CORE LINEPIPE

Field Installation Guide

V1.4 Issued March 2026

Contents

1 Introduction

The Field Installation Manual is designed to provide ClickWeld® Technicians and Pipeline Contractors with the information needed for bidding, planning, or executing CORE Liner® pipeline projects.

1.1 CORE Linepipe®

Who We Are

CORE Linepipe® prides itself on providing a cost-effective pipeline system that offers superior corrosion resistance and dual containment, backed by zero environmental releases since beginning operations in 2014.

CORE Linepipe® is a pipeline technology company focused on innovative solutions that rethink traditional pipeline systems. CORE's goal is to change how pipelines are constructed by shifting the focus to factory installation over fieldwork.

CORE Linepipe® has a world class team consisting of energy pipeline veterans who have a proven track record building relationships with clients and delivering positive results, thriving where others cannot.

Zero Environmental Releases

With over 50 clients across North America, CORE Linepipe® has successfully developed a reliable pipeline system with over 1000 km (600 miles) installed to date (2014 to year-end 2024).

Since its incorporation in 2012, CORE has maintained ZERO environmental releases or in-service failures. Providing a dual containment, corrosion-resistant system, CORE exceeds industry ESG (Environmental, Social and Governance) standards.

In addition to supplying a high-quality product, CORE also takes pride in providing high-quality, cost-saving pipe joining services.

1.2 Core Safety

The safety of all stakeholders is paramount to CORE Linepipe® Leadership. Safety is embedded throughout the development of every strategy, system, process, product, and service offering. The CORE Linepipe® team takes pride in our safety culture that is built on:

- The engineering of safety into systems, processes, products, and equipment designs.
- Critical assessment of hazards and work procedures to ensure the safe and efficient operation by production and field personnel.
- Documentation of processes, inspections, near misses, incidents, and daily toolbox talks for training, monitoring, and compliance.

1.3 Core Quality

CORE Linepipe® utilizes an extensive quality assurance and quality control program that adheres to international standards and utilizes Lean and Six Sigma methodologies to ensure we are industry leaders.

CORE Linepipe® policies and procedures provide complete traceability from production to installation, delivering a complete documentation package to every client upon project completion. CORE Linepipe® has a quality commitment that allows our client to focus on everything else.

CORE's QMS is ISO 9001 certified as of November 2022

NSF-ISR
Registered to ISO 9001

1.4 Core Engineering

CORE's engineering and product development team brings world-class expertise in product development, machine design, qualification testing and oil and gas applications. All design work for products, manufacturing equipment, and field equipment has been completed in-house.

1.5 Core Manufacturing

CORE Linepipe® has a state-of-the-art manufacturing facility located about 30 minutes North of Calgary in Crossfield, Alberta, Canada. Sitting on 9 acres, the 60,000 square foot manufacturing centre can produce up to 1200 km/800 miles of pipe per year in sizes from 4" to 12".

1.6 Core Construction Support

CORE Linepipe® has a primary field services center located in Crossfield, Alberta, and satellite service depots in Texas and Colorado. CORE Service® Contractor equipment rentals are available at our service centers and provide Contractors with all the equipment and tools required to fully install CORE Linepipe®. CORE Service® technical support is available across North America to support construction projects and Contractor competency verifications. CORE Service® crews when utilized are self-sufficient in the field, operating out of a mobile workshop and storage trailer that is fully equipped with all required tooling, components, and consumables to complete a job.

1.7 Core Key Performance Metrics (KPI's)

The CORE Service® team works diligently to ensure timely project execution. To ensure the most efficient and cost-effective installation, planning and collaboration between the CORE Service® team and contractor team is critical. Contractors can utilize the CORE Linepipe

baseline KPI's to measure the effectiveness of their certified installation crews. The following Key Performance Indicators are based on historical performance:

KPI Category	KPI Item	4" 6" 8"		10" 12"		Unit of Measure
		Winter	Summer	Winter	Summer	
		KPI Target	KPI Target	KPI Target	KPI Target	
Safety						
	Management Site Safety Audits	1	1	1	1	No. Completed
	TRIF / TRIR	0	0	0	0	Incidents
	Safety Observations	1	1	1	1	Per Day
	FLHA	1	1	1	1	Per Day
Quality						
	Material Receiving Acceptance	>99%	>99%	>99%	>99%	Acceptance Rate
	Joint Repair	<0.5%	<0.5%	<0.5%	<0.5%	Rework / Repair
Delivery						
	Pipe Delivered On-Time	100%	100%	100%	100%	
	Ancillary Items Delivered On-Time	100%	100%	100%	100%	
	Service Crew Provided On-Tim	100%	100%	100%	100%	
Technical						
	Support Response Time	<4	<4	<4	<4	Hours
Execution						
	CORE Management Visits	1	1	1	1	No. Completed
	Mobilization / De-Mobilization	2	2	2	2	No. Units
	Field Press ClickWeld®	15	10	20	15	Minutes
	Field Cut Tie-Ins	2	2	4	4	Hours
	Stab On Tie-Ins	1	1	1	1	Hours
	Flange Installations	2	2	2	2	Hours
	Schedule Interruptions	<5%	<5%	<5%	<5%	Project Duration

1.8 CORE Service Locations

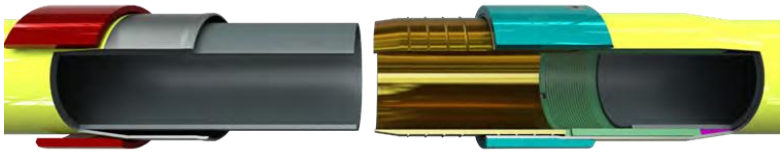
2 CORE Linepipe® Components

2.1 General

CORE Liner® is a corrosion resistant, dual containment pipe-in-pipe system that combines the high-pressure capacity of steel with the corrosion resistance of plastics, utilizing an outer steel pipe with a pre-installed inner HDPE liner. This pipe-in-pipe system provides true dual containment as well as internal and external corrosion resistance from flange to flange.

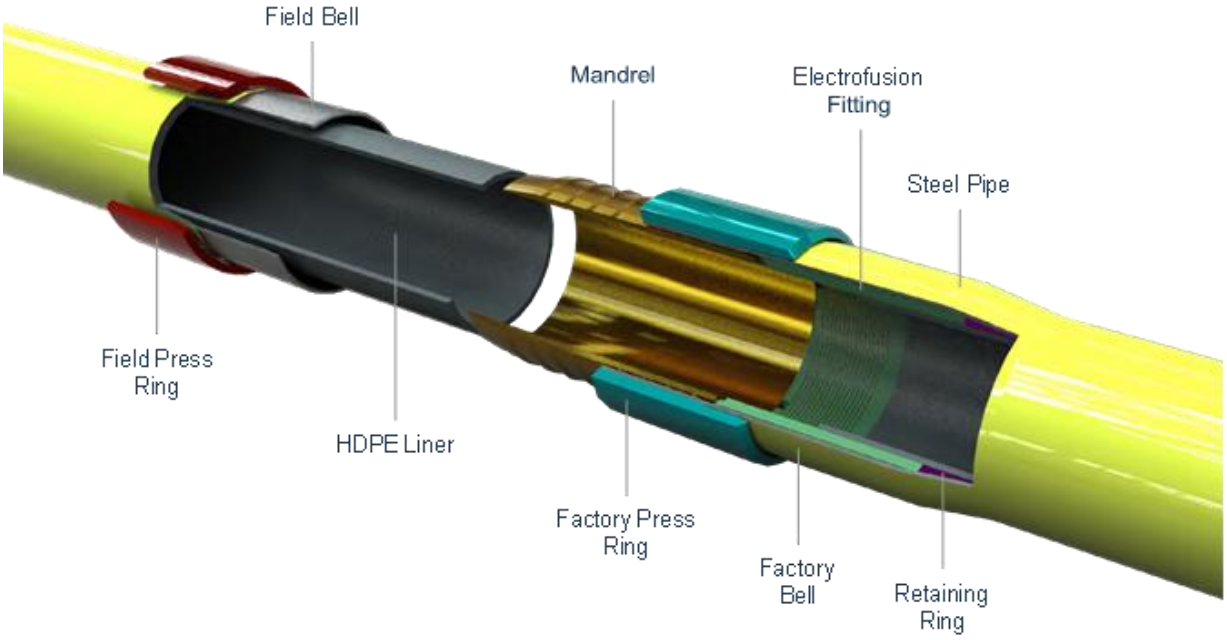
To complete the ClickWeld® joining system, two pipe ends are joined together (factory-end and field-end). The internal HDPE liner is joined using an electrofusion process. The result is less field work, lower total cost of ownership, and increased reliability for the pipeline system. The structural steel pipes provide the pressure capacity, secondary containment and are joined together using the CORE Linepipe® proprietary ClickWeld® system.

The internal plastic liner provides corrosion resistance, primary containment and is joined using an integral electrofusion process.



2.2 ClickWeld®

ClickWeld® is the innovative proprietary mechanical joining system of CORE Linepipe®. The ClickWeld® system uses high grade carbon steel components to form a connection that is gas and liquid tight, eliminating the need for field welding.



The 7-Step Assembly Process:

At the Production Plant:

1) Belled steel factory end is created
2) Liner, electrofusion (EF) coupling, and retaining ring is inserted into the steel pipe
3) A mandrel is inserted inside the bell, butted up to EF coupling
4) A factory ring is pressed over the bell completing the factory connection

In the Field:

5) Field and factory ends are stabbed together
6) The field bell is pulled over the mandrel
7) The field ring is finally pressed, deforming the pipe onto the mandrel's profile, completing the ClickWeld® joint.

2.3 Electrofusion

Premium Electrofusion fittings (EF) serve as an alternative to butt fusion for HDPE joining.

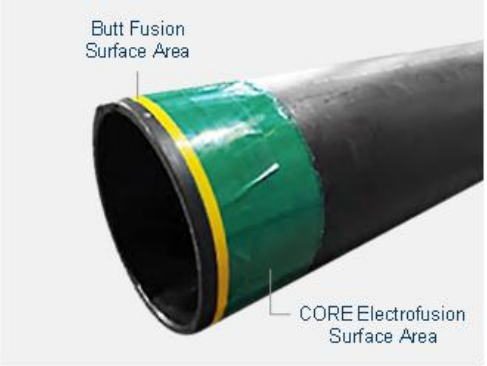
CORE Liner® Dual Zone EF consists of an HDPE coupling with copper wiring embedded inside. That wiring is connected to an electrofusion control unit (ECU) that fuses the coupling and HDPE pipe, creating a homogeneous joint stronger than the parent pipe.

The ECU measures and records a variety of data, adjusts fusion/soak time to account for ambient temperature and ensures continuity of the wiring. This data is included in CORE Liner® quality and traceability documentation.

EF's have more than 70 years of usage and are commonplace in gas distribution and offer significant advantages over butt fusion.

Advantages:

- 7 times the strength and surface area of a perfect butt fusion
- Reinforces the liner against radial collapse
- Anchors the liner against axial collapse
- Increased quality control on all joints due to the Electrofusion Control Unit
- Easier pigging through the full-bore profile at the joint



CORE LINER® PRODUCT	LINER OD (in)	LINER THICKNESS (in)	ELECTROFUSION AREA (in^2)	TRADITIONAL BUTT FUSION AREA (in^2)	EF IMPROVEMENT VS BUTT FUSION
CL440	4.18	0.23	38.00	2.85	13x
CL640	6.30	0.25	53.38	4.79	11x
CL648	6.24	0.25	52.87	4.71	11x
CL671	6.06	0.24	49.84	4.39	11x
CL856	8.18	0.32	74.32	8.06	9x
CL1071	10.10	0.41	93.69	12.35	7.5x
CL1279	12.05	0.48	112.57	17.59	6.5x

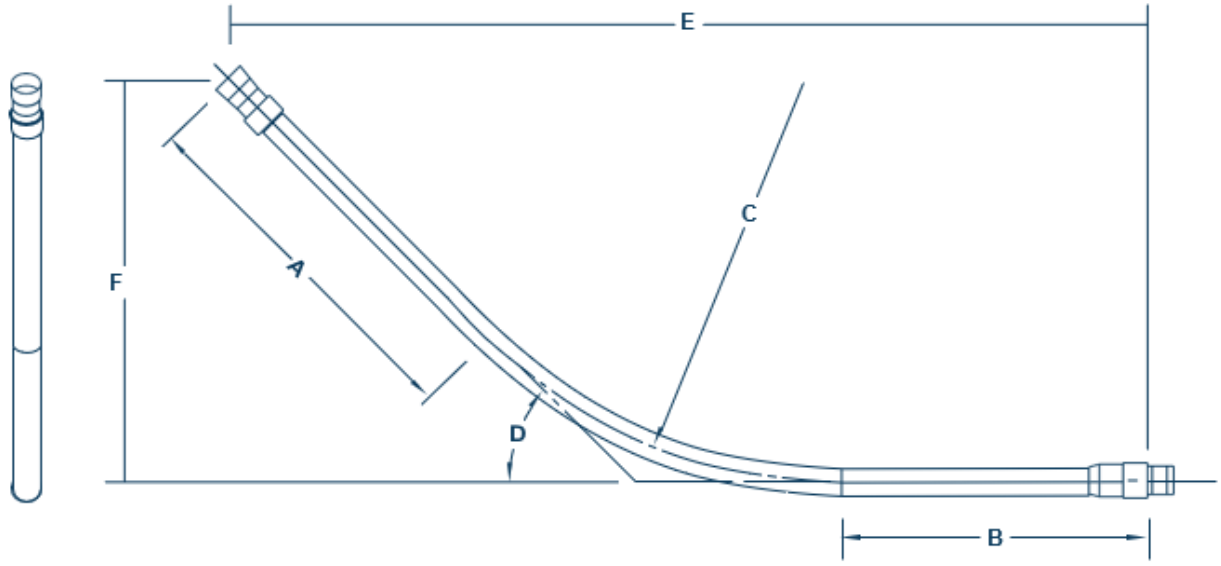
2.4 Bends

The minimum bend radius of CORE Liner® is 20D and must be cold bent to ensure the internal liner and steel are not compromised. CORE Liner® products can easily be field bent using standard field bending equipment.

Bends greater than 30° can be factory bent, improving QA/QC, and saving time in the field, and must be pre-ordered and approved by the client.

2.5 Risers

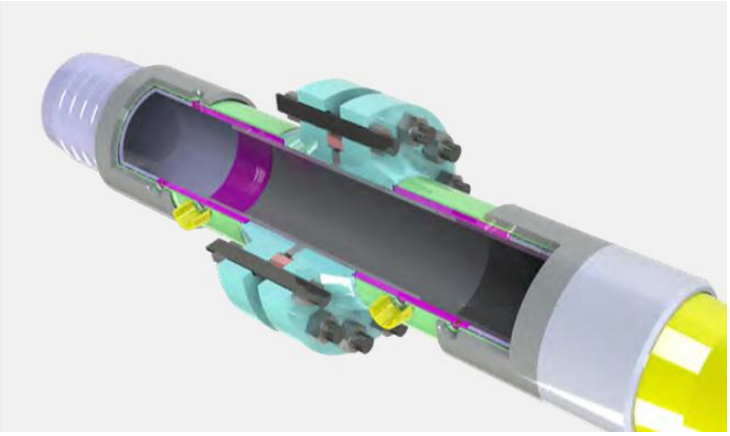
CORE Liner® risers are factory bent to a standard 45° but can be customized to accommodate client requirements. CORE Liner® risers allow clients to have a corrosion resistant pipeline from flange to flange, without having to resort to expensive internal coatings. CORE Liner® risers must be pre-ordered and client sign-off on the CORE Liner® riser drawings is required prior to bending to assure delivered dimensional quality.



Note: D is the angle in degrees and C is the turning radius in mm or inch.

2.6 Flanges, Spacers, Gaskets and Bolt Up

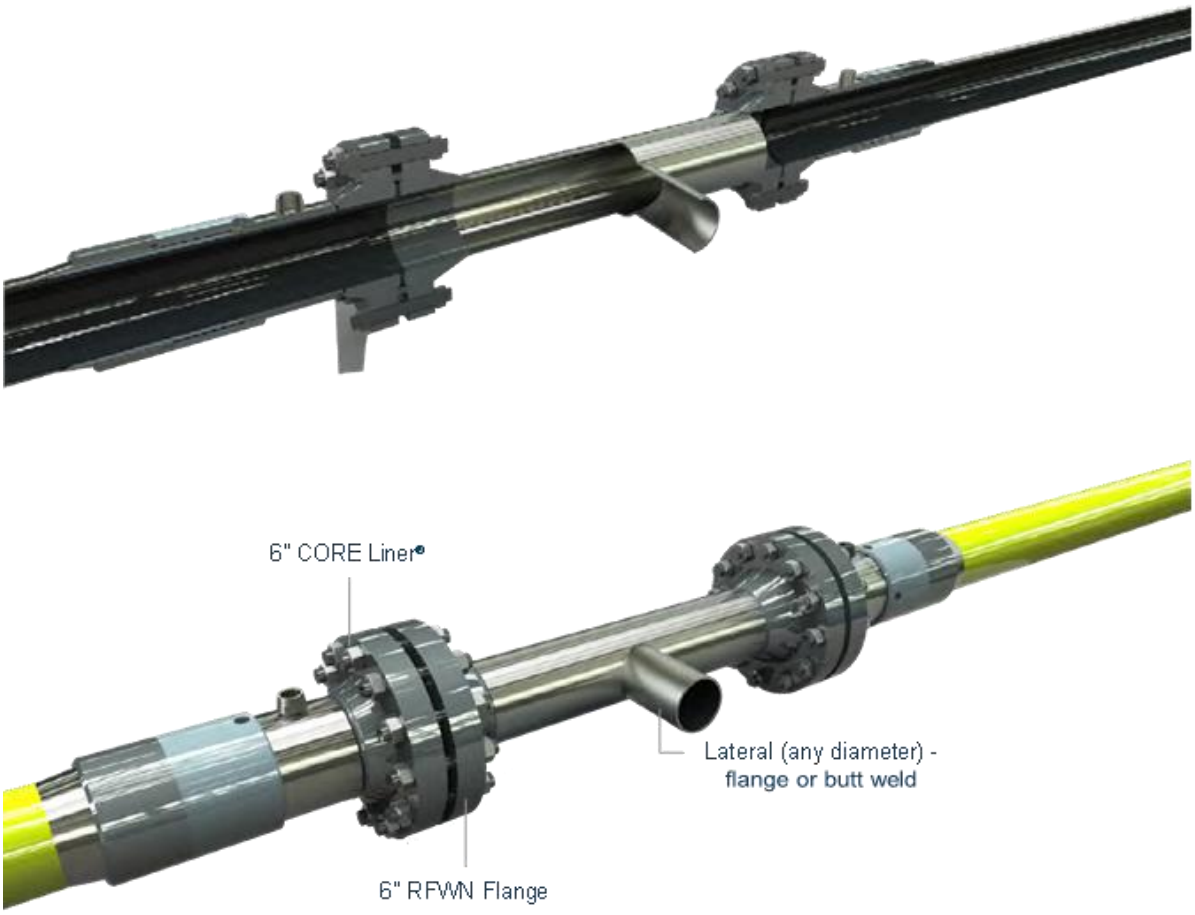
Flanges meet the requirements of ASME B16.5 and are joined to the CORE Liner® pipeline using the patented ClickWeld® joining system. Each flange connection comes with an HDPE stub end, ClickWeld® components, and an electrofusion fitting to easily connect to an existing CORE Liner® pipeline. The design of the flange assembly has safeguards against excessive strain on the HDPE stub end, thereby eliminating a failure mode common to other liner systems.



2.7 Flow Joints

CORE Linepipe® can supply custom stainless steel, flanged, Flow T's and Y laterals upon request. Flanged flow joints are easily integrated into the CORE Liner® system. Alternatively, lap joint, raised faced flanged carbon steel flow joints can be fabricated and internally coated by a third party. Please contact a CORE Linepipe® representative for guidance.

PRODUCT DESCRIPTION	ID (in)	ID (mm)
CL440	3.72	94
CL640	5.81	148
CL648	5.74	146
CL671	5.59	142
CL856	7.52	191
CL1071	9.37	238
CL1279	11.14	283



2.8 Vents

CORE Linepipe® provides a stainless-steel vent tube, fittings, and needle valves to connect to the thread-o-let port located on each CORE Liner® flange.

2.9 Joint Coatings

Although many external coatings are suitable for use on CORE Liner® pipelines, CORE Linepipe® recommends using STOPAQ as external corrosion protection on CORE Liner® joints. Nevertheless, CORE Linepipe® clients may elect to use other external coatings. Please contact a CORE Linepipe® sales representative for confirmation of suitability, guidance and training recommendations for your coating of choice.

