Standard Specification for Cold Formed Carbon Structural Steel Tubing Made from Metallic Precoated Sheet Steel

This standard is issued under the fixed designation A1076/A1076M; 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 round, square, rectangular, and special shape, electric-resistance-welded structural tubing produced from precoated sheet steel with the following coatings on both sides: zinc (galvanized) or 55% aluminum-zinc alloy. This product is intended for applications requiring minimum mechanical properties and corrosion resistance of both exterior and interior surfaces.

1.2 This specification is applicable to orders in either inch-pound units (as A1076) or SI units (as A1076M). Within the text, SI units are shown in brackets. The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards:

A90/A90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
A370 Test Methods and Definitions for Mechanical Testing of Steel Products
A902 Terminology Relating to Metallic Coated Steel Products
A924/A924M Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

3. Terminology

3.1 Definitions—See Terminology A902 for definitions of general terminology relating to metallic-coated hot-dip products.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 de-dimpled, adj—the condition of the end of tubing after removal of the protrusion or deformation created by the punch cut operation.

3.2.1.1 Discussion—The dimple is a protrusion that is displaced from the inside diameter and is unrelated to a shear burr.

3.2.2 structural tubing, n—tubing tension tested with reported test results.

4. Product Size

4.1 The standard covers products available in the following sizes:

<table>
<thead>
<tr>
<th>Product</th>
<th>Wall Thickness, max</th>
<th>Exterior Dimension, max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round Tubing</td>
<td>0.25 in. [6.35 mm]</td>
<td>Diameter – 3 in. [130 mm]</td>
</tr>
<tr>
<td>Square, Rectangular, or Special Shapes</td>
<td>0.25 in. [6.35 mm]</td>
<td>Periphery – 16 in. [405 mm]</td>
</tr>
</tbody>
</table>

5. Classification

5.1 The finished tube is available in the following designations:

5.1.1 Round structural tubing steel grade with minimum yield strength 33 ksi [230 MPa], 42 ksi [290 MPa], and 46 ksi [315 MPa] in the finished tube.

5.1.2 Shaped structural tubing steel grade with minimum yield strength 39 ksi [270 MPa], 46 ksi [315 MPa], and 50 ksi [345 MPa] in the finished tube.

5.1.3 The finished tube is available as zinc-coated or 55% aluminum-zinc alloy-coated with a recommended minimum of 0.40 oz/ft² [120 g/m²] total both sides.

6. Ordering Information

6.1 The ordered wall thickness of the tubing shall be the total of the base metal and the metallic coating.
6.2 Orders for product to this specification shall include the following information, as necessary, to adequately describe the desired product.

6.2.1 Steel grade designation,
6.2.2 Chemically treated or not chemically treated raw material,
6.2.3 Coating designation,
6.2.4 Organic or inorganic coating if required,
6.2.5 Oiled or dry,
6.2.6 End condition,
6.2.6.1 Burrs removed if required,
6.2.7 Mill cut or de-dimpled end condition,
6.2.7.1 When the end finish is not specified, mill cut will be furnished,
6.2.8 Dimensions (show outside diameter and wall thickness for round tubing), (outside dimensions and wall thickness for square, rectangle, or special shapes), and length,
6.2.9 Quantity (length or weight),
6.2.10 Mill certification (if required),
6.2.11 End-use application, and
6.2.12 Recoating of outside diameter weld and heat-affected area of coating, if required.

7. Coating Properties

7.1 Zinc Coating Weight [Mass]:
7.1.1 Coating weight [mass] shall conform to the requirements as shown in Table 1 for the specific coating designation.

The thickness of the tube includes both the base metal and the coating.

7.1.2 Use the following relationships to estimate the coating thickness from the coating weight [mass]:

- 1 oz/ft² coating weight = 1.7 mils coating thickness
- 7.14 g/m² coating mass = 1 µm coating thickness

7.2 55% Aluminum-Zinc Coating Weight [Mass]:
7.2.1 Coating weight [mass] shall conform to the requirements as shown in Table 2 for the specific coating designation.
7.2.2 Use the following relationships to estimate the coating thickness from the coating weight [mass]:

- 1 oz/ft² coating weight = 3.2 mils coating thickness
- 3.75 g/m² coating mass = 1 µm coating thickness

7.3 Coating Weight To Coating Mass Conversion:
7.3.1 1 oz/ft² coating weight = 305.15 g/m² coating mass

7.4 Coating Weight [Mass] Tests:
7.4.1 Coating weight [mass] tests shall be performed in accordance with the requirements of Specification A924/A924M.
7.4.2 The referee method to be used shall be Test Method A90/A90M.

