BRL-K552/04
Datum 2022-12-02

Evaluation Guideline

for the Kiwa product certificate for
Thermoplastics piping systems for the transport of liquid oil and related products and their vapours

Trust
Quality
Progress

Preface

This evaluation guideline has been accepted by the Kiwa Board of Experts “Tanks, Tank installations & Appendages”, wherein all the relevant parties in the field of thermoplastics piping systems for the transport of liquid oil and related products and their vapours are represented. This Board of Experts also supervises the certification activities and where necessary require the evaluation guideline to be revised. All references to Board of Experts in this evaluation guideline pertain to the above mentioned Board of Experts.

This evaluation guideline will be used by Kiwa in conjunction with the Kiwa Regulations for Certification.

Kiwa Nederland B.V.

Sir Winston Churchilllaan 273

Postbus 70

2280 AB RIJSWIJK

The Netherlands

Tel. +31 88 998 44 00
Fax +31 88 998 44 20
info@Kiwa.com
www.kiwa.nl

Validation
This evaluation guideline has been declared binding by Kiwa on 01-04-2022

5911.80330

Contents

1 Introduction

1.1 General

This evaluation guideline includes all relevant requirements which are employed by Kiwa when dealing with applications for the issue and maintenance of a certificate for products used for the transport of liquid oil and related products and their vapours.

This guideline replaces the evaluation guideline BRL-K552/03, dated 01-02-20211. The quality declarations issued and based on that guideline will lose their validity at a maximum period of 6 months after validation of this BRL.

For the performance of its certification work, Kiwa is bound to the requirements as included in NEN-EN-ISO/IEC 17065 “Conformity assessment - Requirements for bodies certifying products, processes and services”.

1.2 Field of application / scope

The products are intended to be used for

- The transport of liquid oil and related products according to PGS 28, PGS 30 (PGS Class 1 through 4 products) or PGS31. These liquids are for example (bio)fuels, waste oils, lubricating oils, HVO, Diesel Exhaust Fluid, solvents, etc.;
- For above ground and underground applications;
- For maximum positive working pressures of 5,0 bar(g);
    - If the max. working pressure will be higher than 5 bar(g) additional testing may be required. This is to be assessed by the certification body.
- For minimum negative working pressures of -0,8 bar(g) (= +0,2 bar absolute);
- For a maximum liquid flow of 5 m/s;
- For an expected lifetime of 20 years.

NOTES:

1. This Evaluation Guideline only covers barrier layers (see Chapter 5) made of thermoplastic materials.
2. LPG is not considered to be a liquid oil product and accordingly the piping systems complying with this Evaluation Guideline are not suitable for LPG applications.
3. For liquid products other than the (bio)fuels, waste oils, lubricating oils, HVO, Diesel Exhaust Fluid (AdBlue, AUS 32) etc. the test liquids and the requirements for the chemical resistance and resistance to permeation shall need to be modified.
4. The following pressures are common in pressure systems:
    - A working pressure of 2,5 bar(g)
    - A rest pressure of 0,8 bar(g)

1.3 Acceptance of test reports provided by the supplier

If the supplier provides reports from test institutions or laboratories to prove that the products meet the requirements of this evaluation guideline, the supplier shall prove that these reports have been drawn up by an institution that complies with the applicable accreditation standards, namely:

- NEN-EN-ISO/IEC 17020 for inspection bodies;
- NEN-EN-ISO/IEC 17021-1 for certification bodies certifying systems;
- NEN-EN-ISO/IEC 17024 for certification bodies certifying persons;
- NEN-EN-ISO/IEC 17025 for laboratories;
- NEN-EN-ISO/IEC 17065 for certification bodies certifying products.

Remark:
This requirement is considered to be fulfilled when a certificate of accreditation can be shown, issued either by the Board of Accreditation (RvA) or by another institution that has been accepted as a member with an agreement on mutual recognition and acceptance of accreditation, which have been drawn up within EA, IAF and ILAC. The accreditation shall refer to the examinations as required in this evaluation guideline. When no certificate of accreditation can be shown, Kiwa shall verify whether the accreditation standard is fulfilled.

1.4 Quality declaration

The quality declaration to be issued by Kiwa is described as a Kiwa product certificate.
A model of the certificate to be issued on the basis of this evaluation guideline has been included for information as Annex I.

2 Terms and definitions

2.1 Definitions

In this evaluation guideline, the following terms and definitions apply:

- **Barrier layer**: Inside layer of the pipe which is direct in contact with the medium and is resistant to the chemical properties of this medium.
- **Board of Experts**: the Board of Experts “Tanks, Tank installations & Appendages” (TTA).
- **Certification mark**: a protected trademark of which the authorization of the use is granted by Kiwa, to the supplier whose products can be considered to comply on delivery with the applicable requirements.
- **Coupling**: Metallic or non-metallic component attached to the primary pipe either by expansion or external compression. The coupling may have either straight threads or proprietary threads that interface with fittings.
- **Ducting pipe**: Flexible thermoplastics pipe which is used to facilitate removal of the primary pipe(s) without the need to excavate the site and to prevent soil loads on the primary pipe. The ducting pipe may contain slots or holes.
- **Electro fusion fitting**: A polyethylene fitting which contains one or more integral heating elements, by which the supplied electrical energy is transformed into heat; the heating element produces the molten surface necessary in order to realise a sound fusion joint of the assembled PE primary pipes.
- **Entry seal**: A liquid-tight flexible fitting used to seal piping or conduit at the wall of a tank sump or dispenser sump or manifold sump.
- **Evaluation Guideline (BRL)**: the agreements made within the Board of Experts on the subject of certification.
- **Fitting** Metallic or non-metallic component connected to the primary pipe or standard pipe fitting. An example of a fitting is a cast elbow that has straight threads on one end and female BSPT or NPT threads in the other port to interface with standard threaded piping.
- **Inspection tests**: 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.
- **Installation:** configuration consisting the pipe work, fittings and appliances;
- **Integrated secondary containment**: A loose outer casing of the primary pipe with the function of a barrier and prevention of damage of the primary pipe. The interstitial space may contain permeation products of the primary pipe and may be ventilated to remove these products and/or may be used for leak detection.
- **IQC scheme (IQCS):** a description of the quality inspections carried out by the supplier as part of his quality system.

- **Initial investigation**: tests in order to ascertain that all the requirements recorded in the evaluation guideline are met.

- **Outer layer**: Outside layer of the primary pipe and outside layer of the integrated secondary containment

- **Piping system**: The piping system for the transport of liquid oil or related products comprises a primary pipe with or without an integrated secondary containment and/or secondary containment pipe and/or ducting pipe and/or sumps, including the relevant fittings and couplings and sealing elements. Vapour recovery lines are considered to be part of the piping system.

- **PGS Class 1 through Class 4 fluids according to the PGS guidelines**: The PGS 28 and PGS 30 make use of the following classes:

PGS Class	**Products**
PGS Class 1	Fluids with a flash point < 23 °C and a boiling point beginning at > 35°C
PGS Class 2	Fluids with a flash point ≥ 23 °C and ≤ 55 °C
PGS Class 3	Fluids with a flash point > 55 °C and ≤ 100 °C
PGS Class 4	Fluids with a flash point > 100 °C

- **Primary pipe**: Flexible thermoplastics pipe, which transports the liquid oil or related product and which is therefore in direct contact with the oil or related product.

- **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.

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

- **Rest pressure**: Pressure which remains inside the primary pipe in case the liquid oil or related product inside the primary pipe does not flow.

- **Secondary containment pipe**: Flexible thermoplastics pipe, which houses the primary pipe. The function of the secondary containment pipe is either a barrier or collector of leakage, which has passed through a leak in the wall of the primary pipe. The interstitial space may contain permeation products of the primary pipe and may be ventilated to remove these products and/or may be used for leak detection.

- **Sump**: A containment chamber that is fastened to the top of an underground storage tank (tank sump) or that is located below a product-dispensing device (dispenser sump). This chamber is used to isolate a submersible turbine pump (tank sump, if so equipped), as well as miscellaneous valves and fittings from the ground environment.

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

- **Test boot**: A liquid-tight flexible fitting used to seal and test the secondary pipe. Generally designed to seal one side of the boot to the outside of the secondary

pipe and the other side to either the primary pipe or outer surface of the primary coupling.

- **Working pressure**: Pressure applied to the liquid oil or related product in the primary pipe in case the liquid oil or related product flows from the tank to the dispenser.

3 Procedure for granting a product certificate

3.1 Initial investigation

The initial investigation to be performed are based on the (product) requirements as contained in this evaluation guideline, including the test methods, and comprises the following:

- 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 remaining procedures.

3.2 Granting the product certificate

After finishing the initial investigation, the results are presented to the Decision maker (see § 13.2) deciding on granting the certificate. This person evaluates the results and decides whether the certificate can be granted or if additional data and/or tests are necessary.

3.3 Investigation into the product and/or performance requirements

Kiwa will investigate the to be certified products against the certification requirements as stated in the certification requirements.
The necessary samples will be drawn by or on behalf of Kiwa.

3.4 Production process assessment

When assessing the production process, it is investigated whether the producer is capable of continuously producing products that meet the certification requirements. The evaluation of the production process takes place during the ongoing work at the producer.
The assessment also includes at least:

- The quality of raw materials, half-finished products and end products;
- Internal transport and storage.

3.5 Contract assessment

If the supplier is not the producer of the products to be certified, Kiwa will assess the agreement between the supplier and the producer.
This written agreement, which is available for Kiwa, includes at least:
Accreditation bodies, scheme managers and Kiwa will be given the opportunity to observe the certification activities carried out by Kiwa or on behalf of Kiwa at the producer.

4 Product requirements and test methods

4.1 General

This chapter lists the product and performance requirements that have to be met by the thermoplastics piping systems for the transport of liquid oil and related products and their vapours.

The complete piping system shall be assessed. A description of the piping system shall be stated in the technical specifications on the product certificate.

Besides the requirements stated in this evaluation guideline, the following points are of interest for the system assessment.
Static electricity: at the moment of issue of this guideline no requirements are defined for these piping systems with regard to static electricity. When requirements in PGS are available then this guideline will be revised on this aspect.
Sumps: when sumps are used it is advisable to take measures in order to prevent dangerous situations because of accumulation of vapours in the sump. For further information in this regard reference shall be made to BRL-K21006.
Microbiological influences: it is generally known that the quality characteristics of certain types of thermoplastics may be reduced due to the influence of microbiological organisms. In these cases additional testing may be required. This is to be assessed by the certification body.

4.2 Abbreviations

PP = a pressure pipe for a pressure piping system (PP = pressure pipe)
SP = a suction pipe for a suction piping system (SP = suction pipe)

4.3 Resistance to permeation of the system

The complete piping system, including couplings, fittings, sealing rings etc. shall be evaluated with regard to the resistance to permeation of the medium. The test shall be carried out per specified pipe length in accordance with the requirements stated in § 5.21.

4.4 Requirements pertaining to the various piping system components

The requirements pertaining to the various components used in the piping system are covered in the following chapters or Evaluation Guideline:

Component	Requirements
Primary pipe with or without an integrated secondary containment	Chapter 5
Secondary containment, ducting pipe and joints	Chapter 6
Vapour recovery lines	Chapter 7
Filling pipes	Chapter 8
Couplings and fittings for primary pipes with or without an integrated secondary containment	Chapter 9
Elastomeric sealing elements for the secondary pipe and sumps	Chapter 10
Sumps	BRL-K21006

4.5 Installation instructions

The manufacturer shall provide proper written installation and users' instructions in the language of the country where the piping system is to be installed and used. The installation instructions shall clearly indicate how the different piping elements (primary, secondary, ducting, vapour recovery and filling) can be identified. Where ducting pipes are used, movement of the inner pipe(s) can occur resulting in the wearing of the inner pipe(s) and the ducting pipe. The installation instructions shall

specify the measures to be taken to prevent unacceptable damage of the pipes and include instructions for pressure testing of the piping system.

These instructions shall reference compliance with the national environmental regulations pertaining to the above ground or underground transport of liquid oil and related products and their vapours. National regulations stipulate that the installation is to be carried out by installers certified in accordance with the requirements of BRL SIKB 7800. These installation companies shall be trained by the manufacturer to install the specific manufacturers' piping system.

When an end-user or the relevant PGS document requires a leak detection system to be installed in a pressure system, this must be done only after consultation with the manufacturer of the piping system. The leak detection system used shall fulfil the requirements of the relevant PGS document.

4.6 Marking

The piping components and packaging shall be provided with clear, legible and indelible marking as follows:
Kiwa (or Kiwa word mark);

- Manufacturer's name, trade name, system name or logo;
- Certificate number in accordance with this Evaluation Guideline;
- Production date (year, month, day) or code from which the production date can be derived.

Additionally, the following will apply for:
Primary pipe with or without an integrated secondary containment
These pipes shall be marked as indicated at intervals of no more than 2 m. In addition, the code "PP" for pressure pipe or "SP" for suction pipe as applicable. Also, the word "ABOVE GROUND" or the word "UNDERGROUND" shall be clearly stated for above ground or underground applications as applicable. For both applications above ground and underground applications marking with the word "ABOVE GROUND" and the word "UNDERGROUND" on the pipes are applicable.

Alternatively, for marking with the word "ABOVE GROUND" and/or the word "UNDERGROUND" the applications can also be documented in the installation instructions.

Secondary containment and ducting pipes and filling pipes
These pipes shall be marked as indicated at intervals of no more than 2 m. Also, the word "ABOVE GROUND" or the word "UNDERGROUND" shall be clearly stated for above ground or underground applications as applicable. For both applications above ground and underground applications marking with the word "ABOVE GROUND" and the word "UNDERGROUND" on the pipes are applicable.

Alternatively, for marking with the word "ABOVE GROUND" and/or the word "UNDERGROUND" the applications can also be documented in the installation instructions.

Couplings and fittings for primary pipes with or without an integrated secondary containment
In addition to the marking on the components, the packaging of the fittings and couplings shall also be marked as indicated.

Elastomeric sealing elements for secondary containment pipes
In addition to the marking on the components, the packaging of the elastomeric sealing elements shall also be marked as indicated.

5 Primary pipe with or without an integrated secondary containment

5.1 General

This chapter specifies the requirements and test methods for the thermoplastic primary pipe with or without an integrated secondary containment.

5.2 Sampling and conditioning of the test samples

Unless otherwise specified, the testing shall be carried out on test pieces which are at least 16 hours old at (23 ±2) °C after a conditioning of at least 16 hours at the same temperature.

