English translation

AR 208
May 2019
Dutch version

Approval requirement 208

Ductile cast iron wide range fittings for use with pipes of different materials

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Foreword

This GASTEC QA Approval requirement (Dutch version) has been approved by the Board of Experts product certification GASTEC QA, in which relevant parties in the field of gas related products are represented. This Board of Experts supervises the certification activities and where necessary require the GASTEC QA Approval requirement to be revised. All references to Board of Experts in this GASTEC QA Approval requirement pertain to the above mentioned Board of Experts.

This GASTEC QA Approval requirement (Dutch version) will be used by Kiwa Nederland BV in conjunction with the GASTEC QA general requirements and the KIWA regulations for certification.

This approval requirement is a translation from the Dutch validated version and can only be used as a supporting document.

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Contents

1 Introduction

1.1 General

This GASTEC QA approval requirement in combination with the GASTEC QA general requirements include all relevant requirements, which are adhered by Kiwa as the basis for the issue and maintenance of a GASTEC QA certificate for ductile cast iron wide range fittings for use with pipes of different materials.

This GASTEC QA Approval requirements replace the GASTEC QA Approval Requirements 208 “Ductile cast iron wide range fittings for use with pipes of different materials” dated May 2016 and amendment from November 2017.

List of changes:

- Update to the new format for GASTEC QA approval requirements
- These approval requirements have been fully reviewed textually.
- All general requirements have been deleted and included in the GASTEC QA general requirements document
- Change of paragraphs

The product requirements have not changed.

1.2 Scope

These requirements and test methods are applicable to ductile cast iron wide range fittings intended for single use with pipe components made from a number of pipe materials (ductile iron, grey iron, PVC-U, PVC HI, PE, steel, fibre-cement), for providing a leak tight seal over a wide range of pipe external diameters:

- to convey gas of the 1st, 2nd and 3rd family gasses according to Table 1 of NEN-EN 437.
- with a maximum operating pressure of 8 bar to be installed below ground or above ground inside a building or cabinet.
- Diameter range of DN 32 to DN 400
- for ambient temperatures between:
    - -5 °C and +30 °C class A
    - -10 °C and +40 °C class B

2 Definitions

In this approval requirement, the following terms and definitions are applicable:

Board of Experts: The Board of Experts GASTEC QA.

Depth of engagement: Distance between the end of the pipe and the face of the socket.

Ductile cast iron: Cast iron used for pipes, fittings and accessories in which graphite is present substantially in spheroidal form.

End-load resistance: Resistance to end-load transmitted via the connecting pipe and generated by internal pressure.

Evaluation Guideline: The agreements made within the Board of Experts on the subject of certification.

Fitting: Casting other than a pipe which allows pipeline deviation, change of direction or bore.

Flange: End of a pipe or fitting extending perpendicular to its axis, with bolt holes equally spaced on a circle.

NOTE A flange may be fixed or adjustable; an adjustable flange comprises a ring, in one or several parts assembled together, which bears on an end joint hub and can be freely rotated around the axis before jointing.

Flanged joint: Joint between two flanged ends

Gasket: Sealing component of a joint

Joint: Connection between the ends of two pipes and/or fittings in which a gasket is used to effect a seal.

Joint angular deflection: Angle between the axis of two connected pipeline components which a flexible joint can accommodate.

Joint gap: The largest axial distance between the ends of the two pipes to be connected, or the largest axial distance between the end of the pipe and the face of the opposite part such as flange, end cap, spigot (See also 4.5.2).

Leak tightness test pressure: Pressure applied to a component in order to ensure its leak tightness.

Manufacturer: The party that produces the product.(not necessary the supplier).

Maximum operating pressure (MOP): Maximum pressure that a component is capable of withstanding continuously in service under normal operating conditions

Nominal size (DN): Alphanumerical designation of size for components of a pipework system, which is used for reference purposes. It comprises the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections. [see EN ISO 6708]

Nominal pressure (PN): Alphanumerical designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system. It comprises the letters PN followed by a dimensionless number. [see EN 1333]

NOTE All equipment of the same nominal size DN designated by the same PN number have compatible mating dimensions.

Non-end-load resistance: Lack of resistance to axial loads without additional external mechanical axial support.

