

PRESSURE EQUIPMENT & PRESSURE VESSELS

LEARNING OUTCOME

Describe the requirements of the Work Health and Safety legislation and standards with regard to pressure equipment and pressure vessels at a workplace.

ASSESSMENT CRITERIA

- Describe the statutory or minimum requirements relating to pressure equipment and pressure vessels at a workplace.
- Describe control measures that eliminate or minimise the hazards associated with pressure equipment and pressure vessels.
- Describe the testing and inspection requirements associated with pressure equipment and pressure vessels.

REFERENCES

- Work Health and Safety Act 2011
 - Part 2 – Health and Safety Duties
 - Part 4 – Authorisations
- Work Health and Safety Regulation 2011
 - Section 224: Pressure equipment
 - Schedule 3: High risk work licences and classes of high risk work
 - Schedule 5: Registration of plant and plant designs
- Managing risks of plant in the workplace Code of Practice 2013
- AS/NZS1200 - Pressure equipment
- AS1210 – Pressure vessels
- AS2971 – Serially produced pressure vessels
- AS4343 – Pressure equipment – Hazard levels
- AS/NZS3788 - Pressure equipment – In-service Inspection;
- AS2030 series - Gas cylinders;
- AS2337 - Gas cylinder test stations;

PRESSURE EQUIPMENT

The Work Health and Safety Regulation 2011 (WHS Regulation) Schedule 19 defines **Pressure equipment** as meaning boilers, pressure vessels and pressure piping.

Note: The inspection, testing, maintenance and marking sections of this module are a guide only as these requirements are specific to each gas cylinder.

STATUTORY PROVISIONS

Registration of Registerable Plant Design

In accordance with the Work Health and Safety Act 2011 (The Act), a person must not use or supply plant listed in Schedule 5 Part 1 of the WHS Regulation 2011 unless the design of the plant is registered. The design of the following pressure equipment must be registered:

- Pressure equipment, other than pressure piping, and categorized as hazard level A, B or C or D according to the criteria in section 2.1 of AS 4343:2005 (Pressure equipment – hazard levels).
- Gas cylinders covered by section 1.1 of AS2030.1:2009 (Gas cylinders – General Requirements)

The following pressure equipment are not included in the list of pressure equipment to be registered:

- A heritage boiler;
- Any pressure equipment (other than a gas cylinder excluded from the scope of AS/NZS 1200:2000 (Pressure Equipment));

Registration

Part 4 of the Work Health and Safety Act 2011 requires for PCBU's to register high risk plant specified in Schedule 5 Part 2 of the WHS Regulation 2011 before it is used. The following pressure equipment are registerable:

- Boilers categorized as hazard level A, B or C according to the criteria in section 2.1 of AS 4343:2005 (Pressure equipment – hazard levels).
- Pressure vessels categorized as hazard level A, B or C according to the criteria in section 2.1 of AS 4343, except -
 - gas cylinders; and
 - LP gas fuel vessels for automotive use; and
 - Serially produced vessels.

Inspection requirements for registered plant

Registrable plant will require a declaration that the item of plant has been inspected by a competent person and assessed by that person as being safe to operate ('safe to operate' statement).

The maintenance, inspection and testing must be carried out:

- in accordance with the manufacturers recommendations, if any; or
- if there are no manufacturer's recommendations, in accordance with the recommendations of a competent person; or
- in relation to inspection, if it is not reasonably practicable to comply with paragraph (a) or (b), annually

Record keeping requirements for registered plant

The person conducting a business or undertaking (PCBU) that is in control of an item of registrable plant must keep a record of all tests, inspections, maintenance, commissioning, decommissioning, dismantling and alterations of plant for the period that the plant is used or until the person relinquishes control of the plant. If the plant is relinquished to another party, these records must be given to the person taking control of the plant.

