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AISC Certification Program for Bridge and Highway Metal Component Manufacturers

Standard for Bridge and Highway Metal Component Manufacturers—2008

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AMERICAN INSTITUTE OF STEEL CONSTRUCTION

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1. Purpose

The purpose of the AISC Certification Program for Bridge and Highway Metal Component Manufacturers is to confirm to *owners*, the design community and the construction industry that a certified *manufacturing* firm has the personnel, organization, experience, procedures, knowledge, equipment and commitment to produce *components* of the quality required for normal bridge and highway construction.

2. Scope

This Certification Standard for Bridge and Highway Metal Component Manufacturers offers assistance to manufacturing and transportation professionals and to *owners* in assessing *manufacturers'* capability to satisfy *component* quality needs. Users of this *standard* should verify the *manufacturer's* capacity independently.

The *standard* describes certification requirements for facilities that *manufacture* and supply specific *components* composed primarily of metal to bridge and highway construction projects. These facilities have *quality management systems* with defined functions and responsibilities. The scope of this certification does not include installation, or erection of the *components*.

Certification to this *standard* is appropriate for *manufacturers* of *components* that include bracing not designed for primary loads (diaphragms, cross frames and lateral bracing); camera, light, sign and signal support structures; bridge rail; stairs; walkways; grid decks; drains; scuppers; expansion joints; bearings; ballast plates; and mechanical movable bridge equipment. *Manufacturers* of camera, light, sign and signal support structures; high mast light towers; bridge rail; complex expansion joints; high load multi-rotational (HLMR) bearings; and mechanical movable bridge equipment shall also be required to meet specific supplemental requirements to this *standard*.

The *quality management system* of these *manufacturing* facilities (not products) is certified. The certification should not be interpreted as a product inspection of *components*. Certification includes all functions of *manufacturing* and providing *components* from receipt of contract through final delivery. To maintain certification status, the *manufacturer* shall follow its *quality management system*, regardless of whether the requirement for this certification is in *contract documents*, and shall supply and be responsible for the entire *component*.

The certification program is open to all *manufacturers* of *components* covered by this *standard*, regardless of size and regardless of AISC membership status.

3. References

The *manufacturer* shall have the reference documents and standards necessary for existing contracts readily available to those who need them.

The *manufacturer* shall have the latest editions available and be able to demonstrate the ability to work to and meet the requirements of:

- AISC *Selected ASTM Standards for Structural Steel Fabrication*
- AASHTO/ASTM standards applicable to the *component manufacturers* product and/or *contract documents* (for verification purposes)
- AWS D1.1 *Structural Welding Code – Steel*, AWS D1.2 *Structural Welding Code – Aluminum*, or AASHTO/AWS D1.5 *Bridge Welding Code*. (Welding codes shall be applicable to *manufacturer's* product and *contract documents*. At least one welding code shall be available.)
- AWS A2.4 *Symbols*
- AWS A3.0 *Terms and Definitions*
- AISC *Code of Standard Practice for Steel Buildings and Bridges*[1]
- SSPC Steel Structures Painting Manual, Volume I, Good Painting Practice
- SSPC Steel Structures Painting Manual, Volume II, Systems and Specifications
- *Owners' specifications* for all projects in progress or proposed.

4. Definitions

The following terms are *italicized* where used in this *standard* to alert the user that the term is defined in this section. As used in this *standard*, the words **shall** or **will** denote a mandatory requirement. The word **should** denotes a guideline or recommendation. The word **may** denotes an opportunity to make a choice.

AISC. American Institute of Steel Construction—the certifying body.

ASTM. American Society for Testing and Materials.

AWS. American Welding Society.

Assembly. Two or more *components* joined to make a part or product that can be the final item or that join to other *components*. Joining methods include welding, bolting, pressure fit, molding, and adhesion.

C of C. Certificate of Compliance or Certificate of Conformance.

[1]An electronic PDF version of this reference may be downloaded free from **www.aisc.org/freepubs**.

Checker. A person in a *detailing* organization who, because of experience and ability, has advanced successfully to a position of responsibility with the ability to perform the final verification of *shop drawings* without direct supervision.

Checking (of shop and installation drawings). A detailed review of all diagrams and dimensions on *shop and installation drawings* by a qualified *checker* other than the original *detailer*. Checking will compare the drawings to contract documents and applicable references. Issues to review include, but are not limited to:

- Geometry
- Correct connections
- Proper notes
- Proper material usage
- Assignment of complete welding symbols
- Proper coatings and preparation
- Proper depiction and notation of instructions and details necessary for field installation.

Coating. Coatings may include paint, powder coatings, galvanizing, metalizing, Teflon and electro-deposited metals.

Component. A bridge or transportation related item that *contract documents* stipulate to be obtained from an AISC Certified Bridge and Highway Metal Component Manufacturer and that is not covered by either the AISC Simple Bridge or AISC Major Bridge Fabricator Certifications. A *component* may be entirely produced by the *manufacturer*, or comprised of subassemblies and parts from *subcontractors* and *suppliers*, assembled by the *manufacturer*. A finished *component* may ship as a single piece or multiple elements, and may require field assembly or adjustment, based upon installation instructions provided by the *manufacturer*.

Contract Documents. The documents that define the responsibilities of the parties that are involved in *manufacturing* and installing of *components*. These documents normally include the *design drawings*, the *specifications* and the contract.

Corrective Action. The action or actions undertaken to identify and eliminate the root cause of a product or process *nonconformance* to prevent its recurrence. Corrective action is not the repair or rework of an identified nonconforming product or process to meet specified requirements.

Customer. Entity (potentially the general contractor, specialty contractor, *owner*) contracting with the *manufacturer* for *manufactured components*.

Design Drawings. The graphic and accompanying narrative portions of the *contract documents* showing the design, location and dimensions of the work. These documents generally include: plans, elevations, sections, details, schedules, diagrams and notes.

Detailer. Person who performs the function of *detailing*.

Detailing. The function that produces *shop and installation drawings* from *contract documents*.