PRODUCT	APPLICATION
STOPAQ WRAPPINGBAND CZ	OPERATING TEMPERATURE UP TO 50°C (122°F)
STOPAQ WRAPPINGBAND CZH	OPERATING TEMPERATURE UP TO 70°C (158°F)
STOPAQ WRAPPINGBAND CZHT	OPERATING TEMPERATURE UP TO 85°C (185°F)
STOPAQ OUTERWRAP PE	OPERATING TEMPERATURE UP TO 70°C (158°F)
STOPAQ OUTERWRAP HTPP	OPERATING TEMPERATURE UP TO 85°C (185°F)
SCAR GUARD®	HDD JOINT COATING SCOUR PROTECTION

3 Construction Execution Planning

3.1 Pre-job Meeting

Within 2-3 weeks prior to shipping materials, CORE requires a pre-job kickoff meeting to collaborate and strategize with the pipeline contractor to ensure project is set up for success.

The purpose of the Pre-Job Meeting is to coordinate on the manpower/equipment requirements, work sequence, work schedule, logistics, safety protocols, communication channels, etc.

REQUIRED MEETING ATTENDEES		
CORE Linepipe®	**Pipeline Contractor**	**Customer/Client**
CS Manager / Superintendent	Spread Boss	Inspector

OPTIONAL MEETING ATTENDEES		
CORE Linepipe®	**Pipeline Contractor**	**Customer/Client**
Sales Representative	Management	Project Manager
ClickWeld Technician	HSE / QC	HSE / Integrity

3.2 Weather Limitations

ClickWeld® and electrofusion of CORE Linepipe® is permissible at pipe temperatures from -22˚F (-30˚C) to +113˚F (+45˚C). Like most pipe joining systems, the ClickWeld® and electrofusion process may be challenging in severe weather conditions. Excessive dust, rain and snow must be kept clear of the ClickWeld® joining process.

The CORE Service® team is available to review weather situations with the Contractor and pipeline inspector. The CORE Service® team reserves the right to recommend suspending operations if weather conditions have the potential to affect the quality of the pipe joining activities.

3.3 Contractor Competency Qualifications

The CORE Service® team offers two options for construction execution. Option one is a CORE Service® integrated plan that utilizes CORE Service® crews and equipment to complete the ClickWeld® and electrofusion of CORE Linepipe®. Option two is a contractor total install plan that utilizes the CORE Service® ClickWeld® Competency Program to train Contractor personnel to complete the ClickWeld® joining process using specialized ClickWeld® equipment and tools rented from CORE Service®. Both options are supported by the senior technical staff of the CORE Service® department for Quality Assurance.

Activity	Option 1 – CORE Service® Integrated	Option 2 – Contractor Total Install
ROW Prep and Pipe Stringing	Contractor	Contractor
Bending	CORE Service® (Shop) / Contractor	CORE Service® (Shop) / Contractor
Joint Cut and Scrape	Contractor	Contractor
Mainline ClickWeld®	CORE Service®	Contractor (Certified Level 2)
Electrofusion	CORE Service®	Contractor (Certified Level 1)
Joint Coating	Contractor	Contractor
Ditch, Holiday Detect, Lower In	Contractor	Contractor
Tie In, Cut, Swage and ClickWeld®	CORE Service®	Contractor (Certified Level 3)
ClickWeld® Flange Installation	CORE Service®	Contractor (Certified Level 2)
ClickWeld® Pull Head Installation	CORE Service®	Contractor (Certified Level 1)
HDD Installations	Contractor	Contractor
Backfill and Cleanup	Contractor	Contractor
Pressure Test	Contractor	Contractor

Prior to starting work it is strongly recommended that the contractor put the appropriate personnel through CORE Linepipe® Rise modules.

Contractor Staff Position	Rise Training Modules Recommended
Spread Boss	Project Execution Modules
Joint Coating Personnel	Project Execution Modules STOPAQ Application Guide
Side Boom Operator	Project Execution Modules ClickWeld® Mainline Field Press Remote Control
Stabber / Laborers	Level 1 ClickWeld® Certification
Joint Prep Personnel	Level 1 ClickWeld® Certification
Track Hoe Operator	Project Execution Modules Field Press Remote Control Excavator Operator

4 ROW

4.1 ROW Preparation

Prior to the material arriving on site, the pipeline contractor should complete typical ROW preparation activities (fencing, stripping, clearing, brushing etc.).

When utilizing the CORE Service® teams for joining they will require unrestricted access to the ROW to ensure job efficiency.

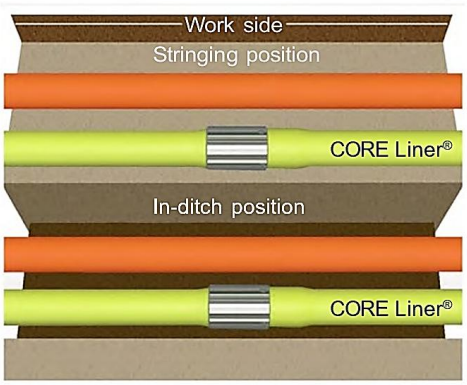
A minimum ROW width of 50 feet (15 meters) is required. A minimum workspace of 21 feet (6.4 meters) from the edge of ROW to the ditch is required to complete the mainline ClickWeld® procedure. To maximize productivity 4 feet (1.3 meters) of workspace is required on each side of CORE Liner®. Avoid having the spill pile on work side, the spill pile to be on opposite sides of the ditch.

4.2 Pipe Positioning

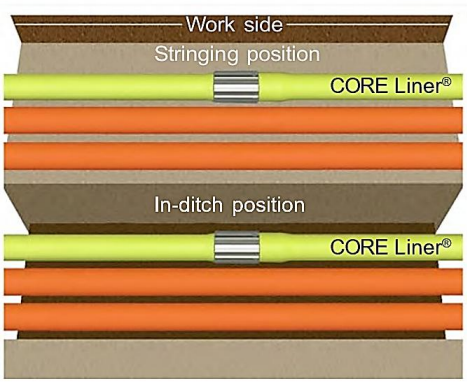
The preferred sequencing of the ROW depends on the number of lines in the trench.

- CORE Liner® can be installed in any sequence or in- ditch position on multi-line projects
- The stringing position of CORE Liner® does not have to match the install position.
- To maximize productivity when constructing multiple lines, it is optimal to have the CORE Liner® line in the following installed positions (in the ditch)
    - Outside position on dual line
    - Inside position on 3 or more lines
    - Avoid being a middle line

Two lines:



Three (or more) Lines:



5 Hauling and Stringing

5.1 Pipe Hauling

CORE Linepipe® loading can be arranged through the CORE Linepipe® Logistics team. CORE Logistics can arrange for a preferred carrier to ship the pipe or load the Contractor or Client selected carrier. CORE Liner® will be loaded on specially designed pipe bunks (provided by CORE Linepipe®). Each level of pipe is individually strapped to ensure safe delivery and stringing. Pipe bunks must be returned to CORE Linepipe®. Unreturned pipe bunks will be invoiced to the project.

CORE Linepipe® shipping information:

Canadian Shipping

CORE Liner® Item	Weight per Joint (kg)	Payload Net (kg)	Joints per truck	Total per truck (m)
CL440	270	26,332	78	1,459
CL640	400	26,332	60	1,122
CL648	459	26,332	56	1,047
CL671	637	26,332	40	748
CL856	720	26,332	35	655
CL1071	1,287	26,332	20	374
CL1279	1,570	26,690	17	318

USA Shipping

CORE Liner® Item	Weight per Joint (lbs)	Payload Net (lbs)	Joints per truck	Total per truck (ft)
CL440	595	37,850	63	3,864
CL640	882	37,850	41	2,576
CL648	1,011	37,850	37	2,269
CL671	1,404	37,850	26	1,595
CL856	1,586	37,850	24	1,472
CL1071	2,837	37,850	13	793
CL1279	3,474	37,850	11	671

5.2 Directional Assembly

CORE Liner® products have dissimilar ends (factory and field end). The field end can be replicated in the field, factory end cannot.

Factory-End Field-End Factory-End Field-End

Factory End - the mechanical male end of the product (alternatively described as the side of the factory installed press ring)

Field End - the mechanical female end (alternatively described as the side of the field installed press ring).

Product orientation has a significant impact on the installation logistics, productivity, and efficiency of the job. To maximize efficiency, there is a need to properly synchronize the site layout with the direction of pipe loading, pipe stringing, workflow, crossing, boring, and tie-in directions. Proper planning can avoid wasted time on site as well as wasted materials.

CORE Liner® is assembled most efficiently in one direction as shown in the ROW Layout diagram (pg.15). This is opposite to the direction of a typical pipeline workflow although CORE can be assembled in either direction. The CORE factory end should be pointing in the direction of workflow.

The standard CORE Liner® pull head connects to the factory end of the pipeline; this is the preferred end for the HDD pull direction.

5.3 Pipe End Protection

As end packaging performs a critical function in protecting ClickWeld® components, the packaging must be kept on the pipe ends up until the installation time. Prolonged storage without packaging can result in corrosion and contamination. Pipe that has been stored in the field for a long duration is subject to inspection and approval prior to installation. Removal of contamination is a critical step to ensure product quality and requires time and vigilance that typically slows down installation. The factory end packaging is weather resistant, not water resistant, additional protection should be added for night capping in lowered-in sections.

As part of the material receiving process ensure all pipes that arrive on a project have adequate packaging at both ends.

- If the packaging has minor damage, repair by patching over the damaged area. Weather-resistant pipeline tape is recommended.
- If there is no packaging on the pipe ends, or the packaging is severely damaged, the pipe ends need to be repackaged. The required material can either be procured locally or from CORE Linepipe®.
- Basic layering of packaging consists of:
    - Plastic netting over steel parts: to provide an air gap between the steel and the plastic bag.

- UV resistant plastic bag onto the pipe end extending over the steel onto the pipe cover: to keep out moisture.
- Stretch wrap around the bag to hold it in place.
- Tape around plastic bag: to seal the pipe end and secure bag.

5.4 Stringing Procedure and Equipment

Exceptional care is required to ensure that the ends of each joint of pipe are not damaged. Stringing hooks cannot be used on pipe ends. This can potentially damage the packaging, mandrel, or liner ends of the CORE Liner® system.

CORE Linepipe® can be unloaded using conventional slings, vacuum, pipe handler (deckhand) or other approved methods. The Contractor must ensure an appropriate stringing procedure and lifting devices are in place according to industry recognized safety standards and procedures. The Contractor must ensure correct unloading zones and clearance, inspect paperwork and pipes, mark pipe center points for balanced lifting, and use steel stakes in the trailer pockets as secondary safety where possible. Vacuum lifters are preferred over calipers or slings to minimize personnel risk and pipe damage. Pipes must be lifted vertically, stabilized with lanyards if needed, and placed carefully on tubs or dunnage without ground contact. Maintain clear zones around unloading operations to ensure safety.

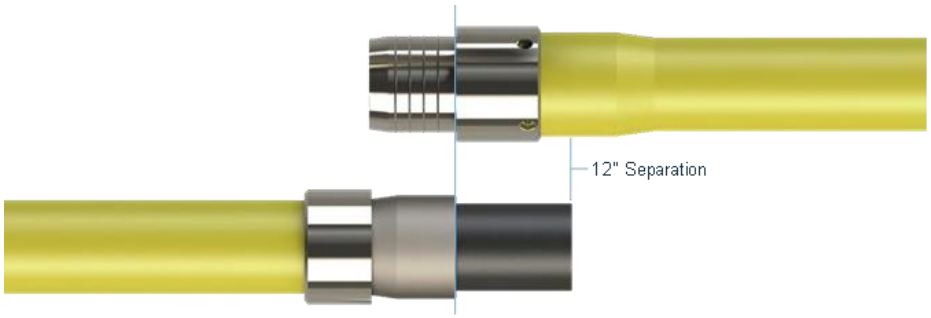
Do not unpack or unwrap the ends of the CORE Liner®. The Pipe End Protection must stay intact until the ClickWeld® joining process begins.

5.5 Pipe Stringing

The pipe should be strung directionally as agreed upon in the project pre-job meeting (factory and field-end, directional stringing required).

The pipe is to be strung to ensure that the factory ring (mechanical male-end) is aligned with the field end bell (mechanical female-end) of the adjacent pipe (illustrated below).

Stringing Line



CORE Liner® is required to be double tubbed. The Contractor should plan on using twice as many pipe tubs than conventional steel pipeline stringing. The tubs should be placed 11.5 feet (3.5 meters) from the pipe end. When possible, tall tubs are preferred. Stringing on single tubs will reduce the efficiency of preparing the ends for joining.

Crotches are required every 7 joints in good, flat, ground conditions. In poor ground conditions crotches should be utilized as frequently as is necessary to ensure pipe stability and safety.

Crotch with 4”x6” Material

6” CORE Liner® on a Crotch

5.6 Pipe Storage

If pipe staging is necessary, set aside a flat level area of an appropriate size. CORE Linepipe® requires different storage practices from that of bare steel. Safe and effective storage of CORE Liner® products require two main considerations over conventional steel pipe:

- The ends of the pipe have rings that increase the diameter of the pipe. This larger diameter restricts the ability to “pyramid” stack the pipe. Spacers (pipe bunks) are required between the pipe layers to secure the pipe stack and to protect the pipe cover.
- The ends of the pipe require keeping the packaging in place to protect the ClickWeld® components from the environment.

Follow the below steps for storing CORE Liner®:

1) Ensure the storage location has stable, level ground. Verify that the area has sufficient access for operators, lifting equipment, and pipe.

2) Clear the area of any hazards that may affect the pipe and the storage process.
3) CORE Liner® can be placed on wooden dunnage for a single level. The spacing of the dunnage should allow equipment to access the pipe and evenly support the pipe. Sufficient support under the pipe is needed to reduce cover damage. There must however be stops on the ends to prevent the pipe from rolling.
4) When stacking pipe, pipe bunks are required. Ensure the pipe maintains even contact within the bunks. Misaligned or twisted bunks put unwanted stress on the pipe cover. CORE Linepipe® cannot be stacked without bunks. Bunks can be purchased for extra storage.
5) Place pipe into bunks. Follow industry standards for proper lifting and moving of pipe. Start by placing pipe in the back-bunk pocket. Slow controlled movement is needed to ensure the pipe fits into the pockets and does not roll off the bunks. If available, anti-roll-off equipment should be used (like a forklift on the back side). Aggressive pipe placement should be avoided to reduce pipe cover and packaging damage.
6) Place each layer of bunks above the previous bunk layer as more pipe layers are added. Avoid stacking pipe layers too high as it becomes difficult to see pipe placement and causes excessive cover damage.
7) Bunks need to be returned to CORE Linepipe®. If bunks are not returned, a purchase invoice will be created. Contact a CORE Linepipe® representative should the bunks be required for long-term storage after the project has been completed.
8) Please refer to your CORE Linepipe® representative for any questions and/or support.

Stockpiled Pipe

Pipe Bunks

6 Bending

The standard (and minimum) bend radius of CORE Liner® is 20D and must be cold bent to ensure the internal liner and steel are not compromised. CORE Liner® products can easily be field bent using standard field bending equipment. CORE engineered drawings of bend configurations are available in typical or customized format. Bends greater than 30° can be factory bent, improving QA/QC, and saving time in the field, and must be pre-ordered and approved by the client.

6.1 Shop Bends

Effective coordination and approval processes are essential for managing pipe bending for CORE Linepipe® projects to ensure accuracy and protection of materials. This involves confirming bend specifications, obtaining approvals, and scheduling with third-party bending companies.

- **Bend specifications confirmation:** Upon project award, the project coordinator verifies the complete list of bends with sales and the customer, detailing parameters such as length, radius, bend angle, tangent lengths, and quantity. Approval for these parameters must be obtained before incurring shipment or bending costs.
- **Bending company responsibilities:** The third-party bending company must follow specific procedures considering the internal CORE Liner®, special ClickWeld® joint characteristics, and protective measures to preserve coatings and prevent damage. After bending, operators inspect pipe integrity, mark bend angles and serial numbers on pipes and documentation and promptly send the Bill of Lading or Packing Slip to the project coordinator.
- **Loading and transport precautions:** Loading times are coordinated with the bending company, ensuring protection of ClickWeld® ends, secure placement with dunnage and blocks, appropriate use of belly wraps and straps, and limiting pipe overhang beyond trailer width.

6.1.1 Shop Bend Hauling

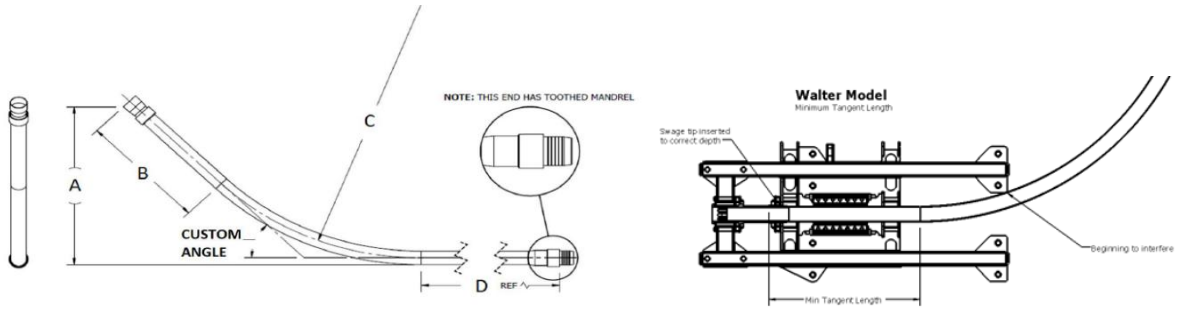
The number of bends that can be hauled on a single load in impacted by the variation in pipe size and bend angle. Similar sizes and angles can be stacked more efficiently than a variety of sizes and angles.

CORE Liner® Item	Typical Maximum Bends Per Load
CL440	15
CL640	12
CL648	12
CL671	12
CL856	8
CL1071	5
CL1279	5

6.2 Field Bending

Field Bending CORE Linepipe® can be completed using standard field bending equipment and procedures. Completed bends should meet the requirements of the project code of construction (CSA Z662, ASME B31.4, etc.). CORE Liner® must be cold bent with a minimum bend radius of 20D for small diameter (NPS 4,6,8) and 40D for large diameter (NPS 10,12).

