AUTO/STEEL PARTNERSHIP
PROJECT TEAM MEMBERS

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PROJECT GOALS

The purpose of this project was to evaluate various weld repair processes and to provide joint test data for use by OEMs.

An Auto/Steel Partnership Repairability Team Project
PROJECT APPROACH

• Using coupon test assemblies fabricated from various grades of 3rd GEN AHSS, a variety of repair process joints were destructively tested. The resulting data can be used by OEMs to update repair process strategies

• 3rd GEN 980 uncoated, 3rd GEN 980 GI coated, and 3rd GEN 1180 GI were tested

• Repair processes investigated include: resistance spot welding (RSW), gas metal arc welding (GMAW), gas metal arc brazing (GMAB), and mechanical fastening

• Production and service adhesives were also tested

• Tests include shear tension and cross tension quasi-static, shear tension fatigue, cross-sections for microscopy and metallurgical analysis and cross-sections
PROJECT RESULTS | TYPICAL JOINT AND CROSS-SECTION PHOTOS

1.4 mm 3rd Gen 980 - uncoated (Lot#152): RSW (Production)

RSW (Production)

RSW (Production) with production adhesive
PROJECT RESULTS | TYPICAL JOINT AND CROSS-SECTION PHOTOS

1.4 mm 3rd Gen 980 - uncoated (Lot#152): RSW (Service)
PROJECT RESULTS | TYPICAL JOINT AND CROSS-SECTION PHOTOS

1.4 mm 3rd Gen 980 - uncoated (Lot#152): GMAW and GMAB

GMAW Plug

GMAB Plug

GMAB Slot
PROJECT RESULTS | TYPICAL JOINT AND CROSS-SECTION PHOTOS

1.4 mm 3rd Gen 980 - uncoated (Lot#152): Hemlok Rivet

- Hemlok Rivet
- Hemlok Rivet with production adhesive
- Hemlok Rivet with service adhesive
PROJECT RESULTS | TYPICAL JOINT AND CROSS-SECTION PHOTOS

1.4 mm 3rd Gen 980 - HDGI (Lot#156): RSW (Production)
PROJECT RESULTS | TYPICAL JOINT AND CROSS-SECTION PHOTOS

1.4 mm 3rd Gen 980 - HDGI (Lot#156) : RSW (Service)

RSW (Service)

RSW (Service) with service adhesive
PROJECT RESULTS | TYPICAL JOINT AND CROSS-SECTION PHOTOS

1.4 mm 3rd Gen 980 - HDGI (Lot#156) : GMAW and GMAB
PROJECT RESULTS | TYPICAL JOINT AND CROSS-SECTION PHOTOS

1.4 mm 3rd Gen 980 - HDGI (Lot#156): Hemlok Rivet

![Hemlok Rivet](image1)

![Hemlok Rivet with production adhesive](image2)

![Hemlok Rivet with service adhesive](image3)

Hemlok Rivet

Hemlok Rivet with production adhesive

Hemlok Rivet with service adhesive
PROJECT RESULTS | TYPICAL JOINT AND CROSS-SECTION PHOTOS

1.4 mm 3rd GEN 1180 - HDGI (Lot#165): RSW (Production)

RSW (Production)

RSW (Production) with production adhesive
PROJECT RESULTS | TYPICAL JOINT AND CROSS-SECTION PHOTOS

1.4 mm 3rd GEN 1180 - HDGI (Lot#165): RSW (Service)

![Typical Joint and Cross-Section Photos]

- RSW (Service)
- RSW (Service) with service adhesive

LME cracks are visible in the photos.
1.4 mm 3rd GEN 1180 - HDGI (Lot#165): RSW (Service)
PROJECT RESULTS | TYPICAL JOINT AND CROSS-SECTION PHOTOS

1.4 mm 3rd GEN 1180 - HDGI (Lot#165): Hemlok Rivet

- Hemlok Rivet
- Hemlok Rivet with production adhesive
- Hemlok Rivet with service adhesive
PROJECT RESULTS | JOINT PEAK LOAD DISPLACEMENT PLOTS

1.4mm 1180 3rd GEN HDGI (Lot 165), Shear Tension

Graph showing load-displacement curves for various joint types and conditions.
PROJECT RESULTS | JOINT PEAK LOAD DISPLACEMENT PLOTS

1.4mm 1180 3rd GEN HDGI (Lot 165), Cross Tension

[Diagram showing load-displacement plots with various methods represented by different lines and markers.]
PROJECT RESULTS | JOINT PEAK LOAD COMPARISON BAR CHART

Shear Tension Comparison For All Types

Shear Tension

Error bars indicate minimum and maximum peak loads for each group.
Cross Tension Comparison For All Types

Error bars indicate minimum and maximum peak loads for each group.
PROJECT RESULTS | TYPICAL FRACTURE PHOTOS

980 3rd GEN HDGI (Lot 156), CT

button pull – both sheets/cohesive separation

1180 3rd GEN HDGI (Lot 165), CT

interfacial

1180 3rd GEN HDGI (Lot 165), ST

interfacial/cohesive separation

RSW (Production)
PROJECT RESULTS | TYPICAL FRACTURE PHOTOS – SHEAR & CROSS TENSION

GMAW

980 3rd GEN Uncoated (Lot 152), ST

weld pullout – top sheet

980 3rd GEN Uncoated (Lot 152), CT

weld pullout – both sheets

1180 3rd GEN HDGI (Lot 165), CT

braze fracture

GMAB

980 3rd GEN HDGI (Lot 156), ST

braze fracture/braze pullout – top sheet
PROJECT RESULTS | TYPICAL FRACTURE PHOTOS

Structural Mechanical Rivet

980 3rd GEN Uncoated (Lot 152), ST

rivet separation

980 3rd GEN Uncoated (Lot 152), CT

rivet separation/cohesive separation
PROJECT CONCLUSIONS AND RECOMMENDATIONS

• For materials evaluated in this project, appropriate repair methods can be selected.
• Adhesive increased shear tension peak loads but had little effect on cross-tension peak loads.
• Production adhesive joints had higher peak loads compared to service adhesive joints for both shear tension and cross tension.
• LME cracking was observed in the 3rd GEN 1180 spot welds, both production and repair welder.
• LME observed in the 3rd GEN 980 - HDGI service spot welds.
• Significant LME cracking was observed in the GMAW plug and GMAB slot joint configurations:
  • 1.4 mm 3rd GEN 980 - HDGI (Lot#152) GMAW plug.
  • 1.4 mm 3rd GEN 1180 - HDGI (Lot#165) GMAW plug, GMAB plug and GMAB slot.
FOR MORE INFORMATION

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