Outside diameter OD: Outside diameter of the pipe(s) to be connected.

Product requirements: Requirements made specific by means of measures or figures, focusing on (identifiable) characteristics of products and containing a limiting value to be achieved, which limiting value can be calculated or measured in an unequivocal manner.

Shelf life: the length of time a product may be stored without becoming unsuitable for use**.**

Spigot: male end of a pipe or fitting.

Supplier: the party that is responsible for ensuring that the products meet and continue to meet the requirements on which the certification is based.

Wide range fitting: fitting intended for use with pipes of various materials which:

- is used in a pipeline to make the connection between two spigots of pipes, fittings or valves, etc. , and,
- allows for radial and axial displacements at installation.

The wide range fittings may be provided on one end with PE or ductile cast iron spigot-ends, end cap or a flange connection.

NOTE Some fittings are designed such that they can slide over the pipes in order to facilitate easy assembly.

3 Product requirements

3.1 Material requirements

The materials of the wide range fittings should be based on the following requirements:

	Material	Requirements
Spigot	Ductile cast iron/ PE 100(RC)	See 3.4.2.1/ 3.4.2.2
Body	Ductile cast iron	See 3.6
Clamp ring/ clamp	Ductile cast iron	See 3.6
Flanges	Ductile cast iron	See 3.6
Coating of the body (internal and external)	Epoxy or polyamide	See 3.7
Coating of bolts	Dry anti-galling coating	See 3.7.2
Rubber	NBR	See 3.8
Bolts and nuts	Steel/ Stainless steel	See 3.9

Table 1: Material requirements

3.2 Diameter range

The wide range fittings are defined by the minimum and maximum outside diameters of the pipes to be connected. The diameter range shall be specified by the manufacturer. Within this diameter range, the performance shall be guaranteed at the manufacturer's declared MOP.

The minimum working range of outside diameters for wide range fittings is given in table 2.

Maximum DN of the pipes to be connected	Minimum working diameter range (mm)
32 < DN ≤ 100	20
100 < DN ≤ 200	23
200 < DN ≤ 300	33
300 < DN ≤ 400	41

Table 2: Minimum working diameter range

Informative Annex A gives the outside diameters of existing pipes, according to current ISO, EN or national standards.

3.3 Surface condition and repairs

Wide range fittings shall be free from defects and surface imperfections which could lead to non-compliance with chapters 3 and 4.

When necessary, fittings may be repaired, for example by welding, in order to remove surface imperfections and localized defects which do not extend through the entire wall thickness, provided that :

- the repairs are carried out according to the manufacturer's written procedure.
- the repaired fittings comply with all the requirements of chapters 3 and 4.

3.4 Type of joints and interconnection

3.4.1 Flanged joints

Flanged joints shall be constructed in such a way that they may be attached to flanges whose dimensions and tolerances comply with EN 1092-2.

Flanges may be designed to be compatible with different DN (e.g. DN 50-60-65) and/or different PN (e.g. PN 10/16).

Certain flange adaptors, especially for repair purposes, are designed to cater for flanges other than EN 1092-2. Consequently, some dimensions (e.g. thickness, bolt holes) have been designed to suit. Such flange adaptors shall not compromise functionality or compatibility with EN 1092-2 flanges.

3.4.2 Spigot connection

3.4.2.1 Ductile cast iron spigot end

The material of the ductile cast iron spigot end shall comply with article 3.6 and shall be part of the body of the fitting.

3.4.2.2 PE Spigot

The PE spigot connection shall be PE 100, which complies with EN 1555-2.

3.4.3 End cap

The material of the end cap shall comply with article 3.6 and shall be part of the body of the fitting. When the end cap is provided with a threaded hole, the thread shall comply with ISO 7-1/ EN 10226-1.

3.4.4 Wide range joint

Wide range joints shall be end-load resistant or non-end-load resistant and shall meet the performance requirements detailed in chapter 4.

The manufacturer shall declare for which pipe materials the joint is end-load or non-end-load resistant

Supporting sleeves (inserts) may be necessary depending on pipe material, on pipe wall thickness, on joint design and on local authorities. They shall provide adequate support over the entire compression area of the gasket. The manufacturer shall specify the support sleeve (dimensions, material, shape) and indicate when supporting sleeves shall be used.

