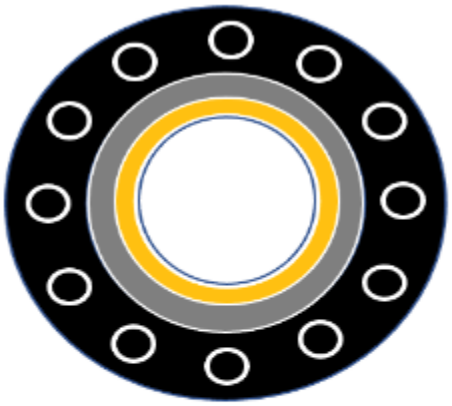
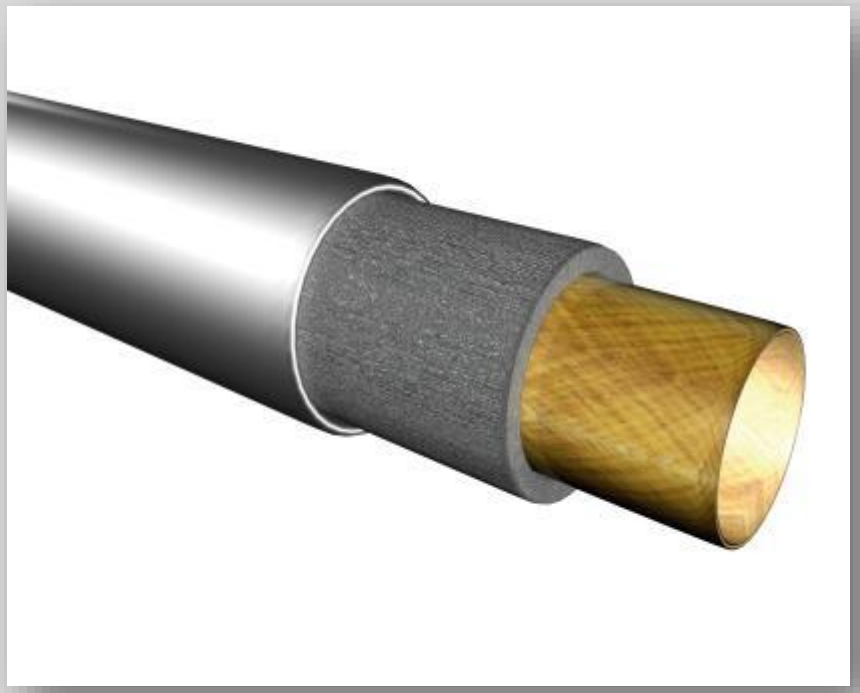


PIPEinPIPE

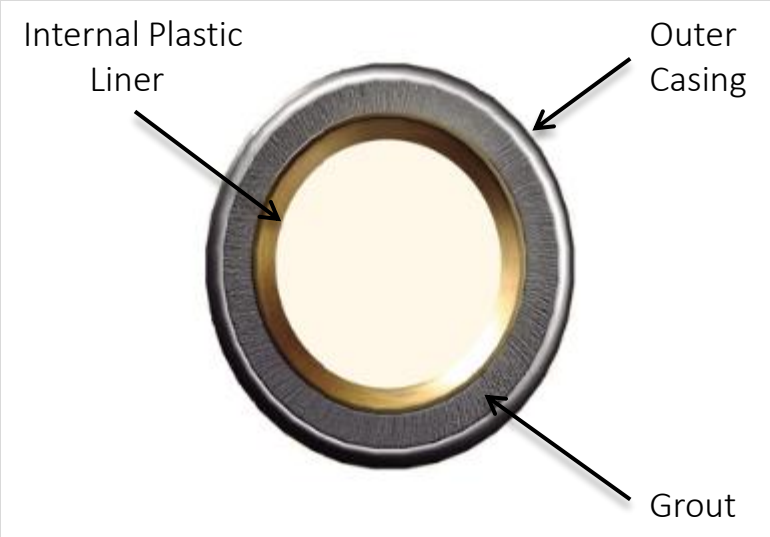
TECHNOLOGIES INC.

The Solution to Your Internal Corrosion Problem & Multiwall Containment Requirements

With its double wall containment, the IT3 multiwall systems technology meets or exceeds integrity management by greatly enhancing corrosion resistance commonly inherent to the industry. IT3 technology warrants consecutive, dependable and safe distribution of oil, gas, petrochemical, slurry, mining, fisheries and water lines eliminating material loss and the risk of potential threats and damages by third parties.

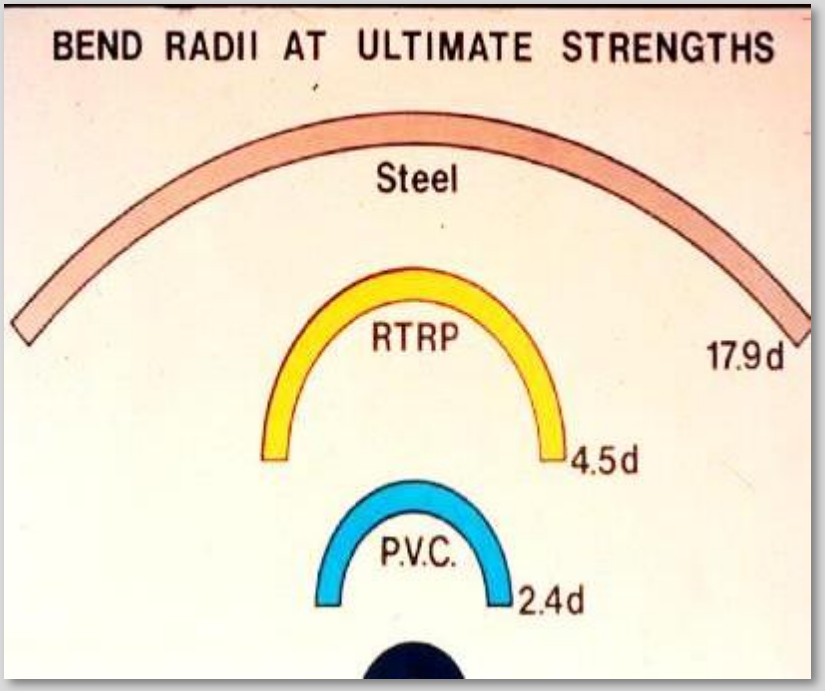


IT3 System



Pipe in Pipe Technologies (PPT) focuses on the composition of three components (IT3) which pertains to the insertion of a corrosion resistant liner into a steel pipe and grouting the anulus, as a result provides a superior alternative product that strengthens its resistance to corrosion, temperature fluctuations and external damage. Dependent on the transport fluid, flow characteristics and regulated operating requirements the inner liner may consist of FRP, Thermoplastics and Steel.