8. Chemical Composition

8.1 Base Metal:
8.1.1 The base metal shall be manufactured using the basic oxygen or electric furnace process.

### Table 1 Weight [Mass] of Zinc Coating Requirements

<table>
<thead>
<tr>
<th>Type</th>
<th>Coating Designation</th>
<th>Total Both Sides, oz/ft²</th>
<th>Single-Spot Test</th>
<th>SI Units</th>
<th>Total Both Sides, g/m²</th>
<th>Single-Spot Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Inch-Pound Units</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>G235</td>
<td>2.35</td>
<td>0.80</td>
<td>200</td>
<td>700</td>
<td>238</td>
</tr>
<tr>
<td></td>
<td>G210</td>
<td>2.10</td>
<td>0.72</td>
<td>180</td>
<td>600</td>
<td>204</td>
</tr>
<tr>
<td></td>
<td>G185</td>
<td>1.85</td>
<td>0.64</td>
<td>160</td>
<td>550</td>
<td>190</td>
</tr>
<tr>
<td></td>
<td>G165</td>
<td>1.65</td>
<td>0.56</td>
<td>140</td>
<td>450</td>
<td>154</td>
</tr>
<tr>
<td></td>
<td>G140</td>
<td>1.40</td>
<td>0.48</td>
<td>120</td>
<td>350</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>G115</td>
<td>1.15</td>
<td>0.36</td>
<td>90</td>
<td>250</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>G100</td>
<td>1.00</td>
<td>0.30</td>
<td>75</td>
<td>200</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>G90</td>
<td>0.90</td>
<td>0.20</td>
<td>60</td>
<td>180</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>G80</td>
<td>0.80</td>
<td>0.12</td>
<td>50</td>
<td>120</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>G70</td>
<td>0.70</td>
<td>0.10</td>
<td>45</td>
<td>90</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>G60</td>
<td>0.60</td>
<td>0.05</td>
<td>35</td>
<td>60</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>G50</td>
<td>0.50</td>
<td>0.03</td>
<td>30</td>
<td>30</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>G40</td>
<td>0.40</td>
<td>0.02</td>
<td>25</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>G30</td>
<td>0.30</td>
<td>0.01</td>
<td>20</td>
<td>15</td>
<td>5</td>
</tr>
</tbody>
</table>

Table Note: Use the information provided in 7.1.2 to obtain the approximate coating thickness from the coating weight [mass].

A The coating designation number is the term by which this product is specified. Because of the many variables and changing conditions that are characteristic of continuous hot-dip coating lines, the zinc coating is not always evenly divided between the two surfaces of a coated sheet; nor is it always evenly distributed from edge to edge. However, the minimum triple-spot average coating weight (mass) on any one side shall not be less than 40% of the single-spot requirement.

B No minimum means that there are no established minimum requirements for triple- and single-spot tests.
TABLE 2 Weight [Mass] of 55% Aluminum-Zinc Coating Requirements

<table>
<thead>
<tr>
<th>Coating Designation</th>
<th>Minimum Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Triple-Spot Test</td>
</tr>
<tr>
<td></td>
<td>Total Both Sides, oz/ft²</td>
</tr>
<tr>
<td>AZ30</td>
<td>0.30</td>
</tr>
<tr>
<td>AZ35</td>
<td>0.35</td>
</tr>
<tr>
<td>AZ40</td>
<td>0.40</td>
</tr>
<tr>
<td>AZ50</td>
<td>0.50</td>
</tr>
<tr>
<td>AZ55</td>
<td>0.55</td>
</tr>
<tr>
<td>AZ60</td>
<td>0.60</td>
</tr>
</tbody>
</table>

The coating designation number is the term by which this product is specified. Because of the many variables and changing conditions that are characteristic of continuous hot-dip coating lines, the weight [mass] of the coating is not always evenly divided between the two surfaces of a sheet, nor is the coating evenly distributed from edge to edge. However, it can normally be expected that not less than 40% of the single-spot test limit will be found on either surface.

8.1.2 The heat analysis shall conform to the requirements of Table 3.

9. Mechanical Properties of Finished Tube

9.1 The precoated mechanical tubing shall conform to the mechanical properties of Tables 4 and 5.

9.2 Tests for mechanical properties shall be conducted in accordance with the methods specified in Specification A924/A924M except that the requirements of A370 for the preparation of tubing-test specimen shall apply.

10. Flattening Test

10.1 The integrity of the weld shall be determined in conjunction with the flattening test described in Specification A1076/A1076M. The flattening test shall be made on round structural tubing. A flattening test is not required for shaped structural tubing.

11. Oiling

11.1 When specified, tubing shall have a protective coating applied before shipping to retard white rust of the metallic coating on closely nested products and red rust on non-recoated outside diameter weld areas. Should the order specify shipment without a protective coating, the lubricant incidental to manufacturing will remain and the purchaser will assume responsibility for rust in transit and storage.

TABLE 3 Chemical Requirements

<table>
<thead>
<tr>
<th>Designation</th>
<th>Composition, %—Heat Analysis Element, max (unless otherwise shown)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Carbon</td>
</tr>
<tr>
<td>Round Grade 33 [230]</td>
<td>0.15</td>
</tr>
<tr>
<td>Round Grade 42 [290]</td>
<td>0.18</td>
</tr>
<tr>
<td>Round Grade 46 [315]</td>
<td>0.25</td>
</tr>
<tr>
<td>Shaped Grade 39 [270]</td>
<td>0.15</td>
</tr>
<tr>
<td>Shaped Grade 46 [315]</td>
<td>0.18</td>
</tr>
<tr>
<td>Shaped Grade 50 [345]</td>
<td>0.25</td>
</tr>
</tbody>
</table>

A Applies to wall thicknesses of 0.120 in. [3.05 mm] and over. For wall thicknesses under 0.120 in. [3.05 mm], the minimum elongation shall be subject to agreement between the manufacturer and purchaser.

B A flattening test is not required for shaped structural tubing. A flattening test is required for round structural tubing.

C Applies to specified wall thicknesses (t) of 0.120 in. [3.05 mm] and over. For wall thicknesses under 0.120 in. [3.05 mm], the minimum elongation shall be subject to agreement between the manufacturer and purchaser.

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12. Other Requirements

12.1 The requirements for the following can be found in Specification A500/A500M:

12.1.1 Permissible Variations in Dimensions,
12.1.2 Special Shape Structural Tubing,
12.1.3 Number of Tests,
12.1.4 Retests,
12.1.5 Test Methods,
12.1.6 Inspection,
12.1.7 Rejection,
12.1.8 Certification,
12.1.9 Product Marking,
12.1.10 Packing, Marking, and Loading, and
12.1.11 Government Procurement.

13. Keywords

13.1 55% aluminum-zinc alloy-coated; structural tubing; tubing; zinc coated