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JIS Z 3316 : 2017

(JWES)

**Solid wires and rods for TIG
welding of mild steel, high strength
steel and low temperature service
steel**

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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) 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 3316**:2011 is replaced with this Standard.

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Solid wires and rods for TIG welding of mild steel, high strength steel and low temperature service steel

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 636**:2015, Edition 4 and **ISO 16834**:2012, Edition 2 with some modifications of the technical contents. **ISO 636** is a combined standard between **EN 1668** and the standard used around the Pacific Rim, and **ISO 16834** is a combined standard between **EN 12534** and the standard used around the Pacific Rim. Either or both of the standards may be applied to the specific global markets. Therefore this Standard gives requirements corresponding to the standards used in Pacific Rim (**ISO 636** System B and **ISO 16834** System B) in the text, excluding those for welding consumables used for weather-resistant steel, and MIG and MAG welding, and those corresponding to **EN 1668** (**ISO 636** System A) in Annex JA, and those corresponding to **EN 12534** (**ISO 16834** System A) in Annex JB for reference.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standards. A list of modifications with the explanations is given in Annex JC.

1 Scope

This Standard specifies solid rods and wires (hereafter generically referred to as filler metals) used for TIG welding of mild steel, high strength steel with a tensile strength in the range of 490 MPa to 830 MPa, and low temperature service steel.

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

ISO 636:2015 *Welding consumables—Rods, wires and deposits for tungsten inert gas welding of non-alloy and fine-grain steels—Classification*

ISO 16834:2012 *Welding consumables—Wire electrodes, wires, rods and deposits for gas shielded arc welding of high strength steels—Classification* (overall evaluation: MOD)

In addition, 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 G 0203 *Glossary of terms used in iron and steel (Products and quality)*

JIS G 0320 *Standard test method for heat analysis of steel products*

JIS G 0321 *Product analysis and its tolerance for wrought steel*

JIS G 3126 *Carbon steel plates for pressure vessels for low temperature service*

JIS G 3127 *Nickel steel plates for pressure vessels for low temperature services*

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 3111 *Methods of tension and impact tests for deposited metal*

NOTE : Corresponding International Standard: ISO 15792-1 *Welding consumables—Test methods—Part 1: Test methods for all-weld metal test specimens in steel, nickel and nickel alloys* (MOD)

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 filler materials and fluxes—Type of product, dimensions, tolerances and markings* (MOD)

JIS Z 3253 *Shielding gases for fusion welding and thermal cutting*

NOTE : Corresponding International Standard: ISO 14175 *Welding consumables—Gases and gas mixtures for fusion welding and allied processes* (MOD)

JIS Z 3423 *Procurement guidelines for welding consumables*

NOTE : Corresponding International Standard: ISO 14344 *Welding consumables—Procurement of filler materials and fluxes* (MOD)

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS G 0203**, **JIS Z 3001-1**, **JIS Z 3001-2** and the following apply.

3.1 solid rods

solid rods with homogenous cross-section

4 Classification and designation by symbols

The filler metals shall be classified according to tensile properties of deposited metal, post-weld heat-treated condition, impact test temperature of deposited metal, absorbed energy level of Charpy test and chemical composition of filler metal, and be designated as shown in Figure 1. However, the combination between mechanical properties (tensile properties and impact properties) of deposited metals and the chemical composition of filler metals shall be as given in Table 1.

One filler metal may have different symbols for mechanical properties of deposited metal, depending on the post-weld heat-treated condition.

