

# SQS Supplement A

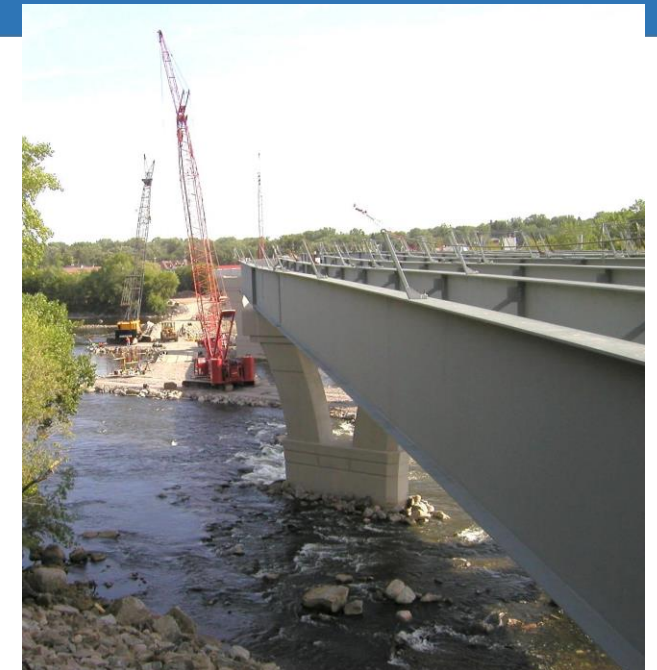


## MnDOT Supplier Qualification Standard

# Bridge Fabricators and Minor Structural Component Manufacturers

Standard supports the Department's Approved Supplier Program for Structural Metals Suppliers as described in the current Standard Specification for Construction

## Supplier Qualification Standard for Suppliers of Fabricated Structural Metal Products



**Minnesota Department of Transportation**  
3485 Hadley Avenue North  
Oakdale, MN 55128-3307



# MnDOT Supplier Qualification Standard

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## Documentation Requirements



### Supplier Quality Management System

Supplement A

Bridge Fabricators and Minor Structural Component Manufacturers

Including requirements for the fabrication of Fracture Critical Members

**Supplement A**  
**Bridge Fabricators and Minor Structural Component Manufacturers**



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Supplement A – Bridge Fabricators and Minor Structural Component Manufacturers

1 General Information

The purpose of this Supplement to the Supplier Qualification Standard is to outline the criteria for qualification to the Minnesota Department of Transportation (MnDOT) Metals Supplier Qualification Program for Bridge and Ancillary Product Manufacturers, including requirements for the fabrication of Fracture Critical Members

Several sections of MnDOT SQS address requirements for aspects of supplier Quality Management Systems that differ greatly amid the listed Supplier Category Processes. These sections have been omitted from the main Supplier Qualification Standard and included in this supplier-specific Supplement. The omitted sections include:

- Section 6: Contract Review
Section 7: Communicating Project Requirements to Production
Section 11: Material Identification
Section 12: Manufacturing Process Control

3 References/Library

This is a list of required and recommended references for MnDOT Suppliers.

Keep reference documents, standards, codes, and other applicable documents readily accessible to the individuals who need them to perform their work. Keep revisions required by existing contracts available.

The list of required references may increase to cover the products, materials, and services that the Supplier provides.

Required references:

- MnDOT Standard Specification for Construction
MnDOT Special Provisions
ASTM Standards for materials used by the company

All structural metals suppliers

Welding Code as required by contract documents for fabrication and manufacturing weldments that the Supplier provides

- AWS D1.1 Structural Welding Code—Steel
AWS D1.2 Structural Welding Code—Aluminum
AWS D1.6 Structural Welding Code—Stainless Steel
AASHTO/AWS D1.5 Bridge Welding Code

Welding codes shall be applicable to the manufacturer’s product and contract documents. All welding codes will be available covering the welded materials used in the miscellaneous products listed for supply on the MnDOT Approved Supplier List.

Simple, Intermediate and Advanced Steel Bridges

- AISC Steel Construction Manual including:
Specification for Structural Steel Buildings
Specification RCSC Specification for Structural Joints Using High Strength Bolts
AISC Code of Standard Practice for Steel Buildings and Bridges
ASNT SNT-TC-1A
ANSI/AWS A2.4 Symbols
ANSI/AWS A3.0 Terms and Definitions

American Association of State Highway and Transportation Officials (AASHTO)

- AASHTO/NSBA S4.1 - Steel Bridge Fabrication QC/QA Guide Specification

6 Contract Review and Project Management

The first objective of a successful project management system is understanding the customer’s project as defined by specifications, design drawings, and general contract documents. The second objective is to translate the customer’s project requirements to the Supplier’s processes to deliver the project the customer expects.

Describe how all applicable contract documents are thoroughly reviewed before a project is accepted. Repeat the review process where contract requirements are revised by contract changes, clarifications from an RFI (request for information), a response to a Supplier proposal, or other official communication from the customer’s authorized representative. The re-review is only required for the areas affected by the changes which must be incorporated into the Supplier’s project planning.

Address these specific documents/criteria at a minimum:

- Contract documents (design drawings and specifications, special provisions and documented communications)
Change orders and addendums
Transmittals from the owner or contractor
Answers to requests for information (RFI)
Responses to Supplier proposals
Delivery schedule, including incentive and disincentive clauses
Management of the project

Show how contract and project specification review is conducted for each transportation project. Design the review to identify and address critical project requirements that may impact project quality and schedule.

Perform the initial review prior to the Supplier’s acceptance of responsibility for performing the work. Begin the review during the project estimation or bid process.

In the review, identify, determine, plan, and record the specific project requirements. Define distribution of the





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record to the responsible individuals in the organization, and identify new documented quality procedures that must be created for the work. Consider any issue that affects the Supplier's capability to perform the work. Include manufacturing, fabrication, and coating requirements, and create records showing consideration of the requirements of this clause at a minimum.

Describe the responsibility for conducting and organizing the review and the methods to communicate the review results to the next steps in the process. Describe the distribution of this information and those individuals responsible to ensure that it is incorporated in the work correctly and as scheduled.

Ensure that the managers and staff with responsibility for execution fully understand the applicable contract requirements. Describe the distribution process and methods to verify receipt, monitor progress, and establish completion schedules.

## 6.1 Notification to the Owner

Describe the plans for transmitting information and records including the recording the transmittal of purchasing data (purchase orders, MTRs and other documentation) to assure that the information is furnished to the Engineer or the QAI appropriate for receiving the information as agreed.

Identify the personnel positions responsible for these records and timely transmittal targets.

Describe how the Supplier assures that the owner's Engineer is provided with a list of fabricators, galvanizers, and painters, including addresses, and a list of products they will provide.

Describe the internal controls to prevent material ordering until the Engineer approves of the shop drawings. If materials are in stock or must be ordered before all shop drawings are approved, describe the methods to prevent including improper materials and causing schedule delays that affect the project.

### 6.1.1 Contract Review Record

Show in a Contract Review Record how the items listed here were reviewed. Make sure that there is a standard distribution to those who need the information and verifying that they receive it. Specify individuals in planning, detailing, procurement, production, and quality functions.

Specific details and directions are typically communicated to shop personnel via shop drawings and memoranda, but other methods and lists may be described.

#### 6.1.1.1 Management of Project

Minimum requirements: Record decisions during communications with the owner/owner representative/GC/CM during project start up, during the

project, and at completion, and provide timely documentation of each event to the party(s) involved. Record any revisions that affect the Supplier's scope for the project and verify shop documents are revised to include the revisions. Record the decisions on responsibility for Owner Verification Inspector coordination and follow up.

#### 6.1.1.2 Request for Information

Minimum requirements: Record items during the review and subsequent pre-fabrication meetings that identify RFIs necessary to aid the production of shop, erection, and installation drawings. Assure that responsibility is assigned.

