



**STEEL**

**FABRICATION**

**QUALITY**

**SYSTEMS**

**GUIDELINE**

**cisc**  **icca**

CANADIAN INSTITUTE OF STEEL CONSTRUCTION  
INSTITUT CANADIEN DE LA CONSTRUCTION EN ACIER



CISC  
STEEL FABRICATION  
QUALITY SYSTEMS GUIDELINE  
AND COMMENTARY



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INSTITUT CANADIEN DE LA CONSTRUCTION EN ACIER

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## **PREFACE**

The Canadian Institute of Steel Construction (CISC) is the national industry association representing the structural steel, open-web steel joist and steel plate fabricating industries in Canada. The CISC functions as a not-for-profit organization promoting the efficient and economic use of fabricated steel in construction.

The CISC has prepared this Guideline in recognition of the interest in meeting the quality requirements of its customers. It is designed to assist CISC Fabricators in developing a Quality System that will provide assurance that products will conform to contractual and regulatory requirements. This guideline addresses the special processes and specific requirements of the steel fabrication industry.

The Guideline is based on the belief that quality awareness is an integral part of all production processes. By promoting a "pride in workmanship" attitude among employees, product quality will be maintained in the most economical manner.

The guideline has been prepared with reference to the following publications:

- (a) CSA S16
- (b) CSA W59
- (c) CSA W47.1
- (d) CISC Code of Standard Practice
- (e) ISO 9001:2000
- (f) ISO 9001:1994

Fabricators shall have their quality assurance program audited and registered by a CISC-approved, accredited quality systems registration organization.

The Institute gratefully acknowledges the Alberta Region Quality Assurance Subcommittee for its contribution to this publication.

## INTRODUCTION

The aim of this User's Guide and Commentary is to provide steel fabrication organizations with clear, easy-to-follow information on the Canadian Institute of Steel Construction's "Steel Fabrication Quality Systems Guideline."

This guideline is suitable for organizations that are not currently operating under a quality system registration, or that are planning to implement a quality system.

All businesses, large and small, already have an established way of doing things, that is, of managing their business. This quality system will identify those features that can help a business consistently meet their customer's requirements. It is not about imposing something totally new. Quality systems are about evaluating and documenting how and why things are done, and recording the results to show it was completed. Most businesses will already carry out many of the operations that the guideline specifies.

Reasons to implement a quality system:

- i) Improve profitability,
- ii) Consistently meet customers' requirements,
- iii) Improvement of performance, coordination, and productivity,
- iv) Provide evidence to your customer and potential customers of the organization's capabilities,
- v) Instill confidence that the intended quality is being achieved and maintained.

A quality system on its own will not automatically lead to improvement of work processes or your product quality. It won't solve all your problems. It is a means for you to take a more systematic approach to your business.



## GETTING STARTED

A suggested first step in formalizing your Quality System is to write out a general overview of your business process from the estimating phase through to shipping of the finished product. This overview may be broken down by department or any other logical means. A flowchart is a useful tool for documenting this.

Once the overview is complete, flesh out the details. Define specific procedures carried out in each department or process area. Write down what is actually done, not what you think the Guideline or an auditor might require. The best source for developing the detailed procedures is the employees who actually carry out the work, or their direct supervisors. This process will be the start of your Work Procedures, or Standard Procedures Manual. It is a useful tool in analyzing your processes and identifying areas of duplication, inefficiency, or neglect. Your Procedures Manual is an internal document and should not be confused with your Quality System (or Quality Assurance) Manual, which is an external, more general document.

When working through this process, keep in mind that the format of the CISC Guideline has been aligned with ISO 9001-2000. This enables you to define and develop your Quality System in context of the ISO 9001-2000 format. This provides a building block approach, which gives you the option of seeking ISO registration in the future by adding additional blocks rather than reformatting your QA Manual.

For convenience, the Commentary appears in grey boxes below the corresponding sections in the CISC Guideline.

# **CISC STEEL FABRICATION QUALITY SYSTEMS GUIDELINE AND COMMENTARY**

## **1. SCOPE AND AIMS OF MANUAL**

The Quality Systems Manual, to be developed by the Fabricator, shall define the scope of application with respect to departments or systems included, and production location if more than one location is covered.

### **Commentary**

In this section, you describe the scope of your operation that is covered by your Quality System Manual. List what departments or process areas are included. Is more than one plant location included? What exclusions have been made?

## **2. NORMATIVE REFERENCE**

References to the following documents, when made in this guideline, indicate the most current published edition.

- (a) CSA S16
- (b) CSA W59
- (c) CSA W47.1
- (d) CISC Code of Standard Practice

### **Commentary**

State that when a published document is referenced, the reference is to the most current published edition legislated in the jurisdiction applicable to your work. In this case, the annual review of your Quality System may include a check for revisions to published documents, and to determine if the revisions affect your procedures. You should also list the CISC Guideline as a reference document for your Quality System.

