Joining of Dissimilar Materials: Weldability of Copper to Brass and Aluminium to Steel using Magnetic Pulse Welding

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Activities

- Tube cutting
- Tube perforation
- Axial crimp joints
- Stainless steel
- Modelling
- Welding
- Case studies
Magnetic pulse welding technology

Electromagnetic welding process:

- Similar to explosive welding
- Similar process
- Different (safer) source of energy
Experimental test set-up
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- Welding experiments with: - Copper – Brass
  - Aluminium – Steel
- Tubes: O.D.: 25 mm – Wall thickness: 1,5 mm
- Solid internal workpieces

**Figure 6.2:** The different geometries of inner workpieces which are used in the experiments:
- a) slant configuration
- b) straight configuration
- c) configuration without collar

**Clamp**

**Internal workpiece**
Parameter optimisation

Parameters varied:

- Air gap width
- Tube end position (field shaper overlap)
- Charging voltage

Investigation methods:

- Metallographic examination (weld length)
- Scanning electron microscopy
- Hardness measurements & leak tests
Cu – Br : Parameter optimisation

Optimal parameters :
• Air gap : 1,0 – 1,5 mm
• Tube end position : 2,5 mm out of the centre of the field shaper
• Energy level : > 26 kJ
Cu – Br: Interface morphology

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Al – St : Interface morphology
Cu – Br : Intermetallic layers
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Cu – Br : Melting phenomena
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Hardness and leak testing

Hardness traverse of a copper-brass weld

<table>
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<tr>
<th>Distance (mm)</th>
<th>Hardness (HV0.2)</th>
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<td>-2</td>
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Hardness weld interface

- Copper tube: 174
- Weld interface: 176
- Brass internal workpiece: 185
- Hardness Av.: 198

Hardness traverse of a aluminium-steel weld

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Hardness weld interface

- Aluminium tube: 144
- Weld interface: 151
- Steel internal workpiece: 263
- Hardness Av.: 317

Av. : 183
Av. : 219
Hardness testing

Hardness in the axial direction

Distance (mm)

Hardness (HV0.2)

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

0 25 50 75 100 125 150 175

Measured 1.5 mm below the surface

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Conclusions & Future research

Conclusions
• Defect free welds
• Intermetallic layers
• Melting phenomena

Future research:
• Repeatability
• Other material combinations