CORE Linepipe® requires the following minimum tangents of straight pipe on the ends of field bends to allow them to fit into the ClickWeld® field press for connection:



Product	Minimum Tangent B	Minimum Tangent D
CL440	864mm (34”)	1397mm (55”)
CL640	1220mm (48”)	1702mm (67”)
CL648	1220mm (48”)	1702mm (67”)
CL671	1220mm (48”)	1702mm (67”)
CL856	1347mm (67”)	1702mm (67”)
CL1071	1702mm (76”)	1931mm (76”)
CL1279	1753mm (78”)	1982mm (78”)

Bend King

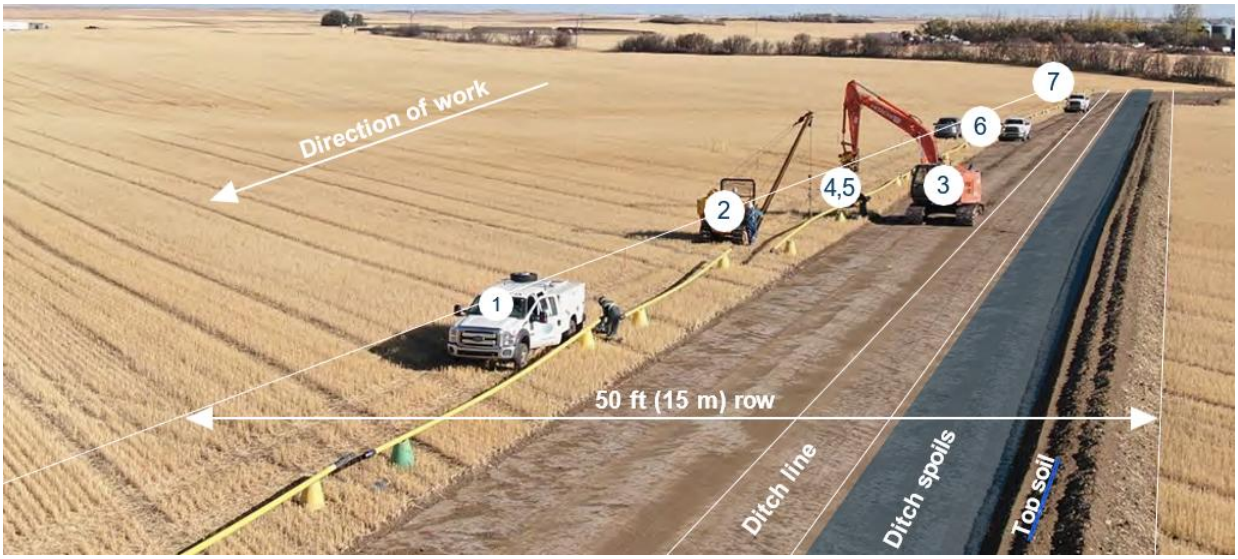
Bending Shoe

Bending Machine

7 Joining

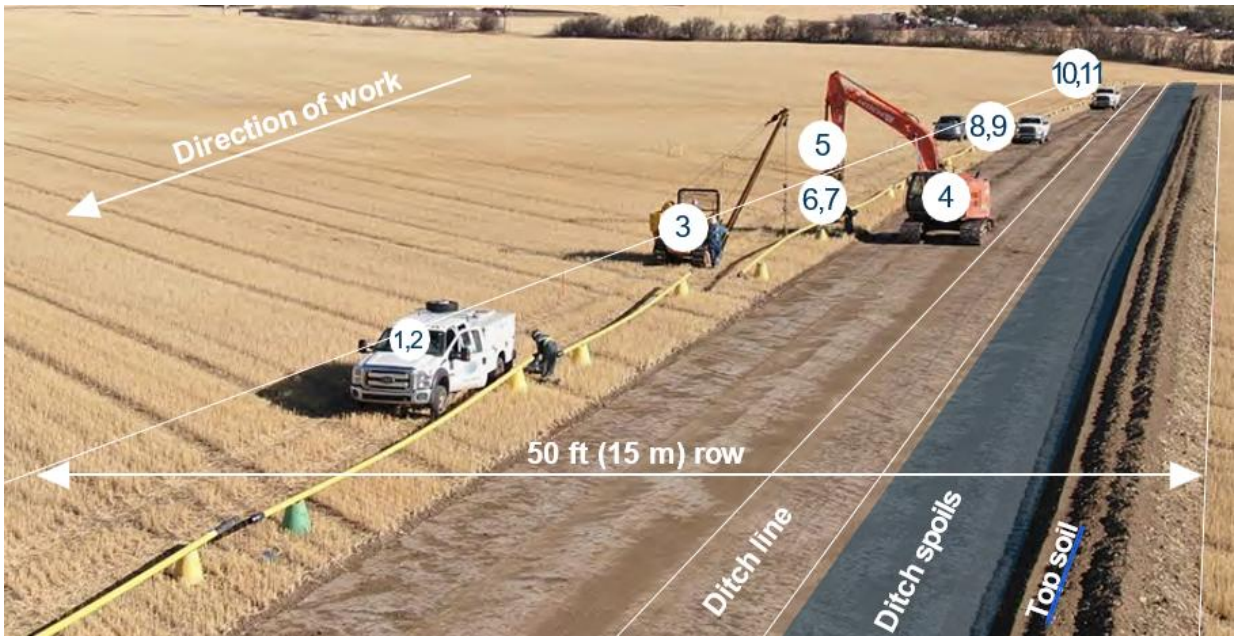
ClickWeld® is completed using the CORE Liner® field press, working with a track hoe and side boom. The ClickWeld® joining crew is like a conventional pipeline welding crew with the field press replacing the welding rig.

Joining Crew for small diameter (NPS 4-8) CORE Linepipe®



Position #	Position	Provided By	Tasks
1	Joint Preparation	Contractor	Remove the end protection Measure, cut, scrape and pre-clean liner
2	Side Boom Operator	Contractor	Position the pipe to be joined (set-in)
3	Track Hoe Operator	Contractor	Position the Field Press for ClickWeld®
4	Field Press ClickWeld Technician	CORE	Clean the mandrel, EF, and liner Align pipe and perform the ClickWeld® Designated signal person for mainline activity
5	Stabber / Labor(s)	Contractor	Total number of labor staff supporting joining will be determined by the contractor based on standard steel pipe joining crew size. Connect / disconnect side boom from pipe Assist with alignment of pipe. Set skid piles / cones
6	Electrofusion Technician	CORE	Electrofusion of the liner to the EF fitting Install metal plugs and seals Record all QC data
7	Joint Coater	Contractor	Apply external coating to joint connection

Joining Crew for large diameter (over NPS 10) CORE Linepipe®



Position #	Position	Provided BY	Tasks
1 / 2	Joint Preparation	Contractor	Remove the end protection Measure, cut, scrape and pre-clean liner
3	Side Boom Operator	Contractor	Position the pipe to be joined (set-in)
4	Track Hoe Operator	Contractor	Position the Field Press for ClickWeld®
5	Field Press ClickWeld Technician	CORE	Clean the mandrel, EF, and liner Align pipe and perform the ClickWeld® Designated signal person for mainline activity
6,7	Stabber / Labor(s)	Contractor	Total number of labor staff supporting joining will be determined by the contractor based on standard steel pipe joining crew size. Connect / disconnect side boom from pipe Assist with alignment of pipe Set skid piles / cones
8 / 9	Electrofusion Technician(s)	CORE	Electrofusion of the liner to the EF fitting Install metal plugs and seals Record all QC data
10 / 11	Joint Coaters	Contractor	Apply external coating to joint connection

7.1 Joining Equipment and Tools

7.1.1 Field Press Setup

These following guidelines can be used for attaching and detaching a field press to an excavator, emphasizing safety precautions, equipment specifications, and operational testing.

- **Task overview:** The task involves safely attaching and detaching the field press to/from an excavator and is performed by field technicians and contractor operators. Hazards include hydraulics, pinch/crush points, and heavy equipment, with required PPE such as hard hats, safety boots, glasses, gloves, ear protection, and high-visibility coveralls.

- **Equipment and safety considerations:** Tools required include various wrenches, hammer, wire brush, field press remote control, and beacon system. Safety reminders stress moving the excavator at minimum speed, having a spotter for collision hazards, and keeping hands clear of attachment mechanisms to avoid cutting or crushing injuries.
- **Excavator configuration and hydraulic connection:** Excavator settings must meet specific hydraulic pressure, flow rate, electrical power, and size requirements depending on the press model. The bucket linkage should be positioned correctly before connecting clean hydraulic hose fittings securely and testing hydraulic flow direction.
- **Attachment, testing, and disconnection procedures:** The field press is attached by aligning the boom and linkage pins, securing the coupler wedge with bolts and nuts, and connecting the beacon system cable. Function tests involve cycling all press cylinders multiple times and inspecting for leaks. Disconnection follows the reverse steps of attachment and hydraulic disconnection.

7.1.2 Excavator Requirements for Field Presses

CORE Liner® is assembled in the field using a proprietary hydraulic field press that connects to an excavator for operation.

Since there are many factors in excavator selection (manufacturer, model, arm length, track width, terrain, ground conditions, etc.) it is up to the contractor to ensure that the excavator that is used to operate the field press on-site meets or exceeds the following requirements.

Specification	SD 100 Series Press (NPS 4,6,8)	LD 300 Series Press (NPS 10,12)
CORE Linepipe Product Size	CL440, CL640, CL648, CL671, CL856	CL1071, CL1279
Hydraulic connection (Auxiliary hydraulics on stick)	Terminate in male 1” NPT CORE will bring and install Stucchi fittings	Terminate in male 1- ¼” NPT CORE will bring and install Stucchi fittings
Required Hydraulic Pressure	3000 psi (207bar)	4900 psi (340bar)
Required Hydraulic Flow	32 GPM (120 LPM)	45 GPM (170 LPM)
Required Electrical Power	24VDC, 10A (we will connect directly to the battery)	24VDC, 10A (we will connect directly to the battery)
Length	11’ 2” (3.40m)	16’ 2-1/2” (4.94m)
Width	5’ 6” (1.68m)	5’ 1-1/2” (1.56m)
Height	9’ 1” (2.77m)	9’ 9-1/2” (2.98m)
Weight (with Tooling)	7,000 lbs. (3,180 kg)	17,000 lbs. (7,730 kg)
Operator Controls	Industrial Wireless Controller (with Manual Backup)	Industrial Wireless Controller (with Manual Backup)
Required Excavator Size (Using CORE Supplied Attachments)	250 Series	350 (Mainline) 470 Series (Tie Ins)

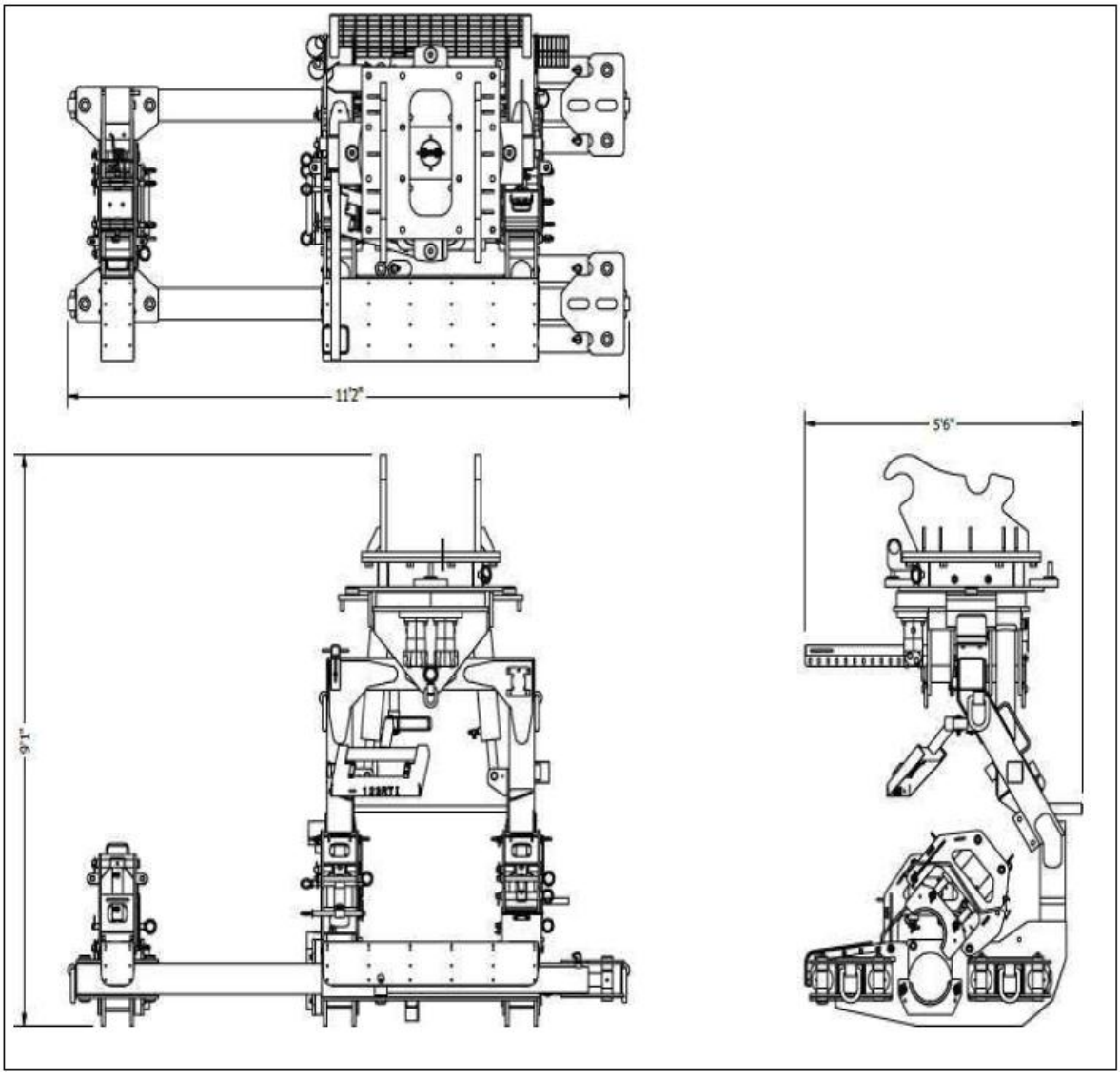
For the Small Diameter 100 Series Press the recommended excavator size is a 250 series, as this gives the most freedom for load positioning and reach. A 200 Series excavator can be used,

but the allowable load positions may limit the useful operating envelope of the machine (may work well for mainline, but it has limitations for in-ground tie-ins).

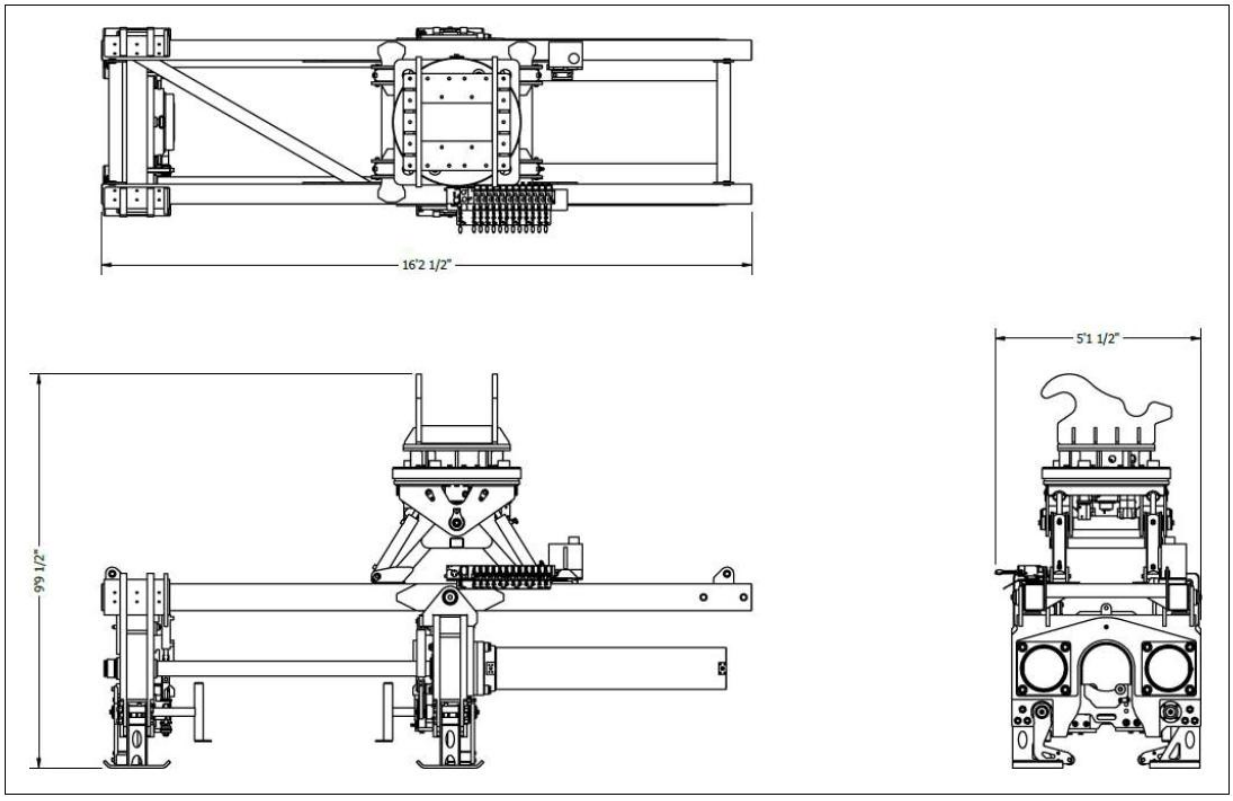
For the Large Diameter 300 Series Press the recommended excavator size is a 470 series, as this gives the most freedom for load positioning and reach. A 350 Series excavator can be used, but the allowable load positions may limit the useful operating envelope of the machine (may work well for mainline, but it has limitations for in-ground tie-ins).

The Field Press is not intended to handle or string full joints of pipe, nor to move any pipe overhead. It is only intended to support, manipulate, and position the end of a single joint when the rest of the pipe is supported by cones, crotch and/or other mobile equipment. The Field Press is only used when making mainline connections, tie-in connections, performing flange installations, or swaging pipe. The maximum anticipated external load (over and above the weight of the press) would be half the weight of one joint of pipe per side of the machine (Ex: CL856 product = total weight of 1,500lbs / CL1279 product = total weight of 3,250lbs).

SD 100 Series Field Press Dimensions



LD 300 Series Field Press Dimensions



7.1.3 Beacon System Wiring

The following guidelines provide details for installing a beacon system on an excavator, including wiring and positioning components to ensure proper operation and safety compliance.

- **Position excavator and control box:** The excavator boom arm should be positioned for easy ladder access, then locked out and powered down. The beacon control box is magnetically attached under the boom between lift rams, ensuring it is secure and unobstructed during arm movement.
- **Wire boom arm cabling:** Attach the magnetic 7-pin trailer connector about one meter from the boom arm's attachment lugs, then zip-tie the cable along hydraulic lines, leaving slack at pivot points. Plug the connector into the control box and neatly coil excess cable to prevent tangling.
- **Connect power delivery cabling:** Open battery access, remove covers to expose terminals, and connect beacon power leads to the main excavator power terminals matching positive to red and negative to black. Route cables securely behind panels, connect to the control box power connector, check the inline fuse, and verify the power delivery light is on. Excess cable should be coiled and secured.
- **Install cab switch:** Attach the wobble switch to the excavator console so it trips when the lockout lever is energized, serving as a fail-safe to activate the beacon light. Route switch cabling to the control box, connect both ends, and secure the cable to prevent damage during operation.

7.1.4 100T Field Press Tooling Change

Changing tooling sets for the Field Press requires careful attention to safety and proper procedures to ensure effective and secure operation. This process is performed by field technicians following specific steps to remove, inspect, install, and verify tooling components.

- **Tooling Removal:** The removal process starts with ensuring the field press clamps are open and locked. Keeper pins and tooling pins are carefully removed using a hammer and punch, with parts secured in a magnetic tray. A clamp locking pin is used to safely release tooling inserts in stages, minimizing uncontrolled falls. Both top and bottom tooling are removed following this procedure.
- **Inspection and Installation:** All tooling parts and keeper pins are inspected for damage or wear before installation. Installation involves cleaning pins (do not grease), organizing tooling per clamp, and correctly orienting inserts, especially ensuring thicker side plates face the pressure side. Tooling pins and reinforcement assemblies are aligned and inserted carefully, with clamp locking pins used to stabilize heavy parts during installation. Clamp 3 tooling requires fully tightened attachment bolts. Keeper pins are reinserted after installation.
- **Safety and Verification:** The excavator must be locked out or de-energized unless power is needed. The Field Press should be on stable footing during tooling changes. After installation, the Field Press is function tested to ensure smooth movement and proper alignment of tooling parts. Safe lifting techniques and awareness of pinch points are emphasized throughout the process.

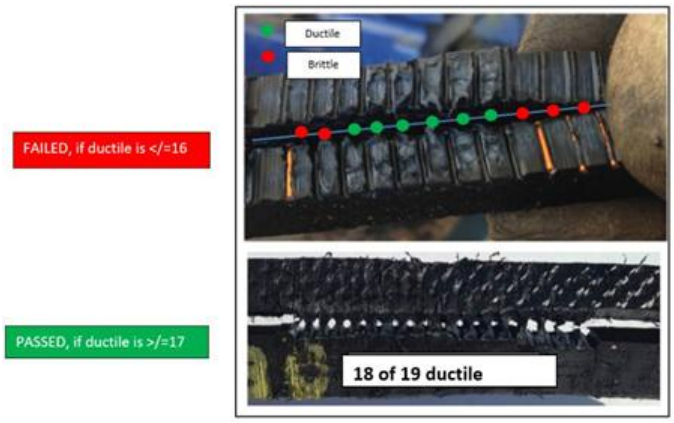
7.2 Decohesion Testing

Decohesion tests are required by code to verify the electrofusion equipment and fittings are functioning properly. When performing a decohesion test, the coupler and liner must be from a matching CORE Liner® pipe series (CL648 liner and CL648 Coupler)

Decohesion testing of EF components is a critical safety and quality assurance process performed and documented by certified field technicians to ensure the integrity of electrofusion connections. The procedure involves specific preparation, fusion, and inspection steps designed to verify the strength and quality of the fusion joints under controlled conditions.

- **Testing frequency guidelines:** Decohesion tests are required at the start of each project, every 50 connections, or when switching to an untested processor, with flexibility for tests done at day-end if over 50 fusions occur daily.
- **Material preparation and setup:** Matching liner and EF couplers must be used, secured in a hitch vise with a cutting guide. Surfaces are cleaned with isopropyl alcohol and dried thoroughly to prevent failures. The EF coupler is positioned correctly with pins installed, and the liner restraint is applied without contacting fusion pins.
- **Fusion and sample preparation:** Fusion is completed following established electrofusion procedures with data recorded. The unused coupler portion is measured and cut precisely to create 5mm thick uniform strips exposing coil wires for testing, ensuring accuracy in strip thickness and squareness.
- **Pull test and inspection:** Test strips are stretched using vise grips and inspected for ductile fusion zones. A minimum of 17 ductile zones per strip is required to pass; failure in any strip necessitates retesting. Safety precautions include using standard PPE and handling hot components carefully.

