National Energy Board

Office national de l'énergie

Quality Assurance for Pipeline Fittings Workshop Summary Report

Canada

Contents

Executive Summary

The National Energy Board (NEB) hosted a Technical Workshop on Quality Assurance for Pipeline Fittings (Workshop) on 28 – 29 June 2017. This initiative was one of the steps that the NEB took in the first phase of Quality Assurance of Pipeline Fittings Project (Project). It is important to note that there have been no failures on in-service NEB-regulated pipelines as a direct result of fittings not fully meeting specifications. The NEB, as Canada's federal pipeline regulator, is committed to influencing improvements in the pipeline fittings supply chain. Although it does not regulate fitting manufacturers, the NEB still looked to facilitate broad dialogue on this important quality assurance issue between various stakeholders to further the goal of preventing incidents that could compromise the safety of people or harm the environment. Experts from pipeline companies, distributors, manufacturers, regulators, academia, consulting companies and standards associations attended the workshop. The purpose of the Workshop was to discuss ideas that could be developed into actions or solutions to improve quality assurance for pipeline fittings throughout the supply chain.

The Workshop was held over the course of 1.5 days and included presentation sessions, a breakout session and a final wrap up session. As a result, possible actions were identified that would improve the quality assurance for pipeline fittings and other components.

In advance of the workshop, a technical paper (Paper) sponsored by the NEB was commissioned. The paper included 10 possible strategies to be adapted by stakeholders in the supply chain to provide more assurance that pipeline fittings are produced and installed with the required material properties. The goal of the Paper was to inform discussions at the workshop in the form of a breakout session. On day two, workshop attendees gathered at each of the eight breakout tables and discussed one (in some cases two) of the proposed strategies in the Paper. The results of each breakout session were recorded and then presented to all attendees for group discussion.

This report provides a summary of the discussions that took place during the breakout session and the recommendations that were made by the participants. It does not reflect the NEB's views and position on the topics that were discussed. In the process of finalizing this summary report the NEB solicited feedback from all Workshop participants to ensure the report accurately captures the discussions that took place during the Workshop. Over 50% of the participating organizations responded and provided feedback on the summary report, as well as additional thoughts on the discussions that took place.

Comments that fell outside of corrections to the content of the summary report will be reviewed and considered in the second phase of the Project. After further review of the discussions and suggestions that are outlined in this report, the NEB will determine any actions that it may take. In the interim, the NEB will continue its work with various stakeholders including the Canadian Standards Association (CSA).

Background

The National Energy Board (NEB) hosted a Technical Workshop on Quality Assurance for Pipeline Fittings on 28 – 29 June 2017. Facilitation of this Workshop was one of the steps that the NEB took in the first phase of Quality Assurance of Pipeline Fittings Project (Project). It is linked to Safety Advisory SA 2016-01A2 and a Draft Order which would require NEB-regulated companies to report to the NEB on pipeline fittings that do not meet specifications. Information on these measures is available on the NEB's website:

http://www.neb-one.gc.ca/sftnvrnmnt/sft/dvsr/sftdvsr/index-eng.html

The purpose of the Workshop was to discuss ideas that could be developed into actions or solutions to improve quality assurance for pipeline fittings throughout the supply chain. Experts from pipeline companies, distributors, manufacturers, regulators, academia, consulting companies and standards associations attended the workshop.

In advance of the workshop a technical paper (Paper) sponsored by the NEB was commissioned to:

1. Examine current quality assurance requirements, processes and procedures used to validate pipe and fittings on pipeline systems; and
2. Identify any gaps or shortcomings in the quality assurance specifications that allow pipe or fittings to be manufactured that do not meet the intended material quality requirements.

This Paper outlined 10 possible strategies to provide more assurance that pipeline fittings are produced and installed with the required material properties. This Paper was sent to all Workshop participants ahead of time to provide a starting point for further discussions.

