Version
June 2025

English version

Approval requirement 207

Pipes of oriented plasticized PVC (PVC-O)

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GASTEC Qa

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Preface Kiwa

This approval requirement (AR) is approved by the Board of Experts (BoE) 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 AR will be used by Kiwa Nederland BV in conjunction with the GASTEC QA general requirements and the KIWA regulations for certification.

In this AR is established which requirements a product and the requestor/ certificate holder of the GASTEC QA product certificate should meet and the matter to which Kiwa evaluates this.

Kiwa has a method which is established in the certification procedure for the execution of:

- The investigation for provisioning and maintaining a GASTEC QA product certificate based on this AR.
- The periodic evaluations of the certified products for the purpose of maintaining a provided GASTEC QA product certificate based on this AR.

Approved by the Board of Experts: Month date, year

Accepted by Kiwa Nederland B.V.: Month date, year

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1 Introduction

1.1 General

This GASTEC QA approval requirement (AR) in combination with the GASTEC QA general requirements, is applied by Kiwa as the basis for the issuing and maintaining the GASTEC QA product certificate for pipes of oriented plasticized PVC (PVC-O).

With this product certificate, the certificate holder can demonstrate to his or her customers that an expert independent organization monitors the production process of the certificate holder, the quality of the product and the related quality assurance.

Next to the requirements established in this AR and the general requirements, Kiwa has additional requirements in the sense of general procedural requirements for certification, as laid down in the internal certification procedures.

This GASTEC QA approval requirement replaces the version of May 2019.

List of changes:
- The approval requirement is fully textually reviewed
- The list of reference standards has been adjusted

The product requirements have not changed.

1.2 Scope

This approval requirement applies to pipes which are made of oriented plasticized PVC (PVC-O). The intended use of these pipes is underground for the transport of gas of the 1st, 2nd and 3rd family gasses according to table 1 of EN 437 with a maximum operating pressure of 8 bar.

2 Definitions

In this approval requirement, the following definitions are applicable:

Board of Experts (BoE): The Board of Experts GASTEC QA.

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

See also the definitions mentioned in the GASTEC QA general requirements.

3 Material and product requirements

This chapter contains the material and product requirements that the raw materials, materials and products used shall meet.

3.1 Material

3.1.1 General

The material from which the pipes are made shall be PVC-U compound. This compound shall consist substantially of PVC-U resin to which shall be added only those additives necessary to facilitate the production of pipes in accordance with this requirement. All additives shall be uniformly dispersed.

3.1.2 Rework material

The use of manufacturer's own reprocess able material produced the manufacture and works testing of products and conforming to the material requirements is permitted. No reprocess able or recyclable material obtained from external sourced shall be used.

3.2 Material classification

3.2.1 MRS value

Oriented pipes made from a defined PVC-U compound and with a well-defined orientation level, in tangential and axial direction, shall be evaluated according to paragraph 4.5. The minimum required strength (MRS) values shall be classified in accordance with 3.2.2 table 1.

3.2.2 Design stress

The design stress shall be based on the value of the lower confidence limit σLPL of the long-term hydrostatic strength for the resistance to internal pressure as determined in accordance with ISO 9080. This σLPL value shall be converted into a minimum required strength (MRS) in accordance with ISO 12162. The MRS shall be divided by an overall service (design) coefficient *C* to give the design stress σ_s, which is expressed by the following equation.

$$\sigma_s = \frac{MRS}{C}$$

Pipe material classification number		315	355	400	450
MRS	MPa	31.5	35.5	40	45
C		2	2	2	2
σ_s	MPa	16	18	20	22.5

Table 1

3.3 Classification and selection of pipes

3.3.1 Classification

Pipes shall be classified to their nominal pressure PN. The nominal pressure PN, the pipe series S and the design stress, σ_S, are connected by the following relationship:

$$PN = \frac{10\sigma_S}{S}$$

$$S = \frac{SDR - 1}{2}$$

$$SDR = \frac{d_n}{e_n}$$

$$\sigma_S = \frac{MRS}{C}$$

Where

e_n	is expressed in millimetres (mm)
PN	is expressed in megapascals (MPa)
MRS	is expressed in megapascals (MPa)
C	is no dimensional

