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Industrial valves — Requirements and testing for metallic valves as pressure accessories

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European foreword

This document (EN 16668:2016) has been prepared by Technical Committee CEN/TC 69 “Industrial valves”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by October 2016, and conflicting national standards shall be withdrawn at the latest by October 2016.

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For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

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Introduction

This European Standard is to be understood as an umbrella standard referencing European harmonized Standards for industrial metallic valves as pressure accessories for industrial applications and covers the relevant minimum requirements to meet the Essential Safety Requirements of the Pressure Equipment Directive.

1 Scope

This European standard applies to metallic valves as pressure accessories for industrial applications with a maximum allowable pressure PS greater than 0,5 bar in accordance with the Pressure Equipment Directive 2014/68/EU and specifies minimum requirements applicable to design, manufacture, testing, materials and documentation.

All relevant essential safety requirements of the Pressure Equipment Directive 2014/68/EU applicable to valves have been taken into consideration and are addressed in this standard.

This standard is not applicable to:

— safety valve and bursting disc (a safety accessory),

— sight glass with its frames (component of a pressure equipment) and

— measurement chambers.

For other exclusions refer to the PED [32].

2 Normative references

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

EN 19:2002, *Industrial valves — Marking of metallic valves*

EN 287-1:2011,[1] *Qualification test of welders — Fusion welding — Part 1: Steels*

EN 545:2010, *Ductile iron pipes, fittings, accessories and their joints for water pipelines — Requirements and test methods*

EN 593, *Industrial valves — Metallic butterfly valves*

EN 736-1:1995, *Valves — Terminology — Part 1: Definition of types of valves*

EN 764 (all parts), *Pressure equipment*

EN 764-4:2014, *Pressure equipment — Part 4: Establishment of technical delivery conditions for metallic materials*

EN 764-5:2014, *Pressure equipment — Part 5: Inspection documentation of metallic materials and compliance with the material specification*

EN 1171, *Industrial valves — Cast iron gate valves*

EN 1349:2009, *Industrial process control valves*

EN 1515-4:2009, *Flanges and their joints — Bolting — Part 4: Selection of bolting for equipment subject to the Pressure Equipment Directive 97/23/EC*

1) This document was superseded with EN ISO 9606-1:2013, *Qualification testing of welders — Fusion welding — Part 1: Steels (ISO 9606-1:2012 including Cor 1:2012)*.

EN 1561:2011, *Founding — Grey cast irons*

EN 1982:2008, *Copper and copper alloys — Ingots and castings*

EN 1983, *Industrial valves — Steel ball valves*

EN 1984, *Industrial valves — Steel gate valves*

EN 10025-2:2004, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

EN 10222–2:1999, *Steel forgings for pressure purposes — Part 2: Ferritic and martensitic steels with specified elevated temperature properties*

EN 10269:2013, *Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties*

EN 12163:2011, *Copper and copper alloys — Rod for general purposes*

EN 12164:2011, *Copper and copper alloys — Rod for free machining purposes*

EN 12266-1:2012, *Industrial valves — Testing of metallic valves — Part 1: Pressure tests, test procedures and acceptance criteria — Mandatory requirements*

EN 12266-2:2012, *Industrial valves — Testing of metallic valves — Part 2: Tests, test procedures and acceptance criteria — Supplementary requirements*

EN 12288, *Industrial valves — Copper alloy gate valves*

EN 12334, *Industrial valves — Cast iron check valves*

EN 12449:2012, *Copper and copper alloys — Seamless, round tubes for general purposes*

EN 12516-1:2014, *Industrial valves — Shell design strength — Part 1: Tabulation method for steel valve shells*

EN 12516-2:2014, *Industrial valves — Shell design strength — Part 2: Calculation method for steel valve shells*

EN 12516-3:2002, *Valves — Shell design strength — Part 3: Experimental method*

EN 12516-4:2014, *Industrial valves — Shell design strength — Part 4: Calculation method for valve shells manufactured in metallic materials other than steel*

EN 13397, *Industrial valves — Diaphragm valves made of metallic materials*

EN 13445-2:2014, *Unfired pressure vessels — Part 2: Materials*

EN 13445-4:2014, *Unfired pressure vessels — Part 4: Fabrication*

EN 13445-5:2014, *Unfired pressure vessels — Part 5: Inspection and testing*

EN 13480-2:2012, *Metallic industrial piping — Part 2: Materials*

EN 13709, *Industrial valves — Steel globe and globe stop and check valves*

EN 13789, *Industrial valves — Cast iron globe valves*

EN 14341, *Industrial valves — Steel check valves*

EN ISO 5817:2014, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817:2014)*

EN ISO 9606 (all parts), *Qualification testing of welders — Fusion welding (ISO 9606, all parts)*

EN ISO 9712:2012, *Non-destructive testing — Qualification and certification of NDT personnel (ISO 9712:2012)*

EN ISO 14732:2013, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732:2013)*

EN ISO 15609-1:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO 15609-1:2004)*

EN ISO 15613:2004, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test (ISO 15613:2004)*

EN ISO 15614-1:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1:2004)*

EN ISO 15614-2:2005, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 2: Arc welding of aluminium and its alloys (ISO 15614-2:2005)*

EN ISO 15614-5:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 5: Arc welding of titanium, zirconium and their alloys (ISO 15614-5:2004)*

EN ISO 15614-6:2006, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 6: Arc and gas welding of copper and its alloys (ISO 15614-6:2006)*

EN ISO 17635:2010, *Non-destructive testing of welds — General rules for metallic materials (ISO 17635:2010)*

3 Terms and definitions

For the purposes of this document, the terms and definitions of EN 736-1, EN 764 (all parts) and the following apply.

3.1
valve
piping component which influences the fluid flow by opening, closing or partially obstructing the passage of the fluid flow or by diverting or mixing the fluid flow

Note 1 to entry Typical valves are gate valves, globe valves, control valves, check valves, diaphragm valves, butterfly valves, plug and ball valves as well as non-standard valves either manual or actuator operated and steam traps, usually covered by a product standard.

[SOURCE: EN 736-1:1995, modified — The Note 1 to entry was added here.]

3.2
production welding
welding carried out during manufacturing before final delivery to the purchaser including joint welding and finishing welding

3.2.1
joint welding
welding used to weld components in order to obtain an integral unit

3.2.2
finishing welding
welding carried out in order to ensure the agreed quality of the casting

[SOURCE: EN ISO 11970:2007, 3.1.2]

3.3
repair welding
welding carried out after delivery to the end user, i.e. after the casting has been in service

[SOURCE: EN ISO 11970:2007, 3.2, modified — The article "any" was deleted at the beginning of the definition.]

3.4
sample
set of one or more units taken from a batch and intended to provide information on the batch

Note 1 to entry: This definition is based on ISO 2859-1.

3.5
material manufacturer
person or organization (like founder, forge-, welding shop) which provides material to the responsible valve manufacturer

4 Category of valves

4.1 Classification of valves

A classification under the use of DN and PS and fluid groups 1 and 2 leads to maximum category III. For respective results see Annex A.

4.2 Sound engineering practice

Valves classified in Article 3 (3), PED, are excluded from conformance to requirements of this standard but shall meet the “sound engineering practice” by conformity to the relevant product standard.

5 Requirements

5.1 Design

5.1.1 General

Valves shall meet the design requirements of this standard and the ones referenced in Annex ZA of their relevant European harmonized standards.

NOTE Annex D contains a summary of European harmonized Standard for valves.

The manufacturer shall conduct a hazard analysis for the intended use and for the reasonably foreseeable conditions.

It is recommended to have this hazard analysis documented.

If the manufacturer identifies hazards which apply to the valve the manufacturer shall take account of his analysis by appropriate measures in order to reduce or eliminate the hazard identified.

5.1.2 Shell design strength

The shell design strength shall be determined by the following:

a) for steel valves designed by the tabulation method: according to EN 12516-1:2014;

b) for steel valves designed by calculation: according to EN 12516-2:2014;

c) for copper alloy, aluminium and cast iron valves: according to EN 12516-4:2014;

d) if the shell strength resistance is validated by an experimental method: according to EN 12516-3:2002.

Appropriate calculation methods other than those specified in the relevant European harmonized standards giving same level of safety may be applied.

