



Technical Guidance for Anti-Corrosion Joint Repair and Damage Restoration of Steel Pipelines

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PART ONE

Radiation-Cured Polyethylene Heat-Shrinkable Anti-Corrosion Material

Heat-Shrink Sleeve (Closed-End Sleeve)



Heat-shrinkable sleeves (closed-end sleeves) are heat-shrinkable corrosion-resistant materials developed for corrosion protection of welded joints in buried and overhead steel pipelines, as well as for thermal insulation patching of insulated pipelines.

● Core Structure and Materials

Double-layer composite design:

- ▶ Base material: Radiation-crosslinked polyethylene with “shape memory” functionality, which shrinks circumferentially upon heating to tightly envelop the pipe.
- ▶ Adhesive layer: Specialized hot-melt adhesive that, when melted, forms a high-strength bond with steel pipes, epoxy coatings, and the base material, achieving integrated sealing and corrosion protection.

● Typical Application Scenarios

- ▶ Pipeline Connection Points:
 - Joint Repair and Corrosion Protection: Repair of welded joints and damaged insulation layers.
 - Special Nodes: Sealing and reinforcement at wall penetrations, flange connections, and clamp locations.
- ▶ Protection Types:
 - Anti-corrosion Piping: Epoxy coating protection for oil and gas pipelines.
 - Thermal Insulation Piping: Repairing damaged insulation layers to restore overall integrity.

Why are heat-shrink sleeves (closed-end sleeves) chosen for covering pipe welds?

01

Corrosion Protection

Environmental

Corrosion Isolation:

Closed-end sleeves form a continuous waterproof and oxygen-barrier seal by tightly enveloping pipe welds, preventing the ingress of corrosive media.

Cathodic Protection

Compatibility: Insulating properties enable seamless integration with pipeline cathodic protection systems, preventing the loss of protective current.

02

Sealing Performance

Waterproof and moisture-proof:

Prevents groundwater and moisture from infiltrating the welded joint area;

Prevents gas leakage:

Gas pipelines demand extremely high sealing integrity. Heat-shrink sleeves minimize the risk of gas leakage caused by micro-pores or cracks at welded joints.

03

Mechanical Protection

Resistance to External

Damage: When pipelines are buried or overhead, the heat-shrink sleeve disperses stress when welded joints are subjected to external forces such as soil pressure, rock friction, or mechanical impact.

Adaptation to Pipeline

Deformation: The closed-end sleeve possesses flexibility, accommodating minor pipeline deformations caused by temperature changes or geological settlement to prevent cracking.

04

Long-Term Durability

Chemical resistance:

Resists acid, alkali, salt spray, and microbial corrosion, matching the pipeline's design service life.

Temperature resistance:

Withstands temperature fluctuations during gas pipeline operation.

05

Ease of Installation

High-efficiency field

installation: Utilizing heat-shrink technology eliminates the need for large equipment, making it suitable for outdoor operations while accommodating various pipe diameters and joint shapes.

Controllable quality:

Standardized construction procedures ensure consistent coverage quality for every joint.

06

Compliance with Specifications

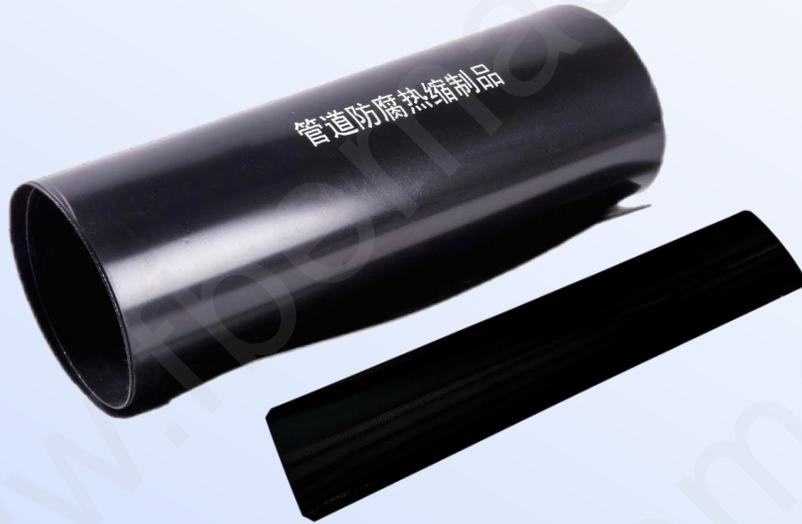
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Require corrosion-resistant repair treatment for butt welds; closed-end sleeves are a certified, proven solution.

Heat-shrink sleeves have become the essential solution for protecting welded joints in gas pipelines due to their combined advantages of corrosion resistance, sealing, mechanical protection, and durability. They directly impact the safe operation and service life of the pipeline.

Heat-Shrinkable Tape (Open-End Sleeve)



Heat-shrinkable tape (open-ended sleeve) is a high-performance protective material specifically developed for corrosion prevention in pipeline engineering.

