BRITISH STANDARD

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Welding consumables — Test methods and quality requirements —

Part 1: Primary methods and conformity assessment of consumables for steel, nickel and nickel alloys

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National foreword

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 14532-1:2004) has been prepared 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of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

This document consists of the following parts:

EN 14532-1, *Welding consumables — Test methods and quality requirements — Part 1: Primary methods and conformity assessment of consumables for steel, nickel and nickel alloys.*

EN 14532-2, *Welding consumables — Test methods and quality requirements — Part 2: Supplementary methods and conformity assessment of consumables for steel, nickel and nickel alloys.*

EN 14532-3, *Welding consumables — Test methods and quality requirements — Part 3: Conformity assessment of wire electrodes, wires and rods for welding of aluminium alloys.*

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

Introduction

This document proposes harmonised verification test conditions for the qualification of welding consumables. The responsibility to identify the extent of the tests to be carried out lies with the manufacturer/supplier on the basis of his assessment of the market requirements.

It should be noted that tests in accordance with this document are made in a way which is not necessarily representative of a real welded structure.

The requirements for the qualification of welding consumable manufacturers, suppliers and distributors are given in EN 12074.

1 Scope

This document describes the basic verification tests, the testing methods, the amount of testing and the requirements for the qualification of welding consumables for steel, nickel and nickel alloys intended for all fields of application.

This document describes a wide range of tests, which are appropriate for the majority of applications. When supplementary tests are required (see EN 14532-2), these can be carried out at any time without the need to repeat the primary tests.

NOTE Additional information is given in Annex O.

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.

EN 439, *Welding consumables — Shielding gases for arc welding and cutting.*

EN 440, *Welding consumables — Wire electrodes and deposits for gas shielded metal arc welding of non alloy and fine grain steels — Classification.*

EN 499, *Welding consumables — Covered electrodes for manual metal arc welding of non alloy and fine grain steels — Classification.*

EN 756, *Welding consumables - Solid wires, solid wire-flux and tubular cored electrode-flux combinations for submerged arc welding of non alloy and fine grain steels – Classification.*

EN 757, *Welding consumables — Covered electrodes for manual metal arc welding of high strength steels — Classification.*

EN 758, *Welding consumables — Tubular cored electrodes for metal arc welding with and without a gas shield of non alloy and fine grain steels — Classification.*

EN 760, *Welding consumables — Fluxes for submerged arc welding — Classification.*

EN 875, *Destructive tests on welds in metallic materials — Impact tests — Test specimen location, notch orientation and examination.*

EN 876, *Destructive tests on welds in metallic materials — Longitudinal tensile test on weld metal in fusion welded joints.*

EN 895, *Destructive tests on welds in metallic materials — Transverse tensile test.*

EN 910, *Destructive tests on welds in metallic materials — Bend test.*

EN 970, *Non destructive examination of fusion welds — Visual examination.*

EN 1011-1, *Welding — Recommendations for welding of metallic materials — Part 1: General guidance for arc welding.*

EN 1043-1, *Destructive test on welds in metallic materials — Hardness testing — Part 1: Hardness test on arc welded joint.*

EN 1321, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds.*

EN 1435, *Non-destructive examination of welds — Radiographic examination of welded joints.*

EN 1597-1, *Welding consumables — Test methods — Part 1: Test piece for all-weld metal test specimens in steel, nickel and nickel alloys.*

EN 1597-2, *Welding consumables — Test methods — Part 2: Preparation of test piece for single-run and two-run technique test specimens in steel.*

EN 1597-3, *Welding consumables — Test methods — Part 3: Testing of positional capability of welding consumables in a fillet weld.*

EN 1599, *Welding consumables — Covered electrodes for manual metal arc welding of creep-resisting steels — Classification.*

EN 1600, *Welding consumables — Covered electrodes for manual metal arc welding of stainless and heat resisting steels — Classification.*

EN 1668, *Welding consumables — Rods, wires and deposits for tungsten inert gas welding of non alloy and fine grain steels — Classification.*

EN 10002-1, *Metallic materials - Tensile testing - Part 1: Method of test at ambient temperature.*

EN 10045-1, *Metallic materials — Charpy impact test— Part 1: Test method.*

EN 10204, *Metallic products — Types of inspection documents.*

EN 12070, *Welding consumables — Wire electrodes, wires and rods for arc welding of creep-resisting steels — Classification.*

EN 12071, *Welding consumables — Tubular cored electrodes for gas shielded metal arc welding of creep-resisting steels — Classification.*

EN 12072, *Welding consumables — Wire electrodes, wires and rods for arc welding of stainless and heat-resisting steels — Classification.*

EN 12073, *Welding consumables — Tubular cored electrodes for metal arc welding with or without a gas shield of stainless and heat-resisting steels — Classification.*

EN 12517, *Non-destructive examination of welds — Radiographic examination of welded joints — Acceptance levels.*

EN 14532-2, *Welding consumables — Test methods and quality requirements — Part 2: Supplementary methods and conformity assessment of consumables for steel, nickel and nickel alloys.*

EN 12534, *Welding consumables — Wire electrodes, wires, rods and deposits for gas shielded metal arc welding of high strength steels — Classification.*

EN 12535, *Welding consumables — Tubular cored electrodes for gas shielded metal arc welding of high strength steels — Classification.*

EN 12536, *Welding consumables — Rods for gas welding of non alloy and creep-resisting steels — Classification.*

EN ISO 544, *Welding consumables — Technical delivery conditions for welding filler materials — Type of product, dimensions, tolerances and markings (ISO 544:2003).*

EN ISO 3690, *Welding and allied processes — Determination of hydrogen content in ferritic arc weld metal (ISO 3690:2000).*

EN ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers (ISO 4063:1998).*

EN ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817:2003).*

EN ISO 6847, *Welding consumables — Deposition of a weld metal pad for chemical analysis (ISO 6847:2000).*

EN ISO 6947, *Welds — Working positions — Definitions of angles of slope and rotation (ISO 6947:1993).*

EN ISO 8249, *Welding — Determination of Ferrite Number (FN) in austenitic and duplex ferritic-austenitic Cr-Ni stainless steel weld metals (ISO 8249:2000).* [1]

EN ISO 14172, *Welding consumables — Covered electrodes for manual metal arc welding of nickel and nickel alloys — Classification (ISO 14172:2003).*

EN ISO 17641-2, *Destructive tests on welds in metallic materials — Hot cracking tests for weldments — Arc welding processes — Part 2: Self-restraint tests (ISO 17641-2:2004).*

EN ISO 18274, *Welding consumables — Wire and strip electrodes, wires and rods for arc welding of nickel and nickel alloys — Classification (ISO 18274:2004).*

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

CR ISO 15608:2000, *Welding — Guidelines for a metallic material grouping system (ISO/TR 15608:2000).*

CR ISO 17663, *Welding — Guidelines for quality requirements for heat treatment in connection with welding and allied processes (ISO/TR 17663:2001).*

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1
auxiliary materials
materials, which are not designed to influence the chemical composition and the mechanical properties of the weld and are not incorporated in the weld, e.g. temporary backing strips

3.2
classification
process where the manufacturer carries out tests on the product to verify the designation according to the appropriate consumable standard

[1] In this document "austenitic-ferritic" is used instead of " ferritic-austenitic".

3.3
qualified welding consumable
welding consumable complying with those requirements of this document identified by the manufacturer

NOTE Additional information is given in Annex O.

3.4
manufacturer
party who has legal responsibility for the finished quality of the product placed upon the market

3.5
supplier
party who purchases the welding consumables from a manufacturer and supplies it under his own brand name

3.6
lot
quantity of welding consumables defined as the manufacturer's standard lot in his quality assurance manual or as defined in ISO 14344

4 Applicable procedures for conformity assessment

The procedures for conformity assessment are described below. Tests and evaluation for the qualification of welding consumables are given in Clauses 5 to 9 and they are carried out under the manufacturer's or supplier's trade designation.

The manufacturer or supplier shall declare the conformity of the product on the label.

NOTE Additional information is given in Annex O.

5 Type qualification test

5.1 General

The compliance of a welding consumable with this document shall be demonstrated by a type qualification test and ongoing control to ensure consistent quality.

The type qualification test (see Annex A) shall consist of:

— testing of the product (see 5.3);

— testing of all-weld metal (see 6.1);

— testing of welded joints (see 6.2).

