KE 207
Concept April 2015

GASTEC QA

Approval Requirements 207

For the Gastec QA product certificate for pipes of oriented plasticized PVC (PVC-O)

Foreword

These GASTEC QA Approval requirements have 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.

These GASTEC QA Approval requirements will be used by Kiwa Nederland BV in conjunction with the KIWA regulations for product certification. This regulation details the method employed by Kiwa during product certification.

Approved by Board of Experts : xxx

Accepted by Kiwa Nederland B.V. : xxx

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1 Introduction

1.1 General

This approval requirement includes all relevant requirements which are adhered by Kiwa as the basis for the issue and maintenance of a Gastec QA certificate for pipes which are made of oriented unplasticized PVC (PVC-O).

1.2 Scope

These requirements apply 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 NEN-EN 437 with a maximum operating pressure of 8 bar.

1.3 Acceptance of test reports provided by the supplier

When the manufacturer provides reports from test Institutions or laboratories in order to demonstrate that the product meets the requirements of this evaluation guideline, the institute or laboratory shall meet one of the applicable accreditation norms, being;

- NEN-EN-ISO/IEC 17025 for laboratories;
- NEN-EN-ISO/IEC 17065 for certification bodies certifying products;

This requirement is being considered to be fulfilled when a certificate of accreditation can be shown, either issued by the Board of Accreditation (RvA) or one of the institutions with which the RvA an agreement of mutual acceptance has been concluded.

The accreditation shall refer to the examination as required in this approval requirement. When no certificate of accreditation can be shown, Kiwa will verify whether the accreditation norm is fulfilled or perform the examination in its own laboratory.

1.4 Quality declaration

The quality declarations to be issued by Kiwa are described as Kiwa product certificate. This product certificate has an indefinite period of validity.

2 Terms and definitions

In this evaluation guideline the following terms and definitions are applicable:

Approval requirement/ Evaluation Guideline: the agreements made within the Board of Experts on the subject of certification.

Board of Experts: The Board of Experts Gastec QA.

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

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

IQC scheme: a description of the quality inspections carried out by the supplier as part of his quality system.

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.

Initial assessment: assessment in order to ascertain that all the requirements recorded in the Evaluation Guideline are met.

Product inspection: tests carried out after the certificate has been granted in order to ascertain whether the certified products continue to meet the requirements recorded in the Evaluation Guideline.

Product certificate: a document, in which Kiwa declares that a product may, on delivery, be deemed to comply with the product specification recorded in the product certificate.

3 Procedure for granting the quality declaration

3.1 Initial assessment

The initial assessment to be performed by Kiwa is based on the (product) requirements as included in this evaluation guideline including the test methods and contains:

- type testing to determine whether the products comply with the product and/or functional requirements,
- Production process assessment
- Assessment of the quality system and the IQC-scheme
- Assessment on the presence and functioning of the required procedures.

3.2 Granting the certificate

After finishing the pre-certification tests the results are presented to the person deciding on granting of certificate. This person evaluates the results and decides whether the certificate can be granted by Kiwa or additional data and/or tests are necessary

3.3 Retaining the certificate

By means of verification of the product and the quality system it is determined by Kiwa if the product continues to comply with the requirements described in this document.

4 Product Requirements

4.1 Material

4.1.1 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.

4.1.2 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.

4.2 Material classification

4.2.1 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 chapter 5.5. The minimum required strength (MRS) values shall be classified in accordance with 4.2.2 Table 1.

4.2.2 Design stress

The design stress shall be based on the value of the lower confidence limit σ_{LPL} of the long term hydrostatic strength for the resistance to internal pressure as determined in accordance with ISO 9080. This σ_{LPL} 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

4.3 Classification and selection of pipes

4.3.1 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

4.3.2 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 4.3.1 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

4.4 General characteristics

4.4.1 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.

4.4.2 Colour

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

4.4.3 Dimensions

4.4.3.1 Outside diameters and wall thicknesses

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

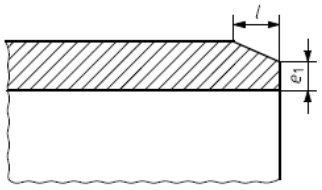
Table 3

4.4.3.2 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 e_1) 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)**
$90 \leq d_n \leq 110$	5
$125 \leq d_n$	7

Table 4



Figuur 1 — Afschuining van de buiseinden

5 Mechanical characteristics

5.1 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 10 h at 20 °C and at the time of 1 000 h at 20 °C, the 99,5 % LPL value shall be taken as the minimum stress level.

For a period of 1 000 h 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 1167-1:2006, 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 5.1.1 for the procedure to establish 20 °C test stress values for testing under provisional qualification.

5.1.1 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.

5.1.1.1 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.

5.2 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

5.3 Resistance to weathering

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

The resistance to weathering shall be performed according to NEN-EN-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 chapter 5.2 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.

5.4 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.

5.5 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 Annex F shall be followed.

6 Physical charateristics

6.1 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., min.wall thickness 1,5 mm)

6.2 K-value

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

6.3 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.