5.3 Wall construction and material of the pipe

The wall construction and the materials to be used for the pipe as tested for compliance with this Evaluation Guideline shall be documented in an appendix to the manufacturer’s contract.

5.4 Appearance

The inner and outer surfaces shall be smooth and flawless, without holes, blisters or other defects. A corrugated profile in the inner surface is allowed. The profile shall be even. The material shall be free of any contamination. The manufacturer's quality system shall include distinct criteria for approval and rejection.

The appearance shall be assessed visually without using any magnification.

5.5 Wall build-up and dimensions of the pipe

The wall build-up, dimensions and applicable tolerances of the PP and SP pipe are documented in an appendix to the manufacturer’s contract. The pipe shall be manufactured with a nominal diameter as declared in the technical specifications on the product certificate.

The build-up of the wall is checked visually and if necessary with the use of a measuring ocular. The inside diameter shall be determined using callipers with an accuracy of 0,05 mm. The outside diameter shall be determined using a measuring tape with an accuracy of 0,10 mm.

5.6 Length of the pipe

The pressure pipe (type PP) and the suction pipe (type SP) shall be delivered in lengths as declared by the manufacturer in the technical specifications on the product certificate. The delivered length shall not be less than 99 % of this declared length.

The length of the pipe shall be measured with a measuring tape with an accuracy of 10 mm. The length of the pipe and the measured value is compared with the declared value.

5.7 Change in length and mean outside diameter of the pressure pipe (Type PP) at positive pressure

After subjecting the pipe to a pressure of 5,0 bar(a) for 5 minutes, none of the test pieces shall have a change in length (ΔL) greater than 2,0 % for a pipe with an corrugated inner surface and 0,5 % for a pipe with a straight (smooth) inner surface. The change of the mean outside diameter (Δd) shall not be greater than 1,25 %.

Note: This test method is in accordance with SAE J343.

Test pieces

For this test 3 pipe test pieces are taken from the pressure pipe, (without the integrated secondary pipe when applicable) equipped with standard couplings, which are installed according the manufacturer's instructions. These couplings shall be provided with equipment to pressurise the test pieces and to maintain this pressure. The length of the pipe between the couplings shall be at least 300 mm.

Apparatus

- Pressure equipment, fit to maintain the pressure at (5,0 ± 0,1) bar(a).
- Measuring device to measure the length with an accuracy of 0,1 mm.
- Measuring device to measure the mean outside diameter with an accuracy of 0,05 mm.

Procedure

- Remove the integrated secondary pipe, when applicable, without damaging the inner pipe;
- Apply two marks in the middle between the couplings, with a distance of 250 mm from each other for the determination of the length and one mark in the middle of the test piece for the determination of the mean outside diameter;
- Make sure that during testing the test piece is completely stretched and without any loading on the couplings;
- Connect the test piece to the pressure equipment;
- Apply a pressure of (5,0 bar(a) ± 0,1) bar(a) for (60^{+5}_{0}) seconds;
- Release the pressure from the test piece and allow the test piece to re-stabilise for (60^{+5}_{0}) seconds;
- Measure after this period the distance between the two marks (L0) in mm and the mean outside diameter (d0) in mm at the mark;
- Apply after this period again the pressure of (5,0 bar(a) ± 0,1) bar(a);
- After a period of (300 ± 15) seconds, and with the test piece still under pressure, measure the length between the marks (L1) in mm and the mean outside diameter at the location of the mark (d1) in mm;
- Calculate the change in length ΔL and the change in mean outside diameter Δd in percentage using equations 5-1 and 5-2.

$$\Delta L = \left(\frac{L1 - L0}{L0}\right) \times 100\% \qquad \text{Equation 5-1}$$

$$\Delta d = \left(\frac{d1 - d0}{d0}\right) \times 100\% \qquad \text{Equation 5-2}$$

Repeat this procedure for the two other test pieces.

5.8 Change in length and mean outside diameter of the suction pipe (Type SP) at negative pressure

After subjecting the pipe to a negative pressure of 0,9 bar(g) (0,1 bar absolute) for 5 minutes, none of the test pieces shall have a change in length (ΔL) greater than 1,5 %. The change of the mean outside diameter (Δd) shall not be greater than 0,5 %. During testing the pipe shall not collapse.

Test pieces

For this test 3 pipe test pieces are needed taken from the suction pipe (without the integrated secondary pipe when applicable) , equipped with standard couplings, which are installed according the manufacturer's instructions. These couplings shall be provided with equipment to induce a negative pressure and to maintain this negative pressure. The length of the pipe between the couplings shall be at least be 300 mm.

Apparatus

Negative pressure device, fit to maintain the negative pressure at ($0{,}9_{0}^{+0{,}05}$) bar(g) [($0{,}1_{-0{,}05}^{0}$)bar(a)];

- Measuring device to measure the length with an accuracy of 0,1 mm.
- Measuring device to measure the mean outside diameter with an accuracy of 0,05 mm.

Procedure

- Remove the integrated secondary pipe, when applicable, without damaging the inner pipe;
- Apply two marks in the middle between the couplings with a distance of 250 mm from each other and one mark in the middle of the test piece for the determination of the mean outside diameter;
- Make sure that during testing the test piece is completely stretched and without any loading on the couplings;
- Connect the test piece to the negative pressure equipment;
- Apply a negative pressure of ($0{,}9_{0}^{+0{,}05}$) bar(g) [($0{,}1_{-0{,}05}^{0}$)) bar absolute] for (60_{0}^{+5}) seconds;
- Release after this time the pressure from the test piece and allow the test piece to re-stabilize for (60+50) seconds;
- Measure the distance between the two marks (L0) in mm and the mean outside diameter (d0) in mm at the location of the mark;
- Apply again the negative pressure of ($0{,}9_{0}^{+0{,}05}$) bar(g) [($0{,}1_{-0{,}05}^{0}$)) bar absolute];
- After a period of (300 ± 15) seconds, and with the test piece still under negative pressure, measure the length between the marks (L1) in mm and the mean outside diameter (d1) at the location of the mark;
- Calculate the change in length ΔL and the mean outside diameter Δd using equations 5-3 and 5-4.

$$\Delta L = \left(\frac{L1-L0}{L0}\right) \times 100\% \qquad \text{Equation 5-3}$$

$$\Delta L = \left(\frac{L1-L0}{L0}\right) \times 100\% \qquad \text{Equation 5-4}$$

Repeat this procedure for each of the test pieces.

5.9 Adhesion strength

The minimum separation rate between the barrier layer and the immediate structural layer of every test piece shall not be lower than 0,5 mm/s (F = 50 N).

Principle

Testing is carried out in accordance with ASTM D 413 "Static mass procedure" using three type “Ring” test pieces. Carry out the testing according ASTM D 413 clause 7.3 and note the time needed for a full disbonding according ASTM D413 clause 7.4. Thereafter calculate per test piece the bond strength according ASTM D 413 clause 13.1.

5.10 Resistance of the pressure pipe (type PP) to a cyclic positive pressure

After testing with a bending radius as declared by the manufacturer the test piece shall show no defects after 250.000 cycles. The bending radius per pipe diameter shall be stated in the technical specifications on the product certificate.

Principle
In principle, the test is carried out according SAE J 343 with a bending of 180° and a rate of 30 cycles per minute.

Test pieces
For this test 2 pipe test pieces are needed taken from the pressure pipe, equipped with standard couplings, which are installed according the manufacturer's instructions. These couplings shall be provided with equipment to pressurise the test pieces and to maintain this pressure.
The length of the pipe (Lv) between the coupling is calculated using Equation 5-5.

$$\mathrm{Lv} = \pi \times R + 2 \times d \qquad \text{Equation 5-5}$$

whereby
Lv = length between the couplings in mm;
R = bending radius in mm as declared by the manufacturer;
d = nominal outside diameter of the pipe in mm.

Apparatus
A cyclic pressure device with the following conditions:
1. Cycle rate (30 ± 5) cycles/minute;
2. Threshold pressure (1,5 ± 0,1) bar(a), surge pressure (10,0 ± 0,1) bar(a);
3. Pressure profile in accordance with Figure 5.1;

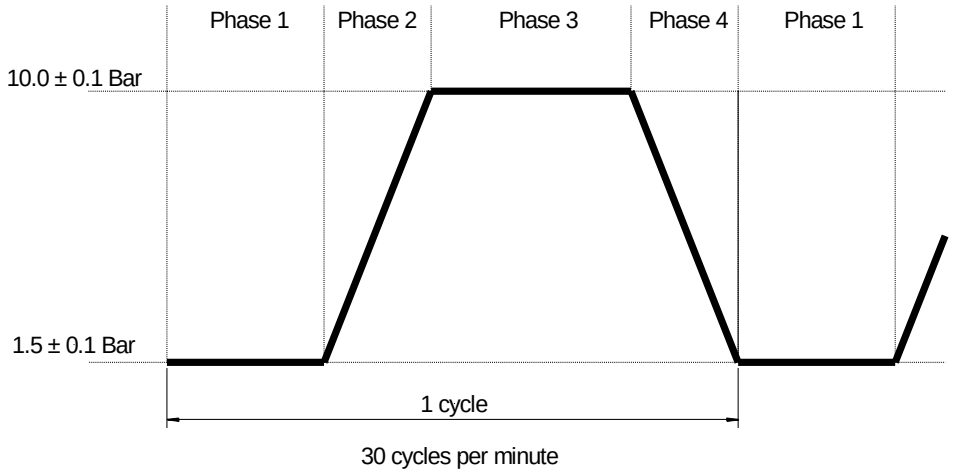


Figure 5.1: Schematic presentation of the pressure

Phase 1: Established threshold pressure (1,5 ± 0,1) bar(a) for (0,60 ± 0,15) seconds;
Phase 2: Constant increase pressure from threshold pressure to maximum pressure over (0,50 ± 0,05) seconds;
Phase 3: Maintain maximum pressure of (10 ± 0,1) bar(a) for (0,75 ± 0,10) seconds;
Phase 4: Decrease pressure from maximum pressure to threshold pressure over (0,60 ± 0,15) seconds.

4. Bending jig with a bending radius as declared by the manufacturer;
5. Device to keep the test piece bent at 180°.

Test liquid
The liquid used for testing is a 50% mixture of water/ethylene glycol (v/v).

Procedure
- Prepare the test piece as stated;
- Bend the test piece 180° around the required bending jig;

- Connect the test piece to the cyclic pressure device. Additional samples may be connected provided the required times and pressures can be achieved on all test pieces simultaneously;
- Fill the device with the test liquid;
- Switch on the cyclic pressure device with the following parameters:
  1. Cycling rate (30 ± 5) cycles/minute;
  2. Low pressure (1,5 ± 0,1) bar(a);
  3. High pressure (10,0 ± 0,1) bar(a);
- Stop the test at 250.000 cycles;

Repeat the procedure with the second test piece.

5.11 Resistance of the suction pipe (type SP) to a cyclic negative pressure

After testing the test piece shall show no defects after 250.000 cycles.

Test pieces

For this test are needed 2 pipe test pieces taken from the suction pipe, equipped with standard couplings, which are installed according the manufacturer's instructions. These couplings shall be provided with equipment to impose a negative pressure on the test piece and to maintain this pressure. The length between the couplings is 900 mm.

Apparatus

Vacuum device to enable a cycling test with air as test medium and the following conditions:

1. Cycle rate (5 ± 1) cycles/minute;
2. Build-up of a cycle
   - 7 seconds negative pressure ($0{,}9_{0}^{+0{,}05}$) bar(g) [($0{,}1_{-0{,}05}^{0}$)) bar absolute];
   - 3 seconds minimum at atmospheric pressure.

Test medium

The test medium is air.

Procedure

- Connect the test piece to the vacuum device and apply the following pressure:
  - 7 seconds 0,1 bar absolute;
  - 3 seconds minimum at atmospheric pressure;
- Stop the test at 250.000 cycles.

Repeat the procedure with the second test piece.

5.12 Resistance of the pressure pipe (type PP) to internal water pressure

After testing the test piece shall resist an internal water pressure as declared in an appendix to the contract with the manufacturer. This internal water pressure shall not be lower than 25,0 bar(a) (5 x 5,0 bar(a)).

Principle

In principle, testing is carried out in accordance with ASTM D 380 clause 16.1 with a constant increasing pressure, whereby the pressure of 25,0 bar(a) is reached within a period of 15 to 60 seconds.

Test pieces

For this test pieces are needed 3 pipe test pieces of the pressure pipe, equipped with standard couplings, which are installed according the manufacturer's instructions. These coupling shall be provided with equipment to pressurise the test pieces and maintain this pressure. The length of the test piece between the couplings shall be at least 300 mm.

Apparatus
Pressure equipment, which is capable to increase the pressure at a speed rate between 0,42 and 1,70 bar per second, in accordance with ASTM D 380 clause 15.1.
Procedure

- Connect the test piece to the pressure equipment and fill it with water;
- Apply the pressure at a rate between 0,42 and 1,70 bar per second;
- Increase the pressure until the test piece bursts and note the pressure in bar(a).

Repeat this test with the two other test pieces.

5.13 Resistance of the pressure pipe (type PP) to a negative pressure

After testing at a negative pressure of 0,9 bar(g) (0,1 bar absolute) for 5 minutes, the change of the outside diameter (Δd) of the pipe shall not exceed 0,5%. During testing the pipe shall not collapse and show no defects.

Test pieces
For this test are needed 3 pipe test pieces taken from the pressure pipe, equipped on one side with a standard coupling and on the other side with a transparent test cap. The couplings are installed according the manufacturer's instructions. The couplings are with equipment to establish a negative pressure and maintain this pressure. The length of the test piece between the couplings shall be at least 300 mm.

Apparatus

- Negative pressure equipment fit to keep the negative pressure at $(0{,}9^{+0{,}05}_{0})$ bar(g) [$(0{,}1^{0}_{-0{,}05})$) bar(a)];
- Lamp which can be used to inspect the inside of the pipe by the transparent coupling;
- Measuring device to measure the mean outside diameter with an accuracy of 0,05 mm.