NOTE The valve obturator normally is no part of the shell – except if an "end of line service" is agreed between valve manufacturer and customer – in this case all PED requirements apply to the obturator as well.

WARNING — Basis of design shall comply with the PED, Annex I, 2.2.2 to 2.2.4. The use of experimental design methods without calculation is limited.

5.1.3 Protection against exceeding the allowable limits

If the hazard analysis identifies the allowable limits under reasonably foreseeable conditions could be exceeded, manufacturer shall fit the valve with a suitable protective device.

5.2 Materials

5.2.1 General requirements

Shell materials shall be selected in EN 12516-1:2014, EN 12516-4:2014 or EN 13445-2:2014. Other metallic shell materials may be used providing they are covered by an EAM or PMA.

The inspection documents of material shall be in accordance with EN 764-5:2014.

NOTE EAM or PMA is not required for valves with PS ≤ 0,5 bar and valves classified in Art 3 (3) of the PED.

Where relevant the requirements given in EN 764–4:2014 should be considered.

5.2.2 European harmonized standards

A summary of Harmonized European Material Standards for shell parts is given in Annex B.

5.2.3 European approval of materials (EAM)

EAM for materials are intended for repeated use. They are established in accordance with EN 764-4:2014 and apply to materials or treatment condition and product forms or dimensions not covered in a European Harmonized Standard.

Annex C contains a link to OJEU Website for European approval of materials (EAM).

5.2.4 Particular Material Appraisal (PMA)

If no material according to a harmonized European material standard is available the manufacturer is obliged to perform or obtain the required particular material appraisal (PMA).

PMA apply also as follows:

— a material or a product form or a thickness not covered by a European material Standard or EAM;

— a material specified in a European material Standard or EAM for materials for pressure equipment is intended in an exceptional case for service conditions outside its specified range of application.

Table 1 shows a selection of EN material standards covering materials for which it is required to obtain a PMA when used as shell material.

Table 1 — EN material standards for which a PMA is required

Main material group	European Standard / Material
Steels specified in European standards	EN 10025–2:2004 (S235JR, S235JRG2 and S355J2G3) EN 10222–2:1999 (P250GH)
Cast irons	EN 1561:2011 EN 545:2010
Copper	EN 1982:2008 EN 12449:2012 EN 12163:2011 EN 12164:2011

5.2.5 Requirements for prevention of brittle fracture at low temperatures

It is the responsibility of the manufacturer to apply appropriate methods for the prevention of brittle fracture at low temperatures. Temperature limits as given in EN 12516-1:2014 and EN 12516-4:2014 shall be considered.

The methods to prevent brittle fracture at low temperatures described in EN 13480-2:2012 and EN 13445-2:2014, Annex B shall be applied.

5.2.6 Selection of bolting material

Material selection for bolting shall be in accordance to EN 10269:2013. Other bolting materials may be used providing they are covered by an EAM or PMA.

EN 1515-4:2009 provides a selection of bolting for equipment subject to the Pressure Equipment Directive 2014/68/EU.

5.2.7 Material selection for parts other than shell

Material selection for parts other than shell is the responsibility of the valve manufacturer.

The stuffing box packing shall not cause corrosion on a stem, shaft or pivot.

NOTE Asbestos materials are not allowed.

5.3 Manufacturing

5.3.1 Welding

5.3.1.1 General requirements

Welding of the shell itself or on components of shell shall only be undertaken if the following conditions are satisfied:

a) a welding procedure specification is held by the manufacturer;

b) the welding procedures selected by the manufacturer are qualified for the field of application;

c) the welders and welding operators are qualified for the work allocated to them and their approval is valid.

Welding of high-alloy martensitic chromium steels (>13 % Cr) requires particular qualification, except casting production welds at the foundry.

NOTE The provision of the fabrication drawings with welding data (weld details, welding procedure and welding fillers) including information on type and extent of non-destructive testing of welding seams, parts lists and copies of the welding procedure qualifications may be subject to agreement between manufacturer and purchaser.

5.3.1.2 Welding procedure specification (WPS)

The manufacturer shall compile welding procedure specifications, in accordance with EN ISO 15609-1:2004 for all welds.

5.3.1.3 Qualification of welding procedure specifications (WPQR)

Welding procedure specifications to be used shall be qualified by reference to an appropriate WPQR.

For the pressure retaining welds of a shell this shall be achieved by performing welding procedure qualification tests in accordance with EN ISO 15614-1:2004, EN ISO 15614-2:2005, EN ISO 15614-5:2004, EN ISO 15614-6:2006 or by preproduction tests in accordance with EN ISO 15613:2004.

For additional requirements to be considered in course of the qualification of welding procedure qualification see EN 13445-4:2014. It is regarded as the obligation of the valve manufacturer to meet the supplementary requirements as applicable.

5.3.1.4 Approval of welders and welding operators

Welders and welding operators shall be qualified according to the applicable part of the EN ISO 9606-series, whereas qualification testing of welders for the fusion welding of steels shall be qualified according to EN 287-1:2011 until EN ISO 9606-1:2013 is published in the Official Journal (OJEU). Qualification of welding operators shall be in accordance with EN ISO 14732:2013.

In the course of the qualification welding of personnel, the additional requirements of EN 13445-4:2014 apply. It is regarded as the obligation of the valve manufacturer to meet the supplementary requirements as applicable.

5.3.1.5 Finishing welding on castings

Finishing welding is only permissible on steel castings.

When carrying out finishing welding on steel castings, the defective area shall be completely rectified; it shall be tested for freedom from inadmissible imperfections.

Finishing welding shall be performed in accordance with a written procedure specifying the requirements for defect removal, welding, heat treatment and non-destructive testing.

Undocumented finishing welding prior to PWHT is permissible provided the defect depth does not exceed 40 % of the wall thickness.

Undocumented finishing welding after PWHT is permissible, provided that the defect depth does not exceed 20 % of the wall thickness or 25 mm, whichever is the smallest value.

Depressions resulting from the removal of imperfections shall be 100 % surface tested in order to ensure the complete removal of the defect. For the surface testing, magnetic particle testing (MT) or penetrant testing (PT) shall be applied as appropriate.

5.3.1.6 Repair of joint weld defects

For requirements for repair of joint weld defects see EN 13445-4:2014, 11.2.

Repair work on the welds and NDE results to be documented and made available to the purchaser on request.

All unacceptable imperfections shall be removed, either by mechanical means (such as grinding or machining) or by thermal means (such as arc air gouging or thermal gouging) or by a combination of thermal and mechanical means. It is the responsibility of the manufacturer to decide how unacceptable imperfections shall be removed. This may be by local means or by removal of the weld from the joint followed by rewelding.

When thermal gouging/arc air gouging is used on austenitic steels, care shall be taken to remove any contamination of the remaining weld or material. Similarly when gouging with carbon electrodes is used on ferritic steels, the affected surface shall be removed by mechanical means to a minimum depth of 0,3 mm.

Thermal gouging methods may not be used for martensitic creep-resisting steel.

When unacceptable imperfections are removed and are not followed by welding, all the remaining thickness shall be greater than the minimum thickness necessary to satisfy the design unless the local area satisfies the conditions of 5.3.2. The area shall have a taper with the adjoining surfaces, and blend smoothly.

Repairs by welding shall be carried out in accordance with a WPS which has been qualified in accordance with 5.3.1.4.

This may be the same WPS as the one used for making the joint originally or a specific qualified repair procedure.

Repairs shall be carried out by qualified welders or operators in accordance with 5.3.2. Weld repaired areas shall be non-destructively examined in accordance with EN 13445-5:2014.

When repair welding is carried out after post weld heat treatment or hydraulic test these operations shall be repeated. Any further post weld heat treatment carried out in accordance with 5.3.2 shall be considered in terms of its effect on material and weld properties.

5.3.1.7 Filler metals and auxiliary materials

For requirements for Filler metals and auxiliary materials see EN 13445-4:2014, 7.5.

5.3.2 Heat treatment

Heat treatment shall be performed whenever this is required to achieve the required mechanical properties of the materials used for shell parts.

For requirements regarding post weld heat treatment (PWHT) see EN 13445-4:2014.