Liner Material



- Selection is made based on specific project parameters, considering factors such as the type of gas or fluid stream, the structural integrity and condition of the outer case pipe, temperature and pressure requirements, and the necessity for abrasion or chemical resistance.
- Commonly selected liner materials include:
  - -FRP-(Fiberglass Reinforced Plastic).
  - -PE-(Polyethylene).
  - -HDPE-(High Density Polyethylene).
  - -PB-(Polybutylene).
  - -PVC-(Polyvinyl Chloride).
- With the continuous development of thermoplastics, temperatures of up to 270°F / 132°C can now be reached. Emerging materials may soon enable fiberglass piping systems to withstand temperatures as high as 350°F / 177°C.

Annular Material

In a compressed liner system, the material's compressive strength must exceed the applied pressure to prevent deformation or material flow.

The unique mixture of compounds in the cement grout makes the IT3 System unique and inferior. It not only enables grout injection into the annulus but, once cured between the liner's outer diameter (OD) and the steel's inner diameter (ID), it creates the following:

-A multi-wall single pipe that meets or exceeds multilayer requirements.

-Optimum flow properties.

-High compression resistance for enhanced durability.

-Efficient hoop stress transfer, improving structural integrity.

-Maintains thermal expansion characteristics similar to steel.

-The high pH of the grout provides an additional corrosion defense on the steel's inner diameter (ID).

-Enhances insulation, improving thermal efficiency.

-Negative buoyancy, ensuring stability in submerged applications.

Grout curing is a chemical reaction that occurs without the need for evaporation or extreme heat. However, the process can be accelerated by applying heat, which can be achieved through various methods.

Variations to the grout can provide insulation and helium monitoring of the annular space.

Outer Case Material

For design level phase II pressures, any material with greater rigidity—determined by its modulus of elasticity and thickness—than the inner liner can effectively serve as the outer casing. The objective is to press the more flexible liner against a rigid outer case, transferring the hoop load to the external structure. Successfully lined materials include corrugated steel, steel, wrought iron, concrete cylinder, aluminum, and fiberglass pipe."

Comparison of Friction Pressure Loss FRP vs. CS

			delta P per	
Exxon Tar Sands Project	ID in	c	Q = 4.9 m3/sec psi	Q = 3.6 m3/sec psi
GRP Liner	43.5	150	5.04	2.85
New Carbon Steel	46.5	120	5.51	3.11
Used Carbon Steel	46.5	100	7.72	4.36
Corroded Carbon Steel	46.5	80	11.68	6.70

Notes:

Hazen Williams formula for water flow used for calculations

c = Hazen Williams friction factor

Calculations performed for 2 study cases of potential peak flow rates.

IT3 – Design Levels

IT3 Phase I – The liner is engineered to withstand the system's operating pressure and requirements independently, without relying on the outer case pipe for pressure containment. The outer case primarily serves as a conduit for the liner while providing structural support and impact protection. The grout secures the liner in place, preventing movement-related damage caused by fluid hammer and thermal expansion.

IT3 Phase II – The liner is designed to operate up to its short-term burst pressure capacity. This design approach is based on the fact that FRP pipes incorporate a 5:1 to 7:1 safety factor to account for cyclic loading. In this scenario, failure typically occurs due to shear between the glass and resin caused by cyclic stress. However, since the liner remains in a compressed state within the multiwall structure, it is not subjected to cyclic loading, effectively eliminating this specific failure mode.

IT3 – In Situ Repair

The IT3 system is the most advantageous for the recovery of existing pipe lines and is equally important for decommissioned or abandoned pipe lines. When abnormalities are detected and jeopardize the integrity of the pipeline, failure becomes a critical concern. PPT can use the existing steel pipe as a conduit for the installation of the liner, thus rejuvenating the impact resistance and hoop strength.

The IT3 system is exceptional in areas where access is restricted:

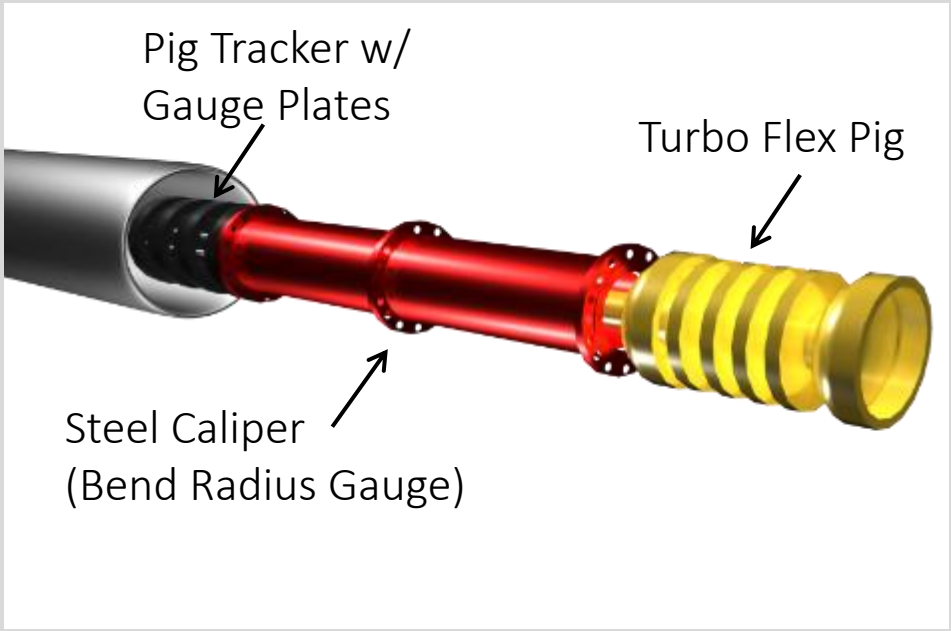
- The entire line does not need to be exposed, considerably reducing excavation costs.

- Old pipe lines can be restored to their original pressure specifications.

- A liner maybe inserted in great lengths, dependent on work space and fittings on the existing steel pipe line.

- Adaptations can be made to existing fittings or replaced.

1. Line Cleaning and Calibration

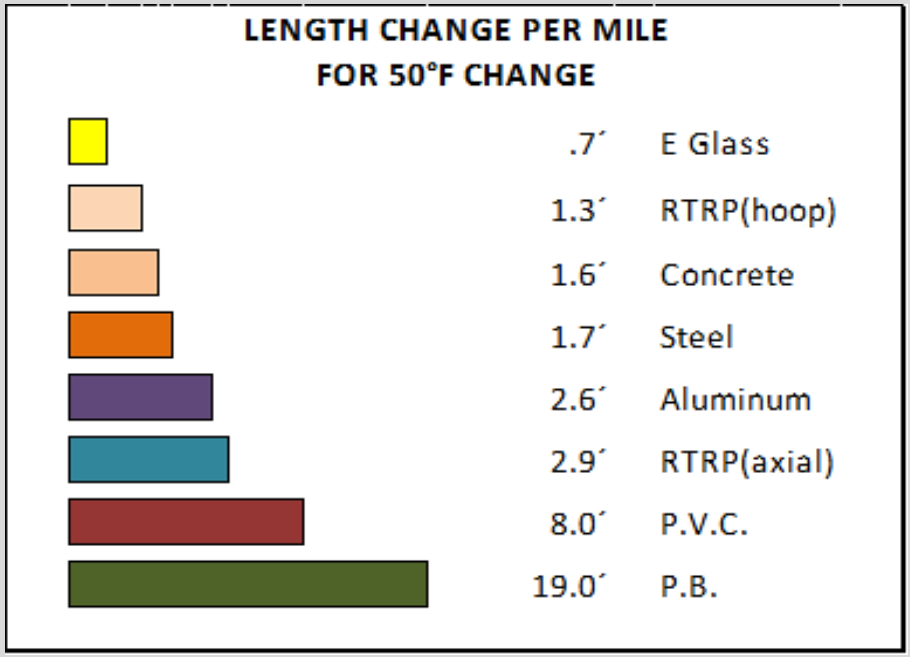


The initial run(s) involve cleaning with surfactants to eliminate uncontaminated residuals and remove flammable gases, particularly in petroleum-based pipelines.