7 Marking and instructions

7.1 Marking

The product shall be marked with the following information.

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

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

7.2 Instructions

The supplier shall provide instructions. These instructions shall be in the Dutch language and describe that the product is Gastec QA certified. In addition the instructions shall contain information about:

- 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

7.3 Packaging

The product shall be pack in such a way that damaging under normal conditions is not possible.

8 Quality system requirements

This chapter contains the requirements that have to be fulfilled by the manufacturer's quality system.

8.1 Manager of the quality system

Within the manufacturers organizational structure an employee must be appointed who is in charge of managing the quality system.

8.2 Internal quality control/quality plan

As part of the quality system the manufacturer must implement an internal quality control schedule (IQC-scheme).
This IQC scheme shall relate to:

- the supplied raw materials or composite materials;
- the production process;
- the end-products;
- the status of measuring and testing means;
- the internal transport, the storage and identification or manner of marking semi-manufactures and end-products.

In this IQC-scheme the following must be demonstrably recorded:

- which aspects are inspected by the manufacturer;
- according to which methods these inspections are carried out;
- how often these inspections are carried out;
- How the inspection results are registered and stored.

This IQC-schedule must be detailed in such a way that it provides Kiwa sufficient confidence that requirements will be continuously fulfilled.

8.3 Procedures and work instructions

The manufacturer must be able to submit procedures for:

- the handling of non-conforming products;
- corrective actions in case non-conformities are found;
- the handling of complaints regarding the products and / or services supplied;
- the work instructions and inspection sheets in use
- Instructions for packaging and closing off of products during storage and transport.

8.4 Other Quality system requirements

The quality system of the manufacturer shall be ISO 9001 certified. The IQC scheme may be combined with the ISO 9001 quality system.

9 Summary of tests and inspections

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

- Initial assessment;
- Product verification;
- Verification of the quality system;

9.1 Test matrix

Description of requirement	Clause guideline or standard	Test within the scope of		
		Initial assessment	Product verification	Frequency
General	4.1.1	X		
Rework material	4.1.2	X		
MRS value	4.2.1	X		
Design stress	4.2.2	X		
Classification	4.3.1	X		
Calculation of wall thickness	4.3.2	X		
Appearance	4.4.1	X	X	Once a year
Colour	4.4.2	X		
Dimensions	4.4.3	X	X	Once a year
Resistance to hydrostatic pressure	5.1	X	X	Once a year
Establishment of the pipe classification	5.1.1	X		
Resistance to impact at 0°C	5.2	X	X	Once a year
Resistance to weathering	5.3	X		
Resistance to gas	5.4	X		
Determination of axial and tangential orientation factor	5.5	X	X	Once a year
Degree of gelation	6.1	X		
K-value	6.2	X		
Vicat softening temperature	6.3	X		
Infra red analysis			X	Once a year
Marking and instructions	7	X	X	Once a year

1) In case the product or production process changes significantly a re-evaluation will be performed.

9.2 Inspection of the quality system

The certification body shall verify if the supplier and/or manaufacturer complies with its obligations. The inspection frequency is determined by the Board of experts and is set to two inspection visits per year.

The inspection visits shall at least relate to:

- The products and product specifications as specified on the certificate;
- The production process of the manufacturer;
- The IQC scheme of the manufacturer and the results of the verifications performed by the manufacturer;
- The correct way of marking the certified products;
- Compliance with the required procedures.

Multiple manufacturers of parts is possible. Depending on the risk for the final product inspection may be performed at these manufactures location.

9.2.1 Non-conformity during inspection

If during inspection of the quality system non-conformities are found, the procedure as determined by the Board of experts shall be followed.

10 Requirements for the certification body

10.1 General

The certification body shall be accredited according to NEN-EN-ISO 17065 for this approval requirement.

The certification body shall have a regulation of equal document in which the general rules for certification are laid down. These rules are in particular:

- The general rules for conducting the pre-certification tests, to be distinguished in:
    - the way suppliers are to be informed about an application is being handled;
    - how the test are conducted;
    - the decision to be taken as a result of the pre certification tests.
- The general directions for conducting inspections and the aspects to be audited,
- The measurements to be taken by certification body in case of Non Conformities,
- Measurements taken by certification body in case of improper Use of Certificates, Certification Marks, Pictograms and Logos,
- Terms for termination of the certificate,
- The possibility to lodge an appeal against decisions of measurements taken by certification body.

10.2 Certification staff

The staff involved in the certification process is sub-divided into:

- Certification assessor/ application reviewer/ reviewer: in charge of assessing design and documentation, assessement of certification requests, review of assessments;
- Site assessor: in charge of carrying out external inspections at the supplier's works;
- Decision-maker: in charge of taking the certification decision based on the pre-certification assessment and continuation of the certificate based on the verification performed.

10.3 Qualification requirements

The qualification requirements consist of:

- Qualification requirements for the executive staff of the certification body that shall fulfil the requirements of NEN-EN-ISO 17065
- Qualification requirements for the executive staff of the certification body set by the Board of Experts for this approval requirement.

