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Evaluation Guideline

for the Kiwa product certificate with technical approval for

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

Amendment to BRL-K552/03

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

Date of amendment: February 18th, 2015
Technology code: CK-S-F5-Opslag-, transport- en afvoersystemen
Validated by BoE "Tanks, Tank installations & Appendages" on February 27th, 2015

Validity
This amendment sheet pertains to BRL-K552/03 dated February 1st, 2011.

Validation
This amendment sheet has been validated by Kiwa per March 15th, 2015.

1.1 General

Revise the text in the last paragraph to read:
For the performance of its certification work, Kiwa is bound to the requirements concerning the agreements on the implementation of certification as detailed in the NEN-EN-ISO/IEC 17065.

1.4 Acceptance of test reports provided by the supplier

Revise the text as follows:
Should the manufacturer submit reports from test Institutions or laboratories in order to demonstrate compliance of the product with the requirements of this evaluation guideline, that institute or laboratory shall comply with the applicable accreditation standards, i.e.:

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

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

The accreditation shall refer to the examination as required in this BRL. When no certificate of accreditation can be shown, Kiwa will verify whether the accreditation norm is fulfilled.

3.1 General

Revise the text as follows:
This chapter refers to the legal requirements in relation to the products manufactured to this Evaluation Guideline.

3.2.1 BARIM/RARIM

Revise the complete paragraph as follows:

3.2.1 Dutch legislation

The thermoplastic pipe systems manufactured in accordance with this Evaluation Guideline fall under the jurisdiction of the Dutch Ministry for Infrastructure and Environment (I&M). The relevant legislation Activiteitenbesluit milieubeheer (AM) specifies the requirements pertaining to various activities and these are further clarified in, amongst others, the Soil Quality Decree (Besluit Bodemkwaliteit) with its regulation.

One of the stipulations of the AM refers to the PGS 30 and the installation in accordance with the Evaluation Guideline BRL-K903. This requirement pertains to all fuels (except for PGS Class 1 fuels).

The certified installation company shall then be able to issue an installation certificate stating that the tank installation complies with the requirement of Evaluation Guideline BRL-K903. Compliance with BRL-K903 can be given when an adequate Risk Inventory and Evaluation (RI&E) has been carried out in accordance with the requirements of document PBV-107776. The tanks and spill containers used for the above ground storage of fuels will be part of this RI&E. The RI&E shall then be evaluated by the Certification Body. On approval of the RI&E the certified installation company can then issue an installation certificate.

The RI&E of each tank installation can be streamlined when use is made of certified products. In that case the RI&E aspects pertaining to these products will not be required. The tanks and spill containers manufactured in accordance with this Evaluation Guideline will comply with all the requirements stipulated in the regulations and the Evaluation Guideline BRL-K903.

Some companies do not fall under the jurisdiction of these regulations. The requirements pertaining to the above ground storage of liquid fuels and lubricants for these companies are laid down in each individual permit. In such cases the local authority shall define the technical and operational requirements for the storage of these fluids in the individual permit and can in a lot of cases refer via the PGS 30, BRL-K903 to this Evaluation Guideline.

14.2 Certification personnel

Revise the text as follows:

- **Certification assessor / Application reviewer**: they are in charge of carrying out the pre-certification tests and assessing the site assessors' reports;
- **Site assessor**: they are in charge of carrying out external inspections at the supplier's works;
- **Decision-makers**: they are 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.

14.2.1 Qualification requirements

Revise Table 14.1 to read:

	Certification assessor / Application reviewer	Site assessor	Decision maker
Basic competence			
• Knowledge and competent assessment of the production processes	• Technical education at Bachelor level or higher • 1 year of relevant working experience	• Technical vocational education at intermediate level or higher • 1 year of relevant working experience	• Technical education at Bachelor level or higher • 5 years of working experience with a minimum of 1 year experience with certification
• Audit skills	• Not applicable	• Training in audit skills • Minimum of 4 complete audits of which at least 1 has been has been carried out independently and witnessed for qualification	• Not applicable
Technical competence			
Knowledge of this BRL	• Detailed knowledge of this BRL • A minimum of 4 complete audits for this BRL or for related BRL's	• Detailed knowledge of this BRL • A minimum of 4 complete audits for this BRL or for related BRL's	• Not applicable
• Relevant knowledge of: • The technology related to the manufacturing of the products to be inspected, the performance of these processes and the provision of these services • The manner in which the products are used, the processes are performed and the services are provided • Any defect which may occur during the use of the product, any error in the execution of processes and any inadequacies in the provision of services	• Relevant technical education at Bachelor level or higher • Specific courses and training (knowledge and skills) related to plastics	• Relevant technical vocational education at intermediate level or higher • Specific courses and training (knowledge and skills) related to plastics	• Not applicable

14.2.2 Qualification

Revise the text as follows:

Certification personnel shall be qualified by assessing the knowledge and skills on the above mentioned requirements. The responsibility for the qualification is determined by the management of the certification body.

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 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 Product Certification. This regulation details the method employed by Kiwa for conducting the necessary investigations prior to issuing the product certificate and the method of external control. The inspection frequency is determined by the above mentioned Board of Experts.

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Validation
This evaluation guideline has been validated by Kiwa on February 1st, 2011

Contents

1 Introduction

1.1 General

This Evaluation Guideline contains all relevant requirements on the basis of which Kiwa issues and maintains a Kiwa Product Certificate for thermoplastics piping systems for the transport of liquid oil products and their vapours.

This Evaluation Guideline replaces BRL-K552/02 dated 1999-07-07 and amendment dated 2003-11-01. All certificates issued in accordance with BRL-K552/02 will lose their validity after a maximum period of 6 months after this Evaluation Guideline has been issued.

During the performance of the certification work, Kiwa is bound to the requirements as stated in NEN-EN 45011 and as laid down in the chapter 14: "Agreements on the implementation of certification".

1.2 Field of application / scope

The products are intended for:

- The transport of liquid oil products (PGS Class 1 through 4 products) according to PGS 28 or PGS 30. These liquids are for example (bio)fuels, waste oils, lubricating oils, etc.;
- For above ground and underground applications;
- For maximum positive working pressures of 5,0 bar(g);
- 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 § 6) 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, 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
   - A rest pressure of 0,8 bar

1.3 Terminology

In this Evaluation Guideline the following terminology shall apply:

- Evaluation Guideline: the agreements made within the Board of Experts on the subject of certification;
- Board of Experts: the Board of Experts "Tanks, Tank installations & Appendages";
- Supplier: the party responsible for ensuring that the products continuously fulfil the requirements on which the certification is based;
  Note: the 'Supplier' may also be the manufacturer of the certified product(s).
- Internal Quality Control Schedule (IQC-schedule): a description of the quality inspections carried out by the supplier as part of his quality system.