5.2 Necessary information

The following product information shall be documented:

— scope of qualification;

— whether qualification is for butt welds and fillet welds or only for fillet welds;

— brand and product name;

— European Standard designation;

— manufacturer's limits of chemical composition of the product or the all-weld metal; these shall not exceed the values given in Annexes B and C, respectively;

— description of the covering, flux or filling material in terms of those major constituents which define the characteristics of the consumable (e.g. oxides, carbonates, fluorides and metals);

— limits of mechanical properties of the all-weld metal in the as welded condition and/or, if applicable, in post weld heat treated conditions;

— ferrite content (if requested);

— hydrogen content (if requested).

5.3 Testing of the product

5.3.1 Testing to demonstrate applicability

The manufacturer shall define the range of testing to demonstrate applicability in such a way that the mechanical properties of the all-weld metal are in accordance with the minimum requirements of this document.

The range of qualification shall be subdivided with relevant information as follows:

— parent metals;

— heat treatment;

— any restriction on material thickness;

— highest and lowest test temperature;

— type of current and polarity;

— root weldability (without backing or sealing run);

— welding positions;

— applicability for single-run and/or multi-run techniques;

— other specific product information (e.g. shielding gas or flux).

5.3.2 Sampling for verification of product physical characteristics

All welding consumables for qualification tests shall be sampled at the manufacturer's or supplier's premises. The sizes and dimensions of welding consumables involved in the qualification test shall be examined in accordance with EN ISO 544, or EN 760 for fluxes, or the manufacturer's product specification (see 5.2 and 5.3.1). In addition other characteristics of the product shall be examined where applicable, e.g. the colour, physical condition and marking.

5.3.3 Chemical composition of the product

The manufacturer shall document that the chemical composition of the solid wire and/or strip welding consumable meets the requirements of the product specification and the limits given in Annex B.

The constituent materials of the consumables shall be documented in accordance with the manufacturer’s specifications.

For the purpose of qualifying a welding consumable it is sufficient to identify the shielding gas in accordance with EN 439.

5.3.4 Marking of products

The marking of the product and the packaging shall be in accordance with EN ISO 544 and for fluxes with EN 760. When other markings replacing the product name are used, such markings shall be unique and unambiguous and are entered into the qualification certificate.

6 Testing

6.1 Testing of all-weld metal

6.1.1 General

All-weld metal test pieces shall be prepared in accordance with EN 1597-1. All-weld metal test pieces are not prepared for welding consumables intended for the following welding processes

— electrogas welding (process 73 according to EN ISO 4063);

— electroslag welding (process 72 according to EN ISO 4063);

— overlay welding;

— single and two run welding, where qualification is not required for multi run welding;

— oxy-fuel gas-welding (process 31 according to EN ISO 4063).

6.1.2 Type and number of test pieces and diameters of welding consumables to be tested

The type of test piece is given in the corresponding welding consumable standard. The number of test pieces depends of the type and diameter of the welding consumable as shown in Table 1.

Table 1 — Number of all weld metal test pieces and diameters of welding consumable to be tested

Type of welding consumable	Number of all-weld metal test pieces	Diameter of welding consumable
covered electrodes	1	4,0 mm [a]
	1	maximum to be qualified
rods for tungsten inert gas welding [b]	1	2,4 mm [c]
wire electrodes for gas-shielded metal arc welding [b]	1	maximum to be qualified
tubular cored electrodes [b]	1	maximum to be qualified
flux-wire combinations for submerged arc welding	1	4,0 mm wire electrodes or maximum to be qualified

[a] Where 4,0 mm diameter has not been manufactured, the closest diameter to 4,0 mm shall be used.

[b] For each shielding gas or gas group for which qualification is required a separate all-weld metal test piece shall be prepared.

[c] Where 2,4 mm diameter has not been manufactured, the closest diameter to 2,4 mm shall be used.

6.1.3 Welding conditions

Welding conditions for the preparation of test pieces shall be selected in accordance with the relevant consumable classification standard, where applicable, or the manufacturer's recommendations. Regarding covered electrodes; diameters not covered by the consumable classification standard shall be welded with 70 % to 90 % of the maximum welding current recommended by the manufacturer. Furthermore, the number of layers shall be adjusted to common welding practice as recommended. When qualification is for both direct current (d.c.) and alternating current (a.c.) operation then testing shall be carried out using alternating current (a.c.).

When qualification is for d.c. operation with both polarities then the polarity recommended by the manufacturer shall be tested.

Preheating shall be applied where it is prescribed in the relevant European Standard or material specifications for the material and material thickness in question. Post weld heat treatment shall be in accordance with the relevant classification standard.

When qualification is for submerged arc welding, the testing shall be carried out by using d.c. positive, or on a.c. when the flux is specially designed for a.c. When the flux is tested on d.c., a.c. can be included in the qualification if the manufacturer can provide positive results from internal tests (see EN 10204).

NOTE It is recommended that the welding heat input used for welding is to be recorded and included in the qualification test report (Annex J).

6.1.4 Testing conditions, test specimen type, number of test specimens and requirements

6.1.4.1 General

In addition to the requirements listed below those from the product standard classification according to the product standard shall be complied with.

If the manufacturer classifies a welding consumable with symbol Z, he shall specify the requirements for the consumable prior to the tests.

6.1.4.2 Tensile tests

The all-weld metal tensile test specimens of ferritic welding consumables may be exposed to a temperature not exceeding 250 ºC for a period not exceeding 16 h for hydrogen removal prior to testing, alternatively a temperature not exceeding 105 ºC for a time not to exceed 48 h may be used.

Two tensile test specimens of 10 mm diameter in accordance with EN 876 shall be prepared. For all weld metal, the test should be carried out in accordance with EN 10002-1 at room temperature and the tensile strength, lower yield strength or proof strength, elongation after fracture (A_5) and reduction of area shall be determined.

For all groups of welding consumables the 0,2 % proof strength shall be determined, except in the case of consumables for non alloy and fine grain steels when the lower yield strength shall be determined.

All results shall meet the requirements of the relevant consumable standard.

6.1.4.3 Impact tests

Charpy V test specimens shall be prepared in accordance with EN 1597-1 and tested in accordance with EN 10045-1. Tests to be carried out at temperatures other than room temperature shall be held at the test temperature for a minimum of 10 min prior to testing.

For all materials the test temperature shall be the lowest temperature proposed by the manufacturer.

One set of three impact test specimens shall be tested at each required temperature in each heat treatment condition.

The average value from Charpy V specimens in each set shall not be lower than the minimum value of impact energy according to Annex D. For parent metal groups 1 to 5 only one individual value may be lower than 47 J but higher than 32 joules.

For consumables for which the classification standard does not require impact properties no impact testing is required by this document.

6.1.4.4 Chemical composition of all-weld metal

The sample for the analysis of the all-weld metal can be taken from the broken pieces of an all-weld metal tensile test specimen or on a pad in accordance with EN ISO 6847. Alternatively analysis may be carried out on a transverse section of the all-weld metal sample. All elements specified in the product standard shall be determined.

The chemical composition of the all-weld metal shall be determined for each diameter tested (Annex C).

For electro-gas and electro-slag the chemical analysis may be performed on a weldment.

The chemical composition of the all-weld metal shall meet the requirements of the manufacturer's product specification and Annex C.

6.1.4.5 Determination of ferrite content (stainless steel weld metal)

For information the ferrite content of the weld metal shall be determined by one of the following methods.

1. Determination of Ferrite Number in accordance with EN ISO 8249;

2. Calculation of Ferrite Number in accordance with Annex E;

3. Metallographic measurement of ferrite percentage.

The method of determination shall be reported. The average ferrite content shall be within the limits given in the product standard or in the manufacturer's specification.

6.1.4.6 Determination of hydrogen content

When required hydrogen shall be assessed in the deposited weld metal on three specimens in accordance with EN ISO 3690. The average hydrogen content shall not exceed the limits given in the product standard or in the manufacturer's product specification.

Prior to hydrogen testing the electrodes or welding fluxes shall be baked/dried at the minimum times and temperatures within the manufacturer's recommended ranges.

6.2 Testing of welded joints

6.2.1 Parent metals

Test pieces shall be prepared with a parent metal selected from Table F.1 (see Annex F) to define the steel material sub-groups according to CR ISO 15608:2000, Table 1 or according to CR ISO 15608:2000, Table 4 to define the nickel or nickel alloy group, for which qualification is required. All materials not mentioned in a material group shall be tested individually.