High Risk Work Licence

Part 4 of the WHS Act requires anyone carrying out high risk work (listed in Schedule 3 of the WHS Regulation) to hold a high risk work licence. The following are classes of high risk work that involve pressure equipment or vessels:

- Standard boiler operation
- Advanced boiler operator;
- Operation of a steam turbine with:
 - an output of 500 kW or more; and
 - is multi-wheeled; or
 - is capable of a speed greater than 3600 revolutions per minute; or
 - has attached condensers; or
 - has a multi-staged heat exchange extraction process
- Operation of a reciprocating steam engine where the diameter of any piston exceeds 250mm

WHS Regulation 2011 s224 – Pressure equipment

The WHS Regulation has specific requirements for pressure equipment as follows:

- (1) The person with management or control of pressure equipment at a workplace must ensure that—
 - (a) the equipment is inspected on a regular basis by a competent person; and
 - (b) any gas cylinder that is inspected is marked with a current inspection mark showing the date of the most recent inspection.
- (2) The person with management or control of gas cylinders at a workplace that is a gas cylinder filling station must ensure that—
 - (a) a gas cylinder is not filled with gas unless it bears a current inspection mark; and
 - (b) a gas cylinder is only filled with gas for which that cylinder is designed.

PRESSURE EQUIPMENT - HAZARDS

Hazards associated with pressure equipment include:

- Defective or damaged pressure equipment or pressure vessels and their components (e.g. cracks, dents, manufacturing defect, leaks)
- Inappropriate hoses, couplings, connections and end fittings used
- Gas cylinders are unsecured during storage, transport or use and can fall or be knocked over.
- Operating the pressure equipment or vessel at a pressure higher than its maximum allowable working pressure
- Lack of or non-functional safety relief valve
- Lack of or non-functional pressure gauge
- Storing or placing pressure equipment or vessels near an ignition source or flammable materials (e.g. fuel, paint, solvents)
- Gas cylinder dropped during handling
- Pressure equipment or pressure vessels placed in a position where they can be damaged by vehicle traffic or general work operations

Control measures that eliminate or minimise the hazards associated with pressure equipment and pressure vessels include:

- A functioning pressure gauge
- A safety relief valve
- Pressure vessels secured by a chain, in a racking system or using a strap
- Pressure equipment and vessels placed in a location where they cannot be damaged by vehicle traffic or general work operations
- Install impact bollards to prevent vehicles from impacting the gas cylinders
- Store and/or transport cylinders in an impact cage.
- Use a gas cylinder carrier or trolley when handling gas cylinders
- Place pressure equipment and pressure vessels away from ignition sources or flammable materials
- Inspect pressure equipment and pressure vessels for defects and damage. Remove any pressure equipment with defects or damage from service.

Pressure equipment and pressure vessels are potentially dangerous plant. Failure of the plant has the potential to result in explosion(s) which could cause death and serious injuries, as well as severe property damage. Incidents associated with pressure plant and equipment can be caused, by one or a combination of the following factors:

- Poor design of equipment;
- Poor manufacture of equipment;
- Improper installation and commissioning procedures and practices;
- Poor design of the workplace;
- Poor operational practice;
- Poor maintenance and repair of equipment;
- Improper alterations to the equipment;
- Improper dismantling and transportation process;
- Failure of alarm and shut down systems.

To ensure pressure equipment is maintained at a serviceable state and operated safely, maintenance should be conducted in accordance with either the manufacturer's instructions, the Australian Standard or competent person's recommendations. The following extracts from the relevant Australian Standards provide guidance on the operation, inspection and testing, manufacturing and use of pressure equipment and pressure vessels.

BOILERS AND PRESSURE VESSELS

Marking and Labelling – Reference AS/NZS 1200 - 2015

The following information should be provided where required:

- for all pressure equipment –
 - the identification of the manufacturer;
 - the year of manufacture;
 - the design registration number;
 - essential maximum and minimum allowable limits; and
 - other marking required by the Standard to which the equipment conforms, including the required conformity assessment mark.
- Depending on the type of pressure equipment, further information necessary for safe installation, operation and use and, where applicable, maintenance and periodic inspection.
- Where necessary, warnings fixed to the pressure equipment drawing attention to misuse which experience has shown might occur.