The decohesion test can be completed in accordance with the CORE Linepipe® Decohesion Testing Work Instruction WIF-0851-082



7.3 Turn and Test

Turn and Test is the first task completed on each piece of pipe once it has arrived in the field and stringing is complete. It involves orienting the pipe properly for the ClickWeld® and electrofusion. It ensures that the electrofusion fitting is in good condition and has not drifted from required specifications during transport.

Effective electrofusion (EF) fitting parameter and stability testing is critical to ensure pipe integrity and proper orientation for the ClickWeld®. This process involves careful inspection, handling, and testing to prevent hazards and guarantee the fitting's performance before use.

- **EF fitting testing procedure:** The procedure includes verifying packaging and pipe numbers, orienting the pipe for fusion, exposing and centering EF pins, verifying electrical parameters with a calibrated multimeter, performing a stability test by striking the pipe and rechecking resistance, and finally resealing the exposed areas to protect from contamination.
- **Criteria for acceptance and actions on failure:** Pins must be centered and resistance readings within specified ranges. An electrical short or unstable fitting indicated by resistance drift requires pipe replacement. Unstable fittings must not be used to avoid fusion failures.

The Turn and Test can be completed in accordance with the CORE Linepipe® Turn and Test Work Instruction WIF-0851-061

Expose the EF Posts

Test the Resistance

Turn the Liner if Required

7.4 Packaging Removal

Packaging removal involves cutting off the tape and plastic weather barrier that is applied at the factory to protect the pipe during transport and storage. Packaging should only be removed immediately prior to performing a ClickWeld® whenever possible. Removing the packaging too early dramatically increases the chance of debris, animals and contaminants entering the pipe.

Proper removal of pipe end packaging in the field is essential to prevent damage and ensure safety. This procedure involves verifying packaging removal authorization, checking pipe identification, confirming prior testing, careful packaging removal, and proper disposal of waste to maintain site safety and environmental standards.

- **Pre-removal checks:** Confirm with supervisors that packaging should be removed to avoid premature exposure that could lead to corrosion or contamination. Verify pipe numbers on both ends against factory stickers, reporting discrepancies immediately. Ensure turn and test procedures have been completed and properly documented.
- **Packaging removal technique:** Use a banana knife held flat against the pipe to cut packaging along its length, taking care not to damage the liner, coating, or mandrel teeth. In cold weather, cut the liner to pull packaging from under the bell before completing removal. Never cut toward oneself or others. Secure pipes to prevent shifting during the process.
- **Waste management:** Collect all packaging materials and dispose of them immediately in appropriate receptacles to prevent tripping hazards, environmental damage, and animal interference. Do not leave waste on the right-of-way or bags out overnight.

End package removal can be completed in accordance with the CORE Linepipe® End Package Removal Work Instruction WIF-0851-094

Removing End Packaging

7.5 HDPE Cut and Scrape Liner Preparation

Proper preparation of the exposed field end liner is critical for ensuring a safe and effective ClickWeld® and fusion processes. Liner preparation is the process of cutting the liner to length, sizing the pipe diameter, and finishing the pipe surface of the plastic liner portion of the CORE Liner® system.

The liner develops a layer of oxides on the surface, both over time and during the extrusion process in manufacturing. These oxides interfere with fusion to the fitting and need to be scraped off. The scraping process also sizes the liner to correctly fit inside the electrofusion fitting.

The liner must be perfectly sized and finished to successfully fuse to the electrofusion fitting. Failure to prepare the liner properly will result in a weak or incomplete fusion and could cause the liner to fail under pressure.

The cut and scrape of the liner must be prepared before any ClickWeld® is pressed, and before a decohesion test is performed.

- **Packaging removal, measurement, and cutting:** Remove packaging per referenced procedures, measure cut length accurately using measuring tape and paint pen, mark the liner, and cut squarely along the liner cutting guide with a reciprocating saw. Clean and deburr the cut liner thoroughly.
- **Liner scraping:** Use the scraper tool according to fitting calibration sheets and ambient temperature adjustments to remove oxidized plastic. Refer to minimum material removal specification on the fitting calibration sheet for scraping details, perform a minimum of two scrapes, checking the outer diameter (OD) to ensure it falls within specified ranges. Excessive scraping or insufficient removal triggers further procedures.
- **Quality control and greasing:** Record the measured OD at least four feet with a paint pen on the body of the pipe from the bell to avoid coating conflicts. Apply a thin layer of grease to the field bell without contaminating the liner, adjusting grease viscosity in cold weather as needed.

The liner preparation can be completed in accordance with the CORE Linepipe® Liner Preparation Work Instruction WIF-0851-062

Cut the liner to length

Scrape the poly to proper OD

Measure the OD

Clean

7.6 Mainline ClickWeld®

The ClickWeld® is Core's proprietary mechanical pipe connection process. It uses a custom-built hydraulic press to compress steel pipe parts together for an extremely strong interference joint. It requires strict adherence to safety protocols and precise operational steps to ensure secure and efficient pipe connections.

- **Equipment and materials:** Essential tools include the Field Press, excavator, side boom, liner insertion tool, grease and brushes, lint-free wipes, isopropyl alcohol, paint pen, banana knife, remote control, and beacon system. Equipment must be inspected prior to use.
- **Safety precautions:** Operators must maintain communication with heavy equipment operators, avoid blind spots, and use remote controls to stay clear of moving parts. Hydraulic lines pose serious risks and must never be tested by hand. Pipe stability on tubs and crotches must be checked and supported as needed.
- **Environmental considerations:** ClickWeld® and electrofusion are performed in temperatures from -30°C to +45°C. Weather conditions such as dust, rain, mud, and snow must be kept away from the joining area.
- **Excavator and danger zone protocols:** Excavators must be locked out unless power is needed. Positive communication is required before entering danger zones. Operators must avoid distractions and ensure beacons signal equipment power status. Non-essential personnel must stay clear.
- **ClickWeld® process steps:** The process includes inspecting and cleaning pipe ends with lint-free wipes and isopropyl alcohol, hand-stabbing the connection to align pipes, engaging the Field Press with clamps, performing the weld under specified pressure ranges, and carefully disengaging the equipment while monitoring pipe stability.
- **Field Press Operation:** The Field Press should be aligned properly with the pipe, clamps closed and locked, and the ClickWeld® performed with controlled pressure within specified ranges to ensure proper sealing without damage. Remote control use is emphasized for safety.

- **Post- ClickWeld® Procedures:** After joining, personnel must clear the danger zone, equipment must be disengaged carefully to avoid pipe movement, and pressure readings recorded on the pipe jacket for visibility during coating.
- **Operational Restrictions:** Large diameter pipe bends with angles over 52 degrees cannot be cut due to transport and joining limitations; precise ClickWeld® execution is critical for these bends.
- **Documentation:** After completion, pressure readings must be recorded on the pipe jacket at least four feet from exposed steel to ensure connection information remains visible through coating.

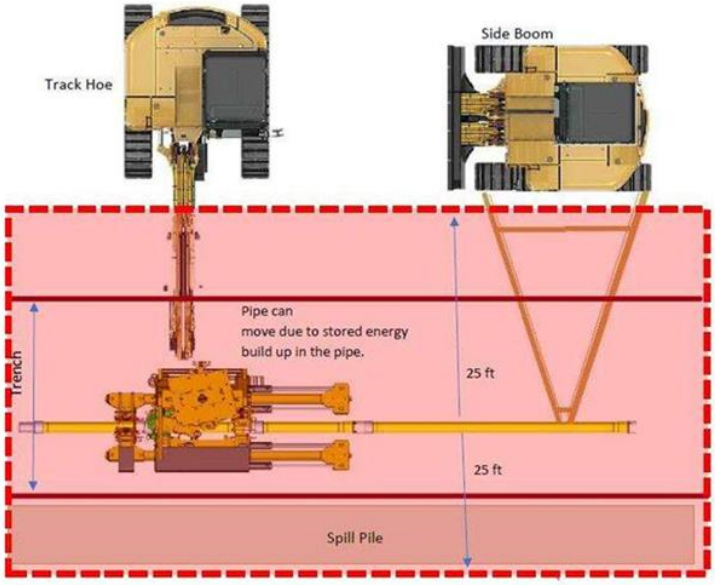
The ClickWeld® can be completed in accordance with the CORE Linepipe® ClickWeld® Mainline Work Instruction WIF-0851-063

Field Press ClickWeld®

100T Press

300T Press

Field Press Danger Zone



DANGER ZONE FREE OF PERSONEL

7.6.1 Field Press Remote Control

The Field Press Remote Control is one of the hazard controls used to help improve the safety of completing a ClickWeld®. Operating the remote-control system for the field press requires strict adherence to safety protocols to protect personnel and ensure equipment functionality.

- **Safety Features and Beacon System:** The remote control enhances safety by keeping operators out of the danger zone, but it has a different operational feel requiring deliberate control movements. The CORE beacon system activates when the excavator's hydraulic system is powered, signaling potential movement and necessitating hazard controls and restricted access to the danger zone. Operating without a functional beacon requires special approval.
- **Starting and Operating the Controller:** To start, insert and turn the key, listen for diagnostic beeps, and press the green start button to initialize the radio link. The emergency stop must be released to activate controls, and the green LED indicates readiness. The remote's paddle layout matches the field press controls but with a shorter lever throw, so small inputs result in larger movements. The controller times out after two minutes of inactivity, requiring reactivation.
- **Shutting Down the Controller:** Engage the emergency stop, turn the key counterclockwise to remove it, store the key securely, and remove the battery for charging. These steps ensure the system is safely powered down and maintained.

The field press remote control can be utilized in accordance with the CORE Linepipe® Field Press Remote Control Work Instruction WIF-0851-078.

Field Press Remote Control

7.7 Electrofusion

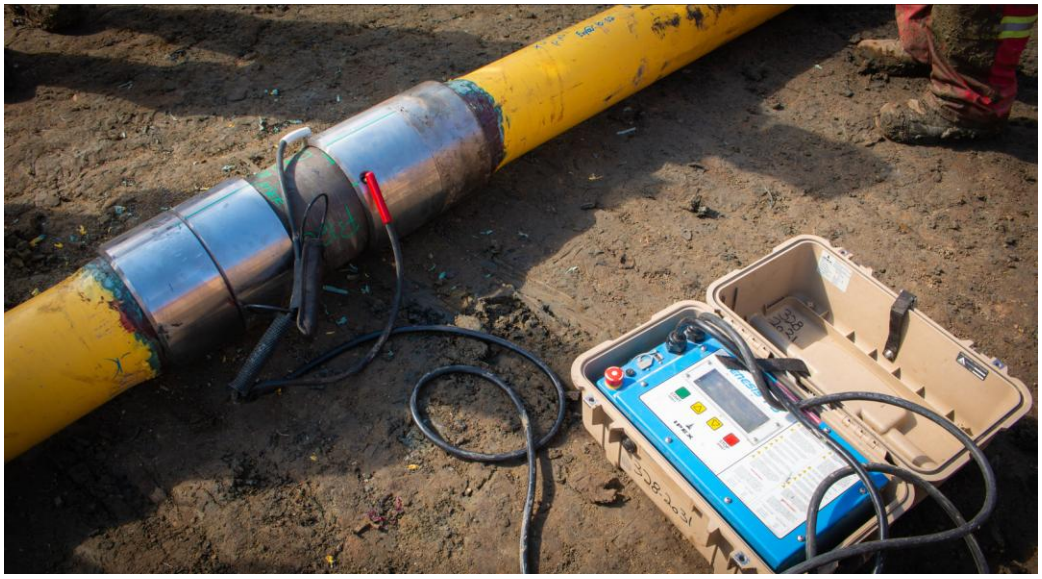
Electrofusion is the process of joining together the HDPE liner that forms the primary containment layer of our dual-wall pipe system. Without 100% successful fusion of liner components, fluids can reach and corrode the steel pressure shell, potentially resulting in an environmental release.

Electrofusion is a critical process for joining pipes in fieldwork, requiring strict adherence to safety protocols, precise equipment handling, and environmental considerations to ensure quality and safety. The procedure involves meticulous preparation, verification, fusion, and documentation steps performed by certified level 1 field technicians.

- **Safety Reminders:** Key safety concerns include avoiding crush hazards by never standing between pipes and vehicles, electrical hazards from high amperage outputs, heat hazards from hot pipe surfaces, laser hazards from scanners, and tripping hazards from fusion cabling.
- **Environmental Conditions:** Electrofusion and ClickWeld® processes are performed in ambient temperatures ranging from -30°C to +45°C. Weather conditions like dust, rain, mud, and snow must be kept clear from the joining process.
- **Fusion Work Zone Setup:** Fusion must be performed with at least two joints between the Field Press and the fusion point to ensure safety and quality.
- **Fusion Pins Preparation:** Pins should be inspected for cleanliness and alignment, cleaned of grease and debris, and tightened using long nose locking pliers until the EF coil wire is partially compressed, avoiding over-torquing.
- **Electrical Parameter Verification:** Use a calibrated multimeter to perform a scratch test to check for shorts between EF pins and steel pipe. Coil resistance must be within acceptable ranges specified in the Fitting Calibration sheets. Short circuits must be resolved before proceeding.
- **Electrofusion Process:** The EF processor must pass a self-test before use. Fittings must be fused the as soon as possible (while observing weather limitations) they are connected to avoid integrity issues. Parameters such as ambient temperature, generator voltage, and frequency are verified before connecting EF leads. The fitting barcode is scanned for correct calibration, and fusion is started after verifying all parameters. Fusion must be continuously monitored, and any errors reported immediately. After fusion, cooling time is observed, and successful fusion confirmed before disconnecting leads and installing plugs, seals, and warning labels.
- **Traceability Recording:** Fusion details must be recorded on a field tablet and marked on the pipe using a paint pen, ensuring EF warning stickers are visible or replaced as needed.

The field electrofusion connections can be completed in accordance with the CORE Linepipe® Field Services Electrofusion Work Instruction WIF-0851-060.

Electrofusion Connection



7.7.1 Electrofusion Troubleshooting

Effective and safe resolution of common electrofusion issues is critical for field technicians working with pipe joining systems.

- **Troubleshooting resistance issues:** For resistance too high (≥4.000 Ω), operators should tighten pins and recheck; if out of specification, supervisors and engineering should be involved for recalibration or pipe removal. For no resistance, pins should be tightened and continuity checked, escalating to supervisors if unresolved.
- **Barcode and calibration errors:** Error 100 indicates barcode scanning issues; operators should check barcode condition and calibration sheets. Errors 113 and 114 signal calibration expiry or absence, requiring unit calibration service.
- **Processor output and connection errors:** Errors such as 102 (resistance mismatch), 103 (shorted coil), 112 (fitting disconnected), and 115-117 (output current/voltage issues) require cleaning output adapters, checking wiring, replacing processors, or consulting supervisors and engineering. Fusion should not be forced if fittings are out of specification.
- **Fusion interruption and temperature errors:** Error 110 occurs if the STOP button is pressed during fusion; operators should verify accidental presses and consult foremen. Error 119 indicates internal control box temperature out of range, requiring cooling and possibly processor replacement.
- **Handling power supply and sensor errors:** Error 108 arises from power supply interruptions, necessitating fuel and connection checks. Error 120 involves zero fusion time due to sensor obstruction or malfunction, requiring cleaning and possible processor replacement.

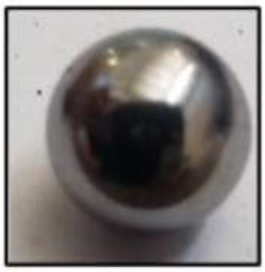
Electrofusion troubleshooting can be completed in accordance with the CORE Linepipe® Electrofusion Troubleshooting Work Instruction WIF-0851-057.

7.8 Metal Seal Installation

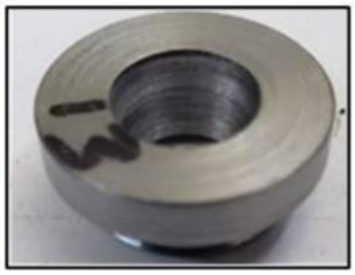
Electrofusion access points are closed with the effective installation of metal seals that serve as a secondary containment layer in pipe assemblies. Field technicians complete the following steps to ensure the proper installation and quality control for metal seal installation.

- **Installation Steps:** Step 1 involves removing EF pins, cleaning plug holes, greasing all surfaces of the metal seal, inserting it fully into the pipe, and placing a greased ball bearing into the seal. Step 2 requires preparing and installing the seal insertion tool with at least three full turns into the factory ring, torquing the plunger bolt to 20 ft-lbs, then removing the tool and verifying the ball bearing is flush; if not, the process is repeated. Step 3 covers preparing black steel plugs by greasing threads and faces, inserting them into the factory ring, and torquing to 20 ft-lbs.
- **Quality Control and Documentation:** After installation, quality control requires recording plug and seal installation details on the pipe using a paint pen, referencing the WIF-0851-058-RXX Traceability Recording form. SiteDocs pre-start inspections and adherence to equipment manufacturer instructions are emphasized for safety and effectiveness.

Ball Bearing



Seal Insert



Torque Seal Insert Tool

Metal seal installation can be completed in accordance with the CORE Linepipe® Metal Seal Installation Instruction WIF-0851-081.

7.8.1 Metal Seal Removal

Removing seals from pipes involves a detailed process using specialized tools to ensure proper extraction without damaging the pipe or seal. The procedure includes installing a removal tool, pushing a ball through the seal, tapping threads into the seal, and then extracting it with a bolt and washer system.

- **Install and position removal tool:** The seal removal tool's bolt is first backed off and then threaded into the factory ring hole until it bottoms out, with positioning adjusted based on the seal's placement inside the drill hole. The bolt is then tightened to push the ball through the seal.
- **Tap seal threads carefully:** Two methods exist for tapping the seal threads to ensure quality: using a drill and tap at very slow speed while maintaining perpendicular alignment or using a manual tap and handle with careful half-turns and back-turns to produce clean threads.
- **Remove seal and handle failures:** After cleaning out shavings, the seal is removed by tightening a bolt and nut assembly that pulls the seal out. If threads are damaged or tear out, an easy out tool is used to extract the seal, which may require vice grips or pliers if it starts spinning.

Tightening the bolt to push the ball through the seal

7.9 Traceability Recording

Field technicians must accurately record quality control (QC) data related to pipe fusion and preparation using Spira FI and on-pipe markings. The following outlines the necessary tools, and step-by-step instructions for recording different types of connections and tests to ensure data integrity and traceability.

- **Task Overview:** The task involves precise recording of QC information on pipes and in Spira FI software, performed by field technicians.
- **Electrofusion Recording:** Technicians must create tickets in the correct job in Spira FI, record the fusion number immediately on the pipe using a paint pen, and ensure all connection details such as pipe type, factory and field end pipe numbers, PSI, EF number, outer diameter (OD), and descriptive location are accurately entered. Photographs of both connection ends must be taken and labeled with the fusion number and end type. After successful fusion, "OK" and initials are written beside the fusion number on the pipe.
- **Pup Recording:** Pups, short pipes connecting two pipes with a single fusion number, require recording two connections under one EF number. The data must maintain continuous line flow direction despite physical orientations.
- **Flange Recording:** Flanges are recorded similarly to mainline connections but involve only one connection with a single fusion. Line direction rules apply, and one end may be recorded in a reversed physical orientation to maintain data flow.
- **Liner Prep Recording:** The final outer diameter of the liner must be recorded on the pipe coating with a paint pen, positioned at least one meter away from the coating end to avoid erasure, preferably behind the factory-written pipe number.
- **ClickWeld® Recording:** ClickWeld® PSI values and the responsible technician's initials (e.g., "CL-BW") must be recorded at least one meter from the coating edge, also behind the factory pipe number, to serve as a reference for connection cleanliness.
- **Field Cut Recording:** When performing field cuts, the SiteDocs Field Cut Data Sheet must be completed during the process and attached as a PDF to the daily Spira ticket. Multiple cuts on a job require repeating the "Cut Data" section without creating multiple forms if possible.
- **Decohesion Test Recording:** Each decohesion test requires filling out the SiteDocs Field Services Decohesion Test Data form during testing.

Traceability Recording can be completed in accordance with the CORE Linepipe® Traceability Recording Work Instruction WIF-0851-058.

7.10 Water Proofing Pipe Ends (Night Caps)

Completed joined sections of CORE Linepipe® must be protected with a waterproof seal using Denso LT Tape and Renwrap 300 (night cap). The following steps and materials are utilized to ensure effective sealing and protection against water ingress.

