equal to 0.02 %, it is permissible to use vanadium, columbium or titanium, or a combination thereof, as stabilizing elements at the producer’s option. In such cases, the applicable limit for vanadium or columbium shall be 0.10 % max. and the limit on titanium shall be 0.15 % max.

It is permissible to furnish as a vacuum degassed or chemically stabilized steel, or both, at the producer’s option.

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

When an aluminum deoxidized steel is required for the application, it is permissible to order Commercial Steel (CS) to a minimum of 0.01 % total aluminum.

For steels containing 0.02 % or more carbon, titanium is permitted at the producer’s option, to the lesser of 3.4N + 1.5S or 0.025 %.

Chromium is permitted, at the producer’s option, to 0.25 % maximum when the carbon content is less than or equal to 0.05 %.

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

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

Shall be furnished as a vacuum degassed and stabilized steel.

TABLE 1 Chemical Composition
For Cold Rolled Steel Sheet Designations CS, DS, DDS, and EDDS

| Designation | C  | Mn  | P   | S   | Al  | Si  | Cu  | Ni  | Cr† | Mo  | V  | Nb | Tietable 1 | C  |
|-------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|----||
| CS Type A,E,F,G | 0.10 | 0.60 | 0.030 | 0.035 | . . . | . . . | 0.20 | . . . | 0.20 | 0.15 | 0.06 | 0.008 | 0.008 | 0.025 |
| CS Type B§ | 0.02 | 0.60 | 0.030 | 0.035 | . . . | . . . | 0.20 | . . . | 0.20 | 0.15 | 0.06 | 0.008 | 0.008 | 0.025 |
| CS Type C,D,E,F,G | 0.08 | 0.60 | 0.10 | 0.035 | . . . | . . . | 0.20 | . . . | 0.20 | 0.15 | 0.06 | 0.008 | 0.008 | 0.025 |
| DS Type A,F | 0.08 | 0.50 | 0.020 | 0.030 | 0.01 min | . . . | 0.20 | . . . | 0.20 | 0.15 | 0.06 | 0.008 | 0.008 | 0.025 |
| DS Type B | 0.02 | 0.50 | 0.020 | 0.030 | 0.02 min | . . . | 0.20 | . . . | 0.20 | 0.15 | 0.06 | 0.008 | 0.008 | 0.025 |
| DDS†,G | 0.06 | 0.50 | 0.020 | 0.025 | 0.01 min | . . . | 0.20 | . . . | 0.20 | 0.15 | 0.06 | 0.008 | 0.008 | 0.025 |

[table continues]

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

$B$ For steels containing 0.02 % or more carbon, titanium is permitted at the producer’s option, to the lesser of 3.4N + 1.5S or 0.025 %.

$C$ When an aluminum deoxidized steel is required for the application, it is permissible to order Commercial Steel (CS) to a minimum of 0.01 % total aluminum.

$D$ Specify Type B to avoid carbon levels below 0.02 %.

$E$ It is permissible to furnish as a vacuum degassed or chemically stabilized steel, or both, at the producer’s option.

$F$ For carbon levels less than or equal to 0.02 %, it is permissible to use vanadium, columbium or titanium, or a combination thereof, as stabilizing elements at the producer’s option. In such cases, the applicable limit for vanadium or columbium shall be 0.10 % max. and the limit on titanium shall be 0.15 % max.

8.1.3 Sheet of these designations except for EDDS are subject to aging dependent upon processing factors such as the

8.1.3 Sheet of these designations except for EDDS are subject to aging dependent upon processing factors such as the

8.1.3 Sheet of these designations except for EDDS are subject to aging dependent upon processing factors such as the

8.1.3 Sheet of these designations except for EDDS are 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 XI 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 are processed to be nonaging; please consult your supplier.

### TABLE 3 Typical Ranges of Mechanical Properties
(Nonmandatory)
For Cold Rolled Steel Sheet Designations CS, DS, DDS and EDDS

<table>
<thead>
<tr>
<th>Designation</th>
<th>Yield Strength</th>
<th>Elongation in 2 in. [50 mm]</th>
<th>( r_m ) Value</th>
<th>( n ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ksi</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS Types A, B, and C</td>
<td>20 to 40 [140 to 275]</td>
<td>( \geq 30 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DS Types A and B</td>
<td>22 to 35 [150 to 240]</td>
<td>( \geq 36 )</td>
<td>1.3 to 1.7</td>
<td>0.17 to 0.22</td>
</tr>
<tr>
<td>DDS</td>
<td>17 to 29 [115 to 200]</td>
<td>( \geq 38 )</td>
<td>1.4 to 1.8</td>
<td>0.20 to 0.25</td>
</tr>
<tr>
<td>EDDS</td>
<td>15 to 25 [105 to 170]</td>
<td>( \geq 40 )</td>
<td>1.7 to 2.1</td>
<td>0.23 to 0.27</td>
</tr>
</tbody>
</table>

* 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.

** 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.

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

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

\( r \) No typical properties have been established.