Operating Instructions

When pressure equipment is placed on the market, it should be accompanied, as far as relevant, with instructions for the user, containing all the safety information relating to the following:

- Mounting, including assembling, or different pieces of pressure equipment.
- Putting into service.
- Use.
- Maintenance including checks by the user.

Use

General

At all times during various operations over its life, pressure equipment should be used by each person involved with the equipment in a manner which minimizes the risk of harm to the health and safety of all persons, property and the environment (i.e. ensures safety).

Equipment Operations

The following operations or stages should be addressed in the overall control of pressure equipment:

- Initial management necessary to ensure the integrity and compliance of the equipment, e.g. procurement, planning, development and site approval, location (e.g. clearances, access and egress), installation and required safeguard (e.g. grading, deluge or screening system against fire).
- Operations such as to commission, (including recommission), operate (including preliminary checks, startup, monitoring, supervision, checks, shutdown and isolation), maintain (including routine replacement and repair, inspection and test), clean, repair, modify (i.e. a change); alter (a change which may affect safety), decommission, dismantle, relocate, store, dispose of and recycle.
- Emergency operations.

In-service Inspection for Pressure equipment

Extracts from AS/NZS 3788:2006 PRESSURE EQUIPMENT – IN-SERVICE INSPECTION

General

Boilers and pressure vessels shall be periodically inspected to assist in assuring safe operation until the next scheduled inspection. These inspections shall assess the condition of the pressure equipment in order to judge its suitability to continue to operate.

Inspection may be both internal and external and may include supplementary non-destructive techniques or pressure tests. An inspection may be performed when the pressure equipment is operating or depressurized. As a result of periodic inspection, a certificate or report of inspection shall be issued to the owner.

First In-service Inspection

When required (indicated by Column 3 of Table 4.1), new pressure equipment shall be inspected internally and externally after its first year of service, the frequency or subsequent inspections may then be determined.

Alternatively, the first in-service inspection may be deferred if it is determined safe to do so by using a Risk Based Inspection (RBI) process (refer also Clause 4.5 and Paragraph B5). The maximum interval between commissioning and the first in-service inspection shall be the nominal inspection interval given in Table 4.1. Any deferment shall be documented in a transparent and auditable manner.

Intervals for Periodic Inspection

Inspection Intervals

These periods may be varied by the in-service inspector or persons with equivalent qualifications and experience, in consultation and agreement with all parties concerned. Requirements for determining shortened or extended inspection intervals can be found in Clause (4.4.4) of this Standard.

External Inspection

External inspection periods may be extended beyond those shown in ASNZS3788, but shall not exceed the internal inspection period.

Internal Inspection

The internal inspection periods listed in the following table are as follows:

Nominal Interval

The internal inspection intervals (Column 5) define nominal maximum inspection intervals based on industry experience. These intervals should be used only when operating experience or condition monitoring gives confidence that no significant deterioration will occur in that period.

Extended Interval

The periods may only be used after at least one or more 'nominal periods' has been undertaken in addition to the first yearly inspection (if applicable) and assessment has clearly demonstrated that such extended intervals are safe. Such a change shall be justified and documented with respect to the correct operating parameters. Changes to these parameters should be preceded by review of the proposal with a competent person.

