This suggested specification is provided as a guide to producing a quality document calling for hot-dip galvanizing of reinforcing steel. This document is not a substitute for professional specifications assistance. It is designed to comply with the Construction Specifications Institute (CSI) format for compatibility with the greatest number of specification systems.

Sections in italics are for reference; they may be included or dropped from the final specification based on the judgment of the specifying professional. References to section numbers refer to standard locations within a CSI-formatted 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 kept 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.
Section 05030
Suggested Specification for Hot-Dip Galvanizing Reinforcing Steel

This specification covers reinforcing steel to be hot-dip galvanized before or after fabrication.

Part 1 – General

1.01 WORK INCLUDED
Furnishing and placing galvanized reinforcing steel for concrete structure in accordance with the contractor plans, and in a manner satisfactory to the engineer.

1.02 RELATED WORK
Steel reinforcement is specified to be furnished in other sections.

1.03 REFERENCES
A. Publications
1. American Galvanizers Association (AGA):
   *Galvanizing for Corrosion Protection: A Specifier’s Guide to Reinforcing Steel*
   *The Design of Products to be Hot-Dip Galvanized After Fabrication*
   *The Inspection of Products Hot-Dip Galvanized After Fabrication*
   *Recommended Details for Galvanized Structures*

2. American Welding Society:
   *Welding Zinc Coated Steel – AWS D19.0-72*

B. Reference Standards
1. American Society for Testing and Materials (ASTM)
   *A 123 / 123M Specification for 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 / 153M Specification for 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 641 Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

A 767 Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

A 780 Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

2. Federal Specifications
   DOD-P-21035 Paint, High Zinc Dust Content, Galvanizing Repair
   MIL-P-26915 Primer Coating, Zinc Dust Pigmented

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

1.04 QUALITY ASSURANCE

1.05 SUBMITTALS
   In accordance with provisions of Section [01300] and [01360], 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 767.

1.06 DELIVERY, STORAGE & HANDLING
   A. Store and protect products under the provisions of Sections [01600] and [01610].

   B. Load and store galvanized articles in accordance with accepted industry standards.

1.07 METHOD OF MEASUREMENT
A. Galvanized Fabric Reinforcement: The quantity of galvanized fabric reinforcement shall be measured as the number of square feet of fabric reinforcement in place, except that the allowance for each lap splice shall not exceed six inches.

B. Galvanized Bar Reinforcement: The quantity of galvanized bar reinforcement shall be measured as the number of pounds of steel bars placed. The weight of bar reinforcing will be computed by the engineer utilizing the unit weight for each size bar. No allowance will be made for the weight of the galvanized coating.

PART 2 – PRODUCTS

2.01 ACCEPTABLE COATING APPLICATORS
Members of the American Galvanizers Association, or equal, approved by the architect and/or engineer.

2.02 STEEL MATERIALS
A. Material to be geometrically suitable for galvanizing as described in ASTM A 384 and A 385. Steel materials suitable for galvanizing include reinforcing steel, structural shapes, pipe, and assemblies.

B. Material to be chemically suitable for galvanizing. Recommended steel materials for hot-dip galvanizing include, but are not limited to:

1. Reinforcing Steel Bars: ASTM A 615/A 615M and A 706/A 706M

2. Reinforced Steel Wire: ASTM A 82, A 496, A 497

Caution: Avoid use of steel with an ultimate tensile strength greater than 150 ksi. These steels have been shown to have potential for hydrogen embrittlement caused by pickling prior to immersion in the galvanizing bath.

C. Steel for Fasteners: The galvanized threads of nuts and mechanical connectors used for assembly with galvanized bolts and reinforcement shall be tapped oversize prior to coating and need not be retapped afterwards. The minimum additional diameter for Class-2A threads galvanized to Class C is as follows:

<table>
<thead>
<tr>
<th>Class-2A Thread</th>
<th>Additional</th>
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D. Steel for Miscellaneous Hardware: Chairs, tie wires, nuts, bolts, washer, other devices, and miscellaneous hardware used to support, position or fasten the reinforcement shall be galvanized. The engineer shall approve the specific hardware that the contractor proposes to use.

E. Steel for Mechanical Connectors: The fabricator shall certify, in writing to the engineer, that the mechanical connectors with oversize threads (if applicable) meet the following three parameters:

1. The maximum slip, at 50% of the yield strength of the reinforcing bar, shall be 0.010”. At least 70% of the maximum slip shall have occurred on the first cycle.

2. The maximum slip at 90% of the yield strength of the reinforcing bar shall be 0.018”.

3. The tensile strength of the splice shall be at least 100% of the specified minimum tensile strength of the reinforcing bar.

2.03 FABRICATION REQUIREMENTS
A. Fabricate structural steel in accordance with Class I, II, III guidelines as described in ASTM’s Manual of Steel Construction.

B. Fabrication practices for products to be in accordance with applicable portions of ASTM A 143, A 384, and A 385, except as specified herein. Avoid fabrication techniques that could cause distortion or embrittlement of steel.

C. The fabricator shall consult with the architect/engineer and hot-dip galvanizer regarding potential problems or potential handling problems during the galvanizing process that may require modifications of design before fabrication proceeds.

ASTM A 767 is currently undergoing technical review to determine the validity of using chromate as it pertains to bond strength.
D. Remove all welding slag, splatter, anti-splatter compounds and burrs prior to delivery to the galvanizer.

E. Surface contaminants that are not removable by the normal chemical cleaning process in the galvanizing operation should be removed by blast cleaning or an alternative method, prior to delivery of steel to the galvanizer.