Documented Procedure (quality management system procedure). A procedure that is established, documented, implemented, and maintained. The documentation provides information about how to perform the activity or process consistently. Documentation can include written instructions, drawings, diagrams, charts, specifications, and references or excerpts of appropriate technical standards and codes. Documentation shall contain:

- The purpose of the procedure
- Process definition that includes steps required for completion
- Assignment of responsibility for completion
- Assignment of responsibility for review of the procedure
- Identification of the records that are generated.

Documented Training. Training in which there is a record of the course outline, a record of who attended, the date it was given, and the instructor who provideds the training.

Element. A primary section of this *standard* as shown in the Table of Contents.

Engineer of Record. The licensed professional who is responsible for sealing the *contract documents*, which indicate that he or she has performed or supervised the analysis, design and document preparation for the structure and has knowledge of the load-carrying structural system.

Executive Management. The *manufacturer's* chief executive officer, president or individuals responsible for overseeing the *quality management system*. Executive management has full authority in final decision-making for all aspects of the *quality management system*.

Installation Drawings. Field-installation or member-placement drawings that are prepared by the *manufacturer* to show the location and attachment of the individual *manufactured components*.

Manufacture (manufacturing, manufactured). The process of designing, producing, testing, and assembling *components* by the manufacturer.

Manufacturer. The entity that manufactures *components*. In the context of this document, the manufacturer is the entity being certified.

MTR. Material Manufacturer's Test Report as described in Section 14 of ASTM A6.

Nonconformance. Attribute(s) of materials, consumables, *manufactured* product (in process or final), and processes not meeting contract, regulatory, or *manufacturer* defined requirements.

NDT (NDE). Nondestructive Testing (Nondestructive Examination). Referencing documents provide specific NDT procedure definitions.

Objective Evidence. Data supporting the existence or verification of something. Records, statements of fact, or other information which are relevant to the audit criteria and verifiable. In this context, it is evidence of whether the *quality management system* is functioning properly. Objective evidence can be obtained through:

- Observation of the performance of a task or physical products
- Measurements
- Tests
- Review of a record, document, or *procedure*
- The result of an interview with one or more employees about their duties or performance of a task.

Owner. The entity that is identified as such or identified as the contracting authority in the *contract documents*.

Owner's Designated Representative for Construction. The *owner* or the entity that is responsible to the *owner* for the construction of the project, including its construction supervision, quality, and acceptance.

Owner's Designated Representative for Design. The *owner* or the entity that is responsible to the *owner* for the overall structural design of the project, including the structural steel frame. This is usually the structural *engineer of record*.

Owner's Designated Representative for Quality. The *owner* or the entity that is responsible to the *owner* for quality inspection of the project. This entity is often referred to as the Quality Assurance Inspector (QAI).

PQR. Procedure Qualification Record as defined by ANSI/AWS A3.0.

Procedure. See *Documented Procedure*.

Quality Assurance (QA). That part of the *manufacturer's* quality management focused on providing confidence that quality requirements will be fulfilled. For the purposes of this program, quality assurance is the planned system of *documented procedures* and organizational requirements developed and implemented for the purpose of measuring and assuring compliance with *customer* requirements and quality goals. Quality assurance encompasses such areas as compliance with project *specification* technical requirements, compliance with referenced standards and achievement of *customer* service objectives. Specific functions included in quality assurance are:

- Determination of quality criteria
- Establishment of a plan to monitor quality, including assignment of *quality control* (inspection)
- Determination of acceptance criteria
- Determination of *QC* personnel qualifications
- Oversight (periodic monitoring) of *QC* activities
- Summarizing and reporting quality conformance measures to management
- Oversight of *corrective action* process.

Quality Control (QC). That part of the *manufacturer's* quality management focused on fulfilling quality requirements. QC is the inspection of work. Conformity evaluation and judgment accompanied, as appropriate, by measuring, testing, or gauging.

Quality Manual. A document stating the quality policy and describing the *quality management system* of the *manufacturer's* organization.

Quality Management System. A system to establish policy, objectives, plans, and resources to direct and control an organization with regard to quality.

Quality Record. A specific type of quality document that provides *objective evidence* of activities performed or results achieved.

RFI. A documented request for information or clarification generated during the construction phase of the project.

Shipping Piece. Individual member for field installation carrying a specific identification mark.

Shop Drawings. Detailed drawings of the individual *shipping pieces*, showing necessary information for their production and assembly.

Specifications. The portion of the *contract documents* that consists of the written requirements for materials, standards and workmanship.

SSPC. The Society for Protective Coatings.

Standard. The *Certification Standard for Bridge and Highway Metal Component Manufacturers*.

Subcontractor. A firm that performs a portion of the manufacturer's contract work such as design, fabrication, detailing, *coating* application, inspection, and test or consulting services.

Supplier. A firm that supplies materials (including but not limited to: mill materials, process supplies, welding consumables, *coatings* and process machinery) or completed product (including but not limited to: fasteners, and proprietary buy-out items) needed to fulfill the *manufacturer's* contract requirements.

Training. See *Documented Training.*

WPS. Welding Procedure Specification as defined by ANSI/AWS A3.0.

5. Management Responsibility

Management shall define and adopt a commitment to quality and shall direct and lead the *manufacturer* to assure continual progress toward achieving the objectives of the commitment.

The *manufacturer's executive management* is responsible to develop and maintain a *quality management system* to meet the specific requirements of this *standard*, industry and government regulations, and *contract documents*.

5.1 Policy for Quality and Quality Goals

Executive management shall adopt, document, and maintain a policy for quality. The policy shall define:

- A commitment to quality and meeting contract requirements
- *Quality management system* objectives that provide a framework for establishing and reviewing quality goals of the *manufacturer's* organization.

Management shall ensure that the policy for quality is understood, implemented, and maintained at appropriate levels of the *manufacturer's* organization.

Executive management shall direct the development of systems necessary and establish measurable quality goals to achieve the objectives of the *manufacturer's* policy for quality. *Executive management* will document and demonstrate that:

- There is a minimum of one specific measurable quality goal related to *component manufacture*
- Specific measurements related to goals are being recorded
- Current goal achievement levels are known relative to a previous measurement or baseline
- As quality goals are achieved, new goals are set that demonstrate commitment to continual improvement. New goals can be a new level of achievement for a previous goal, or a new goal that has not been previously examined.