Procedure

- Apply a mark in the middle of the pipe;
- Make sure that during testing the test piece is totally straight;
- Connect the test piece to the negative pressure equipment;
- Apply a negative pressure of $(0{,}9^{+0{,}05}_{0})$ bar(g) [$(0{,}1^{0}_{-0{,}05})$) bar absolute] for a period of (60+50) seconds;
- Release after this period the negative pressure of the test piece and allow the test piece to re-stabilise for (60+50) seconds;
- Measure the mean outside diameter at the location of the mark (d0) in mm;
- Apply again the negative pressure of $(0{,}9^{+0{,}05}_{0})$ bar(g) [$(0{,}1^{0}_{-0{,}05})$) bar absolute];
- Maintain the negative pressure on the pipe for (300 ± 15) seconds;
- After this period and with the test piece still under negative pressure, measure the mean outside diameter (d1) at the location of the mark;
- At this period and with the test piece still under negative pressure, check with the use of the lamp through the transparent coupling whether or not the inside liner is still intact;
- Calculate the change of the mean outside diameter (Δd) in percentage using Equation 6.6.

$$\Delta L = \left(\frac{L1 - L0}{L0}\right) \times 100\% \qquad \text{Equation 6 6}$$

Repeat this test with the two other test pieces.

5.14 Resistance to impact of the pressure pipe (type PP)

After impact testing at a temperature of –10 °C, the test piece shall withstand without leakage or any other defect an over pressure of 10,0 bar(a) (2 x 5,0 bar(a)) for 168 hours and an overpressure of 25,0 bar(a) (5 x 5,0 bar(a)) for 1 minute.

Test pieces

For this test 2 pipe test pieces are taken from the pressure pipe, equipped with standard couplings, which are installed according the manufacturer's instructions. These couplings shall be provided with equipment to pressurise the test pieces and to maintain this pressure. The length of the test pieces between the couplings shall be at least be 1,0 m.

Apparatus

- Freezing device, large enough to contain a pipe test piece of at least 1,0 m and which can keep the temperature at (-10^{0}_{-4}) °C.
- Pressure equipment fit to maintain the pressure at (10,0 ± 0,1) bar(a) and (25,0 ± 0,1) bar(a).
- Impact tester, fit for dropping a falling weight from a height of (1000 ± 10) mm without notable friction.
- Falling weight with a mass of (555^{+5}_{0}) grams with a spherical bottom with a radius of 25,0 mm.
- Flat, rigid plate.

Test medium

Water.

Procedure

- Place two marks approximately. in the middle of the test piece with a distance between them of about one time the outside diameter of the pipe.
- Condition the test piece for 24 hours at (-10^{0}_{-4}) °C.
- Bring the test piece directly from the freezer in the impact tester on the rigid flat sheet and drop within 10 seconds the falling weight on the test piece from a falling height of 1000 mm on one of the marks.
- Put the test piece back in the freezer for at least one hour.
- Repeat the impact testing on the other mark.
- Condition the test piece for 24 hours at (23 ± 2) °C.
- Fill the test piece after conditioning with the test medium and connect the test piece to the pressure device.
- Apply a pressure of (10,0 ± 0,1) bar(a) for (168 ± 1) hour.
- Increase the pressure to (25,0 ± 0,1) bar(a) and keep this pressure constant for 60^{+10}_{0} seconds.
- At the end of this period, check the test piece visually for leakage.
- After this period, pressurise the test piece to bursting and note the burst pressure in bar(a).

Repeat the procedure with the second test piece.

5.15 Resistance to impact of the suction pipe (type SP)

After impact testing at a temperature of –10 °C, the test piece shall withstand without leakage or any other defect a negative pressure of 0,65 bar(g) (0,35 bar absolute) for 168 hours and a negative pressure of 0,9 bar(g) (0,1 bar absolute) for 1 minute.

Test pieces

For this test are needed 2 pipe pieces taken from the suction pipe, equipped with standard couplings, which are installed according to manufacturer's instructions. These couplings shall be provided with the equipment to induce and to maintain a

negative pressure. The length of the pipe between the couplings shall be at least be 1,0 m.

Apparatus

- Freezing device, large enough to contain a pipe test piece of at least 1,0 m and which can keep the temperature at (-10^{0}_{-4}) °C;
- Negative pressure equipment capable of holding a negative pressure of $(0{,}9^{+0{,}05}_{0})$ bar(g) [$(0{,}1^{0}_{-0{,}05})$ bar(a)];
- Pressure equipment, capable of holding a pressure of (10,0 ± 0,1) bar(a);
- Impact tester, fit for dropping a falling weight from a height of (1000 ± 10) mm without notable friction;
- Falling weight with a mass of (555^{+5}_{0}) grams with a spherical bottom with a radius of 25,0 mm diameter;
- Flat rigid plate.

Test medium

Water.

Procedure

- Place two marks approximately in the middle of the test piece with a distance between them of about one time the outside diameter of the pipe;
- Condition the test piece for 24 hours at (-10^{0}_{-4}) °C;
- Bring the test piece directly from the freezer in the impact tester on the rigid flat plate and drop within 10 seconds the falling weight on the test piece on one of the marks from a falling height of 1000 mm;
- Put the test piece back in the freezer for at least one hour;
- Repeat the impact testing on the other mark;
- Condition the test piece for 24 hours at (23 ± 2) °C;
- Connect the test piece to the negative pressure equipment and apply a negative pressure of $(0{,}65^{+0{,}05}_{0})$ bar(g) [$(0{,}35^{0}_{-0{,}05})$ bar absolute] for (168 ± 1) hour;
- After this period apply a negative pressure of for $(0{,}9^{+0{,}05}_{0})$ bar(g) [$(0{,}1^{0}_{-0{,}05})$ bar absolute] (60^{+10}_{0}) seconds;
- After this period, release the negative pressure and fill the test piece with the test medium and connect the test piece to the pressure device;
- Apply a pressure of (7,0 ± 0,1) bar(a) for (60^{+10}_{0}) seconds;
- At the end of this period, check the test piece visually for leakage;
- After this period, pressurise the test piece to bursting and note the burst pressure in bar(a).

Repeat the procedure with the second test piece.

5.16 Resistance to bending at low temperatures of the pressure pipe (type PP)

After an exposure at a temperature of –10 °C for 24 hours, the test piece shall withstand without leakage or any other defect an over pressure of 10,0 bar(a) (2 x 5,0 bar(a)) for 5 minutes and 25,0 bar(a) (5 x 5,0 bar(a)) for 1 minute.

Test pieces

For this test are needed 2 pipe test pieces taken from the pressure pipe equipped with standard couplings, which are installed according to the manufacturer's instructions. These couplings are provided with equipment to pressurise the test pieces and to maintain this pressure. The length of the pipe between the couplings shall be at least 1,5 m.

Apparatus

- Freezing device, large enough to contain a pipe test piece of at least 1,5 m, and which can keep the temperature at (-10^{0}_{-4}) °C;
- A bending jig made of steel, with a radius equal to the minimum bending radius as declared by the manufacturer;
- Pressure equipment, capable of maintaining the pressure at (10,0 ± 0,1) bar(a) and (25,0 ± 0,5) bar(a).

Test medium
Water.

Procedure
- Condition the test piece and the bending jig for (24 ± 1) hour at (-10^{0}_{-4}) °C in the freezing device;
- Take the test piece and the bending jig out of the freezer and bend the test piece within 10 seconds at least 180 degrees around the jig;
- Condition the test piece for 24 hours at (23 ± 2) °C;
- Stretch the test piece and fill it with the test medium and connect it to the pressure device;
- Apply a pressure of (10,0 ± 0,1) bar(a) for (5 ± 0,1) minutes;
- Increase the pressure to (25,0 ± 0,1 bar(a)) and keep it constant for (60^{+10}_{0}) seconds;
- Check the test piece at the end of this period visually for leakage;
- After this period, pressurise the test piece to bursting and note the burst pressure in bar(a).

Repeat the procedure with the second test piece.

5.17 Resistance to bending at low temperatures of the suction pipe (type SP)

After an exposure at a temperature of -10 °C for 24 hours, the test piece shall withstand without leakage or any other defect a negative pressure of 0,9 bar(g) (0,1 bar absolute) for 5 minutes, followed by an over pressure of 10,0 bar(a) (2 x 5,0 bar(a)) for 1 minute.

Test pieces
For this test are needed 2 pipe test pieces taken from the suction pipe, equipped with standard couplings, which are installed according the manufacturer's instructions. These couplings shall be provided with the equipment to pressurise the test pieces to a negative and positive pressure and to maintain this pressure. The length of the pipe test piece between the couplings shall be at least be 1,5 m.

Apparatus
- Freezing device, large enough to contain a pipe test piece of at least 1,5 m and which can keep the temperature at (-10^{0}_{-4}) °C;
- A bending jig made of steel, with a radius equal to the minimum bending radius as declared by the manufacturer;
- Negative pressure equipment capable of maintaining the negative pressure at $(0{,}9^{+0{,}05}_{0})$ bar(g) [$(0{,}1^{0}_{-0{,}05})$ bar absolute];
- Pressure equipment, capable of maintaining the pressure at (10,0 ± 0,1) bar(a).

Test medium
Water.

Procedure
- Condition the test piece and the bending jig for (24 ± 1) hour at (-10 0-4) °C in the freezing device;
- Take the test piece and the bending jig out of the freezer and within 10 seconds bend the test piece at least 180 degrees around the jig;

- Condition the test piece for 24 hours at (23 ± 2) °C;
- Straighten the test piece and connect it to the negative pressure equipment;
- Apply a negative pressure of ($0{,}9_{0}^{+0{,}05}$) bar(g) [($0{,}1_{-0{,}05}^{0}$) bar absolute] for (300 ± 15) seconds;
- After this period, release the negative pressure;
- Disconnect the test piece from the negative pressure equipment;
- Fill the test piece with the test medium and connect it to the pressure equipment;
- Apply a pressure of (10,0 ± 0,1) bar(a) for (60 +100) seconds;
- At the end of this period, check the test piece visually for leakage;
- After this period, pressurise the test piece and note the burst pressure in bar(a).

Repeat the procedure with the second test piece.

5.18 Initial ring stiffness

The initial stiffness of the primary pipe at a defection of 3%, determined according to NEN-EN-ISO 9969 with a deflection speed of (5 ± 1) mm/min, shall not be less than 8000 N/m².

5.19 Creep ratio

The creep ratio, determined according to NEN-EN-ISO 9967 on test pieces with an age between 28 and 40 days, a test time of 2000 hour and an extrapolation after 2 years, shall be not higher than 4,0 for polyethylene and polypropylene.

5.20 Chemical resistance

5.20.1 Barrier layer

After testing at 23 °C with the reference liquids I through VII with test pieces fabricated from the inner layer of the pipe:

- the extrapolated value (to 224 days) of the tensile strength shall not be less than 75% of the initial tensile strength;
- the extrapolated value of the elongation at break (to 224 days) shall not be less than 50% and not be higher than 150% of the initial elongation at break.

5.20.2 Outer layer of the pipe

After testing at 23 °C with the reference liquids I through VII with test pieces fabricated from the outer layer of the pipe:

- the extrapolated value (to 224 days) of the tensile strength shall not be less than 75% of the initial tensile strength;
- the extrapolated value of the elongation at break (to 224 days) shall not be less than 45% and not higher than 220 % of the initial elongation at break.

NOTE: The tensile strength is defined as the maximum tensile stress in the test piece at the tensile testing.

5.20.3 Reference liquids

The reference liquids are:

I) <u>Petrol (100% mineral based fuel = Petrol):</u>

- 41.5 % by volume of Toluene
- 41.5 % by volume of Iso-octane
- 15.0 % by volume of Methanol
- 2.0 % by volume of Iso-butanol

II) <u>Kerosene (100% mineral based fuel):</u>

- 41.5 % by volume of Toluene

- 41.5 % by volume of Iso-octane
- 17.0 % by volume of Methyl-tertiary-butyl-ether

III) Diesel (100% mineral based fuel):
- 100.0% Diesel Fuel, grade no. 2 according to ASTM-D975

IV) Bio gasoline containing up to 20% Ethanol:
- 39.0% Toluene
- 39.0% Iso-octane
- 2.0% Iso-butyl alcohol
- 20.0% Ethanol (in accordance with NEN-EN 15376)

The manufacturer can choose to test their product with 5%, 10%, 15% or 20% Ethanol. The chemical resistance for the higher concentration will automatically lead to acceptance for the lower concentration but not vice versa.

V) Bio gasoline containing 85% Ethanol:
- 7.5% Toluene
- 7.5% Iso-octane
- 85.0% Ethanol (in accordance with NEN-EN 15376)

VI) Bio kerosene containing up to 20% Ethanol:
- 33.2% Toluene
- 33.2% Iso-octane
- 6.8% Methyl-tertiary butyl-ether
- 6.8% Ethyl-tertiary butyl-ether
- 20.0% Ethanol (in accordance with NEN-EN 15376)

The manufacturer can choose to test their product with 5%, 10%, 15% or 20% Ethanol. The chemical resistance for the higher concentration will automatically lead to acceptance for the lower concentration but not vice versa.

VII) Bio diesel containing up to 100% FAME:
- 100.0% Rape seed oil methyl ester (FAME according to NEN-EN 14214)
- 0% Diesel Fuel, grade no. 2 according to ASTM D 975

The manufacturer can choose to test their product with 5%, 10%, 15%, 20%, 40%, 60%, 80% or 100% FAME. The chemical resistance for the higher concentration will automatically lead to acceptance for the lower concentration but not vice versa.

VIII) Diesel Exhaust Fluid (AdBlue, AUS 32)
- 32.5% High purity urea
- 67.5% de-ionised water

IX) Hydrotreated Vegetable Oils up to 100% (HVO)
- 100% HVO
- 0% Diesel Fuel

The manufacturer can choose to test their product with 20%, 40%, 60%, 80% or 100% HVO. The chemical resistance for the higher concentration will automatically lead to acceptance for the lower concentration but not vice versa.

Chemical resistance to other fluids will be subject to approval by the certification body.
For PGS31 fluids the method of acceptance is mentioned in the BRL SIKB 7800.

Principle
The initial tensile strength and elongation at break of the barrier and outer layer is determined for a series of test pieces. For the barrier and outer layer four series of test pieces are immersed at 23 °C into each reference liquid I through VII (a total of 28 series are needed). From these test pieces, the tensile strength and elongation at break is determined after 14, 28, 56 and 112 days exposure. By extrapolations of the values obtained, the tensile strength and elongation at break at 224 days can be calculated.

The percentage change of the extrapolated tensile strength and the elongation at break in regard to the initial tensile strength and elongation at break is then verified against the requirements.

Test pieces
For the determination of the tensile strength and the elongation at break, initial and after an exposure of 14, 28, 56 and 112 days, are needed 13 series of 5 test pieces. These test pieces shall be manufactured by injection moulding according to the manufacturer's instructions as included in the quality manual. The sizes of the test pieces is type 1BA according ISO 527-2 with a thickness between 2 and 4 mm.
NOTE: The general principles according NEN-EN-ISO 294-1 apply to the manufacturing of test pieces by injection moulding.