3.5 Dimensional requirements

3.5.1 Wall thickness

The minimum wall thickness shall be as given in table 3, provided that they comply to the requirements of chapter 4.

Maximum DN of the pipes to be connected	Minimum wall thickness (mm)
32 < DN ≤ 200	4,0
200 < DN ≤ 300	5,0
300 < DN ≤ 400	6,0

Table 3: Minimum wall thickness

3.5.2 Joint gap and depth of engagement

The manufacturer shall declare his maximum allowable joint gap (see figures 1 to 4 below) and it should be not less than the values given in table 4.

Maximum DN of the pipes to be connected	Fitting with two joints - joint gap (mm)	Fitting with one joint - joint gap (mm)
32 < DN ≤ 100	20	15
100 < DN ≤ 200	25	20
200 < DN ≤ 300	35	30
300 < DN ≤ 400	55	40

Table 4: Joint gap

NOTE: The maximum joint gap between the pipes or the flange to be connected may be affected by pipe contraction or expansion occurring as a result of temperature or pressure change.

The depth of engagement is related to the joint design. The manufacturer shall declare the minimum depth of engagement (see figures 1 to 4) in the jointing instructions for each type of pipe material. The minimum depth of engagement shall be such that the pipes can support the loads imparted by the jointing system.

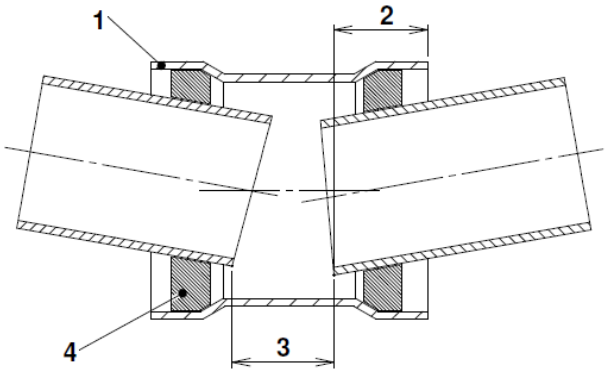

Figure 1: Joint gap for wide range fitting (example)

Key
1 Fitting
2 Depth of engagement
3 Joint gap
4 Joint gasket

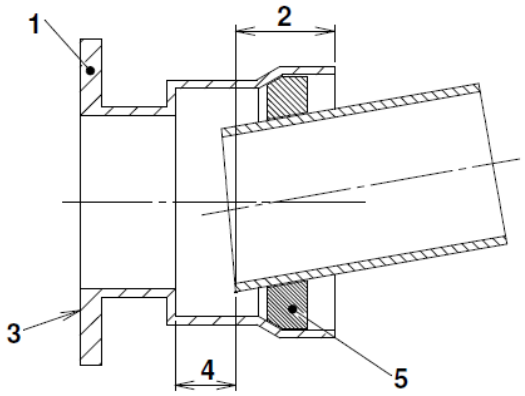

Figure 2: Joint gap for wide range flange adaptor (example)

Key
1 Flange adaptor
2 Depth of engagement
3 Flange face
4 Joint gap
5 Joint gasket

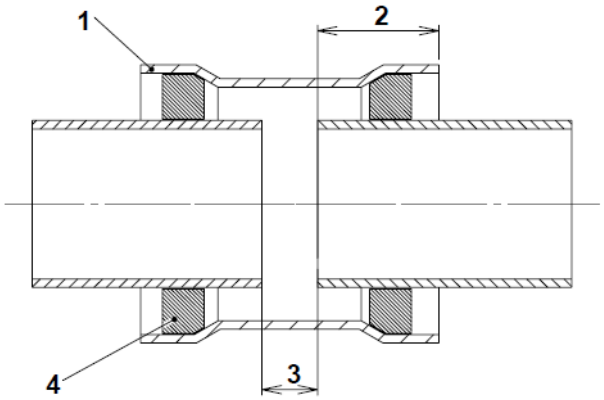

Figure 3: Joint gap for wide range fitting (example)

