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AS/NZS 1596

Australian/New Zealand Standard™

# The storage and handling of LP Gas

Standards Australia

STANDARDS NEW ZEALAND
Paerewa Aotearoa

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Australian/New Zealand Standard™

# The storage and handling of LP Gas

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# PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME-015, Storage and Handling—Liquefied Petroleum Gases, to supersede AS 1596 — 1997, *Storage and handling of LP Gas*.

In 1973, AS CB20, which had been published in 1965 as the first Standard on the subject, was translated to metric units to become AS 1596, but was not comprehensively revised.

A later edition of 1979 contained only the more pressing adjustments, then a more comprehensive review resulted in a new edition in 1983.

The 1989 edition included a rewrite of the cylinder section and revision of the location requirements for cylinder filling and storage areas together with a total review of the fire safety section.

The 1997 edition was prepared as a Joint Australian/New Zealand Standard. The main changes included the use of hazardous areas as defined in the AS/NZS 2430 series of Standards, the removal of approvals by regulatory authorities, and a revision of Section 10 to include procedures relative to the size, type and complexity of the installation.

This revised edition is essentially similar to the 1997 edition, but it incorporates changes made in Amendments 1 and 2 to the 1997 edition. The main changes have been made to––

(a) improve the clarity of expression in several clauses;

(b) describe the parts of a system to which AS/NZS 1596 applies and to which AG 601 applies;

(c) allow for new dispenser designs; and

(d) summarize the requirements that apply to portable cylinder exchange facilities at service stations and other retail sites.

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.

Australian and New Zealand references are separated by a slash (/). Australian references apply in Australia, and New Zealand references apply in New Zealand. Joint Standards apply in both Australia and New Zealand.

# CONTENTS

*Page*

*Page*

# FOREWORD

Safety is the fundamental objective of this Standard and is the most important single issue. Traditionally, this Standard has included a specific section on firefighting provisions, which can mislead by implying that nothing more is necessary to ensure fire safety.

The dangers of such a misapprehension are twofold. At the very least there is the possibility of misdirected effort, something that is never rewarding. At the worst, misplaced trust can easily be generated, and this could lead personnel to place themselves in danger.

Requirements must therefore be based on possibilities that are actual and not merely conjecture, and on an assessment of the real capabilities of the various equipment options.

A major conclusion is that water systems alone cannot ensure total fire safety, no matter how elaborate. They are not even the principal means of protection—that is embodied in the engineering of the installation. The components, their arrangement, the site layout and the operating and maintenance procedures, all form part of the principal fire-safety provisions, the purpose of which is to ensure that the secondary provisions, i.e. the water systems, will never need to be used in a real emergency.

A fire will not occur if any one of the three essential elements, i.e. fuel, air and an ignition source, is missing. It is sometimes possible to eliminate air, for example underground and mounded tanks largely achieve this, but ignition sources and fuel escapes are usually more amenable to control.

Risk of ignition can be minimized by separating potential leaks from ignition sources, controlling access, controlling on-site procedures and activities and good housekeeping by cleaning combustibles from the site. Obviously these measures can only be aimed at coping with the predictable, such as normal operational releases and minor mishaps. To try to cater for gross escapes bordering on the catastrophic would result in separation distances that are out of the question in practical terms, so it is necessary to reduce the probability of any major releases to a level which can reasonably be considered to be negligible.

The prevention of gas escapes, i.e. containment, is considered to be the single most important aspect of this Standard. If gas remains contained, there can be no fire risk. If an escape can be terminated quickly and preferably automatically, the risk of ignition and the consequences are minimized. Thus engineering the containment and valving provisions are considered vital to fire safety.

Loss of containment can result from accidental impact, corrosion, breakdown of seals and gaskets because of long-term deterioration, or rapid breakdown because of fire.

Physical damage arises mainly from vehicles, most commonly either colliding with the installation or driving off with a hose still connected. The solutions are impact protection, the choice of safe location and a variety of measures to either prevent drive-away or make provision against the consequences.

Equipment deterioration is a management matter. Operating and maintenance procedures must be set up in the first place, must be implemented and must not be allowed to lapse subsequently.

Fire threats fall roughly into two classes, i.e. a nearby fire radiating heat to a tank or a fire around the tank and impinging directly on it. A tank can tolerate a certain amount of heat influx, but the level is not high. Heating means a high risk of gas discharge either through a safety valve or through the failure of some feature of the installation; therefore any form of tank heating is not tolerable and must be terminated as quickly as possible.