Apparatus
- Containers, according ISO 175 article 5.1.1.
- Tensile strength testing machine, according ISO 527-1 article 5.1.
- Filtering paper or similar material to dry the test pieces.

Immersing procedure
General
Reference is made to ISO 175 for general instructions regarding the immersing procedure.

Conditioning
Condition the test pieces according to § 5.2.

Determination of dimensions
Before immersing, measure of each test piece the width and thickness in the calibrated part with an accuracy of 0,2 mm. The test pieces are clearly marked to avoid any confusion.

Immersion
Immerse 4 series of 5 test pieces in each reference liquid. While the test pieces are identical, it is permitted that several test pieces are put in the same container as long as they do not touch one another.
Take care that the part of the test piece surface which is in contact with the container side is as small as possible, for example by resting one side on the bottom of the container and the other against the vertical side or by suspending them.

Duration of immersion
After an immersing period of (14 ± 1,0), (28 ± 1,0), (56 ± 1,0) and (112 ± 1,0) days, the immersed test pieces are taken out of the test liquids in order to carry out the tensile testing.

Quantity of test liquid to be used
In general, the test liquid shall have a quantity, that at least 0.4 ml/mm² of the total surface of the test piece is covered with the liquid.

Changing of the test liquid
Stir the liquid every day during the immersion period and change the liquid every seven days.

Determination of the tensile strength and the elongation at break
Determine the tensile strength (σ) and the elongation at break (ε) of the series of test pieces which are not immersed and of the series of test pieces which are immersed into the test liquids I through VII after 14 days, 28 days, 56 days and 112 days according to ISO 527-1 using the tensile speed declared by the manufacturer. Note the actual exposition time of each test piece with an accuracy of 0,05 days and round it up to the nearest 0,1 day.

For every test liquid calculate from the measured values of tensile strength (σ) and elongation at break (ε) of every test piece, starting at 14 days, and the corresponding time (t) in using the method of the least squares the extrapolated value for tensile strength (σ) and elongation at break (ε) at 224 days using the Equations 5-7 and 5-8;

$$\log \sigma_c = \mathrm{A} + B \log t \qquad \text{Equation 5-7}$$

$$\log \varepsilon_t = \mathrm{a} + b \log t \qquad \text{Equation 5-8}$$

Calculate the percentage change for each test liquid of tensile strength and the elongation at break at 224 days in regard to the initial tensile strength and elongation at break and verify the values against the requirements.

NOTE: For PVDF the tensile speed is 25 mm/min, for polyketone 50 mm/min and for polyethylene 100 mm/min. For other materials the tensile speed has to be determined.

5.21 Resistance to permeation

The permeation of petrol and petrol components to the surrounding soil has to be quantified for the materials used in the plastics piping system (pipes, sealing rings, couplings etc) by absorption experiments. After an exposure at 23 °C in the reference liquids I through IX, according to § 5.20.3 and the separate liquids as mentioned below with test pieces fabricated from material of the different pipe layers[1)], the calculated maximum permeation rate Q per pipe length L[2)] shall not exceed 150 mg/24h.

[1)] When the barrier layer itself is sufficient to fulfil the requirements, the measurements can be limited to the barrier layer.
[2)]L = length of pipe from tank to pump (= 50 m with 3 screw fittings). As mentioned in § 5.3the complete piping system, including couplings, fittings, sealing rings etc shall be evaluated with regard to the resistance to permeation of petrol and petrol components.

Note: Scientific research has shown that screw fittings will have a permeation rate of 10 mg/24h. The materials used and the way the fittings are put together determine the period of time after which this rate will be reached. The above mentioned rate of 150 mg/24h is the sum of the number of fittings in a product line of a nominal tank filling station designed with steel piping and screw fittings.

5.21.1 Principle

A series of test pieces is immersed in liquids. From these test pieces, absorption in function of time is measured using their mass increase. This function is used to determine the saturation mass increase and the half-life (= period needed to realise a mass increase of half the saturation value). The diffusion coefficient, the

concentration of the liquid in the plastic and the permeability are calculated from the experimental results.

A series of test pieces with fixed dimensions is immersed in liquids.

From these test pieces absorption in function of time is measured using their mass increase. This function is used to determine the half-life. With the use of this half-life and the thickness of the test piece, the diffusion coefficient is calculated.
With the use of the calculated diffusion coefficient, the calculated concentration in the (barrier layer) of the pipe, the concentration in the outer layer of the pipe in the worst case, the thickness of the barrier layer of the pipe and the specific surface area of the pipe, the permeation rate can be calculated.

Test pieces
For the determination of the resistance against permeation 16 test pieces of about 200 mm x 100 mm each and a thickness of about 50 µm are needed. Test pieces are fabricated as agreed by the manufacturer and the certification body.

NOTE: In case it is impossible to make test pieces of about 50 µm thick from the material, thicker test pieces may be used providing their thickness is the closest possible to 50 µm.

Apparatus
- Thickness meter, with an accuracy of 0.5 µm.
- Container, according to ISO 175 clause 5.1.1.
- Balance, with an accuracy of 0,1% mg of the mass of the test pieces to be weighed.
- Filtering paper or similar material, to dry the test pieces.

Reference liquids
The test liquids are the reference liquids I through VII as stated above.

Immersing procedure
- Reference is made to ISO 175 for general instructions regarding the immersing procedure;
- Condition the test pieces according § 5.2;
- Measure the thickness of each test piece with an accuracy of 0.5 µm and the mass with an accuracy of 0,1 mg (Mo);
- Mark clearly the test pieces to avoid any confusion;
- Immerse 2 test pieces in each of the test liquids in accordance with § 5.20.3.

Quantity of test liquid to be used
The quantity of test liquid must be sufficient to cover the test piece completely.

Positioning the test piece in the container
Since the test pieces are identical, several test pieces may be put in the same container without touching one another.
Make sure that the part of the test piece surface which is in contact with the container side is as small as possible, for example by resting one side on the bottom of the container and the other against the vertical side or by suspending them.

Changing of the test liquid
Stir the liquid every day during the immersing period and change the liquid every seven days.

Rinsing and drying the test piece
Take the test piece out of the liquid and dry the test piece quickly.

Determination of the half-life ($t_{½}$) and the saturation mass (M_s)
Determine per day (i) the mass (M_i) of each test piece in each of the test liquids. Continue the experiment until no significant increase in mass is noted.

Put, in a graph, the time t_1 against the quotient of the mass increase $\mathbf{(M_i - M_o)/M_o}$ at the time t_1.

Determine from the curve the time when the quotient of the mass increase $\mathbf{(M_i - M_o)/M_o} = 0{,}5$.

The corresponding time $t_{½}$ is the half-life in days.

Determine also from the curve the saturation mass ($\mathbf{M_s}$) in mg.

Calculation of the diffusion coefficient
Calculate the diffusion coefficient per test piece using Equation 5-9:

$$D = \frac{5{,}67 \times 10^{-19} \times e^2}{t\ 1/2} \qquad \text{Equation 5-9}$$

Whereby:
- D = the diffusion coefficient in square meters per second (m²/sec);
- e = the thickness of the test piece in micrometers (µm);
- $t_{½}$ = the half-life in days (24h).

NOTE: Equation 5-9 is derived from Equation 5-10

$$D = \frac{49 \times 10^{-3} \times e^2}{t\ 1/2} \qquad \text{Equation 5-10}$$

Whereby:
- D in m²/s;
- e in m;
- t in s.

Average per test liquid the two calculated diffusion coefficients D_m.

Calculation of permeation rate
The permeation rate for each test liquid is calculated using Equation 5-11:

$$Q = 10^9 \times D_m \frac{C1 - C_v}{eb} \times A_s \times 86400 \qquad \text{Equation 5-11}$$

Whereby:
- Q = the permeation rate in milligrams per 24 h (mg/24h) per meter pipe length;
- D_m = the average diffusion coefficient in square meter per second (m²/s);
- e_b = the thickness of the barrier layer in the pipe in millimetres (mm);
- C_1 = the concentration of the test liquid in the inner layer of the barrier layer of the pipe in grams per litre (g/l) and calculated using Equation 5-12;
- A_s = the specific inner surface of the pipe in square metres (m²) per meter pipe length.

$$C_1 = 10^3 \times \frac{(M_s - M_o)}{\{\left({}^{M_o}/_{C_m}\right) + [{}^{(M_s - M_o)}/_{C_L}]\}} \qquad \text{Equation 5-12}$$

Whereby:
M_s = the mass of the test piece in milligrams (mg) in saturated state;
M_o = the mass of the test piece in milligrams (mg) before immersing;
C_m = the density of the material in grams per cubic centimetre (g/cm³);
C_L = the density of the test liquid in grams per cubic centimetre (g/cm³);

C_v = the concentration of the test liquid in the outer layer of the barrier layer of the pipe in grams per litre (g/l);
C_v = always $0 < C_v < C_1$
In the worst case $C_v = 0$.
Therefore, in order to calculate the permeation rate $C_v = 0$ g/l is taken.

Verify per test liquid and pipe built-up the values found against the requirements.

Calculation of permeation rate for pipes with several layers
The permeation rate of the pure components and of the mixture is calculated according as indicated above.
For liquid I, five permeation rates are calculated for each layer, namely: Qi(liquid I), Qi(toluene), Qi(iso-octane), Qi(methanol) and Qi(iso-butanol). The index i stands for layer i. The volume fractions are f(toluene) = 0.415, f(iso-octane) = 0.415, f(methanol) = 0.15 and f(iso-butanol) = 0.02.

Calculate the alternative Q'i(liquid I) using:
Q'i(liquid I) = f(toluene) * Qi(toluene) + f(iso-octane) * Qi(iso-octane) + f(methanol) * Qi(methanol) + f(iso-butanol) * Qi(iso-butanol)

Calculate the ratio: $$A = \frac{Q_1(\text{liquid I}))}{Q_{\prime 1}(\text{liquid I}))}$$ Equation 5-13

The permeation rates to be used for the individual components are for layer i:

$$Q'_i(\text{component}) = A \times Q_i(component)$$ Equation 5-14

Calculate the permeation rate through a two layer pipe by:

$$Q_{12}(\text{component}) = \frac{Q'_1(\text{component}) \times Q'_2(\text{component})}{Q'_1(\text{component}) + Q'_2(\text{component})}$$ Equation 5-15

through a three layer pipe by:

$$Q_{123}(\text{component}) = \frac{Q'_1(\text{comp.}) \times Q'_2(\text{comp.}) \times Q'_3(\text{comp.})}{Q'_1(\text{comp.})Q'_2(\text{comp.}) + Q'_2(\text{comp.})Q'_3(\text{comp.}) + Q'_1(\text{comp.})Q'_3(\text{comp.})}$$ 5-16

etc.

Q'12(liquid I), Q'123(liquid I), etc. are calculated analogously to Q'1 and are used in § 5.21. Repeat the same procedure for liquids II through IX.

Calculation of permeation rate through rubber seal
See Equation 5-11. As now corresponds with the area that is exposed to the fuel and eb with the thickness of the rubber seal after compression as defined by the manufacturer.

Calculation of permeation to the ground for a primary pipe in a secondary pipe or integrated secondary containment (no bonding between the primary and the secondary pipe)
When an air flow at a temperature of 10 to 20 °C is applied between the primary and the secondary layer, the permeation through the secondary pipe to the soil is reduced. For the fuel components considered, the saturation in air is about 100 mg/l. The secondary pipe is thought to have a higher permeation rate for fuel components than the primary pipe.

The permeation through the secondary pipe is then given by:

$$Q_{prim-sec} = \frac{Q'_{prim}(liquid I)}{V} \frac{Q'_{prim}(liquid I)}{100}$$ Equation 5-17

or by Q'prim(liquid I) when Qprim-sec is larger than Q'prim(liquid I).
V is the air volume per day which is flown between the primary and the secondary pipe.

5.22 Relative Temperature Index of the barrier layer

The classification of the Relative Temperature Index according UL 746 B of the raw material of the (barrier layer) of the pipe, shall not be less than 50 °C.

5.23 Oxidation induction time

The isothermal oxidation induction time (OIT) of the polyethylene material shall not be less than 20 minutes and of the polypropylene material not less than 16 minutes when determined in accordance with ISO 11357-6 with a test temperature of 200 °C. Preferably, the tangent method shall be used and when this is not possible the offset method with a trigger value of 0,05 W/g shall be used. The test samples shall be taken from the actual surface of the pipe and the test shall be carried out in duplicate.

5.24 Resistance to weathering

The external layer of the pipe shall be resistant to weathering or shall have a degradation mechanism which results in a barrier to UV radiation when exposed to this radiation. In the latter case the degradation mechanism shall be limited to the surface of the pipe material (< 1 mm depth).

5.24.1 Black HDPE material

When use is made of carbon black to achieve the resistance to weathering then the manufacturer shall ensure that the following requirements are met with:

- The particle size of the carbon black shall be between 10 and 25 nm, and
- The carbon black content in the pipe material used is between 2 to 2,5%.

This can be demonstrated in writing by obtaining inspection reports in accordance with EN 10204:2004 type 2.2 or inspection certificates in accordance with EN 10204:2004 type 3.1 or a declaration of conformance from the manufacturer of the material. In this event additional testing is not required. When this requirement is not met then testing in accordance with § 5.24.2is required. Materials complying with this requirement are suitable for use for both above ground as well as underground applications.

5.24.2 Other plastic materials

All other plastic materials, and black HDPE material that is not in compliance with the requirements of § 5.24.1, used for the external layer of the pipe shall be tested in accordance with NEN-EN-ISO 4892-1 and NEN-EN-ISO 4892-2 under the following conditions:

- Xenon arc lamp;
- Black standard temperature, 65 °C;
- Relative humidity 65%;
- Spray cycle:
    - Spray duration: 18 minutes,
    - Drying time between sprays: 102 minutes.

<u>Pipes for above ground installation</u>
The elongation at break of the external pipe material used shall be determined prior to exposure. The material shall thereafter be exposed to a global irradiance of 68 GJ/m² (corresponding to an irradiance of 2.3 GJ/m² for the band from 300 nm to 400 nm).

The elongation at break after exposure shall be greater than 50% of the initial value measured.

Pipes for underground installation
The elongation at break of the external pipe material used shall be determined prior to exposure. The material shall thereafter be exposed to a global irradiance of 3.4 GJ/m² (corresponding to an irradiance of 0.23 GJ/m² for the band from 300 nm to 400 nm). The elongation at break after exposure shall be greater than 50% of the initial value measured.