● Typical Application Scenarios

▶ Core Applications:

- Weld Joint Corrosion Protection: Post-welding joint protection for pipelines, replacing traditional cold-wrap tape or asphalt coatings.
- External Protection for Insulated Pipelines: Repairing damaged insulation layers to prevent moisture intrusion into polyurethane foam insulation.

▶ Special Conditions:

- Crossing Section Protection: High mechanical stress zones during river or road crossings.
- Non-Standard Sections: Customized wrapping for irregular joints such as valves and flanges.

● Supporting Materials

▶ Specialized Fixing Plate (Ensures Stability at Overlap Joints)

The company's proprietary fixing plate features a three-layer composite structure with high-strength fiberglass mesh as the intermediate layer. This design suppresses polyethylene deformation at high temperatures, enhances tensile strength, improves fixing effectiveness, and achieves “zero” slip at heat-shrink tape overlap joints.

▶ Primer (Enhances Interface Adhesion)

Fiber-Reinforced Heat-Shrinkable Tape



● Product Structure

Featuring a three-layer composite structure, from outer to inner layers:

- ◆ Reinforced Backing Layer: Constructed with HDPE substrate, offering superior tensile strength and abrasion resistance;
- ◆ Intermediate Reinforcement Layer: Embedded high-strength adhesive-coated fiber mesh, providing excellent tear resistance;
- ◆ Functional Adhesive Layer: Specialized hot-melt sealant formulation, delivering high shear strength and peel strength.

Fiber-reinforced heat-shrinkable tape (open sleeve) is a high-performance corrosion-resistant joint sealing system specifically developed for demanding construction environments.

● Core Performance and Application Scenarios

▶ Horizontal Directional Drilling (HDD) Protection

- Resistance to Tensile Stress: Pipelines endure immense pulling forces during drilling; this jointing system prevents damage to the anti-corrosion coating.
- Resistance to Soil Friction: Reinforced HDPE layer minimizes friction damage from borehole walls.
- Waterproof Sealing: Thermoplastic adhesive layer provides complete sealing against mud and groundwater infiltration.

▶ Subsea/Onshore Pipe Trailing Protection

- Saltwater Corrosion Resistance: Suitable for subsea pipelines, withstanding salt spray and microbial corrosion.
- Impact Resistance: Prevents abrasion of the anti-corrosion coating from rocks and hard objects during trailing operations.

▶ Complementary Application Solutions

- Combined with “Crossing Protection Heat-Shrinkable Tape”: Dual-layer protection, with the outer protective tape providing additional resistance to mechanical damage.

Under what circumstances should heat-shrinkable tape (open-ended sleeves) be selected for wrapping pipe welds?

Space-constrained or unable to perform closed-mouth construction

When weld joints are located in confined areas (such as near valves, elbows, brackets, etc.), closed sleeves may be unable to fully encase the joint due to insufficient space, whereas open sleeves can be installed in sections or provide partial coverage.

Temporary protection or emergency repairs

During emergency repairs or temporary welding operations, the open sleeve can be quickly installed, pending subsequent permanent closure.

Special Pipeline Structures

Certain irregularly shaped components (such as tees and flange connections) present challenges for closed sleeves due to their complex geometries. Custom open sleeves or segmented wrapping solutions are required in such cases.

Inspection and Maintenance Requirements

For applications requiring frequent inspection of weld quality (such as laboratory or test-section pipelines), open-end sleeves facilitate disassembly and repeated operations.

Features of Open-End Sleeves

Flexible Installation: Adaptable to complex geometries or spatial constraints.

Lower Cost: Open-end sleeves are priced lower than closed-end sleeves.



PART TWO
Comparison of
Different Materials

Epoxy Coal Tar Anti-Corrosion Coating



► Advantages:

Strong chemical corrosion resistance: Excellent resistance to acids, alkalis, salts, groundwater, and other corrosive substances.

Strong adhesion: Forms a robust bond with steel pipe surfaces, resisting peeling.

Superior mechanical properties: High hardness after curing, providing impact resistance and wear resistance.

Suitable for harsh environments: Applicable in highly corrosive settings such as underground burial, underwater, and marshland applications.

► Disadvantages:

Complex application: Requires multiple coats (primer + topcoat) and lengthy curing time (over 24 hours).

Poor environmental performance: Contains solvent emissions (VOCs), failing to meet modern eco-friendly standards.

Poor low-temperature performance: Difficult to cure at low temperatures (<5° C), prone to cracking.

► Applicable Scenarios:

- Highly corrosive soils or water bodies (e.g., chemical industrial zones, saline-alkali land).
- Traditional pipeline anti-corrosion projects (gradually being replaced by new materials).



Polyethylene Adhesive Tape



► Advantages:

- Easy to apply: Cold-wrap installation requires no heating, ideal for field operations.
- Excellent flexibility: Adapts to irregular pipe surfaces (e.g., elbows, flanges).
- Superior electrical insulation: Suitable for pipelines requiring cathodic protection.
- Eco-friendly and solvent-free: Zero VOC emissions, compliant with environmental standards.

