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# AISC Certification Program for Steel Bridge Fabricators

Standard for Steel Bridges—2011

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Approved by the AISC Certification Committee



**AMERICAN INSTITUTE OF STEEL CONSTRUCTION**

One East Wacker Drive, Suite 700

Chicago, Illinois 60601-1802

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This Standard was approved by the Certification Committee:

Jeffrey E. Dave, Chairman  
Henry B. Brummel  
Theodore L. Droessler  
Heather Gilmer  
Charles Johnson  
Keith Landwehr  
Clayton Larson

Paul C. Palmes  
Terry Peshia  
Homer R. Peterson, II  
Alan T. Sheppard  
Louis N. Triandafilou  
Thomas M. Vossmeier  
Keith A. Grubb, Secretary

The Committee gratefully acknowledges the following task committee members for their contributions to this document:

Robert C. Bills  
Steve Fugate  
Heather Gilmer  
Mary A. Grieco  
Fred A. Hlebichuk  
Dennis Nash

Kent M. Nelson  
Dennis Noernberg  
Russ Panico  
Jeffrey C. Smith  
Louis N. Triandafilou  
William Via



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## 1. Purpose

The purpose of the AISC Certification Program for Steel Bridge Fabricators is to confirm to *owners*, the design community, the construction industry, and the public that a certified steel bridge *fabrication* facility has the personnel, organization, experience, *documented procedures*, knowledge, equipment, and commitment to produce fabricated steel of the quality required for steel highway or railroad bridge construction.

## 2. Program Scope and Fabricator Eligibility

This Certification Standard for Steel Bridges offers assistance to steel bridge professionals, *owners*, general contractors, and other interested parties in assessing *fabricators'* capability to satisfy project quality needs. Specifiers of this standard are encouraged to evaluate fabricator capability independently, particularly with regard to project- or owner-specific requirements.

The standard describes requirements for certification of facilities that fabricate and supply steel highway or railroad bridges. These facilities have *quality management systems* with defined functions and responsibilities.

The quality management system of *fabrication* facilities (not products) is certified. The certification should not be understood as a product inspection of fabricated steel bridges. Certification includes all functions of providing steel bridge fabrication from receipt of contract through final delivery. The scope of this certification does not include design or erection. For bridge rehabilitation, the specifier is encouraged to consider on a project-specific basis the nature of the items being fabricated to determine whether this certification is appropriate. Likewise, for pedestrian bridges the specifier is encouraged to consider the structure type and loading to determine which is the most appropriate certification for a particular project.

The scope of this certification does not extend to the application of complex coating systems as defined in AISC 420/SSPC-QP 3 *Certification Standard for Shop Application of Complex Protective Coating Systems*.

The certification program is open to all fabricators of steel highway or railroad bridges, regardless of size and regardless of AISC membership status.

This standard, including its supplemental requirements, has three categories of certification: simple bridges, intermediate bridges, and advanced bridges. Fabricators producing fracture-critical members, intermediate bridges, or advanced bridges shall be required to meet specific supplemental requirements.

*Simple bridges* consist of unspliced rolled sections.

*Intermediate bridges* are typical bridges that do not require extraordinary measures. Typical examples might include: (1) a rolled beam bridge with field or shop splices, either straight or with a radius over 500 ft; (2) a built-up

I-shaped plate girder bridge with constant web depth (except for dapped ends), with or without splices, either straight or with a radius over 500 ft; (3) a built-up I-shaped plate girder with variable web depth (e.g., haunched), either straight or with a radius over 1000 ft; (4) a truss with a length of 200 ft or less that is entirely or substantially pre-assembled at the certified facility and shipped in no more than three sub-assemblies.

*Advanced bridges* are those requiring an additional standard of care in fabrication and erection, particularly with regard to geometric tolerances. Examples include tub or trapezoidal box girders, closed box girders, large or non-preassembled trusses, arches, bascule bridges, cable-supported bridges, moveable bridges, and bridges with particularly tight curve radius.

## 3. References

The *fabricator* shall have the reference documents and standards necessary to make personnel aware of work requirements. References shall be consistent with the requirements of existing contracts and be readily available to those who need them.

## 4. Definitions

The following terms are italicized where they appear for the first time in a section to alert the user that the term is defined in this section. Acronyms for professional organizations are not italicized in the text. 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.

*AASHTO*. The American Association of State Highway and Transportation Officials.

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

*ASNT*. The American Society for Nondestructive Testing.

*ASTM*. ASTM International.

*AWS*. American Welding Society.

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

*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 drawings, digital manufacturing models, and erection framing drawings)*. A detailed review of all sketches and dimensions on *shop drawings*, *digital manufacturing models*, and *erection framing drawings* by a qualified *checker* other than the original *detailer*.

