ACARP Project C23005

Use of plastic metal for temporary repair of flamepath on flameproof equipment used in underground coal mines

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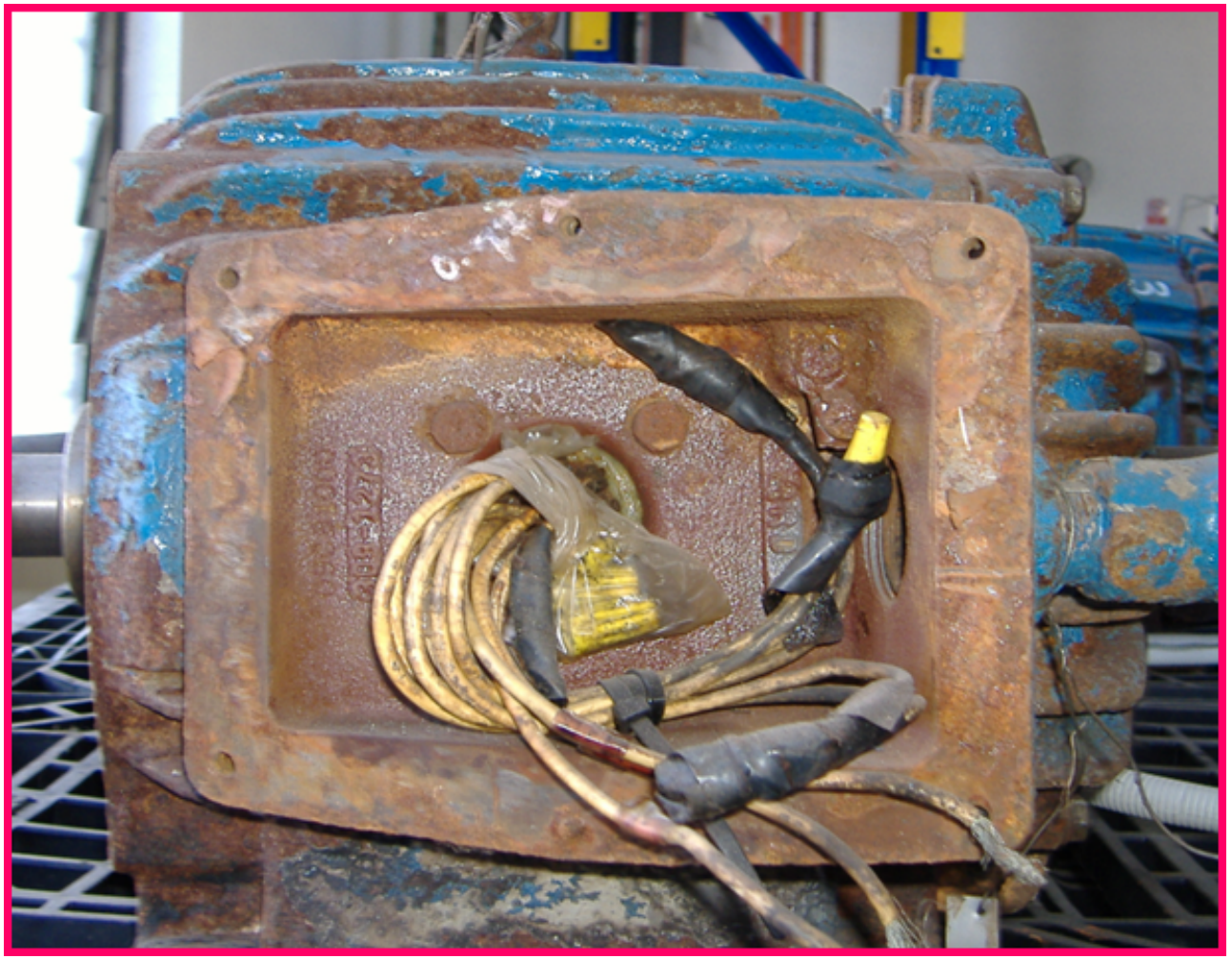
Background

- When certified flameproof equipment is inspected and a defect is identified such as corrosion of flamepath or deformation due to trapped cable or washer or a debris. The equipment will need to be repaired.
- In-situ method would be to repair by welding
- This process has risks – hot surface, arcs and sparks
- Can it be repaired temporarily without welding?

