



CERTIFICATION BOARD FOR INSPECTION PERSONNEL

**Standard of Proficiency
for the Certification of
Pressure Equipment Inspectors**

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STANDARD OF PROFICIENCY FOR THE CERTIFICATION OF PRESSURE EQUIPMENT INSPECTORS

FOREWORD

This Standard of Proficiency defines the requirements for the issue of certificates of competence to inspectors performing inspection of pressure equipment within the scope of the Health and Safety in Employment (Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999.

These regulations require equipment inspectors performing inspection of pressure equipment to hold a certificate of competence. Certificates of competence also provide a basis for International Accreditation New Zealand to approve inspectors as signatories of inspection bodies.

Certification and re-certification in accordance with this standard confirms the qualifications, training, and experience of pressure equipment inspectors.

The qualifications described by this Standard of Proficiency have been prepared for registration at level 6, on the NZQA framework.

This standard of proficiency must be read in conjunction with the General Section - Standards of Proficiency for the Certification of Inspectors.

1 SCOPE AND GENERAL

1.1 Scope

This Standard of Proficiency covers the certification of equipment inspectors performing new-construction and in-service inspection of pressure equipment.

1.2 Certificates of competence

The certificates of competence which may be granted are:

- (a) Pressure equipment inspector (PEI), and
- (b) Pressure equipment inspector with endorsement A (PEI with endorsement A)
- (c) Pressure equipment inspector with endorsement B (PEI with endorsement B).

Note: The principle difference between a PEI and a PEI with an endorsement is that an inspector with an endorsement has demonstrated by examination and assessment a wider knowledge of inspection of specified categories of equipment.

2 CERTIFICATION PROCESS

Candidates seeking certification shall satisfy the requirements of the General Section – Standards of Proficiency for the Certification of Inspectors, for their category of pressure equipment inspection discipline, by completing:

- (a) The pre-requisite training, qualifications and experience in 3 below for either:
 - PEI certificate of competence, or
 - PEI with endorsement certificate of competence, and
- (b) The examinations in 4 below for either:

- PEI certificate of competence, or
- PEI with endorsement certificate of competence

3 PRE-REQUISITE TRAINING, QUALIFICATIONS AND EXPERIENCE

Candidates shall complete the following training, qualifications and experience and include with their Application for Certification the documentation described in the General Section - Standards of Proficiency for the Certification of Inspectors.

3.1 PEI certificate of competence

Candidates shall:

- (a) Hold current CBIP Certified Welding Inspector or Senior welding Inspector certification, and
- (b) Have a total of six credit points for Training, Qualifications and Experience accumulated as described in 3.1.1 and 3.1.2 below or, other industrial experience as described in 3.1.3.

Note: Candidates for a PEI certificate of competence must, when undertaking pre-requisite certification as a welding inspector, ensure that any welding inspection reports submitted to the CBIP primarily relate to pressure equipment. Where candidates hold an existing CWI certificate of competence they shall demonstrate to the CBIP that this requirement has been met by past inspection work or, they shall undertake sufficient additional inspection work, related to pressure equipment, to satisfy this criterion.

3.1.1 Training and qualifications (4 credit points maximum)

1 credit point maximum from any of the following:

- Successfully completing an independently assessed and verified CBIP recognised course in pressure equipment inspection
- A CBIP recognised certificate in welding engineering.

2 credit points maximum from any of the following:

- An approved diploma in engineering from a CBIP recognised training establishment.
- Approved 1st Class Marine Engineer's Certificate.
- Bachelor Degree in a relevant Technology or Science.
- New Zealand Certificate of Engineering or an equivalent qualification e.g. Higher National Certificate in Engineering.

3 credit points maximum from any of the following:

- Approved 1st Class Marine Engineer's Certificate with steam endorsement
- Bachelor Degree in Engineering
- Higher National Diploma in Engineering
- Masters Degree in relevant Technology or Science

3.1.2 Experience (4 credit points maximum)

1 credit point for each year of fully documented experience as listed below:

- In the inspection or fabrication of pressure equipment whilst in a position of responsibility with a DOL recognised Inspection Body, fabricator or equipment owner.
- In the, operation, maintenance, inspection or fabrication of pressure equipment whilst in a position of responsibility, which in the opinion of the CBIP is both appropriate and relevant, or

3.1.3 Other industrial experience

Instead of the above credit point assessment, candidates may submit information on other similar industrial experience they have had to the CBIP. The CBIP will advise whether this experience satisfies the pre requisite training, qualifications and experience for entry to the PEI certification process.

