AS 1375—2013

Australian Standard®

# Industrial fuel-fired appliances

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The following are represented on Committee AG-011:

- Australian Petroleum Production and Exploration Association
- Energy Networks Association
- Engineers Australia
- Gas Appliance Manufacturers Association of Australia
- Gas Energy Australia
- Gas Technical Regulators Committee
- Major Commercial/Industrial Gas Equipment Manufacturers
- Major Industrial Gas Installations
- Master Plumbers and Mechanical Services Association of Australia

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Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

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Australian Standard®

# Industrial fuel-fired appliances

Originated as AS 1375—1973 and part of AS 1853—1976.
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# PREFACE

This Standard was prepared by the Standards Australia Committee AG-011, Industrial and Commercial Gas Fired Appliances, to supersede AS 1375—1985, *Industrial fuel-fired appliances (known as the SAA Industrial Fuel-fired Appliances Code)* and part of AS 1853—1983, *Automatic oil and gas burners—Mechanical draught.*

In this current edition, the Standard has been completely revised in light of changing international trends in standards as industry experience is consolidated in key areas. The emergence of new technology that enables the key safety features to be adequately managed has been one of the main areas of change in solvent processing equipment. In addition, the inclusion of new research that allows optimisation of safety protection systems has also benefited the changes in this Standard. Every effort has been made to ensure that requirements are not ambiguous and where practical, guidance is provided on the means of compliance.

This edition represents a major revision, the main features of which are as follows:

(a) AS 1853—1983 was a precursor Standard for gas burners that, for the past 14 years, have been covered by AS 3814, *Industrial commercial gas-fired appliances*, and AS 1853 has largely been rendered obsolete. However, oil is still a common fuel in areas remote to reticulated gas and, given that, this Standard covers all fuels. It was natural to expand the scope to include all of the specific requirements for oil systems. AS 1853—1983 has been withdrawn from publication as a result. Specifically, gas systems are now aligned with AS 3814 to remove any ambiguity that may have arisen.

(b) Section 7 is now devoted to liquid fuel firing systems and includes the key elements that were part of AS 1853 with the original liquid systems in this Standard.

(c) The concept of HAZOP has been introduced into the Standard as a vital tool in the safe design process for complex appliances. Guidance is provided in a new Appendix I on its application.

(d) More attention is paid to the appliance control and electrical design and ensuring that, apart from the burner management system, compliance to relevant electrical and machinery standards are complied with. In this regard, PES based safety systems are to be compliant with AS 61508, *Functional safety of electrical/electronic/programmable electronic safety-related systems*, or AS IEC 61511, *Functional safety—Safety instrumented systems for the process industry sector*. Hazardous areas are to be compliant with the relevant standards as applicable.

(e) The general subject of shutdown in the event of malfunction has received attention to ensure that it is compatible with AS 3814.

(f) The section that deals with non-fuel combustible atmospheres has been substantially revised to remove any ambiguity in the safety requirements for the appliance design.

(g) The addition of an exemption from requiring explosion relief for appliances that operate at very dilute concentrations of solvents is included to streamline the acceptance process for appliances as spray booths with fuel-fired heating apparatus.

(h) The use of flammable gas monitoring technology has been included to allow greater optimization and flexibility without compromising safety on solvent evaporation processes. This is in step with international standards and their wide acceptance on such appliances as printing presses.

(i) The allowance of higher than previous concentrations is based on overseas experience and the inclusion of measures that will maintain the same level of safety without conservative design requirements. A more energy efficient operation of appliances is now possible with the implementation of new measuring and monitoring technology to appropriate standards.

(j) Information on and the treatment of combustible dusts have now been included in the Standard.

(k) Information on solvents properties and combustible dusts has been included and this is now part of the expanded Appendix G. Additional references are also provided.

(l) There has been the inclusion of operating principles that apply to incineration processes. This has been expanded to include the application of high concentrations that may occur with high efficiency low temperature appliances or remediation systems that are designed to treat hydrocarbon waste materials.

(m) Appendix B has been made more comprehensive and it now includes requirements to tailor testing for PES based systems.

(n) Appendix C has been revised in line with current flame safeguard designs and to make applications more consistent with requirements of the applicable standards.

