



Supplementary Criteria for Accreditation **Gas Cylinder Testing**



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Tohu Matatau Aotearoa

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Supplementary Criteria for Accreditation

Mechanical Testing Laboratory Accreditation Programme

Gas Cylinder Testing

AS LAB C4.3

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1 Introduction

Supplementary criteria, such as this document, expand on the International Accreditation New Zealand (IANZ) general criteria for accreditation, and are subsidiary to those general requirements.

This document defines specific requirements for accreditation for gas cylinder testing laboratories and must be read in conjunction with current issues of the following IANZ general criteria documents.

(a) *Procedures and Conditions for Accreditation (AS 1)*

This document describes IANZ, its role in accreditation of laboratories and the process of gaining accreditation.

(b) *ISO/IEC 17025 General Requirements for the competence of testing and calibration laboratories*

This international standard describes the base criteria for the effective management of a laboratory. Laboratories complying with this standard may be accredited by IANZ. The laboratory's quality manual will include procedures to cover these requirements, as appropriate to the testing being undertaken. See section 10 below.

(c) *Specific Criteria - Mechanical Testing (AS LAB C4)*

Specific criteria documents provide explanation and interpretation of ISO/IEC 17025 for particular types of testing, e.g. mechanical testing.

This Supplementary Criteria document is subsidiary to the above documents and provides information on staff, accommodation, equipment and other aspects of good laboratory management practice that are considered to be minimum standards for gas cylinder testing laboratories. It also contains background information on gas cylinder testing and the IANZ requirements for accreditation. It should be read in conjunction with the appropriate test method for the cylinders under test.

2 Background

The increasing use of compressed gases in commerce and industry as a fuel and their widespread use in sports such as diving and in medical and firefighting equipment, has led to a subsequent increase in the demand for the periodic testing of compressed gas storage containers.

Serious injury can result from the sudden release of the stored energy in a compressed gas cylinder through failure. This risk can be substantially reduced by the maintenance of these cylinders in good repair and by regular inspection and testing.

In 1980, the New Zealand Department of Labour Inspectorate of Dangerous Goods gazetted regulations, under the Dangerous Goods Act, setting out schedules for the periodic inspection and testing of gas cylinders, and formalised the recognition of competent laboratories to carry out that testing.

In 1996, the Dangerous Goods Act was repealed and replaced by the Hazardous Substances and New Organisms Act (HSNO). A new Government authority, The Environmental Risk Management Authority (ERMA New Zealand) was established to administer the new Act and ERMA became part of the Environmental Protection Authority (EPA) in 2011.

In 2015 the Health and Safety at Work Act came in to force and in 2017 the Health and Safety at Work (Hazardous Substances) Regulations, including requirements for certification, marking and testing of Gas Cylinders, were promulgated. Under these regulations, Worksafe authorises test stations accredited under ISO/IEC 17025 to inspect and test cylinders, issue test reports and carry out associated functions. Test stations accredited by IANZ must have at least one Approved Signatory authorised to issue test reports.

Cylinders for automotive alternative fuel use, LPG and CNG, come under similar requirements. The New Zealand Transport Agency (NZTA) have accepted that any cylinder testing laboratory accredited by IANZ for automotive cylinders is deemed to be approved by them. Notices concerning automotive cylinders (e.g. changes in requirements), will appear in the Government "Gazette", and gas cylinder testing laboratories should regularly obtain these for updates on approvals, withdrawals, etc. Laboratories setting up to test automotive cylinders will also need to obtain all relevant back copies of Gazette Notices.

Each individual gas cylinder testing laboratory needs to have available all equipment necessary to carry out the testing they are seeking accreditation for. The Regulatory Authority will not allow laboratories to carry out parts of tests (e.g. although LPG cylinders are subject primarily to visual only tests, the station must have

the necessary equipment and expertise to carry out the default hydraulic test in the case of a doubtful cylinder).

3 Procedure for Obtaining IANZ Accreditation

3.1 The first step is to obtain and study the following publications:

- (a) IANZ *Procedures and Conditions for Accreditation* (AS 1)
- (b) ISO/IEC 17025 *General requirements for the competence of testing and calibration laboratories*
- (c) IANZ *Specific Criteria for Accreditation - Mechanical Testing* (AS LAB C4)
- (d) IANZ *Supplementary Criteria for Accreditation - Gas Cylinder Testing* (AS LAB C4.3 - this document).

