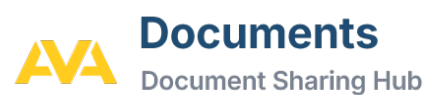


Australian/New Zealand Standard™

LP Gas fuel systems for vehicle engines



AS/NZS 1425:2013

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee ME-046, Gas Fuel Systems for Vehicle Engines. It was approved on behalf of the Council of Standards Australia on 10 September 2013 and on behalf of the Council of Standards New Zealand on 26 August 2013.
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The following are represented on Committee ME-046:

Australian Automobile Association
Australian Industrial Truck Association
Automotive Alternative Fuels Registration Board
Department for Transport, Energy and Infrastructure, SA
Department of Natural Resources and Mines, QLD
Department of the Premier and Cabinet, SA
EnergySafety WA
Federal Chamber of Automotive Industries
Gas Association of New Zealand
Gas Energy Australia
International Association for Natural Gas Vehicles
Motor Traders' Association of New South Wales
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Australian/New Zealand Standard™

LP Gas fuel systems for vehicle engines

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME-046, Gas Fuel Systems for Vehicle Engines, to supersede AS/NZS 1425:2007.

The objective of this Standard is to provide designers, manufacturers, installers and regulatory authorities with technical requirements for LP Gas fuel systems for vehicle engines so as to provide functional, safe installations.

The first edition of this Standard, published in Australia in 1973, was derived in the main from NFPA 58. A revision in 1979 introduced compartments and sub-compartments to control random leakage, required external filling points, and upgraded the strength of mountings, amongst other things. The first amendment in October 1980 introduced automatic fill limiters, and the second in 1981 virtually eliminated the hydrostatic-relief valve.

The 1982 edition was generally a consolidation, in which editorial presentation was improved and a number of adjustments of detail occurred, the most significant of which was that attempts to make the excess-flow valve more sensitive were abandoned in the face of experience with inadvertent shut-off of fuel to the engine. Amendment 1 of May 1984 corrected and clarified minor detail. Amendment 2 of December 1985, besides further polishing detail, upgraded a number of requirements related to the security of a container and its fittings in a collision.

Amendment 3 of July 1987 permitted safety valves to discharge into a sub-compartment or compartment. This represented a major reversal of the previous policy of insistence on piping such discharges to exit vertically outside the vehicle.

The 1989 edition of the Standard incorporated changes to the requirements for fixed liquid level gauges, sizing of ventilation ducts and their construction materials, heat shielding and the referencing of AS 3509—1988, *LP gas fuel vessels for automotive use*.

The 1999 edition was a Joint Standards Australia/Standards New Zealand edition and the layout and content of sections were restructured to facilitate easy referencing with the grouping of all material on a subject in the one location.

The 2003 edition introduced clauses related to the installation of fuel injection systems, the decommissioning of redundant LP Gas fuel systems, medium pressure hose up to 450 kPa and an Appendix relating to exhaust emission testing. It also incorporated descriptive procedures for providing assurance of compliance with exhaust emission standards. Requirements were incorporated for certified kits to meet exhaust emission standards. Appendix D was introduced to outline requirements for testing vehicles, manufactured to comply with ADR 79/00, ADR 79/01, ADR 80/00 and ADR 80/01.

The 2007 edition of the Standard incorporated changes to requirements for valve materials and testing procedures and simplified emission testing requirements.

The 2013 edition (this edition) introduces clauses related to the protection against container ‘hot bursting’ in a vehicle fire situation. The committee commissioned an extensive testing program which identified containers in certain vehicle installations that required protection against possible ‘hot bursting’. However, the committee also identified that the testing program would need to be ongoing to further test container ‘hot bursting’ when fitted to vehicles with plastic floor pans, utility tray tops and underslung vehicle installations. Any identified opportunities for further improvement of the Standard would become subject to further amendments.

Also included is an appendix which details real fire test procedures for testing container 'hot bursting' in specific vehicle installations where the Standard does not address that specific type of installation.

Further minor changes were also made in Appendix D to exhaust emission standards which now include vehicles manufactured to comply with ADR 80/02 and ADR 80/03. Also included are interim arrangements for vehicles manufactured to comply with ADR 79/03. These exhaust emission limits will be further reviewed and be subject to future amendments as required.

Also reviewed for the 2013 edition were the requirements for heavy truck exhaust emissions standards when LP Gas is introduced into the engine combustion cycle. The Committee's position is, that unless a relevant and accepted in-service test procedure is developed and produces repeatable results, the relevant ADR legislative requirements will apply. The committee is also of the view that an in-service exhaust emission test may be incorporated into future amendments when available and supported by regulators in Australia.