Workshop

The workshop was held over the course of 1.5 days as per the program in Appendix A. There were a total of 9 presentation sessions, a breakout session where all attendees were divided into groups to discuss one (or in some cases two) strategies each, and a final wrap up session where each group presented the outcome of their discussions. Peter Watson, the CEO of the NEB, provided the opening and closing remarks for the Workshop.

Breakout Session Outcomes

The objective of the breakout session was to discuss the strategies that were outlined in the Paper within the context of people, process and technology and discuss possible actions that could be taken by manufacturers, operators, distributors, standards bodies and regulators. The summary of these sessions are as follows:

Strategy 1 – Quality Management Systems (QMS)

It is recommended, as a minimum, that the pipeline operating company require QMS alignment from suppliers of pressure-carrying pipe and fittings and their upstream suppliers, as well as the pipeline and facilities construction contractor(s). There are actions that can be taken by all parties along the supply chain to help in achieving this goal. Some of such actions are outlined in the following paragraphs in this section.

It is important that the operating companies have a relationship with manufacturing and distributing companies. Operating companies should maintain a list of approved manufacturers (AML) and distributors (ADL), and should require distributing companies to follow the operating companies' AML. It is also important to have a better feedback loop with the manufacturing and distributing companies to follow up on identified issues. There is general consensus among manufacturers that some of the "quality inspectors" who purchasers send to manufacturing facilities are poorly trained and instructed. This leads to production inefficiencies, unnecessary rejections or rework, and extra costs for manufacturers. Operating companies should exercise more control over training and competency of third party inspectors.

Manufacturing and distributing companies should have a QMS, and those seeking a listing on an AML or ADL should be required to demonstrate effectiveness of the QMS. However more effort is required in implementation of all the elements of their QMS. One area in particular that was discussed as requiring more attention is training of personnel and ensuring that qualified people are on the job. When selecting a sub-vendor (e.g., for starting materials or services), manufacturing companies must have clear and pre-approved criteria. They also need to have a fitting recall process in place and maintain a better feedback loop with operating companies and distributors.

Pipeline regulators should engage with other regulators (e.g., NEB, Alberta Energy Regulator, BC Oil and Gas Commission, Pipeline and Hazardous Materials Safety Administration), accreditation bodies (e.g., International Standard Organization (ISO)) and standards development organizations (e.g., CSA, Manufacturers Standardization Society, American Society of Mechanical Engineers) that have influence or insight into current manufacturing practices. It

is also important that the regulators are more engaged with smaller operating companies for better insight into their QMS. Regulators should influence the standards to address modern manufacturing processes and raise the level of minimum requirements. They should also provide example guidelines such as minimum requirements for QMS.

Table 1 - Quality Management Systems (QMS)

Stakeholder	People	Process	Technology
Operating Company	- Relationship with manufacturers and distributors - Set qualification expectations for the training and competency of third party inspectors	- Maintaining AML and ADL - Requiring distributors to follow AML - Feedback loop with manufacturing and distributing companies	
Manufacturing Company	- Provide qualifications and expectations for the Training and competency of personnel	- Recall process - Pre-approved criteria for selecting sub-vendors - Feedback loop with operating and distributing companies	
Distributing Company	- Relationship with manufacturers and operating companies	- Following operating company's AML - AML for stock purchases - Pre-approved criteria for selecting distributors - Recall process - Feedback loop with operating, manufacturing and other distributing companies	
Regulator	- Engaging with other regulators and accrediting bodies on the manufacturing and distribution side - Direct engagement with manufacturers - More engagement with smaller companies	- Working with standards body and industry to update/raise the level of minimum standards or revising the applicable regulations - Providing guidelines on minimum requirements for QMS	
Standards Body	- Engaging with regulators and industry	- Working with regulators and industry to provide clarity on requirements and to update/raise the level of minimum standards - Requirements for a manufacturing recall process	

Strategy 2 – Development of Manufacturer Procedure Specifications (MPS)
Strategy 3 – Development of Inspection and Test Plans (ITP)

When required by the pipeline operating company or referenced standard, the supplier should provide a manufacturer procedure specification (MPS) highlighting its manufacturing processes, quality assurance methods, quality control activities, and a description of applicable dimensional checks, material testing, and Non Destructive Testing (NDT). The MPS should clearly identify the audited and approved suppliers of raw materials, consumables, and component parts, in a manner that is traceable to the products supplied, and the quality management practices utilized during the production of these materials and receipt of such materials at the manufacturer's facility.