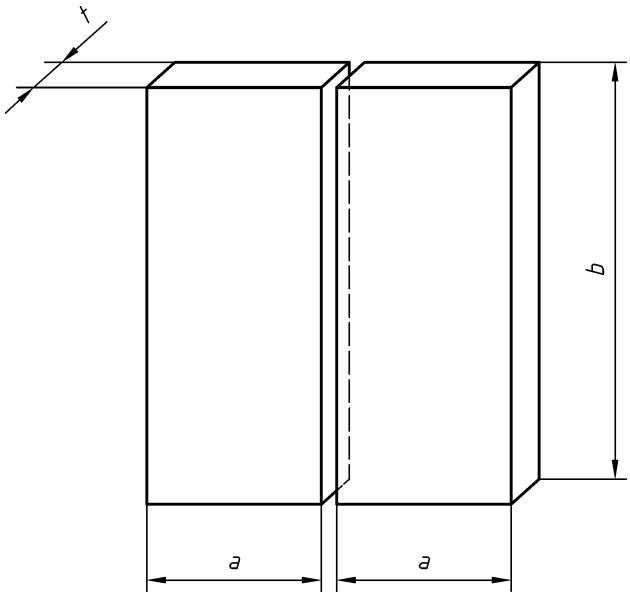
For a wire-flux combination intended for multi run submerged arc welding only one test piece shall be prepared with a parent metal with the highest strength or the highest alloy content of the material groups according to CR ISO 15608:2000 for which qualification is required.

Test plate material shall have a certification, e.g. in accordance with EN 10204.

6.2.2 Type and dimensions of the test pieces

The actual length, *b* (see Figure 1), will be influenced by the welding process and shall be sufficient to allow the welding process to stabilise and the specimens required and any retest specimens to be taken.

The width, *a* (see Figure 1), of the welded test pieces shall be sufficient to permit the necessary test specimens to be prepared.



Key

a = 3t; minimum value 150 mm
b = 6t; minimum value 350 mm

Figure 1 - Test piece for a butt weld in plate

A joint preparation in accordance with the manufacturer's welding procedure specification shall be used. The material thickness of the test pieces shall be selected from Annex G. When the term unlimited is requested at least one test piece shall use minimum 25 mm material thickness or 20 mm for stainless steel.

NOTE Guidance for joint preparation is given in EN 1597-2, EN 1597-3 and EN ISO 9692-1.

For testing covered electrodes with a nominal electrode efficiency of > 125 %, a fillet weld joint in accordance with EN 1597-3 shall also be made. In this case the minimum weld length is 500 mm. The plate thickness shall be between 10 mm and 12 mm (single layer welding).

Where welding consumables are intended only for fillet welding (e.g. gravity welding), a test piece in accordance with EN 1597-3 shall be performed instead of the butt weld.

For two-run technique with the submerged arc welding process a test piece in accordance with EN 1597-2 shall be used. If the field of application does not include two-run technique, the test piece shall be welded with butt weld preparation using multi-run technique.

6.2.3 Welding conditions

6.2.3.1 General

On carrying out the test welds, the following welding conditions shall be observed.

6.2.3.2 Preheating

Preheating shall only be applied where it is prescribed in the relevant European Standard or material specifications for the material and thickness in question.

6.2.3.3 Interpass temperature and heat input

Interpass temperature shall be as recommended by the steel manufacturer and/or the consumable manufacturer. When not specified the requirements for the interpass temperature given in Table 2 shall be used. Limitation in heat input shall be applied if given in parent metal standards and/or specifications according to EN 1011-1.

Table 2 — Interpass temperature

Welding consumable	Interpass temperature [a] °C
Non-alloy and fine grain	120 to 200
Creep resisting	Preheat temperature + 50
Ferritic Cr-steels	200 to 300
Martensitic Cr-steels	200 to 300
Soft martensitic CrNi-steels	100 to 160
Austenitic CrNi(Mo)-steels	150
Austenitic - Ferritic CrNiMoN-steels	150
Nickel and nickel alloys	100
[a] Single values in the table means maximum temperatures.	

6.2.3.4 Welding positions

One weldment for each welding position for which qualification is required shall be used for the tests.

Welding consumables for manual metal arc welding, tubular cored electrode welding, gas shielded metal arc welding and tungsten inert gas welding tested in the flat position (PA) also includes the qualification in the horizontal-vertical position (PC) according to EN ISO 6947. This does not apply to high efficiency covered electrodes (> 125 %).

6.2.3.5 Type of current and polarity

When qualification is for both direct (d.c.) and alternating (a.c.) current, each type of current shall be used at least once in the test programme. The same principle applies for the choice of the positive and negative pole when qualification is only for direct current. In cases where the manufacturer recommends a polarity change in completing the weld, both polarities may be used in a single weld in order to minimize the number of test pieces.

6.2.3.6 Welding parameters and bead sequence

Welding of the joints shall be carried out with welding parameters consistent with the welding position, the diameter of welding consumable and the welding process as recommended by the manufacturer.

6.2.3.7 Consumable diameters

The diameters to be used for the test are given in Table 3. The weld shall be carried out from the root bead to the final pass using a sequence of increasing diameters.

Table 3 — Consumable diameters

Type of welding consumable	Range of qualification diameter mm	Diameter to be used for the flat position (PA) [a] mm	Diameter to be used for other position mm
Covered electrodes	2,5 to 6,0 [b]	2,5 or 3,2 [c] and 4,0 and 5,0 and 6,0	as recommended for the position
Rods for tungsten inert gas welding or oxyacetylene welding	0,6 to 1,2 1,0 to 4,0 2,0 to 6,0	1,0 1,6 and 2,4 or 2,5 2,4 or 2,5 and 4,0 and 6,0	
Wire electrodes for gas shielded metal arc welding	0,6 to 1,6 0,6 to 3,2	0,8 and 1,2 or 1,6 0,8 or 1,0 and 1,6 or 2,4	
Tubular cored electrodes	1,2 to 2,4 [b] 1,2 to 4,0	1,2 or 1,6 and 2,0 1,2 or 1,6 and 2,4 or 3,2	
Wire electrodes for submerged arc welding	3,0 to 5,0 [d]	4,0	–

[a] Depending on diameter range submitted to qualification.

[b] Smaller or larger diameters, if needed.

[c] Only root pass and second pass or layer.

[d] If a smaller or larger diameter is applied for, the smallest or the largest diameters applied for shall be included additionally in the test.

6.2.3.8 Root weldability

A welding consumable also intended for root welding without any backing or sealing run shall be tested in the flat (PA) position according to EN ISO 6947. The root shall be evaluated for steels according to EN ISO 5817 level B. If other preparations are selected in order to achieve the root weld, these shall be indicated in the certificate.

6.2.3.9 Shielding gases

Shielding gases to be used in the test shall be selected from Table 4 in relation to the qualification required.

For welding of test pieces with tungsten inert gas welding any gas in group I of EN 439 may be used. For other gases not included in EN 439 the qualification is for that gas only.

Table 4 — Shielding gases

Gas tested EN 439	Shielding gases Qualification range EN 439
M2	M2
M32	M3
C	C
C + M21 (2 tests)	M2; M3; C
I	I
R + I	R; I

6.2.4 Number of test pieces

During preparation of welded joints for the qualification test the combination of material thickness, welding position and parent metals shall be considered to minimise the number of test pieces, see Annex I.

6.2.5 Number of test specimens

6.2.5.1 General

The following test specimens shall be taken from each test piece as required in 6.2.6.

6.2.5.2 Butt welds

For the testing described in 6.2.6 the following test specimens shall be prepared:

— 2 transverse tensile test specimens according to EN 895;

— 2 face bend test specimens according to EN 910;

— 2 root bend test specimens according to EN 910;

— 1 macro section according to EN 1321 with hardness test (HV 10), EN 1043-1;

— 1 micro section according to EN 1321;

— in addition if applicable: 1 set of 3 impact test specimens according to EN 875 notch in the centre of the weld tested at the lowest temperature for which qualification is required.

In addition, for electro-gas and electro-slag butt welds with a material thickness above 20 mm, a longitudinal tensile test specimen according to EN 876 shall be tested. For single-run and two-run technique reference is made to EN 1597-2.

6.2.5.3 Fillet welds

For the testing described in 6.2.6 the following test specimens shall be prepared:

— 1 macro section according to EN 1321;

— 1 fracture test according to EN 1597-3.

