内衬管使用说明书

Inserted Hoses User Manual

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Shandong Saigao Group Corporation

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一、燃气管道内衬修复

Inserted Hoses used for gas pipelines

（一）、柔性复合软管内衬修复技术

Lining repair methods of flexible composite hose

■ 在待修复管道内内衬一条耐高压、耐腐蚀的连续柔性复合软管；

A high-pressure, corrosion-resistant continuous flexible composite hose is lined inside the pipeline to be repaired;

■ 该软管紧贴原管道内壁且自身具备承压性能；

The hose is close to the inner wall of the original pipeline and has its own pressure-bearing performance;

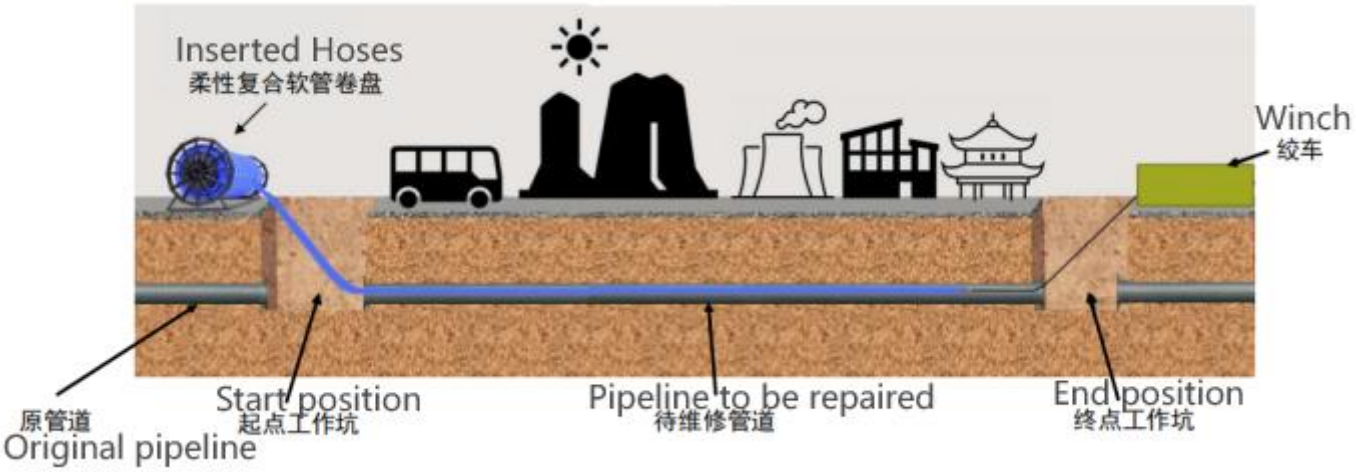
■ 软管为工厂定制化生产，施工现场无需接长；

The hose is customized for the factory and does not need to be extended at the construction site;

■ 软管两端使用专用接头与原管道连接，安全可靠。

The hose is connected to the original pipeline with a special joint at both ends, which is safe and reliable.

Installation Principle of Flexible Composite Hoses



Installation Process of Flexible Composite Hoses

1. 柔性复合软管的结构。

The structure of the flexible composite hose.

柔性复合软管结构分为三层：

The flexible composite hose structure is divided into three layers:

（1）外层/保护层：耐磨和保护（材质 PE/TPU）；

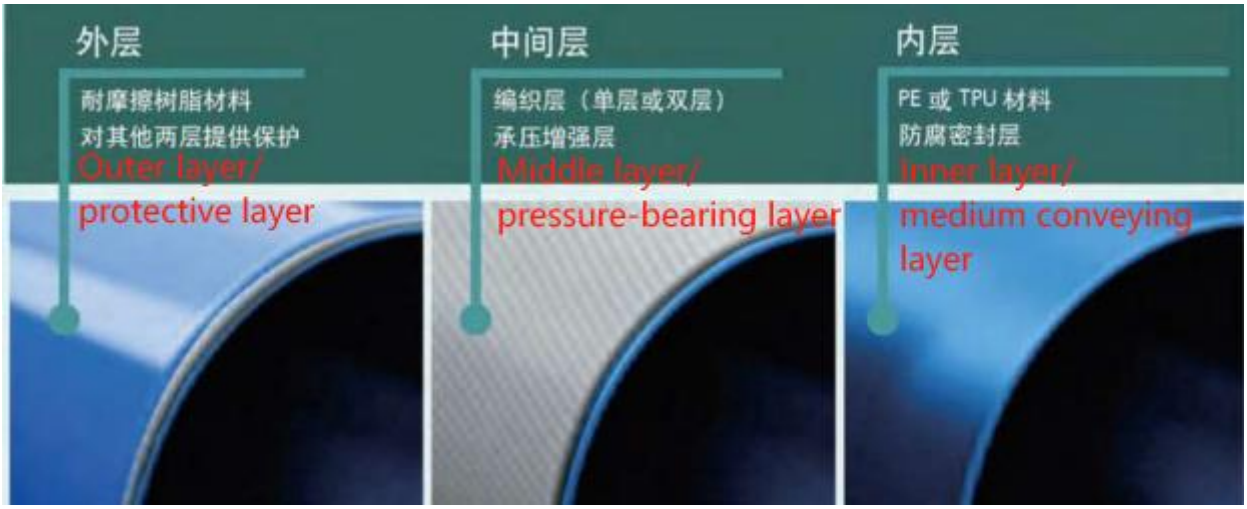
Outer layer/protective layer: wear-resistant and protective (PE/TPU material);

（2）中间层/承压层：承受介质输送压力（材质涤纶）；

Middle layer/pressure-bearing layer: withstands the medium and convey pressure (polyester material);

（3）内层/介质输送层：满足流体输送的要求（材质 TPU）。

Inner layer/medium conveying layer: meets the requirements of fluid conveying (TPU material).



2. 柔性复合软管在待修复管道内状态。

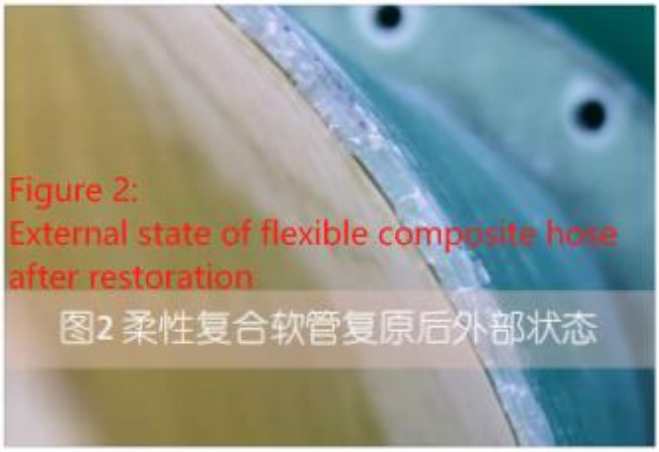
Status of the flexible composite hose in the pipeline to be repaired.

