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WATER-TUBE BOILERS

1984

STANDARDS ASSOCIATION OF AUSTRALIA
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THE FOLLOWING GOVERNMENT DEPARTMENTS AND SCIENTIFIC AND INDUSTRIAL organizations were officially represented on the committee entrusted with the preparation of this standard:

Aluminium Development Council
Australasian Institute of Metals
Australian Chamber of Commerce
Australian Compressed Air Institute
Australian Institute of Energy
Australian Institute of Non-destructive Testing
Australian Institute of Petroleum Limited
Australian Liquefied Petroleum Gas Association
Australian Mines and Metals Association
Australian Society of Sugar Cane Technologists
Australian Valve Manufacturers Association
Australian Welding Institute
Australian Welding Research Association
Boiler and Unfired Pressure Vessel Manufacturers and Users
Bureau of Steel Manufacturers of Australia
Confederation of Australian Industry
Department of the Capital Territory
Department of Defence
Department of Mines and Energy
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Insurance Council of Australia
Metal Trades Industry Association of Australia
Railways of Australia Committee
Society of Mechanical Engineers of Australia
State Departments of Labour and Industry and Machinery Inspection
Universities and Technical Colleges

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AUSTRALIAN STANDARD

WATER-TUBE BOILERS

AS 1228–1980

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PREFACE

This edition of this standard was prepared by the Association's Committee on Boilers and Unfired Pressure Vessels. The standard was first published in 1972 as part of the program of revision of Parts I–IV and V of AS CB1, SAA Boiler Code. It forms part of the SAA Boiler Code (AS 1200) which is referred to in Statutory Regulations in Australia, and which covers requirements for land installations of shell boilers, water-tube boilers, unfired pressure vessels, pressure piping, welder certification, and related matters.

Revisions and additions contained in the three published amendments to the first edition, together with other revisions and additions approved by the committee have been incorporated in this edition. The clauses, tables and figures which have been subject to technical change or addition subsequent to Amendment No 3 to AS 1228 — 1972 are listed in the 'Annex' following the Index.

The standard follows, in principle, other parts of the SAA Boiler Code by giving guidance to manufacturers, Inspecting Authorities and users in the form of minimum engineering standards for the design, construction, inspection, testing and installation of water-tube boilers.

It is based on BS 1113 : 1969 which includes the relevant requirements of ISO/R 831. ISO/R 831 is the subject of continuing study and development to increase its scope and to take account of trends in design and construction, and this standard will accordingly be revised as further recommendations are issued.

The ISO Recommendation and the standards in this series have been formulated with the object of providing adequate protection of life and property, a reasonably long and safe period of usefulness, and a proper margin for deterioration in service.

The standard contains basic data necessary for design, including material specifications, design parameters, requirements for fabrication, inspection and testing. These requirements are specified in terms of principles to the fullest possible extent, supplemented where necessary by further detail to obtain uniform interpretation of principle and guidance as to best methods. In other areas the standard indicates where caution is necessary because it is felt that a direct prohibition would be unwise at the present level of knowledge.

The specific design requirements of the standard are based on a simplified engineering approach and are intended to be the standard methods of design. However, in special instances, particularly where guidance is not provided in this standard, other methods may be used provided that the validity of the design is satisfactorily established.

Section 4 of this standard (manufacture and workmanship) includes requirements for those matters which come within the normal function of the manufacturer. Requirements as to workmanship for plates, tubes, forgings and castings in the condition in which they are normally supplied to the manufacturer are included in the relevant standards specifying such materials.

This standard does not specify individual welding processes or procedures. It provides guidance by which a welding process or procedure or the application of equipment or material for various welding processes or procedures by individual manufacturers may be approved for the manufacture of water-tube boilers and their ancillary pressure parts. It also specifies requirements whereby the competence of individual welders may be established and qualified.

In general, the tests required for the approval of welding procedures, for the competence of welders and for production control, together with the requirements for non-destructive examination, have been formulated with fusion welding processes in mind. Where a pressure welding process is employed, e.g. flash welding for joining tubes, it will be necessary to modify or extend these requirements to ensure that adequate precautions are taken for the avoidance of faults peculiar to the process used. Special requirements of this nature should be subject to prior agreement between the manufacturer and the Inspecting Authority.

No guidelines on construction can be written in sufficient detail to ensure good workmanship in construction. Each boiler manufacturer is responsible for taking every necessary step to make sure that the quality of workmanship and construction is such as will ensure compliance with good engineering practice.