(o) Appendix D has been corrected to ensure that the equations are correct. The application of Case B has been clarified. Appendix D has been expanded, mainly to include an additional option, i.e. using excess air to achieve infinity critical time. This technique has many attractions, notably it avoids the need to depend on very fast-reacting protective systems. Appendix D therefore reflects some change of emphasis.

(p) Appendix E has largely remained unchanged as the techniques for explosion relief are consistent with current practice and provide conservative estimates for relief areas. References to additional material that will allow the calculation of the strength of ducting and appliances have been included. NFPA 68 is an alternative that can be used for appliances that are outside the scope of the methods proposed in the appendix particularly in the application where dusts are encountered such as spray driers and dust collection systems associated with fuel-fired plant. This is consistent with international acceptance of NFPA 68 for explosion relief estimation and protection of appliances.

(q) Appendix F has changed to reflect changing technology in the printing industry and incineration systems. The relationship and the effect of temperature on lower explosive limit (LEL) has now been included in this Appendix as are graphs on allowable operating regions for various applications. Additional examples are now included to assist with the application of temperature correction of LEL and selection of allowable operating concentrations that are above 25% of LEL.

(r) Appendix G has been expanded to include information that is commonly available on the properties of solvents and dusts in particular that can be used in the application of Appendices E and F.

(s) Appendix H has been reviewed and minor changes have been made.

(t) Appendices J through to N are devoted to liquid firing systems that were part of AS 1853 in the consolidation process of the two Standards.

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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# FOREWORD

Safety, which is an essential in all industrial activity, can be achieved in even the most sensitive processes by adequate equipment design and operating procedures. Not only do fuel-fired appliances generate fuel/air mixtures, they may also contain or operate in atmospheres which include finely divided combustible materials. In such conditions, hazards are always a possibility and this Standard gives principles for designing such appliances to operate with safety.

The most common accidents in heated industrial equipment are internal explosions that result from the accidental ignition of accumulations of fuel/air mixtures, volatile solvents, other vapours, or combustible dusts. An explosion becomes damaging when the internal pressure created exceeds the ability of the appliance to contain it, and, since few appliances are of sufficient strength to withstand pressures of a high order, it is necessary—

(a) to prevent the accumulation of combustible mixtures;

(b) to avoid their ignition wherever possible; and

(c) depending on the operating characteristics and reliability of these preventive measures, to provide means of relieving or mitigating the effect of an explosion.

When a fuel is introduced into an enclosed space, it is potentially unsafe until it is ignited; if the ignition attempt fails, or if the flame is extinguished at any time after initial ignition, unburnt fuel can accumulate in the enclosure, and may quickly reach potentially dangerous proportions.

Therefore, the principal and most important of all the safety devices on an appliance is its ignition system; all other protective measures should be considered as secondary provisions, i.e. back-up systems for which the need arises only when the primary protection, the ignition system, has failed.

Given a known fuel flow rate and a known combustion chamber volume, it is possible to calculate how long it would take for accumulated fuel to become dangerous if not ignited. This is called ‘the critical time’, and is a characteristic of each individual appliance. It indicates the maximum allowable delay in ignition, and also the maximum safe response time for any ignition failure protection system.

It is always preferable to extend the critical time to the greatest possible extent, rather than depend too much on sensitive flame-monitoring equipment. The use of pilot ignition, or low-fire starting, or the provision of high levels of dilution by excess air, all have the effect of extending the critical time, and in the period since the first edition of this Standard the emphasis has developed in the direction of encouraging designers to extend the critical time to infinity. Another alternative is to ensure that the structure is strong enough to be explosion resistant. Where the critical time is shorter than the reaction time of the ignition-failure protection system, and cannot be extended, the speed and efficiency and reliability of the ignition system becomes vital, and facilities for relieving excessive explosion pressures become essential.

This Standard is based on the view that the hazard during the starting up phase is considerably greater than that at any other part of the operating cycle. Thus attention is concentrated on protection and supervision during ignition, and critical time considerations are applied only during this period. Lighting-off from a pilot, or turn-up after a low-fire start, or flame failure during operation, are not considered to be sufficiently problematical to warrant the application of critical time considerations.