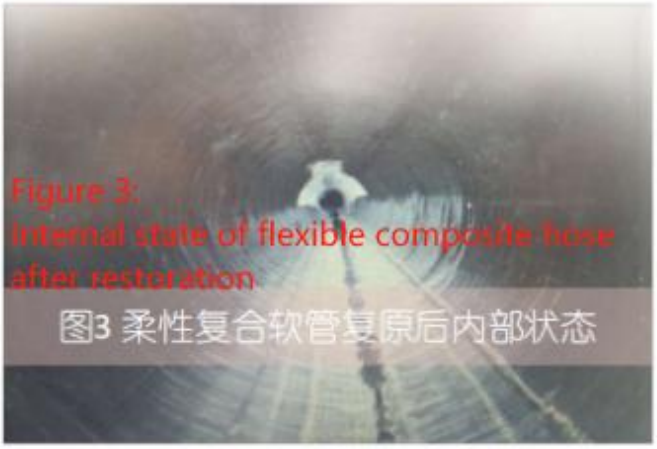
（1）柔性复合软管装入待维修管道前，先使用专用设备对其缩径成“U”形，再使用施工牵引设备将其装入待修复管道。折 U 后的柔性复合软管在待维修管道内的状态如图 1 所示；

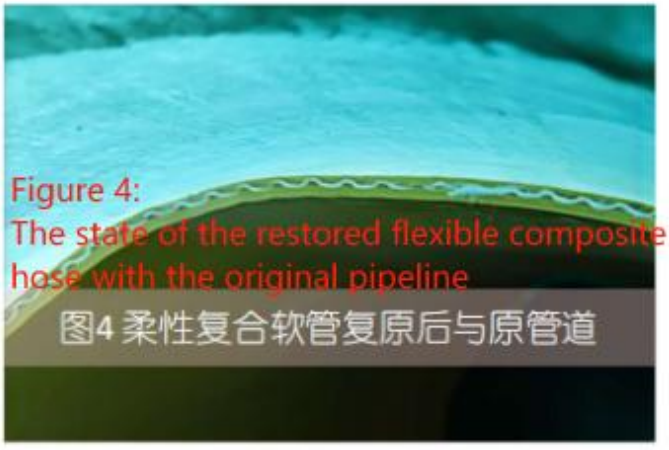
Before the flexible composite hose is installed in the pipeline to be repaired, it is first reduced to a "U" shape using special equipment, and then installed in the pipeline to be repaired using construction traction equipment. The status of the flexible composite hose after the U-fold in the pipeline to be repaired is shown in Figure 1;

（2）柔性复合软管安装就位后，使用气囊或夹具将其两端密封，在其中一端安装注气孔。通过注气口向安装完成的柔性复合软管内部注入压缩空气，使其“复圆”，柔性复合软管复圆后在待维修管道内、外部的状态如图 2、3、4 所示。

After the flexible composite hose is installed in place, use an air bag or clamp to seal both ends of it, and install an air injection hole at one end. Compressed air is injected into the installed flexible composite hose through the air injection hole to make it "round". The status of the flexible composite hose after rounded inside and outside the pipeline to be repaired is shown in Figures 2, 3, and 4.







3. 柔性复合软管专用接头。

Flexible composite hoses special joints.

■ 柔性复合软管通过与其配套的专用接头和原管道连接；

The flexible composite hose is connected to the original pipe through the matching special joints;

■ 柔性复合软管专用接头按其锁紧方式可分为注胶式专用接头（图 1）和卡箍式专用接头（图 2）；

The special joint for flexible composite hose can be divided into glue injection type special joint (Fig. 1) and clamp type special joint (Fig. 2) according to its locking method;

■ 专用接头由外套（卡箍）和芯子两部分组成；

The special joint consists of two parts: the outer sleeve (clamp) and the core;

■ 每个项目的专用接头须根据项目使用需求进行单独设计；

The special joint for each project must be designed separately according to the project usage requirements;

■ 柔性复合软管依靠与接头芯子在装配时的过渡或者过盈配合密封。

The flexible composite hose relies on the transition or interference fit with the joint core during assembly to seal.

图一 Fig. 1

图二 Fig. 2

3.1 柔性复合软管注胶式专用接头。

Flexible composite hose glue injection type joint.

注胶式专用接头装配示意图，图 1；

Assembly diagram of the glue injection type joint, Fig. 1;

注胶式专用接头由外套和芯子两部分组成，图 2；

The glue injection type joint consists of two parts: the outer sleeve and the core, Fig. 2;

高压注胶机使用大于 20MPa 的推送压力，将液体胶充满接头外套金属空腔，需保证空腔内无空隙。

金属空腔在压力的作用下发生变形，将柔性复合软管锁紧在接头芯子上；

The high-pressure glue injection machine uses a push pressure greater than 20MPa to fill the metal cavity of the joint sleeve with liquid glue, and it is necessary to ensure that there is no gap in the cavity. The metal cavity deforms under the action of pressure, locking the flexible composite hose on the joint core;

液体胶彻底硬化后，金属空腔与其组成一个固态、体积不变、且不塌缩的整体。

After the liquid glue is completely hardened, the metal cavity forms a solid, volume-invariant, and non-collapsed whole with it.

图一 Fig. 1

接头外套 **接头芯子**

Joint Sleeve **Joint Core**

图二 Fig. 2

3.2 柔性复合软管卡箍式专用接头。

Flexible composite hose clamp type joint

卡箍式专用接头装配示意图，图 1；

Assembly diagram of clamp type joint, Fig. 1;

卡箍式专用接头由卡箍和芯子两部分组成，图 2；

The clamp type joint consists of two parts: the clamp and the core, Fig. 2;

使用高强螺栓将外卡连接成一个整体并紧固至设计的预紧力，通过机械式多段挤压的方式，将柔性复合软管与接头芯子彻底锁紧。

Use high-strength bolts to connect the outer clamp into a whole and tighten it to the designed preload. Through mechanical multi-stage extrusion, the flexible composite hose and the joint core will be completely locked.

图一 Fig. 1

接头卡箍 **接头芯子**

Joint Clamp **Joint Core**

图二 Fig. 2

4. 柔性复合软管卡箍式专用接头安装（卡箍式为例）。

Installation of the flexible composite hose clamp type joint (take clamp type as an example).