► Disadvantages:

- Low mechanical strength: Poor impact resistance and wear resistance, prone to damage from external forces.
- Limited temperature tolerance: Long-term operating temperature generally $\leq 60^{\circ}\text{C}$; prone to softening at high temperatures.
- Bonding strength dependent on surface preparation: Incomplete rust removal on steel pipes may cause edge lifting and water seepage.
- Poor resistance to soil stress: Prone to displacement and cracking in loose or settling soil.

► Applicable Scenarios:

- Temporary corrosion protection or short-term shielding (e.g., pipeline storage protection).
- Corrosion protection for low-pressure, non-critical pipelines (e.g., water supply and drainage pipelines).

Radiation-Cured Polyethylene Heat-Shrink Sleeves (Closed-End Sleeves)



► Advantages:

Excellent Sealing: Forms a tight bond with pipes after heat shrinkage, providing complete waterproofing and moisture resistance.

High Mechanical Strength: Impact-resistant and wear-resistant, suitable for demanding environments like pipe dragging and directional drilling.

Chemical resistance: Withstands soil, seawater, and microbial corrosion.

Efficient installation: Rapid heating-based installation (10-15 minutes per joint).

Versatile compatibility: Compatible with 3PE, FBE, and other coatings for extensive joint repair and corrosion protection.

► Disadvantages:

Requires specialized equipment: Relies on flame guns or electric heating cables, with training required for installation.

Higher cost: Unit price exceeds polyethylene adhesive tape and epoxy coal tar anti-corrosion coatings (though overall lifespan is longer).

► Applicable Scenarios:

- Corrosion protection for long-distance pipeline welds (e.g., oil and natural gas pipelines).
- High-risk environments such as directional drilling crossings and subsea pipelines.
- Critical projects requiring long-term corrosion protection (design life ≥ 30 years).

Comprehensive Comparison



Characteristics	Epoxy Coal Tar Anti-Corrosion Coating	Polyethylene Adhesive Tape	Radiation-Cured Polyethylene Heat-Shrink Sleeve
Corrosion Resistance	10-20 years	5-15 years	Over 30 years
Construction Difficulty	High (multi-layer coating)	Low (Cold Wrap)	Medium (Heating required)
Mechanical Strength	High	Low	Extremely high
High Temperature Resistance	≤80°C	≤60°C	≤80°C
Environmental Friendliness	Poor (solvent-based)	Excellent (VOC-free)	Excellent (VOC-free)
Suitable Environments	Highly corrosive soils/water bodies	Low-pressure piping/temporary protection	Harsh environments (HDD, subsea)
Cost	Medium	Low	High
Selection Recommendations	Use with caution: Only for traditional projects or budget-constrained construction (phased out).	Consider for: Temporary protection or low-pressure piping (e.g., municipal water supply/drainage); restricted construction conditions (no power supply, no heating capability).	Preferred: For high-risk, long-life projects (e.g., oil/gas pipelines, subsea pipelines); requires resistance to mechanical stress (e.g., directional drilling, pipe-laying operations).



PART THREE

Construction

Process

Specifications



Construction Specifications for Heat-Shrink Sleeves (Closed-End Sleeves)

Step 1: Inserting the Heat Shrink Sleeve



Before aligning the steel pipes, first place the heat-shrink sleeve (closed-end sleeve) along with the liner film over the steel pipe and move it to a location that does not interfere with welding operations. (Typically about 1.5 meters away)

Step 2: Sandblasting for Rust Removal



Before performing surface sandblasting for rust removal, the pipe section at the repair joint must be preheated using a non-polluting heat source to a temperature at least 5°C above the dew point.



Use sandblasting equipment/angle grinders or similar tools to remove rust, weld slag, and other contaminants from the pipe section at the repair joint. The rust removal grade must achieve Sa2½ as specified in GB/T 8923.1, with anchor pattern depth reaching 40µm-90µm.



After rust removal, surface dust must be cleared. The surface cleanliness grade shall not be lower than Grade 3 as specified in GB/T 18570.3.



