

Weld Seam Quality Control & NDT Testing Manual

Technical Standard Operating Procedures for ERW & LSAW Weld Integrity Verification

1. Executive Summary & Quality Commitment

The integrity of the longitudinal weld seam is the primary determinant of safety and structural longevity in Electric Resistance Welded (ERW) and Longitudinal Submerged Arc Welded (LSAW) steel pipes. Engineering concerns regarding microstructural alignment at the fusion line, hidden micro-fissures, and pressure boundary blowout stress are absolute barriers to procurement.

This technical manual details the definitive Quality Assurance (QA) workflow executed at our mills. By integrating **Online Intermediate Frequency Heat Treatment** with an exhaustive tri-layer Non-Destructive Testing (NDT) matrix—comprising **Ultrasonic Testing (UT)**, **Eddy Current Testing (ET)**, and **Hydrostatic Structural Destructive Verification**—we guarantee that our longitudinal welded junctions perform equivalently to the seamless pipe body parent material.

2. Online Seam Annealing (Heat Treatment Process)

During high-frequency induction welding, the rapid thermal localized cycling generates a hardened, brittle martensitic structure along the heat-affected zone (HAZ). To restore flexibility and corrosion resistance, our mill executes continuous inline seamless normalizing.

The Mechanical Operation Flow:



- **Temperature Tracking:** Monitored via non-contact dual-wavelength infrared pyrometers to maintain strict adherence within $\pm 10^{\circ}\text{C}$ limits.
- **Microstructural Refinement:** Reheating the weld zone above the upper critical transformation temperature (Ac_3) triggers grain recrystallization, completely wiping out weld stress profiles and eliminating grain boundary anomalies.

3. Tri-Layer Non-Destructive Testing (NDT) Workflows

To ensure zero-defect escape parameters before shipping, every standard length of straight seam welded pipe undergoes consecutive volumetric and surface electrical inspections.

A. Online & Offline Ultrasonic Testing (UT) — Internal Volumetric Scan

Ultrasonic inspection serves as our primary defense mechanism against sub-surface inclusions, micro-porosities, and incomplete fusion boundary tracking.

- **Mechanism:** Multi-channel piezoceramic angle-beam probes are aligned directly over the weld centerline, pulsing high-frequency acoustic waves (2.5MHz – 5MHz) into the junction footprint.
- **Automated Gating:** Real-time automated physical monitoring triggers an audible alarm and active spray-paint tagging mechanisms if internal flaw echo amplitudes cross reference-block thresholds (calibrated via explicit API 5L N5 longitudinal notches).

B. Eddy Current Testing (ET) — Surface & Near-Surface Scan

Eddy Current evaluation is utilized primarily to catch high-density localized surface imperfections, penetrating outer scale variables.

- **Mechanism:** Concentric encircling or sector-configured induction coils generate high-frequency magnetic fields across the pipe matrix, establishing continuous localized electrical eddy loops.
- **Defect Trapping:** Any hairline cracks, pinholes, or surface slivers disrupt the eddy currents, shifting coil impedance vectors which are recorded immediately by high-speed digital software.

C. Full-Body Hydrostatic Testing — Ultimate Structural Pressure Verification

Every single piece of straight seam welded pipe undergoes real-time hydrostatic testing to physically validate the mechanical boundary capability of the weld seam.

NDT Test Methodology	Primary Flaw Detection Focus	Testing Location Thresholds	Compliance Verification Codes
Ultrasonic Testing (UT)	Volumetric internal cracks, slag inclusions, fusion path tracking errors, sub-surface pores.	Executed online immediately post-cooling + repeated offline post-beveling.	API 5L Spec, ASTM A53, EN 10217-1
Eddy Current (ET)	Hairline surface fissures, outer skin slivers, longitudinal scratches, outer pinholes.	Integrated inline directly prior to the final mechanical sizing arrays.	ASTM E309, EN 10246-3
Hydrostatic Test	Physical yield verification, leak path tracking, macro weld rupture checks.	Executed offline at the final testing bay. Pressure held for ≥ 5 seconds .	API 5L Barlow Formula (up to 100% SMYS)

 Quality Assurance Benchmark: Full Traceability & MTC 3.1 Validation

All data profiles from the automated UT/ET systems and hydrostatic pressure-holding charts are cross-mapped with the unique pipe serial tracking stencil. This immutable process trail ensures that each Mill Test Certificate (MTC) issued under EN 10204 3.1 lists verified non-destructive inspection data.

Do You Have Strict NDT Inspection Protocols or Third-Party Witness Requirements for Your Pipeline Tender?

Our facility supports full customer audits and welcoming Bureau Veritas, SGS, or Lloyd's Register inspectors for comprehensive witness validation.

Contact Our Lead QA Engineering Sales Manager: HUDSON@cangtiepipe.com | WhatsApp: +86 19061773869

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