1.4 Acceptance of test reports supplied by the supplier

If the supplier submits reports from certification bodies or testing laboratories to show that the requirements and procedures of the Evaluation Guideline are met, it will have to be shown that such reports were prepared by a certification body or testing laboratory meeting the prevailing accreditation standard, i.e.

- NEN-EN 45011 for certification bodies certifying products;
- NEN-EN-ISO/IEC 17020 for inspection bodies;
- NEN-EN-ISO/IEC 17021 for certification bodies certifying systems;
- NEN-EN-ISO/IEC 17024 for certification bodies certifying persons;
- NEN-EN-ISO/IEC 17025 for laboratories.

The certification body or testing laboratory body is deemed to meet these criteria if an accreditation certificate can be submitted which has been issued by Dutch Council of Accreditation (Raad voor

Accreditatie) or an accreditation body with which Raad voor Accreditatie has concluded a mutual acceptance agreement. This accreditation should relate to the tests required for this Evaluation Guideline.

If no accreditation certificate can be submitted, Kiwa itself shall verify whether the accreditation standard has been met or carry out the tests concerned itself, or have them carried out under its direct supervision. Test reports from laboratories, other than mentioned above (manufacturer laboratories, or universities or colleges, not accredited nor notified for the relevant testing) may be accepted. The certification body shall assess these reports. In EOTA GD 004 – The Provisions of Data For Assessments leading to ETA – guidance is given how to proceed in such cases.

1.5 Product certificate with technical approval

The model of the product certificate with technical approval, issued on the basis of this Evaluation Guideline has been included in Annex I.

2 Definitions

Barrier layer
Inside layer of the pipe which is direct in contact with the medium and which is more or less permeation tight

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.

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.

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.

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 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 product and which is therefore in direct contact with the oil product.

Rest pressure
Pressure which remains inside the primary pipe in case the liquid oil 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.

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 product in the primary pipe in case the liquid oil product flows from the tank to the dispenser.

3 Legal requirements

3.1 General

This chapter contains the legal requirements in relation to the tanks and spill containers manufactured in accordance with this Evaluation Guideline.

3.2 Legal requirements

3.2.1 BARIM/RARIM

The tanks and spill containers manufactured in accordance with this Evaluation Guideline fall under the jurisdiction of the Ministry of Infrastructure and Environment (Ministerie van Infrastructuur en Milieu = I&M). I&M has specified the requirements pertaining to various industries with regard to the environment in the BARIM (Besluit Algemene Regels voor Inrichtingen Milieubeheer). The requirements stipulated in the BARIM are further clarified in the RARIM (Regeling Algemene Regels voor Inrichtingen Milieubeheer).

In one of the stipulations of the RARIM it is required that all installations for the above ground storage of fuels shall be installed by an installation company that has been certified in accordance with the requirements of Evaluation Guideline BRL-K903. This requirement pertains to all fuels (except for petrol) and waste oils.

The certified installation company shall then be able to issue an installation certificate stating that the tank installation complies with the requirement of Evaluation Guideline BRL-K903. Compliance with BRL-K903 can be given when an adequate Risk Inventory and Evaluation (RI&E) has been carried out in accordance with the requirements of document PBV-107776. The tanks and spill containers used for the above ground storage of fuels and waste oils will be part of this RI&E. The RI&E shall then be evaluated by the Certification Body. On approval of the RI&E the certified installation company can then issue an installation certificate.

The RI&E of each tank installation can be streamlined when use is made of certified products. In that case the RI&E aspects pertaining to these products will not be required. The tanks and spill containers manufactured in accordance with this Evaluation Guideline will comply with all the requirements stipulated in BARIM, RARIM and Evaluation Guideline BRL-K903.

Some companies do not fall under the jurisdiction of the BARIM/RARIM. The requirements pertaining to the above ground storage of liquid fuels, waste oils and lubricants for these companies are laid down in each individual permit. In such cases the local authority shall define the technical and operational requirements for the storage of these fluids in the individual permit and can in a lot of cases refer via the PGS 30, BRL-K903 to this Evaluation Guideline.

3.2.2 Regulations pertaining to the agricultural and greenhouse industries

The present regulations pertaining to the agricultural and greenhouse industries stipulate compliance with the document CPR 9-6. This document has been withdrawn and these regulations are no longer being updated. Both these regulations will be integrated in the new regulation for the agricultural industry that is presently being drafted. This regulation shall conform to the format of the BARIM/RARIM – see § 3.2.1.

4 Certification procedure

4.1 Initial evaluation

The initial evaluation shall be carried out on the basis of the product requirements stipulated in this Evaluation Guideline and shall include the relevant test methods as follows:

- Test samples in order to determine whether the products comply with the product requirements;
- Evaluation of the production process;
- Evaluation of the quality system and the IQC schedule;
- Determine whether the required procedures are available and are fully implemented.

4.2 Certification

On conclusion of the initial evaluation the results will be presented to the decision maker of the certification body. The decision maker will evaluate whether the certificate can be issued or whether additional information and/or test results are required before the certificate can be issued.

5 Product requirements and test methods

5.1 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 products and their vapours.

The complete piping system shall be assessed and the results of the assessment shall be reflected in the technical approval with product certificate. A description of the piping system shall be stated in the technical approval.

5.2 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)

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.

5.3 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 § 6.21.
Remark:
In order to meet the permeation requirements a double wall pipe system may be equipped with a permeation control unit that ventilates the interstitial space thereby preventing the condensation of the permeated product in the secondary pipe. An explosion proof vacuum pump is used to create a flow of fresh air through the interstitial space whereby the outlet air can then be monitored for the presence of excessive hydrocarbon contents that could exceed the 10% LEL (Lower Explosion Level). A permeation control unit is a safety measure and is not intended to replace an unlined double wall pipe system in combination with excessive ventilation.

Flow and running time frequencies of the permeation control unit are calculated on the basis of the permeation characteristics of the primary pipe. The permeation control unit is to be connected to all product lines where the interstitial spaces may be connected by means of a manifold. In case of pressure systems hydrocarbon monitoring is required in order to be able to shut down the pressure or submersible pumps. A permeation control unit is not required in case of Diesel and similar products.