In development of ITP the following should be included as appropriate: testing frequency, hold points, acceptance criteria, calibration requirements, personnel qualification, reporting, and document retention. Additional information, where applicable should include:

- Segregation of non-conforming material;
- Re-testing provisions, retention of test specimens; and
- Supplemental testing of similar materials

There has to be a continuous feedback loop between MPS and ITP, including discussions on checks and balances.

MPS ←→ ITP

It is important to leverage cross sector best practices and lessons learned (e.g., aviation and auto industry). There are rigorous processes and procedures that already exist for manufacturing of line pipe. The pipe requirements could be adapted to the fittings selection as well (e.g., requirements for submission of MPS and ITP). It is also beneficial to engage with working groups in Canadian Energy Pipeline Association (CEPA) and The Interstate Natural Gas Association of America (INGAA). Collaboration of parties can help in producing an express knowledge document that could provide helpful guidance into the industry standards such as CSA Z245.11 and MSS SP-75.

Table 2 – Development of MPS and ITP

Stakeholder	People	Process		Technology
Operating Company	- Engagement with CEPA and INGAA knowledge transfer forums	- Improvement of detailed (post purchase) ITP - Leveraging cross sector best practices - Review and assess MPS and internal ITP during qualification process	- Development of an Express Document to feed into the standard	
Manufacturing Company		- Improvement of detailed MPS - Improvement of detailed (manufacturing) ITP - Leveraging cross sector best practices		
Distributing Company		- Maintaining the MPS and submitting to purchaser - Improvement of detailed (distributor) ITP - Leveraging cross sector best practices		
Regulator		- Facilitate technical discussions and workshops that can lead to improved MPS and ITP		
Standards Body		- Implement more rigorous requirements and controls as part of the standard (e.g. as an informative annex)		

Strategy 4 – Manufacturing Traceability

Manufacturing companies should consider collecting their data at a more granular level. Consideration should be given to recording the unique identification of each manufacturing component, raw material and/or consumable to enable traceability. Quality control documentation, collected for a process such as heat treatment, pressure test, NDT results, test pieces, and mechanical and metallurgical test results should be traceable to the batch of finished goods. There is a manufacturing concern however for managing the smaller diameter fittings that are produced in high quantities. For this reason it is suggested to define a range of applicability for traceability of fittings.

Industry standards can be improved to include traceable raw material, heat treatment, and testing data for those products not project specific. Standards should require traceability of component size, furnace, heat treatment time, and temperature. Serial numbers could become the unique identifier of all the information expected to be collected. There should be a requirement for providing minimum information behind a serial number in the standard to ensure traceability in the event something goes wrong (e.g. notice of early potential failure in the event if the manufacturer goes out of business or is acquired by another company). Standards should also outline requirements for a mandatory Certified Material Test Report (CMTR) where manufacturing location and origin of materials such as steel is noted, an example is EN 10204, which describes requirements for CMTRs.

Operating companies and distributors should consider periodic visiting and re-auditing of the manufacturer(s) as part of their AML maintenance. The manufacturing traceability records of

applicable fittings should be maintained and in an accessible, digital format after the component is installed. Unique identifiers assigned to fittings and tied to geospatial locations and manufacturing traceability records facilitate the future locating and assessment of any fitting that is related to possible performance deficiencies. The pipeline operator may employ tracking software that integrates with manufacturer systems and maintains product traceability from raw material through to installed location. The operating company would be accountable for maintaining all the records.