Poor or no maintenance ?



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Consequence

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Objectives of the study

- To determine if it is feasible to use plastic metal for temporary repair of flamepath
- Determine limitations of application and use
- Conduct tests beyond those specified in the protection standards
- Inform industry and regulators of findings
- Establish test criteria for plastic metals
- Establish competency for person undertaking repair

Selection of products

- There are a number of products available that may be suitable for temporary repair of flamepaths

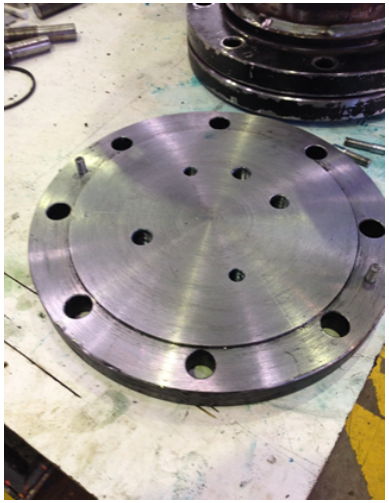
Analysis

- Type of compound
  - liquids (2 part, epoxy plus powder),
  - Putty
- Continuous Operating Temperature (COT) range
- Curing time
- Shelf life
- Compound Property
  - Tensile strength
  - Thermal conductivity
  - Hardness

Selection of suitable enclosure

- Ideal – Obtain existing certified enclosure
- Next Best - fabricate



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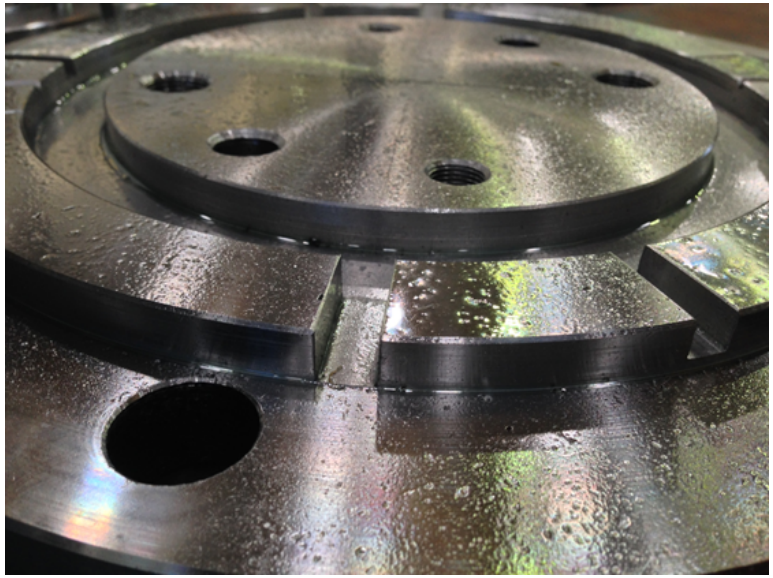
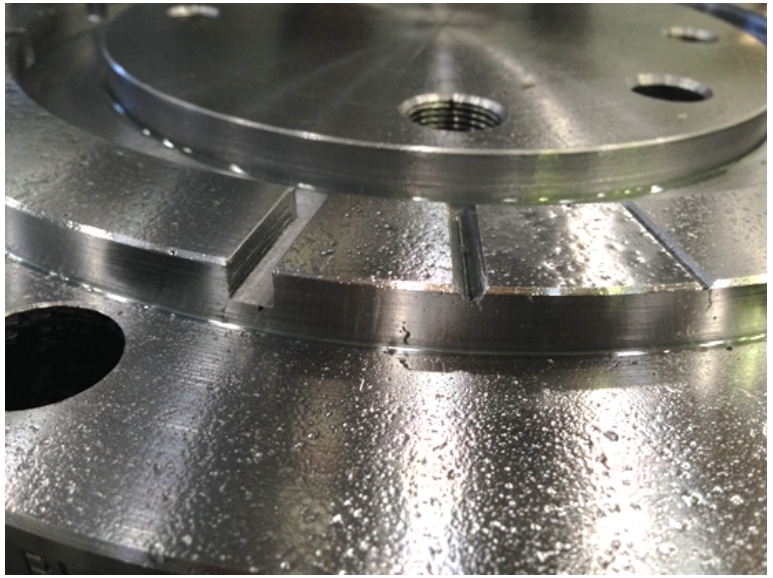
Selection of suitable enclosure