*Contract Documents.* The documents that define the responsibilities of the parties that are involved in bidding, fabricating and erecting steel bridges. 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 identified nonconforming product to meet specified requirements.

*Design Drawings.* The graphic and pictorial 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 drawings*, *digital manufacturing models*, and *erection framing drawings* from *contract documents*.

*Documented 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 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 provides the training.

*Erection Framing Drawings.* Field-installation or member placement drawings that are prepared by the *fabricator* to show the location and attachment of the individual *shipping pieces*. Means and methods, safety procedures, and engineering calculations for erection are excluded from the *fabricator's* responsibilities for *erection framing drawings*.

*Executive Management.* The chief executive officer, president, or other individuals with executive function and the authority to assign resources. *Executive management* has ultimate authority and responsibility in final decision making for all aspects of the *quality management system*.

*Fabrication.* The process of preparation and assembly of individual parts into a *shipping piece*. *Fabrication* includes all production operations performed in the manufacturing

and shipping of the product (e.g., assembly, welding, drilling, sawing, milling, and thermal and mechanical cutting).

*Fabricator.* The entity that is responsible for fabricating the steel bridge. NOTE: The *fabricator* referenced in this document is the entity being certified.

*Manufacturing Model.* Digital sub-model of the Logical Product Model as defined in Appendix A of the AISC *Code of Standard Practice for Steel Buildings and Bridges*. The *manufacturing model* includes data represented in *detailing* for *fabrication*.

*MTR.* Material test report, manufacturer's test report, or mill test report, meeting the requirements of the "Test Reports" section of ASTM A6.

*Nonconformances.* Attributes of materials, consumables, fabricated product (in-process or final), or processes that do not meet contract, regulatory, or *fabricator*-defined requirements.

*NDT (NDE).* Nondestructive Testing (Nondestructive Examination).

*Objective Evidence.* Data supporting the existence or verification of something. In this context, it is evidence that 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, *documented procedure*, or other document.
- The result of an interview with one or more employees about their duties or performance of a task.

*Owner.* The entity or its authorized representative who has authority to define or accept changes to contract requirements and who is or represents the ultimate *owner* of the finished/completed product.

*PQR.* (Welding) procedure qualification record as defined by AWS A3.0.

*Quality Assurance (QA).* That part of 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 assuring compliance with the requirements of the *contract documents*, providing confidence that quality goals are achieved, and measuring effectiveness of the *quality management system*. *QA* encompasses such areas as compliance with project *specification* technical requirements, compliance with referenced standards, and achievement of

customer service objectives. Specific functions included in *QA* are:

- Determination of quality criteria to meet, as a minimum, the requirements of the *contract documents*.
- Establishment of a plan to monitor quality, including assignment of *quality control* (inspection), in order to meet, as a minimum, the requirements of the *contract documents*.
- Determination of acceptance criteria.
- Determination of *QC* personnel qualifications.
- Oversight of *QC* activities.
- Summarizing and reporting quality conformance measures to all levels of management.
- Oversight of *corrective action* process.

Some documents used in the steel bridge industry define “QA” as the quality verification activities carried out by the *owner*, but in this standard, *QA* refers to the *fabricator’s* activities as described above.

*Quality Control (QC)*. *QC*, for the purpose of this standard, is the inspection of work, i.e., conformity evaluation and judgment accompanied as appropriate by measuring, testing or gauging. *QC* includes but is not limited to confirming that *documented procedures* are met; personnel performing the work are properly qualified; equipment is appropriate and in acceptable working order; and the proper materials are used and are in compliance with inspection criteria.

*Quality Manual*. A document stating the quality policy and describing the *quality management system* of the *fabricator’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.

RCSC. Research Council on Structural Connections.

*Repair*. Action taken on a nonconforming product to make it acceptable for the intended use.

*Rework*. Action taken on a nonconforming product to make it conform to the requirements.

*RFI*. Request for Information. A written request to the *owner* for information or clarification generated after award of the contract.

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

*Shop Drawings*. Drawings of the individual *shipping pieces* that are to be produced in the *fabrication* shop.

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

SSPC. SSPC: The Society for Protective Coatings.

*Standard*. The Certification Standard for Steel Bridges.

*Subcontractor*. A firm that performs a portion of the *fabricator’s* contract work such as *fabrication*, *detailing*, coating application, inspection or consulting services.

*Supplier*. A firm that supplies materials (including but not limited to mill materials, process supplies, welding consumables, coatings, fasteners and process machinery) and completed purchased product needed to fulfill the *fabricator’s* contract requirements.

*Training*. See *Documented Training*.

WPS. Welding procedure specification as defined by AWS A3.0.