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/STANDARDS NEW ZEALAND

Australian/New Zealand Standard **LP Gas fuel systems for vehicle engines**

S E C T I O N 1 S C O P E A N D G E N E R A L

1.1 SCOPE AND APPLICATION

1.1.1 Scope

This Standard specifies requirements for liquefied petroleum gas (LP Gas) fuel systems for engines mounted on motor vehicles, either for the propulsion of the vehicles or for driving some auxiliary function, for example a mixer or a pump. It provides requirements for the design and construction of component parts and for their installation in vehicles, and for tests, commissioning and periodic inspection.

This Standard does not apply to LP Gas usage such as the gas supply system for appliances in caravans, mobile homes, forklifts, floor sweepers, polishers, tow tractors, elevating work platforms and industrial engines (refer to AS 4983), or for the propulsion of marine craft (refer to AS 4732).

This Standard does not address the requirements that may apply to structural modifications carried out on the vehicle. Prior to the commencement of such work, guidance should be sought from a local Transport Authority, vehicle manufacturer or a professional engineer experienced in automotive disciplines.

1.1.2 Application

This Standard shall be read as defining the minimum requirements of acceptability.

The relevant authority having jurisdiction may determine the extent of application of this Standard.

1.2 REFERENCED DOCUMENTS

A list of the Standards referred to in this Standard is given in Appendix A.

1.3 NEW DESIGNS AND INNOVATIONS

Any alternative materials, equipment, designs, method of assembly or procedures, which do not comply with the specific requirements of this Standard, or are not mentioned in it, but which give equivalent results to those specified, may be acceptable. Under such conditions the regulatory authority can give advice on the procedure for approval.

1.4 DEFINITIONS

For the purpose of this Standard, the following definitions apply.

1.4.1 Approved, approval

Approved by or approval of the regulatory authority.

1.4.2 Authority

The authority having regulatory powers to control the design, manufacture and installation of equipment described in this Standard in the country, State or Territory in which the vehicle is registered.

NOTES:

- 1 In some areas, vehicle installations and stationary installations are under the control of different authorities.
- 2 A listing of agency information is provided in Appendix B.

1.4.3 Authorized person**(a) *In Australia***

A person qualified, authorized or licensed by the relevant Australian Commonwealth or State body to install or service LP Gas equipment in automotive vehicles.

(b) *In New Zealand*

A person registered by the NZ Transport Agency to install and service LP Gas equipment in automotive vehicles, or a person approved by separate statutory authority.

1.4.4 Automatic fill limiter (AFL)

A provision in the filling system which automatically terminates filling when a predetermined liquid level in the container has been reached.

1.4.5 Automatic fuel shut-off device

A provision for automatically shutting off the fuel supply unless certain essential conditions exist.

1.4.6 Bi-fuel vehicle

A vehicle that can operate on either LP Gas or an optional fuel (e.g. petrol).

1.4.7 Capacity (of a container)

The total net internal volume of the container, expressed in litres.

NOTE: This was previously known as 'water capacity'.

1.4.8 Certified kit

A kit comprising the fuel control and engine management system components including a list of those components for identification (see Paragraph D3.3) and detailed installation instructions, which has been successfully tested in accordance with the relevant requirements of Appendix D.

1.4.9 Compartment

A structure which encloses the whole of the container and its fittings, whose purpose is to collect any gas leakage which might occur, so that it can be discharged to open air (see also Clause 1.4.50).

1.4.10 Container

A pressure vessel, cylinder or tank for the storage of LP Gas to be used as fuel for the internal combustion engine.

1.4.11 Contents gauge

A gauge which gives a visual indication of the liquid content of the container. This may be read at the container or remotely.

1.4.12 Department of Infrastructure and Transport (DIT)

The federal department responsible for transport matters. At the time of this edition of this Standard the name of the department is DIT.

1.4.13 Double non-return valve

Two non-return valves arranged in series to provide dual security against backflow

1.4.14 Dual-fuel vehicle

A vehicle that can operate as part LP Gas and part optional fuel (e.g. diesel) or the alternative fuel (diesel only).

1.4.15 Electronic Control Unit (ECU)

Any embedded system that controls one or more of the electrical systems or subsystems in a motor vehicle.

1.4.16 Excess-flow valve

A valve normally in the open position which closes automatically when flow in a specified direction exceeds a predetermined limit.

1.4.17 Fill line

Piping used for the conveyance of fuel from the filling connection to the container.

1.4.18 Fixed liquid level gauge

A gauge which indicates the maximum permitted liquid level in the fuel container incorporating a tube arranged with its open end located at the liquid level, so that gaseous discharge changes to liquid discharge as the liquid surface reaches the level.

1.4.19 Fuel filter

A component that is capable of removing from the fuel all particulate matter which could cause malfunction of other components or valves downstream in the system, and is capable of being removed, cleaned or replaced.

1.4.20 Fuel injector

A device operated by an engine management system for injecting LP Gas into the engine under pressure either in liquid or gaseous form.