Key
1 Fitting
2 Depth of engagement
3 Joint gap
4 Joint gasket

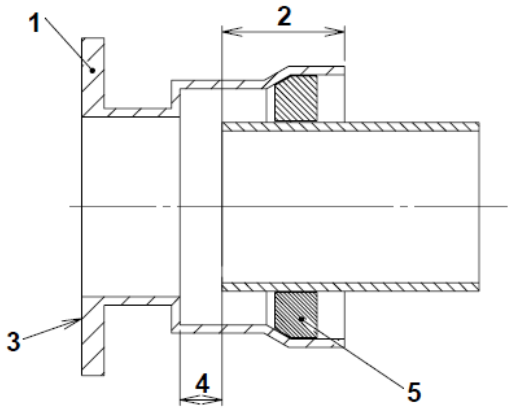

Figure 4: Joint gap for wide range flange adaptor (example)

Key
1 Flange adaptor
2 Depth of engagement
3 Flange face
4 Joint gap
5 Joint gasket

3.5.3 Ductile cast iron spigot

The dimensions of the ductile cast iron spigot shall comply with the dimension given in table 5. The free length of the cast iron spigot shall comply with NEN 7231 table 3.

d_n	outside diameter	
	Min	Max
50	50	50,7
63	63	63,7
75	75	75,7
90	90	90,7
110	110	110,7
125	125	125,7
160	160	160,7
200	200	200,7
250	250	250,8
280	280	280,9
315	315	316,0
400	400	401,0

Table 5 : Dimensions ductile cast iron spigot

3.5.4 PE Spigot

The PE spigot shall be PE pipe SDR 11 and shall have a minimum free length according to table 6.

Pipe diameter (mm)	Spigot free length (mm)
63	160
90	210
110	210
160	260
200	270
250	300
315	340
400	370

Table 6: Minimum free length PE spigot

3.6 Mechanical properties of ductile cast iron

3.6.1 Tensile properties

Ductile cast iron fittings shall have a minimum tensile strength, R_m, of 420 MPa and a minimum elongation at fracture of 5 %. The tensile strength test shall be carried out in accordance with ISO 6892-1.

3.6.2 Hardness

The Brinell hardness shall be tested in accordance with EN-ISO 6506-1 and shall not exceed 250 HB. The test shall be performed on the casting or on a sample cut from the casting.

3.7 Coatings

3.7.1 General

Unless otherwise agreed between manufacturer and purchaser, all fittings shall be delivered externally and internally coated (epoxy or polyamide). The external and internal coatings shall comply with EN 14901.

All coatings shall be works-applied.

The suitability of the coating shall be verified by performing the cathodic disbondment test according to paragraph 4.8.

3.7.2 Coating of bolts and nuts

Bolts and nuts shall be suitably protected with an anti-galling coating to inhibit cold-welding of the threads. Bolts shall be coated with a dry anti-galling coating.

3.8 Rubber material

Rubber gasket materials shall comply with the requirements of EN 682 type GA or GB for ambient temperature class A. Type GAL or GBL for ambient temperature class B.

3.9 Bolts and nuts

The mechanical properties of the bolts and nuts shall comply with EN-ISO 3506-1 and EN-ISO 3506-2 grade A2 and/or A4. The dimensional properties shall comply as a minimum with the requirements of EN -ISO 4016 and EN- ISO 4034.

4 Performance requirements and test methods

4.1 General

In order to ensure the fitness for purpose of the wide range joints, there shall be a performance test using at least one from each of the groupings given below:

- DN 32 to DN125 (preferred around 100 mm).
- DN 150 to DN 300 (preferred around 200 mm).
- DN 350 to DN 400 (preferred around 400 mm).

One outside diameter is representative of a grouping when the performances are based on the same design parameters throughout the size range. The performance tests shall be carried out either on fitting or flange adaptor, provided the joint design is identical.

If a grouping covers products of different designs and/or manufactured by different processes, the grouping shall be sub-divided.

The product shall be tested using the smallest and largest pipe size specified by the manufacturer.

The performance tests shall be carried out using supporting sleeves (inserts) when necessary (see paragraph 3.4.4).

The wide range joint shall be tested in combination with a PE spigot and flanged joint.