F. Shop- or field-bending of reinforcing bar before or after galvanizing shall pay special attention to the minimum bend diameters required by Table 2 of ASTM A 767.

PART 3 – EXECUTION

3.01 SURFACE PREPARATION
Pre-clean steelwork in accordance with accepted methods to produce the best possible surface for quality hot-dip galvanizing.

3.02 APPLICATION OF COATING
A. Galvanize steel members, fabrications and assemblies after fabrication by the hot-dip galvanizing process in accordance with ASTM A123, A 767 or A 641 as appropriate.

B. Galvanize miscellaneous hardware, such as chairs, tie-wires, nuts, bolts, and washers in accordance with ASTM A 153.

C. Safeguard products against steel embrittlement in conformance with ASTM A 143.

D. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

3.03 SURFACE TOUCH-UP
Tears or sharp spikes shall be removed by hand-sanding or power-tool grinding. These operations shall remove the excess zinc, while leaving behind a fully compliant zinc coating with the required minimum thickness. If the coating thickness in the touched-up area falls below the minimum specified thickness, the area may be repaired as detailed in ASTM A 780.

3.04 COATING REQUIREMENTS
A. Coating Weight: Conform with Table 1 of ASTM A 767, Table 1 of ASTM A 153, or Tables 1, 2, and 3 of ASTM A 641, as appropriate.

B. Surface Finish: Continuous, adherent, smooth, and as 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.

D. Special Quality Provisions: Galvanized reinforcing bars that are “frozen” together shall be rejected. The presence of tears or sharp spikes, which make the bar hazardous to handle, shall be cause for rejection. Ash inclusions shall not be cause for rejection.

E. Storage: Galvanized bar that will be stored in the field in excess of 30 days shall be stored off the ground on dunnage to allow air circulation to prevent the formation of wet storage stain. Material galvanized in accordance ASTM specifications shall be free from wet storage stain. These corrosion deposits, if present, shall be removed in a manner satisfactory to the chief engineer/engineering services prior to incorporation of the material into the work. After removal of the wet storage stain, the coating shall have a uniform appearance free from uncoated spots, acid, flux, or black spots.

3.05 TESTS
A. Inspection and testing of hot-dip galvanized coatings shall be done under the guidelines provided in the AGA publication Inspection of Products to be Hot-Dip Galvanized After Fabrication.

B. Include visual examination and tests in accordance with ASTM A 767, A 153, or A 641 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.

3.06 CONSTRUCTION REQUIREMENTS
A. Placing and Fastening: Prior to placing galvanized reinforcement, all grease, dirt, mortar, and other foreign substances shall be removed from all surfaces of the galvanized parts. Galvanized reinforcement shall be placed in the position indicated and within the allowable tolerances specified. Before concrete is
placed, all reinforcement shall be securely fastened and supported with approved chairs or other approved devices.

B. Bar Splices: Bar splices shall be permitted only where shown on the contract plans. Should the contractor desire to splice bars at locations other than those shown on the contract plans, written permission to do so shall first be obtained from the chief engineer/engineering services. Such permitted splices shall be distributed or located at points of low tensile stress. Splices shall not be permitted unless a minimum of two inches can be provided between the spliced bar and the nearest adjacent bar. All splices for bars shall be made by use of a mechanical connector or by placing the bars in contact and wiring them together for the length of the splice. No welded splice will be permitted.

C. Placement in Structural Slabs: Supports shall be spaced no farther apart than 4’ center-to-center, nor shall any support be closer than 6” from the edge of any future concrete surface. Bridge slab reinforcement shall be placed in accordance with the following tolerances:

- Vertical: +/- ¼”
- Horizontal: +/- ½”

The structural slab reinforcement mats (top and bottom) shall be securely connected together. This connection may be accomplished by wiring or other means approved by the engineer. Connections shall be placed no farther apart than foot on center. The supports may be utilized for this purpose.

Connecting devices shall neither deflect the reinforcement nor interfere with the smooth flow of concrete.

Immediately prior to placement of concrete, the engineer shall verify that the reinforcing steel is positioned within the above-stated tolerances. If the allowable tolerances are exceeded, the engineer shall order that the position of the reinforcing steel be corrected before granting permission for placing concrete. All concrete placed in violation of this provision shall be rejected and removed.

Subsequent to placement of concrete, the engineer shall verify, at random, that the vertical clear-distance from the top of the structural slab to the top mat of main reinforcing, as shown on the contract plans, is correct within tolerance of plus or minus 1/2” (1.27 cm). If the tolerance is exceeded the engineer shall review the nature and extent of the deficiencies and shall designate one or more of the following alternatives:
1. The affected concrete placement shall be removed and placed in whole or in part.

2. The contractor shall provide special corrective measures as directed by the chief engineer.

3. The concrete placement shall be accepted without corrective action.

The removal of the concrete placement and its subsequent replacement, or other corrective work that the contractor is directed to perform, shall be accomplished at no additional cost to the authority.

3.07 REPAIR OF DAMAGED COATINGS
A. The maximum area to be repaired is defined in accordance with ASTM A 123, 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 or flame-cutting, or during handling, transport or erection by one of the approved methods in accordance with ASTM A 780 when damage exceeds 3/16” (4.8 mm) in width. Minimum thickness requirements for the repair are described in ASTM A 123, Section 6.2, current edition.

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END OF SECTION

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APPENDIX 1: Related Specifications

The following is a list of additional available references and standards that apply to galvanizing.

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


   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
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*