### TABLE 4 Mechanical Property Requirements
(Nonmandatory)
For Cold Rolled Steel Sheet Designations SS, HSLAS, and HSLAS-F

<table>
<thead>
<tr>
<th>Designation</th>
<th>Yield Strength, min</th>
<th>Tensile Strength, min</th>
<th>Elongation in 2 in. or 50 mm, min, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ksi [MPa]</td>
<td>ksi [MPa]</td>
<td></td>
</tr>
<tr>
<td>SS:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 33 [230] Types 1 and 2</td>
<td>33 [230]</td>
<td>48 [330]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 40 [275] Types 1 and 2</td>
<td>40 [275]</td>
<td>52 [360]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 60 [410]</td>
<td>60 [410]</td>
<td>75 [480]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 70 [480]</td>
<td>70 [480]</td>
<td>85 [540]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 80 [550]</td>
<td>80 [550]</td>
<td>82 [565]</td>
<td>6</td>
</tr>
<tr>
<td>HSLAS:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 45 [310] Class 1</td>
<td>45 [310]</td>
<td>60 [410]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 45 [310] Class 2</td>
<td>45 [310]</td>
<td>55 [380]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 50 [340] Class 2</td>
<td>50 [340]</td>
<td>60 [410]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 55 [380] Class 1</td>
<td>55 [380]</td>
<td>70 [480]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 60 [410] Class 1</td>
<td>60 [410]</td>
<td>75 [520]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 60 [410] Class 2</td>
<td>60 [410]</td>
<td>70 [480]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 65 [450] Class 1</td>
<td>65 [450]</td>
<td>80 [550]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 65 [450] Class 2</td>
<td>65 [450]</td>
<td>75 [520]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 70 [480] Class 1</td>
<td>70 [480]</td>
<td>85 [585]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 70 [480] Class 2</td>
<td>70 [480]</td>
<td>80 [550]</td>
<td>6</td>
</tr>
<tr>
<td>HSLAS-F:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 60 [410]</td>
<td>60 [410]</td>
<td>70 [480]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 70 [480]</td>
<td>70 [480]</td>
<td>80 [550]</td>
<td>6</td>
</tr>
<tr>
<td>Grade 80 [550]</td>
<td>80 [550]</td>
<td>90 [620]</td>
<td>6</td>
</tr>
</tbody>
</table>

* 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.

\( a \) 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.
8.2 SS, HSLAS, HSLAS-F, SHS, and BHS:

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

8.2.2 The available strength grades for SHS and BHS are shown in Table 5.

8.2.3 Tension Tests:

8.2.3.1 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 uncranked ends of unprocessed coils.

8.2.3.2 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.

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

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

8.2.3.5 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.

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

8.2.3.7 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.

8.2.3.8 Bake hardenable steel shall conform to bake hardening index requirements included in Table 5 for the grade specified. The method for measuring the bake hardening index is described in Annex A1. Bake hardenable steel shall exhibit a minimum increase in yield strength of 4 ksi [25 MPa] as based on the upper yield point or 3 ksi [20 MPa] as based on the lower yield stress, after a prestrained specimen has been exposed to a standard bake cycle (340°F [170°C]) for 20 min.

8.2.4 Bending Properties:

8.2.4.1 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 shall 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, specify the appropriate surface texture and condition. For additional information, see the 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, specify the sheet to be furnished not oiled (dry).

10. Retests and Disposition of Non-Conforming Material

10.1 Retests, conducted with the requirements of Section 11.1 of Specification A 568/A 568M, are permitted when an unsatisfactory test result is suspected to be the consequence of the test method procedure.

10.2 Disposition of non-conforming material shall be subject to the requirements of Section 11.2 of 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, HSLAS-F, SHS, and BHS, 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

---

**TABLE 5 Mechanical Property Requirements**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Yield Strength, min</th>
<th>Tensile Strength, min</th>
<th>Elongation in 2 in. or 50 mm, min, %</th>
<th>Bake Hardening Index, min</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ksi [MPa]</td>
<td>ksi [MPa]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHS:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BHS:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

| A 1008/A 1008M – 07a |

* Where an ellipsis ( . . . ) appears in the table, there is no requirement.

* 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.
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, HSLAS-F, SHS, or BHS). 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 bake hardenable steel; bake hardening index; carbon steel sheet; cold-rolled steel sheet; commercial steel; deep drawing steel; drawing steel; extra deep drawing steel; high-strength low-alloy steel; high-strength low-alloy steel with improved formability; solution hardened steel; steel sheet; structural steel

ANNEX

(Mandatory Information)

A1. BAKE HARDENABLE STEELS

A1.1 Determination of Bake Hardening Index

A1.1.1 The bake hardening index (BHI) is determined by a two-step procedure using a standard longitudinal (rolling direction) tensile-test specimen, prepared in accordance with Test Methods and Definitions A 370. The test specimen is first strained in tension. The magnitude of this tensile “pre-strain” shall be 2% (extension under load). The test specimen is then removed from the test machine and baked at a temperature of 340°F [170°C] for a period of 20 min. Referring to Fig. A1.1, the bake hardening index (BHI) of the material is calculated as follows:

\[ BHI = B - A \]  

(A1.1)

FIG. A1.1 Representation of Bake Hardening Index
where:
\[ A = \text{flow stress at 2\% extension under load, and} \]
\[ B = \text{yield strength [upper yield strength (}B_u\text{) or lower yield strength (}B_l\text{)] after baking at 340°F [170°C] for 20 min.} \]

A1.1.2 The original test specimen cross section (width and thickness) is used in the calculation of all engineering strengths in this test.