Where qualification is required only for fillet welding hardness testing HV 10 in accordance with EN 1043-1 is required, except for material group 8 in accordance with CR ISO 15608:2000.

6.2.6 Test conditions and specimen geometry

6.2.6.1 Non-destructive tests

The test pieces shall be subject to visual examination in accordance with EN 970. Butt welds shall be subject to radiographic examination in accordance with EN 1435 class B. If heat treatment is applicable, testing shall be carried out after heat treatment.

Acceptance criteria for visual examination shall be EN ISO 5817 level B and for radiography EN 12517 level 1, except for cellulosic electrodes where level C/level 2 applies, unless otherwise specified by the consumable manufacturer.

6.2.6.2 Tensile tests

Transverse tensile test specimens according to EN 895 with a gauge length L_v (welded area plus at least 80 mm) shall be used. The tensile strength and the location of the fracture shall be determined.

6.2.6.3 Bend tests

Bend test specimens shall be used according to EN 910. The angle and the elongation shall be determined.

6.2.6.4 Impact test

For the impact test, specimens in accordance with EN 10045-1, with a notch location VWT0/2 according to EN 875 shall be used.

If impact testing of thickness of 5 mm to 10 mm is required the preparation of test specimens shall be carried out at the midthickness with notch location VWT0 according to EN 875.

When impact testing of the welding consumable at temperatures below 0 ºC is required, one test shall be carried out on a welded joint, welded in the vertical up position if this position is part of the type qualification, otherwise in the flat position.

For consumables for which the classification standard does not require impact testing no impact testing is required by this document.

6.2.6.5 Macroscopic examination

A transverse macro section shall be taken from each test piece and documented by photograph. The weld shall be examined microscopically with a magnification of at least 200x and any crack-like or volumetric imperfections shall be reported.

6.2.6.6 Hardness test

Hardness tests according to EN 1043-1, HV 10 (for wall thickness < 5 mm HV 1 shall be used), shall be carried out in the weld only and documented for information, except for material group 8 in accordance with CR ISO 15608:2000.

6.2.7 Welded joints – Technical requirements

The requirements are given in Annex H.

6.2.8 Post weld heat treatment

Post weld heat treatment shall be carried out if required for the parent metals or for the all-weld metal according to applicable standards. The post weld heat treatment temperatures, holding time and heating/cooling rates given in CR ISO 17663 shall be considered.

6.2.9 Hot cracking tests

The hot cracking test shall be carried out according to EN ISO 17641-2. For welding consumables a hot cracking test is required for material group 8 with Ferrite Number < 3 (see 6.1.4.5), and for material groups 41 – 48 according to CR ISO 15608:2000. The acceptance criteria shall be no cracks greater than 1,5 mm.

7 Retests

If the results of the NDT are not acceptable a new test assembly shall be subjected to NDT. Should these results be unacceptable the product shall be subject to reconsideration.

If the results of any other test fail to meet the requirement, that test shall be repeated twice. The results of both retests shall meet the requirement. Specimens for retest may be taken from the original test assembly or from a new test assembly using parent metals of the same type, welding consumables from the same production lot and the same welding procedure as used for the first test assembly. For chemical analysis, retest need be only for those specific elements that failed to meet the 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 test, 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 Range of qualification

8.1 General

The qualification shall cover a range assessed according to this document and may additionally cover a range assessed according to EN 14532-2.

8.2 Parent metals

The range of qualification shall cover all compatible parent metals for which the all weld metal meets or exceeds the specified minimum yield strength of the parent metal. The tensile strength of the butt welds shall meet or exceed the specified minimum tensile strength of the parent metal. The chemical composition of stainless steel weld metal shall be compatible with the base metal.

8.3 Post weld heat treatment

Qualification shall be limited to the post weld heat treatment conditions used in the tests with a temperature tolerance ± 10 °C.

8.4 Combination of welding consumables and auxiliary materials

Combinations of welding consumables (e.g. wire-flux or wire-gas combinations) and auxiliary materials (e.g. backing strips or inserts) used in the test shall be stated in the certificate.

8.5 Welding positions

The qualification shall be limited to the welding positions used in the tests or as permitted by 6.2.3.4 and 6.2.4.

8.6 Current and polarity

The qualification shall be limited to the type of current and polarity used in the tests or as permitted by 6.1.3 and 6.2.3.5.

8.7 Root weldability

The suitability for single sided root welding shall be included in the certificate when requirements defined in 6.2.3.8 have been fulfilled. Root weldability is independent of parent metal wall thickness.

8.8 Diameter range

The range of diameters qualified shall be as given by 6.2.3.7.

8.9 Maximum temperature

The maximum temperature should be the same as for the parent metal.

8.10 Minimum temperature

The minimum temperature to be tested is that for which satisfactory impact test values in the all-weld metal and the welded joint were achieved.

8.11 Undermatching strength

If the all-weld metal shows a lower yield strength or proof strength lower than the parent metals included in the range of qualification, the actual values shall be given in the certificate.

8.12 Material thickness

The qualification shall be limited to the material thickness given in Annex G depending on the test piece thickness.

9 Type qualification test report

A type qualification test report shall be prepared and shall include the results of the tests carried out and evaluation of the results on the basis of the requested range of application. Suggested information to be included is given in Annex J.

10 Certificate

After successful completion of the relevant tests, a type qualification certificate of the welding consumable is issued according to Annex K on the basis of the type qualification test report.

11 Extension of the range of qualification

If the range of qualification of the welding consumable shall be extended, appropriate tests related to the extension shall be performed.

12 Modification of the welding consumables

If the qualified welding consumable has been modified so that the characteristic values are outside the information which are given according to 5.2 the necessary tests shall be performed to demonstrate that the product still complies with the requirements agreed for the range of qualification.

13 Transfer of qualification

The transfer of qualification of one trade name to another trade name shall be documented. Formats are given in Annex L and Annex M.

For products for which the production is transferred to another factory on the basis of the same specifications the manufacturer shall demonstrate compliance with the classification or product specification by all-weld-metal tests.

14 Prolongation of qualification

Annex N shows the minimum of tests to be performed for the prolongation of the type qualification.

Annex A
(informative)

Type qualification tests – Overview

Table A.1 — Type qualification tests – Overview

Test No.	Test description	Clause reference	Test purpose
		Primary test	
1	All-weld metal: – chemical analysis; – mechanical properties.	5.3 and 6.1	Classification of product in accordance with product standard. Part of qualification when required by directive, rules or application standards.
2	Welded joint: – mechanical properties and hot cracking susceptibility.	5.3 and 6.2	Part of qualification when required by directive, rules or application standards.

Annex B
(normative)

Solid product composition – Limits

Table B.1 — Solid product composition – Limits

Ranges of chemical composition		Stainless and heat resisting steels in accordance with EN 12072 [a]	Unalloyed and creep-resisting steels in accordance with EN 440, EN 756, EN 1668, EN 12070 and EN 12536 [a]	High strength steels in accordance with EN 12534 [a]	Nickel and nickel alloys in accordance with EN ISO 18274
%		%	%	%	
C	all	–	–	–	Limits for all elements according to EN ISO 18274
Si	all	± 0,35	± 0,20	± 0,15	
Mn	≤ 2,5	± 0,40	± 0,30	± 0,20	
	> 2,5 to 5,0	± 0,50	± 0,30	± 0,20	
	> 5,0	± 1,0	–	–	
P	all	0,030	0,025	0,015	
S	all	0,020	0,025	0,015	
Cr	≤ 0,8	–	± 0,15	± 0,20	
	> 0,8 to 3,0		± 0,30	–	
	> 3,0 to 7,0		± 0,50		
	> 7,0 to 11,0		± 1,0		
	> 11,0	± 1,0 [b]	–		
Ni	≤ 2,0	–	± 0,30	± 0,25	
	> 2,0 to 6,0	± 0,50			
	> 6,0	± 1,0		–	
Mo	≤ 0,70	–	± 0,10	± 0,10	
	> 0,70 to 3,0	± 0,25	± 0,20	–	
	> 3,0	± 1,0	± 0,20		
Nb/Ta	all	–	± 0,10		
V	all		± 0,10		
W	all		± 0,10		
N	all		–		

[a] When limits are given in the table, these apply within those of the appropriate consumable standard. Where no limits are given in the table only those of the consumable standard apply. No extension of the consumable standard limits is permitted.