5.3.3 Traceability

Suitable procedures shall be established and maintained by the material manufacturer and valve manufacturer for identifying the material making up the shell and components of the shell as well as weldings which contribute to pressure resistance by suitable means from receipt, through production, up to the final test of the manufactured pressure equipment.

5.3.4 Qualification of non-destructive testing personnel

Non-destructive testing personnel shall be qualified and certified in accordance with EN ISO 9712:2012 except for visual inspection for which personnel shall be qualified but need not be certified. Non-destructive testing personnel shall hold an appropriate certificate of competence (e.g. personnel certification on non-destructive testing level 1, 2 or 3 as appropriate).

5.4 Non-destructive testing (NDT)

5.4.1 Non-destructive testing of steel castings

For non-destructive testing of steel castings guidance is given in Annex E.

5.4.2 Non-destructive testing of joint welding

Non-destructive testing of joint welding shall be in accordance with Annex F.

5.5 Final assessment

Valves shall meet the requirements given in Table 2 and Table 3 below.

Table 2 — Inspection

Assessment	Subject	Requirements
Visual assessment	Type of valve	Conformity to purchaser specification
	Material	Conformity to purchaser specification
	Marking	see 5.6
	Surface and coating	see 5.7
Documentation	As appropriate	see 5.8
NOTE As appropriate the final inspection is carried out internally and externally on every part of the valve, in the course of manufacture (e.g. where testing during the final inspection is no longer possible).		

Table 3 — Testing

Requirements	Testing and Inspection - Remarks
1 Shell strength	EN 12266–1:2012, Annex A, A.2, Test P10; Process control valves shall also complied with EN 1349:2009, 6.1
2 Shell tightness If the result of hazard analyses identifies the need of the shell tightness test P11, it is required.	EN 12266–1:2012, Annex A, A.3, Test P11; Process control valves shall also complied with EN 1349:2009, 6.1
3 Seat tightness If the result of hazard analyses identifies the need for seat tightness test, then P12 test is required.	EN 12266–1:2012, Annex A, A.4, Test P12; For Process control valves the EN 1349:2009, 6.3 shall be applied.
4 Obturator strength If a pressure related hazard is identified in relation with the obturator of the valve (for example in valves used as end of line service), P 20 Test of EN 12266–2:2012 is required in addition.	EN 12266–2:2012, Annex A, A.2, Test P 20

5.6 Marking

Marking shall be in accordance with EN 19:2002 and the relevant harmonized European product standards.

5.7 Surface and coating testing

Protective coating or special surface treatment shall be inspected or tested in accordance with the purchaser specification.

5.8 Documentation

5.8.1 Documentation for final inspection

In general the following technical documents shall be available as appropriate:

— evidence of qualification of NDT personnel relevant to the equipment category;

— evidence of qualification of permanent joining personnel relevant to the equipment category;

— data dealing with heat treatment (e.g. diagram of temperatures);

— inspection documents for base materials and welding consumables;

— procedures for assuring material traceability;

— NDT test reports, including radiographic films;

— test reports of destructive tests (e.g. test coupons);

— reports on defects or deviations arising during manufacture;

— data related to the preparation of component parts (e.g. forming chamfering);

— evidence of qualification of permanent joining procedures;

— reports on testing according to EN 12266-1 and EN 12266-2 (as applicable).

The rules of the Pressure Equipment Directive 2014/68/EU and the product specification, which includes the technical delivery conditions, shall be applied. If an inspection certificate 3.1 is required, the quality system of the material manufacturer shall fulfil EN 764-5.

5.8.2 Accompanying documents

— Operating instructions shall be supplied by the manufacturer for valves with CE-marking.

NOTE 1 Valves with PS ≤ 0,5 bar and valves under PED, Article 3 (3) to be accompanied by an adequate instruction for use.

NOTE 2 To deliver the Declaration of Conformity is subject of agreement between manufacturer and purchaser.

— The manufacturer's declaration shall make reference to this standard.

  Valves with PS ≤ 0,5 bar and valves under PED, Article 3 (3) may be accompanied with a “statement of conformity” of sound engineering practice.

— The supply of technical documentation is subject to agreement (see 5.8.1).

Annex A
(normative)

Classification of valves

For all valves covered by the product standards listed in Table A.1 nominal size (DN), maximum allowable pressure (PS) and the fluid group are considered as appropriate for valve classification as shown in Tables A.2 to A.5. Consequently the maximum PED category for these valves ends up in category III even when installed in a higher categorized pressure equipment.

NOTE For valves not covered by product standards listed in Table A.1 it is the manufacturer's responsibility to consider either the volume (V) or the nominal size (DN) for the classification of the valve.

The value PS (maximum allowable pressure), for PN designated valves PS is equal to PN, is the value specified in EN 12516-1:2014 or by the manufacturer.

Valves, which shall be used both for liquid and for gaseous fluids, shall be classified for gaseous fluids.

Valves, which shall be used both for fluids of Fluid Group 1 and fluids of Fluid Group 2, shall be classified in Fluid Group 1.

Table A.1 — Harmonized product standards

Reference and title of the European harmonized product standard
EN 593, *Industrial valves — Metallic butterfly valves*
EN 1171, *Industrial valves — Cast iron gate valves*
EN 1349, *Industrial process control valves*
EN 1983, *Industrial valves — Steel ball valves*
EN 1984, *Industrial valves — Steel gate valves*
EN 12288, *Industrial valves — Copper alloy gate valves*
EN 12334, *Industrial valves — Cast iron check valves*
EN 13397, *Industrial valves — Diaphragm valves made of metallic materials*
EN 13709, *Industrial valves — Steel globe and globe stop and check valves*
EN 13789, *Industrial valves — Cast iron globe valves*
EN 14341, *Industrial valves — Steel check valves*

NOTE The following tables are based on Table 6 to 9 of PED, Annex II.

Table A.2 — Fluid Group 1 – Gas

PN	Class	DN 25	DN 32	DN 40	DN 50	DN 65	DN 80	DN 100	DN 125	DN 150	DN 200	DN 250	DN 300	DN 350	DN 400	DN 450	DN 500	DN 600	DN 700	DN 750	DN 800	DN 900	DN 1000
2,5																							
6				Category I																			
10																							
16																							
	150																						
25																							
40														Category III									
	300				Category II																		
63		Art. 3 (3)																					
100																							
	600																						
	900																						
160																							
	1500																						
250																							
	2500																						
320																							
400																							
	4500																						

Exceptionally, valves intended for unstable gasses and falling within Categories I or II shall be classified in Category III.

NOTE For module selection see Table A.6.

Table A.3 — Fluid Group 1 – Liquid

PN	Class	DN 25	DN 32	DN 40	DN 50	DN 65	DN 80	DN 100	DN 125	DN 150	DN 200	DN 250	DN 300	DN 350	DN 400	DN 450	DN 500	DN 600	DN 700	DN 750	DN 800	DN 900	DN 1000
2,5																							
6					Art. 3 (3)																		
10															Category I								
16																							
	150																						
25																							
40																							
	300																						
63											Category II												
100																							
	600																						
	900																						
160																							
	1500																						
250																							
	2500																						
320																							
400																							
	4500								Category III														

Valves with a PN 2.5 and a DN > DN 800 shall be classified in Category I.

NOTE For module selection see Table A.6.

Table A.4 — Fluid Group 2 – Gas

PN	Class	DN 25	DN 32	DN 40	DN 50	DN 65	DN 80	DN 100	DN 125	DN 150	DN 200	DN 250	DN 300	DN 350	DN 400	DN 450	DN 500	DN 600	DN 700	DN 750	DN 800	DN 900	DN 1000
2,5																							
6																							
10			Art. 3 (3)																				
16																							
	150																						
25																							
40																							
	300																						
63						Category I				Category II					Category III								
100																							
	600																						
	900																						
160																							
	1500																						
250																							
	2500																						
320																							
400																							
	4500																						

Exceptionally, valves containing fluids at a temperature greater than 350°C and falling within Category II shall be classified in Category III.

NOTE For module selection see Table A.6.

