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In the event of any doubts arising as to the contents,
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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Electric Measuring Instruments Manufacturers' Association (JEMIMA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS C 1602** : 1995 is replaced with this Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public or utility model rights.

Thermocouples

Introduction

This Japanese Industrial Standard has been prepared based on the third edition of **IEC 60584-1** published in 2013 with some modifications of the technical contents.

The portions given sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with the explanations is given in Annex JC.

1 Scope

This Standard specifies the thermocouples to be used for the temperature measurement.

NOTE 1 Temperatures in this Standard are based on the International Temperature Scale of 1990 (ITS-90).

NOTE 2 "*t*" indicates the temperature expressed in degrees Celsius, the unit symbol °C.

NOTE 3 The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows :

IEC 60584-1 : 2013 *Thermocouples — Part 1 : EMF specifications and tolerances* (MOD)

The symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1.**

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 7502 *Micrometer callipers*

JIS B 7507 *Vernier, dial and digital callipers*

JIS B 7516 *Metal rules*

JIS C 1302 *Insulation resistance testers*

JIS C 1610 *Extension and compensating cables for thermocouples*

JIS R 1401 *Non-Metallic protection tubes for thermocouples*

JIS R 1402 *Non-metallic insulating tubes for thermocouples*

JIS Z 8103 *Glossary of terms used in measurement*

JIS Z 8703 *Standard atmospheric conditions for testing*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS Z 8103**, and the following apply.

3.1 thermocouple

assembly composed of two types of conductors which are electrically joined at one end each other to generate electromotive force

3.2 thermocouple element wire

metal wire or alloy wire composing a thermocouple

3.3 measuring junction

joint of thermocouple element wires to give thermal contact with an article under temperature measurement

3.4 reference junction

junction between a thermocouple and a lead wire or between a compensating cable and a lead wire for measuring the electromotive force, which is kept at a known constant temperature

In this Standard, the reference junction temperature is 0 °C.

3.5 insulating tube

tube to prevent element wires of thermocouple from short-circuiting each other

3.6 protection tube

tube to be fitted for protection of the temperature measuring junction and the element wires from direct contact with the article under temperature measurement, the atmosphere, etc.

3.7 terminal

metal fitting attached to a thermocouple through which its electromotive force is taken out

3.8 thermocouple with protection tube

thermocouple with insulating tube attached, which is inserted into a protection tube and fitted with terminals

3.9 compensating cable

a couple of conductors covered with insulation having nearly the same electromotive force characteristic as that of the thermocouple to be used in combination at appropriate range of temperatures including the ordinary temperature, which are used for the connection between the connection part of thermocouple and the reference junction to compensate the temperature difference between them

3.10 electromotive force (EMF)

difference in electric power generated in a couple of conductors composing a thermocouple when they are placed in an environment having a temperature gradient

3.11 reference electromotive force

electromotive force imparted to the temperature at measuring junction specified for each type of thermocouple

3.12 reference function

polynomial of temperatures to express the reference electromotive force

3.13 tolerance

allowable maximum limit of the remainder obtained by subtracting the temperature at measuring junction from the temperature obtained by converting the electromotive force using the reference function

3.14 limit of normal service

limit of temperature at which a thermocouple can be used in air continuously

3.15 limit of extended range service

limit of temperature at which a thermocouple can be used in air for a short time

3.16 stability

amount of change in the electromotive force characteristics when a thermocouple is heated in air

3.17 standard thermometer

thermometer used as the standard apparatus in the electromotive force characteristic test which is carried out by the comparison method

4 Classification

The thermocouples are classified according to the composing materials as given in Table 1.

Table 1 Classification

Symbol of type	Composing materials	
	Positive side conductor	Negative side conductor
B	Platinum — rhodium alloy containing 30 % rhodium	Platinum — rhodium alloy containing 6 % rhodium
R	Platinum — rhodium alloy containing 13 % rhodium	Platinum
S	Platinum — rhodium alloy containing 10 % rhodium	Platinum
N	Alloy based on nickel, chromium and silicon	Alloy based on nickel and silicon
K	Alloy based on nickel and chromium	Alloy based on nickel and aluminium
E	Alloy based on nickel and chromium	Alloy based on copper and nickel
J	Iron	Alloy based on copper and nickel
T	Copper	Alloy based on copper and nickel
C	Tungsten — rhenium alloy containing 5 % rhenium	Tungsten — rhenium alloy containing 26 % rhenium

5 Reference electromotive force

The reference electromotive force are defined by the reference function.

The reference function is represented by polynomial (1). However, polynomial (2) is used for Type K thermocouples at temperatures in the range of 0 °C to 1 372 °C. The coefficients of the polynomial for each thermocouple type and the temperature range are as given in Annex JA.

$$E = a_0 + \sum_{i=1}^{n} a_i t^i \quad \cdots\cdots (1)$$

$$E = b_0 + \sum_{i=1}^{n} b_i t^i + c_0 \exp\left[c_1 (t - 126.968\,6)^2\right] \quad \cdots\cdots (2)$$

where, E : reference electromotive force (unit : μV)

t : arbitrary temperature (unit : °C)

a_0, b_0, a_i, b_i, c_0 and c_1 : coefficients of polynomial

n : order of polynomial

The tables of the reference electromotive force obtained by using the reference function are given in Annex A.

6 Tolerances

The tolerances are as given in Table 2.