A permeation control unit is not covered by this Evaluation Guideline.

5.4 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 6
Secondary containment, ducting pipe and joints	Chapter 7
Vapour recovery lines	Chapter 8
Filling pipes	Chapter 9
Couplings and fittings for primary pipes with or without an integrated secondary containment	Chapter 10
Elastomeric sealing elements for the secondary pipe and sumps	Chapter 11
Sumps	BRL-K21006

5.5 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 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-K903. 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.

5.6 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 of the technical approval 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:

<u>Primary pipe with or without an integrated secondary containment</u>

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.

<u>Secondary containment and ducting pipes and filling pipes</u>

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.

<u>Couplings and fittings for primary pipes with or without an integrated secondary containment</u>

In addition to the marking on the components, the packaging of the fittings and couplings shall also be marked as indicated.

<u>Elastomeric sealing elements for secondary containment pipes</u>

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

6 Primary pipe with or without an integrated secondary containment

6.1 General

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

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 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.

6.4 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.

6.5 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 approval.

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.

6.6 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 approval. 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.

6.7 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 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.
- 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 ± 0,1) bar 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 ($\mathbf{L_0}$) in mm and the mean outside diameter ($\mathbf{d_0}$) in mm at the mark;
- Apply after this period again the pressure of (5,0 bar ± 0,1) bar;
- After a period of (300 ± 15) seconds, and with the test piece still under pressure, measure the length between the marks ($\mathbf{L_1}$) in mm and the mean outside diameter at the location of the mark ($\mathbf{d_1}$) in mm;
- Calculate the change in length **ΔL** and the change in mean outside diameter **Δd** in percentage using equations 6-1 and 6-2.

$$\Delta L = \left(\frac{L_1 - L_0}{L_0} \right) x\, 100\% \qquad \text{Equation 6-1}$$

$$\Delta d = \left(\frac{d_1 - d_0}{d_0} \right) x\, 100\% \qquad \text{Equation 6-2}$$

Repeat this procedure for the two other test pieces.

6.8 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 (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 $(0{,}9^{+0{,}05}_{0})$ bar [$(0{,}1^{\ 0}_{-0{,}05})$ bara];
- 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 $(0{,}9^{+0{,}05}_{0})$ bar [$(0{,}1^{\ 0}_{-0{,}05})$ bar absolute] for (60^{+5}_{0}) seconds;

- Release after this time the pressure from the test piece and allow the test piece to re-stabilize for (60^{+5}_{0}) seconds;
- Measure the distance between the two marks (L_0) in mm and the mean outside diameter (d_0) in mm at the location of the mark;
- Apply again the negative pressure of $(0{,}9^{+0{,}05}_{0})$ bar [$(0{,}1^{\ 0}_{-0{,}05})$ bar absolute];
- After a period of (300 ± 15) seconds, and with the test piece still under negative pressure, measure the length between the marks (L_1) in mm and the mean outside diameter (d_1) at the location of the mark;
- Calculate the change in length ΔL and the mean outside diameter Δd using equations 6-3 and 6-4.

$$\Delta L = \left(\frac{L_1 - L_0}{L_0} \right) \times 100\% \qquad \text{Equation 6-3}$$

$$\Delta d = \left(\frac{d_1 - d_0}{d_0} \right) \times 100\% \qquad \text{Equation 6-4}$$

Repeat this procedure for each of the test pieces.

6.9 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.

6.10 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 approval.

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 (L_v) between the coupling is calculated using Equation 6-5.

$$L_v = \Pi \times R + 2 \times d \qquad \text{Equation 6-5}$$

whereby
L_v = 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, surge pressure (10,0 ± 0,1) bar;
3. Pressure profile in accordance with Figure 6.1;

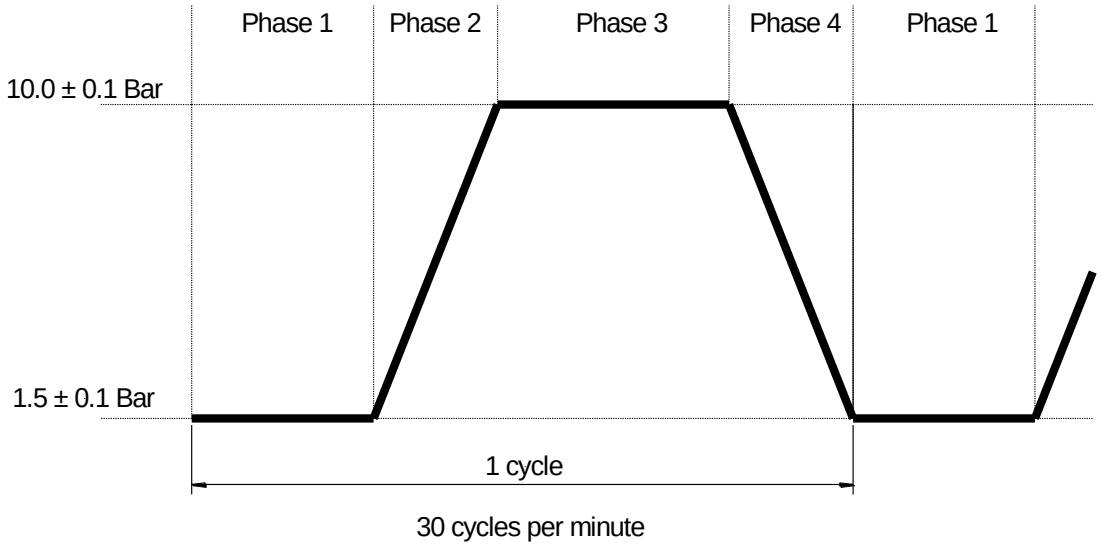

Figure 6.1: Schematic presentation of the pressure

Phase 1: Established threshold pressure (1,5 ± 0,1) bar 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 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;
  3. High pressure (10,0 ± 0,1) bar;
- Stop the test at 250.000 cycles;

Repeat the procedure with the second test piece.

6.11 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 ($0{,}9\ ^{+0{,}05}_{0}$) bar [($0{,}1\ ^{0}_{-0{,}05}$) 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.

6.12 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 (5 x 5,0 bar).

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 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.

Repeat this test with the two other test pieces.

