

Australian Standard™

**Pressure equipment—Operation and
maintenance**



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STANDARDS AUSTRALIA

RECONFIRMATION

OF

AS 3873—2001

Pressure equipment—Operation and maintenance

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Technical Committee ME-001 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

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NOTES

Australian Standard™

Pressure equipment—Operation and maintenance

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PREFACE

This Standard was prepared by the Standards Australia/Standards New Zealand Committee ME-001, Pressure Equipment to supersede AS 3873—1995, *Pressure equipment—Operation and maintenance*.

The Joint Committee agreed to produce this document as an Australian only Standard.

This Standard is a result of a consensus among members of Committee ME-001. Consensus means general agreement by all interested parties. Consensus includes an attempt to remove all objections and implies much more than the concept of a simple majority, but not necessarily unanimity. It is consistent with this meaning that a member may be included in the Committee list and yet not be in full agreement with all clauses of this Standard.

It was recognized that there was a need to specify requirements and give guidance to the parties concerned with the operation and maintenance of pressure equipment. Existing Standards specify requirements for design, manufacture and installation of pressure equipment systems, but do not provide information for their operation or maintenance.

This Standard attempts to provide minimum requirements for a method of ensuring safe and reliable operation of pressure equipment and for safety during maintenance, inspection, alteration, storage and disposal. In some circumstances, additional requirements may be necessary for adequate performance or safety. This Standard may be used as a guide for training.

The main changes in this revision are as follows:

- (a) Alignment with Standardization Guide No. 17.1, *Drafting of Standards that may be referenced under occupational health and safety legislation*.
- (b) A new appendix to give guidance on assessment of competency.
- (c) Revised requirements and guidance on risk assessment to align with AS/NZS 4360, *Risk assessment*.
- (d) Revised Section 4, Safety management system, to become Appendix C.
- (e) Incorporation of former Appendix J, Typical example of a generic risk assessment for automotive fuel pressure vessels, into Appendix D.

The principal object of this Standard is to provide uniform, safe and economic requirements and guidance for operation and maintenance of pressure equipment.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard

Pressure equipment—Operation and maintenance

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies the minimum requirements and gives guidance on the operation and maintenance of boilers, pressure vessels, associated control and safety equipment, piping and auxiliaries, (e.g. boiler fuel handling and firing equipment, heaters, fans, pumps, feedwater treatment and the like) and gives guidance in the execution of such work. It also covers actions required from initial receipt of the equipment on-site until final disposal.

This Standard applies to commissioning, operation, maintenance, alterations, routine inspection, dismantling storage and disposal. It includes specific requirements for safety management systems, including, where appropriate, risk assessment.

Requirements cannot be written in sufficient detail to cover all aspects of the above. Necessary action is required to ensure the continued safe operation of the pressure equipment. This may require outside expert advice, which may typically include the use of risk assessment or other appropriate methods.

This Standard generally applies to pressure equipment covered by AS/NZS 1200. The extent of the application of the requirements is dependent on the hazard levels of the equipment and service conditions.

NOTES:

- 1 'Duty of care' is now prescribed on employers and employees regardless of regulation or standards. This Standard does not supersede 'duty of care'.
- 2 Users of this Standard are reminded that it has no legal authority in its own right, but may acquire legal standing when adopted by government or an authority having jurisdiction, or if specified as part of a commercial contract.

1.2 APPLICATION AND OBJECTIVE

1.2.1 Application

This Standard is intended for use by owners or users of pressure equipment. The user may also be the owner. The owner may have purchased, leased or hired the equipment.

Sections 1, 2 and 3 of this Standard specify general requirements applicable to all pressure equipment, while subsequent Sections provide additional requirements and guidance for specific types of equipment.

1.2.2 Objective

This Standard is intended to provide owners and users with clear minimum requirements for operation of pressure equipment and maintenance of its integrity to ensure safe economic performance and protection of persons, equipment and the environment.

1.3 REFERENCED DOCUMENTS

The documents referred to in this Standard are listed in Appendix A.

1.4 DEFINITIONS

For the purposes of this Standard, the definitions in AS/NZS 1200 and those listed below apply.

1.4.1 Boiler, limited attendance

A boiler designed for fully automatic operation with fail-safe features and suitable for periods of operation without human supervision, subject to regular checks by a competent boiler attendant and subject to specified supervision and maintenance procedures, (see AS 2593).