Table A.5 — Fluid Group 2 – Liquid

PN	Class	DN 25	DN 32	DN 40	DN 50	DN 65	DN 80	DN 100	DN 125	DN 150	DN 200	DN 250	DN 300	DN 350	DN 400	DN 450	DN 500	DN 600	DN 700	DN 750	DN 800	DN 900	DN 1000
2,5																							
6																							
10																							
16																							
	150																						
25																							
40						Art. 3 (3)																		
	300																						
63															Category I								
100																							
	600																						
	900																						
160																							
	1500																						
250																							
	2500																						
320																							
400																							
	4500														Category II								

NOTE For module selection see Table A.6.

Table A.6 — Module selection – PED, Annex II, Article Section 1

Category	**I**	**II**	**III**	**IV**
Modules	A	A1	B1 + D	G
	–	D1	B1 + F	–
	–	E1	B + E	B + D
	–	–	B + C1	B + F
	–	–	H	H1
NOTE Higher modules can be used for lower categories.				

Annex B
(informative)

European harmonized standards for materials and components for shell parts

To give guidance and gather awareness, Table B.1 summarizes European harmonized standards for materials and components for shell parts to provide an overview to the user of this standard. The latest edition of the Official Journal of the European Union (OJEU) shall be used.

The user is advised that:

— standards may be deleted or added to this list,

— only those issues and amendment as listed in the actual Official Journal of the European Union have the status of an European harmonized Standard,

— the actual list of European harmonized Standard can be found at the European Commission's home page.

Table B.1 — European harmonized standards for materials and components for shell parts

Product Form	Steel other than stainless steel	Stainless steel	Aluminium	Copper
Plate and strip	EN 10028–2 EN 10028–3 EN 10028–4 EN 10028–5 EN 10028–6	EN 10028–7	EN 12392	EN 1653
Bar	EN 10273	EN 10272	EN 12392	–
Seamless tube	EN 10216–1 EN 10216–2 EN 10216–3 EN 10216–4 EN 10305–4	EN 10216–5	EN 12392	EN 1057 EN 12451 EN 12452 EN 12735–1 EN 12735–2 EN 13348
Welded tube	EN 10217–1 EN 10217–2 EN 10217–3 EN 10217–4 EN 10217–5 EN 10217–6 EN 10305–6	EN 10217–7	– (EN 13480–8 [a])	–
Fitting	EN 10253–2	EN 10253–4	– (EN 13480–8[a])	–
Forging	EN 10222–2 EN 10222–3 EN 10222–4	EN 10222–5	EN 12392	EN 12420
Steel castings	EN 10213	EN 10213	–	–
Cast Iron	EN 1562 EN 1563 EN 1564	EN 13835	–	–
Steel for fasteners	EN 10269	EN 10269	–	–

NOTE The standards referenced are those listed in the Official Journal of the European Union 2014/C313/53 dated 12th September 2014.

[a] EN 13480–8 specifies requirements for parts such as welded tubes and fittings. For further information refer to NOTE 1 in EN 13480–8:2012, 8.2.1.

Annex C
(informative)

European Approval of Materials (EAM)

Detailed information concerning European Approval of Materials is available from the following address:

http://ec.europa.eu/growth/sectors/pressure-gas/pressure-equipment/directive/index_en.htm

The user is advised that the actual list of European Approval of Materials can be found at the European Commission's home page.

Annex D
(informative)

European harmonized supporting standards for valves

To give guidance and gather awareness, Table D.1 summarizes European harmonized standards for valves to provide an overview to the user. The latest edition of the Official Journal of the European Union (OJEU) shall be used.

NOTE The standards referenced are those listed in the Official Journal of the European Union 2014/C 313/53 dated 12th September 2014.

The user is advised that

— standards may be deleted or added to this list,

— only those issues and amendment as listed in the actual Official Journal of the European Union have the status of an European harmonized Standard,

— the actual list of European harmonized Standard can be found at the European Commission's home page.

Table D.1 — Overview of European harmonized standards for valves

Reference and title of the European harmonized supporting standard
EN 19, *Industrial valves — Marking of metallic valves*
EN 334, *Gas pressure regulators for inlet pressures up to 100 bar*
EN 593, *Industrial valves - Metallic butterfly valves*
EN 1171, *Industrial valves — Cast iron gate valves*
EN 1349, *Industrial process control valves*
EN 1626, *Cryogenic vessels — Valves for cryogenic service*
EN 1983, *Industrial valves — Steel ball valves*
EN 1984, *Industrial valves — Steel gate valves*
EN 12178, *Refrigerating systems and heat pumps — Liquid level indicating devices — Requirements, testing and marking*
EN 12263, *Refrigerating systems and heat pumps — Safety switching devices for limiting the pressure — Requirements and tests*
EN 12266–1, *Industrial valves — Testing of valves — Part 1: Pressure tests, test procedures and acceptance criteria — Mandatory requirements*
EN 12266–2, *Industrial valves — Testing of metallic valves — Part 2: Tests, test procedures and acceptance criteria — Supplementary requirements*
EN 12284, *Refrigerating systems and heat pumps — Valves — Requirements, testing and marking*
EN 12288, *Industrial valves — Copper alloy gate valves*

EN 12334, *Industrial valves — Cast iron check valves*
EN 12516–1, *Industrial valves — Shell design strength — Part 1: Tabulation method for steel valve shells*
EN 12516–2, *Industrial valves — Shell design strength — Part 2: Calculation method for steel valve shells*
EN 12516–3, *Valves — Shell design strength — Part 3: Experimental method*
EN 12516–4, *Industrial valves — Shell design strength — Part 4: Calculation method for valve shells manufactured in metallic materials other than steel*
EN 13175, *LPG equipment and accessories — Specification and testing for Liquefied Petroleum Gas (LPG) tank valves and fittings*
EN 13371, *Cryogenic vessels — Couplings for cryogenic service*
EN 13397, *Industrial valves — Diaphragm valves made of metallic materials*
EN 13611, *Safety and control devices for gas burners and gas burning appliances — General requirements*
EN 13709, *Industrial valves — Steel globe and globe stop and check valves*
EN 13789, *Industrial valves — Cast iron globe valves*
EN 14341, *Industrial valves — Steel check valves*

Annex E
(informative)

Non-destructive testing of steel castings

E.1 Terms and Definitions

The following additional terms and definitions are used within this annex.

E.1.1

individual production

manufacturing of individual components that is not followed by subsequent series production

E.1.2

initial sample

first component manufactured under conditions of series production, on which no finishing welding has been carried out when the decision regarding the further procedure (result of non-destructive tests) is taken

E.1.3

series production

components produced maintaining the same conditions as for the initial batch, independent of the time

E 1.4

quality level

definition to evaluate the soundness of a cast, based on the type, size and amount of selected imperfections

E.2 Non-destructive testing of steel castings

E.2.1 General

Regarding the general requirements for cast steel parts, EN 1559-1 and EN 1559-2 apply in addition to the material standards.

For the non-destructive testing, the extent of testing to verify the quality level and permissible indicating characteristics given in Table E.3 shall apply. Depending on the different requirements for the internal and external conditions of castings, cast steel shall be delivered in quality levels classified with Table E.1 and Table E.2. The standards to be applied for non-destructive testing are given in Table E.1 and Table E.2.

The non-destructive testing personnel shall be certified for the test methods given in Table E.1 and Table E.2. The acceptance standards and criteria are given in Table E.3.

In the case of a surface testing or a volumetric on shell resulting in inadmissible indications and/or findings, the finishing weldings are carried out as shown in Figure E.1 or E.2.

Each finishing welding shall be subjected to a surface testing and, for the quality level 1, 2 and 3, to a volumetric testing. For wall openings, the surface testing shall be carried out on both sides of the finishing welding; here, a radiographic testing and/or an ultrasonic testing shall be performed in addition.

The relevant surface testing as well as the ultrasonic testing to be carried out if appropriate shall be performed following the final heat treatment; the radiographic testing can be carried out prior to the final heat treatment.

