

European standard

NF EN ISO 16834**October 2007**

French standard

Classification index: **A 81-326****ICS: 25.160.20**

Welding consumables

Wire electrodes, wires, rods and deposits for gas-shielded arc welding of high strength steels

Classification

F : Produits consommables pour le soudage — Fils-électrodes, fils, baguettes et dépôts pour le soudage à l'arc sous flux gazeux Vdes aciers à haute résistance — Classification
 D : Schweißzusätze — Drahtelektroden, Drähte, Stäbe und Schweißgut zum Schutzgasschweißen von hochfesten Stählen — Einteilung

French standard approved

by decision of the Director General of AFNOR on September 5, 2007 taking effect on October 5, 2007.

Replaces the approved standard NF EN 12534, dated October 1999.

Correspondence

The European standard EN ISO 16834:2007 has the status of French standard and reproduces in full the international standard ISO 16834:2006.

Analysis

This document specifies requirements for classification of wire electrodes, wires, rods and weld deposits in the as-welded condition and in the post-weld heat-treated (PWHT) condition for gas-shielded metal arc welding and tungsten inert-gas welding of high strength steels with a minimum yield strength greater than 500 MPa, or a minimum tensile strength greater than 570 MPa.

Descriptors

Technical International Thesaurus: arc welding, gas shielded welding, scale: corrosion, filler metal, classifications, symbols, specifications, elastic limit, tensile strength, elongation, flexural strength, chemical composition, mechanical tests, chemical analysis, delivery condition, designation.

Modifications

With respect to the document replaced, addition of a second classification approach founded on the standards used in the countries of the Pacific zone,

Corrections



National foreword

References to French standards

The correspondence between the standards figuring in the clause "Normative references" and the identical French standards is as follows:

<i>ISO 544</i>	<i>: NF EN ISO 544 (classification index: A 81-301)</i>
<i>ISO 13916</i>	<i>: NF EN ISO 13916 (classification index: A 89-253)</i>
<i>ISO 14344</i>	<i>: NF EN ISO 14344 (classification index: A 81-050)</i>

The correspondence between the standards figuring in the clause "Normative references" and French standards having the same scope, but which are not identical, is as follows:

<i>ISO 31-0</i>	<i>: NF X 02-001 and NF X 02-003</i>
<i>ISO 14175</i>	<i>: NF EN 439 (classification index: A 81-010)</i>
<i>ISO 15792-1</i>	<i>: NF EN 1597-1 (classification index: A 81-054-1)</i>



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 16834

February 2007

ICS 25.160.20

Supersedes EN 12534:1999

English Version

**Welding consumables - Wire electrodes, wires, rods and
deposits for gas-shielded arc welding of high strength steels -
Classification (ISO 16834:2006)**

Produits consommables pour le soudage - Fils-électrodes,
fils, baguettes et dépôts pour le soudage à l'arc sous flux
gazeux des aciers à haute résistance - Classification (ISO
16834:2006)

Schweißzusätze - Drahtelektroden, Drähte, Stäbe und
Schweißgut zum Schutzgasschweißen von hochfesten
Stählen - Einteilung (ISO 16834:2006)

This European Standard was approved by CEN on 21 January 2007.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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EN ISO 16834:2007 (E)

Foreword

The text of ISO 16834:2006 has been prepared by Technical Committee ISO/TC 44 "Welding and allied processes" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 16834:2007 by Technical Committee CEN/TC 121 "Welding" the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2007, and conflicting national standards shall be withdrawn at the latest by August 2007.

This document supersedes EN 12534:1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Endorsement notice

The text of ISO 16834:2006 has been approved by CEN as a EN ISO 16834:2007 without any modification.



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PUBLIC**

ISO 16834:2006(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16834 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 3, *Welding consumables*.



Introduction

This International Standard recognizes that there are two somewhat different approaches in the global market to classifying a given wire electrode, wire, rod or deposit, and allows for either or both to be used, to suit a particular market need. Application of either type of classification designation (or of both where suitable) identifies a product as classified in accordance with this International Standard. The classification in accordance with system A is mainly based on EN 12534, *Welding consumables — Wire electrodes, wires, rods and deposits for gas shielded metal arc welding of high strength steels — Classification*. The classification in accordance with system B is mainly based upon standards used around the Pacific Rim.

Future revisions will aim to merge the two systems into a single classification system.