4.2 Wide range joints

4.2.1 General

The requirements and test conditions are summarized in table 7. The wide range joints shall exhibit no visible leakage, deformation or displacement of the pipe sections when subjected to the tests. The displacement shall reach a stable value and cease.

Test	Test requirements	Pipe sections	Test conditions	Test method
Non-end- load resistance fitting + end-load resistance fitting	- test pressure : 25 mbar, 200 mbar, 1 bar, (air) - test pressure: MOP (air or water) - test pressure: 1,5x MOP.(water) - test duration: 5 minutes after stabilisation - no visible leakage	Stiff pipe of maximum OD	Joint with angular deflection	4.3, 4.6 and 4.7
End-load resistance fitting	- test pressure : 3x MOP + 5 bar (water) - test duration: 2 hours after stabilization - no deformation, visible leakage or displacement of the pipe sections.	Stiff pipe of maximum OD	Joint with angular deflection	4.3 and 4.7
			Joint aligned and maximum joint gap, with shear load	4.4, 4.5 and 4.7
End-load resistance fitting	- test pressure : 3x MOP + 5 bar (water) - test duration: 2 hours after stabilization - no deformation, visible leakage or displacement of the pipe sections.	Stiff pipe of minimum OD	Joint with angular deflection	4.3 and 4.7
			Joint aligned and maximum joint gap, with shear load	4.4, 4.5 and 4.7
End-load resistance fitting	- test pressure : 3x MOP + 5 bar (water) - test duration: 2 hours after stabilization - no deformation, visible leakage or displacement of the pipe sections.	PVC pipe of minimum OD	Joint aligned and maximum joint gap, with shear load	4.4, 4.5 and 4.7
End-load resistance fitting	- test pressure : 3x MOP + 5 bar (water) - test duration: 2 hours after stabilization - no deformation, visible leakage or displacement of the pipe sections.	PE pipe of minimum OD	Joint aligned and maximum joint gap	4.5 and 4.7

Table 7: performance testing of the joints: requirements and test conditions.

4.3 Angular deflection

All wide range joints shall be designed to be fully flexible. The allowable angular deflection declared by the manufacturer shall be not less than 3° for DN 32 to DN 400. For the performance testing the maximum angular deflection, declared by the manufacturer will executed.
The leak tightness test shall be performed according to 4.6 and 4.7

4.4 Shear load

All joints shall be performance tested with a resultant shear force of not less than 20 times the DN, in newtons, taking into account the weight of the pipe and of its contents and the geometry of the test assembly.
The shear load test condition is not required for PE pipes, due to their longitudinal flexibility.

Shear load for joints.
A vertical force *W* shall be applied to the fitting. The vertical force *W* shall be such that the resultant shear force *F* across each of the two joints is equal to the value specified in paragraph 4.2.3, taking into account the weight force *M* of the fitting and of its contents:

$W = 2F - M$

The leak tightness test shall be performed according to 4.7

Shear load for flange adaptors.
The vertical force *W* applied to the flange adaptor shall be such that the resultant shear force *F* across the joint is equal to the value specified in paragraph 4.2.3, taking into account the weight force *M* of the flange adaptor and of its contents:

$W = F - M$

Where

W is the vertical force in newtons
F is the shear force in newtons
M is the weight force in newtons.

The leak tightness test shall be performed according to 4.7

4.5 Maximum joint gap

The wide range joint shall show no visible leakage with the maximum joint gap. The maximum joint gap is created between the joint and the smallest pipe diameter for which the wide range joint is suitable as declared by the manufacturer (see paragraph 4.1). The smallest pipe diameter is selected form the standard pipe size ranges as mentioned in appendix A. The leak tightness test shall be according to 4.7

4.6 Leak tightness test of joints with air

4.6.1 Wide range joint

The test shall be carried out on an assembled joint comprising a ductile cast iron wide range fitting and two pipe sections (see figure 5).

The test apparatus shall be capable of providing suitable end and lateral restraints whether the joint is in the aligned position, deflected or subjected to a shear load. It shall be equipped with a pressure gauge with an uncertainty of ± 5 % reading.