The user will also need to consider many factors beyond those covered by this standard in the final specification of a boiler and is cautioned that the standard is not a complete design handbook and that he should be aware of the need for competent engineering judgement.

It should be noted that the standard has been written primarily to suit conditions in Australia where there is a strong relationship between the manufacturer (and designer) and the Inspecting Authority. However, it is not intended to weaken the important link between these parties and the purchaser, who will be concerned with many other aspects beyond the scope of this standard and who may specify additional or alternative requirements; but such requirements must not be less than those already specified in the standard and must comply with the requirements of the Inspecting Authority in the State where the boiler is to be operated. Statements of above requirements should form part of the contract documents between the purchaser and manufacturer. Attention is drawn to Appendix H which sets out information that should be supplied by the purchaser and the manufacturer.

Users of this standard are reminded that it has no legal authority in its own right, but may acquire legal standing in one or more of the following circumstances:

(a) Adoption by a government or other authority having jurisdiction.

(b) Adoption by a purchaser as the required standard of construction when placing a contract.

(c) Adoption where a manufacturer states that a vessel is in accordance with this standard.

This standard makes reference to the following documents:

AS 1000 The International System of Units (SI) and Its Application

AS 1074 Steel Tubes and Tubulars Threaded or Suitable for Threading with Pipe Threads of Whitworth Form

AS 1101 Graphical Symbols for General Engineering
Part 3 — Symbols for Welding

AS 1171 Methods for Magnetic Particle Testing of Ferromagnetic Products and Components

AS 1200 SAA Boiler Code

AS 1204 Structural Steels — Ordinary Weldable Grades

AS 1210 SAA Unfired Pressure Vessels Code

AS 1250 SAA Steel Structures Code

AS 1271 Valves, Water Gauges and Other Fittings for Boilers and Unfired Pressure Vessels

AS 1349 Bourdon Tube Pressure and Vacuum Gauges

AS 1375 SAA Industrial Fuel Fired Appliances Code

AS 1544 Methods for Impact Tests on Metals
Part 2 — Charpy V-notch

AS 1548 Steel Plates for Boilers and Unfired Pressure Vessels

AS 1680 Code of Practice for Interior Lighting and the Visual Environment

AS 1710 Method for Ultrasonic Testing of Carbon and Low Alloy Steel Plate, and Classification of Quality

AS 1722 Pipe Threads of Whitworth Form
Part 1 — Sealing Pipe Threads

AS 1750 Steel Sections and Bars for Boilers and Unfired Pressure Vessels

AS 1796 SAA Welding Certification Code

AS 1835 Seamless Steel Tubes for Pressure Purposes

AS 1836 Welded Steel Tubes for Pressure Purposes

AS 1853 Rules for the Design and Construction of Single Automatic Oil and Gas Burners and Their Application to Boilers

AS 1947 Metric Units for Use in Mechanical Engineering and Related Fields

AS 2062 Methods for Non-Destructive Penetrant Testing of Products and Components

AS 2129 Flanges and Bolting for Pipes, Valves and Fittings

AS 2177 Radiographic Examination of Welded Butt Joints in Metal
Part 1 — Methods of Test
Part 2 — Image Quality Indicators (IQI) and Recommendations for Their Use

AS 2207 Methods for Ultrasonic Testing of Fusion Welded Joints in Steels

AS 3000 Rules for the Electrical Equipment of Buildings, Structures and Premises

AS B164 Recommendation for the Radiographic Examination of Fusion Welded Butt Joints in Steel (superseded by AS 2177, Part 1*)

AS B230 Recommendation for the Radiographic Examination of Fusion Welded Circumferential Butt Joints in Steel Pipes (superseded by AS 2177, Part 1*)

AS B261 Method for Ultrasonic Examination of Welds (superseded by AS 2207*)

AS B262 Specification for Image Quality Indicators for Radiography and Recommendations for Their Use (superseded by AS 2177, Part 1*)

AS CB15 SAA Pipe Welding Code
Part 1 — Oxy-Acetylene Welding of Ferritic Steel Piping
Part 3 — Arc Welding of Ferritic Steel Piping
Part 5 — Flash Butt Welding of Steel Pipes and Tubes