Consideration should be given to the concept of a data audit or assessment, similar to a third party inspector. The data/records that are produced through manufacturing become the only tangible records of operational assets – quality of the data in these data records is imperative.

Furthermore, the traceability data can form the baseline of modern pipeline operations that include preventative instead of reactive analytics. Operators should consider leveraging the electronic asset data to their benefit to streamline and optimize their operations while also meeting potential new data retention requirements.

Table 3 – Manufacturing Traceability

Stakeholder	People	Process	Technology
Operating Company	- Direct engagement with manufacturer or distributor	- Records maintenance - Translation of records into usable data/information that are easily accessible - Leveraging traceability data to make better operational decisions	- Tying unique identifiers to geospatial locations - Integrating operator and manufacturer tracking software - Standardization of data repository for consistent analysis
Manufacturing Company		- Unique identification number for applicable manufacturing component, raw material and/or consumable - Producing electronic data alongside with the hard copy records	- Maximization of data capture with more granularity - Integrated operator and manufacturer tracking software - Electronic data capture platforms as opposed to hand tallies
Distributing Company		- Tracking standard CMTRs - Tracking unique identifiers - Require and maintain the same records/data that the operator is expected to eventually have	- Integrated distributor and manufacturer tracking software - Standardized data repository for consistent analysis
Regulator		- Project approval requirements that require demonstration of a well-managed asset data traceability system for operators - Requirements for traceability of fittings in final installed pipeline systems.	
Standards body		- Requirements for providing minimum information behind a unique identification number - Mandatory and standardized CMTR - Clearly defined requirements for traceability, both around what needs to be maintained and how it should be maintained/accessed	

Strategy 5 – Material Inspection
Strategy 6 – Raw Materials Verification

Material inspection and testing requirements are specified in the MPS and ITP, specific to the material being manufactured and the manufacturing process. Operators in most cases supplement contracts with additional requirements. Processes that are observed in audit are typically better controlled, and infrequent inspection may result in snap shots that are not representative of full production.

There is little to no traceability of distributor sourced fittings relative to the steel or plate mills, unlike the traceability in place for line pipe. CMTR reviews and post procurement chemical analysis suggest that low carbon or lean alloying chemistries having larger standard deviations may be an issue that when combined with variable uncertainties in heat treatment practices, generally result in substandard material properties.

It is important that the fittings be given a similar level of importance as the line pipe so they do not become the weak link. It is beneficial to put a mandatory requirement in place for a third party certification (or a NORSOK[1] approach). As mentioned in the previous section, unique identifier requirements should be put in place for serialization of the fittings. Regular auditing should be scheduled to ensure these traceability requirements are being implemented. There is also an apparent need for a governing body in this area, or perhaps the implementation of a similar approach to NORSOK's. It is important that small pipeline companies can have the same quality assurance even when they purchase from the distributors.

There are also existing technologies that could be employed for raw (or final) material inspection and verification. One of such technologies is Optical Emission Spectroscopy (OES) for nondestructive determination of chemical composition. Consideration should also be given to measuring hardness at specific points on the fitting to provide directional indication with regard to tensile strength as well as uniformity of material hardness across the envelope of the fitting. There are hardness measuring devices available that use a depth-load indentation which are capable of generating a stress strain curve (resulting in YS and UTS values) for a material when given enough measurement points.

[1] To help standardize processes and create uniform product requirements, the NORSOK set of specifications were created in the 1990s. They are managed by Standards Norway on behalf of the various Norwegian industry participants. As an addition to typical "material" NORSOK specifications, a "qualification" specification named M-650 was also established to ensure improved quality verification for critical materials. While NORSOK M-650 began as a manufacturing qualification specific to the Norwegian offshore industry, it has become a trusted certification around the world as many large end users have begun to rely on the qualification across their global operations.