Flammable vapours or dusts have essentially the same characteristics as fuel, i.e. they possess upper and lower combustible limits, stoichiometric ratios and characteristic flame speeds. Any material that will oxidize is potentially explosive if it is in a finely divided state and mixed with air. Since it is never possible to guarantee the absolute elimination of all possible sources of accidental ignition, first attention should be given to preventing the formation of combustible mixtures, the usual method being by dilution with air, but sometimes inert gases or products of combustion are used. Since these measures also cannot be guaranteed to be absolutely reliable, it is necessary to provide explosion relieving facilities whenever such combustibles are present, unless the appliance can withstand any possible explosion pressure.

Some types of appliance make use of atmospheres that are rich in combustible materials, often well above the upper combustible limit, and at temperatures that are above the normal auto-ignition temperatures. For these appliances the same basic rules apply, i.e. the simultaneous occurrence of combustible mixtures and igniting temperatures must be prevented unless in strictly controlled circumstances.

Certain priorities should be kept clearly in mind when the protection needs of an appliance are being decided. The first priority should be that no injury to personnel results. The minimizing or containment of damage to the appliance or its surroundings, while important, is a secondary consideration.

Certain essential safety rules have widespread application irrespective of wide varieties of configuration, methods of heating, or types of control. For example a reaction to a fault or to a danger must be equally effective whether it is the reaction of an attendant or of an automatic device; adherence to a certain sequence of events may be equally important irrespective of whether the timing is provided manually or automatically. The safety of an industrial appliance is a function of the features peculiar to that individual appliance, and the functions of any accessories often cannot be specified independently, but must be derived from and be suitable for the needs of the individual application.

Thus it will be noticed that this Standard in general avoids giving mandatory lists of precisely what types of hardware should be fitted to particular appliances. In particular it makes little mention of ‘automatic burners’ or ‘package burners’ and makes no attempt to provide rules for such burners independently of the whole appliance. When this Standard is used to check individual appliances, it will be necessary to decide whether the controls provided for the operating techniques specified are capable of providing, with a sufficient degree of reliability, the functional characteristics that are necessary for the safety of the particular appliance. The intent of this Standard is to describe how to determine and apply these critical appliance characteristics.

STANDARDS AUSTRALIA

# Australian Standard
# Industrial fuel-fired appliances

## SECTION 1 SCOPE AND GENERAL

### 1.1 SCOPE

This Standard sets out requirements and safety principles relating to the design, installation, and operation of industrial appliances that involve the combustion of gas or liquid fuel, or other fuel in air suspension, or the generation of combustible vapours in such appliances.

NOTES:

1 Although the rules for combustion safety given in this Standard are applicable in principle to very high energy release appliances such as large land boilers for electricity generation and for solid fuel and pulverized coal firing, it should be recognized that appliances of such a size present unique problems, often requiring comparatively sophisticated control systems. Each such case should be studied individually and its safety evaluated in relation to its own particular conditions.

2 More comprehensive requirements for gas-fired appliances are contained in AS 3814.

### 1.2 APPLICATION

The requirements of this Standard may be read in conjunction with, but do not take precedence over, any Statutory Regulations that may apply in any area.

NOTE: It should be noted that an installation may come under the jurisdiction of several authorities with differing areas of responsibility, and that an approval from one does not necessarily constitute an approval from others. Thus the construction of any plant may require separate approvals from authorities interested in flammable and combustible liquids, factory or machinery safety, electricity, gas, health, environment, water supply, sewerage and drainage, or the training and licensing of personnel.

### 1.3 NEW DESIGNS AND INNOVATIONS

Any novel materials, designs, methods of assembly, procedures, etc. which do not comply with a specific requirement of this Standard, or are not mentioned in it, but which give equivalent results to those specified, may not necessarily be prohibited but specific approval should be sought from the relevant Technical Regulator.

### 1.4 REFERENCED DOCUMENTS

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

### 1.5 DEFINITIONS

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

#### 1.5.1 Appliance

An assembly that uses fuel or other means to apply heat to objects or materials, or to produce a special atmosphere.

NOTE: Appliances as referred to in this Standard do not include vehicle refuelling appliances.