TABLE 4.1
INSPECTION INTERVALS

1		2	3	4	5	6
Pressure equipment		Commissioning inspection required? (see Clause 4.2)	First yearly inspection required? (see Clause 4.4.3)	Inspection interval, years		
				External inspection (see Notes 2 and 3 and Clause 4.4.4.1)	Internal inspection	
					Nominal interval (see Clause 4.4.4.1)	Extended interval (see Clause 4.4.4.1)
1	BOILERS (see Note 12)					
1.1	Electric boilers	Y	N	2	4	8
1.2	Coil-type forced circulation boilers	Y	N	2	(see Note 15)	
1.3	All other boilers	Y	Y	1	1	4 (see Note 4)
2	STEAM PRESSURE VESSELS					
2.1	Jacketed vessels				(See Note 14)	
	$pV \leq 30$ MPa.L	N	N			
	$pV > 30$ MPa.L	Y	Y	2	4	8
2.2	Other steam pressure vessels (see Appendix S for deaerators)					
	$pV \leq 30$ MPa.L	N	N	(See Note 14)	(See Note 14)	
	$30 < pV \leq 100$ MPa.L	Y	N	(See Note 14)	(See Note 14)	
	$pV > 100$ MPa.L	Y	Y	2	4	8
3	VESSELS WITH QUICK-ACTUATING CLOSURES					
3.1	Containing gases (including steam)				(See Note 14)	
	$pV \leq 15$ MPa.L	N	N			
	$pV > 15$ MPa.L	Y	Y	2	4	8
3.2	Containing liquids				(See Note 14)	
	$pV \leq 100$ MPa.L	N	N			
	$pV > 100$ MPa.L	Y	Y	2	4	8
4	FIRED HEATERS OR CONVECTION BANKS	Y	Y	2	4	8
5	WATER HEATERS	Y	N	4	12	12
6	COMPRESSED AIR CONTAINING VESSELS					
	$pV \leq 100$ MPa.L	N	N		(See Note 14)	
	$100 < pV \leq 150$ MPa.L	Y	N		(See Note 14)	
	$pV > 150$ MPa.L	Y	N	2	4	12
7	STATIC STORAGE VESSELS (see Notes 5 and 17)					
7.1	Gases (non-corrosive condition) including above-ground LPG storage vessels	Y	N	2	10	12
7.2	Gases (other conditions) including anhydrous ammonia	Y	Y	2	2	4
8	STORAGE TANKS TO API 620 OR EQUIVALENT	(See Appendix T)				

(continued)

TABLE 4.1 (continued)

1	2	3	4		
			5		
			6		
Pressure equipment	Commissioning inspection required? (see Clause 4.2)	First yearly inspection required? (see Clause 4.4.3)	Inspection interval, years		
			External inspection (see Notes 2 and 3 and Clause 4.4.4.1)	Internal inspection	
				Nominal interval (see Clause 4.4.4.1)	Extended interval (see Clause 4.4.4.1)
9 PROCESS VESSELS (see Note 6)					
9.1 Hazard Level A	Y	Y	2	4	8
9.2 Hazard Level B	Y	Y	2	4	12
9.3 Hazard Level C	Y	Y	2	4	12
9.4 Hazard Level D	Y	N	4	(See Note 14)	(See Note 14)
10 AUXILIARY VESSELS (see Note 7 and 17)					
10.1 Accumulators					
$pV \leq 100$ MPa.L	N	N		(See Note 14)	
$100 < pV \leq 200$ MPa.L	Y	N		(See Note 14)	
$pV > 200$ MPa.L	Y	Y	2	12	12
10.2 Other auxiliary vessels containing corrosive, toxic or flammable contents and except those covered Note 19.	Y	Y	2	4	12
10.3 Particular auxiliary vessels (See Note 19)	Y	Y		(See Note 19)	
11 REFRIGERATION AND AIR-CONDITIONING VESSELS (see Note 13)					
11.1 Group A1 refrigerants to AS/NZS 1677.1					
$pV \leq 100$ MPa.L	N	N		(See Note 14)	
$100 < pV \leq 200$ MPa.L	Y	N		(See Note 14)	
$pV > 200$ MPa.L	Y	Y	2	12	12
11.2 Groups A2, A3, B1 and B2 refrigerants to AS/NZS 1677.1	Y	Y	2	12	12
12 STATIC LOW TEMPERATURE VESSELS (BELOW -10°C) (See Clause 4.12)					
12.1 Insulated, non-vacuum, non-jacketed, non-toxic contents	Y	N (see Note 14)	4	12	12
12.2 Insulated non-vacuum, non-jacketed, toxic contents	Y	N	4	12	12
12.3 Vacuum insulated:					
(a) inner vessel	Y	N		(see Clause 4.12.1)	
(b) outer vessel	Y	N	4	(see Clause 4.12.1)	
12.4 Jacketed non-vacuum vessels:					
(a) inner vessel	Y	N		(see Clause 4.12.2)	
(b) outer vessel	Y	N	4	(see Clause 4.12.2)	