1.4.21 Fuel line

A fill line, fuel service or return line.

1.4.22 Fuel pump

A pump located either inside the container or in the service line used to pump liquid LP Gas from the container.

1.4.23 Fuel selector

A device to select which fuel(s) is supplied to the engine.

1.4.24 Fuel service line

Piping used for the conveyance of LP Gas from the container to the engine bay.

1.4.25 Gas-air mixer

A device for introducing gaseous fuel to the induction air of the engine.

1.4.26 Hot burst

Splitting or rupturing due to internal pressure in combination with flame impingement that has weakened the material of the fuel container.

1.4.27 Hydrostatic-relief valve

A valve whose purpose is to relieve and prevent overpressure in any fuel service line carrying LP Gas liquid.

1.4.28 Ignition source

A source of energy sufficient to ignite a flammable atmosphere and includes naked flames, exposed incandescent material, electric welding arcs, and electrical or mechanical equipment or components not approved for use in hazardous areas.

A vehicle is not regarded as being an ignition source while it is entering or leaving the hazardous zone surrounding a fuel dispenser, for refuelling.

1.4.29 Insulated sealed connection

A sealed plug which allows electrical power to be passed into the container for example to supply a liquid injection fuel pressure pump.

1.4.30 Internal (component)

A fitting or component constructed with its significant working parts within the container perimeter so that any damage to exposed portions will not prevent effective safe functioning of the component, for example closure, reseating or pressure relief.

The perimeter of the container is taken to mean not only the surface of the container and ends, but also the outline of any boss, spigot or nozzle welded to so as to project outwards from it. The outline of welded brackets, mountings, guards, sub-compartments, or the like would not be considered as being the perimeter for the purpose of this Clause.

1.4.31 Licensed installer

A person who has completed an authorized training course and is registered with the authority (see Clause 1.4.2).

1.4.32 LP Gas

A mixture of propane and butane in varying proportions with minor traces of other hydrocarbons.

1.4.33 Maximum permitted filling level

The level of the liquid in a container when the liquid contents are, in Australia, 80% of the total available internal volume of the container, or in New Zealand, 85% of the total available internal volume of the container.

NOTE: The total available internal volume will be less than the total volume when internal components are fitted to the container.

1.4.34 May

Indicates the existence of an option.

1.4.35 Mono-fuel vehicle

A vehicle that can operate on LP Gas only.

1.4.36 NATA

National Association of Testing Authorities.

1.4.37 Non-return valve

A valve which permits fuel flow in only one direction.

1.4.38 POL coupling

An LP Gas union connection as specified for Type 21 in AS 2473.2 and having a left-hand thread.

1.4.39 Pressure

Gauge pressure (as opposed to absolute pressure).

1.4.40 Professional engineer

A person who is—

- (a) a professional engineer in the relevant discipline who has appropriate experience and competence in the relevant field;
- (b) a Corporate Member of the Institution of Engineers Australia or the Institution of Professional Engineers New Zealand; or
- (c) eligible to become a Corporate Member of the Institution of Engineers Australia or the Institution of Professional Engineers New Zealand, and has appropriate experience and competence in the relevant field.

1.4.41 Regulator

A device used to control the delivery pressure of gaseous fuel to the engine.

1.4.42 Relief valve

A valve which automatically discharges fluid to atmosphere or a reduced pressure system so as to prevent a predetermined pressure being exceeded. It is used primarily for non-compressible fluids (i.e. liquids). It is activated by the static pressure upstream of the valve.

1.4.43 Removable container

A container which is designed to be removed from the vehicle for refuelling, usually in exchange for a full container.

1.4.44 Return line

Piping used for the conveyance of LP Gas from the engine bay back to the container.

1.4.45 Safety coupling

A coupling which is normally open when in use, but which closes automatically to both directions when uncoupled.

1.4.46 Safety valve

A valve which automatically discharges vapour to atmosphere so as to prevent a predetermined pressure being exceeded. It is activated by the static pressure upstream of the valve.

1.4.47 Service valve

A manually operated shut-off valve fitted on the container which can open or shut-off the LP Gas supply to the engine for maintenance servicing or emergency requirements.

1.4.48 Shall

Indicates that a statement is mandatory.

1.4.49 Should

Indicates a recommendation.

1.4.50 Sub-compartment

A structure attached to the container, which encloses the container fittings, and whose purpose is to collect any gas leakage which might occur, so that it can be discharged to open air.

NOTE: The primary function of a compartment or sub-compartment is leakage collection and discharge, not physical protection. This is a separate need, which may equally well be provided by some other means.

1.4.51 System pressure

The maximum capable working pressure of the fuel system. This may be higher than container pressure when a pump is used.

1.4.52 Vaporizer

A device which vaporizes LP Gas liquid for delivery to the gas/air mixer or a fuel injector.