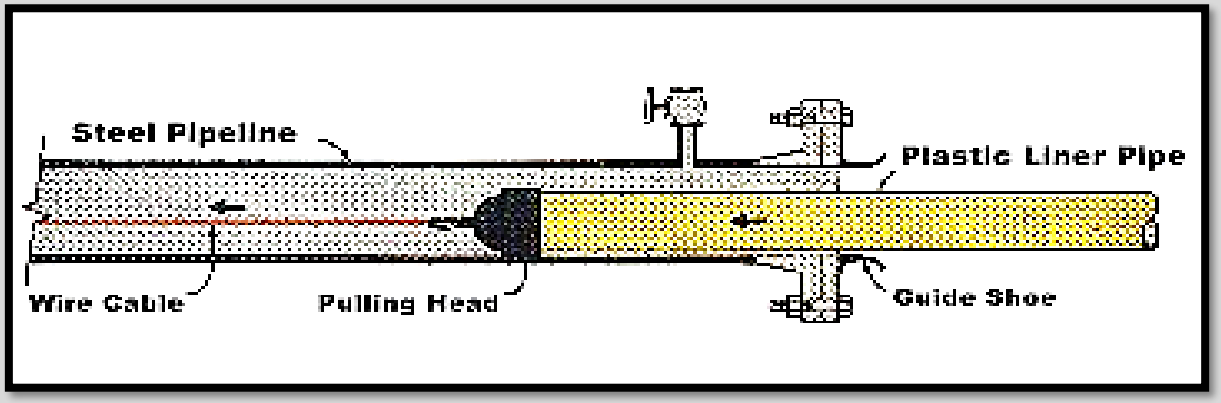
A pig tracker equipped with gauge plates, a bend radius gauge, and a push pig is launched to identify internal protrusions, as well as external dents, kinks, or bends.

Ensuring that the liner passes from the insertion point to the tie-in point without deformation or potential scarring / grooving is crucial for the proper functionality of the IT3 System.

