Guide to Material Specifications for Metal   DSM-01

1.0 Scope

1.1 This document defines the format for IMMI material specifications written for steel and establishes guidelines for several use issues.

2.0 Purpose

2.1 To define a standard specification for IMMI material specifications.

3.0 References


3.5 Standard Specification for Steel, Carbon (0.15 maximum percent), Hot-Rolled Sheet and Strip Commercial Quality, ASTM A569.


3.9 Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled, and Steel Sheet, Cold-Rolled, High-Strength, Low-Alloy, with Improved Formability, ASTM A715.


3.11 Standard Practice for Determining the Inclusion Content of Steel, ASTM E45.


3.14 SAE Numbering System for Wrought or Rolled Steel, SAE J402b.

3.15 Chemical Compositions of SAE Carbon Steels, SAE J403g.

3.16 Chemical Compositions of SAE Alloy Steels, SAE J404h.

3.17 Steel High-Strength, Hot-Rolled Sheet and Strip, Cold-Rolled Sheet and Coated Sheet, SAE J1392.
4.0 Description Format

4.1 The description is an alpha numeric characterization of the material which has significance in that it identifies the AISI number for the material, its final processing, quality, temper and surface condition.

4.2 The description is of the format ABCDEFG where the characters have the following significance.

4.2.1 A is the AISI standard designation for the material as defined in SAE J403g or SAE J404h.

4.2.2 B is the designation of final processing.

4.2.2.1 CR designates cold-rolled.
4.2.2.2 HR designates hot-rolled.
4.2.2.3 1P designates hot-rolled followed by one pass cold-rolled.
4.2.2.4 CRG designated CRS followed by additional pass or passes for gage control.

4.2.3 C is the designation of the product form.

4.2.3.1 BR designates bar.
4.2.3.2 PL designates plate.
4.2.3.3 SH designates sheet.
4.2.3.4 ST designates strip.
4.2.3.5 TV designates tube.

4.2.4 D is the designation of the material quality.

4.2.4.1 CQ designates commercial quality.
4.2.4.2 DQ designates drawing quality.
4.2.4.3 DQSK designates drawing quality special killed.
4.2.4.4 MQ designates merchant quality.
4.2.4.5 SQ designates special quality.
4.2.4.6 FQ designates forming quality.

4.2.5 E is the designation of the temper.

4.2.5.1 T1 designates No. 1 hard temper.
4.2.5.2 T2 designates No. 2 half hard.
4.2.5.3 T3 designates No. 3 quarter hard.
4.2.5.4 T4 designates No. 4 skin rolled.
4.2.5.5 T5 designates No. 5 dead soft.
4.2.5.6 AN designates annealed.
4.2.5.7 SA designates spheroidize annealed.
4.2.5.8 A designates annealed.
4.2.5.9 AA designates annealed.
4.2.5.10 AR designates as rolled.
4.2.5.11 DSA designates double spheroidized.
4.2.5.12 FH designates full hard.
4.2.5.13 IN designates intermediate hardness.
4.2.5.14  SO designates soft annealed.

4.2.6  F is the designation of surface condition.

   4.2.6.1  AR designates as rolled.
   4.2.6.2  PO designates pickled and oiled.
   4.2.6.3  S1 designates dull.
   4.2.6.4  S2 designates bright.
   4.2.6.5  S3 designates luster.
   4.2.6.6  SP designates pickled.

4.2.7  G is the designation of edge condition

   4.2.7.1  No. 1 designates round edge.
   4.2.7.2  No. 2 designates natural mill edge.
   4.2.7.3  No. 3 designates approximate square edge by slitting, not filing.
   4.2.7.4  No. 4 designates round edge produced by edge rolling.
   4.2.7.5  No. 5 designates approximate square edge by rolling or filing after slitting.
   4.2.7.6  No. 6 designates square edge produced by edge rolling.

5.0  Material Specification Code

5.1  The material specification code is a two digit numerical assignment to represent the material specification in the cost identifier field of the Item Master which is originated and maintained in the business system’s data base. The numbers are assigned in the order in which the material specifications are written. The number of digits are limited to two because of space available in the field.

6.0  Material Group

6.1  The material group is a generic description of the material which verbally indicates the carbon level and alloy if present.

7.0  Material

7.1  This is the AISI numerical designation for the material as found in the Standard Practice for Numbering Metals and Alloys, ASTM E547.