- **Preparation and initial wrapping:** Begin wrapping the Denso LT Tape starting 6 inches from the bell of the pipe, overlapping the tape by half its width and pressing firmly to ensure a seal, continuing to the pipe end. Four strips are used to cover the pipe end, with one strip applied at a 90-degree angle to the others.
- **Securing the seal:** After applying the Denso LT Tape, wrap the entire taped area with Renwrap 300 to secure the pipe end and cover all tape layers. Then slide an 18”x47” poly bag over the pipe end, fold it by 4 inches, and wrap another layer of Denso LT Tape over the poly bag extending past the Renwrap 300. Finish by tightly stretch wrapping the poly bag, stopping about 1 inch before the tape layers.

- **Final layers:** Apply another layer of Denso LT Tape from the ring to the pipe body, followed by an additional Renwrap 300 layer extending beyond the Denso LT Tape for added protection.

Water proofing of pipe ends can be completed in accordance with the CORE Linepipe® Water Proofing Pipe End Work Procedure SWP-17.

Initial Wrapping

Renwrap

Poly Bag

8 Field Coating

It is recommended that ClickWeld® joints are externally protected by a corrosion resistant coating. CORE Liner® products are compatible with a range of external coating options.

CORE Linepipe® recommends using STOPAQ as external corrosion protection on CORE Liner® product. CORE Linepipe® recommends using ScarGuard for mechanical protection of the STOPAQ coated joint.

CORE Linepipe® carries a stock of STOPAQ and ScarGuard and can supply it with the pipe delivery to site. Contact the CORE Liner® sales representative for further details. Refer to the Appendix for the STOPAQ/ScarGuard coating procedure.

Any holidays in the coating that are detected during the holiday detection process should be repaired using the STOPAQ material, in similar steps to what is described in the STOPAQ application procedure.

Completed Field Joint Coating

8.1 ClickWeld® Readiness Verification

ClickWeld® and electrofusion joints must be complete, which includes installed inserts and plugs, before a ClickWeld® joint is ready to be externally coated. Please ensure that the ClickWeld® joint is fully completed prior to applying the external coating. To verify that the ClickWeld® joint is completed and ready to be externally coated.

Check for ALL of the following prior to applying external coating:

- Both plugs are installed
- EF # is written
- OK and initials are present

There is only one acceptable scenario that indicates a ClickWeld® joint is ready to be externally coated. The image below shows the requirement of the EF #, two installed plugs, and an ok with initials. If any of these three are missing, do not complete external coating. Confirm with the ClickWeld® Field Technician before moving forward.

Completed ClickWeld® ready for coating

8.2 Pipe Heating Warning Restrictions

CORE Liner® is susceptible to damage by heating as it has a polyethylene liner inside the pipeline. Overheating CORE Liner® can potentially lead to damage, failure, and costly repairs.

1) CORE Liner® must not be overheated from the installation of the external coating. CORE Liner® has a polyethylene liner inside the pipeline. Damage/failure of the liner could occur because of overheating. Liner damage/failure is not visible from the outside of the pipeline. Overheat scenarios could require costly repairs.

2) The temperature of the entire surface to be coated shall be measured using a calibrated digital surface contact thermometer. The surface temperature must be measured frequently to promptly detect when the required temperature is reached. When measuring the temperature, allow the digital surface contact thermometer to touch the surface for at least three seconds (and until the temperature reading stabilizes) before taking the temperature reading.

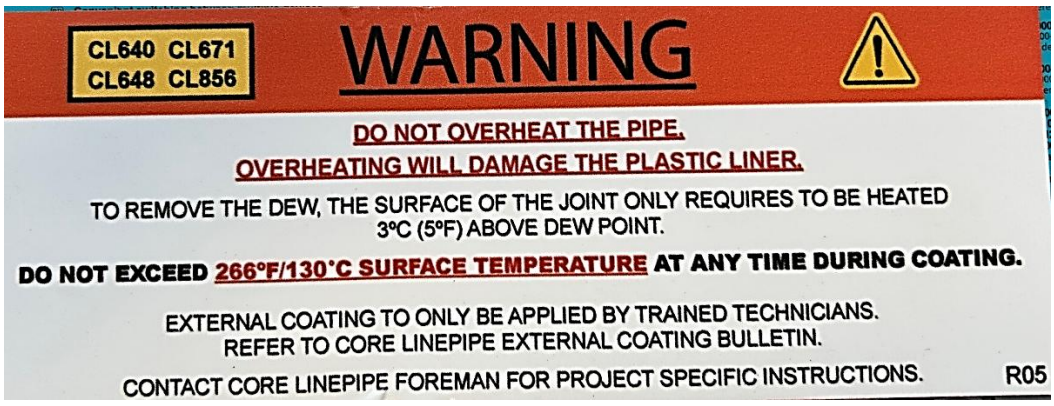
3) Contact your CORE Service® team for any questions or clarifications.

4) All personnel involved in applying external coatings on CORE Linepipe® products must sign the Sign-Off and Acknowledgement of CORE Linepipe® External Coating Requirements sheet.

5) The CORE Liner® pipe should never be heated to a surface temperature above the following:

CORE Liner® Item	Maximum Allowable Temperature
CL440	85°C (185°F)
CL640	130°C (266°F)
CL648	130°C (266°F)
CL671	130°C (266°F)
CL856	130°C (266°F)
CL1071	85°C (185°F)
CL1279	85°C (185°F)

6) The warning sticker (shown below) is to be removed from on the pipe after the external coating is applied and prior to holiday detection.



8.3 STOPAQ

Although many external coatings are suitable for use on CORE Liner® pipelines, CORE Linepipe® recommends using STOPAQ as external corrosion protection on CORE Liner® joints.

Stopaq® is intended for cold application without the use of heat. Significant pipe heating typical of shrink sleeve applications is not required for Stopaq®. Only removing the dew from the pipe surface, if present, is needed for the application of Stopaq®. If dew is not present, no heat application is required.

Removing the dew, where dew is present, only requires a minimal amount of heat. To remove the dew, use a tiger torch on a low setting for between 10 – 20 seconds in a continuous uniform movement along and around the surface to be coated.

The application process requires trained personnel, specific equipment, and careful surface preparation to ensure coating effectiveness and prevent damage to the pipeline liner.

- **Heat application guidelines:** STOPAQ® is designed for cold application; only minimal heat is used to remove dew from the pipe surface, targeting a temperature 3°C above the dew point. Excessive heat can damage the internal plastic liner, especially on bare pipe sections. Heating should be done carefully per joint and followed immediately by coating.
- **Surface preparation:** The ClickWeld® fitting surface must be cleaned to a minimum SSPC/NACE SP3 or ISO 8501 St2/St3 standard with light abrasion adjacent to cutback areas.
- **Solvent cleaning:** Use approved solvents like isopropanol ≥95% or any solvent that evaporates without residue to degrease and clean the surface after preparation.
- **Wrappingband application:** Wrappingband strips are cut and applied with overlaps onto the ClickWeld® joint and mainline coating, ensuring no air entrapment and proper coverage according to the specific ClickWeld® fitting dimensions.
- **Inspection of Wrappingband:** The applied Wrappingband must be smooth, tight, crack-free, fully adhered, with proper overlaps, no air pockets, and pass a 15 kV holiday test using a brush probe.
- **Outerwrap application:** Outerwrap is spirally wrapped over the Wrappingband with tension, starting and ending with full circumferential wraps, maintaining ≥50% overlap and avoiding air inclusions or bridging. The tape end should be secured properly.
- **Inspection of Outerwrap:** The Outerwrap must be smooth, tight, fully in contact with Wrappingband, free of cracks or holes, with proper overlap and no large wrinkles.

The application procedure for the STOPAQ material on ClickWeld® joints is detailed in the STOPAQ ClickWeld® Application Guide.

All personnel involved in applying external coatings on CORE Linepipe® products must be trained by a representative of the external coating manufacturer. It is strongly recommended that all personnel involved in applying external coatings on CORE Linepipe® products complete the CORE Linepipe® external coating RISE training course.

STOPAQ Product	Maximum Allowable Temperature
STOPAQ WRAPPINGBAND CZ	OPERATING TEMPERATURE UP TO 50°C (122°F)
STOPAQ WRAPPINGBAND CZH	OPERATING TEMPERATURE UP TO 70°C (158°F)
STOPAQ WRAPPINGBAND CZHT	OPERATING TEMPERATURE UP TO 85°C (185°F)
STOPAQ OUTERWRAP PE	OPERATING TEMPERATURE UP TO 70°C (158°F)
STOPAQ OUTERWRAP HTPP	OPERATING TEMPERATURE UP TO 85°C (185°F)

Total Maximum Rolls per ClickWeld®					
STOPAQ Product	NPS 4	NPS 6	NPS 8	NPS 10	NPS 12
WRAPPINGBAND 100MM/4”	0.65	0.51	0.70	1.02	1.40
WRAPPINGBAND 50MM/2”	0.12	0.29	0.40	0.58	0.80
OUTERWRAP 75MM/3”	0.54	0.45	0.56	0.90	1.12
OUTERWRAP HTPP 100MM/4”	0.25	0.33	0.41	0.66	0.82

8.4 ScarGuard Mechanical Protection for HDD

ScarGuard® is recommended by CORE Linepipe® for mechanical protection of STOPAQ coated ClickWeld® joints in bores and horizontal directional drilling (HDD) applications, providing abrasion resistance through a composite overcoat of fiberglass cloth and water-activated flexible resin that cures quickly to shield pipeline coatings from mechanical stresses during HDD operations.

ScarGuard® is installed by wrapping it around the pipe with a 50% overlap, ensuring a minimum of 6 inches (150mm) extension beyond the existing coating. A compression film is applied immediately after, also with a 50% overlap, to compress the ScarGuard layers together.

The application procedure for the Scar-Guard® material is detailed in the CANUSA-CPS ScarGuard® Installation Guide (IG_NA_SCG.pdf).

Total Maximum Rolls per ClickWeld®					
ScarGuard® Product	NPS 4	NPS 6	NPS 8	NPS 10	NPS 12
SCARGUARD 6” x 30’ ROLL	1	1	1	1.5	2

8.5 Sleeves

CORE Linepipe® recommends avoiding the use of Heat-Shrinkable Sleeve Systems to eliminate the potential for damaging the internal liner during installation.

If installed with precision and strict quality assurance Canusa-CPS's heat shrinkable sleeve product lines offer a broad range of pipeline sleeves that are compatible with CORE Linepipe®

CANUSA-CPS Product	Minimum Install Temp	CORE Linepipe® Compatibility
K-60	65°C (150°F)	All Products
GTS-65	70°C (158°F)	All Products
KLON	75°C (167°F)	CL640, CL648, CL671, CL856
KLNN	90°C (195°F)	CL640, CL648, CL671, CL856
GTS-80	70-80°C (158-175°F)	CL640, CL648, CL671, CL856
TBK-60	75℃ (167℉)	CL640, CL648, CL671, CL856
TBK-80	110°C (230°F)	CL640, CL648, CL671, CL856

The procedure for installing Canusa-CPS heat shrinkable sleeves on CORE Linepipe® requires trained installers, adherence to specific procedures, and careful temperature monitoring to achieve effective adhesion and avoid liner damage.

- **Installer training and qualifications:** Installers must be trained by Canusa and hold a valid Canusa ticket for the specific coating product before beginning work. The Manufacturer's Qualified Application Procedure (MQAP) must be followed, and a copy is provided with each coating material box. Installers must also be familiar with CSA Z245.30 requirements.
- **Pre-installation checks and documentation:** Installers must verify the presence of two plugs on each ClickWeld® joint before installing shrink sleeves and record electrofusion numbers or pipe serial numbers along with surface temperature measurements. This data is submitted to the CORE Linepipe® traceability report for inclusion in the quality control package.
- **Surface preparation and application:** Surfaces must be cleaned of contaminants such as grease to ensure adhesion. Contouring of ClickWeld® rings using Canusa-CPS mastic filler/AquaSeal is required to accommodate abrupt shoulders. Uniform heating of the application area is mandatory, with specific target temperatures depending on the sleeve type, and maximum surface temperatures must not exceed the CORE Linepipe® product limits listed on the heat warning stickers.
- **Temperature control and safety:** Surface temperature must be frequently measured with a calibrated digital thermometer during heating, with readings taken after the temperature stabilizes. Overheating must be avoided to prevent damage to the CORE Liner® polyethylene liner, which is not externally visible and can lead to costly repairs. Heating ovens if used, must be fully functional to prevent localized overheating. Overheated connections will need to be cut out.

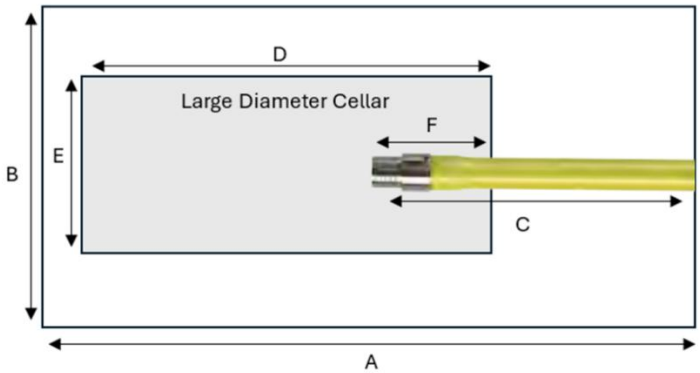
9 Trenching

Proper ditching and trenching practices are essential for the safe and effective installation of CORE Liner® and CORE Linepipe® systems.

CORE Liner® system is most efficiently joined above grade and lowered into the ditch. For mainline sections that do not require the presence of workers in the excavation, a straight walled ditch is recommended, unless conditions require a sloped ditch for soil stability. The trench bottom should be contoured closely to the pipe shape and free of debris or materials that could damage the pipe coating.

At risers and tie-in points where CORE Service® is working in the ditch, trenches must be kept safe with proper slopes, access, and egress, free from mud, ice, and water, and have smooth bottoms without hazardous materials to support pipes and workers uniformly.

Bell holes must be accessible and large enough for installation equipment. CORE Linepipe® requires bell holes to be excavated to the following dimensions:



Dimension	100t Series Field Press (NPS 4,6,8)	300t Series Field Press NPS (10,12)
A	6.1m (20ft)	7.6m (25ft)
B	2.4m (8ft)	2.4m (8ft)
C	3.0m (10ft)	3.7m (12ft)
D	N/A	3.7m (12ft)
E	N/A	1.8m (6ft)
F	N/A	1.2m (4ft)
Cellar Depth	N/A	0.6m (2ft)

10 Lowering In

Proper installation of CORE Liner® pipe involves using approved pneumatic rubber-tire cradles to accommodate the larger ClickWeld® joint diameter while protecting coatings and ensuring correct pipe positioning in the trench. The process requires careful preparation of the ditch, proper equipment use, and adherence to spacing and stress minimization protocols to prevent damage and facilitate tie-ins.

- **Ditch and bedding preparation:** The ditch must be of adequate width and depth, free of debris and rocks, and properly bedded. Native materials are preferred for bedding, with OWNER supplying any necessary replacement materials. Rock shields and pipeline weights for buoyancy control must be installed as required.
- **Pipe handling and lowering:** Pipes must be lowered using appropriate cradles or wide belts that are free of foreign objects, ensuring the weight is evenly distributed to avoid strain or damage. Side bends and sags should be positioned correctly for tie-ins, with slack provided as directed.
- **Inspection:** Proper grounding and holiday detection with repairs are mandatory. Rocks harmful to pipelines must be removed or padded, and bell holes for tie-ins must accommodate joining equipment with adequate pipe slack.

10.1.1 Holiday Detection (Jeeping)

Holiday detection (jeeping) or CORE Liner® pipes can be completed like coated carbon steel pipelines. The coating manufacturer general holiday detector voltage recommendations for YJ or YJ2K coated CORE Liner® pipes are as follows:

	YJ / Perma-bond Coating		YJ2K / Ultrabond IIISDE Coating	
Product	Coating Thickness (mm)	Voltage (V)	Coating Thickness (mm)	Voltage (V)
CL440	0.75	7,500	1.22	12,200
CL640	0.85	8,500	1.22	12,200
CL648	0.85	8,500	1.22	12,200
CL671	0.85	8,500	1.22	12,200
CL856	1.00	10,000	1.22	12,200
CL1071	1.00	10,000	1.22	12,200
CL1279	1.25	12,500	1.22	12,200
Note: For ARO coated pipe the voltage setting would be 125 V/mil				

It is recommended not to exceed the above voltage values and to use detectors SPY Model 785 / 790 (or equal).

The holiday detection voltages required at externally coated joints may be different than the voltages used for the field coated sections of the pipe. Ensure the appropriate voltages are applied at joint coatings and pipe coatings. Holiday detection of the STOPAQ coated sections requires a voltage of 15,000 volts. Please refer to the STOPAQ Application Guide for further guidance on holiday detection for STOPAQ coatings.

Any holidays in the coating that are detected during the detection process should be repaired using the STOPAQ material, in similar steps to what is described in the STOPAQ application procedure.

Rubber Tire Cradles

Pipeline Holiday Detection (Jeeping)

11 Tie Ins

Efficient and safe tie-in of ClickWeld® pipe connections requires detailed planning, hazard management, and adherence to precise operational steps. The process involves coordinated use of specialized equipment, careful handling of pipe coatings, and strict safety protocols to ensure quality and prevent injury.

- **Hazards and safety measures:** Operators must be vigilant about suspended loads, pinch points, hydraulic risks, and heavy equipment movements, maintaining communication and avoiding blind spots. The Field Press and its hydraulics pose pinch and high-pressure hazards.
- **Environmental considerations:** Operations are viable between -30°C and +45°C, avoiding dust, rain, mud, and snow near the joining process. Pipe stability on supports must be verified and reinforced based on ground conditions.
- **Essential equipment and tools:** Key tools include the Field Press with remote control, excavator, side boom, liner insertion tools, cleaning supplies, and a beacon system to indicate hazards. Pre-start inspections and following manufacturer guidelines are mandatory.
- **Field Press and excavator protocols:** Remote control use is recommended in tight spaces, with warnings to bystanders. Excavators must be locked out unless powered for specific tasks, with clear communication to minimize personnel in danger zones. The beacon signals hydraulic power status and requires management approval if non-functional.
- **Tie-in procedure:** Steps include moving the field ring, measuring and marking pipe lengths, cutting and swaging the pipe, cleaning, greasing, inserting the bird's mouth, and

securing clamps before performing the ClickWeld® connection and safe disengagement of the Field Press. Cuts are preferred above ground for efficiency and safety.

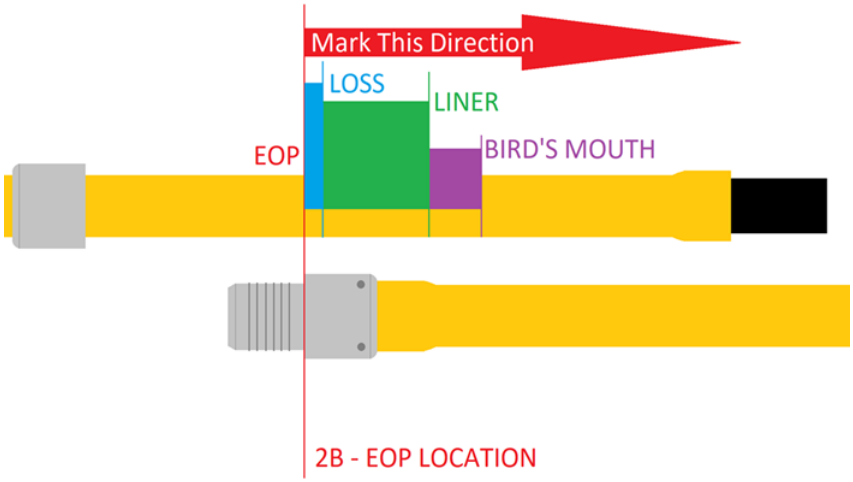
- **Coating removal after swaging:** Different coatings require specific removal methods involving cutting, peeling, scraping, heating, and cleaning with attention to temperature limits, fire safety, and pipe stability. Temperature monitoring and documentation are essential throughout.
- **ClickWeld® tie-in specifics:** Side booms position pipes for mechanical and forward-backward movements. Pipes are placed in clamps, aligned using booms and tools, cleaned, greased, and connected via ClickWeld®. Clamps are released carefully after ensuring personnel safety, and pipes are lowered for electrofusion.
- **Quality assurance and final installation:** Tie-ins must align correctly without force, apply approved coatings, and inspect for coating damage. Pipes must rest flat on the ditch bottom with proper support and no over-excavation (excluding cellars). Owner approval and photo documentation may be required before backfilling.