Table E.1 — NDE extent for butt weld ends in steel castings depending on quality level

Material Group[c]	Classification based on PS x DN [bar x mm]	Wall thickness limit	Quality level[a] weld ends	Surface testing MT/PT[b] [%]		Volumetric testing RT [%]	
				initial sample	Series production	initial sample	Series production
A, B, C	≤ 20 000	≤ 51 mm	1	100	random testing on areas identified as critical on initial sample or at generally difficult-to-cast locations.	100	random testing on areas identified as critical on initial sample or at generally difficult-to-cast locations.
	> 20 000	≤ 51 mm	1		10 % of the castings of each batch with a minimum of one casting per batch shall be tested on critical areas identified by initial sample or at generally difficult to cast locations		10 % of the castings of each batch with a minimum of one casting per batch shall be tested on critical areas identified by initial sample or at generally difficult to cast locations
	> 20 000	> 51 mm to 115 mm	1		100 % of the castings of each batch shall be tested at generally difficult to cast locations		100 % of the castings of each batch shall be tested at generally difficult to cast locations
	> 20 000	> 115 mm to 300 mm	1				

a For quality levels and the related permissible indicating characteristics see Table E.3.

b For magnetisable steel casting magnetic particle testing (MT) is preferred.

c For a material groups see Annex F.

Table E.2 — NDE extent for shell in steel castings depending on quality level

Material Group[c]	Classification based on PS x DN [bar x mm]	Wall thickness limit	Quality level[a] shell	Surface testing MT/PT[b] [%] initial sample	Surface testing MT/PT[b] [%] Series production	Volumetric testing RT [%] initial sample	Volumetric testing RT [%] Series production
A, B, C	≤ 3 500	–	4	100	not imposed	100	not imposed
	> 3 500 up to ≤ 20 000		4		random testing on areas identified as critical on initial sample or at generally difficult-to-cast locations.		random testing on areas identified as critical on initial sample or at generally difficult-to-cast locations.
	> 20 000	< 51 mm	3		10 % of the castings of each batch with a minimum of one casting per batch shall be tested on critical areas identified by initial sample or at generally difficult to cast locations		10 % of the castings of each batch with a minimum of one casting per batch shall be tested on critical areas identified by initial sample or at generally difficult to cast locations
	> 20 000	> 51 mm to 115 mm	2		100 % of the castings of each batch shall be tested at generally difficult to cast locations		100 % of the castings of each batch shall be tested at generally difficult to cast locations
	> 20 000	> 115 mm to 300 mm	2				

a For quality levels and the related permissible indicating characteristics see Table E.3.

b For magnetisable steel casting magnetic particle testing (MT) is preferred.

c For a material groups see Annex F.

Initial sample is required in case of:

— initial production;

— new production of the model device;

— change of production technology or material; or

— structural changes.

Initial sample documentation:

— Documentation of the results of the testing for dimensional stability and material quality as well as of the surface and volumetric testing, and the butt joint testing if appropriate;

— Documentation of casting, gating and feeder technologies;

— Documentation of the production conditions (moulding plant, core manufacturing method, moulding materials, refractory dressing, casting temperature, etc.):

— Unless otherwise agreed, the sampling documentation shall be retained by the material manufacturer.

All changes of the production technology and/or the materials related with an optimization or correction of the testing results during the series production shall be communicated by the material manufacturer to the pressure accessory manufacturer unsolicited.

E.2.2 Testing procedures

E.2.2.1 Volumetric testing

Methods shall be selected according to EN ISO 17635:2010, Table 3.

The common testing technique for volumetric testing is radiographic testing. It is acceptable to use ultrasonic testing if it is demonstrated that ultrasonic testing will satisfy the required quality level.

The areas for ultrasonic testing are the same as the ones to be radiographic tested.

Acceptance criteria shall be based on Table E.3.

If requested by the purchaser the positioning of the radiographic images shall be agreed with the purchaser.

E.2.2.2 Radiographic testing (RT)

For quality level 1 and 2 according to this standard, test class B in accordance with EN 12681 shall be complied with. Deviating from this, for bodies having nominal sizes DN ≤ 150, the minimum distance between the radiation source and the shell surface in accordance with test class A of EN 12681 is admissible. The image quality class shall be specified in accordance with EN ISO 19232-3.

For quality level 3 and 4, the test can be carried out in class A and with a less stringent image quality class.

In the case of a reduced minimum distance between the radiation source and the shell surface the requirements in accordance with EN ISO 17636-1 class A shall be fulfilled as far as feasible.

The radiographic images shall be marked with a code number, which can be traced back to the order. And additionally, each radiographic image shall have a sequence number. For the purpose of film localization, a reference grid shall be stamped onto the body surface and also displayed on the X-ray film.

The unambiguous assignment of the radiographic images shall be documented (e.g. photograph, film location plan). Regarding the radiographic testing performed, a test report shall be prepared. The test report shall contain the information according to EN 12681 and Table E.1 and E.2 of this standard. The acceptance standards and acceptance criteria are given in Table E.3.

E.2.2.3 Ultrasonic / testing (UT)

Ultrasonic testing shall not be used for welding ends. The testing shall be carried out in accordance with EN 12680-1 (equal to ISO 4992-1). Acceptance criteria are given in Table E.3.

The marking "UT" shall be punched, close to the heat number, on each cast part that has been subjected to ultrasonic testing.

E.2.2.4 Surface testing

For the surface testing, either magnetic particle testing (MT) or penetrant testing (PT) shall be applied as appropriate.

NOTE For magnetisable steel casting magnetic particle testing (MT) is preferred.

E.2.2.5 Magnetic particle testing (MT)

The testing shall be carried out according to EN 1369. Acceptance criteria are given in Table E.3.

E.2.2.6 Penetrant testing (PT)

The testing shall be carried out according to EN 1371-1 or EN 1371-2. Acceptance criteria are given in Table E.3.

E.2.2.7 Corrosion Testing (optional)

For austenitic steel castings according to EN 10213, testing for resistance to intercrystalline corrosion in accordance with EN ISO 3651-2 shall be performed for each cast and heat treatment batch.

E.2.2.8 Hardness (optional)

Brinell hardness testing in accordance with EN ISO 6506-1 shall be performed on external surfaces to ensure the casting is within the specified limits for the finished product. The hardness shall be measured on each tested casting at same measurement point. Results shall be documented.

E.2.2.9 Dimensional testing (optional)

The manufacturer shall specify, verify and set acceptance criteria for critical dimensions. Results shall be documented.

E.2.2.10 Visual Testing (optional)

Visual testing shall be in accordance to EN 13018 and EN 1370.

Table E.3 — Quality levels and permissible indicating characteristics

Quality level	Permissible indicating characteristics[b]			
	PT[c]	MT[c]	RT[c]	UT[c]
1[a]	SP1, CP1	SM1	A1,B1,CA1,CB1, CC1, CD1	1
2	SP2, CP2, LP2, AP2	SM2, LM2, AM2	A2,B3,CA2,CB3, CC3, CD3	2
3	SP3, CP3, LP3, AP3	SM3, LM3, AM3	A3,B3,CA3,CB3, CC3	3
4	SP4, CP4, LP4, AP4	SM3, LM3, AM3	A4,B4,CA4,CB4, CC4, CD4	4

a Surface testing: Linear indications or displays arranged in series are not permitted;

b Visual testing is subject to agreement;

c The testing techniques shall be as specified in EN ISO 17635.