1）先将接头芯子插入柔性复合软管内衬部；

First insert the joint core into the lining of the flexible composite hose;

2）使用定位螺栓将卡箍按顺序定位到管口法兰上；

Use positioning bolts to position the clamps on the pipe flange in sequence;

3）调整卡箍轴向位置，将其装入接头上的定位槽中；

Adjust the axial position of the clamp and install it into the positioning grooves on the joint;

4）使用高强螺栓将卡箍逐一连接，并按规范紧固至设计值；

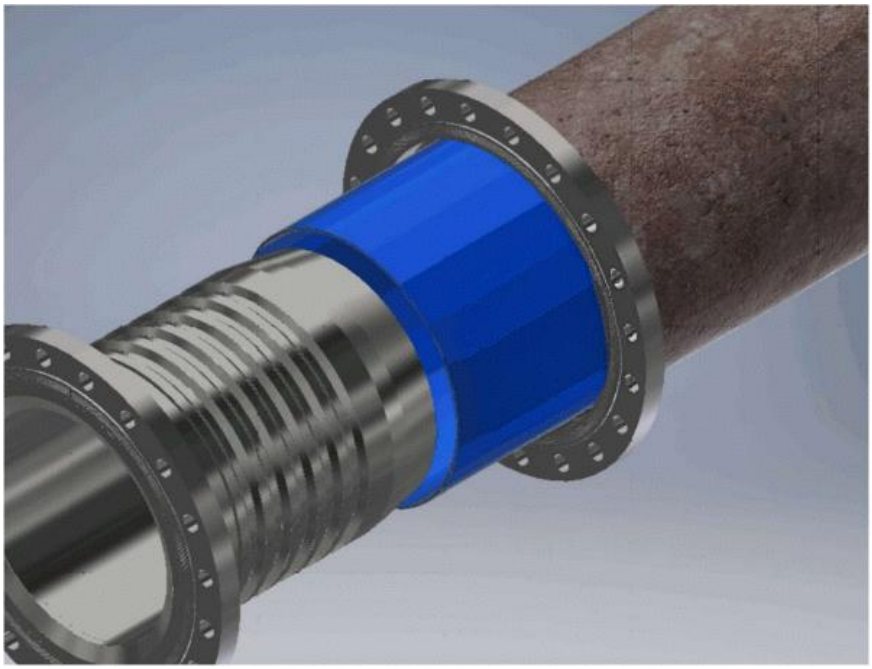
Use high-strength bolts to connect the clamps one by one and tighten them to the designed value according to the specifications;

5）检查测量卡箍安装尺寸是否符合图纸要求；

Check and measure whether the installation dimensions of the clamps meet the requirements of the drawings;

6）安装完成。

The installation is complete.



5. 柔性复合软管专用接头与原管道连接。

Flexible composite hose special joint is connected to the original pipeline.

柔性复合软管接头与原管道已维修端推荐采用软连接（定位螺栓）或不连接（定位丝）的方式连通，图 1、2；

It is recommended that the flexible composite hose joint be connected to the original pipe repaired end by soft connection (positioning bolts) or no connection (positioning wires), as shown in Figures 1 and 2;

柔性复合软管专用接头通过短节实现与原管道未维修端进行连接。其与短节的连接方式可使用焊接连接，也可使用法兰连接，图 2、3。

The flexible composite hose special joint is connected to the original pipe unrepaired end through a pup joint. The connection method with the pup joint can be welding connection or flange connection, as shown in Figures 2 and 3.

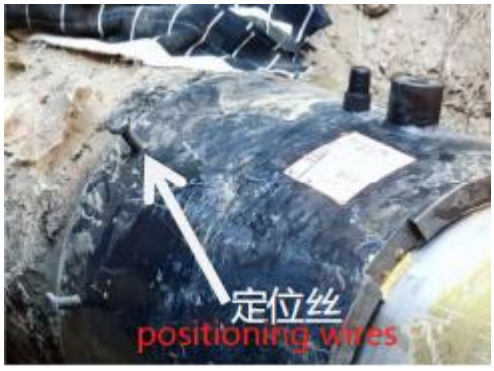


图 1 注胶式接头，使用定位丝定位，接头与旧管道无连接。

Fig. 1: Glue injection type joint, using positioning wires for positioning, with no connection between the joint and the old pipeline.

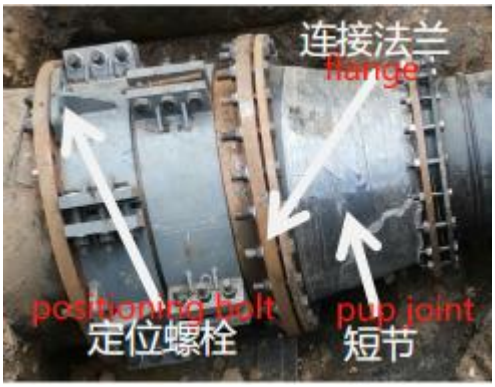


图 2 夹具式接头，使用定位螺栓定位，与旧管道无连接，接头芯子与短节法兰连通。

Fig. 2 : Clamp type joint, using positioning bolts to locate, with no connection to old pipeline. The joint core is connected to the flange.

图 3 注胶式接头，接头芯子与短节焊接连通。

Fig. 3: Glue injection type joint, the joint core is welded to the pup joint.

6. 增加支管。

Add branch pipes.

修复后的燃气管道将重新形成一个新的、连续的闭合通路，该通路仅在维修端与未维修端的结合处设置接口。

The repaired gas pipeline will re-form a new, continuous closed passage, which only has an interface at the junction of the repaired end and the unrepaired end.

如需在柔性复合软管上增加支线，则需在支线位置切断软管，并在软管端口处安装专用接头并使用三通连接即可，详见下图。

If a branch line is needed to be added to the flexible composite hose, you need to cut the hose at the branch position, install a special joint at the hose port and use a tee joint, as shown in the figure.

7. 非开挖修复依据。

Specification of trenchless rehabilitation.

■ CJJ-T2010 燃气管道非开挖修复技术规程；

CJJ-T2010 Technical specification for trenchless rehabilitation of gas pipelines;

■ CJJ/T147-2010 城镇燃气管道非开挖修复更新工程技术规程；

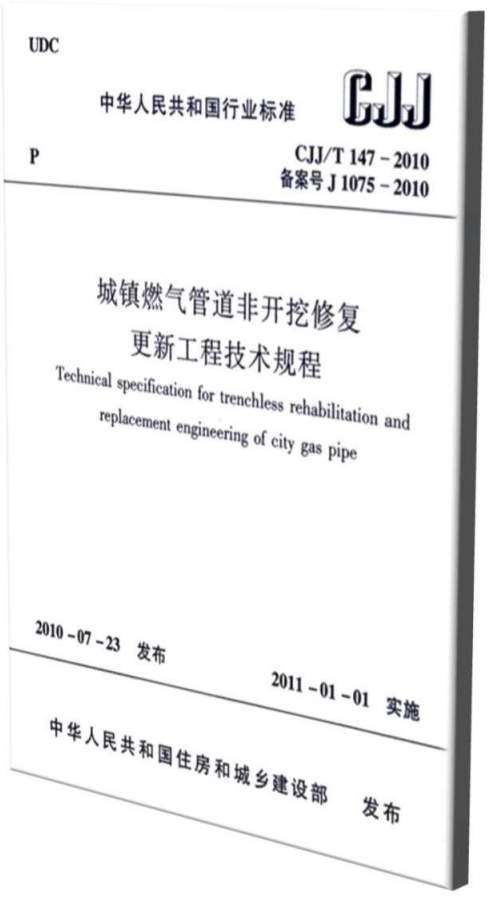
CJJ/T147-2010 Technical specification for trenchless rehabilitation and replacement engineering of city gas pipe;

■ CJJT 250-2016 城镇燃气管道穿跨越工程技术规程；

CJJT 250-2016 Technical specification for crossing and serial crossing engineering of city gas pipeline;

■ CJJ51-2016 城镇燃气设施运行、维护和抢修安全技术规程。

CJJ51-2016 Safety technical specification for operation, maintenance and rush-repair of city gas facilities.



8. 管道非开挖修复所需设备。

Equipment required for trenchless pipeline rehabilitation.