11.1 Field Cuts for Tie Ins

CORE Liner® field crews can cut pipe to custom length on location by augmenting the field-end of the CORE Liner® product. The factory-end cannot be modified. This allows for the field fabrication and installation of a precisely measured in-line joint or flanged end fitting. There is NO welding required in this process. No pre-ordered fixed length PUPS or special materials are required.

The procedure requires the use of various tools and equipment, including exact saws, gas saws, reciprocating saws, measuring tapes, grease and brushes, clamps, field press and remote control, impact wrenches, excavators, and other hand tools. Pre-start inspections and adherence to manufacturer instructions are mandatory to ensure safety and efficiency.

- **Field Ring -** To prepare for pipe cutting, slide the Field Ring beyond the intended cut point with at least 7 feet clearance for the Field Press; if absent, install the Field Ring with the outer bevel facing away from the pipe end to be cut. Ensure both the Field Ring and pipe are free from rust, dirt, mud and ice before proceeding.
- **Data Recording -** During cutting operations, the SiteDocs QMS form Field Cut Data Sheet FMF-0851-002 must be completed with all applicable data fields filled in; for instance, temperature fields are only required if heating the pipe is involved, such as when cutting types other than YJ pipe.
- **Measurement -** Accurate measurement for pipe field cuts is crucial, especially for tie-ins where pipes should be positioned close to their final in-ditch location. The process involves marking the End Of Pipe (EOP) based on the factory end bell, then sequentially marking the Loss, Liner, and Bird’s Mouth distances, always extending the cut length rather than shortening it.



Measurements vary by pipe size and type, and verification of these measurements ensures they sum correctly to the Total Cut Length. Proper measurement direction, presence of a field ring, and documentation of cut lengths in the Field Cut Data form are essential steps in this procedure. The table below contains the measurements for each size.

Product	Bird's Mouth	Liner	Loss	Total Cut Length
CL440	4" (101.6 mm)	8 3/4" (222.3 mm)	1" (25.4 mm)	13 3/4" (349.3 mm)
CL640	5" (127.0 mm)	11" (279.4 mm)	1 1/4" (31.8 mm)	17 1/4" (438.2 mm)
CL648	5" (127.0 mm)	11" (279.4 mm)	1" (25.4 mm)	17" (431.8 mm)
CL671	4" (101.6 mm)	10 13/16" (274.6 mm)	1 1/4" (31.8 mm)	16 1/16" (408.0 mm)
CL856	4" (101.6 mm)	10 1/4" (260.4 mm)	1 1/4" (31.8 mm)	15 1/2" (393.7 mm)
CL1071	6" (152.4 mm)	17 3/4" (450.9 mm)	2" (50.8 mm)	25 3/4" (654.1 mm)
CL1279	6" (152.4 mm)	17 3/8" (441.3 mm)	2 1/8" (54.0 mm)	25 1/2" (647.7 mm)

- **First Cut -** Proper pipe cutting involves stabilizing and supporting the pipe to prevent unpredictable movement, measuring and marking the cut-off section, and designating a clear fall-away zone for safety. Using a gas saw, the steel pipe is cut at the Bird's Mouth mark with controlled force to avoid kickback, followed by the Exact Saw to cut only the steel without penetrating the liner. The Bird's Mouth portion is then removed carefully without deforming the pipe. Finally, a reciprocating saw is used to cut a symmetrical "S" shaped Bird's Mouth into the liner, leaving at least one inch uncut for easier insertion into the swage tip.

Bird's Mouth shape, showing the remaining uncut liner portion in blue

- **Swaging** - Swaging involves precise installation and alignment of the swage and F.E.C. (Field End Clamp) on a pipe to ensure proper liner insertion and avoid damage. The process requires careful inspection, cleaning, and tightening to maintain grip without deforming the pipe. The swage must be clean, smooth, and free of defects such as chips or burrs to prevent liner damage during insertion. It is installed into the field press and clamped securely. The F.E.C. is positioned on the pipe at a specified measurement and tightened using a torsion bar following a specific alternating pattern to maximize grip and avoid deformation. The swage tip is carefully guided into the liner and positioned just inside the steel pipe edge with a visible uniform liner ring to ensure proper alignment and prevent damage. Adjustments are made to maintain an even gap around the circumference. Metal slivers created during swaging must be removed with pliers to avoid liner scratching. Grease is applied to the swage tip before full insertion, stopping immediately when the steel contacts the swage lip to prevent deformation. Extreme caution is advised when releasing the field press due to tension and potential pipe movement.
- **Second Cut** – Second cut involves executing a precise cut on a pipe bell using a Swage Jig, Toothless Mandrel, and Exact Saw. It includes verifying blade position, marking the cut on the pipe coating, securing tools, setting the saw depth and blade orientation, and using a screwdriver to maintain the kerf alignment during cutting, ensuring accurate preparation for subsequent testing.
- **Bell Check and Weld Seam Marking -** Bell check and weld seam marking involves removing the steel cut-off while leaving the Toothless Mandrel in place to inspect for damage and locate the weld seam inside the cut-off. The weld seam is marked externally, the cut-off is realigned with the swaging mark, and the seam mark is extended beyond the bell onto the un-swaged pipe. After removing the cut-off and mandrel, the Swage Jig is placed back to ensure the bell edge fits within the specified groove before proceeding to coating removal.

Field cuts can be completed in accordance with the CORE Linepipe® UNIFIED Field Cut WIF-0851-098-R01

11.2 Removing Pipe Coating with Temp Restrictions

Safe removal of factory coatings from pipes after field swaging involves identifying coating types—YJ / Perma-bond (plastic with black mastic) and YJ2K / Ultrabond IIISE (green epoxy)—and adhering to temperature limits based on pipe size. For YJ, the plastic jacket is cut and peeled off, with mastic scraped using a lubricated draw knife and cleaned with citrus cleaner. For YJ2K, heating with a tiger torch and scraping is done cautiously with temperature monitoring, using mandrels and off-cuts as heat sinks. Post-removal, internal liner temperature is monitored for 7 minutes to ensure it remains below 70°C, with all temperature data recorded on a Field Cut Data Sheet before proceeding to dye penetrant testing.

Coating removal can be completed in accordance with the CORE Linepipe® Coating Removal WIF-0851-088-R02

11.3 Dye Penetrant Testing

Dye penetrant testing on swaged pipe sections involves cleaning the weld seam, applying dye, allowing penetration time, removing excess dye, applying developer, and inspecting for defects. Safety precautions include addressing the flammability of the dye propellant and using double eye protection when grinding. Any defects found must be reported immediately, with results recorded on the Field Cut Data Sheet.

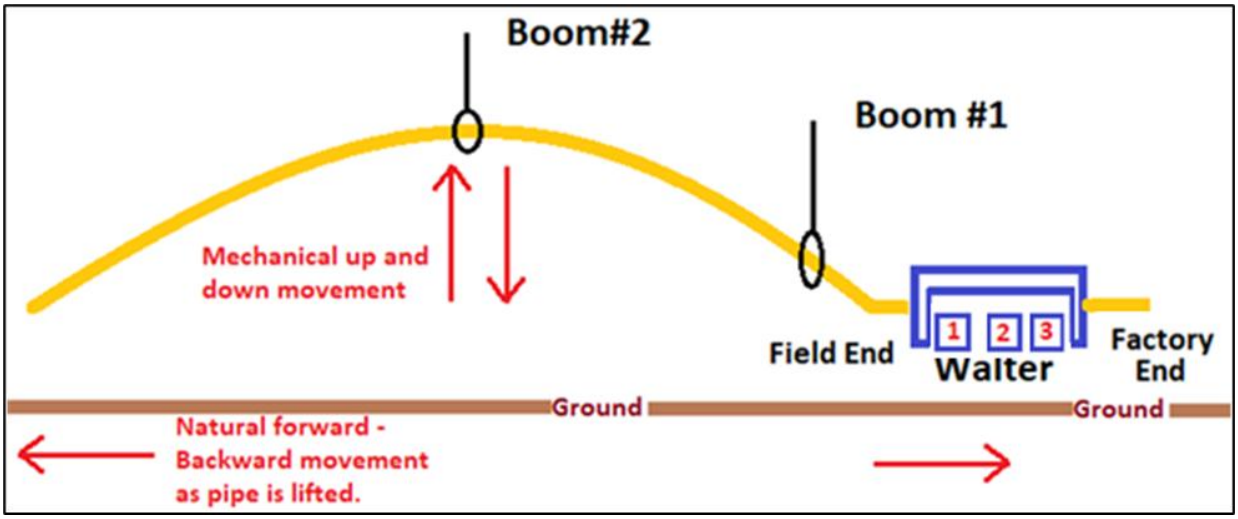
Dye penetrant testing can be completed in accordance with the CORE Linepipe® Dye Penetrant Testing WIF-0851-086-R01

11.4 Tie in ClickWeld®

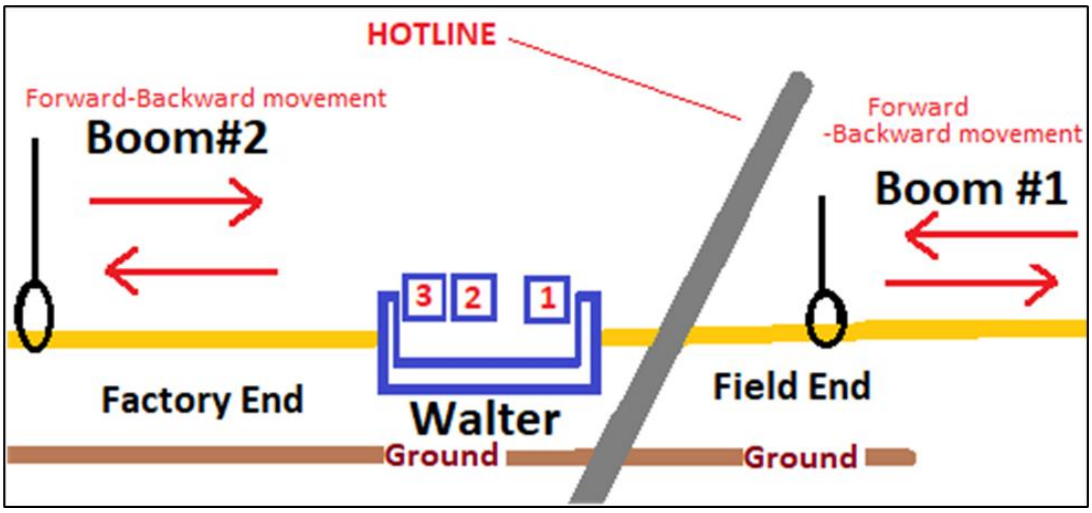
Effective planning and careful execution are critical for performing a tie-in ClickWeld®, focusing on pipe and equipment positioning to ensure the liner clears the mandrel safely. The process involves strategic movement of the pipe, either vertically or horizontally, to reduce liner length while avoiding deformation or safety hazards.

- **Plan equipment and pipe movements:** The Contractor tie-in foreman must assess the pipe layout, plan and communicate the entire tie-in from start to finish, considering equipment positioning, pipe movement, and press operation, while accounting for site constraints such as access points and obstructions. Optimal configurations involve moving the field end to lose liner length in Clamp 1, but flexibility is required based on site conditions. Hot line crossings and nearby obstructions must also be considered during planning.
- **Use vertical or horizontal pipe movement:** Losing liner length can be achieved through vertical movement, which involves lifting the pipe to create a bow when both ends are secured, or through horizontal movement, which is preferred and involves shifting unrestrained pipe ends without lifting. Horizontal movement is safer and easier, especially when tying in bends to straight sections, while vertical movement is typically not feasible through line crossings.

Vertical Movement



Horizontal Movement



- **Prepare and execute tie-in safely:** Pipe preparation for a ClickWeld® tie-in follows mainline procedures, ensuring the pipe is ready before lifting or manipulation to minimize suspended time. During press engagement, the non-moving pipe end must be secured first, and movements should be slow and controlled to avoid kinking or deformation. After securing both ends and closing the connection carefully, the ClickWeld® is completed as in mainline operations, with caution to release stored energy safely after disengaging the press.

Tie in Click Welds can be completed in accordance with the CORE Linepipe® Tie-In ClickWeld WIF-0851-067-R02

11.5 Tie in / Repair Pups

Premanufactured pups with dual factory end mandrels serve as repair or tie-in joints, and their installation into the CORE Liner® system involves confirming and preparing pipe ends, checking and securing pins, measuring and preparing liners, carefully installing and orienting the pup, performing ClickWeld®, and completing fusion with electrofusion while recording traceability data.

Tie in pups can be completed in accordance with the CORE Linepipe® Pup and Midline Vent ClickWeld WIF-0851-069-R01

11.6 Reducer Pup

The installation of the CORE Liner® transition pup enables the connection between CL671 and CL648 pipes, requiring precise steps and specialized equipment. This process is intended for engineer-approved applications and must be performed by senior ClickWeld® Technicians.

- **Preparation of CL648 pipe:** The CL648 pipe end is field cut and swaged, then clamped into the FEC with the appropriate swage body and liner reduction swage tip to start reducing the liner diameter. Cleaning and lubrication with dish soap are applied to ensure proper swaging. The liner is gradually reduced by swaging while measuring to achieve the correct diameter.
- **Measurement and preparation of liners:** After removal from the FEC, the required liner length is measured precisely using two measuring tapes, and the CL648 and CL671 liners are cut and scraped according to specific parameters referenced in a field end pipe preparation guide.
- **Assembly and welding:** The transition pup is stabbed into the CL648 pipe end with attention to its directional orientation, followed by positioning under Walter and butting into the field end. The liner funnel is installed and cleaned, and the other CL671 pipe end is connected. Grease is applied to both pipe bells before performing ClickWeld® and electrofusion steps. Final documentation of the transition pup installation is completed on a tablet.

Reducer pups can be completed in accordance with the CORE Linepipe® 671-648 Reducer ClickWeld WIF-0851-076

11.7 Large Diameter Tie in Fitting Installation (CL1071 / CL1279)

A Large Diameter Tie-In Fitting must be installed where the geometry of the tie-in cannot provide enough slack to complete the connection using the conventional tie in procedure. The following steps outline pipe preparation, assembly, EF fusion, and final pressing to ensure correct alignment and secure installation.

- **Pipe cutting and preparation:** Pipes should be cut with a pre-swage overlap of 263±3mm and post-swage length of 472±3mm on each side, resulting in a 792±12mm gap. Field press rings must be positioned correctly with specific chamfer orientations.

- **Swaging:** Field end flare both sides, any excessive field end flares should be ground down without exceeding 20mm axially.

- **Second Cut:** Cut swaged sections to correct length. Remove external coating from swaged area while maintaining torch temps below maximum. Cut liner to correct length, scrape and clean.

- **Assembly of components:** Tie-in press rings are placed over pipes with mandrels inserted against field bells. EF and fillers are installed on the side with sufficient liner length, while sleeves and side fillers are positioned on the opposite end. Pipes are then aligned axially, ensuring no parts pass over liner ends.

- **EF fusion process:** The EF and filler are centered over the liner-liner connection, with adjustments made to side fillers if necessary. A 0.25” spacing between one mandrel shoulder and field bell end is ensured for clamp installation. The tie-in clamp is installed exposing terminals, tightened, and the EF is fused, followed by cooling before further assembly.

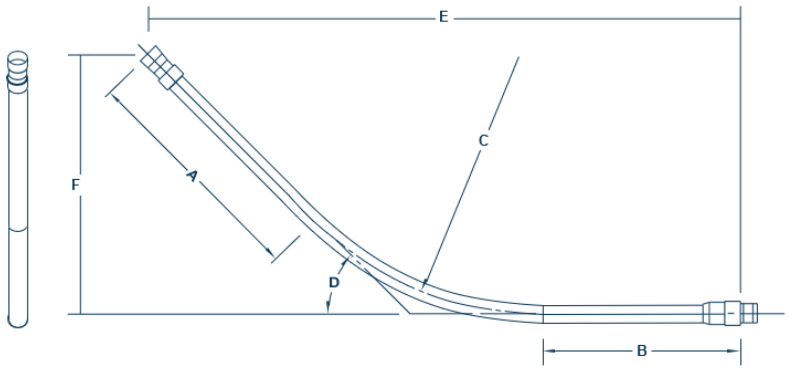
- **Final pressing and assembly:** After cooling, fillers overlap over EF, mandrels are pushed to remove gaps, and the sleeve is slid over the assembly. The first and second tie-in press rings are pressed using a back stop tool and field press, with sleeve length adjusted if needed. Remaining field press rings are installed ensuring minimal gaps between rings.

11.8 Field Ring Extension Tool

The field ring extension tool is used when performing a ClickWeld on back-to-back bends, where the rams of the 100-ton press would otherwise contact the bend before the weld is completed. The tool is placed around the pipe, directly behind the field ring, effectively extending the ring. This shortens the press ram stroke, creating the clearance needed to complete the ClickWeld without interference from the bends.

12 Riser Installation

Risers must be factory bent and pre-ordered with customer approval on dimensional drawings before bending. Installation requires at least two separate lifting devices, and risers should be supported following industry best practices or company policy, considering ditch depth and riser dimensions. As-built drawings are available after bends are completed.



12.1 Flange ClickWeld

CORE Liner® flanges are proprietary and unique ASME B16.5 raised face flanges, mounted with a ClickWeld® joint on one end and a plastic stub end on the other end. The following instructions outline how to effectively install flanged ends to the ClickWeld system, for both riser and non-riser flange installations under various conditions.

- **Preparation steps:** Flange type is determined first (riser or non-riser). Flanges are unwrapped and matched to pipe numbers. Measurements for liner length are taken from the center of the flange EF fitting. Interior flange surfaces are cleaned, and liners are prepared following referenced procedures.
- **Installation process:** For risers, the pipe is laid on tubs and pipe stands, leveled, and the flange installed with the weld-o-let facing the inside radius. For non-risers, the flange is installed with the weld-o-let facing upwards. The flange is aligned using a torpedo level before completing the ClickWeld. After pressing the field ring on, the stub end is measured, cut, scraped, cleaned, and inserted carefully.
- **Fusion:** The final electrofusion of the connection is performed according to the referenced field services electrofusion procedure.

12.2 Trenching for Risers

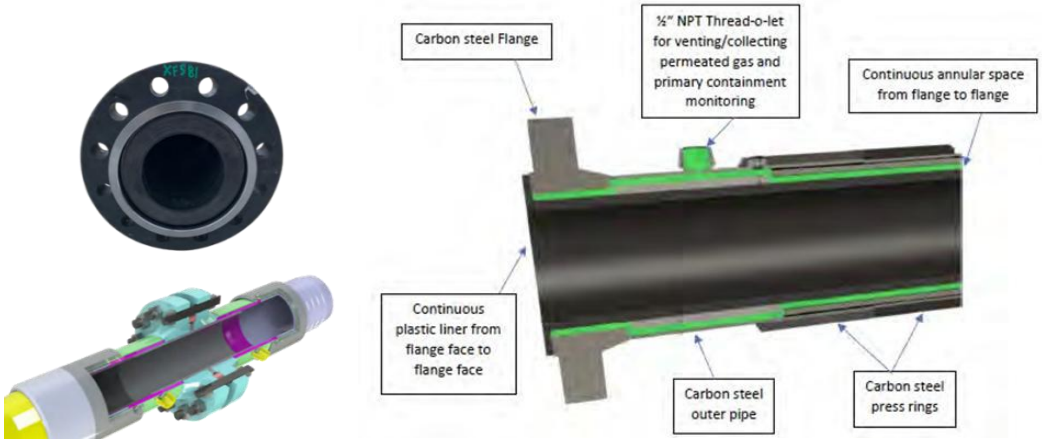
Proper installation and support of riser assemblies are critical to ensure structural integrity and prevent stress on above-ground piping. The contractor is responsible for installation in compliance with owner specifications.

- **Avoid over excavation:** Risers should be installed on virgin ground, and the trench bottom must be contoured to the pipe to provide continuous support.
- **Installation and testing responsibilities:** The contractor should install, and test riser assemblies per owner plans and specifications and ensure above-ground piping does not impart stress on risers.
- **Quality assurance criteria:** QA procedures include verifying proper support, coating, insulation, correct torque on mechanical connections, proper placement of cathodic jumpers, correct valve installation, proper installation of riser vents, and stress-free above-ground assemblies.