These documents are available from IANZ to all applicant laboratories and, with the exception of ISO/IEC 17025, they may be downloaded from the IANZ website.

3.2 Copies of the required test methods should be obtained and studied with these notes. In New Zealand, the predominant test methods used are contained in the AS 2337 suite of standards.

3.3 If advice concerning accreditation is required, it can be obtained from IANZ, either by telephone or through a visit to the laboratory.

Technical advice may be available through the Cylinder Testing Laboratory Association (CTLA). Anyone contemplating testing gas cylinders is strongly recommended to become a member of this organisation for access to technical support and information.

3.4 When the laboratory considers that it is ready for accreditation, an application may be submitted to IANZ. The application and supporting documents will be reviewed, and an initial assessment will be arranged on a mutually agreed date once IANZ is satisfied that the facility is adequately prepared for an accreditation assessment.

3.5 The initial assessment will be carried out by an Assessment Team comprising one IANZ staff assessor and one or two independent technical experts who are knowledgeable about the type of testing being assessed. The choice of experts is made by IANZ but the test station has the right to veto an expert who is unacceptable for any significant reason.

3.6 The Assessment Team will review all aspects of the laboratory's operation, including the witnessing of demonstration tests.

The assessment is conducted in a relatively informal manner. It results either in a recommendation from the Assessment Team for accreditation to proceed or for accreditation to be conditional upon such operational enhancement as they consider necessary. It must be emphasised that accreditation is never refused point blank. A laboratory can always obtain accreditation if it is prepared to accept and act upon the detailed recommendations of the assessors.

3.7 After IANZ accreditation is awarded, the laboratory will be subject to annual re-assessment. Continuation of accreditation will be dependent upon satisfactory performance at (and between) assessments. A consistent and repeated high standard of compliance with all requirements may allow the re-assessment period to be increased to two years.

3.8 IANZ exists not only to accredit testing facilities but also to provide advice and guidance directly or indirectly, to enable them to achieve accreditation. It must be stressed that IANZ cannot provide consulting services and any advice or information provided will be of a general nature only.

3.9 If you are interested in becoming accredited with IANZ or require further information, please contact:

The Programme Manager
Gas Cylinder Testing Laboratory Accreditation
International Accreditation New Zealand
Private Bag 28908, Remuera, Auckland
626 Great South Road, Ellerslie, Auckland
Telephone: 09-525 6655

4 IANZ Classes of Test

To identify specific areas of technical expertise or scope of work, IANZ allocates each area with a number, called the Class of Test. Gas Cylinder Testing is a subset of the general Mechanical Testing Programme and its class of test number is 4.54.

5 Laboratory Accommodation and Safety

5.1 Accommodation

Accommodation in a gas cylinder testing laboratory needs to be adequate for the range and quantity of cylinders being tested.

Provision will need to be made for adequate storage facilities for equipment, test records, calibration records, manuals, etc, and suitable facilities for the recording of test data, the performance of calculations and the preparation of test reports.

The following are specific considerations for gas cylinder testing:

- (a) Adequate lighting
- (b) Adequate space for cylinder cleaning, preparation and testing
- (c) Adequate space for cylinder storage both before and after testing
- (d) Adequate secure and separated storage space for the holding of condemned cylinders
- (e) Adequate supply of (preferably de-aerated) water
- (f) Adequate disposal of cleaning products
- (g) Adequate drainage of water

5.2 Safety

The safety of cylinder testing staff must be of prime consideration for laboratory management. Unsafe practices will have an adverse effect on the IANZ assessment.

Under the requirements of the Health and Safety at Work Act 2015, laboratories will need to identify, and then eliminate, minimise or isolate the hazards associated with their activities.

It is expected that gas cylinder testing laboratories will have considered, and provided appropriate safety procedures to cover such items as:

- (a) Noise - from equipment such as compressors
- (b) Personal Protection - safety clothing, etc
- (c) Gas Disposal - safe disposal systems for flammable or toxic gases. The appropriate local Council Officer or local Worksafe- Enforcement Officer must be consulted in this respect. It is strongly recommended that a letter of approval for the disposal method is obtained from the officer.

Although the lack of adequate consideration to safety will adversely affect the outcome of an initial assessment, specific safety aspects are not included within the requirements for accreditation. Consequently, the Assessment Team will not be assessing the adequacy of any safety procedures in the station.

6 Laboratory Equipment Management and Calibration

6.1 General

The predominant test methods used for testing gas cylinders in New Zealand are contained in the AS 2337 suite of standards. Other test methods are also used, particularly for composite cylinder testing, and these will each be assessed for inclusion as a specific entry in the Scope of Accreditation.