AS CB18 SAA Pressure Piping Code
Part 1 — Ferrous Piping

AS Z5 Glossary of Metal Welding Terms and Definitions

ISO/R 831 Rules for Construction of Stationary Boilers

BS 1113 Water-tube Steam Generating Plant (Including Superheaters, Reheaters and Steel Tube Economizers)

BS 1387 Steel Tubes and Tubulars Suitable for Screwing to BS 21 Pipe Threads

BS 1501 Steels for Fired and Unfired Pressure Vessels—Plates

BS 1503 Steel for Fired and Unfired Pressure Vessels—Forgings

BS 1504 Specification for Steel Castings for Pressure Purposes

BS 1560 Steel Pipe Flanges and Flanged Fittings (Nominal Sizes $\frac{1}{2}$ in to 24 in) for the Petroleum Industry
Part 2 — Metric Dimensions

BS 1952 Copper Alloy Gate Valves for General Purposes

BS 1953 Copper Alloy Check Valves for General Purposes

BS 2094 Glossary of Terms Relating to Iron and Steel

BS 3059 Specification for Steel Boiler and Superheater Tubes
Part 2 — Carbon, Alloy and Austenitic Stainless Steel Tubes, with Specified Elevated Temperature Properties

BS 3605 Seamless and Welded Austenitic Stainless Steel Pipes and Tubes for Pressure Purposes

* Superseded standards are maintained at SAA Libraries for inspection.

BS 4076 Specification for Steel Chimneys

BS 4080 Methods for Non-destructive Testing of Steel Castings

BS 5154 Copper Alloy Globe, Globe Stop and Check, Check, and Gate Valves for General Purposes

BS 5500 Unfired Fusion Welded Pressure Vessels

ASTM E 125 Reference Photographs for Magnetic Particle Indications on Ferrous Castings

ASTM E 446 Reference Radiographs for Steel Castings Up to 2 in (51 mm) in Thickness

ANSI/NFPA 85E Pulverized Coal-fired Multiple Burner Boiler — Furnaces

ANSI/NFPA 85F Standard for the Installation and Operation of Pulverized Fuel Systems

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STANDARDS ASSOCIATION OF AUSTRALIA

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FOREWORD

This standard does not prohibit the use of materials or methods of design or construction which are not specifically referred to herein.

Therefore the application of the standards which comprise the SAA Boiler Code may give rise to a continual need for consideration of unusual and other designs which do not comply in all respects with the requirements of the relevant standard or which are not adequately covered by that or other standards.

Where it is desired to use materials or methods of design or construction which do not comply with the requirements of or are not adequately covered by the standard, designs incorporating such departure should be submitted to the relevant Inspecting Authority for approval. Where necessary, SAA Committee ME/1, Boilers and Unfired Pressure Vessels, may be asked to serve in an advisory capacity in the determination of the suitability of such design.

In addition, if any ambiguity is found, or where doubt arises as to the meaning or effect of the requirements of this standard or whether anything ought to be done or not done in order to comply fully with the standard, the question should be referred to SAA Committee ME/1 for an interpretation of the intent of those particular requirements of the standard.

It is emphasized that the above mentioned activities of the committee are limited to technical aspects of the standard and that the committee has no power or jurisdiction to adjudicate upon contractual or regulatory matters or the duties of persons concerned with the subject of the submission.

Methods developed by Committee ME/1 for communicating the findings of the committee are as follows:

Committee Opinion: A Committee Opinion is issued in reply to a specific enquiry from a specific organization and applies only to the set of circumstances referenced in the Committee Opinion. Copies of Committee Opinions are sent to the relevant Inspecting Authorities and may be used by the Authorities as the basis for approval of the particular application or for approval of similar submissions from other organizations. A list of current Committee Opinions is published in AS 1200.

Interpretation: An Interpretation is issued when the committee judges the subject of an enquiry to be of sufficient importance or of probable wide application. A postal ballot is held and the reply is published as an Interpretation which is to be regarded as equivalent to an Amendment to the relevant standard, effective from the date of issue. A list of current Interpretations is published in AS 1200.

Where the committee judges the subject to be suitable, a Committee Opinion or Interpretation may be incorporated in an Amendment to the relevant standard, whereupon the Committee Opinion or Interpretation is withdrawn. Where the timing is appropriate, the finding of the committee may be issued directly as an Amendment.

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This standard sets out requirements for materials, design, construction, installation, inspection and testing of those parts of water-tube steam boilers and water-heating units subject to pressure.