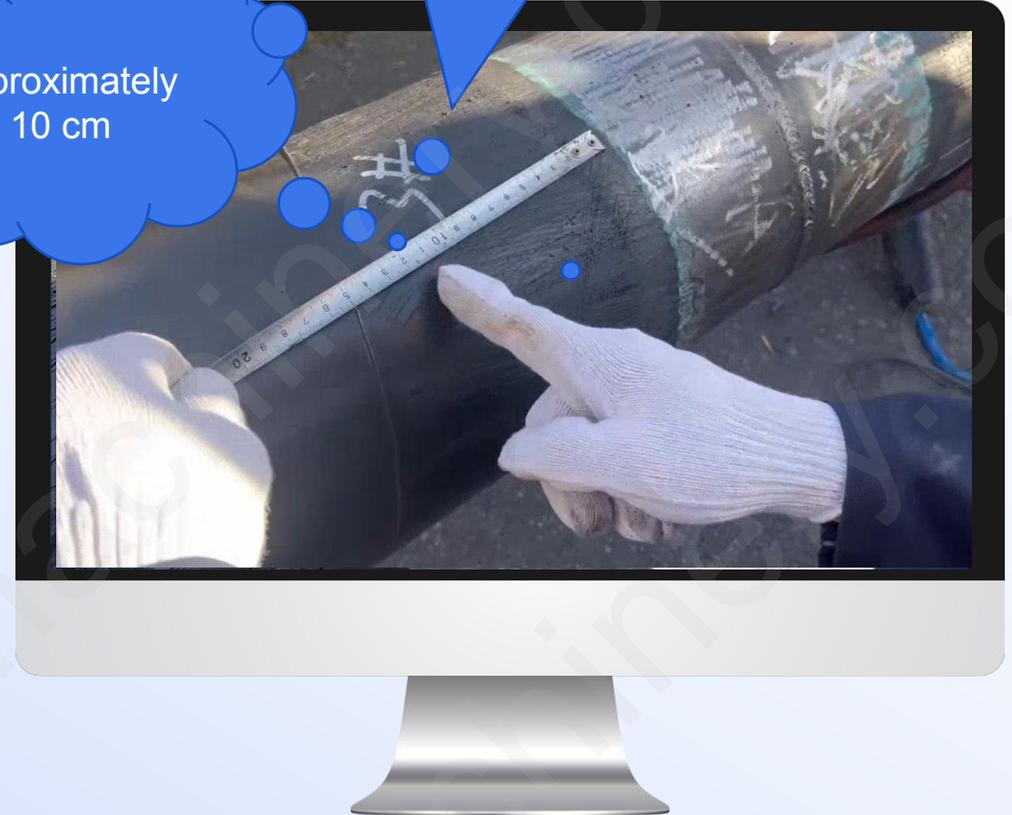
Step 3: Dehumidify and Heat

- ✓ Use a flame heater to uniformly heat the pipe surface at the joint, preheating the pipe to remove moisture from its surface;
- ✓ During preheating, use a thermometer to measure the temperature of the pipe surface at the joint;
- ✓ Simultaneously, use a wire brush to roughen the polyethylene layer at the joint overlap area;
- ✓ Note: If the edges of the pipe's anti-corrosion coating break at right angles, use a knife or other tool to chamfer them into a 30° slope.
- ✓ The grinding width of the polyethylene layer at the overlap joint should be approximately 10 cm.

Preheat temperature controlled between 50–70°C

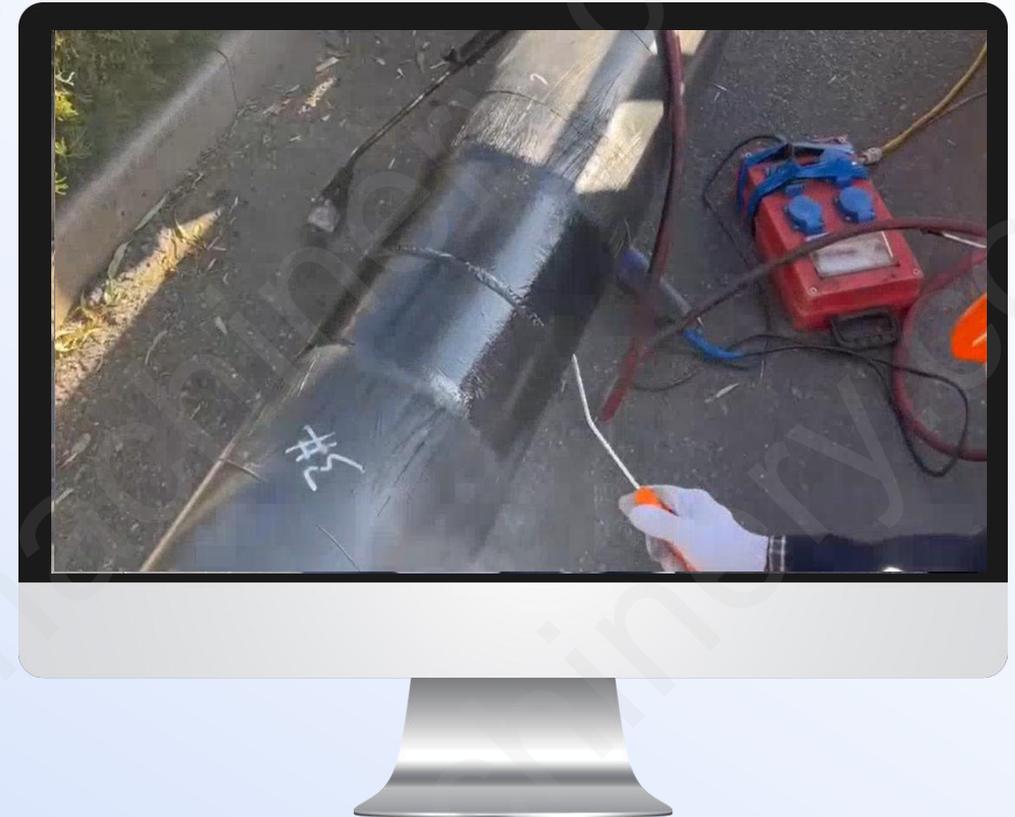
Enhance adhesion between hot melt adhesive and the original polyethylene layer of the pipe