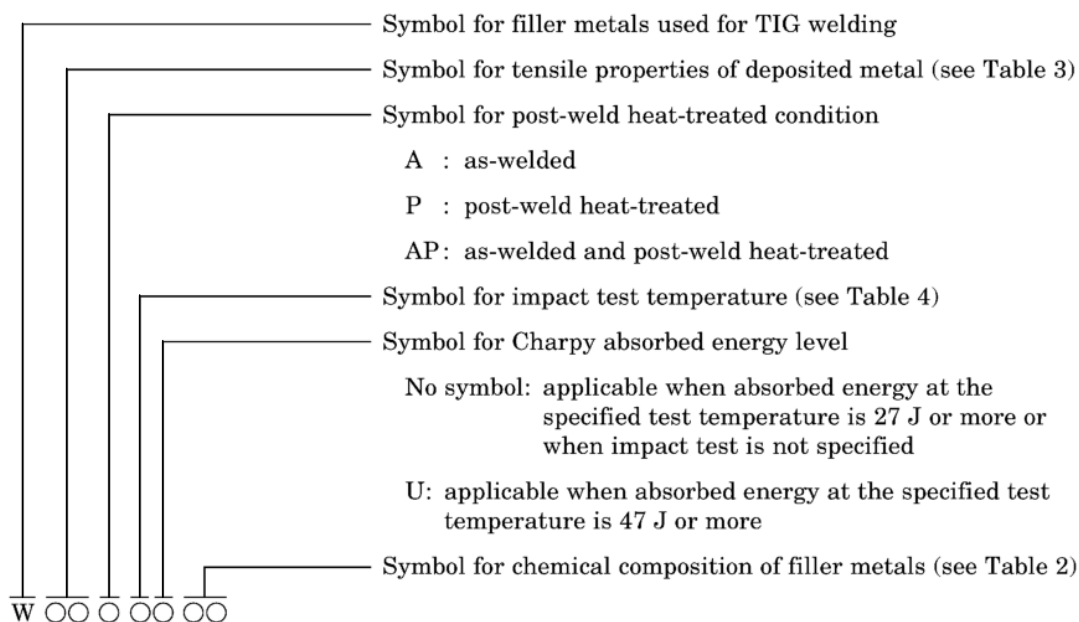


Figure 1 Designation of classification of filler metals

Table 1 Combination between mechanical properties of deposited metal and chemical composition of filler metals

Mechanical properties of deposited metal		Chemical composition of filler metals
Symbol for tensile properties given in Table 3	Symbol for impact test temperature given in Table 4	Symbol for chemical composition of filler metals given in Table 2
35, 43, 49, 55, 57	Y, 0, 2, 3, 4, 5, 6, 7, 8, 9, 10, Z	2, 3, 4, 6, 10, 12, 16, 1M3, 2M3, 2M31, 2M32, 3M3, 4M3, 3M1T, 4M31, 4M3T, N1, N2, N3, N5, N7, N71, N9, N1M2T, N1M3, N2M3, 0
59, 62, 69, 76, 78, 83	Y, 0, 2, 3, 4, 5, 6, Z	2M3, 3M3T, 3M31, 3M1, 3M3, 4M3, 3M1T, 4M31, 4M3T, N1M2T, N1M3, N2M1T, N2M2T, N2M3, N2M3T, N2M4T, N3M2, N3M2J, N4M2, N4M3T, N4M4T, N5M3, N5M3T, N7M4T, C1M1T, N3C1M4T, N4CM2T, N4CM21T, N4CM22T, N5CM3T, N5C1M3T, N6CM2T, N6C1M4, N6C2M2T, N6C2M4, N6CM3T, 0

5 Quality

5.1 Dimensions, dimensional tolerances and product condition of filler metals

The dimensions, dimensional tolerances and product condition of filler metals shall comply with **JIS Z 3200**.

5.2 Chemical composition of filler metals

For chemical composition of filler metals, the chemical analysis shall be performed according to the method in **6.2**, and the test result shall comply with Table 2.