NOTE: With the approval of the Inspecting Authority, this standard may also apply to the parts of 'water-tube type' vapour-generating and hot liquid units subject to internal vapour or liquid pressure.

1.2 APPLICATION. This standard specifically applies to land installations of water-tube boilers, as defined in Clause 1.3 including integral superheaters, reheaters and steel tube economizers and also to superheaters, reheaters and steel tube economizers independently fired or heated.

It also applies to all pressure parts containing fluid up to and including the valves separating the pressure parts from —

(a) steam pipes to and from other equipment;
(b) water pipes to and from other equipment;
(c) drain pipes; and
(d) the surrounding atmosphere, except that for safety valves, their vent piping to the atmosphere is also covered.

The standard does not apply to brickwork or similar settings, supports, insulation, air preheaters, mechanical stokers, ash disposal equipment, forced or induced draught equipment or their accessories, except for items important to basic safety and inspection (see Section 8).

1.3 DEFINITIONS. For the purposes of this standard the following definitions shall apply.

1.3.1 Boiler — an arrangement of vessels and interconnecting parts, wherein steam, or other vapour, is or is intended to be generated or water or other liquid is or is intended to be heated at a pressure above that of the atmosphere by the application of fire or the products of combustion or by electrical means. It shall also include valves, gauges, and other fittings, as required in Section 7 herein and, where consistent with the requirements of this standard, shall include the boiler setting, and associated equipment. It does not include a fully flooded system or pressurized system where the water is or is intended to be heated to a temperature not greater than 99°C, or other liquid is or is intended to be heated to a temperature not greater than 1°C below the normal atmospheric boiling temperature of the liquid.

1.3.2 Integral piping — that piping within the whole of the circulatory system of the boiler between the feed inlet valve and the main stop valve and, in the case of a reheater, between the reheater inlet header and the reheater outlet header. In addition, certain pipework connected to boiler pressure parts or to the pipes forming the main circulatory system but not to external equipment or to atmosphere, are included in this category. Such pipework includes integral boiler sootblower piping to the drain valves, blowdown, drain, sampling and air release piping between the point of take-off and the appropriate valves, also boiler unit instrument and impulse piping including piping to water gauges, alarms and transmitters.

Integral piping does not include tubes forming the heating surfaces in individual components, such as in reheaters, superheaters, etc.

NOTE: Any component of the boiler circulatory pipework system which has multiple inlets, outlets or connections, should be considered to be a header and is to comply with the clauses covering cylindrical shells, drums or headers.

1.3.3 Design pressure — the maximum allowable operating pressure (not including accumulation, Clause 7.2.3) for —

(a) natural or assisted flow boilers, at the top of the steam or water drum;
(b) once-through forced flow boilers, at the final superheater outlet, except where an intervening shut-off valve is fitted;
(c) steam reheaters, independently fired superheaters, and economizer separated from the boiler by a shut-off valve, at the final outlet of the particular equipment.

1.3.4 Calculation pressure.

(a) Except as specified in (b) below, the calculation pressure for all pressure parts is the design pressure (Clause 1.3.3) increased, where applicable, to take into account the pressure differential and hydrostatic head corresponding to the most severe conditions of operation.
(b) For those portions of the pressure parts of superheaters of natural and assisted flow boilers, and of independently fired superheaters (including the integral piping up to and including the steam stop valve), and of reheaters, which are manufactured from ferritic wrought steel and forgings, whose design is governed by allowable stresses derived from S_R (see Clause 2.2.2) and for those made from austenitic wrought steels (see Clause 2.2.3), the calculation pressure is the pressure at which the highest set safety valve on the superheater or reheater outlet is set to lift, increased to take into account the pressure drop corresponding to the most severe conditions of operation.

1.3.5 Design temperature — the metal temperature at the coincident calculation pressure, used to select the design stress and to determine the dimensions of the boiler component under consideration.

1.3.6 Design stress — the maximum allowable stress for use in the formulas for calculation of pressure parts.

1.3.7 Minimum calculated thickness — the minimum thickness calculated according to the formulas to resist loadings, before corrosion or other allowances are added.

1.3.8 Inspecting Authority — the Authority having statutory powers to control the design, manufacture, installation and certification of boilers in the State or Territory in which the boiler is to be operated, except that where the boiler is not subject to such statutory jurisdiction the Inspecting Authority shall be the purchaser of the boiler, or the person or organization named as such in the purchase order.