Approximately 10 cm



Step 4: Application of Solvent-Free Epoxy Primer

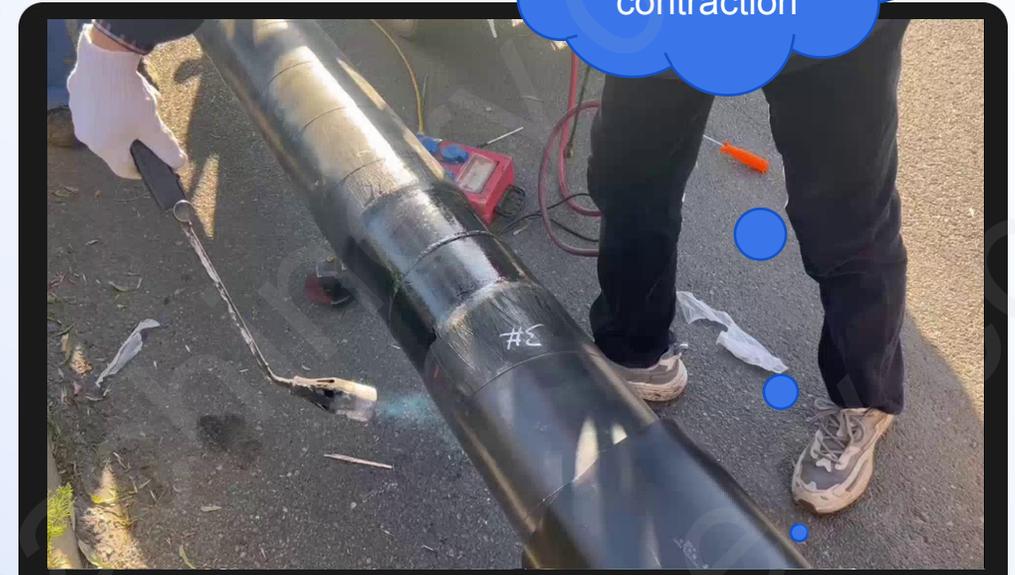
- ✓ Mix the A and B components of the solvent-free epoxy primer in the specified ratio and stir thoroughly until uniform.
- ✓ Apply the mixed solvent-free epoxy primer evenly to the steel pipe surface at the joint using a brush or roller.
- ✓ Note: Generally, epoxy primer does not need to be applied to areas other than the steel pipe surface at the joint.



Step 5: Heat and shrink the heat-shrink sleeve.

- ✓ Quickly peel off the inner liner of the heat-shrink sleeve and position it over the steel pipe weld joint;
- ✓ Ensure both ends overlap the pre-applied coating on the steel pipe by at least 80mm, aligning them concentrically with the pipe; support both ends with a 30mm-thick backing plate or manually lift the heat-shrink sleeve for support;
- ✓ Use a liquefied petroleum gas torch to heat the sleeve evenly from the center outward along its circumference;
- ✓ After central shrinkage is complete, gradually heat toward one end until the sleeve shrinks flat, expelling air for a tight seal;
Repeat the heating process toward the opposite end.

Facilitates gas
expulsion
during
contraction



Step 6: Tempering Heating and Inspection

- ✓ After complete installation, heat uniformly from the center toward both ends along the circumference;
- ✓ Use finger pressure to check the melting condition of the heat-shrink sleeve's hot melt adhesive, ensuring it is fully melted, bonded securely, and with adhesive overflow at both ends.
- ✓ If bubbles or voids are detected, gently expel trapped air using a roller after reheating;

Finally, inspect the surface. If no cracks, scorching, or bubbles are present, the installation is considered satisfactory.

Adhesive overflow





Heat-Shrinkable Tape (Open- End Sleeve) Installation Specifications

Pre-treatment of Joint Location — Step 1: Sandblasting for Rust Removal



Before performing surface sandblasting for rust removal, the steel pipe at the joint location shall be preheated using a non-polluting heat source to a temperature at least 5°C above the dew point.



Use sandblasting equipment/angle grinders to remove rust and weld slag from the pipe surface at the repair joint. The rust removal grade must meet Sa2½ as specified in GB/T 8923.1, with anchor pattern depth reaching 40µm–90µm.



Pre-treatment of Repair Area

Step 2: Dust Removal

After rust removal, surface dust must be cleared. The surface cleanliness grade shall not be lower than Grade 3 as specified in GB/T 18570.3.