Table 2 Chemical composition of filler metals

Unit: %

Symbol for chemical composition of filler metals	Chemical composition ^{a), b)}									
	C	Si	Mn	P	S	Ni	Cr	Mo	Cu ^{c)}	Others
2	0.07 max.	0.40 to 0.70	0.90 to 1.40	0.025 max.	0.035 max.	0.15 max.	0.15 max.	0.15 max.	0.50 max.	Ti 0.05 to 0.15 Zr 0.02 to 0.12 Al 0.05 to 0.15 V 0.03 max.
3	0.06 to 0.15	0.45 to 0.75	0.90 to 1.40	0.025 max.	0.035 max.	0.15 max.	0.15 max.	0.15 max.	0.50 max.	V 0.03 max.
4	0.07 to 0.15	0.65 to 0.85	1.00 to 1.50	0.025 max.	0.035 max.	0.15 max.	0.15 max.	0.15 max.	0.50 max.	V 0.03 max.
6	0.06 to 0.15	0.80 to 1.15	1.40 to 1.85	0.025 max.	0.035 max.	0.15 max.	0.15 max.	0.15 max.	0.50 max.	V 0.03 max.
10	0.02 max.	0.20 max.	0.70 max.	0.025 max.	0.025 max.	0.15 max.	0.15 max.	0.10 max.	0.50 max.	V 0.05 max.
12	0.02 to 0.15	0.55 to 1.00	1.25 to 1.90	0.030 max.	0.030 max.	—	—	—	0.50 max.	—
16	0.02 to 0.15	0.40 to 1.00	0.90 to 1.60	0.030 max.	0.030 max.	—	—	—	0.50 max.	—
1M3	0.12 max.	0.30 to 0.70	1.30 max.	0.025 max.	0.025 max.	0.20 max.	—	0.40 to 0.65	0.35 max.	—
2M3	0.12 max.	0.30 to 0.70	0.60 to 1.40	0.025 max.	0.025 max.	—	—	0.40 to 0.65	0.50 max.	—
2M31	0.12 max.	0.30 to 0.90	0.80 to 1.50	0.025 max.	0.025 max.	—	—	0.40 to 0.65	0.50 max.	—
2M32	0.05 max.	0.30 to 0.90	0.80 to 1.40	0.025 max.	0.025 max.	—	—	0.40 to 0.65	0.50 max.	—
3M1	0.05 to 0.15	0.40 to 1.00	1.40 to 2.10	0.025 max.	0.025 max.	—	—	0.10 to 0.45	0.50 max.	—
3M1T	0.12 max.	0.40 to 1.00	1.40 to 2.10	0.025 max.	0.025 max.	—	—	0.10 to 0.45	0.50 max.	Ti 0.02 to 0.30
3M3	0.12 max.	0.60 to 0.90	1.10 to 1.60	0.025 max.	0.025 max.	—	—	0.40 to 0.65	0.50 max.	—
3M31	0.12 max.	0.30 to 0.90	1.00 to 1.85	0.025 max.	0.025 max.	—	—	0.40 to 0.65	0.50 max.	—
3M3T	0.12 max.	0.40 to 1.00	1.00 to 1.80	0.025 max.	0.025 max.	—	—	0.40 to 0.65	0.50 max.	Ti 0.02 to 0.30
4M3	0.12 max.	0.30 max.	1.50 to 2.00	0.025 max.	0.025 max.	—	—	0.40 to 0.65	0.50 max.	—
4M31	0.07 to 0.12	0.50 to 0.80	1.60 to 2.10	0.025 max.	0.025 max.	—	—	0.40 to 0.60	0.50 max.	—
4M3T	0.12 max.	0.50 to 0.80	1.60 to 2.20	0.025 max.	0.025 max.	—	—	0.40 to 0.65	0.50 max.	Ti 0.02 to 0.30
N1	0.12 max.	0.20 to 0.50	1.25 max.	0.025 max.	0.025 max.	0.60 to 1.00	—	0.35 max.	0.35 max.	—
N2	0.12 max.	0.40 to 0.80	1.25 max.	0.025 max.	0.025 max.	0.80 to 1.10	0.15 max.	0.35 max.	0.35 max.	V 0.05 max.