An accidental on-site fire is dealt with in the main by preventive measures and procedures. Flammable liquid spills, the greater concern, are prevented from becoming a major hazard by kerbing, grading and other spillage control measures. Rubbish should not accumulate on a well-kept site, but, if a minor fire should start, the extinguishers and hose reels specified should cope.

Nearby high radiation fires are an important consideration. There is obviously no point in providing elaborate cooling systems if there is nothing nearby to burn, yet there will be cases where there is a real risk and other cases where it will be necessary to show care. A survey of each site is necessary. The radiation level from an average building fire is known to be of the order of 150 $kW/m^2$, and the tolerable heat flux at the tank surface is known to be 10 $kW/m^2$, hence the limiting distances to potential hazards can be calculated and a decision on the need for heat protection can be made.

When a fire has developed on the LP Gas system itself, there is a great potential for escalation of the incident. A leak, particularly of liquid, can throw a flame a considerable distance. If such a flame impinges on a tank, the heat flux is almost always considerably in excess of the tolerable level. It is particularly serious if the flame impingement is on the vapour space of the tank, and this does not necessarily mean the top, as it must be borne in mind that a tank that is virtually empty is entirely vapour space. An impingement fire is likely to escalate and may cause failure of the tank resulting in a sudden release of the tank's contents which are ignited by the impinging flame. The resulting fire cannot be fought by conventional methods, hoses or extinguishers. The only effective way to fight a gas fire is to turn off the gas.

Therefore the engineering of the installation constitutes the most significant and most effective element in fire safety considerations. Fire safety is achieved principally by mechanical means, i.e a system of valves which control all outflow of LP Gas, whether liquid or vapour, and can shut down the system, preferably automatically, should an incident occur.

This Standard has been reviewed from the standpoint that where gas remains contained there can be no risk. If an escape occurs it must be terminated quickly and preferably automatically, so that the risk of ignition and the consequences of it are minimized. Attention has been paid to defining possible causes of gas escape and the capabilities and shortcomings of particular types of equipment. The outcome was not so much a radical change as a refinement and re-orientation to ensure that the aims are clearer and the best options are utilized. Key aspects of the engineering side of the installation are as follows:

- The worst possible event, a tank rupture, cannot be allowed to occur. To achieve this, it must be inherent in the design of an installation that losses of containment are prevented where possible or otherwise controlled or safely directed. The engineering of the containment provisions must virtually eliminate the risk of a gas fire within the installation.
- An escape of liquid is more serious than an escape of vapour, except that any impingement of flame on an unwetted (vapour space) tank surface is critical.
- Openings into a tank should not be more numerous, nor larger, than they need to be.
- Every opening above a stated minimum size should have double protection, termed the primary and the secondary control systems.
- The primary shut-off system must function automatically, i.e. either a non-return valve or an excess flow valve. Non-return valves must be given preference wherever they can be used, and must be incorporated in every one-way liquid filling entry. The reason for this preference is that a non-return valve will shut in any condition of back-flow, whereas an excess flow valve will shut only in specific outflow conditions.
- The design and installation of the primary shut-off system must be such that it remains essentially functional should any attached external components be impacted or sheared off.

- The selection of the secondary shut-off system depends on the function of the opening. Where the primary control is a non-return valve, a manual secondary control may be adequate; sometimes even another non-return valve will suffice for small tanks.
- Where the primary shut-off system is an excess flow valve, the secondary shut-off system for vapour outlets does not need to be elaborate, but it must be some form of positive shut-off valve which may be manual. If a liquid connection, it must be capable of remote operation and must have automatic closing in the event of fire. The objective is to be able to shut all liquid outlets from a position of safety.
- Careful thought must be given in the design stage to ensure that any filling or withdrawal connection, shear point, screwed or flanged connection, or other feature to which flame could flash in the event of fire is located and directed to avoid flame impingement, especially on the vapour area of the tank. Pipework should be designed to minimize the number of flanges and joints.
- Generally the equipment should have adequate short-term tolerance for radiated heat sufficient to allow time to set up and bring into operation protective cooling measures.
- Water sprays and sprinkler systems are not a substitute for protective valving. More work on the valve system design is preferable to more work on the water system. However, water may help by slowing down or preventing escalation, depending on the scale of the incident.
- Training, operating, and maintenance procedures need to be set up in the first place, implemented, and not subsequently allowed to lapse.
- A certain basic level of firefighting equipment is required for all but the most minor installations, to cope with the unpredictable. Water sprays are not necessarily mandatory from the point of view of tank size as in the past. They are one of several alternative forms of incidental heat protection, and the need is determined from a survey of the actual site conditions.

