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Welding consumables — Covered electrodes for manual metal arc welding of stainless and heat-resisting steels — Classification

Produits consommables pour le soudage — Électrodes enrobées pour le soudage manuel à l'arc des aciers inoxydables et résistant aux températures élevées — Classification

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 3, *Welding consumables*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 3581:2016), which has been technically revised.

The main changes are as follows:

— the document has been updated in accordance with the drafting guidelines laid out in the ISO House Style;

— the dates of normative references have been updated to show their latest editions;

— a new Clause 3 (Terms and definitions) has been added in accordance with the standard structure of ISO documents;

— “weld metal recovery” now reads “nominal electrode efficiency” throughout, in accordance with ISO 2401;

— a new Table 2 has been added listing classification systems;

— new alloys have been added to Table 3 (formerly Table 2) and associated clauses of the document;

— the chemical compositions of several alloys have been updated in Table 3 (formerly Table 2);

— certain alloys have been reclassified in Table 3 (formerly Table 2);

— a new footnote was added to Table 3 (formerly Table 2) regarding Co content;

— the wording of Clause 9 (formerly Clause 8) has been updated.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html. Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html.

Introduction

This document provides a classification system for covered electrodes for manual metal arc welding of stainless and heat-resisting steels in terms of chemical composition of deposited weld metal and type of electrode covering. Other properties of the electrodes are specified by reference to tables.

This document recognizes that there are two somewhat different approaches in the global market for classifying a given covered electrode for arc welding of stainless steel. It allows for either or both to be used to suit a particular need. Application of either (or both) type(s) of classification designation identifies a product as classified according to this document. It is important to note that the two systems are not exactly equivalent; therefore, each system is to be used independently of the other, without combining designators in any way.

The classification according to nominal composition (system A) is mainly based on EN 1600. The classification according to alloy type (system B) is mainly based on standards used around the Pacific Rim.

Welding consumables — Covered electrodes for manual metal arc welding of stainless and heat-resisting steels — Classification

1 Scope

This document specifies requirements for classification of covered electrodes, based on the all-weld metal chemical composition, the type of electrode covering and other electrode properties, and the all-weld metal mechanical properties, in the as-welded or heat-treated conditions, for manual metal arc welding of stainless and heat-resisting steels.

This document is a combined standard providing for classification utilizing a system based upon classification according to nominal composition or utilizing a system based upon classification according to alloy type.

a) Paragraphs and tables which carry the label "classification according to nominal composition-A" or "ISO 3581-A" are applicable only to products classified to that system.

b) Paragraphs and tables which carry the label "classification according to alloy type-B" or "ISO 3581-B" are applicable only to products classified to that system.

c) Paragraphs and tables which carry neither label are applicable to products classified according to either or both systems.

Annex B gives information on considerations on weld metal ferrite content.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 544, *Welding consumables — Technical delivery conditions for filler materials and fluxes — Type of product, dimensions, tolerances and markings*

ISO 6847, *Welding consumables — Deposition of a weld metal pad for chemical analysis*

ISO 14344, *Welding consumables — Procurement of filler materials and fluxes*

ISO 15792-1:2020, *Welding consumables — Test methods — Part 1: Preparation of all-weld metal test pieces and specimens in steel, nickel and nickel alloys*

ISO 15792-3, *Welding consumables — Test methods — Part 3: Classification testing of positional capacity and root penetration of welding consumables in a fillet weld*

ISO 80000-1:2022, *Quantities and units — Part 1: General*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Classification

4.1 General

Classification designations are based upon two approaches for indicating the chemical composition of the all-weld metal deposit obtained with a given electrode.

The "nominal composition ISO 3581-A" approach uses designation components directly indicating the nominal levels of certain alloying elements, given in a particular order, and some symbols for low but significant levels of other elements, whose levels are not conveniently expressed as integers.

The "alloy type ISO 3581-B" approach uses tradition-based three-digit or four-digit designations for alloy families, and occasionally an additional character or characters for compositional modifications of each original alloy within the family.

Both designation approaches include additional designators for some other classification requirements, but not entirely the same classification requirements, as explained in the following clauses.

Table 1 lists the tests required for classification of an electrode under each approach.

In many cases, a given commercial product can be classified using both approaches. Then, either or both classification designations can be used for the product.

Table 1 — Summary of test requirements

Electrode designation		Size[a] mm	Position of welding[b]					
			Chemical analysis test		All-weld metal tension test		Fillet weld test	
ISO 3581-A	ISO 3581-B		ISO 3581-A	ISO 3581-B	ISO 3581-A	ISO 3581-B	ISO 3581-A	ISO 3581-B
Coating type symbol B and position symbols 1 and 2	Position and coating type symbol – 15	2,5 (or 2,4 or 2,6)	Not required	PA	Not required	Not required	Not required	Not required
		3,2 or 3,0	PA	PA	Not required	Not required	Not required	Not required
		4,0	PA	PA	PA	PA	Not required	PB, PF, PD
		5,0 or 4,8	Not required	PA	Not required	Not required	Not required	PB
		6,0 (or 5,6 or 6,4)	Not required	PA	Not required	Not required	Not required	PB

[a] If the size is not manufactured, the next nearest size may be substituted (provided that the substituted size is different from that specified in this table).

[b] The abbreviations PA, PB, PD, PF and PG indicate welding positions in accordance with ISO 6947:2019:

PA flat

PB horizontal vertical

PD horizontal overhead

PF vertical up

PG vertical down

Table 1 *(continued)*

Electrode designation		Size[a] mm	Position of welding[b]					
			Chemical analysis test		All-weld metal tension test		Fillet weld test	
ISO 3581-A	ISO 3581-B		ISO 3581-A	ISO 3581-B	ISO 3581-A	ISO 3581-B	ISO 3581-A	ISO 3581-B
All coating types and position symbol 3	Not applicable	3,2 or 3,0	PA	Not applicable	Not required	Not applicable	Not required	Not applicable
		4,0	PA		PA		Not required	
		5,0 or 4,8	Not required		Not required		Not required	
All coating types and position symbol 4	Position symbol – 4 and all coating types	2,5 (or 2,4 or 2,6)	Not required	PA	Not required	Not required	Not required	PG
		3,2 or 3,0	PA	PA	Not required	Not required	Not required	PG
		4,0	PA	PA	PA	PA	Not required	PG
		5,0 or 4,8	Not required	PA	Not required	Not required	Not required	PG
All coating types and position symbol 5	Not applicable	3,2 (or 3,0)	PA	Not applicable	Not required	Not applicable	Not required	Not applicable
		4,0	PA		PA		Not required	
		5,0 (or 4,8)	Not required		Not required		Not required	
Coating type symbol R and position symbols 1 and 2	Position and coating type symbols – 16 and – – 17	2,5 (or 2,4 or 2,6)	Not required	PA	Not required	Not required	Not required	Not required
		3,2 (or 3,0)	PA	PA	Not required	Not required	Not required	Not required
		4,0	PA	PA	PA	PA	Not required	PB, PF, PD
		5,0 (or 4,8)	Not required	PA	Not required	Not required	Not required	PB
		6,0 (or 5,6 or 6,4)	Not required	PA	Not required	Not required	Not required	PB