(continued)

TABLE 4.1 (continued)

1		2	3	4	5	6
Pressure equipment		Commissioning inspection required? (see Clause 4.2)	First yearly inspection required? (see Clause 4.4.3)	Inspection interval, years		
				External inspection (see Notes 2 and 3 and Clause 4.4.4.1)	Internal inspection	
					Nominal interval (see Clause 4.4.4.1)	Extended interval (see Clause 4.4.4.1)
13	BURIED OR MOUNDED PRESSURE EQUIPMENT	Y	(see Paragraph D6.2.2 and Appendix R)		In accordance with Table 4.1 for particular type of vessel	
14	PRESSURE PIPING (see Notes 20 and 21)					
14.1	Hazard Level A	Y	Y	2	4	8
14.2	Hazard Level B or C confirmed to be in corrosive, vibrating or elevated temperature service after 1 st yearly inspection	Y	Y	2	4	8
14.3	Hazard Level D piping (See Note 14); or Hazard Level B or C piping confirmed to be in non-corrosive, non-vibrating service and non-creep service after 1 st yearly inspection	Y	Y	8		
15	TRANSPORTABLE VESSELS (see Appendix E and Notes 1, 8, 9, 10, 11, 16, and 17)					
15.1	Service conditions					
15.1.1	Cargo (Refer to AS 4343)					
15.1.1.1	Lethal	Y	Y	1	2	2
15.1.1.2	Very harmful	Y	Y	1	5	5
15.1.1.3	Harmful	Y	Y	1	5	5
15.1.1.4	Non-harmful	Y	N	3	6	9
(a)	Non-harmful powder discharge vessel. (Aluminium construction)	Y	N	2	2	4
(b)	Non-harmful powder discharge vessel. (Steel construction)	Y	N	3	6	9
(c)	Non-harmful powder discharge vessel. (Other material construction)	Y	Y	1	5	5
15.1.2	Low-temperature (<-10°C) (see Clause 4.12)					
15.1.2.1	Non-vacuum insulated, non-jacketed	Y	Y	1	6	6
15.1.2.2	Vacuum insulated (see Note 15)					
(a)	Inner vessel	Y	N			
(b)	Outer vessel	Y	Y	1		

(continued)

TABLE 4.1 (continued)

1	2	3	4	5	6
Pressure equipment	Commissioning inspection required? (see Clause 4.2)	First yearly inspection required? (see Clause 4.4.3)	Inspection interval, years		
			External inspection (see Notes 2 and 3 and Clause 4.4.4.1)	Internal inspection	
				Nominal interval (see Clause 4.4.4.1)	Extended interval (see Clause 4.4.4.1)
15.2 Material of construction					
15.2.1 AS 1210 Group G steels (see Notes 9 and 10)	Y	Y	1	3	6
15.2.2 Austenitic alloy steels					
15.2.2.1 Stabilized grades (such as 316Ti, 321 and 347)					
(a) Non-vacuum insulated (see 15.1.2.1 of this table)					
(b) Vacuum insulated (see 15.1.2.2 of this table)					
15.2.2.2 Non-stabilized grades (such as 302 and 304)					
(a) Non-vacuum insulated	Y	Y	1	6	6
(b) Non-vacuum insulated cold stretched	Y	Y	1	3	3
(c) Vacuum insulated (see 15.1.2.2 of this table)					
15.2.3 Other materials	Y	Y	1	5	5
15.3 Liquefied gas transport drums (chlorine and ammonia)	(See Appendix W)				
15.4 Other transportable vessels (see Note 10)	Y	Y	1	5	5
16 Pressure relief devices	Y	Y	1	(See Note 18)	
17 Heritage boilers and pressure vessels	(See Appendix Y)				