### **3. TERMS AND DEFINITIONS**

The following terms and definitions apply to this guideline or are commonly used in the industry. The fabricator may choose to include industry-specific, or company-specific terms and definitions in this section.

#### **Corrective Action**

An action taken to eliminate the cause of a detected nonconformity or other undesirable situation

#### **Defect**

The non-fulfillment of a requirement that is recognized and corrected while in current process. For example, a misplaced cleat detected at the fit checking stage may be directed back to the fitting station for proper relocation; this may be considered a defect and not a nonconformity.

#### **Document**

Information and its supporting medium used to define and/or establish quality requirements

#### **Nonconformity**

The non-fulfillment of a requirement

#### **Objective Evidence**

Data supporting the existence or verity of something

#### **Preventive Action**

Action to eliminate the cause of a potential nonconformity or other undesirable potential situation

#### **Quality Assurance**

Quality assurance means to establish measures to prevent problems and to demonstrate that such measures are taken and are effective, providing confidence that the quality requirements will be fulfilled.

**Quality Control**

Quality control encompasses activities aimed at determining whether results obtained through an activity conform to stated objectives for this activity. The results are measured and then compared with a pre-established objective for this activity.

**Quality Management System**

A system to establish the policy and objectives required to direct and control an organization with respect to quality and to achieve those objectives

**Quality Objective**

An aim or goal related to improvement in the quality system

**Quality Policy**

Overall intentions and direction of an organization related to quality as formally expressed by senior level management

**Record**

A record is something stating results achieved or providing evidence of activities performed.

**Root Cause**

The initial and main reason why an event occurs. In corrective action, the removable factor leading to the elimination of future nonconformity

**Commentary**

Define any company-specific terms and definitions that may be used in your procedures and/or QA Manual. If company-specific terminology does not match the terminology in the Guideline, don't feel obligated to change your terminology to suit. If what you are doing works well, don't change it.

## **4. QUALITY SYSTEM REQUIREMENTS**

### **4.1 General Requirements**

The Fabricator shall develop a Quality System Manual that documents the processes necessary to provide assurance that finished products conform to customer requirements in accordance with the requirements of this guideline.

#### **Commentary**

A Quality System Manual allows for the effective communication and understanding of a fabricator's intentions regarding quality.

The Quality Manual should describe how the company fulfils the requirements of the Steel Fabrication Quality Systems Guideline and may be structured in a similar fashion to the Guideline.

The Quality System Manual is an index or "roadmap" of your Quality System and is not as in-depth or descriptive as a Manual of Procedures, which details specific work activities.

The Quality System Manual should reference applicable work procedures and documents where relevant. The Quality System Manual is general and available to your customers, while your procedures are detailed, internal documents.

The Manual should be reviewed and updated as necessary, but at least annually, and should contain revision numbers and dates. The manual should be considered a 'controlled' document. A controlled document is one whose distribution and current revisions must be tracked and logged. Define who requires controlled copies of the manual. Typically, this would be internal distribution and possibly your registrar, and retained engineer, if applicable. External distribution of your Quality System manual is typically considered uncontrolled.

## **4.2 Work Procedures**

The Quality System Manual shall be supported with applicable work procedures and sample documents.

### **Commentary**

A Manual of Procedures provides employees and management with step-by-step directives through the major activities undertaken by the fabricator on a regular basis.

The purpose of having a Manual of Procedures is to reduce uncertainty regarding the proper flow of events and information from the start of a job until completion and delivery.

A Manual of Procedures may contain specialized instructions that could possibly place an organization at an advantage over its competitors and does not need to be released to customers. Therefore, its distribution should be controlled and used primarily for internal purposes.

The individual procedures may be structured in various ways including a flowchart format, which will visually illustrate actual practice and show interrelations between positions and departments.

A Manual of Procedures helps to ensure that work practices, which lead to a quality product, are completed the same way, every time. For this reason, all employees in the organization should have access to these procedures, or at least the appropriate procedures for their functional area. Think about the easiest, most practical way of making this information available to your employees and choose the format accordingly.

The procedures should be generated by asking the people doing the work how it is actually done, using the employees' terminology and language. Flowchart the overall processes before building individual

procedures. Look for overlaps, duplication, negative gaps, and improvement opportunities in the process.

The Manual of Procedures should reference applicable documents where relevant.

The Manual of Procedures should attempt to avoid describing, in too much detail, activities that are obvious to the person responsible for the task, or already provided for through other standards or procedures. For example, a procedure should not tell a welder how to weld. Instead it could describe the flow of material and information to and from the welder, necessary checks and inspections, appropriate records which need to be completed during the process, identification of pieces, and other supplementary notes.