A1.1.3 The pre-straining of 2\% in tension is intended to simulate a modest degree of forming strain, while the subsequent baking is intended to simulate a paint-curing or similar treatment. In the production of actual parts, forming strains and baking treatments can differ from those employed here, and as a result, final properties can differ from the values obtained under these controlled conditions.

### APPENDIXES

(Nonmandatory Information)

**X1. BENDING PROPERTIES**

**TABLE X1.1 Suggested Minimum Inside Radius for Cold Bending**

**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.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Grade</th>
<th>Minimum Inside Radius for Cold Bending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-Strength Low-Alloy Steel</td>
<td>Class 1</td>
<td>Class 2</td>
</tr>
<tr>
<td>45 [310] 50 [340] 55 [380] 60 [410] 65 [450] 70 [480]</td>
<td>2 t 2 t 2 t 2 t 3 t 3 t</td>
<td>1 ½ t 1 ½ t 2 t 2 ½ t</td>
</tr>
<tr>
<td>High-Strength Low-Alloy Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with Improved Formability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 [340] 60 [410] 70 [480] 80 [550]</td>
<td>1 t 1 ½ t 2 t 2 t</td>
<td></td>
</tr>
<tr>
<td>Solution Hardened Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 [180] 31 [210] 35 [240] 41 [280] 44 [300]</td>
<td>½ t 1 t 1 ½ t 2 t 2 t</td>
<td></td>
</tr>
<tr>
<td>Bake Hardenable Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 [180] 31 [210] 35 [240] 41 [280] 44 [300]</td>
<td>½ t 1 t 1 ½ t 2 t 2 t</td>
<td></td>
</tr>
</tbody>
</table>
X2. RELATED ISO STANDARDS

The ISO standards listed below may be reviewed for comparison with this ASTM standard. The relationship between the standards may only be approximate; therefore, the respective standards should be consulted for actual requirements. Those who use these documents must determine which specifications address their needs.

ISO 3574 Cold-Reduced Carbon Steel Sheet of Commercial and Drawing Qualities
ISO 4997 Cold-Reduced Steel Sheet of Structural Quality
ISO 13887 Cold-Reduced Steel Sheet of Higher Strength with Improved Formability

X3. HARDNESS PROPERTIES

TABLE X3.1 Typical Hardness Values

<table>
<thead>
<tr>
<th>Designation</th>
<th>Hardness-Rockwell B Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS Type A</td>
<td>70 or less</td>
</tr>
<tr>
<td>CS Type B</td>
<td>70 or less</td>
</tr>
<tr>
<td>CS Type C</td>
<td>70 or less</td>
</tr>
<tr>
<td>DS Type A</td>
<td>60 or less</td>
</tr>
<tr>
<td>DS Type B</td>
<td>60 or less</td>
</tr>
<tr>
<td>DDS</td>
<td>55 or less</td>
</tr>
<tr>
<td>EDDS</td>
<td>45 or less</td>
</tr>
</tbody>
</table>

NOTE 1—The hardness values shown are at the time of shipment.
NOTE 2—Test for hardness shall be conducted in accordance with the requirements of Test Methods E18.
NOTE 3—The hardness values are Rockwell B scale as measured or converted from the appropriate Rockwell scales.
NOTE 4—The typical hardness values apply to the full range of steel sheet thickness. Hardness tends to increase as the steel sheet thickness decreases.
NOTE 5—Hardness testing is commonly used to assess the relative formability of various designations of uncoated steel sheet. This assessment done by many users is recognized to be only an approximation of the relative formability and therefore cannot be used as a specification requirement.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 1008/A 1008M – 07) that may impact the use of this standard. (Approved Sept. 1, 2007.)

(1) Revised Footnote C in Table 1.

(2) Revised Footnote C in Table 2.

Committee A01 has identified the location of selected changes to this standard since the last issue (A 1008/A 1008M – 06a) that may impact the use of this standard. (Approved Feb. 1, 2007.)

(1) Revised Section 8.1.2.

Committee A01 has identified the location of selected changes to this standard since the last issue (A 1008/A 1008M – 06) that may impact the use of this standard. (Approved Oct. 1, 2006.)

(1) Revised Footnote C in Tables 1 and 2.

Committee A01 has identified the location of selected changes to this standard since the last issue (A 1008/A 1008M – 05b) that may impact the use of this standard. (Approved Sept. 1, 2006.)
Revised Section 7.2.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).