1）柔性复合软管牵引设备；

Flexible composite hose traction equipment;

2）柔性复合软管包裹、缠绕设备；

Flexible composite hose wrapping and winding equipment;

3）柔性复合软管变形设备；

Flexible composite hose deformation equipment;

4）柔性复合软管复原设备；

Flexible composite hose recovery equipment;

5）柔性复合软管试压设备；

Flexible composite hose pressure testing equipment;

6）柔性复合软管大盘驱动设备等。

Flexible composite hose large disk driving equipment, etc.

5 台各种规格管道检测机器人
（适用管径 300-1500）
5 pipeline inspection robots of various specifications
(Suitable for pipe diameters of 300-1500)

管道内窥镜（适用管径 100-200）
Pipeline endoscope (suitable for pipe diameter 100-200)

管道潜望镜(QV)
Pipe Quick View Inspection

9. 柔性复合软管内衬修复技术优势。

Advantages of flexible composite hose lining repair technology.

1）软管材料耐腐蚀、抗渗透性佳、耐温性好（-30~110℃），延长原管道使用寿命 50 年；

The hose material is corrosion-resistant, permeability-resistant and temperature-resistant (-30~110℃), extending the service life of the original pipeline by 50 years;

2）软管本身可承受一定内压，可输送水、气、油及混输；

The hose itself can withstand a certain internal pressure and can transport water, gas, oil and mixed transportation;

3）可进行长距离管道修复，单次可连续维修长度达 2Km，减少工作坑开挖的数量和面积；

It can repair long-distance pipelines, and the continuous repair length can reach 2Km at a time, reducing the number and area of working pit excavation;

4）可通过 90°弯头，安装便捷，施工周期短，场地占用小，减轻项目审批压力、降低项目成本；

It can pass through a 90° elbow, which is convenient to install, with a short construction period and small site occupation, reducing the pressure of project approval and reducing project costs;

5）广泛适用于各种金属管和非金属管，如石棉水泥管、钢管、铸铁管、钢筋混凝土管等；

It is widely applicable to various metal pipes and non-metal pipes, such as asbestos cement pipes, steel pipes, cast iron pipes, reinforced concrete pipes, etc.;

10. 柔性复合软管内衬修复技术缺点。

Disadvantages of flexible composite hose lining repair technology.

1）软管材质防穿刺性能较差；

The hose material has poor puncture resistance;

2）管线为工厂定制化生产，施工现场无法接长；

The pipeline is customized in the factory and cannot be extended at the construction site;

3）软管安装完成后，取出较为困难；

After the hose is installed, it is difficult to remove;

4）软管本身不具备承受外压的性能，因此承受外压还是依托于原管道。

The hose itself does not have the ability to withstand external pressure, so it still relies on the original pipeline to withstand external pressure.

（二）、柔性复合软管非开挖修复法与翻转内衬法的区别

Differences between flip lining method and flexible

1. 翻转内衬法施工流程：

Construction process of the flip lining method:

①管道停输 →②开挖作业坑→③断管置换 →④高压水清洗 →⑤管内摄像检查 →⑥内衬作业 →⑦加热、固化 →⑧管内摄像检查 →⑨端口处理 →⑩内衬段试压（含 90°剥离实验）→⑪接管回填 →⑫维修段压力实验→⑬送气回填 修复完成。

①Stop conveying→ ②Excavate a pit→ ③Replace the broken pipe→ ④Clean using high-pressure water→ ⑤Video inspection inside the pipe→ ⑥Lining operation→ ⑦ Heating and curing→ ⑧Video inspection inside the pipe→ ⑨Port treatment→ ⑩Lining section pressure test (including 90° peeling test)→ ⑪Backfill the repaired pipe→ ⑫Perform pressure test on the repaired part→ ⑬Restore conveying gas, repair completed.

2. 柔性复合软管施工流程：

Construction process of the flexible composite hose:

①管道停输 →②开挖作业坑→③断管置换 →④清管 →⑤管内摄像检查 →⑥内衬作业 →⑦安装柔性复合软管专用接头及短节接管 →⑧维修段压力实验 →⑨送气回填送气回填修复完成。

①Stop conveying→ ②Excavate a pit→ ③Replace the broken pipe→ ④Pipe cleaning→ ⑤ Video inspection inside the pipe→ ⑥Lining operation→ ⑦Install flexible composite hose special joints and pup joints→ ⑧Perform pressure test on the repaired part→ ⑨Restore conveying gas, repair completed.

注：管道维修工作中，污废主要产生于对待维修管道的清理环节，需要重点考虑。内翻法主要使用高压水对待维修管道进行清洗，由于内衬管需要粘在原管道上，因此该法对清洗的要求极高。且萘等物质遇水后会乳化，极易造成遗撒，故而需要重点关注。

Notes: In pipeline rehabilitation process, waste is mainly generated in the cleaning process of the pipeline to be repaired, which needs to be specially considered. The flip lining method mainly uses high-pressure water to clean the pipeline to be repaired. Since the inner liner needs to be glued to the original pipeline, this method has extremely high requirements for cleaning. In addition, substances such as naphthalene will emulsify when they come into contact with water, which is very easy to cause scatter, so it needs to be paid special attention.

二、油田管道内衬修复

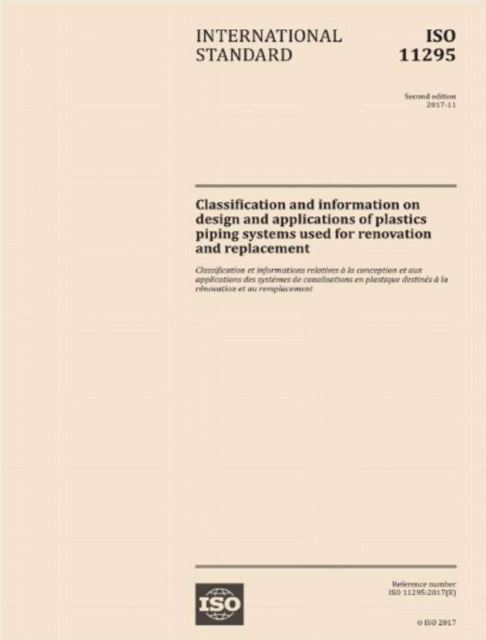
Inserted Hoses used for oilfield pipelines

（一）、管材结构及性能评价

Hose structure and performance evaluation

内衬修复技术已列入国际标准-ISO11295-201

Lining repair technology has been included in the international standard - ISO11295-201



INTERNATIONAL STANDARD

ISO 11295

Second edition 2017-11

Classification and information on design and applications of plastics piping systems used for renovation and replacement

Classification et informations relatives à la conception et aux applications des systèmes de canalisations en plastique destinés à la rénovation et au remplacement

ISO

Reference number ISO 11295:2017(E)