## 5. Management Responsibility

Management at all levels shall define and adopt a commitment to quality. Management shall direct and lead the *fabricator* to assure continuous progress toward achieving the objectives of the commitment. The *fabricator’s quality assurance* management is responsible for developing and maintaining a *quality management system* to meet the specific requirements of this standard, industry and government regulations, and contract requirements.

### 5.1 Quality Policy and Quality Goals

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

- A commitment to quality, including a commitment to meet contract requirements.
- Quality management system objectives that provide a framework for establishing and reviewing quality goals of the *fabricator’s* organization.

Management at all levels shall ensure that the quality policy is understood, implemented, and maintained at appropriate levels of the *fabricator’s* organization.

Executive management shall direct the development of systems necessary and establish measurable quality goals to achieve the objectives of the *fabricator’s* quality policy. Executive management along with quality assurance management shall document and demonstrate that:

- There are measurable quality goals related to steel bridge *fabrication*.
- 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 quality assurance management shall review the fabricator's quality management system at planned intervals, but not less than annually.

Records from management reviews shall be maintained. Management review requirements shall be defined by the fabricator and include a specific method to obtain, appropriately 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 findings.
- 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 documented 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 nonconformance (for example, errors in welding, bolting and 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 (see Section 5.4).

## 5.3 Management Representative for Quality

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 the ability, responsibility, and authority to:

- Ensure that documented 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 contract requirements throughout the fabricator's organization.
- Review the quality management system at defined intervals sufficient to ensure the stability of the quality management system and its relevance and effectiveness in satisfying this standard.
- Communicate with external parties on matters relating to the quality management system.

## 5.4 Resources

The fabricator 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 documented 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, or individual licenses or certifications.

Qualification requirements:

- For production and *QA* management functions: at least five years steel fabrication experience or training.
- For *QC* and purchasing management functions and for detailing *checkers*: at least three years steel fabrication experience or training.

Personnel and management 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 for *quality control* management (including the Management Representative for Quality) may not serve as or report to production management.

Production supervisors shall be familiar with the requirements of applicable *specifications*.

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

- Detailing.

- Purchasing.
- Fabrication operations.
- Quality assurance.
- Quality control.

Management at all levels shall be aware of the requirements for the management review detailed in Section 5.2 and the results of the most recent review.

The fabricator shall have the following personnel on staff or available under contract, certified in accordance with ASNT-TC-1A:

- at least one Certified Level III *NDT* administrator for each *NDT* method performed in the shop.
- at least one Certified Level II technician for each *NDT* method performed in the shop.

The fabricator shall have documented procedures for certifying and updating *NDT* personnel.

The fabricator shall have enough AWS Certified Welding Inspectors (or other personnel as permitted by AASHTO/AWS D1.5 clause 6.1.3, “Inspection Personnel Qualification”) to monitor all shifts on which welding is performed.

The fabricator shall have a competent welding technician on staff. The welding technician shall have extensive knowledge and experience with or education in welding processes, procedures, and equipment and with the development, preparation, qualification, and execution of welding procedure specifications.

#### 5.4.2 Buildings, Workspace and Associated Utilities

A fabrication facility shall consist of areas and buildings that provide space for the routine functions considered to be part of steel fabrication.

The areas and buildings (including housekeeping, ventilation and clean air supply, and electrical supply) shall be conducive to achieving consistent quality work.

#### 5.4.3 Fabrication Process Equipment

The fabricator shall have under their control the equipment and software necessary to perform fabrication consistent with the contract documents.

#### 5.4.4 Inspection Equipment

The fabricator shall have the inspection equipment necessary to verify conformance with the requirements of the contract documents.

### 5.5 Internal Communication

Executive management shall ensure that appropriate communication processes are established within the fabrica-

tor’s organization and that communication takes place on a regular basis regarding the effectiveness of the quality management system.

Drawing, material and production due dates shall be scheduled by suitable areas or sequences, and schedules shall be disseminated to appropriate personnel.

Drawing, material and production schedules shall be kept current.

Operational quality meetings among fabrication management, quality management and others, as necessary, shall be held on a regular basis. The meetings should include discussions of quality problems and countermeasures to prevent future quality problems. These meetings should be held at least quarterly.

## 5.6 Documentation Requirements

### 5.6.1 General Requirements

Quality management system documentation shall include:

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

### 5.6.2 Quality Manual

The fabricator 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 may be satisfied 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 fabricator.

The quality manual shall include or reference documents that include:

- Policies and organizational description.
- Organizational chart describing 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.

- Evidence of qualification for individuals in positions requiring it.
- A facility plan.
- An equipment list.
- Established documented procedures.
- Description of the interaction and communication between the individual processes within the system used by the fabricator to produce products of the required quality.

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

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

#### 5.6.2.2 Approval

Executive management shall approve 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 *fabricator* shall develop a *documented procedure* for contract and project *specification* review requiring completion of these reviews for each steel bridge project performed. The review shall begin no later than the fabricator's acceptance of responsibility for performing the work. Ideally, the review should begin during the project estimation or bid process.

The review shall identify, determine, plan, and record the specific project requirements as well as define distribution of the recorded specific project requirements (such as coating requirements, weld restrictions, etc.) to the responsible individuals in the fabricator's organization, and identify new documented quality procedures that must be created for the work. This review shall consider any issue that affects the fabricator's capability to perform the work. The review shall include *fabrication* and erection requirements (such as erection aids, sequencing of *NDT*, or erection sequence) and priorities. The fabricator's documented procedure shall include provisions for communication with the general contractor and the erector about fabrication issues that may affect erection.

The documented procedure shall provide for review of the original *contract documents*, revised contract documents and changes received through clarification (e.g., requests for information 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 and allocation of adequate resources. Such evidence shall indicate consideration of pertinent sections of this standard managed by the functions listed in Section 5.4.1 and other critical project requirements that, if missed, may have a major impact on project quality and satisfying the contract.

## 7. Detailing

### 7.1 Detailing Procedures

#### 7.1.1 Preparation of Shop Drawings and Erection Framing Drawings

The shop and *erection framing drawings* produced shall incorporate all contract requirements, *specifications*, codes and relevant standards to adequately procure materials, fabricate the steel bridge, and provide instructions to the erector for location of *shipping pieces* in the completed structure. To ensure this, a *documented procedure* for preparation of shop and erection framing drawings shall be developed, which describes:

- How project requirements are reviewed and incorporated.
- How the *fabricator* coordinates, proposes changes, and tracks information with the general contractor or *owner* (e.g., change orders and *RFIs*), and how the associated resolutions are tracked and controlled.

#### 7.1.2 Detailing Standards

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

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

The detailing standards shall describe the fabricator's methods of drawing layout, including but not limited to:

- Sections and views.

- Title block information.
- The method of designating shipping sequences.
- The piece marking system.
- Commonly used shop abbreviations.
- Showing bolt placement lists (including bolt type and installation requirements).
- Information required on weld symbols including any special *NDT* requirements.

The detailing standards shall describe the fabricator's method for:

- Selection of connection geometry.
- Detailing holes, fasteners, washers, cuts and copes.
- Assignment of appropriate welding symbols (shop and field welds).
- Selecting bolt installation method (for shop-installed bolts).
- Showing surface preparation (including specification of surface finish).
- Designating coating requirements (including coating materials and dry film thickness).
- Showing any necessary special instructions to fabricate and erect the steel bridge.

### 7.1.3 Shop and Erection Framing Drawings

The fabricator shall develop a documented procedure to provide for *checking* of all shop and erection framing drawings and to describe the method used to release *shop drawings* for *fabrication*.

#### 7.1.3.1 Checking of Shop and Erection Framing Drawings

The documented procedure for checking of shop and erection framing drawings shall describe the method used by the fabricator or its *subcontractor* to perform and record the final check of shop and erection framing drawings to ensure compliance with *contract documents* before release for fabrication and erection. 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 erection framing drawing.

For computer-generated shop drawings and *manufacturing models*, the documented procedure shall identify the data, variables, graphics, calculating formulas, and other output that are checked to determine that the software is functioning correctly, and shall include provisions for verifying accuracy of input.

When detailing is performed by a subcontractor, the documented procedure shall define the extent

of review required by management and the extent of checking required of received detailing products before release for fabrication and erection.

The documented procedure for checking shop drawings, manufacturing models, and erection framing drawings shall include comparing those documents and models to project requirements that include, but are not limited to:

- Geometry.
- Use of the correct connections.
- Proper notes.
- Proper material usage.
- Assignment of complete welding symbols.
- Proper coatings and preparation.
- Proper representation on erection framing drawings including the notation of any necessary instructions and depiction of details necessary to conduct the work in the field.

#### 7.1.3.2 Approval of Shop Drawings and Release for Fabrication

The documented procedure for release of shop and erection framing drawings shall describe the method used to document owner approval of shop drawings released for fabrication, whether produced in-house or through a subcontractor. Such methods may include signatures, stamps, logs, files or lists.

#### 7.1.3.3 Externally Supplied Shop Drawings

When the fabricator receives shop drawings from the owner or another fabricator, a documented procedure shall define the method of receipt, revision and control of those drawings.

## 7.2 Detailing Personnel

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

### 7.2.1 Detailing Management

Responsibilities for detailing management shall include:

- Overseeing the production of shop and erection framing drawings.
- Communicating with owners' representatives for design.
- Scheduling.
- Developing and maintaining company detailing standards and documented detailing procedures.
- Transmittals related to obtaining approval from the owner's designated representative for design or construction.

- Coordinating and incorporating construction requirements.
- *Training* of employed *detailers* and checkers.

Qualification requirements for detailing management personnel shall include experience in detailing and checking shop and erection framing drawings approved by an owner for a variety of structures representative of projects the fabricator provides. The fabricator shall determine and describe methods to demonstrate competence.

Detailing management shall be familiar with the requirements of pertinent codes and specifications.

### 7.2.2 Detailing Functions

Personnel who perform detailing or checking of shop and erection framing drawings shall have experience in drawing projects similar to the projects the fabricator provides and shall have knowledge of applicable material specifications and of mill rolling practices as they affect the detailing of structural steel.

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 fabrication. Qualification requirements for checkers shall be defined and documented as required in Section 5.4.1 and include training and experience in connection selection. Demonstrated competency of employed and subcontracted individuals performing final checks shall be documented by detailing management.

### 7.2.3 Subcontract Services

In lieu of employed staff personnel, subcontractors may be used for the following functions: detailing, connection consultation, checking of shop and erection framing drawings, and training of detailers and checkers. However, the fabricator retains the responsibility for compliance with the requirements of this standard.

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

## 8. Document and Data Control

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

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

### 8.1 Review and Approval

The *fabricator* shall designate which function and authority levels have responsibility for review and approval of internal standards and documented procedures. 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 documented procedure for document and data control shall describe the frequency and requirements for review and updating, and establish a method to identify changes.

### 8.2 Customer Requirements

The documented procedure shall define methods for receipt and documentation of *owner* and general contractor requirements and fabricator originated changes as they occur throughout the *fabrication* and detailing process. Requirements may be received in original *contract documents*; in subsequent telecommunications, letters, transmittals related to product requirements; and in change orders or contract addenda.

The documented 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 *erection framing drawings* to all necessary departments and personnel at the fabricator'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 documented procedure and there shall be a method for monitoring and identifying the latest revision. The fabricator shall establish a method to ensure identification of changes to the quality manual or referenced documented procedures from previous revisions. Documents shall remain legible and easily identifiable.

### 8.4 Access

Relevant and current documented 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 documented procedure shall describe methods to prevent inadvertent use of controlled documents that are obsolete in the fabrication or erection process.

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

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

A transmittal system shall be established to record the distribution of drawings, documents and *specifications* to all recipients. This system shall have provisions for establishing project-specific distribution lists in accordance with the requirements of the contract documents.

The records shall indicate the status of approval and release to fabrication or erection.

## 9. Control of Quality Records

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

- Identification.
- Collection.
- Storage.
- Maintenance.
- Retrieval and backup of electronic data.
- 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:

- Contract review.
- Contract clarifications.
- Design change records, including contract construction changes and addendums.
- *RFIs* with *owner* responses.
- Drawing logs.
- Mill and consumable purchase orders.
- *MTRs*.
- *C of Cs*.
- Inspection records.
- *NDT* reports.
- Radiographs, if retained by the *fabricator* rather than the *owner*.
- 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

shall be at least long enough to permit evaluation of the records during the course of project construction unless a longer period is required by contract or government regulation, and not less than the duration of any warranty provided by the *fabricator*.

### 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 *fabricator* for the required time period.

## 10. Purchasing

The *fabricator* 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 *fabricator*. Purchasing documents, subcontractor and supplier qualification records, and records of the periodic evaluation of subcontractors and suppliers shall be maintained.

Purchasing personnel shall be familiar with ordering information required to control variables affecting the quality of purchased material. The *fabricator* shall ensure that proper instructions, current copies of relevant codes and *specifications*, and all relevant contract requirements are furnished to purchasing personnel.

### 10.1 Purchasing Data

The *fabricator* 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, 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 inspection records.

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

### 10.2 Selection and Evaluation of Subcontractors and Suppliers

The *fabricator* shall evaluate and select subcontractors and suppliers on the basis of their ability to meet subcontract requirements, the *fabricator'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 fabricator conducts initial and ongoing evaluation of all subcontractors and suppliers. Management shall determine:

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

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

### 10.3 Fabrication Subcontractors

Subcontractors performing welding, bolting or assembly shall have the applicable AISC Certification on projects requiring AISC Certification.

### 10.4 Detailing Subcontractors

The fabricator's documented 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 fabricator is subcontracting.
- Implementation and effectiveness of documented procedures to track *RFIs*.
- Employment experience records for individual *detailers* and *checkers*.
- For ongoing evaluation, detailing error frequency and severity from fabricator records.

The fabricator's documented procedure shall define detailing subcontractor evaluation criteria that include how the following information is identified on or incorporated into drawings:

- Material requirements and special conditions.
- Coating requirements.
- Contract document special conditions.
- Inspection requirements.
- Welding symbols.
- Conformance to the fabricator's detailing standard.
- Drawing check complete.
- Identification of checkers.
- Identification of detailers.

When the fabricator awards detailing subcontracts in advance of evaluation, the fabricator's documented procedure shall include methods to assess the "pre evaluation" level of risk to meeting:

- Subcontract requirements.
- The fabricator's quality management system.

- The requirements of this standard.
- Project requirements.
- Specific inspection requirements.

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

### 10.5 Verification of Purchased Product, Materials and Services

The fabricator's documented procedure for purchasing shall define the extent of 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. Inspection and test reports, C of Cs, or other evidence of *quality control* shall be kept on file as defined in the fabricator's documented procedure required by Section 9.

## 11. Material Identification and Traceability

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

### 11.1 Material Identification

The documented procedure shall describe how the fabricator marks or maintains the identification of base materials from the point of receipt to the point of the first fabricating operation (or beyond, if required; see Section 11.2) to assure incorporation of the correct materials into the product.

- Structural steel material shall be identified as stated in *contract documents*.
- Welding consumables shall be identified in accordance with the appropriate ANSI/AWS specification.
- Coating materials (excluding metallic coating) shall be identified on the container by, at a minimum, color (pigment description and federal standard number, or manufacturer's number), lot/batch number, ID/stock number, quantity of coating in container, date of manufacture, date of expiration, and manufacturer's name and address.
- Metallic coatings shall be identified by, at a minimum, composition and the appropriate ASTM specification, including hot dip or mechanical galvanizing and metallizing.
- Fasteners shall be stored in containers clearly identified by type, grade, size and lot number(s).

Records that provide a basis for material identification (e.g., *MTRs* and *C of Cs* for base materials, fasteners, welding consumables, and coatings) shall be filed and retained as defined in the fabricator's documented procedure required by Section 9.

### 11.2 Material Traceability

The fabricator shall develop a documented procedure to maintain traceability of materials from the point of receipt and throughout the course of *fabrication*. The fabricator 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 heat numbers is necessary only when specifically required by contract or by supplemental requirements of this standard.

## 12. Fabrication Process Control

The *fabricator* shall develop *documented procedures* for process control necessary to produce a consistent acceptable level of furnished product quality in accordance with the applicable codes and *specifications*. *Fabrication* processes include but are not limited to thermal and mechanical cutting, fitting and assembly, welding, drilling, punching, bolting, shearing, milling, sweep and camber, bending and straightening, heating operations, and coating.

The process definition shall show inspection points and, if inspection is at less than 100% frequency, a sampling plan. The assessment is demonstrated by the inspection points and sampling plan of the documented inspection and testing procedure (Section 13).

Effective implementation of the following documented procedures is required as a minimum:

### 12.1 Welding

The fabricator's documented procedure for welding shall include:

- *WPSs*.
- Preheat requirements.
- *PQRs* (when required).
- Storage (including ovens) and identification requirements for welding consumables.
- Welder, welding operator, and tack welder qualifications and qualification test records, in accordance with AASHTO/AWS D1.5.
- 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.
- Traceability of welds to the welders who produce them.

Approved *WPSs* shall be in close proximity to and used by the welders.

### 12.2 Bolt Installation

The fabricator's documented bolting procedure shall include storage, rotational capacity testing, pre installation verification, installation, and inspection of fastener assemblies for snug-tightened, pretensioned and slip-critical joint types. The documented procedure shall meet the requirements of the RCSC *Specification for Structural Joints Using High-Strength Bolts*.

### 12.3 Material Preparation for Application of Coatings

The fabricator's documented 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 fabricator's documented 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 fabricator shall develop a documented procedure defining an equipment maintenance program to produce the required quality. The documented procedure shall define evaluation and preventive maintenance for, at minimum, equipment necessary to meet product quality and delivery requirements.

## 13. Inspection and Testing

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

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

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

For each type of inspection less than 100%, the documented procedure shall describe the methods for establishing sampling plans and for adjusting the level and frequency of inspection to assure expected contract quality. The fabricator's methods shall 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 determined to be effective.

### 13.1 Assignment of QC Inspections and Monitoring

The documented inspection procedure shall define inspection and testing and the required records to meet the project requirements and shall assign *QC* inspection and 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 certifications granted by recognized industry organizations related to steel bridge *fabrication* can be used as a basis for qualification.

QC inspectors shall be periodically monitored by *QA* (see definition in Section 4) witnessing QC work or repeating their duties.

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

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

### 13.2 Inspection Procedure

The fabricator's documented procedure shall include provisions for the following:

#### 13.2.1 Material Receipt Inspection

Materials received shall be checked for conformance with the purchase order requirements. The receiver shall identify the material, grade, size and quantity and look for visible shipping damage.

*MTRs* and *C of Cs* for base materials, fasteners, welding consumables, coatings, and any other product which becomes part of the shipped component shall be checked for compliance with the purchase order requirements.

If materials are supplied by the *owner*; the fabricator shall verify that the material meets the requirements of the *contract documents*.

#### 13.2.2 In-Process Inspection

Materials shall be inspected for specification and grade, workmanship and tolerances using appropriate codes, standards or a documented plan before fabrication begins. The fabricator shall employ in-process inspection plans and practices for specified process requirements and inspection acceptance criteria that

are not verifiable at final inspection or for which final inspection can hinder assembly. In process inspection is appropriate for processes including but not limited to welding, bolting, coating surface preparation, and coating application.

Compliance with the fabricator's documented process control procedures shall be monitored.

#### 13.2.3 Final Inspection

The fabricator shall conduct final inspection. Designated, qualified QC inspectors shall perform the final inspection of all steel bridge products prior to shipping.

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

#### 13.2.4 Inspection Records

The documented 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 fabricator's documented procedure required by Section 9. Inspection records shall clearly show the products and product aspects that were inspected and who performed the inspection.

## 14. Calibration of Inspection, Measuring and Test Equipment

The *fabricator* 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 documented 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 as required by the *contract documents*.

Inspection, measuring and test equipment shall be used in a manner consistent with the required measurement. The precision capability of the equipment used shall support reliable determination of compliance with acceptance criteria. *Owners* may require that technical data and reference standards pertaining to the measurement equipment be made available 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 documented 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, and 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 fabricator's facility.
- The accuracy acceptance criteria for variation between measured and standard values for calibration of each piece of equipment.
- The action to be taken when equipment does not meet the calibration requirements. This action includes disposition of the measuring device and an evaluation of the impact to product that was measured using the device.
- Calibration *quality record* maintenance as defined in the fabricator's documented procedure required by Section 9.
- Method of preventing inadvertent use of uncalibrated equipment where calibration is required.

## 15. Control of Nonconformances

The *fabricator* shall develop a *documented procedure* to identify and control *nonconformances*. Nonconformances may be identified by the fabricator's inspection program, by process monitoring, during internal and external audits, or by *owner* representatives or other observers. Nonconformances may be required to be addressed by the *corrective action* documented procedure (Section 16) and shall be reviewed during the management review (Section 5.2). *QC* inspectors finding nonconforming work shall have authority to stop the work and responsibility to inform the operating supervisor of the nonconformance.

### 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 level described by the documented procedure.

## 15.2 Nonconforming Product

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

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.

Owner approval is typically required by contract for treatment of nonconformances and shall be documented in writing.

The responsibility, authority and required qualifications for the personnel selecting treatment of nonconforming product shall be defined by the documented procedure. The treatment of nonconforming product may be:

- Redesign for approval.
- *Rework*.
- Owner-approved nonconforming product (*repair* or use as-is).
- Scrap.

If the treatment is rework or repair, the result shall be inspected per drawing, *specification*, project requirements, and the fabricator's documented inspection procedure.

## 16. Corrective Action

The *fabricator* 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 documented 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 shall 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 complaint has been received from an *owner*, general contractor or erector.

The corrective action documented 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 documented procedure shall define the functional positions authorized to issue a CAR and initiate the corrective action process.
2. Assign responsibility and establish a time frame for the response to a CAR.
3. Investigate and document the scope of the nonconformance, root causes, 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 *executive 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. The *fabricator* shall provide for suitable loading, blocking and bracing for shipment.

If a shipping agreement between the fabricator and the *owner*, general contractor, or *subcontractors* exists, material shall be shipped in compliance with the agreement, including sequencing that complies with erection needs. Shipments by subcontractors shall be coordinated and monitored for compliance with shipping instructions.

Owner-supplied material or material paid for as “material on hand” before *fabrication* 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 owner.

### **18. Training**

Personnel responsible for functions that affect quality, including, but not limited to, project managers, *detailers*, inspectors, welding personnel, fitters, and painters, shall receive initial and periodic *documented training*. *Training* records are *quality records* controlled as required in Section 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 and documentation of successful completion is desirable.

### **19. Internal Audit**

The *fabricator* shall perform an internal audit of the *quality management system* at least once a year to evaluate compliance and the effectiveness of implementation. Different parts of the quality management system may be audited at different times and different frequencies, as long as all elements of the quality management system are audited annually. Audits shall be scheduled based on the importance of the area being audited.

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

## SUPPLEMENTAL REQUIREMENTS

(Refer to Section 2)

### I. Requirements for Fabricators of Intermediate Bridges

#### I2. Program Scope and Fabricator Eligibility

To be certified under this standard, the *fabricator* shall have:

- supplied plate girder spans with field splices for highway or railroad bridges within the last five years, or
- established a *documented training* program for the purpose of communicating intermediate bridge work functions to the work forces, and demonstrated capability to fabricate intermediate bridges.

#### I5.4.3 Fabrication Process Equipment

Equipment shall include automatic, mechanized or semi-automatic welding equipment.

#### I7.1.2 Detailing Standards

The *detailing* standards shall define the fabricator's method for presenting information on shop assembly (blocking) drawings.

#### I7.2.2 Detailing Functions

Detailing personnel shall have an understanding of bridge geometry, including but not limited to vertical and horizontal alignment, cross-slope, and roadway transitions.

#### I12. Laydown/Assembly

The fabricator's *documented procedure* for shop assembly of field connections shall include, at a minimum, the following items:

- provisions for control of assembled dimensions for both vertical and horizontal geometry.
- provisions for control of accuracy of drilling and reaming of field connections.
- documented procedures, including reference drawings, for match-marking shop-assembled pieces.
- provisions for assuring the accuracy of numerically controlled equipment, if *contract documents* permit the use of such equipment in lieu of physical assembly.

### A. Requirements for Fabricators of Advanced Bridges

#### A2. Program Scope and Fabricator Eligibility

To be certified under this standard, the *fabricator* shall have:

- supplied advanced bridges for highway or railroad applications within the last five years, or
- supplied intermediate bridges for highway or railroad use, established a *documented training* program for the purpose of communicating advanced bridge work functions to the work forces, and demonstrated capability to fabricate advanced bridges.

Fabricators of advanced bridges shall meet the supplemental requirements for fabricators of intermediate bridges.

Users of this standard are encouraged to evaluate fabricator capability on a project-specific basis.

#### A6. Contract and Project Specification Review and Communication

The fabricator's *documented procedure* shall include a process for communicating with individuals in the fabricator's organization, the general contractor, and the owner regarding special *fabrication*-related requirements for advanced bridges including:

- shop assemblies.
- dimensional control and verification.
- welding.
- *NDT*.
- high-performance materials.
- erection considerations.
- other atypical or special job requirements.

Decisions made in the process of these communications shall be recorded, approved by the appropriate parties (if applicable) and the record shall be distributed to the appropriate parties. This distribution shall be controlled in accordance with Sections 6 and 8.

#### A12.1 Welding

The fabricator's documented procedure for welding shall include a distortion control program.

## SUPPLEMENTAL REQUIREMENTS

(Refer to Section 2)

### F. Requirements for Fabricators of Bridges with Fracture-Critical Members

#### F2. Program Scope and Fabricator Eligibility

To be certified under this standard, the *fabricator* shall have:

- supplied fracture-critical bridges in accordance with AASHTO/AWS D1.5 within the last five years, or
- supplied non-fracture-critical intermediate or advanced bridges, established a *documented training* program for the purpose of communicating fracture-critical work functions to the work forces, and demonstrated capability to fabricate fracture-critical members.

##### F5.6.2.1 Organization:

The *quality manual* shall include or reference a written Fracture Control Plan meeting the requirements of AASHTO/AWS D1.5.

##### F7.1.3. Detailing Standards

The *detailing* standards for preparation of bills of material shall include whether the material is to be used for fracture-critical applications.

The detailing standards for the fabricator's shop and *erection framing drawings* shall define the manner of identifying fracture-critical welds.

#### F10.1 Purchasing Data

The fabricator's written purchasing documents shall identify material to be used for fracture-critical applications.

#### F11.2 Material Traceability

The fabricator's *documented procedures* for identification of material and for material traceability shall include provisions for maintaining heat and *MTR* identity of fracture-critical material throughout the *fabrication* process.

#### F12.1 Welding

The fabricator's documented procedure for welding shall include:

- *PQRs*.
- fracture-critical provisions for welding procedure qualification, preheat, and storage of consumables.

#### F13.2 Inspection Procedure

The fabricator's documented procedure shall include provisions for inspection of fracture-critical welds.

#### F15.2 Nonconforming Product

The fabricator's documented procedure shall include provisions for *repair* of critical and non-critical fracture-critical welds in accordance with AASHTO/AWS D1.5.





**AMERICAN INSTITUTE OF STEEL CONSTRUCTION**

One East Wacker Drive, Suite 700, Chicago, Illinois 60601

312.670.2400      [www.aisc.org](http://www.aisc.org)

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