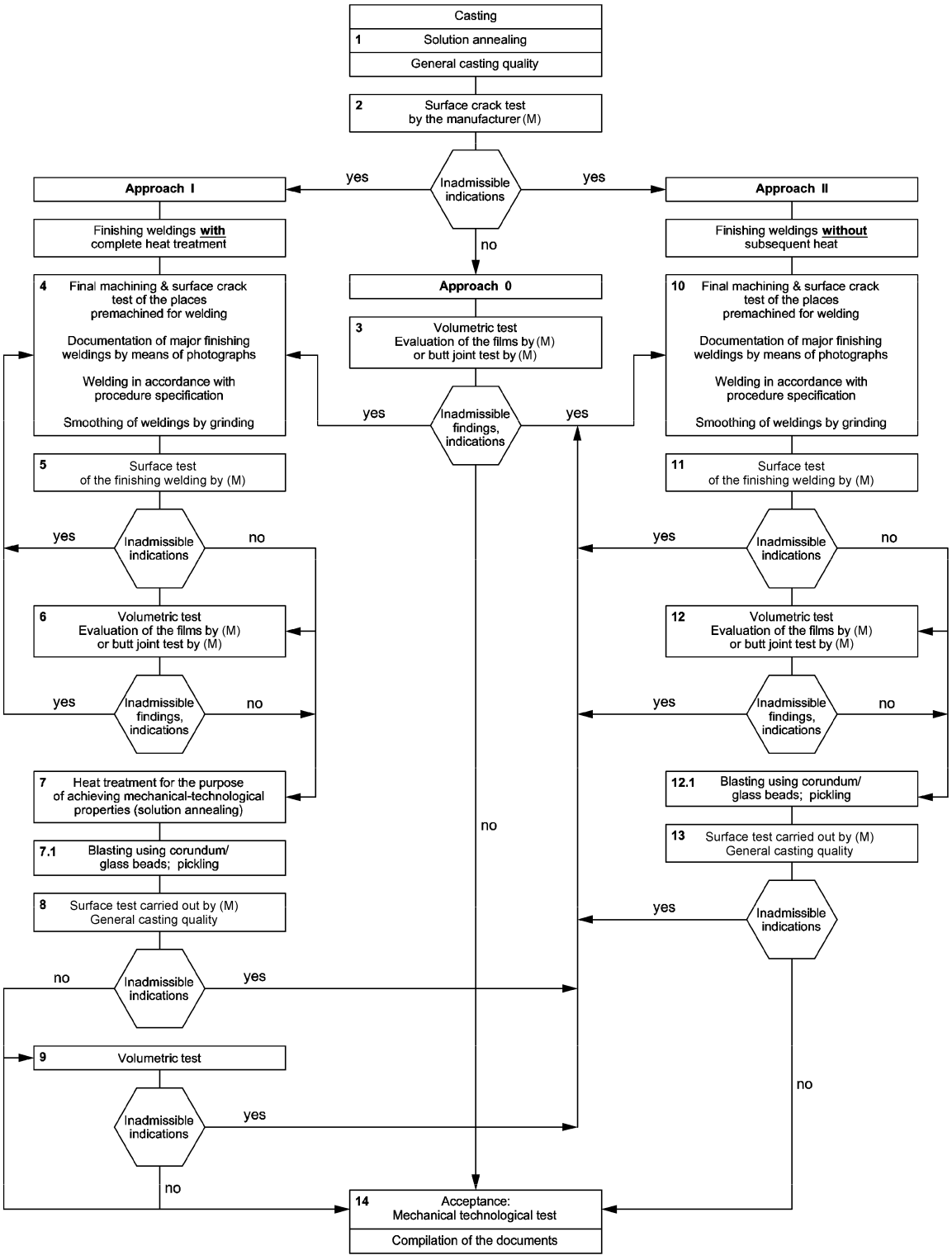

Figure E.1 — Test procedure for finishing welding for valves made of austenitic steel casting

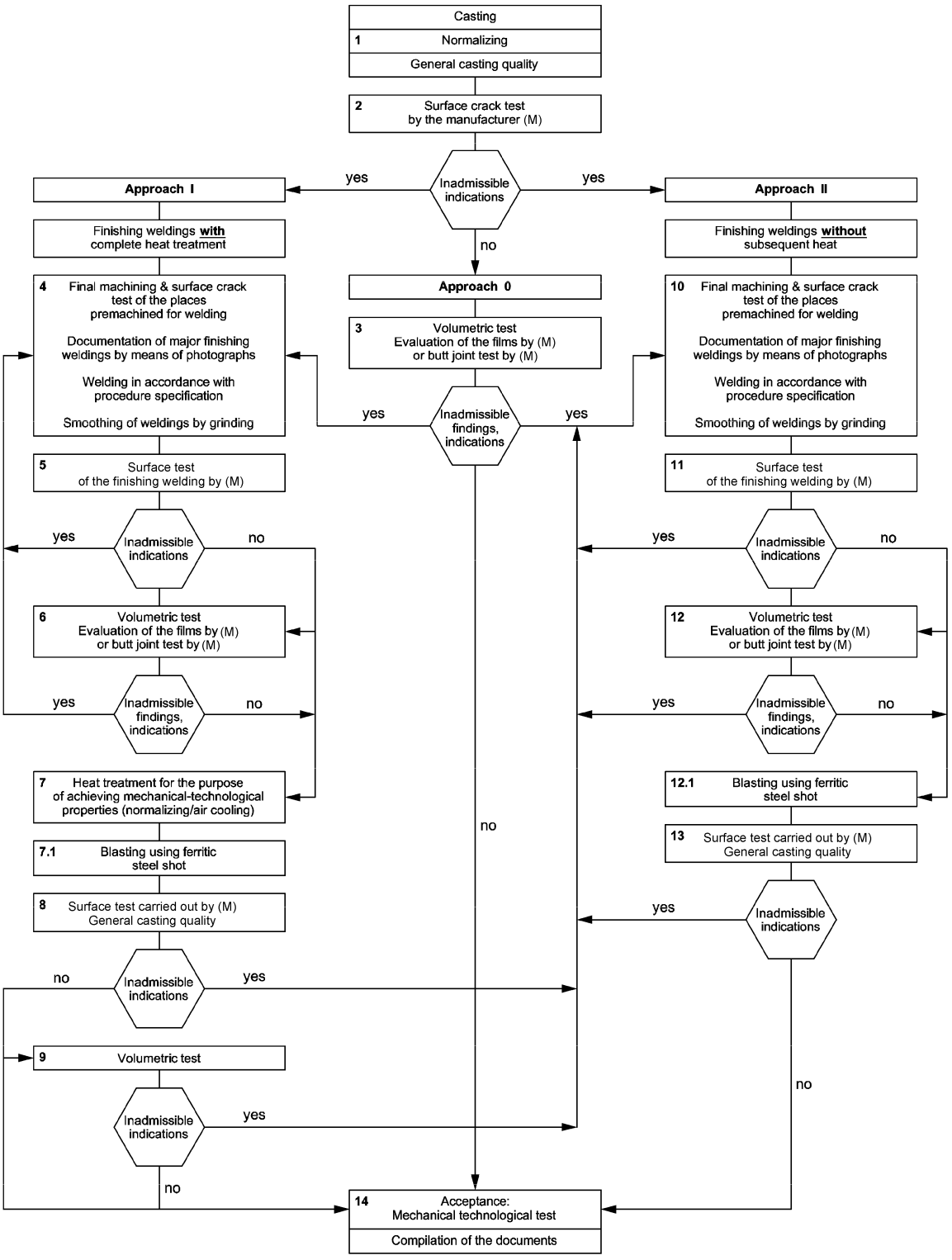

Figure E.2 — Test procedure for finishing welding for valves made of ferritic steel castings

Annex F
(normative)

Non-destructive testing (NDT) of joint welding

F.1General

The required extent of non-destructive testing depends on the joint coefficient k_c, the weldability of the base material and the type of the welded joints.

This annex applies also for components welded onto a shell (auxiliary connection)

At the same time all NDT prescribed by design, intended to increase joint coefficient, shall be performed also when not foreseen by the Table F.1, and by applying the acceptance standards.

For joint coefficient k_c equal to 1 production test are required and shall comply with EN 13445-4:2014, Clause 8.

For non-destructive testing of welded construction shell EN 13445–5:2014 may also be used alternatively.

F.2Non-destructive testing (NDT) extent

For joint coefficient k_c equal to 1 or 0,85, the extent of NDT is given in Table F.1.

For joint coefficient k_c equal to 0,7, all welds are subjected to 100 % Visual Testing only.

For the selection of the appropriate NDT-method see Table F.4.

Table F.1 — Extent of NDT for longitudinal and circumferential joint welding of the shell and auxiliary connections

Material Group Index[a]	Joint coefficient k_c	All welds	Longitudinal welds		Circumferential welds			Auxiliary connections[b]			
			Surface testing	Volumetric testing	Surface testing		Volumetric testing	Surface testing		Volumetric testing	
		Visual testing (VT) [%]	MT/PT[d] [%]	RT/UT[d] [%]	e_n[c] [mm]	MT/PT[d] [%]	RT/UT[d] [%]	e_n[c] [mm]	MT/PT[d] [%]	e_n[c] [mm]	RT/UT[d] [%]
A	0,85	100	10	10	> 0	nil	5	> 0	nil	> 0	nil
	1,0		100	100			10		10		
B	0,85		10	10	≤ 30	5	10	> 0	10	> 0	nil
					> 30	10					
	1,0		100	100	≤ 30	5	25				
					> 30	10					
C	0,85		10	10	≤ 30	10	25		25	> 0	25
					> 30	25					
	1,0		100	100	> 0	100	100		100		100

a See Table F.2.

b See EN 12516–1:2014.

c e_n is the nominal thickness of the shell.

d The percentage is referred to a number of shells manufactured in batches, at least one valve taking in a production line.

