COVENANT

Covenant certificate
K101779/04

Issued *2024-08-01*

Replaces *K101779/03*

Soluforce® spoolable reinforced industrial piping system for the transport of hydrogen

STATEMENT BY KIWA

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

Soluforce B.V.

as specified in this Covenant certificate and marked with the Kiwa®-mark in the manner as indicated in this Covenant certificate may, on delivery, be relied upon to comply with Kiwa Covenant manual K15013 dated May 2022.

Ron Scheepers
Kiwa

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

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

Soluforce® spoolable reinforced industrial piping system for the transport of hydrogen

PRODUCT SPECIFICATION

The Soluforce® piping system is intended to be used and designed for the transport of hydrogen for industrial applications.
The certified piping system consists of two nominal diameters DN100 and DN125 with two types as follows:

- Soluforce Classic types 'M480 H2T' and 'M570 H2T';
- Soluforce Light types 'L480 H2T' and 'L570 H2T';

The pipes are delivered on rolls with a length of 400 m.
The Soluforce® piping system consists of the following components:

1) Spoolable pipes: HDPE inner pipe with an aluminium barrier layer[a)], an aramid strengthening layer and a HDPE outer protection layer;
2) In-line couplings: combination of butt-fusion weld and electrofusion socket;
3) End-fittings: combination of electrofusion socket and stainless-steel flange adapter or stainless steel end cap.

[a)] The barrier layer consists of a winded aluminium multilayer laminate that minimizes the permeation of hydrogen through the pipe wall.

The technical specifications of the different components of the piping system are laid down between Pipelife and Kiwa in by Kiwa authenticated technical drawings and PDS's (product description specifications).
The construction of the piping system is a non-metallic spoolable reinforced plastic line pipe according API Specification 15S.

The provisions and the verification and assessment methods included or referred to in the Kiwa Covenant have been written based upon the assumed working life of the Soluforce® piping system for the intended use of 50 years when installed in the works. These provisions are based upon the current state of the art and the available knowledge and experience.

The products mentioned in the tables below belong to this product certificate

Type designation	**M480 H2T**	**M570 H2T**	
Nominal diameter	4	6	inch
Nominal internal diameter (DN)	100	125	mm
Actual internal diameter	98	122	mm
Outer diameter	125	149	mm
Maximum allowable operating pressure (MOP)	52	42	bar

Type designation	**L480 H2T**	**L570 H2T**	
Nominal diameter	4	6	inch
Nominal internal diameter (DN)	100	125	mm
Actual internal diameter	98	122	mm
Outer diameter	125	149	mm
Maximum allowable operating pressure (MOP)	21	17	bar

For more details about the characteristics and requirements imposed on the Soluforce® piping system reference is made to the full text version of the Covenant.

MARKING

The products shall be marked with the Kiwa® word mark.

Pipes

The minimum required marking on the pipes shall be:

- Kiwa word mark;
- The manufacturer's name;
- The pipe type designation "Soluforce M480 H2T" or "Soluforce M570 H2T" or "Soluforce L480 H2T" or "Soluforce L570 H2T";
- Application and pressure class as follows:
  - "H2T pipe PN42" for M570 H2T;
  - "H2T pipe PN52" for M480 H2T;
  - "H2T pipe PN17" for L570 H2T;
  - "H2T pipe PN21" for L480 H2T;
- Nominal outside diameter and nominal wall thickness of the pipe in mm;
- Production code (charge number);
- Rol number;

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- Length (meter) indication;
- The Kiwa Covenant number;

The realization of the marks is as follows: durable and indelible at intervals of not more than 1 m.

In-line couplings and end-fittings

The minimum required marking on the in-line couplings and end pieces shall be:
- Kiwa word mark (if not possible, then on the smallest packaging);
- The manufacturer's name or trade name or system name;
- Nominal outside diameter of the corresponding pipe in mm;
- Production code.

The minimum required marking on the smallest packaging unit shall be:
- Kiwa word mark (if not possible, then on the smallest packaging);
- The manufacturer's name, the system name and Kiwa Covenant number;
- Nominal outside diameter and wall thickness of the corresponding pipe in mm;
- Material identification of the end piece body.

The realization of the marks is as follows: durable and indelible on each end piece/packaging.

APPLICATION AND USE

The Soluforce® piping system is intended to be used and designed for the transport of hydrogen for industrial applications, with maximum nominal pressures according to the two tables above and a minimum temperature of – 40 ºC and a maximum temperature of 65 ºC.
The maximum allowable operating pressures (MOP) of 42 bar and 52 bar are based on the considerations for the maximum allowable pressure for gas service, under API Specification 15S.

The following values for the permeation of hydrogen through the different parts of the Soluforce® piping system are declared and confirmed by permeation tests in accordance with chapter 7 of the Covenant, see the table below.

Declared values for permeation of hydrogen

Characteristic	Chapter of the Covenant	Declared value(s) [2)]
Permeation rates at 42 bar	7	Spoolable pipe M480 H2T: 0,0227 ml/(m.day) [1)] In-line coupling: 0,356 ml/day End-fitting: 14,6 ml/day
Permeation rates at 42 bar	7	Spoolable pipe M570 H2T: 0,0525 ml/(m.day) [1)] In-line coupling: 0,363 ml/day End-fitting: 14,9 ml/day
Permeation rates at 52 bar	7	Spoolable pipe M480 H2T: 0,0280 ml/(m.day) [1)] In-line coupling: 0,438 ml/day End-fitting: 18,0 ml/day
Permeation rates at 21 bar	7	Spoolable pipe L480 H2T: 0,01120 ml/(m.day) [1)] In-line coupling: 0,175 ml/day End-fitting: 7,2 ml/day
Permeation rates at 17 bar	7	Spoolable pipe L570 H2T: 0,02125 ml/(m.day) [1)] In-line coupling: 0,147 ml/day End-fitting: 6,0 ml/day

[1)] ml/(m.day) = amount of ml per meter pipe length per day

[2)] The permeation rates of hydrogen through the pipe wall as well as through the in-line couplings and end-fittings is low compared to other piping system materials. Several comparisons are made with e.g. PE-100RC pipe where permeation rates are 175 times lower in case of low pressure (2 bar) applications and even 4.600 times lower in case of high pressure (42 bar) applications like with Soluforce®.
Further, for indoor natural gas applications applies that if a leakage larger than 1 l/h is found, it must be checked whether no dangerous gas concentration is present. Even if the 14,9 ml/day of a Soluforce® end-fitting is concentrated at one location, the permeated volume is still over 1.600 times as low as 1 l/h.

RECOMMENDATIONS FOR CUSTOMERS

Check at the time of delivery whether:
- the supplier has delivered in accordance with the agreement;
- the mark and the marking method are correct;
- the products show no visible defects as a result of transport etc.

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If you should reject a product on the basis of the above, please contact:

- SoluForce B.V.

and, if necessary,

- Kiwa Nederland B.V.

Consult the supplier’s processing guidelines for the proper storage and transport methods.