[a] If the size is not manufactured, the next nearest size may be substituted (provided that the substituted size is different from that specified in this table).

[b] The abbreviations PA, PB, PD, PF and PG indicate welding positions in accordance with ISO 6947:2019:

PA flat

PB horizontal vertical

PD horizontal overhead

PF vertical up

PG vertical down

Table 1 *(continued)*

Electrode designation		Size[a] mm	Position of welding[b]					
			Chemical analysis test		All-weld metal tension test		Fillet weld test	
ISO 3581-A	ISO 3581-B		ISO 3581-A	ISO 3581-B	ISO 3581-A	ISO 3581-B	ISO 3581-A	ISO 3581-B
Not applicable	Position and coating type symbols – 26 and – 27	2,5 (or 2,4 or 2,6)	Not applicable	PA	Not applicable	Not required	Not applicable	Not required
		3,2 (or 3,0)		PA		Not required		Not required
		4,0		PA		PA		PB
		5,0 (or 4,8)		PA		Not required		PB
		6,0 (or 5,6 or 6,4)		PA		Not required		PB

[a] If the size is not manufactured, the next nearest size may be substituted (provided that the substituted size is different from that specified in this table).

[b] The abbreviations PA, PB, PD, PF and PG indicate welding positions in accordance with ISO 6947:2019:

PA flat

PB horizontal vertical

PD horizontal overhead

PF vertical up

PG vertical down

4.2 Classification systems

4.2.1 General

Table 2 gives the requirements for classification according to:

— nominal composition — ISO 3581-A, and

— alloy type — ISO 3581-B.

NOTE The composition of the core wire, which can be substantially different from the weld metal composition, is not considered a classification criterion.

Table 2 — Classification systems

Classification according to:	
Nominal composition — ISO 3581-A	**Alloy type — ISO 3581-B**
The classification is divided into five parts:	The classification is divided into four parts:
1) a symbol indicating the product or process to be identified (see 5.1)	1) a symbol indicating the product or process to be identified (see 5.1)
2) a symbol indicating the chemical composition of all-weld metal (see Table 3)	2) a symbol indicating the chemical composition of all-weld metal (see Table 3)
3) a symbol indicating the type of electrode covering (see 5.3)	3) a symbol indicating the welding position (see Table 6)
4) a symbol indicating the nominal electrode efficiency, R_N, and type of current (see Table 5)	4) a symbol indicating the type of electrode covering. This also serves to specify the type of current which can be used with the electrode classified (see 5.2.3)
5) a symbol indicating the welding position (see Table 6)	

4.2.2 Classification: nominal composition — A

This classification includes all-weld metal properties obtained with a covered electrode as follows. The classification is based on an electrode diameter of 4 mm, with the exception of testing for welding position. When 4-mm-diameter electrodes are not manufactured, the next closest diameter shall be tested.

Classification according to nominal composition is split into two sections.

— Compulsory section: includes the symbols for the type of product, the chemical composition, and the type of covering, i.e. symbols in accordance with 5.1 and 5.2.

— Optional section: includes the symbols for the nominal electrode efficiency, R_N, (see ISO 2401) the type of current, and the welding positions for which the electrode is suitable, i.e. the symbols in accordance with 5.4 and Table 5.

The full designation (compulsory and optional sections, as applicable) shall be used on packages and in the manufacturer's literature and data sheets.

4.2.3 Classification: alloy type — B

This classification includes all-weld metal properties obtained with a covered electrode as follows. The classification is based on an electrode diameter of 4 mm for mechanical properties, with the exception of testing for welding position and for chemical analysis of the weld metal. When 4-mm-diameter electrodes are not manufactured, the next closest diameter shall be tested. In classifying welding electrodes according to alloy type, the symbols for all four parts (product or process, alloy type, welding position and type of electrode covering) in accordance with 5.1, 5.2 and 5.4 are compulsory.

The full designation shall be used on packages and in the manufacturer's literature and data sheets.

5 Symbols and requirements

5.1 Symbol for the product or process

5.1.1 Classification according to nominal composition — A

The symbol for a covered electrode using the manual metal arc welding process for stainless and heat-resisting steels in accordance with ISO 3581-A shall be the letter E.

5.1.2 Classification according to alloy type — B

The symbol for a covered electrode using the manual metal arc welding process for stainless and heat-resisting steels in accordance with ISO 3581-B shall be the letters ES. The initial letter “E” indicates a covered electrode while the letter “S” indicates stainless and heat-resisting steels.

5.1.3 Symbol for the chemical composition of all-weld metal

The symbols in Table 3 indicate the chemical composition of all-weld metal determined in accordance with Clause 6. The all-weld metal obtained with the covered electrodes in Table 3, in accordance with Clause 7, shall also fulfil the mechanical property requirements for that electrode as specified in Table 4.

A symbol classification in parentheses indicates a near match in the other designation system, but not an exact match. The correct designation for a given composition is the one without parentheses. A given product may, by having a more restricted chemical composition that fulfils both sets of requirements, be assigned both designations independently, provided that the mechanical property requirements are met.

5.2 Symbol for type of electrode covering

5.2.1 General

The type of electrode covering determines, to a large extent, usability characteristics of the electrode and properties of the weld metal. See Annex A for information on coating types.

5.2.2 Classification according to nominal composition — A

The following two symbols are used to describe the type of covering:

— B denotes a basic covering;

— R denotes a rutile-based covering.

