

REFERENCE COPY  
INFORMATION CENTRE  
STANDARDS AUSTRALIA

AS 2091—1981  
UDC 681.2:536.531.084

# Australian Standard 2091—1981

WITHDRAWN:  
19990701

## RESISTANCE THERMOMETERS AND THEIR ELEMENTS (PLATINUM, COPPER, NICKEL)



**STANDARDS ASSOCIATION OF AUSTRALIA**  
*Incorporated by Royal Charter*



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

Australian Medical Association  
Bureau of Meteorology  
Chambers of Commerce, N.S.W. and Vic.  
Chief Secretary's Department, Vic.  
Commonwealth Serum Laboratories  
Confederation of Australian Industry  
Department of Agriculture, N.S.W.  
Department of Science and Technology  
Government Chemical Laboratories, W.A.  
National Measurement Laboratory  
National Standards Commission  
Railways of Australia Committee  
Royal Australian Chemical Institute  
University of Sydney  
Victorian State Laboratories

---

This standard, prepared by Committee C/H/1, Laboratory Glassware and Related Apparatus, was approved on behalf of the Council of the Standards Association of Australia on 25 August 1981, and was published on 14 December 1981.

---

To keep abreast of progress in industry, Australian standards are subject to continuous review and are kept up-to-date by the issue of amendments or new editions as necessary. It is important therefore that standards users ensure that their standards are up-to-date. Full details of all SAA publications will be found in the Annual List of Australian Standards; these details are supplemented by listings in the SAA monthly journal 'The Australian Standard'. Information on the Annual List and 'The Australian Standard' may be obtained from any sales office of the Association, where details are also available of the current status of individual standards. Suggestions for improvements to published standards, addressed to the head office of the Association, are welcomed.

---

*This standard was issued in draft form for public review as DR 77040.*

AUSTRALIAN STANDARD

# RESISTANCE THERMOMETERS AND THEIR ELEMENTS (PLATINUM, COPPER, NICKEL)

AS 2091-1981

First published .....1981

PUBLISHED BY THE STANDARDS ASSOCIATION OF AUSTRALIA  
STANDARDS HOUSE, 80 ARTHUR ST, NORTH SYDNEY. N.S.W.

ISBN 0 7262 2417 0



15 DEC 1981

## PREFACE

This standard was prepared by the Association's Committee on Laboratory Glassware and Related Apparatus under the direction of the Chemical Standards Board following a recommendation from the subcommittee on thermometers that such a project be undertaken.

The standard is one of a series of standards for thermometers, others being—

- AS 1006 Solid Stem General Purpose Thermometers
- AS 1030 Dial-type General Purpose Thermometers for Use in the Dairying Industry
- AS 1031 Metal-cased Mercury-in-glass Thermometers for Use in the Dairying Industry
- AS 1286 Right-angled Earth Thermometers
- AS 2190 Clinical Maximum Thermometers
- AS R13 Maximum, Minimum and Ordinary Meteorological Thermometers
- AS R33 Short Solid-stem Thermometers for Precision Use
- AS R34 Long Solid-stem Thermometers for Precision Use

In preparing this standard the responsible committee took cognizance of the requirements specified in—

- BS 1904 Industrial Platinum Resistance Thermometer Elements
- OIML\* Recommendation Electrical Resistance Thermometers (Platinum, Copper, Nickel)

and acknowledgement is made of the assistance obtained therefrom.

Attention is drawn to BS 1041, Code for Temperature Measurement, Part 3—Industrial Resistance Thermometry, which sets out the principles and methods of resistance thermometry, constructional features, installation procedures and measuring circuitry.

---

\*International Organization of Legal Metrology.

©Copyright — STANDARDS ASSOCIATION OF AUSTRALIA 1981

Users of standards are reminded that copyright subsists in all SAA publications. No part of this publication may be reproduced, stored in a retrieval system in any form or transmitted by any means without prior permission in writing of the Standards Association of Australia.

## CONTENTS

	<i>Page</i>
<b>SECTION 1. SCOPE AND GENERAL REQUIREMENTS</b>	
1.1 Scope .....	4
1.2 Application .....	4
1.3 Definitions .....	4
1.4 Temperature Range .....	4
1.5 Classification .....	4
1.6 Information to be Supplied by the Manufacturer .....	4
1.7 Identification and Marking .....	5
<b>SECTION 2. DESIGN CONSIDERATIONS</b>	
2.1 Relationship Between Temperature and Nominal Resistance .....	6
2.2 Tolerances .....	7
2.3 Electrical Supply .....	7
2.4 Electrical Leads .....	7
2.5 Protection of Element .....	7
2.6 Stem Design .....	7
<b>SECTION 3. PERFORMANCE REQUIREMENTS</b>	
3.1 General .....	8
3.2 Sequence of Testing .....	8
3.3 Ice-point Resistance .....	8
3.4 Self-heating .....	8
3.5 Thermo-electric Effect .....	8
3.6 Stability .....	8
3.7 Sustained Immersion at Limiting Temperature .....	8
3.8 General Insulation Resistance .....	8
3.9 Resistance of Insulation to High Voltage .....	8
3.10 Resistance to Dropping (Sealed Thermometers Only) .....	8
3.11 Resistance to Vibration (Sealed Thermometers Only) .....	8
3.12 Endurance Test (Sealed Thermometers Only) .....	8
3.13 Resistance to Pressure (Sealed Thermometers Only) .....	8
<b>APPENDICES</b>	
A Relationship Between Temperature and Resistance Ratio for Resistance Thermometer Elements .....	9
B Method for Determining Calibration Immersion Depth .....	11
C Method for Determining Ice-point (°C) Resistance .....	12
D Method for Determining Thermal Response Time .....	13
E Method for Determining Self-heating .....	14
F Method for Determining Thermo-electric Effect .....	16
G Method for Determining Stability at Maximum Working Temperature .....	16
H Method for Determining the Effect of Sustained Immersion at Limiting Temperatures .....	17
J Method for Determining Insulation Resistance, and High Voltage Test on Insulation .....	17
K Method for Determining Resistance to Dropping (Sealed Thermometers) .....	18
L Vibration Test (Sealed Thermometers) .....	18
M Endurance Test (Sealed Thermometers) .....	19
N Pressure Test (Sealed Thermometers) .....	20