5.2 Direction and Leadership

Executive management and management of functional positions that perform and verify work affecting quality shall review the *manufacturer's quality management system* at planned intervals, but not less than annually.

Records from management reviews shall be maintained. Management review requirements will be defined by the *manufacturer* and include a specific method to obtain, appropriately assess and analyze, and then report the following:

- Results of internal, external and AISC audits
- Opportunities for improvement of product quality
- *Corrective action* activity and resolution based on internal and external stimuli
- Need for changes to the *quality management system*
- *Customer* feedback, for example: surveys, letters of recognition, personal interviews, requests for rework and complaints
- The level of qualification and *training* of personnel
- Channels for communication to address and resolve all quality issues including *customer* complaints
- Process performance, which is the effectiveness of the means, methods, and practices that produce the product. Process performance may be monitored with measures and data that include: process *nonconformance* records (e.g., errors in following welding, bolting or *detailing procedures*), shipping delays, improper disposition of *nonconformances*, AISC audit *corrective action* requests not closed in time, failure to conduct management review or other meetings per *documented procedure.*
- Product *nonnonconformance*. Attributes of *manufactured* product (in-process or final) that do not meet acceptance criteria, for example; errors in welding, bolting, *coating*, or dimensionality
- Results from previous management reviews.

Results from the management review shall include the record and implementation plan for any decisions and actions related to:

- Improvement of the effectiveness of the *quality management system* and its processes
- Improvement of product quality
- Resource needs.

5.3 Management Representative

Executive management shall appoint a member of management who may or may not be the chief executive– and who, regardless of other responsibilities, shall have ability, responsibility, and authority to:

- Ensure that *procedures* needed for the *quality management system* are established, implemented and maintained in accordance with this *standard*.
- Report to *executive management* on the performance of the *quality management system* and any need for improvement.
- Promote awareness of *customer* requirements throughout the *manufacturer's* organization.
- Review the *quality management system* at defined intervals sufficient to ensure its relevance and effectiveness in satisfying this *standard*.
- Communicate with external parties on matters relating to the *quality management system*.

5.4 Resources

The *manufacturer* shall have the resources needed to comply with *contract documents*.

5.4.1 Personnel

The qualification requirements, responsibility, authority, and the interrelation of functional positions that manage, perform and verify work affecting quality shall be defined as required in Section 5.6.

Personnel performing defined functions shall have the required qualifications and the ability to successfully perform the function. *Objective evidence* of qualification may be demonstrated through biographies, resumes, training records, and individual licenses or certifications.

Personnel can be assigned to more than one task, provided they are qualified and able to fully perform the duties of each position. Individual(s) responsible for *quality assurance* or *quality control* management who report to (or serve as) production management shall also report directly to (or be) *executive management*.

Qualified management shall be assigned to manage the functions detailed in *elements* 5 through 19 of this *standard* and shall include as a minimum the Management Representative and positions that manage:

- Engineering when design is performed by the *manufacturer*
- *Detailing*
- Purchasing
- *Manufacturing* operations
- *Quality assurance*
- *Quality control.*

Members of management shall be aware of the requirements for the management review detailed in Section 5.2 and the results of the most recent review.

5.4.2 Buildings, Workspace and Associated Utilities

A *manufacturing* facility shall consist of areas and buildings that provide space for routine functions considered part of *component manufacturing*. The areas and buildings shall be conducive to achieving consistent work quality.

5.4.3 Process Equipment (both hardware and software)

The *manufacturer* shall have under their control the equipment necessary to perform the functions common to their *manufacturing* process and consistent with the specifications and standards common to the work. Equipment shall be maintained to produce the required quality.

5.5 Internal Communication

Executive management shall ensure that appropriate communication processes are established within the *manufacturer's* organization and that the effectiveness of the *quality management system* is communicated to appropriate individuals.

5.6 Documentation Requirements

5.6.1 General Requirements

Quality management system documentation shall include:

- A *quality manual*
- Statements of a quality policy and quality objectives (as described in Section 5.1)
- *Procedures* and their associated *quality records* required by this *standard*
- Documents needed by the organization to ensure the effective planning, operation, and control of its processes.

The extent of the *quality management system* documentation can differ from one organization to another due to: the size of organization, the type of activities, the complexity and interaction of processes.

5.6.2 Quality Manual

The *manufacturer* shall establish and maintain a *quality manual* satisfying all of the requirements of this *standard*, as well as applicable reference documents, industry and government regulations, codes, and contract requirements. Requirements may be satisfied in a single document called the *quality manual* or in separate documents referenced by the *quality manual*.

5.6.2.1 Organization

The *quality manual* shall include a page showing the current revision date and the name and location of the *manufacturer*.

The *quality manual* shall include or reference documents that include:

- Policies and organizational description
- Organizational chart describing responsibility, authority, and the interrelationship of functional positions that manage, perform, and verify work affecting quality
- Job descriptions and required qualifications for *executive management* and functional positions that manage, perform, and verify work affecting quality
- Qualification evidence and biographies for individuals in positions that require qualification
- A Facility Plan
- An Equipment List
- Established documented procedures

- Description of the interaction and communication between the *quality management system* processes used by the *manufacturer* to produce products of the required quality.

Procedures may be issued separately or be an integral part of the *quality manual*. The *manufacturer's* management determines the level of detail in the *quality manual* and *procedures*. At a minimum, these documents shall be detailed sufficiently to describe the *quality management system* used by the *manufacturer* to assure the required quality.

Management shall define what additional *procedures*, drawings, or other documents are required beyond the minimum requirements set by this *standard* to meet the needs of the *manufacturer's* organization and its *customers*.

5.6.2.2 Approval

Executive management shall document their approval of the *quality manual*. At a minimum, the *quality manual* shall be signed and dated by the highest ranking individual responsible for the facility.

6. Contract and Project Specification Review and Communication

The *manufacturer* shall develop a *documented procedure* for contract and project *specification* review requiring their completion for every project that includes performance or a product in accordance with *specifications*. The review shall begin no later than the *manufacturer's* acceptance of responsibility for performing the work.