Pre-treatment of Repair Area

Step 3: Dehumidification

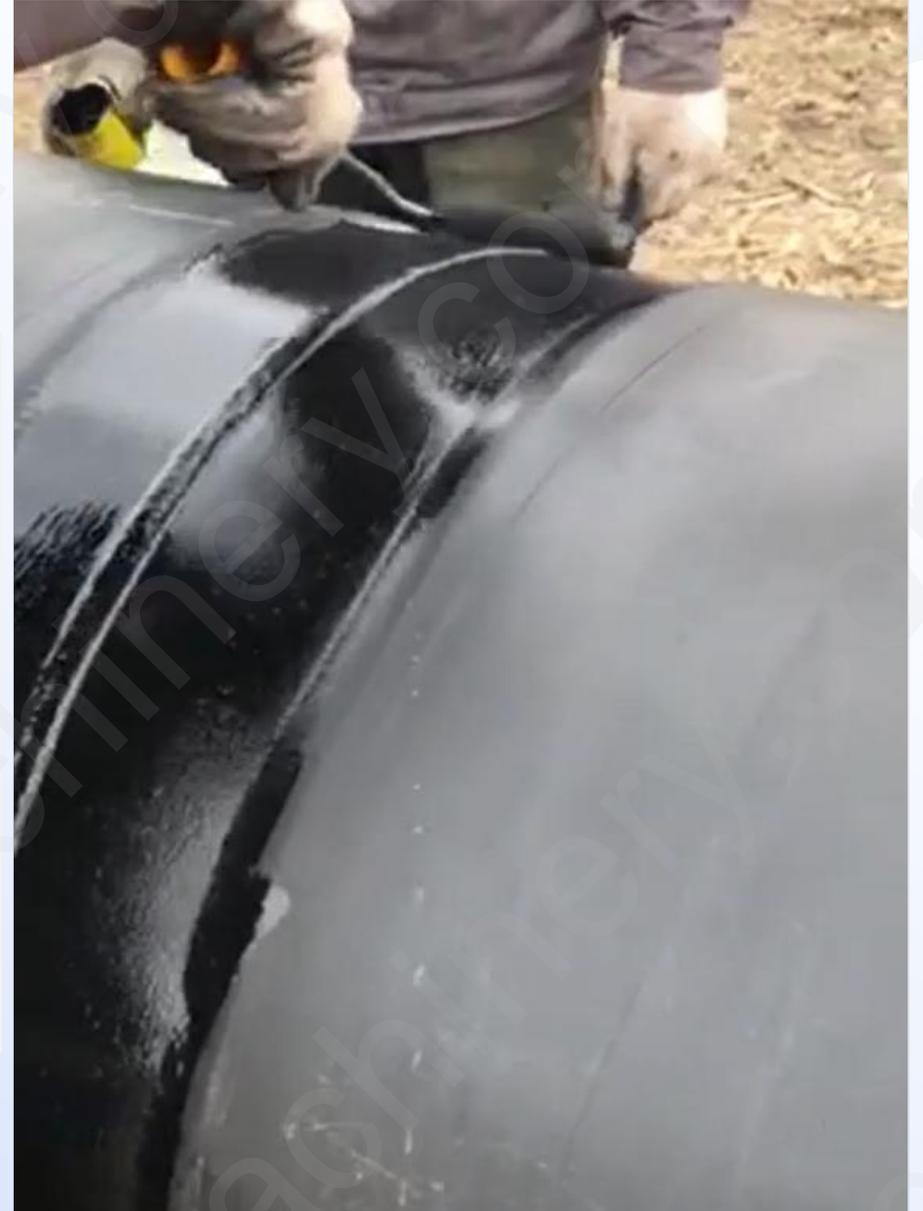
- ◆ Use a flame heater to uniformly heat the surface of the steel pipe at the joint area, preheating the pipe to remove moisture from its surface.
- ◆ Simultaneously preheat the polyethylene layers at both ends of the anti-corrosion steel pipe. Maintain the dehumidification temperature between 50–70°C.



Pre-treatment of Repair Area

Step 4: Painting

- ◆ Mix the A and B components of the solvent-free epoxy primer in the specified ratio and stir thoroughly;
- ◆ Apply the thoroughly mixed solvent-free epoxy primer quickly and evenly with a brush/roller onto the pipe weld seam;
- ◆ Note: Generally, solvent-free epoxy primer does not need to be applied to areas other than the surface of the repaired steel pipe.



Pre-treatment of Repair Area

Enhance the adhesion between the hot-melt adhesive and the original polyethylene layer of the pipe.

Step 5: Roughening Treatment

- ◆ Heat the polyethylene layer at the overlap joint using a flame heater;
- ◆ Roughen the original polyethylene layer at the overlap joint with a wire brush until it becomes coarse.



Installation of Heat-Shrink Tubing (Open-End Sleeve)

Step 5: Apply Heat-Shrink Tubing

- ◆ Heat one end of the heat-shrinkable tape (open sleeve) to activate its adhesive layer, then bond it to the repair joint and wrap it around the steel pipe surface.
- ◆ Heat the adhesive layer on the other end of the heat-shrinkable tape (open sleeve) and secure it to the repair joint along the overlap line.
- ◆ Note: During installation, ensure the overlap length between the heat-shrinkable tape (open sleeve) and the polyethylene anti-corrosion coating at both ends is equal.



Installation of Heat-Shrink Tubing (Open-End Sleeve)

- Our proprietary adhesive film exhibits high bonding strength and shear resistance with polyethylene layers, ensuring “zero” slip at heat-shrink tape overlaps;
- Prevents tape detachment during use;
- Completely resolves issues such as voids and uneven adhesive layers at tape overlaps.