Table 4 – Material Inspection and Raw Materials Verification

Stakeholder	People	Process	Technology
Operating Company	- Creation of a governing body for manufacturing - NORSOK approach	- Implement audits of supplier's vendor(s)	- OES - Hardness measuring devices
Manufacturing Company		- Traceability of the fittings	- OES - Real time monitoring of manufacturing processes - Hardness measuring devices
Distributing Company		- Traceability of the fittings	
Regulator			
Standards body		- Requirement for a mandatory third party certification of production process - Requirement for serialization of the fittings - Requirement for regular auditing of implementation of traceability	

Strategy 7 – Manufacturing Procedure Qualification (MPQ)

The issues with mechanical properties arise during the manufacturing process and are most associated with heat treatment. There are many variables involved in heat treatment, all of which can create unintended differences in tensile strength and other mechanical properties from the baseline established in the CMTR. These include:

- General temperature control
- The variability of temperatures in different locations (within the furnace)
- Contact with pallets or other support systems
- The effect of heat treatment on areas of differing wall thickness within a fitting
- The time taken to transfer a fitting to the quenching bath

Heat treatment issues are largely associated with fittings having specified minimum yield strengths (SMYS) greater than 359 MPa (Grade 359, Y52). These fittings require greater levels of heat treatment and are more sensitive to micro-alloying and time windows for quenching. The materials and processes to achieve Grade 359 or lower grade materials have been established for many years and are well understood. Steel manufacturers typically make one class of materials that are suitable for Grade 359 and lower and another class of materials that are suitable for Grade 359 and higher. The latter materials are generally suitable for the heat treatment and quenching processes that are used to achieve higher yield strengths.

Some companies attempt to mitigate perceived risk by specifying additional wall thickness. This can be counter-productive because as wall thickness increases, the potential for variability in the effectiveness of heat treatment also increases, particularly for wall thicknesses above 25mm.

Deviations from any of the qualification production parameters such as furnace loading plan, furnace hold times, quench media temperature or agitation can result in substandard products even if the industry standard requirements are ostensibly met. This effect is compounded if multiple deviations in production parameters occur.

The MPQ can be used to validate manufacturing conditions specified for the MPS. The MPQ concept also introduces the idea of essential variables for manufacturing. For example, If a fitting is qualified with a time delay of 3 minutes from furnace door opening to quench tank immersion, what reasonable tolerances could be applied on the time delay for production manufacturing?

It is necessary to standardize and narrow the standard deviations of the control parameters in the materials, manufacturing, and heat-treatment procedures. Deviations in essential variables should result in rejection or reprocessing of fittings. Procedures have to be specified at the process design stage. Standardization should apply to all operating companies and fitting manufacturers uniformly in order to avoid the possibility of any party being subjected to commercial disadvantage. As such, the standardized procedures should contain the control parameters (soak and transfer times, thicknesses, furnace and quench tank temperatures etc.). Consideration should be given to enhancement of qualified Non Destructive Examination (NDE) methods to supplement destructive testing of fittings. It is important to specify minimum training requirements for manufacturing personnel, including training with respect to the original process qualification tests. The possibility of using analytical design (to a recognized piping code) and quality control/ assurance processes in lieu of or supplementary to proof testing should be explored. Development of an express document or an annex to the appropriate standard (e.g., CSA Z245.11) would appear to be the most feasible way to implement improvements.

