AS 1596—1989

Australian Standard®

LP Gas—Storage and handling

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The following interests are represented on Committee ME/15:

- Australasian Corrosion Association
- Australian Liquefied Petroleum Gas Association
- Board of Fire Commissioners of New South Wales
- Confederation of Australian Industry
- Department of Environment and Planning, N.S.W.
- Department of Industrial Affairs and Employment, S.A.
- Department of Industrial Relations, N.S.W.
- Department of Labour, S.A
- Department of Labour, Vic.
- Department of Minerals and Energy, Vic
- Department of Mines, Qld
- Department of Mines, Tas
- Department of Mines, W.A
- Energy Authority of New South Wales
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PREFACE

This Standard was prepared by the Standards Australia Committee on Storage and Handling of Liquefied Petroleum Gases, to supersede AS 1596—1983, *The Storage and Handling of Liquefied Petroleum Gases.*

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 only minor updating was done, a comprehensive revision not being attempted.

A later edition of 1979 contained only the more pressing adjustments, and a more comprehensive review was put in hand, with a new edition being published in 1983.

The development process has been carried a stage further in this edition, some of the more significant aspects being as follows:

(a) The requirements for protective valves have been reviewed and revised as part of a study of fire safety. The philosophy concerning the relationship between these valves and other fire-protective provisions is explained in a new Foreword which should be read carefully.

(b) The clauses that deal with design pressure fo liquids piping between shut-off valves, and associated relief valves, have been rewritten to clarify the intent.

(c) The location of filling connections has been reviewed in the light of growing experience with underground tanks, and to encourage the use of low-loss hose couplings and associated procedures.

(d) Requirements for the protection of underground piping and tanks have been adjusted to take account of developments in techniques and new reference standards.

(e) Considerable changes of detail concerning the location of tanks in relation to he surroundings have been made. Particular attention has been paid to underground tanks and their components, such as filling points, safety valve discharge points, etc as the result of experience in buying tanks at service stations.

(f) Recognition is given to pumps that incorporate devices to restrict the escape of LPG in the event of a seal failure; location concessions apply, th object being to encourage the use of such designs.

(g) the whole of the Section on cylinders has been rewritten, partly to incorporate editorial changes and partly to treat more logically such aspects as—

    (i) the use of specific surface coatings in certain severe conditions;

    (ii) location requirements;

    (iii) restrictions on use indoors;

    (iv) the extent of hazardous zones,which affect proximity to ignition sources, windows, etc (experiments on gas dispersal after a release permitted the redrawing of the zones); and

    (v) indoor and outdoor storage of cylinders not in use, i.e. reserve or exhausted cylinders.

(h) The location requirements for cylinder filling stations have been revised so as to treat as separate issues the filling area itself and the associated storage of cylinders.

(i) The Section on automotive filling stations has been reviewed with considerable adjustment to detail. Illustrations provide more detail of the types of system and the related requirements.

(j) The former Section 8 (Tankers and Tanks for Transport) has been deleted, other Standards and regulations having made it redundant.

(k) Minor adjustments have been made in the former Section 9 (Operations) (now Section 8) to deal with maintenance of cathodic protection systems, scheduled checks of installations generally, the use of safety adaptors for in-situ filling of cylinders and some smaller tanks, and the supervision of automotive refuelling.

(l) The overall treatment of fire safety has been totally reviewed, and a Foreword has been added to explain the outcome. This Foreword should be read carefully, as it explains some fundamental concepts which need to be clearly understood in order to optimize the safety of each individual installation.

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FOREWORD

Safety is the fundamental objective of this Standard, and fire safety is the most important single issue. Traditionally this Standard has included a specific Section of 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, 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 rarely possible to eliminate air, but ignition sources and fuel escapes are amenable to control.

Ignition sources can be eliminated as a credible risk by means of separation distances, the control of access, the control of on-sit procedures and activities, and good housekeeping the site clear of combustibles. Obviously these measures can only be aimed at coping with the predictable, such as normal operational releases, minor mishaps, and the like. 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 fire safety. 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 of it are minimised. Thus the engineering of the containment and valving provisions is considered vital to fire safety.

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

Physical damage arises mainly from vehicles, most commonly ether 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 the equipment proof 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, a nearby fire radiating heat to a tank or a fire around the tank and impinging directly on it. A tank can in fact 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 eating is not tolerable and must be terminated as quickly as possible.

An accidental on-sit fire is dealt with in the main by preventive measures and procedures. Petrol spills, the greater concern, are prevented from becoming a major hazard by kerbing, grading, and other spillage control. Accumulations of rubbish should not happen on a well-dept site, but, if a minor fire should start, the extinguishers and hose reels specified should cope.

Nearby fires that radiate highly 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 be seen to be being careful. 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 LPG system itself, there is a great potential for serious trouble. 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 considerable 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 rapidly and can not be fought by the conventional methods, hoses, or extinguishers. The only effective way to fight a gas fire is to turn the gas off.

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 LPG 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 is not so much a radical change as a refinement and re-orientation to ensure that the aims are clearly and the best options are utilized. Key aspects of the engineering side of the installation are as follows:

(a) The major objective must be that the worst possible event, a tank rupture, cannot occur. To achieve this,it must be inherent in the design of an installation that escapes are prevented where possible, or otherwise they are controlled or safely directed. Thus the engineering of the containment provisions must virtually eliminate the risk of a gas fire within the installation.