- Prepare slots for material testing
- 10mm, 8mm, 6mm (Square), 4mm & 2mm (V-slot)





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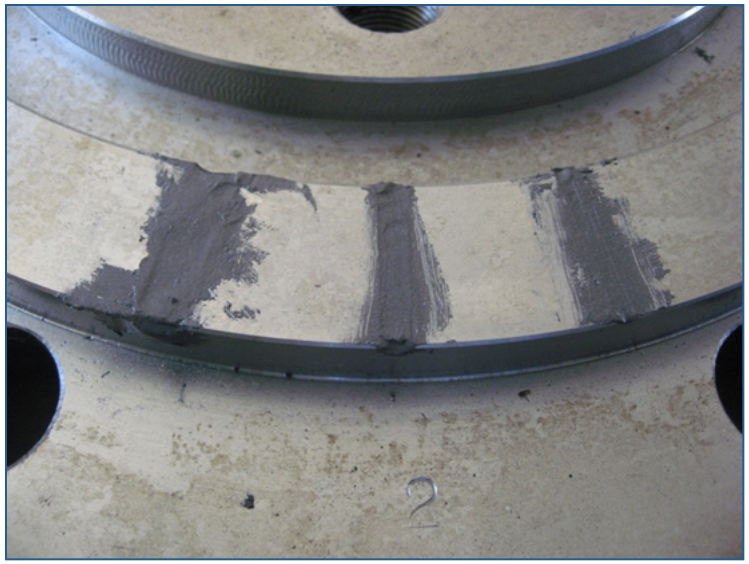
Prepare material

- Each compound was prepared as per manufacturers specification



Prepare material

- Each compound was prepared and finished such that the surface finish was around 6.3µm