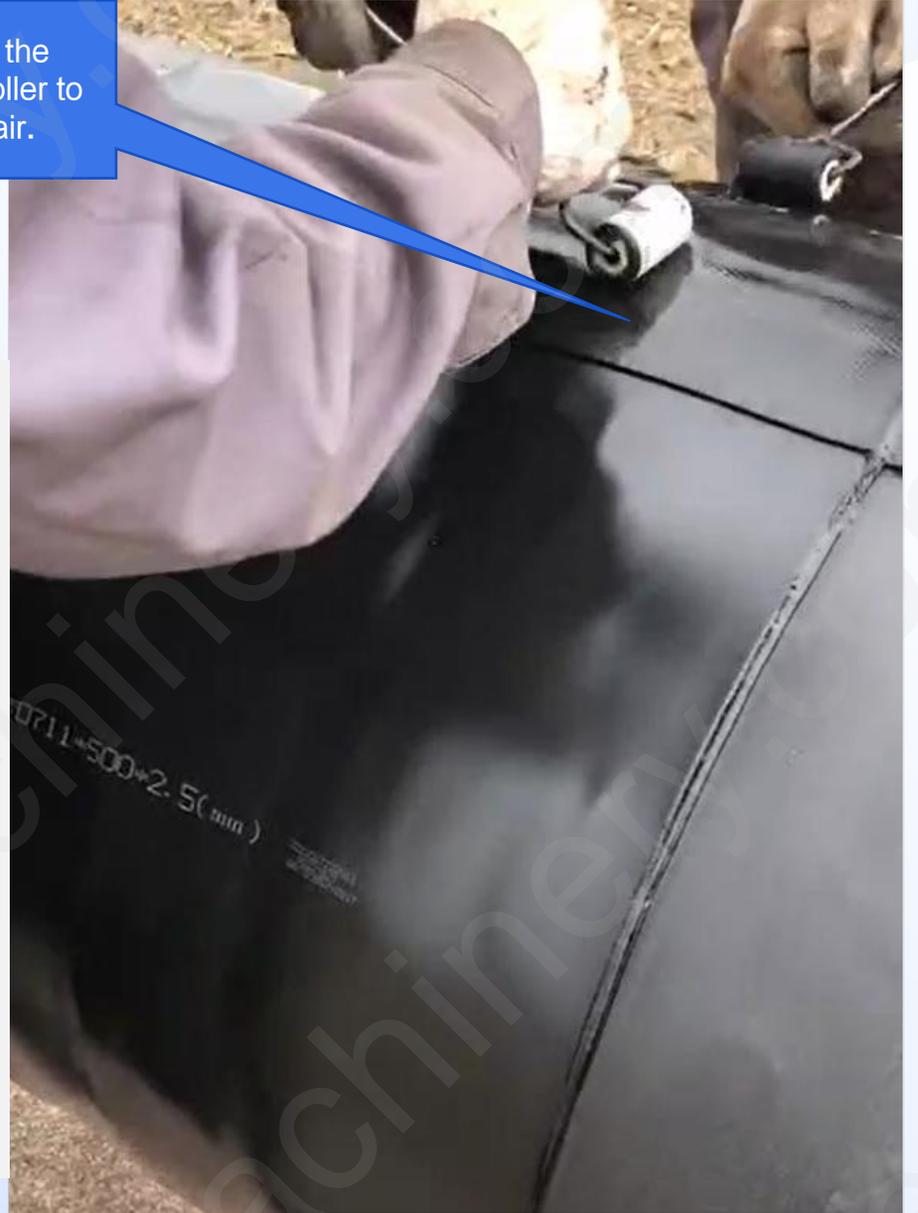


- ◆ Slightly heat the hot-melt adhesive surface of the fixing plate, ensuring the adhesive layer melts around the edges;
- ◆ Then quickly press the fixing plate firmly onto the overlapping edge of the heat-shrinkable tape.

Step 5: Heat the fixing plate and secure it.

Installation of Heat-Shrink Tubing (Open-End Sleeve)

If bubbles or wrinkles appear during the shrinking process, use a pressure roller to flatten them and expel any trapped air.



Step 6: Heat Shrink

- ◆ Heat the center section of the heat-shrink sleeve circumferentially using a flame heater, causing it to shrink first at the center. Then heat and shrink it from the center toward the opposite end.
- ◆ Move the heater evenly up and down and front to back to ensure uniform heating across the entire heat-shrink sleeve. Continue until the hot melt adhesive is fully melted and the sleeve shrinks completely to fit snugly over the pipe weld.
- ◆ Heat the overlapping and raised sections at both ends of the fixing plate and the polyethylene layer of the steel pipe, then use a pressure roller to press and seal them.

Installation of Heat-Shrink Tubing (Open-End Sleeve)

Step 7: Heat Treatment

- ◆ Apply heat treatment to the entire assembly of heat-shrink tubing and retaining clip to fully melt the hot-melt adhesive and enhance adhesion.

