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Pressure equipment design verification Area of Practice

Pressure Equipment Design Verification deals with the process which assures the integrity of pressure vessels, boilers, pressure piping, and gas cylinders for the stated design and operating conditions. This Area of Practice is limited to verification of designs by others. It does not include original design of pressure equipment.

Some of the indicative activities in this area of practice are to separately check and verify the following as appropriate.

- all design inputs
- hazard level
- load cases, internal and external pressure
- acceptance criteria
- material and corrosion allowance
- thickness of pressure components
- post weld heat treatment
- non-destructive testing
- low temperature requirements and impact test
- none-pressure parts welded to pressure components
- fatigue and creep analysis
- sour service requirement
- fracture mechanics, FEA modelling analysis.

These activities could take place in any of the following pressure equipment design verification domains.

- pressure vessels, steam boilers and heat exchangers
- piping
- low pressure storage tanks
- furnaces
- air receivers
- package equipment.

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1. Pressure equipment definition

In this document the pressure equipment is defined in two categories:

Category 1: They are steam boilers, pressure vessels, heat exchangers (Shell and Tube, Air cooled, Plate and Frame), piping, pipelines and other components and assemblies subject to pressure loading (Usually more than 0.5 bar gauge).

Category 2: Double wall low pressure storage tanks, furnaces, air receivers and package equipment

They are both part of pressure equipment family however category 1 has more general application in different industries. Category 2 is more applicable to oil and gas, petrochemical and coal seam gas refinery plants.

2. Who is the Verifier?

The verifier is an independent person with extensive experience in this field to ensure that there has been a deliberate effort in design and approval process based on technical aspects and assurance system requirements.

The verifier and designer both should be knowledgeable in pressure equipment however the verifier is the final check over the design and as such there is a higher expectation that verifier is knowledgeable, skilled and exercises due care and judgement.

It is important that the verifier has had no input into the initial design activity to ensure that verification process is accomplished without any prior assumptions or prejudices and as comprehensive as possible.

It is possible for the designer and verifier to be in the same company but there should be quality assurance system to ensure independence of design in the first stage and verification in the second stage.

3. Eligibility criteria

The basic requirements are higher than just general knowledge of pressure vessel and piping. The ideal applicant is someone with enough experience as designer in the past and verifier in the most recent roles for both categories. We may consider the following three listed items as minimum.

a) Hold a Washington Accord Degree or equivalent in an appropriate engineering discipline plus at least five years' experience in design and reasonable knowledge of test and maintenance for at least two items in category 1 as well as good general knowledge of items category 2.

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b) Experienced engineer in verification process, hazard calculation, design and plant registration and preparation of test and inspection (AS/NZS ISO/IEC 17020). Practicing as a verifier should be a significant component of career background.

c) Familiar with the AS/NZ, ASME, ANSI, API, ASTM, AWS, AISI, NACE and Workplace Safety Act and Regulation codes, standards and applications (refer to the last section for the list of applicable codes).

4. Scope of Work and process

4.1 The basis of design is set of information such as volume and size, number and size of connections, material and operating conditions usually in process data sheet format which is a basis to populate mechanical data sheet and calculation book based on specification and design code.

4.2 Design calculation is finalized based on engineering task specification and nationally or internationally recognized code and standard (AS, ASME, API, DEAN, PD5500, GB150, etc).

4.3 The verifier works within an agreed scope to verify the design, taking into account all safety parameters. Refer to section 6 for verification process.

4.4 The design verifier then issues a certificate of design verification which includes a brief description of the equipment, service, design code, operation and test conditions and hazard level for equipment registration (if applicable).

5. Verification process

The following elements and methods shall be used to verify the mechanical design and drawings especially for those with higher level of hazard classification.

5.1 Verify the content to ensure that documents are adequate and are signed by the designer. All design inputs in 5.1 as well as hazard level, material, corrosion allowance, headers, flat plates, tube sheets, threaded and flexible joints, nozzles, flanges, bolting, supports, attachments, design loads (piping, seismic, wind, etc.), post weld heat treatment (PWHT), non-destructive testing (NDT), test pressure and position to be checked.