The manual's sections should be reviewed at least yearly and contain revision numbers and dates. Old manuals should be replaced without undue delay.

## **4.3 Control of Documents**

### **4.3.1 General**

The Fabricator shall establish and maintain procedures for approval, issue, and maintenance of the documents and data required for the operation of the Quality System. Required documentation shall include, but may not be limited to, the following:

- (a) Contract drawings, specifications, and amendments
- (b) Detail and erection drawings
- (c) Welding documentation as required by CSA W47.1
- (d) Purchase orders

### **4.3.2 Erection diagrams and shop details**

#### **4.3.2.1**

The Fabricator or his assigned representative shall prepare shop details and erection diagrams from Certified for Construction contract documents. Preparation, use, and approval of these

documents shall conform to Section 5 of the CISC Code of Standard Practice, and Provincial and Territorial Engineering Association guidelines, where applicable.

#### **4.3.2.2**

Revisions to detail drawings/data shall be dealt with in the same manner as the originals, or as agreed upon with the customer.

#### **4.3.2.3**

Current issues of appropriate documentation shall be available at all points of use. Provision must be made to ensure that obsolete drawings/data are removed from all points of use.

#### **4.3.2.4**

A shop drawing control system shall be maintained.

#### **4.3.3**

The Fabricator shall control the documentation required for procured and subcontracted items.

#### **4.3.4**

The Fabricator shall ensure that all required documentation is reviewed for adequacy prior to release.

#### **4.3.5**

The Fabricator shall define the retention period for documentation, including consideration for requirements of specific contracts and governing legislation.

### **Commentary**

In quality management terms, documents are defined as information and its supporting medium used to define and/or establish quality requirements. Some typical quality documents are listed in Section 4.3.1 of the Guideline. Your Quality System Manual is also a quality document.



Shop drawings can be used to illustrate the difference between quality documents and quality records. A shop drawing issued to the shop for fabrication is a quality document because it defines requirements for manufacturing an item. Once the shop drawing is issued as part of a turnover package, or is signed off to confirm completion and/or conformance, it becomes a quality record.

As a fabricator, you should make a master list of what you consider pertinent quality documents, and indicate which of these documents need to be controlled. Typically, controlled documents will include design drawings, shop and erection drawings and standard blank forms such as transmittal forms, purchase order forms, shipping bills, inspection sheets, etc.

You should look to eliminate redundant or duplicated documentation. Don't get trapped into creating an onerous system of paperwork. Section 4.3.4 addresses the review and approval of standard blank forms (controlled documents), as well as completed documents. Be practical with the defined period of retention and minimize this requirement. Also, consider electronic archiving as an alternative to hardcopy.

## **4.4 Control of Quality Records**

### **4.4.1**

The Fabricator shall establish and maintain a system for the identification, collection, and storage of the records determined to demonstrate conformance to the requirements and effective operation of the Quality System. Required records shall include, but may not be limited to, the following:

- (a) Contract drawings, specifications, and amendments,
- (b) Mill test reports,
- (c) Purchase orders,
- (d) Applicable inspection and test records,
- (e) Calibration records for measuring and inspection equipment,

- (f) Shipping and receiving reports,
- (g) Nonconformity, corrective action, and preventive action reports.

#### **4.4.2**

All records required by the contract specifications shall be available for review by the customer or his representative.

#### **4.4.3**

The Fabricator shall control the records required for procured and subcontracted items.

#### **4.4.4**

The Fabricator shall define retention periods for records, including consideration for requirements of specific contracts and governing legislation.

#### **Commentary**

Quality records state results achieved or provide evidence of activities performed. You should compile a master list of Quality records and describe which ones need to be retained, where they are retained, and how long they are retained. Also create a standard turnover package format for quality records for submission to the customer if requested.

### **5. MANAGEMENT RESPONSIBILITY**

#### **5.1 Management Commitment**

Management is responsible for ensuring that:

- (a) A documented statement is in place that describes the Fabricator's Quality Policy with respect to commitment and quality objectives,
- (b) All employees are made fully aware of their authority and role in the Quality System as described in section 5.3.1,

- (c) A Quality System that conforms to the requirements of this guideline is implemented,
- (d) A senior-level management representative is appointed to ensure that the requirements of the Quality System are maintained and reported,
- (e) A quality system audit is carried out by a third party at a maximum interval of one year,
- (f) The Quality System is reviewed at a senior management level at a maximum interval of one year, or more frequently, to ensure its continuing suitability and effectiveness,
- (g) Adequate resources are provided to carry out the Quality System including performance and verification of work.

#### Commentary

Your company's Quality Policy needs to be included in your Quality Systems manual. It should also be posted in your office and shop for exposure to customers and employees.

