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(JWES/JSA)

**Welding rods and solid wires for
welding of titanium and titanium
alloys**

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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 the Japan Welding Engineering Society (JWES)/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 Z 3331:2009** is replaced with this Standard.

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Welding rods and solid wires for welding of titanium and titanium alloys

Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **ISO 24034** published in 2005 and Amendment 1 (2008) 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. Annex JA and Annex JB contain matters that are not given in the corresponding International Standard.

1 Scope

This Standard specifies the solid rods (hereafter referred to as “rods”) and solid wires (hereafter referred to as “wires”) used for TIG welding, MIG welding, plasma welding, electron beam welding and laser welding of titanium and titanium alloys.

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

ISO 24034:2005 *Welding consumables—Solid wires and rods for fusion welding of titanium and titanium alloys—Classification* and Amendment 1:2008 (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 H 0321 *General rules for inspection of non-ferrous metal materials*

JIS H 1611 *Titanium and titanium alloys—General rules for chemical analysis*

JIS H 1612 *Methods for determination of nitrogen in titanium and titanium alloys*

JIS H 1614 *Methods for determination of iron in titanium and titanium alloys*

JIS H 1617 *Methods for determination of carbon in titanium and titanium alloys*

JIS H 1618 *Methods for determination of silicon in titanium and titanium alloys*

JIS H 1619 *Methods for determination of hydrogen in titanium and titanium alloys*

JIS H 1620 *Methods for determination of oxygen in titanium and titanium alloys*

JIS H 1621 *Methods for determination of palladium in titanium alloys*

JIS H 1622 *Titanium alloys—Methods for determination of aluminium*

JIS H 1624 *Titanium alloys—Method for determination of vanadium*

JIS H 1630 *Method for atomic emission spectrometric analysis of titanium*

JIS H 1631 *Titanium alloys—Method for X-ray fluorescence spectrometric analysis*

JIS H 4600 *Titanium and titanium alloys—Sheets, plates and strips*

JIS Z 3001-1 *Welding and allied processes—Vocabulary—Part 1: General*

JIS Z 3001-2 *Welding and allied processes—Vocabulary—Part 2: Welding processes*

JIS Z 3200 *Welding consumables—Technical delivery conditions for welding filler materials—Type of product, dimensions, tolerances and markings*

NOTE : Corresponding International Standard: ISO 544 *Welding consumables—Technical delivery conditions for welding filler materials—Type of product, dimensions, tolerances and markings* (MOD)

JIS Z 3423 *Procurement guidelines for welding consumables*

NOTE : Corresponding International Standard: ISO 14344:2002 *Welding and allied processes—Flux and gas shielded electrical welding processes—Procurement guidelines for consumables* (MOD)

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS Z 3001-1** and **JIS Z 3001-2** and the following apply.

3.1 solid rods

round or square solid rods with homogenous cross-section

4 Classification of rods and wires

The rods and wires are classified according to the chemical composition, and designated by symbols as shown in the following.

Further, examples of base metals to which each classification of rods and wires are typically applied are shown in Annex JA.

S Ti ○○○○ (Ti○○○○○○○○○○)

Chemical symbol of rod or wire (see table 1)¹⁾

Symbol for classification of rod or wire (see table 1)

Ti 01○○: Titanium classified by the mass fraction of oxygen²⁾

Ti 22○○: Titanium alloy with deliberately small addition of palladium or ruthenium with low oxygen

Ti 24○○: Titanium alloy with deliberately small addition of palladium or ruthenium but consists of a higher oxygen content

Ti 34○○: Titanium alloy which contains about 0.5 % (mass fraction) nickel

Ti 35○○: Titanium alloy which contains about 0.5 % (mass fraction) cobalt

Ti 46○○: Titanium alloy which contains about 6 % (mass fraction) aluminium, about 2 % (mass fraction) tin, about 4 % (mass fraction) zirconium and about 2 % (mass fraction) molybdenum

Ti 48○○: Titanium alloy which contains about 8 % (mass fraction) aluminium, about 1 % (mass fraction) vanadium, and about 1 % (mass fraction) molybdenum

Ti 51○○: Titanium alloy which contains about 5 % (mass fraction) aluminium, about 1 % (mass fraction) vanadium, about 1 % (mass fraction) tin, about 1 % (mass fraction) zirconium and about 1 % (mass fraction) molybdenum

Ti 52○○: Titanium alloy which contains about 5 % (mass fraction) aluminium and about 2.5 % (mass fraction) tin

Ti 63○○: Titanium alloy which contains about 3 % (mass fraction) aluminium and about 2.5 % (mass fraction) vanadium

Ti 64○○: Titanium alloy which contains about 6 % (mass fraction) aluminium and about 4 % (mass fraction) vanadium

S: Symbol indicating a rod or a wire

Notes ¹⁾ In addition to the symbol for classification (example: S Ti 6400), the chemical symbol (example: TiAl6V4) may be indicated [example: S Ti 6400 (TiAl6V4)].

²⁾ Titanium (S Ti 01○○) rods and wires are classified, as are the base metals to which they are applied, by the oxygen content, which affects the tensile strength of the rods and wires. The relationship between the oxygen content and tensile strength of base metals is shown in Annex JB.

5 Quality

5.1 Appearance of rods and wires

The appearance of rods and wires shall be in accordance with **JIS Z 3200**.

5.2 Chemical composition of rods and wires

The chemical composition of rods and wires, when tested by the chemical analysis described in clause 6, shall comply with the requirements in table 1.