Reinforced CIPP for Pressure Pipe Rehabilitation
Cured-in-place Pipe (CIPP)

- Resin impregnated tube with:
  - Glass reinforced felt
  - Woven polyester jacket
- Inversion or Pull-in installation methods
- Water, steam, or UV curing methods
- Tight fitting = greater flow maximization
- Joint less, pipe-within-a-pipe that protects against corrosion, build-up, and leakage
Applications

Technical Envelope

- Diameter = 6” to 96”
- Max. Operating Pressure = >250 psi
- Bends = up to 45°
- Effluent Temp. = up to 150° F
- Physical Properties = exceed ASTM F1216 / AWWA M28
Design Standards
ASTM F1216 / AWWA M28

- Internal design:
  - Operating pressure, transients, vacuum
- External design:
  - Soil, groundwater, traffic, and other live loads
- Other factors:
  - Ovality, bends, services
  - Unrestrained burst testing
  - Validates safety factor
  - Safety factors vary by manufacturer.
CIPP Liners are comprised of:

1. Thermosetting resin
2. Felt Tube
3. Coating

Gravity Sewer Systems:
- Primary Concern: Buckling from External Loading
- Polyester Resin / Standard Felt
- Felt has minimal contribution to cured physical properties

Pressure Pipe Systems:
- Primary Concerns: External Loading AND Internal (Tensile) Stresses
- Vinyl Ester or Epoxy Resins
- Felt Tube Reinforced with Fibers

Emphasis on Resin vs. Emphasis on Resin AND Tube
Tube Construction
Glass Composite Structure

- Epoxy/polyester felt structure
  - Provides for external load capacity
  - Layer thickness can be varied depending on loading conditions

C = 140

- PP/TPU coating
  - Water contact surface
  - Coating also provides water barrier for installation processes & handling

- Epoxy/fiberglass structure
  - Provides high tensile strength
  - Number of layers vary depending on diameter and internal pressure
Woven Jacket Structure

C = >120

**General Woven Jacket Liner Construction**

1. Polymeric Membrane
2. Woven Liner + Epoxy
3. Woven Liner + Epoxy
Liner Terminations
Liner Terminations – Two Schools of Thought

Adhesive

Mechanical
End Termination - Adhesive

- End prepared prior to lining
  - SSPC-SP7 / NACE 4
- Resin application
  - Acts as a bonding agent b/t liner and host pipe
- CIPP liner installation / curing
- Liner cut flush with existing pipe
- Mechanical fittings connected to existing host pipe for closure

* This process relies solely on the integrity of the host pipe (long term) in order to maintain water tightness
End Termination - FRP

- Precast FRP composite pipe
  - Interior abraded and primed with bonding agent
  - CIPP inserted through FRP and cured to obtain a watertight bond
- Eliminates need to connect back to the host pipe
- Promotes the use of standard mechanical joint fittings
End Termination - FRP

- GRP Termination Piece
- Spool Piece
- Host Pipe
- MJ Restraint
ZERO RELIANCE ON HOST PIPE FOR CLOSURE
End Termination – Hymax Compression Fitting

- PVC 900
- Closure Pipe
- Lined Host Pipe
- SS Band
- Hymax Reducer 2000
- Blocking
- Spool Piece
- C900 PVC
- Split PVC
- Ring Pipe
- Blocking/Support for Backfill

Hymax Reducers
Service Connections
Service Connections – Two Schools of Thought

Adhesive

Mechanical
Service Connections - Adhesive

- **Step 1** – intense cleaning to prepare pipe surface for resin
- **Step 2** – plugging of existing service connection
- **Step 3** – locating of the existing service (after lining)
- **Step 4** – reinstatement of the existing service (via drilling)

* This process relies solely on the integrity of the host pipe (long term) in order to maintain water tightness
Service Connections - Mechanical

• Robotic reinstatement of service connections
• Reduces/Eliminates need for costly excavations
• Does not rely on host pipe for water tightness
Service Connections - Mechanical

• Step 1 – reverse threading (internal) of protruding service

• Step 2 – plugging of existing service connection

• Step 3 – locating and drilling of the existing service (after lining)

• Step 4 – installation of mechanical connection
Pressure Testing
...recommended pressure and leakage test would be at twice the known working pressure or at the working pressure plus 50 psi, whichever is less.
Thank you!

Steve Soldati, P.E.

ssoldati@aegion.com

(407) 576-0849