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

After testing at a negative pressure of 0,9 bar (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 [$(0,1\ ^{0}_{-0,05})$ bara];
- 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 [$(0,1\ ^{0}_{-0,05})$ bar absolute] for a period of (60^{+5}_{0}) seconds;
- Release after this period the negative pressure of the test piece and allow the test piece to re-stabilise for (60^{+5}_{0}) seconds;
- Measure the mean outside diameter at the location of the mark ($\mathbf{d}_0$) in mm;

- Apply again the negative pressure of $(0{,}9^{+0{,}05}_{0})$ bar [$(0{,}1\ ^{0}_{-0{,}05})$ 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 ($\mathbf{d_1}$) 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 ($\mathbf{\Delta d}$) in percentage using Equation 6.6.

$$\Delta d = \left(\frac{d_1 - d_0}{d_0} \right) x\,100\% \qquad \text{Equation 6-6}$$

Repeat this test with the two other test pieces.

6.14 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 (2 x 5,0 bar) for 168 hours and an overpressure of 25,0 bar (5 x 5,0 bar) 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 and (25,0 ± 0,1) bar.
- 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 for (168 ± 1) hour.
- Increase the pressure to (25,0 ± 0,1) bar 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.

Repeat the procedure with the second test piece.

6.15 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 (0,35 bar absolute) for 168 hours and a negative pressure of 0,9 bar (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 [$(0{,}1\ ^{0}_{-0{,}05})$ bara];
- -Pressure equipment, capable of holding a pressure of (10,0 ± 0,1) bar;
- 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 [$(0{,}35\ ^{0}_{-0{,}05})$ bar absolute] for (168 ± 1) hour;
- After this period apply a negative pressure of for $(0{,}9\ ^{+0{,}05}_{0})$ bar [$(0{,}1\ ^{0}_{-0{,}05})$ bar absolute] (300 ± 15) 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 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.

Repeat the procedure with the second test piece.

6.16 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 (2 x 5,0 bar) for 5 minutes and 25,0 bar (5 x 5,0 bar) 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 and (25,0 ± 0,5) bar.

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 for (5 ± 0,1) minutes;
- Increase the pressure to (25,0 ± 0,1 bar) 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.

Repeat the procedure with the second test piece.

6.17 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 (0,1 bar absolute) for 5 minutes, followed by an over pressure of 10,0 bar (2 x 5,0 bar) 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 [(0,1 $^{0}_{-0,05}$) bar absolute];
- Pressure equipment, capable of maintaining the pressure at (10,0 ± 0,1) bar.

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 $^{+0,05}_{0}$) bar [(0,1 $^{0}_{-0,05}$) 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 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 and note the burst pressure in bar.

Repeat the procedure with the second test piece.

6.18 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.

6.19 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.

6.20 Chemical resistance

6.20.1 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.

6.20.2 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.

6.20.3 Reference liquids

The reference liquids are:

I) Petrol (100% mineral based fuel = Petrol):

- 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) Kerosene (100% mineral based fuel):

- 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 20% FAME:

- 20.0% Rape seed oil methyl ester (FAME according to NEN-EN 14214)
- 80.0% Diesel Fuel, grade no. 2 according to ASTM D 975

The manufacturer can choose to test their product with 5%, 10%, 15% or 20% FAME. 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.

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 § 6.2.

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 6-7 and 6-8;

$$\log \sigma_c = A + B \log t \qquad \text{Equation 6-7}$$

$$\log \varepsilon_t = a + b \log t \qquad \text{Equation 6-8}$$

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.

6.21 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 VII, according to § 6.20.3 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 § 5.3 the 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.

6.21.1 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.

Test liquids

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 § 6.2;
- 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 § 6.20.3.

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 $(M_i - M_o)/M_o$ at the time t_1.

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

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

Determine also from the curve the saturation mass (M_s) in mg.

Calculation of the diffusion coefficient
Calculate the diffusion coefficient per test piece using Equation 6-9:

$$D = \frac{5{,}67 * 10^{-19} * e^2}{t_{1/2}}$$ Equation 6-9

Whereby:
- **D** = the diffusion coefficient in square meters per second (m^2/sec);
- **e** = the thickness of the test piece in micrometers (µm);
- $t_{½}$ = the half-life in days (24h).

NOTE: Equation 6-9 is derived from Equation 6-10

$$D = \frac{49 * 10^{-3} * e^2}{t_{1/2}}$$ Equation 6-10

Whereby:
- **D** in m^2/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 6-11:

$$Q = 10^9 * D_m \frac{C_1 - C_v}{e_b} * A_s * 86400$$ Equation 6-11

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 (m^2/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 6-12;
- A_s = the specific inner surface of the pipe in square metres (m^2) per meter pipe length.

$$C_1 = 10^3 * \frac{(M_s - M_o)}{\left\{\left(M_o / C_m\right) + \left[(M_s - M_o) / C_L\right]\right\}}$$ Equation 6-12

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/cm^3);
C_L = the density of the test liquid in grams per cubic centimetre (g/cm^3);
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: Q_i(liquid I), Q_i(toluene), Q_i(iso-octane), Q_i(methanol) and Q_i(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) * Q_i(toluene) + **f**(iso-octane) * Q_i(iso-octane) + **f**(methanol) * Q_i(methanol) + **f**(iso-butanol) * Q_i(iso-butanol)

Calculate the ratio:

$$A = \frac{Q_i(\text{liquid I})}{Q_i'(\text{liquid I})} \qquad \text{Equation 6-13}$$

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

$$Q_i'(\text{component}) = A * Q_i(\text{component}) \qquad \text{Equation 6-14}$$

Calculate the permeation rate through a two layer pipe by:

$$Q_{12}(\text{component}) = \frac{Q_1'(\text{component}) * Q_2'(\text{component})}{Q_1'(\text{component}) + Q_2'(\text{component})} \qquad \text{Equation 6-15}$$

through a three layer pipe by:

$$Q_{123}(\text{component}) = \frac{Q_1'(\text{comp.}) * Q_2'(\text{comp.}) * Q_3'(\text{comp.})}{Q_1'(\text{comp.})Q_2'(\text{comp.}) + Q_2'(\text{comp.})Q_3'(\text{comp.}) + Q_1'(\text{comp.})Q_3'(\text{comp.})} \qquad 6\text{-}16$$

etc.

Q'_{12}(liquid I), Q'_{123}(liquid I), etc. are calculated analogously to Q'_1 and are used in § 6.21.
Repeat the same procedure for liquids II through VII.