Table F.2 — Grouping system for metallic materials for industrial valve

Material Group Index	Sub-group	Type of steel [a]
A	1.1 [b]	Steels with a specified minimum yield strength $R_{eH} \leq 275$ N/mm² [c]
	1.2 [b]	Steels with a specified minimum yield strength 275 N/mm² < $R_{eH} \leq 360$ N/mm² [c]
	8.1	Austenitic stainless steels with Cr ≤ 19 %
B	1.3 [b]	Normalized fine grain steels with a specified minimum yield strength $R_{eH} > 360$ N/mm² [c]
	1.4 [b]	Steels with improved atmospheric corrosion resistance whose analysis may exceed the requirements for the single elements as indicated in group under Footnotes [b] and [c]
	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
	4.1 [d]	Steels with Cr ≤ 0,3 % and Ni ≤ 0,7 %
	4.2 [d]	Steels with Cr ≤ 0,7 % and Ni ≤ 1,5 %
	8.2	Austenitic stainless steels with Cr > 19 %
	8.3	Manganese austenitic stainless steels with 4 % < Mn ≤ 12 %
	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 %
	10.1	Austenitic-ferritic stainless steels (duplex) with Cr ≤ 24 %
	10.2	Austenitic-ferritic stainless steels (duplex) with Cr > 24 %
C	3.1 [e]	Quenched and tempered steels with a specified minimum yield strength 360 N/mm² < $R_{eH} \leq 690$ N/mm²
	3.2 [e]	Quenched and tempered steels with a specified minimum yield strength $R_{eH} > 690$ N/mm²
	3.3 [e]	Precipitation hardened steels except stainless steels
	5.1 [f]	Steels with 0,75 % ≤ Cr ≤ 1,5 % and Mo ≤ 0,7 %
	5.2 [f]	Steels with 1,5 % < Cr ≤ 3,5 % and 0,7 % < Mo ≤ 1,2 %
	5.3 [f]	Steels with 3,5 % < Cr ≤ 7,0 % and 0,4 % < Mo ≤ 0,7 %
	5.4 [f]	Steels with 7,0 % < Cr ≤ 10,0 % and 0,7 % < Mo ≤ 1,2 %
	6.1 [g]	Steels with 0,3 % ≤ Cr ≤ 0,75 %, Mo ≤ 0,7 % and V ≤ 0,35 %
	6.2 [g]	Steels with 0,75 % < Cr ≤ 3,5 %, 0,7 % < Mo ≤ 1,2 % and V ≤ 0,35 %
	6.3 [g]	Steels with 3,5 % < Cr ≤ 7,0 %, Mo ≤ 0,7 % and 0,45 % ≤ V ≤ 0,55 %
	6.4 [g]	Steels with 7,0 % < Cr ≤ 12,5 %, 0,7 % < Mo ≤ 1,2 % and V ≤ 0,35 %
	7.1	Ferritic or precipitation hardened stainless steels with C ≤ 0,35 % and 10,5 % ≤ Cr ≤ 30 %
	7.2	Martensitic or precipitation hardened stainless steels with C ≤ 0,35 % and 10,5 % ≤ Cr ≤ 30 %

	11.1 [h]	Steels covered by sub-group referred to Footnote [b] except 0,25 % < C ≤ 0,5 %, with 0,25 % ≤ C ≤ 0,35 %
	11.2 [h]	Steels covered by sub-group referred to Footnote [b] except 0,25 % < C ≤ 0,5 % with 0,35 % ≤ C ≤ 0,5 %

[a] This table is a reprint of CEN ISO/TR 15608.

[b] Steels with a specified minimum yield strength R_{eH} ≤ 460 N/mm² and with analysis in %: C ≤ 0,25; Si ≤ 0,60; Mn ≤ 1,70; Mo ≤ 0,70; S ≤ 0,045; *P* ≤ 0,045; Cu ≤ 0,40; Ni ≤ 0,5; Cr ≤ 0,3 (0,4 for castings); Nb ≤ 0,05; V ≤ 0,12; Ti ≤ 0,05. (For Cr, Mo, Ni Cu and V a higher value is acceptable if Cr + Mo + Ni + Cu + V ≤ 1 %)

[c] In accordance with the specification of the steel product standards, R_{eH} may be replaced by $R_{p0,2}$ or $R_{p0,5}$.

[d] Low vanadium alloyed Cr-Mo-(Ni) steels with Mo ≤ 0,7 % and V ≤ 0,1 %.

[e] Quenched and tempered steels and precipitation hardened steels except stainless steels with a specified minimum yield strength R_{eH} > 360 N/mm².

[f] Cr-Mo steels free of vanadium (not deliberately added to the material) with C ≤ 0,35 %.

[g] High vanadium alloyed Cr-Mo-(Ni) steels.

[h] A higher value is accepted provided that Cr + Mo + Ni + Cu + V ≤ 1 %.

Table F.3 — Grouping system for metallic materials for industrial valves (EN 12516–1:2014)

Material Group Index	EN Standard	Designation	Material No.	Group No.	Material Group Index	EN Standard	Designation	Material No.	Group No.
A	10025–1	S235JR[a]	1.0037	1E0	B	10028–4	15NiMn6	1.6228	7E1
	10025–1	S235JRG2	1.0038	1E1		10213–3	G9Ni14	1.5638	7E1
	10213–2	GP240GR	1.0621	2E0		10222–3	X12Ni5	1.568	7E1
	10028–2	P265GH	1.0425	3E0		10222–3	15NiMn6	1.6228	7E1
	10213–2	GP240GH	1.0619	3E0		10028–4	12Ni14	1.5637	7E3
	10222–2	P245GH[a]	1.0352	3E0		10028–4	X8Ni9	1.5662	7E3
	10222–2	P250GH	1.0460	3E0		10028–4	12Ni19	1.568	7E3
	10028–2	P295GH	1.0481	3E1		10028–4	11MnNi5–3	1.6212	7E3
	10222–2	P280GH	1.0426	3E1		10222–3	12Ni14	1.5637	7E3
	10028–2	16Mo3	1.5415	4E0		10222–3	X8Ni9	1.5662	7E3
	10222–2	16Mo3	1.5415	4E0		10222–3	13MnNi6–3	1.6217	7E3
	10028–3	P275NL1	1.0488	7E0		10213–4	GX2CrNiMoN26–7-4	1.4469	16E0
	10028–3	P275NL2	1.1104	7E0		10213–4	GX2CrNiMoCuN25–6-3–3	1.4517	16E0
	10213–3	G17Mn5	1.1131	7E0	C	10213–2	G20Mo5	1.5419	4E0
	10213–3	G20Mn5	1.622	7E0		10028–2	13CrMo4–5	1.7335	5E0
	10028–3	P355NL1	1.0566	7E1		10213–2	G17CrMo5–5	1.7357	5E0
	10028–3	P355NL2	1.1106	7E1		10222–2	13CrMo4–5	1.7335	5E0
	10028–3	P275N	1.0486	8E0		10028–2	10CrMo9–10	1.738	6E0
	10028–3	P355N	1.0562	8E1		10213–2	G17CrMo9–10	1.7379	6E0
	10028–3	P275NH	1.0487	8E2		10222–2	11CrMo9–10	1.7383	6E0
	10222–4	P285NH	1.0477	8E2		10213–2	GX15CrMo5	1.7365	6E1