12.3 Flange Bolt Up

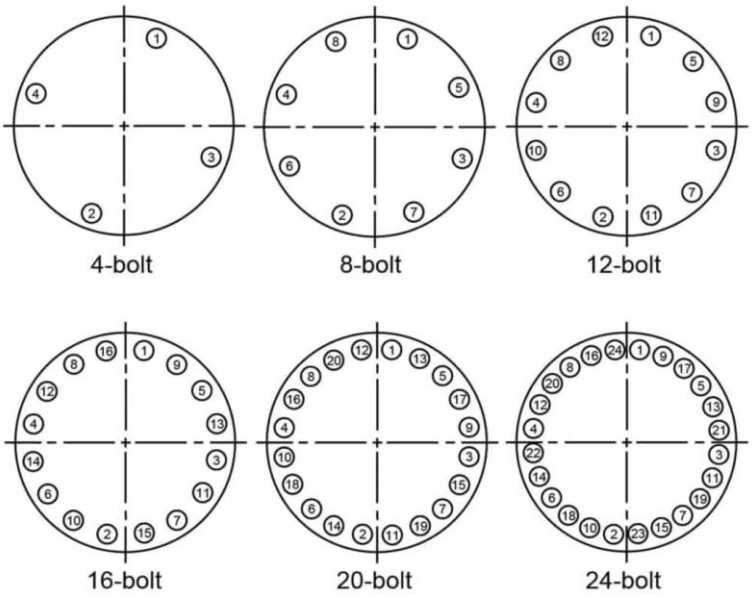
CORE Liner® flanged ends are designed with specific components and configurations to ensure leak-tight, durable pipeline joints. These include a steel flange with a polymer stub end, and compression rings that prevent excessive compression and enhance sealing performance.

CORE Liner® flanges require longer studs and carbon steel compression rings to protect the plastic during bolt-up. Multiple compression ring types are available for different ANSI classes and service requirements, with specific configurations to ensure electrical isolation and prevent galvanic corrosion when connecting to different metal flanges.



12.3.1 Flange Torque Specifications

Flanges should be tightened in the specified pattern determined by how many bolts are required for the flange as outlined in the following diagram:



Flanges should be torqued according to the following table:

Size and Rating	Compression Ring Type	Step 1 Repeat 2x	Step 2 Repeat 2x	Step 3 Repeat 2x	Step 4 Repeat 2x		Step 6 Repeat Until Full Torque
		ft-lbs	ft-lbs	ft-lbs	ft-lbs		ft-lbs
NPS 4 300 ANSI	Standard	80	150	300	N/R		300
NPS 4 300ANSI	High Performance	80	150	300	N/R		300
NPS 4 600 ANSI	Standard	80	150	300	400		400
NPS 4 900 ANSI	High Performance	80	150	300	500		500
NPS 4 1500 ANSI	High Performance	80	160	390	650		650
		ft-lbs	ft-lbs	ft-lbs	ft-lbs		ft-lbs
NPS 6 300 ANSI	Standard	80	150	300	N/R		300
NPS 6 300 ANSI	High Performance	80	150	300	N/R		300
NPS 6 600 ANSI	Standard	80	150	300	500	Step5	500
NPS 6 900 ANSI	High Performance	80	150	360	600	Wait 1hr min.	600
NPS 6 1500 ANSI	High Performance	80	200	500	820		820
		ft-lbs	ft-lbs	ft-lbs	ft-lbs		ft-lbs
NPS 8 300 ANSI	Standard	80	150	300	400		400
NPS 8 600 ANSI	Standard	80	150	360	600		600
NPS 8 900 ANSI	High Performance	80	300	500	850		850
		ft-lbs	ft-lbs	ft-lbs	ft-lbs		ft-lbs
NPS 10 300 ANSI	Standard	80	100	300	600		600
NPS 10 600 ANSI	Standard	80	300	500	850		850
NPS 10 900 ANSI	High Performance	80	400	800	950		950
		ft-lbs	ft-lbs	ft-lbs	ft-lbs		ft-lbs
NPS 12 300 ANSI	Standard	80	300	500	700		700
NPS 12 600 ANSI	Standard	80	300	500	850		850
NPS 12 900 ANSI	High Performance	80	400	800	1130		1130

The plastic flange will relax over time. The longer you wait, the less cycles in step 6 will be necessary to reach final torque.

12.3.2 Bolt up Specification

Size and Rating	Stud Spec A193 B7M or A320 L7M			Nut Spec A194 2HM or 7M
	Size	Length Single (inch)	Length Double (inch)	Size
NPS 4 300 ANSI	0.75"-10 UNC	6	6	0.75"-10 UNC HEAVY HEX NUT
NPS 4 300ANSI HP	0.75"-10 UNC	6	6	0.75"-10 UNC HEAVY HEX NUT
NPS 4 600 ANSI	0.875"-9 UNC	7	7	0.875"-9 UNC HEAVY HEX NUT
NPS 4 900 ANSI	1.125"-7 UNC	8	8	1.125"-7 UNC HEAVY HEX NUT
NPS 4 1500 ANSI	1.25"-7 UNC	10	10	1.25"-7 UNC HEAVY HEX NUT
NPS 6 300 ANSI	0.75"-10 UNC	6	6	0.75"-10 UNC HEAVY HEX NUT
NPS 6 300 ANSI HP	0.75"-10 UNC	7	7	0.75"-10 UNC HEAVY HEX NUT
NPS 6 600 ANSI	1”-8 UNC	8	8	1"-8 UNC HEAVY HEX NUT
NPS 6 900 ANSI	1.125"-7 UNC	10	10	1.125"-7 UNC HEAVY HEX NUT
NPS 6 1500 ANSI	1.375”-8 UNC	14	14	1.375"-8 UNC HEAVY HEX NUT
NPS 8 300 ANSI	0.875"-9 UNC	6	8	0.875"-9 UNC HEAVY HEX NUT
NPS 8 600 ANSI	1.125"-7 UNC	8	8	1.125"-7 UNC HEAVY HEX NUT
NPS 8 900 ANSI	1.375”-6 UNC	12	12	1.375"-6 UNC HEAVY HEX NUT
NPS 10 300 ANSI	1”-8 UNC	8	8	1"-8 UNC HEAVY HEX NUT
NPS 10 600 ANSI	1.25"-7 UNC	10	10	1.25"-7 UNC HEAVY HEX NUT
NPS 10 900 ANSI	1.375”-8 UNC	12	12	1.375"-8 UNC HEAVY HEX NUT
NPS 12 300 ANSI	1.125"-7 UNC	8	8	1.125"-7 UNC HEAVY HEX NUT
NPS 12 600 ANSI	1.25"-7 UNC	10	10	1.25"-7 UNC HEAVY HEX NUT
NPS 12 900 ANSI	1.375”-6 UNC	12	12	1.375"-6 UNC HEAVY HEX NUT

Single - CORE LINEPIPE flange to standard flange (either a customer flange, or blind flange)
Double - CORE LINEPIPE flange to CORE LINEPIPE flange

12.3.3 Compression Rings

Three types of compression rings are used. A standard ring for ANSI 300 and 600 classes without a gasket; a high-performance single ring with two O-rings on one side requiring a gasket for ANSI 900 and 1500 classes; and a high-performance double ring with O-rings on both sides for demanding applications, not requiring a gasket.

Standard

High Performance

The compression ring with the standard configuration sits between a CORE Liner® flange and an adjoining CORE Liner® or standard raised face steel flange, and does not require the use of a gasket. The compressed face of the polymer liner acts as the sealing element to ensure a leak tight connection.

The high-performance compression ring single sits directly against a CORE Liner® flange on the side of the two O-rings, and requires a gasket to seal between the back of the high-performance compression ring and the raised face of the adjoining steel flange.

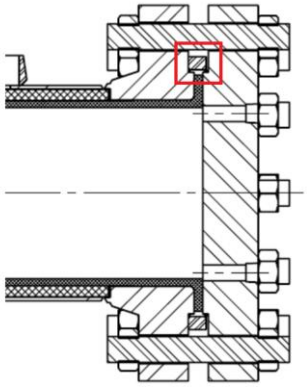
The High-Performance compression ring double sits between a CORE Liner® flange and an adjoining CORE Liner® flange, and does not require the use of a gasket. The O-rings compressed against the face of the polymer liner act as the sealing element to ensure a leak tight connection.

Standard

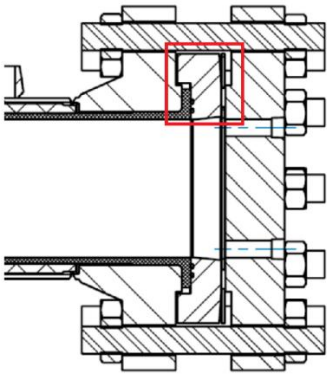
High Performance

It is very important that the steel compression ring between the flanges is being compressed between the steel flanges.

Standard Compression Ring



High Performance Compression Ring



For each of CL440, CL640, CL648, CL671, CL856 and CL1279, a flanged joint may use any of the following compression rings, depending on the project requirements:

Compression Rings	Function	ANSI 300	ANSI 600	ANSI 900	ANSI 1500
Standard Single	Between a CORE Liner® flange and a raised face flange	Yes	Yes	-	-
Standard Double	Between a CORE Liner® flange and a CORE Liner® flange	Yes	Yes	-	-
Isolation	Used with a non-conductive isolation ring for electrical isolation between a CORE Liner® flange and a raised face flange	Yes	Yes	-	-
High-Performance Single	For demanding applications between a CORE Liner® flange and a raised face flange	Yes	Yes	Yes	Yes
High-Performance Double	For demanding applications between a CORE Liner® flange and a CORE Liner® flange	Yes	Yes	Yes	Yes

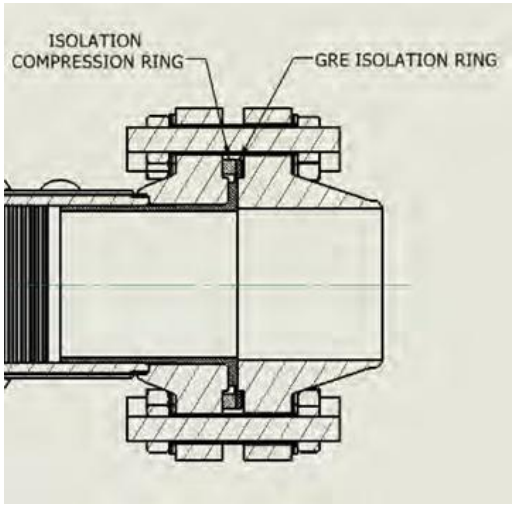
Notes:

- A standard compression ring double is longer in length than a standard compression ring single.
- A high-performance compression ring double has O-rings on both sides.
- Electrical isolation is generally required when a CORE Liner® flange is joined to a stainless-steel flange.
- The isolation compression ring is shorter than the standard compression ring single, to account for the thickness of the non-conductive isolation ring.
- The electrical isolation on high performance compression rings requires the use of an electrical isolation gasket between the High-Performance compression ring and the stainless-steel flange. The High-Performance compression ring itself remains unchanged.
- All electrical isolation joints, irrespective of the compression ring configuration, need to use electrically non-conductive sleeves and washers for the flange studs.

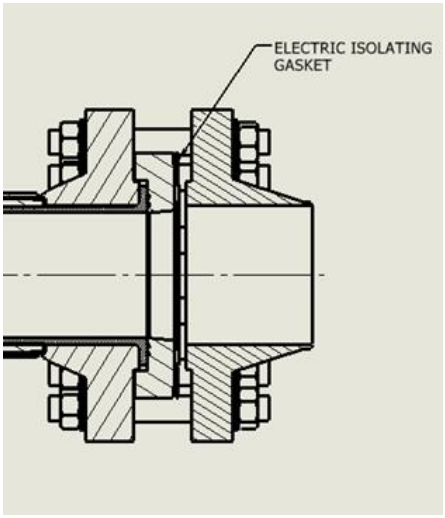
12.3.4 Electrical Isolation

To prevent galvanic corrosion between carbon steel flanges and adjoining metallic flanges of different materials, electrical isolation is implemented using electrically non-conductive materials. For standard compression ring configurations, this involves placing a non-conductive isolation ring between the compression ring and the adjoining flange, with a shorter compression ring to accommodate it. For high-performance compression rings, an electrically non-conductive gasket is placed between the back of the compression ring and the adjoining flange to achieve isolation.

Standard configuration



High Performance configuration



12.4 Coating Underground Flange Connections

CORE does not apply external protection to flange assemblies. For underground flanges, it is recommended that the contractor apply STOPAQ or equivalent to the flange assembly.

12.5 Riser Vent Installation

CORE Linepipe® provides stainless-steel vent tubing, fittings, and needle valves designed for connection to the thread-o-let port on CORE Liner® flanges. The installation involves measuring and bending riser tubing into a “U” shape, adding length for jumper tubing flexibility, preparing fittings with Teflon tape and moly paste to prevent corrosion, installing all fittings and valves except for jumpers, and ensuring tubing ends are undamaged before tightening. Valves should remain open during hydrotesting when applicable to ensure proper assembly and function.

13 Horizontal Directional Drilling (HDD)

CORE Linepipe® products are designed for horizontal directional drilling (HDD) and boring applications, featuring custom reusable pull heads that prevent mandrel damage and ensure strong tensile capability. Proper planning of bore directionality, minimum pipe protrusion of 10 meters at entry and exit points, pre-pull hydrotesting, and installation of plugs, seals, and corrosion protection are essential for successful pulls. For higher pull loads, welding connections to carbon steel pipe is necessary, and precautions must be taken to protect

external coatings, especially when installing into bore casings. Scar-Guard is recommended as additional external coating on ClickWeld connections for HDD sections.

13.1 HDD Section Pre-Testing

CORE Linepipe® recommends performing hydrotests on critical CORE Liner® HDD/Bore pipeline sections before pull-in, using ClickWeld flanges at both ends. The hydrotest includes a 30-minute strength test at 1.25 times design pressure and a 30-minute leak test at 2 MPa, with vent lines open, proper sealing, no external coating on connections, and utilizing medium density foam pigs for fill and de-watering. Pressure is monitored digitally, and test details are recorded, with specific procedures for pressure holding and venting during strength and leak tests as outlined in section 15 of this installation guide.

13.1.1 Pre-Testing Temperature Considerations

At low temperatures, HDPE material becomes more rigid, thus possibly introducing a risk of the liner cracking during hydrotest. This consideration is particularly applicable for pipeline sections that are hydrotested while above ground. To address this consideration, the following is recommended:

For hydrotests where the actual temperature of the test fluid is above 32^0F (0^0C) it is required to pressurize and depressurize the pipeline at a steady rate not exceeding 100 psig/minute (700 kPa/minute).

For hydrotests where the actual temperature of the test fluid is between -4^0F (-20^0C), and 32^0F (0^0C) it is required to pressurize and depressurize the pipeline at a steady rate not exceeding:

- 25 psig/minute (175 kPa/minute), at pipeline pressures between zero and 500 psig (3,450 kPa); and
- 100 psig/minute (700 kPa/minute) at pipeline pressures above 500 psig (3,450 kPa).

For hydrotests where the actual temperature of the test fluid is below -4^0F (-20^0C), it is required to:

- Heat the test fluid such that to have a test fluid at a temperature above 41^0F (5^0C).
- For above ground bore pre-tests, tarp the pipeline and maintain it at a temperature of around 32^0F (0^0C) using suitable air heaters.
- Allow enough time until the temperature of the pipeline wall and the temperature of the test fluid even out.
- Pressurize and depressurize the pipeline at a steady rate not exceeding:
    - 25 psig/minute (175 kPa/minute), at pipeline pressures between zero and 500 psig (3,450 kPa); and
    - 100 psig/minute (700 kPa/minute) at pipeline pressures above 500 psig (3,450 kPa).

13.2 Pull Head Installation

CORE Linepipe Pull Heads can only be installed on the Factory end of the pipe, this should be taken into consideration when planning HDD direction and section layout. For HDD pull back utilizing the Field end a standard pull head will need to be welded onto the section. For HDD scenarios that exceed the max pull strength of the CORE bolt on pull head, a standard pull head will need to be welded onto the section, and a repair pup will be required for final tie in. Proper installation of the pull head assembly is crucial for safe and effective horizontal directional drilling (HDD) operations, as it ensures operational integrity and prevents costly work stoppages. The process involves careful handling and specific steps to prepare and assemble the pull head components.

- **Preparation and sealing:** Packaging is removed following established procedures, EF pins are taken out, and pipe numbers are transferred to the mandrel for identification. Viton seals and black steel plugs are installed and torqued to 40 ft-lbs to seal plug holes properly. The mandrel end plug is inserted and tightened using a star pattern to ensure uniform contact and seal integrity.
- **Pull head assembly:** The pull head halves are disassembled, bolts inspected and replaced if necessary, according to pipe size specifications. The lug plate is greased and installed, and the pull head halves are carefully engaged with the mandrel teeth. Bolts are greased with anti-seize and torqued to 40 ft-lbs to secure the assembly firmly.
- **Waterproofing and protection:** Surfaces are cleaned of contaminants before applying a single layer of Denso tape with at least 50% overlap, followed by a layer of black polymer tape to compress and seal the Denso tape. A protective steel sleeve is installed over the pull head and secured with black polymer tape to prevent damage and ensure it remains in place during lifting and manipulation.

Pull head installation can be completed in accordance with the CORE Linepipe® Pull Head Installation WIF-0851-070-R01

13.3 HDD Installation Information

Product	Max. Pull Force Welded Pull Head		Max. Pull Force Reuseable Pull Head		OD of Pull Head		ClickWeld OD		Min. Reamer Size	
	lb	kN	lb	kN	in	mm	in	mm	in	mm
CL440	90,000	401	60,000	267	7.3	185	5.98	152	12	305
CL640	130,000	579	80,000	356	9.5	241	8.25	210	14	356
CL648	160,000	713	80,000	356	9.5	241	8.25	210	14	356
CL671	230,000	1024	80,000	356	9.5	241	8.66	220	14	356
CL856	190,000	846	80,000	356	12.8	325	10.75	273	16	406
CL1071	380,000	1,692	100,000	444	14.0	356	13.74	349	22	559
CL1279	510,000	2,271	100,000	444	16.5	419	15.83	402	26	660

Crossings and horizontal directional drilling (HDD) must be conducted in accordance with the jurisdictional regulations, with established written procedures and execution plans to protect existing infrastructure and the environment while ensuring pipeline integrity. The HDD quality assurance should confirm crossing agreements, design plans, equipment adequacy, necessary sampling and regulatory notifications, cathodic protection, inspections, safe site preparation, appropriate equipment use, suitable backfill material, and comprehensive record keeping including third-party authorizations are all properly managed throughout the crossing activities.

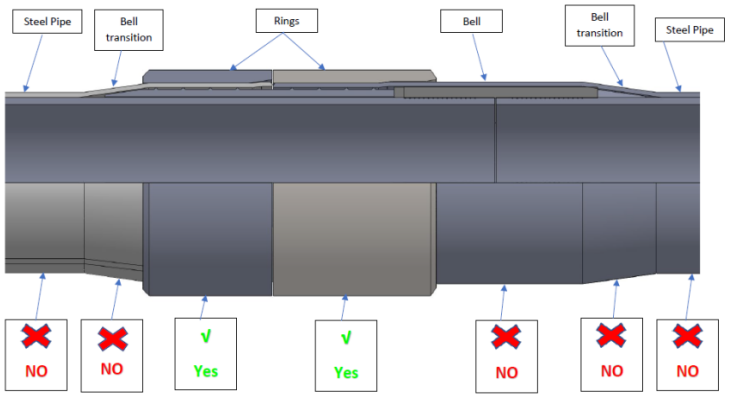
CORE Linepipe is constructed from Grade 359 (5L) pipe (high-strength steel). Pipe supports during an HDD pullback must be designed to support the pipe's weight and prevent overstressing without hindering the pullback process. Temporary supports on rollers can be used to distribute the load and guide the pipe to minimize bending stress. Factors like pipe weight, diameter, and bend radius should be considered when determining support spacing and design.

- **Weight and Strength:** Grade 359 pipe is a high-strength steel, so you'll need to determine its specific weight per unit length to accurately calculate the required support strength.
- **Bending Radius:** To prevent overstressing the pipe during the pull, adhere to the 1000xD rule, which requires the bend radius to be at least 1000 times the pipe's diameter.
- **Ground and Support Equipment:** The supports must be able to safely handle the pipe's weight, and temporary supports like rollers or sleepers can help distribute the load and guide the pipe.
- **Pullback Force:** The force generated by the HDD rig increases axially along the length of the pipe, placing stress on the pipe.

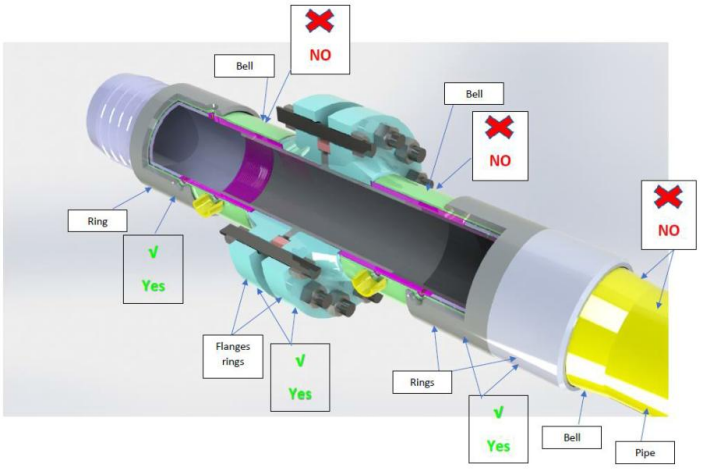
13.4 Test Lead Installation

Exothermic welding for electrical conductors must be performed only on the ClickWeld® ring or flange ring to avoid damaging the HDPE lining, with specific prohibited areas including the CORE Liner® pipe surface and bell transition zones.