5.2 Verify the material compatibility with service conditions, stress/strain limits. Some critical services such as sour services have certain criteria for material selection.

5.3 Pressure component thicknesses to be verified by calculation (shell, ends, jackets, nozzles, manways, opening, flanges, gaskets, bolts, stays, covers, reinforcing plates, pipe, pipeline schedule, etc). Non-pressure parts such as supports to be checked against load cases.

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5.4 Verify the PWHT and NDT requirements in design as well as weld size and type in weld map drawing as a basis for WPS and PQR weld documents.

5.5 Verify the application of fracture mechanics, FEA modelling analysis, fatigue design, thermal stress as provided in AS/NZS 1200/1210, AS 4458 and AS/NZS 3788, ASME VIII Div2 (if applicable).

5.6 Verify the requirement of Safety Management System (SMS) outcomes for pipeline design and pavement type.

6. Assessment Process

The applicant must provide a statement of experience, recent responsibilities and demonstrate how this area of practice has been kept up to date. This statement must comply with criteria in section 4 and to be supported with name and contact details of minimum two people as reference in the field of pressure equipment design or verification.

Minimum three different examples of verification from the items in category 1 or 2 (at least one from category 1) to be submitted as evidence. It is important to check design code, input parameters, hazard level assumption, material compatibility with service conditions, special requirements for corrosive or sour service, safety factors, final registration, and overall systematic approach to ensure the integrity of verification process.

The assessor will examine the submitted examples and where competency is not evident, application will be returned to applicant for further clarification. Final professional interview seeks to confirm that applicant can operate at the level of a Chartered pressure equipment verifier, able to operate autonomously.

Applicants with pressure equipment design verification as the second area of practice might be invited to interview after application assessment which should include updated CV and CPD, statement of experience and three verified examples.

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7. Design code and standard applicable to pressure equipment

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Name	**Description**	**Name**	**Description**
AS1200	Pressure Equipment	AS1210 / ASME	Pressure Vessel Design Code
AS4343	Pressure equipment„ Hazard levels	AS3892	Pressure Equipment Installation
AS4458	Pressure equipment - Manufacture	AS2129	Flanges for Pipes, Valves and Fittings
AS4037	Examination and Testing	AS3920	Pressure equipment - Conformity assessment
AS3857	Tube Sheet Heat Exchanger Design	AS4942	Pressure equipment
AS1228	Pressure equipment - Boilers	AS1940	The storage and handling of flammable and combustible liquids
AS2593	Safety management and supervision - Boilers	AS2971	Serially produced pressure vessels
AS1271	Safety valves for boilers and unfired pressure vessels	AS2809	Road tank vehicles for dangerous goods
AS1692	Steel tanks for flammable and combustible liquids	AS4897	Design, installation and operation of underground storage systems
AS3711	Freight containers	AS4681	The storage and handling of Class 9 dangerous goods
AS1170 / UBC	Wind, seismic, vibration	AS4452	The storage and handling of toxic substances
AS1596	The storage and handling of LP Gas	AS4081	The storage and handling of liquid and liquefied polyfunctional isocyanates
AS2714	The storage and handling of organic peroxides	AS3780	The storage and handling of corrosive substances
INTERNATIONAL			
ASME I	Power Boilers	ASME II	Material selection for Boiler and Pressure Vessel
ASME V	Non-destructive Examinations	ASME IX	Welding and Brazing Procedure
B16.5 / B16.47	Pipe, Flange and Fittings	TEMA	Tubular Exchangers
API661	Air Cooled Heat Exchangers	API662	Plate Heat Exchangers
API650	Welded Atmospheric Storage Tanks	API579	Fitness for Service
API620	Low Pressure Storage Tank	NACE / MR0175	Material selection for H2S Service
WRC	Stress analysis		

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How to apply

Pressure equipment design is an area of practice and is available to those who want to become Chartered. It's available to all occupational categories.

A pressure equipment verifier should have satisfactory knowledge, training and experience in design and verification of design of pressure equipment (refer to section 2 and 3 above for more information).

Note that pressure equipment test and inspection is excluded from this area of practice.

Learn more about becoming Chartered and how to apply.

If you want to add pressure equipment design as an additional area of practice, email us to enquire about the process.

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