The following requirements and the calibration details in Appendix 1 are based on the requirements of the AS 2337 standards. Other test methods may have different and/or additional requirements and these will need to be met.

Two types of hydraulic test apparatus are included in AS 2337: the water jacket apparatus and non-water jacket apparatus. Both are illustrated in the standard.

6.1.1 Water jacket apparatus

The water jacket apparatus, as its name suggests, surrounds the cylinder with a jacket of water which is not under pressure. Any changes in the volume of the cylinder are reflected directly by changes in the volume of water in the surrounding jacket.

6.1.2 Non-water jacket apparatus

With this apparatus, the cylinder is pressurised with water to the test pressure. The pressure is then released and the permanent expansion is calculated as the extra volume of water remaining in the cylinder compared with the original volume.

6.2 Specific Equipment

6.2.1 Pressure Gauges

(a) Working Pressure Gauges

Two industrial grade working pressure gauges of minimum nominal 150mm diameter are required. Other pressure indicating devices are acceptable if of equivalent accuracy and readability. Two working pressure gauges are required as a quality control aspect. The two readings can be compared and if the difference exceeds 1% of the maximum scale value this may indicate the need for the gauges to be calibrated and adjusted if necessary.

The standard requires that the working gauges must not be used below 20% of their maximum scale values. This means that test stations using a wide range of test pressures may need more than one pair of working gauges.

(b) Test Gauges

One test grade, 150mm minimum diameter, master gauge is required. Other pressure indicating devices are acceptable if of equivalent accuracy and readability. A test gauge used for the calibration of an industrial (i.e. working) gauge must have a maximum scale value at least equal to the maximum scale value of the industrial gauge and not more than 1.5 times that of the industrial gauge. (Refer AS 1349).

(c) All of the above gauges must comply with the accuracy requirements of AS 1349.

(d) Working gauges must be calibrated, at periods no greater than three monthly.

(e) Test gauges must be calibrated by an IANZ accredited gauge calibration laboratory at periods not greater than 12 monthly and an IANZ endorsed calibration certificate obtained.

(f) Digital Pressure Gauges, when used as test gauges, must be stable and readable to at least three significant figures.

6.2.2 Volume Measurement

(a) AS 2337 requires that the graduated tube (burette) for volume measurement be calibrated before commissioning. An IANZ endorsed calibration certificate must be obtained.

(b) AS 2337 allows a non-graduated tube to be used for volume measurement. IANZ requires that the associated graduated scale and the tube bore diameter and bore uniformity all be calibrated by a suitable IANZ accredited calibration laboratory (as in (a) above) and that IANZ endorsed calibration certificates be obtained.

(c) AS 2337 specifies that "....the graduated tube should be capable of containing 1/4000 of the volume of the largest cylinder that may be tested...." and "....suitably graduated so that permanent changes of 1/20 000 of the volume of the smallest cylinder to be tested may be readily observed".

6.2.3 Mass measuring equipment

Equipment for measuring mass, either for mass checks or for measuring the original volume of the cylinder when this is not stamped on the cylinder, needs to have a maximum error of 0.5%, as specified in AS 2337.

Any weighing appliance, either mechanical or electronic, which satisfies this specification is acceptable. The appliance must be calibrated by a suitable IANZ accredited calibration laboratory at five yearly intervals and an IANZ endorsed calibration certificate obtained. Similarly, check masses must be calibrated at five yearly intervals and an IANZ endorsed calibration certificate obtained.

The weighing capacity will need to range from the tare weight of the smallest cylinder to be tested to the weight of the largest cylinder to be tested when it is filled with water. This may necessitate more than one weighing appliance to cover the range of cylinders being tested.

6.2.4 Other Equipment

Other items of equipment will be required and these will include but are not restricted to:

- (a) Cylinder clamping and handling facilities
- (b) Visual inspection facilities including inspection lights, mirrors, magnifying devices, straightedge, profile gauge, steel rule
- (c) Torque wrench and adaptors
- (d) Thread checking facilities e.g. Taps and Gauges
- (e) Metal Stamps
- (f) Cleaning equipment
- (g) Drying equipment.

7 Laboratory Staff

General staff requirements are discussed in the IANZ publications *Procedures & Conditions of Accreditation AS 1* and *Specific Criteria for Accreditation - Mechanical Testing AS LAB C4*.