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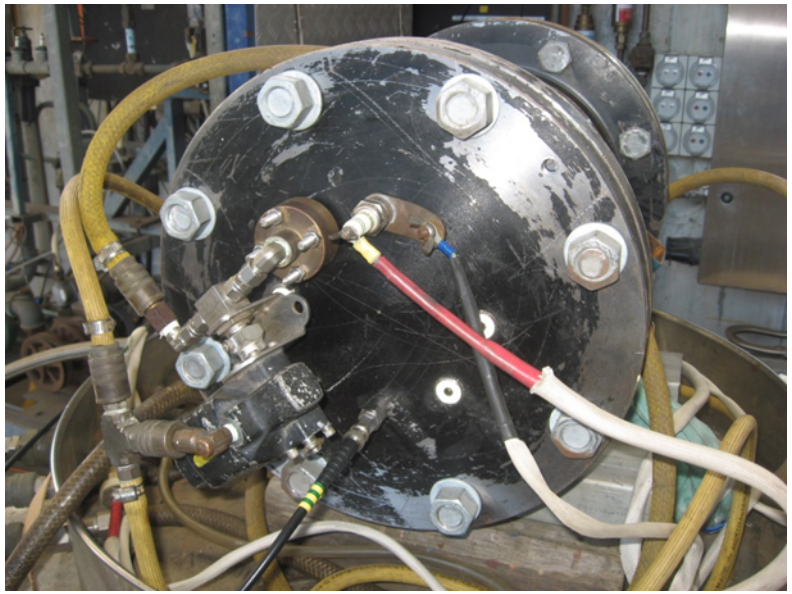
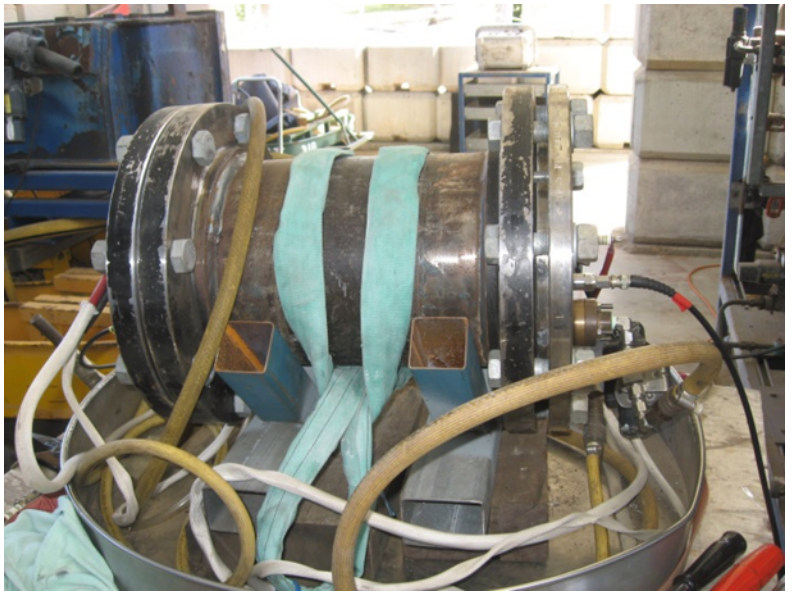
Testing of enclosure

- Testing of fabricated enclosure to prove compliance with IEC 60079-0 & IEC 60079-1 (Reference pressure determination tests)





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Testing of enclosure

- Testing of fabricated enclosure to prove compliance with IEC 60079-0 & IEC 60079-1 (Hydrostatic overpressure test)