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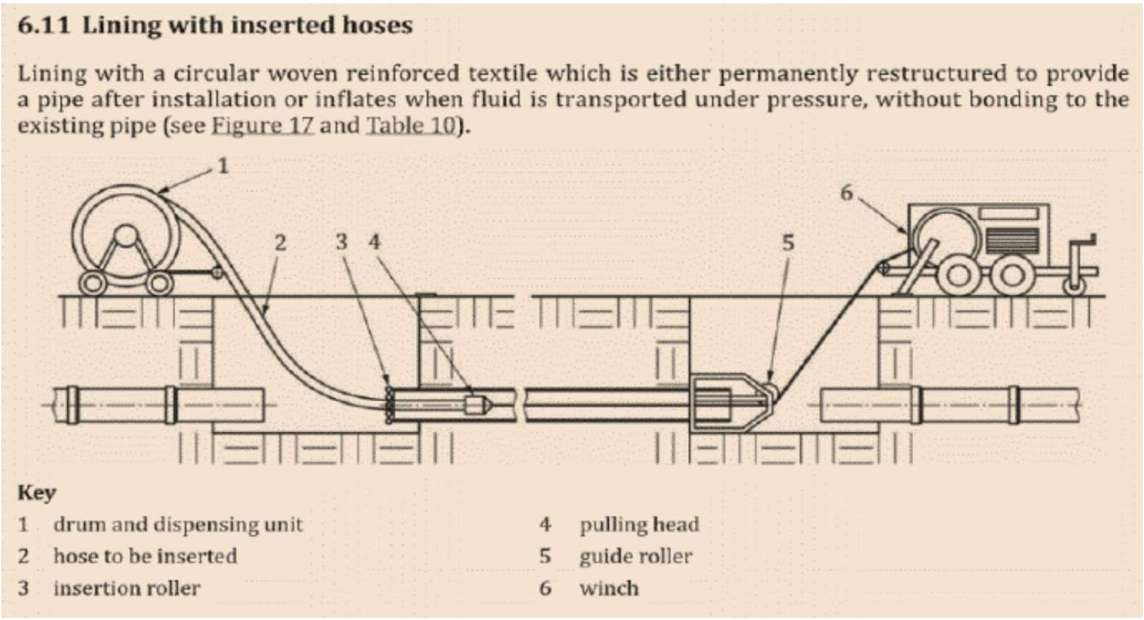

6.11 Lining with inserted hoses

Lining with a circular woven reinforced textile which is either permanently restructured to provide a pipe after installation or inflates when fluid is transported under pressure, without bonding to the existing pipe (see Figure 17 and Table 10).

Key

1 drum and dispensing unit
2 hose to be inserted
3 insertion roller
4 pulling head
5 guide roller
6 winch

非开挖修复依据。

Specification of trenchless rehabilitation.

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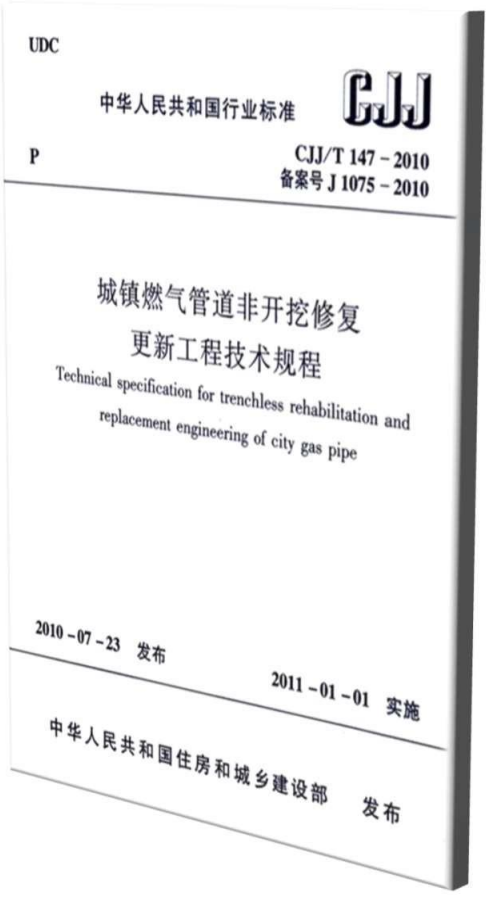
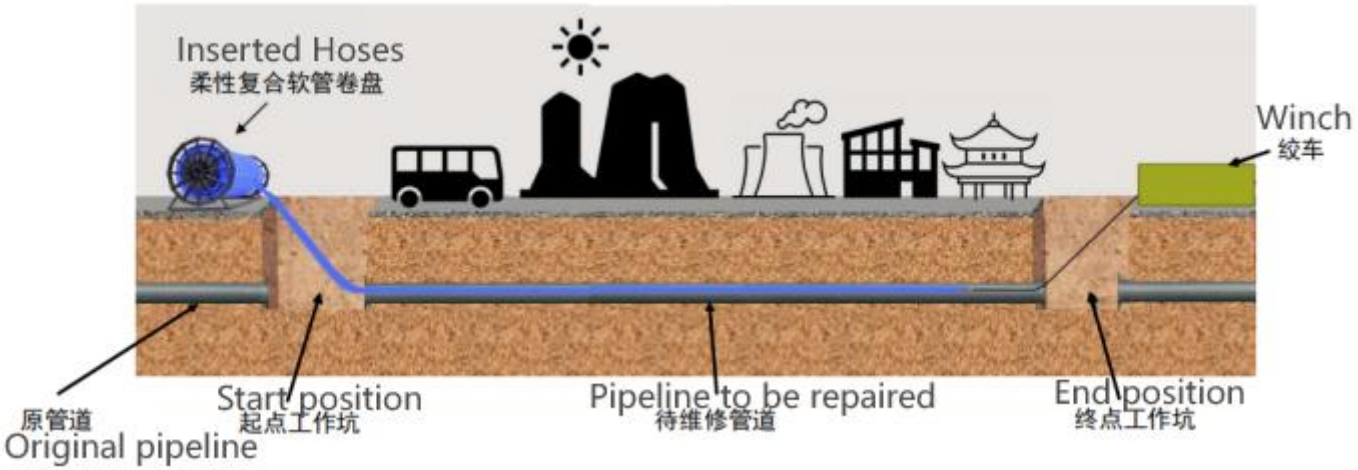


1. 技术原理。

Technical principles.

管道非开挖管修复技术（Inserted Hoses- IH 技术）是在原金属管道内衬入一条高压连续复合软管，形成“管中管”复合结构。

Inserted Hoses - IH technology is to line the original metal pipe with a high-pressure continuous composite hose to form a "hose in pipe" composite structure.