The review shall identify, determine, plan, and record the specific project requirements as well as define distribution of those recorded requirements to the responsible individuals in the *manufacturer's* organization. This review will consider the current status of any issue that affects the *manufacturer's* capability to perform the work.

The *procedure* shall provide for review of the original *contract documents*, revised *contract documents* and changes received through clarification (e.g. *requests for information* [*RFI*} or other sources) to assure that the affected staff (e.g., engineering, procurement, assembly, *QC*) fully understand the applicable contract requirements.

Evidence of contract review can take the form of technical summaries, signoffs, change orders, schedules and allocation of adequate resources. Such evidence shall indicate consideration of pertinent *elements* of this *standard* managed by the functions listed in Section 5.4.1 and other critical *component* requirements that, if missed, may have a major impact on project quality and satisfying the contract.

7. Design and Detailing

7.1 Design Procedure

Where *component* design is provided by the *manufacturer*, the design process shall be defined by a *documented procedure*. The *procedure* shall describe steps in the design development, review and verification phases of the process. The *procedure* shall:

- Define methods for determining *component* product requirements from:
  - *Contract documents*
  - *Customer* and industry input
  - Regulatory and code requirements
  - Similar component designs.
- Define a design review process to identify and propose solutions for *nonconformances* with product requirements. Identify the individuals responsible and keep records of the design review process.
- Define methods to identify, document, evaluate, and approve design changes before implementation. Keep records of all documents.
- Describe a means for validating the function of the resulting *component* with respect to intended uses and identified *component* requirements. Identify individuals responsible and keep records of the validation process.

7.1.1 Professional Engineer Review of Design for Standard Components

For products that are standard *components* not specific to any one project, the *manufacturer* shall have on file and available to the *customer* a set of design calculations reviewed and stamped by a professional engineer to signify that the designed product meets the current applicable code requirements for its intended use. Any design tables or design processes published with the product literature shall also be reviewed and stamped by a professional engineer. *Shop drawings* for these *components* shall include a statement that the *component* details are based on designs that have been reviewed and stamped by a professional engineer and are on file with the *manufacturer*.

7.1.2 Professional Engineer Review of Design for Non-Standard Components

For products that are job-specific, the *manufacturer* shall retain the services of a professional engineer to review and stamp the site-specific design of the *component*. The engineer shall also review the *shop drawings* produced for the *component* and verify their consistency with the design. The results of this review shall be indicated on the *component shop drawings*.

7.2 Detailing Procedure

7.2.1 Preparation of Manufacturing Drawings

The *manufacturing* drawings produced shall incorporate all *customer* requirements, specifications, codes and relevant standards to adequately procure materials, *manufacture* and install the *component*. To ensure this, a *documented procedure* for preparation of *manufacturing shop and installation drawings* shall be developed, which describes:

- How project requirements are reviewed and incorporated.
- How the *manufacturer* coordinates, proposes changes, and tracks information with the *customer* (e.g., change documents, *requests for information* [*RFI*]) and how the associated resolutions are tracked and controlled.
- How the manufacturer includes owner-required information on each drawing (e.g., route, section, county, contract number, and structure identification).

7.2.2 Detailing Standards

The *manufacturer* will prepare and utilize *detailing* standards describing technical preferences and requirements customarily used in the *manufacturing* facility. These standards will show special information required on advance bills such as allowances for cuts or supplementary requirements. The standards will include how bills of material are prepared which, at a minimum, include:

- Sizes
- Appropriate ASTM or AASHTO specification references
- Special ordering information
- Any allowances or tolerances.

The *detailing* standards will illustrate the *manufacturer's* preferred methods of *shop and installation drawing* layout, including:

- Views
- Title block information
- The method of designating shipping sequences
- The piece marking system
- Dimensional preferences
- Commonly used shop abbreviations
- Assembly and installation requirements.

If applicable, illustrate information to be included on weld symbols and the preferred way to designate surface preparation and *coating* requirements.

7.2.3 Shop and Installation Drawings

The *manufacturer* shall develop a *documented procedure* to provide for *checking* of all *shop and installation drawings* and to describe the approval method used for *shop and installation drawings*. The *manufacturer* may describe *checking* and approval in a single *procedure* or separately in two or more documents.

7.2.3.1 Checking of Shop and Installation Drawings

The *procedure* for *checking* of *shop and installation drawings* shall describe the method used by the *manufacturer* or its *subcontractor* to perform and record the final check of *shop and installation drawings* to ensure compliance with *contract documents* before release for *manufacture* and installation. Evidence of the effective implementation of such methods may include signatures, stamps, logs, files or lists. Records shall provide means for identification of the individual *checker* who performed the final check of each *shop or installation drawing*.

For computer-generated *shop drawings*, the *procedure* will identify the data, variables, graphics, calculating formulas and other output that are checked to verify the accuracy of the software.

When *detailing* is performed by a *subcontractor*, the *procedure* will define the extent of review by *detailing* management and *checking* of received *detailing* products before release for *manufacture* and installation.

7.2.3.2 Approval of Shop and Installation Drawings

The *procedure* for approval of *shop and installation drawings* shall describe the method used to document the approval of *shop and installation drawings* released for *manufacture* and installation. Such methods may include signatures, stamps. logs, files or lists.

The method shall have provisions for recording approval of *shop drawings*, whether produced in house or through a *subcontractor*, by the *owner's designated representatives for design and/or construction*.

The procedure shall require that any waiver of approval from the *owner's designated representative for design* or from the *owner's designated representative for construction* be in writing.

7.2.3.3 Customer Supplied Shop Drawings

When the *manufacturer* receives *shop drawings* from the *customer*, a *documented procedure* shall define the method of receipt, revision and control of those drawings.

7.3 Detailing Function Resources

7.3.1 References (required library)

The *manufacturer* shall maintain as a minimum, a library of the applicable references listed in *element* 3.

7.3.2 Personnel

The *manufacturer's* staff shall manage *detailing*. *Detailing* functions may be performed by employees or *subcontractors*.