1.4.2 Boiler, unattended

A boiler designed for fully automatic operation with fail-safe features and suitable for periods of operation without human supervision, subject to regular checks by a competent person and subject to specified supervision and maintenance procedures, (see AS 2593).

1.4.3 Competency

A competency comprises knowledge and skill and the application of that knowledge and skill to the standard of performance required.

1.4.4 Facility

The buildings, containers or equipment which contain a process.

1.4.5 Fired heater

A pressure vessel in which a liquid is heated below its atmospheric boiling temperature or a process fluid is heated in tubes above or below its atmospheric boiling temperature by the application of fire, the products of combustion or electric power or similar high temperature means.

1.4.6 Hazard

The potential to cause injury or illness, or damage to property or environment.

1.4.7 Hazard level

The level to which pressure equipment has the potential to cause injury or illness or damage to property and environment. See AS 4343.

1.4.8 Hazardous substance

A substance possessing toxic, reactive, flammable or explosive properties, or is otherwise harmful to persons or the environment.

1.4.9 Hot work

Work involving electric or gas welding, cutting, brazing or similar flame or spark-producing operations.

1.4.10 In-service inspection body

A body corporate, firm or person external to that of the owner, or an owner's inspection department, able to provide the inspection services of pressure equipment.

1.4.11 Inspectors

1.4.11.1 In-service inspector

A person who carries out in-service inspection of pressure equipment in accordance with AS/NZS 3788.

1.4.11.2 Inspector

Any person involved with the inspection function in accordance with this Standard.

1.4.12 Interlock

A device that makes the operation of an item of equipment dependent on the fulfilment of predetermined conditions by another item of equipment.

1.4.13 May

Indicates that a statement is optional.

1.4.14 Operator

A person who operates and controls a pressure equipment system or section of the system with authority of the owner or user. Such a person is competent, suitably trained and instructed in the hazards associated with the pressure equipment and in the safe methods of operation, and is adequately supervised.

1.4.15 Pressure parts

The pressure retaining parts of pressure equipment, e.g. boiler drums, vessels, headers and pipes.

1.4.16 Process

Any activity involving a pressurized fluid.

1.4.17 Shall

Indicates that a statement is mandatory.

1.4.18 Should

Indicates a recommendation.

1.4.19 Use

To commission, operate, maintain, inspect, clean or decommission pressure equipment.

SECTION 2 MANAGEMENT AND PERSONNEL

2.1 GENERAL

This Section provides requirements and recommendations for the implementation of a safety management system and procedures to manage the use of pressure equipment and ensure the safety of personnel.

NOTE: See Appendix B for the application of a safety management system.

2.2 SAFETY MANAGEMENT SYSTEM

A safety management system provides the following:

- (a) The implementation of procedures to manage the use (operation and maintenance) of pressure equipment and associated systems of work. Procedures should be available to the operating and maintenance personnel.
- (b) Control of the safety and integrity of the pressure equipment and related systems of work, minimization of the potential for, and consequences of leakage or failure of the equipment, and protection of persons, property and the environment.

The safety management system should —

- (i) be appropriate to the type of equipment, its location, the process and content, the hazards (hazard levels) and risks involved, the size, type and complexity of the operations, and the persons involved;
- (ii) be integrated with or supplement, where required, a quality system for the owner and user's product and operations;
- (iii) ensure requirements are understood and suitable work practices are implemented for guidance; and
- (iv) be periodically reviewed and operation and maintenance procedures audited for compliance.

2.3 DOCUMENTATION FOR SAFETY MANAGEMENT SYSTEMS

Documentation for the safety management system shall be maintained. The documentation should include the following, as appropriate to the complexity of the plant and size of the organization:

- (a) Details of the organizational structure for management of the pressure equipment.
- (b) Information showing the interrelationship between safety management personnel, operations and maintenance personnel and other relevant resources.
- (c) Nominations of personnel to —
 - (i) arrange for an inspection program to AS/NZS 3788 that takes into account the manufacturer's recommendations and any other requirement found necessary for the safe and secure operation of the equipment;
 - (ii) ensure that incidents, damage, faults or defects with pressure equipment be reported, recorded and rectified (see Clause 2.13);
NOTE: See Appendix C for a guide on user's documentation and records.
 - (iii) notify the in-service inspector of incidents or changes that could affect the integrity of the pressure equipment; and
NOTE: See Appendix C.
 - (iv) supervise the safety of pressure equipment.
- (d) The process to review the system on a regular basis and record the results of the reviews.