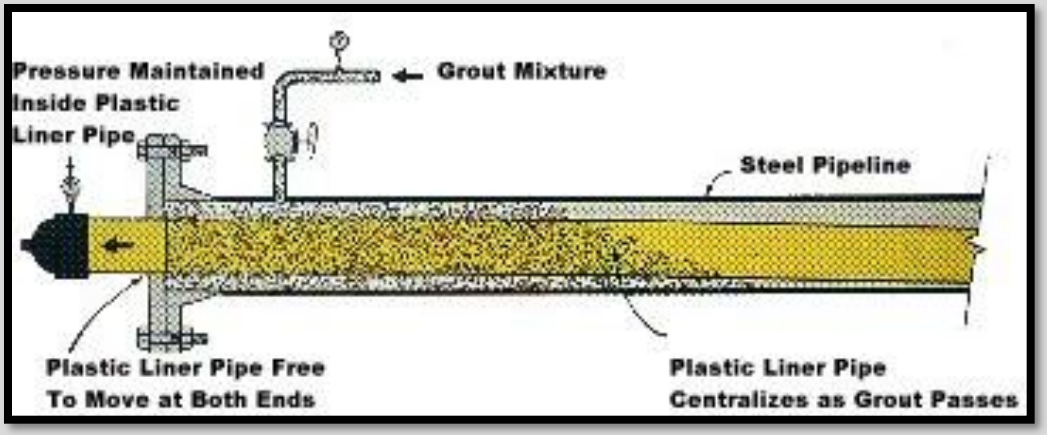
Steel Caliper

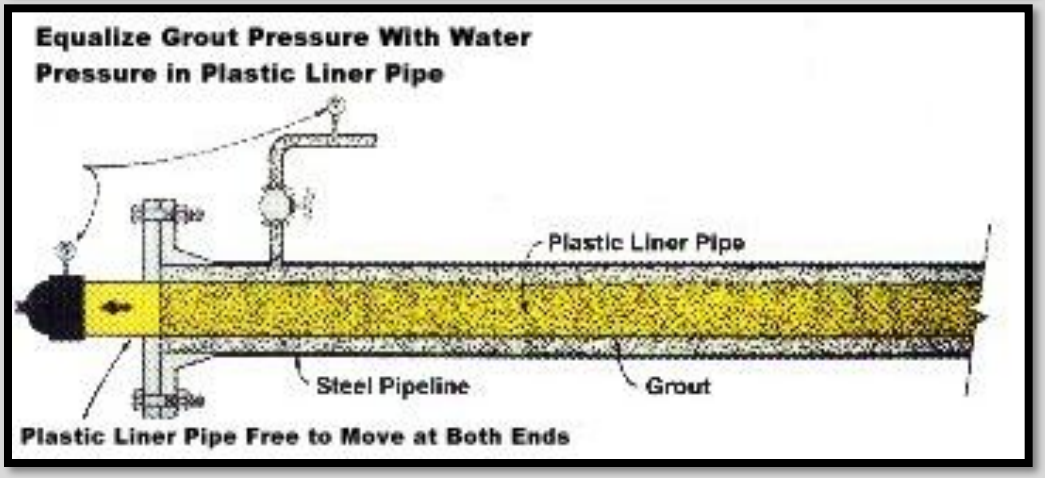


2. Liner Insertion

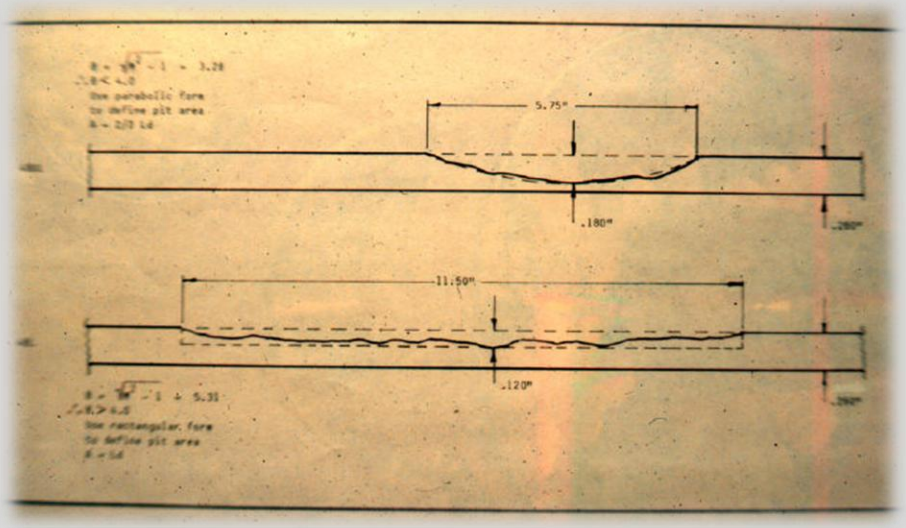


3. Grouting and Pressure Equalization

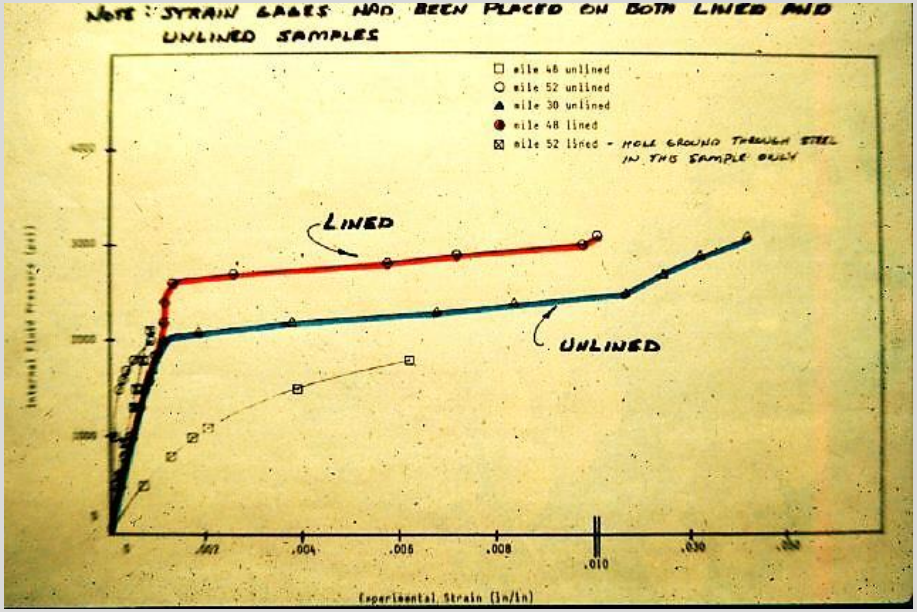




Pit Bridging Capability



Rehabbed IT3® vs. New Pipe (in situ)



In Situ Repair Experience:

Alaska, US - 48” Gathering Lines (Produced Fluids);
YPFB Arica, CHL – 16” IT3 System; **Rosarito, MEX** - Product Line;
Bahamas, US - 36” Water Ballast Line

Alaska, US

Arica, CHL

Rosarito, MEX

Bahamas, US

Petroperu Terminals with IT3 Ship to Shore Pipelines both White and Black in each Terminal

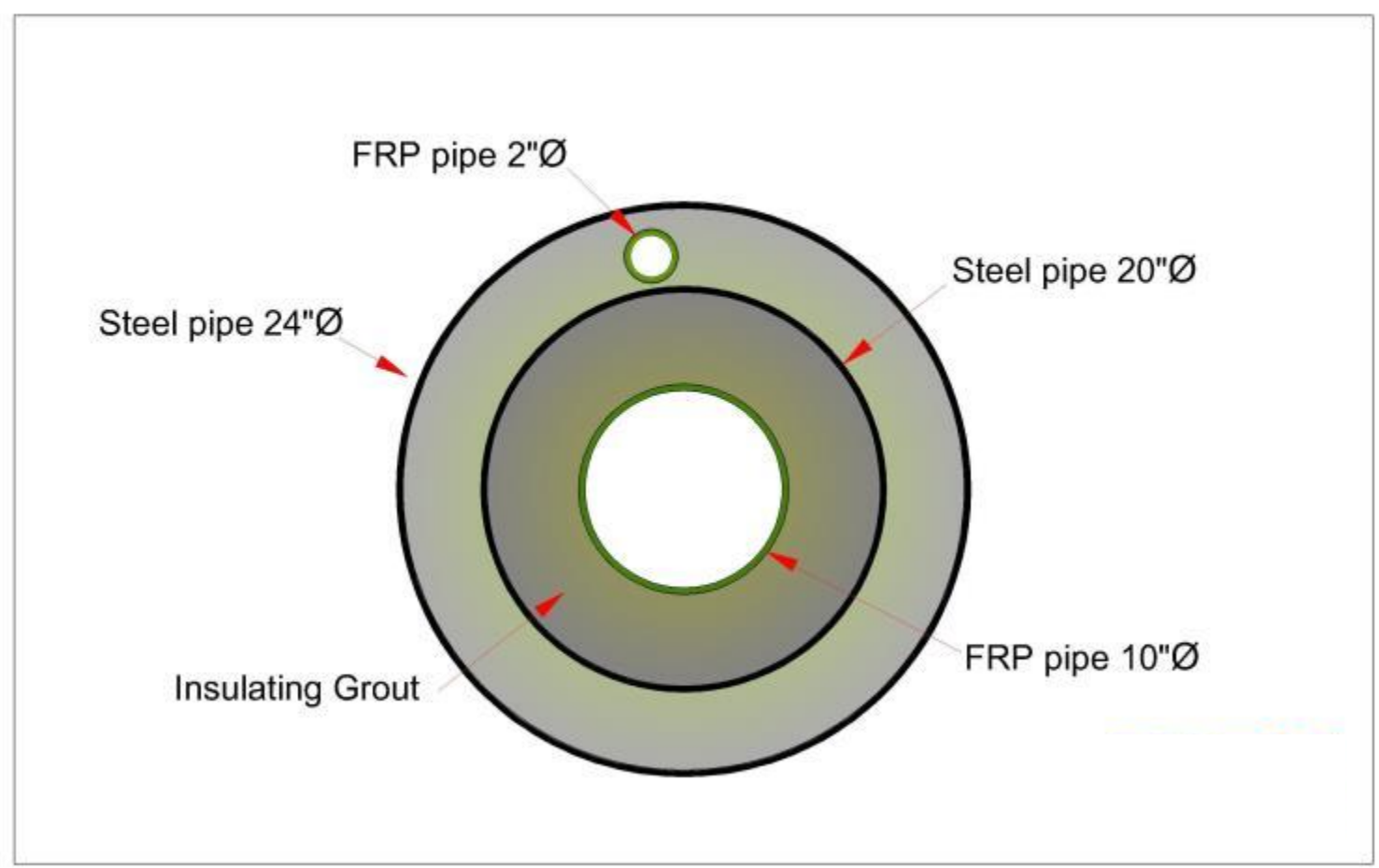
New IT3® Pipe

Line Centralization and Cutting Feasibility

- Mechanical centralizers are used in the fabrication of new IT3® plant manufactured pipe.
- Centralizers are primarily used so that double random length joints of pipe can be field cut to length as required.