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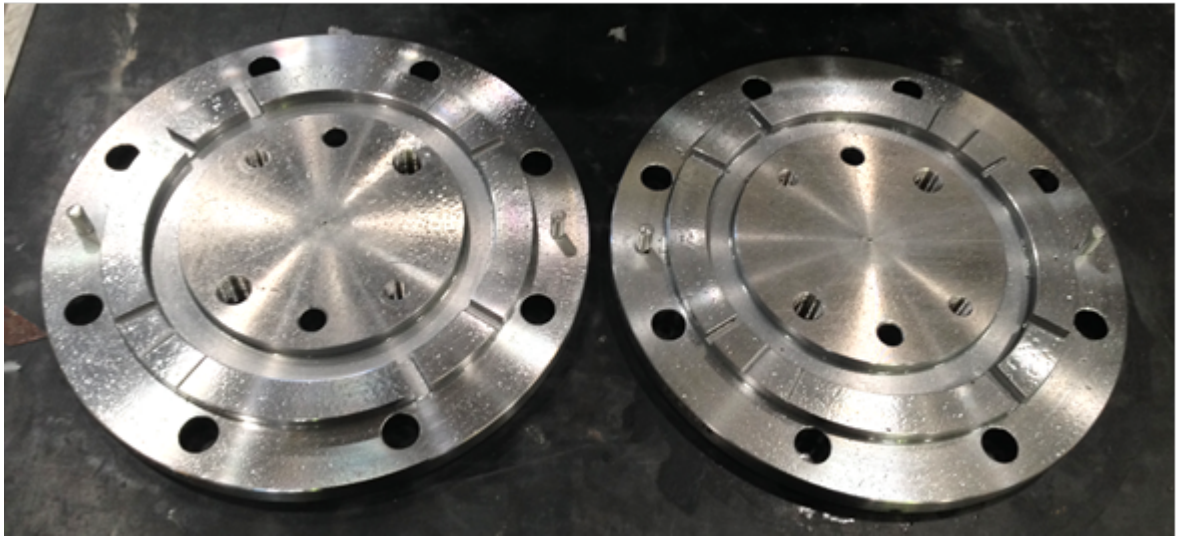
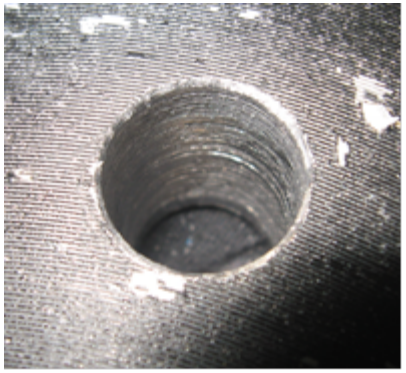
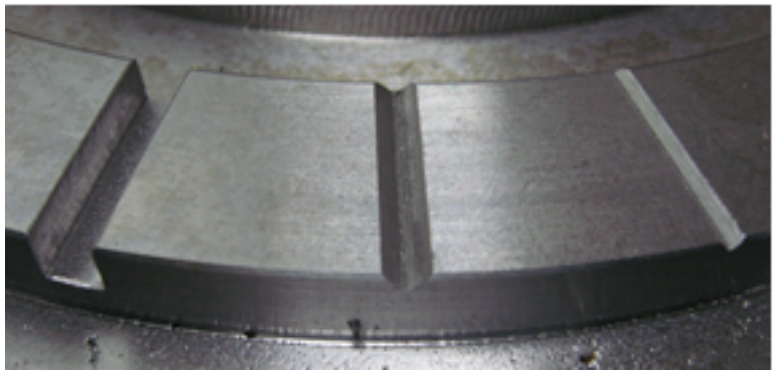
Material Preparation







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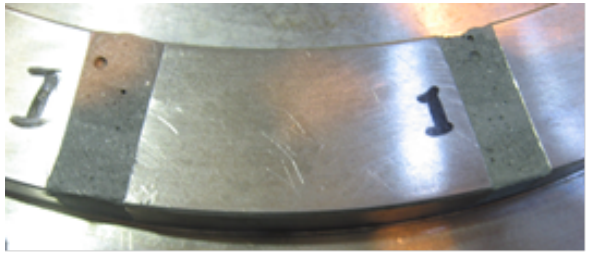
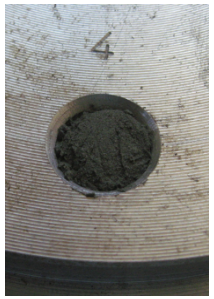
Material Preparation





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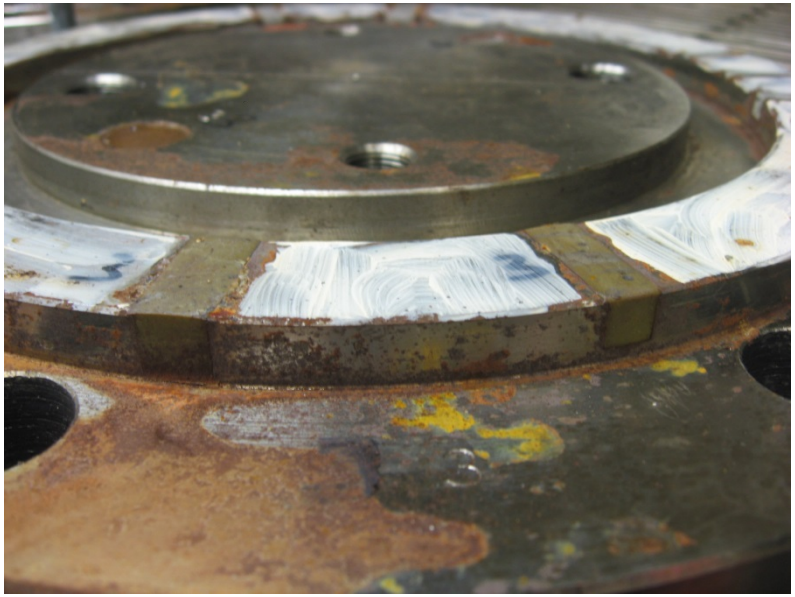
Conditioning of material