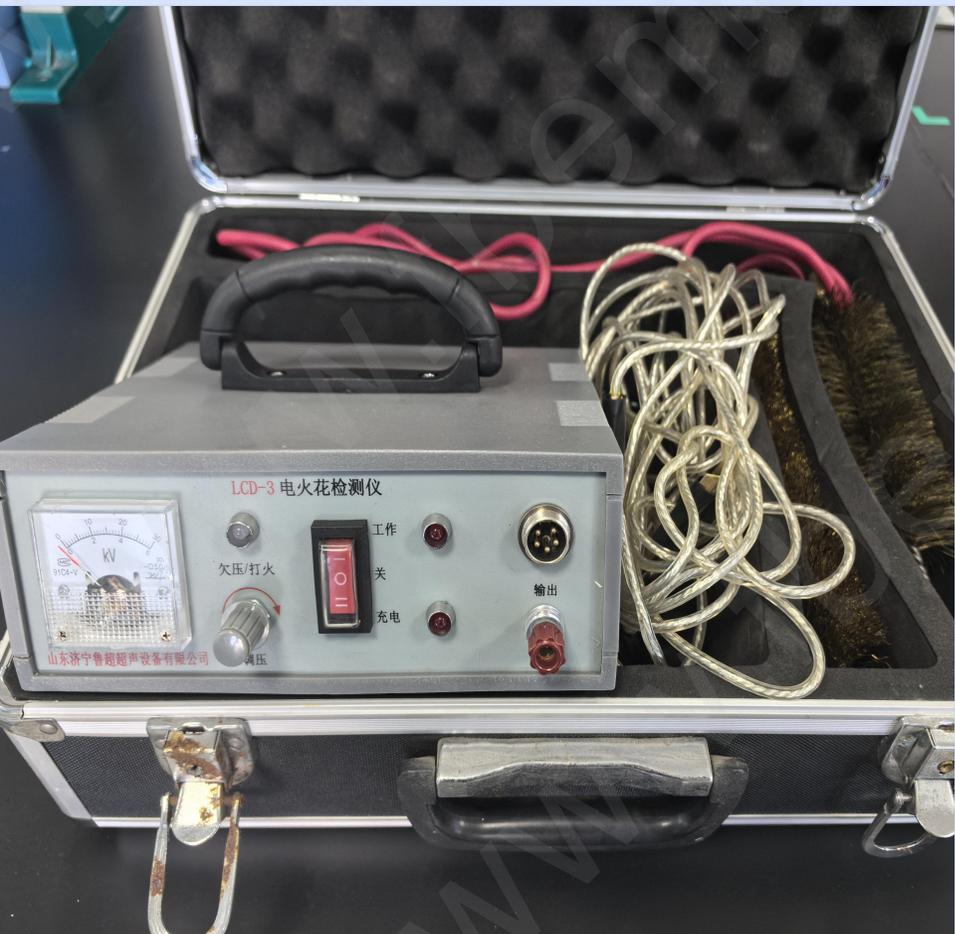




PART FOUR

Quality Acceptance Criteria

Operating Procedures for the Spark Leak Detector



01 Anti-corrosion Coating Leak Detection Technology

Inspection of coating integrity, particularly the precise localization of coating defects, detection of large and medium-sized coating failures, and effective repairs are critical measures to ensure effective insulation between soil and pipeline, enhance cathodic protection effectiveness, and extend pipeline service life.

02 Leak Point Detection

- Each joint must undergo leak detection using an electrical spark leak detector at 15kV. The scanning electrode movement speed shall not exceed 0.3m/s, with no detectable leaks as the pass criterion.
- If leaks are detected, apply an additional layer of heat-shrink tape for repair.

Peel Strength Test



- The inspection shall be conducted in accordance with the method specified in GB/T 23257. Inspection areas include the pipe body and the overlapping zone with the anti-corrosion coating. The pipe body temperature during inspection should be maintained between 15 and 25°C.
- The peel strength for both the steel pipe and the anti-corrosion coating shall not be less than 50 N/cm, with 80% of the surface exhibiting cohesive failure. When peel strength exceeds 100 N/cm, interfacial failure is permissible, provided the primer on the peel surface remains fully adhered to the steel pipe.
- Conduct random sampling of one joint per unit daily; for butt joints, sample one joint per 20 joints:
 - If any joint fails inspection, double the sampling rate. Should failures persist after doubling the sampling rate, all joints in that pipeline section shall be reworked.
 - After passing inspection, reheat the peel test strip to its original position and apply one additional heat-shrink sleeve.
 - All heat-shrink sleeves failing inspection shall be reworked.
- ▶ Note: Adhesion strength testing must be conducted 24 hours after joint installation.



PART FIVE

Product

Advantages

Product Advantages



01

Full Industry Chain Coverage

Covering the entire industry chain from compounding, pelletizing, extrusion, irradiation, expansion, adhesive production to coating, we maintain a comprehensive production and testing equipment system to ensure full control from raw materials to finished products.

02

Complete Product Specifications

Heat Shrink Sleeves (Closed-End Type): Minimum diameter 15mm, maximum diameter up to 1547mm.

03

Cost Optimization & Fast Delivery

Fully integrated in-house production with no subcontracting ensures ample capacity and efficient supply. Emergency orders receive response within 24 hours.

04

Consistent Quality

Imported raw materials guarantee consistent quality and reliability.



PART SIX

Product Application

Examples





**Thank you for
watching.**