[b] For alloys with Mn contents > 4,5 % the range of Cr shall be ± 1,5.

Annex C
(normative)

All-weld metal from covered and tubular cored electrodes – Limits of chemical composition

Table C.1 — All-weld metal from covered and tubular cored electrodes – Limits of chemical composition

Limits of chemical composition		Covered and tubular cored electrodes for non alloy and fine grain steels in accordance with EN 499 and EN 758 [a]	Covered and tubular cored electrodes for high strength steels in accordance with EN 757 and EN 12535 [a]	Covered and tubular cored electrodes for stainless and heat resisting steels in accordance with EN 1600 [a] and EN 12073	Covered and tubular cored electrodes for creep-resisting steels in accordance with EN 1599 [a] and EN 12071	Covered electrodes for nickel and nickel alloys in accordance with EN ISO 14172
%		%	%	%	%	
C	all	0,12 [b]	0,10	–	– [c]	Limits for all elements according to EN ISO 14172
Si	all	± 0,20	± 0,30	± 0,40	± 0,25	
Mn	≤ 2,0	± 0,25	± 0,30	± 0,35	± 0,30	
	> 2,0 to 4,5			± 0,50		
	> 4,5			± 1,0		
P	–	–	–	–	–	
S	–	–	–	–	–	
Cr	≤ 0,8	–	± 0,20	–	± 0,15	
	> 0,8 to 3,0		–		± 0,25	
	> 3,0 to 7,0				± 0,40	
	> 7,0			± 1,0 [d]	± 0,80	
Ni	≤ 1,8	–	± 0,30	± 0,50	± 0,30	
	> 1,8 to 6,0		± 0,40			
	> 6,0 to 15,0		–	± 1,0		
	> 15,0			± 1,5		
Mo	≤ 0,70	–	± 0,15	± 0,25	± 0,15	
	> 0,70 to 3,0				± 0,20	
	> 3,0			± 0,50		
Nb/Ta	all	–	–	–	–	
V	all	–	–	–	± 0,1	
W	all	–	–	–	± 0,1	
N	all	–	–	–	–	
B	all	± 0,003	± 0,003	–	–	
Ti	all	± 0,03	± 0,03	–	–	

[a] When limits or ranges are given in the table, these apply within those of the appropriate consumable standard. Where no limits are given in the table only those of the consumable standard apply. No extension of the consumable standard limits is permitted.

[b] For cellulosic covered electrodes C content may be max. 0,20 %. For tubular cored electrodes without a gas shield C content may be 0,30 % maximum.

[c] For CrMoWV 12 type C range shall be ± 0,035 %.

[d] For alloys with Mn contents > 4,5 % the range of Cr shall be ± 1,5 %.

Annex D
(normative)

All-weld metal of welding consumables for steel, nickel and nickel alloys – Requirements

Table D.1 — All-weld metal of welding consumables for steel, nickel and nickel alloys – Requirements

Parent metal group according to CR ISO 15608:2000 *) (see 8.1)	Test temperature °C [a]	R_{eL} or $R_{p0,2}$ min. N/mm²	$R_{p1,0}$ min. N/mm²	R_m min. N/mm²	A_5 min. %	KV min. J
1.1	RT	285	–	480	22	47 [b]
1.2	RT	360	–	520	22	47 [b]
2	RT	380 [c]	–	530 [c]	18	47 [b]
3	RT	500 [c]	–	610 [c]	18	47 [b]
8.1	RT	205	240	510	25	32 [b]
8.2	RT	200	240	470	30	40 [d]
8.3	RT	320	–	600	25	32 [b]
10.1	RT	450	500	550	20	40 [d]
10.2	RT	470	520	600	20	40 [d]
41 to 48	RT	Values as defined by the consumable manufacturer				

a RT = Room temperature (23 ± 5) °C.

b Also applies to the minimum verification temperature.

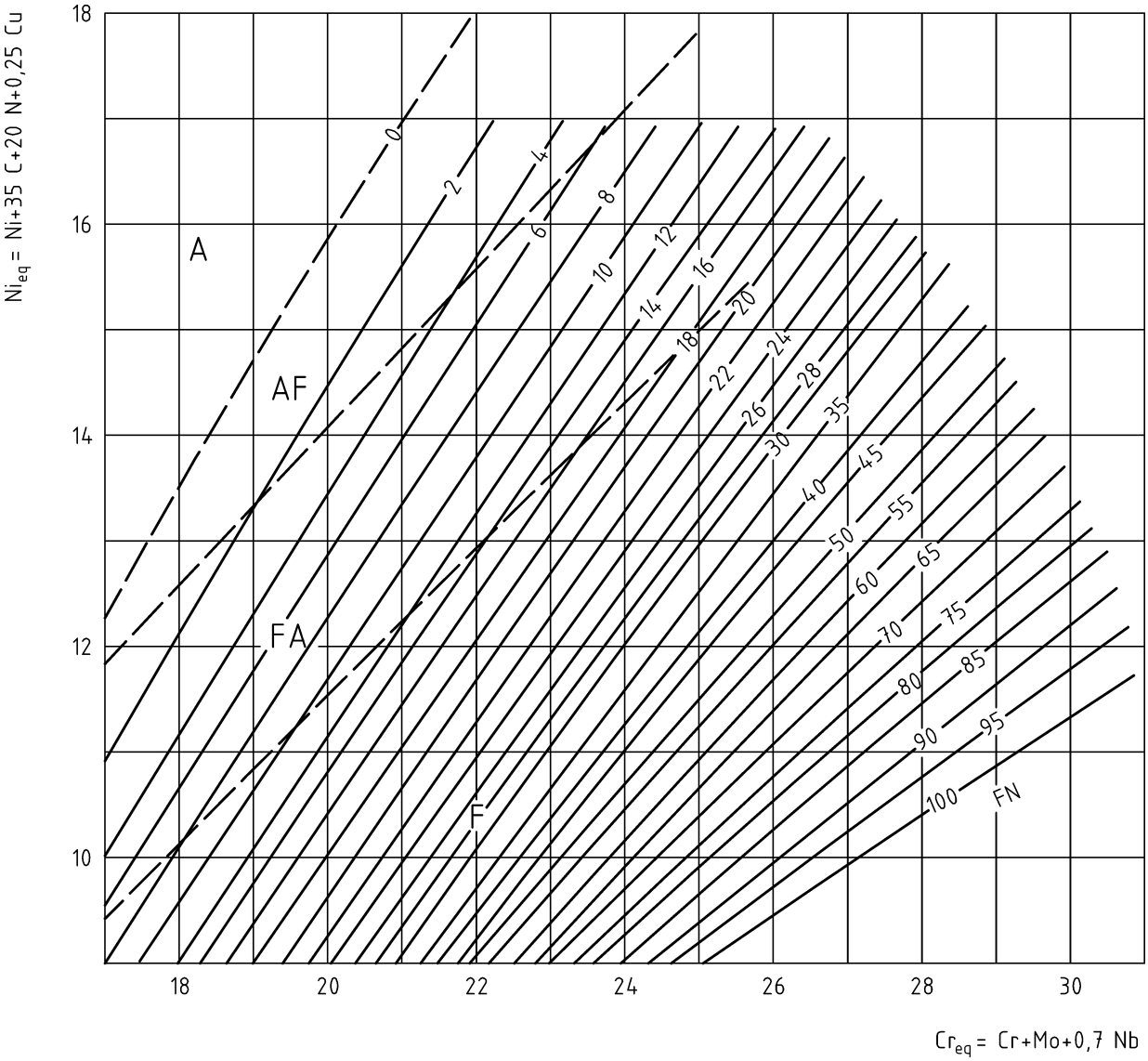
c If the consumable is intended for steels with higher yield and tensile strength the minimum requirements of the parent metal apply, see 8.1.

d If the minimum verification temperature is less than - 10 ºC, min. 32 J or a higher agreed value.

*) Explanation of the material groups see Annex P.