This International Standard provides a classification in order to designate wire electrodes, wires, rods and deposits in terms of their chemical composition and, where required, in terms of the yield strength, tensile strength and elongation of the all-weld metal. The ratio of yield to tensile strength of weld metal is generally higher than that of the parent metal. Users should note that matching weld-metal yield strength to parent-metal yield strength will not necessarily ensure that the weld-metal tensile strength matches that of the parent material. Where the application requires matching tensile strength, therefore, selection of the consumable should be made by reference to column 3 of Table 1A or 1B.

It should be noted that the mechanical properties of all-weld metal test specimens used to classify the electrodes, wires and rods will vary from those obtained in production joints because of differences in welding procedure, such as electrode size, width of weave, welding position and material composition.

Requests for official interpretations of technical aspects of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 3 via the user's national standardization body; a listing of these bodies can be found at www.iso.org.





Welding consumables — Wire electrodes, wires, rods and deposits for gas-shielded arc welding of high strength steels — Classification

1 Scope

This International Standard specifies requirements for classification of wire electrodes, wires, rods and weld deposits in the as-welded condition and in the post-weld heat-treated (PWHT) condition for gas-shielded metal arc welding and tungsten inert-gas welding of high strength steels with a minimum yield strength greater than 500 MPa, or a minimum tensile strength greater than 570 MPa. One wire electrode can be tested and classified with different shielding gases.

This International Standard is a combined specification providing for classification utilizing a system based upon the yield strength and the average impact energy of 47 J of all-weld metal, or utilizing a system based upon the tensile strength and the average impact energy of 27 J of all-weld metal.

- a) Subclauses and Tables which carry the suffix letter “A” are applicable only to wire electrodes, wires, rods and deposits classified according to the system based upon the yield strength and the average impact energy of 47 J of all-weld metal under this International Standard.
- b) Subclauses and Tables which carry the suffix letter “B” are applicable only to wire electrodes, wires, rods and deposits classified according to the system based upon the tensile strength and the average impact energy of 27 J of all-weld metal under this International Standard.
- c) Subclauses and Tables which do not have either the suffix letter “A” or the suffix letter “B” are applicable to all wire electrodes, wires, rods and deposits classified under this International Standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 31-0:1992, *Quantities and units — Part 0: General principles*

ISO 544, *Welding consumables — Technical delivery conditions for welding filler materials — Type of product, dimensions, tolerances and markings*

ISO 13916, *Welding — Guidance on the measurement of preheating temperature, interpass temperature and preheat maintenance temperature*

ISO 14175, *Welding consumables — Shielding gases for arc welding and cutting*

ISO 14344, *Welding and allied processes — Flux and gas shielded electrical welding processes — Procurement guidelines for consumables*

ISO 15792-1:2000, *Welding consumables — Test methods — Part 1: Test methods for all-weld metal test specimens in steel, nickel and nickel alloys*

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3 Classification

Classification designations are based upon two approaches to indicate the tensile properties and the impact properties of the all-weld metal obtained with a given wire electrode, wire or rod. The two designation approaches include additional designators for some other classification requirements, but not all, as will be clear from the following clauses. In most cases, a given commercial product can be classified according to the classification requirements in both systems. Then either or both classification designations can be used for the product.

A wire electrode, wire or rod shall be classified in accordance with its chemical composition in Table 3A or Table 3B. A weld deposit shall be classified with additional symbols in accordance with the mechanical properties of its all-weld metal, using a shielding gas from a specific group.

3A Classification by yield strength and 47 J impact energy

The classification is divided into six parts:

- 1) the first part gives a symbol indicating the product/process to be identified;
- 2) the second part gives a symbol indicating the strength and elongation of all-weld metal (see Table 1A);
- 3) the third part gives a symbol indicating the impact properties of all-weld metal (see Table 2);
- 4) the fourth part gives a symbol indicating the shielding gas used (see 4.4);
- 5) the fifth part gives a symbol indicating the chemical composition of the wire electrode, wire and rod used (see Table 3A);
- 6) the sixth part gives a symbol indicating the post-weld heat treatment in case this is applied (see 4.6A).

3B Classification by tensile strength and 27 J impact energy

The classification is divided into five parts:

- 1) the first part gives a symbol indicating the product/process to be identified;
- 2) the second part gives a symbol indicating the strength and elongation of the all-weld metal in either the as-welded or post-weld heat-treated condition (see Table 1B);
- 3) the third part gives a symbol indicating the impact properties of all-weld metal in the same condition as specified for the tensile strength (see Table 2). The letter "U" after this designator indicates that the deposit meets an average optional requirement of 47 J at the designated Charpy test temperature;
- 4) the fourth part gives a symbol indicating the shielding gas used (see 4.4);
- 5) the fifth part gives a symbol indicating the chemical composition of the wire electrode, wire and rod used (see Table 3B).