LEGEND:

- p = Design pressure, in megapascals
 V = Maximum volume and liquid space, in litres
 Y = Yes
 N = No

NOTES:

- The designated inspection date (as shown on the certificate of inspection) may be deferred by a maximum of three months to allow the inspection to be scheduled during a shutdown or maintenance period. A deferral is the subject of agreement between the owner and the competent person or in-service inspector. The justification for a deferral shall be documented by the owner, and included with the inspection records for the equipment concerned. The following inspection date shall be determined by the original designated date, not the deferred date. In New Zealand it is the responsibility of the inspection body to decide on the extension of inspection intervals.
- External inspection covers the visual confirmation of the condition of fittings, protective devices, protective coatings, insulation, fireproofing, bolting, supports, pressure equipment identification and security of attachments and the absence of defects, such as corrosion, leaks, bulging, signs of heat or cold, signs of cracking, e.g. at exposed welds particularly those adjacent to supports, excessive dents and integrity of supports and clamps.
- The rate of external corrosion may be governed by the atmospheric environment. AS/NZS 2312 classifies the environment into mild, moderate, severe industrial and very severe. Pressure equipment located in severe industrial and very severe environments may need to have the external inspection interval reduced.

- 4 Extended interval is available only to boilers which have adequate water treatment facilities and have demonstrated reliability and have not been subjected to a change of fuel types (e.g. gas to solid fuel) outside the original design parameters.
- 5 Gases may be stored in either the liquefied or gaseous state. These vessels exclude low-temperature vessels normally operating below -10°C and buried static storage pressure equipment.
- 6 Process vessels are those which form part of a process train and which are subject to changes in temperatures, pressure and/or contents during the process cycle. Process vessels exclude other pressure equipment specifically referred to in Table 4.1. Where the type of vessel used in the process is specifically referred to in another part of Table 4.1, then the more stringent of the two internal inspection intervals shall be applied.
- 7 Auxiliary vessels are those which form part of a package or part of a subsystem, e.g. suction/discharge vessels, filters, knock-out vessels, intercoolers and hydraulic accumulators.
- 8 When a transportable vessel used for the carriage of anhydrous ammonia is permanently removed from anhydrous ammonia service, a further annual internal inspection is required 12 months after the last period during which ammonia was carried.
- 9 All transportable vessels constructed to AS 1210 group G steels (quenched and tempered) and all other transportable vessels in liquefiable gas service (other than vacuum-insulated vessels) having a volume exceeding 14000 L shall be non-destructively examined both internally and externally in accordance with Appendix E, Paragraph E3.3 after the first year of service.
- 10 Where required by Note 9, non-destructive examination of external welds on non-vacuum insulated vessels may be carried out using the ultrasonic method permitted in Appendix E, Paragraph E3.3.
- 11 For these insulated vessels, at the 6-yearly internal inspection, the insulation is to be removed locally to allow all welds which are subject to cyclic bending stress during the operation of the vessel (see Note 1 to Table E1) to be examined.
At 12-yearly intervals all insulation shall be removed from the vessel for a complete external examination.
- 12 For boilers, the inspections given in this Table (4.1) are not to be confused with the inspections listed in AS 2593. The listed intervals apply regardless of attendance category. All boilers with hazard levels D and E and miniature boilers complying with AMBSC do not require inspection to this Table (4.1).
- 13 For Group A1 refrigerants, internal inspection is not required on the refrigerant side. Toxicity, flammability and combustibility of refrigerants are not included in this lower pressure grouping.
- 14 This equipment is sometimes considered as low risk when operated in accordance with good engineering practice and process control. Despite this low risk, the pressure equipment and control equipment shall be maintained in a fit and safe condition for service, including regular operating surveillance. Any major repairs or alterations to pressure equipment shall be subject to compliance with Section 6.
- 15 Normally cannot be inspected internally, see Clause 4.12.
- 16 Where a transportable vessel fits into more than one type defined in Table 4.1, the most stringent of the requirements for inspection is to be applied.
- 17 Conditions may only be considered non-corrosive based on demonstrated experience in identical service. For example, the storage of anhydrous ammonia in a carbon steel vessel would in general be considered as a corrosive condition due to the possibility of stress corrosion cracking. However, proven effective control of the risk of stress corrosion cracking by selection of steel, post-weld heat treatment, dosing with water and control of oxygen and other contaminant ingress may allow the service to be deemed non-corrosive.
- 18 See Clauses 4.7 and 4.8.
- 19 Some auxiliary vessels are designed for intervals between internal access in excess of 10 years, eg high voltage electricity circuit breakers. Where such vessels contain no known deterioration mechanism and there is a significant population of such vessels, the interval between inspections may be determined by a competent person and agreed to by the parties concerned.
- 20 Appendix I gives guidance on piping integrity and inspection. Hazard level is determined by AS 4343.
- 21 Refer to Clause 4.13. Internal inspection refers to obtaining information on the condition of the internal surface by either internal inspection or use of non-destructive inspection (e.g. radiography or ultrasonic thickness testing or pulsed eddy current techniques).