The requirements of the Standard have been devised on the basis of a definite concept as to the handling of a fire emergency involving LP Gas storages, the elements of which are as follows:

- Rapid evaluation of the nature of the fire is imperative.
- If it is an adjacent fire in some other structure or material, then the problem is whether the heat radiation to the tank is sufficient to require remedial action.
- If gas is escaping the priority tasks are to prevent escalation, to stabilize, then to terminate. The twin needs are to shut off the gas flow and, in the meantime, to cool any areas that may need it.
- If stability can be achieved, there is nothing wrong with letting the gas burn if it is doing no harm, even to the extent of burning off all the stored gas if this is the safest thing to do.
- If the situation is obviously escalating, and gas flow cannot be stopped, then the emergency teams must be evacuated.
- Spray systems can protect against incident radiation, but cannot be trusted to cope with a concentrated flame impingement.

The automotive filling installation requirements of this Standard incorporate location requirements based on risk assessment. These requirements may be used by designers, developers, planners and authorities dealing with location and land-use planning aspects of LP Gas service stations.

These requirements are based on hazard analysis, quantified risk assessment and event trees of a generalized LP Gas service station and its operation.

A significant program of fire testing, conducted to demonstrate actual release rates and flame lengths prevailing under various conditions involving loss of containment, was performed by industry. The resultant experimental data together with additional failure data, risk reduction measures and a safety management system has been incorporated into event trees to provide an in-depth assessment on which the requirements are based.

Inadequacy of applicable local failure-frequency data was found to be the primary limiting factor in the analysis and as a result the assessment may be subject to review in the future should additional data become available.

The assessment specifically considered the technical, operational and safety requirements associated with a single 8000 L above-ground storage tank, its associated equipment and activities. In respect of a residential area the assessment provided a cumulative risk of a fatality at 7.5 m of 1 × E-6 per annum, being a borderline result which was particularly sensitive to assumptions made on input, ignition and delivery frequency, thus a distance of 10 m was considered representative of the QRA outcome. A conservative figure of 15 m has been used in the Standard.

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**The storage and handling of LP Gas**

# SECTION 1 SCOPE AND GENERAL

## 1.1 SCOPE AND APPLICATION

### 1.1.1 Scope

This Standard specifies requirements for the location, design, construction, commissioning and operation of installations for the storage and handling of LP Gas, and includes the management of emergencies.

It does not apply to the following situations:

(a) Refrigerated storage of LP Gas or refrigeration systems (see AS/NZS 1677 series).

(b) Underground storage of LP Gas in mined caverns or geological formations.

(c) Plant or equipment in which LP Gas is processed or produced, or vessels which form an integral part of that processing equipment (but does include post manufacturing storage).

(d) Industrial gas-consuming equipment (see AS 1375/NZS 5261).

(e) Automotive installations as addressed in AS/NZS 1425 and in AS 2809.3/NZ *LPG Tankwagon Code*.

(f) Transport operations as covered in Australia by the ADG Code and in New Zealand by the requirements of the relevant authority.

(g) From the outlet of the first regulator on a fixed consumer piping installation where the LP Gas container is installed on the same site, or from the outlet of the consumer billing meter or regulator where LP Gas is reticulated to the site from storage off the site (see AG 601/NZS 5261).

NOTE: Figures illustrating where each Standard or code applies are given in Appendix A.

(h) From the outlet of the first regulator in an LP Gas installation supplying multiple customers on separate sites to the outlet of the customer billing meter or regulator on each site (see AG 603/NZS 5258).

(i) LP Gas systems for caravans, catering vehicles or marine craft (see AG 601/NZS 5428).

### 1.1.2 Application

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

This Standard applies to installations commenced after its publication date. Unless otherwise specifically indicated in this Standard it shall not apply to existing installations.

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

NOTE: ‘Commenced’, for the purpose of this Clause, means the point at which site or equipment construction has begun.