- Thermal endurance test
  - 4 weeks at 95°C and 90% RH
  - 24 hours at ambient temperature of 25°C
  - 24 hours at -25°C



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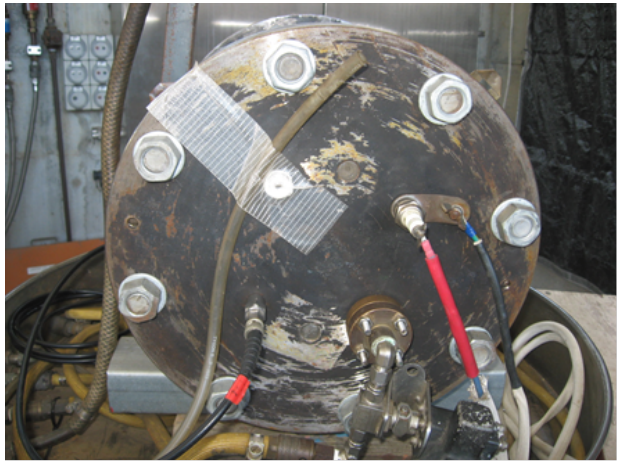
Testing and observations

- Impact tests on the potting in through holes
- Reference pressure determination tests with the compound (potting)
- Hydrostatic test at 1060 kPa applied for 60 s
- Flame non-transmission tests



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Testing and observations

- Flame non-transmission tests
  - 5 test conducted using hydrogen methane mix
  - No transmission, however minor erosion of material

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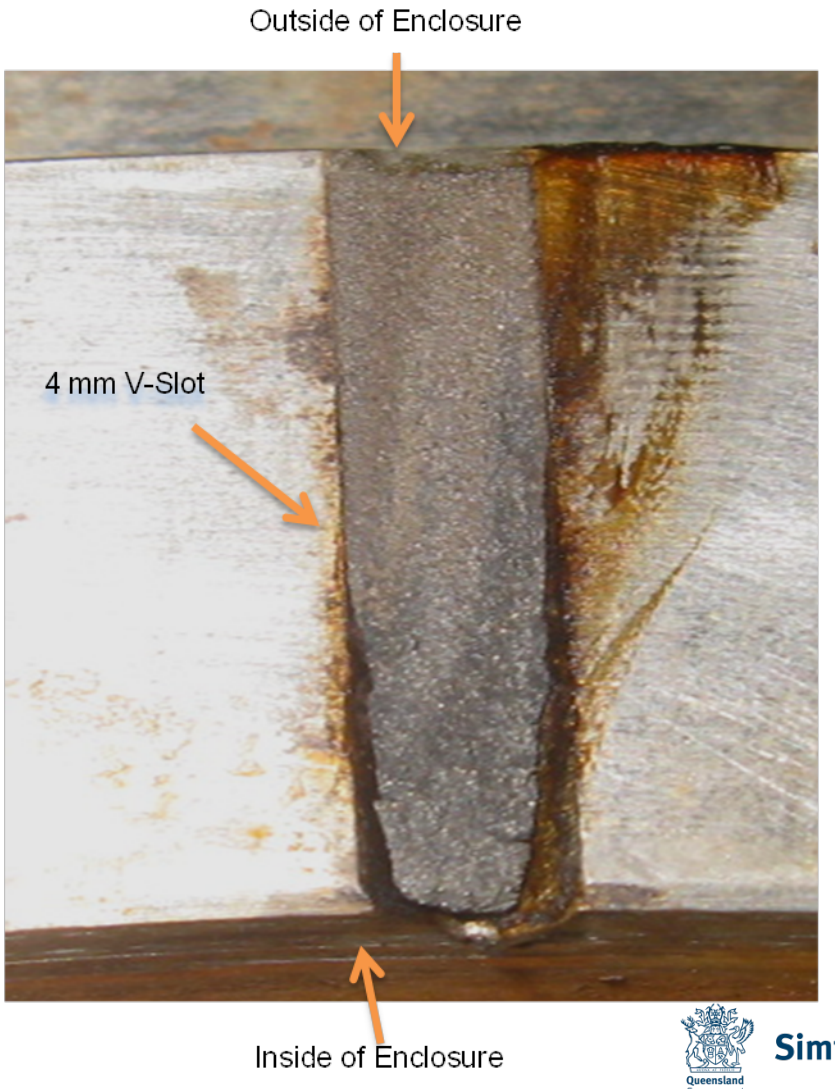
Testing and observations