Alternatively, pipes for underground installation may also be tested using natural weathering in accordance with the requirements of NEN-EN-ISO 16871.

6 Secondary containment, ducting pipe and joints

6.1 General

This chapter specifies the requirements and test methods for the thermoplastics secondary containment, ducting pipe and joints.

6.2 Sampling and conditioning of the test samples

Unless otherwise specified, the testing shall be carried out on test pieces which are at least 16 hours old at (23 ±2) °C after a conditioning of at least 16 hours at the same temperature.

6.3 Material

6.3.1 Basic material

The secondary containment and ducting pipe are made of polyethylene or polypropylene to which are added only those additives and colorants, which are necessary to manufacture the pipe according to the requirements included in this chapter.

The reference density of the material, determined according to NEN-EN-ISO 1183-1 method B and NEN-EN-ISO 1183-2, shall be at least 930 kg/m3 for polyethylene and at least 890 kg/m3 for polypropylene.

Note: Presently only requirements for polyethylene and polypropylene materials have been included. In case of future interest, the guideline must be revised.

6.3.2 Reprocessed material

The use of manufacturers own reprocessed material, obtained during the production of pipes according to the requirements of this chapter, may be used. Reprocessed materials from external sources and recycled materials shall not be used.

6.3.3 Melt mass-flow rate

The melt mass-flow rate (MFR) of the polyethylene pipe material, determined according to ISO 1133 condition 18 (temperature: 190 °C; loading mass: 5 kg) shall be as follows:

- 0,2 g/10 min < MFR (190/5) < 1,4 g/10 min

The melt mass-flow rate (MFR) of the polypropylene pipe material, determined according to ISO 1133 condition 12 (temperature: 230 °C; loading mass: 2,16 kg) shall be as follows:

- MFR (230/2,16) < 1,5 g/10 min

6.3.4 Thermal stability

The external layer of the secondary pipe shall comply with the requirements of § 5.23.

No requirements are set for the pipe material of the ducting pipe.

6.4 Appearance

The colour of the pipe is laid down in an appendix to the contract with the producer.

The pipe shall have an regular profile. The inside and outside surface shall be smooth and intact, and free of blisters or other defects. The material must be free of any contamination.

The secondary containment pipe shall be without holes. The ducting pipe may contain slots or holes.

The manufacturer's quality system shall include distinct criteria for approval and rejection. The appearance shall be assessed visually without using any magnification.

6.5 Dimensions of the secondary pipe

6.5.1 Profile and diameter of the pipe

The nominal diameter of the secondary pipe shall be of adequate size to house the primary pipe. The pipe's profile, dimensions and admissible tolerances are laid down in drawings included in an appendix to the contract with the producer. The nominal diameter shall be stated in the technical specifications on the product certificate.

The dimensions of the pipe shall be measured using suitable measuring equipment, with an accuracy of 0,10 mm.

6.5.2 Length of the pipe

The standard length of the pipe and the allowed tolerances shall be declared by the manufacturer. Special lengths with tolerances can be agreed upon between producer and customer.

The length of the pipe will be measured with a measuring tape with an accuracy of 10 mm.

6.6 Initial ring stiffness

The initial stiffness at a defection of 3%, determined according to NEN-EN-ISO 9969 with a deflection speed of (5 ± 1) mm/min, shall not be less than 4000 N/m².

6.7 Creep ratio

The creep ratio, determined according to NEN-EN-ISO 9967 on test pieces with an age between 28 and 40 days, a test time of 2000 hour and an extrapolation after 2 years, shall be not higher than 4,0 for polyethylene and polypropylene.

6.8 Chemical resistance

After testing in accordance with § 5.20with the reference liquids I through VII according to § 5.20.3, the test pieces manufactured made from the basic material, shall meet the following requirements:

- the extrapolated value (to 224 days) of the tensile strength not be less than 75% of the initial tensile strength;
- the extrapolated elongation at break (to 224 days) not be less than 45% and not be greater than 220% of the initial elongation at break.

6.9 Resistance against UV-ageing

The external layer of the secondary pipe shall comply with the requirements of § 5.24.

6.10 Resistance to impact

After testing at a temperature of –10 °C, the secondary containment pipe shall not leak at a positive pressure of 0,35 bar(g). The ducting pipe shall not show any signs of breakage after performing this test.

Test pieces

For this test 2 pipe test pieces of pipe provided with couplings according to the manufacturer's instructions. These couplings shall be provided with devices to pressurise the test pieces. The length of the pipe between the couplings shall be at least 1,0 m.

Apparatus

- Freezing device large enough to contain a pipe test piece of at least of 1,0 m and which can keep the temperature at (-10^{0}_{-4}) °C.
- Pressure equipment to maintain an air pressure of (0,35 ± 0,05) bar(g).
- Impact tester fit for dropping a falling weight from a height of (1000 ± 10) mm without notable friction, and at the bottom side provided with a flat stiff plate.
- Falling weight with a mass of (555^{+5}_{0}) g and with a spherical bottom with a radius of 25,0 mm.

Procedure

- Place two marks approximately in the middle of the test piece with a distance between them of about one time outside diameter of the pipes.
- Condition the test piece for at least 1 hour at (-10^{0}_{-4}) °C.
- Bring the test piece directly from the freezer in the impact tester on the stiff flat plate and drop the falling weight within 10 seconds from a height of 1000 mm on one of the marks.
- Put the test piece back in the freezer for at least 1 hour.
- Repeat the impact testing on the other marked point.
- Allow the test piece to reach (23 ± 2) °C.
- Connect the test piece to the pressure device (not applicable for the ducting pipe, see requirement) and apply an air pressure of (0,35 ± 0,05) bar(g).
- Check whether there are any defects in the test piece by using a soap solution.
- Repeat the procedure for the second test piece.

6.11 Resistance to permeability (Only valid when used as secondary containment pipe)

The requirements for permeation as mentioned in § 5.21 concern the complete piping system per specified pipe length. The secondary containment pipe shall be assessed as part of the system in accordance with § 5.21.

6.12 Joints

In case CEN standards are available for requirements and test methods for joints or couplings (for example for the applications in gas and water distribution or sewage) then these requirements and test methods might be applicable. This shall be assessed by the certification body. In case no CEN or other standards are available, the requirements and test methods shall be agreed in accordance with the certification body.

7 Vapour recovery lines

7.1 General

This chapter specifies the requirements and test methods for the thermoplastics vapour recovery lines.

7.2 Wall construction and material of the pipe

The wall construction and the materials to be used for the pipe is laid down in an appendix to the contract with the manufacturer.

7.3 Appearance

The inner and outer surfaces shall be smooth and flawless, without holes, blisters or other defects. A corrugated profile in the inner surface is allowed. The profile shall be even. The material shall be free of any contamination. The manufacturer's quality system shall include distinct criteria for approval and rejection. The appearance shall be assessed visually without using any magnification.

7.4 Wall build-up and dimensions of the pipe

The wall build-up, dimensions and admissible tolerances of the pipe are laid down in the specification included in the appendix to the contract with the manufacturer. The pipe shall be manufactured with a nominal diameter as declared in the technical specifications on the product certificate.

The build-up of the wall is checked visually and if necessary with the use of a measuring ocular. The inside diameter shall be determined using callipers with an accuracy of 0,05 mm. The outside diameter shall be determined using a measuring tape with an accuracy of 0,10 mm.

7.5 Length of the pipe

The pipes shall be delivered in lengths as declared by the manufacturer in the technical specifications on the product certificate. The delivered length shall not be less than 99 % of this declared length.

The length of the pipe shall be measured with a measuring tape with an accuracy of 10 mm. The length of the pipe and the measured value is compared with the declared value.

7.6 Adhesion strength

When tested in accordance with § 5.9, the minimum separation rate between the barrier layer and the immediate structural layer of every test piece shall not be lower than 0,5 mm/s (F = 50 N).

7.7 Resistance to impact and positive pressure

After impact testing in accordance with § 5.14 at a temperature of -10 °C, the test piece shall withstand without leakage or any other defect a positive pressure of 10,0 bar(a) (2 x 5,0 bar(a)) for 168 hours and an overpressure of 25,0 bar(a) (5 x 5,0 bar(a)) for 1 minute.

7.8 Resistance to impact and negative pressure

After impact testing in accordance with § 5.15 at a temperature of -10 °C, the test piece shall withstand without leakage or any other defect a negative pressure of 0,65 bar(g) (0,35 bar absolute) for 168 hours and a negative pressure of 0,9 bar(g) (0,1 bar absolute) for 1 minute.

7.9 Resistance to bending at low temperatures and positive pressure

After an exposure in accordance with § 5.16 at a temperature of -10 °C for 24 hours, the test piece shall withstand without leakage or any other defect a positive pressure of 10,0 bar(a) (2 x 5,0 bar(a)) for 5 minutes and 25,0 bar(a) (5 x 5,0 bar(a)) for 1 minute.

7.10 Resistance to bending at low temperatures and negative pressure

After an exposure in accordance with § 5.17at a temperature of -10 °C for 24 hours, the test piece shall withstand without leakage or any other defect a negative pressure of 0,9 bar(g) (0,1 bar absolute) for 5 minutes, followed by an over pressure of 10,0 bar(a) (2 x 5,0 bar(a)) for 1 minute.

7.11 Initial ring stiffness

The initial stiffness at a defection of 3%, determined according to NEN-EN-ISO 9969 with a deflection speed of (5 ± 1) mm/min, shall not be less than 8000 N/m².

7.12 Creep ratio

The creep ratio, determined according to NEN-EN-ISO 9967 on test pieces with an age between 28 days and 40 days, a test time of 2000 hour and an extrapolation after 2 years, shall be not higher than 4,0 for PE and PP.

7.13 Chemical resistance

Barrier layer

After testing at 23 °C with the reference liquids I through IX according to § 5.20.3 with test pieces fabricated from the inner layer of the pipe:

- the extrapolated value (to 224 days) of the tensile strength shall not be less than 75% of the initial tensile strength;
- the extrapolated value of the elongation at break (to 224 days) shall not be less than 50% and not be higher than 150% of the initial elongation at break.
- Outer layer of the pipe
- After testing at 23 °C with the reference liquids I through VII according to § 6.20.3 with test pieces fabricated from the outer layer of the pipe:
- the extrapolated value (to 224 days) of the tensile strength shall not be less than 75% of the initial tensile strength;
- the extrapolated value of the elongation at break (to 224 days) shall not be less than 45% and not higher than 220 % of the initial elongation at break.

NOTE: The tensile strength is defined as the maximum tensile stress in the test piece at the tensile testing.

7.14 Resistance to permeation

The requirements for permeation as mentioned in § 5.21 concern the complete piping system per specified pipe length. The vapour recovery line shall be assessed as part of the system in accordance with § 5.21.

7.15 Relative Temperature Index of the barrier layer

The classification of the Relative Temperature Index according UL 746 B of the raw material of the (barrier layer) of the pipe, shall not be less than 50 °C.

8 Filling pipes

8.1 General

This chapter specifies the requirements and test methods for the thermoplastics filling pipes.

8.2 Wall construction and material of the pipe

The wall construction and the materials to be used for the pipe is laid down in an appendix to the contract with the manufacturer.

8.3 Appearance

The inner and outer surfaces shall be smooth and flawless, without holes, blisters or other defects. A corrugated profile in the inner surface is allowed. The profile shall be even. The material shall be free of any contamination. The manufacturer's quality system shall include distinct criteria for approval and rejection.

The appearance shall be assessed visually without using any magnification.

8.4 Wall build-up and dimensions of the pipe

The wall build-up, dimensions and admissible tolerances of the pipe are laid down in the specification included in the appendix to the contract with the manufacturer. The pipe shall be manufactured with a nominal diameter as declared in the technical specifications on the product certificate.

The build-up of the wall is checked visually and if necessary with the use of a measuring ocular. The inside diameter shall be determined using callipers with an accuracy of 0,05 mm. The outside diameter shall be determined using a measuring tape with an accuracy of 0,10 mm.

8.5 Length of the pipe

The pipes shall be delivered in lengths as declared by the manufacturer in the technical specifications on the product certificate. The delivered length shall not be less than 99 % of this declared length.

The length of the pipe shall be measured with a measuring tape with an accuracy of 10 mm. The length of the pipe and the measured value is compared with the declared value.

8.6 Adhesion strength

When tested in accordance with § 5.9, the minimum separation rate between the barrier layer and the immediate structural layer of every test piece shall not be lower than 0,5 mm/s (F = 50 N).

8.7 Resistance to impact and positive pressure

After impact testing in accordance with § 5.14 at a temperature of - 10 °C, the test piece shall withstand without leakage or any other defect a positive pressure of 10,0 bar(a) (2 x 5,0 bar(a)) for 168 hours and an overpressure of 25,0 bar(a) (5 x 5,0 bar(a)) for 1 minute.

8.8 Resistance to bending at low temperatures and positive pressure

After an exposure in accordance with § 5.16 at a temperature of -10 °C for 24 hours, the test piece shall withstand without leakage or any other defect a positive pressure

of 10,0 bar(a) (2 x 5,0 bar(a)) for 5 minutes and 25,0 bar(a) (5 x 5,0 bar(a)) for 1 minute.

8.9 Initial ring stiffness

The initial stiffness at a defection of 3%, determined according to NEN-EN-ISO 9969 with a deflection speed of (5 ± 1) mm/min, shall not be less than 8000 N/m².

8.10 Creep ratio

The creep ratio, determined according to NEN-EN-ISO 9967 on test pieces with an age between 28 days and 40 days, a test time of 2000 hour and an extrapolation after 2 years, shall be not higher than 4,0 for PE and PP.

8.11 Chemical resistance

Barrier layer

After testing at 23 °C with the reference liquids I through IX in accordance with § 5.20.3 with test pieces fabricated from the inner layer of the pipe:

- the extrapolated value (to 224 days) of the tensile strength shall not be less than 75% of the initial tensile strength;
- the extrapolated value of the elongation at break (to 224 days) shall not be less than 50% and not be higher than 150% of the initial elongation at break.
- Outer layer of the pipe
- After testing at 23 °C with the reference liquids I through VII in accordance with § 5.20.3 with test pieces fabricated from the outer layer of the pipe:
- the extrapolated value (to 224 days) of the tensile strength shall not be less than 75% of the initial tensile strength;
- the extrapolated value of the elongation at break (to 224 days) shall not be less than 45% and not higher than 220 % of the initial elongation at break.

NOTE 1: The tensile strength is defined as the maximum tensile stress in the test piece at the tensile testing.