#### 6.1.1.3 Purchasing

Minimum requirements: Record the review of the required materials, and identify unique items or prefabricated components with significant lead times. Identify the need for subcontracting in all processes, and plan for notification to the owner. Record the review of requirements for domestic supply.

### MnDOT specific requirement for subcontracting:

If the MnDOT Approved Supplier List covers the supply type, then an organization on the ASL must be used for subcontracted work.

#### 6.1.1.4 Detailing

Minimum requirements: Review and verify the plausibility of the sequencing and delivery schedule requirements based on current assets and commitments. Obtain required field measurements and the timing for assembly requirements. Document a review of the assembly requirements and required tolerances, noting unique connections and details to be completed by the Supplier. Document the impact of the fabrication/ manufacturing schedule on detailing capacity and commitments, noting any potential need for subcontracted detailing.

#### 6.1.1.5 Submittals and Acceptance/Review by Contractor or Owner

Minimum requirements: Clearly identify the submittals required and the timing necessary to satisfy the owner's requirements. Identify requirements for field measurements and documentation of existing conditions.

#### 6.1.1.6 Material Identification and Traceability

Minimum requirements: Record any deviations from shop standard identification, as well as requirements for the involvement of a customer representative (present for the transfer of identification, review of CMTRs, etc.) Record or reference project specific requirements related to materials. Consider including: how material is protected or packaged for delivery to the shop, exposure requirements for weathering steel, or other details.





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6.1.1.7 Fabrication/manufacturing process

Minimum requirements: Review capability and load on equipment and work stations including the need to subcontract some production processes and receive owner approval. Consider the relevance and impact of these elements on the project at a minimum:

- Large bending or roll curving
- Full or line assembly requirements
- Hole making requirements and restrictions
- Field splices DA, RA or CNC
- FCM material and welding
- Edge finishing
- architectural issues
- Machining
- Hold points
- Seismic requirements
- Complex coating

6.1.1.8 Inspection

Minimum requirements: Note unique inspection types, changes in frequency or documentation, and reporting from standard practices, procedures, and methods. Identify NDE, and assess and document the need to subcontract inspection and NDE, any independent testing, or witness services necessary.

Show the review and consideration of shift coverage for CWIs and NDE technicians. Appraise the personnel experience required, particularly for FCMs, and requirements for documenting the technical experience and certification of personnel

6.1.1.9 Training and qualification

Minimum requirements: Show personnel qualifications needed beyond current levels to meet contract requirements

6.1.1.10 Project Communication

Determine the means of communication with the Owner and Contractor representatives as part of the Contract review and before work begins. Record contact information for the Owner and Contractor Representatives, and any specific communication requirements mandated by contract documents.

At or before the review, identify a project manager for all communication with the Owner’s Engineer and Inspector.

6.1.2 Pre-fabrication meeting(s)

Hold pre-fabrication meetings for projects with the customer when required by the contract or when necessary for decisions affecting planning.

MnDOT specific requirement for prefabrication meetings:

MnDOT typically required prefabrication meetings for the Intermediate and Advanced Bridge Categories, but may

require a meeting if MnDOT or the contractor identify a need.

If a project pre-fabrication meeting with the Owner and Contractor Representative is required, include the pre-fabrication meeting record, including a description of decisions, and include it as the final attachment of the Contract Review record prior to fabrication. Conduct the meeting after the first contract review, project award, and preferably after completed shop drawing are approved. For large projects, all shop drawings may not be submitted together for approval.

Revisit the contract review process for every meeting. Describe how the contract review record is used and revised after the meeting and how information is distributed. Going back to the original process assures an evaluation of decisions made and the clarity of requirements and their effects on downstream processes and schedules through product delivery.

Document in the Contract Review record if the Owner elects not to have a pre-fabrication meeting. Determine the requirement of a pre-fabrication meeting within two weeks of the conclusion of the first contract review and establish a schedule if appropriate.

6.1.3 Production Schedules and Production Planning

Describe how production schedules for the product and for shop details are created and documented. Include how they are generated, the frequency of updates, and the key personnel who are on distribution, including the Owner. Show production dates for project shipping pieces or lots in the schedule.

Indicate how often the schedule is reviewed. The issue of a new schedule is a sufficient record of this review. The review may be by a single project manager or a group of key individuals. Record the discussion or actions arising from customer communications and quality issues that affect the timely delivery of the product.

Address project planning in the same or separate documents. Consider measuring project status by project percent complete, earned value, or other measure. Include information on the physical product, such as “welding complete on X spans”, “ready to ship X sections”, or other appropriate metric to measure project status.

6.2 Project Management

Simple, Intermediate, and Advanced Bridge Category Requirement

Documented the project management process and address how internal and customer information is realized in the project. Describe the project management system, especially project management responsibilities, project management authorities, and how project managers





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interact with the Engineer, Verification Inspectors (QAI), and Contractors on transportation projects.

### 6.2.1 Project Management Function

Split the project management function between several positions, or lay the project management function on a single position. Describe how resources are handled throughout the duration of the project and the warranty period. Address these activities:

- Planning
- Execution
- Monitoring and Controlling
- Completion

### 6.2.2 Project Management System (PM)

Create a PM System in a suitable format with a complexity commensurate with the Supplier's business model, the critical nature of the product, and the demands of the owner and the contractor. Effectively meet the minimum requirements with an electronic format, paper format, or a combination of mediums.

When pre-fabrication meetings are held, they are a part of the Contract Review process and an important part of the Project Management (PM) System. Describe the role of Project Manager(s) in these meetings, the responsibility for agendas, decisions reached, follow up of action items, open activities, and the communication of results for incorporation s into the project.

Address in the PM system at a minimum:

- Timely and accurate management of RFIs, assuring that appropriate actions result based on customer answers.
- Coordination of all interfacing operations to assure coordination, including structural steel, bearings, mechanical and electrical elements, and ancillary pieces.
- Consistent communication of project status between the Supplier and their customers. Consider including scheduling assistance between all parties in order to complete projects on time and at the contracted quality level.
- On-site assistance for Owners and Contractors.
- Proper planning, preparation, and a proactive attitude to steer each project to a successful finish.
- That a specific liaison responsibility and method is developed for working with verification inspectors.
- How specific decision points/gates/approval points are prominently identified in the system with methods to assure conformance.
- Identifying and monitoring shipping schedules and logistics, including scheduling orders with the Contractor.

- Providing a project review activity at the close of a project to capture positive discoveries and items for improvement. Document the results and make them available for consideration for future projects.

## 6.3 Quality Records

- Contract review record.
- Minutes of pre-fabrication meetings
- Schedules
- RFIs and Contract Clarifications
- Design change records, including contract construction changes and addendums
- Supplier proposals and owner responses

## 7 Detailing and Communication of Project Requirements

Address how the review, generation, revision, approval, control and issue of shop drawings are done. Include the responsibility for the management and functions of this element, as well as the responsibility for specific tasks, including but not limited to:

- ensuring that detailing procedures are followed
- checking of shop drawing
- drawing submittals and owner responses
- documentation of drawing changes

### 7.1 Scheduling Detailing

Describe how detailing production meetings are held on a regular basis to review the status of drawing approval and release schedules. Describe how the schedules with due dates are distributed to appropriate personnel.

### 7.2 Preparation of shop and erection drawings

#### 7.2.1 Contract documents

Identify who is responsible for reviewing the contract documents plans and specifications, including addenda and special provisions. Note how to address any deviations in the detailing or fabrication standards not discovered during the initial contract review process that will affect detail drawings and consider the deviations for the RFI (request for information) or Supplier proposal processes.

Specifically review issues of material specification, loading, shipping, erection, non-destructive examination, welding issues, and any special processes required. Present deviations affecting the standard detailing practice.

Maintain a current copy of the contract documents at the Supplier's facility. Describe a method to track the current status of contract drawings, specifications, addendums, and other documents that affect the final product. Include signatures, stamps, logs, files or lists. Clearly show the status, date received and revision date of customer design drawings and contract documents.