2.4 COMMISSIONING OPERATIONS

Pressure equipment should be initially operated, inspected, tested and adjusted to the specified performance parameters.

For equipment with hazard levels A, B and C (see AS 4343), the commissioning should be in accordance with a documented procedure provided for initial checks and start up, sequence of operations and required tests and restart of existing facilities after shutdown for adjustment, maintenance or other purpose.

For complex equipment, special care should be taken at interfaces between different sections of work.

A competent person should be appointed, with the required knowledge of the facilities to be commissioned, to perform the commissioning activities.

A complete set of plant and equipment operation documentation should be made available to the personnel assigned to perform the commissioning.

Where appropriate, at the end of commissioning, a report should be prepared and it should include a list of all actions taken or recommended for future implementation.

2.5 RISK MANAGEMENT

Risk assessment shall be performed that identifies hazards, which could arise from the interaction of individual pressure equipment with other equipment in the facility, assesses risk and proposes control of risk to the lowest practical level.

NOTE: Refer to Appendix D for more detailed information on the risk management process for pressure equipment.

A risk assessment should —

- (a) be appropriate to the complexity of the process and system involving the pressure equipment;
- (b) identify, evaluate and control the hazards involved with the pressure equipment; and identify any events that could result in personnel injury, injury to the public or damage to plant or the environment; and
- (c) be based on a rationale that includes the extent of the hazards, number of potentially affected personnel, age of the process, the operating history of the process and its probable impact on personnel, property and environment.

A risk assessment for pressure equipment should also be integrated with the risk assessment required for associated plant and for major hazard facilities. The risk assessment should complement the safety management system and any product quality system.

2.6 PROCESS INFORMATION

2.6.1 Availability

Relevant information necessary for the process involved with the pressure equipment should be made available for the purpose of —

- (a) compiling the process safety information;
- (b) identifying process hazards;
- (c) conducting risk assessments;
- (d) developing operating and safety procedures;
- (e) investigating any incident involving safety, health or the environment;
- (f) planning emergency procedures; and
- (g) planning compliance audits.

2.6.2 Process contents

Fluids used in the process shall be suitably described and identified. See AS 4343 for hazard levels.

2.7 OPERATOR AND MAINTENANCE PERSONNEL TRAINING

2.7.1 Training

Personnel involved with the operation and maintenance of pressure equipment shall be appropriately trained to a level that ensures an understanding of the process and its effects on the pressure equipment.

The training should emphasize specific health and safety hazards, operating procedures and emergency operations for the pressure system to be operated. Specialized training may be necessary where noxious or hazardous fluids are involved.

To enable the operator to have an understanding of the full range of normal operating duties and emergency procedures, sufficient reference manuals and drawings or relevant information should be readily available to provide immediate knowledge of the function of each valve, switch, interlock and monitor. Reference materials and information should be reviewed at least every five years.

Where any alterations to equipment or procedures occurs, training to cover such alterations should be undertaken. A schematic circuit or flow diagram for the system should be available to the operators. It should include all controls, valves and relevant operating parameters with those of importance in an emergency clearly identified. It should be revised when any changes are made to the system.

The information should be clearly identifiable with the system and parts of the system to which it refers.

NOTE: A guide for the training and skills for boiler operators is given in Appendix E.

2.7.2 Refresher training

Where necessary, refresher training shall be provided to personnel involved in operating pressure equipment to ensure that the employee understands and adheres to the current operating procedures of the process. The frequency and extent of refresher training should be determined by the relevant parties concerned.

2.7.3 Training and competency documentation

Personnel involved in specific tasks of operating pressure equipment shall receive appropriate training in the current operating procedures. A record which contains the identity of the employee, the date of training and the means used to verify that the employee understood the training and the competency level attained shall be retained.

2.8 OPERATION AND MAINTENANCE

The operation of pressure equipment shall be in accordance with the manufacturer's, owner's or user's safe working procedures.

Regular checks should be carried out and documented. Each excursion outside the normal operating parameters or maintenance requirements shall be documented.

Where required, the pressure equipment system should be shut down and secured either to carry out regular maintenance and inspection, or to protect personnel and plant in the event of an emergency.

After maintenance or inspection, all isolation permits should be cancelled and the plant should be fit for service.

Personnel involved in the operation of pressure equipment shall be trained and competent to operate the nominated pressure equipment, and, where required, hold an appropriate certificate of competency.