3.2 PEI with endorsement certificate of competence

Candidates shall have:

- (a) Held a certificate of competency as a PEI for at least three years, or
- (b) Had at least five years experience of fabrication and in-service inspection of the equipment in 4.1.1 below, other than the provision of NDT services.

4 EXAMINATIONS

4.1 PEI certificate of competence

The examinations for a PEI certificate of competence are comprised of the following papers; it is recommended by the CBIP that they are taken in the order shown:

- (a) Module 1: Inspector's Responsibilities and Legislative Requirements
- (b) Module 3: Pressure Equipment Fabrication, Repairs and Alterations
- (c) Module 4: In-service Inspection and Repair

Note: Module 2 was removed and replaced by CWI, which is a prerequisite for PEI certification.

4.1.1 Modules 1, 3 and 4

These modules cover fabrication and in-service inspection of the following equipment:

- (a) Pressure vessels fabricated from carbon steels without post weld heat treatment and austenitic stainless steels up to and including 316 grades.
- (b) Hot water boilers.
- (c) Boilers without superheat and associated piping systems, and fabricated from carbon steels without post weld heat treatment and austenitic grades up to and including 316 grades.
- (d) Piping systems fabricated from carbon steels without post weld heat treatment and austenitic stainless steels up to and including 316 grades.
- (e) Steam engines covered by the PECPR Regulations, and

to the extent that it is pertinent to the inspection work of a PEI, these modules also cover the following systems, processes and activities:

- (a) Boiler management systems for attended, unattended and limited attendance boilers.
- (b) Repairs and alterations.
- (c) Witnessing and verifying tests including mechanical testing of welding procedures during fabrication and in-service inspection.
- (d) Understanding and recognising the types and causes of deterioration and defects.
- (e) Reporting results of inspection.
- (f) Interpretation and evaluation of inspection results for pressure equipment listed above in sections in a) to d).
- (g) Recommendations on future inspection periods.
- (h) Approval of inspection and test plans and preparation/approval of any specific inspection procedures required.

Sample examination questions for modules 1, 3 and 4 are given in Appendix A

4.2 PEI with endorsement certificate of competency

The examinations for PEI with endorsement are comprised of the following papers:

- (a) PEI with endorsement A Module 5: Inspection of Boilers, Steam Turbines and Steam Engines
- (b) PEI with endorsement B Module 6: Inspection of pressure vessels and associated piping of any design, materials of construction and wall thickness

4.2.1 Module 5

This module covers the following equipment:

- (a) Boilers with superheating systems or, which have parts that are subject to post weld heat treatment.
- (b) Steam turbines.
- (c) Other steam engines

4.2.2 Module 6

This module covers the following equipment:

- (a) Pressure vessels and pressure piping that are subject to post weld heat treatment.
- (b) Pressure vessels and pressure piping that are fabricated from materials in addition to carbon steels not requiring heat treatment and austenitic stainless steel up to grade 316.
- (c) Pressure Vessels that are of lined or clad construction.
- (d) Pressure vessels that are used for low temperature or cryogenic service
- (e) Pressure Vessels that are transportable or, subject to cyclical operation in service.

4.3 Recertification

4.3.1 PEI

The recertification exam will comprise one paper based on Modules 1, 3 and 4.

4.3.2 PEI with Endorsement A and/or B

The recertification exam will comprise one paper based on Modules 1, 3, 4 and either Module 5, or Module 6 as appropriate.

4.4 Sample Questions

Sample questions for Modules 1, 3 and 4 examination papers are given in Appendix A.

4.5 Knowledge Requirements

The knowledge requirements underlying the examination papers for pressure equipment inspectors are given in Appendix B.

4.6 Recognition of overseas qualifications and exemptions

The CBIP will consider applications for exemptions from the module 3, 4, 5 and 6 examination papers.

There will be no exemptions for the module 1 examination paper; it is a compulsory examination for all candidates. Exemptions will not be granted for Modules 5 and 6.

