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 $\gamma$ 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

CRUG MEETING
SEPTEMBER 7, 2012
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).
• 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

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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