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Australian Standard 1375–1979

SAA INDUSTRIAL FUEL-FIRED APPLIANCES CODE

STANDARDS ASSOCIATION OF AUSTRALIA
Incorporated by Royal Charter

THE FOLLOWING SCIENTIFIC, INDUSTRIAL AND GOVERNMENTAL ORGANIZATIONS and departments were officially represented on the committee entrusted with the preparation of this standard:

Australian Gas Association

Australian Institute of Energy

Australian Institute of Petroleum

Bureau of Steel Manufacturers of Australia

Confederation of Australian Industry

Department of Construction

Department of Mines and Energy

Departments of Labour and Industry

Insurance Council of Australia

Metal Trades Industry Association of Australia

Metropolitan Fire Brigades Board (Victoria)

Oil Burning Industry Association of Australia

University of Melbourne

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To keep abreast of progress in industry, Australian standards are regularly reviewed. Suggestions for improvements to published standards, addressed to the head office of the Association, are welcomed.

AUSTRALIAN STANDARD

RULES FOR THE DESIGN, CONSTRUCTION AND OPERATION OF INDUSTRIAL FUEL-FIRED APPLIANCES

known as the

SAA INDUSTRIAL FUEL-FIRED APPLIANCES CODE

AS 1375–1979

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PREFACE

This revised standard was prepared by the Association's Committee on Industrial Fuel-fired Equipment. The standard was first issued in 1973 and is now revised to incorporate amendments published since then, and to update it generally.

In the main the amendments have concentrated on the appendices, which are a vital feature of this standard because of the importance of the design guidance which they provide.

Some of the basic data on the characteristics of volatile solvents had been rendered obsolete by alterations to the source material, NFPA 325M. Amendment 1 of 1975 therefore brought Appendix G up-to-date, and as a further development for the long term, consideration is being given by another committee to the publication of these details as a separate reference standard, in which case it will be removed from AS 1375.

Amendment 2 of December 1976 adjusted an important formula in Appendix E for calculating the size of explosion vents, whose use had been found to give inconsistent results. The formula was checked back to its source, the cause was found and the problem rectified.

The investigation leading to Amendment 2 disclosed further possibilities for clarifying and updating Appendix E, so Amendment 3 was published in September 1977, in which the appendix was rewritten completely.

During the preparation of Amendment 3 some inconsistencies had been found in Appendix F, which details the method of calculating ventilation air for those ovens in which volatile vapours may occur. This material had been derived initially from NFPA 86A, but as that code had been considered difficult to follow, the text had been re-written in another form. Subsequently certain worked examples in the 1973 version proved unsatisfactory, so work was initiated on what was intended to become Amendment 4 and which would have comprised a revision of Appendix F.

However, by the time this development was completed and balloted, it became apparent that the issue of another amendment at this stage would make the code unduly inconvenient to read; certain cosmetic improvements were desirable and so the work to date has been consolidated and incorporated in this revised edition. It is emphasized that this is not a general revision; aside from the incorporation of previously-published amendments, the only alterations concern Appendix F and minor adjustments elsewhere. The remainder of the standard has not been reviewed in any way, since there have, as yet, been no adverse reactions which would indicate a need for such a review.

Since AS 1375 was first published, AS 1853—1976 was published by the same committee as a companion standard. It is a single standard having two basic subjects: one a specification of the construction and functions of a single automatic oil burner, and the second rules for the application of such a burner in single or multiple installations on steam boilers. The first portion is complementary to AS 1375 in that it describes an automatic burner which may be used on AS 1375-type appliances. The second portion supersedes AS 1375 insofar as the application of automatic burners to steam boilers is concerned.

This standard sets out fundamental requirements for the general design, construction, installation and operation of a broad range of heated industrial appliances in which explosion hazards could occur, whether due to the combustion of a fuel in an enclosed space, or to the generation of volatile materials in an enclosed space, or to any combination of the two. It constitutes a statement of basic principles and ultimate aims; subsequent ancillary documents may be prepared to describe in detail the physical means of obtaining these aims in specific cases, having due regard to economic and other practical considerations. Until such documents become available, interested parties are invited to make use of the provisions of Rule 1.4, particularly in those cases where a number of generally similar installations may be involved.