Material Group Index	EN Standard	Designation	Material No.	Group No.	Material Group Index	EN Standard	Designation	Material No.	Group No.
	10222–4	P285QH	1.0478	8E2		10222–2	X16CrMo5–1	1.7366	6E1
	10028–3	P355NH	1.0565	8E3		10213–2	GX23CrMoV12–1	1.4931	9E0
	10222–4	P355NH	1.0565	8E3		10222–2	X20CrMoV11–1	1.4922	9E0
	10222–4	P355QH1	1.0571	8E3		10222–2	X10CrMoVNb9–1	1.4903	9E1
	10028–7	X2CrNi19–11	1.4306	10E0					
	10213–4	GX2CrNi19–11	1.4309	10E0					
	10222–5	X2CrNi18–9	1.4307	10E0					
	10028–7	X2CrNi18–9	1.4307	10E0					
	10028–7	X2CrNiN18–10	1.4311	10E1					
	10222–5	X2CrNiN18–10	1.4311	10E1					
	10028–7	X5CrNi18–10	1.4301	11E0					
	10222–5	X6CrNi18–10	1.4948	11E0					
	10028–7	X6CrNi18–10	1.4948	11E0					
	10213–4	GX5CrNi19–10	1.4308	11E0					
	10222–5	X5CrNi18–10	1.4301	11E0					
	10028–7	X6CrNiTi18–10	1.4541	12E0					
	10028–7	X6CrNiNb18–10	1.455	12E0					
	10213–4	GX5CrNiNb19–11	1.4552	12E0					
	10222–5	X6CrNiTi18–10	1.4541	12E0					
	10222–5	X6CrNiNb18–10	1.455	12E0					
	10222–5	X6CrNiTiB18–10	1.4941	12E0					
	10028–7	X6CrNiTiB18–10	1.4941	12E0					
	10028–7	X2CrNiMo17–12–2	1.4404	13E0					
	10213–4	GX2CrNiMo19–11–2	1.4409	13E0					
	10222–5	X2CrNiMo17	1.4404	13E0					

Material Group Index	EN Standard	Designation	Material No.	Group No.	Material Group Index	EN Standard	Designation	Material No.	Group No.
		–12–2							
	10222–5	X2CrNiMo17–12–3	1.4432	13E0					
	10213	GX2NiCrMo28–20–2	1.4458	13E0					
	10028–7	X2CrNiMo17–12–3	1.4432	13E0					
	10222–5	X2CrNiMo18–14–3	1.4435	13E0					
	10028–7	X2CrNiMo18–14–3	1.4435	13E0					
	10028–7	X1CrNiMoCu25–20–5	1.4539	13E0					
	10222–5	X2CrNiMoN17–11–2	1.4406	13E1					
	10028–7	X2CrNiMoN17–11–2	1.4406	13E1					
	10222–5	X2CrNiMoN17–13–3	1.4429	13E1					
	10028–7	X2CrNiMoN17–13–3	1.4429	13E1					
	10028–7	X5CrNiMo17–12–2	1.4401	14E0					
	10222–5	X3CrNiMo17–13–3	1.4436	14E0					
	10028–7	X3CrNiMo17–13–3	1.4436	14E0					
	10213–4	GX5CrNiMo19–11–2	1.4408	14E0					
	10222–5	X5CrNiMo17–12–2	1.4401	14E0					
	10028–7	X6CrNiMoTi17–12–2	1.4571	15E0					
	10028–7	X6CrNiMoNb17–12–2	1.458	15E0					
	10213–4	GX5CrNiMoNb19–11–2	1.4581	15E0					
	10222–5	X6CrNiMoTi17–12–2	1.4571	15E0					
	10028–7	X6CrNiMoNb17–12–2	1.4580	15E0					
	10222–5	X2CrNiMoN25–7-4	1.4410	16E0					
	10028–7	X2CrNiMoN25–7-4	1.4410	16E0					

Material Group Index	EN Standard	Designation	Material No.	Group No.	Material Group Index	EN Standard	Designation	Material No.	Group No.
	10213	GX2CrNiMoN 22–5-3	1.4470	16E0					
	10028–7	X2CrNiMoN2 2–5-3	1.4462	16E0					
	10222–5	X2CrNiMoN2 2–5-3	1.4462	16E0					
[a] PMA required. See requirements given in 5.2.4.									

F.3Selection of NDT-methods

For a selection of non-destructive testing methods see Table F.4.

The testing techniques shall be as specified in EN ISO 17635:2010. For standard service conditions the quality level shall be quality level C in accordance with EN ISO 5817:2014.

For service conditions, like fatigue and creep, higher quality level may be agreed between manufacturer and purchaser.

Table F.4 — Selection of NDT-methods

Purpose	NDT-method
Detection of surface imperfections (VT)	The following additional requirements for some imperfections applies: - stray arc (601), removal plus 100 % MT or PT to ensure no imperfection; - spatter (602), weld spatter shall be removed from all pressure parts and load carrying attachment welds. - isolated non-systematic spatter is permitted on components made of group 1 materials; - torn surface (603), grinding mark (604), chipping mark (605) shall be ground to provide a smooth transition; - underflushing (606) shall not be permitted. Any local underflushing shall be related to design characteristics (calculated thickness + corrosion allowance).
Detection of surface imperfections (PT,MT)	For ferritic steels magnetic particle testing (MT) shall be used. For austenitic and austenitic-ferritic stainless steels, penetrant testing (PT) shall be used.
Detection of internal imperfections (RT, UT)	Methods shall be selected according to EN ISO 17635:2010, Table 3 and the testing techniques shall be in accordance with Table A.5 (RT-F) and Table A.8 (UT).
Other NDT techniques in EN ISO 17635:2010 may be used providing they are proven to satisfy the required quality levels given in Table F.4.	

Annex ZA
(informative)

Relationship between this European Standard and the essential requirements of Directive 2014/68/EU (Pressure equipment Directive) aimed to be covered

This European Standard has been prepared under a Commission's standardization request M/071 to provide one voluntary means of conforming to essential requirements of Directive 2014/68/EU (Pressure equipment Directive).

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Annex I of Directive 2014/68/EU

Essential Requirements Directive 2014/68/EU	Nature of requirement	Clause(s)/sub-clause(s) of this EN	Remarks/Notes
1.3	Potential of misuse	5.1.3	
2.1	General Design	5.1.1	
2.2	Design for adequate strength	5.1.2	
2.2.1	Design loadings factors	5.1.2 a), 5.1.2 c)	
2.2.2	Design for adequate strength (refer 2.2.3 or 2.2.4)	5.1.2 b), 5.1.2 c)	
2.2.3	Design calculation method	5.1.2 a), 5.1.2 b), 5.1.2 c)	
2.2.4	Experimental design method	5.1.2 d)	
2.6	Corrosion	5.1.2 a), 5.1.2 b), 5.1.2 c)	

Essential Requirements Directive 2014/68/EU	Nature of requirement	Clause(s)/sub-clause(s) of this EN	Remarks/Notes
2.10 a) b)	Protection against exceeding the allowable limits of pressure equipment	5.1.3	
3.1.2	Permanent joining	5.3.1.1, 5.3.1.2, 5.3.1.3, 5.3.1.4, 5.3.1.6	
3.1.3	Non destructive tests	5.3.4	
3.1.4	Heat treatment	5.3.2	
3.1.5	Traceability	5.3.3	
3.2.1	Final inspection	5.5, Table 2, Table 3	
3.2.2	Proof test	5.5, Table 3	
3.3 a) b) c)	Marking and labelling	5.6	
3.4 a) b) c)	Operating instructions	5.8.2	
4.1 a	Material appropriate properties	5.2.1 to 5.2.6	
4.1 c	Material not ageing	5.2.1	
4.1 d	material suitable for processing procedures	5.2.1	
4.2	Material	5.2.1 to 5.2.6	
4.1 e	Avoid significant undesirable effects when the various materials are put together	5.2.1	
4.3	ensure that the material used	5.2.1	

Essential Requirements Directive 2014/68/EU	Nature of requirement	Clause(s)/sub-clause(s) of this EN	Remarks/Notes
	conforms with the required specification.		
7.1.1	symbols	5.2.1	
7.1.2	Permissible membrane stress	5.1.2 b)	
7.2	Joint coefficients	5.4.2, Annex F	
7.4	Hydrostatic test pressure	5.5	
7.5	Material Characteristics	5.2.1 to 5.2.6	

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

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[7] EN 1559-2, *Founding — Technical conditions of delivery — Part 2: Additional requirements for steel castings*

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[32] Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment

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