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Intermediate and Advanced Bridge Requirement

When the Supplier works directly for the prime contractor, show transmittals of the relevant contract requirements and special provisions plus subcontract provisions for the project.

Demonstrate understanding of the necessary provisions for drawing control/security for homeland security projects.

7.2.2 Submittal Documents for approval

MnDOT specific requirement for simple, intermediate and advanced bridge suppliers

Submit only checked drawings for approval. Describe how production schedules are prepared and how dates for fabrication are established and presented for approval.

- Detailed plans showing the dimensions and sizes of materials,
Details and information necessary for fabrication,
Fastener lists for shop and field erection,
Blocking and camber diagrams,
Match marking diagram,
Radiographic diagram showing weld locations and identification
Complete field erection plan showing piece marks, and
Existing dimensions as measured in the field for projects that supply existing structures
WPSs and PQRs covering the work

7.2.3 Submittal Documents at Completion

Describe how the as-built drawings are prepared and reviewed for submittal at the completion of shop work. Describe how activities demonstrate othe drawings accurately reflect the actual configuration of all structural members and components, including modifications made during fabrication and upon delivery to the project. Describe what controls are in place to assure that physical files are readable. Scan resolutions are suggested at 400 dpi.

7.2.4 Customer communication and RFIs

Describe the controls and PM System responsibilities to assure that all detailing is be performed in accordance with the most recent contract documents, including contract drawings, specifications, and responses to RFIs. Generate and address RFIs using Supplier’s PM system where the current status of RFIs is also tracked. Create RFIs to obtain the best information in the shortest time, contributing to quality and schedule. To that end, RFIs and RFI logs:

- Address a single problem/single question
Include a proposed response
Include justification to aid the customer (code passages, cost or schedule impact)
Track what is done after the answer is received.

Addresses how the Supplier handles communication or correspondence between the detailing function and any outside party: Owner Transportation Engineer, General Contractor, Architect, or other project entity is documented. Address how the Supplier tracks and handles communication in their system when there is a project specific system required by the project contractor.

7.2.5 Revision control

Describe how drawings are controlled electronically, by hard copy or both to assure that only the most current drawings are used. Describe how drawings are identified during generation, their approval process, their release for fabrication, manufacture or processing, the distribution of revisions after release, and the destruction or segregation of superseded drawings.

7.2.6 Detailing Standard

Create a document that communicates how shop details are created by in-house detailers and subcontract detailers to maintain the most consistent format of details presented to the shop reducing errors. At a minimum, address these items in this document(s):

- Bill of materials
- Sizes and quantities
- Unique piece marks
- ASTM or AASHTO M specification
- Special order information
- Tolerances or allowances
- CVN requirements
- Marking for FCM for fracture critical projects
Sections and views
Drawing layout
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.
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.







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- Specific requirements for notes and graphics when the product will be galvanized.
  - Assure compliance with ASTM A385 for providing information to the galvanizer on materials, identification and physical characteristics installed during fabrication to assure a quality service.

#### Fracture Critical project requirements

- Address in how fracture critical material is identified on advance bills and detail drawings.
- Address how FC welds noted on detail drawings and how FC WPSs are assigned.

#### MnDOT-specific requirements

- Department's structure number
- Department Project number
- Federal Project number (if applicable)

##### 7.2.7 Checking

Define the responsibility for checking and the job description or other suitable documentation of the minimum qualification for lead and assistant checkers. Provide for checking of all drawings by a qualified checker who did not produce the drawing. The Checker will compare the shop drawings to the project's requirements. Issues to review include, but are not limited to:

- Geometry; dimensions
- Use of the correct connections;
- General and drawing notes;
- material usage;
- Assignment of complete welding symbols including WPS identification on MnDOT;
- coatings and preparation;
- representations on erection drawings including instructions and details necessary for work in the field.

Define the actions after the checking is complete if discrepancies are subsequently found in the process

##### 7.2.8 Drawing approval by the Owner

Describe the method used to submit drawings and to document Engineer approval of shop drawings released for fabrication, whether produced in-house or through a subcontractor.

##### 7.2.9 Release for Production and Erection

Describe the process for releasing production drawings, erection drawings, fabrication plans, production packages and other documentation that will control the production and quality of products and services supplied to transportation projects.

Describe the marks, notations, or other means that control the actual documents in electronic or hard copy format to

personnel with responsibility to execute the project. Clearly indicate the status of the drawing(s) to all personnel. Address the distribution to personnel and locations in the firm.

Address methods to control current revisions after release and to collect and destroy or segregate superseded versions through master drawing logs, libraries or other conventions.

##### 7.2.10 Customer Supplied Shop Drawings

Define the method of receipt, revision, and control of drawings received from the owner or another fabricator. A formal check of the drawings is not required, but the format and presentation must be understandable to shop personnel. Log the receipt of these drawings into the project management system.

##### 7.2.11 Quality Records

- RFIs
- Customer correspondence
- Communication record/log
- As built drawings
- Schedules
- Shop and erection drawings
  - ◀ Checked copy
  - ◀ Approved copy
- New Project Administrative checklist
- PM System logs
  - ◀ RFI
  - ◀ Drawing logs
  - ◀ Contract document logs
    - Detailed plans showing the dimensions and sizes of materials,
- Details and information necessary for fabrication,
- Fastener lists for shop and field erection,
- Blocking and camber diagrams,
- Match marking diagram,
- Radiographic diagram showing weld locations and identification
- Complete field erection plan showing piece marks, and
- All dimensions as measured in the field for projects that include existing structures
- WPSs and PQRs covering the work

## 11 Material Identification and Traceability

Develop a documented procedure for the identification and traceability of materials and products used in transportation projects. The procedure describes how the supplier assures appropriate identification at the purchasing and receiving process and then how the identification is marked or maintained from the point of receipt to the point of delivery to the transportation project. Design the process to assure incorporation of the correct materials into the product and





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the ability of the Owner to trace the materials to the product at a later date at the levels specified.

11.1 Level ONE—for minor structural components

MnDOT requires LEVEL ONE traceability for these MnDOT products:

- Bearing assemblies
- Sole plates
- Expansion joint devices
- Shear connectors
- Ballast plates
- Diaphragms for bridges (except curved steel bridges)
- Pile and appurtenances
- Drainage systems
- Guardrail connections
- Railings
- Fencing
- Conduit systems
- Protection angles
- Electric lighting
- Traffic signs
- Signal systems
- Other system or component designated by the Engineer.

11.2 Level TWO—for major structural components

MnDOT Requires traceability by piece number for these MnDOT projects:

- Advanced, Intermediate and Simple Bridges
- Prefabricated Pedestrian bridges,
- Post and truss materials for overhead traffic structures,
- High mast light towers,
- Modular expansion devices,
- Pot bearings and high load, multi-rotation bearings, and
- Other items designated by the Engineer.

11.3 Level THREE—for structural components identified as fracture critical members

File and retain records that provide a basis for material identification (e.g., CMTRs and C of Cs for base materials, fasteners, welding consumables, and coatings) as defined in the documented procedure required by Control of Quality Records.

11.4 Identification of Base Metals

Maintain the required identification (size, type and grade at a minimum) from receipt through to the first fabrication operation. This is the most basic requirement for identification. Maintain that identification throughout the fabrication process by individual marks or material assignment documents recording the identification of

elements of a piece-marked item or group of items. or provide a connection to the purchase order, the heat number and a Supplier job/project number that will provide the Owner the required traceability at project delivery.

Maintain and transfer the identification to drops and remnants maintained as stock if the material will be used in transportation projects in the future.

11.5 Traceability of Base Material

Different levels of traceability are required by different customers and for various product types. The Supplier must describe all methods that are required by the specifications of their transportation customers.