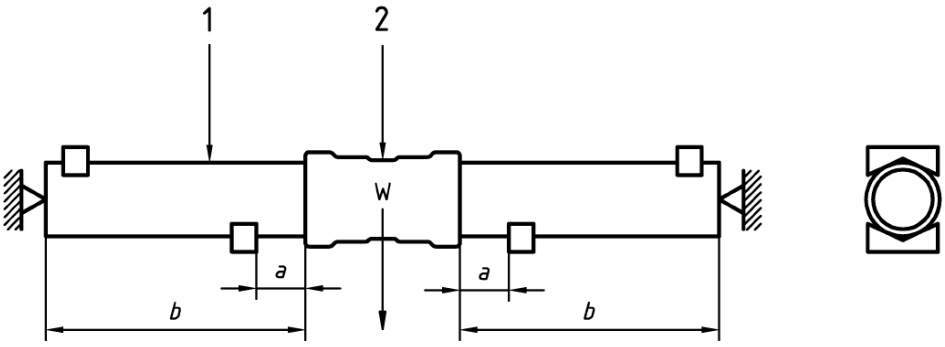

Figure 5: Test assembly for a fitting

Key
1 Pipe section
2 Ductile iron fitting

The pipes shall be supported by means of V shaped blocks with an angle of 120°, located at a distance *a*, of 0,2 x OD in mm, from the fitting face, and up to a maximum of 50 mm. The length of each pipe section *b*, shall be at least 2 x OD in mm, and with a minimum of 1 m.

The test shall not begin before the temperature of the test assembly has stabilized between 10 °C and 25 °C. The pressure shall be raised steadily until it reaches the test pressure given in table 7.

For an end-load resistant joint, the test assembly, and the test procedure are identical, except that there shall be no end restraint so that the axial thrust is taken by the end-load resistant joint under test. In addition, possible axial movement of the spigot shall be monitored.

4.6.2 Flange adaptor

For a flange adaptor, half of the test apparatus shall be used (see figure 6).

The test procedure shall be as in paragraph 4.6.1

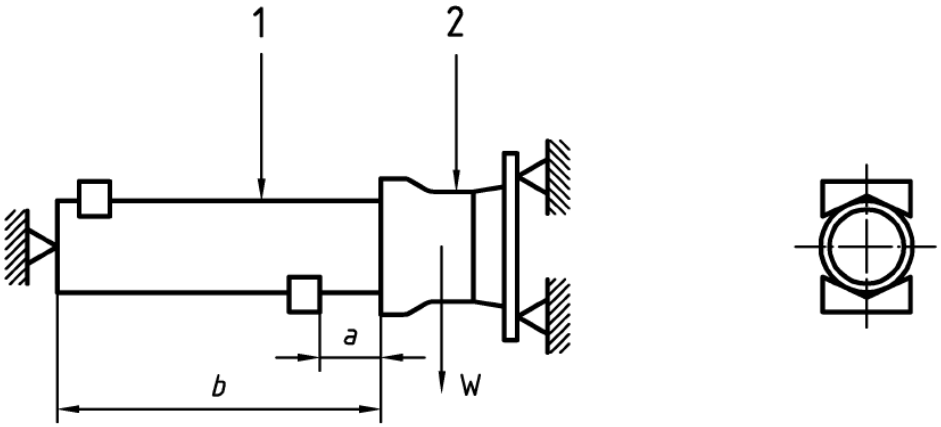

Figure 6: Test assembly for a flange adaptor

Key
1 Pipe section
2 Flange adaptor

4.7 Leak tightness test of joints with water

For the strength test the test set as described under paragraph 4.6.1 or 4.6.2 shall be used. The test assembly is filled with water. The test shall not begin before the temperature of the test assembly has stabilized between 10 °C and 25 °C. The pressure shall be raised steadily until it reaches the test pressure given in table 7.

4.8 Cathodic disbondment test

For each test specimen[1)], a plastic pipe section with d = 75 mm and h = 100 mm is sealed onto the coated surface using an electrically non-conducting adhesive, making sure to effectively seal the joint. The pipe is filled with a sodium chloride solution at a concentration of c(NaCl) = 0.5 mol/L.

Before sealing, remove the coating in the middle of the test plate with a face cutter so that there is an uncoated area with a diameter of 6mm.