7.3.2.1 Detailing Management

Responsibilites for *detailing* management shall include:

- Overseeing the production of *shop and installation drawings*
- Communicating with designers
- Scheduling
- Developing and maintaining company *detailing* standards and *detailing procedures*
- Transmittals related to obtaining approval from the *owner's designated representatives for design and/or construction*
- Coordinating and incorporating construction requirements
- Training of employed *detailers* and *checkers.*

Qualification requirements for *detailing* management personnel shall include one or more of the following:

- Experience in *detailing* and *checking shop and installation drawings* approved by an *owner* for projects, products, or services of equal or greater complexity than the company provides. The *manufacturer* shall determine and describe methods to demonstrate competence.
- Graduate engineer with experience related to manufacturing
- Licensed P.E. or S.E., with experience related to manufacturing.

7.3.2.2 Detailing Functions

Personnel who perform *detailing* and/or *checking* of *shop and installation drawings* shall have experience in drawing projects similar to the projects the company provides.

Detailers in training shall work under the supervision of a trained *detailer* or *checker*.

A qualified *checker* shall check all *shop drawings* before release for *manufacture*. Qualification requirements for *checkers* shall be defined and documented as required in Section 5.4.1. Demonstrated competency of employed and subcontracted individuals performing final checks shall be documented by *detailing* management.

7.3.2.3 Subcontract Services

In lieu of employed personnel, *subcontractors* may be used for the following functions: *detailing*, *checking* of *shop and installation drawings*, and training of *detailers* and *checkers*. However, the *manufacturer* retains the responsibility for compliance with the requirements of this *standard*.

The *manufacturer* shall define and document the qualification and selection process for choosing *subcontractors* as required in Section 10.2.

8. Document and Data Control

The *manufacturer* shall develop a *documented procedure* to control documents and data affecting quality including:

- The *quality manual*
- Contract documents (dissemination and revision control)
- Shop and installation drawings
- Detailing standards
- All *documented procedures.*

8.1 Review and Approval

Internal standards and procedures that are controlled by the *manufacturer* shall be reviewed and approved by authorized management. Revisions to the *quality manual* and other *quality management system* documents shall be reviewed for adequacy and approved by the same function and authority level that authorized the original document. The *procedure* for document and data control shall describe the frequency and requirements established by management for review and updating, and establish a method to identify changes.

8.2 Customer Requirements

The *procedure* shall define methods for receipt and documentation of *customer* requirements and corresponding

manufacturer-originated changes for compliance as they occur throughout the *manufacturing* and *detailing* process. *Customer* requirements may be received in original *contract documents*, or subsequent telecommunications, letters, transmittals related to product requirements, and construction changes or contract addenda.

The *procedure* shall require records (e.g., logs, files, or master lists) that show receipt of change data, incorporation, issue, and distribution of approved and revised *shop drawings* and *installation drawings* to all necessary departments and personnel at the *manufacturer's* facility and necessary external organizations, *subcontractors*, or *suppliers*.

8.3 Revision Control

The revision to the previous document shall be clearly identifiable on each amended document and reflected in data controlled by the *procedure* and there shall be a method for monitoring and identifying the latest revision.

The *manufacturer* shall establish a method to ensure identification of changes to the *quality manual* or referenced *procedures* from the previous revisions. Documents shall remain legible and easily identifiable.

8.4 Access

Relevant and current *procedures* and policies pertinent to an area of operation or management shall be available and readily accessible to all personnel responsible for performing work affecting the product quality.

8.5 Obsolescence and Transmittal

The *procedure* shall describe methods to prevent inadvertent use of controlled documents that are obsolete in the *manufacturing* or installation process.

A method shall be established and maintained showing the latest revisions and location of:

- The *quality manual* and other *quality management system* documents
- *Contract documents* including *design drawings* and *owner* change orders
- *Shop and installation drawings.*

A transmittal system shall be established to record the distribution of drawings, documents and specifications to:

- *Customers*
- *Subcontractors*
- *Suppliers.*

The records shall indicate the status of approval and release to shop or installation.

9. Control of Quality Records

The *manufacturer* shall develop a *documented procedure* for *quality records* that provides for:

- Identification
- Collection
- Storage (location)
- Maintenance
- Retention (time duration)
- Disposition.

All *quality records* shall be legible and shall be stored in such a way that they are retrievable from facilities that provide a suitable environment to prevent damage, deterioration or loss. *Quality records* typically include, but are not limited to:

- Inspection records
- *NDT* reports
- Mill and consumable purchase orders
- MTRs
- C of Cs
- Contract review
- Contract clarifications
- *RFIs* with *owner* responses
- Design change records, including contract construction changes and addendums
- Drawing logs
- *Component* design validation records
- Records or summaries of *nonconformance* reports
- *Corrective action* reports
- *Training* records
- *Subcontractor* and *supplier* qualifications and evaluations
- Internal and external *quality management system* audit records.

9.1 Retention of Quality Records

Retention times shall be established and recorded for records retained for any purpose. The retention periods will be at least to the point of the *manufacturer's* final project ship date plus three years unless a longer period is required by contract or government regulation, and not less than the duration of any warranty provided by the *manufacturer*.

9.2 Availability of Quality Records

Specific *quality records* required by contract or regulation shall be made available for the *owner's* review and evaluation by the *manufacturer* for the required time period.

10. Purchasing

The *manufacturer* shall develop a *documented procedure* to ensure that *subcontractors* and *suppliers* provide materials, products, and services conforming to project requirements. Responsibility for quality of the subcontracted products and services remains with the Certified *manufacturer*. Purchase documents, *subcontractor* and *supplier* qualification records, and records of the periodic evaluation of *subcontractors* and *suppliers* shall be maintained.

10.1 Purchasing Data

The *manufacturer* shall clearly describe subcontracted work and the purchased products, materials, and services ordered in written purchasing documents. This shall include but not be limited to:

- The type of service, material, class, grade and other unique identification
- The applicable specifications, drawings, process requirements, and inspection instructions and any witness points required by the *owner* or the *quality management system*
- Delivery instructions and date
- Required *C of Cs*, *MTRs* and *NDT* reports.

