North American Society for Trenchless Technology
NO-DIG 2006

Nashville, Tennessee
March 27-29, 2006

Cured-in-Place-Pipe (CIPP)
Quality Assurance / Quality Control

Cured-in-Place-Pipe (CIPP) liners were introduced in North America in the late 1970's. The process involves the insertion of a tube impregnated with a thermosetting resin, which is expanded and cured to form a tight fitting liner within the host pipe, a pipe within a pipe. The CIPP process is classified as renovation because it incorporates the existing pipeline fabric into the finished product to produce improved performance of the original pipeline. CIPP liners have many applications from sewer mainlines and laterals, industrial and special waste pipelines to pressure pipe.

CIPP liner QA/QC issues address both the component products and its design and installation. The component products include the resin and tube. Design elements are thickness and fit. Installation QA/QC issues include pull tensions, fit and processing temperatures and time (cure).

Thermoset Resins

There are three generic types of resins:

- Polyester - commonly used in sewer applications,
- Vinyl ester - used in severe duty, industrial and special waste applications,
- Epoxy - commonly used in potable water and pressure pipe applications.

Resins exhibit varying characteristics dependent upon their type and formulation. Independent testing and similar service environment history should be included in the tendered submission. Samples can be taken and tested from the job site to verify wall thickness and expected immediate performance properties.

Resins also exhibit varying short and long-term flexural properties. The short-term flexural properties are tested using ASTM D790, providing an immediate result. These values are reduced for long-term effects; these properties are used to determine wall thickness using the equations in F 1216.

CIPP QA/QC Design Issues. The key design consideration in CIPP liner installation is the ability of the cured-in-place pipe to withstand buckling. The resin and lining tube type combine to determine the design thickness of the cured-in-place pipe necessary to avoid potential buckling. The types of resins have been described above. There are generically two types of lining tubes –

non-reinforced and reinforced liners. The reinforced liners can be divided into fiberglass and carbon fiber laminates.

Buckling occurs due to persistent loads from ground water, soil, and live loads, which causes the pipe to creep reducing its capability to resist external pressures. The pipe wall thickness designed is based on the anticipated effect on pipeline creep of external loads over a 50 year period as specified by ASTM 1216-93, equation X1.3.

Lateral Installation using CIPP. The CIPP process is an effective means of restoring laterals. Air inversion is commonly used to insert the liner. Installation can be made from the cleanout or mainline.

Pipeline Assessment/CCTV QA/QC. Prior to beginning the design and installation of a CIPP, the condition of the host pipe must be assessed and cleaned. The topic of pipeline assessment is discussed in a separate paper entitled – *Quality Assurance/Quality Control in Closed Circuit Television (CCTV) Pipeline Assessment.*

Bypass QA/QC design and installation issue. The flow of the existing service must be diverted/bypassed during CIPP installation. The topic of bypass is discussed in a separate paper entitled – *Quality Assurance/Quality Control in Pumps*.

CIPP QA/QC Construction Issues. CIPP liners are installed by either the inversion or pulling-in method. Each method has standards for proper installation. ASTM F1216 describes proper installation using the inversion method. Pull-in installation procedures are described in ASTM F1743 for conventional tubes and in ASTM F2019 for reinforced tube installations.

When installing CIPP liners thorough records should be kept on the installation and curing of the resin. Field specimens should be taken by owner or a representative of the owner following an established chain of custody.

Construction and Post Construction Testing. Third party testing should be performed to validate that the CIPP liner meets specifications for: tangent modulus, flexural strength and design thickness. Field inspection of completed CIPP liner project should look for annular gaps, interior bulges, ribs, ripples, fold or other irregularities.

The interface between exterior surface and the liner at the manhole entrance and exist should be watertight. Finished ends of the liner should be neat and smoothly cut. Finally a CCTV inspection should be conducted before the warranty period expires.

For Further Information on CIPP Please Visit

Booth 308

Booth 721

Booth 613

Booth 508

Booth 208

Booth 521 & 523

Booth 700

Booth 220

Booth 321

Booth 328

Booth 602

Booth 420 & 422

Booth 615

Booth 620

Booth 128

Booth 404

For Further Information on CIPP Resins Please Visit

Booth 424 & 426

Booth 417 & 516

Booth 209 & 211

Booth 618

For Further Information on Testing, Inspection & Bypass Please Visit

Booth 417 & 516

Booth 505

Booth 500

Booth 316

Booth 200

Booth 223

Booth 123 & 125

Booth 612