NOTE: See Appendix F for a guide on assessing the competency of personnel.

2.9 MAINTENANCE SYSTEM

2.9.1 General

The maintenance system shall ensure the following:

- (a) That pressure equipment systems, together with setting(s), management system(s), interlock(s), and energy and environmental equipment, are maintained in safe condition and are not likely to present a hazard to personnel.
- (b) That inspections, maintenance and cleaning are carried out having regard to procedures recommended by the designer and manufacturer, or those developed by a competent person.
- (c) Establishment of the competency of the maintenance organization and personnel (see Clause 2.9.2).
- (d) Establishment of, and adherence to, a maintenance program for the pressure equipment plant and ancillaries.

2.9.2 Maintenance organization

The maintenance organization shall have competent personnel and procedures to ensure satisfactory and safe completion of the work.

The organization shall —

- (a) be a pressure equipment manufacturer with appropriate experience in the design and manufacture of pressure equipment and their safety systems; or
- (b) have appropriate experience in maintenance and operation in the nominated type of pressure equipment, particularly in regard to the safety systems employed.

2.10 CONTRACTORS

A contractor shall be selected on the basis of the contractor's ability to perform the work competently. Where they are employed, they shall be —

- (a) informed of the known or potential fire, explosion, toxic release or other hazards related to the contractor's work, and the pressure equipment;
- (b) advised of the applicable provisions of the emergency action plan required by Clause 3.4.4; and
- (c) where appropriate, made aware of safe work practices to control the entrance, presence and exit of the contractor and the contractor's employees in all process areas using the pressure equipment.

2.11 PERSONNEL PARTICIPATION AND CONSULTATION

The following measures shall be taken to ensure personnel participation and consultation:

- (a) Develop and maintain a written plan of action, where appropriate, regarding personnel participation in safety and health matters in Items (b) and (c).

- (b) Consult with personnel exposed to risk with respect to hazards identification, risk assessment, control of risk, the development of the other elements of equipment safety practices in this Standard, training, information and proposed changes to equipment, processes or work practices which could affect health and safety.

NOTE: 'Consult' does not mean agreement.

- (c) Provide relevant personnel access to risk assessment and to other information required by this Standard.

2.12 MANAGEMENT OF CHANGE

Written procedures, where appropriate, shall be prepared and implemented to manage changes, including alterations to equipment, process chemicals, technology and operating conditions, that affect safety or the integrity of pressure equipment or the total system. See also Clause 3.1.2 for review.

The procedures shall ensure that the following considerations are addressed prior to any change in process or procedures:

- (a) The technical basis for any proposed change.
- (b) Impact of change on safety and health of personnel, plant and environment.
- (c) Modifications to operating or maintenance procedures.
- (d) Necessary time period for the change.
- (e) Authorization requirements for the proposed change, if applicable.

Personnel involved in operating pressure equipment and its maintenance whose work tasks will be affected by the change, shall be informed of, and trained in, the change prior to start-up of the affected equipment (see Clause 2.7).

The operating and maintenance procedures or practices shall be updated accordingly. A review process should be conducted to evaluate the success of changes.

2.13 RECORDS

2.13.1 General

Short-term and long-term records relating to pressure equipment shall be kept and shall be sufficient to enable the condition to be determined, its fitness for further operation properly assessed and to enable any repairs or modification to be carried out safely.

NOTE: See also Appendix B.

Appropriate documents shall be used and records shall be maintained (see Clause 2.3). A copy of the manufacturer's data report with any amendments and endorsements and a copy of the latest certificate of inspection should be available (see Table C1).

Documents and records should be in writing or in electronic form, kept safely, be readily retrievable, and where related to health and safety be available to safety representatives and others, as appropriate.

2.13.2 Access to records

Access to records shall be controlled and made available to the safety representatives when requested.

2.13.3 Relocation

On relocation of pressure equipment, records shall be transferred to the new owner, user or selling agent, except when the equipment is sold for scrap.

NOTE: The regulatory authority may require notification on disposal or relocation of pressure equipment.

2.14 INCIDENT INVESTIGATION

Each incident, dangerous occurrence or excursion outside operating parameters which resulted in, or could reasonably have resulted in, an unsafe condition, e.g. catastrophic release of a hazardous chemical from a pressure vessel, shall be investigated, and corrective action taken and reported if required. This shall be done in accordance with AS/NZS 3788.