Purchasing documents for materials furnished to ASTM specifications shall include the information required in the "Order Information" section of the ASTM standard.

10.2 Selection of Suppliers and Subcontractors

The *manufacturer* shall evaluate and select *subcontractors* and *suppliers* on the basis of their ability to meet subcontract requirements, the *manufacturer's quality management system*, the requirements of this *standard*, project requirements, and any specific inspection requirements.

A *documented procedure* shall be developed that describes how the *manufacturer* conducts initial and ongoing evaluation of *subcontractors* and *suppliers*. Management shall determine:

- Evaluation criteria
- Reevaluation interval
- Personnel involved in the evaluation process.

The *manufacturer* will evaluate *subcontractors* and *suppliers* via an audit or documented acceptable past experience. At a minimum, quality of the finished products and timely, proper delivery of services or products shall be part of the evaluation *procedure*.

10.2.1 Manufacturing Subcontractors

On projects requiring AISC Certification of the *component manufacturer*, a *subcontractor* selected to *manufacture* or provide assembly for a significant portion or all of a *component* shall have the required AISC Certification.

Exception: If a written waiver is obtained from the *owner* on projects requiring AISC Certification, a subcontracted manufacturer that is not AISC Certified is permitted.

10.2.2 Design Subcontractors

The *manufacturer's procedure* defines the methods used for initial and ongoing evaluation of design *subcontractors* and may include direct or third party review of one or more of the following:

- Design products and other work to assess ability to perform the specific type of work the manufacturer is subcontracting
- Implementation and effectiveness of procedures to identify, document, evaluate, and approve design changes
- Employment experience records, education, and licensing for individual engineers and designers
- For ongoing evaluation, design error frequency and severity from manufacturer records.

10.2.3 Detailing Subcontractors

The *manufacturer's procedure* defines the methods used for initial and ongoing evaluation of *detailing subcontractors* and may include direct or third party review of one or more of the following:

- Drawing products and other work to assess ability to perform the specific type of work the *manufacturer* is subcontracting
- Implementation and effectiveness of procedures to track *RFIs*
- Employment experience records for individual *detailers* and *checkers*
- For ongoing evaluation, *detailing* error frequency and severity from *manufacturer* records.

The *manufacturer's procedure* shall define *detailing subcontract*or evaluation criteria that include how the following information is identified and incorporated into drawings:

- Material requirements and special conditions
- *Coating* requirements
- *Contract document* special conditions
- Inspection requirements

- Conformance to the *manufacturer's detailing* standard
- Drawing check complete
- Identification of *checkers.*

When the *manufacturer* awards *detailing* subcontracts in advance of evaluation, the *manufacturer's procedure* shall include methods to assess the "pre-evaluation" level of risk for not satisfying:

- Subcontract requirements
- The manufacturer's quality management system
- The applicable requirements of this *standard*
- Project requirements
- Specific inspection requirements.

For "award in advance of evaluation", the *manufacturer's procedure* shall require a full evaluation of *detailing subcontractors* during the performance of the subcontracted work. Ongoing evaluation, as required in the *procedure*, shall be conducted if the *detailing subcontractor* is to be considered as a source for future work.

10.3 Verification of Purchased Product, Materials, and Services

The *manufacturer's procedure* for purchasing shall define the control necessary to ensure conformance to the project requirements. This may depend upon the type of product, the potential impact of subcontracted product on the quality of the final product or the records available for the demonstrated capability and performance of similar products in previous projects. Test reports, *C of Cs*, or other evidence of *quality control* shall be kept on file as defined in the *manufacturer's procedure* required by *element* 9.

10.4 Customer Verification of Manufactured Product

The *customer* or the *customer's* representative shall be allowed the right to verify the conformance of the final product to the project requirements at the *manufacturer's* premises.

10.5 Control of Customer-Supplied Material

If materials are supplied by the *customer*; the *manufacturer* shall verify, store and maintain materials in an appropriate fashion. Verification shall include confirmation that the material is what is required and meets the quality requirements. *Customer*-supplied material shall be protected to prevent use in other than its intended purpose. Any such product that is lost, damaged, or is otherwise unsuitable for use shall be recorded and reported to the *customer*.

11. Material Identification and Traceability

The *manufacturer* shall develop a *documented procedure* for identification of material and material traceability.

11.1 Material Identification

The *procedure* will describe how the *manufacturer* marks or maintains the identification of base materials from the point of receipt to the point of the first *manufacturing* operation to assure incorporation of the correct materials into the product.

- Structural Steel material shall be identified as stated in the AISC *Code of Standard Practice for Steel Buildings and Bridges* and in *contract documents*.
- Welding consumables shall be identified by the appropriate ANSI/AWS specification.
- *Coating* materials (excluding metallic *coating*) for *components* shall be identified by *coating* specification (for each coat if multiple coats), manufacturer, and manufacturer's product name.
- Metallic *coatings* for *components* shall be identified by composition and the appropriate ASTM specification, including hot dip or mechanical galvanizing and metallizing.
- Fasteners for *components* shall be stored in containers clearly identified by type, grade, size and lot number(s).

MTRs, manufacturer's test reports, and *C of Cs* for base materials, adhesives, fasteners, welding consumables, and *coatings* provide minimum material identification. In the absence of special contract requirements, these records shall constitute sufficient evidence that the material satisfies the purchase order requirements. Records that provide a basis for material identification shall be filed and retained as defined in the *manufacturer's procedure* required by *element* 9.

11.2 Material Traceability

From the point of receipt and during the course of *manufacture*, materials shall maintain traceability. The *manufacturer* may use a marking method that identifies material type and grade or use a method that provides traceability through piece, *assembly*, or group numbering. Material traceability to corresponding *MTRs* is necessary only when specifically required by contract.

12. Manufacturing Process Control

The *manufacturer* shall develop *documented procedures* for process control necessary to produce a consistent, acceptable level of furnished product quality in accordance with applicable codes and specifications. The *manufacturer* will develop *procedures* for all *manufacturing* processes done

at the facility. *Manufacturing* processes include: cutting, fitting and assembly, welding, drilling, punching, shearing, machining, bolting, cleaning, and *coating*. *Procedure* detail shall be sufficient to describe the operation and identify the tools and verification instrumentation required.