8.12 Resistance to permeation

The requirements for permeation as mentioned in § 5.21 concern the complete piping system per specified pipe length. The filling pipe shall be assessed as part of the system in accordance with § 5.21.

8.13 Relative Temperature Index of the barrier layer

The classification of the Relative Temperature Index according UL 746 B of the raw material of the (barrier layer) of the pipe, shall not be less than 50 °C.

9 Couplings and fittings for primary pipes with or without an integrated secondary containment

9.1 General

This chapter specifies the requirements and test procedures for the couplings and fittings for the primary pipe in a piping system for the transport of liquid oil and related products.

9.2 Material

9.2.1 Copper – copper alloys (brass/ bronze) couplings and fittings

The material of the couplings and fittings which are made of copper – copper alloys shall comply with the NEN-EN 12164. The used material shall be resistant to the applicable medium(s) and their vapour(s). This shall be demonstrated by a written statement of the (material) supplier and needs to be documented

9.2.2 Stainless steel couplings and fittings

The material of the couplings and fittings that are made of stainless steel shall be seamless minimum 1.4301 (Type 304) according NEN-EN 10088 for machined parts and 1.4308 (CF8 A351) for cast parts according NEN-EN 10213. The used material shall be resistant to the applicable medium(s) and their vapour(s). This shall be demonstrated by a written statement of the (material) supplier and needs to be documented.

9.2.3 Cast iron couplings and fittings

The material of couplings and fittings that are made of cast iron shall be of type ductile iron and shall comply with the NEN-EN 1563. All cast iron parts shall be coated with a minimum of 0,01 mm (0,0004 inch) of clear zinc or nickel to protect the coupling or fitting against corrosion. The used material shall be resistant to the applicable medium(s) and their vapour(s). This shall be demonstrated by a written statement of the (material) supplier and needs to be documented.

9.2.4 Non metallic couplings and fittings

In case CEN standards are available for requirements and test methods for non-metallic couplings and fittings, then these requirements and test methods including the chemical resistance in accordance with § 5.20, might be applicable. This shall be assessed by the certification body. In case no CEN standards are available, the requirements and test methods shall be agreed in accordance with the certification body.

9.2.5 Sealing elements (gaskets)

When sealing elements (gaskets) are applied in the couplings and fittings, they shall be manufactured of plastics, rubber or metallic material. These sealing elements shall be resistant to the fluids. This to be assessed by the certification body.
Rubber sealing elements shall comply with the requirements of NEN-EN 682, table 3.

In case CEN standards are available for requirements and test methods for plastics sealing elements, then these requirements and test methods including chemical resistance to the fluids mentioned in § 5.20, might be applicable. This shall be assessed by the certification body. In case no CEN standards are available, the

requirements and test methods shall be agreed in accordance with the certification body.

9.3 Form and dimensions

9.3.1 General

The dimensions of the couplings and fittings shall correspond with the size and tolerances of the primary pipe, as laid down in § 5.5.

Couplings and fittings shall be suitable for mounting without the primary pipe being distorted or unnecessary weakened. Cuttings or constrictions, between two surfaces that are enclosed can be, in general, allowed. The form, dimension sand admissible tolerances of the couplings and fittings are indicated on the work drawings in an appendix to the contract with the producer.

The dimensions of the couplings or fittings are determined with a slide gauge, with an accuracy of 0,10 mm, and with a clock gauge provided with ball-shaped sensors, with an accuracy of 0,05 mm. The sensors' diameter should be smaller than the internal diameter of the coupling.

9.3.2 Appearance

The appearance is assessed visually without using any magnification.

9.3.3 Threading

Threading must be smooth and faultless and fit for purpose. The threading of the coupling and fitting is laid down in an appendix to the contract with the manufacturer. The threading of the coupling may be non-standard, provided they interface with the appropriate sized fitting of the same manufacturer.

The threading of the sections of fittings that are intended to interface with standard pipe or fittings shall comply with ISO 7-1. This is to insure the manufacturer's fittings will properly interface industry standard pipe fittings.

The inspection of the threading is in accordance with ISO 7-2.

9.3.4 Minimum wall thickness metal couplings and fittings

In no case shall the cross section of the wall thickness of couplings and fittings made of a copper – zinc alloy be less than the size indicated in NEN-EN 1254-3. The minimum wall thickness for couplings or fittings made from stainless steel is 1,2 mm and for cast iron 4,5 mm.

9.4 Leak tightness of the joints

During testing of the coupling or fitting according to § 5.10, § 5.11, § 5.12, § 5.13, § 5.16and § 5.17, the joints shall be leak-tight.

Test pieces

The test pieces required shall be prepared in accordance with the instructions of the manufacturer. Testing is carried out **without a supporting bush** unless the manufacturer explicitly specifies the use of a supporting bush.

9.5 Strength of the joints

After testing the pull-out strength of the coupling or fitting shall not be less than the force calculated as follows:

$$\mathrm{F} = 1{,}5 * \Pi * \sigma_t * e_m(\mathrm{d}_n - e_m) \qquad \text{Equation 9-1}$$

whereby:

- F is the minimum pull-out force in N

- d_n is the nominal outside diameter in mm
- e_m is the mean wall thickness in mm
- σ_t is the permissible induced hoop stress in N/mm^2 and can be calculated as follows:
    - $\sigma_t = (p(d_n - e_m))/(2.\ e_m)$,
    - p = 2 x 5,0 bar(a) which is equal to 1 N/mm^2 for pressure and suction pipes

Determination of the pull-out force

Test pieces
For the test, two pipe lengths with couplings or fittings at both ends are needed, installed according to the manufacturer's instructions. The length of the pipe between the couplings or fittings is depending on the dimensions of the tensile strength testing machine.

Apparatus
Tensile strength testing machine, in accordance with ISO 527-1, article 5.1.

Pr**ocedure**
- Manufacture the test pieces.
- Place the test piece in the tensile testing machine and pull out the joint with a tensile speed of 50 mm/min until failure.
- Per test piece record the maximum tensile force in Newton (N) and average the values determined.
- Verify the average value with the requirements.

9.6 Resistance to permeation

The requirements for permeation as mentioned in § 5.21 concern the complete piping system per specified pipe length. The couplings and fittings shall be assessed as part of the system in accordance with § 5.21.
In order to meet this requirement the product lines can be provided with an anti-permeation ring in order to close the gap between the pipe ends that are to be fusion welded. The anti-permeation ring is a metal or plastic device that prevents the liquid from coming in contact with the unlined fitting and thereby enabling permeation. If used then the material of the anti-permeation ring shall be chemically resistant to the reference liquids I through IX when tested in accordance with § 5.20 and shall be placed in each fusion fitting thus creating an uninterrupted permeation barrier.

In case of coaxial fittings in double wall pipe systems the anti-permeation ring is not required as no liquid shall be present in the interstitial space.

10 Elastomeric sealing elements for the secondary pipe and sumps

10.1 General

This appendix specifies the requirements and test methods for the elastomeric sealing elements for the secondary pipe and for the sumps.

10.2 Material

The elastomeric sealing elements must comply with the requirements in NEN-EN 681-1 for type WG and the hardness class (IRHD) as chosen by the manufacturer, taking into account the following:
The change in volume in oil (see Table 2 of NEN-EN 681-1) after 72 h at 23 °C exposure to reference liquid 1 and 3 according to ISO 1817 shall be lower than + 50 %.

10.3 Form and dimensions

10.3.1 General

The dimensions of the sealing elements must correspond with the dimensions and tolerances of the conduit or pipe intended to pass through. Where literal tolerances of the parts are unavailable, industry recognised dimensions shall be acceptable.

NOTE: The manufacturer installation instructions shall incorporate guidelines for making throughputs in the sumps.

10.3.2 Form, dimensions and admissible tolerances

The form, dimensions and admissible tolerances of the sealing elements are laid down in the work drawings as an appendix to the contract with the manufacturer. The type of sealing elements belonging to the system are stated in the Technical specifications on the product certificate.

The dimensions of the sealing elements are determined with the use of a slide gauge, with a resolution of 0,10 mm, and with a clock gauge provided with ball shaped sensors, with a resolution of 0,05 mm. The sensors' diameter shall not be smaller than the internal side of the sealing elements.

Alternate measuring devices used to measure the parts diameter may be used provided they are agreeable to the certification body and are included in the manufacturer's contract.

10.4 Strength and tightness of the test boot

The test boots shall be installed in a test fixture such that they can be subjected to positive and/or negative pressure. The test boots shall be leak tight when subjected to the following pressures:

1. Leak-tightness with air at 0,35 bar(g) positive pressure and 0,3 bar(g) negative pressure (0,7 bar(a)).
2. Hydrostatic strength 1,75 bar(a) for 1 minute at 23 °C.

10.5 Resistance to permeation

The requirements for permeation as mentioned in § 5.21 concern the complete piping system per specified pipe length. The elastomeric sealing elements shall be assessed as part of the system in accordance with § 5.21.

11 Requirements in respect of the quality system

This chapter contains the requirements which have to be met by the supplier's quality system.

11.1 Manager of the quality system

Within the supplier's organizational structure, an employee who will be in charge of managing the supplier's quality system must have been appointed.

11.2 Internal quality control/quality plan

The supplier shall have an internal quality control scheme (IQC scheme) which is applied by him.

The following must be demonstrably recorded in this IQC scheme:

- which aspects are checked by the supplier;
- according to what methods such inspections are carried out;
- how often these inspections are carried out;
- in what way the inspection results are recorded and kept.

This IQC scheme should at least be an equivalent derivative of the model IQC scheme as shown in the Annex II.

11.3 Control of test and measuring equipment

The supplier shall verify the availability of necessary test and measuring equipment for demonstrating product conformity with the requirements in this evaluation guideline.
When required the equipment shall be kept calibrated (e.g recalibration at interval).
The status of actual calibration of each equipment shall be demonstrated by traceability through an unique ID.
The supplier must keep records of the calibration results.
The supplier shall review the validity of measuring data when it is established at calibration that the equipment is not suitable anymore.

11.4 Procedures and working instructions

The supplier shall be able to submit the following:

- procedures for:
  - dealing with products showing deviations;
  - corrective actions to be taken if non-conformities are found;
  - dealing with complaints about products and/or services delivered;
- the working instructions and inspection forms used.

11.5 Design changes

Design changes of the certified products shall always be reported to the certification body prior to the start of production. The certification body shall evaluate these changes in order to determine the impact these changes have on the initial approved design and to determine which type tests shall have to be repeated.

Products that have been subjected to a design change can only be identified with the quality stamp of the certification body after they have been given a written approval by the certification body.

12 Summary of tests and inspections

This chapter contains a summary of the following tests and inspections to be carried out in the event of certification:

- **initial evaluation:** tests in order to ascertain that all the requirements recorded in the evaluation guideline are met;
- **Surveillance assessment:** assessment 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;
- **inspection of the quality system of the supplier:** monitoring compliance of the IQC scheme and procedures.

12.1 Test matrix

Description of requirement	Article no. of BRL	Category (see note)	Tests within the scope of		
			Initial evaluation	Surveillance assessment after issue of the certificate	
				Assessment	Frequency
Primary pipe with or without an integrated secondary containment					
Wall construction and material of the pipe	5.3	2	Yes	Yes	Every audit
Appearance	5.4	2	Yes	Yes	Every audit
Wall build-up and dimensions of the pipe	5.5	1	Yes	Yes	Every audit
Length of the pipe	5.6	2	Yes	Yes	1x / year
Change in length and mean outside diameter of the pressure pipe (Type PP) at positive pressure	5.7	2	Yes	Yes	1x / year
Change in length and mean outside diameter of the suction pipe (Type SP) at negative pressure	5.8	2	Yes	Yes	1x / year
Adhesion strength	5.9	1	Yes	Yes	1x / year
Resistance of the pressure pipe (type PP) to a cyclic positive pressure	5.10	1	Yes	Yes	1x / 3 years
Resistance of the suction pipe (type SP) to a cyclic negative pressure	5.11	1	Yes	Yes	1x / 3 years
Resistance of the pressure pipe (type PP) to internal water pressure	5.12	1	Yes	Yes	1x / year
Resistance of the pressure pipe (type PP) to a negative pressure	5.13	1	Yes	Yes	1x / year
Resistance to impact of the pressure pipe (type PP)	5.14	1	Yes	Yes	1x / 3 years
Resistance to impact of the suction pipe (type SP)	5.15	1	Yes	Yes	1x / 3 years
Resistance to bending at low temperatures of the pressure pipe (type PP)	5.16	1	Yes	Yes	1x / year
Resistance to bending at low temperatures of the suction pipe (type SP)	5.17	1	Yes	Yes	1x / year
Initial ring stiffness	5.18	1	Yes	Yes	1x / 3 years
Creep ratio	5.19	1	Yes	Yes in event of change	By every change
Chemical resistance	5.20	1	Yes	Yes in event of change	By every change
Resistance to permeation	5.21	1	Yes	Yes in event of change	By every change
Relative Temperature Index of the barrier layer	5.22	1	Yes	Yes in event of change	By every change
Oxidation induction time	5.23	1	Yes	Yes in event of change	By every change
Resistance to weathering	5.24	1	Yes	Yes in event of change	By every change