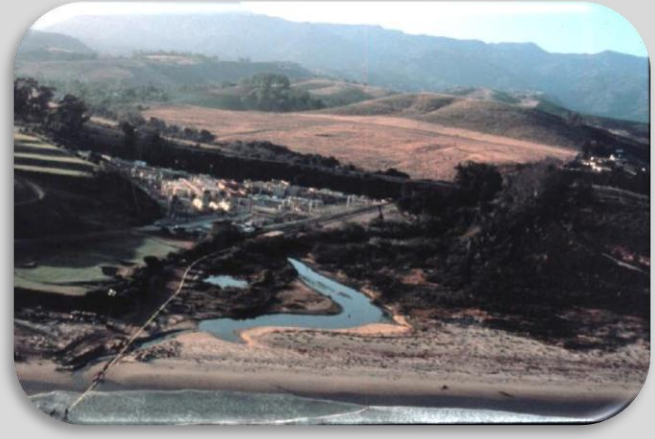
Presentation for Welding SK Joints

IT3® for Special Projects – L.P.G. Line



New IT3® System

First Use of The SK-Joining System
“Santa Barbara Project (1982)”

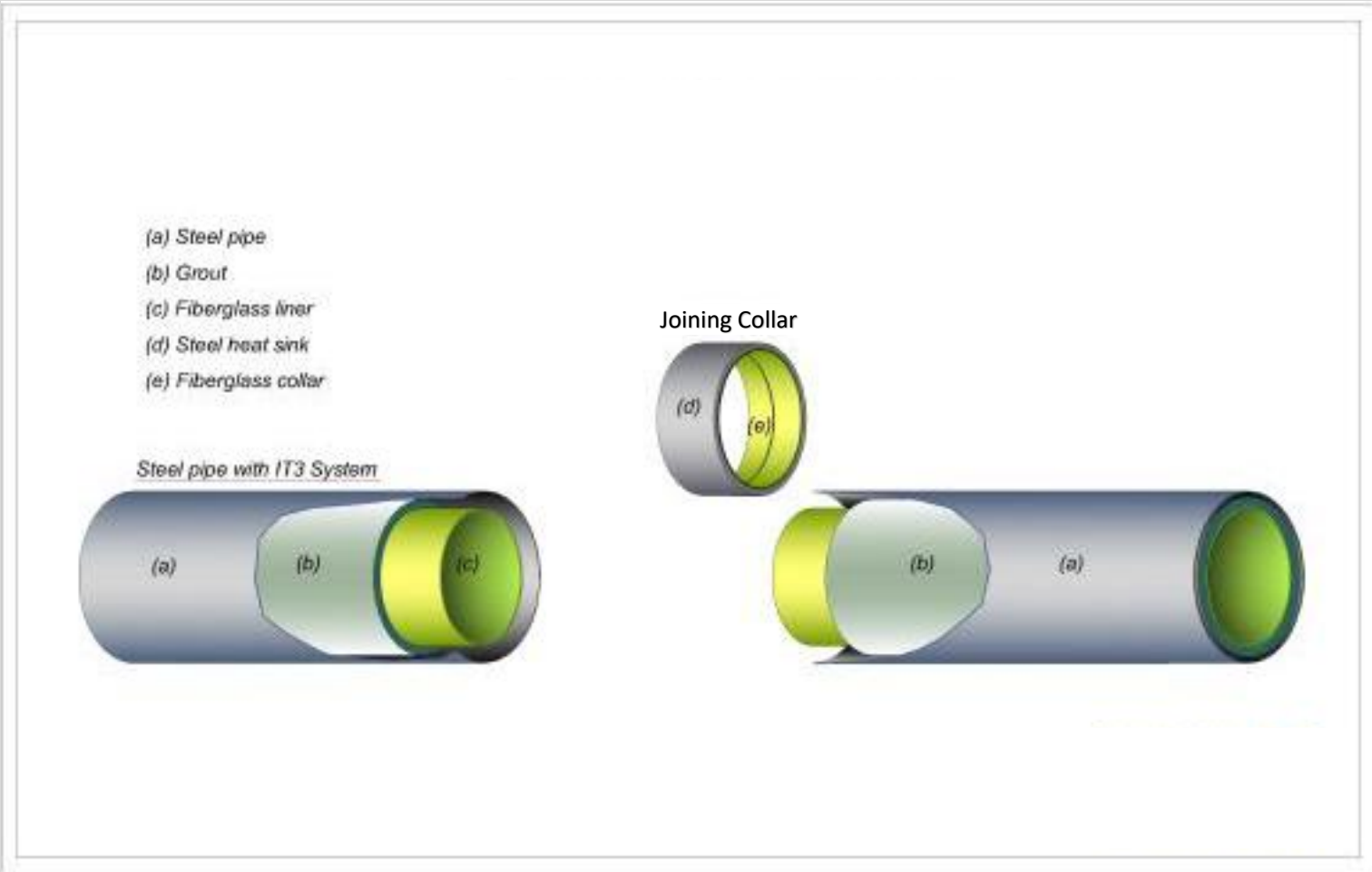


New IT3® Pipe

Treating The IT3 System as Plant Piping - Cut to length as required using The SK-Joint; (Any fitting available in steel is available in The IT3 System).