The process definition will show that the *manufacturer* has assessed the process and identified the source and potential magnitude of variability in the process. The assessment is demonstrated by the inspection points and sampling plan of the inspection and testing *procedure* (*element* 13).

Regardless if these processes are routinely performed at the facility, effective implementation of the following *documented procedures* are required as a minimum:

12.1 Welding

The *manufacturer's* welding *procedure* shall include:

- *WPSs*
- Preheat requirements
- *PQRs*
- Welder, welding operator, and tack welder Qualifications and Qualification Test Records
- Welder, welding operator, and tack welder performance records—to provide *objective evidence* that the "period of effectiveness" has not been exceeded and satisfactory performance is consistently achieved.

12.2 Bolt Installation

The *manufacturer's* bolting *procedure* shall include pre-installation verification for pretensioned joints, installation, and inspection of fastener assemblies.

12.3 Material Preparation for Application of Coatings

The *manufacturer's procedure* shall support achievement of cleanliness and surface profile required by *coating* manufacturer recommendations and product data sheets and by project *specifications*.

12.4 Coating Application

The *manufacturer's procedure* shall support application and curing of *coatings* in accordance with manufacturer recommendations and product data sheets and with project *specifications*.

12.5 Equipment Maintenance

The *manufacturer* shall develop a *documented procedure* defining an equipment maintenance program to produce the required quality. The *procedure* shall define evaluation and preventive maintenance for, at minimum, equipment critical to product quality and delivery requirements.

13. Inspection and Testing

The *manufacturer* shall develop a *documented procedure* for inspection and testing activities to verify that the product quality meets project requirements.

The inspection and testing *procedure* shall define receipt, in-process, and final inspection of all materials and products furnished to a project.

Product determined to be nonconforming during inspection and testing shall be addressed by the *manufacturer's nonconformance procedure* required in *element* 15.

For each type of inspection less than 100 percent, the *procedure* shall describe the methods for establishing sampling plans and for adjusting the level and frequency of inspection to assure expected contract quality. The *manufacturer's* methods will adjust the level and frequency of inspection at any time the required level of quality is not met. The level or frequency of an inspection sampling plan shall not be zero where a *nonconformance* has been identified and *corrective action* has not been fully implemented and verified as effective.

13.1 Assignment of QC Inspections and Monitoring

The *procedure* shall define inspection and testing and the required records to meet the project requirements and shall assign *QC* inspection and *QC* monitoring duties.

Qualification requirements for *QC* inspectors shall be defined and documented as required in Section 5.4.1. *QC* inspectors shall be assigned on the basis of qualification, evidenced by experience, training and education. Qualification standards and individual certifications granted by recognized industry organizations related to *component manufacturing* can be used as a basis for qualification.

QC inspectors shall be periodically monitored by *QA* repeating the *QC* duties or witnessing their work. The *procedure* shall document how often *quality control* activities are sampled and checked.

Production personnel may be assigned to *QC* inspection duties under the following conditions:

- They are trained and knowledgeable in the practice of proper inspection methods and acceptance criteria specified for the material or products they are inspecting.
- They are aware of their responsibilities and are given time to perform them.
- They do not inspect their own work for final acceptance of product.
- Their work is monitored by qualified *quality control* personnel.

13.2 Inspection Procedure

The *manufacturer's procedure* shall include provisions for the following:

13.2.1 Material Receipt Inspection

Materials received shall be compared to the purchase order requirements. The receiver shall identify the material, grade, and quantity and look for visible shipping damages. The receiver shall inspect material for obvious deviations from the requirements of purchase order specifications.

13.2.2 In-Process Inspection

The *manufacturer* shall employ in-process inspection plans and practices to provide a level of compliance assurance for specified process requirements and inspection acceptance criteria that are not verifiable at final inspection or that can hinder assembly. In-process inspection is appropriate for: welds, fit-up tolerances in areas not visible after welding, bolting, and cleaning and *coating* application on areas not accessible during final inspection.

Materials shall be inspected for specification and grade, workmanship, and tolerances using appropriate codes, standards, or a documented plan before *manufacturing* begins. Compliance with the *manufacturer's* documented process control *procedures* shall be monitored.

The *manufacturer* shall perform *NDT* in all areas designated in the *contract documents* and as required by the welding code.

Under the conditions described in Section 13.1, production personnel shall be capable of inspecting the product or subassemblies before sending it to the next process.

13.2.3 Final Inspection

The *manufacturer* shall conduct final inspection. Designated, qualified *QC* inspectors shall perform the final inspection of *component* products after the fitting, welding, and *coating* operations, but prior to delivery. Inspection of products may be cumulative after each *manufacturing* process or by final inspection just prior to delivery.

Demonstrated competency of employees and subcontracted individuals performing final inspection shall be documented and evidenced by experience, training, and education.

13.2.4 Inspection Records

The inspection *procedure* shall indicate what records and marks are used to document inspections. In-process inspections shall be verifiable until the final inspection of the piece.

Final inspections shall be documented. The *quality records* produced shall be filed and retained as defined in the *manufacturer's procedure* required by *element* 9. Inspection records shall clearly show the products and product aspects that were inspected and who performed the inspection.

14. Inspection, Measuring and Test Equipment

The *manufacturer* shall develop a *documented procedure* to control, calibrate, and maintain inspection, measuring and test equipment used to demonstrate that products and processes comply with specified requirements. Tools with devices for measuring properties or process variables are included when used to demonstrate the compliance of products and processes to the specified requirements.

The *procedure* shall define equipment calibration frequency. However, the volt/amp meters used to verify compliance with *WPS* parameters (on a welding machine or auxiliary meters) shall be calibrated whenever the accuracy of the meter is in question and at a minimum every twelve months.

Inspection, measuring and test equipment shall be used in a manner consistent with the required measurement. The precision capability of the equipment shall support reliable determination of compliance with acceptance criteria. When specifically required, technical data pertaining to the measurement equipment shall be made available to the *owner's* representative for verification that the equipment is calibrated and performing properly.