It is expected that all staff will be familiar with the laboratory's quality system and be adequately trained for the duties they perform.

Approved signatories must be familiar with carrying out test procedures as well as having a sound knowledge of the standards and any other relevant technical references (see section 11 - Summary below). They must be independently capable of determining appropriate courses of action in the event of problems in the laboratory. Understanding of the causes of unusual test performances will be expected.

8 Test Methods

8.1 Test Procedures for Gas Cylinders

The Hazardous Substances Regulations requires tests on gas cylinders to be carried out in accordance with the Australian Standard AS 2337.

The test methods generally include the following:

- (a) External visual examination
- (b) Internal visual examination
- (c) Mass check
- (d) Hydraulic stretch or proof test

Failure of a cylinder to pass one or more of the required tests is grounds for condemning it and rendering it unserviceable for further use. Clause 15.57 of the Health and Safety at Work (Hazardous Substances) Regulations has specific requirements with regard to the outcome should a cylinder fail the test.

8.1.1 External and Internal Examination

This is an assessment of damage and corrosion of the cylinder walls. Some quantitative measurements are made on the cylinder, and failure of a cylinder to meet stated criteria on sizes of gouges, cuts, dents and other mechanical damage will require the cylinder to be condemned.

8.1.2 Mass Check

The Mass Check is a quantitative check on the loss of mass by a cylinder due to wall thinning by corrosion or damage. The mass loss failure criterion from AS 2337.1 is 5% of the manufacturer's tare mass.

8.1.3 Hydraulic Stretch Test

The cylinder is pressurised, usually with water, to a predetermined test pressure above its normal working pressure. The cylinder will expand under pressure and may not return to its original size when the pressure is removed. This expansion varies depending on the materials of construction, the test pressure and the condition of the walls of the cylinder. The expansion is measured immediately following the pressure removal, and once it exceeds a stated value the cylinder is condemned.

8.1.4 Hydraulic Proof test

The Proof test is a go/no-go test of the gas cylinder's ability to withstand a test pressure without leaking or deforming. Any leaks, deformation, or loss of pressure leads to the cylinder being condemned.

8.2 Special Criteria for testing FRP cylinders

8.2.1 Before testing any FRP cylinders, test stations must be assessed for testing these cylinders and accreditation awarded. A specific entry will appear on the Schedule to the Certificate of Accreditation.

8.2.2 The testing of these cylinders is generally carried out in accordance with AS 2337.3 Inspection and testing of fibre reinforced plastics (FRP) gas cylinders.

Later generations of FRP cylinders, generally those with non-metallic liners, require testing to a DOT or ISO test method. This type of testing is not discussed in this document.

8.2.3 All breathing air cylinders (including SCUBA) must be tested by the hydraulic stretch test method. For testing FRP SCBA, the failure criterion given in AS2337.3 is a permanent increase in volume greater than 0.06% of the cylinder water capacity (note that this is 3x greater than the failure criterion of 0.02% for other types of cylinders).

8.2.4 External examination of the FRP over-wrap involves defect evaluation which can be very difficult, and those test stations not routinely testing FRP cylinders are urged to be very cautious. If in any doubt about the acceptability of a particular defect, a second opinion should be obtained from another IANZ accredited gas cylinder testing laboratory.

8.2.5 The repair of the FRP wrapping is covered by the standard. Repair of defects affecting the structural integrity of the cylinder are not permitted, and repairs are limited to basic steps designed to stop any further deterioration of minor surface damage. Only staff suitably trained may undertake repairs and only after specific approval has been obtained. Please refer to IANZ.

8.3 Special criteria for testing FRP wrapped CNG automotive cylinders.

8.3.1 These types of cylinders have suffered unusual modes of failure and specific testing procedures have been developed and approved by NZTA. Only those laboratories that have undergone special training in these procedures and been assessed as competent will be authorised to test FRP wrapped CNG cylinders. Refer to IANZ.

8.4 Special criteria for testing stainless steel cylinders

8.4.1 Stainless steel domestic LPG cylinders

The inherent material characteristics of stainless steel, combined with a relatively thin wall section, means the testing of these cylinders in the conventional manner described in AS 2337.1 poses some difficulties. Stainless steel can exhibit specific material changes, resulting in porosity in the heat affected zone of the weld. This heat affected zone is commonly seen as a brown "stain", extending about 6mm on either side of the welded seam.