Table 2 (continued)

Unit: %

Symbol for chemical composition of filler metals	Chemical composition ^{a), b)}									
	C	Si	Mn	P	S	Ni	Cr	Mo	Cu ^{c)}	Others
N3	0.12 max.	0.30 to 0.80	1.20 to 1.60	0.025 max.	0.025 max.	1.50 to 1.90	—	0.35 max.	0.35 max.	—
N5	0.12 max.	0.40 to 0.80	1.25 max.	0.025 max.	0.025 max.	2.00 to 2.75	—	—	0.35 max.	—
N7	0.12 max.	0.20 to 0.50	1.25 max.	0.025 max.	0.025 max.	3.00 to 3.75	—	0.35 max.	0.35 max.	—
N71	0.12 max.	0.40 to 0.80	1.25 max.	0.025 max.	0.025 max.	3.00 to 3.75	—	—	0.35 max.	—
N9	0.10 max.	0.50 max.	1.40 max.	0.025 max.	0.025 max.	4.00 to 4.75	—	0.35 max.	0.35 max.	—
N1M2T	0.12 max.	0.60 to 1.00	1.70 to 2.30	0.025 max.	0.025 max.	0.40 to 0.80	—	0.20 to 0.60	0.50 max.	Ti 0.02 to 0.30
N1M3	0.12 max.	0.20 to 0.80	1.00 to 1.80	0.025 max.	0.025 max.	0.30 to 0.90	—	0.40 to 0.65	0.50 max.	—
N2M1T	0.12 max.	0.30 to 0.80	1.10 to 1.90	0.025 max.	0.025 max.	0.80 to 1.60	—	0.10 to 0.45	0.50 max.	Ti 0.02 to 0.30
N2M2T	0.05 to 0.15	0.30 to 0.90	1.00 to 1.80	0.025 max.	0.025 max.	0.70 to 1.20	—	0.20 to 0.60	0.50 max.	Ti 0.02 to 0.30
N2M3	0.12 max.	0.30 max.	1.10 to 1.60	0.025 max.	0.025 max.	0.80 to 1.20	—	0.40 to 0.65	0.50 max.	—
N2M3T	0.05 to 0.15	0.30 to 0.90	1.40 to 2.10	0.025 max.	0.025 max.	0.70 to 1.20	—	0.40 to 0.65	0.50 max.	Ti 0.02 to 0.30
N2M4T	0.12 max.	0.50 to 1.00	1.70 to 2.30	0.025 max.	0.025 max.	0.80 to 1.30	—	0.55 to 0.85	0.50 max.	Ti 0.02 to 0.30
N3M2	0.08 max.	0.20 to 0.55	1.25 to 1.80	0.010 max.	0.010 max.	1.40 to 2.10	0.30 max.	0.25 to 0.55	0.25 max.	Ti 0.10 max. V 0.05 max. Zr 0.10 max. Al 0.10 max.
N3M2J	0.05 to 0.15	0.10 to 0.70	1.00 to 1.50	0.025 max.	0.025 max.	1.40 to 2.10	0.30 max.	0.25 to 0.55	0.40 max.	V 0.05 max.
N4M2	0.09 max.	0.20 to 0.55	1.40 to 1.80	0.010 max.	0.010 max.	1.90 to 2.60	0.50 max.	0.25 to 0.55	0.25 max.	Ti 0.10 max. V 0.04 max. Zr 0.10 max. Al 0.10 max.
N4M3T	0.12 max.	0.45 to 0.90	1.40 to 1.90	0.025 max.	0.025 max.	1.50 to 2.10	—	0.40 to 0.65	0.50 max.	Ti 0.01 to 0.30
N4M4T	0.12 max.	0.40 to 0.90	1.60 to 2.10	0.025 max.	0.025 max.	1.90 to 2.50	—	0.40 to 0.90	0.50 max.	Ti 0.02 to 0.30
N5M3	0.10 max.	0.25 to 0.60	1.40 to 1.80	0.010 max.	0.010 max.	2.00 to 2.80	0.60 max.	0.35 to 0.65	0.25 max.	Ti 0.10 max. V 0.03 max. Zr 0.10 max. Al 0.10 max.
N5M3T	0.12 max.	0.40 to 0.90	1.40 to 2.00	0.025 max.	0.025 max.	2.40 to 3.10	—	0.40 to 0.70	0.50 max.	Ti 0.02 to 0.30

Table 2 (concluded)