The standard is intended to provide an authoritative source of fundamental safety principles for the use of responsible and competent persons or organizations, and must not be regarded as being either an instruction manual for untrained persons or a specification for detailed appliance design. It has no legal authority in its own right, but may acquire legal standing in one or more of the following circumstances:

- Adoption by a Statutory Authority having jurisdiction
- Adoption by a purchaser as a required standard of construction when placing a contract
- Adoption where a supplier or contractor states that an installation is in accordance with it.

This standard may require reference to the following Australian standards:

AS 1020	SAA Static Electricity Code
AS 1318	SAA Industrial Safety Colour Code
AS 1470	Code of General Principles for Safe Working in Industry
AS 1657	SAA Code for Fixed Platforms, Walkways, Stairways and Ladders
AS 1940	SAA Flammable and Combustible Liquids Code
AS 3000	SAA Wiring Rules

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Australian Standard
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FOREWORD

Safety is an essential factor in all industrial activity; it can be achieved in even the most sensitive processes if adequate equipment design and operating procedures have been developed for the purpose. Fuel-fired appliances are intended to process fuel/air mixtures, and may 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 to occur 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 be able to withstand pressures of a high order, it is necessary first to prevent the accumulation of combustible mixtures, secondly to avoid their ignition wherever possible, and thirdly, depending on the operating characteristics and reliability of these preventive measures, to provide means for relieving or mitigating the effect of an explosion.

When a finely divided fuel is introduced into an enclosed space, it is potentially unsafe until it is ignited; and so the first essential safety rule for fuel firing is that ignition should be as close to instantaneous as possible, and the second is that ignition reliability must be of a very high order. 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.

The amount of energy that can be released in the form of fuel before the accumulation becomes dangerous can be calculated, and is called the *critical energy;* the time required to reach the critical energy point is called the *critical time.* Both critical energy and critical time are functions of, and are peculiar to, the individual appliance. Critical time indicates the maximum allowable time delay for ignition to occur with safety, and also the maximum safe response time for any flame-failure safeguard system. The critical times for certain high-input equipment may sometimes be too short to allow available safety equipment to react, in which case the efficiency of the ignition system becomes critical and facilities for relieving excessive explosion pressures are essential.

It should be recognized that a differing degree of hazard exists during the starting-up phase in comparison with the operating phase of an appliance. The hazard inherent during the ignition of the fuel is greater than that existing after it has been ignited and the appliance is operating normally.

Combustible 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 burn is potentially explosive if it is in the 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.

Certain 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 avoided unless in strictly controlled circumstances.

The first essential when considering the protection of an appliance against a potential hazard should be that no injury to personnel results. A secondary consideration is that damage to the appliance or its surroundings should be minimized or contained. This order of priorities should be the criterion for determining protection requirements.

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 mechanically. 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 using this standard to check individual appliances, it will be necessary to decide whether the controls provided or 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 appliances. The intent of this standard is to describe how to determine these critical appliance characteristics.

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, 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.

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. These Rules (hereinafter referred to as 'this Code') set out safety principles relating to the design, installation, and operation of industrial appliances that involve the combustion of gas, oil, or other fuel in air suspension, or the generation of combustible vapours in such appliances.

1.2 RELATIONSHIP WITH REGULATIONS. The requirements of this Code should be read in conjunction with any Statutory Regulations that may apply in any area.

1.3 NEW DESIGNS, INNOVATIONS. Notwithstanding the specific requirements of this Code, any novel materials, designs, techniques, methods of assembly, etc, which give equivalent results to those specified may be considered for acceptability. Such cases should be referred to SAA Committee ME/21, Industrial Fuel-fired Equipment, for adjudication.