Application for recognition of overseas equipment inspection qualifications and for exemptions from examination papers shall be made in accordance with the requirements of the General Section – Certification of Inspectors.

APPENDIX A

Sample Examination Questions (Informative)

Examination Format:

All module examination papers are open book. Candidates should bring with them an unmarked copy of what ever references they wish to bring from Appendix A1.

Module Examinations

The module examinations questions are in a multi-choice format, on the subject matter given in the competency and knowledge requirements for the relevant module.

The pass mark is 70% or higher in each module.

Sample questions Modules 1 to 4 (* is the correct answer)

Module 1 – Inspector’s responsibilities and Attributes

- Q1 In the Code of Practice for Pressure Equipment, a change to the design of, adding to or taking elements away from equipment is a:
- (a) repair
 - (b) change
 - (c) alteration*
 - (d) modification
- Q2 According to the Code of Practice for Pressure Equipment, a fault inherent in a particular kind of equipment, resulting from deficiencies in the design or manufacturing process, that may cause serious harm to a person is called a:
- (a) type fault*
 - (b) defect
 - (c) imperfection
 - (d) flaw
- Q3 According to the Code of Practice for Pressure Equipment, the use of an alternative material is to have the agreement of the _____, unless otherwise permitted by a trade agreement, AS/NZS 1200 or, an ‘Enquiry Case’ or other mechanism of the standard concerned:
- (a) manufacturer
 - (b) inspector
 - (c) end user
 - (d) purchaser*
- Q4 According to the Code of Practice for Pressure Equipment, unless amended by the Code pressure vessels shall be designed in accordance with:
- (a) AS/NZS 3788
 - (b) AS/NZS 1200*
 - (c) BS EN 288
 - (d) PD 5500

- Q5 According to the Code of Practice for Pressure Equipment, Ammonia pipe work constructed to ASME B31.5 shall be inspected and tested in accordance with:
- (a) Section 3.7.2 of the Code of Practice
 - (b) AS/NZS 1200
 - (c) ASME B31.5
 - (d) Chapter VI of ASME B31.3*
- Q6 According to the Requirements for Inspection Body Accreditation in New Zealand, an inspection report must include:
- (a) Date of Inspection
 - (b) Description of subcontracted work
 - (c) Information of what has been omitted from the original scope of work
 - (d) All of the above*
- Module 3 – Pressure equipment fabrication
- Q7 According to the P.E.C.P.R. Regulations, a pressure vessel means an unfired vessel used to hold, transport, store or use:
- (a) Gasses at pressure exceeding 50 kPag
 - (b) Liquids at pressure exceeding 50 kPag
 - (c) Steam
 - (d) (a) & (b)
 - (e) (a) & (b) & (c)*
- Question 2 to Question 4 are general knowledge and should be answered to with regard to welded fabrication technology
- Q8 The type of document that describes the requirements for a given material is commonly referred to as:
- (a) a code
 - (b) a standard
 - (c) a specification*
 - (d) a and b above
- Q9 What is the effect of Sulphur when it has been incorporated into the steel?
- (a) affects the machinability of the steel
 - (b) makes the material prone to solidification 'hot' cracking*
 - (c) improves the hardness of the material
 - (d) improves the impact strength of the steel
- Q10 Which element has the greatest effect on steel regarding its susceptibility to cracking:
- (a) nickel
 - (b) manganese
 - (c) copper
 - (d) carbon*
- Q11 According to the PD 5500, radiographic acceptance levels for isolated pores in materials of 8 thick is:
- (a) 3.0mm
 - (b) 4.5mm
 - (c) 6.0mm
 - (d) 2.0mm*

- Q12 According to the General Requirements of ASME VIII Div 1, where a steel plate edge is cut by thermal cutting any detrimental discoloration shall be:
- (a) removed by mechanical means*
 - (b) accepted after inspecting to see if the surface roughness is acceptable
 - (c) examined using magnetic particle inspection
 - (d) without any further inspection or preparation
- Q13 According to the General Requirements of ASME VIII where magnetic particle examination is prescribed it shall be done by in accordance with:
- (a) ASME V
 - (b) ASNT CP 189
 - (c) Appendix 6*
 - (d) ASNT SNT TC 1A
- Q14 According to the Approval testing fusion welding procedure requirements of PD 5500 Section V all welding shall be carried out with a welding procedure which conforms to:
- (a) BS EN 287 Pt 2
 - (b) BS EN 288 Pt 2*
 - (c) BS EN 287 Pt 1
 - (d) BS EN 288 Pt 3