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GAS CYLINDERS

Extracts from AS2030.1 – 2009: Gas cylinders – general requirements

Cylinder Manufacturing and Inspection

General

The manufacturer shall be technically capable and shall possess all resources required for the satisfactory manufacture of gas cylinders. The manufacturer shall have construction and testing facilities that are acceptable to a third party inspection body (e.g. by successfully passing an audit).

Inspection and Testing Requirements

The following requirements shall be met:

- The manufacturer shall ensure that appropriate production testing is carried out, and shall perform sufficient inspections to ensure that the cylinders comply with the relevant cylinder Standard.
- The manufacturer shall conduct any other inspections and tests which may be required by the inspection body.
- The inspection body (or its delegate) shall certify each complying cylinder and permanently apply its mark thereon.
- A manufacturer's test certificate, signed by the inspection body and the manufacturer, shall be issued before the gas cylinders are released.

Periodic Inspection and Testing

Cylinders shall be subjected to periodic inspection and testing by a test station which complies with Clause 6.1. Periodic inspection and testing shall be performed in accordance with the requirements of the relevant Parts of AS 2030, of AS 2337.1, and of the other relevant Parts of AS 2337.

Extracts from AS2030.5 – 2009: Gas cylinders – filling, inspection and testing of refillable cylinders

Acceptance Criteria for Inspection and Testing

The testing and inspection tests and the acceptance and rejection criteria can be found in AS2337.1 and AS2337.3.

Safety Devices

General

All cylinders shall be fitted with safety devices, except for the following:

- Safety devices shall not be fitted to cylinders containing either a medical compressed gas or a toxic gas.
- Fitment of a safety device to a cylinder is optional for the following:
 - Cylinders in non-underwater breathing applications, e.g. SCBA.
 - Where the cylinder has a diameter of 115 mm or less, or a water capacity of 3.5 kg or

less, and safety device T (see Table 6) is specified in Tables 2, 3 and 4 for the intended contents.

- Cylinders in a bundle which utilize one common safety device, in compliance with Clause 5.3.2. Safety devices shall comply with AS 2613. The fitment of safety devices shall be in accordance with Tables 2, 3 and 4, as appropriate to the intended contents. There shall be unimpeded escape of discharge from any safety device.

NOTE: Requirements for fitment of safety devices to cylinder valves are specified in AS 2473.1.

Safety devices on bundles

Where cylinders for non-flammable non-toxic gas are manifolded together, one common safety device of a rated capacity not less than the sum of the capacities required for all of the manifolded cylinders may be used in place of individual safety devices, provided that there is no shut-off valve between the common safety device and any of the cylinders.

Composite gas cylinders

Where safety devices are fitted to composite gas cylinders, they shall be verified as being of suitable type and performance by testing of the complete cylinder.