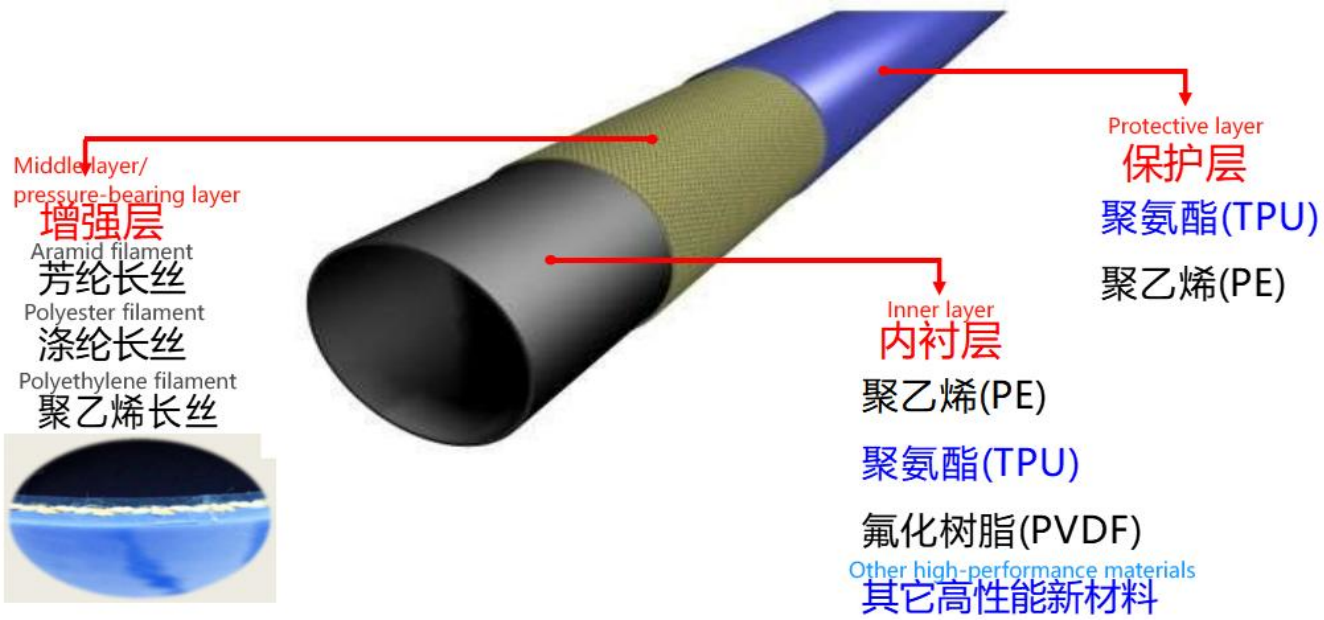


管内衬修复技术原理

Inserted Hoses - IH Technology

2. 管材结构。

The structure of the hose.



3. 管材性能。Hose performances.

3.1 参数 Specification

NO.	项目 Item	单位 Unit	指标 Standard	测试标准 Specification
1	工作压力(裸管) Work Pressure (bare hose)	MPa	≤8.0	GB/T15560-1995 根据纤维材料确定 based on fiber material
2	工作温度 Working Temperature	℃	-40-100	GB/T 1633-2006 根据树脂材料确定 based on resin material
3	最小轴向拉伸强度 Minimum axial tensile strength	T	2-200	GB/T1040-2006
4	涂层剥离强度 Coating peel strength	N/25CM	≥80	GB/T2791－1995
5	抗弯折性 Flexural resistance	次 frequency	≥4×10^4	GB/T3903-2008
6	耐磨性 Wear resistance	CM^3	0.5-1.2	GB/T1689-1998
7	气体渗透性 Gas permeability	cm^3 CH_4 lN×mm/(bar ×m^2×h)	0.5	企标 enterprise standard
8	单根连续长度 Single continuous length	m	≤5000	可按工程需求定制 Customizable according to engineering requirements

3.2 常用规格型号

Common specifications and models

内径 I.D. (mm)	裸管设计压力 Designed Pressure of Bare Hose (MPa)	裸管爆破压力 Blasting Pressure of Bare Hose (MPa)
DN50	8.0	16/24
DN80	8.0	16/24
DN100	8.0	16/24
DN127	7.0	14/21
DN150	6.0	12/18
DN200	5.0	10/15
DN250	4.5	9.0/13.5
DN300	4.2	8.4/12.6
DN400	4.2	8.4/12.6
DN500	3.0	6.0/12
DN600	2.0	4.0/6.0
DN800	2.0	4.0/6.0

注：可按工程设计需求定制

Note: Can be Customized according to engineering requirements.

3.3 管材油田现场评价

Hose site evaluation in oil fields.

油田酸性强腐蚀环境浸泡 1 年(评价条件：矿化度 24 万 mg/L; CI-13 万 mg/L；温度 60-70℃)，管材表面光洁，服役前后红外图谱波峰无差异。

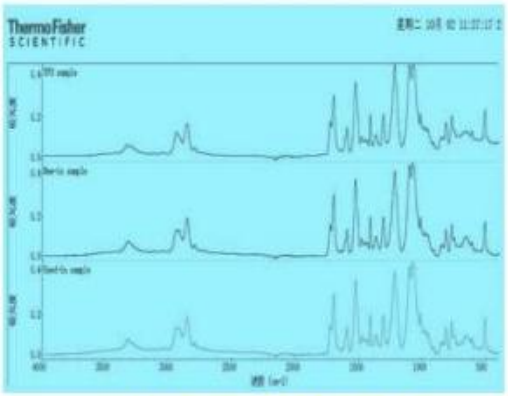
After being immersed in the highly acidic and corrosive environment of the oil field for one year (evaluation conditions: mineralization 240,000 mg/L; CI-130,000 mg/L; temperature 60-70°C), the surface of the hose is smooth and there is no difference in the infrared spectrum peaks before and after service.

浸泡试验现场

Immersion testing site

取样后擦拭称重

Wipe and weigh after sampling



试验前/后红外图谱分析

Infrared spectrum analysis before/after the experiment

检测报告

管材基本性能检测检测结果（DN100/PN4.0MPa）：爆破强度 11.8 MPa、维卡软化温度 95 ℃ （GB/T 1633 B50 法）。

Basic performance test results of hoses (DN100/PN4.0MPa): Blasting strength 11.8 MPa, Vicat softening temperature 95 ℃ (GB/T 1633 B50 method).

4. 非开挖技术 VS 传统开挖换管。

Non excavation technology VS traditional excavation for pipe replacement.

施工周期短

施工周期短缩短 50%-70%

Short construction period.

Shorten the construction period by 50% -70%.

价格降低 20%-50%

开挖面积小

不破坏路面、水池等

The price is decreased by 20% -50%.

Small excavation area;

Not damaging the road surface, water tank, etc.

非金属材料优异性能

使用寿命延长 20-50 年

耐腐蚀

不结蜡

摩阻小

Excellent performance of non-metallic materials.

Extend service life by 20-50 years;

Corrosion preventive;

No wax formation;

Low friction resistance.

安全系数高

修复长度长

中间无接头

自我承压

High safety factor.

Long repair length;

No joint in the middle;

Strong self pressure bearing ability.

（二）、关键技术及研究认识

Key technologies and research insights

1. 技术特点。

Technical characteristics.

