Designation: A384/A384M – 07 (Reapproved 2019)

# Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies[1]

This standard is issued under the fixed designation A384/A384M; 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 Steel assemblies and subassemblies fabricated by welding, such as composite structural members, sash, weldments, etc., that are to be hot-dip galvanized after fabrication, are subject to warpage and distortion of the material due to the heating and cooling integral to the galvanizing operation, particularly when it is necessary for the assembly to be dipped more than once to coat the entire surface.

1.2 This specification is applicable in either inch pounds or SI units. Inch pounds and SI units are not necessarily exact equivalents. Within the text of this specification and where appropriate, SI units are shown in parentheses.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

A143/A143M Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement

A385 Practice for Providing High-Quality Zinc Coatings (Hot-Dip)

A780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

## 3. Factors in Warpage and Distortion

3.1 One of the most commonly distorted and warped members of assemblies is that of sheets or plates from No. 20 gage [0.812 mm] to ¼ in. [6.35 mm] in thickness which are assembled by welding or riveting to bar-size shapes, angles, channels, tees, etc. The sheets or plates have residual stress from the welding or riveting as well as stress from rolling operations to bring the sheet or plate to its final thickness. As the sheet or plate is heated to galvanizing temperature, 820 to 850 °F (438 to 454 °C), the stress can be slightly relieved but the constraint of the framing does not allow the stresses to be completely relieved. The stress relief is minimal and, thus, the internal stress level of the sheet or plate compounds because of the addition of the contraction forces. When the fabrication cools after galvanizing, the framing also restricts the contraction of the sheet or plate further increasing internal stresses. If the warpage or distortion is minimal, the fabrication may be acceptable but, if the distortion is significant, the fabrication may need to be reworked with the sheet or plate attached to the frame after hot-dip galvanizing.

3.2 Warpage is accentuated by the use of nonsymmetrical sections such as channels. Regardless of size, channels that are galvanized by themselves often require straightening after galvanizing. This is not true of an I-beam, pipe, H-column, or any other section that is symmetrical about both its major axes. Channels and other nonsymmetrical sections should be avoided for the framework of a sheet metal assembly that is to be hot-dip galvanized whenever it is possible to use symmetrical shapes or sections as framing pieces.

3.2.1 Checkered plate may also warp or distort during galvanizing due to the asymmetry of the plate design. Since all of the deformations are on one side of the plate, the residual stress from fabricating the checkered plate may cause warpage or distortion. This may be accentuated by attaching checkered plate to a frame before hot-dip galvanizing.

3.3 The use of wide radii bends in corners is recommended. In the case of sheet metal, the product that has a right-angle bend in the sheet metal itself will remain flatter and be freer from distortion if the radius of the bend is as large as practical. For extremely tight bends that are integral to the fabrication,

[1] This practice is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.13 on Structural Shapes and Hardware Specifications.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.