Receive MTRs with the shipment or before shipment. Compare MTRs with the purchase order requirements and the shipping information. After this review, the MTR does not need to be maintained on file.

11.5.1 Traceability and marking by project—

LEVEL ONE

Create a method to capture the heat numbers and actual MTRs used in a project. Submittal of MTRs at the end of a project is not necessary but they are kept on file to support creating a Certificate of Conformance for the Owner. There is no requirement to assure that specific heat numbers are used in a specific piece or shape. Ensure the project is traceable to a group of Certified MTRs in the Supplier’s system and that CMTRs are retained for seven years.





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Create **Material Assignment Sheets** to show all the material and associated heat numbers that were used in the project according to shape. Include heat numbers by shape used in the project for customer reference

Sample Material Assignment Sheet. Use any convenient format that conveys this information.

Material	shape/size	heat number(s)	PO number
ASTM A36	4x4x.250 angle	#2AO335, #2AO346, #GT788654	10957
ASTM A36	C10 x 15.3 channel	VT502271	110152
ASTM A709 Gr 50W	¾"	# 1501108-01	110160

11.5.2 Traceability and marking by piece number—LEVEL TWO

Create an effective system to provide traceability by heat number to the Supplier piece number and main component part for girders (TF-top flange, BF-bottom flange, WB-web).

Create material assignment sheets, sketches, maps or other means to document for the Owner the heat numbers for the specific plates or shapes by specific location used in each main member by member piece mark of their project.

Beginning at the first operation, maintain heat number on all primary bridge materials until the material is permanently joined into a piece marked member, using paint stick or other suitable method not detrimental to the member’s function. Provide a “cut sheet” or other similar document to the QAI at this point in the process.

As each part numbered element is attached to piece marked members, record heat numbers of these attachments on a girder sheet/traveler (created for each project) connected to that main member number. Maintain main member component documentation through fabrication to delivery by steel stamp (non-oil based paint or low stress die-stamps) before blasting, ID re-applied after blasting or blasting and painting. Maintain main member identification to the point of delivery to the jobsite/customer acceptance/ownership. Submit records of heat number traceability for the project. Maintain these records for seven years after delivery.

Provide wide flange beams, flanges, webs, splice plates, welded cover plates, and fracture critical members with identification numbers placed on each individual piece of material that can be referenced to the corresponding heat number.

**Create Material Assignment Sheets** showing all the material and associated heat numbers that were used in the project according to piece number.

Sheet	Pc Mk	Girder	Qty	Description	Material	length	Heat #	PO#
15	15A2	15BF1	1	PL 2X28	50WT3	53’6-7/16”	2C324-502	JF-22800
15	15A2	15BF2	1	PL3-1/2X28	50WT3	42’6”	2C323-201	JF-22800
15	15A2	15BF3	1	PL3-1/2X28	50WT3	20’6”	7103914	JF-22821
15	15A2	15BF4	1	PL 2x28	50WT3	39’6-2/8”	7103915	JF-22821
15	15A2	15TF1	1	PL 2X26	50WT3	53’-5”	2C324-502	JF-22800
15	15A2	15TF2	1	PL3-1/2X26	50WT3	42’6”	2C323-201	JF-22800
15	15A2	15TF3	1	PL3-1/2X26	50WT3	20’6”	7103914	JF-22821
15	15A2	15TF4	1	PL 2X26	50WT3	39’7-1/8”	7103714	JF-22821
15	15A2	15WB1	1	PL 3/4X88	50WT3	82’11-3/8”	7103776	JF-22821
15	15A2	15WB2	1	PL 3/4X88	50WT3	73’1-7/16”	7103404	JF-22821
15	15A2	Y5	8	PL 3/4X11	50W	7’-4”	7103382	JF-22821

Sample Material Assignment Sheet. Use any convenient format that conveys this information.





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11.5.3 Traceability and marking by plate serial number—LEVEL THREE

Record the serial number when traceability for a specific plate or shape is required by contract or fracture control plan. The PO, ABOM, BOM initiates this requirement with the vendor and with receivers at the Supplier location. These documents designate other special marking requirements, such as those for fracture critical material (FCM).

Track this material the same as LEVEL TWO but add a plate serial number.

Sample Material Assignment Sheet. Use any convenient format that conveys this information of the fastener components including records of galvanizing for fasteners diameter and size, and include Material Test Reports for each that are galvanized.

Sheet	Pc Mk	Girder	Qty	Descr.	Mtrl.	Lgth.	Ht. #	Serial #	PO#
15	15A2	*****	1	Girder	****	156'-13/16"	7103915	01	JF-22821
15	15A2	15BF1	1	PL 2X28	50WT3	53'6-7/16"	2C324-502	912394	JF-22800
15	15A2	15BF2	1	PL3-1/2X28	50WT3	42'6"	2C323-201	912394	JF-22800
15	15A2	15BF3	1	PL3-1/2X28	50WT3	20'6"	7103914	04	JF-22821
15	15A2	15BF4	1	PL 2x28	50WT3	39'6-2/8"	7103915	01	JF-22821
15	15A2	15TF1	1	PL 2X26	50WT3	53'-5"	2C324-502	912394	JF-22800
15	15A2	15TF2	1	PL3-1/2X26	50WT3	42'6"	2C323-201	912394	JF-22800
15	15A2	15TF3	1	PL3-1/2X26	50WT3	20'6"	7103914	04	JF-22821
15	15A2	15TF4	1	PL 2X26	50WT3	39'7-1/8"	7103714	05	JF-22821
15	15A2	15WB1	1	PL 3/4X88	50WT3	82'11-3/8"	7103776	07	JF-22821
15	15A2	15WB2	1	PL 3/4X88	50WT3	73'1-7/16"	7103404	05	JF-22821
15	15A2	Y5	8	PL 3/4X11	50W	7'-4"	7103382	04	JF-22821

Sample Material Assignment Sheet. Use any convenient format that conveys this information.





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## Identification for FCM

## FC Category Requirement

Address how materials are received, handled, identified, and physically marked for projects with FCM requirements. Meet the requirements for traceability LEVEL THREE

## 11.6 MTR (Material Test Reports)

MTRs should arrive with or before the shipment. Verify upon receipt that the MTR matches any heat number markings on the material from the supplier or the mill.

Use MTRs to verify that the material is what was ordered before the first fabrication process takes place on that piece. Once the verification is made, keep MTRs on file. Depending on contract requirements, forward copies to the onsite inspector and submit as material assignment sheets

## 11.7 Identification of (high strength fastener assemblies) Bolts

Store fasteners in containers clearly identified by type, grade, size, and lot number(s) including rotational capacity lot number when applicable. Indicate test status on fastener assemblies or components that have had pre-installation verification testing performed on them. Maintain records of rotational capacity and pre-installation verification testing.

Assure that certificates of conformance for fastener assembly components (bolt, nut, and washer) are traceable by lot,

## 11.8 Identification of Welding Consumables

Identify welding consumables in accordance with the appropriate ANSI/AWS A5.X specification and classification. Identify flux and electrode oven contents. Do not use welding consumables without verified identification. Labels on shielding gas bottles must verify compliance with AWS A5.32. Assure that certificates of conformance for welding consumables are current and show diffusible hydrogen content and meet AWS D1.5, Clause 12 requirements.

## 11.9 Identification for Uncontrolled Material

Mark some materials “uncontrolled”, “not for bridge use”, or other suitable marking when the identification has been lost or the material was not purchased for transportation projects. Require that the method effectively prevent materials that are not controlled, identified, or traceable per the requirements of this section from being incorporated into the product.

Define a method and responsibility to perform proper testing and documentation acceptable to the Engineer to restore identification and traceability of uncontrolled material.

## 11.10 Product Identification

Clearly describe the responsibilities and methods to maintain the identification of product components in the fitting process and partial and full assembly. Maintain the customer and project identification at all times on the production floor using direct marking or through Supplier documentation system.

Through the use of material bills, shop drawings, material assignment sheets, weld maps, product certifications, and other methods, describe how unique transportation customer identification systems are accurately communicated and executed in the detailing, purchasing, production and shipping activities

## Girders and major bridge parts

Mark girders and other major bridge pieces with the main member number through fabrication to delivery by steel stamp (non-oil based paint or low stress die stamps) before blasting, ID is rechecked after blasting. Maintain main member identification to the point of delivery to the jobsite/customer acceptance/ownership.

## MnDOT identification system for NDE

Plan for and describe how this system for weld identification is executed so that weld NDE can be accurately tracked. Specifically include the responsibilities and methods to mark how the splice plane number and the piece components code is assigned to the Suppliers piece mark system.

## Bearings

Describe how bearings are marked per design plans and traceability is maintained to that marking system. Consider the specific bearing location on the framing plan becoming the ID stamped into the bearing, or any other method pre-approved by the Engineer.

## Railing

Clearly tag/piece mark all railing assemblies prior to shipment. At a minimum, Identification markings include individual piece marks. Tags may mark bundles of elements for the bridge and/or project number(s), Supplier and applicator job numbers. Ensure all marking(s) will not be visible to the public when the railing is in its installed position. Include the specific method of identification in the procedure.

## Match Marking

Show in detail the methods for match marking pieces, and for field assembly in detailing standards, following the method on shop/erection/installation drawings. Information on drawings or shop procedures or work instructions guide production personnel to apply markings before disassembly to assure proper fit in the field.

Address the following in the procedure:





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- A match marking system that uses a series of letters and numbers to indicate the exact location in the structure without continual reference to detail drawings.
- Use low stress die stamps before disassembly, or use a marking material that can be removed without damage to the appearance of the surface of the product in the field after installation.
- Document how and where pieces will be marked to ensure proper location and orientation of pieces

11.11 Quality Records

- Supplier bill-of-lading, purchasing documents.
- Certificates of conformance
- Material Test Reports (MTRs)
  - ◀ Plates and shapes
  - ◀ Welding consumables
  - ◀ High strength Bolts

12 Fabrication/Manufacturing Process Control

Address these requirements in the Quality Management System Documentation.

12.1 Required Documented Processes

Address in the documentation the requirements of this standard for the qualification, testing, control and training for the processes described in this clause and applicable for the Supplier’s operations.

- Welding
- High strength Bolting
- Fracture Control Plan (when Supplier is qualified for FCM work) Note:
  - Cold Cambering, Bending, Curving, Straightening (when Supplier uses these processes)
  - Match marking, of assembly components with full size holes, especially splice plates and members
  - Heat Cambering, Bending, Curving, Straightening (when Supplier uses these processes)
  - Rolling (if the shop has rolling equipment) Machining such as milling, planning, finishing
  - Hole making/Drilling/Punching
  - Assembly

12.2 Approval of Fabrication/Manufacturing Processes for MnDOT projects

MnDOT Specific Requirement

Include descriptions of the processes planned for the production and measurement of product.

When the contract indicates processes are prohibited, restricted or need formal permission by MnDOT, describe the proposed quality management system controls,

including responsibilities, previous uses, measurements and qualification testing, and submit the documentation as part of your quality manual/procedures for review. Specifically note that portion of the submittal is proposing a deviation from the contract. The process is considered approved when the description is reviewed and approved as part of the documentation review. The MnDOT Program Director may request samples of work quality, photographs or sample documents as part of this process of review.

The process will be audited during the next onsite audit.

12.3 Accessibility

Assure Fabrication/Manufacturing Process Control documentation is readily available to appropriate personnel to the complete their work.

Describe how WPSs, shop drawings, work instructions, and procedures are made accessible to personnel with responsibilities that assure the quality of the product, such as material receipt, burning, fitters, welders, machine operators and other crafts, with instruction in applicable language for those employed by the Supplier.

Provide translators if needed to aid Supplier QC plus the Owner’s Verification Inspectors and Auditors assessing the implementation of the requirements.

12.4 Required Documented Processes

Document and implement a procedure when a process is critical or is judged to be out of control by the owner’s representative during an internal audit or an external audit where documented procedures are not specifically required by this standard.

FC category Requirement

Include restrictions for punching, stamping, cold bending and thermal cutting of FCMs, as well as the requirements of clause 12 of AASHTO/AWS D1.5—Bridge Welding Code.

Address connection and removal of temporary attachments, and their inclusion on approved shop drawings.

Address the owner pre-approvals required for specific operations.

12.5 Notification and submittals before work begins

Assure that the Quality Management System provides specified notifications to customers to plan for verification inspections throughout fabrication, including milestones they identify.

Define how required documentation (copies of purchase orders, Mill Test Reports (MTRs), or other documentation required by the Engineer) is collected and made available to the QAI in a timely manner so that inspection or review requirements do not impact project schedules.





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**MnDOT specific requirement**

For MnDOT projects, assure that methods ensure notifying the Engineer at least 5 business days before the fabricator begins the first fabrication operations (cutting or drilling) so that the Engineer can perform inspections. Do not begin work before notifying the Engineer.

**12.6 Drilling Accuracy**

The Supplier must control hole quality resulting from the drilling operations. The documented procedure should include:

- Method of drilling holes, whether punched, sub-sized and reamed, drilled in assembly, drilled through a template, or drilled with numerically controlled equipment
- Means of locating hole patterns of primary bolted connections using the shop drawings
- Inspection frequency during drilling operation to include drilling equipment setup and finished hole quality.

**12.6.1 Numerically Controlled Equipment**

The procedure should include the following:

- Identify the limitations/conditions for the specific equipment to be used (component geometry, ambient conditions including temperature, humidity, and lighting)
- Define the Supplier's control of machining/drilling programs including verification of input data for accuracy, storage and labeling/naming of programs, and the process of releasing the programs to production.
- Identify the typical source of programs, either derived from shop drawings by an in-house technician or received from a subcontracted source.
- Describe the expected sequence of machine placement on the components including physical alignment checks and performing dry-runs prior to equipment operation.

**12.7 Documented Process for Base Metal Repair**

Define the criteria and procedures for base metal repairs. Base methodology on D1.5 or other source, but establish NDT, decision to repair or scrap, preparation and repair for each anticipated type, including as-received and shop caused.

**12.8 Welding Process Control**

Verify by a documented procedure that weld procedures are in accordance with the project specification and the current edition of the AWS D1.X welding codes that apply to the Supplier's work. Assure that welds are made to the size and configuration shown on the approved shop drawing.

**12.8.1 Welding Procedures (WPS)**

Perform all welding and tacking for transportation projects according to an appropriately qualified and approved WPS.

Describe how WPSs are generated, revised, controlled and assigned to production work.

Include in the procedure how WPSs are maintained and updated, and made available to the welders. Define how welders are trained, qualified, maintain documented continuity, and can visually inspect their own work.

Ensure welders/and or supervisors are prepared to demonstrate how they know that the correct, owner approved WPS is used.

Welders and/or supervisors must demonstrate how they assure compliance to the WPS they are using and how compliance is periodically monitored.

Note: During an audit, the welder may be asked to describe and demonstrate how the base material, filler metal, electrical characteristics, preheat and other requirements of the WPS are executed and maintained.

**12.8.1.1 WPS (Prequalified Welding Procedure Specifications)**

Develop prequalified WPSs for each process, joint, and position required, meeting the requirements of the appropriate AWS D1.X as it relates to a transportation contract. Define the responsibility for development.

**12.8.1.2 WPS (Qualified Welding Procedure Specifications) and PQR (Procedure Qualification Records)**

Develop and perform a weld procedure qualification test based on the need for Welding Procedure Specifications (WPSs), resulting in a Procedure Qualification Record (PQR) used as a basis for those WPSs.

An independent CWI who is not an employee of the Supplier or has no affiliation or loyalties that would comprise his/her technical judgment witnesses (signature) the preparation of test plates and the welding of PQRs.

Define the responsibility for all aspects of the development of the PQR and the WPS, including coordination of making of test plates, making of test coupons, machining and testing of plates and coupons, and maintaining files of all documents. Ensure the responsibilities defined are in accordance with the current edition of AWS D1.X.

Include the following as records of the test:

- The PQR,
- Parameter worksheet – amps, volts, travel speed/pass locations
- CMTR of the base materials and any backing material,
- Certificate of conformance for filler materials (and flux), and





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- Records of destructive and nondestructive tests.
- Record the testing lab used and their A2LA lab certification.

MnDOT Specific Requirement

Note: A2LA specific laboratory requirements are a MnDOT specific requirement. For non MnDOT projects, test lab certification to a recognized national standard is still required.

MnDOT specific requirement

MnDOT approves all WPSs (stamped) before use in production for a MnDOT project. Submit information or Procedure Qualification Records (PQR's) and supporting documentation demonstrating that the proposed WPS's meets the requirements of the AASHTO/AWS D1.5—Bridge Welding Code edition used in their preparation. Once accepted by the Engineer, non-Fracture Critical WPSs supported by these PQRs are valid without expiration. For Fracture Critical WPSs, refer to Clause 12 of the current AWS D1.5.

MnDOT specific requirement

If tack welds are completely re-melted and incorporated into the finished weld:

- (a) Minimum preheat requirements shall not apply but weld zones shall be free of foreign material.
- (b) WPSs for tack welding do not require qualification testing as long as consumables are compatible with subsequent weld passes.
- (c) Tack welds are not be subject to the all the quality requirements of AASHTO/AWS D1.5—Bridge Welding Code. Discontinuities such as undercut, unfilled craters, and porosity need not be removed

The Supplier must plan for and run re-melting tests as part of a PQR when this provision is used. The test must record the size of largest tack weld that is fully consumed.

Assure that all WPSs derived from the PQR reflect this information for production and inspection in production. Do not exceed the tack size that was derived in the consumption test.

FC Category Requirement

Preheat and interpass controls are different from non-fracture critical work. Procedures and work instructions may need to supplement this information on WPSs for FCM.

Describe the monitoring before and during welding to ensure compliance. List on each WPS or other references accessible to the welder the minimum preheat and interpass requirements.

12.8.2 Weld Repair Procedures

Address the need for weld metal repairs proportionate to the criticality of the product and specification and code requirements.

12.8.3 Repair welding on Fracture Critical Material and FCM welds

FCM category requirement

Document how repair by welding is performed in accordance with Clause 12 of AASHTO/AWS D1.5—Bridge Welding Code. Addresses in the procedure:

- Preparation of joint surfaces
- Excavation of the area and faring of surfaces when a weld is removed
- Notification to the customer of critical FC repairs
- Pre-approval of repair procedures for non-critical FC repairs
- Treatment of tack welds and temporary welds

12.8.4 Welder Qualification

Qualify (test) all welders and weld operators in accordance with the provisions of AWS D1.X for the process, position, and material required for the work before the welder begins work. Qualification records are certified by the Supplier's CWI. If a third party testing agency qualifies Supplier personnel or performs final visual inspection, NDE, or destructive testing, that agency's CWI will certify the results. Destructive and non-destructive test results will be certified by the organization performing the tests.

Describe what records are filed and the responsibility for the maintenance of the records of each welder or weld operator, including his/her original certification(s) and continuity record that support current qualifications.

FC Category Requirement

Describe how welder qualifications are tracked and checked to be compliant with the requirements of clause 12 of the AASHTO/AWS D1.5—Bridge Welding Code. Assure that methods are in place for the unique duration of qualification and more frequent retesting requirements.

MnDOT specific requirement

Ensure an independent/3<sup>rd</sup> Party CWI witnesses and performs visual inspection of welder qualification testing.

Include in the procedure how coupons are identified properly and either forwarded to a testing laboratory for mechanical or RT testing, or how identification and test integrity is maintained if the testing is done in house.

12.8.4.1 WQTR (welder qualification test records) must include:

- Supplier certification signature







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- WPS used for the test
- The position observed
- Test date
- Witness used, signature and CWI#

**12.8.4.2 Welder Qualification Maintenance**

At a minimum, show in the record: the welder, the process, the date certified for each process, the date recorded, and a mark or indication of who observed. Accurately document welder's use of each process, maintaining continuity of use from the date certified to present with no breaks in the record greater than 180 days.

Ensure the record (log, roster, or other suitable document) is available to production supervision if there is a need to check welder's or weld operator's current qualification to work on a particular project.

Ensure that records are available to the Owner's Verification Inspector.

**Fracture Critical Requirement**

Include FC specific requirements in the maintenance of welder qualifications and continuity.

**12.8.5 Consumables**

Describe in a procedure how the Supplier assures that consumables used in each operation meet the requirements of the WPS per the AWS A5.X specification on the WPS. This includes how they are stored, marked, and distributed to production. Identify the specific responsibilities for control.

Describe low hydrogen procedures for the SMAW, FCAW and SAW processes. Assure that the low hydrogen procedure addresses these elements:

- Packaging requirements specified by purchasing function
- Initial storage at receipt inspection
- Exposure limits, methods to record limits appropriate for the consumable
- Process for backing and re-baking
- Maintenance of flux and consumable integrity including flux recovery and recycling
- Cleanliness and handling during the welding process and between welding sessions

**12.8.6 Consumables for FCM****FC category Requirement**

Address in a procedure the unique packaging, impact requirements, oven temperature, exposure time, baking and flux recovery requirement of Clause 12 AASHTO/AWS D1.5—Bridge Welding Code for each of the processes used for FMC welding.

**12.8.7 Prior to Welding**

Identify the activities that take place before welding begins on a transportation project.

Consider the follow list of activities as instructive. These items are non-mandatory, but may help identify pre-welding activities.

Require that checks are done by the welder or weld supervision:

- Verify the current qualifications of each welder for process(es) and position(s) used on the project.
- Ensure weld procedures are Owner approved and understood by the welders, welding foremen and quality control.
- Verify that the welding consumables (wire, flux, gasses) are appropriate and match the requirements of the WPS.
- Prior to fitting welded joints, examine the condition of the material, especially for defects in the joint area.
- Check fit-up of joints that are to be welded, including root face, angle of bevel, the alignment of the parts, and the uniformity of root opening.
- Ensure run-on/run-off tabs are of adequate length, shape and size to allow full weld throat the entire length of the joint.
- Check surfaces to be welded for cleanliness, with mill scale and rust removed to the extent required, and absences of moisture, lubricants or other foreign material detrimental to welding.
- Visually inspect tack welds for integrity and defects. They are to be as small as practical. No temporary welds are allowed on any flange or web solely for positioning or restraint. Tack welds on flanges and webs must be incorporated in the final weld. Assure that the size of tack welds does not exceed the size that was derived in the consumption test run during WPS testing for SAW. Consider including the tack weld size and/or a notation on the SAW WPS that reminds welders and inspectors what the max allowable tack is for that SAW WPS.
- Review weld joints shown on the shop drawings for potential conditions which may require weld sequencing or heating parameters not specified on the approved weld procedure
- Prepare for a check of welding parameters with a calibrated gage.
- Tack welds are an appropriate size, sound and not cracked before welding begins
- A distortion control plan is in place and implemented
- Verify preheat temperatures, and methods to maintain for interpass
- Verify ambient temperatures and wind conditions





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12.8.8 During Welding

Consider the follow list of activities as instructive. These items are non-mandatory, but may help identify activities during welding.

Require that checks are done by the welder or weld supervision:

- Plan for Owner Verification Inspector surveillance for heating, and for multipass welds for FC
- Supervisors periodically observe the technique and performance of welders to ensure procedures and techniques conform to approved WPS
- Periodically verify that the amperage, voltage, travel speed, preheat and interpass temperatures are within tolerances and stay within the heat input parameters of the WPS.
- Assure that root and intermediate passes are cleaned and deficiencies corrected before succeeding weld passes. Wire brushing, grinding or chipping may be used to remove slag between weld passes, but no unspecified peening or distorting of weld metal shall be permitted without the specific approval of the Owner Verification Inspector.

12.8.9 After Welding

Consider the follow list of activities as instructive. These items are non-mandatory, but may help identify post welding activities.

Require that checks are done by the welder or weld supervision:

- Welds shall be cleaned of slag and initially inspected by the welder.
- Weld VT including, bead shape, weld size, and identify discontinuities.
- Final weld finishing requirements are checked
- Inspection is timed after blasting but before painting if blasting is planned.

12.8.10 Weld Quality and weld repair

Require that welders and weld operators conduct visual inspection of their own work and to determine if work is in conformance before the work is presented to QC Inspectors. Define their responsibility and reporting methods for nonconformances. Describe the method for recording weld nonconformances and their repairs for non-fracture critical welds.

Address responsibility, and how repair procedures are created, available, used, and understood by welders. Include the approval of a QCI before the repair begins. Include the approval of a QAI before the repair begins as appropriate for the agency requirement.

MnDOT specific requirement

A **weld repair** is defined as any area of the welded product not in compliance with the approved WPS, the Supplier’s quality manual/procedures or the current edition of AASHTO/AWS D1.5—Bridge Welding Code. Any alterations or additions when the desired weld is not achieved on the first attempt, is considered a repair.

Address how repairs are identified and approved. Describe the methods and responsibility for creating and selecting repair procedures and gaining approval from MnDOT prior to use.

Consider developing and submitting base material repair and weld repair procedures for review and stamping at the start of a project. Notification is still necessary; however, repair may begin immediately.

Do not perform a weld repair without a weld repair procedure that has been reviewed and stamped by MnDOT in place. Create a Supplier NCR and obtain a signoff from the MnDOT onsite representative.

When a reviewed, stamped weld repair procedure is not in place, the proposed repair must be reviewed before the repair can begin. Create a Supplier NCR also as above. However in this case, MnDOT will process the Supplier’s NCR using a Fabricator/Contractor Request for Deviation (MnDOT form) which will be sent for approval to the MnDOT Engineer.

Consider using reviewed and stamped repair procedures for these types of defects:

- Infrequent porosity
- Undersized welds
- Poor profiles
- Undercut
- Cold lap
- Base metal repairs such as gouges, laminations and arc strikes.
- Cracked tack

12.8.11 Weld traceability—intermediate and advanced category only

Ensure welders mark their welds with a non-permanent, unique identification traceable through the final inspection process.

Include how the Supplier provides customer specific weld identification systems for welds that are subject to nondestructive testing by RT or UT. Consider including methods to show:

- Supplier piece mark identification
- Splice plane number
- Piece component code
- Notation
  - ◀ Method to establish weld centerline
  - ◀ Selection and use of IQIs





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- ◀ Recording untested areas in the identification scheme

### 12.8.12 Welding Equipment

Assure that the power sources, wire and flux delivery systems and other equipment consistently deliver parameters to meet the requirements of approved welding procedures.

Maintain records of welding machine volt/amp reading log (verification) in intervals at three months or less.

### 12.8.13 Quality Records

- Welding Procedure Specification (WPS)
- Procedure Qualification Record (PQR)
  - ◀ Parameter worksheet – amps, volts, travel speed/pass locations, interpass temperatures
  - ◀ CMTR of the base materials and any backing material,
  - ◀ Certificate of conformance for filler materials (and flux), and
  - ◀ Records of destructive and nondestructive tests.
  - ◀ Record of the tack consumption test
  - ◀ Record the testing lab used and their a2la lab certification.
- Welder and Weld Operator Qualification Test Records (WQTR)
- Welder qualification maintenance (Roster, continuity Log)
- Weld NDT records
- Weld nonconformance records
- Weld repair procedures
- Radiographs, if retained by the fabricator rather than the owner

## 12.9 Bolting Process Control

Assure that the storage, pre-installation verification, rotational capacity testing, installation, and inspection of high strength fastener assemblies are in accordance with the project specification and the current edition of RCSC *Specification for Structural Joints Using High Strength Bolts*.

It is not required to address shipping bolts, which are bolts installed for temporary use, or fasteners, other than high strength.

A Fastener Assembly is One bolt, washer(s), and one nut of the same diameter and grade selected and tested to install together constitute a “fastener assembly” (fastener assembly).

### 12.9.1 Receiving

Describe how all structural fastener assemblies are received in sealed containers until used. Containers are kept in a clean, dry location out of weather. Require certificates of conformance and documentation for required manufacturer testing with all shipments and their review by a qualified position. When required by the project, forward certificates of conformance to the customer.

Inspect the containers and check the container marking to assure the bolt/washer/nut type, lot and size designation is correct and legible on the side of the container or other means that will ensure traceability.

### 12.9.2 Storage

Describe the controls, responsibilities, and methods to store fastener components to protect them from dirt and corrosion in closed containers at the site of installation. Provide for a protected shelter. Define how fastener components are removed only as necessary and containers are closed and returned to protected storage as soon as possible when they are not use. Provide reconditioning instructions where this practice is used if allowed by the owner and fastener manufacturer.

### 12.9.3 Pre-Installation Verification

Provide a step by step instruction for performing this test in accordance with *RCSC Specification for Structural Joints Using High Strength Bolts*.

Perform this test on bolt/nut/washer combinations that will be installed in pre-tensioned joints. It is not required to perform this test on bolt/nut/washer combinations that will be installed in joints that are designated as “snug tight” condition only.

If the diameter, grade or lot of one or more of the components of the assembly changes; the new combination is a new fastener assembly. Describe what is done when a new combination must be tested and recorded as a unique fastener assembly.

Describe how the results of the pre-installation verification are recorded. Make the record available to installation crews and inspectors to check which lots have been tested together and can be used in production. Make these records available for the contractor and the QAI.

### 12.9.4 Rotational Capacity Testing

Provide a step by step instruction of how the test is conducted meeting the requirements of FHWA or the owner’s requirements. Address:

- ROCAP lot certification from the manufacturer
- The initial tension of the snug tight condition
- Bringing the fastener assembly to minimum installation tension
- Appropriate rotation beyond minimum installation tension
- A method to record results and mark testing lots.
- Determination of failure criteria

### 12.9.5 Shop Installation

Address how these issues are evaluated and communicated to production and inspection activities.





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- Requirements for installation including the owner’s requirements of projection of the installed bolt.
- Requirements for extra assemblies shipped to the field per the erection contractor requirements for verification testing and to cover damage and loss in the field.
- Requirements for assemblies sent to an owner’s lab to meet verification testing requirements.
- Requirements for how holes are drilled including sizing, use of templates and any limitation on number of thickness allowed in a single operation.
- Restrictions when punching of holes is allowed.
- Hole condition; edges, burrs related to drilling, and distortion related to forming or heat-treating processes
- Treatment of faying surfaces including limitations for cleaning, blasting or painting
- How the correct fastener assemblies are drawn from storage and how they are provided to installation crews

MnDOT specific requirement:

- Place structural bolts with a projection from 1/8 in to 3/8 in [3 mm to 10 mm] through the nut

12.9.6 Initial Tightening Procedure—Snug Tight

Provide a step by step instruction that includes:

- Assessment of the condition of the faying surfaces
- Inspecting the bolts before installation
- Bring the plies to firm contact
 

Note: specific conditions should be evaluated in connecting thick plies. A bolt may be fully tensioned attempting to bring plies together, and then subsequently over-tightened in applying the pre-tensioning method. If sufficient contact is not achieved by snug tight then an alternate criteria or a change in the surface condition by machining or grinding may be necessary. The Engineer must be consulted before reducing plate thickness or changing the “snug tight” criteria.

12.9.7 PreTension Procedures

Provide a step by step instruction that includes:

- Assessment of the condition of the faying surfaces
- Steps above to achieve snug tight condition
- Methods for either turn-of-nut, direct tension indicating washers or both methods
- Reuse or retightening of previously fully tightened bolts

12.9.8 Contact surfaces of bolt splices

Address how the requirements of these surfaces are prepared.

If a painted surface is called by contract plans, define how the required slip co-efficient is qualified by the coating manufacturer. Include how the coating is purchased, called on shop drawings, maximum dry film thicknesses permitted, and what training, direction or work instructions control shop execution.

12.9.9 Shipping of Fasteners

Bolts for steel bridge structures are usually installed in the field although some are installed in the shop. When bolts will be installed in the field, they must be shipped to the field in containers that prevent exposure to the elements and maintain the integrity (cleanliness and lubrication level as delivered by the manufacturer) of the fasteners.

The actual fasteners to be used on the job are never shipped installed in the members unless they are completely tightened in their final installed condition.

“Shipping Bolts” are “junk” bolts that are used to secure pieces and components temporarily during the shipping process. They can also be used to secure parts during installation. However, they are not permanently installed in the structure. When the final installation is planned, these shipping bolts are replaced with “fresh from the keg” fastener assemblies in manufacturers’ delivered condition.

This is important for two reasons:

- When fasteners are shipped to the field partially tightened, they are exposed for an indefinite time, compromising the lubricant and cleanliness condition of the threads and washers.
- When fasteners are shipped to the field partially tightened (for example, snug-tight). This prevents tightening the fasteners in conformance with the specifications.

12.9.10 Quality Records

- Pre-installation Bolt Testing Records
  - ◀ Rotational Capacity Test Record.
  - ◀ PIV
- Certificates of conformance (for fastener assembly components)
- Calibration certificates of conformance for bolt tension calibrator

12.10 Weathering Steel

Address the cleaning and preparation of surfaces to be weathered in accordance with contract requirements.

Address when contracts require the Supplier to use a pre-wetting and drying process in one or more specific cycles to initiate the formation of the protective patina before steel is exposed to salt spray or other detrimental contamination. Describe how the Supplier controls, performs, and documents process checks for the control of this process and the inspection process.





## Supplement A – Bridge Fabricators and Minor Structural Component Manufacturers

## 12.11 Assembly

**Advanced bridge category Requirement****Intermediate and Simple bridge category requirement when contracts require special, full, or partial assembly**

Create and maintain a documented procedure to assess the contract requirements for shop assembly, to modify existing written procedures, and to create additional procedures required for laydown/assembly.

The procedure should show that the Supplier has the knowledge, necessary equipment, and physical area necessary for the specified assembly. Define the assigned responsibilities for the assembly process, and the qualifications required for those roles.

Project specific assembly procedures must comply with the contract specified method and tolerances unless Supplier proposed changes are accepted by the owner.

**12.11.1 General Requirements**

Outline in a general procedure the steps necessary in developing project specific plans that address the following:

**Equipment**

Itemize and describe equipment vital to the assembly such as surveying, drilling, handling/positioning.

- Large facility equipment (e.g., lifting and positioning equipment, travel lift heights and capacities, drilling equipment that is CNC controlled or manual drilling using physical templates) Also consider how large facility fabrication equipment access and utilization on other projects will be effected by the assembly process.
- Small equipment (e.g. Welders, Drills, Jacks, surveying/geometry verification, jack stands, blocking pieces)
- Permanent towers and benchmarks for survey equipment
- Unique or specialized equipment and personnel needed during the assembly (e.g.: line boring, chilling pins, milled connections, stress relief).

**Qualifications**

- Identify personnel responsible for shop assembly drawings, assembly plans, and assembly execution
- Describe the qualification or basis of designating responsible personnel.

**Necessary space attributes**

The exact need for space is dictated by the specific project planned or the anticipated supply sequence.

- Available indoor space with adequate overhead lift capacity, plus vertical and column-free clearance

- Available outdoor space suitable for laydown with adequate access, considering soil stability and typical weather related constraints for the location.
- Access and equipment to move fabricated elements within the facility and to the assembly site
- Consider contract requirements and plan for location and space for individual or overall assemblies (e.g.: Line Assembly, Full Assembly, Geometric Assembly, Panel Assembly or Special Assembly)

**12.11.2 Execution of Laydown/Assembly**

Include the following minimum steps to conduct a compliant laydown/assembly. In addition, the Supplier's documented procedure should provide for pre-approval of plans.

**Control of Assembled Dimensions**

Determine shop practices necessary to result in the required accuracy and control of the assembly. Minimum practices requiring definition are:

- Verification of dimensions and working points throughout component fabrication before assembly to assure proper geometry is maintained before assembly – valid in-process inspection evidence.
- the required status of components prior to their placement in the assembly – no pending repairs, no open quality issues, completed quality records, faying surface cleanliness requirements, etc. [Avoid allowing the correction of components after laydown/assembly.]
- Shop drawings include blocking diagrams that:
- indicate progression of assembly and required components
- identify carry-over components
- define restrictions on rotation of assembly unit(s) from true field position
- define required elevations and support locations, including special tolerances
- indicate the cambered position, whether no-load or self-weight
- Describe the means of measuring the assembly including:
- the required accuracy of dimensions and angles. Differentiate between conditions if appropriate.
- use of conventional tools or laser systems
- Location of survey equipment and location of permanent towers
- Consideration for the effects of adverse conditions on equipment.
- Sequence of assembly and hold/verification check points. Identify the personnel authorized to release hold/check points.
- Sequence of disassembly and shipping





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- Coordination of temperature correction information from shop to site

**Drilling Accuracy**

The Supplier should make provisions for controlling hole quality resulting from the drilling operations during the assembly process. The assembly procedure should include:

- Verification of field splice locations, orientation, and template fit-up prior to drilling. Address how:
  - pilot holes are used,
  - plates are secured during drilling.
- field splice gap is assured before the drilled in assembly process begins.
- Verification of hole edge distances before the drilling in assembly begins at field splices.

**Final package documentation should include (Advanced and Intermediate bridge categories Requirement):**

- Inspection records of the assembly process.
- Completed survey results covering the complete length and width of the bridge structure. If panel, geometric, progressive or other methods than full assembly were employed, the survey must show how controls and digital modeling verified the full structure assembly was accurately duplicated.
- Assembly blocking sheet

**MnDOT specific requirement**

- CNC controlled drilling is not acceptable as an alternative to assembly.
- A plate can be used as a template only one time. Templates with installed bushings may be used more than once with advance permission

**Match-marking Shop-Assembled Components**

Reference drawings should include standard match-marking details, but the Supplier’s procedure must also:

- Indicate the shop convention for numbering individual components of drilled field splices.
- Include acceptable methods of marking the steel, such as low-stress die stamps or other means.
- Describe the sequence of placement, drilling, marking and packaging of all loose connection pieces
- Define the information required on the shop/reference drawings. Field splices and their assigned match-marks should be clearly indicated and the drawings distributed to the field.

**12.11.3 Final Disposition**

Describe how documented records, such as material assignments, element and assembly dimensions, NDE, etc., should be compiled, verified complete, and distributed to the required entities.

**12.11.4 Quality Records**

Record assembly and inspection data. Consider recording these data on copies of the erection details, blocking diagrams, critical dimension tabulation from the detailing department, or other suitable record. Assure that the record shows the deviations from the design plans and approved shop drawings, and compare these with the permitted tolerances from AASHTO/AWS D1.5—Bridge Welding Code or contract design drawings.

The data must demonstrate acceptable geometric compliance to the contract.





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**Supplement A**  
**Bridge Fabricators and Minor Structural Component Manufacturers**



Minnesota Department of Transportation:  
Metals Supplier Qualification Program