4 Symbols and requirements

4.1 Symbol for the product/process

The symbol for the wire electrode, wire or rod used in the arc welding process shall be the letter G (gas-shielded metal arc welding) and/or W (tungsten inert gas welding).

4.2 Symbol for strength and elongation properties of all-weld metal

4A Classification by yield strength and 47 J impact energy

The symbol in Table 1A indicates yield strength, tensile strength and elongation of the all-weld metal in the as-welded condition determined in accordance with Clause 5.

Table 1A — Symbol for tensile properties of all-weld metal (Classification by yield strength and 47 J impact energy)

Symbol	Minimum yield ^a strength MPa	Tensile strength MPa	Minimum ^b elongation %
55	550	640 to 820	18
62	620	700 to 890	18
69	690	770 to 940	17
79	790	880 to 1 080	16
89	890	940 to 1 180	15
^a For yield strength, the lower yield (R_{el}) is used when yielding occurs, otherwise the 0,2 % proof strength ($R_{p0,2}$) is used. ^b Gauge length is equal to five times the test specimen diameter.			

4B Classification by tensile strength and 27 J impact energy

The symbol in Table 1B indicates yield strength, tensile strength and elongation of the all-weld metal in the as-welded condition or in the post-weld heat-treated condition determined in accordance with Clause 5.

Table 1B — Symbol for tensile properties of all-weld metal (Classification by tensile strength and 27 J impact energy)

Symbol ^a	Minimum yield ^b strength MPa	Tensile strength MPa	Minimum ^c elongation %
59X	490	590 to 790	16
62X	530	620 to 820	15
69X	600	690 to 890	14
76X	680	760 to 960	13
78X	680	780 to 980	13
83X	745	830 to 1 030	12
^a X is "A", "P" or "AP" (see 4.6B). ^b For yield strength, the lower yield (R_{el}) is used when yielding occurs, otherwise the 0,2 % proof strength ($R_{p0,2}$) is used. ^c Gauge length is equal to five times the test specimen diameter			

NOTE Post-weld heat treatment can alter the strength of the weld metal from that obtained in the as-welded condition.

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4.3 Symbol for impact properties of all-weld metal

4.3A Classification by yield strength and 47 J impact energy

The symbol in Table 2 indicates the temperature at which an impact energy of 47 J is achieved under the conditions given in Clause 5A. Three test specimens shall be tested. Only one individual value may be lower than 47 J but not lower than 32 J.

4.3B Classification by tensile strength and 27 J impact energy

The symbol in Table 2 indicates the temperature at which an impact energy of 27 J is achieved in the as-welded condition or in the post-weld heat-treated condition under the conditions given in Clause 5B. Five test specimens shall be tested. The lowest and highest values obtained shall be disregarded. Two of the three remaining values shall be greater than the specified 27 J level, one of the three may be lower but shall not be less than 20 J. The average of the three remaining values shall be at least 27 J. Three test specimens shall be tested when the optional supplemental designator "U" is used to indicate that the weld deposit will meet a minimum impact energy of 47 J at the test temperature. The impact value shall be determined by the average of the three test specimens. The average of three values shall be 47 J or greater.

When an all-weld metal or a welded joint has been classified for a certain temperature, it automatically covers any higher temperature in Table 2.

Table 2 — Symbol for impact properties of all-weld metal or welded joint

Symbol	Temperature for minimum average impact energy of 47 J ^{a, b} or 27 J ^b °C
Z	No requirements
A ^a or Y ^b	+ 20
0	0
2	– 20
3	– 30
4	– 40
5	– 50
6	– 60
^a See 4.3A.	
^b See 4.3B.	



4.4 Symbol for shielding gas

The symbols M, A and C indicate shielding gas as described in ISO 14175. No symbol shall be used for tungsten inert gas welding when argon shielding gas in accordance with ISO 14175 is used.

The symbol C shall be used when the classification has been performed with the shielding gas ISO 14175 - C1, carbon dioxide.

The symbol A shall be used when the classification has been performed with Ar + 1 to 5 % O₂.

The symbol G shall be used to indicate that some other shielding gas was used, as agreed between the purchaser and supplier.

4.4A Classification by yield strength and 47 J impact energy

The symbol M, for mixed gases, shall be used when the classification has been performed with the shielding gas ISO 14175 - M21, but without helium.

4.4B Classification by tensile strength and 27 J impact energy

The symbol M shall be used when the classification has been performed with the shielding gas ISO 14175 - M21, but restricted to Ar + 20 to 25 % CO₂, but without helium.