Cathodic polarization of the pipe is achieved with a potentiostat, setting a nominal voltage of U0.1 AgCl = -1550 mV (corresponding to UH = -1260 mV, Ukalomel ges = -1500 mV).

A similar polarization effect may also be achieved by simply causing a short circuit with a magnesium anode, provided that the voltage is approximately UH = -1200 mV.
This test lasts 30 days and is performed at a temperature of (23 ± 2) °C.

In order to determine the cathodic disbondment, make 6 radial cuts, starting from the uncoated area and proceeding to the coating surface of the cast. An hour after the end of the test, the coating is removed from the uncoated middle area with a blade.
In this context, the mean disbonded depth (= adhesion loss of the coating) is determined from the edge of the uncoated area to the adherent coating.

The following limits for the cathodic disbondment are valid: Temperature	Test duration	Cathodic disbondment
23 ± 2 °C	30 days	≤ 10 mm

[1)]For fittings whose shape or size make them ineligible for cathodic disbonding tests test plates may be used instead. The test plate is approx. 100 x 110 x 15 mm. It must be of the same material as the fittings to be coated. One of the flat surfaces should be moulded with "normal" foundry sand and the other with core-making sand. The side using core-making sand should be marked with the letter K in one corner during the casting process. The test plate is clamped in a DN 150 fitting in such a way that the “core side” of the test plate is on the inside. The complete test piece is blasted in this position. Clean fibre-free gloves must be used when removing test plates. The test plate is coated without the fitting.

Source: Gütegemeinschaft Schwerer Korrosionsschutz

5 Marking, instructions and packaging

5.1 Marking

All fittings shall be legibly and durably marked and shall bear at least the following information:

- The GASTEC QA mark, logo or punch mark.
- Manufacturer's name or mark.
- Identification of ductile cast iron.
- DN and PN rating of flanges when applicable.
- The minimum and maximum outside diameters (range of external diameters over which the product works).
- MOP of the fitting.
- Production or assembling date (at least month and year) of the product

The first five markings given above shall be cast-on or cold stamped the other markings can be applied by any method, e.g. painted on the casting.

5.2 Instructions

The supplier shall provide instructions. These instructions shall be in the Dutch language and shall contain information about:

- The use and installation of the product.
    - maximum allowable joint gap.
    - minimum depth of engagement.
    - maximum allowable angular deflection.
    - pipe materials for which the fitting or the flange adaptor is intended to be used.
    - end-load or non-end-load resistance.
    - need for supporting sleeves (insert).
    - bolt torque.
- The conditions under which it shall be used.
- How it can be determined if the product is correctly installed.
- The way the product shall be stored.
- The maximum shelf life of the product.

5.3 Packaging

The product including the associated components required for its assembly shall be packaged individually. Special storage or handling conditions shall be specified on the packaging. The packaging shall protect the product from dirt, dust and other contaminants during transport and storage till the point of use where the packaging will be removed

6 Quality system requirements

The supplier shall make a risk assessment of the product and production process according to chapter 3.1.1.1 and 3.1.2.1 of the GASTEC QA general requirements. The risk assessments shall be available to Kiwa for review.

7 Summary of tests

This chapter contains a summary of tests to be carried out during:

- The initial product assessment;
- The periodic product verification;

7.1 Test matrix

Description of requirement	Clause	Test within the scope of		
		Initial product assessment	Product verification	
			Verification	Frequency
Material	3.1	X	X	Once a year
Diameter range	3.2	X	X	Once a year
Surface conditions and repairs	3.3	X		
Types of joints	3.4	X		
Dimensional requirements	3.5	X	X	Once a year
Mechanical properties of ductile cast iron	3.6	X		
Coatings	3.7	X	X	Once a year
Rubber material	3.8	X	X	Once a year
Bolt and nuts	3.9	X	X	Once a year
Performance requirements of joints	4	X	X	Once a year
Marking and instructions	5	X	X	Once a year

8 List of referenced documents and source

8.1 Standards / normative documents

All normative references in this Approval Requirement refer to the editions of the standards as mentioned in the list below.

