# Cable-Connector Welding For Hybrid/Electric Vehicles

**Value Propositions From IWSL's Unique Welding Technology**

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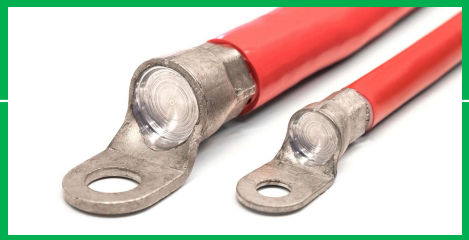
# Use of Stranded-Wire High Current Aluminum Cables In Hybrid/Electric Vehicles

| Problems | Global Competition | IWSL's Solutions |
|---|---|---|
| 1. Not Possible So Far To Melt A length of Stranded-Wire Aluminum Cable With A Connector – Laser and Arc Welding Ineffective In Large Volume And Expensive | Draexlmaier Group in Germany offers a friction-welded cable-connector assembly (photo from website)  | IWSL is able to melt a length of the aluminum stranded wires with the connector- Unique ability patented or patent-pending in the US, Europe, China, India and other countries |
| 2. Crimped Aluminum Joints creep, cold-flow and corrode creating loose joints not fit for high current passage | <u>Shortcomings</u> |   |
| 3. Crimped Joints Not Good in Vibratory Environments. Ultrasonic Welds are not capable of welding these cable sizes | 1. Only a vertical outer plane of the wires is welded together<br>2. The assembly is still susceptible to creep and cold flow | A length of stranded-aluminum wires are shown to have been melted together with a connector. Appropriate interlayers may be present. No More Loose Joints! |

# Why Work With IWSL?

## Stranded Aluminum Wire Cable-Connector Welds

## Hybrid/Electric Vehicles

- **Quality and Durability Through The Only "Melted & Solidified" Cable-Connector Welds In The Industry**
  - **Welds Do Not Creep Or Cold Flow**
  - **No More Loose Connections Generating Unwanted Heat**
  - **Lowest Joining/Manufacturing Cost**
  - **Very Repeatable High Volume Manufacturing Process**
  - **Enable Capturing the 50% Weight Savings and 90% Cost Savings from Substituting Aluminum for Copper**
- **Competitive Methods Are Unreliable**
  - **Joints Become Loose In Service Generating Unwanted Heat/Risk**
  - **High Joining Costs**

# Weight And Cost Savings: Al Vs. Cu

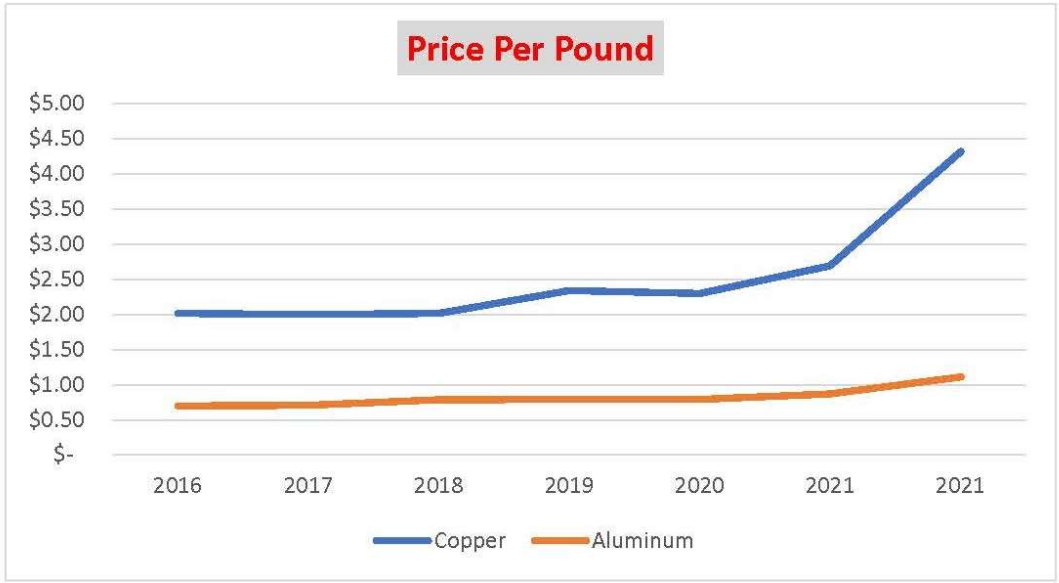
**Weight and Cost Savings by using high current/high voltage stranded-wire aluminum cables in a hybrid/electric vehicle instead of copper cables**

| No | Item | Length (meters) | Copper cross-section ($mm^2$ of copper) | Copper cable weight (grams) | Copper cable weight (pounds) | Equivalent Aluminum cross-section ($mm^2$) | Equivalent aluminum cable weight (grams) | Equivalent aluminum cable weight (pounds) |
|---|---|---|---|---|---|---|---|---|
| 1 | Power cable that connects motor to inverter | 0.2 | 50 | 900 | 1.98 | 75 | 405 | 0.89 |
| 2 | 6 to 8 high voltage cables of length 8 feet each connecting battery, inverter, brake regenerator, etc. | 20 | 50 | 90000 | 198.42 | 75 | 40500 | 89.29 |
| | | | | | | | | |
| | Total cable weight | | | | 200.40 | | | 90.18 |
| | Totl cable cost | | | | $ 661.32 | | | $ 54.11 |
| | Weight Savings By Using Stranded-wire aluminum cables instead of stranded-wire copper cables (pounds/vehicle) | | | | | | | 110.22 |
| | Cost Savings By Using Stranded-wire aluminum cables instead of stranded-wire copper cables (US $/Vehicle) | | | | | | | $ 607.22 |

# Aluminum vs Copper Price Chart over last 5 years

## Price per Pound

| | Year | Copper | Aluminum | |
|---|---|---|---|---|
| 6-Jun-16 | 2016 | $ 2.02 | $ 0.70 | 7-Jun-16 |
| 10-Jan-17 | 2017 | $ 2.01 | $ 0.71 | 12-Jan-17 |
| 8-Jan-18 | 2018 | $ 2.02 | $ 0.79 | 7-Jan-18 |
| 10-Jan-19 | 2019 | $ 2.34 | $ 0.79 | 10-Jan-19 |
| 7-Jan-20 | 2020 | $ 2.30 | $ 0.79 | 9-Jan-20 |
| 7-Jan-21 | 2021 | $ 2.69 | $ 0.87 | 7-Jan-21 |
| 25-Feb-21 | 2021 | $ 4.32 | $ 1.12 | 25-Feb-21 |




Notes

**Copper projected to be $4.75/LB in 2021**

Research Data

https://tradingeconomics.com/commodity/aluminum