3.3.2 Calculation of wall thickness

The relationship between the nominal wall thickness e_n and the nominal outside diameter *d*n is specified in ISO 4065. The values for nominal pipe wall thickness e_n for nominal pressure ratings PN, can be calculated by substituting the values for MRS, *C*, and *d*n in the formula:

$$e_n = \frac{d_n}{2S_o + 1}$$

where S_o is the calculated preferred value of the nominal S series number of the pipe from paragraph 3.3.1. Values shall be rounded to one decimal place according to the rules of ISO 4065.

NOTE Nominal S numbers and their calculated values are given in ISO 4065 for the R10 series of preferred numbers. For the R20 series required for this International Standard, refer to ISO 3.

The nominal outside diameter and nominal wall thickness for the relevant nominal pressure and material classes are specified in table 2.

Material class	Pressure class PN for design coefficient *C*=2.0
315	8
355	8
400	10
450	10

Pipe series S numbers preferred and computed values (ISO 3) and standard dimension ratios (SDR)		
S	20.0	16.0
S_{calc}	19.953	15.849
SDR	41.0	33.0
d_n	**e_n mm**	
63	-	2.0
75	2.0	2.3
90	2.2	2.8
110	2.7	3.4
160	4.0	4.9
200	4.9	6.2
250	6.2	7.7
315	7.7	9.7

Table 2

3.4 General characteristics

3.4.1 Appearance

When viewed without magnification, the internal and external surface of the pipe shall be smooth, clean and free from scoring, cavities and other surface defects. The material shall not contain visible impurities. The ends of the pipe shall be cut cleanly and square to the axis of the pipe.

3.4.2 Color

The pipe shall be yellow (RAL 1004), orange (RAL 1033) or alternatively marked with yellow or orange stripes.

3.4.3 Dimensions

3.4.3.1 Outside diameters and wall thickness

The outside diameter, wall thickness and out-of-roundness shall be in correspondence with table 3. The dimensions of the pipe shall be measured according to ISO 3126.

Nominal size DN	Mean outside diameter d_{em}		Out-of-roundness	Wall thickness *e*			
				SDR 41		SDR 33	
	Min	Max	Max	Min	Max	Min	Max
63	63	63.2	1.6			2.0	2.4
75	75	75.3	1.8	2.0	2.4	2.3	2.8
90	90	90.3	2.2	2.2	2.7	2.8	3.3
110	110	110.4	2.7	2.7	3.2	3.4	4.0
160	160	160.5	3.9	4.0	4.6	4.9	5.6
200	200	200.6	4.8	4.9	5.6	6.2	7.1
250	250	250.8	6.0	6.2	7.1	7.7	8.7
315	315	316.0	7.6	7.7	8.7	9.7	10.9

Table 3

3.4.3.2 Plain ends

Pipes with plain ends shall comply with following requirements:
a) the chamfer shall be between 5° en 15°.
b) the length of the chamfer shall be according to table 4.
c) the wall thickness at the end of the chamfer (see e1) shall not be less than 50 % of the minimum allowed wall thickness for the pipe according to table 3.

Nominal outside diameter d_e (mm)	**Length of the chamfer l_{min} (mm)**
90 ≤ *d*n ≤ 110	5
125 ≤ *d*n	7

Table 4

4 Performance requirements and test methods

This chapter contains the performance requirements and associated test methods that the products shall meet. This chapter also specifies the limit values, if applicable.

4.1 Resistance to hydrostatic pressure

Resistance to hydrostatic pressure shall be verified using the induced stresses derived from the analysis of the test data in accordance with ISO 9080. For a period of 10h at 20 °C and at the time of 1000h at 20 °C, the 99,5 % LPL value shall be taken as the minimum stress level.

