

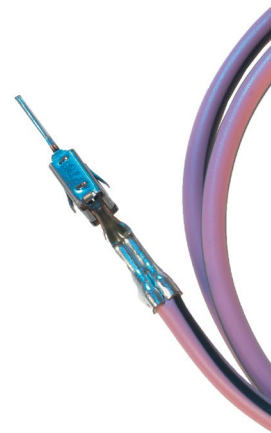
# LITEALUM

**Reliable long-term electrical contacts**

Securely terminating  
aluminum-stranded conductors

## ALUMINUM - THE WIRING MATERIAL OF THE FUTURE.

Aluminum is a good conductor of electricity. In the car industry, within many areas this lightweight material is in the process of replacing copper in power cables. There are two key advantages in using aluminum: lower material costs and – even more importantly – considerably less mass than copper. If aluminum wiring is used, a wiring harness in a mid-sized vehicle can shed two to three kilograms of "fat". This trims fuel consumption and CO<sub>2</sub> emissions. Aluminum can score points even in vehicles with alternative drive trains (hybrid and electric vehicles) – by helping extend the range of travel possible in electric driving mode.



### Three questions to consider when selecting your supplier

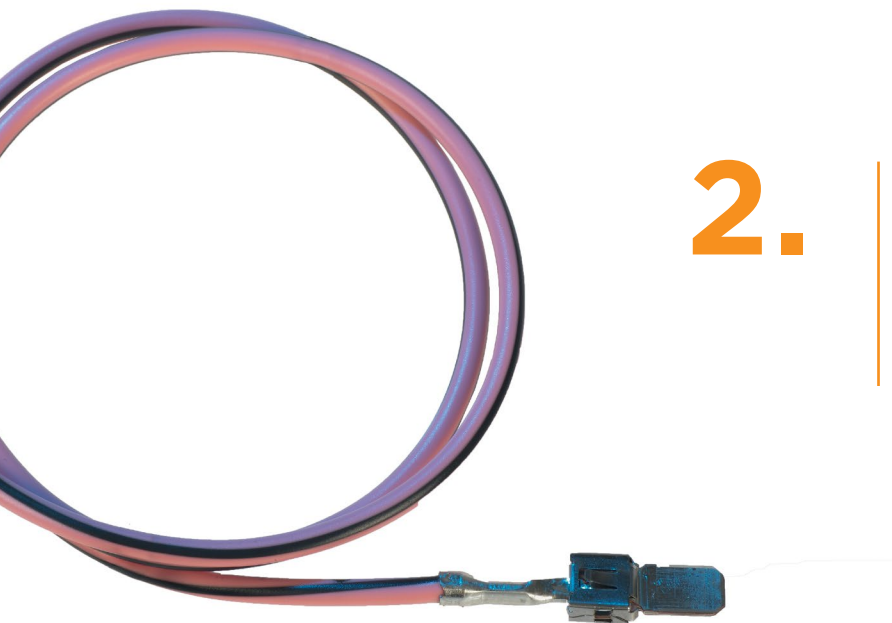
The wiring harness is one of a vehicle's heaviest components. No wonder it gets extra attention when it comes to saving weight. Lightweight aluminum wiring can replace heavier copper wires in the wiring harness. But aluminum is a demanding material. To ensure reliable electrical contacts over time, the connector technology must be designed specifically for stranded conductors made of aluminum. This calls for lots of general knowledge and process expertise. That's why you should be careful when choosing your supplier of plug-in connectors.

TE Connectivity is one of the leading providers of passive electronic components. Based on our extensive experience, when choosing your supplier we recommend that you ask the following three questions. This will help you find the right manufacturer, one whose plug-in connectors completely meet and match your own high standards for process reliability and durability.

# 1.

**Is the company familiar with the special challenges aluminum presents for contacts, and does it have the necessary production and process expertise?**

Where aluminum is used in place of copper, there are several aspects to consider where the contacts are concerned. **Page 4**



# 2.

**Does the company offer a reliable solution for long-term electrical contacts in stranded conductors made of aluminum?**

Aside from electrical stability, the connection needs to be mechanically stable and highly corrosion-resistant. **Page 6**

# 3.

**Does the company have testing and inspection facilities of its own to ensure the quality of its products, from development through series production?**

To ensure the highest possible availability for plug-in connectors, the testing and inspection technology must meet the highest standards. **Page 8**

The new LITEALUM crimp can be processed fully automatically using standard machines.



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# CONSIDERATION 1:

FAMILIARITY WITH THE MATERIAL.

