



## **Suggested Specification for Hot-Dip Galvanizing**

Revised May 2002

This suggested specification is provided as a guide to producing a quality document calling for after-fabrication hot-dip galvanizing of steel elements of a project. This document is not a substitute for professional specification assistance. It is designed to comply with the CSI format for compatibility with the greatest number of specification systems.

Sections in italics are for reference and may be included or excluded from the final specification based on the judgment of the specifying professional. References to section numbers refer to standard locations within a CSI format specification.

Section 1.03 may include other reference documents as required.

Section 2.01 may include a list of pre-qualified galvanizing providers.

Section 2.02 contains a cautionary note that should be included in the final form.

For assistance with this or other galvanizing specifications call the AGA's specification hotline at 800-HOT-SPEC (800-468-7732), fax 720-554-0909, or e-mail [aga@galvanizeit.org](mailto:aga@galvanizeit.org).

# Section 05040

## Hot-Dip Galvanizing

This specification covers iron and steel materials to be hot-dip galvanized after manufacture or fabrication, including but not limited to:

1. General steel articles
2. Structural steel members
3. Fabricated steel assemblies
4. Wire work fabricated from uncoated wire
5. Steel forgings
6. Iron castings
7. Iron and steel pipe
8. Fasteners and miscellaneous hardware
9. Fencing materials
10. Ornamental iron

### **PART 1 - GENERAL**

#### **1.01 WORK INCLUDED**

1. Hot-dip galvanizing of iron and steel materials

#### **1.02 RELATED WORK**

1. Steel materials, fabrications and assemblies are specified to be furnished and installed in various other sections (including, but not limited to [insert section list here])

#### **1.03 REFERENCES**

##### A. Publications

1. American Galvanizers Association (AGA):

*Inspection of Products Hot-dip Galvanized After Fabrication*

*The Design of Products to be Hot-dip Galvanized After Fabrication*

*Recommended Details of Galvanized Structures*

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*Quality Assurance Manual*

2. Research Council on Structural Connections of the Engineering Foundation:

*Specification for Structural Joints Using ASTM A 325 or A 490 bolts.*

B. Reference standards

1. American Society for Testing and Materials (ASTM):

*A 123 / A 123M Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*

*A 143 Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement*

*A 153 / A 153M Zinc Coating (Hot-Dip) on Iron and Steel Hardware*

*A 384 Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies*

*A 385 Practice for Providing High-Quality Zinc Coatings (Hot-Dip)*

*A 767 / A 767M Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement*

*A 780 Repair of Damaged Hot-Dip Galvanized Coatings*

*B 6 Specification for Zinc*

*D 6386 Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting*

*E 376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods*

2. Federal specifications

*DOD-P-21035 Paint, High Zinc Dust Content, Galvanizing Repair*

*MIL-P-26915 Primer Coating, Zinc Dust Pigmented*

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*Additional references and standards that may apply to particular applications are found in the appendix to this section.*

## **1.04 QUALITY ASSURANCE**

- A. Coating applicator: Company specializing in hot-dip galvanizing after fabrication and following the procedures in the *Quality Assurance Manual* of the American Galvanizers Association.
- B. Pre-construction Conference for Metal Fabrications: Contractor shall schedule a meeting to be attended by contractor, architect, fabricator and galvanizer. Topics to be addressed include project schedule, scope of metal fabrications, coordination between fabricator and galvanizer, finish of surfaces, application of coatings, submittals and approvals.
- C. Coordination Between Fabricator and Galvanizer: Prior to fabrication, fabricators shall submit approved fabrication shop drawings to the galvanizer. The Galvanizer shall review fabricator's shop drawings for suitability of materials for galvanizing and coatings and coordinate any required fabrication modifications.
- D. Materials: For steel to be hot-dip galvanized, provide steel chemically suitable for metal coatings complying with the following requirements: carbon below 0.25%, phosphorous below 0.04%, manganese below 1.3%, and silicon below 0.04%. Notify the galvanizer if steel does not meet these requirements so that suitability for galvanizing may be determined and whether special processing techniques are required.

## **1.05 SUBMITTALS**

In accordance with provisions of Section [01400] [01430], submit an original and two copies of the coating applicator's notarized Certificate of Compliance that the hot-dip galvanized coating meets or exceeds the specified requirements of **ASTM A 123 / A 123M, A 153 / A 153M, or A 767**, as applicable.