	Certification assessor/ application reviewer/ Reviewer	Site assessor	Decision maker
Basic competence			
Knowledge of business processes, skills to make professional judgments	1 year of relevant working experience. Reviewer: 3 years of relevant working experience of which at least 1 year in the field of certification.	1 year of relevant working	5 years of relevant working experience of which at least 1 year in the field of certification
Audit skills	Na	Audit training. At least 4 site assessments including 1 independent under supervision.	na
Technical competence			
Knowledge of the content of the scheme(s)	Knowledge of the approval requirement in detail.	Knowledge of the chapters related to the quality system and testing of the approval requirement in the cluster.	
For the location assessor knowledge of: • the technology used for the manufacture of the products inspected, the operation of processes and the delivery of services; • the way in which products are used, processes are operated and services are delivered; • any defects which may occur during the use of the product, any failures in the operation of the process and the relevant techniques for quality control.		A minimum of 1 year experience in manufacturing, -testing, -inspection and/or the installation business, including: 3 x coached inspections 1 x independent inspection	
For the cerification assessor/ application reviewer/ reviewer Generic knowledge of • gas distribution materials • the various type of products and materials used in gas distribution; • the way the products are applied in the gas distribution system; • the critical parameters and components in the system.	A minimum of 2 year experience in manufacturing, testing, inspection or installation of gas distribution materials.		

10.4 Qualification

Certification staff must be demonstrably qualified by evaluation of education and experience of the above-mentioned requirements. Qualification of staff is done by the management of the certification body.

10.5 Report initial assessment

The certification body lays down the results of the initial assessment in a report. This report shall full fill the following requirements:

- Completeness: the report shall decide on all requirements mentioned in the approval requirement.
- Traceability: the results on which a decision is based shall be traceable.
- Basis for decision: the decision maker shall base his decision on the findings laid down in the report.

10.6 Decision for granting the certificate

The decision for granting the certificate shall be made by a qualified decision maker which has not been involved in the initial assessment. The decision shall be recorded traceable.

10.7 Nature and frequency of external inspections

The certification body shall carry out audits at the supplier and/ or manufacturer at regular intervals to check whether the supplier complies with his obligations. The results of each inspection shall be traceable recorded in a report.

10.8 Interpretation of requirements

The Board of Experts may record the interpretation of requirements of these evaluation guidelines in one separate interpretation document.

10.9 Reporting to Board of experts

The certification body reports at least once a year about the certification activities. In this report the following items are to be addressed:

- Changes in the amount of certificates
- Amount of verifications performed in relation to the set frequency
- Result of the verifications
- Measures imposed by non-conformities
- Complaints received by third parties about certified products

11 List of referenced documents

11.1 Standards/ normative documents

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

Sorted by number:

NEN-EN 437: 2003+A1: 2009	Test gases- test pressure – appliance categories
NEN-EN-ISO 1167-1: 2006	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure - Part 1: General method
NEN-EN-ISO 1167-2: 2006	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure - Part 2: Preparation of pipe test pieces
NEN-EN-ISO 1628-2: 1999	Plastics - Determination of the viscosity of polymers in dilute solution using capillary viscometers - Part 2: Poly(vinyl chloride) resins
NEN-EN-ISO 2505: 2005	Thermoplastics pipes - Longitudinal reversion - Test method and parameters
ISO 2507-1: 1995	Thermoplastics pipes and fittings - Vicat softening temperature - Part 1: General test method
NEN-EN-ISO 3126: 2005	Plastics piping systems - Plastics components - Determination of dimensions
ISO 3127: 1994	Thermoplastics pipes - Determination of resistance to external blows - Round-the-clock method
ISO 4065: 1996	Thermoplastics pipes - Universal wall thickness table
NEN 7230: 2011	Kunststofleidingsystemen voor gasvoorziening – buizen van slagvast polyvinylchloride (slagvast PVC) – eisen en beproevingsmethoden
NEN-EN-ISO 9001: 2008 +C1: 2009	Quality management systems – Requirements
NEN-EN-ISO 9080: 2012	Plastics piping and ducting systems - Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation
ISO 9852: 2007	Unplasticized poly(vinyl chloride) (PVC-U) pipes - Dichloromethane resistance at specified temperature (DCMT) - Test method
NEN-EN-ISO 12162: 2009	Thermoplastics materials for pipes and fittings for pressure applications - Classification, design coefficient and designation
NEN-ISO 16422: 2014	Pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O) for the conveyance of water under pressure – specifications
NEN-EN-ISO 16871: 2003	Plastics piping and ducting systems - Plastics pipes and fittings - Method for exposure to direct (natural) weathering

Appendix A: Model IQC-scheme or frame-IQC-scheme

Subject	Aspect	Method	Frequency	Registration
Incoming control supplied materials				
Production process *(equipment)*				
Finished product *(inspection)*				
Test and measurement equipment				
Logistics, storage, identification, marking of products				