Cable And Fuse Welding For Electric/Hybrid Vehicles

First thoughts

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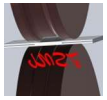

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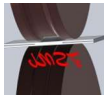
A Business Partnership with IWSL has the Potential for a Very Profitable Relationship

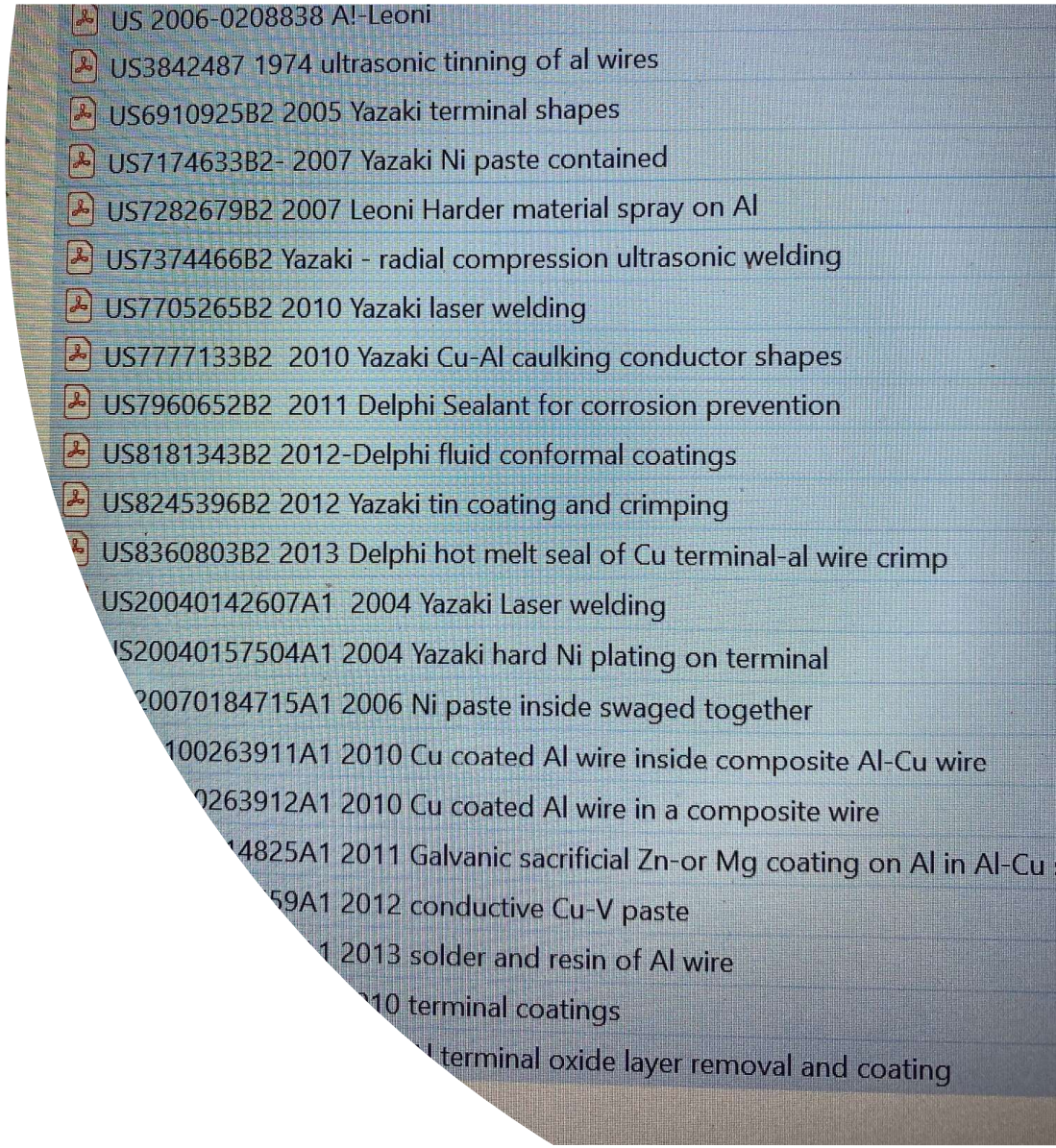
- **Global volume currently exceeds 100 million cables/year and 15 million fuses per year and is increasing**
- **These larger sized cables (typically 35-60 mm^2 of copper cross-section) can not be manufactured with high quality using processes used for smaller cables such as ultrasonic welding, crimping or Capacitor-Discharger welding**
  - **Large amount of R&D done globally, but especially in Germany and Japan has resulted in a multitude of patents**
  - **Many of the methods are not environmentally friendly and use a large amount of soldering chemicals. All methods are very expensive to use.**
- **IWSL's alternative patent provides an environmentally friendly method that also has cost and quality advantages over presently used methods**

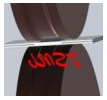


*Can share costing parameters if interested, in future conversations

IWSL has a competitive advantage in the current landscape

- **A majority of patents on hybrid/electric car cable welding have been from Leoni (Germany) and Yazaki (Japan)**
- **They do not show an ability to weld copper or light-weight aluminum cables inexpensively**
- **Other major players are General Cable in the USA and TE Connectivity in China**
- **Our patents beat all these listed in terms of cost/quality and the ability to weld aluminum cables as well as copper cables**
  - **IWSL has multiple patent families in the major jurisdictions across the world**

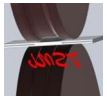




Focused-Resistance Welding (FRW™)