Table 5 – Manufacturing Procedure Qualification

Stakeholder	People	Process	Technology
Operating Company			- Development of an express document or an annex to the appropriate standard - Development of qualified NDE methods to supplement destructive testing of fittings
Manufacturing Company		- Using analytical design and quality control/ assurance (to a recognized piping code) in lieu of or supplementary to proof testing should be explored	
Distributing Company		- Maintain the traceability of the fittings	
Regulator			
Standards body	- Specification of mandatory training for manufacturing personnel	- Standardization of the standard deviations of the control parameters for historic and modern manufacturing and heat-treatment procedures for the wider range of materials	

Strategy 8 – Inspection and Testing Enhancements

The following items may be considered for inclusion in industry standards as well as company specifications and/or commercial agreements to ensure testing is representative of the finished products:

- Increase lot testing frequencies (more sampling within each lot) to ensure test results are representable of each heat treatment batch.
- Specify locations of test coupons for lot testing including the location within furnace loads.
- Conduct additional furnace uniformity testing to ensure adequate temperature settings and equipment calibration.
- Conduct additional destructive tests of finished fittings to verify the accuracy of coupon tests (first article testing).[2]
- Conduct hardness and metallographic testing to supplement lot testing.
- Restrict the use of retesting and reheat treatments without prior purchasing company approval (includes distributors).

[2] CMTRs are associated with steel heats and qualified manufacturing processes, not necessarily to the individual fittings which are produced with those materials and processes. The ideal way to verify mechanical properties is through so-called "first article testing", destructive testing of one of each batch of fittings produced. However, since fittings are often produced in very small batches, first article testing is not cost effective or practical for manufacturers or purchasers and is rarely done.

- Require the addition of images of the charts or records of all heat treatment temperature and hold times in final documentation.
- Mandate traceability to clearly track each batch of fitting's control parameters from raw material origins through to finished goods.
- Provide for documentation of raw material, process parameters and test results of fittings, intended for distributors.
- Apply minimum restrictions on material chemistries for high strength products.
- Qualify and track heat treatment parameters:

    - Furnace loading, support and stacking procedures including the use of racks or stands.
    - Apply requirements and calculations for heat treatment hold times.
    - Apply quench temperature change limits, agitation, and process time requirements.

Discussions were focused on quality assurance of large diameter, high strength fittings. A suggested enhancement for CSA Z245.11 is to mandate traceability level to lot definition in Clause 9.1.3.4(a)).[3]

Table 6 – Inspection and Testing Enhancements

Stakeholder	People	Process	Technology
Operating Company	- Better communications between operator, manufacturer, and the third party inspectors on the scope and expectations of inspections - Dedicated "fittings" training for inspectors	- Enhancement of company specifications and/or commercial agreements - First article testing to validate coupon test result - Enhanced qualification tests	
Manufacturing Company		- Enhancement of manufacturing processes and practices	
Distributing Company		- Enhanced qualification tests	
Regulator		- Work with standards body to enhance requirements	
Standards body		- Enhancement of the applicable standard(s) - Improvement of lot definition in CSA Z245.11	

[3] Definition of Lot in CSA Z245.11, Clause 9.1.3.4:

For grades less than Grade 290, a lot shall consist of all fittings from one heat of material of the same starting thickness that are

a) heat treated in the same charge as the test coupons; or

b) heat treated in the same manner as the test coupons in one or more furnaces that are controlled within a range of 30 °C and equipped with recording sensors.

Strategy 9 – Procurement

Fittings are procured through distributors based on a listing of pre-qualified manufacturers commonly known as AML. The manufacturers are subject to future removal from the purchasers' AML should substandard or non-conforming materials be identified during (or after) the procurement acceptance and testing process. It is also beneficial if the operating companies maintain a list of approved raw material manufacturers. As a result the fitting manufacturer will be obliged to purchase from approved mills only.

Procurement policies and procedures including manufacturer pre-qualification and periodic review should be reviewed or developed in the standard operating practices to ensure pipeline operator quality strategies are transferred to all parties in the supply chain.

Operating companies should provide comprehensive purchase orders (PO) that require the manufacturer/ distributor be prequalified and have adequate quality controls before purchasing materials. Project planning should allow for timely ordering of the required fittings. Training and educating the distributors is another necessary qualification step. Both operating and distributing companies must train their procurement personnel to have an understanding of production, manufacturing and technical specifications of the procured fittings.