Description of requirement	Article no. of BRL	Category (see note)	Tests within the scope of		
			Initial evaluation	Surveillance assessment after issue of the certificate	
				Assessment	Frequency
Secondary containment, ducting pipe and joints					
Material	6.3	1	Yes	Yes	Every audit
Appearance	6.4	2	Yes	Yes	Every audit
Dimensions of the secondary pipe	6.5	2	Yes	Yes	Every audit
Initial ring stiffness	6.6	1	Yes	Yes	1x / year
Creep ratio	6.7	1	Yes	Yes in event of change	By every change
Chemical resistance	6.8	1	Yes	Yes in event of change	By every change
Resistance against UV-ageing	6.9	1	Yes	Yes in event of change	By every change
Resistance to impact	6.10	1	Yes	Yes in event of change	By every change
Resistance to permeability (Only valid when used as secondary containment pipe)	6.11	1	Yes	Yes in event of change	By every change
Joints	6.12	1	Yes	Yes	Every audit
Vapour recovery lines					
Wall construction and material of the pipe	7.2	2	Yes	Yes	Every audit
Appearance	7.3	2	Yes	Yes	Every audit
Wall build-up and dimensions of the pipe	7.4	1	Yes	Yes	Every audit
Length of the pipe	7.5	2	Yes	Yes	Every audit
Adhesion strength	7.6	1	Yes	Yes	1x / year
Resistance to impact and positive pressure	7.7	1	Yes	Yes	1x / year
Resistance to impact and negative pressure	7.8	1	Yes	Yes	1x / year
Resistance to bending at low temperatures and positive pressure	7.9	1	Yes	Yes	1x / year
Resistance to bending at low temperatures and negative pressure	7.10	1	Yes	Yes	1x / year
Initial ring stiffness	7.11	1	Yes	Yes	1x / year
Creep ratio	7.12	1	Yes	Yes in event of change	By every change
Chemical resistance	7.13	1	Yes	Yes in event of change	By every change
Resistance to permeation	7.14	1	Yes	Yes in event of change	By every change
Relative Temperature Index of the barrier layer	7.15	1	Yes	Yes in event of change	By every change
Filling pipes					
Wall construction and material of the pipe	8.2	2	Yes	Yes	Every audit
Appearance	8.3	2	Yes	Yes	Every audit
Wall build-up and dimensions of the pipe	8.4	1	Yes	Yes	Every audit
Length of the pipe	8.5	2	Yes	Yes	1x / year
Adhesion strength	8.6	1	Yes	Yes	1x / year
Resistance to impact and positive pressure	8.7	1	Yes	Yes	1x / year
Resistance to bending at low temperatures and positive pressure	8.8	1	Yes	Yes	1x / year
Initial ring stiffness	8.9	1	Yes	Yes	1x / year
Creep ratio	8.10	1	Yes	Yes in event of change	By every change
Chemical resistance	8.11	1	Yes	Yes in event of change	By every change
Resistance to permeation	8.12	1	Yes	Yes in event of change	By every change
Relative Temperature Index of the barrier layer	8.13	1	Yes	Yes in event of change	By every change
Couplings and fittings for primary pipes with or without an integrated secondary containment					
Material	9.2	1	Yes	Yes	Every audit
Form and dimensions	9.3	1	Yes	Yes	Every audit
Leak tightness of the joints	9.4	1	Yes	Yes	1x / year
Strength of the joints	9.5	1	Yes	Yes	1x / year

Description of requirement	Article no. of BRL	Category (see note)	Tests within the scope of		
			Initial evaluation	Surveillance assessment after issue of the certificate	
				Assessment	Frequency
Resistance to permeation	9.6	1	Yes	Yes in event of change	By every change
Elastomeric sealing elements for the secondary pipe and sumps					
Material	10.2	1	Yes	Yes	Every audit
Form and dimensions	10.3	1	Yes	Yes	1x / year
Strength and tightness of the test boot	10.4	1	Yes	Yes	1x / year
Resistance to permeation	10.5	1	Yes	Yes in event of change	By every change
Product requirements and test methods					
Installation instructions	4.5	3	Yes	Yes	1x/year
Marking	4.6	2	Yes	Yes	Every audit
Requirements in respect of the quality system					
Internal quality control/quality plan	11.32	3	Yes	Yes	Every audit
Procedures and working instructions	11.44	3	Yes	Yes	Every audit
Design changes	11.55	1	Yes	Yes	Every audit

Note:
Non-conformities can be reported during the surveillance audits. These non-conformities can be classified into the following categories:

1. Critical (Major): These non-conformities can lead to a dangerous situation or result in a substandard product. The manufacturer shall, after approval from the certification body, implement corrective actions to rectify the situation within a maximum period of 2 weeks. Failure to do so shall result in the withdrawal of the certificate.
2. Important (Minor): These non-conformities can in the long term lead to a substandard product. The manufacturer shall, after approval from the certification body, implement corrective actions to rectify the situation within a maximum period of 3 months. Failure to do so shall result in the withdrawal of the certificate.
3. Less important (Minor): These non-conformities are less important but shall be rectified within a reasonable amount of time. The certification body shall check the corrective action taken during the following surveillance audit.

During the initial evaluation of the product, type tests have to be performed to determine whether the product meets the specified performance and product requirements. The requirements that shall be fulfilled in order to qualify for certification are stated in the above matrix. In the event of a change of the raw material or the supplier thereof the type tests shall be repeated by the tank manufacturer.

The quality system of the manufacturer is also audited during the initial evaluation.

After certification the certification body shall periodically assessment the manufacturer for compliance with this Evaluation Guideline. During these assessments a periodic repetition of some of type tests can also be required.

12.2 Inspection of the quality system of the supplier

The quality system of the supplier will be checked by Kiwa on the basis of the IQC scheme.
The inspection contains at least those aspects mentioned in the Kiwa Regulations for Certification.

13 Agreements on the implementation of certification

13.1 General

Beside the requirements included in these evaluation guidelines, the general rules for certification as included in the Kiwa Regulations for Certification also apply.

13.2 Certification staff

The staff involved in the certification may be sub-divided into:

- Certification assessor/Reviewer (**CAS/RV**): in charge of carrying out the pre-certification tests and assessing the inspectors' reports;
- Site assessor (**SAS**): in charge of carrying out external inspections at the supplier's works;
- Decision maker (**DM**): in charge of taking decisions in connection with the pre-certification tests carried out, continuing the certification in connection with the inspections carried out and taking decisions on the need to take corrective actions.

13.2.1 Qualification requirements

The competency criteria for the certification personnel are set in the table below. Education and experience of the concerning certification personnel shall be recorded demonstrably.

Basic requirements	**Evaluation criteria**
Knowledge of company processes Requirements for conducting professional assessments on products, processes, services, installations, design and management systems.	*Relevant experience: in the field* **SAS, CAS/RV** : 1 year **DM**: 5 years inclusive 1 year with respect to certification Relevant technical knowledge and experience on the level of: **SAS**: High school **CAS/RV, DM** : Bachelor
Competence for execution of site assessments. Adequate communication skills (e.g. reports, presentation skills and interviewing technique).	**SAS**: Kiwa Assessment training or similar and 4 site assessments including 1 autonomic under review.
Execution of initial examination	**CAS**: 3 initial assessments under review.
Conducting review	**RV**: conducting 3 reviews

Technical competences	**Evaluation Criteria**
Education	**General**: Education in one of the following technical areas: • Civil Enginereing; • Enginering.
Testing skills	**General:** • 1 week laboratory training (general and scheme specific) including measuring techniques and performing tests under supervision ; • Conducting tests (per scheme).

Experience - specific	**CAS** • 3 complete applications (excluding the initial assessment of the production site) under the direction of the **PM** • 1 complete application self-reliant (to be evaluated by **PM**) • 3 initial assessments of the production site under the direction of the **PM** • 1 initial assessment of the production site self-reliant (witnessed by **PM**) **SAS** • 5 inspection visits together with a qualified **SAS** • 3 inspection visits conducted self-reliant (witnessed by **PM**)
Skills in performing witnessing	**PM** Internal training witness testing

Legenda:

- Certification assessor (**CAS**)
- Decision maker (**DM**)
- Product manager (**PM**)
- Reviewer **(RV)**
- Site assessor (**SAS**)

13.2.2 Qualification Certification staff

The qualification of the Certification staff shall be demonstrated by means of assessing the knowledge and experience to the above mentioned requirements. In case staff is to be qualified on the basis of deflecting criteria, written records shall be kept.

13.3 Report initial investigation and surveillance assessments

The certification body records the results of the initial investigation and surveillance assessment in a report.

This report shall comply with the following requirements:

- completeness: the report provides a verdict about all requirements included in the evaluation guideline;
- traceability: the findings on which the verdicts have been based shall be recorded and traceable;
- basis for decision: the **DM** shall be able to base his decision on the findings included in the report.

13.4 Decision for granting the certificate

The decision on the granting a certificate or the imposition of measures regarding to the certificate must be based on results recorded in the dossier

The results of an initial evaluation and a surveillance assessment (in case of a critical (Major) non-conformities) must be assessed by a reviewer.

Based on the review performed, the decision maker determines whether:

• The certificate can be issued,

• Sanctions are imposed,

• The certificate must be suspended or withdrawal.

The decision for granting the certificate shall be made by a qualified Decision maker which has not been involved in the pre-certification tests.

The decision shall be recorded in a traceable manner.

13.5 Nature and frequency of third party assessments

The certification body shall carry out surveillance assessments on site at the supplier at regular intervals to check whether the supplier complies with his obligations. The Board of Experts decides on the frequency of assessments.

At the time this BRL entered into force, the frequency of assessments amounts 2 assessment(s) on site per year for suppliers with a quality management system in accordance with ISO 9001 for their production, which has been certified by an acknowledged body (in accordance with ISO/IEC 17021) and where the IQC scheme forms an integral part of the quality management system. In case the supplier is not in possession of a quality management system in accordance with ISO 9001, which has been certified by an acknowledged body (in accordance with ISO/IEC 17021), the frequency shall be increased to 4 visits for the duration of one year. In case the (sub-)supplier is not in possession of the product certificate (issued by Kiwa according BRL-K552), the frequency is decreased to 1 assessment.

The assessment program on site shall cover at least:

- the product requirements;
- the production process;
- the suppliers IQC scheme and the results obtained from inspections carried out by the supplier;
- the correct way of marking certified products;
- compliance with required procedures;
- handling complaints about products delivered.

The results of each assessment shall be recorded by Kiwa in a traceable manner in a report.

13.6 Non conformities

When the certification requirements are not met, measures are taken by Kiwa in accordance with the sanctions policy as written in the Kiwa Regulation for Certification.
The Sanctions Policy is available through the “News and Publications” page on the Kiwa website "Kiwa Regulation for Certification".

13.7 Report to the Board of Experts

De certification body shall report annually about the performed certification activities. In this report the following aspects are included:

- mutations in number of issued certificates (granted/withdrawn);
- number of executed assessments in relation to the required minimum;
- results of the inspections;
- required measures for established Non-Conformities;
- received complaints about certified products.

13.8 Interpretation of requirements

The Board of Experts may record the interpretation of requirements set out in this evaluation guideline in one or more interpretation document(s). This(The) interpretation document(s) is/are available for the members of the Board of Experts, the certification bodies and the certificate holders on this evaluation guideline. This interpretation document(s) is/are published on the Kiwa website.

13.9 Specific rules set by the Board of Experts

No specific rules has been defined by the Board of Experts. If specific rules are defined these rules shall be followed by the certification body.

14 Titles of standards

14.1 Standards / normative documents

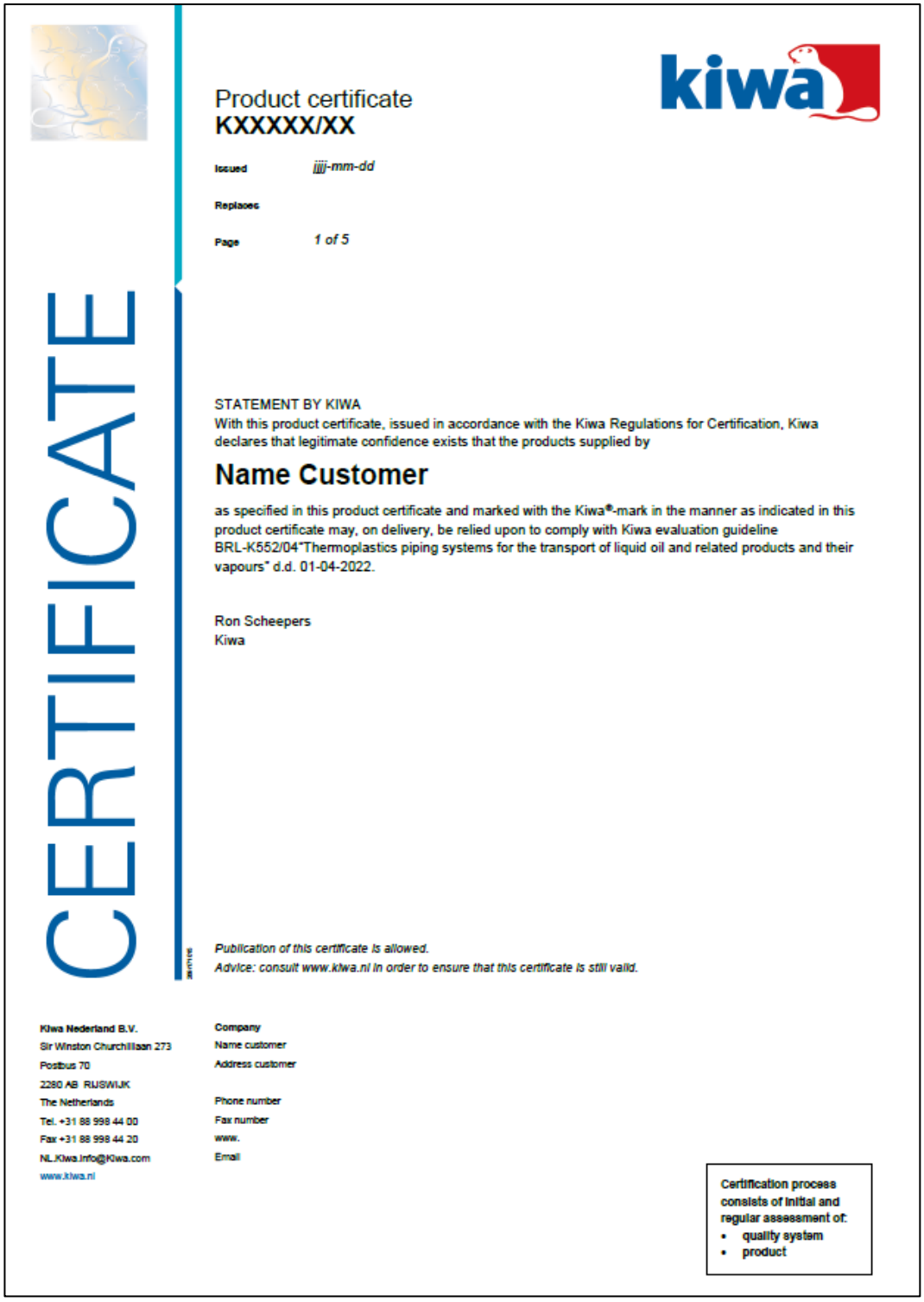
Number	Title	Version*
NEN-EN ISO/IEC 17020	Conformity assessment - General criteria for the operation of various types of bodies performing inspection	
NEN-EN ISO/IEC 17021	Conformity assessment - Requirements for bodies providing audit and certification of management systems	
NEN-EN ISO/IEC 17024	Conformity assessment - General requirements for bodies operating certification of persons	
NEN-EN ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories	
NEN-EN ISO/IEC 17065	Conformity assessment - Requirements for bodies certifying products, processes and services	
ASTM D 380	Standard Test Methods for Rubber Hose	
ASTM D 413	Standard test methods for Rubber property – Adhesion to Flexible substrate	
ASTM D-975	Standard Specification for Diesel Fuel Oils	
BRL SIKB 7800	Tankinstallaties	
ISO 7-1 incl. Corr. C1	Pipe threads where pressure-tight joints are made on threads – Part 1: Dimensions, tolerances and designation	
ISO 7-2	Pipe threads where pressure-tight joints are made on threads – Part 2: Verification by means of limit gauges	
NEN-EN 681-1 incl. ammdts. A1 to A3	Elastomeric seals – Material requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanized rubber	
NEN-EN 682 incl. ammdt. A1	Elastomeric seals – Material requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids	
NEN-EN 728	Plastics piping and ducting systems – Polyolefin pipes and fittings – Determination of oxidation induction time	
NEN-EN 1254-3	Copper and Copper alloys – Plumbing fittings – Part 3: Fittings with compression ends for use with plastics pipes	