8.0  Quality

8.1  Quality is a two to four letter designation to identify the type of manufacturing operations used to make the material. It usually limits the uses of the steel. As an example, commercial quality steels are very economical but are not killed and, therefore, not heat treatable. Selection of a quality level for a new specification requires a thorough knowledge of the manufacturing processes to which the material will be subjected, the finished parts end use, and coordination with the supplier and steel source. It is also suggested that a similar part be reviewed as a reference.
A list of the current designations and descriptions is as follows:

<table>
<thead>
<tr>
<th>Material Group</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alloy Steel</td>
<td>CQ - Commercial Quality</td>
</tr>
<tr>
<td>Alloy Steel</td>
<td>DQ - Drawing Quality</td>
</tr>
<tr>
<td>Alloy Steel</td>
<td>DQSK - Drawing Quality Special Killed</td>
</tr>
<tr>
<td>Alloy Steel</td>
<td>MQ - Merchant Quality</td>
</tr>
<tr>
<td>Alloy Steel</td>
<td>SQ - Special Quality</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>CQ - Commercial Quality</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>DQ - Drawing Quality</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>DQSK - Drawing Quality Special Killed</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>MQ - Merchant Quality</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>SQ - Special Quality</td>
</tr>
<tr>
<td>High Strength Steel</td>
<td>D - Dual Phase Grade</td>
</tr>
<tr>
<td>High Strength Steel</td>
<td>S - Structural Quality</td>
</tr>
<tr>
<td>High Strength Steel</td>
<td>SQ - Special Quality</td>
</tr>
<tr>
<td>High Strength Steel</td>
<td>W - Weathering Steel</td>
</tr>
<tr>
<td>Low Carbon Steel</td>
<td>CQ - Commercial Quality</td>
</tr>
<tr>
<td>Low Carbon Steel</td>
<td>DQ - Drawing Quality</td>
</tr>
<tr>
<td>Low Carbon Steel</td>
<td>DQSK - Drawing Quality Special Killed</td>
</tr>
<tr>
<td>Low Carbon Steel</td>
<td>MQ - Merchant Quality</td>
</tr>
<tr>
<td>Low Carbon Steel</td>
<td>SQ - Special Quality</td>
</tr>
</tbody>
</table>

9.0 General Specification

9.1 This designates the applicable standards and specifications that apply to the material specification being written. These should include ASTM designations where possible.
10.0 Additional Specification

10.1 These are industry standard specifications detailing required characteristics not included in the general specifications.

11.0 Exception

11.1 This is used to further qualify additional requirements which are deletions or exceptions from a standard specification.

12.0 Grain Size

12.1 Grain size refers to the prior austenitic grain size as determined by indirect methods of either a microscope or fracture. It affects machining, forming, blanking and heat treating and sometimes, in conflicting directions. Experience is a good guide for determining the desired grain size as well as similarly processed parts. The supplier and the steel manufacturer should also be involved in this phase of determining the specification.

13.0 Grain Note

13.1 The grain note defines the acceptable grain shape and distribution. The specification used to measure the grain size should also be noted.

14.0 Finish Method

14.1 This defines the final rolling process used to reduce the cross sectional area of the metal stock, or shape the metal product.

15.0 Temper

15.1 This defines the level of the reheating of the steel for the purpose of decreasing hardness and increasing toughness. It can be defined by describing the carbon form produced during the annealing process, spheroidize annealed is an example, or by the harness level achieved by the degree of rolling, quarter hard is an example. Examples are shown in the following table.

15.1.1 No. 1 Hard – For stamping or punching flat pieces requiring rigidity and strength.
15.1.2 No. 2 Half Hard – For simple blanking operations. Will bend at sharp right angle across the grain (direction of rolling).
15.1.3 No. 3 Quarter Hard – Will bend flat on itself across the grain. Takes some bending with the grain.
15.1.4 No. 4 Pinch Pass or Skin Rolled – For tubing, molding, some deep drawing. Will bend both ways of the grain.
15.1.5 No. 5 Dead Soft – For deep drawing and difficult forming. Extremely soft, it will bend flat on itself both ways of the grain.
<table>
<thead>
<tr>
<th>Material Group</th>
<th>Temper Number</th>
<th>Temper Description</th>
<th>Hardness for .25 &gt;T&gt;.07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alloy Steel</td>
<td>AN - Annealed</td>
<td>CRS, Alloy Bar</td>
<td>85 HRB Max</td>
</tr>
<tr>
<td>Alloy Steel</td>
<td>AR - As Rolled</td>
<td>CRS</td>
<td></td>
</tr>
<tr>
<td>Alloy Steel</td>
<td>SA - Spheroidize Annealed</td>
<td>CR S</td>
<td></td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>A</td>
<td>For applications requiring cold forming. It is produced to give a microstructure favorable to cold forming.</td>
<td>Per ASTM A684/684M, Figure 2</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>AA - Annealed</td>
<td>For modified steel composition.</td>
<td>HRB 76 Max</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>FH - Full Hard</td>
<td>For flat applications. It is produced to minimum hardness.</td>
<td>Per agreement between IMMI &amp; producer.</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>IN - Intermediate Hardness</td>
<td>For applications when unique hardness range is agreed to per agreement between IMMI and producer.</td>
<td>HRB 90 Max</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>SA - Spheroidize Annealed</td>
<td>For applications requiring cold forming. It is produced to give a microstructure favorable to cold forming.</td>
<td>Per ASTM A684/684M, Figure 2</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>SO - Soft Annealed</td>
<td>For applications requiring moderate cold forming. It is produced to a max hardness.</td>
<td>Per ASTM A684/684M, Figure 1</td>
</tr>
<tr>
<td>High Strength Steel</td>
<td>TT - Not Specified</td>
<td>Temper not designated for this material.</td>
<td>This material is specified by yield strength</td>
</tr>
<tr>
<td>Low Carbon Steel</td>
<td>T1 - No. 1 Hard</td>
<td>For stamping or punching flat pieces requiring rigidity and strength.</td>
<td>HRB 84 Min</td>
</tr>
<tr>
<td>Low Carbon Steel</td>
<td>T2 - No. 2 Half Hard</td>
<td>For simple blanking operations. Will bend at sharp right angle across the grain (direction of rolling).</td>
<td>70-85 HRB</td>
</tr>
<tr>
<td>Low Carbon Steel</td>
<td>T3 - No. 3 Quarter Hard</td>
<td>Will bend flat on itself across the grain. Takes some bending with the grain.</td>
<td>60-75 HRB</td>
</tr>
<tr>
<td>Low Carbon Steel</td>
<td>T4 - No. 4 Skin Rolled</td>
<td>For tubing, molding, and some deep drawing. Will bend both ways of grain.</td>
<td>HRB 65 Max</td>
</tr>
<tr>
<td>Low Carbon Steel</td>
<td>T5 - No. 5 Dead Soft</td>
<td>For deep drawing and difficult forming. Will bend flat on itself in any direction.</td>
<td>HRB 55 Max</td>
</tr>
</tbody>
</table>
16.0 Surface Condition