5.2.3 Classification according to alloy type — B

The following three symbols are used to specify the type of covering on the electrode:

— 5 denotes a basic covering intended for DC welding;

— 6 denotes a rutile-based coating intended for DC or AC welding (except that position and coating type −46 is DC);

— 7 denotes a modified rutile-based coating containing a considerable amount of silica, intended for DC or AC welding (except that position and coating type −47 is DC).

Table 3 — Chemical composition requirements

Symbol classification by:		Chemical composition [a,b,c] % (by mass)											
Nominal composition [d,e] (ISO 3581-A)	**Alloy type** [e] (ISO 3581-B)	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Nb + Ta	N	Other specified elements [f]
Martensitic and ferritic types													
—	409Nb	0,12	1,0	1,00	0,04	0,03	11,0 to 14,0	0,6	0,75	0,75	0,50 to 1,50	—	—
13	(410)[e]	0,12	1,0	1,5	0,030	0,025	11,0 to 14,0	0,60	0,75	0,75	—	—	—
(13)[e]	410	0,12	0,90	1,0	0,04	0,03	11,0 to 14,0	0,7	0,75	0,75	—	—	—
13 4	(410NiMo)[e]	0,06	1,0	1,5	0,030	0,025	11,0 to 14,5	3,0 to 5,0	0,4 to 1,0	0,75	—	—	—
(13 4)[e]	410NiMo	0,06	0,90	1,0	0,04	0,03	11,0 to 12,5	4,0 to 5,0	0,40 to 0,70	0,75	—	—	—
17	(430)[e]	0,12	1,0	1,5	0,030	0,025	16,0 to 18,0	0,60	0,75	0,75	—	—	—
(17)[e]	430	0,10	0,90	1,0	0,04	0,03	15,0 to 18,0	0,6	0,75	0,75	—	—	—
—	430Nb	0,10	1,0	1,00	0,04	0,03	15,0 to 18,0	0,6	0,75	0,75	0,50 to 1,50	—	—
Austenitic types													
—	209	0,06	1,00	4,0 to 7,0	0,04	0,03	20,5 to 24,0	9,5 to 12,0	1,5 to 3,0	0,75	—	0,10 to 0,30	V 0,10 to 0,30
—	219	0,06	1,00	8,0 to 10,0	0,04	0,03	19,0 to 21,5	5,5 to 7,0	0,75	0,75	—	0,10 to 0,30	—
—	240	0,06	1,00	10,5 to 13,5	0,04	0,03	17,0 to 19,0	4,0 to 6,0	0,75	0,75	—	0,10 to 0,30	—
19 9	(308)[e]	0,08	1,2	2,0	0,030	0,025	18,0 to 21,0	9,0 to 11,0	0,75	0,75	—	—	—
(19 9)[e]	308	0,08	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 11,0	0,75	0,75	—	—	—

Table 3 *(continued)*

Symbol classification by:		Chemical composition [a,b,c] % (by mass)											
Nominal composition [d,e] (ISO 3581-A)	**Alloy type** [e] (ISO 3581-B)	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Nb + Ta	N	Other specified elements [f]
19 9 H	(308H)[e]	0,04 to 0,08	1,2	2,0	0,03	0,025	18,0 to 21,0	9,0 to 11,0	0,75	0,75	—	—	—
(19 9 H)[e]	308H	0,04 to 0,08	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 11,0	0,75	0,75	—	—	—
19 9 L	(308L)[e]	0,04	1,2	2,0	0,030	0,025	18,0 to 21,0	9,0 to 11,0	0,75	0,75	—	—	—
(19 9 L)[e]	308L	0,04	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 11,0	0,75	0,75	—	—	—
19 9 N L	308LN	0,035	0,90	0,5 to 2,0	0,025	0,025	18,00 to 21,00	9,00 to 11,00	0,50	0,75	—	0,06 to 0,10	—
(20 10 3)[e]	308Mo	0,08	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 12,0	2,0 to 3,0	0,75	—	—	—
—	308LMo	0,04	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 12,0	2,0 to 3,0	0,75	—	—	—
—	308N	0,10	0,90	1,0 to 4,0	0,04	0,03	21,0 to 25,0	7,0 to 10,0	—	—	—	0,12 to 0,30	—
—	349	0,13	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	8,0 to 10,0	0,35 to 0,65	0,75	0,75 to 1,20	—	V 0,10 to 0,30 Ti 0,15 W 1,25 to 1,75
19 9 Nb	(347)[e]	0,08	1,2	2,0	0,030	0,025	18,0 to 21,0	9,0 to 11,0	0,75	0,75	8 × C to 1,1	—	—
(19 9 Nb)[e]	347	0,08	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 11,0	0,75	0,75	8 × C to 1,00	—	—
—	347L	0,04	1,00	0,5 to 2,5	0,040	0,030	18,0 to 21,0	9,0 to 11,0	0,75	0,75	8 × C to 1,00	—	—
19 12 2	(316)[e]	0,08	1,2	2,0	0,030	0,025	17,0 to 20,0	10,0 to 13,0	2,0 to 3,0	0,75	—	—	—