Joints and Patents

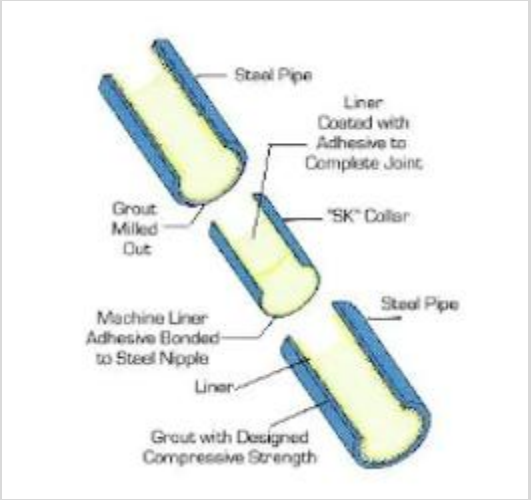
Joining Collar

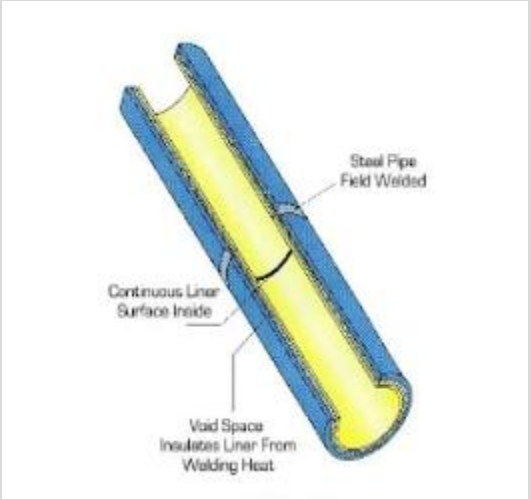


SSJ Collar

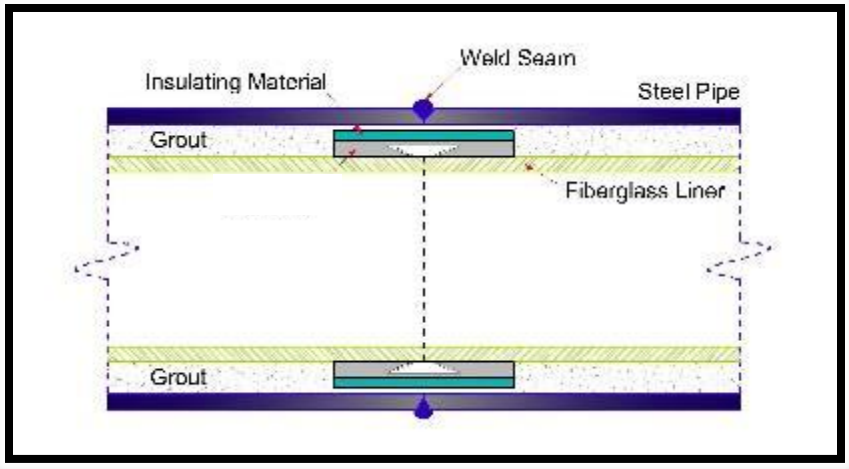
The String and Single joint (SSJ) collar is primarily used for when the liner is centered at each end of the outer pipe / conduit with regards to an entire pipe string or 40’ single joint.

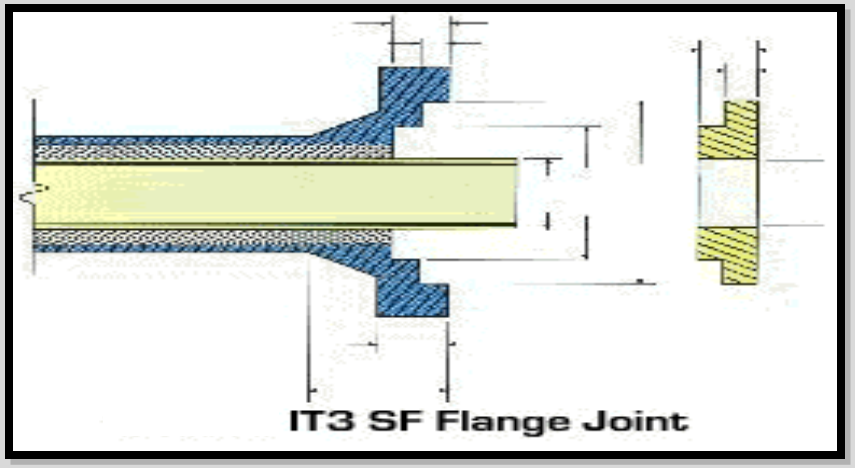
This joining system is most advantageous with new IT3 systems

