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Plastics piping systems for renovation of underground water supply networks -- Part 11: Lining with inserted hoses

地下供水管网非开挖修复用塑料管道系统

第 11 部分: 软管穿插内衬法

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Plastics piping systems for renovation of underground water supply networks -- Part 11: Lining with inserted hoses

1 Scope

This document specifies the technical requirements for M stage hoses and fittings for plastic piping systems used in water supply network renovation using the lining with inserted hoses, and I stage system requirements, construction and acceptance.

This document applies to the hoses for repairing underground water supply networks with an operating temperature not exceeding 45°C (hereinafter referred to as the hoses) and their accessories. Repairs to above-ground pipes in water supply networks can be carried out in accordance with this document.

NOTE 1: The supplier provides the pressure reduction factor. The purchaser is responsible for selecting the appropriate product specified in this document based on its specific application requirements and in conjunction with relevant laws, regulations, standards, or specifications.

NOTE 2: When the internal membrane is PE, the applicable operating temperature does not exceed 40°C. When the internal membrane is TPU, the applicable operating temperature does not exceed 45°C.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 528-2009, *Rubber, vulcanized or thermoplastic -- Determination of tensile stress-strain properties*

GB/T 531.1, *Rubber, vulcanized or thermoplastic -- Determination of indentation hardness -- Part 1: Durometer method (Shore hardness)*

GB/T 1040.4, *Plastics -- Determination of tensile properties -- Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*

GB/T 2918, *Plastics -- Standard atmospheres for conditioning and testing*

GB/T 5563, *Rubber and plastics hoses and hose assemblies -- Hydrostatic testing*

GB/T 6283, *Chemical products -- Determination of water Karl-Fischer method*

(general method)

GB/T 7142, *Determination of time-temperature limits for plastic after prolonged exposure to heat*

GB/T 9573, *Rubber and plastics hoses and hose assemblies -- Methods of measurement of the dimensions of hoses and the lengths of hose assemblies*

GB/T 10002.1-2023, *Unplasticized poly (vinyl chloride) (PVC-U) pipes for water supply*

GB/T 13663.1, *Polyethylene (PE) piping systems for water supply -- Part 1: General*

GB/T 14905-2020, *Rubber and plastics hoses. Determination of adhesion between components*

GB/T 15560-1995, *Standard test method for short-time hydraulic failure and resistance to constant internal pressure of the plastics pipes for the transport of fluids*

GB/T 16604, *Polyester Filament for Industry*

GB/T 17219, *Hygienic safety evaluation of distribution equipment, protective materials and treatment materials in drinking water system*

GB/T 18253-2018, *Steel and steel products -- Types of inspection documents*

GB/T 19278, *General terms and their definitions of thermoplastic pipes, fittings and valves*

GB/T 42823, *Para-aramid filament yarns*

GB/T 43982.1, *Plastics piping systems for renovation of underground water supply networks -- Part 1: General*

GB 50268, *Code for construction and acceptance of water and sewerage pipeline works*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 19278, GB/T 43982.1 apply.

3.1 hose

a liner pipe that is made of flexible fabric as reinforcement layer, covered with rubber/plastic anti-seepage layer (internal membrane) on the inside and rubber/plastic external membrane on the outside

NOTE: When using a hose as a repair lining, the hose and the existing pipe can have both a loose fit (with radial clearance reserved during design) and a tight fit. A loose-fit hose independently withstands internal pressure during operation without transferring radial stress to the existing pipe. A tight-fit hose typically withstands internal pressure together with the existing pipe.

3.2 internal membrane

a rubber/plastic material layer covering the inner side of the hose reinforcement layer with sealing and wear-resistant functions

3.3 reinforcement layer

the designed pressure-bearing layer in the hose structure

NOTE: It is usually a fiber braided structure and also has the function of stabilizing the size of the pipe.

3.4 external membrane

a rubber/plastic material layer covering the outside of the reinforcement layer with anti-seepage and wear-resistant functions

3.5 M stage

the stage where pipeline components have been factory-fabricated but have not yet undergone any on-site treatment according to specific pipeline repair methods

[Source: GB/T 43982.1-2024, 3.5.1]

3.6 I stage

the stage that the final form of the pipeline components after installation, all on-site work has been completed according to the specific pipeline repair method

[Source: GB/T 43982.1-2024, 3.5.2]

4 Symbols and abbreviations

The symbols and abbreviations defined in GB/T 43982.1 and the following apply to this document.

4.1 Symbols

d_e: outside diameter (at any point)

$d_{em,\,max}$: maximum average outside diameter

$d_{em,\,min}$: minimum average outside diameter

d_n: nominal hose outside diameter

e_n: nominal wall thickness

e_t: reinforcement layer thickness

e_1: internal membrane thickness

e_2: external membrane thickness

T: aging test temperature

t: hot water aging life

4.2 Abbreviations

CCTV: closed circuit television

PE: polyethylene

PET: poly (ethylene terephthalate)

PN: nominal pressure

PPTA: poly (p-phenylene terephthalamide)

TPU: thermoplastic polyurethane elastomer

5 Requirements for M stage hose

5.1 Hose structure and materials

The hose structure mainly includes the internal membrane reinforcement layer and external membrane, as shown in Figure 2. The common materials of each layer are shown in Table 1.

surface of the hose. The marking shall not cause cracks or premature failure of the hose. The legibility shall not be lost during normal storage, transportation, and installation.