Table 3 *(continued)*

Symbol classification by:		Chemical composition [a,b,c] % (by mass)											
Nominal composition [d,e] (ISO 3581-A)	**Alloy type** [e] (ISO 3581-B)	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Nb + Ta	N	Other specified elements [f]
(19 12 2)[e]	316	0,08	1,00	0,5 to 2,5	0,04	0,03	17,0 to 20,0	11,0 to 14,0	2,0 to 3,0	0,75	—	—	—
(19 12 2)[e]	316H	0,04 to 0,08	1,00	0,5 to 2,5	0,04	0,03	17,0 to 20,0	11,0 to 14,0	2,0 to 3,0	0,75	—	—	—
(19 12 3 L)[e]	316L	0,04	1,00	0,5 to 2,5	0,04	0,03	17,0 to 20,0	11,0 to 14,0	2,0 to 3,0	0,75	—	—	—
19 12 3 L	(316L)[e]	0,04	1,2	2,0	0,030	0,025	17,0 to 20,0	10,0 to 13,0	2,5 to 3,0	0,75	—	—	—
19 12 3 N L	316LN	0,035	0,90	0,5 to 2,0	0,025	0,025	18,0 to 20,0	12,0 to 13,0	2,5 to 3,0	0,75	—	0,06 to 0,10	Co 0,20
—	316LCu	0,04	1,00	0,5 to 2,5	0,040	0,030	17,0 to 20,0	11,0 to 16,0	1,20 to 2,75	1,00 to 2,50	—	—	—
—	316LMn	0,04	0,90	5,0 to 8,0	0,04	0,03	18,0 to 21,0	15,0 to 18,0	2,5 to 3,5	0,75	—	0,10 to 0,25	—
—	317	0,08	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	12,0 to 14,0	3,0 to 4,0	0,75	—	—	—
—	317L	0,04	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	12,0 to 14,0	3,0 to 4,0	0,75	—	—	—
19 12 3 Nb	(318)[e]	0,08	1,2	2,0	0,030	0,025	17,0 to 20,0	10,0 to 13,0	2,5 to 3,0	0,75	8 × C to 1,1	—	—
(19 12 3 Nb)[e]	318	0,08	1,00	0,5 to 2,5	0,04	0,03	17,0 to 20,0	11,0 to 14,0	2,0 to 3,0	0,75	6 × C to 1,00	—	—
19 13 4 N L	—	0,04	1,2	1,0 to 5,0	0,030	0,025	17,0 to 20,0	12,0 to 15,0	3,0 to 4,5	0,75	—	0,20	—
—	320	0,07	0,60	0,5 to 2,5	0,04	0,03	19,0 to 21,0	32,0 to 36,0	2,0 to 3,0	3,0 to 4,0	8 × C to 1,00	—	—
—	320LR	0,03	0,30	1,50 to 2,50	0,020	0,015	19,0 to 21,0	32,0 to 36,0	2,0 to 3,0	3,0 to 4,0	8 × C to 0,40	—	—

Table 3 *(continued)*

Symbol classification by:		Chemical composition [a,b,c] % (by mass)											
Nominal composition [d,e] (ISO 3581-A)	**Alloy type** [e] (ISO 3581-B)	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Nb + Ta	N	Other specified elements [f]
Ferritic-austenitic types, sometimes referred to as austenitic-ferritic types													
22 9 3 N L	(2209)[e]	0,04	1,2	2,5	0,030	0,025	21,0 to 24,0	7,5 to 10,5	2,5 to 4,0	0,75	—	0,08 to 0,20	—
(22 9 3 N L)[e]	2209	0,04	1,00	0,5 to 2,0	0,04	0,03	21,5 to 23,5	8,5 to 10,5	2,5 to 3,5	0,75	—	0,08 to 0,20	—
23 7 N L	2307	0,04	1,0	0,4 to 1,5	0,030	0,020	22,5 to 25,5	6,5 to 10,0	0,8	0,50	—	0,10 to 0,20	—
25 7 2 N L[d]	—	0,04	1,2	2,0	0,035	0,025	24,0 to 28,0	6,0 to 8,0	1,0 to 3,0	0,75	—	0,20	—
25 9 3 Cu N L	(2593)[e]	0,04	1,2	2,5	0,030	0,025	24,0 to 27,0	7,5 to 10,5	2,5 to 4,0	1,5 to 3,5	—	0,10 to 0,25	—
(25 9 3 Cu N L)[e]	2593	0,04	1,00	0,5 to 1,5	0,04	0,03	24,0 to 27,0	8,5 to 10,5	2,9 to 3,9	1,5 to 3,0	—	0,08 to 0,25	—
25 9 4 N L[d]	(2595)[e]	0,04	1,2	2,5	0,030	0,025	24,0 to 27,0	8,0 to 11,0	2,5 to 4,5	1,5	—	0,20 to 0,30	W 1,0
(25 9 4 N L)[e]	2595	0,04	1,2	2,5	0,03	0,025	24,0 to 27,0	8,0 to 10,5	2,5 to 4,5	0,4 to 1,5	—	0,20 to 0,30	W 0,4 to 1,0
—	2594	0,04	1,00	0,5 to 2,0	0,04	0,03	24,0 to 27,0	8,0 to 10,5	3,5 to 4,5	0,75	—	0,20 to 0,30	—
25 9 4 W N L	2594W	0,04	1,0	0,5 to 2,5	0,04	0,03	23,0 to 27,0	8,0 to 11,0	3,0 to 4,5	1,0	—	0,08 to 0,30	W 2,5
—	2553	0,06	1,00	0,5 to 1,5	0,04	0,03	24,0 to 27,0	6,5 to 8,5	2,9 to 3,9	1,5 to 2,5	—	0,10 to 0,25	—
Fully austenitic types													
—	33-31	0,03	0,9	2,5 to 4,0	0,02	0,01	31,0 to 35,0	30,0 to 32,0	1,0 to 2,0	0,4 to 0,8	—	0,3 to 0,5	—
—	383	0,03	0,90	0,5 to 2,5	0,02	0,02	26,5 to 29,0	30,0 to 33,0	3,2 to 4,2	0,6 to 1,5	—	—	—

