AS 3857—1990

Australian Standard®

# Heat exchangers—Tubeplates—Method of design



STANDARDS AUSTRALIA

This Australian Standard was prepared by Committee ME/1, Boilers and Unfired Pressure Vessels. It was approved on behalf of the Council of Standards Australia on 23 August 1990 and published on 10 December 1990.

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The following interests are represented on Committee ME/1:

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STANDARDS AUSTRALIA

# Amendment No. 1
# to
# AS 3857—1990
# Heat exchangers—Tubeplates—Method of design

**REVISED TEXT**

The 1990 edition of AS 3857 is amended as follows. The amendments should be inserted in the appropriate places.

*SUMMARY:* This Amendment applies to Clauses 5.3, 5.5.2, 5.5.3 and 5.6; Paragraphs C2.1, C2.2, C3.1, and C3.2; and Figures 3.5, B1 and C1.

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Australian Standard®

# Heat exchangers—Tubeplates—Method of design

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# PREFACE

This Standard was prepared by the Standards Australia committee on Boilers and Unfired Pressure Vessels. Acknowledgement is gratefully made of the considerable assistance provided by ICI Australia Engineering Pty Ltd which developed this method of design.

The Standard covers a new method for the design of heat exchanger tubeplates and associated matters. It was originally drafted with the intention that it would be incorporated into AS 1210, *SAA Unfired Pressure Vessels Code*, as a replacement for the method contained in the first and second editions of AS 1210 but subsequently withdrawn. However, during the course of development of the proposal, its content was extended and it is now a self-contained method of design more suitable for publication as a separate Standard.

The Standard will provide an additional method to the methods currently specified in AS 1210 for the design of tubeplates for heat exchangers complying with that Standard. The method may also be suitable for the design of some boiler tubeplates.

Although the design method may appear to be somewhat complex, it is no more so than some design methods for other pressure vessel components such as flanges.

While the method is applicable to long-hand calculations, its most effective use will be achieved by programming a computer. An appendix provides a simple alogrithm for calculating Lord Kelvin's modified Bessel functions and this algorithm allows programs to be compiled on small personal computers. Tabulated values of the functions are also provided in the appendix. Suggested worksheets and worked examples of calculations are included in another appendix.

As the proposed design methods allows actual stresses at any location to be determined, it can be used for heat exchangers designed to AS 1210 Supplement 1—Unfired Pressure Vessels—Advanced Design and Construction (Supplement to AS 1210—1989).

Tubeplates designed in accordance with this method are already in service both in Australia and other countries, having been approved by the relevant Inspecting Authority on a case-by-case basis.

The theoretical background for the method given in this Standard is given in a technical paper titled 'Australian Tubesheet Code' by P McGowan and I Mirovics presented at the ASME Conference on Pressure Vessels and Piping at Nashville, Tennesee in June 1990.

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# Australian Standard

# Heat Exchangers—Tubeplates—Method of Design

**1 SCOPE** This Standard sets out a method for designing flat, circular tubeplates of the following configurations:

(a) Fixed tubeplates as in heat exchangers consisting of two tubeplates clamped or welded to a shell between them, with or without an expansion joint in the shell.

(b) Tubeplates of U-tube or bayonet heat exchangers.

(c) Floating tubeplates.

Such tubeplates are used in shell-and-tube heat exchangers and in some types of boilers including fire-tube and waste heat boilers.

**2 APPLICATION** This Standard is intended for use in association with an appropriate pressure vessel or boiler Standard such as—

(a) shell-and-tube heat exchangers .....AS 1210 or AS 1210 Supplement 1

(b) boilers .....AS 1797.

Calculated and permissible stresses in the tubeplates, tubes and shell shall be determined from this Standard but all other design criteria specified in the relevant pressure vessel or boiler Standard shall apply.

In the application of this Standard it will also be necessary to determine metal temperature from other sources (see Clause 5.1).

**3 REFERENCED DOCUMENTS** The following documents are referred to in this Standard:

| | |
|---|---|
| AS | |
| 1210 | Unfired pressure vessels |
| 1210 Supplement 1 | Unfired pressure vessels—Advanced design and construction (Supplement to AS 1210—1989) |
| 1797 | Boilers—Fire-tube, shell, and miscellaneous |
| EJMA | Standards of the Expansion Joint Manufacturers Association, Inc. |

## 4 MATERIALS AND COMPONENTS

**4.1 Acceptable materials** Materials for tubeplates and associated components shall comply with a material specification listed, or as otherwise permitted, in AS 1210, AS 1210 Supplement 1 or AS 1797, as appropriate.

**4.2 Design strength** The material design strengths, used in the analysis of the tubeplate, shall comply with the values specified, or as otherwise permitted, in AS 1210, AS 1210 Supplement 1 or AS 1797, as appropriate.

**4.3 Coefficient of thermal expansion** The values which shall be used for the mean coefficient of thermal expansion are given in Table 4.3.

**4.4 Young modulus (modulus of elasticity)** The values which shall be used for Young Modulus are given in Table 4.4.

**4.5 Expansion joints** Metallic expansion joints should comply with the requirements specified in the 'Standards of the Expansion Joint Manufacturers Associations, Inc.' or equivalent.