- Flame erosion tests
  - 50 tests conducted using 9.8% methane in air mix

  - No transmission

Testing and observations

- Flame erosion tests
  - Closer inspection



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Testing and observations

- Other compounds

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Next Steps

- Conduct further tests of flamepath that are damaged due to the following:
  - Trapped washer in flange of flameproof enclosure
  - Impact damage on flamepaths (roughly in the middle of flamepath)
  - Test for various sizes and depth
  - Obtain feedback from end users (mines), inspectorate and the OEMs
  - Prepare plastic metal material testing criteria
  - Prepare competency requirements for undertaking repair

Indentations

Washer imprint across the flamepath

Impact damage across the flamepath

Deep stretch across the flamepath

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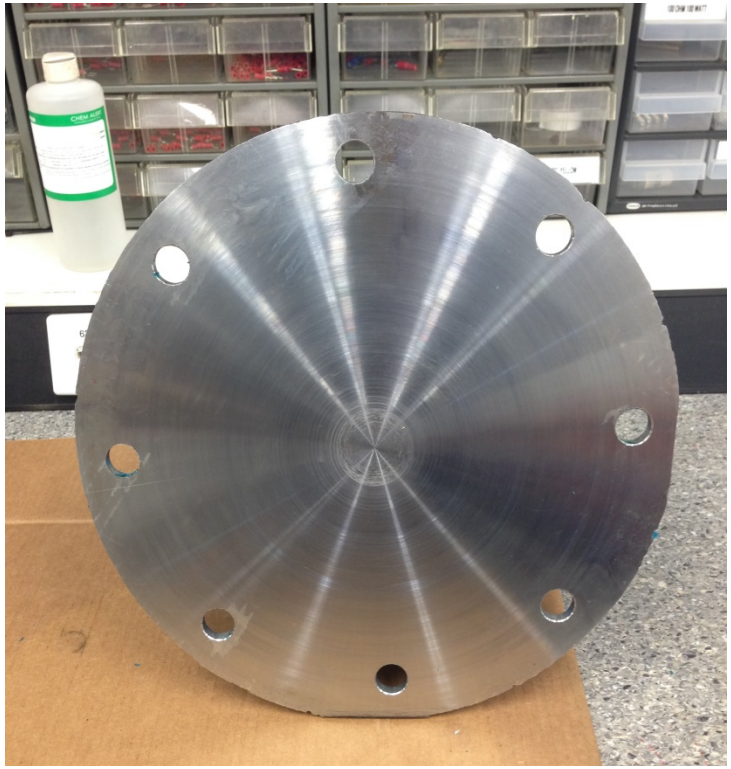
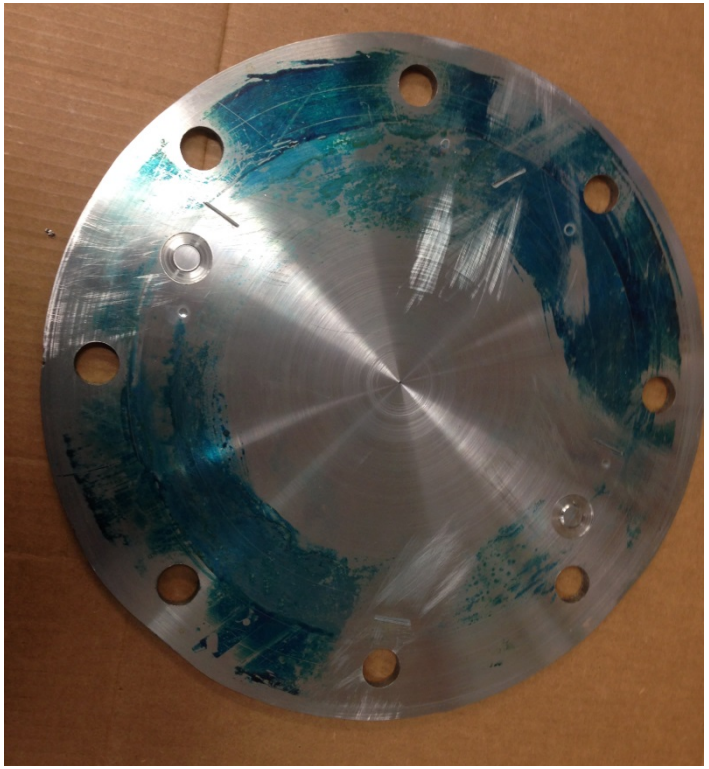
New thin cover plate