## **1.06 DELIVERY, STORAGE & HANDLING**

- A. Store and protect products under the provisions of Section [01600] [01620].
- B. Load and store galvanized articles in accordance with accepted industry standards.

## **PART 2 - PRODUCTS**

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## 2.01 ACCEPTABLE COATING APPLICATORS

Members of the AGA or equal approved by the architect and/or engineer. *A list of American Galvanizers Association members is available upon request (800-468-7732) or at [www.galvanizeit.org](http://www.galvanizeit.org).*

## 2.02 STEEL MATERIALS

A. Material for galvanizing to be geometrically suitable for galvanizing as described in ASTM A 384 and A 385. Steel materials suitable for galvanizing include structural shapes, pipe, sheet, fabrications and assemblies.

B. Material to be chemically suitable for galvanizing.

*Steels containing carbon below 0.25%, phosphorus below 0.04% and manganese below 1.3%, either individually or in combination, and providing the silicon content is 0.04% or less, will normally develop a typical coating when conventional galvanizing techniques are applied.*

*In cases where steel is selected for considerations other than galvanizing and the chemistry of the elements (C, Mn, P, and Si) exceeds the limits indicated above, the steel may be galvanizable. The galvanizer must be advised of the variation in advance so that it can be determined if the material is galvanizable and whether special processing techniques are required.*

Recommended steel materials for hot-dip galvanizing include but are not limited to:

1. Structural shapes and plates: ASTM A 36, A 242 type 2, A 283, A 441, A 500, A 501, A 529, A 572, A 588 and A 992.
2. Steel for fasteners:

<b>General Category</b>	<b>Bolt Material</b>	<b>Nut Material</b>
Carbon Steel	A 307 Gr A or B	A 563 Gr A
High-strength	A 325 Type 1	A 563 Gr DH
Tower Bolts	A 394	A 563 Gr A
Quenched & Tempered (Carbon Steel Bolts)	A 499	A 563 Gr C
Quenched & Tempered (Alloy Steel Bolts)	A 354 Gr BC	A 563 Gr DH

3. Steel for sheet metal articles: ASTM A 569 or A 570.
4. Steel for pipe or tubing: ASTM A 53, A 120 or A 595, Gr A or B.

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*CAUTION: Avoid use of steel with an ultimate tensile strength greater than 150 ksi. These steels have been shown to have a potential for hydrogen embrittlement resulting from the pickling process prior to galvanizing.*

## **2.03 FABRICATION REQUIREMENTS**

- A. Fabricate structural steel in accordance with Class I, II, III guidelines as described in AGA's *Recommended Details for Galvanized Structures*.
- B. Fabrication practices for products to be in accordance with the applicable portions of ASTM A 143, A 384, and A 385, except as specified herein. Avoid fabrication techniques that could cause steel distortion or embrittlement.
- C. The fabricator shall consult with architect/engineer and hot-dip galvanizer regarding potential concerns, including handling issues, during the galvanizing process that may require design modification before fabrication proceeds.
- D. Remove all welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing.
- E. Provide holes and/or lifting lugs to allow for handling during galvanizing.
- F. Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil, paint and other deleterious material prior to fabrication.
- G. Remove by blast-cleaning, or other methods, surface contaminants and coatings that are not removable by the normal chemical cleaning process in the galvanizing operation.
- H. Whenever possible, slip joints should be used to minimize field welding of material.

## **PART 3 - EXECUTION**

### **3.01 SURFACE PREPARATION**

Pre-clean steel work in accordance with accepted methods to produce an acceptable surface for quality hot-dip galvanizing.

### **3.02 COATING APPLICATION**

- A. Galvanize steel members, fabrications and assemblies after fabrication by the hot-dip process in accordance with ASTM A 123 / 123M.
- B. Galvanize bolts, nuts, washers and iron and steel hardware components in accordance with ASTM A 153 / 153M.
- C. Safeguard products against steel embrittlement in conformance with ASTM A 143.
- D. Galvanize reinforcing steel in accordance with ASTM A 767.
- E. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

### **3.03 COATING REQUIREMENTS**

- A. Conform to paragraph 6.1 of ASTM A 123 / 123M, Table 1 of ASTM A 153 / 153M, or Table 2 of A 767, as appropriate.