Manufacturers should follow an approved list of suppliers (plate, pipe, welding filler material, milling, heat treatment, forging), that has been accepted by the purchaser. There should also be a sign-off authority on the manufacturing side to approve the finished product. Similarly a sign-off authority should exist on the distributor and operating company side to approve that the purchased product meets all the necessary specifications.

Feasibility of creation of a governing body in this area could be explored. Development of a Monogram™ Program[4] similar to American Petroleum Institute's (API) could prove beneficial. The regulatory body should enforce this program, the operator company should require it from the manufacturer and the manufacturer should implement it. In case of failure, the ownership should lie with the governing body (similar to the nuclear industry).

[4] The API Monogram is an API registered certification mark. Through the API Monogram Program, licensed manufacturers are given the authority to apply the mark to equipment that meets API product specification requirements and has been manufactured within a quality management system that meets API Spec Q1.

Table 7 – Procurement

Stakeholder	People		Process	Technology
Operating Company	- Training the distributor to supply from the AML - Training procurement personnel to follow policies and procedures	- Collaboration for creation of a governing body	- Enhancement of Procurement policies and procedures - Maintaining an AML - Requiring the distributors to follow AML - Comprehensive/quality controlled PO - Sign-off authority - Requiring manufacturers to implement a program similar to API Monogram™	
Manufacturing Company			- Maintaining an approved list of suppliers - Sign-off authority - Implementing a program similar to API Monogram™	
Distributing Company	- Training and competency of personnel		- Following operating company's AML - Sign-off authority	
Regulator			- Enforcement of a program similar to API Monogram™	
Standards body			- Development of a program similar to API Monogram™	

Strategy 10 – Acceptance and Testing

Pipeline operating companies should conduct pre- and post-purchase testing/screening processes for manufacturer and distributor supplied fittings. It should also request and review CMTRs against its chemical and mechanical specifications prior to acceptance. Prior to delivery to the job site, the pipeline operator should visually inspect the component and conduct magnetic particle inspection (MPI) of the pipe ends and any suspect areas. Wall thickness needs to be spot checked in addition to the checks initiated in areas identified by the visual inspection. In part to avoid weldability issues in the field, the pipeline operating company should not allow substitutions of higher yield, lower wall thickness materials without conducting engineering assessments and/or engineering designs. The trend has been for purchasers to specify lower carbon-equivalencies combined with higher yield strengths. This can be challenging for manufacturers as there is a direct correlation between carbon-equivalency and yield strength. The manufacturers generally agree that 0.43 to 0.45 is a reasonable range. Many companies specify 0.42 and some have attempted to go below 0.40. The carbon equivalent (CE) value should be reviewed at the CMTR evaluation stage against pipeline operating company specifications, welding procedures, and applicable CSA and API standards.

Alignment between standards (e.g., CSA, MSS, API and ASME) is required in terms of chemical, mechanical and dimensional properties and treating fittings with similar level of importance as the line pipe. Requirements for CMTR must be standardized with the ability to verify and trace the product to its source. The manufacturer is the only body that can issue the CMTR. The development of a joint annex on inspection in CSA and MSS is beneficial. The timing of inspection and inspector's competency requirements should be outlined in the annex and a third party inspection to become mandatory. As mentioned earlier, fittings have to have traceability.

Table 8 – Acceptance and Testing

Stakeholder	People	Process	Technology
Operating Company		- Pre- and post-purchase testing - CMTR review - Visual inspection - MPI - Spot checking wall thickness	
Manufacturing Company		- Only body to issue CMTR - Fitting traceability	
Distributing Company		- Fitting traceability	
Regulator			
Standards body	- Requirements for inspectors competency	- Alignment between standards - Standardization of CMTR - Mandatory third party inspection	- Joint CSA MSS annex on inspection

Proposed Next Steps

There are possible actions that can be taken by different stakeholders across the supply chain in order to improve the quality assurance for pipeline fittings and other components. The workshop facilitated input from many stakeholders. After further review of the discussions and suggestions that are outlined in this report, the NEB will determine any actions that it may take. In the interim, the NEB will continue its work with various stakeholders including CSA.