Table 3 *(continued)*

Symbol classification by:		Chemical composition [a,b,c] % (by mass)											
Nominal composition [d,e] (ISO 3581-A)	**Alloy type** [e] (ISO 3581-B)	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Nb + Ta	N	Other specified elements [f]
(20 25 5 Cu N L)[e]	385	0,03	0,90	1,0 to 2,5	0,03	0,02	19,5 to 21,5	24,0 to 26,0	4,2 to 5,2	1,2 to 2,0	—	—	—
18 15 3 L	—	0,04	1,2	1,0 to 4,0	0,030	0,025	16,5 to 19,5	14,0 to 17,0	2,5 to 3,5	0,75	—	—	—
18 16 5 N L[d]	—	0,04	1,2	1,0 to 4,0	0,035	0,025	17,0 to 20,0	15,5 to 19,0	3,5 to 5,0	0,75	—	0,20	—
20 25 5 Cu N L	(385)[e]	0,04	1,2	1,0 to 4,0	0,030	0,025	19,0 to 22,0	24,0 to 27,0	4,0 to 7,0	1,0 to 2,0	—	0,25	—
20 16 3 Mn N L[d]	—	0,04	1,2	5,0 to 8,0	0,035	0,025	18,0 to 21,0	15,0 to 18,0	2,5 to 3,5	0,75	—	0,20	—
25 22 2 N L	—	0,04	1,2	1,0 to 5,0	0,030	0,025	24,0 to 27,0	20,0 to 23,0	2,0 to 3,0	0,75	—	0,20	—
27 31 4 Cu L	—	0,04	1,2	2,5	0,030	0,025	26,0 to 29,0	30,0 to 33,0	3,0 to 4,5	0,6 to 1,5	—	—	—
—	3155	0,10	1,00	1,0 to 2,5	0,04	0,03	20,0 to 22,5	19,0 to 21,0	2,5 to 3,5	0,75	0,75 to 1,25	—	Co 18,5 to 21,0 W 2,0 to 3,0
Special types, often used for dissimilar metal joining													
18 8 Mn[d]	—	0,20	1,2	4,5 to 7,5	0,035	0,025	17,0 to 20,0	7,0 to 10,0	0,75	0,75	—	—	—
18 9 Mn Mo[d]	(307)[e]	0,04 to 0,14	1,2	3,0 to 5,0	0,035	0,025	18,0 to 21,5	9,0 to 11,0	0,5 to 1,5	0,75	—	—	—
(18 9 Mn Mo)[e]	307	0,04 to 0,14	1,00	3,30 to 4,75	0,04	0,03	18,0 to 21,5	9,0 to 10,7	0,5 to 1,5	0,75	—	—	—
20 10 3	(308Mo)[e]	0,10	1,2	2,5	0,030	0,025	18,0 to 21,0	9,0 to 12,0	1,5 to 3,5	0,75	—	—	—
22 12	(309)[e]	0,15	1,2	2,5	0,030	0,025	20,0 to 23,0	10,0 to 13,0	0,75	0,75	—	—	—

Table 3 *(continued)*

Symbol classification by:		Chemical composition [a,b,c] % (by mass)											
Nominal composition [d,e] (ISO 3581-A)	**Alloy type** [e] (ISO 3581-B)	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Nb + Ta	N	Other specified elements [f]
(22 12)[e]	309	0,15	1,00	0,5 to 2,5	0,04	0,03	22,0 to 25,0	12,0 to 14,0	0,75	0,75	—	—	—
23 12 L	(309L)[e]	0,04	1,2	2,5	0,030	0,025	22,0 to 25,0	11,0 to 14,0	0,75	0,75	—	—	—
(23 12 L)[e]	309L	0,04	1,00	0,5 to 2,5	0,04	0,03	22,0 to 25,0	12,0 to 14,0	0,75	0,75	—	—	—
23 12 Nb	(309Nb)[e]	0,10	1,2	2,5	0,030	0,025	22,0 to 25,0	11,0 to 14,0	0,75	0,75	8 × C to 1,1	—	—
—	309LNb	0,04	1,00	0,5 to 2,5	0,040	0,030	22,0 to 25,0	12,0 to 14,0	0,75	0,75	0,70 to 1,00	—	—
(23 12 Nb)[e]	309Nb	0,12	1,00	0,5 to 2,5	0,04	0,03	22,0 to 25,0	12,0 to 14,0	0,75	0,75	0,70 to 1,00	—	—
—	309Mo	0,12	1,00	0,5 to 2,5	0,04	0,03	22,0 to 25,0	12,0 to 14,0	2,0 to 3,0	0,75	—	—	—
23 12 2 L	(309LMo)[e]	0,04	1,2	2,5	0,030	0,025	22,0 to 25,0	11,0 to 14,0	2,0 to 3,0	0,75	—	—	—
(23 12 2 L)[e]	309LMo	0,04	1,00	0,5 to 2,5	0,04	0,03	22,0 to 25,0	12,0 to 14,0	2,0 to 3,0	0,75	—	—	—
29 9[d]	(312)[e]	0,15	1,2	2,5	0,035	0,025	27,0 to 31,0	8,0 to 12,0	0,75	0,75	—	—	—
(29 9)[e]	312	0,15	1,00	0,5 to 2,5	0,04	0,03	28,0 to 32,0	8,0 to 10,5	0,75	0,75	—	—	—
Heat-resisting types													
16 8 2	(16-8-2)[e]	0,08	0,60	2,5	0,030	0,025	14,5 to 16,5	7,5 to 9,5	1,5 to 2,5	0,75	—	—	—
(16 8 2)[e]	16-8-2	0,10	0,60	0,5 to 2,5	0,03	0,03	14,5 to 16,5	7,5 to 9,5	1,0 to 2,0	0,75	—	—	—
21 10 N	—	0,06 to 0,09	1,0 to 2,0	0,3 to 1,0	0,02	0,01	20,5 to 22,5	9,5 to 11,0	0,5	0,3	—	0,10 to 0,20	Ce 0,05

Table 3 *(continued)*

Symbol classification by:		Chemical composition [a,b,c] % (by mass)											
Nominal composition [d,e] (ISO 3581-A)	**Alloy type** [e] (ISO 3581-B)	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Nb + Ta	N	Other specified elements [f]
25 4	—	0,15	1,2	2,5	0,030	0,025	24,0 to 27,0	4,0 to 6,0	0,75	0,75	—	—	—
(22 12)[e]	309H	0,04 to 0,15	1,00	0,5 to 2,5	0,04	0,03	22,0 to 25,0	12,0 to 14,0	0,75	0,75	—	—	—
25 20	(310)[e]	0,06 to 0,20	1,2	1,0 to 5,0	0,030	0,025	23,0 to 27,0	18,0 to 22,0	0,75	0,75	—	—	—
(25 20)[e]	310	0,08 to 0,20	0,75	1,0 to 2,5	0,03	0,03	25,0 to 28,0	20,0 to 22,5	0,75	0,75	—	—	—
25 20 H	(310H)[e]	0,35 to 0,45	1,2	2,5	0,030	0,025	23,0 to 27,0	18,0 to 22,0	0,75	0,75	—	—	—
(25 20 H)[e]	310H	0,35 to 0,45	0,75	1,0 to 2,5	0,03	0,03	25,0 to 28,0	20,0 to 22,5	0,75	0,75	—	—	—
—	310Nb	0,12	0,75	1,0 to 2,5	0,03	0,03	25,0 to 28,0	20,0 to 22,0	0,75	0,75	0,70 to 1,00	—	—
—	310Mo	0,12	0,75	1,0 to 2,5	0,03	0,03	25,0 to 28,0	20,0 to 22,0	2,0 to 3,0	0,75	—	—	—
18 36	(330)[e]	0,25	1,2	2,5	0,030	0,025	14,0 to 18,0	33,0 to 37,0	0,75	0,75	—	—	—
(18 36)[e]	330	0,18 to 0,25	1,00	1,0 to 2,5	0,04	0,03	14,0 to 17,0	33,0 to 37,0	0,75	0,75	—	—	—
—	330H	0,35 to 0,45	1,00	1,0 to 2,5	0,04	0,03	14,0 to 17,0	33,0 to 37,0	0,75	0,75	—	—	—
Precipitation hardening type													
—	630	0,05	0,75	0,25 to 0,75	0,04	0,03	16,00 to 16,75	4,5 to 5,0	0,75	3,25 to 4,00	0,15 to 0,30	—	—
Others not listed above													
	Z [g]	Any other agreed composition											