Section 5.1 (b) indicates that all employees need to be made fully aware of their role and responsibilities in the company's quality system. The cornerstone philosophy of the CISC Quality Systems Guideline is that quality awareness is an integral part of the production process. The system focuses on maintaining a "people-based" approach, where the responsibility for quality assurance lies with the people that are doing the work. Therefore, how you educate and promote your quality system to your employees is essential to the success of your system. This can be done through employee orientations and Quality Systems training sessions. Keep records of these activities.

Appoint a senior-level management representative to be responsible for effective implementation and maintenance of your system. This person may also have production-related responsibilities. Again, the philosophy of the CISC Guideline is that production and quality work together, not independently.

Your Senior management review should include review of: audit results, customer feedback, process performance statistics, nonconformities statistics, corrective actions and preventative actions. It should also include recommendations for improvement and results of recommendations and actions suggested at previous reviews.

We strongly recommend the use of an internal audit to ensure that you are doing what your manual and procedures say you do. This gives you the chance to identify opportunities for improvement in your organization. You define the procedures and extent of your internal audit. If deemed effective, use the registrar's Audit checklist to perform your audit. The CWB audit form may provide a useful template to audit your welding certification requirements. You may also consider auditing only selected parts of your system at each internal audit.

## **5.2 Organization**

### **5.2.1**

The Fabricator shall define an organizational structure, which includes the following functions as applicable:

	QUALITY ASSURANCE
	ENGINEERING
	PRODUCTION
MANAGEMENT	DRAFTING
	PURCHASING
	SALES / ESTIMATING
	PROJECT MANAGEMENT

### **5.2.2**

This chart represents a typical organizational structure. Departments may vary from company to company, and more than one function may be held by one person. Any of the functions noted may be subcontracted.

#### **Commentary**

Your organization chart should include specific position titles within each department, and their hierarchy of authority. Describe position titles, but do not include specific names. This avoids the need to make revisions to your manual every time you have personnel changes.

Although some of the functions may be subcontracted, please note that CSA Standard W47.1 requires welding supervisors to be employed full time by the certified company.

## **5.3 Responsibility and Authority**

### **5.3.1**

Each employee is responsible for the quality of his or her own work and carries an equally important share in the effectiveness of the quality assurance process.

#### **5.3.1.1**

All employees are responsible to ensure that the work performed by them conforms to a standard of workmanship required by the company in accordance with the applicable contract requirements.

### **5.3.2**

Management is responsible for ensuring that responsibility and authority is defined for carrying out the following:

- (a) ensuring that all product quality verifications are carried out on a continuous basis,

- (b) dealing with nonconformities and ensuring that the specified dispositions are carried out on a continuing basis,
- (c) communicating with the customer's appointed inspection representative(s),
- (d) work is carried out in accordance with the applicable codes and standards;
- (e) all welding is in accordance with the latest requirements of CSA Standards W47.1 and W59,
- (f) nonconformities of a technical nature are dealt with in accordance with the applicable codes and standards,
- (f) ensuring that all production personnel understand the contract requirements pertinent to their assignment,
- (h) providing sufficient notice and making proper arrangements for required inspection,
- (i) ensuring that all contract requirements, including revisions, are conveyed to the relevant departments and incorporated into the detail drawings and other fabrication data,
- (j) purchasing all items in accordance with the contract requirements, including revisions and obtaining the required documentation.

### Commentary

What can you do to clearly communicate the responsibilities and authorities to all employees?

It is vital that the responsibilities and authorities listed in the Guideline be clearly communicated to all employees. It is also vital

that company-specific standards of workmanship be defined and clearly communicated to all affected employees. This can be via QA training sessions, employee orientations, company policy statements, company procedure manuals, periodic QA and/or production meetings. All training and orientation should be recorded and signed off by participants.

Remember the approach stated in the Preface and Section 5.3.1 that stresses that employees should be encouraged to produce quality work and empowered in the process. Consider how you can promote pride in workmanship within your organization. Keep records of what you do to meet this requirement.

Ensure that management clearly defines the responsibilities and level of authority that each employee has with respect to the Quality Assurance and Production System. This includes identification of the position or department responsible for carrying out the activities listed in Sections 5.3.2 (a) through (j). This can be done by asking who currently has this specific responsibility in the organization. Look at your organization chart for validation. The same position may fulfill one or more of the required items. As in the organization chart, avoid the use of names by specifying positions.

This also includes responsibilities of all employees in fulfilling their role in the production of a quality product.

## **6. RESOURCE MANAGEMENT**

Except as stated in Section 6.1, the Fabricator shall identify the personnel and the corresponding level of education, training, skills, and experience required in order to ensure that work affecting product quality is carried out in the required manner.

### **6.1 Welding Personnel**

Welders, welding operators, tack welders, welding supervisors, and welding engineers shall be qualified to the requirements of the latest issue of CSA standard W47.1.