Calculation of permeation rate through rubber seal
See Equation 6-11. A_s now corresponds with the area that is exposed to the fuel and e_b 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:

$$Q_{\text{prim-sec}} = \frac{Q'_{\text{prim}}(\text{liquidI})}{V} \frac{Q'_{\text{prim}}(\text{liquidI})}{100} \qquad \text{Equation 6-17}$$

or by Q'_{prim}(liquid I) when $Q_{\text{prim-sec}}$ is larger than Q'_{prim}(liquid I).
V is the air volume per day which is flown between the primary and the secondary pipe.

6.22 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.

6.23 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.

6.24 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).

6.24.1 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 § 6.24.2 is required. Materials complying with this requirement are suitable for use for both above ground as well as underground applications.

6.24.2 Other plastic materials

All other plastic materials, and black HDPE material that is not in compliance with the requirements of § 6.24.1, 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.

<u>Pipes for underground 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 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.

7 Secondary containment, ducting pipe and joints

7.1 General

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

7.2 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.

7.3 Material

7.3.1 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.

7.3.2 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.

7.3.3 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:

- 0,3 g/10 min < MFR (190/5) < 1,0 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

7.3.4 Thermal stability

The external layer of the secondary pipe shall comply with the requirements of § 6.23.

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

7.4 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.

7.5 Dimensions of the secondary pipe

7.5.1 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 approval with product certificate.

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

7.5.2 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.

7.6 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 8000 N/m².

7.7 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.

7.8 Chemical resistance

After testing in accordance with § 6.20 with the reference liquids I through VII according to § 6.20.3, 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.

7.9 Resistance against UV-ageing

The external layer of the secondary pipe shall comply with the requirements of § 6.24.

7.10 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. 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.
- 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.
- Check whether there are any defects in the test piece by using a soap solution.
- Repeat the procedure for the second test piece.

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

The requirements for permeation as mentioned in § 6.21 concern the complete piping system per specified pipe length. The secondary containment pipe shall be assessed as part of the system in accordance with § 6.21.

7.12 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 stated in the technical approval.

8 Vapour recovery lines

8.1 General

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

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 approval.

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 approval. 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 § 6.9, 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 § 6.14 at a temperature of -10 °C, the test piece shall withstand without leakage or any other defect a positive pressure of 10,0 bar (2 x 5,0 bar) for 168 hours and an overpressure of 25,0 bar (5 x 5,0 bar) for 1 minute.

8.8 Resistance to impact and negative pressure

After impact testing in accordance with § 6.15 at a temperature of -10 °C, the test piece shall withstand without leakage or any other defect a negative pressure of 0,65 bar (0,35 bar absolute) for 168 hours and a negative pressure of 0,9 bar (0,1 bar absolute) for 1 minute.

8.9 Resistance to bending at low temperatures and positive pressure

After an exposure in accordance with § 6.16 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 (2 x 5,0 bar) for 5 minutes and 25,0 bar (5 x 5,0 bar) for 1 minute.

8.10 Resistance to bending at low temperatures and negative pressure

After an exposure in accordance with § 6.17 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 (0,1 bar absolute) for 5 minutes, followed by an over pressure of 10,0 bar (2 x 5,0 bar) for 1 minute.

8.11 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.

8.12 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.

8.13 Chemical resistance

Barrier layer

After testing at 23 °C with the reference liquids I through VII according to § 6.20.3 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.

8.14 Resistance to permeation

The requirements for permeation as mentioned in § 6.21 concern the complete piping system per specified pipe length. The vapour recovery line shall be assessed as part of the system in accordance with § 6.21.

8.15 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.

9 Filling pipes

9.1 General

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

9.2 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.

9.3 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.

9.4 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 approval.

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.

9.5 Length of the pipe

The pipes shall be delivered in lengths as declared by the manufacturer in the technical approval. 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.

9.6 Adhesion strength

When tested in accordance with § 6.9, 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).

9.7 Resistance to impact and positive pressure

After impact testing in accordance with § 6.14 at a temperature of - 10 °C, the test piece shall withstand without leakage or any other defect a positive pressure of 10,0 bar (2 x 5,0 bar) for 168 hours and an overpressure of 25,0 bar (5 x 5,0 bar) for 1 minute.

9.8 Resistance to bending at low temperatures and positive pressure

After an exposure in accordance with § 6.16 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 (2 x 5,0 bar) for 5 minutes and 25,0 bar (5 x 5,0 bar) for 1 minute.

9.9 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.

9.10 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.

9.11 Chemical resistance

Barrier layer
After testing at 23 °C with the reference liquids I through VII in accordance with § 6.20.3 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 § 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 1: The tensile strength is defined as the maximum tensile stress in the test piece at the tensile testing.

9.12 Resistance to permeation

The requirements for permeation as mentioned in § 6.21 concern the complete piping system per specified pipe length. The vapour recovery line shall be assessed as part of the system in accordance with § 6.21.

9.13 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.

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

10.1 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 products.

10.2 Material

10.2.1 Copper – zinc alloys (bronze) couplings and fittings

The material of the couplings and fittings which are made of copper – zinc alloys shall comply with the following minimum requirements according to NEN-EN 12164 table 2:

- rod stock shall be CuZn39Pb3, and
- hot press work shall be CuZn40Pb2.

10.2.2 Stainless steel couplings and fittings

The material of the couplings and fittings that are made of stainless steel shall be seamless Type 304 or Type 304L or Type 316 for machined parts and CF8 A351 for cast parts.

10.2.3 Cast iron couplings and fittings

The material of couplings and fittings that are made of cast iron shall be of type ductile iron. 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.

10.2.4 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 § 6.20, 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 stated in the technical approval.

10.2.5 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 § 6.20, 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 stated in the technical approval.

Note: When other sealing materials are used, the requirements shall be assessed by the certification body and stated in the technical approval.

10.3 Form and dimensions

10.3.1 General

The dimensions of the couplings and fittings shall correspond with the size and tolerances of the primary pipe, as laid down in § 6.5.

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.

10.3.2 Appearance

The appearance is assessed visually without using any magnification.

10.3.3 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.

10.3.4 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.

10.4 Leak tightness of the joints

During testing of the coupling or fitting according to § 6.10, § 6.11, § 6.12, § 6.13, § 6.16 and § 6.17, 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.

10.5 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:

$$F = 1{,}5 * \Pi * \sigma_t * e_m (d_n - e_m) \qquad \text{Equation 10-1}$$

whereby:

- **F** is the minimum pull-out force in N
- $\mathbf{d_n}$ is the nominal outside diameter in mm
- $\mathbf{e_m}$ is the mean wall thickness in mm
- σ_t is the permissible induced hoop stress in N/mm² and can be calculated as follows:
  - $\sigma_t = (\mathbf{p}(\mathbf{d_n} - \mathbf{e_m}))/(2.\ \mathbf{e_m})$,
  - $\mathbf{p}$ = 2 x 5,0 bar which is equal to 1 N/mm² 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

Procedure

- 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.

