ASME PCC-2 Standard Part 4 Articles

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PRESENTATION AGENDA

- Summary
- Development history
- Material Qualification
- Design calculations
- Installation
- Installer Certification
- Future Plans

ASME PCC Standards

- ASME Post Construction Committee was formed in 1995 to develop codes and standards addressing technical issues after initial construction.
- It has published three standards to date:
  - PCC-1, Guidelines for Pressure Boundary Bolted Flange Joint Assembly
  - PCC-2, Repair of Pressure Equipment and Piping
  - PCC-3, Inspection Planning Using Risk-Based Methods

ASME PCC-2 Standard

- PCC-2 has five parts covering:
  - Introduction
  - Welded Repairs
  - Mechanical Repairs
  - Nonmetallic and Bonded Repairs
  - Examination and Testing
- The first edition was in 2006, which was revised in 2008 and 2011.
- The next edition is planned for 2013.

SUMMARY OF SECTION 4

- There are three articles within Part 4.
  - Article 4.1 High Risk Wrap Applications
    - Non-leaking pipes
    - Leaking pipes
  - Article 4.2 Low Risk Wrap Applications
    - Leaking and non leaking water piping systems.
  - Article 4.3 Liner Applications

SECTION 4 ARTICLES SUMMARY

- All articles cover:
  - Material qualification
  - Design calculations
  - Installation, installation documentation and installer training

ARTICLE 4.1 CONTENTS

1. Description
2. Limitations
3. Design
4. Fabrication
5. Examination
6. Testing
7. References

Mandatory Appendix I - Design Data Sheet
Mandatory Appendix II - Qualification Data for Repair System
Mandatory Appendix III – Short Term Spool Survival Test
Mandatory Appendix IV - Measurement of γ for Leaking pipe Calculation
Mandatory Appendix V - Measurement of Performance Test Data
Mandatory Appendix VI - Measurement of Impact Performance
Mandatory Appendix VII – Installer Qualifications
Mandatory Appendix VIII – Installation
Mandatory Appendix IX – Glossary of Terms and Acronyms

HISTORY

- The ASME identified the need for the use of composite repair for piping and set up the Sub-group within the Post Construction Committee in 2002.
- The Sub-group has a membership made up of representatives from manufacturers, users, owners, consultants, and research organizations.
- The Sub-group is chaired by Wes Rowley and has 12 permanent members (and 5 alternates).

HISTORY - CONTINUED

- The first issue of Article 4.1 was in 2006
- The second issue was in 2008.
- The third issue was in 2011.
- The fourth issue is planned for 2013 (in the approval process at present).
- The Sub-group continues to meet to further enhance the non-metallic repair articles.

INTERFACE WITH ISO

- Article 4.1 is complementary with ISO TS-24817 document which was issued in 2006.
- The chairman of the ISO document is a permanent member of the PCC Sub-group Non-metallic Repair.
- We have attempted to keep the two documents reasonably parallel in technical content.
- The test, design equations and installation requirements are essentially identical.

BASIC PHILOSOPHY

- Two Design Cases Are Covered
  - Non-Leaking Pipes
  - Leaking Pipes
- Design Options Are Available - the more testing a manufacturer does leads to less design derating
- Several Sets of Design Equations are offered depending upon specific design conditions.
- Installation Documentation, Installer Training and Qualification are covered.

MANDATORY BASIC MATERIAL QUALIFICATION TESTS

- Tensile Strength and Modulus
- CTE
- Tg or HDT
- Bonding to Metals, Adhesion
- Short Term Spool Test for Type A Repairs – pressure test of a wrapped pipe with a machined defect.
- Hardness – Barcol or Shore D

TESTS REQUIRED FOR LEAKING PIPES

- Energy Release Rate
- In Plane Shear Modulus
- Impact test of a repaired pipe

OPTIONAL LONG TERM TESTS

- Coupon Tests – Creep Rupture
- 1000 hour repaired pipe pressure tests
- Lap-Shear High Temperature Soak tests

OTHER OPTIONAL TEST CONSIDERATIONS

- Cyclical Loading
- Fire Performance
- Electrical Conductivity
- Chemical Resistance
- Cathodic Disbondment

COMPOSITE vs. METAL MATERIALS

- Composite materials cannot sustain long term loads near their short term coupon test levels as metals can. This effect is called “creep-rupture”
- Composite materials do not yield as metals usually do.
- Cyclical loading performance of composite materials is usually not as good as metals.

DESIGN OF NON-LEAKING REPAIRS (Type A Repairs)

- There are several sets of design equations based upon:
  - Assumptions concerning the pipe yielding
  - Considering the remaining strength of the pipe
  - The extent of long term testing completed for the repair material (the more testing provides for less derating of the composite)

DESIGN CONSIDERATIONS (Type A Repairs)

- Composite strength and modulus
- Thermal expansion differences between the pipe and the composite
- Operating temperature
- Cyclical loading
- Length of the repair beyond the defect
- External loads
- Stress intensity factors in bends, tees, nozzles, and other mechanical configurations

DESIGN OF LEAKING REPAIRS (Type B Repairs)

- The capability of a composite repair is primarily a function of the following:
  - Bonding to the substrate pipe (energy release rate)
  - Modulus of the repair material
  - In plane shear modulus of the repair system

DESIGN CONSIDERATIONS (Type B Repairs)

- There is a large standard deviation in the tests of energy release rate values, therefore large design factors are used.
- Equations are listed for circular and slot defects. The slot equations will be further refined to include axial and circumferential defects.
- The Type A repair design equations also apply for Type B repair design.

INSTALLATION CONSIDERATIONS

- Health and safety requirements
- Defect assessment
- Material handling and storage
- Documentation of the design
- Defects in the repair
- Documentation of the repair

INSTALLER QUALIFICATION

- Basic – Installer
- Advanced – Supervisor
- Training requires:
  - Classroom
  - Hands on installations
  - Wrap a test pipe for Type B repair certification with subsequent pressure test
  - Written test

FUTURE PLANS

- Further refinement of Article 4.1
- Address other repair situations including
  - Dents and Gouges
  - Patches
  - Additional leak situations.
- Continued coordination with the ASME B31 Piping Codes and ISO standards development organizations
- Further regulator involvement