Table 3 *(continued)*

Symbol classification by:		**Chemical composition** [a,b,c] % (by mass)											
Nominal composition [d,e] (ISO 3581-A)	**Alloy type** [e] (ISO 3581-B)	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Nb + Ta	N	Other specified elements [f]

[a] Single values shown in this table are maximum values.

[b] Analysis shall be made for the elements for which specific values are shown in this table. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis shall be made in order to determine that the total of these other elements, except iron, is not present in excess of 0,50 %.

[c] For alloys intended for high temperature, Bi should be restricted to 20 parts per million (ppm) maximum.

[d] The sum of P and S values may not exceed 0,050 %, except for 25 7 2 N L; 18 16 5 N L; 20 16 3 Mn N L; 18 8 Mn; 18 9 Mn Mo and 29 9.

[e] A symbol classification in parentheses indicates a near match in the other designation system, but not an exact match. The correct designation for a given composition is the one without parentheses. A given product may, by having a more restricted chemical composition that fulfils both sets of requirements, be assigned both designations independently, provided that the mechanical property requirements are met.

[f] Cobalt (Co) value is 0,5 maximum, unless otherwise specified.

[g] Consumables for which the chemical composition is not listed shall be symbolized similarly and prefixed by the letter Z. The chemical composition ranges are not specified and it is possible that two electrodes with the same Z classification are not interchangeable.

Table 4 — Mechanical property requirements

Nominal composition (ISO 3581-A)	Alloy type (ISO 3581-B)	Minimum proof strength $R_{p0,2}$ MPa	Minimum tensile strength R_m MPa	Minimum elongation[a] %	Post weld heat treatment
—	409Nb	—	450	13	760 °C to 790 °C for 2 h[b]
13	(410)	250	450	15	840 °C to 870 °C for 2 h[c]
(13)	410	—	520	15	730 °C to 760 °C for 1 h[d]
13 4	(410NiMo)	500	750	15	580 °C to 620 °C for 2 h[e]
(13 4)	410NiMo	—	760	10	595 °C to 620 °C for 1 h[e]
17	(430)	300	450	15	760 °C to 790 °C for 2 h[c]
(17)	430	—	450	15	760 °C to 790 °C for 2 h[b]
—	430Nb	—	450	13	760 °C to 790 °C for 2 h[b]
19 9	(308)	350	550	30	none
(19 9)	308	—	550	25	none
19 9 H	(308H)	350	550	30	none
(19 9 H)	308H	—	550	25	none
19 9 L	(308L)	320	510	30	none
(19 9 L)	308L	—	520	25	none
19 9 N L	308LN	210	520 to 670	30	none
—	308Mo	—	550	25	none
—	308LMo	—	520	25	none
—	308N	—	690	20	none
—	349	—	690	23	none
19 9 Nb	(347)	350	550	25	none
(19 9 Nb)	347	—	520	25	none
—	347L	—	510	25	none
19 12 2	(316)	350	550	25	none
(19 12 2)	316	—	520	25	none
—	316H	—	520	25	none
19 12 3 L	(316L)	320	510	25	none

NOTE All-weld metal can have elongation and toughness values that are lower than those of the parent metal.

[a] Gauge length is equal to five times the test specimen diameter.

[b] Furnace cooling at a rate not exceeding 55 °C/h down to 595 °C then air cooling to ambient.

[c] Furnace cooling down to 600 °C then air cooling.

[d] Furnace cooling at a rate not exceeding 110 °C/h down to 315 °C then air cooling to ambient.

[e] Air cooling.

[f] These electrodes have high carbon in the all-weld metal for service at high temperatures. Room temperature elongation has little relevance to such applications.

[g] Air cool to ambient, followed by precipitation hardening at 610 °C to 630 °C for 4 h then air cool to ambient.

Table 4 *(continued)*

Nominal composition (ISO 3581-A)	Alloy type (ISO 3581-B)	Minimum proof strength $R_{p0,2}$ MPa	Minimum tensile strength R_m MPa	Minimum elongation[a] %	Post weld heat treatment
(19 12 3 L)	316L	—	490	25	none
19 12 3 N L	316LN	210	520 to 670	30	none
—	316LCu	—	510	25	none
—	316LMn	—	550	15	none
—	317	—	550	20	none
—	317L	—	520	20	none
19 12 3 Nb	(318)	350	550	25	none
(19 12 3 Nb)	318	—	550	20	none
19 13 4 N L	—	350	550	25	none
—	320	—	550	28	none
—	320LR	—	520	28	none
22 9 3 N L	(2209)	450	550	20	none
(22 9 3 N L)	2209	—	690	15	none
—	2307	—	690	15	none
23 7 N L	—	450	570	20	none
25 7 2 N L	—	500	700	15	none
25 9 3 Cu N L	—	550	620	18	none
25 9 4 N L	—	550	620	18	none
—	2594	—	760	10	none
25 9 4 W N L	2594W	—	690	15	none
—	2553	—	760	13	none
—	2593	—	760	13	none
—	2595	—	760	10	none
—	3155	—	690	15	none
—	33-31	—	720	20	none
18 15 3 L	—	300	480	25	none
18 16 5 N L	—	300	480	25	none
20 25 5 Cu N L	—	320	510	25	none
20 16 3 Mn N L	—	320	510	25	none
21 10 N	—	350	550	30	none
25 22 2 N L	—	320	510	25	none
27 31 4 Cu L	—	240	500	25	none

NOTE All-weld metal can have elongation and toughness values that are lower than those of the parent metal.

[a] Gauge length is equal to five times the test specimen diameter.