Annex E
(normative)

Calculation of delta ferrite



Key:
A = austenite
AF = austenite-ferrite
FA = ferrite-austenite
F = ferrite

Figure E.1 — WRC - 1992 diagram

Annex F
(normative)

Range of qualification for steels

Table F.1 — Range of qualification for steels

Test plate	Range of qualification	
	Strength, N/mm^2	Group according to CR ISO 15608:2000 *)
$R_{eH}/R_{p0,2} \leq 360$	$R_{eH}/R_{p0,2} \leq 360$	1.1, 1.2
$360 < R_{eH}/R_{p0,2} \leq 460$	$R_{eH}/R_{p0,2} \leq 460$	1.X, 2.1
$460 < R_{eH}/R_{p0,2} \leq 550$	Matching steels	2.1, 2.2, 3.1, 4, 9.1
$550 < R_{eH}/R_{p0,2} \leq 690$	Matching steels	3.1, 3.3, 4
$690 < R_{eH}/R_{p0,2} \leq 830$	Matching steels	3.2, 3.3, 4
$830 < R_{eH}/R_{p0,2}$	Matching steels	3.2, 3.3, 4
Group 5 to 11 according to CR ISO 15608:2000 *), excluded 9.1	–	Same sub-group
*) Explanation of the material groups see Annex P.		

Annex G
(normative)

Butt welds – Thickness limits

Table G.1 — Butt weld - Thickness limits

Welding consumable [a]	Type	Material thickness for test pieces	Maximum material thickness qualified
covered electrodes	covered electrodes A, R, RR, RA, C, RC, RB	as requested	2 x welded thickness maximum 30 mm
	covered electrodes B	≥ 25	unlimited [a]
	covered electrodes R, RA and RB for groups 8 and 10 in accordance with CR ISO 15608:2000	≥ 20	
	high performance covered electrodes RR and RA	as requested	2 x welded thickness
tubular cored electrodes	tubular cored electrodes B, M, R, P, W, Y	as requested	2 x welded thickness
		≥ 25	unlimited
	tubular cored electrodes V	as requested	welded thickness
TIG rods and TIG wires	–	as requested	2 x welded thickness, unlimited for root welds
gas-shielded metal arc welding wire electrodes	–	as requested	2 x welded thickness maximum 50 mm
wire electrodes and tubular cored electrodes for electro-slag and electro-gas welding	–	as requested	corresponding to the smallest and highest welded thickness
flux/wire combinations for multi-run technique	FB, AB	≥ 25	unlimited
	other than FB and AB	as requested	2 x welded thickness for two-run technique welded thickness
oxyfuel welding rods	–	as requested, maximum 8 mm	maximum 8 mm

[a] For fillet welds the limit of the throat thickness shall be 0,5 x the allowable thickness according to the table.

Annex H
(normative)

Welded joints – Technical requirements

Table H.1 — Welded joints in steel, nickel and nickel alloys – Technical requirements

Type of test	Requirements	
Non-destructive test	see 6.2.6.1	
transverse tensile test	Tensile strength as specified for the parent metal or as specified for the welding consumable in the determination of suitability.	
impact test[a] with V-notch specimen taken from the middle of the weld	for verification at room temperature and above	As specified for the parent metal in transverse direction. When using austenitic-ferritic, austenitic and nickel base welding consumables ≥ 40 J.
	for verification below room temperature	At the lowest verification temperature requested: – when using ferritic welding consumables ≥ 27 J [b]; – when using austenitic -ferritic, austenitic and nickel base welding consumables ≥ 32 J [b] .
bend test	bending angle degrees	bending mandrel diameter [c]
	180	4 x a
	If a bending angle of 180 degrees is not achieved without cracks, the following applies: < 180 to 90 elongation (L_o = width of weld + thickness symmetrical with weld) ≥ minimum elongation A of parent metal (see EN 910) < 90 elongation across width of weld > 30 % and flawless appearance of fracture.	
macroscopic examination	the macro section of the welded joint shall show a complete weld build-up and complete fusion of the weld in accordance with 6.2.6.1, (see 6.2.6.5).	
hardness testing	for information only (see 6.2.6.6)	

[a] For specimens with a width other than the standard width of 10 mm, the impact energy requirements are reduced as follows in relation to the cross-sectional area of the specimen, e.g. for cross-section 10 x 7,5 mm 5/6 and for cross-section 10 x 5,0 mm 2/3 of the required impact energy. For groups 8, 10, 41 to 48 according to CR ISO 15608:2000 the impact energy is proportional to the area under the notch.

[b] Or a higher agreed value. Only one of the individual values may be less than the minimum specified value, and by not more than 30 %.

[c] “a” means test specimen thickness.

Annex I
(normative)

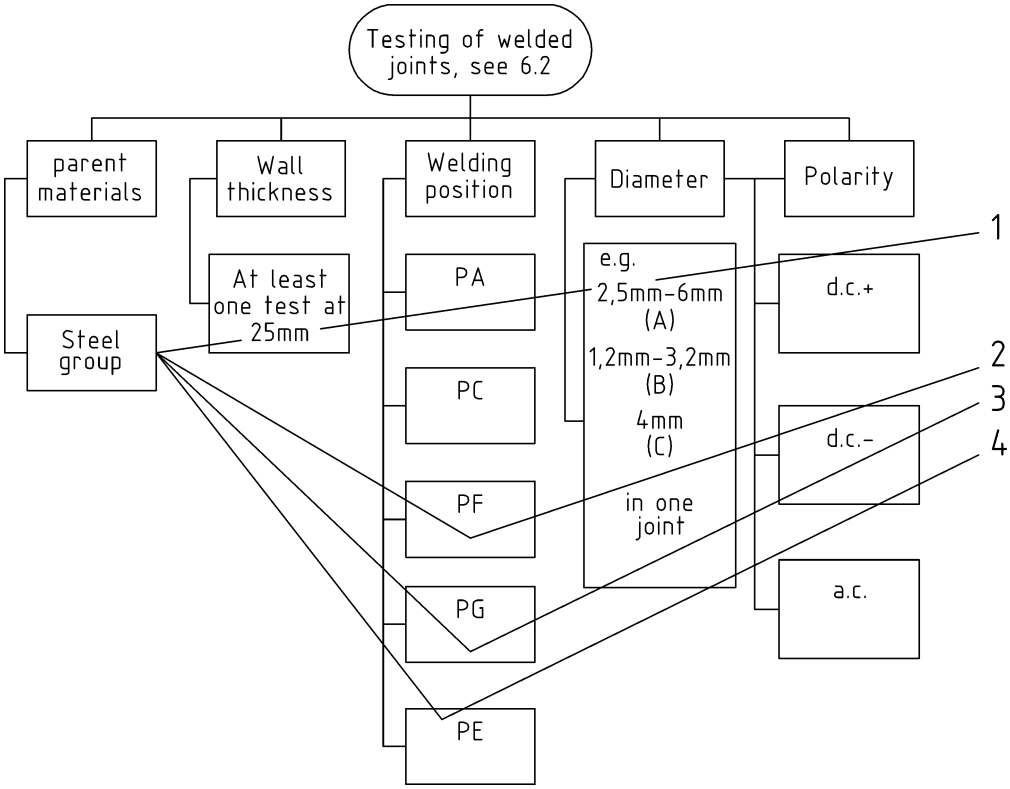
Number of test pieces in a type qualification test

Table I.1 — Number of test pieces in a type qualification test

Type of welding consumable	Number of all-weld metal test pieces	Number of test pieces in weld metal joints
Covered electrodes for manual metal arc welding	2 [a]	4 [a]
Rods for tungsten inert gas welding	1 [a]	4 [a]
Rods for oxyacetylene welding	1 [a]	4 [a]
Wire electrodes for gas-shielded metal arc welding	1 [a]	4 [a]
Tubular cored electrodes for metal arc welding with or without a gas shield	1 [a]	4 [a]
Flux-wire combinations for submerged arc welding	1	1 [b]

[a] The number is related to the range of testing to demonstrate applicability defined by the welding consumable manufacturer see 5.3.1. The example is related to the welding positions PA, PC, PE, PF, PG in accordance with EN ISO 6947 without post weld heat treatment.

[b] If the combination is intended only for multi-run technique the test piece shall be welded with that technique using butt weld preparation. If also two-run technique is included a second test piece shall be prepared in accordance with EN 1597-2.



Key

1 Test 1: 25 mm thickness, PA position, largest and smallest diameters on one joint, d.c.+

2 Test 2: less than 25 mm thickness, PF position, recommended diameter, d.c. –

3 Test 3: less than 25 mm thickness, PG position, recommended diameter, d.c. –

4 Test 4: less than 25 mm thickness, PE position, recommended diameter, d.c. –

A covered electrode

B tubular cored electrode

C electrode for submerged arc welding

Figure I.1 — Selection of joints for testing

Figure I.1 shows an example of how a choice of joints to be tested may be made from the possible permutations specified in 6.2.1 to 6.2.3.7. Qualification is for a consumable to weld one steel group in all positions and thickness, using d.c. with either polarity. Each required thickness, welding position, consumable diameter and polarity is covered by at least one joint while the total number of joints is limited to four. Note that welding in the PA position also covers the PC position. Any other set of joints taking in all the required variations would be equally acceptable.