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Replacing copper conductors with aluminum ones meets key specifications in motor-vehicle technology with regard to lightweight design and materials availability. Although along with its strengths, aluminum also has several properties that can make its use as a material for conductors more challenging.

To ensure the highest possible product quality you should ask your supplier:

- Is the company aware of the difficulties aluminum contacts can present?
- Does it know how to set about meeting the challenges involved?
- Is it already experienced in the use of aluminum as a material for electrical contacts?

#### 1. Preventing creep

Under mechanical strain, the aluminum alloy tends to exhibit signs of what is referred to as “creep” at temperatures considerably lower than in the case of copper. That is why aluminum-copper connections need to be established at connection points on the wiring harness in a way that prevents a loss of electrical performance over the lifecycle of the product.

#### 2. Preventing electrochemical corrosion

There is a high potential difference between aluminum and copper. As a result, in the presence of moisture more base aluminum tends to decay at the aluminum-copper connection. Appropriate steps need to be taken to prevent this electrochemical corrosion.

#### 3. Keeping lower strength in mind

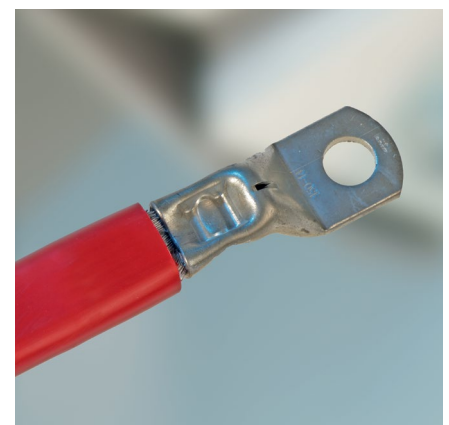
The mechanical strength of aluminum is equal to only about one-third of copper. This must be factored in when using it as conductor material if the wires are to achieve a high level of mechanical strength while achieving the necessary retention forces in the connections.

#### 4. Ensuring electrical contact

Aluminum forms a dense and very hard oxide layer that prevents corrosion while insulating at the same time. There must be a reliable way to destroy this oxide layer if there is going to be good electrical conductivity.

#### Specific expertise in the area of aluminum contacts

At TE Connectivity, aluminum is a familiar material to us. For high-voltage applications, we have successfully developed the COPALUM crimp connector for contacts with aluminum conductors. The connector has proven itself in the field. For stranded conductors made of aluminum we offer tried and tested solutions with AMPLIVAR crimping technology and the related group of products. The underlying findings based on these products went into the development of the new LITEALUM crimps by TE Connectivity. Our development goal: Process-stable, reliable contact using aluminum stranded connectors, with the kinds of cross-sections found in automobiles.



Proven during extensive use: COPALUM crimp connector for contacts with aluminum conductors.

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# CONSIDERATION 2:

## DEEP PROCESS EXPERTISE.

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**F**ully automated contacts using aluminum conductors require a well grounded grasp of the processes involved. Your supplier needs to take steps that will reliably ensure lasting aluminum contacts.

To assess your supplier's production process and reliability of electrical contacts, you should ask:

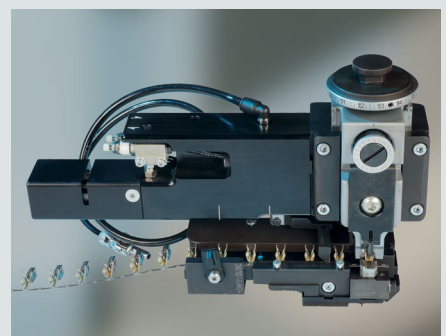
- Has the company mastered the production process?
- Is a reliable electrical connection achieved?
- Is there high mechanical tensile strength and corrosion resistance?
- Can the company produce in large quantities?

Thanks to our extensive experience in the area, we understand very well the production processes involved in electrical connectors. We know where the emphasis needs to be placed to achieve high quality. To provide reliable contacts in aluminum conductors, we have developed and validated a LITEALUM crimp for use specifically in wiring harnesses.

**Top:** Due to partial cold welding, the serrations on the crimp sleeve create a reliable electrical connection.

**Center:** The new crimp barrel is formed to create a broad area of contact with the copper for as many wires as possible.

**Bottom:** The crimping tool, similar for aluminum and copper, is individually adjusted for crimping.



**Ready to crimp: The new LITEALUM crimp by TE Connectivity**

Our new LITEALUM crimp barrel eliminates the sources of familiar problems encountered when crimping to aluminum leads. Their form and surface design are precision-tuned to suit the material properties of the aluminum lead.