## Commentary

Specific job descriptions for each position in your organization can be used to clearly identify qualifications required for new hires, to perform annual evaluation of existing personnel, and to identify training requirements.

Section 6.1 defines requirements for welding personnel. Define hiring, education, training criteria for other personnel whose function affects product quality. Be careful not to trap yourself with unpractical requirements. A statement like “at the supervisor’s discretion based on experience or other criteria” is acceptable. You may want to expand on training recommended or available to personnel. Consider the requirements of Sections 5.3.1 and 7.6.1.

## **7. PROCESS MANAGEMENT**

### **7.1 QC Planning**

The Fabricator shall determine the procedures, documentation, records and resources required to ensure that his product meets the customer requirements.

## Commentary

This section is a general statement that says “tell us how you do your work, and how you verify what you have done.” The key here is the statement “the Fabricator shall determine the ....” In general, document the steps used to process a typical contract through your system from estimating stage to final shipping. Refer to the Commentary for Sections 4.1 and 4.2.

### **7.2 Contract Review**

#### **7.2.1**

The Fabricator shall have a system in place to ensure that contract requirements are reviewed and incorporated into the work.



### **7.2.2**

The Fabricator shall ensure that the necessary expertise, personnel, equipment, and plant resources are available to meet the contract requirements.

### **7.2.3**

The Fabricator shall ensure that all additions and revisions to contract requirements are duly communicated to the necessary personnel, and incorporated into the work.

#### **Commentary**

You should develop procedures for the following activities:

- i) Prior to submitting a bid, confirm that the requirements of Section 7.2.2 are satisfied. A bid checklist and procedures for peer and/or senior management review of bids prior to submission may be established.
- ii) Upon receipt of a contract, you need to convey contract requirements to your drafting, purchasing, engineering, and/or production departments. Procedures for developing project information sheets and/or conducting project start-up meetings for certain sizes or types of projects may be established.
- iii) Ensure that someone is responsible for the review of contract specifications.
- iv) Ensure that someone is responsible for the review and comparison of Issued for Construction (IFC) documents to Bid documents.
- v) Define who receives initial and ongoing IFC documents and how revisions are communicated to purchasing, engineering, drafting, shop, and the field.

## **7.3 Purchasing**

### **7.3.1**

Purchase orders shall clearly describe the goods and services being ordered. The descriptions shall include the following information as

applicable to the product being purchased:

- (a) Quantity
- (b) Unit of Measure
- (c) Product Name
- (d) Manufacturer's Description
- (e) Size and Length
- (f) Material Specification
- (g) Special Properties (e.g. Impact Category)
- (h) Finish
- (i) Inspection Instructions
- (j) Special Packaging or Shipping Instructions
- (k) Applicable standards
- (l) Scope of work
- (m) Attachments to the purchase order
- (n) Tolerances

### **7.3.2**

For subcontracted work, the Fabricator is responsible to ensure that the final product meets the customer requirements.

### **7.3.3**

Specifications, drawings, process requirements, inspection instructions and other relevant technical data shall accompany the purchase order if applicable.

### **7.3.4**

Purchase orders shall clearly specify the written documentation that shall be provided to verify conformance with purchase orders.

## **Commentary**

Develop procedures to define who is authorized to issue Purchase Orders, the information that is necessary to be included, and distribution of Purchase Orders. Define procedures describing how you ensure that the subcontractor's product meets the requirements

of your contract. You may include your Inspection Test Plan (ITP) and/or QC documents for use by your vendor, or approve use of your vendor's QC documents. Your ITP may include a requirement to perform final inspection on subcontracted products, or acceptance of your vendor's final inspection records.

## **7.4 Receiving**

### **7.4.1**

Incoming materials shall be matched against receiving slips and purchase orders.

### **7.4.2**

Nonconformities that are identified at the receiving stage shall be dealt with in accordance with Section 8.1, Control of Nonconformity.

### **7.4.3**

Material shall not be used or processed until it has been inspected and approved for use.

## **Commentary**

Define responsibilities and procedures for matching incoming materials with received product, transferring material identification markings if required by your procedures in Section 7.5, and verify that receiving bills match purchase orders. Define procedures for how you inspect and/or release materials for use. You may include procedures to segregate or flag nonconforming items so that they can be dealt with as per Section 8.1.

## **7.5 Material Verification**

### **7.5.1**

The Fabricator shall be able to verify the material specification of all items in stock and incorporated into the work.

### **7.5.2**

Where individual pieces, lots, and batches are restocked, the identification system shall be maintained.

#### **Commentary**

Review the requirements of CSA Standard S16, Clauses 5.2 and 30.6, and define the method you will use to ensure that the required material grade is incorporated into the work. Purchasing practices, colour coding, legible marking, and cutting records are examples of acceptable means of correlating Mill Test Reports to fabricated products.