SECTION 3 GENERAL OPERATING AND MAINTENANCE PROCEDURES AND PRACTICES

3.1 GENERAL

3.1.1 Operating procedures

Appropriate operating procedures shall satisfy the following criteria:

- (a) Be prepared and documented for the operation, maintenance and inspection of the pressure equipment. The degree of documentation and supervision, inspection and recording required shall be appropriate to the complexity of the pressure equipment, its location and its operating conditions.

NOTE: See Appendix B for documentation procedures.

- (b) Include procedures required in this Section (3) and elsewhere in the Standard.
- (c) Give clear instruction and guidance, as required, on the essential aspects of the activities covered by procedures.
- (d) Include, or reference, specific safety and health precautions required for the activity.
- (e) Be readily accessible to the relevant personnel.

3.1.2 Review

The operating, maintenance and safety procedures shall be reviewed as often as necessary to ensure that they reflect current operating practice, including changes that result from changes in process, technology and equipment, and changes to facilities. The procedures shall be verified periodically to ensure that they are current and accurate.

3.1.3 Operating limits

Necessary steps shall be taken to ensure that the pressure equipment is used within the limits of its design. These limits not only relate to pressure and temperature but also process contents including any contaminants and similar, e.g. water quality of steam-raising equipment or any other factor influencing the integrity of the equipment.

3.1.4 Reporting

A reporting system shall be established that incorporates all data related to monitoring performance requirements.

If the operating limits set under Clause 3.1.3 are exceeded, the in-service inspector shall be informed of the extent and length of time of the breach. An assessment should be made, and, if required, an engineering evaluation as to the effect of the excursion on the equipment, and as a result the inspection frequency may be altered or a corrective action may be required.

3.2 OPERATING PROCEDURES

3.2.1 General

The operating procedures and instructions shall be prepared to cover each item or arrangement of pressure equipment and shall include at least the following, as appropriate:

- (a) The pre-start checks and initial startup (see Clause 3.2.2).
- (b) Normal cycle of operations of the equipment to produce its designed product.

- (c) The shutdown cycle of pressure systems and equipment including process shutdown, emergency shutdown and isolation shutdown. The emergency shutdown shall include the conditions under which an emergency shutdown is required, and the assignment of shutdown responsibility to operators to ensure that emergency shutdown is executed in a safe and timely manner.
- (d) Re-start, following an emergency shutdown.
- (e) Consequences of deviation from operating limits and action to avoid or correct deviation.
- (f) The keeping of updated regularly revised information for proper operation, such as tape for PLC control systems.
- (g) Where an automatic control system is used, a checklist giving procedures to monitor and control settings.
- (h) Safety systems and their functions.
- (i) The correct drainage, purge or decontamination procedure of pressure equipment in preparation for, or after completion, of maintenance or inspection.
- (j) The correct use of safeguard systems and personal protective equipment, where necessary.

The operating procedures shall be readily accessible to relevant personnel who work with or maintain the pressure equipment.

3.2.2 Pre-start equipment check

Prior to commissioning of new or altered pressure equipment, an equipment check shall be made to ensure the following:

- (a) Pressure equipment is in a safe condition.
- (b) Gags and isolation devices have been removed.
- (c) Valves are in correct start positions.
- (d) Pressure vessel inspection is completed and, where appropriate, the certificate of inspection is available for display.
- (e) Safety, operating, maintenance and emergency procedures are in place.
- (f) For the new systems, a suitable risk assessment has been performed and any recommendations have been resolved or implemented.

NOTE: See Appendix D.

- (g) Personnel involved with the operation has been appropriately trained (see Clause 2.7).
- (h) The pressure equipment has been identified to facilitate safe operation.

3.3 OPERATIONAL SURVEILLANCE

Where appropriate, programmed operational surveillance of pressure equipment shall be carried out and reported and recorded.

NOTE: Operational surveillance broadly encompasses 'on-line' and 'off-line' checks, examination and tests for assessment of the condition of equipment (usually associated with machinery) and its safety and performance. It includes comparison with specified requirements and prediction of future condition of the equipment. Together with periodic in-service inspection, it forms an important part of the quality control and quality assurance of the system.