Annex J
(informative)

Suggested qualification test report

J.1 Extent of qualification applied for by manufacturer

J.1.1 Parent metals;
J.1.2 Product dimensions;
J.1.3 Heat treatment;
J.1.4 Any restriction on material thickness;
J.1.5 Highest and lowest test temperature;
J.1.6 Type of current and polarity;
J.1.7 Root weldability without backing or sealing run;
J.1.8 Welding positions;
J.1.9 Applicability for single-run and/or multi-run techniques;
J.1.10 Other specific product information (e.g. shielding gas(es) or flux.

J.2 Manufacturer's data

J.2.1 Scope of qualification applied for by the manufacturer or supplier;
J.2.2 Whether qualification is for butt welds and fillet welds or only for fillet welds;
J.2.3 Brand and product name, marking where applicable;
J.2.4 EN standard designation;
J.2.5 Limits of mechanical properties of the all-weld metal in the as welded condition and/or, if applicable, in post weld heat treated conditions;
J.2.6 Limits of chemical composition of the product/all-weld metal;
J.2.7 Description of the covering, flux or filling material in terms of major constituents (e.g. oxides, carbonates, fluorides and metals);
J.2.8 Redrying data, where applicable;
J.2.9 Ferrite content (if requested);
J.2.10 Hydrogen content (if requested).

J.3 Testing

J.3.1 Testing of welding consumable:
- Dimensions EN ISO 544 or EN 760;
- Evidence of chemical composition, e.g. of core wire and coating;
- Product identification;
- Colours or surface condition;

J.3.2 Testing of all-weld metal:
- Welding conditions used;
- Heat treatment conditions, where applicable;
- Verification of chemical composition;
- Verification of mechanical properties;
- Verification of ferrite content, where applicable;
- Review of manufacturer's internal test results;

J.3.3 Testing of welded joint(s):
- Certificates of parent metals used;
- Welding conditions used for the welded joint(s);
- Heat treatment conditions, where applicable;
- Evaluation of the welded joint(s):
  – Non-destructive tests;
  – Mechanical tests;
  – Others;

J.3.4 Evaluation of other tests:
- Resistance to hot cracking;
- Verification of hydrogen content.

J.4 Special tests at the manufacturer's request

J.5 Assessment of conformity and issue of appropriate certificates

J.6 Statement that the certificate is only valid as long as the product is manufactured within the limits tested

J.7 Documentation of the product

The test results shall be included with the associated requirements.

Annex K
(informative)

Type qualification certificate

Name of test body: .....

Manufacturer/Supplier: .....

Form of welding consumable: .....

Product name: .....

European Standard designation: .....

Validity (The validity of this certificate will be stated in the last edition of the list of qualified consumables)

The above mentioned welding consumable is suitable for the following scope of application on the basis of the tests performed:

— parent metals and heat treatment according to : .....

— welding process according to : .....

— welding position according to : .....

— type of current and polarity : .....

— diameter range : .....

— highest test temperature : .....

— lowest test temperature.: .....

— welding unsupported root welds : .....

— multi run welding : .....

— single or two run welding max. thickness : .....

— joint types : .....

Annex L
(informative)

Transfer of qualification – Application

Company's name (manufacturer)

Re.: **Transfer of type qualification for our welding consumable**

.....

(manufacturer's product name)

to the product name

.....

(supplier's product name)

of the company

.....

(supplier's name)

We confirm that we supply the welding consumable

.....

(manufacturer's product name)

Which has been tested by you :.....

Certificate No.: .....

To the company : .....

(supplier's name)

The company : .....

(supplier's name)

Will supply our above-mentioned welding consumable under their product name: .....

.....

(supplier's product name)

The company's declaration of identity (affidavit) is attached (Annex M).

We undertake to notify you in the case of termination of the contract.

Manufacturer's signature.

Enclosure: Supplier's declaration of identity (affidavit).

Annex M
(informative)

Transfer of qualification – Declaration of identity

Company's name (supplier)

Re.: **Type qualification of our welding consumable**

.....

(supplier's product name)

We apply for type qualification of our above-mentioned welding consumable and inform you that this welding consumable is supplied to us only by the company:

.....

(name of manufacturer)

The product in question is the manufacturer's product name:

.....

(manufacturer's product name)

Supplied by the company:

.....

(name of manufacturer)

For whom the qualification certificate No. :.....

has already been issued.

Furthermore, we authorise you to transfer and certify to us any future changes in the range of application of the aforementioned welding consumable.

We apply for transfer and undertake to notify you promptly in the case of termination of the contract.

Supplier's signature.

Annex N
(normative)

Prolongation of qualification – Manufacturer's tests

Table N.1 shows the minimum of tests to be performed within the scope of the manufacturer's in plant testing system required for prolongation of the type qualification test of welding consumables.

Table N.1 — Prolongation of qualification – Manufacturer's tests

Welding consumables		Testing of product within a two year period [a]		Testing of all-weld metal within a two year period [a]		
		Chemical analysis	Sieve analysis	Chemical analysis	Tensile test RT [c]	Impact test [b] Lowest test temperature
covered electrodes and tubular	EN 499 EN 758	no test	no test	10	4	8 [d]
	EN 1600 EN 12073				no test [e]	no test
cored electrodes	EN 1599 EN 12071				4	4
	EN ISO 14172				10	no test
	EN 757 EN 12535				10	10
Fluxes for submerged arc welding		6	10	10	2 [f]	2 [f]
Solid products		per production lot (heat)	no test	no test		

[a] If less than 20 production lots are produced, the chemical composition of every second production lot shall be determined and half the number of tensile test and impact test specimens shall be tested.

[b] One test comprises three specimens.

[c] The specimens shall be taken from the all-weld metal. Test piece according to EN 876. Testing shall be performed in the as-welded condition where acceptable for the all-weld metal. If post weld heat treatment is necessary, testing shall be performed in the softest condition (e.g. quenched and tempered).

[d] If the lowest test temperature is RT only four tests apply.

[e] Except for high temperature austenitics where 10 tests are required.

[f] The specimens shall be taken from all-weld metal which shall be prepared using a 4 mm diameter wire appropriate to the flux. Test piece according to EN 876.

Annex O
(informative)

Qualification under the supervision of a test body

O.1 Introduction

Test and evaluation for the qualification of welding consumables are carried out under the responsibility of the manufacturer/supplier and, at his request, under the supervision of a test body.

It is recommended that the following are agreed between the manufacturer/supplier and the test body.

O.2 Conformity of the product

The manufacturer or supplier shall declare the conformity of the product by identifying the test body on the label with the qualification number. Procedures for maintaining the qualifications are given in O.4.

The methods for conformity assessment deemed suitable for welding consumables are in accordance with the "Global Approach for Certification and Testing"[2]. (from the introduction)

If required by directives, application standards or other technical rules and regulations the conformity of product shall be tested in accordance with the requirements specified by the holder of the certificate.

Necessary information specified in 5.2 shall be submitted to the test body. Sampling, testing and verification of product properties shall be carried out under the supervision of the test body.

O.3 Marking of products

The test body shall verify that the marking of the product and the packaging is in accordance with EN ISO 544 and for fluxes with EN 760. When other markings replacing the product name are used, such markings shall be unique and unambiguous and are entered into the qualification certificate. Production lots manufactured after the type qualification shall be marked with the test body identity on the packaging label of the smallest packaging unit.

O.4 Certificate

After successful completion of the relevant tests and test report, the test body issues a type qualification certificate of the welding consumable according to Annex K on the basis of the type qualification test report.

O.5 Transfer of qualifications

O.5.1 If a supplier wishes to market under his own product name a welding consumable already tested elsewhere, he shall apply for this in writing to the test body which carried out the type qualification test.

O.5.2 Both the manufacturer of the qualified welding consumable and the supplier shall declare in writing to the test body that the welding consumable delivered to the supplier is identical to that which has already been tested.