1.5 VEHICLE MODIFICATIONS

Any modification to any vehicle resulting from the installation of LP Gas equipment shall be carried out in accordance with sound engineering practices. Modifications include any alterations to the following:

- (a) *Suspension* Including mounting locations, geometry, ground clearance adjustment, axles and stub axles, or steering mechanism.
- (b) *Original fuel storage* Including the fuel container assembly, fuel container mounting, venting or filler assemblies.

NOTE: In some instances the original fuel container constitutes a structural member of the vehicle.

- (c) *Vehicle structure* Including any additional holes, welded joints, direct load bearing points and structural alteration near seat belt anchorages.

Holes greater than 13 mm shall not be located within 40 mm of the edge of a panel, welded joint or direct load bearing point or any structural alterations within 200 mm of any seat belt anchorage or child restraint anchorage. The only holes permitted greater than 13 mm diameter are for the installation of the filling valve, spacer tubes, wiring looms or for venting purposes.

- (d) *Engine* Including mounting fuel delivery components.
- (e) *Braking system* Including the handbrake and components.
- (f) *Spare wheel location* Including the spare wheel mounting and its anchorage.

The spare wheel mounting and its anchorage shall be designed to withstand a minimum design load of 20g in any direction.

- (g) *Anchorage* Including seat anchorages, seat belt anchorages and child restraint anchorages.

Modifications carried out to areas listed in Items (a) to (g) shall comply with the following:

- (i) In Australia, the Australian Design Rules.
- (ii) In New Zealand, the relevant Codes and Standards accepted by the NZ Transport Agency.

1.6 MINOR ALTERATIONS

The weight of the LP Gas container(s) will affect the tare weight of the vehicle, and the effect on the legal and manufacturer's rating on tyre and axle loadings should be considered. In no circumstances shall the vehicle's critical load distribution, which affects safety considerations, be compromised.

1.7 ENGINE MANAGEMENT SYSTEM

Any alteration(s) made to a vehicle's original equipment or the engine's fuel management system shall not adversely affect the original manufacturer's design, safety level and performance when operating on the fuel for which it was designed, including on-board diagnostics (OBD).

The following paragraphs of this Clause do not apply in New Zealand:

Where a vehicle was originally designed to operate with a closed loop engine management system, an LP Gas closed loop management system shall be installed that results in exhaust emission levels for LP Gas operation that meet the requirements of the Australian design rules (ADR) applicable to the vehicle.

Where LP Gas equipment is fitted to a vehicle which was originally certified to ADR 79/00, the installer shall use a certified kit tested and installed in accordance with the relevant test requirements of Paragraph D2 of Appendix D.

Where LP Gas equipment is fitted to a vehicle which was originally certified to ADR 79/01, the installer shall use a certified kit tested and installed in accordance with the requirements of Paragraph D3 of Appendix D.

Where LP Gas equipment is fitted to a vehicle which was originally certified to ADR 70/00, the installer shall undertake the conversion in accordance with one of the methods specified in Paragraph D4 of Appendix D.

Where LP Gas equipment is fitted to a vehicle which was originally certified to ADR 80/00, 80/01, 80/02 or 80/03, the installer shall use a certified kit tested and installed in accordance with the requirements of Paragraph D5 of Appendix D.

Where LP Gas equipment is fitted to a vehicle which was originally certified to ADR 79/02, the installer shall use a certified kit tested and installed in accordance with the requirements of Paragraph D6 of Appendix D.

Where LP Gas equipment is fitted to a vehicle which was originally certified to ADR 79/03, the installer shall use a certified kit tested and installed in accordance with the requirements of Paragraph D7 of Appendix D.

1.8 PERFORMANCE REQUIREMENTS

The fuel delivery and control system shall not compromise vehicle safety systems where fitted.

1.9 LP GAS EQUIPMENT AND COMPONENTS

Only equipment acceptable to the relevant body shall be used.

NOTE: For Australia only, the documentation requirements for installers are specified in Paragraphs D2.3, D3.3, D4.3 or D5.3 of Appendix D as appropriate.

1.10 CERTIFIED KIT

Certification of a kit only extends to the emissions performance of a modified vehicle the kit was intended for. Emissions related hardware, software or calibrations that are used shall not be modified by the installer to the extent it would violate the original fuel strategy upon which the certification was based.

1.11 PREVIOUSLY USED EQUIPMENT

Previously used equipment may be reinstalled or transferred to another vehicle, provided that—

- (a) the equipment is in good condition and continues to comply with current Standards;
- (b) the fuel container has been subjected to the preliminary examination described under the conditions set out in Section 6 in AS 2030.1; and

- (c) the following components and materials are not reused:
 - (i) Any piping or hose that has been subject to the LP Gas.
 - (ii) Any fittings used for the connection of pipes or hoses to components subject to container pressure.
 - (iii) Any grommets or fittings used to seal piping through bulkheads.