Module 4 - In-Service Inspection

- Q1 Ultrasonic wall thickness testing shall be carried out to
- (a) AS 1710
 - (b) AS 2452.3*
 - (c) AS 2452.1
 - (d) AS 2452.2
- Q2 According to AS/NZS 3788 the assessment of planar defects may be carried out per AS/NZS 3788 on vessels that operate in the temperature range of:
- (a) 0°C to 400°C*
 - (b) 20°C to 400°C
 - (c) -20°C to 350°C
 - (d) Nothing is specified in AS/NZS 3788
- Q3 According to AS/NZS 3788 static pressure vessels containing a liquefied petroleum gas the maximum nominal period for internal inspection is every:
- (a) 10 years*
 - (b) 4 years
 - (c) 2 years
 - (d) 12 years
- Q4 According to AS/NZS 3788 who is responsible for ensuring the measurements made for assessing the integrity of pressure equipment:
- (a) The fabricator
 - (b) The inspector
 - (c) The owner*
 - (d) The Inspection Body
- Q5 According to AS/NZS 3788, during the inspection of a drum for transporting liquefied gas, a dent is discovered with 140 mm diameter, 15mm deep in the shell. This condition is:
- (a) acceptable
 - (b) not acceptable*
 - (c) may be accepted by the owner

(d) may be accepted by a registered design engineer

- Q6 According to AS/NZS 3788 Type IV cracking occurs in the HAZ of 2Cr2Mo3V, in steel pipes, operating at temperatures above:
- (a) 730°C
 - (b) 640°C
 - (c) 500°C
 - (d) 540°C*
- Q7 When performing a hydrostatic pressure test at a pressure of 3Mpa, the pressure gauge used shall be graduated to:
- (a) approximately five times the test pressure
 - (b) approximately one and half times the test pressure
 - (c) approximately three times the test pressure
 - (d) approximately twice the test pressure*
- Q8 According to the Code of Practice for Boilers, an Unattended Boiler constructed after 1996 shall have the following controls:
- (a) Feed water availability alarm
 - (b) Steam temperature and pressure controls
 - (c) Flame detector or ionisation rod flame monitoring to supervise pilot flame
 - (d) All of the above*

APPENDIX B

Outline of Knowledge Requirements (Informative)

B.1 Introduction

It is an important factor in the safe and reliable operation of any facility, to ensure mechanical integrity, reliability, safety and fitness for purpose and service. It is therefore essential that the inspectors who perform the inspection functions have the necessary knowledge to be competent in the inspections that they perform in order to provide value to the client and recommend to the Inspection Body that a certificate of inspection be issued.

B.2. General Requirements

B2.1 Introduction

The following sub-sections define the core requirements to guide candidates on the extent of knowledge required in order to be prepared for both the examinations and their future work. Modules 1 to 4 define the requirements and depth of knowledge for the Pressure Equipment Inspector (PEI) and modules 5 and module 6 outline the PEI with endorsements.

B2.2 Process operation

It is essential that the inspector understands the pressure equipment operational process in order to identify where and what corrosion/degradation mechanisms are expected and consequently where to concentrate the Inspection effort.

B2.3 Metallurgical and corrosion degradation mechanisms

The inspector must understand the pressure equipment operational conditions and underlying reasons that dictate materials selection and the interpretation of the relevant standards and codes of practice in respect to material selection.

B2.4 Metallurgy and Welding

Welding knowledge is taken as a prerequisite by means of the candidate having to have done the CWI Certification prior to doing the PEI Certification. As a minimum, the inspector must understand:

- (a) The criteria that dictate the selection of materials including the iron/carbon phase diagrams and the effect of alloying on the properties of materials by alloying.
- (b) mechanical testing and acceptance criteria for materials and weldments.
- (c) the relationship between metal properties and the phenomena of fatigue, ductile and brittle fracture and embrittlement.
- (d) knowledge of fundamentals of composition and structures of metallic materials and their responses to heat treatment both during manufacturing and welding.
- (e) the codes and standards that pertain to welding procedures, welder qualifications and associated consumables.