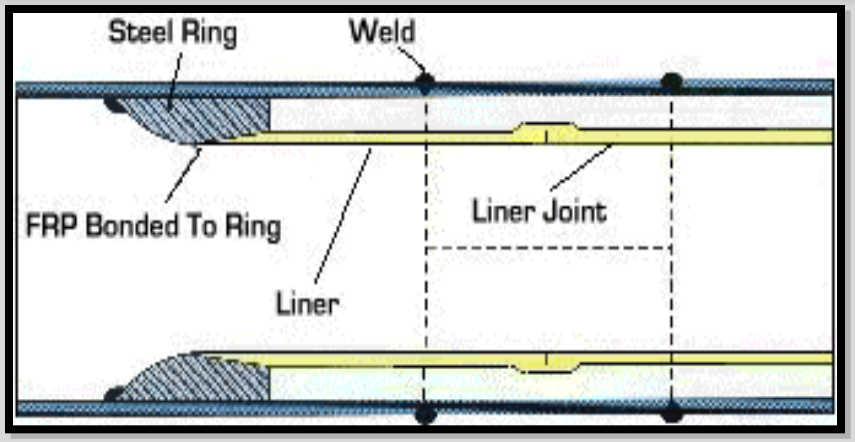


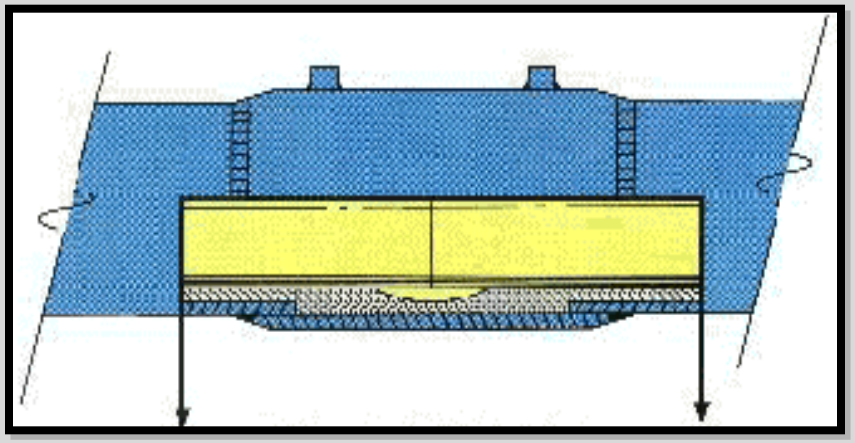


Various Joints

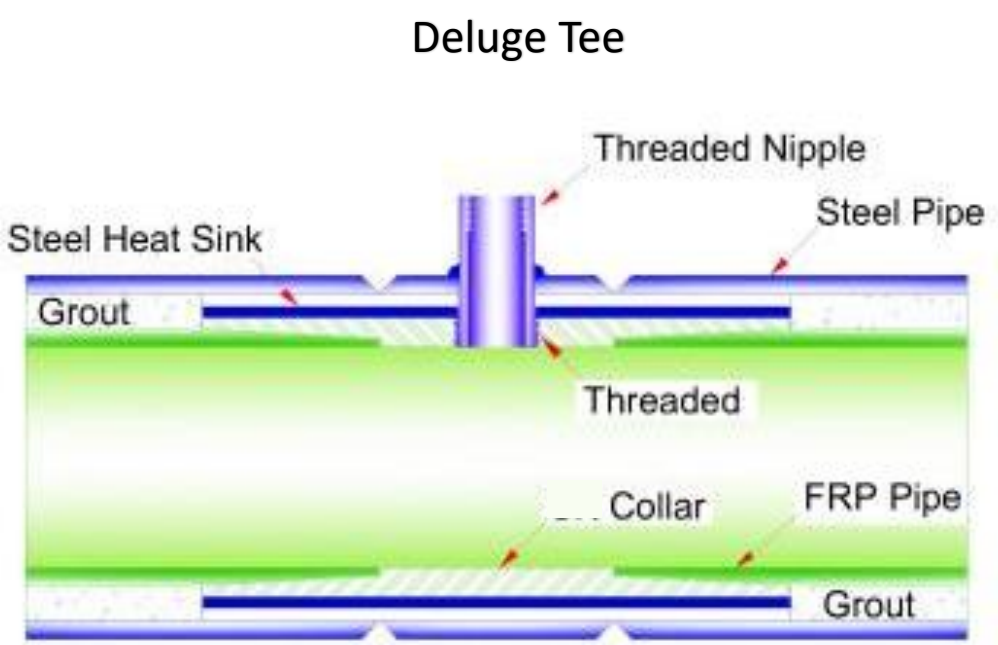




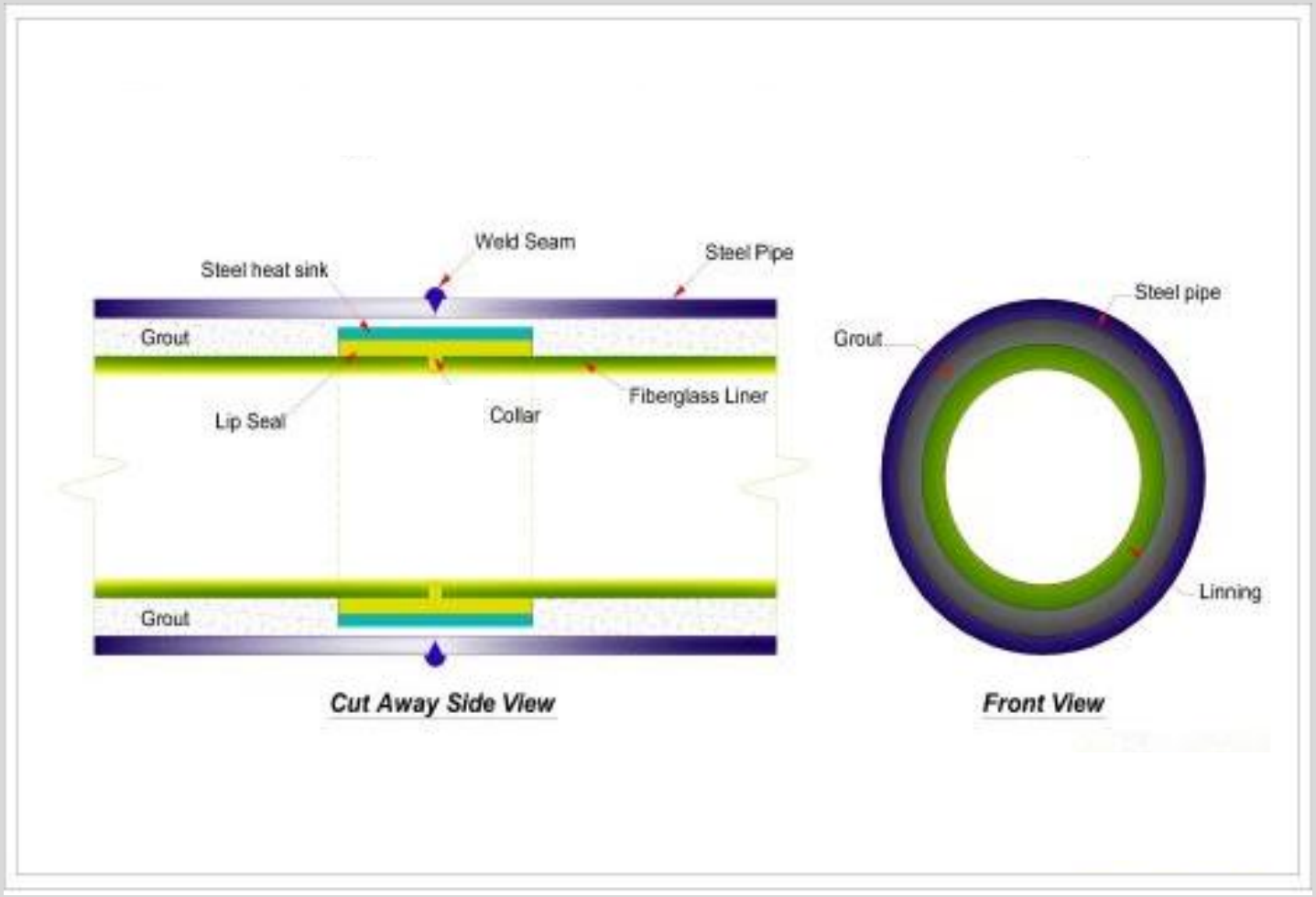




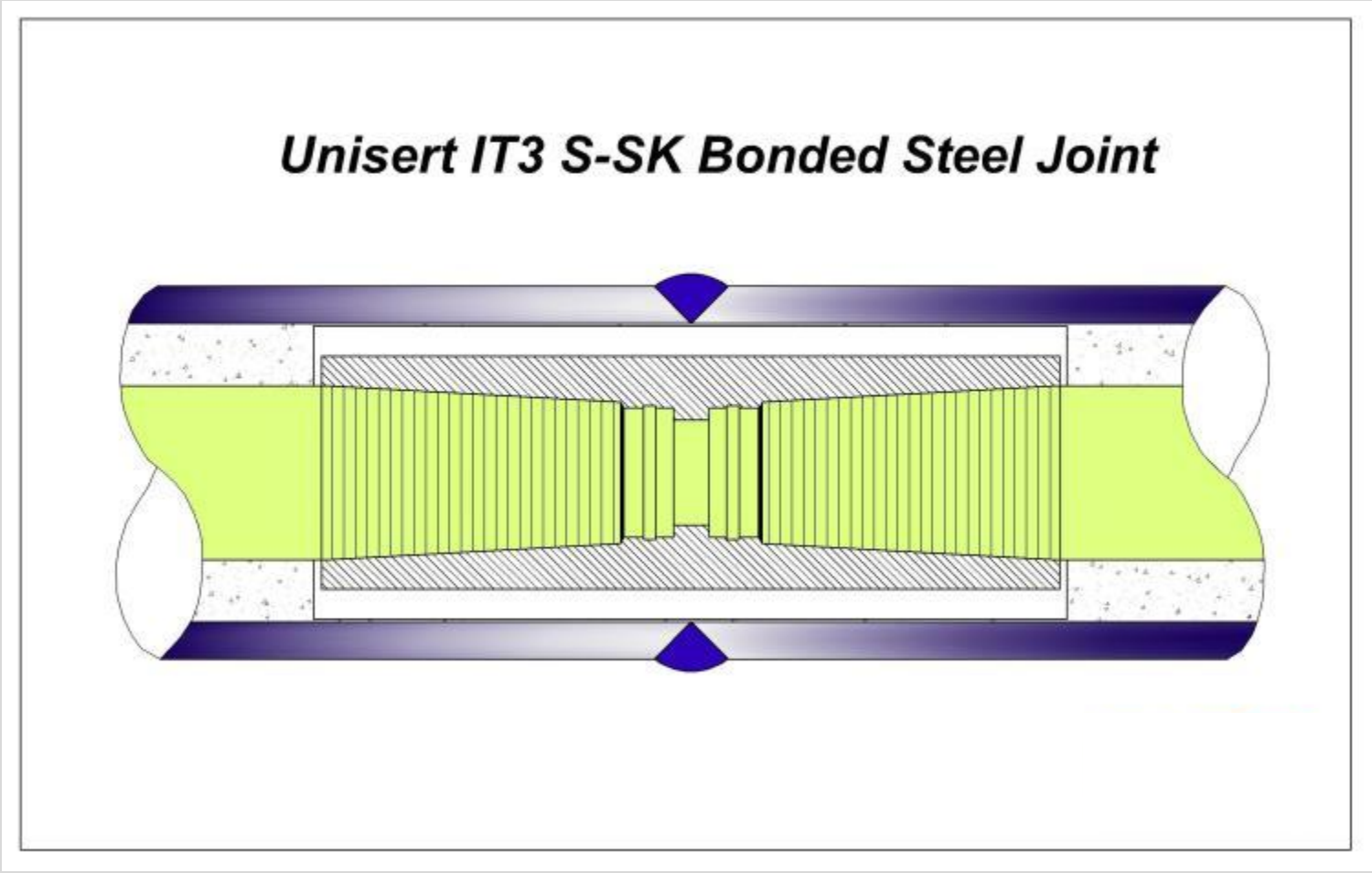
IT3 Deluge Tee



IT3 Collar & Weld Seam on Pipe

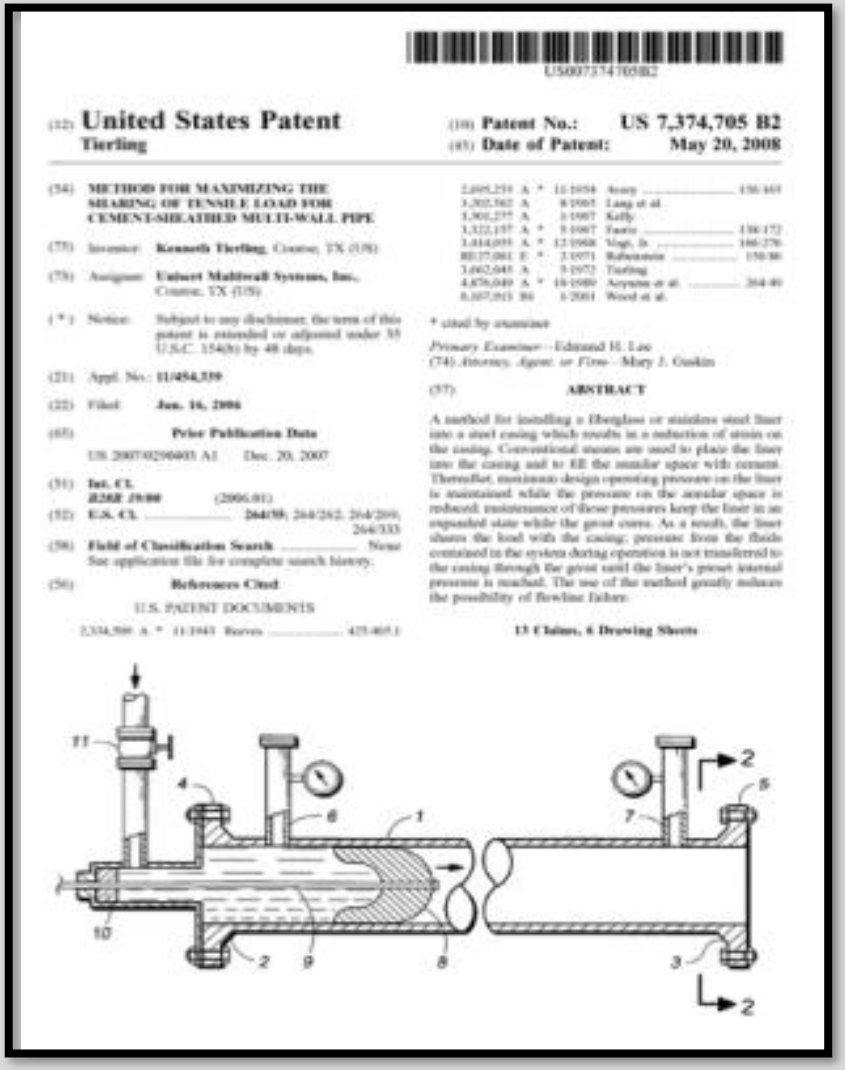


S-SK Joint



Patents

- In-situ Lining
  - International Patent No. US 3,662,045
  - International Patent No. US 7,374,705
  - International Patent No. Canada 933339
- S-K Collar
  - International Patent No. US 4,400,019
- S-SK Collar
  - International Patent No. US 6,231,086B1
- Lip Seal Joint
  - International Patent No. US 7,942,422B2



US007374705B2

(12) **United States Patent**
Tierling

(10) **Patent No.: US 7,374,705 B2**
(45) **Date of Patent: May 20, 2008**

(54) **METHOD FOR MAXIMIZING THE SHARING OF TENSILE LOAD FOR CEMENT-SHEATHED MULTI-WALL PIPE**

(75) Inventor: **Kenneth Tierling**, Conroe, TX (US)

(73) Assignee: **Uniset Multiwall Systems, Inc.**, Conroe, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 48 days.

(21) Appl. No.: **11/454,339**

(22) Filed: **Jun. 16, 2006**

(65) **Prior Publication Data**

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(51) **Int. Cl.**
B32B 19/00 (2006.01)

(52) **U.S. Cl.** **264/30**; 264/262; 264/269; 264/333

(58) **Field of Classification Search** ..... None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,334,500 A * 11/1943 Reeves 425/405.1