CSA Standards W47.1 and W59 do not require that welding electrodes be traced by Material Test Reports. Electrodes used must conform to the requirement of your Welding Procedure Specifications (WPS) and the applicable CSA Standard W48 or AWS A5 standard. Electrodes must be handled and stored in accordance with the requirements of CSA Standard W59.

## **7.6 Control of Workmanship**

### **7.6.1**

All employees shall be made aware of their responsibilities under Section 5.3.1 of this Guideline as they apply to workmanship.

### **7.6.2**

Workmanship and tolerances shall conform to the applicable clauses in the latest editions of CSA Standards S16, W59, and to the CISC Code of Standard Practice.

### **7.6.3**

Fabricators performing welding shall be certified by the Canadian Welding Bureau in accordance with the requirements of CSA Standard W47.1.

#### **7.6.4**

The Fabricator shall ensure that manufacturing operations are carried out under controlled shop conditions. Controlled shop conditions shall include all conditions that affect product quality and the achievement of customer requirements.

#### **7.6.5**

All tools and equipment used shall be suitable to perform the work and shall be in proper working order.

#### **Commentary**

To make employees aware of their responsibilities and the expected level of workmanship, methods such as employee orientation sessions, QA training, and written distributions can be utilized. You should keep signed and dated records of employee training sessions and documentation distributions.

Your production Inspection Test Plan (ITP) should define how you meet the requirements of Section 7.6.2. Your quality control records should document your conformance.

The CSA Standard W47.1 requirements address welding engineer, welding supervisor, welder, welding operator, and tack welder personnel qualifications. In addition, the development and adherence to approved welding procedures is a primary component of W47.1 certification. You should develop a system for verifying that these certification requirements are in place, being adhered to and records maintained.

Your quality control should define which shop conditions need to be controlled in order to ensure that product quality and customer requirements can be achieved. These conditions may include air quality, humidity, temperature, wind conditions, lighting, visibility, and worker ergonomics.

Implement a maintenance program that includes procedures for equipment maintenance and calibration as well as records of confirmation that the maintenance and calibration have been performed.

## **7.7 Product Verification**

The Fabricator shall verify conformance to the contract requirements.

### **7.7.1**

The Fabricator shall define inspection points and inspection record requirements to verify conformance to the contract requirements, including the following:

- (a) Examination of material for size, conformance to dimensional tolerances, and surface condition or defects,
- (b) Examination of assemblies for overall dimensions, and location and orientation of holes and detail components,
- (c) Verification that welding is carried out in accordance with the company's welding standards. This includes visual examination of completed weldments,
- (d) Examination of surface preparation and finish.

### **7.7.2**

Any additional inspection requirements noted in the contract documents shall be identified and implemented.

### **7.7.3**

The Fabricator shall provide access to and cooperation with the customer's designated representative for inspection of the work as required. Unless specific provisions are included in the contract documents, such inspections shall be scheduled so as not to impede the progress of production.

#### **7.7.4**

The Fabricator shall ensure that all verification has been performed in conformance with contract requirements and this Guideline.

#### **7.7.5**

All test records specified above are maintained in accordance with Section 4.4.

#### **Commentary**

Product Verification is a method that ensures that customers receive specifically what is required by the contract documents.

To begin this process, you could create a list of contract requirements using information extracted from the contract review process in Section 7.2. This list is often in the form of a Quality Control Plan or an Inspection and Test Plan (ITP) and may be specific to each project, customer, and fabricator. All inspections and special requirements noted in the contract documents should be included in this plan. The minimum verification steps are defined in Sections 7.7.1 (a) through (d).

The locations of the verifications in Section 7.7.1 (a) will vary with each fabricator, but these verifications could minimize any rework that may be required if they occur prior to downstream production stages. The verifications in Section 7.7.1 (b) follow interpretation of shop drawings or use of CNC data. It would be proactive to ensure correct interpretation of drawings prior to welding and/or coating processes to minimize any possible rework; however, the location and timing of these verifications will vary.

Weld quality and inspection requirements are documented in CSA Standard W59. The minimum requirement is that welds be visually examined. Other examination methods may be required to fulfill your in-house requirements, code requirements, or customer's requirements. You must maintain records of all inspection

examinations performed. Some suggestions are signing off of shop drawings and checklists.

The examination of surface preparation and finish is very project-specific. Coordination and incorporation of this work requires clear and distinct instructions where the level of surface preparation, application techniques and curing must be continuously controlled and verified in some form of painting inspection record.

Examination of surface preparation and finish must be documented as a minimum requirement of this guideline.

Contract-specific inspection requirements should be noted on your ITP and/or directly on shop drawings.