1.12 LP GAS WITHDRAWAL FROM AUTOMOTIVE SYSTEMS

An automotive LP Gas fuel system shall not be provided with connection points to facilitate the decanting of LP Gas liquid or the withdrawal of LP Gas vapour for applications other than engine fuel.

1.13 DECOMMISSIONING OF LP GAS FUEL SYSTEM

Where an automotive LP Gas fuel system becomes redundant, the gas fuel system shall be decommissioned and reverted to a petrol only or diesel only fuel system. The procedure shall be as follows:

- (a) Unload the LP Gas fuel by one of the methods specified in Appendix C of AS 2746—2008.
- (b) Decommission the LP Gas fuel system by the complete removal of the gas fuel system, including the container, filling connection and service line, and returning to the vehicle's original fuel specification.

1.14 WORKING AREA AND SAFE PRACTICES

The working area, specialist equipment and the practices applied during installation, inspection, testing and commissioning shall comply with AS 2746 or NZ Land Transport Rule: Vehicle Equipment 2004, Section 2.6, as applicable.

1.15 REGULATORY AGENCIES

Nominated agencies in New Zealand and the States and Territories of Australia are responsible for activities relating to LP Gas vehicles.

NOTE: A list of regulating agencies is given in Appendix B.

SECTION 2 COMPONENTS

2.1 GENERAL SUITABILITY

2.1.1 General

Components shall be suitable for the conditions of use, for example temperature, pressure, corrosion, compatibility and vibration. Suitability shall be proved by testing wherever appropriate.

2.1.2 Suitability for pressure

The design pressure for a component subject to system pressure shall be the container design pressure plus the maximum boost pressure capability of the pump if used. The suitability of any such components shall be determined either by strength calculation in accordance with normal pressure vessel procedures, or by the ability to withstand bursting in a hydrostatic pressure test at not less than 10.2 MPa or 3.5 times the maximum design pressure, whichever is the greater, applied for not less than 1 min.

In addition, each such component shall not suffer damage sufficient to cause leakage or malfunction after being subjected to a cyclic pressure test comprising 10 000 applications of a hydrostatic pressure of 5 MPa or 1.96 times the design pressure, whichever is the greater. Connections to the component under test, methods of mounting and means of blanking openings shall be representative of actual installation fittings, and shall not provide additional stiffening or support for the component under test.

The material of any valve body that is subject to container pressure shall comply with AS 2473.

Components having moving parts shall not leak or suffer unacceptable loss of performance when subjected to repeated cycles or normal operation as nominated in Table 2.1.

TABLE 2.1
MOVING PARTS TEST

Components	Requirement
Non-return valve	6000 cycles
Bleed valve (of a fixed liquid level gauge)	6000 cycles
Service valve	6000 cycles
Excess-flow valve	6000 cycles
Automatic fill limiter (the valve functions only)	6000 cycles
Liquid level sensor, whether a part of a filling shut-off valve or of another contents gauge	100 000 cycles
Hydrostatic-relief valve	6000 cycles
Automatic fuel shut-off device	100 000 cycles
Regulator	100 000 cycles
Filling connection	6000 cycles
Fuel injector	100 000 000 cycles
Pump	3000 hours (or equivalent for part duty cycle pumps)

2.2 SUITABILITY FOR INSTALLATION

Components shall be robust enough to withstand the stresses imposed by fitting and tightening the connections.

2.3 MODIFICATION

Modifications to an approved component shall not be made without specific approval of the manufacturer or the regulatory authority.

2.4 METALS

Metals used in valves on the container shall be those specified in AS 2473. Aluminium alloys may be used for other components except piping and pipe fittings. Metallic materials having a melting point lower than 500°C shall not be used in any application where failure could result in gas escape.

2.5 NON-METALS

Non-metallic synthetic materials used in seals or diaphragms in contact with LP Gas shall comply with the following requirements:

- (a) The part shall not change volume or mass in excess of that shown in Table 2.2 after immersion in hexane or pentane at 20°C for 70 hours.
- (b) The part shall not show visible evidence of deterioration after exposure to oxygen at 2 MPa and 20°C for 96 hours.

TABLE 2.2
IMMERSION TEST LIMITS

Nature of change	Maximum permissible change %	
	Diaphragms	Other parts
Volumetric swelling	25	25
Volumetric shrinking	10	1
Loss of mass	15	10

SECTION 3 CONTAINER SUB-ASSEMBLY

3.1 APPLICATION

This Section addresses the location, mounting, protection, venting and installation requirements for the container sub-assembly.