SCUBA cylinders

A bursting disc type safety device with suitable protection against corrosion shall be fitted to all cylinders for SCUBA applications.

Non-periodic Inspection and Testing

Inspection and tests other than periodic inspection and tests shall be carried out where appropriate by a test station, and shall be in accordance with the following:

- Prior to first filling, stamping with a test station mark in accordance with the requirements of AS 2337.1, and with the requirements of AS 2337.3, as appropriate.
- Prior to change of gas traffic, as required by Clause 8 and Table 1.
- Prior to filling, should defects be suspected, inspection and tests as appropriate to the suspected defect.
- Following initial fitting, or replacement of a valve, inspection in accordance with Clause 7.3.
- At the discretion of the cylinder owner, at a time less than the periodic interval.

Care and Handling

Avoidance of Oil, Grease and Water

Neither oil nor grease shall be allowed to come into contact with the valves or cylinders used for the storage and transport of any gas. Particular care shall be taken to prevent contamination of any cylinder which contains oxygen, nitrous oxide, chlorine, any other oxidizing agent or any gas for human respiration. Care shall be taken to ensure that water is not allowed to enter a cylinder between hydrostatic test or inspections.

NOTE: Exclusion of moisture and other potentially corrosive materials is particularly important for cylinders manufactured from high strength steel where the relatively thin walls provide little corrosion allowance.

Closing valves for transportation

The shut-off valve for each cylinder shall be closed during transportation.

Cylinders for toxic gases

A gastight seal shall not be removed from a toxic gas cylinder unless appropriate protection (e.g. personal protective equipment) is afforded to the person(s) removing the seal. While the seal is being removed, a check for leakage shall be carried out.

Need to Keep cylinders Cool

Filled cylinders shall be kept away from sources of heat which are likely to overheat the cylinder, above its maximum working temperature.

Avoidance of shock

Cylinders should not be allowed to fall upon one another or be otherwise subjected to undue mechanical shock. During transport and use, cylinders shall be secured.

Correct Orientation

Cylinders filled with liquefied gas shall be transported, stored, and used in a manner which ensures that the safety device is in direct contact with the vapour space.

Extracts from AS2337.1 – 2004: Gas cylinder test stations – General requirements, inspection and tests – gas cylinders

Inspections and tests to be performed**Cylinders already stamped with a certificated test station mark**

Cylinders shall be subjected to inspection and tests specified in AS 2030.1 and, as appropriate, in this Standard.

It is recommended that the tests listed below be performed in the suggested sequence. In particular, the visual examinations should be carried out before the pressure test or ultrasonic examination

- Identification of gas and valve removal
- External visual inspection
- Internal examination
- Inspection of cylinder neck
- Pressure test or ultrasonic examination
- Mass test
- Operations on rejected cylinders
- Operations on accepted cylinders

- Complete records

Cylinders that fail the inspection or tests shall be rejected. The decision to reject a cylinder may be taken at any stage during the inspection and test procedure.

Where there are still doubts about the condition of the cylinder after the above tests, refer to Clause 6.5.

Heat exposure may affect the mechanical properties of cylinders, especially aluminium or composite materials. Therefore, the maximum temperature for any inspection or test operation shall be limited to the manufacturer's recommendation.

Inspection of Cylinders without a certificated test station mark

Before a gas cylinder can be stamped with a test station's certificated mark, prior to its first filling in Australia, it is necessary to verify the suitability of the cylinder for filling in accordance with AS 2030.1.

The following steps shall be followed:

- Verify that all the required documentation and markings as specified in AS 2030.1 are correct
- Identification of contents, if the cylinder has been in service
- External visual inspection
- Internal visual inspection, when corrosion is suspected
- Pressure test or ultrasonic examination, if required
- Mass test, if required

Subsequent to inspections and test, cylinders shall be treated as follows:

- Operations on rejected cylinders
- Operations on accepted cylinders

Cylinders which do not pass all the inspection requirements of AS 2030.1 shall not have a test station mark applied.

Version	Date	Author
1	30/06/2018	WHSQ