For a period of 1000h at 60 °C, the 99,5 % LPL value established from analysis of test data at 60 °C in accordance with ISO 9080 can be taken as the minimum stress level. In case of a lack of data, alternatively, a value of 0.625 times the MRS value shall be taken as the minimum stress level.

When tested using end cap type A in accordance with ISO 1167-1 and using the combinations of test temperatures and induced stresses so derived, the pipe shall not fail in less than the times stated above.

See 4.1.1 for the procedure to establish 20 °C test stress values for testing under provisional qualification.

4.1.1 Establishment of the pipe material classification

The minimum required strength of the pipe materials for the purpose of this International Standard shall be evaluated according to the procedures of ISO 9080.

Whenever there is a change in material the relevant type tests shall be carried in accordance with ISO 1452-2 as indicated in the relevant table.

4.1.1.1 Determination of pipe material classification

Procedure

Pipe material shall be designated by the material type (PVC-O) and the level of the minimum required strength (MRS) in accordance with Table 1. The pipe material shall have an MRS equal to the values as specified in table 1.

The MRS value for classification shall be derived from σ_{LPL} in accordance with ISO 12162. The σ_{LPL} is determined by analysis in accordance with ISO 9080, of hydrostatic pressure tests carried out in accordance with ISO 1167-1 and ISO 1167-2 and using end caps type A, tested with water in water.

4.2 Resistance to impact at 0 °C

Pipes shall be tested at 0 °C in accordance with ISO 3127 and shall have a true impact rate (TIR) of not more than 10 % when using masses given in table 5. The radius of the striker nose shall be R= 12.5 mm. The drop height shall be 2 meter.

Nominal size DN	Total mass kg
63	4
75	5
90	5
110	6.3
160	8
200	10
>225	12.5

Table 5

4.3 Resistance to weathering

The material shall be sufficiently stable after UV-exposure (weathering)

The resistance to weathering shall be performed according to ISO 16871. In total 24 test pieces of a 63 mm pipe with a length of 1 meter shall be placed under an angle of 45°C. The test pieces shall be placed such that they form one surface area. The radiation shall be measured on location. After an exposure of 3.5 GJ/m^2 of radiation the test pieces are cut into 5 pieces of 20 cm each for further testing.

After exposure to weathering the test pieces are tested against the resistance to impact according to paragraph 4.1.2 using a mass of 1.2 kg. A maximum of 2 out of 100 test pieces may fail. It is allowed to stop the test if after 60 test no test piece has failed. The pipe is than considered to be resistant to weathering.

4.4 Resistance to gas

The resistance to gas shall be determined according to NEN 7230 chapter 4.2.10 using samples taken from a tube with a nominal diameter of 110 mm.

4.5 Determination of axial and tangential orientation factor

The axial and tangential orientation factor determined conforming to ISO 2505 shall be in accordance with table 6.

Orientation factor	315	355	400	450
λ_a	≥ 1.1	≥ 1.2	≥ 1.2	≥ 1.2
λ_r	≥ 1.6	≥ 1.6	≥ 1.6	≥ 1.6

Table 6

The test parameters and test procedure according to ISO 16422-E, Annex E shall be followed.

4.6 Degree of gelation

The pipe material shall show no visual decay after testing according to ISO 9852 (bath temperature 15 °C, immersion time 15 min., minimum wall thickness 1.5 mm).

4.7 K-value

The K value of the PVC-U resin used shall be at least 64, when tested in accordance with ISO 1628-2.

4.8 Vicat softening temperature

When determined in accordance with ISO 2507-1, the Vicat softening temperature of the compound shall be not less than 80 °C.

5 Marking, instructions and packaging

5.1 Marking

The product shall be marked with the following information.

- GASTEC QA, GASTEC QA logo or punch mark
- Manufacturers name or trademark
- Pipe material
- MRS value
- Nominal outside diameter and SDR classification
- Nominal pressure PN
- Production date or code

The pipes shall be permanently marked at intervals not greater than 1 meter.