■ 耐腐蚀--非金属耐蚀性；

Corrosion resistance--non-metallic, corrosion resistance;

■ 承压高--裸管承压 8.0 MPa、最高爆破压力 24MPa(DN100)；

High pressure bearing--bare hose bearing pressure 8.0 MPa, maximum blasting pressure 24MPa (DN100);

■ 重量轻--米重 2 kg(DN100)，牵引设备选择范围广；

Light weight--weight: 2 kg/m (DN100), has wide selection range of traction equipment;

■ 施工快--施工速度 300-400 m/h;

Fast construction--construction speed 300-400 m/h;

■ 过弯头--次通过 R=5D、R=4D 弯头(>90°)；

Through elbows--through R=5D, R=4D elbows (>90°) at a time;

■ 口径宽--修复管线 DN50-DN800；

Wide diameter--repair pipeline DN50-DN800;

■ 距离长--根据工程需要，一次施工【直线最大距离】2.0-2.5km；

Long distance--according to project needs, one-time construction [maximum straight line distance] is 2.0-2.5km;

■ 适应腐蚀管道、承压性能差、弯头多、距离长、征地难的管道修复。

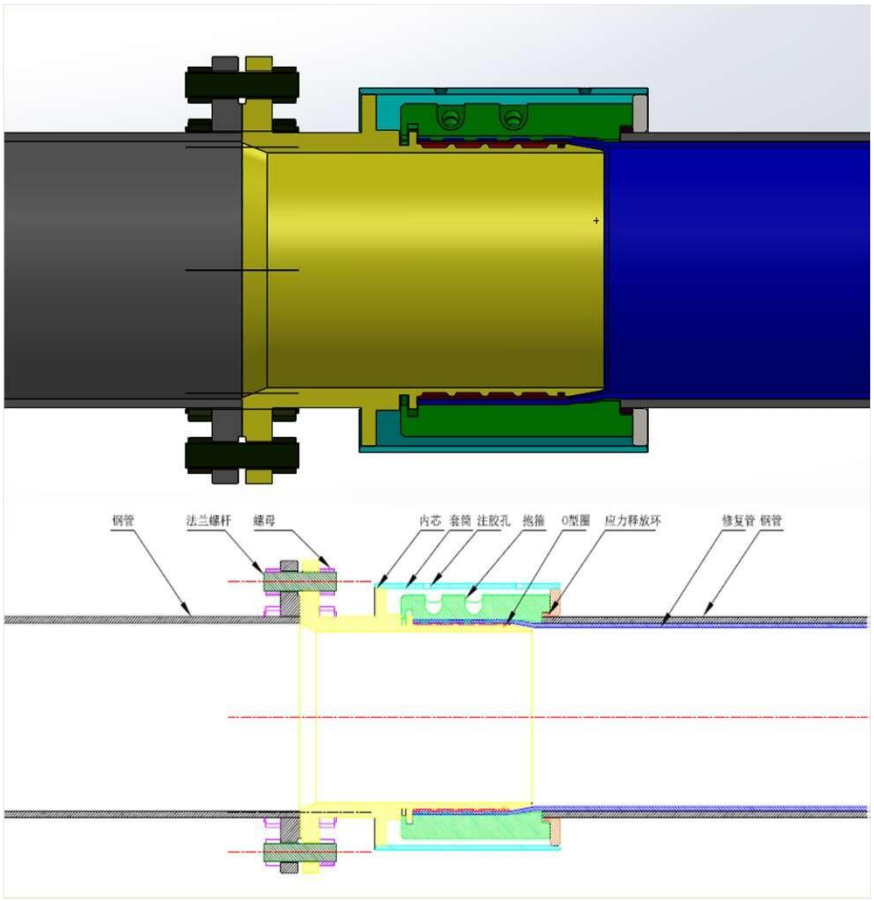
Suitable for repairing corroded pipelines, pipelines with poor pressure performance, multiple elbows, long distances, and difficult land acquisition.

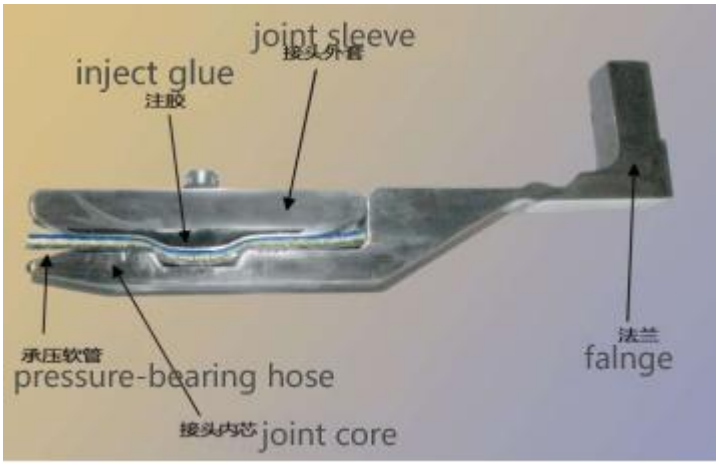
2. 接头连接方式。

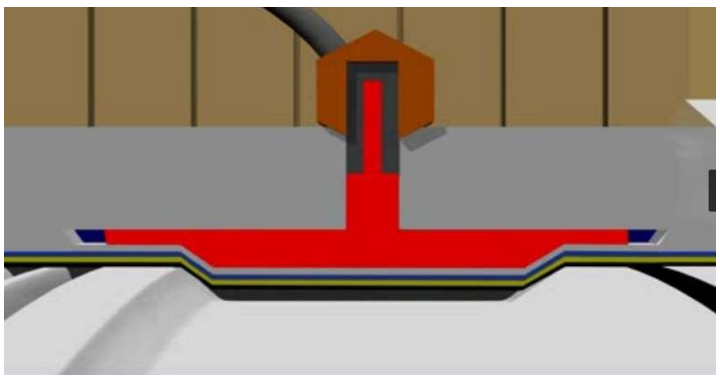
Joint connection methods.

2.1 端部接头

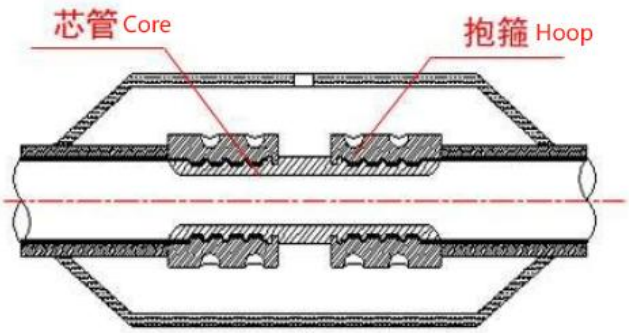
End joints







2.2 中间接头
Middle joints



断管处连接示意图（类哈呋包裹）
Schematic diagram of the connection at the broken pipe

接头防腐
The joint is corrosion-resistant
环氧粉末静电喷涂或高温聚氨酯喷涂
Epoxy powder electrostatic spraying or high-temperature polyurethane spraying

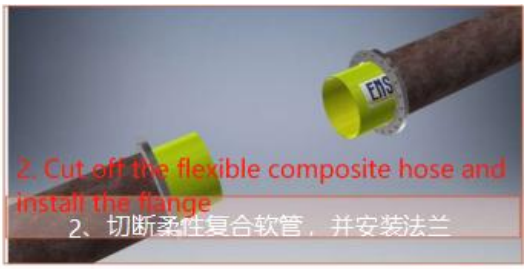
3. 管道口径变化解决方案。Solution for pipeline diameter changes.