(f) the various forms of welding techniques as well as the QA and QC procedures that apply to the common welding processes i.e. SMAW, GMAW, FCAW, GTAW, SAW.

B2.5 Inspection techniques and NDT

The inspector must have an understanding of the applicability, safety and accuracy of various methods and inspection techniques (invasive and non-invasive) used to detect manufacturing defects or degradation mechanisms in all types of pressure equipment and service. Appropriate techniques used and commonly applied include visual, functionality testing (relief valves), destructive testing, condition monitoring, radiographic and ultrasonic, eddy current electromagnetic and other NDT techniques.

The Inspector must recognise the limitations of the various methods and techniques and take this into account when deciding on the values of that employed (i.e. it may be necessary to supplement the method or techniques used with another one to increase confidence). His knowledge of this subject should be such that he can converse with specialists in the field and evaluate the results of their examinations. Training in the methods and techniques of NDT is only required to create an awareness of NDT methods and their application; it is not required for inspectors to execute routine NDT activities. For these activities certified NDT technicians shall be used.

B2.6 Mechanical Maintenance

The Inspector must be aware of the purpose, tasks and roles of the maintenance function. He should have a clear understanding of its routine and non-routine activities (e.g. shutdowns) and constraints (work preparation, planning, financial considerations, expenditure control, impact of work volume generated by inspection, reliability, etc.)

B2.7 Design and manufacturing codes and standards, and methods of manufacturing, inspection and repair.

The inspector must have sound detailed knowledge and experience in the use of the codes and standards covering design, manufacturing and repair, to ensure compliance with the applicable norms. Familiarisation with the full range of

standards relevant to static and transportable equipment and piping systems published by AS, ASME, ASME/ANSI, TEMA and British Standards is essential. The inspector must understand the fundamental principles within the standards sufficiently to resolve any conflict between them and to advise their client of their applicability.

It is not the intention that the inspector should be fully conversant with every aspect of every standard, but that the Technical Manager of Inspection Body (as defined in ISO 17020), employing the inspectors must be capable of providing detailed technical backup on request.

It is essential that the inspectors are fully aware with the requirements for the development, review and implementation of Inspection and Test Plans (ITP's)

B2.8 Special tools

The inspector must be aware all of tools available to determine "fitness for purpose" of equipment (e.g. finite element analysis and fracture mechanics). He must recognise the limitations of the various tools and take this into account when deciding on the values of the methods and techniques employed (i.e. it may be necessary to supplement the method used with another one to increase confidence).

B2.9 Inspection methodologies

The inspector must be knowledgeable about corrosion loop, critically ranking and selective risk-based inspection methodologies and any other reliability methodology to optimise equipment inspection intervals. He shall be capable of participating in multi-disciplinary teams to develop, implement or maintain this methodology for the relevant plant.

B2.10 Quality Assurance Systems

The inspector must be aware of Quality Assurance and Quality Control concepts/systems e.g. ISO 9000 standards.

B2.11 Record keeping and report writing

The inspector must be capable of preparing and maintaining accurate and proper records and reports of all relevant inspections to build up the necessary historic data to maintain the reliability of the equipment and also meet statutory requirements.

B3 Pressure Equipment Inspectors

The PEI is capable of carrying out the majority of the fabrication and in-service inspections required in New Zealand. The range of inspections generally carried out by the PEI is defined in Clause 1.4.28. The depth of knowledge required is defined in modules 1 to 4.

B4 Pressure Equipment Inspectors with specific Endorsements

The PEI with endorsements is capable of carrying out the fabrication and in-service inspections of pressure equipment requiring certification. The range of endorsements is given in Clause 1.4.29. The depth of knowledge required is defined in modules 1 to 4 (i.e. PEI) and the relevant endorsements A and B knowledge required from modules 5 and module 6.

A primary role of the PEI with endorsements is the implementation and review of the fabrication and in-service inspections of high hazard level plant typically located in, but not restricted to, the petrochemical, process and power industries and any specialised pressure equipment that requires specific knowledge.

B5 The knowledge requirements are based on:

Modules 1, to 4 are for PEI,

Modules 1, to 4 Plus Modules 5 and/or Module 6 for PEI with Endorsements,