10.6 Resistance to permeation

The requirements for permeation as mentioned in § 6.21 concern the complete piping system per specified pipe length. The couplings and fittings shall be assessed as part of the system in accordance with § 6.21. 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 VII when tested in accordance with § 6.20 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.

11 Elastomeric sealing elements for the secondary pipe and sumps

11.1 General

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

11.2 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 %.

11.3 Form and dimensions

11.3.1 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.

11.3.2 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 Approval.

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.

11.4 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 positive pressure and 0,3 bar negative pressure (0,7 bara).

2. Hydrostatic strength 1,75 bara for 1 minute at 23 °C.

11.5 Resistance to permeation

The requirements for permeation as mentioned in § 6.21 concern the complete piping system per specified pipe length. The elastomeric sealing elements shall be assessed as part of the system in accordance with § 6.21.

12 Quality system requirements

12.1 General

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

12.2 Manager of the quality system

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

12.3 Internal quality control schedule

As part of the quality system the manufacturer must implement an internal quality control schedule (IQC-schedule).

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

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

This IQC-schedule shall be in the format as shown in the annex. The schedule must be detailed in such a way that it provides the certification body sufficient confidence that requirements will be continuously fulfilled.

At the time of the initial evaluation this schedule shall have been functioning for a period of at least 3 months.

Statistical process control, if used by the manufacturer, shall be performed according to ISO 2859-1, with an inspection and AQL-level to be approved by the certification body.

12.4 Procedures and work instructions

The manufacturer must be able to submit:

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

12.5 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.

13 Summary of tests and inspections

This chapter contains a summary of tests and inspections to be carried out during:
Initial evaluation: the investigation necessary in order to determine whether all requirements of the evaluation guideline are fulfilled,
Inspection visit: the surveillance inspections carried out after issue of the certificate in order to determine whether the certified products continuously fulfil the requirements of this evaluation guideline. The inspections are carried out according to the frequency indicated.
Inspection of the quality system: inspection with regard to the correct implementation of the IQC-schedule and procedures.

13.1 Test matrix

Description of requirement	BRL Article	Category (see note)	Tests within the scope of		
			Initial evaluation	Surveillance audit after issue of the certificate	
				Audit	Frequency
Primary pipe with or without an integrated secondary containment					
Wall construction and material of the pipe	6.3	2	Yes	Yes	Every audit
Appearance	6.4	2	Yes	Yes	Every audit
Wall build-up and dimensions of the pipe	6.5	1	Yes	Yes	Every audit
Length of the pipe	6.6	2	Yes	Yes	1x / year
Change in length and mean outside diameter of the pressure pipe (Type PP) at positive pressure	6.7	2	Yes	Yes	1x / year
Change in length and mean outside diameter of the suction pipe (Type SP) at negative pressure	6.8	2	Yes	Yes	1x / year
Adhesion strength	6.9	1	Yes	Yes	1x / year
Resistance of the pressure pipe (type PP) to a cyclic positive pressure	6.10	1	Yes	Yes	1x / 3 years
Resistance of the suction pipe (type SP) to a cyclic negative pressure	6.11	1	Yes	Yes	1x / 3 years
Resistance of the pressure pipe (type PP) to internal water pressure	6.12	1	Yes	Yes	1x / year
Resistance of the pressure pipe (type PP) to a negative pressure	6.13	1	Yes	Yes	1x / year
Resistance to impact of the pressure pipe (type PP)	6.14	1	Yes	Yes	1x / 3 years
Resistance to impact of the suction pipe (type SP)	6.15	1	Yes	Yes	1x / 3 years
Resistance to bending at low temperatures of the pressure pipe (type PP)	6.16	1	Yes	Yes	1x / year
Resistance to bending at low temperatures of the suction pipe (type SP)	6.17	1	Yes	Yes	1x / year
Initial ring stiffness	6.18	1	Yes	Yes	1x / 3 years
Creep ratio	6.19	1	Yes	Yes in event of change	By every change
Chemical resistance	6.20	1	Yes	Yes in event of change	By every change
Resistance to permeation	6.21	1	Yes	Yes in event of change	By every change
Relative Temperature Index of the barrier layer	6.22	1	Yes	Yes in event of change	By every change
Oxidation induction time	6.23	1	Yes	Yes in event of change	By every change
Resistance to weathering	6.24	1	Yes	Yes in event of change	By every change
Secondary containment, ducting pipe and joints					
Material	7.3	1	Yes	Yes	Every audit
Appearance	7.4	2	Yes	Yes	Every audit
Dimensions of the secondary pipe	7.5	2	Yes	Yes	Every audit
Initial ring stiffness	7.6	1	Yes	Yes	1x / year