3.2 CONTAINER

3.2.1 General

A fuel container shall comply with one of the following Australian or Australian/New Zealand Standards or in New Zealand, the NZ Land Transport Rule: Vehicle Equipment 2004, Section 2.6, and shall have a design notified or registered by the appropriate Statutory Authority and subject to requirements in Clause 6.1(c)(ii):

- (a) AS/NZS 3509.
- (b) AS 1210 (for a design pressure of 2.55 MPa).
- (c) AS 2030.1 and AS 2030.5 (for propane/LP Gas).

Every container shall be inspected and tested in accordance with the relevant parts of AS 2337 and certified by a gas cylinder test station registered under MP 48 prior to use.

3.2.2 Use of removable containers

Containers which are removed for refuelling shall be used only in the following applications:

- (a) Vehicles which are unable to refuel at a service station by reason of their slow travelling capability or the inability to locate a service station within their reach.
- (b) For the fuel supply to an auxiliary engine of a vehicle which does not use LP Gas for its propulsion engine.

3.3 COMPONENTS FOR FIXED CONTAINERS

A container system that is installed for in situ filling on a vehicle shall be specifically designed and provided with the following components:

- (a) Filler connection.
- (b) Filler cap.
- (c) Filler non-return valve system.
- (d) Automatic fill limiter.
- (e) Service valve.
- (f) Excess-flow valve (except for a vapour withdrawal service outlet).
- (g) Safety valve.
- (h) Contents gauge.
- (i) Automatic fuel shut-off device (not applicable to New Zealand).
- (j) Internal, double non-return valve or single gastight non-return valve for the return line where fitted.
- (k) Internal fuel pump (if required).

3.4 COMPONENTS FOR REMOVABLE CONTAINERS

A container that is removed from the vehicle for filling shall be provided with at least the following components:

- (a) Filler connection.
- (b) Filler cap.
- (c) Service valve.
- (d) Excess-flow valve (except for a vapour withdrawal service outlet).
- (e) Fixed liquid level gauge or automatic fill limiter (only if filled by monitoring volume).
- (f) Safety valve.

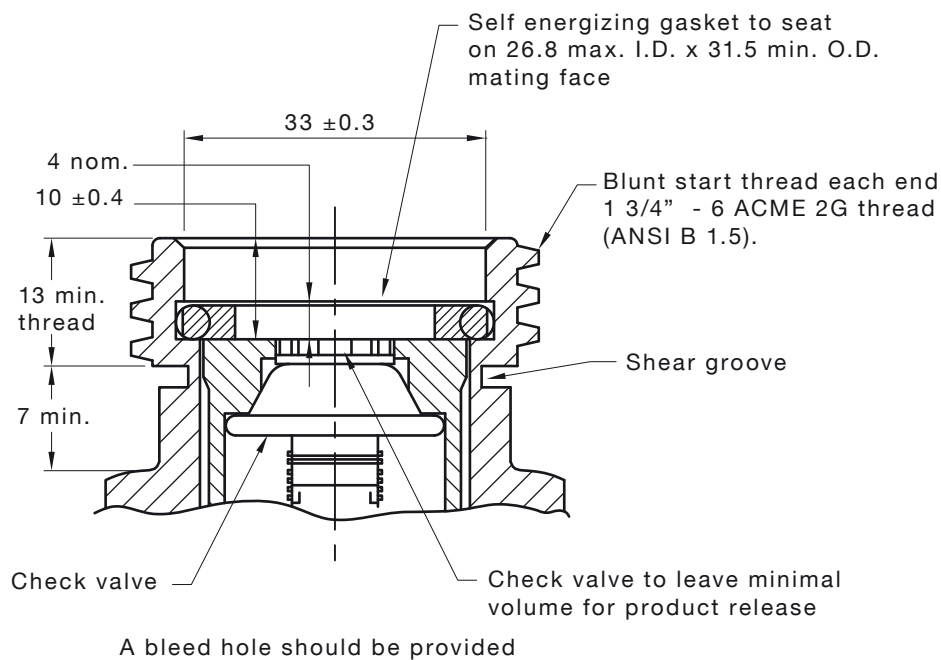
3.5 COMPONENT SUITABILITY

Container components other than those makes and models nominated by the container manufacturer or professional engineer for use with that particular container shall not be fitted.

Components may be combined into multifunction units, provided that the requirements for each individual function have been satisfied.

3.6 FILLING CONNECTION

The container filling connection shall be a 1 3/4 inch male ACME thread conforming to Figure 3.1, except that for a removable container a POL coupling may be used. A remote filling connection shall incorporate a provision to prevent it from rotating when the mating dispenser nozzle is connected or disconnected.



DIMENSIONS IN MILLIMETRES

FIGURE 3.1 FILLING CONNECTION

3.7 FILLER NON-RETURN VALVE SYSTEM

3.7.1 Direct filling system

Where the filling connection is on the container, it shall incorporate a double non-return valve in which one valve at least shall be a gastight type.