16.1 The surface condition defines the finish of the surface produced by the final treatment. Bright, dull and as rolled are examples of the surface conditions used. A list of current designations and descriptions are as follows.

<table>
<thead>
<tr>
<th>Material Group</th>
<th>Surface Condition</th>
<th>Material Group</th>
<th>Surface Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alloy Steel</td>
<td>AR - As rolled</td>
<td>High Strength Steel</td>
<td>PO - Pickled &amp; oiled</td>
</tr>
<tr>
<td>Alloy Steel</td>
<td>S1 - Dull</td>
<td>High Strength Steel</td>
<td>S1 - Dull</td>
</tr>
<tr>
<td>Alloy Steel</td>
<td>S2 - Bright</td>
<td>High Strength Steel</td>
<td>SP - Pickled</td>
</tr>
<tr>
<td>Alloy Steel</td>
<td>S2 - Luster</td>
<td>Low Carbon Steel</td>
<td>PO - Pickled &amp; oiled</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>S1 - Dull</td>
<td>Low Carbon Steel</td>
<td>S1 - Dull</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>S2 - Bright</td>
<td>Low Carbon Steel</td>
<td>S2 - Bright</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>S3 - Luster</td>
<td>Low Carbon Steel</td>
<td>S3 - Luster</td>
</tr>
<tr>
<td>High Strength Steel</td>
<td>AR - As rolled</td>
<td>Low Carbon Steel</td>
<td>SP - Pickled</td>
</tr>
</tbody>
</table>

17.0 Hardness

17.1 Hardness defines the resistance of metal to plastic deformation usually by indentation.

18.0 Edge Condition

18.1 The edge conditions are defined:

18.1.1 No.1 Perfect square or rounded edge.
18.1.2 No. 2 Natural mill edge.
18.1.3 No. 3 Approx. square edge by slitting, not filed.
18.1.4 No. 4 Round edge produced by edge rolling.
18.1.5 No. 5 Approx. sq. edge by rolling or filling after slitting.
18.1.6 No. 6 Square edge produced by edge rolling.

19.0 Fitness for Use

19.1 This identifies the processes of manufacturing and the end product for which the material will be used as a reference for the material supplier to ensure the proper material will be furnished. Examples are shown below. Delete or add applicable operations.

Bar - This material must be fit for machining, heat treating and plating processes. The end product will be utilized in an occupant restraint system.

Plate - This material must be fit for blanking, forming and plating processes. The end product will be utilized in an occupant restraint system.

Sheet - This material must be fit for blanking, forming, heat treating and plating processes. The end product will be utilized in an occupant restraint system.
Strip - This material must be fit for blanking, forming, heat treating and plating processes. The end product will be utilized in an occupant restraint system.

Tube - This material must be fit for plating processes. The end product will be utilized in an occupant restraint system.

20.0 Material Form

20.1 The material form defines the final form of the material; bar, plate, sheet and tube are examples.

21.0 Chemistry

21.1 Chemistry defines the acceptable levels of the elements that are combined to make the material.

22.0 Microstructure

22.1 The microstructure defines the structure for the metal as revealed by microscopic observation at a magnification greater than ten diameters.

23.0 Comments

23.1 This space is used to add any additional information pertinent to the specification, which is not covered above.