APPENDIX A

Workshop Program

Wednesday 28 June 2017	
8:00am	**Registration and Coffee**
8:15am	**Workshop Format:** Facilitator
8:20am	**Welcome:** Peter Watson, CEO and Chair, National Energy Board
8:30 – 9:20am	**Session 1** **Overview of Quality Assurance for Pipeline Fittings** DNV-GL An explanation of the pipeline components production process; the quality assurance check points typically in the supply chain for pipeline components; and the extent to which pipeline fittings may be susceptible to not meeting specifications
9:20 – 9:50am	**Session 2** **Regulator's Perspective** NEB, PHMSA, ABSA Reasons the regulator believes this issue is important and why steps must be taken to prevent future occurrences. Identifying the role regulators have in the Quality Assurance (QA) and Quality Control (QC) processes
9:50am – 10:10am	**Coffee and Networking**
10:10 – 10:50am	**Session 3** **Pipeline Company Quality Assurance Procedures – Design / Procurement** TransCanada PipeLines, Enbridge Understanding company QA requirements for procurement of pipeline fittings and identifying what standards are applicable and where there may be opportunities for improvement
10:50 – 11:30am	**Session 4** **Pipeline Company Quality Assurance Procedures – Installation Inspection and Testing** Enbridge, Rosen Group Pipeline company QC procedures for inspections and testing including standards requirements. Pre-workshop questionnaire feedback will be used to prompt discussion
11:30 – 12:00pm	**Session 5** **Traceability of Pipeline Components by Pipeline Companies** Vintri Technologies What a company should track to identify risks with pipeline components before and after installation
12:00 Noon	**Lunch Provided**

Wednesday 28 June 2017	
Noon	**Lunch Provided**
1:00 – 1:30pm	**Session 6**
Third party Inspection Procedures and Standards Devon Canada	
Assess how a company confirms that contracted inspection services address the potential for pipe and pipeline components to not meet specifications	
1:30 – 2:30pm	**Session 7**
Research on Pipeline Fittings Out-Of-Specification CanmetMaterials	
An integrated thermal treatment/microstructure/mechanical properties model, i.e. a predictive tool to determine whether a fitting with a specified metallurgy, geometry and grade would meet the required standards taking into account realistic plant-specific processing variations	
2:30pm – 2:50am	**Coffee and Networking**
2:50 – 4:30pm	**Session 8**
Manufacturing of Pipeline Components Manufacturers' Panel – Allied Group; Tecnoforge; TK Corporation; Canadoil	
Presentations and panel discussion on Manufacturer's QA/QC processes and procedures. This includes identification of manufacturers' standards	
4:30pm	**End of Day**
Thursday 29 June 2017	
8:00am - 8:30am	**Coffee and Networking**
8:30 – 9:00	**Session 9**
Traceability of Pipeline Components by Manufacturers TD Williamson	
What a manufacturer should track to identify risks with materials and products	
9:00 – 9:45am	**Session 10**
Recommended Actions for Companies Breakout Tables for Discussion	
Possible actions and strategies for pipeline and processing plant companies to improve quality assurance for new, previously purchased and currently in service pipeline fittings	
9:45am – 10:15am	**Coffee and Networking**
10:15 – 10:50am	**Session 11**
Recommended Actions for Manufacturers and Regulators Breakout Tables for Discussion	
Possible actions and strategies for manufacturers and regulators to improve quality assurance for pipeline components	
10:50 – 11:45am	**Session 12**
Workshop Outcome Summary Plenary	
Key outcomes from breakout sessions to be reviewed	
11:45am	**Conclusion:** Peter Watson, CEO and Chair, National Energy Board
12:00pm	**End of Workshop**