(b) An escape of liquid is more serious than escape of vapour, except that any impingement on an unwetted (vapour space) tank surface is critical.

(c) Openings into a tank should not be more numerous nor larger, than they need to be.

(d) Every opening above a stated minimum size should have double protection, termed the primary and the secondary shut-off systems.

(e) The primary shut-off system must be one that functions 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 back flow whereas an excess flow valve will shut only in specific outflow conditions.

(f) 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.

(g) 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 do 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, t 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.

(h) 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.

(i) 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.

(j) Water sprays and sprinkler systems can not be substituted for protective valving. More work on the valve system design is better than more work on the water system. However, water may help by slowing down or preventing escalation depending on the scale of the incident.

(k) Site management has a continuing responsibility to ensure that training, operating, and maintenance procedures are set up in the first place, are implemented, and are not subsequently allowed to lapse.

(l) 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 LPG storage, the elements of which are as follows:

(i) Rapid evaluation of the nature of the fire is imperative.

(ii) If it is an adjacent fire in some other structure or material, then the only problem is whether the heat radiation to the tank is sufficient to require remedial action.

(iii) If gas is escaping the priority task is 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.

(iv) 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.

(v) If the situation is obviously escalating, and gas flow cannot be stopped, then the emergency teams must be evacuated.

(vi) Spray systems can protect against incident radiation, but cannot be trusted to cope with a concentrated flame impingement.

STANDARDS AUSTRALIA

Australian Standard
LP Gas—Storage and handling

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This Standard specifies requirements for the design, construction, and operation of installations for the storage and handling of liquefied petroleum gas LPG that are generally industrial, commercial, or rural in nature, and for certain associated transport operations.

It does not apply to—

(a) the refrigerated storage of LPG;

(b) plant or equipment in which LPG is processed or produced, or vessels which form an integral part of that processing equipment;

(c) industrial gas-consuming equipment (see AS 1375);

(d) installations of piping and appliances in domestic premises, or of cylinders, piping, and appliances in boats and caravans (see AG 601 or the ALPGA Marine Code and Caravan Code);

(e) automotive installations (see AS 1425); and

(f) such transport operations as are covered by the Australian Dangerous Goods Code.

NOTES:

1. Refrigerated storage of LPG requires the individual approval of each installation.
2. In general this Standard should be read as defining the lower limit of acceptability, not the norm, so that a higher level of quality than that specified is considered to comply.

1.2 NEW DESIGNS, INNOVATIONS. Novel materials, designs, methods of assembly, procedures, etc, which do not comply with the specific requirements of the Standard, or are not mentioned in it, but which give equivalent results to those specified, are not necessarily prohibited. Standards Australia Committee ME/15, Storage and Handling of Liquefied Petroleum Gases, can act in an advisory capacity concerning equivalent suitability, but specific approval remains the prerogative of the Statutory Authority.

1.3 INTERPRETATIONS. Questions concerning the clarity, meaning, application or effect of any part of the Standard may be referred to Standards Australia Committee ME/15 for explanation. The authority of the committee is limited to matters of interpretation and it will not adjudicate in disputes.

1.4 REFERENCED DOCUMENTS. A list with titles of the documents referred to in this Standard is given in Appendix A.

1.5 DEFINITIONS. For the purpose of this Standard, the definitions below apply.

1.5.1 Automotive filling station—a location at which vehicle fuel tanks are filled from dispensers while on the vehicle. Such stations may or may not be open to the public.

1.5.2 Approved, approval—approved by, or approval of, the Authority.

1.5.3 Authority, authority having jurisdiction—the Authority having statutory (legal) control of the subject installation.

1.5.4 Boundary—the boundary of the whole of the site under the same occupancy as that on which the installation is included.

1.5.5 Capacity (of a tank or cylinder)—the total volume of the space enclosed within the tank or cylinder.

NOTE: This is often referred to as 'water capacity'.

1.5.6 Combustible liquid—a combustible liquid as defined in AS 1940, i.e. one having a flashpoint over 61°C.

1.5.7 Compound—an area bounded by natural ground contours or by bund, and intended to retain spillage or leakage. (A pit or tank may be used to provide the same function).

1.5.8 Cylinder—a container which falls within the scope of AS 2030.1.

1.5.9 Decanting—a cylinder-filling procedure by which transfer of gas from cylinder to cylinder or tank to cylinder is carried out without the use of a pump, using only the product differential pressure. In this procedure, gas is vented from the fixed liquid level gauge of the cylinder being filled.

1.5.10 Emergency shut-off system—a valve and an associated control system that complies with specific requirements of this Standard, the purpose of which is to facilitate safe shut-down in an emergency.

1.5.11 Excess-flow valve—a normally open valve which closes automatically when a predetermined flow rate in a particular direction has been exceeded.

1.5.12 Fire rating—the fire resistance of a structure as defined and determined by AS 1530.4.

1.5.13 Fixed liquid level gauge—a gauge which indicates the maximum permitted liquid level in the fuel container. It is usually one of two types: one is 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; the other is a sight-glass of the circular window-type, marked at the level. Alternative level-gauging methods of equivalent reliability are available.

1.5.14 Fire wall—a wall or other barrier constructed and placed with the object of preventing the spread of fire or the radiation of heat from any place to some other place.

1.5.15 Fusible link—a safety device consisting of a suitable low melting point material which is intended to yield or melt at a predetermined temperature.