Unit: %

Symbol for chemical composition of filler metals	Chemical composition ^{a), b)}									
	C	Si	Mn	P	S	Ni	Cr	Mo	Cu ^{c)}	Others
N7M4T	0.12 max.	0.30 to 0.70	1.30 to 1.70	0.025 max.	0.025 max.	3.20 to 3.80	0.30 max.	0.60 to 0.90	0.50 max.	Ti 0.02 to 0.30
C1M1T	0.02 to 0.15	0.50 to 0.90	1.10 to 1.60	0.025 max.	0.025 max.	—	0.30 to 0.60	0.10 to 0.45	0.40 max.	Ti 0.02 to 0.30
N3C1M4T	0.12 max.	0.35 to 0.75	1.25 to 1.70	0.025 max.	0.025 max.	1.30 to 1.80	0.30 to 0.60	0.50 to 0.75	0.50 max.	Ti 0.02 to 0.30
N4CM2T	0.12 max.	0.20 to 0.60	1.30 to 1.80	0.025 max.	0.025 max.	1.50 to 2.10	0.20 to 0.50	0.30 to 0.60	0.50 max.	Ti 0.02 to 0.30
N4CM21T	0.12 max.	0.20 to 0.70	1.10 to 1.70	0.025 max.	0.025 max.	1.80 to 2.30	0.05 to 0.35	0.25 to 0.60	0.50 max.	Ti 0.02 to 0.30
N4CM22T	0.12 max.	0.65 to 0.95	1.90 to 2.40	0.025 max.	0.025 max.	2.00 to 2.30	0.10 to 0.30	0.35 to 0.55	0.50 max.	Ti 0.02 to 0.30
N5CM3T	0.12 max.	0.20 to 0.70	1.10 to 1.70	0.025 max.	0.025 max.	2.40 to 2.90	0.05 to 0.35	0.35 to 0.70	0.50 max.	Ti 0.02 to 0.30
N5C1M3T	0.12 max.	0.40 to 0.90	1.40 to 2.00	0.025 max.	0.025 max.	2.40 to 3.00	0.40 to 0.60	0.40 to 0.70	0.50 max.	Ti 0.02 to 0.30
N6CM2T	0.12 max.	0.30 to 0.60	1.50 to 1.80	0.025 max.	0.025 max.	2.80 to 3.00	0.05 to 0.30	0.25 to 0.50	0.50 max.	Ti 0.02 to 0.30
N6C1M4	0.12 max.	0.25 max.	0.90 to 1.40	0.025 max.	0.025 max.	2.65 to 3.15	0.20 to 0.50	0.55 to 0.85	0.50 max.	—
N6C2M2T	0.12 max.	0.20 to 0.50	1.50 to 1.90	0.025 max.	0.025 max.	2.50 to 3.10	0.70 to 1.00	0.30 to 0.60	0.50 max.	Ti 0.02 to 0.30
N6C2M4	0.12 max.	0.40 to 0.60	1.80 to 2.00	0.025 max.	0.025 max.	2.80 to 3.00	1.00 to 1.20	0.50 to 0.80	0.50 max.	Ti 0.04 max.
N6CM3T	0.12 max.	0.30 to 0.70	1.20 to 1.50	0.025 max.	0.025 max.	2.70 to 3.30	0.10 to 0.35	0.40 to 0.65	0.50 max.	Ti 0.02 to 0.30
0	As agreed between the purchaser and the manufacturer.									
Notes ^{a)} “—” means that the chemical composition is not specified. ^{b)} When the elements (excluding iron) not shown in this table are detected during the chemical analysis of filler metals (6.2) and <u>can be determined</u> , or when they are intentionally added, the total content shall not exceed 0.50 %. ^{c)} The copper content in any coating is included.										

5.3 Mechanical properties of deposited metal

The mechanical properties of deposited metal shall be as follows.

- For tensile strength, proof stress and elongation of deposited metal, the tensile test shall be performed according to 6.3, and the result shall comply with Table 3.
- For Charpy absorbed energy of deposited metal, the impact test shall be performed according to 6.3, and the result shall comply with Table 4.