Creep ratio	7.7	1	Yes	Yes in event of change	By every change
Chemical resistance	7.8	1	Yes	Yes in event of change	By every change
Resistance against UV-ageing	7.9	1	Yes	Yes in event of change	By every change
Resistance to impact	7.10	1	Yes	Yes in event of change	By every change
Resistance to permeability (Only valid when used as secondary containment pipe)	7.11	1	Yes	Yes in event of change	By every change
Joints	7.12	1	Yes	Yes	Every audit
Vapour recovery lines					
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	Every audit
Adhesion strength	8.6	1	Yes	Yes	1x / year
Resistance to impact and positive pressure	8.7	1	Yes	Yes	1x / year
Resistance to impact and negative pressure	8.8	1	Yes	Yes	1x / year
Resistance to bending at low temperatures and positive pressure	8.9	1	Yes	Yes	1x / year
Resistance to bending at low temperatures and negative pressure	8.10	1	Yes	Yes	1x / year
Initial ring stiffness	8.11	1	Yes	Yes	1x / year
Creep ratio	8.12	1	Yes	Yes in event of change	By every change
Chemical resistance	8.13	1	Yes	Yes in event of change	By every change
Resistance to permeation	8.14	1	Yes	Yes in event of change	By every change
Relative Temperature Index of the barrier layer	8.15	1	Yes	Yes in event of change	By every change
Filling pipes					
Wall construction and material of the pipe	9.2	2	Yes	Yes	Every audit
Appearance	9.3	2	Yes	Yes	Every audit
Wall build-up and dimensions of the pipe	9.4	1	Yes	Yes	Every audit
Length of the pipe	9.5	2	Yes	Yes	1x / year
Adhesion strength	9.6	1	Yes	Yes	1x / year
Resistance to impact and positive pressure	9.7	1	Yes	Yes	1x / year
Resistance to bending at low temperatures and positive pressure	9.8	1	Yes	Yes	1x / year
Initial ring stiffness	9.9	1	Yes	Yes	1x / year
Creep ratio	9.10	1	Yes	Yes in event of change	By every change
Chemical resistance	9.11	1	Yes	Yes in event of change	By every change
Resistance to permeation	9.12	1	Yes	Yes in event of change	By every change
Relative Temperature Index of the barrier layer	9.13	1	Yes	Yes in event of change	By every change
Couplings and fittings for primary pipes with or without an integrated secondary containment					
Material	10.2	1	Yes	Yes	Every audit
Form and dimensions	10.3	1	Yes	Yes	Every audit
Leak tightness of the joints	10.4	1	Yes	Yes	1x / year
Strength of the joints	10.5	1	Yes	Yes	1x / year
Resistance to permeation	10.6	1	Yes	Yes in event of change	By every change
Elastomeric sealing elements for the secondary pipe and sumps					
Material	11.2	1	Yes	Yes	Every audit
Form and dimensions	11.3	1	Yes	Yes	1x / year
Strength and tightness of the test boot	11.4	1	Yes	Yes	1x / year

Resistance to permeation	11.5	1	Yes	Yes in event of change	By every change
Product requirements and test methods					
Installation instructions	5.5	3	Yes	Yes	1x/year
Marking	5.6	2	Yes	Yes	Every audit
Quality system requirements					
Internal quality control schedule	12.3	3	Yes	Yes	Every audit
Procedures and work instructions	12.4	3	Yes	Yes	Every audit
Design changes	12.5	1	Yes	Yes	Every audit

* = Certificate of conformity (specifications from suppliers)

Table 13.1: Test and audit matrix

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

1 = Critical: 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: 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: 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 audit the manufacturer for compliance with this Evaluation Guideline. During these audits a periodic repetition of some of type tests can also be required.

14 Agreements on the implementation of certification

14.1 General

In addition to the requirements stipulated in this Evaluation Guideline the general requirements pertaining to certification as stated in the Kiwa-Regulations for Product Certification will be applicable.

Specifically, the following shall be applicable:

- The general procedure for conducting the initial evaluation including:
  - The method of informing the suppliers regarding the processing of the application;
  - The conduction of the initial evaluation;
  - The decision taken after the conduction of the initial audit.
- The general procedure for conducting the audits and the relevant checkpoints;
- The procedure to be implemented by the certification body in the event of non-conformities;
- The procedure to be followed by the certification body in the event of unauthorized use of the certificates, certification mark, pictograms and logos.
- The procedure to be followed in the event of termination of the certificate;
- The possibility to contest a decision made by the certification body.

14.2 Certification personnel

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

- **Certification engineer**: they are in charge of carrying out the pre-certification tests and assessing the inspectors' reports;
- **Inspectors**: they are in charge of carrying out external inspections at the supplier's works;
- **Decision-makers**: they are 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.

14.2.1 Qualification requirements

The Board of Experts has set the following qualification requirements for the subject matter of this Evaluation Guideline

Requirements	Function and responsibility		
	Certification Engineer	Inspector	Decision maker
Education: general	• Relevant technical education at Bachelor level or higher • Internal training in certification and Kiwa policy • Training in audit skills	• Technical vocational education at intermediate level or higher • Internal training in certification and Kiwa policy • Training in audit skills	• Technical education at Bachelor level or higher • Internal training in certification and Kiwa policies • Training in audit skills
Education: specific	• Training related to this Evaluation Guideline • Specific courses and training (knowledge and skills) related to plastics	• Training related to this Evaluation Guideline • Specific courses and training (knowledge and skills) related to plastics	• Not applicable
Experience: general	• 1 year of relevant working experience • A minimum of 4 complete certification cycles of which at least 1 has been witnessed for qualification	• 1 year of relevant working experience • A minimum of 4 complete certification cycles of which at least 1 has been witnessed for qualification	• 4 years of working experience, with a minimum of 1 year of experience with certification

Requirements	Function and responsibility		
	Certification Engineer	Inspector	Decision maker
Experience: specific	• Detailed knowledge of this Evaluation Guideline • A minimum of 4 complete certification cycles for this Evaluation Guideline or related Evaluation Guidelines	• Detailed knowledge of this Evaluation Guideline • A minimum of 4 complete certification cycles for this Evaluation Guideline or related Evaluation Guidelines	• Basic knowledge of this Evaluation Guideline

Table 14.1 Qualification requirements for certification personnel

The level of education and the experience of the certification staff involved should be demonstrably recorded.

14.2.2 Qualification

Certification personnel shall be qualified on the basis of the above mentioned criteria. Should qualification be otherwise determined then this shall be recorded.

The responsibility for the qualification of the certification personnel is determined by:

- Decision-makers: qualification of certification engineers and inspectors
- Management of the certification body: qualification of the Decision-makers.

14.3 Report initial audit

The certification body shall detail the findings of the initial audit in a report. This report shall comply with the following:

- Complete: The report shall indicate the findings pertaining to each and every requirement detailed in this Evaluation Guideline;
- Traceability: The findings used to determine compliance with the requirements shall be traceable;
- Basis for the decision: The decision maker responsible for certification shall be able to decide on the basis of the findings detailed in the report.

14.4 Decision regarding certification

The decision to certify the supplier shall be made by a qualified decision maker who has not participated in the initial audit. This decision shall be traceable.

14.5 Product certification

The product certificate shall be in conformance with the model in Annex I.

14.6 Nature and frequency of external audits

The certification body shall ensure that the supplier continues to comply with the certification requirements. The number of external audits shall be determined by the Board of Experts. At the time of publication of this Evaluation Guideline the number of audits has been fixed at 4 audits per year.

The audits shall at least include:

- The IQC schedule of the supplier and the results of the internal inspections carried out;
- The correct marking of the certified products;
- The implementation of the required procedures.

The audit results shall be reported by the Kiwa inspector in a report.

Note: In case the manufacturer's quality system is certified in accordance with ISO 9001, a reduction of the frequency of the external audits may be applicable.