Acceptable Exothermic Weld Locations on a ClickWeld®



Acceptable Exothermic Weld Locations on a ClickWeld® Flange



14 Backfill and Cleanup

Proper backfilling is critical to ensuring that CORE Linepipe external corrosion is maintained. When backfilling CORE Linepipe, contractors must ensure proper support and coverage of pipelines without damaging the external coating or pipe. Backfilling should be carried out by skilled operators with qualified spotters and preferably witnessed by an inspector. Quality assurance includes verifying the pipe rests on suitable bedding, using appropriate backfill material, installing trench breakers and erosion controls, managing trench water and pipe buoyancy, ensuring backfilling is performed tightly daily, and protecting pipe ends from water and debris.

15 Pressure Testing

The CORE Liner® hydrotest procedures ensure the integrity and leak tightness of factory-built pipe-in-pipe systems by conducting combined strength and leak tests. The CORE Liner® Hydrotest Procedure provides detailed guidelines on water volume requirements, testing steps, pressures, durations, temperature limitations and monitoring protocols for completed pipelines.

- **Single hydrotest approach:** The carbon steel pipeline and internal lining are tested simultaneously through a joint hydrotest, consisting of a strength test followed by a leak test, in accordance with CSA Z662 standards.
- **Fluid volume:** Different CORE Liner® products require specific volumes of water per mile (or kilometer) for filling and pressurizing, ranging from 425 ft³/mile (7.5 m³/km) to 3,675 ft³/mile (65 m³/km) depending on the product type.

Product	Hydrotest Fluid Volume	
	ft^3 / mile	m^3 / km
CL440	425	7.5
CL640	1,000	18
CL648	975	17.5
CL671	925	16.5
CL856	1,675	30
CL1071	2,600	46
CL1279	3,675	65

- **Strength test procedure:** The strength test mandates filling the pipeline completely, removing air, and applying a minimum pressure of 1.25 times the Maximum Allowable Operating Pressure (MAOP) at the lowest elevation point, holding the pressure for specified durations based on pipeline length and vent spacing. Pressure bumps and holds are performed at various stages to ensure stability.
- **Pressure and hold durations:** Pressure is increased in increments, holding for 15 minutes or longer until stable or rising pressure is achieved, with final test pressures maintained for at least 4 hours to monitor for leaks, considering ambient temperature fluctuations.
- **Liner leak test details:** Following the strength test, the pipeline is depressurized to a low pressure to allow liner relaxation, then pressurized to around 2 MPa (290 psi) and held for 4 hours while monitoring vents for any liquid flow indicating leaks.
- **Hydrotest reporting:** A detailed CORE Linepipe Hydrotest Report form is provided to record test parameters such as date, customer, job number, pipeline dimensions, elevations, test pressures, medium, water source, temperature, gauge numbers, inspectors, and observations to ensure comprehensive documentation.

15.1.1 Pressure Test Staging Tables

CL440	300 ANSI	600 ANSI	900 ANSI	1500 ANSI
Maximum Operating Pressure (MOP)	720 psi 4.96 MPa	1,440 psi 9.93 MPa	2,160 psi 14.89 MPa	2,620 psi 18.09 MPa
Bump Pressure 1 (60 minutes per 1000m if largest distance between liner vents)	50 psi 0.3 MPa	50 psi 0.3 MPa	50 psi 0.3 MPa	50 psi 0.3 MPa
Bump Pressure 2 (Hold 15 minutes or until stable or rising)	300 psi 2.1 MPa	500 psi 3.4 MPa	500 psi 3.4 MPa	800 psi 5.5 MPa
Bump Pressure 3 (Hold 15 minutes or until stable or rising)	500 psi 3.4 MPa	1,000 psi 6.9 MPa	1,200 psi 8.3 MPa	1,800 psi 12.4 MPa
Bump Pressure 4 (Hold 15 minutes or until stable or rising)	700 psi 4.8 MPa	1,500 psi 10.3 MPa	2,200 psi 15.2 MPa	2,800 psi 19.3 MPa
Test Pressure Minimum	900 psi 6.2 MPa	1,800 psi 12.4 MPa	2,700 psi 18.6 MPa	3,275 psi 22.6 MPa
Test Pressure Maximum	1,125 psi 7.8 MPa	2,225 psi 15.3 MPa	3,350 psi 23.1 MPa	3,640 psi 25.1 MPa

CL640	300 ANSI	600 ANSI	900 ANSI
Maximum Operating Pressure (MOP)	720 psi 4.96 MPa	1,440 psi 9.93 MPa	1,780 psi 12.29 MPa
Bump Pressure 1 (60 minutes per 1000m if largest distance between liner vents)	50 psi 0.3 MPa	50 psi 0.3 MPa	50 psi 0.3 MPa
Bump Pressure 2 (Hold 15 minutes or until stable or rising)	300 psi 2.1 MPa	500 psi 3.4 MPa	500 psi 3.4 MPa
Bump Pressure 3 (Hold 15 minutes or until stable or rising)	500 psi 3.4 MPa	1,000 psi 6.9 MPa	1,200 psi 8.3 MPa
Bump Pressure 4 (Hold 15 minutes or until stable or rising)	700 psi 4.8 MPa	1,500 psi 10.3 MPa	1,800 psi 12.4 MPa
Test Pressure Minimum	900 psi 6.2 MPa	1,800 psi 12.4 MPa	2,225 psi 15.3 MPa
Test Pressure Maximum	1,125 psi 7.8 MPa	2,225 psi 15.3 MPa	2,475 psi 17.1 MPa

CL648	300 ANSI	600 ANSI	900 ANSI
Maximum Operating Pressure (MOP)	720 psi 4.96 MPa	1,440 psi 9.93 MPa	2,140 psi 14.74 MPa
Bump Pressure 1 (60 minutes per 1000m if largest distance between liner vents)	50 psi 0.3 MPa	50 psi 0.3 MPa	50 psi 0.3 MPa
Bump Pressure 2 (Hold 15 minutes or until stable or rising)	300 psi 2.1 MPa	500 psi 3.4 MPa	500 psi 3.4 MPa
Bump Pressure 3 (Hold 15 minutes or until stable or rising)	500 psi 3.4 MPa	1,000 psi 6.9 MPa	1,200 psi 8.3 MPa
Bump Pressure 4 (Hold 15 minutes or until stable or rising)	700 psi 4.8 MPa	1,500 psi 10.3 MPa	2,200 psi 15.2 MPa
Test Pressure Minimum	900 psi 6.2 MPa	1,800 psi 12.4 MPa	2,675psi 18.4 MPa
Test Pressure Maximum	1,125 psi 7.8 MPa	2,225 psi 15.3 MPa	2,970 psi 20.5 MPa

CL671	300 ANSI	600 ANSI	900 ANSI	1500 ANSI
Maximum Operating Pressure (MOP)	720 psi 4.96 MPa	1,440 psi 9.93 MPa	2,160 psi 14.89 MPa	3,160 psi 21.81 MPa
Bump Pressure 1 (60 minutes per 1000m if largest distance between liner vents)	50 psi 0.3 MPa	50 psi 0.3 MPa	50 psi 0.3 MPa	50 psi 0.3 MPa
Bump Pressure 2 (Hold 15 minutes or until stable or rising)	300 psi 2.1 MPa	500 psi 3.4 MPa	500 psi 3.4 MPa	1000 psi 6.9 MPa
Bump Pressure 3 (Hold 15 minutes or until stable or rising)	500 psi 3.4 MPa	1,000 psi 6.9 MPa	1,200 psi 8.3 MPa	2,200 psi 15.2 MPa
Bump Pressure 4 (Hold 15 minutes or until stable or rising)	700 psi 4.8 MPa	1,500 psi 10.3 MPa	2,200 psi 15.2 MPa	3,400 psi 23.4 MPa
Test Pressure Minimum	900 psi 6.2 MPa	1,800 psi 12.4 MPa	2,700 psi 18.6 MPa	3,950 psi 27.2 MPa
Test Pressure Maximum	1,125 psi 7.8 MPa	2,225 psi 15.3 MPa	3,350 psi 23.1 MPa	4.390 psi 30.3 MPa

CL856	300 ANSI	600 ANSI
Maximum Operating Pressure (MOP)	720 psi 4.96 MPa	1,440 psi 9.93 MPa
Bump Pressure 1 (60 minutes per 1000m if largest distance between liner vents)	50 psi 0.3 MPa	50 psi 0.3 MPa
Bump Pressure 2 (Hold 15 minutes or until stable or rising)	300 psi 2.1 MPa	500 psi 3.4 MPa
Bump Pressure 3 (Hold 15 minutes or until stable or rising)	500 psi 3.4 MPa	1,000 psi 6.9 MPa
Bump Pressure 4 (Hold 15 minutes or until stable or rising)	700 psi 4.8 MPa	1,500 psi 10.3 MPa
Test Pressure Minimum	900 psi 6.2 MPa	1,800 psi 12.4 MPa
Test Pressure Maximum	1,125 psi 7.8 MPa	2,225 psi 15.3 MPa

CL1071	300 ANSI	600 ANSI	900 ANSI
Maximum Operating Pressure (MOP)	720 psi 4.96 MPa	1,440 psi 9.93 MPa	1,950 psi 13.44 MPa
Bump Pressure 1 (60 minutes per 1000m if largest distance between liner vents)	50 psi 0.3 MPa	50 psi 0.3 MPa	50 psi 0.3 MPa
Bump Pressure 2 (Hold 15 minutes or until stable or rising)	300 psi 2.1 MPa	500 psi 3.4 MPa	500 psi 3.4 MPa
Bump Pressure 3 (Hold 15 minutes or until stable or rising)	500 psi 3.4 MPa	1,000 psi 6.9 MPa	1,200 psi 8.3 MPa
Bump Pressure 4 (Hold 15 minutes or until stable or rising)	700 psi 4.8 MPa	1,500 psi 10.3 MPa	2,000 psi 13.8 MPa
Test Pressure Minimum	900 psi 6.2 MPa	1,800 psi 12.4 MPa	2,440 psi 16.8 MPa
Test Pressure Maximum	1,125 psi 7.8 MPa	2,225 psi 15.3 MPa	2,710 psi 18.7 MPa

CL1279	300 ANSI	600 ANSI	900 ANSI
Maximum Operating Pressure (MOP)	720 psi 4.96 MPa	1,440 psi 9.93 MPa	1,830 psi 12.61 MPa
Bump Pressure 1 (60 minutes per 1000m if largest distance between liner vents)	50 psi 0.3 MPa	50 psi 0.3 MPa	50 psi 0.3 MPa
Bump Pressure 2 (Hold 15 minutes or until stable or rising)	300 psi 2.1 MPa	500 psi 3.4 MPa	500 psi 3.4 MPa
Bump Pressure 3 (Hold 15 minutes or until stable or rising)	500 psi 3.4 MPa	1,000 psi 6.9 MPa	1,200 psi 8.3 MPa
Bump Pressure 4 (Hold 15 minutes or until stable or rising)	700 psi 4.8 MPa	1,500 psi 10.3 MPa	1,800 psi 12.4 MPa
Test Pressure Minimum	900 psi 6.2 MPa	1,800 psi 12.4 MPa	2,290 psi 15.8 MPa
Test Pressure Maximum	1,125 psi 7.8 MPa	2,225 psi 15.3 MPa	2,540 psi 17.5 MPa

15.2 Testing Procedure for Repairs and Closure Connections

The Testing Procedure for In-service CORE Liner® Repairs or Closure Tie-ins (CLP-TB-044) ensures that any completed repair or closure connection maintains structural integrity, leak tightness, and compliance with CORE specifications and CSA Z662 requirements.

This procedure applies to all in-service repair or closure connections requiring verification before returning the pipeline to operation.

Before completing the final connections, any replacement pipe or new tie in sections must be pretested at 1.25×MOP for four hours and then at 290 psi for an additional four hours. The new final connections, connecting the new line or repair segment into the existing segment must be left with one electrofusion port open, fitted with tubing and a valve to monitor or remove fluids from the annular space, with containment materials properly installed.

During the hydrotest, the repaired area remains fully exposed while the pipeline is pressurized to the highest available operating pressure and held for four hours under continuous inspection to confirm no leakage or abnormalities in the repair zone or annular monitoring line.

Once the test is successfully completed, technicians remove the tubing, install the electrofusion seal and plug, and apply the appropriate external corrosion protection following CORE coating guidelines and the manufacturer’s MQAP.

The procedure aligns with CSA Z662 guidance for tie-ins and composite pipe repairs, and any testing that would exceed normal operating pressures requires an engineering assessment as mandated in CSA Z662 Section 10.3.9.1.

16 De-watering and Pigging

De-watering CORE Liner® after hydrotesting can be completed using medium density foam pigs. The annular space of CORE Liner® should be vented prior to depressurizing the pipeline bore. It is required to depressurize the bore slowly to allow the gas that permeated the liner to fully vent out of the annular space.

Internal Dimensions for Pig Sizing:

CORE Liner® Item	Internal Dimension (ID)	
	inches	mm
CL440	3.72	94
CL640	5.81	148
CL648	5.74	146
CL671	5.59	142
CL856	7.52	191
CL1071	9.37	238
CL1279	11.14	283

17 Startup and Operation

CORE Liner® startup, operation, and maintenance require specific procedures to ensure integrity and performance.

- **Startup procedures:** After hydrotesting, the pipeline should be started with a controlled, gradual increase in flow while keeping vents open to allow gas in the annular space to vent and to verify liner leak tightness.
- **Venting requirements:** Gas permeation through the polymer liner can increase annular pressure, so the annular space must be vented regularly to keep its pressure below the bore pressure. Initial venting is recommended weekly, adjustable based on gas volume vented, with a minimum monthly venting frequency. Frequent venting is essential for pipelines with gas phases and pressure fluctuations.
- **Depressurization and vacuum handling:** The annular space must be fully vented before depressurizing the bore to prevent liner buckling or collapse. The liner can resist full vacuum, but vents should remain closed under vacuum conditions, and vacuum breakers are recommended if vacuum lasts over an hour.
- **Maintenance operations:** CORE Liner® can be pigged using medium-density foam or polyurethane disk pigs to prevent buildup, avoiding steel wire brush pigs to protect the liner. Hot oiling should not exceed specified pressure, and temperature limits and requires venting before and after. The polymer liner is resistant to alcohols like methanol and ethanol, which can be used for continuous or batch treatment with appropriate oxygen mitigation.

18 Quality Management System (QMS)

CORE Linepipe Inc.'s Quality Manual outlines its adherence to ISO 9001:2015 standards for its patented products.

The manual identifies key processes such as Design and Development, Sales, Purchasing, Production and Assembly, Field Operations, and Shipping and Receiving, each with defined responsibilities, risks, resources, and quality objectives to ensure effective control and continuous improvement.

Documented information is organized into a five-tier structure, with stringent document control and records management practices to maintain current data and protect information integrity, including third-party and electronic records.

18.1 QMS Records

CORE Linepipe® provides a complete Quality Control (“QC”) package for CORE Liner® products, including material MTRs and installation data, at the end of the project. Upon special request, the MTRs can be provided separately prior to the commencement of the construction. Any other QC requirements for mechanical works are to be provided by the mechanical contractor.

All CORE Linepipe® ClickWeld® and electrofusion data is collected daily in the Reconciliation Report and verified against the delivery Pipe Tally.

18.2 Inspection and Test Plan (ITP)

For all CORE Linepipe® installations an approved Inspection and Test Plan must be utilized to maintain quality assurance throughout the material handling and joining processes. The CORE Service® team can provide a CORE Linepipe® specific ITP to certified Contractors to incorporate into their overall project ITP. When the CORE Service® installation crew is utilized, they will provide and complete the CORE Linepipe® ITP for field installation.

18.3 Field Work Instructions

CORE Service® field construction activities are controlled using Field Work Instructions (WIF) for each critical field construction procedure. CORE ClickWeld® receive competency training, mentorship and verification for each Field Work Instruction as part of their certification. The following is a list of the current Field Work Instructions.

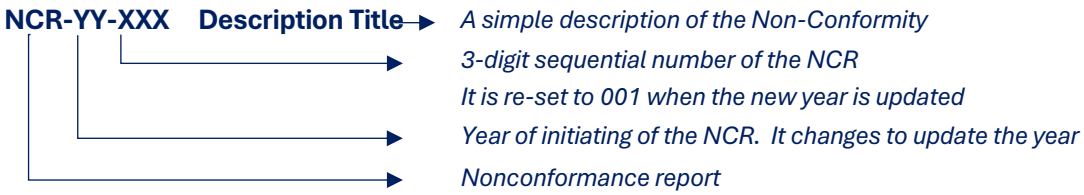
Procedure / WIF	Tech Level
WIF-0851-057-R01 Electrofusion Troubleshooting	1
WIF-0851-060-R01 Field Services Electrofusion	1
WIF-0851-061-R01 Turn and Test	1
WIF-0851-062-R01 Liner Preparation	1
WIF-0851-071-R02 Large Diameter Liner Preparation	1
WIF-0851-073-R01 Multimeter Calibration	1
WIF-0851-074-R02 Large Diameter Field Services Electrofusion	1

WIF-0851-075-R01 Electrofusion Recalibration	1
WIF-0851-081-R02 Metal Seal Installation	1
WIF-0851-082-R01 Decohesion Testing	1
WIF-0851-093-R01 Generator Troubleshooting	1
WIF-0851-094-R01 End Packaging Removal	1
WIF-0851-063-R02 ClickWeld Mainline	2
WIF-0851-065-R03 Large Diameter ClickWeld Mainline	2
WIF-0851-068-R01 Flange ClickWeld	2
WIF-0851-070-R01 Pull Head Installation	2
WIF-0851-072-R01 Riser Vent Installation	2
WIF-0851-078-R01 Field Press Remote Control	2
WIF-0851-083-R01 Field Press Setup	2
WIF-0851-085-R02 Liner Expansion	2
WIF-0851-089-R01 Trailer Transport Prep	2
WIF-0851-090-R01 Beacon System Wiring	2
WIF-0851-091-R01 Field Press Tooling Change	2
WIF-0851-097-R01 Hand-Stabbing Pipe	2
WIF-0851-100-R01 Large Diameter Riser Vents	2
QPR-0821-1 R01 Field Services Project Tickets and Invoicing	3
QPR-0840-13 R01 CORE Liner Bending Procedure	3
WIF-0851-058-R01 Traceability Recording	3
WIF-0851-067-R02 Tie-In ClickWeld	3
WIF-0851-069-R01 Pup and Midline Vent ClickWeld	3
WIF-0851-084-R01 In-Service Tie-In	3
WIF-0851-086-R01 Dye Penetrant Testing	3
WIF-0851-087-R01 Stockpiled Pipe Inspection	3
WIF-0851-088-R02 Coating Removal	3
WIF-0851-095-R03 Large Diameter Field Cut	3
WIF-0851-096-R02 Large Diameter Tie-in Pup	3
WIF-0851-098-R01 UNIFIED Field Cut	3
WIF-0851-099-R01 UT Gauge	3
WIF-0851-101-R01 Direct-Wire Fusion	3

18.4 Control of Non-Conformances

Effective management of nonconforming products in CORE Linepipe operations is ensured through a comprehensive procedure that defines responsibilities, identification, disposition, and documentation processes. The procedure covers all CORE products and related materials, requiring personnel to report nonconformances, which are then quarantined and reviewed by the Quality Assurance Coordinator. Corrective actions are initiated to analyze root causes and prevent recurrence, with disposition decisions made in regular meetings, including options like repair, rework, scrap, or return. All nonconformance reports are standardized and stored systematically, supported by related procedural documents for quality assurance and compliance.

NCR Naming Convention



Note: Separation using "-" is mandatory on the numbering NCR-YY-XXX

18.5 Corrective and Preventative Action Procedure (CAPA)

The Corrective and Preventive Action Procedure (CAPA) is used to address quality assurance issues, defining roles, timelines, and criteria for initiation based on severity. It covers key definitions, responsibilities of the triage team and Quality Assurance Coordinator, documentation standards linking CAPAs to nonconformance reports, and requirements for verification and record keeping ensuring compliance with ISO 9001 standards.