5.2 Instructions (when applicable)

The supplier shall provide user instructions in the Dutch language and in the language of the country in which the product will be used. These instructions shall have the following information included:

- The use and installation of the product
- 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 shall be pack in such a way that damaging under normal conditions is not possible.

6 Quality system requirements

The requirements for the quality system are described in the GASTEC QA general requirements. An important part of this are the requirements for drawing up a risk analysis (e.g., an FMEA) of the product design and the production process in accordance with chapters 3.1.1.1 and 3.1.2.1. This risk analysis shall be available for inspection by Kiwa.

7 Summary of evaluation

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

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

7.1 Evaluation matrix

Description of requirement	Clause	Investigation within the scope of		
		Initial product assessment	Product verification	
			Inspection	Frequency
Product requirements	**3**			
Material	3.1			
General	3.1.1	X	X	Once a year
Rework material	3.1.2	X	X	Once a year
Material classification	3.2			
MRS value	3.2.1	X		
Design stress	3.2.2	X		
Classification and selection of pipes	3.3			
Classification	3.3.1	X		
Calculation of wall thickness	3.3.2	X		
General characteristics	3.4			
Appearance	3.4.1	X	X	Once a year
Colour	3.4.2	X		
Dimensions	3.4.3	X	X	Once a year
Performance requirements	**4**			
Resistance to hydrostatic pressure	4.1	X	X	Once a year
Establishment of the pipe classification	4.1.1	X		
Resistance to impact at 0°C	4.2	X	X	Once a year
Resistance to weathering	4.3	X		
Resistance to gas	4.4	X		
Determination of axial and tangential orientation factor	4.5	X	X	Once a year
Degree of gelation	4.6	X		
K-value	4.7	X		
Vicat softening temperature	4.8	X		
Infra-red analysis			X	Once a year
Marking and instructions	**5**			
Marking	5.1	X	X	Once a year
Instructions	5.2	X	X	Once a year
Packaging	5.3	X	X	Once a year

8 List of referenced documents and source

8.1 Standards/ normative documents

Number	Title	Version *
ISO 1167-1	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure - Part 1: General method	2006
ISO 1167-2	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure - Part 2: Preparation of pipe test pieces	2006
ISO 1628-2	Plastics - Determination of the viscosity of polymers in dilute solution using capillary viscometers - Part 2: Poly(vinyl chloride) resins	2020
ISO 2505	Thermoplastics pipes - Longitudinal reversion - Test method and parameters	2023
ISO 2507-1	Thermoplastics pipes and fittings - Vicat softening temperature - Part 1: General test method	2017
ISO 3126	Plastics piping systems - Plastics components -Determination of dimensions	2005
ISO 3127	Thermoplastics pipes - Determination of resistance to external blows - Round-the-clock method	2017
ISO 4065	Thermoplastics pipes - Universal wall thickness table	2018
ISO 9080	Plastics piping and ducting systems - Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation	2012
ISO 9852	Unplasticized poly(vinyl chloride) (PVC-U) pipes - Dichloromethane resistance at specified temperature (DCMT) - Test method	2017
ISO 12162	Thermoplastics materials for pipes and fittings for pressure applications - Classification, design coefficient and designation	2009
ISO 16422-1	Pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O) for the conveyance of water under pressure — Part 1: General	2024
ISO 16422-2	Pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O) for the conveyance of water under pressure — Part 2: Pipes	2024
ISO 16422-5	Pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O) for the conveyance of water under pressure — Part 5: Fitness for purpose of the system	2024

ISO 16871	Plastics piping and ducting systems - Plastics pipes and fittings - Method for exposure to direct (natural) weathering	2003
NEN 7230	Plastics piping systems for gas supply - Pipes of high-impact polyvinyl chloride (PVC-HI) - Requirements and test methods	2020

*) If no date of issuance is specified in this column, the current version of the document applies.

8.2 Source of informative documents

Number	Title	Version *
EN 437	Test gases- test pressure – appliance categories	2021
General requirements GASTEC QA		

*) If no date of issuance is specified in this column, the current version of the document applies.