3.7.2 Remote filling system

3.7.2.1 Filling connection

Where the filling connection is remote from the container, the backflow prevention system shall be one of the following:

- (a) A single gastight non-return valve at the filling connection, plus a double non-return valve at the container of which at least one element shall be gastight.
- (b) A gastight non-return valve at the container, plus a double non-return valve at the filler connection of which at least one element shall be gastight.
- (c) Double non-return valves at both the container and the filling connection of which at least one element of each valve shall be gastight.
- (d) A single gastight non-return valve at the filling connection, plus a manual shut-off valve together with a gastight non-return valve at the container.

NOTE: Certain statutory regulations further restrict the number of options permitted.

3.7.2.2 Fill line

The fill line shall meet the following conditions:

- (a) Rigid piping, fittings or hose assemblies used as a fill line shall comply with Clauses 4.2.1, 4.2.2(b), 4.2.2(c), 4.3, 4.4 and 4.5.
- (b) The minimum size for a fill line shall be of 9.5 mm internal diameter tube with the minimum orifice size in any fitting or reduction in cross-sectional area of 47.78 mm² between the end of the fill coupling check valve and the beginning of the AFL valve, to be no less than 7.8 mm internal diameter.
- (c) Rigid piping, used as a fill line from the remote fill to the automatic fill limiter, which passes through an enclosed space need not pass through conduit, provided that the piping is protected by its location, there are no pipe joints within the enclosed space, the points of passage through the enclosure walls are sealed gastight by approved means, and they comply with the requirements of Item (a) of this Clause.
- (d) Where the fill line is not fitted inside a duct or conduit, the fill line shall be fitted with suitable metallic or plastic clips no more than 600 mm apart, follow the shortest practicable route and be protected by the construction of the vehicle and shielded where required.

3.7.3 Internal non-return valve

At least one of the non-return valves in the backflow prevention system shall be of such a type that damage to the assembly external to the container will not impair the operation of the valve.

3.7.4 Filler cap

The filler cap shall be captive, and shall be either capable of withstanding the design pressure (2.55 MPa) or designed so that pressure does not accumulate.

3.7.5 Filling point location

The filling point shall be located so that the following conditions are satisfied:

- (a) The filling connection is made and filling is supervised from outside the vehicle. The filling connection may be directly mounted on the container only if the method of access to it from outside does not result in the opening of a vapour path to the interior of the vehicle, thereby negating the effectiveness of a compartment or sub-compartment.
- (b) The filling connection is protected by being located in a recess below the surface of a body panel, or by being located so that equivalent protection is provided by the construction of the vehicle.
- (c) The filling connection shall not be installed on the rear or side impact face of the rear bumper bar.
- (d) The filling connection shall not be installed on a part of the vehicle that is moveable in relation to the vehicle structure (e.g. doors).
- (e) If the filling connection is below the vehicle body shell or structure it shall be protected from chance impact and collision in a forward, backward or sideways direction by structural members of a chassis or permanent body work, and shall not be fitted lower than—
 - (i) the lowest structural component of the body; or
 - (ii) the lowest structural component of the frame or subframe, if any.

NOTE: The distance between the filling connection and ground level should be no less than 450 mm for the purpose of ease of filling and a reduction in risk of an incomplete connection being made.

3.8 AUTOMATIC FILL LIMITER (AFL)

3.8.1 Design

An automatic fill limiter (AFL) shall comply with the following requirements:

- (a) The operation of the shut-off action shall not depend on a bleed of LP Gas to the atmosphere.
- (b) The AFL shall not incorporate any feature whereby the liquid level can be altered from outside the container after installation.
- (c) A type of AFL which depends for its accuracy on correct radial orientation, for example a screw-in type, shall incorporate a permanent provision to indicate the correct setting or position.
- (d) Where multiple container installations are involved an AFL shall be incorporated in each container.

3.8.2 Performance

When the AFL is fitted to the container for which it is intended and that container has been correctly oriented, its performance shall be as follows:

- (a) Filling shall be shut-off before the maximum permitted filling level has been exceeded.
- (b) The filling shut-off function shall be operable at any pressure differential across it between 70 kPa and 1000 kPa. Any adjacent or inbuilt non-return valve is considered not to be part of the AFL for this requirement.
- (c) The leakage rate into the container after shut-off shall be such that the liquid volume does not increase by more than 5% of the total available container volume in 8 min.

3.8.3 Durability

The AFL shall continue to comply with Clause 3.8.2 subsequent to testing as follows:

- (a) The moving parts test specified in Clause 2.1.2 and Table 2.1 shall be carried out using either air or water at a pressure of 700 kPa. The liquid level sensor shall be operated either by a mechanical device or by changing the liquid level.
- (b) The liquid level sensor shall move through its full available travel, with acceleration and deceleration not exceeding 1g.
- (c) The complete unit shall be subjected to vertical vibrations at 17 Hz and 6 mm amplitude for 200 h. The unit shall be mounted in its normal working orientation with the liquid level sensor unrestrained for this test.
- (d) The liquid level sensor shall be subjected to an external LP Gas liquid pressure of not less than 1.1 times the design pressure, that is 2.8 MPa, for 30 min. It shall then be subject to LP Gas vapour pressure corresponding to ambient temperature for a further 30 min.