Technical Annex

Applicability: Hybrid and Electric Car Cables; The welds shown in the next few slides passed all tests specified in USCAR Standard, "PERFORMANCE STANDARD FOR AUTOMOTIVE ELECTRICAL CONNECTOR SYSTEMS"



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Quality Requirements For The Welds

- **IWSL's cable welds are tested per the test standard for these welds published by the US Center of Automotive Research, Ann Arbor, Michigan.**
- **These tests include and are not limited to:**
  - **Resistivity checks of the welds using micro-ohm meters**
  - **Shear strength**
  - **Peel Strength**
  - **IWSL's welds meet the USCAR specification and exceed it by at least 50% in terms of shear/peel strength**

Covered by IWSL's US and International Patents, PCT coverages and Pending Patent Applications

Large Cables Can Be Welded Without Plating/Solder Filler

Significantly Reducing Costs

Stranded Copper Wire (50 mm^2) Welded to Silver-Plated Connector Plate And Shear Tested: >4000 Newton Shear Strength Exceeds Specification Requirements by 50% With No Weld-Interface Failure

Cables of 100 mm^2 copper cross-section can be welded with present equipment; Higher capacity equipment can be readily designed and built

Covered by IWSL's US and International Patents, PCT coverages and Pending Patent Applications

FRW™ Can Weld Smaller Wires Cost Effectively

Stranded Copper Wire (20 mm^2) Welded to Connectors

Torsion-tested Cable-Connector Weld Shows Excellent Quality

Covered by IWSL's US and International Patents, PCT coverages and Pending Patent Applications

Welded Aluminum Stranded Wire Cables

Enable Light-Weighting of Electric/Hybrid Vehicles

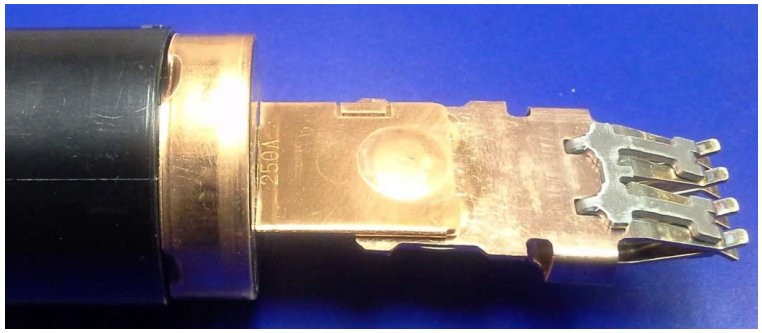
>1000 Newton Shear Strength Exceeds Specified Requirement by 50%

FRW™ Can Weld Stranded Aluminum Wire Cables To Aluminum/Brass Connectors

Covered by IWSL's US and International Patents, PCT coverages and Pending Patent Applications

FRW™ Welds Electric/Hybrid Vehicle Fuse-Connectors

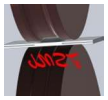
Copper-Copper Fuse Weld Peel Test Quality Check
Demonstrates weld stronger than parts welded
Weld size can be increased if necessary



Applicability: Electric/Hybrid Vehicle Replaceable Fuses Welded To Connectors

Advantages:

1. **No broken fuse wires as in ultrasonic welding**
2. **Reliable melted & solidified weld nugget**

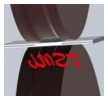


Covered by IWSL's US and International Patents, PCT coverages and Pending Patent Applications

No Plating/coating/Solder Filler Needed Significantly Reducing Costs

Stranded Copper Wire (35 mm^2) welded to connector box: >4000 Newton Shear Strength

High Quality Weld Without Deforming Connector Box's Shape/Size



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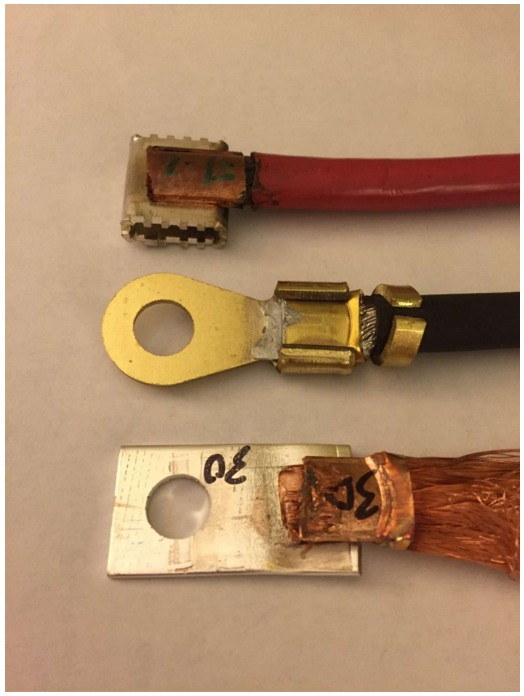
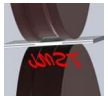
Better Durability Due To Higher Weld Strength And Lack of Intermetallic-Compound Formation



Variety of Copper and Aluminum Stranded-wire Cables FMRW™ welded to connectors:

1. **Silver plated box to 35 mm^2 copper cable; no deformation of box**
   - **4000 Newton weld strength**
2. **25 mm^2 Aluminum cable welded to brass connector through an interlayer**
   - **1000 Newton weld strength without crimps**
3. **Shear tested 50 mm^2 copper cable welded to silver plated copper connector**
   - **Greater than 4000 Newton weld strength versus 1200 Newton strength of an ultrasonic weld**



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