*Special thickness requirements should refer to ASTM A 123 / 123M, 3.1.7., and be specified as the minimum average mils of thickness. Extra thick coatings are not always obtainable.*

- B. Surface Finish: Continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.
- C. Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

### **3.04 TESTS**

- A. Inspection and testing of hot-dip galvanized coatings shall be done under the guidelines provided in the AGA publication *Inspection of Products Hot-dip Galvanized After Fabrication*.
- B. Include visual examination and tests in accordance with ASTM A 123 / 123M, A 153 / 153M, or A 767, as applicable, to determine the thickness of the zinc coating on the metal surface.
- C. Furnish notarized Certificate of Compliance with ASTM standards and specifications herein listed. The Certificate must be signed by the galvanizer and contain a detailed description of the material processed. The Certificate shall include information as to the ASTM standard used for the coating.

### **3.05 REPAIR OF DAMAGED COATING**

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A. The maximum area to be repaired is defined in accordance with ASTM A 123 / 123M, Section 6.2, current edition.

1. The maximum area to be repaired in the field shall be determined in advance by mutual agreement between parties.

B. Repair areas damaged by welding, flame cutting or during handling, transport or erection by one of the approved methods in accordance with ASTM A 780 whenever damage exceeds 3/16" in width. Minimum thickness requirements for the repair are those described in ASTM A 123 / 123M, Section 6.2, current edition.

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**END OF SECTION**

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# APPENDIX 1: Additional References & Standards

## **1. American Association of State Highway and Transportation Officials (AASHTO):**

M 30 *Wire Rope And Fittings For Highway Guardrail; Standard Specification For*

M 111 *Zinc (Hot-Galvanized) Coatings On Products Fabricated From Rolled, Pressed And Forged Steel Shapes, Plates, Bars And Strips*

M 120 *Zinc Metal (Slab Zinc); Standard Specification For*

M 164 *High-Strength Bolts For Structural Steel Joints, Including Suitable Nuts And Plain Hardened Washers; Standard Specification For*

M 167 *Structural Plate Of Pipe, Pipe-Arches, And Arches; Standard Specification For*

M 180 *Corrugated Sheet Steel Beams For Highway Guardrail; Standard Specification For*

M 181 *Chain-Link Fence; Standard Specification For*

## **2. American Society for Testing and Materials (ASTM):**

A 53 *Pipe, Steel, Black And Hot-Dipped, Zinc-Coated, Welded And Seamless; Standard Specification For*

A 90 *Weight Of Coating On Zinc-Coated (Galvanized) Iron And Steel Articles; Standard Test Method For*

A 307 *Carbon Steel Externally Threaded Standard Fasteners; Standard Specification For*

A 325 *High-Strength Bolts For Structural Steel Joints; Standard Specification For*

A 390 *Zinc-Coated Steel Chain-Link Fence Fabric; Standard Specification For*

A 392 *Zinc-Coated Steel Chain-Link Fence Fabric; Standard Specification For*

A 394 *Galvanized Steel Transmission Tower Bolts; Standard Specification For*

A 449 *Quenched And Tempered Steel Bolts And Studs; Standard Specification For*

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A 563 *Carbon And Alloy Steel Nuts; Standard Specification For*

A 595 *Steel Tubes, Low-Carbon, Tapered For Structural Use; Standard Specification For*

A 702 *Steel Fence Posts And Assemblies, Hot-Wrought; Standard Specification For*

A 740 *Hardware Cloth (Woven Or Welded Galvanized Steel Wire Fabric); Standard Specification For*

A 741 *Zinc-Coated Steel Wire Rope And Fittings For Highway Guardrail; Standard Specification For*

A 896 *Practice For Conducting Case Studies Of Galvanized Structures*

A 992 /A 992M *Standard Specification For Steel For Structural Shapes For Use In Building Framing*

B 6 *Zinc (Slab Zinc), standard Specification for*

D 6386 *Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting*

E 376 *Measuring coating thickness by Magnetic-field or Eddy-current (Electromagnetic) Test Methods; Standard Recommended Practice*

F 573 *Residential Zinc-Coated Steel Chain-Link Fence Fabric; Standard Specification for*

F 626 *Fence Fittings; Standard Specification for*

3. **American Welding Society (AWS):**

Publication entitled *Welding Zinc-Coated Steel*

4. **Canadian Standards Association (CSA):**

G 164M *Hot-dip Galvanizing of Irregularly Shaped Articles*

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