由于柔性复合软管是根据原管道的维修长度整条定制的，因此，修复后的管道将重新形成一个新的、连续的闭合通路，该通路仅在维修端与未维修端的结合处设置接口。

Due to the fact that the flexible composite hose is customized as a whole based on the repair length of the original pipeline, the repaired pipeline will re-form a new, continuous closed passage, which only has an interface at the junction of the repaired end and the unrepaired end.

如需在柔性复合软管上增加支线，则需在支线位置切断软管，并在软管端口处安装专用接头并使用三通连接即可，详见下图。

If a branch line is needed to be added to the flexible composite hose, you need to cut the hose at the branch position, install a special joint at the hose port and use a tee joint, as shown in the figure.

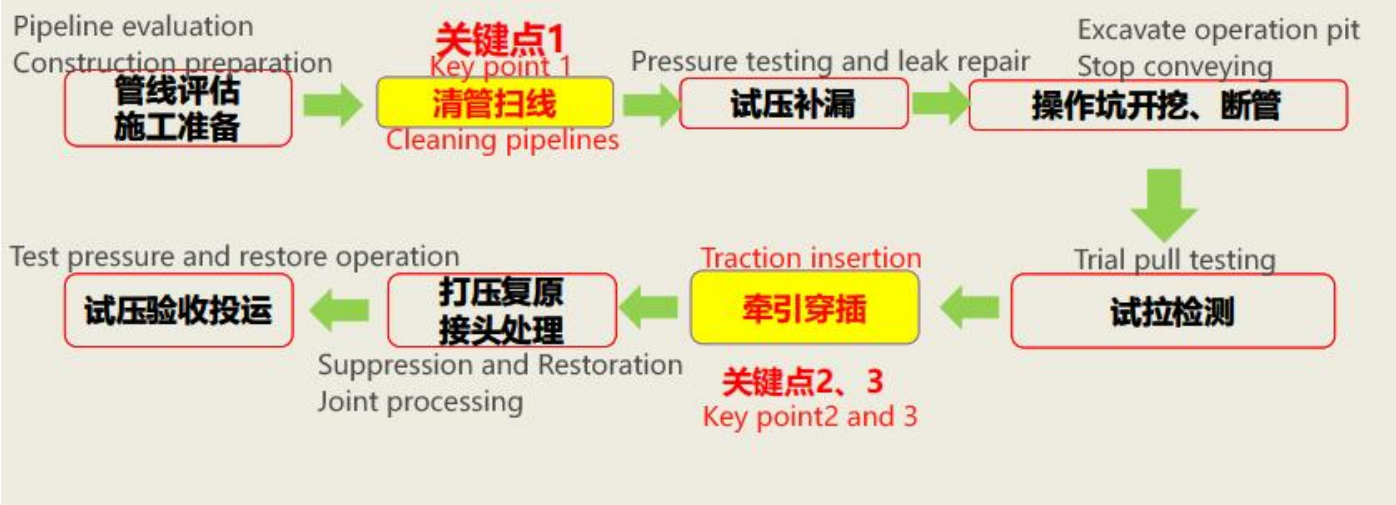


4. 施工流程。

Construction process.

4.1 施工作业工艺分为 8 步，其中关键点有 3 项。

The construction process is divided into 8 steps, with 3 key points.



4.1.1 关键点对策 1

Key point measure 1

对策：采用管线清洗机具，确保管线内无尖锐焊瘤。

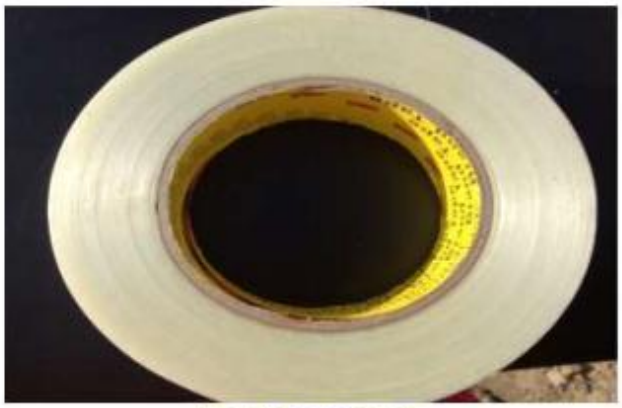
Measure: Use pipeline cleaning equipment to ensure that there are no sharp weld bumps inside the pipeline.

4.1.2 关键点对策 2

Key point measure 2

对策：采用纤维增强胶带，确保软管内衬是折叠状态；配套自动化折叠装置，提高施工时效。

Measure: Use fiber-reinforced tape to ensure that the hose lining is folded; Equipped with automated folding devices to improve construction efficiency.



纤维增强胶带

fiber-reinforced tape

软管自动化压U折叠设备

automated U-folding device

4.1.3 关键点对策 3

Key point measure 3

对策：在高压连续复合软管与钢丝绳连头处安装旋转环，避免软管内穿插施工过程发生扭转。

Measure: Install a rotating ring at the joint between the high-pressure continuous composite hose and the steel wire rope to avoid twisting during the construction process of hose for internal insertion.

（二）、关键技术及研究认识

Key technologies and research insights

1. 技术对比。

Technical comparisons.

类型	软管内衬修复技术	PE管内衬修复技术	CIPP原位固化技术
适应性	长距离、多弯头、高坡度及涉水管道修复和新建管道的源头防腐。	适应于管线穿孔孔径≤4×4cm钢铁骨架存在、弯头较少管线修复。	适应于连续多弯头管道修复。
不足	大口径软管无环刚度	1、一次施工500-800m； 2、PE管逐根焊接，施工时效低； 3、PE管不承压，原管道承压性能降低易爆管。	1、一次施工200-300m； 2、施工程序复杂，时效低； 3、员工素质要求高。

Type	Hose lining repair technology	PE pipe lining repair technology	CIPP in-situ curing technology
Applicability	Suitable for source anti-corrosion of long-distance, multi elbows, high slope, and water related pipeline repair and new pipeline construction	Suitable for pipeline repair with a diameter ≤ 4x4cm, steel skeleton, and few elbows.	Suitable for pipeline repair with continuous elbows.
Disadvantage	Hose with large diameter has no ring stiffness	1. Short construction distance, only 500-800m at a time; 2. PE pipes are welded one by one, with low construction efficiency; 3. PE pipes do not bear pressure, and the original pipeline's pressure bearing performance is reduced, making it easier explosive.	1.Short construction distance, only 200-300m at a time; 2.The construction process is complex and the timeliness is low; 3. High requirements for employee quality.

2. 管道材料结蜡试验评价。

Wax deposition test evaluation.

同材质结蜡性能对比表明：非金属材质具有优异的防蜡性能，管道经非金属内衬修复后，在输送高含蜡原油条件下结蜡风险大幅度降低。

同种材质结蜡性能对比表明：金属材质旧管道比新管道结蜡风险高。

The comparison of wax deposition of the same material shows: non-metallic materials have excellent anti-waxing performance. After the pipeline is repaired with non-metallic lining, the risk of wax deposition is greatly reduced under the condition of transporting high wax content oil.

The comparison of wax deposition of the same material shows that the risk of waxing in old metal pipelines is higher than that of new pipelines.

20#新材质 20#旧材质

20# New Material 20# Old Material

HDPE

TPU