3.9 FIXED LIQUID LEVEL GAUGE

Where a fixed liquid level gauge is fitted, it shall indicate when the liquid level is at the maximum permitted filling level.

Any opening communicating between the gauge and the interior of the container shall be internally located and not larger than 1.4 mm diameter.

A fixed liquid level gauge shall comply with the following requirements:

- (a) The gauge valve shall be of the sealed stem type.
- (b) It shall not be possible to remove moving parts of the gauge valve.
- (c) The outlet shall be provided with a cap or plug capable of retaining container design pressure.

3.10 CONTENTS GAUGE

An electrically operated contents gauge within the sub-compartment shall be suitable for use in a Zone 2 area (see AS/NZS 60079.10.1).

3.11 EXCESS-FLOW VALVE

An excess-flow valve shall comply with the following requirements:

- (a) The valve shall be internal.
- (b) The nominal closing flow rate shall not exceed 215 mL/s of LP Gas liquid.
- (c) The bypass flow rate when the valve is shut shall not exceed 3.3 mL/s of LP Gas liquid at 350 kPa differential pressure.
- (d) The valve shall reopen automatically when the excess-flow condition has ceased.

NOTE: In order to comply with Clause 3.16(d), the excess-flow valve should be located inboard of the service valve, and is usually attached directly to it.

3.12 SERVICE VALVE

A service valve shall comply with the following requirements:

- (a) The valve shall be a manually operated shut-off valve complying with the material requirements of AS 2473.
- (b) The valve shall close in a clockwise direction.

- (c) The seal or gland-retaining nut shall be so designed that the nut cannot be unscrewed by the action of the spindle.
- (d) The direction of opening or closing of the valve shall be clearly indicated.

3.13 AUTOMATIC FUEL SHUT-OFF DEVICE AT CONTAINER

The automatic fuel shut-off device (container) shall automatically act to prevent the flow of liquid to the service line unless the following conditions are simultaneously satisfied:

- (a) The ignition is on.
- (b) The engine is turning.

Where the system allows gas to vent to the atmosphere/engine, the automatic fuel shut-off device may be permitted to open for a period of up to 3 s when the ignition is first turned on, so as to allow priming of the fuel system. A maximum of 3 s of 'on period' is permitted when the engine is stalled as opposed to when the engine is turned off.

The automatic fuel shut-off device may be permitted to open to allow purging of the system for extended periods, where the system does not allow gas to escape to atmosphere and there are leak detection mechanisms or equivalent safety strategies.

The automatic fuel shut-off device shall open against all pressure differentials up to its rated working pressure when the valves are energized.

For overpressure protection of the service line, the automatic fuel shut-off device shall have a reflux (backflow opening) pressure of 0.275 MPa maximum above normal service line pressure and shall be protected with a filter located on the up-stream side. Care shall be taken with the fitting of the automatic fuel shut-off device to ensure correct direction of flow. Overpressure protection for the service line may be provided by other means, for example as part of the pump multivalve where equivalent protection is provided.

An automatic fuel shut-off device fitted within a compartment or sub-compartment of a container shall be of the electrically encapsulated type with electrical terminals located outside of the compartment or sub-compartment or comply with the requirements of Clause 3.22.

A single current limiting device (i.e. fuse) shall be fitted in the positive power supply to the automatic fuel shut-off device(s) for the purpose of circuit protection. A means to deactivate the automatic fuel shut-off device shall be provided in accordance with Clause 6.9.2, Item (g)(i) and fitted in the engine bay area, readily accessible and labelled accordingly.

Wiring circuits, electronics and terminals provided for activation or deactivation of the automatic fuel shut-off device shall be protected so as to minimize the possibility of the control/safety shutdown feature being overridden. This protection shall be achieved by the routing of wiring away from potential voltage sources or by the incorporation of backfeed protection in the circuitry.

NOTE: This requirement does not preclude the use of combination modules comprising dual-fuel selector/safety switch/fuel gauge units.

The automatic fuel shut-off device shall not be directly activated by switching to earth. Indirect switching to earth when interfacing with an Electronic Control Unit (ECU) would be allowed provided that a relay is used to switch the positive power supply to the automatic fuel shut-off device. This relay shall be located as close as possible but not more than 300 mm from the ECU. The wiring between the ECU and the relay shall be suitably protected to prevent accidental short to earth conditions.

Multiple container installations shall comply with the requirements in Clause 4.7.