**1. Secure electrical connection**

The inside of the LITEALUM crimp barrel is fitted with sharp-edged serrations. During crimping, the serrations break through the oxide layer on the aluminum lead, and partial cold welding provides a reliable, good electrical connection. The residual tension remaining in the LITEALUM crimp is negligible and cannot cause creep.

**2. Preventing cable breakage**

The intelligent geometry of the LITEALUM crimp barrel prevents notching of the aluminum leads. The rear of the LITEALUM crimp has a gradient over the course of which deformation and elongation of the lead continuously decreases. This prevents notching and breakage.

**3. Effective corrosion protection**

To prevent electrochemical corrosion, the insulation is crimped within the rear of the LITEALUM crimp barrel. At the front end, additional material is formed and spots of sealing compound are used to provide lasting corrosion protection. As a result, the connection is also suitable for unsealed plug-in connectors in the vehicle interior.

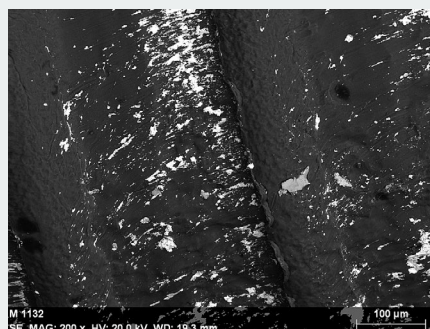
**Fully automated processing**

A fully automated process uses a specially tailored crimping tool to create contacts with the aluminum stranded conductors. This results in productivity comparable to what is achieved in processing conventional copper conductors. The harness maker can use its existing equipment with only minor modifications.

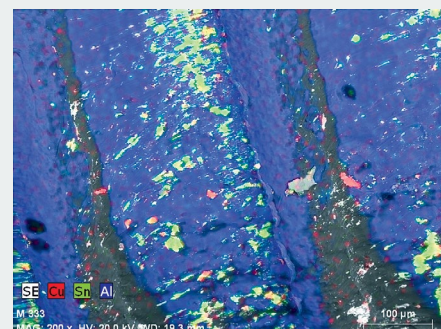
There are several special requirements that aluminum processing applies to the entire manufacturing process: wire de-reeling, align the aluminum stranded lead, stripping, positioning the lead in the crimping tool and crimp monitoring system. The special crimp design calls for a new crimp monitoring system.

All of these challenges are fully satisfied thanks to the innovative design of the crimping tools, specially adapted standard machinery and optimum coordination of the individual processes involved.