1.4 INTERPRETATIONS. Questions concerning the meaning, application, or effect of any part of this Code may be referred to SAA Committee ME/21, Industrial Fuel-fired Equipment, for interpretation. The authority of this committee is limited to matters of interpretation, and it will not adjudicate in disputes.

1.5 DEFINITIONS. For the purpose of this Code the following definitions apply.

1.5.1 Appliance — industrial-type equipment, irrespective of application or location, used to apply heat to objects or materials or to produce a special atmosphere.

1.5.2 Approval, approved — with the approval of, acceptable to, and meeting the prescribed standards of, the Authority having jurisdiction.

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

1.5.4 Critical energy — the maximum potential energy in the form of unignited fuel which may be introduced into an appliance before a potentially hazardous level is reached. (Refer to Appendix D for further explanation and methods of determination.)

1.5.5 Critical time — the time required to accumulate unignited fuel in such quantity and proportions that, if it were ignited, the pressure of the resultant explosion would constitute a hazard. (Refer to Appendix D for further explanation and methods of determination.)

1.5.6 Dilution — the supply of fresh air, or other suitable diluent, and its circulation, distribution and exhaust to outside atmosphere, with the purpose of diluting flammable vapours or dusts to concentrations that are below the lower explosive limit (LEL).

1.5.7 Duct — taken to include —

(a) any passage that leads gases from an external combustion chamber to the appliance;

(b) any passage that introduces ventilating air;

(c) any passage that recirculates air or gases either external to or as an integral part of the appliance;

(d) any exhaust for process products, vapours or dusts.

1.5.8 Flame simulation — a false signal, indicating that flame is present when in fact no flame is present.

1.5.9 Flue — a duct used to remove products of combustion to the outside atmosphere after their purpose has been fulfilled.

1.5.10 Fresh air — air which, at the point of usage, is essentially free from solid particles, fibres, liquid droplets, or gaseous contaminants.

1.5.11 Installer — a person or organization who undertakes the responsibility of making the installation, and not an individual tradesman employed by the installer.

1.5.12 Interlock — a device which makes the operation of an item of equipment dependent on the fulfilment of predetermined conditions by any other item of equipment.

1.5.13 Lockout — a condition in which the device under consideration has been turned off and can be restarted only after an initial manual action.

1.5.14 'May' — the word 'may' implies the right to use discretion.

1.5.15 Proved — means that the relevant condition has been sensed and registered as being correct. The term applies to both sensing by automatic control equipment and to visual or other personal verification by an operator.

1.5.16 Purging — the use of air or inert gas to remove and replace a potentially dangerous atmosphere.

1.5.17 'Shall' and 'should' — the word 'shall' is to be understood as mandatory and the word 'should' as advisory.

1.6 AUTHORITY, RESPONSIBILITIES, GENERAL PRECAUTIONS.

1.6.1 Statutory Requirements. Appliances shall not, when installed, contravene the requirements of any Statutory Authority which may be applicable; e.g. factory or machinery safety, electricity, gas, health, water supply, sewerage and drainage.

1.6.2 Qualifications of Staff. Installation, maintenance and operating staff shall be trained for their particular function and shall be licensed, or otherwise authorized, under the terms of any Statutory regulation which may be applicable.

1.6.3 General Safety. The design, installation and operation of any appliance should be such as to permit compliance with the provisions of AS 1470.

1.6.4 Alterations, Extensions, Repairs. It shall be the responsibility of the owner to ensure that any alterations, or repairs to any appliance or associated equipment do not render the installation hazardous or otherwise unacceptable to the Authority.

SECTION 2. DESIGN AND CONSTRUCTION

2.1 GENERAL DESIGN.

2.1.1 Expansion. The appliance together with conveyors and other equipment shall incorporate where necessary provisions to prevent damage resulting from thermal expansion and contraction.

2.1.2 Ladders or Steps. Any ladder or step which may be needed to reach valves or other operating controls on the appliance should be an integral part of the appliance. Refer to AS 1657.

2.1.3 Protection of Equipment. Guard rails or equivalent protection shall be provided where necessary to protect controls and equipment from damage or from alteration of settings by traffic, mechanical equipment, and the like.