‘On-line’ surveillance may include the following actions:

- (a) Observation, recording, processing and correlation of operational data such as pressures, temperatures, temperature gradients, and cycles which can also be used for the calculation of remaining life where affected by creep or fatigue.
- (b) Condition (vibration) monitoring.
- (c) Visual and other sensory observation, e.g. odour and noise observation and survey to detect progressive changes in configuration, changes in support, corrosion on external surfaces and general damage.
- (d) Use of specialized measuring equipment, such as corrosometers, continuous creep strain measurement, and direct monitoring of movement of acoustic emission.
- (e) Use of specialized metallurgical or non-destructive examination procedures.
- (f) Infra-red thermography and process fluid analysis.

For in-service inspection, refer to Clause 3.7.

3.4 SAFETY PRACTICES AND EMERGENCY PROCEDURES

3.4.1 General

A safe working environment shall be provided for all personnel.

3.4.2 Safety during maintenance

3.4.2.1 General

Procedures to ensure safety during cleaning, inspection and maintenance shall be implemented. The documented procedures shall be accessible to all maintenance personnel. Where appropriate, safety and emergency procedures should be formulated in a manual or equivalent document.

3.4.2.2 Entry into pressure equipment

Where entry to a confined space is required, the requirements of AS 2865 shall be met.

3.4.2.3 Entry into flues and furnaces

Safety procedures for entry into flues or furnaces shall be similar to those for entry into a confined space and shall comply with AS 2865.

3.4.2.4 Hot work on pressure equipment systems

All hot work, such as oxy-cutting, welding and grinding, shall be carried out in accordance with the safe working procedures to control risk of fire, explosion, collapse, or other damage to equipment or persons. See AS 1674 for welding safety.

Where a permit system operates, a permit for hot work operations conducted on or near equipment containing material hazardous in hot work shall be issued.

Typically, the permit indicates that fire prevention and protection requirements have been implemented prior to beginning the hot work; the date authorized for hot work; and the identity of the object on which hot work is to be performed. The permit shall be kept on file until completion of the hot work.

3.4.2.5 Static electricity

Where static electricity could be generated by the process or work, precautions shall be implemented, and the static electricity shall be discharged in accordance with AS/NZS 1020.

3.4.2.6 *Cooling pressure parts by hosing*

Except in an emergency, no pressure part should be hosed with cold water to reduce its temperature quickly, otherwise major immediate or potential damage may occur.

3.4.3 **Safe isolation**

Where it is necessary for inspection, maintenance or other purposes, provision shall be provided to isolate the pressure equipment from all pressure sources.

Where the source of pressure is from another connected item of pressure equipment which could be in operation during inspection, the provision for isolation shall be one of the following:

- (a) One stop valve and a blanking plate.
- (b) Two stop valves with an atmospheric vent between.
- (c) The removal of a section of interconnecting pipework.
- (d) Other methods acceptable to the parties concerned.

All the provisions for isolation shall be located between the pressure equipment and each connected source of pressure. Where the source of pressure serves only one vessel, one stop valve only is required, provided that the pressure source is rendered inoperative.

The use of stop valves to isolate pressure relief valves from pressure vessels shall only be used in accordance with the requirements of fitting stop valves between pressure-relief devices and vessels, as given in AS 1210.

Power-operated stop valves shall be locked in the closed position without reliance on computer-controlled shut off.

Isolation procedures for liquid-filled pressure vessels and piping shall not cause excessive pressure build-up. This may be achieved by pressure protection devices remaining in service; and —

- (i) liquid-filled vessels and piping being partially drained to allow for thermal expansion; or
- (ii) vessel or piping being depressurized and vented.

Caution is required when draining or venting to prevent failure due to vacuum.

3.4.4 **Emergency planning**

An emergency action plan for operation of pressure equipment shall be established and implemented. The emergency action plan shall include procedures for handling releases of any hazardous substance from the pressure equipment.

3.4.5 **Safety practices and emergency procedures**

Safety practices and emergency procedures shall be implemented. To test for compliance, compliance audits shall be carried out.

NOTE: See Paragraph D13, Appendix D for information on compliance audits.

The compliance audit shall be conducted by at least one person knowledgeable in the process involving the pressure equipment. A report of each audit shall be prepared and the user shall retain the two most recent reports.

An appropriate response to each of the findings of the compliance audit shall be determined and documented, and the action taken to correct any deficiencies documented.

3.4.6 Safety information and records for pressure equipment used with hazardous substances

Safety information relating to the pressure equipment and contained hazardous substance shall be collated prior to conducting any required risk assessment. It shall include appropriate material safety data sheets. The compiling of written safety information is to enable the personnel involved in operating the equipment to identify and understand hazardous substances.