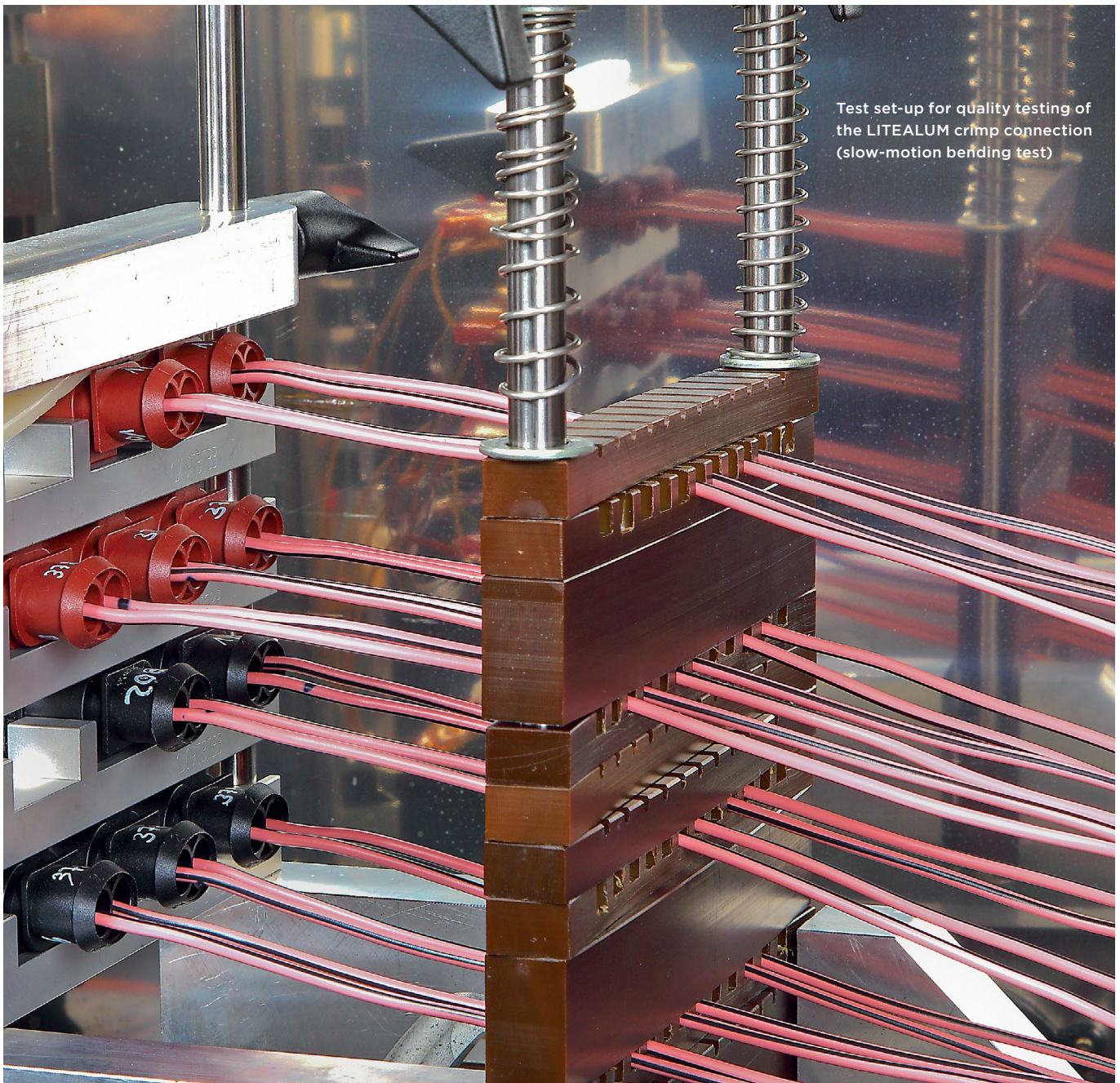
Detailed view using REM



EDX analysis of the elements



**At right:** After the crimping tool is closed, partial cold-welding areas are formed between the crimp sleeve and the aluminum lead that are comparable with those of copper leads.



Test set-up for quality testing of the LITEALUM crimp connection (slow-motion bending test)

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# CONSIDERATION 3:

## RELIABLE TESTING AND INSPECTION METHODS.

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The automobile industry has considerable demands when it comes to the reliability of electrical connectors – even more so where the goal of lifecycle durability is concerned. Use of aluminum in vehicle wiring creates high demands for testing within the scope of development and product safety.

If you attach importance to developed and tested quality from a single source, you should ask your supplier:

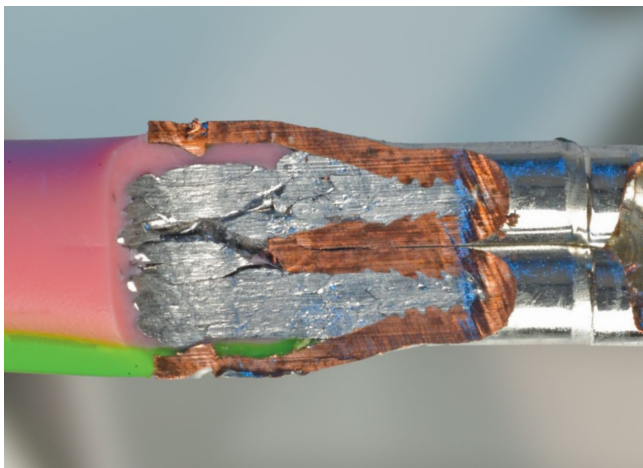
- Does the company have testing and inspection facilities of its own?
- Does the technology meet the highest standards?
- Do the testing and inspection procedures used deliver absolutely reliable results?

At the TE Connectivity Test Competence Center in Bensheim (Germany), development, research and tests and validation of the new LITEALUM crimp dovetail closely with one another. This makes the best use of the minds of the experts working there. Our testing and inspection specialists apply high-precision testing and analytical technology that represents the current state of technology. Scanning electron microscopy, for instance, generates sharp, high-resolution images. 3-D computer tomography provides the insights only a „penetrating“ perspective can produce. High-resolution X-ray radiography makes three-dimensional analysis possible, permitting important conclusions about product quality.

The result of tested quality, "made by TE Connectivity": very high reliability in the new LITEALUM crimp connections for the automobile industry.

#### The very latest testing and analytical technology

- Analytical scanning electron microscope
- 3-D X-ray computer tomography
- Climatic test cabinets
- Temperature shock chambers
- Vibration systems
- 4-component corrosive-gas testing system/crimp validation
- Tensile test machinery
- Steam jet system



Light-optical microscopic images of longitudinal sections demonstrate the high strength of the LITEALUM crimp connection.