5.8.2 The interval between hose marks shall not exceed 1 m.

5.8.3 Hose marks shall at least include the information listed in Table 5.

5.9 Packaging, transportation and storage

5.9.1 Hoses shall be packaged. The manufacturer's name and address shall be clearly indicated on the outer packaging, label or sign.

5.9.2 During transportation, the hose shall not be scratched, dropped, subjected to severe impact, exposed to the sun, rain, or contaminated by oil or other chemicals.

5.9.3 Hoses shall be stored in a well-ventilated warehouse with a flat floor, away from heat sources and chemical contamination. Sun protection measures shall be taken when stacking outdoors.

6 Requirements for M stage pipe fittings

6.1 Classification

M stage pipe fittings include pipe end connectors of various structures, which are used to fix the lined hose to the original pipe wall at the end of the repaired original pipe, isolating the hose ends from the conveying medium and providing ports for subsequent connections.

Typical connection forms between pipe end joints, hoses and existing pipelines include

6.5 Marks

6.5.1 Pipe fitting markings shall be permanently and legibly marked on the outer surface of the fitting. Marks shall not cause cracks or premature failure of the fitting. Clarity shall not be lost during normal storage, transportation, and installation.

6.5.2 Pipe fitting marks shall at least include the contents listed in Table 6.

7 Accessories

The sanitary properties of accessory materials that come into contact with drinking water shall comply with the relevant provisions of GB/T 17219.

8 System requirements for I stage

8.1 Material properties

8.1.1 Hygienic properties

For drinking water pipes, the installed lining system shall not cause any unacceptable deterioration of water quality.

The sanitary properties of materials in contact with drinking water shall comply with the requirements of GB/T 17219.

8.1.2 Filling resin requirements

The filling resin of the injection joint shall be submitted with a suitability test certificate.

8.2 Geometric properties

8.2.1 After I stage installation, the hose must be fully inflated at the design pressure. After inflation, the inner wall must be free of cusps, bulges, wrinkles, twists, or damage. It must not bulge out of the original pipe from damaged areas. For lined hoses designed for a tight fit, there must be no gaps or cavitation between the hose and the original pipe inner wall after inflation.

8.2.2 The minimum inside diameter of the installed hose shall not be less than the nominal value provided by the supplier.

NOTE 1: The minimum inner diameter has two functions: one is to reserve sufficient cross-section for flow capacity; the other is to reserve sufficient space for daily maintenance equipment or inspection channels.

NOTE 2: The maximum inside diameter of the rehabilitated piping system is limited by the inside dimensions of the original pipe and the wall thickness and tightness of fit of the installed lining system.

8.3 System suitability

The suitability of the system for I stage shall meet the requirements of 6.4.

9 Construction

9.1 Preparation

9.1.1 Site preparation for repairing water distribution networks using the lining with inserted hoses shall be clearly defined in the installation manual or construction plan.

9.1.2 The outer diameter of the repair hose shall be slightly smaller than the cross-sectional diameter of the original pipeline to be repaired.

9.1.3 Before repair work, the original pipeline shall be cleaned and dredged to ensure that the inner diameter is unobstructed.

NOTE: For general site preparation, see GB/T 37862.

9.2 Storage and transportation

The storage and transportation of repair hoses shall comply with the following regulations.

a) Protective measures shall be taken to ensure that hoses are not excessively damaged during unloading, on-site handling and storage.

NOTE 1: Excessively damaged hose is defined as any score exceeding 10% of the wall thickness or any permanent kinks, creases, or folds caused by severe bending operations.

b) The storage surface shall be flat and free of large sharp stones, debris or garbage.

NOTE 2: Scratches caused by storage and transportation may cause hose damage during installation.

c) Fabric slings and slings shall be used when lifting. When the overall length of the lifted cargo exceeds 12 m, a sling beam shall be used.

d) The bottom of the transport device shall be flat and free of sharp edges or ridges. The hose can be transported on a reel.

e) Before loading, the hose shall be visually inspected for damage.

f) The hose ends shall be sealed during storage, transportation, and reeling/unreeling.

9.3 Equipment

9.3.1 Winch and pole-type pulling equipment

Winches and pole-type pulling equipment must comply with the following requirements:

a) The winch mainly consists of a hoist and a traction cable, which is connected to a hose via a connecting cone;

b) Rod-type pulling equipment usually consists of a hydraulically driven carriage and a series of pulling rods with threaded or snap-on connections, connected to a hose through a connecting cone;

c) The winch equipment and traction device shall be equipped with a real-time display device to record the load applied to the wire rope or traction rod during installation in the form of a data chart or digital form;

d) Protective measures shall be provided to prevent the operator from coming into contact with exposed wire ropes or pull rods of winches or traction equipment;

e) The working load of the traction cable or traction rod shall be controlled so that the axial stress of the hose does not exceed the tensile strength of the hose.

9.3.2 Guide device

The original pipe inlet shall be equipped with a guide device. The guide device shall be safe and reliable. The hose shall not be damaged during insertion. No parts shall fall off

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