To overcome these problems, specific procedures, including the use of a water sensitive powder or spray, have been approved. These cylinders are considered as "doubtful" cylinders and as such each cylinder must undergo a full hydraulic stretch test.

Laboratories wishing to test stainless steel cylinders will undergo specific assessment and these cylinder types will be included as a specific entry in the Scope of Accreditation.

8.4.2 Stainless Steel Automotive Cylinders

As described above, the porosity in the heat affected zone is of particular importance when a cylinder is contained in the enclosed space of a vehicle boot.

To ensure that these cylinders are adequately tested for porosity, NZTA require stainless steel automotive LPG vessels to be proof tested for a period of five minutes. A water sensitive powder or spray is to be used on the weld seams.

9 Test Reports

9.1 AS 2337.1 and NZS ISO/IEC 17025 set out the general requirements for test records and reports. Most stations will use a certificate/report format based on that set out in the test standard.

9.2 It is a requirement that the original stamped markings are recorded prior to any conversion (e.g. psi to kPa). To make this easier most stations have enhanced the test record/certificate format to allow space for the specific recording of these values.

9.3 All gas cylinder test reports must be signed by an IANZ Approved Signatory for the issuing laboratory.

9.4 A permanent copy of the original report must be retained by the laboratory for a minimum of one year more than the test period for the cylinder concerned. For many cylinders this will mean a retention period of eleven years.

Similar requirements apply to softcopy (computer) retained test certificates. They must be a permanent record (unable to be changed), and a full copy of the certificate issued to the client (i.e. complete with the signature of the Approved Signatory who has issued the certificate). Please refer to IANZ.

9.6 All test data including equipment calibration records must be retained for the same period as the test report.

10 Quality System

A fundamental requirement of the IANZ accreditation system of ensuring good laboratory practice is a documented Quality System complying with ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories.

The quality system, usually contained in a Quality Manual, is essentially the documentation of all the policies and procedures used by the laboratory to ensure that the quality of testing is maintained.

An example quality manual suitable for gas cylinder testing laboratory use is available from the CTLA. Although it is not a requirement for gas cylinder testing laboratories to use this example, most have adopted it.

11 Summary

The following is a summary of the reference documents that include information that is considered essential. A detailed knowledge of these is required and up-to-date copies will need to be obtained.

These documents will include, as appropriate but not be limited to, the latest editions of:

Test and Calibration Standards (as appropriate)

- (a) AS 2337 (parts 1 and 3)
- (b) AS 2030
- (c) AS 1349
- (d) Documented In-house test methods
- (e) Other standards.

Regulatory Documents

- (a) The Health and Safety at Work Act 2015
- (b) Health and Safety at Work (Hazardous Substances) Regulations 2017
- (c) Relevant Gazette Notices.

IANZ documents

- (a) *Procedures and Conditions for Accreditation (AS 1)*
- (b) *ISO/IEC 17025 - General requirements for the competence of testing and calibration laboratories*
- (c) *Specific Criteria - Mechanical Testing Laboratories (AS LAB C4)*
- (d) *Supplementary Criteria - Gas Cylinder Testing (AS LAB C4.3 - this document).*

Other Documents

- (a) Guide to Gas Cylinders (or other Code of Practice)
- (b) CTLA Technical Directives
- (c) CTLA Newsletters.

Appendix 1: Equipment Calibration Intervals

Type of Equipment	Period Between Successive Calibrations	Calibration Procedures and Equipment Requirements
Pressure Gauges Master Gauges Working Gauges	Twelve monthly Three monthly	External to AS 1349 or equivalent In-house to AS 1349 or equivalent
Weighing Appliances – Cylinder mass checks	Five years *Weekly when in use <i>*Weighing appliances not being regularly used must be checked on a monthly basis as a minimum requirement</i>	External. Maximum allowable error 0.5% of the mass being weighed. In-house
Weighing Appliances – Cylinder expansion checks	Three years *Daily when in use	External. Maximum allowable error 0.5% of the mass being weighed. In-house
Check Masses	Five years	External
Timers Clock (with sweep second hand) Electric Mechanical	- Twelve months Three months	None required In-house against radio pips, the Measurement Standards Laboratory talking clock or the Teletext timer
Burettes	On Commissioning	External
Test Rigs	On commissioning, and when any significant repair or replacement of any pressure retaining components is carried out	Internal – Expansion check.
External	Calibration must be carried out by an appropriate IANZ accredited calibration laboratory.	
In-house	Calibration is normally carried out in the test station by test station staff.	