Section 7.7.4 requires the fabricator to ensure all inspections and verifications were completed as per the contract requirements. In other words, the fabricator completes the ITP with some form of acceptance. The signing off of the ITP and/or providing a turnover package with evidence of required verifications can fulfill this requirement. This verification step includes verification that your QC procedures have been followed in all departments including contract management, drafting, purchasing, and shipping.

## **7.8 Customer-Supplied Products**

### **7.8.1**

Upon receipt, the Fabricator shall examine all items for compliance with the customer-supplied documentation and to detect nonconformities.

### **7.8.2**

The Fabricator shall promptly report to the customer any item found to be damaged, incomplete, or otherwise unsuitable.

### **7.8.3**

Unless otherwise specified, it is the responsibility of the customer to ensure that items supplied by the customer conform to the contract



requirements.

#### Commentary

It is recommended that previous agreement be made with the customers whose products will be visually inspected prior to incorporation into the work. This avoids the necessity of shaking out and inspecting all customer-supplied material at the time of receipt.

### **7.9 Storage, Loading, and Shipping**

#### **7.9.1**

The Fabricator shall maintain procedures to ensure that all items are properly prepared, handled, and/or packaged for storage and shipping to prevent damage to the product.

#### **7.9.2**

The Fabricator shall ensure that items loaded correspond to the shipping bill.

#### **7.9.3**

The Fabricator shall maintain records of all items that have been shipped.

#### Commentary

The fabricator's procedures should include directions for piece or batch marking, packaging, loading, shipping bill verification, and documentation maintenance.

### **7.10 Control of Measuring and Inspection Equipment**

#### **7.10.1**

The Fabricator shall maintain procedures to define the frequency and methods of checking, testing, and/or calibration of measuring and inspection equipment.

### **7.10.2**

The Fabricator shall ensure that the equipment is suitable for the work and capable of measuring within the required tolerances.

### **7.10.3**

The Fabricator shall ensure that new equipment, stored equipment, and repaired equipment are checked before use.

### **7.10.4**

The Fabricator shall ensure that the calibration status is controlled by physical marking, or other means.

### **7.10.5**

The Fabricator shall ensure that calibration records for measuring and inspection equipment are maintained.

#### **Commentary**

When you develop procedures for control of measuring and inspection equipment you should address the following items:

- i) Identify what measuring and inspection equipment requires control,
- ii) Identify the accuracy tolerances of the equipment and its intended use,
- iii) Identify the verification or calibration required based on the manufacturer's recommendations, recognized standards, or a procedure acceptable to management,
- iv) Identify the interval between verification or calibration,
- v) Define how you verify or control calibration status. One method of control may be to label each instrument with the date on which it was last calibrated. You may also choose to identify measuring and inspection equipment with an ID number. This number can be correlated to calibration records.

New, stored, and repaired equipment should be checked before being used. New inspection equipment cannot be assumed to be ready for use. A certificate of inspection or compliance may be suitable verification for new equipment.

## **8. MEASUREMENT, ANALYSIS, AND IMPROVEMENT**

### **8.1 Control of Nonconformity**

#### **8.1.1**

The Fabricator shall establish a procedure to deal with nonconformities in order to ensure that only products that meet the contract requirements are released.

#### **8.1.2**

The Fabricator shall define the:

- (a) Authority for disposition of nonconformities;
- (b) Need for nonconformity reporting;
- (c) Method of identifying nonconformities to prevent unintended use.

#### **8.1.3**

The Fabricator shall ensure that all nonconformities are handled in one of the followings ways:

- (a) In consultation with the customer, the item may be judged to be acceptable for its intended use “as is”.
- (b) The item may be reworked or repaired by an acceptable procedure that conforms to the contract requirements. In this instance, items must be re-inspected prior to release.
- (c) The item may be rejected and/or returned to stock for re-use as allowable, or to the subcontractor/supplier as applicable.
- (d) The item may be scrapped.

#### 8.1.4

Records of the results and disposition of nonconformities shall be maintained in accordance with the requirements of Section 4.4.

##### Commentary

It is important that inspections be carried out. It is equally important that people know what to do with the nonconforming (deficient) product or material if it fails the inspection. The primary objective is to ensure that your organization does not deliver nonconforming products to the customer.

Not every workmanship error made in the shop needs to be considered a documented nonconformity. The fabricator should determine the level of severity of workmanship errors that should be reported. In many cases, these errors may be identified and repaired in the course of fabrication. Take into consideration the time required to make the repair and determine if the piece passed a previous inspection point. Even though many workmanship errors may not be reported, you should consider the value in identifying problematic trends that should be corrected.

Control of nonconformities should be done by clearly identifying the product or material as nonconforming. Segregating nonconformities in designated areas, and marking of the product or material are the most obvious examples.

Define the personnel in the organization that have the authority to decide what to do with nonconforming products (see Section 5.3.2).