4.5 Symbol for the chemical composition of wire electrodes, wires and rods

The symbol in Table 3A or Table 3B indicates the chemical composition of the wire electrode, wire and rod and includes an indication of characteristic alloying elements.



Table 3A — Symbol for chemical composition (Classification by yield strength and 47 J impact energy)

Symbol	Chemical composition in % (mass fraction) ^{a, b}										
	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V	Total other elements
Z	Any other agreed composition										
Mn3NiCrMo	0,14	0,60 to 0,80	1,30 to 1,80	0,015	0,018	0,50 to 0,65	0,40 to 0,65	0,15 to 0,30	0,30	0,03	0,25
Mn3Ni1CrMo	0,12	0,40 to 0,70	1,30 to 1,80	0,015	0,018	1,20 to 1,60	0,20 to 0,40	0,20 to 0,30	0,35	0,05 to 0,13	0,25
Mn3Ni1Mo	0,12	0,40 to 0,80	1,30 to 1,90	0,015	0,018	0,80 to 1,30	0,15	0,25 to 0,65	0,30	0,03	0,25
Mn3Ni1,5Mo	0,08	0,20 to 0,60	1,30 to 1,80	0,015	0,018	1,40 to 2,10	0,15	0,25 to 0,55	0,30	0,03	0,25
Mn3Ni1Cu	0,12	0,20 to 0,60	1,20 to 1,80	0,015	0,018	0,80 to 1,25	0,15	0,20	0,30 to 0,65	0,03	0,25
Mn3Ni1MoCu	0,12	0,20 to 0,60	1,20 to 1,80	0,015	0,018	0,80 to 1,25	0,15	0,20 to 0,55	0,30 to 0,65	0,03	0,25
Mn3Ni2,5CrMo	0,12	0,40 to 0,70	1,30 to 1,80	0,015	0,018	2,30 to 2,80	0,20 to 0,60	0,30 to 0,65	0,30	0,03	0,25
Mn4Ni1Mo	0,12	0,50 to 0,80	1,60 to 2,10	0,015	0,018	0,80 to 1,25	0,15	0,20 to 0,55	0,30	0,03	0,25
Mn4Ni2Mo	0,12	0,25 to 0,60	1,60 to 2,10	0,015	0,018	2,00 to 2,60	0,15	0,30 to 0,65	0,30	0,03	0,25
Mn4Ni1,5CrMo	0,12	0,50 to 0,80	1,60 to 2,10	0,015	0,018	1,30 to 1,90	0,15 to 0,40	0,30 to 0,65	0,30	0,03	0,25
Mn4Ni2CrMo	0,12	0,60 to 0,90	1,60 to 2,10	0,015	0,018	1,80 to 2,30	0,20 to 0,45	0,45 to 0,70	0,30	0,03	0,25
Mn4Ni2,5CrMo	0,13	0,50 to 0,80	1,60 to 2,10	0,015	0,018	2,30 to 2,80	0,20 to 0,60	0,30 to 0,65	0,30	0,03	0,25
^a If not specified: Ti ≤ 0,10, Zr ≤ 0,10 and Al ≤ 0,12. The residual mass fraction of copper in the steel, including any coating, shall comply with the stated value. ^b Single values shown in this Table are maximum values.											



Table 3B – Symbol for chemical composition (Classification by tensile strength and 27 J impact energy)

Symbol	Chemical composition in % (mass fraction) ^{a, b}									
	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Ti
0	Any agreed analysis not specified in this International Standard									
2M3	0,12	0,30 to 0,70	0,60 to 1,40	0,025	0,025	—	—	0,40 to 0,65	0,50	—
3M1	0,05 to 0,15	0,40 to 1,00	1,40 to 2,10	0,025	0,025	—	—	0,10 to 0,45	0,50	—
3M1T	0,12	0,40 to 1,00	1,40 to 2,10	0,025	0,025	—	—	0,10 to 0,45	0,50	0,02 to 0,30
3M3	0,12	0,60 to 0,90	1,10 to 1,60	0,025	0,025	—	—	0,40 to 0,65	0,50	—
3M31	0,12	0,30 to 0,90	1,00 to 1,85	0,025	0,025	—	—	0,40 to 0,65	0,50	—
3M3T	0,12	0,40 to 1,00	1,00 to 1,80	0,025	0,025	—	—	0,40 to 0,65	0,50	0,02 to 0,30
4M3	0,12	0,30	1,50 to 2,00	0,025	0,025	—	—	0,40 to 0,65	0,50	—
4M31	0,05 to 0,15	0,50 to 0,80	1,60 to 2,10	0,025	0,025	—	—	0,40 to 0,65	0,40	—
4M3T	0,12	0,50 to 0,80	1,60 to 2,20	0,025	0,025	—	—	0,40 to 0,65	0,50	0,02 to 0,30
N1M2T	0,12	0,60 to 1,00	1,70 to 2,30	0,025	0,025	0,40 to 0,80	—	0,20 to 0,60	0,50	0,02 to 0,30
N1M3	0,12	0,20 to 0,80	1,00 to 1,80	0,025	0,025	0,30 to 0,90	—	0,40 to 0,65	0,50	—
N2M1T	0,12	0,30 to 0,80	1,10 to 1,90	0,025	0,025	0,80 to 1,60	—	0,10 to 0,45	0,50	0,02 to 0,30
N2M2T	0,05 to 0,15	0,30 to 0,90	1,00 to 1,80	0,025	0,025	0,70 to 1,20	—	0,20 to 0,60	0,50	0,02 to 0,30
N2M3	0,12	0,30	1,10 to 1,60	0,025	0,025	0,80 to 1,20	—	0,40 to 0,65	0,50	—
N2M3T	0,05 to 0,15	0,30 to 0,90	1,40 to 2,10	0,025	0,025	0,70 to 1,20	—	0,40 to 0,65	0,50	0,02 to 0,30
N2M4T	0,12	0,50 to 1,00	1,70 to 2,30	0,025	0,025	0,80 to 1,30	—	0,55 to 0,85	0,50	0,02 to 0,30
N3M2 ^c	0,08	0,20 to 0,55	1,25 to 1,80	0,010	0,010	1,40 to 2,10	0,30	0,25 to 0,55	0,25	0,10
N4M2 ^d	0,09	0,20 to 0,55	1,40 to 1,80	0,010	0,010	1,90 to 2,60	0,50	0,25 to 0,55	0,25	0,10
N4M3T	0,12	0,45 to 0,90	1,40 to 1,90	0,025	0,025	1,50 to 2,10	—	0,40 to 0,65	0,50	0,01 to 0,30
N4M4T	0,12	0,40 to 0,90	1,60 to 2,10	0,025	0,025	1,90 to 2,50	—	0,40 to 0,90	0,50	0,02 to 0,30
N5M3 ^e	0,10	0,25 to 0,60	1,40 to 1,80	0,010	0,010	2,00 to 2,80	0,60	0,35 to 0,65	0,25	0,10

Table 3B (continued)

Symbol	Chemical composition in % (mass fraction) ^{a, b}									
	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Ti
N5M3T	0,12	0,40 to 0,90	1,40 to 2,00	0,025	0,025	2,40 to 3,10	—	0,40 to 0,70	0,50	0,02 to 0,30
N7M4T	0,12	0,30 to 0,70	1,30 to 1,70	0,025	0,025	3,20 to 3,80	0,30	0,60 to 0,90	0,50	0,02 to 0,30
C1M1T	0,02 to 0,15	0,50 to 0,90	1,10 to 1,60	0,025	0,025	—	0,30 to 0,60	0,10 to 0,45	0,40	0,02 to 0,30
N3C1M4T	0,12	0,35 to 0,75	1,25 to 1,70	0,025	0,025	1,30 to 1,80	0,30 to 0,60	0,50 to 0,75	0,50	0,02 to 0,30
N4CM2T	0,12	0,20 to 0,60	1,30 to 1,80	0,025	0,025	1,50 to 2,10	0,20 to 0,50	0,30 to 0,60	0,50	0,02 to 0,30
N4CM21T	0,12	0,20 to 0,70	1,10 to 1,70	0,025	0,025	1,80 to 2,30	0,05 to 0,35	0,25 to 0,60	0,50	0,02 to 0,30
N4CM22T	0,12	0,65 to 0,95	1,90 to 2,40	0,025	0,025	2,00 to 2,30	0,10 to 0,30	0,35 to 0,55	0,50	0,02 to 0,30
N5CM3T	0,12	0,20 to 0,70	1,10 to 1,70	0,025	0,025	2,40 to 2,90	0,05 to 0,35	0,35 to 0,70	0,50	0,02 to 0,30
N5C1M3T	0,12	0,40 to 0,90	1,40 to 2,00	0,025	0,025	2,40 to 3,00	0,40 to 0,60	0,40 to 0,70	0,50	0,02 to 0,30
N6CM2T	0,12	0,30 to 0,60	1,50 to 1,80	0,025	0,025	2,80 to 3,00	0,05 to 0,30	0,25 to 0,50	0,50	0,02 to 0,30
N6C1M4	0,12	0,25	0,90 to 1,40	0,025	0,025	2,65 to 3,15	0,20 to 0,50	0,55 to 0,85	0,50	—
N6C2M2T	0,12	0,20 to 0,50	1,50 to 1,90	0,025	0,025	2,50 to 3,10	0,70 to 1,00	0,30 to 0,60	0,50	0,02 to 0,30
N6C2M4	0,12	0,40 to 0,60	1,80 to 2,00	0,025	0,025	2,80 to 3,00	1,00 to 1,20	0,50 to 0,80	0,50	0,04
N6CM3T	0,12	0,30 to 0,70	1,20 to 1,50	0,025	0,025	2,70 to 3,30	0,10 to 0,35	0,40 to 0,65	0,50	0,02 to 0,30
^a The total amount of the elements (excluding iron) which are not shown in this Table shall not exceed 0,50 %. ^b Single values shown in the Table and footnotes are maximum values. ^c V 0,05, Zr 0,10, Al 0,10 ^d V 0,04, Zr 0,10, Al 0,10 ^e V 0,03, Zr 0,10, Al 0,10										



4.6 Symbol for condition of post-weld heat treatment

4.6A Classification by yield strength and 47 J impact energy

The symbol T indicates that strength, elongation and impact properties in the classification of all-weld metal are obtained after a post-weld heat treatment. The post-weld heat-treated condition shall be as specified in 5.3A.

4.6B Classification by tensile strength and 27 J impact energy

The symbol A shall be added to the classification of the weld deposits classified in the as-welded condition. The symbol P shall be added to the classification for weld deposits classified in the post-weld heat-treated condition. Both symbols AP shall be added to the classification for weld deposits classified in both conditions.

4.7 Rounding-off procedure

For purposes of determining compliance with the requirements of this International Standard, the actual test values obtained shall be subjected to the rounding-off rules of ISO 31-0:1992, Annex B, Rule A. If the measured values are obtained by equipment calibrated in units other than those of this International Standard, the measured values shall be converted to the units of this International Standard before rounding off. If an average value is to be compared to the requirements of this International Standard, rounding off shall be done only after calculating the average. In the case where the testing standard cited in the normative references of this International Standard contains instructions for rounding off that conflict with the instructions of this International Standard, the rounding-off requirements of the testing standard shall apply. The rounded-off results shall fulfil the requirements of the appropriate table for the classification under test.

5 Mechanical tests

5A Classification by yield strength and 47 J impact energy

Tensile and impact tests shall be carried out in the as-welded condition or in the post-weld heat-treated condition using an all-weld metal test assembly type 1.3 in accordance with ISO 15792-1:2000, Table 1, using 1,2 mm diameter for gas-shielded electrodes, or test assembly type 1.1 in accordance with ISO 15792-1:2000, using 2,4 mm diameter for tungsten inert-gas welding rods or wires, and welding conditions and PWHT condition as described in 5.1A, 5.2A and 5.3A.

5B Classification by tensile strength and 27 J impact energy

Tensile and impact tests shall be carried out in the as-welded condition or in the post-weld heat-treated condition using an all-weld metal test assembly type 1.3 in accordance with ISO 15792-1:2000, Table 1, using 1,2 mm diameter for gas-shielded electrodes, or using test assembly type 1.1 and 2,4 mm diameter for tungsten inert-gas welding rods or wires, and welding conditions and PWHT condition as described in 5.1B, 5.2B, and 5.3B. If a 1,2 mm or 2,4 mm diameter is not manufactured, use the closest size at settings as recommended by the manufacturer.

5.1 Preheating and interpass temperatures

5.1A Classification by yield strength and 47 J impact energy

Welding of the all-weld metal test piece shall be executed in a temperature range from 120 °C to 180 °C, with the exception of the first layer in the test assembly, which may be welded without preheating.

5.1B Classification by tensile strength and 27 J impact energy

Preheating and interpass temperatures shall be selected for the appropriate weld metal type from Table 4B. The interpass temperature shall be measured using temperature-indicator crayons, surface thermometers or thermocouples (see ISO 13916).



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The interpass temperature shall be measured using temperature-indicator crayons, surface thermometers or thermocouples, see ISO 13916.

Welding shall continue until the assembly has reached the maximum interpass temperature given in Table 4B. If, after any pass, this interpass temperature is exceeded, the test assembly shall be cooled in air to a temperature within that range. If below interpass temperature, reheat into the interpass range.

Table 4B — Preheating and interpass temperatures

Symbol	Preheat temperature °C	Interpass temperature °C
G0 and W0	As agreed between purchaser and supplier	
Other symbols except for G0 and W0	Min. 100	150 ± 15

5.2 Welding conditions and pass sequence

5.2A Classification by yield strength and 47 J impact energy

The welding conditions shall be as indicated in Table 5A and the pass sequence as given in Table 6A. The direction of welding to complete a layer consisting of two passes shall not vary, but the direction of welding of layers shall be alternated.

Table 5A — Welding conditions

Process	Diameter mm	Welding current A	Welding voltage V	Contact tube distance mm	Travel speed mm/min
G	1,2	280 ± 10	^a	20 ± 3	450 ± 50
W	2,4	200 ± 20	^b	—	150 ± 15
^a The welding voltage will depend on the choice of shielding gas. ^b It is not possible to set the voltage on tungsten inert-gas (TIG) equipment.					

Table 6A — Pass sequence

Process	Diameter mm	Passes per layer	Number of layer
G	1,2	2 ^a	6 to 10
W	2,4	2 ^b	8 to 11
^a The top layer can be completed with 3 passes. ^b The top layer can be completed with 3 or 4 passes.			

5.2B Classification by tensile strength and 27 J impact energy

The welding conditions in Table 5B shall be used with the pass sequence in Table 6B. The direction of welding for each pass shall not vary. However, the direction of welding for different passes may be alternated.

Table 5B — Welding conditions

Process	Diameter mm	Welding current A	Welding voltage V	Contact tube distance mm	Travel speed mm/min
G	1,2	290 ± 30	^a	20 ± 3	330 ± 60
W	2,4	220 ± 30	^b	—	100 ± 30
^a The welding voltage will depend on the choice of shielding gas. ^b It is not possible to set the voltage on tungsten inert-gas (TIG) equipment.					

Table 6B — Pass sequence

Process	Diameter mm	Passes per layer	Number of layer
G	1,2	2 or 3	6 to 10
W	2,4	2 ^a	8 to 11
^a The top layer can be completed with 3 or 4 passes.			

5.3 Post-weld heat-treated condition

5.3A Classification by yield strength and 47 J impact energy

Test assemblies made with wire electrodes, wires, rods and deposits classified in the PWHT condition shall be heat treated at 560 °C to 600 °C for 1 h. The test assembly shall be left in the furnace for cooling down to 300 °C.

5.3B Classification by tensile strength and 27 J impact energy

Test assemblies made with wire electrodes, wires, rods and deposits classified in the PWHT condition shall be heat treated at 610 ± 25 °C for 1 h $+15 \min$. The furnace shall be at a temperature not higher than 300 °C when the test assembly is placed in it. The heating rate, from that point to the 610 ± 25 °C holding temperature, shall not exceed 220 °C per hour. When the holding time has been completed, the assembly shall be allowed to cool in the furnace to a temperature below 300 °C at a rate not exceeding 195 °C per hour. The assembly may be removed from the furnace at any temperature below 300 °C, and allowed to cool in still air to room temperature.

6 Chemical analysis

Chemical analysis shall be performed on specimens of the wire or rod. Any analytical technique may be used, but in case of dispute, reference shall be made to established published methods.

6A Classification by yield strength and 47 J impact energy

The results of chemical analysis shall fulfil the requirements given in Table 3A for the classification under test.

6B Classification by tensile strength and 27 J impact energy

The results of chemical analysis shall fulfil the requirements given in Table 3B for the classification under test.

7 Retest

If any test fails to meet the requirement, that test shall be repeated twice. The results of both retests shall meet the requirement. Specimens for the retest may be taken from the original test assembly or from a new test assembly. For chemical analysis, retests need be only for those specific elements that failed to meet their test requirement. If the results of one or both retests fail to meet the requirement, the material under test shall be considered as not meeting the requirements of this specification for that classification.

In the event that, during preparation or after completion of any test, it is clearly determined that prescribed or proper procedures were not followed in preparing the weld test assembly or test specimen(s), or in conducting the tests, the test shall be considered invalid, without regard to whether the test was actually completed, or whether the test results met, or failed to meet, the requirement. That test shall be repeated, following proper prescribed procedures. In this case, the requirement for doubling the number of test specimens does not apply.

8 Technical delivery conditions

Technical delivery conditions shall meet the requirements in ISO 544 and ISO 14344.



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9 Examples of designation

9A Classification by yield strength and 47 J impact energy

The designation of wire electrodes, wires, rods and deposits shall follow the principle given in the examples below:

EXAMPLE 1A

A weld deposit produced by gas-shielded metal arc welding (G) having a minimum yield strength of 620 MPa (62) and a minimum average impact energy of 47 J at – 60 °C (6) under mixed gas (M) using the wire Mn4Ni1Mo in the as-welded condition:

ISO 16834-A - G 62 6 M Mn4Ni1Mo

A wire electrode complying with the chemical requirement of Mn4Ni1Mo in Table 3A is designated:

ISO 16834-A - G Mn4Ni1Mo

where

ISO 16834-A = standard number, with classification by yield strength and 47 J impact energy;

G = wire electrode and/or deposit, gas-shielded metal arc welding (see 4.1);

62 = strength and elongation in the as-welded condition (see Table 1A);

6 = impact properties in the as-welded condition (see Table 2);

M = shielding gas (see 4.4);

Mn4Ni1Mo = chemical composition of the wire electrode (see Table 3A).

EXAMPLE 2A

A weld deposit by tungsten inert-gas welding (W) having a minimum yield strength of 550 MPa (55) and a minimum average impact energy of 47 J at – 60 °C (6) under argon shield using the wire/rod Mn4Ni1Mo in the post-weld heat-treated condition (T) is designated:

ISO 16834-A - W 55 6 Mn4Ni1Mo T

9B Classification by tensile strength and 27 J impact energy

The designation of the wire electrode, wires, rods and deposits shall follow the principle given in the example below:

EXAMPLE 1B

A weld deposit produced by gas-shielded metal arc welding (G) having a minimum tensile strength of 690 MPa (69) and a minimum average impact energy of 27 J at – 60 °C (6) under mixed gas (M) using the wire N2M3T in the as-welded condition (A) is designated:

ISO 16834-B - G 69A 6 M N2M3T

A wire electrode complying with the chemical requirement of N2M3T in Table 3B is designated:

ISO 16834-B - G N2M3T

where

ISO 16834-B = standard number, with classification by tensile strength and 27 J impact energy;

G = wire electrode and/or deposit, gas-shielded metal arc welding (see 4.1);

69A = strength and elongation in the as-welded condition (see Table 1B);

6 = impact properties in the as-welded condition (see Table 2);

M = shielding gas (see 4.4);

N2M3T = chemical composition of the wire electrode (see Table 3B).

EXAMPLE 2B

A weld deposit by tungsten inert-gas welding (W) having a minimum tensile strength of 620 MPa (62) and a minimum average impact energy of 27 J at – 60 °C (6) under argon shield using the wire/rod N2M3 in the post-weld heat-treated condition (P) is designated

ISO 16834-B - W 62P 6 N2M3

A wire/rod complying with the chemical requirement of Mn4Ni1Mo in Table 3 is designated:

ISO 16834-A - W Mn4Ni1Mo

where

ISO 16834-A = standard number, with classification by yield strength and 47 J impact energy;

W = wire/rod and/or deposit, tungsten inert-gas welding process (see 4.1);

55 = strength and elongation (see Table 1A);
6 = impact properties (see Table 2);

Mn4Ni1Mo = chemical composition of the wire/rod (see Table 3A);

T = post-weld heat-treated condition (see 4.6).

A wire/rod complying with the chemical requirement of N2M3 in Table 3 is designated:

ISO 16834-B - W N2M3

where

ISO 16834-B = standard number, with classification by tensile strength and 27 J impact energy;

W = wire electrode and/or deposit, tungsten inert-gas welding process (see 4.1);

62P = strength and elongation in the post-weld heat-treated condition (see Table 1B);

6 = impact properties in the post-weld heat-treated condition (see Table 2);

N2M3 = chemical composition of the wire/rod (see Table 3B).

EXAMPLE 3B

A weld deposit by tungsten inert gas welding (W) having a minimum tensile strength of 620 MPa (62) and a minimum average impact energy of 47 J at – 20 °C (2) under argon shield using the wire/rod 2M3 in the as-welded condition (A) is designated:

ISO 16834-B - W 62A 2U 2M3

A wire/rod complying with the chemical requirement of 2M3 in Table 3 is designated:

ISO 16834-B - W 2M3

where

ISO 16834-B = standard number, with classification by tensile strength and 27 J impact energy

W = wire electrode and/or deposit, tungsten inert-gas welding process (see 4.1);

62A = strength and elongation in the as-welded condition (see Table 1B);

2U = impact properties in the as-welded condition, also meeting 47 J at the indicated test temperature (see 3B 3) and Table 2);

2M3 = chemical composition of the wire/rod (see Table 3B).