2.1.4 Accumulations within Cavity Walls. Cavity walls in an appliance structure, whether or not they contain insulating material, shall be so designed that condensible products of combustion or flammable gases and vapours cannot accumulate within them.

2.1.5 Support of Insulation. Adequate supports shall be provided to prevent the settling of, or the occurrence of voids in, insulating materials.

2.1.6 Electrostatic Earthing. Where there is any danger that static electric charges may cause an explosion, provision shall be made for electrical bonding and earthing in accordance with AS 1020.

2.1.7 Belt Drives. Belt drives that are used in proximity to flammable fuel/air mixtures, vapours, or dusts should be of the antistatic type.

2.1.8 Strength of Doors. The strength of fasteners and mountings of doors and covers over access ports or openings shall be sufficient to ensure that explosion pressures will not cause them to open before explosion reliefs operate, unless the doors or covers themselves form part of the designed explosion relief.

2.1.9 Prevention of Accidental Fires. An appliance shall be so designed, and in particular heating means shall be so located, that accumulations of combustible waste or similar material on a scale likely to cause accidental fires are prevented.

2.1.10 Free Circulation. Shelves, loading arrangements, and internal design generally shall be such that the circulation of dilution air, the exhaust of vapours, and purging, are not impaired.

2.1.11 Adjusting Devices. Any appliance adjusting device that affects the safety of the appliance shall be so designed that —

(a) it may be readily and conveniently reset as required;

(b) it is, if important to the safety of the equipment, protected against unauthorized interference;

(c) it is not upset by temperature changes;

(d) it is not susceptible to sticking or seizing under normal conditions of use;

(e) it incorporates locking or holding arrangements, which are sufficiently positive to prevent subsequent movement through accident, vibration, or expansion; the tightening of any such locking devices shall not significantly alter any setting.

2.1.12 Electrical Equipment. Any electrical equipment and wiring shall comply with the appropriate requirements of Part 1 and Part 2 of AS 3000.

2.1.13 Inlet Guards. Any inlet outside the appliance shall be protected by a screen, and shall be so guarded or so located that it is not likely to be obstructed.

2.2 APPLIANCE HEATING AND FUEL SYSTEMS.

2.2.1 Fuel Shut-off. A means for quickly shutting-off the flow of fuel shall be fitted adjacent to each burner, and shall be so located that it is readily accessible at all times. If access may be prevented in the event of fire, explosion, or other emergency, another shut-off shall be provided in a safe location.

NOTE: Any arrangement that shuts off the internal valves of a burner would comply with this requirement.

2.2.2 Manual Ignition Equipment. Any manually inserted gas torch shall be connected by means of approved flexible tubing which shall be of the minimum length for the purpose. Where extended distances occur between burners two or more lighting torches shall be used. Torches of the oil-soaked type shall be of a metal rod, with provision for securing the absorbent material to the rod, and a safe quenching pot shall be provided.

2.2.3 Gas Piping and Components. Gas piping, fittings and components that form part of the appliance shall comply with the requirements of the Authority.

2.2.4 Fuel Supply. Fuel supply installations shall comply with AS 1940 for oil fuel, or with the Authority's requirements for gas.

2.2.5 Solid Fuel Systems. Systems for the handling, preparation and supply of powdered or pulverized solid fuel shall be so designed that the possibility of uncontrolled ignition or explosion of the fuel within the supply system is minimized.

NOTE: The hazards resulting from residual fuel contained within the fuel-handling system after shutdown require particularly close attention, and procedures to clear out this residual fuel, or render it inert, or prevent the generation of volatiles in stationary fuel in hot bunkers and handling equipment, must be arranged and enforced.

2.2.6 Hot Fluid Heating Systems. Elements, radiators, etc, containing heated fluids shall be designed to withstand the maximum temperatures and pressures to which they are likely to be subjected.

2.3 MATERIALS.

2.3.1 Specifications. Material used in the construction of an appliance shall comply with the relevant Australian standard, or an appropriate