14.7 Interpretation of the requirements

The Board of Experts may specify how the requirements are to be interpreted. These interpretations shall be documented in a separate interpretation document.

15 List of referenced documents

15.1 Standards and normative documents:

Number	Title	Issue date
ASTM D 380	Standard Test Methods for Rubber Hose	2006-01-01
ASTM D 413	Standard test methods for Rubber property – Adhesion to Flexible substrate	2000-01-01
ASTM D-975	Standard Specification for Diesel Fuel Oils	2007-10-19
BARIM	Besluit Algemene Regels voor Inrichtingen Milieubeheer (Activiteitenbesluit)	2010-01-01
BRL-K903	Certification scheme for Installers of Tank Installations (REIT)	2006-12-08
ISO 7-1 incl. Corr. C1	Pipe threads where pressure-tight joints are made on threads – Part 1: Dimensions, tolerances and designation	2007-08-01
ISO 7-2	Pipe threads where pressure-tight joints are made on threads – Part 2: Verification by means of limit gauges	2000-09-15
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	2005-09-01
NEN-EN 682 incl. ammdt. A1	Elastomeric seals – Material requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids	2005-09-01
NEN-EN 728	Plastics piping and ducting systems – Polyolefin pipes and fittings – Determination of oxidation induction time	1997-02-01
NEN-EN 1254-3	Copper and Copper alloys – Plumbing fittings – Part 3: Fittings with compression ends for use with plastics pipes	1998-02-01
NEN-EN 12164 incl. ammdt. A1	Copper and copper alloys – Rod for free machining purposes	2000-06-01
NEN-EN-ISO 1133	Plastics – Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics	2005-06-01
NEN-EN-ISO 175	Plastics – Methods of test for the determination of the effects of immersion in liquid chemicals	2000-04-01
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	2002-04-01
NEN-EN-ISO 527-1 incl. ammdt. A1	Plastics – Determination of tensile properties. Part 1: General principles – Details of extensometer	2005-09-01
NEN-EN-ISO 527-2 Incl. Corr. 1:1994	Plastics – Determination of the tensile properties –Part 2: Test conditions for moulding and extrusion plastics	1996-07-01

Number	Title	Issue date
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	2004-02-01
NEN-EN-ISO 1183-2	Plastics – Methods for determining the density of non-cellular plastics – Part 2: Density gradient column method	2004-08-01
NEN-EN-ISO 2818	Plastics – Preparation of test specimens by machining	1997-02-01
NEN-EN-ISO 4892-1	Plastics – Methods of exposure to laboratory light sources Part 1: General guidance	1999-07-01
NEN-EN-ISO 4892-2 incl. ammdt. A1	Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps	2009-08-01
NEN-EN-ISO 8256	Plastics – Determination of tensile impact strength	2004-07-01
NEN-EN-ISO 9967	Thermoplastics pipes – Determination of creep ratio	2007-11-01
NEN-EN-ISO 9969	Thermoplastics pipes – Determination of the ring stiffness	2008-01-01
NEN-EN-ISO 16871	Plastics piping and ducting systems - Plastics pipes and fittings - Method for exposure to direct (natural) weathering	2003-07-01
NEN-ISO 1817	Rubber, vulcanised – Determination of the effect of liquids	2006-11-01
PBV-107776	Richtlijn tankinstallaties voor vloeistoffen en dampen – ondergronds en bovengronds	2004-12-01
PGS 28	Publicatiereeks Gevaarlijke Stoffen: Vloeibare aardolieproducten – Afleverinstallaties en ondergrondse opslag	2005-03-01
PGS 30	Publicatiereeks Gevaarlijke Stoffen: Vloeibare aardolieproducten – Buitenopslag in kleine installaties	2005-06-10
RARIM	Regeling Algemene Regels voor Inrichtingen Milieubeheer	2010-01-01
SAE J 343	Tests and procedures for SAE 100R series Hydraulic Hose and Hose Assemblies	2004-01-01
UL 746 B	Polymeric Materials – Long Term Property Evaluations	2000-11-29

Annex I Model certificate

Product certificate
KXXXXXX/01

Issued

Replaces

Page 1 of 2

Name of product

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

Name of supplier

complying with the technical specifications as laid down in this product certificate and marked with the Kiwa®-mark in the manner as indicated in this product certificate, on delivery, may be relied upon to comply with the Kiwa evaluation guideline BRL-K552-03 dated 2010-09-01 "Thermoplastics piping systems for the transport of liquid oil products and their vapours".
The product has been tested for compliance for the following media:

- Petrol (100% mineral based fuel)
- Kerosene (100% mineral based fuel)
- Diesel (100% mineral based fuel)
- Bio petrol containing up to 20% Ethanol (= up to E20)
- Bio petrol containing 85% Ethanol (= E85)
- Bio kerosene containing up to 20% Ethanol
- Bio diesel containing up to 20% FAME (= up to B20)

The piping system is suitable for above ground /underground installation.

Kiwa N.V.

ing. B. Meekma
director

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

Kiwa Nederland B.V.
Sir W. Churchill-laan 273
P.O. Box 70
2280 AB RIJSWIJK
The Netherlands
Tel. +31 70 414 44 00
Fax +31 70 414 44 20
E-mail info@kiwa.nl
www.kiwa.nl

Supplier
Plastic Piping B.V.
Benzinestraat 1
1234 AA PLASTICWIJK
The Netherlands

Telephone: +31.123.456 789
Telefax: +31.123.456 780
E-mail: info@plastic-piping.nl
Internet: www.plastic-piping.nl

Certification process consists of initial and regular inspection of:
- **Quality system**
- **Product**

Kiwa® product certificate KXXXXX/01

Thermoplastics piping systems for the transport of liquid oil 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 products with a flash-point of – 20 up to + 50ºC for tank installations according to Kiwa Evaluation Guideline BRL-K903.

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 (0.2 bar absolute) or a positive working pressure of 5.0 bars.

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,
rest pressure: 0.9 bar.

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 system recommended by the pipe manufacturer and capable of monitoring all sections of the pipeline according to Kiwa Evaluation Guideline

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 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 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. 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 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 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.

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-K903 ”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 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 bars maximum.

Pressure system

Operating pressure

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

Rest pressure

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

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-K903.

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-K903: “Certification scheme for Installers of Tank Installations (REIT)”.
- Kiwa Evaluation Guideline BRL-K552: “Thermoplastic piping systems for the transport of liquid oil 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-schedule

Subjects	Aspects	Method	Frequency	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				