This safety information shall include information pertaining to the operating hazards of pressure equipment used with hazardous substances or produced by a hazardous process and shall include information pertaining to the technology of the process.

3.5 ORDERLINESS OF SYSTEM AND SURROUNDING AREA

Measures shall be taken to ensure that the pressure equipment system and its surrounding area are maintained in a clean, safe and tidy condition.

This typically should include—

- (a) the removal of all excess equipment and materials (including flammable materials) from the area;
- (b) the removal of all substances and obstacles that could cause a hazard to personnel, from stairways, platforms and access areas;
- (c) the removal or isolation of spillages of solid, liquid and gaseous fuels, ash and dust and maintenance of drainage;
- (d) illumination to allow safe operation and maintenance;
- (e) maintenance of area lighting, surveillance systems and security; and
- (f) signs and equipment identification which are easily understood.

3.6 MAINTENANCE PROCEDURES

3.6.1 Maintenance program

A program and maintenance procedures shall be developed for the pressure equipment system. Documented procedures shall be readily available to operators, service personnel and inspectors.

3.6.2 Control system

The operating and safety controls shall be tested or checked during each maintenance program. Typically, these may include—

- (a) safety valves;
- (b) pressure protection devices;
- (c) pressure gauges;
- (d) overrides and interlocks;
- (e) emergency shutdown systems; and
- (f) instrumentation.

3.6.3 Repairs and alterations

Where a repair or modification is required to ensure the continuing integrity and safety of the pressure equipment, the repair procedure shall comply with AS/NZS 3788.

3.6.4 Temporary and emergency repairs

Where temporary and emergency repairs are used, a suitable hazard and risk assessment should follow any such repairs.

3.7 INSPECTION

The inspection system of pressure equipment shall be in accordance with AS/NZS 3788 and any in-house procedures deemed necessary. The equipment should be prepared prior to an inspection.

Regular operational surveillance (see Clause 3.3) is an essential part of the operation of all pressure equipment systems. This should be carried out by the person responsible for the operation of the equipment and will normally consist of visual observation of the equipment and its ancillary equipment to detect deterioration so that remedial action can be taken at an early stage. Any abnormality, e.g. temperature, pressure, smell, heat, noise or vibration, should be logged and investigated.

3.8 OUT-OF-SERVICE STORAGE

3.8.1 General

When pressure equipment is taken out of service, it should be emptied and, where appropriate, flushed out or decontaminated. An inspection should be made to determine if any repair work is necessary and what mechanical and chemical cleaning should be done. The equipment should then be stored by dry or wet storage where appropriate. Freshly cleaned metal surfaces are much more vulnerable to storage corrosion than surfaces that have operational oxides on them. Where chemical cleaning is necessary, it is preferable to delay this until the equipment is ready to be returned to service. An organization experienced in storage methods should be consulted.

Monitoring of the condition of stored equipment shall be implemented at an appropriate frequency and results of checks recorded.

NOTE: Complete installed equipment items which are 'dry-stored' or 'mothballed' should be subject to the same storage processes.

3.8.2 Disconnecting and removal

Disconnecting and removal of pressure equipment shall be carried out in a safe manner by personnel with an understanding of possible hazards.

Prior to removal—

- (a) the equipment contents shall be transferred to a waste collection container for disposal, or re-use;
- (b) all pipework shall be disconnected and the system made secure against leakage; and
- (c) all electrical connections shall be isolated from power and disconnected.

Special care shall be taken in the handling of pressure equipment that had been used with hazardous chemicals to avoid contamination of the site or the possibility of injury to personnel.

3.8.3 Dry storage

A dry storage procedure may be preferable for equipment out of service for extended periods or in locations where freezing temperatures may be expected.

Before dry storage, the equipment should be thoroughly dried, since any moisture left on the metal surface may cause corrosion during lengthy standing and precautions should be taken to preclude entry of moisture from steam lines, feed lines or air.

NOTE: Appendix G gives an example of dry storage.

3.8.4 Wet storage

A wet storage procedure may be used for pressure equipment where the out-of-service period is likely to be short, e.g. wet storage is ideal where the pressure equipment is on stand-by at short notice. No special procedure or additives may be needed provided that the process fluid is non-corrosive.

Alternative procedures are available for wet storage depending on the type of pressure equipment and its process application.

NOTE: Appendix G details wet storage.

3.9 DISPOSAL

Disposal of equipment shall be conducted in a safe manner.