EN 437: 2003+A1: 2009	Test gases- test pressure – appliance categories
EN 1333: 2006	Flanges and their joints - Pipework components - Definition and selection of PN
EN-ISO 6708: 1995	Pipe components - Definition and selection of DN (nominal size)
EN 1092-2: 1997	Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 2: Cast iron flanges
EN 1555-2: 2010	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 2: Pipes
EN-ISO 3506-1: 2009	Mechanical properties of corrosion-resistant stainless steel fasteners - Part 1: Bolts, screws and studs
EN-ISO 3506-2: 2009	Mechanical properties of corrosion-resistant stainless steel fasteners - Part 2: Nuts
EN-ISO 4016: 2011	Hexagon head bolts - Product grade C
EN-ISO 4034: 2013	Hexagon regular nuts (style 1) - Product grade C
EN-ISO 6506-1: 2014	Metallic materials - Brinell hardness test - Part 1: Test method
EN 14901: 2014	Ductile iron pipes, fittings and accessories - Epoxy coating (heavy duty) of ductile iron fittings and accessories - Requirements and test methods
EN 682: 2002	Elastomeric seals - Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids
EN 10208-1: 2009	Steel pipes for pipelines for combustible fluids - Technical delivery conditions - Part 1: Pipes of requirement class A
EN-ISO 6892-1: 2009	Metallic materials – tensile testing – part 1: method at room temperature
NEN 7231: 2011	Kunststofleidingsystemen voor gasvoorziening – hulpstukken van slagvast polyvinylchloride (slagvast PVC) – eisen en beproevingsmethoden.

EN 10226-1: 2004	Pipe threads where pressure tight joints are male on the treads – Part 1 taper external threads and parallel internal threads.
ISO 7-1: 1994+Cor 1: 2007	Pipe threads where pressure-tight joints are made on the threads - Part 1: Dimensions, tolerances and designation

Appendix A: outside diameters of existing pipes

	Ductile Iron	Steel	PVC-HI	PE	Fibre-Cement			
	NEN 7244-4	EN 10208-1	NEN 7230	EN 1555-2	DIN 19800a			
Sizes (DN)					PN6	PN10	PN12,5	PN16
25				$25^{+0,3}_{-0}$				
32				$32^{+0,3}_{-0}$				
40				$40^{+0,4}_{-0}$				
50		$60,3^{+0,5}_{-0,5}$	$50^{+0,2}_{-0}$	$50^{+0,4}_{-0}$			83	85
63			$63^{+0,2}_{-0}$	$63^{+0,4}_{-0}$				
75			$75^{+0,3}_{-0}$	$75^{+0,5}_{-0}$		98	100	104
80	$98^{+1}_{-2,7}$	$88,9^{+0,7}_{-0,7}$						
90			$90^{+0,3}_{-0}$	$90^{+0,6}_{-0}$				
100	$118^{+1}_{-2,8}$	$114,3^{+0,9}_{-0,9}$						
110			$110^{+0,4}_{-0}$	$110^{+0,7}_{-0}$	118	120	124	130
125			$125^{+0,4}_{-0}$	$125^{+0,8}_{-0}$				
140			$140^{+0,5}_{-0}$					
150	$170^{+1}_{-2,9}$	$168,3^{+1,3}_{-1,3}$						
160			$160^{+0,5}_{-0}$	$160^{+1,0}_{-0}$	145	149	153	159
180			$180^{+0,6}_{-0}$					
200	$222^{+1}_{-3,0}$	$219,1^{+1,6}_{-1,6}$	$200^{+0,6}_{-0}$	$200^{+1,2}_{-0}$	172	178	182	190
225			$225^{+0,7}_{-0}$					
250	$274^{+1}_{-3,1}$	$273,0^{+2,0}_{-2,0}$	$250^{+0,8}_{-0}$	$250^{+1,5}_{-0}$				
300	$326^{+1}_{-3,3}$	$323,9^{+2,4}_{-2,4}$						
315			$315^{+1,0}_{-0}$	$315^{+1,9}_{-0}$	226	234	240	252
355			$355^{+1,0}_{-0}$	$355^{+2,2}_{-0}$				
400	$429^{+1}_{-3,5}$	$406,4^{+3,0}_{-3,0}$	$400^{+1,0}_{-0}$	$400^{+2,4}_{-0}$	278	286	296	308

Table A.1: Outside diameters of existing pipes (in mm), according to current ISO, EN and national standards