Sometimes it is an option to use a nonconforming product and release it to the customer in an “as is” condition. This is only allowed with a concession (approval) from the customer. Any repaired or reworked product must be reinspected and documentation maintained.

In the event that a nonconformity is detected after delivery, appropriate actions need to be taken. For example, if a fabricated beam is being erected and the bolting holes are missing or in the wrong location, a number of actions might be required to fix the problem:

- i) Investigate to find out the root cause,
- ii) Segregate and quarantine the product,
- iii) Determine and authorize disposition (fix problems).

There must be records kept to prove that disposition has been completed on any nonconformities found. A statistical analysis of the data in these records may reveal trends, suggest process changes and help determine the effectiveness of corrective actions.

## **8.2 Corrective Action**

### **8.2.1**

The Fabricator shall maintain a system for implementation of corrective action. Procedures for corrective action shall include directives for investigation of the cause, recommendations to prevent recurrence, and follow-up.

### **8.2.2**

The Fabricator shall determine the level of corrective actions required considering the magnitude of the problems and the associated risks.

### **Commentary**

Improvement does not happen without implementing changes. When reviewing your nonconformities, identify if there is a need for corrective action. If so, investigate the root cause and determine what actions can be taken to eliminate recurrence. Once you have implemented a corrective action, you should verify that the action is effective.

Not all nonconformities require corrective actions. For example, when a saw operator has cut a beam too short, the action taken is to restock the short material and cut another piece to the correct length. If this is an isolated incident, then all that is required is a material disposition. If a trend appears such that the saw operator is making too many errors, then Corrective Action may be necessary.

## **8.3 Preventive Action**

### **8.3.1**

The Fabricator shall maintain a system for implementation of preventive action, and establish a procedure to deal with preventive action initiatives.

### **8.3.2**

The Fabricator shall determine the level of preventive action required, considering the magnitude of the problems and the associated risks.

#### **Commentary**

The purpose of preventive action is to eliminate the cause of a potential nonconformity or other potentially undesirable situation. Preventive action is taken when a potential nonconformity is identified as a result of the analysis of data, records, and other relevant sources of information. Other sources of information may include customer feedback, employee suggestions, and learning experiences gathered during your registration process.

Preventing the causes of potential problems with your products, processes, quality management system, and customer satisfaction are important steps toward your continuous quality improvement process.

Develop procedures to be followed for identifying and implementing preventive action. Your procedures may include:

- i) Identifying the potential problem,
- ii) Examining the root cause,
- iii) Putting a plan in place to prevent occurrence of the problem,
- iv) Recording actions taken,
- v) Evaluating the effectiveness of the plan.

Determining the need for preventive action may often involve a less formal approach. Preventive action initiatives may be solely based on an employee's knowledge or experience. For example a welding supervisor may anticipate that welding on a particular assembly with flux-core will generate too much heat, creating unacceptable levels of distortion. A preventive action measure may be to weld the assembly with an alternate process, resulting in less heat input, less distortion, and resulting in a conforming product.

## **8.4 Analysis of Data**

### **8.4.1**

In accordance with Section 7.7, the Fabricator shall define inspection points and inspection record requirements to verify conformance to the contract requirements.

### **8.4.2**

The Fabricator shall define critical inspection points and collect and analyze relevant data pertaining to those critical inspection points employing suitable and defined statistical techniques. This will be completed at suitably defined intervals.

### **8.4.3**

The Fabricator shall establish improvement objectives, where necessary, in accordance with the analyzed data and other defined sources of data. Other sources of data may include, but are not limited to, Nonconformance Reports and Corrective Actions at a minimum.

## Commentary

Analyzing data is an essential activity for any improvements in your quality management system, processes, and products or services.

Examples of data may include:

- i) Nonconformance reports,
- ii) Corrective/Preventive Action reports,
- iii) Customer feedback and satisfaction,
- iv) Trends in the market and sales,
- v) Supplier performance,
- vi) Trends from measurement and monitoring of product characteristics,
- vii) Trends from process control activities,
- viii) Machine downtime,
- ix) Customer delivery dates,
- x) Evaluation of training effectiveness,
- xi) Cost of Rework,
- xii) Effectiveness of the quality management system.

Your measurement and monitoring activities too may have generated significant amounts of data that can be analysed to show any trends. Any trends you may find can suggest that there are problems in your processes and/or in the quality management system, and indicate areas where improvements may be required. Suitable and defined statistical techniques referred to in Section 8.4.2 need not be complicated. Suitable techniques may be as simple as grouping shop errors by process or trade classification, or defining quantities of a certain type of defect error that indicates a negative trend.

Results of analysis can also be used for:

- i) Management review,
- ii) Decision for corrective and preventive actions,
- iii) As input to assessing customer complaints and satisfaction,
- iv) Conformance to customer requirements.