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[2] 93/465/EWG - Resolution of the council of July 22nd, 1993 on the modules to be used in the technical directives of harmonization for the various phases of the conformity evaluation (Official Journal of the EC No L 220, Aug. 30th, 1993, p.23 ff).

Both parties shall immediately inform the appropriate body should the contractual relationship be terminated (see Annexes L and M).

O.5.3 The supplier will receive the type qualification certificate for the welding consumable which will not mention that it is a transfer. The products of several manufacturers shall not be combined under one product name of the supplier unless the product is traceable by the test body to the manufacturer.

O.6 Prolongation of the type qualification of welding consumables

The test body shall extend the validity of the certificate of a qualified welding consumable after a period not exceeding two years provided the following requirements are met:

a) the manufacturer's in-plant testing system (see EN 12074, EN ISO 9001) is shown to be adequate;

b) the necessary tests as defined in this document (see Annex N) have been carried out and documented by the inspection department of the manufacturer, independent of the production.

If for any reasons the above requirements are not met a corrective action programme shall be agreed between the manufacturer and the test body. If the agreed corrective action programme is not implemented the qualification will be withdrawn.

O.7 Dormant welding consumables type qualification

The validity of a type qualification may be suspended at the manufacturer's request. If the manufacturer subsequently applies for the dormant type qualification to be revived the application shall be accepted if the following conditions are fulfilled.

a) no changes according to 5.2 have occurred compared with the original type qualification;

b) on restarting production the welding consumable shall be tested by means of one set of tests specified in Annex N in the presence of the test body.

Annex P
(informative)

List of material groups according to CR ISO 15608:2000

Table P.1 — Grouping system for steel according to CR ISO 15608:2000

Group	Sub-group	Type of steel
1		Steels with a specified minimum yield strength $R_{eH} \leq 460$ N/mm² [a] and with analysis in % : C ≤ 0,25 Si ≤ 0,60 Mn ≤ 1,70 Mo ≤ 0,70 [b] S ≤ 0,045 P ≤ 0,045 Cu ≤ 0,40 [b] Ni ≤ 0,5 [b] Cr ≤ 0,3 (0,4 for castings) [b] Nb ≤ 0,05 V ≤ 0,12 [b] Ti ≤ 0,05
	1.1	Steels with a specified minimum yield strength $R_{eH} \leq 275$ N/mm²
	1.2	Steels with a specified minimum yield strength 275 N/mm² < $R_{eH} \leq 360$ N/mm²
	1.3	Normalized fine grain steels with a specified minimum yield strength $R_{eH} > 360$ N/mm²
	1.4	Steels with improved atmospheric corrosion resistance whose analysis may exceed the requirements for the single elements as indicated under 1
2		Thermomechanically treated fine grain steels and cast steels with a specified minimum yield strength $R_{eH} > 360$ N/mm²
	2.1	Thermomechanically treated fine grain steels and cast steels with a specified minimum yield strength 360 N/mm² < $R_{eH} \leq 460$ N/mm²
	2.2	Thermomechanically treated fine grain steels and cast steels with a specified minimum yield strength $R_{eH} > 460$ N/mm²
3		Quenched and tempered steels and precipitation hardened steels except stainless steels with a specified minimum yield strength $R_{eH} > 360$ N/mm²
	3.1	Quenched and tempered steels with a specified minimum yield strength 360 N/mm² < $R_{eH} \leq 690$ N/mm²
	3.2	Quenched and tempered steels with a specified minimum yield strength $R_{eH} > 690$ N/mm²
	3.3	Precipitation hardened steels except stainless steels
4		Low vanadium alloyed Cr-Mo-(Ni) steels with Mo ≤ 0,7 % and V ≤ 0,1 %
	4.1	Steels with Cr ≤ 0,3 % and Ni ≤ 0,7 %
	4.2	Steels with Cr ≤ 0,7 % and Ni ≤ 1,5 %

(to be continued)

Table P.1 — Grouping system for steel according to CR ISO 15608:2000 (*concluded*)

Group	Sub-group	Type of steel
5		Cr-Mo steels free of vanadium with C ≤ 0,35 % [c]
	5.1	Steels with 0,75 % ≤ Cr ≤ 1,5 % and Mo ≤ 0,7 %
	5.2	Steels with 1,5 % < Cr ≤ 3,5 % and 0,7 % < Mo ≤ 1,2 %
	5.3	Steels with 3,5 % < Cr ≤ 7,0 % and 0,4 % < Mo ≤ 0,7 %
	5.4	Steels with 7,0 % < Cr ≤ 10,0 % and 0,7 % < Mo ≤ 1,2 %
6		High vanadium alloyed Cr-Mo-(Ni) steels
	6.1	Steels with 0,3 % ≤ Cr ≤ 0,75 %, Mo ≤ 0,7 % and V ≤ 0,35 %
	6.2	Steels with 0,75 % < Cr ≤ 3,5 %, 0,7 % < Mo ≤ 1,2 % and V ≤ 0,35 %
	6.3	Steels with 3,5 % < Cr ≤ 7,0 %, Mo ≤ 0,7 % and 0,45 % ≤ V ≤ 0,55 %
	6.4	Steels with 7,0 % < Cr ≤ 12,5 %, 0,7 % < Mo ≤ 1,2 % and V ≤ 0,35 %
7		Ferritic, martensitic or precipitation hardened stainless steels with C ≤ 0,35 % and 10,5 % ≤ Cr ≤ 30 %
	7.1	Ferritic stainless steels
	7.2	Martensitic stainless steels
	7.3	Precipitation hardened stainless steels
8		Austenitic steels
	8.1	Austenitic stainless steels with Cr ≤ 19 %
	8.2	Austenitic stainless steels with Cr > 19 %
	8.3	Manganese austenitic stainless steels with 4 % < Mn ≤ 12 %
9		Nickel alloyed steels with Ni ≤ 10,0 %
	9.1	Nickel alloyed steels with Ni ≤ 3,0 %
	9.2	Nickel alloyed steels with 3,0 % < Ni ≤ 8,0 %
	9.3	Nickel alloyed steels with 8,0 % < Ni ≤ 10,0 %
10		Austenitic ferritic stainless steels (duplex)
	10.1	Austenitic ferritic stainless steels with Cr ≤ 24 %
	10.2	Austenitic ferritic stainless steels with Cr > 24 %
11		Steels covered by group 1 [d] except 0,25 % < C ≤ 0,5 %
	11.1	Steels as indicated under 11 with 0,25 % < C ≤ 0,35 %
	11.2	Steels as indicated under 11 with 0,35 % < C ≤ 0,5 %

[a] In accordance with the specification of the steel product standards, R_{eH} may be replaced by $R_{p0,2}$ or $R_{t0,5}$.
[b] A higher value is accepted provided that Cr + Mo + Ni + Cu + V ≤ 0,75 %.
[c] "Free of vanadium" means not deliberately added to the material.
[d] A higher value is accepted provided that Cr + Mo + Ni + Cu + V ≤ 1 %.

Table P.2 — Grouping system for nickel and nickel alloys according to CR ISO 15608:2000

Group	Type of nickel and nickel alloys
41	Pure nickel
42	Nickel-copper alloys (Ni/Cu) Ni ≥ 45 %, Cu ≥ 10 %
43	Nickel-chromium alloys(Ni/Cr/Fe/Mo) Ni ≥ 40 %
44	Nickel-molybdenum alloys (Ni/Mo) Ni ≥ 45 %, Mo ≤ 32 %
45	Nickel-iron-chromium alloys (Ni/Fe/Cr) Ni ≥ 30 %
46	Nickel-chromium-cobalt alloys (Ni/Cr/Co) Ni ≥ 45 %, Co ≥ 10 %
47	Nickel-iron-chromium-copper alloys (Ni/Fe/Cr/Cu) Ni ≥ 45 %
48	Nickel-iron-cobalt alloys (Ni/Fe/Co/Cr/Mo/Cu) 25 % ≤ Ni ≤ 45 % and Fe ≥ 20 %

Bibliography

[1] EN ISO 9692-1, *Welding and allied processes — Recommendation for joint preparation — Part 1: Manual metal-arc welding, gas-shielded metal-arc welding, gas welding, TIG welding and beam welding of steels (ISO 9692-1:2003).*

[2] EN ISO 9001, *Quality management systems — Requirements (ISO 9001:2000).*

[3] EN 12074, *Welding consumables — Quality requirements for manufacture, supply and distribution of consumables for welding and allied processes.*

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