Comparison Report

Global Pressure Equipment Forum

January 27, 2026

Developed by: Global Pressure Equipment Forum

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Acknowledgements

This report was coordinated by Vinzenz Barut (ABSA), Jason Reinhart (ABSA), and Liliana Constantinescu (TSSA).

Introduction

Safety systems programs for pressure equipment have developed in countries and throughout the world for over 100 years to provide assurances for public safety. The goal of each safety system program is similar and were often developed for the specific needs of the country or region. The development of these safety system programs from country or region led to variances and are often not compatible.

The variances in safety system programs are a result of the needs from interested parties such as governments, owner-users, manufacturers, distributors, and the public. These programs consist of regulatory rules, directives, and codes of construction which provide for requirements that the pressure equipment industry must follow for all activities. These activities include design, construction, installation, operation, maintenance, and decommissioning which highlights and encompasses the lifecycle of pressure equipment.

There is little doubt that by administering these safety system programs the public have been assured safe operation of pressure equipment.

A global pressure forum was created to provide an appropriate assembly to discuss technical and administrative topics related to pressure equipment. There are three goals of this Forum:

- Share information regarding pressure equipment regulatory requirements used in different countries
- Discuss the differences between pressure equipment requirements and showing opportunities or alternative approaches to bridge gaps without sacrificing pressure equipment safety.
- Provide support to the pressure equipment industry in safe implementation of alternative approaches.

Objectives of the Global Pressure Equipment Forum

The Global Pressure Equipment Forum was an initiative to provide an opportunity and formal assembly of pressure equipment professionals to share ideas and information to further pressure equipment safety.

The concept of pressure equipment safety evolved from the specific needs into safety programs of local regions such as provinces, states, and countries. This led to differences between areas such as regulatory requirements, administration, design, registration, inspection, construction, joining procedures, operation, maintenance, and decommissioning of pressure equipment. The safety systems for each region have had success in protecting the public and that the safety programs are effective.

North American historical timeline shows that injuries and fatalities were widespread. The disaster of 1865 on the Sultana riverboat where 1169 passengers perished may have been prevented if robust pressure equipment safety systems were in place. This remains the worst maritime disaster

in the United States history. Between 1870 and 1890, 15,000 injuries occurred with 10,000 fatalities over the same period. To provide support to industry and prevent further fatalities arising from the operation of pressure equipment, in 1911, the American Society of Mechanical Engineers (ASME) was formed and in 1914 Section I was published. The Canadian Standards Association (CSA Group) was chartered in 1919 and published CSA B51 twenty years later in 1939.

A Canadian Interprovincial Agreement was established in 1909 where delegates assembled in Regina, Saskatchewan. This agreement where delegates from Ontario, Manitoba, Saskatchewan, Alberta and British Columbia established two major controls for the design and construction of pressure equipment. The first was the function of Design Survey whereby the design of the pressure equipment was to be impartially surveyed verifying the design conforms to the code of construction. The second was to establish an Affidavit of Construction issued by the pressure equipment manufacturer of boilers and pressure vessels. The affidavit documented and recorded the construction of the pressure equipment.

Canadian jurisdictional and regulatory differences remain as a result of independent legislation development within the provinces and territories of Canada. These differences may present challenges to those needing to import pressure equipment into multiple jurisdictions and comply with regulatory requirements. For clear guidance on regulatory requirements, it is recommended to contact the respective jurisdictions.

Global Pressure Equipment Forum Members

These Forum members graciously lent their time and shared their pressure equipment expertise to provided guidance and information regarding their respective safety programs. The following list are past and present members of the Forum.

Anne Chaudouet,

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Robert Barrett – Exchanger Industries,

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Purpose

The purpose of this report is to highlight the similarities between pressure equipment safety systems and welding procedure and welder qualifications in Canada and the European Union.

1. The focus for pressure equipment safety system comparison will be the Canadian standard CSA B51 and the European Union Directive 2014/68/EU.
2. Welding procedure comparison. Welder qualification comparisons will focus on the ASME Section IX and EN ISO 9606-1 with EN ISO14732.

Pressure equipment safety and welding procedures apply to all types of pressure equipment, this report will focus on pressure vessels only. Additional pressure equipment such as fittings and piping systems was excluded from the comparison and may be addressed in another report.

Discussion of Comparison 1 – Pressure Equipment Safety Systems

The discussion of the pressure equipment safety systems required an understanding of the regulatory framework between Canada and EU. CSA B51 provides general requirements that all provinces and territories of Canada have agreed to legislatively make mandatory for administering pressure equipment safety systems. In the EU, the member states have adopted Directive PED 2014/68/EU.

What is CSA B51? – The Canadian Safety Standard Association (CSA Group) established the national standard CSA B51: Boiler, pressure vessel, and pressure piping code through a consensus standard development process and this process has been approved by the Standards Council of Canada. The CSA Group administers the process and establishes rules that promote fairness, but does not test, evaluate, or verify the content of the standard.

CSA B51 has a broad scope that include boilers, pressure vessels, pressure piping and fittings. However, it excludes pressure components in hydraulic elevators, devises for gas-filled switch gear

and control gear, and pressure vessels for the transportation of dangerous goods that are regulated by Transport Canada.

The main clauses of CSA B51-19 that were of interest to this forum were Clauses 4-General Requirements, 5-Identification, 6-Boilers, 7-Pressure Vessels and 8-Piping and fittings.

What is the PED? PED 2014/68/EU**?** – Essential Safety Requirements

Is a Directive that provides for legislative requirements and essential safety requirements to ensure manufactured pressure equipment is eligible to be placed on the EU market. This Directive provides for the harmonization of member states laws relating to the pressure equipment market. This Directive applies to the design, manufacture and conformist assessment of pressure equipment and assemblies with a maximum allowable pressure greater than 0.5 bar.

This Directive excludes a variety of pressure equipment such as onshore/offshore piping within a pipeline scope, networks of water associated equipment, pressure vessels covered by Directive 2014/29/EU (air or N2 pressure vessels), aerosol dispensers Directive 75/324/EEC, equipment intended for the functioning of vehicles, equipment that is classified no higher than Category I, etc… For a full and detailed list of exempted pressure equipment, it is suggested to review Article 2 (a) though (u) of PED 2014/68/EU.

What is a Notified Body?

A Notified Body is an organization that has been designated by an EU member state that administer the conformity assessment requirements of PED. These organizations may also administer the conformity of individual member state's jurisdictional requirements where they operate.

A Notified Body Inspector provides for

- Conformity Assessment: verifies that a manufactured pressure equipment or assembly complies with the essential safety requirements, Section I, of PED. This may include reviewing drawings, equipment inspection, testing and quality management assessments.
- Certification: Issues a Certificate of Conformity before any markings are issued, such as the CE marking.
- Quality Program Surveillance: providing periodic audits for manufacturers

What is an Authorized Inspector?

An Authorized Inspector is certified and commissioned by the National Board. The rules for commissioned inspectors are specified in the Part 4 of the NB-263 RCI-1.

The Authorized Inspector provides for

1. Verification that all aspects of construction for pressure equipment are in compliance with the appropriate ASME Boiler and Pressure Vessel Code.
2. Verification that the manufacturer has a valid Certification of Authorization and maintains an accepted quality program.
3. Verification of drawings, design calculations and material specification control.
4. Performing examinations and inspections.
5. Verification of welding procedure specifications and qualified personnel are in compliance with ASME BPV Code.
6. Verification of NDE and heat treatment are performed using accepted procedures.
7. Review and accept corrective action such as non-conformance dispositions.
8. Ensuring accurate certification and stamping of manufactured pressure equipment.
9.

Pressure Equipment Life

This Forum considered five segments of a pressure equipment life cycle:

1. Quality Management System,
2. Design and Registration,
3. Construction,
4. Operation and Maintenance and
5. Decommissioning.

These segments were discussed during the Forum meetings, and it was concluded that three segments were deemed to have the most bearing for manufacturers in Canada and EU. This report considered the Design and Registration, Construction and Quality Management Systems. Annex 1 of this report provides a direct clause and article comparison of CSA B51-19 and PED 2014/68/EU.

Comparison Elements

Quality Management Systems

The CSA B51 method of quality management system is specified by the code of construction and is irrespective of the hazardous nature of the process fluid or design pressure and temperature of the pressure vessel. PED 2014/68/EU provide flexibility for manufacturers to choose an appropriate conformity assessment procedure for each pressure vessel to be manufactured.

CSA B51 quality management system requirements are established by the design code of construction used for the design and manufacturing for the pressure equipment. In most cases, ASME provides for the requirements for a pressure vessel manufacturer's quality management system, such as Appendix 10 of ASME BPV Code Section VIII Div.1. For fitting manufacturers, CSA

provides informative Annex F *Quality control program for manufacturers of fittings* that specifies 9 elements for manufacturing control.

PED 2014/68/EU Article 4(1) *Technical Requirements* confirms that pressure equipment shall satisfy the essential safety requirements of Annex I. It also introduces the use of conformity assessment tables found in Annex II. The process fluid hazardous group number that must be determined in Article 13 is needed to determine the assessment table used in Annex II. The conformity assessment tables use the design pressure and volume of the pressure equipment to specify the category of module that a manufacturer will need for conformity assessment. In some cases, there is more than one module of conformity procedure associated with a category of module whereby the manufacturer may choose which module of conformity procedure they will need conformance. Annex III *Conformity Assessment Procedures* outlines the requirements for each of the module conformity procedure.

Design and Registration

The Design and Registration life cycle segment considers what is required of a manufacturer when designing pressure equipment and what are the applicable codes of construction. In addition, the registration requirements prior to fabrication.

There is no centralized group, agency, or association that provides design registration in either market. The engagement with jurisdictions in Canada and Notified Bodies in the EU require that the manufacturer will need to engage with one or more groups to ensure regulatory requirements for design and registration. The jurisdictions or notified bodies provide the expertise for a design review and in determining the compliance and conformance with the applicable essential safety elements, codes of construction, and standards.

The general design requirements are specified in CSA B51 with specific reference to ASME Boiler and Pressure Vessel Codes I through XIII and other ASME standards. CSA B51 includes specific requirements for certain pressure equipment designs depending on their specific use such as pressure vessels, boilers, blowdown and blow off vessels, fittings and pressure piping. This provides for consistency of design throughout Canada and little flexibility to choose the code of construction or standard to use for the design of pressure equipment.

The EU general pressure equipment requirements are listed in Annex I Essential Safety Requirements of PED 2014/68/EU. There is no specified reference to a design code of construction or standard, however, Annex I provides for the minimum requirements for any design code of construction to conform. This provides for maximum flexibility to choose the code of construction or standard while maintaining the essential requirements for all pressure equipment safety.

CSA B51 establishes the Canadian Registration Numbering (CRN) system to allow a Canadian jurisdiction to assign a registration number for pressure equipment that has been registered within their respective jurisdiction. The design and registration number are recorded by the jurisdiction and any manufactured product constructed that are in compliance with the registered design may

be placed into pressure service in the jurisdiction. The manufacturer will be required to register the pressure equipment design in all jurisdictions where the pressure equipment will be put into service.

A design review process would be performed by a Notified Body confirming conformance with Annex I. The Notified Body does not assign a registration number however the pressure equipment may be placed into pressure service in any of the EU member state market. This would mean a manufacturer would engage with a single Notified Body to ensure that their manufactured pressure equipment be installed within an EU member state jurisdiction.

Construction

CSA B51 specifies the applicable ASME codes of construction for pressure equipment to be manufactured, and PED 2014/68/EU provides a framework whereby the obligation of the manufacturer is to design and manufacture pressure equipment provided the manufactured equipment conforms with the essential safety requirements set out in Annex I.

Clauses 4 and 5 of CSA B51 requires identification of pressure equipment by a manufacturer by the use of stamping and nameplate. The use of stamping and nameplates is fairly harmonized with the adopted code of construction from ASME BPV Code with the addition that the CRN being stamped on the nameplate.

PED 2014/68/EU Article 3 of Annex I provides for marking and labelling of pressure equipment. Also, conformity assessment procedures of Annex III provide for CE marking, with the exception of conformity assessment procedure Module B that is a standalone module which does not require marking.

CSA B51 requires a pressure equipment manufacturer to complete a Manufacturer's Data Report (MDR) for each pressure vessel. This is a document that records the manufacturing details such as the materials and method of construction and specifies the responsibility of the manufacturer. This document is certified by a jurisdiction inspector showing compliance with the code of construction such as the ASME Boiler and Pressure Vessel Code.

Article 17 and Article IV of PED 2014/68/EU provides a description of the EU Declaration of Conformity (DoC). It is a document that declares that the pressure equipment meets all applicable EU directives and regulations. It also declares that all conformity assessment procedures have been followed.

Discussion of Comparison 2 – Welding Procedure Specifications

This section provides a comparative summary of the requirements set forth in ASME Section IX and the corresponding European standards (ISO) for the qualification of welding procedures. The detailed comparison is found in Annex 2. The comparison in this review focused on the qualification of welding procedures using two common processes: Gas Metal Arc Welding (GMAW) and Shielded Metal Arc Welding (SMAW). Although other processes were not reviewed it is expected that similar differences would exist for other welding processes.

When working with specification and qualification of welding procedures in accordance with European Standards there are more standards that must be navigated, when compared to ASME codes. Table A.1 in Annex A in ISO 15607 can be reviewed to become familiar with the European Standards associated with the qualification of a weld procedures.

Standards used in this comparison include:

· ASME Section IX – Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

· ISO 15607 – Specifications and qualification of welding procedures for metallic materials – General Rules

· ISO 15609-1 – Welding Procedure Specification – Part 1: Arc Welding

· ISO 15609-2 – Welding Procedure Specification – Part 2: Gas Welding

· ISO 15614-1 – Specification and Qualification of Welding Procedures for Metallic Materials – Part 1: Arc and Gas Welding of Steels and Arc Welding of Nickel and Nickel Alloys

The number of differences that exist when comparing the standards are numerous, and the main differences are summarized in the following table.

Main Differences between ASME Section IX:2021 and ISO 15614-1:2017 + A1:2019	
ISO 15614-1	**ASME Section IX**
Many standards for qualification of welding procedures	Only one standard
Welding and testing of welding pieces shall be verified by an examiner or an examining body	Responsible for the supervision, control, evaluation and acceptance of welding and testing of welding pieces is a person designated as per QG-106
WPQR is certified by an examiner or an examining body	PQR is certified by the Manufacturer
WPQR is more thorough and includes a pWPS/welding record and ranges of qualification	PQR does not include ranges of qualification
More tests are required (NDE & destructive)	Less tests
Acceptable levels for much more imperfections	No cracks, no incomplete penetration and no lack of fusion
WPQR may need to be recertified if required by the application standard	Existing WPSs may be used without revision per QG-108(a) provided there are no changes in the referencing code, standard, or specification requirements (i.e. changes in impact requirements) or material assignment. New and revised WPSs need to address the requirements of the current code per clause (b) and (c).
Narrower ranges of qualification	Less restrictive
Requirements for impact testing	No requirements for impact testing
No classification for filler materials	Filler materials are identified with F-No. and A-No.

To assist with code familiarity following two tables compare the essential, supplementary essential, and non-essential variables included in ASME Section IX with the equivalent standard ISO requirements.

Discussion of Comparison 3 – Pressure Welder Performance Qualifications and Pressure

This section provides a comparison or ASME Section IX: 2023 edition, Welding, Brazing, and Fusing Qualifications, and various adopted standards from PED such as EN ISO-9606-1:2017 Qualification testing of welders, Fusion welding, Part 1: Steels and EN ISO-14732:2013 Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials. This comparison focuses on the qualification of welding personnel. The details of the comparisons are in found in Annex 3 ASME Sec. IX – PED Pressure Welder Performance Qualifications Comparison.

The comparison specifies similarities and differences in:

- Welding processes;
- Welders' qualification test for butt and fillet welds;
- Essential Variables;
    - Joints,
    - Base and Filler Metals,
    - Positions,
    - Gas,
    - Electrical,
    - Technique,
- Essential Variables – Automatic welding;
- Essential Variables – Machine welding; and
- Additional Requirements

This comparison established the requirements in ASME Section IX and identified the equivalent requirement in the ISO standards. It was observed that the majority of the requirements were essentially the same, however any observed differences have been listed. A short description of the differences were provided.

For butt welds that may be qualified by volumetric NDE, the ASME thickness is ≥6mm whereas the EN ISO-9606-1 limit is ≥8mm. For fillet weld inspections, ASME required fracture and macroscopic examination where as EN ISO-9606-1 required fracture or macro.

There are differences between base and filler metals when qualifying each. When qualifying base metals for welding applicable to OFW, the ASME qualifies the maximum thickness is the thickness of the test coupon, and EN ISO-9606-1 there are no additional qualification requirements. This requirement is found only in the ASME. However, when qualifying filler metals for welding applicable to OFW, the EN ISO-9606-1 specifies different ranges based on the deposited thickness. Additional differences are found in Annex 3.

For Automatic and Machine welding essential variable comparison, it was observed the machine welding requirements are identical, however the automatic welding requirements had key differences shown in EN ISO-14732 that were not specified in ASME.

Annex 3 also compares additional requirements for qualification test coupon, test pieces, type of weld, number of layers, WPS followed, welding conditions, re-tests, revalidation of welder qualifications, operator performance qualification, designation and job knowledge. Each showing either differences in concept, or items found in one standard and not the other.

Conclusion

This report enforces the importance of pressure equipment safety systems and welding procedures established in Canada and EU. Whether the designer of pressure vessels uses the Canadian standards or EU directives it was shown that the safety systems in place enhances the safety within the respective regions. Although differences between the standard and directive are present, these difference alone do not diminish the safety. This was shown in Annex 1 of this report.

Similarly, the comparison between the ASME IX and EN ISO 9606-1 and EN ISO 14732 shows the similarities and differences but in both cases provides for safe joining procedures and welder qualification practices. This was shown in Annex 2 and Annex 3 of this report.

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	**Canada**		**EU (PED DIRECTIVE 2014/68/EU)** Clause/Section Reference Annex I Essential Safety Requirements	
Adopted Codes and Standards			CSA B51 CSA B52		ANNEX I Preliminary Obligation	
					2	The essential safety requirements laid down in this Directive are compulsory. The obligations following from those essential safety requirements apply only if the corresponding hazard exists for the pressure equipment in question when it is used under conditions which are reasonably foreseeable by the manufacturer.
					3	The manufacturer is under an obligation to analyse the hazards and risks in order to identify those which apply to his equipment on account of pressure; he shall then design and construct it taking account of his analysis.
			ASME BPV Code		ANNEX I - 2.2.1 2.2.2	2.2.1 - The pressure equipment shall be designed for loadings appropriate to its intended use and other reasonably foreseeable operating conditions. (Int/Ext. press., temp, corrosion, fatigue, etc...) 2.2.2 Design for adequate strength shall be based on either of the following: — as a general rule, a calculation method, as described in point 2.2.3, and supplemented if necessary by an experimental design method as described in point 2.2.4, — an experimental design method without calculation, as described in point 2.2.4, when the product of the maximum allowable pressure PS and the volume V is less than 6 000 bar·L or the product PS·DN less than 3 000 bar.
	6.1, 7.1	5.1.1.1, 7.1.1		Section I through XIII	ANNEX I 2.2.3 ANNEX I 2.2.4	2.2.3 - Calculation Method (a) Pressure containment and other loading aspects (b)Resistance (c) Stability aspects 2.2.4 - Experimental design method
			ASME Pressure Piping		ANNEX I - 2.2.2	Design for adequate strength shall be based on either of the following: — as a general rule, a calculation method, as described in point 2.2.3, and supplemented if necessary by an experimental design method as described in point 2.2.4, — an experimental design method without calculation, as described in point 2.2.4, when the product of the maximum allowable pressure PS and the volume V is less than 6 000 bar·L or the product PS·DN less than 3 000 bar.
	8.1	5.3.1		B31.1, B31.3, B31.5, B31.9	ANNEX I 2.2.3	Calculation Method (a) Pressure containment and other loading aspects (b)Resistance (c) Stability aspects
			ISO 16528			
			*Alternative Design Codes and Standards			
	1.3	1.2	Exemptions: Hydraulic Elevators, gas-filled switch gear and control gear, and			
	4.3	4.2.2	Canadian Registration Numbers Designators 1, 2, 3, 4, 5, 6,			
Quality Management System			Certificate of Authorization Permit **(Pressure Equipment Manufacturer)**		ANNEX III	CONFORMITY ASSESSMENT PROCEDURE
	Annex F	Annex F		Manufacturer must have a QMS for the appropriate Certificate of Authorization Permit to **Construct** pressure equipment	ANNEX II and III	CONFORMITY ASSESSMENT PROCEDURE
	4.9.1.1 and Annex F	4.1.1.1 and Annx F		The manufacturer of a boiler, pressure vessel, fitting, fired-heater pressure coil, or piping shall demonstrate to the regulatory authority that a satisfactory quality control system is in operation	ANNEX II and III	CONFORMITY ASSESSMENT PROCEDURE
	4.9.1.2	4.1.1.3		Quality control programs maintained by manufacturers of fittings shall be resubmitted for validation at least every 5 years.	ANNEX II and III	CONFORMITY ASSESSMENT PROCEDURE
	4.9.4	4.1.1.5		An organization that supplies materials, including **piping and fittings** for use in pressure piping systems, shall satisfy the regulatory authority that a quality control system is in operation.	ANNEX II and III	CONFORMITY ASSESSMENT PROCEDURE
	4.10.1.1	4.1.2.1		**Holders of ASME Certificates of Authorization** Manufacturers of boilers, pressure vessels, fittings, or piping holding a current certificate of authorization issued by ASME for the range of products being manufactured shall be deemed to have a satisfactory quality control system in operation for the range of products within the scope of the certificate(s)	ANNEX II and III	CONFORMITY ASSESSMENT PROCEDURE

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	**Canada**		**EU (PED DIRECTIVE 2014/68/EU)** Clause/Section Reference Annex I Essential Safety Requirements	
	4.10.1.2	4.1.2.2		**Holders of ASME Certificates of Authorization** Manufacturers in countries other than Canada that manufacture and export boilers and pressure vessels to Canada shall ensure that all boilers and pressure vessels are stamped with the appropriate ASME Code product certification mark and registered with the National Board.	ANNEX II and III	CONFORMITY ASSESSMENT PROCEDURE
	4.10.2.1	4.1.3.1		Manufacturers **not holding an ASME certificate of authorization** may be eligible for acceptance of their boilers, pressure vessels, fittings, or piping by the regulatory authority under the following conditions: a) The manufacturer shall demonstrate by means of a written manual and by review of the manufacturing facilities and procedures that the quality control system in operation meets the requirements of the applicable section of the ASME Code (e.g., Appendix 10, Section VIII, Division 1) or conforms to the quality control program described in Clause 4.9 of this Standard. b) The manufacturer shall be deemed acceptable if, as a result of the review, the regulatory authority concludes that the manufacturer meets the quality control program requirements as determined in Item a). The regulatory authority shall confirm its conclusion in writing. c) The manufacturer shall continue to be acceptable if subsequent reviews demonstrate that its manufacturing facilities and procedures meet the requirements of the applicable section of the ASME Code. If it is found that the manufacturer is not adhering to or implementing the procedures outlined in the quality control system, the approval of the regulatory authority may be withdrawn.	ANNEX II and III	CONFORMITY ASSESSMENT PROCEDURE
	4.10.2.2	4.1.3.2		Quality systems that are not supported by an ASME certificate of authorization shall define the scope of activities relevant to the manufacture or fabrication of the items under consideration. The quality system shall further describe the controls required for code compliance, such as design, materials, processes, inspection, examination, testing, and documentation requirements. The level of detail describing the system shall be consistent with the principles of an appropriate quality program standard.	ANNEX I 4.3	The equipment manufacturer shall take appropriate measures to ensure that the material used conforms with the required specification. In particular, documentation prepared by the material manufacturer affirming compliance with a specification shall be obtained for all materials. For the main pressure-bearing parts of equipment in categories II, III and IV, this shall take the form of a certificate of specific product control. Where a material manufacturer has an appropriate quality-assurance system, certified by a competent body established within the Union and having undergone a specific assessment for materials, certificates issued by the manufacturer are presumed to certify conformity with the relevant requirements of this point.
	4.10.2.3	4.1.3.3		The written manual describing the quality system shall be reviewed, and the facilities and procedures audited, by the regulatory authority or an independent third party having authority either in granting quality program accreditation or in providing compliance verification to a known quality system standard (e.g., ASME AIA, ISO 9000 quality system registrar, NBBI, regulatory authority) and shall be subject to acceptance by the regulatory authority. Documented evidence of an acceptable quality system shall be made available to the regulatory authority upon application for equipment design registration.		
			Certificate of Authorization Permit **(Pressure**			
Design and Registration	4.1, 4.2		Manufacturer must submit pressure equipment design			
	4.1.1	6.2.1.1		Calculations, drawings, and specifications pertaining to the designs of boilers, pressure vessels, fittings, fired-heater pressure coils, and piping shall be submitted to the regulatory authority in the province where the item is intended to be used		
	4.1.1	6.2.1.1		The name of the authorized inspection agency to be employed when a boiler or pressure vessel is to be manufactured outside Canada shall also be submitted when required by the regulatory authority		

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	Canada		EU (PED DIRECTIVE 2014/68/EU) Clause/Section Reference Annex I Essential Safety Requirements	
	4.1.4	6.2.1.4		Revisions to registered designs that require a change in design calculations or otherwise affect the pressure-retaining capability of a boiler, pressure vessel, fired-heater pressure coil, fitting, or piping shall be submitted for registration.		
	4.1.10 and Annex J	6.2.7.1 and Annx J		Finite element analysis (FEA) may be used to support pressure equipment design where the configuration is not covered by the available rules in the code of construction.		
	7		**Pressure Vessel**			
				Applicable Codes and Standards		
	7.1.1	5.2.1		Except as otherwise specified in Clause 7, the standards governing the design, construction, installation, inspection, testing, and repair of pressure vessels shall be those specified in a) the following portions of the ASME Code: i) Section II, Part A; Part B; Part C; Part D; v) Section V; vi) Section VIII, Division 1; vii) Section VIII, Division 2; viii) Section VIII, Division 3; ix) Section IX; and x) Section X; and b) ASME PVHO-1	ANNEX I 4	4 - Materials Materials used for the manufacture of pressure equipment shall be suitable for such application during the scheduled lifetime unless replacement is foreseen. Welding consumables and other joining materials need to fulfil only the relevant requirements of points 4.1, 4.2(a) and the first paragraph of point 4.3, in an appropriate way, both individually and in a joined structure. 4.1 - Materials for pressurised parts 4.2 - The pressure equipment manufacturer shall: (a) define in an appropriate manner the values necessary for the design calculations referred to in point 2.2.3 and the essential characteristics of the materials and their treatment referred to in point 4.1; (b) provide in his technical documentation elements relating to compliance with the materials specifications of this Directive in one of the following forms: — by using materials which comply with harmonised standards, — by using materials covered by a European approval of pressure equipment materials in accordance with Article 15, — by a particular material appraisal; (c) for pressure equipment in categories III and IV, a specific assessment of the particular material appraisal shall be performed by the notified body in charge of conformity assessment procedures for the pressure equipment.
						4.3 - The equipment manufacturer shall take appropriate measures to ensure that the material used conforms with the required specification. In particular, documentation prepared by the material manufacturer affirming compliance with a specification shall be obtained for all materials. For the main pressure-bearing parts of equipment in categories II, III and IV, this shall take the form of a certificate of specific product control. Where a material manufacturer has an appropriate quality-assurance system, certified by a competent body established within the Union and having undergone a specific assessment for materials, certificates issued by the manufacturer are presumed to certify conformity with the relevant requirements of this point.
					ANNEX I 7	SPECIFIC QUANTITATIVE REQUIREMENTS FOR CERTAIN PRESSURE EQUIPMENT The following provisions apply as a general rule. However, where they are not applied, including in cases where materials are not specifically referred to and no harmonised standards are applied, the manufacturer shall demonstrate that appropriate measures have been taken to achieve an equivalent overall level of safety. The provisions laid down in this section supplement the essential safety requirements of points 1 to 6 for the pressure equipment to which they apply. 7.1. Allowable stresses 7.2. Joint coefficients 7.3. Pressure limiting devices, particularly for pressure vessels 7.4. Hydrostatic test pressure 7.5. Material characteristics
	7.1.2	6.2.1.9		The designer of a pressure vessel that incorporates a quick-actuating closure shall take into consideration the requirements of Section VIII, Division 1, Appendix FF of the ASME Code.		

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	**Canada**	**EU (PED DIRECTIVE 2014/68/EU)** Clause/Section Reference Annex I Essential Safety Requirements	
	7.1.3	6.2.6.1	In addition to the impact testing requirements specified in the ASME publications listed in Clause 7.1.1, carbon and low alloy steel used for the construction of pressure vessels at a minimum design metal temperature below –46 °C (–50°F) shall be impact tested at the minimum design metal temperature or a lower temperature, and the test results shall meet the requirements of paragraph UG-84, Section VIII, Division 1, of the ASME Code.		
	7.1.4	7.3.2	All pressure vessels designed for cyclic service and pressure vessels designed to Section VIII, Divisions 2 and 3, of the ASME Code shall comply with the following requirements: a) In ensuring maintenance and safe operation of pressure vessels, the owner shall maintain an appropriate equipment record system containing information about and documentation of incidents affecting the safe operation of the pressure vessels. The recordkeeping media for the equipment record system shall be retrievable and legible, and the information and documentation in them shall be secured to prevent unauthorized or undocumented revisions, additions, or deletions. b) The owner's equipment record system shall include documentation such as the user's design specification, manufacturer's design report, fabrication documents, and operation monitoring results. c) The owner shall establish pressure vessel operation guidelines for operators of the vessels, including the definition of cyclic operations and cycles monitoring, in compliance with the user's design specifications and manufacturer's design reports.		
			d) The owner shall have a certification process for the training and competency of the personnel to operate the vessels within the operation guidelines. e) For incidents where operation of the vessels deviates from the limits of the user's design specification, the operation monitoring results shall document i) the incidents as nonconformities; and ii) technical justification, by a professional engineer, for continued operation.		
	7.1.5.1	6.2.7.2	Use of Part 5 of Section VIII, Division 2, of the ASME Code to override provisions under Part 4 of Section VIII, Division 2, of the ASME Code is prohibited.		
	7.1.5.2	6.2.7.3	Use of Part 5 of Section VIII, Division 2, of the ASME Code in addition to or to supplement requirements in Part 4 of Section VIII, Division 2, of the ASME Code is not considered as using Part 5 to override provisions under Part 4.		
	7.3	6.2.5	When manholes are specified or required for a pressure vessel, they shall be at least 406 mm (16 in) in inside diameter or oval with inside dimensions of 305 × 406 mm (12 × 16 in).	ANNEX I 2.4	(a) Pressure equipment shall be designed and constructed so that all necessary examinations to ensure safety can be carried out (b) Means of determining the internal condition of the equipment shall be available, where it is necessary to ensure the continued safety of the equipment, such as access openings allowing physical access to the inside of the pressure equipment so that appropriate examinations can be carried out safely and ergonomically;
			Water Heaters	ANNEX I 5	5 - Fired or otherwise heated pressure ewuipment with a risk of overheating as preferred to in Articel 4(1) (a) appropriate means of protection are provided to restrict operating parameters such as heat input, heat take- off and, where applicable, fluid level so as to avoid any risk of local and general overheating; (b) sampling points are provided where required to allow evaluation of the properties of the fluid so as to avoid risks related to deposits and/or corrosion; (c) adequate provisions are made to eliminate risks of damage from deposits; (d) means of safe removal of residual heat after shutdown are provided; (e) steps are taken to avoid a dangerous accumulation of ignitable mixtures of combustible substances and air, or flame blowback.
	7.4.1.1	5.2.2.1	A water heater with a maximum diameter of 610 mm (24 in) is not required to be constructed to the requirements of this Standard, provided that the maximum heat input does not exceed 30 kW electrical or 400 000 BTU/h.	ANNEX I 5	5 - Fired or otherwise heated pressure ewuipment with a risk of overheating as preferred to in Articel 4(1) (a) appropriate means of protection are provided to restrict operating parameters such as heat input, heat take- off and, where applicable, fluid level so as to avoid any risk of local and general overheating; (b) sampling points are provided where required to allow evaluation of the properties of the fluid so as to avoid risks related to deposits and/or corrosion; (c) adequate provisions are made to eliminate risks of damage from deposits; (d) means of safe removal of residual heat after shutdown are provided; (e) steps are taken to avoid a dangerous accumulation of ignitable mixtures of combustible substances and air, or flame blowback.

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	**Canada**	**EU (PED DIRECTIVE 2014/68/EU)** Clause/Section Reference Annex I Essential Safety Requirements	
	7.4.1.2	5.2.2.2	Water heaters shall be designed to meet the requirements of Section I; Part HLW, Section IV; or Section VIII, Division 1, of the ASME Code, but the heat input, temperature, and volume exemptions in the ASME Code shall not apply.	ANNEX I 5	5 - Fired or otherwise heated pressure ewuipment with a risk of overheating as preferred to in Articel 4(1) (a) appropriate means of protection are provided to restrict operating parameters such as heat input, heat take- off and, where applicable, fluid level so as to avoid any risk of local and general overheating; (b) sampling points are provided where required to allow evaluation of the properties of the fluid so as to avoid risks related to deposits and/or corrosion; (c) adequate provisions are made to eliminate risks of damage from deposits; (d) means of safe removal of residual heat after shutdown are provided; (e) steps are taken to avoid a dangerous accumulation of ignitable mixtures of combustible substances and air, or flame blowback.
	7.4.1.3	5.5.2	**Relief valves** for water heaters shall be of adequate capacity, with a minimum inlet size of NPS 3/4 (NPS 1 for water heaters heated indirectly by steam in a coil or pipe), and shall be provided with a suitably designed lifting device.		
			Hot Water Tanks	ANNEX I 5	5 - Fired or otherwise heated pressure ewuipment with a risk of overheating as preferred to in Articel 4(1) (a) appropriate means of protection are provided to restrict operating parameters such as heat input, heat take- off and, where applicable, fluid level so as to avoid any risk of local and general overheating; (b) sampling points are provided where required to allow evaluation of the properties of the fluid so as to avoid risks related to deposits and/or corrosion; (c) adequate provisions are made to eliminate risks of damage from deposits; (d) means of safe removal of residual heat after shutdown are provided; (e) steps are taken to avoid a dangerous accumulation of ignitable mixtures of combustible substances and air, or flame blowback.
	7.4.2.1	5.2.3.2	A hot water tank with a maximum diameter of 610 mm (24 in) shall not be subject to the requirements of this Standard.		
	7.4.2.2	5.2.3.3	Hot water tanks shall be designed to meet the requirements of Section VIII, Division 1, of the ASME Code. Corrosion-resistant potable hot water tanks may be designed to Part HLW, Section IV, of the ASME Code.	ANNEX I 2.6 2.7	2.6 - Corrosion or other chemical attack Where necessary, adequate allowance or protection against corrosion or other chemical attack shall be provided, taking due account of the intended and reasonably foreseeable use. 2.7 Wear Where severe conditions of erosion or abrasion may arise, adequate measures shall be taken
	7.4.2.3	5.2.3.4	Hot water tanks shall be designed for a minimum pressure of 690 kPa (100 psi) and a minimum design temperature of 95°C (200°F).	ANNEX I 5	This pressure equipment shall be calculated, designed and constructed so as to avoid or minimise risks of a significant loss of containment from overheating. In particular it shall be ensured, where applicable, that: (a) appropriate means of protection are provided to restrict operating parameters such as heat input, heat take- off and, where applicable, fluid level so as to avoid any risk of local and general overheating; (b) sampling points are provided where required to allow evaluation of the properties of the fluid so as to avoid risks related to deposits and/or corrosion; (c) adequate provisions are made to eliminate risks of damage from deposits; (d) means of safe removal of residual heat after shutdown are provided; (e) steps are taken to avoid a dangerous accumulation of ignitable mixtures of combustible substances and air, or flame blowback.
	7.4.2.4	5.5.3	**Relief valves** for hot water tanks shall be of adequate capacity, with a minimum inlet size of NPS 3/4, and shall be provided with a suitably designed lifting device.		
	7.4.3	5.2.5	**Hydropneumatic tanks** shall have a minimum design pressure of 690 kPa (100 psi) and meet the requirements of Section VIII, Division 1, of the ASME Code. A hydropneumatic tank with a maximum diameter of 610 mm (24 in), a total volume of 450 L (16 ft3) or less, and a temperature of 65 °C (150°F) or less shall not be subject to the requirements of this Standard.		
	7.4.4	5.2.8.1	**Cushion tanks** having a working pressure exceeding 207 kPa (30 psi) or a diameter exceeding 610 mm (24 in) shall meet the requirements of Section VIII, Division 1, of the ASME Code. Cushion tanks with a maximum diameter of 610mm (24 in) and a pressure of 207 kPa (30 psi) or less shall not be subject to the requirements of this Standard.		

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	**Canada**	**EU (PED DIRECTIVE 2014/68/EU)** Clause/Section Reference Annex I Essential Safety Requirements	
	7.5.1.1	5.2.4.1	The design pressure for **blowoff vessels** shall be as specified in Table 2. A corrosion allowance of at least 3 mm (1/8 in) shall be added to the vessel thickness necessary to meet the requirements of Table 2. The plate thickness shall be at least 9.5 mm (3/8 in).	ANNEX I 2.6 2.7	2.6 - Corrosion or other chemical attack Where necessary, adequate allowance or protection against corrosion or other chemical attack shall be provided, taking due account of the intended and reasonably foreseeable use. 2.7 Wear Where severe conditions of erosion or abrasion may arise, adequate measures shall be taken
	7.5.1.2	5.2.4.2	The minimum diameter and volume of **blowoff vessels** (other than for coil-tube boilers) shall be as specified in Table 3. When more than one boiler is connected to the same blowoff vessel, the vessel shall be designed to suit the largest boiler, except as specified in Clause 7.5.1.3.		
	7.5.1.3	5.2.4.3	The minimum diameter and volume of **blowoff vessels** for coil-tube boilers having a capacity of less than 1200 L (250 Imp gal) may be as specified in Table 4 but shall be not less than the fully flooded volume of the boiler.		
	7.5.2.1	5.2.4.4	To facilitate internal inspection and permit cleaning, a **manhole** that complies with the requirements of Clause 7.3 shall be provided, except in the case of a vessel that is less than 610 mm (24 in) in diameter, where an oval hand hole with inside dimensions of 100 × 150 mm (4 × 6 in) may be used.	ANNEX I 2.4	(b) Means of determining the internal condition of the equipment shall be available, where it is necessary to ensure the continued safety of the equipment, such as access openings allowing physical access to the inside of the pressure equipment so that appropriate examinations can be carried out safely and ergonomically; (c) Other means of ensuring the safe condition of the pressure equipment may be applied in any of the following situations:
	7.5.2.2	5.2.4.5	A **drain connection** of not less than NPS 1-1/2 shall be provided for cleaning and drainage and installed in the bottom of the vessel.	ANNEX I 2.5	Adequate means shall be provided for the draining and venting of pressure equipment where necessary:
	7.5.3.1	5.2.4.6	**Blowoff vessels** shall be provided with an atmospheric vent pipe a) not less than 76 mm (3 in) in inside diameter; b) sized to ensure that the liquid drain seal cannot be blown out; c) without consideration for the area of the water discharge pipe; and d) having no isolating valves.		
	7.5.3.2	5.2.4.7	A **water discharge pipe**, of a size sufficient to discharge the maximum quantity of water that can enter the vessel without an appreciable rise in the water level in the vessel, shall be provided. The water discharge outlet shall be at least 51 mm (2 in) in inside diameter. The water discharge seal shall be designed for 125% of the maximum expected water flow into the vessel. **(blowoff vessels)**		
	7.5.3.3	5.2.4.8	An anti-siphon device shall be fitted on the water seal. **(blowoff vessels)**		
	7.5.3.4	5.2.4.9	A cold water connection shall be provided and enter separately from the blowoff inlet connection. The cold water supply line shall be a minimum of NPS 3/4. **(blowoff vessels)**		
	7.5.3.5	5.2.4.10	A connection with a minimum of NPS 1/2 shall be provided on the vessel shell above the liquid level for a pressure gauge connection. **(blowoff vessels)**		
	7.5.3.6	5.2.4.11	When tangential inlet connections are used, an impingement wear plate shall be provided to take the erosive wear of the entering blowoff. **(blowoff vessels)**		
	7.6.1	5.2.7.1	Except as required by Clauses 7.1, 7.6.2, and 7.6.3, the design, construction, and installation of pressure vessels and piping to be used for storage and handling of anhydrous ammonia shall comply with ANSI/CGA G-2.1. **(Anhydrous ammonia service)**		
	7.6.2	5.2.7.2	**Anhydrous ammonia** storage tanks with a water capacity of 13 660 L (3000 Imp gal) or more shall be constructed with a manhole.		
	7.6.3	5.2.7.3	Except for vessels used in refrigeration systems, pressure vessels intended for use in anhydrous ammonia service shall a) be subjected to post-weld heat treatment before the hydrostatic test; and b) have head and shell materials produced in accordance with fine-grain practice. **(Anhydrous ammonia service)**	ANNEX I 3.1.4	3.1.4 - Heat treatment Where there is a risk that the manufacturing process will change the material properties to an extent which would impair the safety of the pressure equipment, suitable heat treatment shall be applied at the appropriate stage of manufacture.
	7.7.1.1	5.2.6.1	Pressure vessels and piping for **liquefied petroleum gases** shall meet the requirements of the following: a) for fuel tanks on highway vehicles: i) Section VIII, Division 1, of the ASME Code; ii) CSA B149.2 and CSA B149.5; and iii) Annex G; or b) for ground storage tanks: i) Section VIII, Division 1, of the ASME Code; and ii) CSA B149.2.		
	7.7.1.2	5.2.6.2	**Liquefied petroleum gas vessels** with a water capacity of 13 660 L (3000 Imp gal) or more shall be constructed with a manhole.		

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	Canada		EU (PED DIRECTIVE 2014/68/EU) Clause/Section Reference Annex I Essential Safety Requirements	
	7.7.2	5.2.11		When flexible hoses are used with natural gas liquid storage tanks for loading and unloading product, an excess flow valve that is adequately sized for each tank opening used for product flow shall be installed. **(Natural gas liquid service)**		
	7.8	5.2.9		The design, fabrication, installation, inspection, operation, repair, and alteration of **cold-stretched pressure vessels** shall be in accordance with Annex K.		
	9	5.6		The design, construction, installation, inspection, testing, and repair of **refrigeration equipment** shall meet the requirements of CSA B52.		
	6		**Boiler**			
	6.1	5.1.1.1		Except as otherwise specified in this Standard, the standards governing the design, construction, installation, inspection, testing, and repair of boilers shall be those specified in a) the following portions of the ASME Code: i) Section I; ii) Section II, Part A; iii) Section II, Part B; iv) Section II, Part C; v) Section II, Part D; vi) Section IV; vii) Section V; viii) Section VIII, Division 1; ix) Section VIII, Division 2; x) Section VIII, Division 3; and xi) Section IX; and b) ASME CSD-1.	ANNEX I 4	4 - Materials Materials used for the manufacture of pressure equipment shall be suitable for such application during the scheduled lifetime unless replacement is foreseen. Welding consumables and other joining materials need to fulfil only the relevant requirements of points 4.1, 4.2(a) and the first paragraph of point 4.3, in an appropriate way, both individually and in a joined structure. 4.1 - Materials for pressurised parts 4.2 - The pressure equipment manufacturer shall: (a) define in an appropriate manner the values necessary for the design calculations referred to in point 2.2.3 and the essential characteristics of the materials and their treatment referred to in point 4.1; (b) provide in his technical documentation elements relating to compliance with the materials specifications of this Directive in one of the following forms: — by using materials which comply with harmonised standards, — by using materials covered by a European approval of pressure equipment materials in accordance with Article 15, — by a particular material appraisal; (c) for pressure equipment in categories III and IV, a specific assessment of the particular material appraisal shall be performed by the notified body in charge of conformity assessment procedures for the pressure equipment.
						4.3 - The equipment manufacturer shall take appropriate measures to ensure that the material used conforms with the required specification. In particular, documentation prepared by the material manufacturer affirming compliance with a specification shall be obtained for all materials. For the main pressure-bearing parts of equipment in categories II, III and IV, this shall take the form of a certificate of specific product control. Where a material manufacturer has an appropriate quality-assurance system, certified by a competent body established within the Union and having undergone a specific assessment for materials, certificates issued by the manufacturer are presumed to certify conformity with the relevant requirements of this point.
					ANNEX I 7	SPECIFIC QUANTITATIVE REQUIREMENTS FOR CERTAIN PRESSURE EQUIPMENT The following provisions apply as a general rule. However, where they are not applied, including in cases where materials are not specifically referred to and no harmonised standards are applied, the manufacturer shall demonstrate that appropriate measures have been taken to achieve an equivalent overall level of safety. The provisions laid down in this section supplement the essential safety requirements of points 1 to 6 for the pressure equipment to which they apply. 7.1. Allowable stresses 7.2. Joint coefficients 7.3. Pressure limiting devices, particularly for pressure vessels 7.4. Hydrostatic test pressure 7.5. Material characteristics
	4.12	5.2.3.1		Tanks that contain water at a temperature not exceeding 65 °C (150°F) and are not equipped with heating units shall not be subject to registration.		
	6.3.1.1 6.3.1.2 6.3.1.3	7.2.2.2 a) 7.2.2.2 b) 5.1.2.1		Supplementary construction and installation requirements - water gauge		

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	Canada	EU (PED DIRECTIVE 2014/68/EU) Clause/Section Reference Annex I Essential Safety Requirements	
	6.3.2.1 6.3.2.2 6.3.2.3	5.1.2.2 5.1.2.3 5.1.2.4	Supplementary construction and installation requirements - low-water cut-off		
	6.3.3	5.1.1.7	Supplementary construction and installation requirements - Fusible Plug		
	6.3.5	5.1.1.4	Supplementary construction and installation requirements - Boiler Inspection		
	6.3.6	5.1.1.5	Supplementary construction and installation requirements - Loadings		
	6.4	5.1.1.2	**Outlet dampers** on automatically fired boilers shall be interlocked to the burner control system so that the boilers cannot be fired unless the dampers are sufficiently open.		
	6.5.1	5.2.4.12	When the **blowoff** from a boiler having a working pressure exceeding 103 kPa (15 psi) is discharged into a sewer system, a registered blowoff vessel or other suitable registered device shall be placed between the boiler and sewer to reduce the temperature of the water entering the sewer system to 65 °C (150°F) or lower. Blowoff vessels shall be designed in accordance with Clause 7.5.	Article 1 1	This Directive shall apply to the design, manufacture and conformity assessment of pressure equipment and assemblies with a maximum allowable pressure PS greater than 0,5 bar.
	6.5.2	5.2.4.16	**Blowoff systems** of a proprietary design that do not meet the requirements of Clause 7.5.1.2 or 7.5.1.3 shall be designed to meet the requirements of Clause 7.1. The design shall be submitted to the regulatory authority for registration before installation of the system.		
			Thermal Fluid Heaters and Piping		
	6.6.2	5.1.7.2	Thermal fluid heaters in which the fluid is vaporized shall be designed in accordance with the requirements of Part PVG, Section I, of the ASME Code.		
	6.6.3	5.1.7.3	Liquid phase thermal fluid heaters shall be designed in accordance with the requirements of Section I or Section VIII, Division 1, of the ASME Code. When liquid phase thermal fluid heaters are designed to Section VIII, Division 1, of the ASME Code, controls, instrumentation, provision for thermal expansion of the fluid, overpressure protection, and a means of adding fluid to the system shall meet the requirements of Part PTFH, Section I, of the ASME Code.		
	6.6.4	5.1.7.4	When thermal fluid heaters are designed and constructed in accordance with Section I of the ASME Code, heater external piping shall be designed and constructed to ASME B31.1 and shall meet the requirements of Part PTFH, Section I, of the ASME Code. Non-heater external piping shall be designed and constructed to either ASME B31.1 or ASME B31.3. When thermal fluid heaters are designed to Section VIII, Division 1, of the ASME Code, piping used with thermal fluid heaters shall be designed to ASME B31.3.		
			Cast Iron or Cast Aluminum Steam and Hot Water Boilers		
	6.7	5.1.1.3	Each design covering a cast iron or cast aluminum steam or hot water boiler shall be accompanied by a proof test certificate indicating the destruction test pressure for each type or series submitted for approval.	ANNEX I 2.2.4 ANNEX I 3.2.2	2.2.4 Experimental design Method 3.2.2 - Proof test Final assessment of pressure equipment shall include a test for the pressure containment aspect, which will normally take the form of a hydrostatic pressure test at a pressure at least equal, where appropriate, to the value laid down in point 7.4. For category I series-produced pressure equipment, this test may be performed on a statistical basis. Where the hydrostatic pressure test is harmful or impractical, other tests of a recognised value may be carried out. For tests other than the hydrostatic pressure test, additional measures, such as non-destructive tests or other methods of equivalent validity, shall be applied before those tests are carried out.
			Welded Stay Bolts		
	6.8	DELETED	Welded solid staybolts that are 8 in long or shorter shall have telltale holes in accordance with the dimensional requirements of paragraph PG-47.1, Section I, of the ASME Code.		
	8		**Pressure Piping System**		

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	**Canada**	**EU (PED DIRECTIVE 2014/68/EU)** Clause/Section Reference Annex I Essential Safety Requirements	
	8.1	5.3.1	Except as otherwise specified in this Standard, the design, materials, construction, installation, inspection, testing, and repair of pressure piping shall meet the requirements of the following, asapplicable: a) ASME: i) B31.1; ii) B31.3; iii) B31.4; iv) B31.5; and v) B31.9 (except for the requirements allowing use of soldered joints for air piping); b) CSA Group: i) CSA B149.1; ii) CSA B149.2; iii) CSA Z180.1; iv) CAN/CSA-Z662; and v) CSA Z7396.1; c) ARPM IP-2 (for flexible hose assemblies); and d) CDA A4015 (for soldering).	ANNEX I 4 6	4 - Materials Materials used for the manufacture of pressure equipment shall be suitable for such application during the scheduled lifetime unless replacement is foreseen. Welding consumables and other joining materials need to fulfil only the relevant requirements of points 4.1, 4.2(a) and the first paragraph of point 4.3, in an appropriate way, both individually and in a joined structure. 6 - Piping as Referred to in Article 4(1)(c) Design and construction shall ensure: (a) that the risk of overstressing from inadmissible free movement or excessive forces being produced, e.g. on flanges, connections, bellows or hoses, is adequately controlled by means such as support, constraint, anchoring, alignment and pre-tension; (b) that where there is a possibility of condensation occurring inside pipes for gaseous fluids, means are provided for drainage and removal of deposits from low areas to avoid damage from water hammer or corrosion; (c) that due consideration is given to the potential damage from turbulence and formation of vortices; the relevant parts of point 2.7 are applicable; (d) that due consideration is given to the risk of fatigue due to vibrations in pipes; (e) that, where fluids of Group 1 are contained in the piping, appropriate means are provided to isolate 'take-off' pipes the size of which represents a significant risk; (f) that the risk of inadvertent discharge is minimised; the take-off points shall be clearly marked on the permanent side, indicating the fluid contained; (g) that the position and route of underground piping is at least recorded in the technical documentation to facilitate safe maintenance, inspection or repair.
				ANNEX I 7	SPECIFIC QUANTITATIVE REQUIREMENTS FOR CERTAIN PRESSURE EQUIPMENT The following provisions apply as a general rule. However, where they are not applied, including in cases where materials are not specifically referred to and no harmonised standards are applied, the manufacturer shall demonstrate that appropriate measures have been taken to achieve an equivalent overall level of safety. The provisions laid down in this section supplement the essential safety requirements of points 1 to 6 for the pressure equipment to which they apply. 7.1. Allowable stresses 7.2. Joint coefficients 7.3. Pressure limiting devices, particularly for pressure vessels 7.4. Hydrostatic test pressure 7.5. Material characteristics
	8.2	6.2.1.7	Fittings used in piping systems shall be registered in accordance with Clause 4.2.		
	8.3	6.3.3	Welded joints in a pressure piping system shall not be painted or covered until all required inspections are completed by the owner and/or authorized inspection agency in accordance with the code of construction and the Act.		
	8.4	6.3.4	Soldered joints shall not be permitted in services subject to shock or vibration.		
	8.5	6.3.5	Bonding of non-metallic joints shall be performed in accordance with the applicable code of construction. Bonding procedure specifications, and procedure and performance qualification testing, shall be subject to the acceptance of the regulatory authority. Note: For an example of requirements for bonding, refer to Chapter VII of ASME B31.3.		
	8.6	6.2.1.8	The method by which any pressure piping system is to be tested, and the test pressure to be used, shall be submitted for approval to the regulatory authority in the province of installation.		
	8.7	6.3.6	Mechanical joints whose mechanical strength or leak resistance is dependent on friction-only clamped connections shall not be used.		
	4.2, 8	**Fitting**			
	4.2.1	5.4.1	unless they form a part of a boiler or pressure vessel that is subject to inspection by an authorized inspection agency		
	4.2.2, 4.2.7 and Table 1	5.4.2.1, 5.4.2.5, and Table 1	Category of fitting manufactured and Statutory Declaration Form		

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	**Canada**	**EU (PED DIRECTIVE 2014/68/EU)** Clause/Section Reference Annex I Essential Safety Requirements	
	4.2.4, 4.2.6	5.4.2.2, 5.4.2.4	Fittings manufactured outside Canada, shall be accompanied by proof that the manufacturer's quality control program for the manufacturing of the fittings	ANNEX III 5. Module D	3.2. The quality system shall ensure that the pressure equipment is in conformity with the type described in the EU-type examination certificate and comply with the requirements of this Directive that apply to it. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic and orderly manner in the form of written policies, procedures and instructions. This quality system documentation shall permit a consistent interpretation of the quality programmes, plans, manuals and records. It shall, in particular, contain an adequate description of: — the quality objectives and the organisational structure, responsibilities and powers of the management with regard to the quality of the pressure equipment, — the corresponding manufacturing, quality control and quality assurance techniques, processes and systematic actions that will be used, particularly the procedures used for the permanent joining of parts as approved in accordance with point 3.1.2 of Annex I, — the examinations and tests that will be carried out before, during and after manufacture, and the frequency with which they will be carried out, — the quality records, such as inspection reports and test data, calibration data, reports concerning the qualifications or approvals of the personnel concerned, particularly those of the personnel undertaking the permanent joining of parts and the non-destructive tests in accordance with points 3.1.2 and 3.1.3 of Annex I, etc., and — the means of monitoring the achievement of the required quality and the effective operation of the quality system.
	4.2.8	6.2.3	Minimum, documentation in support of fitting design application for a new design registration or a re-registration		
			ADD PSV Clause12		
			Procedures (Welding, Pneumatic Testing, etc…)		
	4.4.1	6.2.2.1	Welding and brazing procedures shall be registered with the regulatory authority of the province where the welding or brazing is to be performed	ANNEX I 3.1.2	Permanent joints and adjacent zones shall be free of any surface or internal defects detrimental to the safety of the equipment. The properties of permanent joints shall meet the minimum properties specified for the materials to be joined unless other relevant property values are specifically taken into account in the design calculations. For pressure equipment, permanent joining of components which contribute to the pressure resistance of equipment and components which are directly attached to them shall be carried out by suitably qualified personnel according to suitable operating procedures. For pressure equipment in categories II, III and IV, operating procedures and personnel shall be approved by a competent third party which, at the manufacturer's discretion, may be: — a notified body, — a third-party organisation recognised by a Member State as provided for in Article 20. To carry out these approvals the third party must perform examinations and tests as set out in the appropriate harmonised standards or equivalent examinations and tests or shall have them performed.
	4.4.2	6.2.2.2	Welding or brazing procedures for equipment fabricated outside Canada shall be registered with the regulatory authority at the place of installation or, at the discretion of the regulatory authority, with an authorized inspection agency.	ANNEX I 3.1.2	Permanent joints and adjacent zones shall be free of any surface or internal defects detrimental to the safety of the equipment. The properties of permanent joints shall meet the minimum properties specified for the materials to be joined unless other relevant property values are specifically taken into account in the design calculations. For pressure equipment, permanent joining of components which contribute to the pressure resistance of equipment and components which are directly attached to them shall be carried out by suitably qualified personnel according to suitable operating procedures. For pressure equipment in categories II, III and IV, operating procedures and personnel shall be approved by a competent third party which, at the manufacturer's discretion, may be: — a notified body, — a third-party organisation recognised by a Member State as provided for in Article 20. To carry out these approvals the third party must perform examinations and tests as set out in the appropriate harmonised standards or equivalent examinations and tests or shall have them performed.

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	**Canada**		**EU (PED DIRECTIVE 2014/68/EU)** Clause/Section Reference Annex I Essential Safety Requirements	
	4.5.1	6.2.2.3		Welding and brazing procedures, procedure qualifications, and performance tests shall be as specified in, or the equivalent of, the procedures, qualifications, and tests specified in a) Section IX of the ASME Code; and b) the code to which the pressure-retaining component is either manufactured or installed.	ANNEX I 3.1.2	Permanent joints and adjacent zones shall be free of any surface or internal defects detrimental to the safety of the equipment. The properties of permanent joints shall meet the minimum properties specified for the materials to be joined unless other relevant property values are specifically taken into account in the design calculations. For pressure equipment, permanent joining of components which contribute to the pressure resistance of equipment and components which are directly attached to them shall be carried out by suitably qualified personnel according to suitable operating procedures. For pressure equipment in categories II, III and IV, operating procedures and personnel shall be approved by a competent third party which, at the manufacturer's discretion, may be: — a notified body, — a third-party organisation recognised by a Member State as provided for in Article 20. To carry out these approvals the third party must perform examinations and tests as set out in the appropriate harmonised standards or equivalent examinations and tests or shall have them performed.
	4.5.3	6.3.2		Welding or brazing tests for equipment fabricated outside Canada shall be acceptable for the purposes of Clause 4.5 only if approved by an inspector or authorized inspection agency approved by the regulatory authority in the province of installation	ANNEX I 3.1.2	Permanent joints and adjacent zones shall be free of any surface or internal defects detrimental to the safety of the equipment. The properties of permanent joints shall meet the minimum properties specified for the materials to be joined unless other relevant property values are specifically taken into account in the design calculations. For pressure equipment, permanent joining of components which contribute to the pressure resistance of equipment and components which are directly attached to them shall be carried out by suitably qualified personnel according to suitable operating procedures. For pressure equipment in categories II, III and IV, operating procedures and personnel shall be approved by a competent third party which, at the manufacturer's discretion, may be: — a notified body, — a third-party organisation recognised by a Member State as provided for in Article 20. To carry out these approvals the third party must perform examinations and tests as set out in the appropriate harmonised standards or equivalent examinations and tests or shall have them performed.
	4.7, 11	7.3.1, 7.4.4.1.1	Manufacturer must submit pressure equipment design			
				Alterations (Pressure Vessels, Boilers, Procedures, etc…)		
				Repairs (Pressure Vessels, Boilers, Procedures, etc…)		
Construction			Certificate of Authorization Permit **(Pressure Equipment Manufacturer)**		ANNEX I 3.1 3.1.1	3.1 - Manufacturing procedures The manufacturer shall ensure the competent execution of the provisions set out at the design stage by applying the appropriate techniques and relevant procedures, especially with a view to the aspects set out below. 3.1.1 Preparation of the component parts

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	**Canada**	**EU (PED DIRECTIVE 2014/68/EU)** Clause/Section Reference Annex I Essential Safety Requirements	
				ANNEX I 3.1.2	Permanent joints and adjacent zones shall be free of any surface or internal defects detrimental to the safety of the equipment. The properties of permanent joints shall meet the minimum properties specified for the materials to be joined unless other relevant property values are specifically taken into account in the design calculations. For pressure equipment, permanent joining of components which contribute to the pressure resistance of equipment and components which are directly attached to them shall be carried out by suitably qualified personnel according to suitable operating procedures. For pressure equipment in categories II, III and IV, operating procedures and personnel shall be approved by a competent third party which, at the manufacturer's discretion, may be: — a notified body, — a third-party organisation recognised by a Member State as provided for in Article 20. To carry out these approvals the third party must perform examinations and tests as set out in the appropriate harmonised standards or equivalent examinations and tests or shall have them performed.
			Welding or brazing performance qualification tests of the welders or brazers who were engaged in the construction complied with the ASME Boiler and Pressure Vessel Code, Section IX		
				ANNEX I 3.1.3 3.1.4 3.1.5	3.1.3 - Non-destructive testing 3.1.4 - Heat Treatment 3.1.5 - Traceability
				ANNEX I 3.2	3.2 Final Assessment 3.2.1 Final Inspection 3.2.3 Inspection of safety devices
		Stamping and Nameplates			
	4.10.1.2	4.1.2.2	Manufacturers in countries other than Canada that manufacture and export boilers and pressure vessels to Canada shall ensure that all boilers and pressure vessels are stamped with the appropriate ASME Code product certification mark and registered with the National Board.	ANNEX I 3.3	Marking and Labelling In addition to the CE marking referred to in Articles 18 and 19 and the information to be provided in accordance with Article 6(6) and Article 8(3), the following information shall be provided:
	5.1.1	6.5.2.1	The nameplate stamping of every boiler, pressure vessel, and Category G fitting (see Table 1) shall include the Canadian Registration Number (CRN) or Canadian Central Registration Number (CCRN). The nameplate shall be stamped in accordance with the requirements of the appropriate section of the ASME Code, except for a) fusible plugs; and b) pressure relief valves (PRVs) used in propane service which are only UL listed as described in Clause 12.11. The stamping for other categories of fittings shall include, at a minimum, identification traceable to the manufacturer and to the CRN or CCRN. This identification shall be submitted to the regulatory authority or a central registration agency with the fitting registration.	ANNEX I 3.3(a)	3.3 Marking and Labelling (a) for all pressure equipment: — the year of manufacture, — identification of the pressure equipment according to its nature, such as type, series or batch identification and serial number, — essential maximum/minimum allowable limits
	5.1.2	6.5.3	When a pressure vessel requiring a nameplate will be exposed to corrosive matter, the nameplate shall be attached in a manner that prevents accumulation of foreign material between the nameplate and the shell, head, or any other part of the pressure vessel subject to internal pressure.	ANNEX I 2.6 2.7	2.6 - Corrosion or other chemical attack Where necessary, adequate allowance or protection against corrosion or other chemical attack shall be provided, taking due account of the intended and reasonably foreseeable use. 2.7 Wear Where severe conditions of erosion or abrasion may arise, adequate measures shall be taken
	5.1.3	5.1.5.2	The designer of a fired-heater pressure coil shall provide a nameplate for the complete heater. The organization responsible for the field assembly shall be shown on this nameplate.		
	5.1.4	6.5.2.2	Only whole numbers shall be used for specifying pressure and temperature ratings on nameplates.		
	5.3.1	6.5.1	Boilers, pressure vessels, safety valves, relief valves, safety relief valves, and rupture discs shall be stamped with an ASME Code product certification mark or other stamp acceptable to the regulatory authority.		

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	Canada	EU (PED DIRECTIVE 2014/68/EU) Clause/Section Reference Annex I Essential Safety Requirements	
	5.3.2	5.1.5.3	Individual modules and welded pressure parts of a fired-heater pressure coil shall be identified by stamping, stencilling, welded tag plates, or other appropriate means to provide traceability to the accompanying documentation.		
	5.3.3	5.1.5.4	At a minimum, individual pressure coils shall have a means of identification that includes the manufacturer's name, year of manufacture, maximum allowable working pressure and design metal temperature, a serial number, and the CRN.		
	5.3.4	6.5.2.3	Welded parts for a boiler or pressure vessel for which a manufacturer's partial data report is required shall be marked as required by the appropriate section of the ASME Code, except that the ASME Code product certification mark shall be required only if the completed boiler or pressure vessel is to be ASME stamped	ANNEX I 3.3	(a) for all pressure equipment: — the year of manufacture, — identification of the pressure equipment according to its nature, such as type, series or batch identification and serial number, — essential maximum/minimum allowable limits. (b) depending on the type of pressure equipment, further information necessary for safe installation, operation or use and, where applicable, maintenance and periodic inspection such as: — the volume V of the pressure equipment in L, — the nominal size for piping DN, — the test pressure PT applied in bar and date, — safety device set pressure in bar, — output of the pressure equipment in kW, — supply voltage in V (volts), — intended use, — filling ratio kg/L, — maximum filling mass in kg, — tare mass in kg, — the fluid group.EN 27.6.2014 Official Journal of the European Union L 189/209
	5.4	6.5.4	Fittings shall be permanently marked as required by MSS SP-25.		
		Manufacturer's Data Report			
			Pressure Vessels, Boilers, Pressure Piping System		
	4.6.1, 4.8.3 and Annex D	6.6.5.2, 6.6.5.1, and Annex D	On completion of construction of a **boiler, pressure vessel, fired-heater pressure coil, or pressure piping** covered by this Standard, a manufacturer's data report signed by a representative of the manufacturer and, except as specified in Clause 4.8.3, countersigned by the inspector or authorized inspector shall be sent by the manufacturer to the regulatory authority of the province of installation.		
	4.6.2	6.6.5.3	**Welded pressure parts** that require inspection under the rules of the applicable ASME construction code are constructed by an organization other than the final manufacturer, that organization shall forward a duly certified partial data report to the organization responsible for completing construction. The partial data report shall be attached to the manufacturer's data report and shall not require an original signature. The original of the partial data report shall be retained by the parts manufacturer for the period specified by the applicable ASME construction code		
	4.6.4	6.6.3	**Multiple identical pressure vessels** manufactured and receiving final inspection in a period not exceeding five consecutive working days, and in lots of 100 or less, may be recorded on one master data report form, which shall be sent to the regulatory authority of the province of manufacture. A copy of this form shall be sent to the regulatory authority of the province of installation for each vessel.		
	4.6.5 and Annex D.7	6.6.4 and Annex D.7	For **cast iron and cast aluminum sectional boilers**, the installer shall, in lieu of a manufacturer's data report, complete a form for each cast iron and cast aluminum sectional boiler installed (see Figure D.7), and the completed forms shall be sent by the installer to the regulatory authority of the province of installation.		
	4.15 and Annex D.5a),b),c)	6.6.1 and Annex D.5 a),b),c)	**Piping** - When required by the regulatory authority in the province of installation, the piping fabricator or installer shall furnish an acceptable piping data report to the regulatory authority.		
		Fabrication Inspection			
	4.8.1	6.4.1	Shop inspection of boilers, pressure vessels, fired-heater pressure coils, or piping b) outside Canada, by an authorized inspection agency		

Pressure Equipment Safety System	CSA B51 Clause Reference (2019)	CSA B51 Clause Reference (2024)	**Canada**	**EU (PED DIRECTIVE 2014/68/EU)** Clause/Section Reference Annex I Essential Safety Requirements
	4.8.2	6.4.2	**Exemption from individual shop inspection** a) low-pressure steel boilers with 4.5 m2 (50 ft2) or less of wetted heating surface; b) cast iron and cast aluminum sectional boilers; c) miniature pressure vessels, as defined in Section VIII, Division 1, of the ASME Code, when the manufacturer has registered its quality control manual with the regulatory authority where the manufacturing shop is located and has completed a manufacturer's data report for miniature pressure vessels [see Figure D.1 a)]; d) hot water tanks, hydropneumatic tanks, and cushion tanks not exceeding 762 mm (30 in) in diameter (with no limit on capacity); e) electric boilers of a capacity up to 60 kW; and f) small pressure vessels registered as Category H fittings and inspected in accordance with Figures 1 a),1 b), and 1 c).	

Table QW-253 SMAW		Variable	Essential	Supplementary Essential	Non-Essential	ISO 15609-1	ISO 15614-1	Variable	Comments (both levels)	Comments (Level 1)	Comments (Level 2)
QW-402 Joints	.1	Groove Design			x	4.4.2	8.4.3	Joint design	No difference between ISO and ASME		
	.4	Backing			x	4.4.7		Backing	No difference between ISO and ASME		
	.10	Root Spacing			x	4.4.2		Joint design	No difference between ISO and ASME		
	.11	Retainers			x	4.4.7		Backing	No difference between ISO and ASME		
QW-403 Base Metals	.5	Group Number		x		4.3.1	8.3.1	Material qualified	Differences exist in material groupings...did not compare		
	.6	T Limits toughness		x			8.3.2.1	Thickness - Toughness	ISO is less restrictive 6mm+ test coupon is less restrictive (i.e. ISO: 10mm qualifies for minimum of 5mm(ISO) rather than 10mm(ASME))		
	.8	T Qualified	x			4.3.2	8.3.2.1	Thickness		No difference between ISO and ASME for thicknesses > 3mm (coupon)	ISO is more restrictive (tighter range) for thicknesses >3mm (coupon)
	.9	t Pass>1/2 in	x				Addressed?				
	.11	P-No. qualified	x				8.3.1	Material qualified	Differences exist in material groupings...did not compare		
		Diameter	NOT ADDRESSED IN ASME IX			4.3.2	8.3.3	Diameter		No difference between ISO and ASME - not an essential variable for either	ISO is more restrictive - diameter is an essential variable (>= 0.5D) for pipe.
QW-404 Filler Metals	.4	F-number	x				8.4.4	Filler material		No difference between ISO and ASME	Silmilar requirements for impact applications. More restrictive for normal applications.
	.5	A-number	x				8.4.4	Filler material		No difference between ISO and ASME	Similar requirements for impact applications. More restrictive for normal applications.
	.6	Diameter			x	4.4.8	8.4.5	Filler size		No difference between ISO and ASME	No difference between ISO and ASME
	.12	Classification		x		4.4.8	8.4.4	Filler material			Silmilar requirements for impact applications. More restrictive for normal applications.

Table QW-253 SMAW		Variable	Essential	Supplementary Essential	Non-Essential	ISO 15609-1	ISO 15614-1	Variable	Comments (both levels)	Comments (Level 1)	Comments (Level 2)
	.30	t	x				8.3.2.2	Deposited thickness	**No difference between ISO and ASME**		
	.33	Classification			x	4.4.8		Welding consumables			
		Handling	NOT DIRECTLY ADDRESSED IN ASME IX			4.4.8		Handling		**No difference between ISO and ASME** - not an essential variable for either	**ISO is more restrictive** - variable is required to be addressed.
QW-405 Positions	.1	Position			x	4.4.3	8.4.2	Position	**ISO is more restrictive** - position is an essential variable for impact and hardness applications in ISO		
	.3	Vertical welding			x		8.4.2	Position	**ISO is more restrictive** - vertical down shall be qualified by a specific test piece in ISO		
QW-406 Preheat	.1	Decrease > 100°F	x			4.4.11	8.4.8	Preheat	**ISO is more restrictive**: 50°C reduction(ISO) vs 55°C (ASME) reduction		
	.2	Preheat maintenance			x	4.4.13		Preheat maintenance tempeature	**No difference between ISO and ASME**		
	.3	Increase >100°F		x		4.4.12	8.4.9	Interpass		**No difference between ISO and ASME**	**ISO is more restrictive**: 50°C increase (ISO) vs 55°C (ASME) increase Applicable for materials group 8, 10, 41 to 48 *********verify and compare material requirements to section ix
QW-407 PWHT	.1	PWHT	x			4.4.15	8.4.11	PWHT	**No difference between ISO and ASME** - addition or deletion of PWHT is not permitted.		
	.2	PWHT (T&T range)		x		4.4.15			**ASME is more restrictive** - PWHT time is not an essential variable (maybe it is addressed in another part of ISO??? that was not reviewed)		

Table QW-253 SMAW		Variable	Essential	Supplementary Essential	Non-Essential	ISO 15609-1	ISO 15614-1	Variable	Comments (both levels)	Comments (Level 1)	Comments (Level 2)
		Post-heating for hydrogen release	NOT ADDRESSED IN ASME IX			4.4.14	8.4.10	Post-heating for hydrogen release		**No difference between ISO and ASME**	**ISO is more restrictive** - temperature and duration shall not be reduced. Shall not be omitted but may be added.
QW-409 Electrical Characteristics	.1	> Heat input		x		4.4.17	8.4.7	Heat input		**No difference between ISO and ASME** when impact applications apply (maximum heat input)c	**ASME is more restrictive** - the upper limit of the heat input qualified is 25% greater than used in welding the test piece in ISO.
	.4	Current or polarity			x	4.4.9	8.4.6	Type current	**ISO is more restrictive** - qualification is given for the type of current and polarity used in the welding procedure test. For process 111 (SMAW), AC also qualified for DC unless impact testing is required.		
	.8	I&E range			x	4.4.9			**No difference between ISO and ASME**		
	.30	Current or polarity		x		4.4.9			**ASME is more restrictive -** ISO does not specifically address current/polarity limitation		
		Handling	NOT ADDRESSED IN ASME IX			4.4.8		Handling	**ISO directly addresses variable**		
		Travel speed range	NOT ADDRESSED IN ASME IX			4.4.10		Travel speed range	**ISO directly addresses variable**		
		Wire Strip feed ran	NOT ADDRESSED IN ASME IX			4.4.10		Wire Strip feed range	**ISO directly addresses variable**		
		Run out length or t	NOT ADDRESSED IN ASME IX			4.5.1		Run out length or travel speed	**ISO directly addresses variable**		
	.1	String or weave			x	4.4.5			**ISO is more detailed**		
	.5	Method of cleaning			x	4.4.4			**No difference between ISO and ASME**		
	.6	Method back gouge			x	4.4.6			**ISO is more detailed**		
	.9	Multiple to single pass/side			x		8.4.3		**No difference between ISO and ASME**		

Table QW-253 SMAW		Variable	Essential	Supplementary Essential	Non-Essential	ISO 15609-1	ISO 15614-1	Variable	Comments (both levels)	Comments (Level 1)	Comments (Level 2)
QW-410 Technique	.25	Manual or automaic			x	4.4.10	8.4.1	Mechanization		Not an essential variable	**ISO is more restrictive** - Each degree of mechanization shall be qualified independently
	.26	Peening			x				**Not directly addressed in ISO**		
	.64	Use of thermal pro	x						**Not directly addressed in ISO**		
	.87	Multiple to single pass/side		x			8.4.3			**Similar requirements** for impact applications.	**Similar requirements** for impact applications.

Table QW-255 GMAW		Variable	Essential	Supplementary Essential	Non-Essential	ISO 15609-1	ISO 15614-1	Variable	Comments (both levels)	Comments (Level 1)	Comments (Level 2)
QW-402 Joints	.1	Groove Design			x	4.4.2	8.4.3	Joint design	No difference between ISO and ASME		
	.4	Backing			x	4.4.7		Backing	No difference between ISO and ASME		
	.10	Root Spacing			x	4.4.2		Joint design	No difference between ISO and ASME		
	.11	Retainers			x	4.4.7		Backing	No difference between ISO and ASME		
QW-403 Base Metals	.5	Group Number		x		4.3.1	8.3.1	Material qualified	Differences exist in material groupings...did not compare		
	.6	T Limits toughness		x			8.3.2.1	Thickness - Toughness	ISO is less restrictive 6mm+ test coupon is less restrictive (i.e. ISO: 10mm qualifies for minimum of 5mm(ISO) rather than 10mm(ASME))		
	.8	T Qualified	x			4.3.2	8.3.2.1	Thickness		No difference between ISO and ASME for thicknesses > 3mm (coupon)	ISO is more restrictive (tighter range) for thicknesses >3mm (coupon)
	.9	t Pass>1/2 in	x				Addressed?				
	.11	P-No. qualified	x				8.3.1	Material qualified	Differences exist in material groupings...did not compare		
		Diameter	NOT ADDRESSED IN ASME IX			4.3.2	8.3.3	Diameter		No difference between ISO and ASME - not an essential variable for either	ISO is more restrictive - diameter is an essential variable (>= 0.5D) for pipe.
	.4	F-number	x				8.4.4	Filler material		No difference between ISO and ASME	Silmilar requirements for impact applications. More restrictive for normal applications.
	.5	A-number	x				8.4.4	Filler material		No difference between ISO and ASME	Similar requirements for impact applications. More restrictive for normal applications.
	.6	Diameter			x	4.4.8	8.4.5	Filler size		No difference between ISO and ASME	No difference between ISO and ASME
	.12	Classification		x		4.4.8	8.4.4	Filler material			Silmilar requirements for impact applications. More restrictive for normal applications.

Table QW-255 GMAW		Variable	Essential	Supplementary Essential	Non-Essential	ISO 15609-1	ISO 15614-1	Variable	Comments (both levels)	Comments (Level 1)	Comments (Level 2)
QW-404 Filler Metals	.23	Product form	x			4.4.8		Welding Consumables	**No difference between ISO and ASME**		
	.24	Supplemental	x			4.1 /4.4.8	8.5.2.2	General / Welding Consumables		**No difference between ISO and ASME**	**ISO is more restrictive** - restricted to the wire system used in the welidng procedure test
	.27	Alloy elements	x			4.1 /4.4.8		General / Welding Consumables	**ASME is more restrictive** - not directly addressed in ISO.		
	.30	t	x				8.3.2.2	Deposited thickness	**No difference between ISO and ASME**		
	.33	Classification			x	4.4.8		Welding Consumables	**No difference between ISO and ASME**		
		Diameter	NOT ADDRESSED IN ASME IX			4.3.2	8.3.3 / 8.4.7	Diameter		**No difference between ISO and ASME** - not an essential variable for either	**ISO is more restrictive** - diameter is an essential variable (>= 0.5D) for piping..
QW-405 Positions	.1	Position			x	4.4.3	8.4.2	Position	**ISO is more restrictive** - position is an essential variable for impact and hardness applications in ISO		
	.3	Vertical welding			x		8.4.2	Position	**ISO is more restrictive** - vertical down shall be qualified by a specific test piece in ISO		
QW-406 Preheat	.1	Decrease > 100°F	x			4.4.11	8.4.8	Preheat	**ISO is more restrictive**: 50°C reduction(ISO) vs 55°C (ASME) reduction		
	.2	Preheat maintenance			x	4.4.13		Preheat maintenance tempeature	**No difference between ISO and ASME**		
	.3	Increase >100°F		x		4.4.12	8.4.9	Interpass		**No difference between ISO and ASME**	**ISO is more restrictive**: 50°C increase (ISO) vs 55°C (ASME) increase Applicable for materials group 8, 10, 41 to 48 *********verify and compare material requirements to section ix
	.1	PWHT	x			4.4.15	8.4.11	PWHT	**No difference between ISO and ASME** - addition or deletion of PWHT is not permitted.		

Table QW-255 GMAW		Variable	Essential	Supplementary Essential	Non-Essential	ISO 15609-1	ISO 15614-1	Variable	Comments (both levels)	Comments (Level 1)	Comments (Level 2)
QW-407 PWHT	.2	PWHT (T&T range)		x		4.4.15			**ASME is more restrictive** - PWHT time is not an essential variable (maybe it is addressed in another part of ISO??? that was not reviewed)		
QW-408 Gas	.1	Trail or change comp			x		8.5.2		**ISO is more restrictive**		
	.2	Single mixture or %	x			4.4.16	8.5.3.1		**ISO is more restrictive**		
	.3	Flow rate			x	4.5.3			**No difference between ISO and ASME**		
	.5	Backing flow			x	4.5.3			**No difference between ISO and ASME**		
	.9	Backing or change comp	x			4.5.3	8.5.2		**ISO is more restrictive**		
	.10	Taril or change comp	x			4.5.3	8.5.2		**ISO is more restrictive**		
QW-409	.1	> Heat input		x		4.4.17	8.4.7	Heat input		**No difference between ISO and ASME** when impact applications apply (maximum heat input)	**ASME is more restrictive** - the upper limit of the heat input qualified is 25% greater than used in welding the test piece in ISO.
	.4	Current or polarity			x	4.4.9	8.4.6	Type current	**ISO is more restrictive** - qualification is given for the type of current and polarity used in the welding procedure test. For process 111 (SMAW), AC also qualified for DC unless impact testing is required.		
	.8	I&E range			x	4.4.9			**No difference between ISO and ASME**		
	.30	Current or polarity	x			4.4.9			**ASME is more restrictive -** ISO does not specifically address current/polarity limitation		
	.32	Transfer mode			x	4.5.3	8.5.2.3	Transfer mode	**ISO is more restrictive** - Short ciruit only qualifies for short ciruit. Spray, pulse and globular qualifies for Spriay, pulse and globular (was the same as ASME in 2019 and earlier).		

Table QW-255 GMAW		Variable	Essential	Supplementary Essential	Non-Essential	ISO 15609-1	ISO 15614-1	Variable	Comments (both levels)	Comments (Level 1)	Comments (Level 2)
		Waveform control					8.5.2.3.2	Waveform control			ISO is more restrictive - Change from one manufacturrer to another manufacturer of the power source or a change in the waveform control mode requires a new qualificaiton test.
		Pulsed mode (without waveform control)					8.5.2.3.3	Pulsed mode (without waveform control)			ISO is more restrictive - When a power source with pulsed mode is used, the identification of the power source manufacturer shall be recorded on the WPQR.
		Without pulsed mode (without waveform control)					8.5.2.3.4	Without pulsed mode (without waveform control)			ISO is more restrictive - identification of the power source manufacturer is required.
		Post-heating for hydrogen release					8.4.10	Post-heating for hydrogen release		No difference	ISO is more restrictive - temperature and duration shall not be reduced. Shall not be omitted but may be added.
QW-410	.1	String or weave		x		4.4.5			ISO is more detailed		
	.3	Orfice cup nozzle size		x		4.5.3			No difference between ISO and ASME		
Technique	.5	Method of cleaning		x		4.4.4			No difference between ISO and ASME		
	.6	Method back gouge		x		4.4.6			ISO is more detailed		
	.7	Oscillation		x		4.4.5			No difference between ISO and ASME		
	.8	Tube-work distance		x		4.5.3			No difference between ISO and ASME		
	.9	Multiple to single pass/side		x			8.4.3		No difference between ISO and ASME		
	.10	Single to multiple electrodes		x		4.5.3			No difference between ISO and ASME		
	.15	Electrode spacing		x					No difference between ISO and ASME		

Table QW-255 GMAW		Variable	Essential	Supplementary Essential	Non-Essential	ISO 15609-1	ISO 15614-1	Variable	Comments (both levels)	Comments (Level 1)	Comments (Level 2)
	.25	Manual or automaic			x	4.4.10	8.4.1	Mechanization		Not an essential variable	**ISO is more restrictive** - Each degree of mechanization shall be qualified independently
	.26	Peening			x				**Not directly addressed in ISO**		
	.64	Use of thermal processes	x						**Not directly addressed in ISO**		
	.87	Multiple to single pass/side		x			8.4.3			**Similar requirements** for impact applications.	**Similar requirements** for impact applications.

<table>
<tr><th>ITEM</th><th>ASME Requirement for welders performance qualification</th><th>PED Requirement for welders performance qualification</th><th>Comparison Section IX - ISO</th><th>CSA Requirement for welders performance qualification</th></tr>
<tr><td>ASME code and European standards for welding and welder's qualification use in manufactuirng of pressure retaining components.</td><td>ASME Section IX</td><td>EN ISO 9606 Qualification testing of welders - Fusion welding - Part 1: Steels
Other ISO 9606 Parts
- Part 2: Aluminium and Aluminium Alloys
- Part 3: Copper and Copper Alloys
- Part 4: Nickel and Nickel Alloys
- Part 5: Titanium and Titanium Alloys; Zirconium and Zirconium Alloys
EN ISO 14732 Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials</td><td>Only 1 standard for qualification of welding personnel in ASME</td><td>ASME Section IX + Canadian Province Regulation</td></tr>
<tr><td>Welding processes</td><td>Shielded Metal-Arc Welding (SMAW)
Gas Metal-Arc Welding (GMAW and FCAW)
Gas Tungsten-Arc Welding (GTAW)
Submerged-Arc Welding (SAW)
Plasma-Arc Welding (PAW)
Oxyfuel Gas Welding (OFW)
Electroslag Welding (ESW)
Electrogas Welding (EGW)
Electron Beam Welding (EBW)
Laser Beam Welding (LBW)
Low-Power Density Laser Beam Welding(LLBW)</td><td>EN ISO 9606-1 Section 1
Fusion welding processes designated as manual or partly mechanized welding. Fully mechanized and automated welding processes are covered in ISO 14732.
Nomenclature for welding and allied processes is given in ISO 4063.

EN ISO 9606-1 Clause 5.2
Each test normally qualifies only one welding process. A change of welding process requires a new qualification test.
Exceptions are as follows:
- a change from solid wire electrode 135 to a metal cored electrode 138, or vice versa, does not require requalification
- a change from solid wire electrode 121 to a tubular cored electrode 125, or vice versa, does not require requalification
- welding with 141, 143 or 145 qualifies for 141, 142, 143 and 145, but 142 only qualifies for 142

It is permitted for a welder to be qualified for two or more welding processes by welding a single test piece (multi-process joint) or by two or more separate qualification tests.</td><td>Essentially the same requirements</td><td></td></tr>
<tr><td rowspan="4">Welders Qualification Tests - butt welds</td><td>Bend tests are mandatory or replaced by radiography</td><td>EN ISO 9606-1 Table 13
Either radiography, bend or fracture test shall be used. When RT is used then additional bend or fracture tests are mandatory for 131, 135, 138 and 311.

For outside pipe diameters D ≤ 25 mm, the bend or fracture tests may be replaced by a notched tensile test of the complete test piece/coupon.</td><td>Different requirements</td><td></td></tr>
<tr><td>Visual inspection is mandatory</td><td>EN ISO 9606-1 Table 13
Visual inspection is mandatory</td><td>Same in both standards</td><td></td></tr>
<tr><td>Volumetric NDE (Radiography/UT) is an option for some processes - SMAW,SAW, GTAW, PAW, and GMAW (except short-circuiting mode for radiographic examination) or a combination of these processes, except for P-No. 21 through P-No. 26, P-No. 51 through P-No. 53, and P-No. 61 through P-No. 62 metals. Welders making groove welds in P-No. 21 through P-No. 26, P-No. 51 through P-No. 53, P-No. 61, and P-No. 62 metals with the GTAW process may also be qualified by volumetric NDE</td><td>EN ISO 9606-1 Table 13
Either radiography, bend or fracture test shall be used. When RT is used then additional bend or fracture tests are mandatory for 131, 135, 138 and 311.

The radiographic testing may be replaced by ultrasonic testing according to ISO 17640 for thicknesses ≥ 8 mm on ferritic steels only. In this case, additional tests are not required.</td><td>ASME: UT ≥ 6 mm
EN ISO 9606-1: UT ≥ 8 mm</td><td></td></tr>
<tr><td>Fracture test is not required</td><td>EN ISO 9606-1 Table 13
Either radiography, bend or fracture test shall be used. When RT is used then additional bend or fracture tests are mandatory for 131, 135, 138 and 311.

For outside pipe diameters D ≤ 25 mm, the bend or fracture tests may be replaced by a notched tensile test of the complete test piece/coupon.</td><td>Fracture only in EN ISO 9606-1</td><td></td></tr>
<tr><td rowspan="3">Welders Qualification Tests - fillet welds</td><td>Visual inspection</td><td>EN ISO 9606-1 Table 13</td><td rowspan="3">ASME: fracture + macro
EN ISO 9606-1: fracture or macro</td><td></td></tr>
<tr><td>Fracture test</td><td>EN ISO 9606-1 Table 13
May be replaced by a macroscopic examination of at least two sections, at least one of which is taken from the stop/start location.
The fracture test on pipes may be replaced by RT.</td><td></td></tr>
<tr><td>Macro examination</td><td>EN ISO 9606-1 Table 13
Macro examination is an option</td><td></td></tr>
<tr><td colspan="5">Essential variable for welders (manual and semiautomatic)</td></tr>
<tr><td rowspan="2">Joints</td><td>QW-402.4 - applicable to SMAW, GTAW, GMAW, FCAW, PAW , LBW
The deletion of the backing in single welded groove welds. Double-welded groove welds are considered welding with backing.</td><td>Table 11 — Range of qualification for backings and consumable inserts
<table><tr><th rowspan="2">Test condition</th><th colspan="6">Range for qualification for backing and consumable inserts</th></tr><tr><th>No backing (ss,nb)</th><th>Material backing (ss,mb)</th><th>Welding from both sides (bs)</th><th>Gas backing (ss,gb)</th><th>Consumable insert (ci)</th><th>Flux backing (ss,fb)</th></tr><tr><td>No backing (ss,nb)</td><td>×</td><td>×</td><td>×</td><td>×</td><td>—</td><td>×</td></tr><tr><td>Material backing (ss,mb)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td></tr><tr><td>Welding from both sides (bs)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td></tr><tr><td>Gas backing (ss,gb)</td><td>—</td><td>×</td><td>×</td><td>×</td><td>—</td><td>—</td></tr><tr><td>Consumable insert (ci)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>×</td><td>—</td></tr><tr><td>Flux backing (ss,fb)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>—</td><td>×</td></tr></table>× indicates those conditions for which the welder is qualified.
— indicates those conditions for which the welder is not qualified.</td><td>Same in both standards</td><td></td></tr>
<tr><td>QW-402.7 -applicable to OFW
The addition of backing.</td><td>EN ISO 9606-1: No additional qualification requirements for OFW regarding backing.</td><td>Only in ASME IX</td><td></td></tr>
</table>

<table>
<tr><th>ITEM</th><th>ASME Requirement for welders performance qualification</th><th>PED Requirement for welders performance qualification</th><th>Comparison Section IX - ISO</th><th>CSA Requirement for welders performance qualification</th></tr>
<tr><td rowspan="3">Base metal</td><td>QW-403.16 applicable SMAW, SAW, GTAW, GMAW, FCAW, PAW, LBW
A change in the pipe diameter beyond the range qualified in QW-452, except as otherwise permitted in QW-303.1, QW-303.2, QW-381.2(c), or QW-382.1(f). For tube-to-tubesheet welding: an increase or decrease greater than 10% of the specified tube diameter.
(a) For a groove weld attaching a set-on nozzle or branch (with the weld preparation on the nozzle or branch), the range qualified from Table QW-452.3 shall be based on the nozzle or branch pipe O.D.
(b) For a groove weld attaching a set-in nozzle or branch (with the weld preparation on the shell, head, or run pipe), the range qualified from Table QW-452.3 shall be based on the shell, head, or run pipe O.D.

Table QW-452.3
Groove-Weld Diameter Limits
<table><tr><th rowspan="2">Outside Diameter of Test Coupon, in. (mm)</th><th colspan="2">Outside Diameter Qualified, in. (mm)</th></tr><tr><th>Min.</th><th>Max.</th></tr><tr><td>Less than 1 (25)</td><td>Size welded</td><td>Unlimited</td></tr><tr><td>1 (25) to 2⅞ (73)</td><td>1 (25)</td><td>Unlimited</td></tr><tr><td>Over 2⅞ (73)</td><td>2⅞ (73)</td><td>Unlimited</td></tr></table>GENERAL NOTES:
(a) Type and number of tests required shall be in accordance with QW-452.1.
(b) 2⅞ in. (73 mm) O.D. is the equivalent of NPS 2½ (DN 65).

Table QW-452.4
Small Diameter Fillet-Weld Test
<table><tr><th>Outside Diameter of Test Coupon, in. (mm)</th><th>Minimum Outside Diameter, Qualified, in. (mm)</th><th>Qualified Thickness</th></tr><tr><td>Less than 1 (25)</td><td>Size welded</td><td>All</td></tr><tr><td>1 (25) to 2⅞ (73)</td><td>1 (25)</td><td>All</td></tr><tr><td>Over 2⅞ (73)</td><td>2⅞ (73)</td><td>All</td></tr></table>GENERAL NOTES:
(a) The type and number of tests required and the qualified fillet sizes shall be in accordance with Table QW-452.5.
(b) 2⅞ in. (73 mm) O.D. is considered the equivalent of NPS 2½ (DN 65).</td><td>EN ISO 9606-1 Clause 5.7
In the case of branch welding, the outside pipe diameter criteria to which Table 7 applies are as follows:
- set-on: the deposited thickness and outside pipe diameter of the branch.
- set-in or set-through: the deposited thickness of the main pipe or shell and the outside pipe diameter of the branch.

For test pieces of different outside pipe diameters, the welder is qualified for the smallest through to the largest diameter qualified.

Table 7 — Range of qualification for outside pipe diameter
Dimensions in millimetres
<table><tr><th>Outside pipe diameter of test piece[a]
D</th><th>Range of qualification</th></tr><tr><td>D ≤ 25</td><td>D to 2D</td></tr><tr><td>D > 25</td><td>≥ 0,5D (25 mm min.)</td></tr></table>[a] For non-circular hollow sections, D is the dimension of the smaller side.</td><td>Different requirements for outside pipe diameter.</td><td></td></tr>
<tr><td>QW-403.2 applicable to OFW
The maximum thickness qualified is the thickness of the test coupon</td><td>EN ISO 9606-1: No additional qualification requirements for OFW regarding base metal.</td><td>Only in ASME IX</td><td></td></tr>
<tr><td>QW-403.18-applicable SMAW, SAW,GTAW, GMAW, FCAW,PAW, OFW, LBW
A change from one P-Number to any other P-Number or to a base metal not listed in Table QW/QB-422, except as permitted in QW-423, and in QW-420. For tube-to-tubesheet welding: a change in the P-Number or A-Number of the tubesheet cladding material (if the cladding material is part of the weld).
<table><tr><th>Base Metal(s) Used for Performance Qualification</th><th>Base Metals Qualified</th></tr><tr><td>P-No. 1 through P-No. 15F, P-No. 34, or P-No. 41 through P-No. 49</td><td>P-No. 1 through P-No. 15F, P-No. 34, and P-No. 41 through P-No. 49</td></tr><tr><td>P-No. 21 through P-No. 26</td><td>P-No. 21 through P-No. 26</td></tr><tr><td>P-No. 51 through P-No. 53 or P-No. 61 or P-No. 62</td><td>P-No. 51 through P-No. 53 and P-No. 61 and P-No. 62</td></tr><tr><td>Any unassigned metal to the same unassigned metal</td><td>The unassigned metal to itself</td></tr><tr><td>Any unassigned metal to any P-Number metal</td><td>The unassigned metal to any metal assigned to the same P-Number as the qualified metal</td></tr><tr><td>Any unassigned metal to any other unassigned metal</td><td>The first unassigned metal to the second unassigned metal</td></tr></table></td><td>EN ISO 9606-1 Clause 5.5.1
The parent material used in a qualification test should be from any suitable material from ISO/TR 15608, material groups 1 to 11.

For processes 142 and 311 (without filer material), the parent material group used in the test is the material group that the welder is qualified for.</td><td>The base metal doesn't play any significant role in both standards when filler material is used</td><td></td></tr>
<tr><td>QW-404.14- applicable to GTAW, OFW, PAW, LBW
The deletion or addition of filler metal.</td><td>EN ISO 9606-1 Clause 5.6
Welding with filler material qualifies for welding without filler material, but not vice versa.

For processes 142 (autogenous TIG welding) and 311 (oxyacetylene welding) without filler material, the parent material group used in the test is the material group that the welder is qualified for.</td><td>ISO 9606-1 allows welding without filler material based on qualification with filler material</td><td></td></tr>
</table>

<table>
<tr><th>ITEM</th><th>ASME Requirement for welders performance qualification</th><th>PED Requirement for welders performance qualification</th><th>Comparison Section IX - ISO</th><th>CSA Requirement for welders performance qualification</th></tr>
<tr><td rowspan="3">Filler metals</td><td>QW-404.15-applicable SMAW, SAW, GMAW, FCAW, OFW, GTAW,PAW, LBW
A Change from one F-Number in Table
QW-432 to any other F-Number or to any other filler metal,
except as permitted in QW-433.

QW-433 ALTERNATE F-NUMBERS FOR WELDER PERFORMANCE QUALIFICATION
The following tables identify the filler metal or electrode that the welder used during qualification testing as "Qualified With," and the electrodes or filler metals that the welder is qualified to use in production welding as "Qualified For." See Table QW-432 for the F-Number assignments.

<table>
<tr><th>Qualified With →
Qualified For ↓</th><th>F-No. 1 With Backing</th><th>F-No. 1 Without Backing</th><th>F-No. 2 With Backing</th><th>F-No. 2 Without Backing</th><th>F-No. 3 With Backing</th><th>F-No. 3 Without Backing</th><th>F-No. 4 With Backing</th><th>F-No. 4 Without Backing</th><th>F-No. 5 With Backing</th><th>F-No. 5 Without Backing</th></tr>
<tr><td>F-No. 1 With Backing</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>F-No. 1 Without Backing</td><td>...</td><td>X</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr>
<tr><td>F-No. 2 With Backing</td><td>...</td><td>...</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>...</td><td>...</td></tr>
<tr><td>F-No. 2 Without Backing</td><td>...</td><td>...</td><td>...</td><td>X</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr>
<tr><td>F-No. 3 With Backing</td><td>...</td><td>...</td><td>...</td><td>...</td><td>X</td><td>X</td><td>X</td><td>X</td><td>...</td><td>...</td></tr>
<tr><td>F-No. 3 Without Backing</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>X</td><td>...</td><td>...</td><td>...</td><td>...</td></tr>
<tr><td>F-No. 4 With Backing</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>X</td><td>X</td><td>...</td><td>...</td></tr>
<tr><td>F-No. 4 Without Backing</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>X</td><td>...</td><td>...</td></tr>
<tr><td>F-No. 5 With Backing</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>X</td><td>X</td></tr>
<tr><td>F-No. 5 Without Backing</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>X</td></tr>
</table>

<table>
<tr><th>Qualified With</th><th>Qualified For</th></tr>
<tr><td>Any F-No. 6</td><td>All F-No. 6 [Note (1)]</td></tr>
<tr><td>Any F-No. 21 through F-No. 26</td><td>All F-No. 21 through F-No. 26</td></tr>
<tr><td>Any F-No. 31, F-No. 32, F-No. 33, F-No. 35, F-No. 36, or F-No. 37</td><td>Only the same F-Number as was used during the qualification test</td></tr>
<tr><td>F-No. 34 or any F-No. 41 through F-No. 46</td><td>F-No. 34 and all F-No. 41 through F-No. 46</td></tr>
<tr><td>Any F-No. 51 through F-No. 55</td><td>All F-No. 51 through F-No. 55</td></tr>
<tr><td>Any F-No. 61</td><td>All F-No. 61</td></tr>
<tr><td>Any F-No. 71 through F-No. 72</td><td>Only the same F-Number as was used during the qualification test</td></tr>
</table>

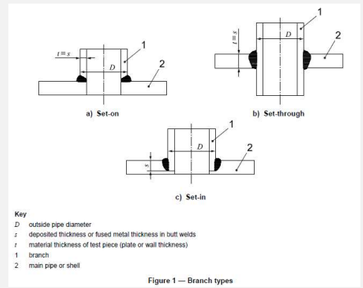
NOTE: (1) Deposited weld metal made using a bare rod not covered by an SFA Specification but which conforms to an analysis listed in Table QW-442 shall be considered to be classified as F-No. 6.</td><td>EN ISO 9606-1 Clause 5.5.2:
Welding with a filler material in one group qualifies the welder for welding with all other filler materials within the same group, as well as other groups, listed in Table 3, and welding on parent materials from groups 1 to 11.

Table 3 — Range of qualification for filler material
<table>
<tr><th rowspan="2">Filler material</th><th colspan="6">Range of qualification</th></tr>
<tr><th>FM1</th><th>FM2</th><th>FM3</th><th>FM4</th><th>FM5</th><th>FM6</th></tr>
<tr><td>FM1</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>FM2</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>FM3</td><td>×</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>FM4</td><td>×</td><td>×</td><td>×</td><td>×</td><td>—</td><td>—</td></tr>
<tr><td>FM5</td><td>—</td><td>—</td><td>—</td><td>—</td><td>×</td><td>—</td></tr>
<tr><td>FM6</td><td>—</td><td>—</td><td>—</td><td>—</td><td>×</td><td>×</td></tr>
<tr><td colspan="7">× indicates those filler materials for which the welder is qualified.
— indicates those filler materials for which the welder is not qualified.</td></tr>
</table>

Table 2 — Filler material grouping
<table>
<tr><th>Group</th><th>Filler material for welding of</th><th>Examples of applicable standards</th></tr>
<tr><td>FM1</td><td>Non-alloy and fine grain steels</td><td>ISO 2560,[2] ISO 14341,[8] ISO 636,[1] ISO 14171,[8] ISO 17632[14]</td></tr>
<tr><td>FM2</td><td>High-strength steels</td><td>ISO 18275,[21] ISO 16834,[13] ISO 26304,[25] ISO 18276[22]</td></tr>
<tr><td>FM3</td><td>Creep-resisting steels Cr < 3,75 %</td><td>ISO 3580,[3] ISO 21952,[23] ISO 24598,[24] ISO 17634[16]</td></tr>
<tr><td>FM4</td><td>Creep-resisting steels 3,75 ≤ Cr ≤ 12 %</td><td>ISO 3580,[3] ISO 21952,[23] ISO 24598,[24] ISO 17634[16]</td></tr>
<tr><td>FM5</td><td>Stainless and heat-resisting steels</td><td>ISO 3581,[4] ISO 14343,[9] ISO 17633[15]</td></tr>
<tr><td>FM6</td><td>Nickel and nickel alloys</td><td>ISO 14172,[7] ISO 18274[20]</td></tr>
</table></td><td>Different principles for grouping of filler materials</td><td></td></tr>
<tr><td>QW-404.22 - applicable to GTAW, PAW, LBW
The omission or addition of consumable
inserts. Qualification in a single-welded butt joint, with or
without consumable inserts, qualifies for fillet welds and
single-welded butt joints with backing or double-welded
butt joints. Consumable inserts that conform to
SFA-5.30 , except that the chemical analysis of the insert
conforms to an analysis for any bare wire given in any
SFA specification or AWS Classification, shall be considered
as having the same F-Number as that bare wire as
given in Table QW-432</td><td>Table 11 — Range of qualification for backings and consumable inserts
<table>
<tr><th rowspan="2">Test condition</th><th colspan="6">Range for qualification for backing and consumable inserts</th></tr>
<tr><th>No backing (ss,nb)</th><th>Material backing (ss,mb)</th><th>Welding from both sides (bs)</th><th>Gas backing (ss,gb)</th><th>Consumable insert (ci)</th><th>Flux backing (ss,fb)</th></tr>
<tr><td>No backing (ss,nb)</td><td>×</td><td>×</td><td>×</td><td>×</td><td>—</td><td>×</td></tr>
<tr><td>Material backing (ss,mb)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>Welding from both sides (bs)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>Gas backing (ss,gb)</td><td>—</td><td>×</td><td>×</td><td>×</td><td>—</td><td>—</td></tr>
<tr><td>Consumable insert (ci)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>×</td><td>—</td></tr>
<tr><td>Flux backing (ss,fb)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>—</td><td>×</td></tr>
<tr><td colspan="7">× indicates those conditions for which the welder is qualified.
— indicates those conditions for which the welder is not qualified.</td></tr>
</table></td><td>Same in both standards</td><td></td></tr>
<tr><td>QW-404.23- applicable to GTAW, PAW, LBW
A change from one of the following filler
metal product forms to another:
(a) bare (solid or metal cored)
(b) flux cored
(c) flux coated (solid or metal cored)
(d) powder</td><td>EN ISO 9606-1 Clause 5.6
The ranges of qualification for filler material type are given in Tables 4 and 5.

Table 4 — Range of qualification for covered electrodes[a]
<table>
<tr><th rowspan="2">Welding process</th><th rowspan="2">Type of covering used in the test[b]</th><th colspan="3">Range of qualification</th></tr>
<tr><th>A, RA, RB, RC, RR, R
03, 13, 14, 19, 20, 24, 27</th><th>B
15, 16, 18, 28, 45, 48</th><th>C
10, 11</th></tr>
<tr><td rowspan="3">111</td><td>A, RA, RB, RC, RR, R
03, 13, 14, 19, 20, 24, 27</td><td>×</td><td>—</td><td>—</td></tr>
<tr><td>B
15, 16, 18, 28, 45, 48</td><td>×</td><td>×</td><td>—</td></tr>
<tr><td>C
10, 11</td><td>—</td><td>—</td><td>×</td></tr>
<tr><td colspan="5">× indicates those filler material types for which the welder is qualified.
— indicates those filler material types for which the welder is not qualified.
[a] For abbreviations, see 4.3.2.
[b] The type of covering used in the qualification test of welders for root run welding without backing (ss nb) is the type of covering qualified for root run welding in production with no backing (ss nb).</td></tr>
</table>

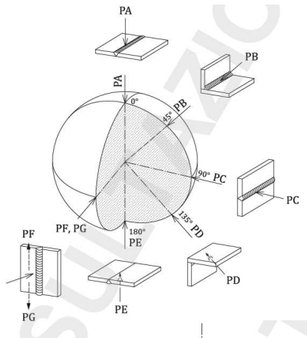
Table 5 — Range of qualification for filler material types[a,b]
<table>
<tr><th rowspan="2">Filler material types used in test piece</th><th colspan="4">Range of qualification</th></tr>
<tr><th>S</th><th>M</th><th>B</th><th>R, P, V, W, Y, Z</th></tr>
<tr><td>Solid wire electrode, rod (S)</td><td>×</td><td>×</td><td>—</td><td>—</td></tr>
<tr><td>Metal cored electrode, rod (M)</td><td>×</td><td>×</td><td>—</td><td>—</td></tr>
<tr><td>Flux cored electrode, rod (B)</td><td>—</td><td>—</td><td>×</td><td>×</td></tr>
<tr><td>Flux cored electrode, rod (R, P, V, W, Y, Z)</td><td>—</td><td>—</td><td>—</td><td>×</td></tr>
<tr><td colspan="5">× indicates those filler material types for which the welder is qualified.
— indicates those filler material types for which the welder is not qualified.
[a] For abbreviations, see 4.3.2.
[b] The type of flux cored wire used in the qualification test of welders for root run welding without backing (ss, nb) is the type of flux cored wire qualified for root run welding in production with no backing (ss, nb).</td></tr>
</table></td><td>Similar, but not identical requirements</td><td></td></tr>
</table>

ITEM	ASME Requirement for welders performance qualification	PED Requirement for welders performance qualification	Comparison Section IX - ISO	CSA Requirement for welders performance qualification
	QW-404.30- applicable to SMAW, SAW, GMAW, FCAW, GTAW,PAW, LBW A change in deposited weld metal thickness beyond that qualified in accordance with QW-451 for procedure qualification or QW-452 for performance qualification, except as otherwise permitted in QW-303.1 and QW-303.2. When a welder is qualified using volumetric examination, the maximum thickness stated in Table QW-452.1(b) applies. **Table QW-452.1(b)** **Thickness of Weld Metal Qualified** Thickness, *t*, of Weld Metal in the Coupon, in. (mm) [Notes (1), (2)] / Thickness of Weld Metal Qualified [Note (3)] All / 2*t* 1/2 (13) and over with a minimum of three layers / Maximum to be welded NOTES: (1) When more than one welder, process, or set of essential variables is used during welding of a test coupon, the thickness, *t*, of the weld metal in the coupon deposited by each welder, for each process, and with each set of essential variables shall be determined and used individually in the "Thickness, *t*, of Weld Metal in the Coupon" column to determine the "Thickness of Weld Metal Qualified." (2) Two or more pipe test coupons with different weld metal thickness may be used to determine the weld metal thickness qualified and that thickness may be applied to production welds to the smallest diameter for which the welder is qualified in accordance with Table QW-452.3. (3) Thickness of test coupon of 3/4 in. (19 mm) or over shall be used for qualifying a combination of three or more welders each of whom may use the same or a different welding process.	**Table 1 — Deposited thickness range of weld metal for single and multi-process joints for butt welds** Welding process used for test piece / Deposited thickness range qualified according to Table 6: Single process joint / Multi-process joint for welding process 1: $z = z_1$ for welding process 2: $z = z_2$ $z = z_1 + z_2$ 1 welding process 1 (ss nb) 2 welding process 2 (ss mb) for welding process 1: z_1 for welding process 2: z_2 for $z = z_1 + z_2$ welding process 1 only for welding of the root area 1 welding process 1 2 welding process 2 3 welding with backing (ss mb) 4 welding without backing (ss nb) **Table 6 — Range of qualification of deposited thickness for butt welds** Dimensions in millimetres Deposited thickness of test piece *z* / Range of qualification[a,b] $z < 3$ / z to 3[c] or z to $2z$[c] whichever is greater $3 \leq z < 12$ / 3 to $2z$[d] $z \geq 12$[e,f] / ≥ 3[f] [a] For single process and the same type of filler material, *z*, is equal to parent material *z*. [b] For branch joints, the range of qualification for deposited thickness is: — for set-on branch, see, for example, Figure 1 a), the deposited thickness of the branch; — for set-through and set-in branches, see, for example, Figure1 b) and c), the deposited thickness of the main pipe or shell. [c] For oxyacetylene welding (311): z to 1,5z [d] For oxyacetylene welding (311): 3 to 1,5z [e] The test piece has to be welded in at least 3 layers [f] For multi-processes, *z* is the deposited thickness for each process. **Table 8 — Range of qualification of material thickness for fillet welds** Dimensions in millimetres Material thickness of test piece *t* / Range of qualification $t < 3$ / t to $2t$, or 3, whichever is greater $t \geq 3$ / ≥ 3  **Figure 1 — Branch types** **EN ISO 9606-1 Clause 5.7** In the case of branch welding, the deposited thickness criteria to which Table 6 applies are as follows: - set-on: the deposited thickness and outside pipe diameter of the branch. - set-in or set-through: the deposited thickness of the main pipe or shell and the outside pipe diameter of the branch. For test pieces of different deposited thicknesses, the welder is qualified for the thinnest through to the thickest deposited and/or parent metal thickness	**Butt welds:** Unlike ISO 9606-1, there is no min. qualified weld metal thinkness in ASME IX. **Fillet Welds:** Butt welds do not qualify fillet welds or vice versa.	
	QW-404.31- applicable to OFW The maximum thickness qualified is the thickness of the test coupon.	**EN ISO 9606-1 Table 6** For oxyacetylene welding (311) the range of qualification of deposited thickness is: - s to 1.5s if s < 3 mm - 3 to 1.5s if 3 ≤ s < 12 mm	Different requirements	
	QW-404.32- applicable to GMAW and FCAW For the low voltage short-circuiting type of gas metal-arc process when the deposited weld metal thickness is less than 1/2 in. (13 mm), an increase in deposited weld metal thickness beyond 1.1 times that of the qualification test deposited weld metal thickness. For weld metal thicknesses of 1/2 in. (13 mm) and greater, use Table QW-451.1, Table QW-451.2, or Tables QW-452.1(a) and QW-452.1(b), as applicable.	EN ISO 9606-1: No limitation of the qualified deposited weld metal thickness due to the transfer mode.	Only in ASME IX	

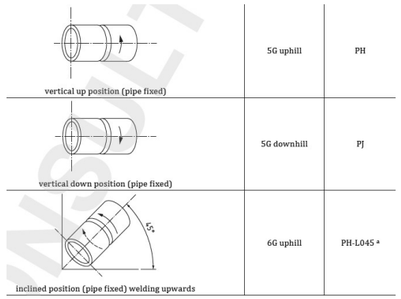
<table>
<tr><th>ITEM</th><th>ASME Requirement for welders performance qualification</th><th>PED Requirement for welders performance qualification</th><th>Comparison Section IX - ISO</th><th>CSA Requirement for welders performance qualification</th></tr>
<tr><td rowspan="2">Positions</td><td>QW-405.1- applicable SMAW, SAW, GMAW, FCAW, OFW, GTAW,PAW,LBW
The addition of other welding positions
than those already qualified. See QW-120, QW-130,
QW-203, and QW-303

Table QW-461.9
Performance Qualification — Position and Diameter Limitations
(Within the Other Limitations of QW-303)
<table><tr><th colspan="2" rowspan="2">Qualification Test</th><th colspan="3">Position and Type Weld Qualified [Note (1)]</th></tr><tr><th colspan="2">Groove</th><th>Fillet or Tack [Note (2)]</th></tr><tr><th>Weld</th><th>Position</th><th>Plate and Pipe Over 24 in. (610 mm) O.D.</th><th>Pipe ≤24 in. (610 mm) O.D.</th><th>Plate and Pipe</th></tr><tr><td>Plate — Groove</td><td>1G</td><td>F</td><td>F [Note (3)]</td><td>F</td></tr><tr><td></td><td>2G</td><td>F, H</td><td>F, H [Note (3)]</td><td>F, H</td></tr><tr><td></td><td>3G</td><td>F, V</td><td>F [Note (3)]</td><td>F, H, V</td></tr><tr><td></td><td>4G</td><td>F, O</td><td>F [Note (3)]</td><td>F, H, O</td></tr><tr><td></td><td>3G and 4G</td><td>F, V, O</td><td>F [Note (3)]</td><td>All</td></tr><tr><td></td><td>2G, 3G, and 4G</td><td>All</td><td>F, H [Note (3)]</td><td>All</td></tr><tr><td></td><td>Special Positions (SP)</td><td>SP, F</td><td>SP, F</td><td>SP, F</td></tr><tr><td>Plate — Fillet</td><td>1F</td><td>--</td><td>--</td><td>F [Note (3)]</td></tr><tr><td></td><td>2F</td><td>--</td><td>--</td><td>F, H [Note (3)]</td></tr><tr><td></td><td>3F</td><td>--</td><td>--</td><td>F, H, V [Note (3)]</td></tr><tr><td></td><td>4F</td><td>--</td><td>--</td><td>F, H, O [Note (3)]</td></tr><tr><td></td><td>3F and 4F</td><td>--</td><td>--</td><td>All [Note (3)]</td></tr><tr><td></td><td>Special Positions (SP)</td><td>--</td><td>--</td><td>SP, F [Note (3)]</td></tr><tr><td>Pipe — Groove [Note (4)]</td><td>1G</td><td>F</td><td>F</td><td>F</td></tr><tr><td></td><td>2G</td><td>F, H</td><td>F, H</td><td>F, H</td></tr><tr><td></td><td>5G</td><td>F, V, O</td><td>F, V, O</td><td>All</td></tr><tr><td></td><td>6G</td><td>All</td><td>All</td><td>All</td></tr><tr><td></td><td>2G and 5G</td><td>All</td><td>All</td><td>All</td></tr><tr><td></td><td>Special Positions (SP)</td><td>SP, F</td><td>SP, F</td><td>SP, F</td></tr><tr><td>Pipe — Fillet [Note (4)]</td><td>1F</td><td>--</td><td>--</td><td>F</td></tr><tr><td></td><td>2F</td><td>--</td><td>--</td><td>F, H</td></tr><tr><td></td><td>2FR</td><td>--</td><td>--</td><td>F, H</td></tr><tr><td></td><td>4F</td><td>--</td><td>--</td><td>F, H, O</td></tr><tr><td></td><td>5F</td><td>--</td><td>--</td><td>All</td></tr><tr><td></td><td>Special Positions (SP)</td><td>--</td><td>--</td><td>SP, F</td></tr></table>NOTES:
(1) Positions of welding as shown in Figures QW-461.1 and QW-461.2.
F = Flat
H = Horizontal
V = Vertical
O = Overhead
SP = Special Positions (see QW-303.3)
(2) Tack welds are not limited by pipe or tube diameters when their aggregate length does not exceed 25% of the weld circumference.
(3) Pipe 2⅞ in. (73 mm) O.D. and over.
(4) See diameter restrictions in Tables QW-452.3, QW-452.4, and QW-452.6.</td><td>Table 9 — Range of qualification for welding positions for butt welds
<table><tr><th rowspan="2">Testing position</th><th colspan="5">Range of qualification</th></tr><tr><th>PA Flat</th><th>PC Horizontal</th><th>PE Overhead</th><th>PF Vertical up</th><th>PG Vertical down</th></tr><tr><td>PA</td><td>×</td><td>—</td><td>—</td><td>—</td><td>—</td></tr><tr><td>PC</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td></tr><tr><td>PE (plate)</td><td>×</td><td>×</td><td>×</td><td>—</td><td>—</td></tr><tr><td>PF (plate)</td><td>×</td><td>—</td><td>—</td><td>×</td><td>—</td></tr><tr><td>PH (pipe)</td><td>×</td><td>—</td><td>×</td><td>×</td><td>—</td></tr><tr><td>PG (plate)</td><td>—</td><td>—</td><td>—</td><td>—</td><td>×</td></tr><tr><td>PJ (pipe)</td><td>×</td><td>—</td><td>×</td><td>—</td><td>×</td></tr><tr><td>H-L045</td><td>×</td><td>×</td><td>×</td><td>×</td><td>—</td></tr><tr><td>J-L045</td><td>×</td><td>×</td><td>×</td><td>—</td><td>×</td></tr></table>NOTE See also 5.3.
× indicates those welding positions for which the welder is qualified.
— indicates those welding positions for which the welder is not qualified.

Table 10 — Range of qualification for welding positions for fillet welds
<table><tr><th rowspan="2">Testing position</th><th colspan="7">Range of qualification</th></tr><tr><th>PA Flat</th><th>PB Horizontal</th><th>PC Horizontal</th><th>PD Overhead</th><th>PE Overhead</th><th>PF Vertical up</th><th>PG Vertical down</th></tr><tr><td>PA</td><td>×</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr><tr><td>PB</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr><tr><td>PC</td><td>×</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td><td>—</td></tr><tr><td>PD</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td><td>—</td><td>—</td></tr><tr><td>PE (plate)</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td><td>—</td><td>—</td></tr><tr><td>PF (plate)</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td><td>×</td><td>—</td></tr><tr><td>PH (pipe)</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td><td>—</td></tr><tr><td>PG (plate)</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>×</td></tr><tr><td>PJ (pipe)</td><td>×</td><td>×</td><td>—</td><td>×</td><td>×</td><td>—</td><td>×</td></tr></table>NOTE See also 5.3.
× indicates those welding positions for which the welder is qualified.
— indicates those welding positions for which the welder is not qualified.

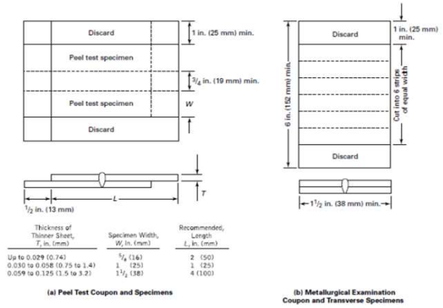
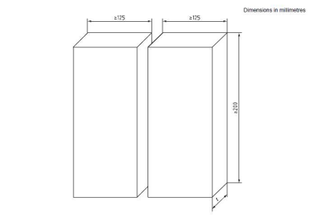
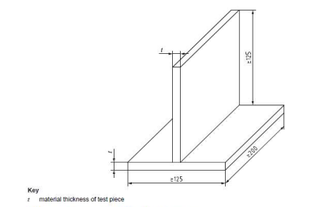
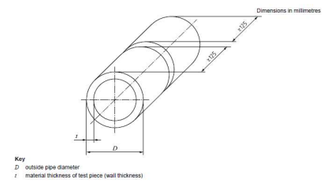
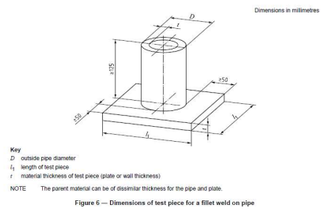
 

Key
A flat position
PB horizontal vertical position
PC horizontal position
PD horizontal overhead position
PE overhead position
PF vertical position (welding upwards)
PG vertical position (welding downwards)

<table><tr><td>5G uphill</td><td>PH</td></tr><tr><td>5G downhill</td><td>PJ</td></tr><tr><td>6G uphill</td><td>PH-L045 *</td></tr></table>
EN ISO 9606-1 Clause 5.8
- Welding two pipes with the same outside pipe diameter, one in welding position PH and one in welding position PC, also covers the range of qualification of a pipe welded in welding position H-L045 using upward welding.
- Welding two pipes with the same outside pipe diameter, one in welding position PJ and one in welding position PC, also covers the range of qualification of a pipe welded in welding position J-L045 using downward welding.
- Outside pipe diameters D ≥ 150 mm can be welded in two welding positions (PH or PJ 2/3 of circumference, PC 1/3 of circumference) using only one test piece. This test covers all positions for the direction of welding used in the test.</td><td>Specific requirements in EN ISO 9606-1</td><td></td></tr>
<tr><td>QW-405.3- applicable to SMAW, GMAW, FCAW, GTAW, PAW ,LBW
A change from upward to downward, or
from downward to upward, in the progression specified
for any pass of a vertical weld, except that the cover or
wash pass may be up or down. The root pass may also
be run either up or down when the root pass is removed
to sound weld metal in the preparation for welding the
second side.</td><td></td><td></td><td></td></tr>
<tr><td>Gas</td><td>QW-408.7- applicable to OFW
A change in the type of fuel gas</td><td>EN ISO 9606-1: No qualification requirements for the type of fuel gas.</td><td>Only in ASME IX</td><td></td></tr>
<tr><td></td><td>QW-408.8- applicable to GMAW, FCAW, GTAW, PAW, LBW
The omission of backing gas except that
requalification is not required when welding a single welded
butt joint with a backing strip or a double-welded
butt joint or a fillet weld. This exception does not apply to
P-No. 51 through P-No. 53, P-No. 61 through P-No. 62, and
P-No. 10I metals</td><td>Table 11 — Range of qualification for backings and consumable inserts
<table><tr><th rowspan="2">Test condition</th><th colspan="6">Range for qualification for backing and consumable inserts</th></tr><tr><th>No backing (ss,nb)</th><th>Material backing (ss,mb)</th><th>Welding from both sides (bs)</th><th>Gas backing (ss,gb)</th><th>Consumable insert (ci)</th><th>Flux backing (ss,fb)</th></tr><tr><td>No backing (ss,nb)</td><td>×</td><td>×</td><td>×</td><td>×</td><td>—</td><td>×</td></tr><tr><td>Material backing (ss,mb)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td></tr><tr><td>Welding from both sides (bs)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>—</td><td>—</td></tr><tr><td>Gas backing (ss,gb)</td><td>—</td><td>×</td><td>×</td><td>×</td><td>—</td><td>—</td></tr><tr><td>Consumable insert (ci)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>×</td><td>—</td></tr><tr><td>Flux backing (ss,fb)</td><td>—</td><td>×</td><td>×</td><td>—</td><td>—</td><td>×</td></tr></table>× indicates those conditions for which the welder is qualified.
— indicates those conditions for which the welder is not qualified.</td><td>Same in both standards</td><td></td></tr>
<tr><td rowspan="2">Electrical</td><td>QW-409.2- applicable to GMAW and FCAW
A change from globular, spray or pulsed
spray transfer welding to short-circuiting transfer welding
or vice versa.</td><td>EN ISO 9606-1 Clause 5.2
Qualifying the welder for dip (short-circuit) transfer mode (131, 135 and 138) shall qualify him for other transfer modes, but not vice versa.</td><td>ISO 9606-1 offers relaxation when short-circuiting transfer has been used for the qualification</td><td></td></tr>
<tr><td>QW-409.4 - applicable to GTAW
A change from AC to DC, or vice versa; and in
DC welding, a change from electrode negative (straight
polarity) to electrode positive (reverse polarity), or
vice versa.</td><td>EN ISO 9606-1 Section 10
The type of current and polarity shall be recorded on the certificate.
The change from AC to DC, or vice versa, is not an essential variable.</td><td>Nonessential variable in ISO 9606-1</td><td></td></tr>
<tr><td>Technique</td><td>QW-410.68-applicable to LBW
A change in welding equipment type (e.g.,
YAG, TAG, etc.).</td><td rowspan="2">The essenial variables and range of qualification for laser beam welding are encompassed in EN ISO 14732</td><td>Specific requirements in ASME IX</td><td></td></tr>
<tr><td>QW-410.88-applicable to LBW
A change from keyhole LBWto LLBW, and
vice versa.</td></tr>
</table>

ITEM	ASME Requirement for welders performance qualification	PED Requirement for welders performance qualification	Comparison Section IX - ISO	CSA Requirement for welders performance qualification
Technique	**QW-410.89-applicable to LBW** An addition or deletion of torch-controlled oscillation. **QW-410.90-applicable to LBW** A change from pulsed mode of operation to continuous mode of operation, and vice versa.	The essential variables and range of qualification for laser beam welding are encompassed in EN ISO 14732.		
		Essential Variables — Automatic Welding		
Automatic Welding	A change from automatic to machine welding A change in the welding process. For electron beam and laser welding, the addition or deletion of filler metal. For laser welding and hybrid welding using lasers, a change in laser type (e.g., a change from CO2 to YAG). For friction welding (excluding friction stir welding), a change from continuous drive to inertia welding or vice versa. For electron beam welding, a change from vacuum to out-of-vacuum equipment, and vice versa	**EN ISO 14732 Clause 4.1** The qualification test for welding operators and weld setters shall follow a preliminary welding procedure specification (pWPS) or welding procedure specification (WPS) prepared in accordance with the relevant part of ISO 15609. Welding operators or weld setters shall be qualified by one of the following methods: a) qualification based on a welding procedure test in accordance with the relevant part of ISO 15614 b) qualification based on a pre-production welding test in accordance with ISO 15613 c) qualification based on a test piece in accordance with the relevant part of ISO 9606 d) qualification based on a production test or production sample test **4.2.2 Automatic welding** The following changes require re-qualification: — change of the welding process (except variants within welding process 13 as defined in ISO 4063) — welding with or without arc sensor and/or joint sensor — change from single-run-per-side technique to multi-run-per-side technique (but not vice versa) — change of type of welding unit (including change in the robot control system) — change from welding with arc sensor and/or joint sensor to welding without arc sensor and/or joint sensor (but not vice versa)	Different requirements	
		Essential Variables — Machine Welding		
Machine Welding	A change in the welding process A change from direct visual control to remote visual control and vice-versa The deletion of an automatic arc voltage control system for GTAW The deletion of automatic joint tracking The addition of welding positions other than those already qualified (see QW-120, QW-130, and QW-303). For GTAW, PAW, and LLBW, the deletion of consumable inserts, except that qualification with consumable inserts shall also qualify for fillet welds and welds with backing. The deletion of backing. Double-welded groove welds are considered welding with backing A change from single pass per side to multiple passes per side but not the reverse For hybrid plasma-GMAW welding, the essential variable for welding operator qualification shall be in accordance with Table QW-357.	**EN ISO 14732 Clause 4.1** The qualification test for welding operators and weld setters shall follow a preliminary welding procedure specification (pWPS) or welding procedure specification (WPS) prepared in accordance with the relevant part of ISO 15609. Welding operators or weld setters shall be qualified by one of the following methods: a) qualification based on a welding procedure test in accordance with the relevant part of ISO 15614 b) qualification based on a pre-production welding test in accordance with ISO 15613 c) qualification based on a test piece in accordance with the relevant part of ISO 9606 d) qualification based on a production test or production sample test **4.2.3 Mechanized welding** The following changes require re-qualification: — change of the welding process (except variants within welding process 13 as defined in ISO 4063) — change from direct visual control to remote visual control and vice versa — deletion of automatic arc length control — deletion of automatic joint tracking — addition of welding positions other than those already qualified in accordance with ISO 9606-1 — change from single-run-per-side technique to multi-run-per-side technique (but not vice versa) — deletion of backing — deletion of consumable inserts	Identical requirements	
		Additional Requirements		

ITEM	ASME Requirement for welders performance qualification	PED Requirement for welders performance qualification	Comparison Section IX - ISO	CSA Requirement for welders performance qualification
Qualification test coupon	**QW-310.1 Test Coupons**. The test coupons may be plate, pipe, or other product forms. When all position qualifications for pipe are accomplished by welding one pipe assembly in both the 2G and 5G positions (see Figure QW-461.4), NPS 6 (DN 150), NPS 8 (DN 200), NPS 10 (DN 250), or larger diameter pipe shall be employed to make up the test coupon as shown in Figure QW-463.2(f) for NPS 10 (DN 250) or larger pipe and in Figure QW-463.2(g) for NPS 6 (DN 150) or NPS 8 (DN 200) diameter pipe. **QW-310.2 Welding Groove With Backing**. The dimensions of the welding groove on the test coupon used in making qualification tests for double-welded groove welds or single-welded groove welds with backing shall be the same as those for any Welding Procedure Specification (WPS) qualified by the organization, or shall be as shown in Figure QW-469.1. A single-welded groove-weld test coupon with backing or a double-welded groove-weld test coupon shall be considered welding with backing. Partial penetration groove welds and fillet welds are considered welding with backing. **QW-310.3 Welding Groove Without Backing**. The dimensions of the welding groove of the test coupon used in making qualification tests for single-welded groove welds without backing shall be the same as those for any WPS qualified by the organization, or as shown in Figure QW-469.2.	**EN ISO 9606-1 Clause 5.3** The qualification test shall be carried out on plate, pipe or other suitable product form. The following criteria are applicable: a) test piece welds with outside pipe diameter D > 25 mm cover welds in plates b) test piece welds in plates cover welds in fixed pipe of outside pipe diameter D ≥ 500 mm c) test piece welds in plates cover welds in rotating pipes of outside pipe diameter D ≥ 75 mm for welding positions PA, PB, PC, and PD	Further restrictions in EN ISO 9606-1 regarding the size of qualified product form	
Test Pieces	Figure QW-464.2 Performance Qualification Test Coupons and Test Specimens 	**EN ISO 9606-1 Clause 6.2** The shape and dimension of test pieces required are shown in Figures 3 to 6. A minimum test piece length for plates of 200 mm is required; the examination length is 150 mm. For pipe circumferences of less than 150 mm, additional test pieces will be required with a maximum of three test pieces.  Figure 3 — Dimensions of test piece for a butt weld in plate   Figure 5 — Dimensions of test piece for a butt weld in pipe  Figure 6 — Dimensions of test piece for a fillet weld on pipe	ISO specifies min size of test coupons	
	QW-301 TESTS The welder or welding operator who prepares the groove weld WPS qualification test coupons meeting the requirements of QW-200 is also qualified within	**EN ISO 9606-1 Clause 5.4** The qualification test shall be carried out as butt or fillet welding. The following criteria are applicable. a) Butt welds cover butt welds in any type of joint **except branch connections**.	Only in ISO 9606-1	

<table>
<tr><th>ITEM</th><th>ASME Requirement for welders performance qualification</th><th>PED Requirement for welders performance qualification</th><th>Comparison Section IX - ISO</th><th>CSA Requirement for welders performance qualification</th></tr>
<tr><td rowspan="4">Type of weld</td><td rowspan="4">the limits of the performance qualifications, listed in QW-304 for welders and in QW-305 for welding operators. The welder or welding operator is qualified only within the limits for positions specified in QW-303.
The welder or welding operator who prepares the fillet weld WPS qualification test coupons meeting the requirements of QW-200 is qualified to weld non-pressure retaining fillet welds only within the limits of the performance qualifications listed in QW-304 for welders and in QW-305 for welding operators. The welder or welding operator is qualified only within the limits for positions specified in QW-303.

Table QW-452.6
Fillet Qualification by Groove-Weld Tests
<table><tr><th>Type of Joint</th><th>Thickness of Test Coupon as Welded, in. (mm)</th><th>Qualified Range</th><th>Type and Number of Tests Required</th></tr><tr><td>Any groove</td><td>All thicknesses</td><td>All base material thicknesses, fillet sizes, and diameters</td><td>Fillet welds are qualified when a welder or welding operator qualifies on a groove weld test</td></tr></table></td><td>b) Butt welds do not qualify fillet welds or vice versa. It is, however, permissible to qualify a fillet weld in combination with a butt weld, e.g. single bevel joint preparation with permanent material backing (a minimum test piece thickness of 10 mm shall be used).

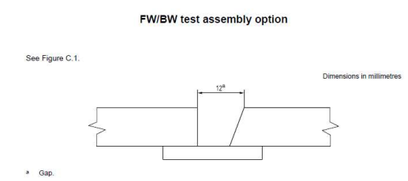
FW/BW test assembly option
 

Figure C.1 — Combined FW/BW test piece

For this combination test, all testing requirements specified in this part of ISO 9606 shall be fulfilled and associated ranges of qualification shall be given based on the test conditions.</td><td rowspan="4">Butt welds do not qualify fillet welds. Additional fillet weld is required in ISO 9606-1 to qualify fillet welds.</td><td></td></tr>
<tr><td>c) Butt welds in pipes qualify branch joints with an angle ≥60° and the same range of qualification. For a branch weld, the range of qualification is based on the outside diameter of the branch.</td><td></td></tr>
<tr><td>d) For applications where the type of weld cannot be qualified by means of either a butt or fillet or for branch connections of less than 60°, a specific test piece should be used to qualify the welder, when specified (e.g. by the product standard).</td><td></td></tr>
<tr><td>e) Butt welds may qualify fillet welds if a supplementary fillet weld test piece is welded with each process, filler material (FM) group and electrode covering/core, in accordance with Tables 3, 4, and 5. The test piece shall be at least 10 mm thick, or the thickness of the butt weld test piece if the thickness is less, and completed using a single layer in the PB position. For this supplementary test, the welder shall be qualified for all fillet welds as given for the butt weld qualification variables related to the range of qualification for fillet welds (e.g. Tables 7, 8, 9, 10 and 12). Fillet weld positions PA and PB are qualified by this test.</td><td></td></tr>
<tr><td>Number of layers</td><td>Table QW-452.1(b)
Thickness of Weld Metal Qualified
<table><tr><th>Thickness, t, of Weld Metal in the Coupon, in. (mm) [Notes (1), (2)]</th><th>Thickness of Weld Metal Qualified [Note (3)]</th></tr><tr><td>All</td><td>2t</td></tr><tr><td>½ (13) and over with a minimum of three layers</td><td>Maximum to be welded</td></tr></table>NOTES:
(1) When more than one welder, process, or set of essential variables is used during welding of a test coupon, the thickness, t, of the weld metal in the coupon deposited by each welder, for each process, and with each set of essential variables shall be determined and used individually in the "Thickness, t, of Weld Metal in the Coupon" column to determine the "Thickness of Weld Metal Qualified."
(2) Two or more pipe test coupons with different weld metal thickness may be used to determine the weld metal thickness qualified and that thickness may be applied to production welds to the smallest diameter for which the welder is qualified in accordance with Table QW-452.3.
(3) Thickness of test coupon of ¾ in. (19 mm) or over shall be used for qualifying a combination of three or more welders each of whom may use the same or a different welding process.</td><td>Table 12 — Range of qualification of layer technique for fillet welds
<table><tr><th rowspan="2">Test piece</th><th colspan="2">Range of qualification[b]</th></tr><tr><th>Single layer (sl)</th><th>Multi-layer (ml)</th></tr><tr><td>Single layer (sl)</td><td>×</td><td>—</td></tr><tr><td>Multi-layer (ml)[a]</td><td>×</td><td>×</td></tr></table>× indicates the layer technique for which the welder is qualified.
— indicates the layer technique for which the welder is not qualified.
[a] During the welding of the test piece, the examiner shall perform visual examination of the first layer in accordance with Clause 7.
[b] When a welder has been qualified using a multi-layer butt weld and he or she makes the supplementary fillet weld test described in 5.4 e), he or she is qualified for both multi- and single layer fillet welds.</td><td>The number of layers is an essential variable in ISO 9606-1</td><td></td></tr>
<tr><td>WPS followed</td><td>QW-301.2 Qualification tests
The performance qualification test shall be welded in accordance with qualified Welding Procedure Specifications (WPS), or Standard Welding Procedure Specifications (SWPS) listed in Mandatory Appendix E, except that when performance qualification is done in accordance with a WPS or SWPS that requires a preheat or postweld heat treatment, these may be omitted</td><td>EN ISO 9606-1 Clause 6.3
The qualification test of welders shall follow a pWPS or WPS prepared in accordance with ISO 15609-1 or ISO 15609-2.</td><td>Different requirements
Unlike ISO 9606-1, ASME IX requires a qualified WPS, unless it is a combination qualification (welding procedure and welding personnel qualification)</td><td></td></tr>
<tr><td rowspan="3">Welding conditions</td><td></td><td>EN ISO 9606-1 Clause 6.3: The test piece shall have at least one stop and restart in the root run and in the capping run. When more than one process is used, then at least one stop and restart shall be carried out for each process, this includes the root run and final run. The stop and restart areas shall be marked.</td><td>Only in ISO 9606-1</td><td></td></tr>
<tr><td></td><td>EN ISO 9606-1 Clause 6.3: The welder shall be allowed to remove minor imperfections by grinding, except for the capping run for which only the stop and restart may be ground. The permission of the examiner or examining body shall be obtained.</td><td>Only in ISO 9606-1</td><td></td></tr>
<tr><td>QW-301.2 Qualification tests
The performance qualification test shall be welded in accordance with qualified Welding Procedure Specifications (WPS), or Standard Welding Procedure Specifications (SWPS) listed in Mandatory Appendix E, except that when performance qualification is done in accordance with a WPS or SWPS that requires a preheat or postweld heat treatment, these may be omitted</td><td>EN ISO 9606-1 Clause 6.3: Any post-weld heat treatment required in the pWPS or WPS may be omitted at the discretion of the manufacturer.</td><td>Same in both standards</td><td></td></tr>
</table>

ITEM	ASME Requirement for welders performance qualification	PED Requirement for welders performance qualification	Comparison Section IX - ISO	CSA Requirement for welders performance qualification
Acceptable requirements for test pieces	**QW-142 SPECIAL EXAMINATIONS FOR WELDERS** Radiographic or Ultrasonic examination per QW-191 may be substituted for mechanical testing of QW-141 for groove-weld performance qualification as permitted in QW-304 to prove the ability of welders to make sound welds. **QW-143 EXAMINATION FOR WELDING OPERATORS** Radiographic or Ultrasonic examination per QW-191 may be substituted for mechanical testing of QW-141 for groove weld performance qualification as permitted in QW-305 to prove the ability of welding operators to make sound welds. **QW-144 VISUAL EXAMINATION** Visual examination as described in QW-194 is used to determine that the final weld surfaces meet specified quality standards**.** **QW-191.2.1 Method** (a) The ultrasonic examination in QW-142 for welders and in QW-143 for welding operators may be conducted on test welds in material 1⁄4 in. (6 mm) thick or greater. (b) Ultrasonic examinations shall be performed using a written procedure in compliance with Section V, Article 1, T-150 and the requirements of Section V, Article 4 for methods and procedures. (c) For terminology, see QW-191.1.2.1. **QW-194 Visual Examination - Performance** Performance test coupons shall show no cracks and complete joint penetration with complete fusion of weld metal and base metal	**EN ISO 9606-1 Section 7** Test pieces shall be evaluated according to the acceptance requirements specified for relevant types of imperfections. Prior to any testing, the following shall be checked: - all slag and spatters are removed; - no grinding on the root and the face side of the weld (according to 6.3); - stop and restart in the root run and in the capping run are identified (according to 6.3); - profile and dimensions. The acceptance requirements for imperfections found by test methods performed according to this part of ISO 9606 shall, unless otherwise specified, be assessed in accordance with ISO 5817. A welder is qualified if the imperfections are within ISO 5817, quality level B, except for the following imperfection types for which level C shall apply: excess weld metal (502); excessive convexity (503); excessive throat thickness (5214); excessive penetration (504); and undercut (501). Bend-test specimens shall not reveal any discrete discontinuity ≥3 mm in any direction. Discontinuities appearing at the edges of a test specimen during testing shall be ignored in the evaluation unless there is evidence that cracking is due to incomplete penetration, slag or other discontinuity. The sum of the greatest discontinuities exceeding 1 mm but less than 3 mm in any one bend specimen shall not exceed 10 mm. If the imperfections in the welder's test piece exceed the permitted maximum specified, then the welder fails the test.	Different requirements ISO 9606-1 is more prescriptive on acceptable/unacceptable indications Different requirements for qualification of NDE examiners	
Re-tests	**QW-320 RETESTS AND RENEWAL OF QUALIFICATION** **QW-321.1 Immediate Retest Using Visual Examination** **QW-321.2 Immediate Retest Using Mechanical Testing** **QW-321.3 Immediate Retest Using Volumetric NDE** **QW-321.4 Further Training** 2 new test coupons required in case of immediate re-test	**EN ISO 9606-1 Section 8** If any test fails to comply with the requirements of this part of ISO 9606, the welder may be given the opportunity to repeat the qualification test **once without further training**.	Different requirements ASME IX requires two new test coupons in case of immediate re-test	
Revalidation of welder qualification	**QW-322.1 Expiration.** The qualification of a welder or welding operator for a process remains valid provided no more than 6 months have passed since the welder or welding operator last used that process. Continuity of qualification shall be confirmed by the qualifying or participating organization(s) as identified in QG-106.2 and QG-106.3, respectively. A welder using manual or semiautomatic welding prolongs qualification for both manual and semiautomatic welding for that process. A welding operator using machine welding prolongs qualification for machine and automatic welding for that process. A welding operator using automatic welding prolongs qualification for automatic welding for that process.	**EN ISO 9606-1 Clause 9.3** Revalidation shall be carried out **by an examiner/examining body**. The skill of the welder shall be periodically verified by one of the following methods. a) The welder shall be **retested every 3 years**. b) **Every 2 years, two welds made during the last 6 months of the validity period shall be tested by radiographic or ultrasonic testing or destructive testing and shall be recorded**. The acceptance levels for imperfections shall be as specified in Clause 7. The weld tested shall reproduce the original test conditions except for thickness and outside diameter. These tests revalidate the welder's qualifications for an additional 2 years. c) A welder's qualifications for any certificate shall be valid as long as it is confirmed according to 9.2 and provided that: - the welder is working for the same manufacturer for whom he or she qualified, and who is responsible for the manufacture of the product - the manufacturer's quality programme has been verified in accordance with ISO 3834-2 or ISO 3834-3 - the manufacturer has documented that the welder has produced welds of acceptable quality based on application standards; the welds examined shall confirm the following conditions: welding position(s), weld type (FW, BW), material backing (mb) or no material backing (nb).	Different requirements ISO 9606-1 gives three options for renewal of the qualification Renewal of already expired qualification is not allowed	
Welder/Welding operator Performance Qualification (WPQ)- ASME Section IX Welder's qualification test certificate- EN ISO 9606-1	**QW-301.4 Record of Tests.** The record of Welder Performance Qualification (WPQ) tests shall include the essential variables (see QW-350), the type of test and test results, and the ranges qualified in accordance with QW-452 for each welder. The record of Welding Operator Performance Qualification (WOPQ) tests shall include the essential variables (see QW-360) and the type of test and test results for each welding operator. Suggested forms for these records are given in Forms QW-484A and QW-484B (see Nonmandatory Appendix B).	**EN ISO 9606-1 Section 10** All essential variables shall be recorded on the certificate. If the test piece(s) fail(s) any of the required tests, no certificate shall be issued. **The certificate shall be issued under the sole responsibility of the examiner or examining body.** A recommended format is detailed in Annex A. If any other form of welder's qualification test certificate is used, it shall contain the information required in Annex A. The examiner or examining body is responsible for verifying that all essential variables are addressed in this certificate. The following non-essential variables shall be recorded on the certificate: - type of current and polarity - parent material group/subgroup - shielding gas In general, for each test piece, a separate welder's qualification test certificate shall be issued.	Different concept on the responsibility for issue of the certificates ASME IX: issued by the organization ISO 9606-1: issued by an examining body	

ITEM	ASME Requirement for welders performance qualification	PED Requirement for welders performance qualification	Comparison Section IX - ISO	CSA Requirement for welders performance qualification
Designation		**EN ISO 9606-1 Section 11** The designation of a welder qualification shall comprise the following items in the order given (the system is arranged so that it can be used for computerization): a) the number of this part of ISO 9606 (ISO 9606-1) b) the essential variables 1) welding processes 2) product type 3) type of weld 4) filler material group or parent material group (autogenous welding) 5) filler material types 6) dimensions of test piece 7) welding positions 8) weld details The type of shielding and backing gas shall not be incorporated in the designation, but shall be included in the welder's qualification test certificate.	Only in ISO 9606-1	
Job knowledge		**EN ISO 9606-1 Annex B** - Job knowledge is recommended, but not mandatory. - In some countries, e.g. Germany, job knowledge is required - Evidence of job knowledge is also required for the renewal of the qualification. - The examination of job knowledge shall be indicated on the welder‘s certificate, either by „Accepted“ or „Not tested“. - The actual tests of a welder's job knowledge can be given by any of the following methods or combinations of these methods: written objective tests, oral questioning following a set of written questions, computer testing, demonstration testing	Only in ISO 9606-1	