For inspection, measuring, and test equipment used to demonstrate the compliance of products and processes to the specified requirements, the *procedure* shall include:

- An equipment list that provides a means for unique identification of each piece of equipment
- Service use for each piece of equipment including the required precision for the types of inspections, measurements or tests
- Handling and storage of inspection, measuring, and test equipment to maintain accuracy and fitness for use
- Calibration frequency for each piece of equipment based upon: service use, requirements of this *standard*, manufacturer's recommendations, project requirements, specification requirements
- Identification of standards or certified equipment having a known valid relationship to internationally or nationally recognized standards used to calibrate each listed piece of equipment. Where such standards do not exist, the basis used for calibration shall be documented.
- The calibration procedure for each piece of equipment calibrated at the *manufacturer's* facility

- The calibration accuracy acceptance criteria for each piece of equipment
- The action to be taken when equipment does not meet the calibration accuracy acceptance criteria
- Calibration *quality record* maintenance as defined in the *manufacturer's procedure* required by *element* 9
- Method of preventing inadvertent use of uncalibrated equipment where calibration is required.

15. Control of Nonconformances

The *manufacturer* shall develop a *documented procedure* to identify and control *nonconformances*. *Nonconformances* may be identified by the *manufacturer's* inspection program, processes monitoring, and during internal or external audits. *Nonconformances* are then addressed by the *corrective action procedure* (*element* 16) and reviewed during the management review (Section 5.2).

15.1 Nonconformance with the Quality Management System

Nonconformances are not limited to nonconforming product. A *nonconformance* related to the performance of the *quality management system* shall be documented to the detail and level described by this *procedure*.

15.2 Nonconforming Product

Nonconforming product not satisfying specified requirements shall be documented and prevented from unintentionally reaching the *customer*. This *procedure* shall provide for identification, documentation, evaluation, segregation (when practical), treatment of nonconforming product, and for notification of the relevant functions concerned.

Nonconforming product shall be clearly marked as soon as practical after discovery. Records shall be kept of the pieces affected, the nature of the *nonconformance*, the treatment selection, authorization, and reinspection results, if applicable.

The responsibility, authority, and required qualifications for the personnel selecting treatment of nonconforming product shall be defined by the *procedure*. will Manufacturer's The treatment of nonconforming product may be:

- Redesign for approval
- Rework
- Repair
- Use as is (after analysis and acceptance by the *manufacturer's* engineering or management)
- *Customer*-approved nonconforming product
- Scrap.

If the treatment is rework or repair, the result will be inspected per drawing, specification, project requirements, and the *manufacturer's* inspection *procedure*. *Owner* approval may be required by contract for treatment of *nonconformances* and will be documented in writing for scrapping *owner*-supplied material, "use as is", "repair", or "rework" treatments, or *customer*-approved acceptance of nonconforming product.

16. Corrective Action

The *manufacturer* shall develop a *documented procedure* for *corrective action*. Any *corrective action* taken shall be appropriate for the magnitude of problems and commensurate with the risks to product quality.

The *corrective action procedure* shall include periodic review of records or summaries of *nonconformances* and of internal and external quality audit reports for determination and initiation of *corrective actions*. *Corrective action* may be applied when:

- There is a *nonconformance* that is repetitive in nature. This can be identified by periodically reviewing *nonconformance* reports or summaries for negative trends.
- Process *nonconformances* are found during the internal and external quality audits indicating that the *quality management system* may not be implemented and functioning as stated in the *quality manual*
- *Nonconformance* with the *quality management system* is found during the day-to-day execution of the system
- *Nonconformance* is unacceptable due to cost or severity.
- A *customer* complaint has been received.

The *corrective action procedure* shall address these steps:

1. Document a *corrective action* request (CAR) that includes the *nonconformance* to be addressed and the requirement that has not been met. The *corrective action procedure* shall define the functional positions authorized to issue a CAR and initiate the *corrective action* process.
2. Assign responsibility and establish a timeframe for the response to a CAR.
3. Investigate and document the scope of the *nonconformance*, root causes, and measures taken to bring a nonconforming product or process into conformance with specified requirements, and list the actions to be taken to prevent recurrence.
4. Communicate the *corrective action* request and resolution to management and appropriate members of the organization.
5. Follow up with periodic monitoring to assure the *corrective action* is implemented and is effective.

17. Handling, Storage and Delivery of Product and Materials

Material shall be stored, loaded and shipped to avoid loss or damage and minimize deterioration. Material shall be marked with identification and shall be listed on a manifest or shipping documents.

If a shipping agreement between the *manufacturer*, the *customer* or the *subcontractors* exists, material shall be shipped in compliance with the agreement, including sequencing that complies with installation needs. Shipments by *subcontractors* shall be coordinated and monitored for compliance with shipping instructions.

18. Training

Personnel responsible for functions that affect quality, including, but not limited to, project managers, designers, *detailers*, inspectors, welding personnel, fitters, and painters, shall receive initial and periodic *documented training*. Training records are *quality records* controlled as required in *element 9*.

Personnel providing *training* shall have appropriate training or experience in the subject they are teaching. *Training* course outlines include the subject and the key points. Evaluation of student comprehension of course material is desirable.

19. Internal Audit

The *manufacturer* shall perform an internal audit of each *element* of the *quality management system* at least once a year to evaluate compliance and the effectiveness of implementation.

The Management Representative or a qualified individual, independent of the function being audited, shall perform the audit and provide a written *quality record* of the audit result from each *element*.

Supplemental Requirements (reference element 2. Scope):

- Camera, light, overhead sign, and signal supports
  none – may be defined in future revisions of this standard
- High mast light towers
  none – may be defined in future revisions of this standard
- Bridge rail
  none – may be defined in future revisions of this standard
- Complex expansion joints (includes modular and finger plate joints, but does not include strip seals and neoprene-only joints)
  none – may be defined in future revisions of this standard
- High load multi-rotational (HLMR) bearings
  none – may be defined in future revisions of this standard
- Mechanical movable bridge equipment
  none – may be defined in future revisions of this standard