Front view of 8 mm thick plate



Back view with indentations

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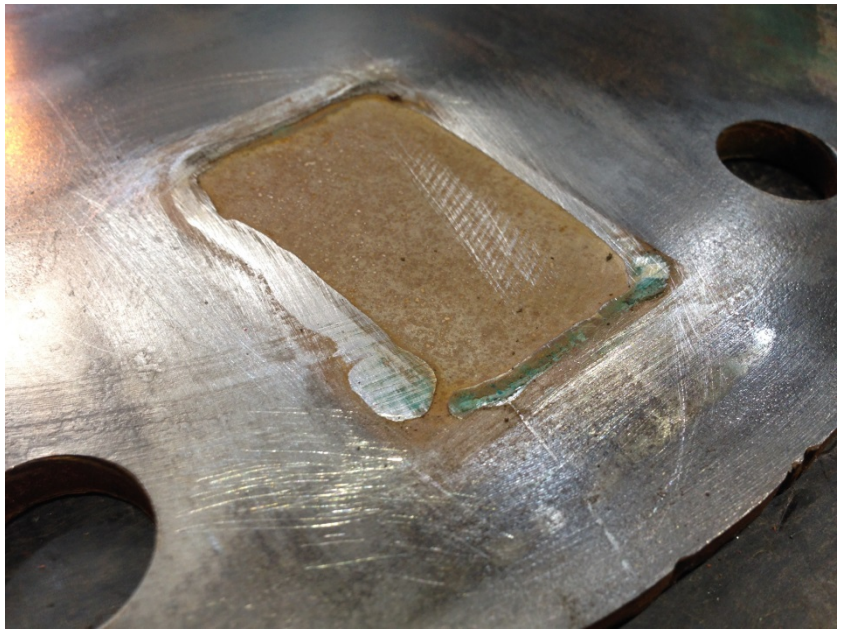
Flamepath damaged by corrosion



Flamepath etched with acid
on 8 mm thick cover plate

Flamepath etched with acid on
thick cover plate

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Conclusions

- Stage 1 – Feasibility study indicated that it is possible to repair flamepaths by use of certain plastic metal
- Test criteria is almost established and will be completed at end of Stage 2
- Original Equipment Manufacturer (OEM) must accept before proceeding with temporary repair
- Include in AS/NZS 2290.1 for temporary repair

Interim ACARP Report

- For details, interim ACARP report is available from ACARP project C23005
- http://www.acarp.com.au/report

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Any questions?

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