## STANDARDS ASSOCIATION OF AUSTRALIA

## Australian Standard

for

## RESISTANCE THERMOMETERS AND THEIR ELEMENTS (PLATINUM, COPPER, NICKEL)

## SECTION 1. SCOPE AND GENERAL REQUIREMENTS

**1.1 SCOPE.** This standard specifies requirements for platinum, copper and nickel resistance thermometers and requirements for their temperature-sensitive elements when energized by direct current or alternating current at frequencies up to limits imposed by the dielectric properties of the insulation used. The frequency would normally be less than 1000 Hz.

## NOTES:

1. Thermometers manufactured in accordance with the recommendations of the International Practical Temperature Scale are not included.
2. Specifications for the electrical instruments needed for the measurement of the resistance or change in resistance of these thermometers are not included.

**1.2 APPLICATION.** This standard applies to resistance thermometers in terms of—

- Section 2—Design considerations
- Section 3—Performance requirements.

**1.3 DEFINITIONS.** For the purpose of this standard, the following definitions apply:

**1.3.1 Thermometer**—a device for ascertaining the temperature of the substance presented to it.

NOTE: Temperatures are measured in terms of the Commonwealth legal units of measurement of temperature which in the case are Celsius degrees as defined in the Weights and Measures (National Standards) Regulations, in force under the Weights and Measures (National Standards) Act 1960-1966.

**1.3.2 Resistance thermometer**—a device containing one or more electrical resistors, which change resistance with temperature and having two, three or four leads for connection to an electrical instrument measuring resistance or change in resistance.

**1.3.3 Resistance at any temperature**—the resistance measured at any temperature,  $t^{\circ}\text{C}$ , denoted by the symbol  $R_t$ .

**1.3.4 Resistance ratio**—the ratio of the resistance at any temperature,  $t^{\circ}\text{C}$ , to that at  $0^{\circ}\text{C}$  (expressed as  $R_t/R_0$ ).

**1.3.5 Sealed thermometer**—a thermometer supplied by the manufacturer, the stem of which is suitable for use without further protection.

**1.3.6 Element**—that part of the thermometer which responds to the temperature of the substance presented to it.

**1.3.7 Calibration immersion depth**—the minimum immersion depth within the medium at which the element of the thermometer complies with the appropriate specification contained within this standard.

**1.3.8  $|t|$** —the value of the temperature without regard to sign.

**1.3.9 Thermal response time**—the time taken for the element to attain a temperature which is a percent of the final temperature change.

**1.4 TEMPERATURE RANGE**

NOTE: Ranges other than those specified in Clauses 1.4.1 to 1.4.3 may be specified by the manufacturer. For platinum thermometers temperatures up to  $850^{\circ}\text{C}$  can be measured but it should be emphasized that temperatures above  $600^{\circ}\text{C}$  can only be measured reliably with specialized techniques.

**1.4.1 Platinum Resistance Thermometers and Elements.** Platinum resistance thermometers and/or elements shall be suitable for measuring temperatures within the overall range  $-200^{\circ}\text{C}$  to  $+660^{\circ}\text{C}$ .

**1.4.2 Copper Resistance Thermometers and Elements.** Copper resistance thermometers and/or elements shall be suitable for measuring temperatures within the overall range  $0^{\circ}\text{C}$  to  $+180^{\circ}\text{C}$ .

**1.4.3 Nickel Resistance Thermometers and Elements.** Nickel resistance thermometers and/or elements shall be suitable for measuring temperatures within the overall range  $0^{\circ}\text{C}$  to  $+180^{\circ}\text{C}$ .

**1.5 CLASSIFICATION.** Electrical resistance thermometer elements shall be classified according to their accuracy as follows, elements designated Category I being of the highest order of accuracy:

- (a) Platinum resistance thermometer element—Category I and Category II.
- (b) Copper resistance thermometer element—Category II and Category III.
- (c) Nickel resistance thermometer element—Category III.

**1.6 INFORMATION TO BE SUPPLIED BY THE MANUFACTURER.** Each thermometer shall be accompanied by the following information:

- (a) The nominal resistance at  $0^{\circ}\text{C}$  and the nominal  $\alpha$  value (see Section 2).
- (b) The maximum working temperature.
- (c) The designation of the class of accuracy (i.e. the category of the thermometer).
- (d) Identification of the lead wires.
- (e) The capacitance to earth, inductance, and maximum frequency of excitation at each of—
  - (i) a temperature not exceeding ambient temperature;
  - (ii) the stated maximum temperature usable with a.c. excitation.