## THE ANSWER TO YOUR QUESTIONS: TE CONNECTIVITY.

**R**ecognized materials expertise, a profound process orientation, and extensive inspection and testing competencies: Does your supplier need to fulfill all of these requirements? Then TE Connectivity is the right partner for you, and our new LITEALUM crimp for aluminum leads is your product of first choice.

The language of facts is a clear one: The newly optimized design for LITEALUM crimps by TE Connectivity is convincing thanks to a highly stable contact resistant to wide temperature fluctuations and moisture, as well as very good corrosion-resistance and high withdrawal forces. At this point in time, we have already developed and qualified 18 different contact systems on the basis of the new LITEALUM crimp. As things stand today, it can be used to process aluminum stranded conductors with lead cross-sections of 1.5mm<sup>2</sup> to 10mm<sup>2</sup>. Another benefit of the new LITEALUM crimp by TE Connectivity: The harness maker can create the lead connection as part of a standard crimping process, using processing machinery already on hand.

Would you like to learn more? We're looking forward to hearing from you.



Source: LEONI Bordnetz-Systeme GmbH

Using lightweight aluminum wiring in wiring harnesses can save lots of weight.

### Innovative plug-in connector systems

TE Connectivity provides you with a broad array of innovative, high-quality plug-in connector systems. When it comes to electrical and mechanical connections of wires and cables, switching modules, integrated circuits and batteries, our electrical and electronic connection products and solutions are practically indispensable.

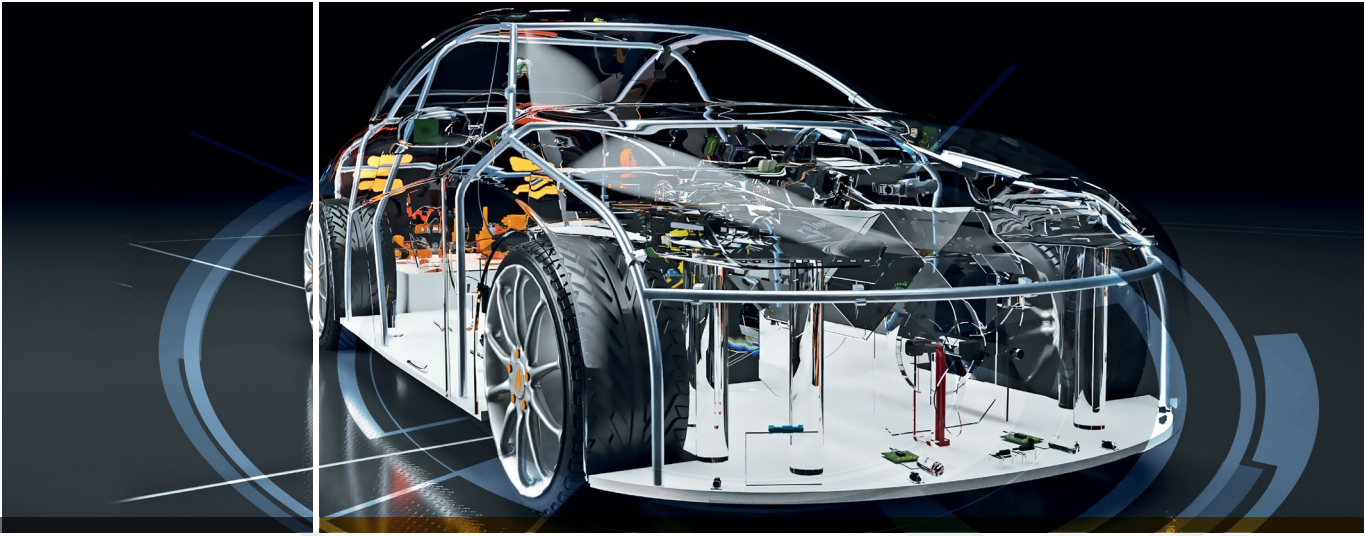
The versatile applications for our products also cover new connections, wires, cables and cable-management systems made of copper and optical fibers that have been specially designed to meet the requirements of the automobile industry. When it comes to connections, with our brands we offer one of the broadest portfolios in the world, a portfolio that also includes the top-end, high-density, high-speed designs communication systems.

#### TE Connectivity - the facts

- One of the world's leading providers of connector products
- More than 50 years of experience developing and producing plug-in connectors
- Holistic, single-source solutions
- Extensive product range: from standardized products to highly developed innovations and customer-specific solutions
- More than 7,000 development engineers ensure a steady stream of innovations
- Worldwide presence in development, production and sales

EVERY  
CONNECTION  
COUNTS





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