2,695,251 A * 11/1954 Avery 156/165
3,302,562 A 8/1965 Lang et al.
3,301,277 A 1/1967 Kelly
3,322,157 A * 5/1967 Faerie 138/172
3,414,035 A * 12/1968 Vogt, Jr. 166/276
RE27,081 E * 2/1971 Rubenstein 150/30
3,662,045 A 5/1972 Tierling
4,876,049 A * 10/1989 Aoyama et al. 264/40
6,107,913 B1 1/2001 Wood et al.

* cited by examiner

Primary Examiner—Edmund H. Lee
(74) *Attorney, Agent, or Firm*—Mary J. Conkin

(57) **ABSTRACT**

A method for installing a fiberglass or stainless steel liner into a steel casing which results in a reduction of strain on the casing. Conventional means are used to place the liner into the casing and to fill the annular space with cement. Thereafter, maximum design operating pressure on the liner is maintained while the pressure on the annular space is reduced; maintenance of these pressures keep the liner in an expanded state while the grout cures. As a result, the liner shares the load with the casing; pressure from the fluids contained in the system during operation is not transferred to the casing through the grout until the liner's preset internal pressure is reached. The use of the method greatly reduces the possibility of flowline failure.

13 Claims, 6 Drawing Sheets

IT3® System Applications- Summary

- New Pipelines
- In-situ Repair / Rehabilitation Projects
- Offshore Pipelines
- Double containment Systems
- Non Traditional Applications
- Spillage and Leak Detection
- Fire Water Lines.