NEN-EN 12164 incl. ammdt. A1	Copper and copper alloys – Rod for free machining purposes
NEN-EN-ISO 1133	Plastics – Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics
NEN-EN-ISO 175	Plastics – Methods of test for the determination of the effects of immersion in liquid chemicals
NEN-EN-ISO 294-1 incl. ammdt. A1	Plastics – Injection moulding of test specimens of thermoplastic materials – Part 1: General principles, and moulding of multipurpose and bar test specimens
NEN-EN-ISO 527-1 incl. ammdt. A1	Plastics – Determination of tensile properties. Part 1: General principles – Details of extensometer
NEN-EN-ISO 527-2 Incl. Corr. 1:1994	Plastics – Determination of the tensile properties – Part 2: Test conditions for moulding and extrusion plastics
NEN-EN-ISO 1183-1	Plastics – Methods for determining the density of non-cellular plastics – Part 1: Immersion method, liquid pyknometer method and titration method
NEN-EN-ISO 1183-2	Plastics – Methods for determining the density of non-cellular plastics – Part 2: Density gradient column method
NEN-EN-ISO 2818	Plastics – Preparation of test specimens by machining
NEN-EN-ISO 4892-1	Plastics – Methods of exposure to laboratory light sources Part 1: General guidance
NEN-EN-ISO 4892-2 incl. ammdt. A1	Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps
NEN-EN-ISO 8256	Plastics – Determination of tensile impact strength
NEN-EN-ISO 9967	Thermoplastics pipes – Determination of creep ratio
NEN-EN-ISO 9969	Thermoplastics pipes – Determination of the ring stiffness
NEN-EN-ISO 16871	Plastics piping and ducting systems - Plastics pipes and fittings - Method for exposure to direct (natural) weathering
NEN-ISO 1817	Rubber, vulcanised – Determination of the effect of liquids

PGS 28	Publicatiereeks Gevaarlijke Stoffen: Vloeibare aardolieproducten – Afleverinstallaties en ondergrondse opslag
PGS 30	Publicatiereeks Gevaarlijke Stoffen: Vloeibare aardolieproducten – Buitenopslag in kleine installaties
PGS 31	Overige gevaarlijke vloeistoffen: opslag in ondergrondse en bovengrondse tankinstallaties
SAE J 343	Tests and procedures for SAE 100R series Hydraulic Hose and Hose Assemblies
UL 746 B	Polymeric Materials – Long Term Property Evaluations

*) When no date of issue has been indicated, the latest version of the document is applicable.

Annex I Model certificate (example)



CERTIFICATE

Product certificate
KXXXXX/XX

kiwa

Issued *jjjj-mm-dd*

Replaces

Page *1 of 5*

STATEMENT BY KIWA
With this product certificate, issued in accordance with the Kiwa Regulations for Certification, Kiwa declares that legitimate confidence exists that the products supplied by

Name Customer

as specified in this product certificate and marked with the Kiwa®-mark in the manner as indicated in this product certificate may, on delivery, be relied upon to comply with Kiwa evaluation guideline BRL-K552/04"Thermoplastics piping systems for the transport of liquid oil and related products and their vapours" d.d. 01-04-2022.

Ron Scheepers
Kiwa

Publication of this certificate is allowed.
Advice: consult www.kiwa.nl in order to ensure that this certificate is still valid.

Kiwa Nederland B.V.
Sir Winston Churchilllaan 273
Postbus 70
2280 AB RIJSWIJK
The Netherlands
Tel. +31 88 998 44 00
Fax +31 88 998 44 20
NL.Kiwa.Info@Kiwa.com
www.kiwa.nl

Company
Name customer
Address customer

Phone number
Fax number
www.
Email

Certification process consists of initial and regular assessment of:
- quality system
- product

Kiwa® product certificate KXXXXX/01

Thermoplastics piping systems for the transport of liquid oil and related products and their vapours

CONTENTS

APPLICATION AND USE

General

The piping systems complying with this Evaluation Guideline are suitable for the transport of liquid oil and related products with a flash-point of
– 20 up to + 50°C for tank installations according to Kiwa Evaluation Guideline BRL SIKB 7800.

Application

The piping system is suitable for use in fuel applications where the maximum speed of the liquid does not exceed 5 m/s. They may be used as a suction line with a negative pressure of a minimum of
0.8 bar(g) (0.2 bar absolute) or a positive working pressure of 5.0 bars absolute.
NOTE 1: For liquid products other than diesel oil, unleaded and leaded petrol the test liquids and the requirements for the chemical resistance and resistance to permeation shall be adapted.
NOTE 2: At the moment of issue of this Evaluation Guideline the following pressures are common in pressure systems:
working pressure: 2.5 bars absolute,
rest pressure: 0.9 bar(a).

Life Expectancy

The product shall have a life expectancy of 20 years.

Leak detection unit

Pressure systems must to be equipped with a leak detection

Ventilation requirements

To satisfy the Dutch environmental regulations, it is required that the interstitial space between the primary and secondary pipe of the product lines is ventilated. A ventilation unit controls this ventilation. The unit consists of an electrically driven vacuum pump. This pump is developed, tested and approved for pumping air mixed with explosive vapours of liquid petrol.
The unit must be explosion proof and equipped with an explosion proof motor.
The unit can be placed in the dispenser, in the above ground filling point cabinet, in a separate box placed on the fluid tight pavement or in a separate box in which case the pump exhaust is connected to a 5m vent stack with flame arrestor above ground level. In all cases proper ventilation has to be provided.
The inlet of the unit is connected to a system of nylon tubing meeting DIN 73378 of sufficient diameter to allow an adequate flow of environmental air into the interstitial space of the product lines. Possible permeation vapours can be extracted at the pump outlet. Optionally, a gas operated leak detection system on the unit may be used.
The unit is dimensioned to provide a functional requirement of a minimum of 20 litre/hr of air with possible vapours per product line.
Product pipes for petrol shorter than 20 m and diesel do not have to be connected to a ventilation unit.
Filling and venting lines do not need a ventilation unit.

Thermoplastics piping systems for the transport of liquid oil and related products and their vapours

TECHNICAL SPECIFICATION

General

Thermoplastic pipe systems for above ground or underground transport of liquid petroleum products according to the Kiwa Evaluation Guideline BRL-K552: 'Thermoplastic piping systems for the transport of liquid oil and related products and their vapours'.

Application

This piping system is suitable to transport fuels like diesel and gasoline/petrol according to class K1, K2 and K3 of the PGS documents. This piping system is suitable for both suction systems as well as pressure systems with a maximum working pressure of 5.0 bars absolute. This pipe system is not allowed for LPG.

Description of the system

General

The Plastic Piping B.V. pipe system is a single wall or a double wall pip system that is used for the transport of petroleum products. Product lines are typically a double wall pipe system with an integrated secondary pipe. There are some applications that use single wall pipes for product lines as well (see note 1). The vapour recovery pipes and fill pipes are normally single wall pipe.

The interstitial space between primary and secondary pipe is ventilated. Any gases or vapour that may permeate from the primary pipe may be dispersed by the connection of an approved ventilation system. For the connections to the tank and to the pumps, only certified fittings must be used.

Piping systems

For suction pipes and pressure pipes, 3 types of primary single wall piping systems and 3 types of secondary double wall piping may be used:

Pipes

- 1½" Plastic Pipe
- 2" Plastic Pipe
- 3" Plastic Pipe

Couplings

- Plastic Piping B.V. for 1½" pipe
- Plastic Piping B.V. for 2" pipe

Note 1: Dutch legislation stipulates the use of a leak detection system for pressure applications. This means that in The Netherlands, for pressure applications, only double wall piping systems equipped with a leak detection unit can be used.

Note 2: Single wall pipes can be used for suction pipe applications for:

- the transport of Diesel, and

- the transport of Petrol up to a maximum pipe length of 20 meters.

For vapour recovery is used:

Pipes

- ¾" Plastic Pipe
- 1" Plastic Pipe
- 1½" Plastic Pipe

Couplings

- Plastic Piping B.V. for ¾" pipe
- Plastic Piping B.V. for 1" pipe
- Plastic Piping B.V. for 1½" pipe

For vents is used:

Pipes

- 2" Plastic Pipe.

Couplings

- Plastic Piping B.V.

For filling is used:

Pipes

- 3" Plastic Pipe
- 4" Plastic Pipe

Couplings

- Plastic Piping B.V. for 3" pipe
- Plastic Piping B.V. for 4" pipe

The primary pipe is made of polyethylene reinforced with a polyester braid and a special inner layer to reduce the permeation of liquid oil and related products. The integrated secondary pipe is made of polyethylene and a protective outer layer of nylon.

The colour of the primary pipe is white or natural.

The colour of the secondary pipe is green or blue.

The colour of the vent pipe is orange or blue.

Fittings

Per pipe length between tank and pump island a maximum of 3 fittings are used. In the product pipe itself no intermediate fittings are used. In vapour recovery pipes intermediate fittings are allowed.

Standard pipe lengths

Pipes may be supplied in boxes or coiled reels dependant upon product type. Standard lengths (depending on the diameter) are 60, 75, 150 and 300 m.

Thermoplastics piping systems for the transport of liquid oil and related products and their vapours

Marking

The products will be marked with the Kiwa logo.
For the different products to be carried out as follows:
Pipes
Un-erasable by ink, at least 1 imprint every 2 m.

Fittings
Un-erasable by impact or etching, or clearly marked on the package.

The marking must at least include:
Pipes
- the Kiwa logo
- the word "Plastic Pipe" on the pipes
- product date or product code
- above ground or underground application. (if applicable)

INSTALLATION

Certified installers

The Plastic Piping B.V. piping systems have to be installed by a Kiwa certified installer according to Kiwa Evaluation Guideline BRL SIKB 7800"Certification scheme for Installers of Tank Installations (REIT)".

Installation-instructions

Plastic Piping B.V. provides installation instructions in Dutch which can be found on the company web site www.opwfcs.com.
Any change in these instructions will be notified to Kiwa.
The instructions shall contain:
- installation instructions,
- inspection instructions, and
- maintenance instructions.

Trained personnel

The pipe may only be installed by trained installers who have a valid training and ID card. Installer training is valid for two years.
Training may only be given to installers by a competent nominated employee of Plastic Piping B.V. or its nominated trainer.

Persons providing training to installers must be Plastic Piping B.V. trained. Trainers posses a valid certificate confirming their being a registered Trainer.
Trainers are re-assessed annually.

Installation

The installation instructions contain notes for storage, transport and the installation itself.

During installation care should be taken to install the ventilation system properly. The correct operation of the system can be checked using a flow meter.

Minimum bending radius

The following minimum bending radius per pipe should be respected:

-	¾"	Plastic pipe:	450 mm
-	1½"	Plastic Pipe:	600 mm
-	1½"	Plastic Pipe:	600 mm
-	2"	Plastic Pipe:	900 mm
-	2"	Plastic Pipe:	900 mm
-	2"	Plastic Pipe:	900 mm
-	3"	Plastic Pipe:	1200 mm
-	3"	Plastic Pipe:	1200 mm

Storage

It is advised to protect the pipe from long term exposure to direct sunlight (UV-light) and to install the pipe within a couple of weeks after delivery to the site of construction.

Thermoplastics piping systems for the transport of liquid oil and related products and their vapours

PERFORMANCE

Suction system

Operating pressure

The working pressure in the system during normal operating conditions is 0, 2 bar absolute.

Rest pressure

When there is no product flow the pressure in the primary pipe will be 0.5 bar(g) maximum.

Pressure system

Operating pressure

The working pressure in the system during normal operating conditions is max 5,0 bar(a).

Rest pressure

When there is no product flow the pressure in the primary pipe will be between 0.9 and 2.2 bar(a).

Permeation

Permeation-research and subsequent calculations have shown that the system (the pipe system between tank and dispensing pump) meets the requirements as formulated in the Kiwa Evaluation Guideline BRL-K552.

MAINTENANCE

Maintenance and inspection

To check the good operation of the system of Environ the 15-yearly inspection is sufficient. In this case the complete tank installation is pressure tested.

The PCU has to be checked yearly by a certified installer according Kiwa Evaluation Guideline BRL SIKB 7800.

RECOMMENDATIONS FOR THE INSTALLER

1. Check the product at the time of delivery according to the paragraph "Technical specification" to ensure that:
   - 1.1 the producer has delivered in accordance with the agreement;
   - 1.2 the mark and the marking method are correct;
   - 1.3 the products show no visible defects as a result of transport

   etc.
2. Check whether the products meet the specifications according to section general, pipes and fittings of the paragraph "Technical specification".
3. If you should reject a product on the basis of the above, please contact:
   - 3.1 Plastic Piping B.V.

   and, if necessary,
   - 3.2 Kiwa N.V.
4. Carry out storage, transport and installation according to the paragraph "Installation".
5. Take the information from the paragraph "Performance" into consideration.

LIST OF DOCUMENTS

- Kiwa Evaluation Guideline BRL SIKB 7800: "Certification scheme for Installers of Tank Installations (REIT)".
- Kiwa Evaluation Guideline BRL-K552: "Thermoplastic piping systems for the transport of liquid oil and related products and their vapours.
- Kiwa Guideline for product certification.

The exact dates of publication of above mentioned documents can be found in the Kiwa Evaluation Guideline BRL-K552.

Annex II Model IQC-scheme (example)

Inspection subjects	Inspection aspects	Inspection method	Inspection frequency	Inspection registration
Raw materials or incoming goods: • Raw materials • Incoming goods				
Production process/ production equipment/ material: • Procedures • Work instructions • Equipment • Release of product				
Finished-products • Pressure testing				
Measuring and testing equipment • Measuring equipment • Calibration				
Packaging and transport • Internal transport • Storage • Preservation • Packaging • Identification or marking of semi-finished and finished products				