[b] Furnace cooling at a rate not exceeding 55 °C/h down to 595 °C then air cooling to ambient.

[c] Furnace cooling down to 600 °C then air cooling.

[d] Furnace cooling at a rate not exceeding 110 °C/h down to 315 °C then air cooling to ambient.

[e] Air cooling.

[f] These electrodes have high carbon in the all-weld metal for service at high temperatures. Room temperature elongation has little relevance to such applications.

[g] Air cool to ambient, followed by precipitation hardening at 610 °C to 630 °C for 4 h then air cool to ambient.

Table 4 *(continued)*

Nominal composition (ISO 3581-A)	Alloy type (ISO 3581-B)	Minimum proof strength $R_{p0,2}$ MPa	Minimum tensile strength R_m MPa	Minimum elongation[a] %	Post weld heat treatment
18 8 Mn	—	350	500	25	none
18 9 Mn Mo	(307)	350	500	25	none
(18 9 Mn Mo)	307	—	590	25	none
20 10 3	—	400	620	20	none
—	309	—	550	25	none
23 12 L	(309L)	320	510	25	none
(23 12 L)	309L	—	520	25	none
23 12 Nb	(309Nb)	350	550	25	none
—	309H	—	550	25	none
(23 12 Nb)	309Nb	—	550	25	none
—	309Mo	—	550	25	none
23 12 2 L	(309LMo)	350	550	25	none
(23 12 2 L)	309LMo	—	520	25	none
—	309LNb	—	510	25	none
29 9	(312)	450	650	15	none
(29 9)	312	—	660	15	none
16 8 2	(16-8-2)	320	510	25	none
(16 8 2)	16-8-2	—	550	25	none
25 4	—	400	600	15	none
—	209	—	690	15	none
—	219	—	620	15	none
—	240	—	690	15	none
22 12	—	350	550	25	none
25 20	(310)	350	550	20	none
(25 20)	310	—	550	25	none
25 20 H	(310H)	350	550	10[f]	none
(25 20 H)	310H	—	620	8	none
—	310Nb	—	550	23	none
—	310Mo	—	550	28	none
18 36	(330)	350	510	10[f]	none
(18 36)	330	—	520	23	none
—	330H	—	620	8	none

NOTE All-weld metal can have elongation and toughness values that are lower than those of the parent metal.

[a] Gauge length is equal to five times the test specimen diameter.

[b] Furnace cooling at a rate not exceeding 55 °C/h down to 595 °C then air cooling to ambient.

[c] Furnace cooling down to 600 °C then air cooling.

[d] Furnace cooling at a rate not exceeding 110 °C/h down to 315 °C then air cooling to ambient.

[e] Air cooling.

[f] These electrodes have high carbon in the all-weld metal for service at high temperatures. Room temperature elongation has little relevance to such applications.

[g] Air cool to ambient, followed by precipitation hardening at 610 °C to 630 °C for 4 h then air cool to ambient.

Table 4 *(continued)*

Nominal composition (ISO 3581-A)	Alloy type (ISO 3581-B)	Minimum proof strength $R_{p0,2}$ MPa	Minimum tensile strength R_m MPa	Minimum elongation[a] %	Post weld heat treatment
—	383	—	520	28	none
—	385	—	520	28	none
—	630	—	930	6	1 025 °C to 1 050 °C for 1 h[g]

NOTE All-weld metal can have elongation and toughness values that are lower than those of the parent metal.

[a] Gauge length is equal to five times the test specimen diameter.

[b] Furnace cooling at a rate not exceeding 55 °C/h down to 595 °C then air cooling to ambient.

[c] Furnace cooling down to 600 °C then air cooling.

[d] Furnace cooling at a rate not exceeding 110 °C/h down to 315 °C then air cooling to ambient.

[e] Air cooling.

[f] These electrodes have high carbon in the all-weld metal for service at high temperatures. Room temperature elongation has little relevance to such applications.

[g] Air cool to ambient, followed by precipitation hardening at 610 °C to 630 °C for 4 h then air cool to ambient.

5.3 Symbol for nominal electrode efficiency and type of current

5.3.1 Classification according to nominal composition — A

The symbols in Table 5 indicate the nominal electrode efficiency, R_N, determined in accordance with ISO 2401, with the type of current shown in the table.

Table 5 — Symbol for nominal electrode efficiency and type of current: ISO 3581-A

Symbol	Nominal electrode efficiency R_N %	Type of current[a]
1	≤105	AC and DC
2	≤105	DC
3	>105 but ≤125	AC and DC
4	>105 but ≤125	DC
5	>125 but ≤160	AC and DC
6	>125 but ≤160	DC
7	>160	AC and DC
8	>160	DC

[a] In order to demonstrate AC operability, tests shall be carried out with no load voltages no higher than 65 V.

Key

AC alternating current

DC direct current

5.3.2 Classification according to alloy type — B

No specific symbol is used to indicate nominal electrode efficiency in this classification system. The type of current is included in the coating type, as given in 5.2.3.

5.4 Symbol for welding position

The symbols for welding position shall be as shown in Table 6.

The symbol for alloy type B in Table 6 shall be determined in accordance with Clause 8.

Table 6 — Symbol for welding position

Classification according to:			
Nominal composition — A		Alloy type — B	
Symbol	Welding positions[a]	Symbol	Welding positions[a]
1	PA, PB, PD, PF, PG	–1	PA, PB, PD, PF
2	PA, PB, PD, PF	–2	PA, PB
3	PA, PB	–4	PA, PB, PD, PF, PG
4	PA		
5	PA, PB, PG		

[a] Welding positions in accordance with ISO 6947:2019:

PA flat position

PB horizontal vertical position

PD horizontal overhead position

PF vertical up position

PG vertical down position

6 Chemical analysis

Chemical analysis is performed on any suitable all-weld metal test specimen. In case of dispute, the test specimen specified in ISO 6847 shall be used. The test results shall meet the requirements of Table 3 for the classification under test.

Any analytical technique may be used, but in case of dispute, reference shall be made to established published methods.

7 Mechanical property tests

7.1 General

Tensile tests and any required retests shall be carried out in the condition specified in Table 4 (as-welded or after post-weld heat treatment). Using the welding conditions given in 7.2 and 7.3, an all-weld metal test assembly type 1.3 shall be prepared in accordance with ISO 15792-1:2020.

7.2 Preheat and interpass temperatures

The preheat and interpass temperatures shall be selected for the appropriate type of weld metal as shown in Table 7.

Table 7 — Preheat and interpass temperatures

Classification according to:					
Nominal composition — A			Alloy type — B		
Alloy symbol	Type of weld metal	Preheat and interpass temperature °C	Alloy symbol	Type of weld metal	Preheat and interpass temperature °C
13 17	Martensitic and ferritic chromium stainless steel	200 to 300	410	Martensitic and ferritic chromium stainless steel	200 to 300
13 4	Soft martensitic stainless steel	100 to 180	409Nb 430 430Nb		150 to 260
All others	Austenitic and duplex ferritic-austenitic stainless steel	150 max.	410NiMo 630	Soft martensitic stainless steel	100 to 260
			All others	Austenitic and duplex ferritic-austenitic stainless steel	150 max.

The interpass temperature shall be measured using temperature-indicating crayons, surface thermometers or thermocouples (see ISO 13916) measured at the mid-point of the assembly approximately 25 mm from the groove edge.

The interpass temperature shall not exceed the temperature indicated in Table 7. If, after any pass, the interpass temperature is exceeded, the test assembly shall be cooled in air to a temperature below that limit.

7.3 Pass sequence

For a 4-mm-diameter electrode and test plate type 1.3 in accordance with ISO 15792-1:2020, the pass sequence shall be two passes per layer. The number of layers shall be limited to a range of seven to nine.

The direction of welding to complete a pass shall not vary. Each pass shall be welded with a welding current of 70 % to 90 % of the maximum current recommended by the manufacturer.

Regardless of the type of covering, welding shall be performed with alternating current when both alternating current and direct current are recommended and with direct current with electrode positive when only direct current is recommended.

8 Fillet weld test

For classification according to alloy type — B, the fillet weld test assembly shall be in accordance with ISO 15792-3. The fillet weld test plate thickness, *t*, and required test results are specified in Table 8. The nominal test plate length, *l*, shall be 250 mm and the nominal test plate width, *w*, shall be 50 mm.

For classification according to nominal composition the fillet weld test is not required.

Table 8 — Fillet weld test plate thickness and test results required (classification according to alloy type — B)

ISO 3581-B symbols for position and coating type	Electrode diameter mm	Type of current	Nominal plate thickness *t* mm	Test position	Fillet size (length of leg) (maximum) mm	Maximum leg length difference[b] mm	Maximum convexity mm
–15	4,0	DC+	6 or 8 or 10	PF	8,0	—	2,0
	4,0		6 or 8 or 10	PB and PD	6,0	1,5	1,5
	4,8 or 5,0		10	PB	8,0	1,5	2,0
	5,6 or 6,0 or 6,4		10	PB	10,0	2,0	2,0
–16	4,0	AC	6 or 8 or 10	PF	8,0	—	2,0
	4,0		6 or 8 or 10	PB and PD	6,0	1,5	1,5
	4,8 or 5,0		10	PB	8,0	1,5	2,0
	5,6 or 6,0 or 6,4		10	PB	10,0	2,0	2,0
–17	4,0	AC	6 or 8 or 10	PF	12,0	—	2,0
	4,0		6 or 8 or 10	PB and PD	8,0	1,5	1,5
	4,8 or 5,0		10	PB	8,0	1,5	2,0
	5,6 or 6,0 or 6,4		10	PB	10,0	2,0	2,0
–25	4,0	DC+	10 or 12	PB	8,0	1,5	1,5
	4,8 or 5,0				8,0	1,5	2,0
	5,6 or 6,0 or 6,4				10,0	2,0	2,0
–26 or –27	4,0	AC	10 or 12	PB	8,0	1,5	1,5
	4,8 or 5,0				8,0	1,5	2,0
	5,6 or 6,0 or 6,4				10,0	2,0	2,0
–45, –46 or –47	2,4 or 2,5	DC+	6 or 8 or 10	PG	5,0	—	2,0[a]
	3,0 or 3,2			PG	6,0		3,0[a]
	4,0			PG	8,0		4,0[a]
	4,8 or 5,0			PG	10,0		5,0[a]

[a] Maximum concavity.

[b] A dash means no maximum leg length difference specified.

9 Rounding procedure

Actual test values obtained shall be subject to ISO 80000-1:2022, B.3, Rule A. If the measured values are obtained by equipment calibrated in units other than those of this document, the measured values shall be converted to the units of this document before rounding. If an average value is to be compared to the requirements of this document, rounding shall be done only after calculating the average. The rounded results shall fulfil the requirements of the appropriate table for the classification under test.

10 Retests

If any test fails to meet the requirements, that test shall be repeated twice. The results of both retests shall meet the requirements. 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.

11 Technical delivery conditions

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

12 Examples of designation

12.1 General

The designation of covered electrodes shall follow the principles given in 12.2, 12.3 or 12.4.

12.2 Example 1: classification according to nominal composition — A

The following example describes classification according to nominal composition — A.

A covered electrode (E) for manual metal arc welding deposits weld metal with a chemical composition of 19 % Cr, 12 % Ni and 2 % Mo (19 12 2 in Table 3). The electrode has a rutile covering (R) and can be used with alternating current or direct current with a nominal electrode efficiency of 120 % (3) in flat butt and flat fillet welds (4). It is designated as follows:

ISO 3581-A - E 19 12 2 R 3 4

Compulsory section:

ISO 3581-A - E 19 12 2 R

where

ISO 3581	is the International Standard number, with A indicating classification according to nominal composition;
E	is the covered electrode for manual metal arc welding (see 5.1.1);
19 12 2	is the chemical composition of all-weld metal (see Table 3);
R	is the type of electrode covering (see 5.2.2);
3	is for use with AC or DC and nominal electrode efficiency of 120 % (see Table 5);
4	is the symbol for welding position PA - Flat position (see Table 6).

12.3 Example 2: classification according to alloy type — B

The following example describes classification according to alloy type — B.

A covered electrode (E) for manual metal arc welding of stainless and heat-resisting steels (S) deposits weld metal with a chemical composition of 19 % Cr, 12 % Ni and 2 % Mo (type 316 in Table 3). The electrode has a rutile covering (6) and can be used with alternating current or direct current electrode positive, and may be used for welding flat butt and flat fillet welds (2). It is designated as follows: