

# TRILLIUM<sup>®</sup> ACTIVE BRAZING



**GRÄNGES**



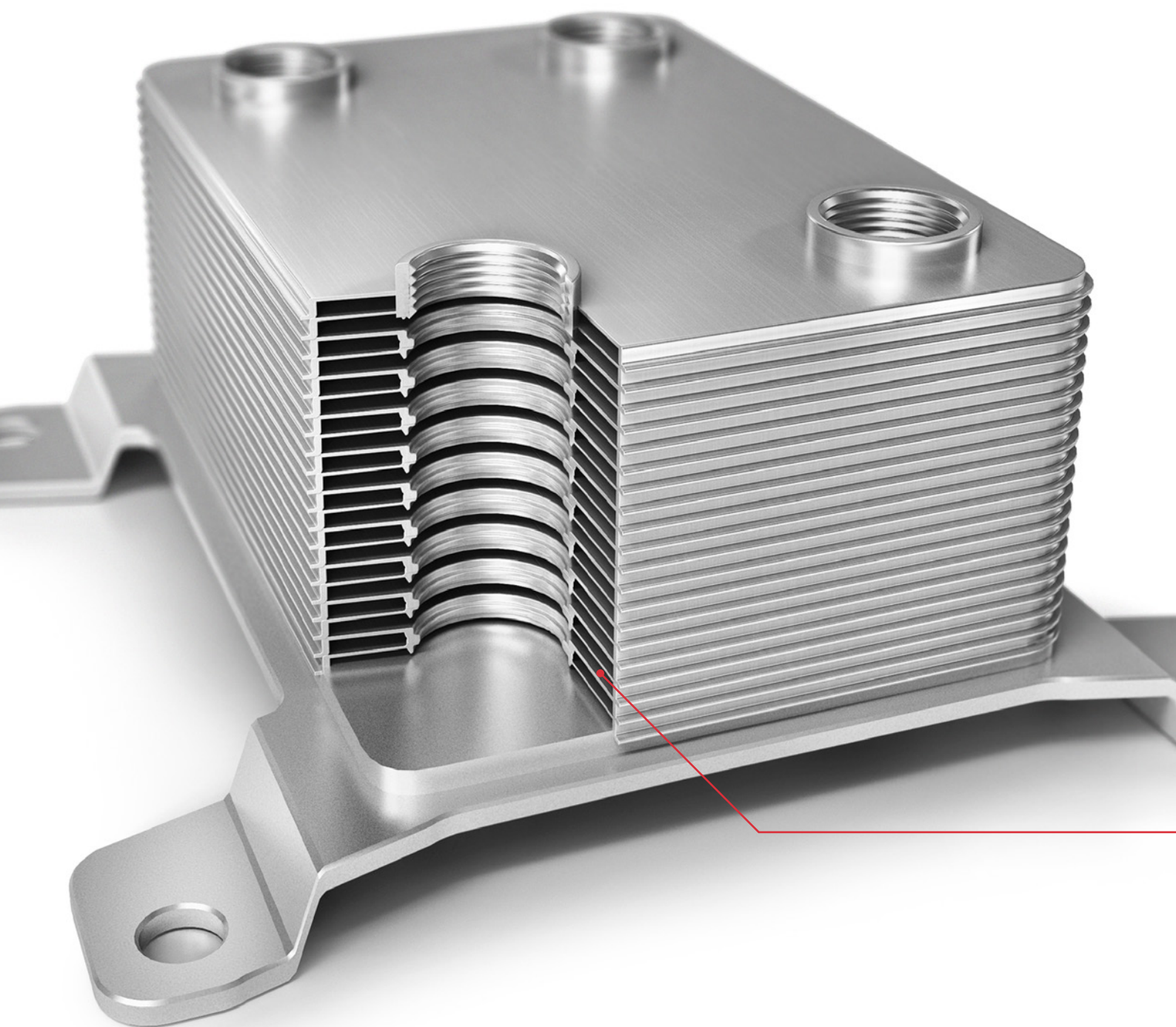
I NEED A SOLUTION  
THAT REDUCES MY  
FLUX RESIDUE LEVELS  
IN FINAL HEX.

I NEED TO ACHIEVE  
COST SAVINGS IN MY  
PRODUCTION PROCESS.

# WE HEAR YOU.

*Whether you are a manager, process engineer, service technician, or business consultant, you know the importance of improving performance and cost savings. Consistent high quality, efficient processes, and sustainable development are the keys to retaining long-term profitability. All of this – and more – is within easy reach. With TRILLIUM®, you can do less and achieve more.*

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# DO LESS, AND GET MORE DONE.

*As a global leader in aluminium engineering, manufacturing, and innovation, Gränges specialises in rolled aluminium products for brazed heat exchangers. After many years of industry-leading research and product development, we can now offer a sophisticated technology that lets you gain more by doing less.*

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At Gränges, our vision is clear: We want to transform the world through innovative aluminium engineering. By providing R&D, product development, and technical support throughout the product's lifecycle, we can help you create smaller, lighter and more designable heat exchangers.

## **INNOVATIVE EFFICIENCY**

With an international patent filed in March 2008, TRILLIUM® technology has been developed in collaboration with key customers and leading technical institutes. The spray forming technique, that creates a metal matrix composite of aluminium-silicone alloy and potassium aluminium fluoride salt, is the foundation of the innovative material. The core benefit: a brazing process without the need to add flux salt. The composite can

then be converted into both single and double-side clad brazing sheets, enabling customers to overcome limitations and create innovative designs.

## **MULTIPLE USE**

Since the launch of the first TRILLIUM® technology, the material has been tested and refined by several leading heat exchanger manufacturers all over the world. Delivered to OEMs (original equipment manufacturers) since 2012, TRILLIUM® is now successfully used in radiators, heaters, evaporators, oil coolers, and CACs.



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## **NEW COMPACT DESIGNS**

Excellent gap-filling and joint formation in units that are especially difficult to flux.

# BETTER BRAZING — BUILT IN.

*Imagine a technology that simplifies the brazing process by making the degreasing, fluxing, cleaning, and drying stages redundant. Instead, we make it happen within the material in a process we call active brazing.*

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Brazing aluminium for heat exchangers usually requires a complex process that includes fluxing, drying, thermal degreasing, and cleaning. It is a process that consumes time, chemicals, and manpower – resources that can be saved or used more efficiently and sustainably. Also, the traditional brazing process generates flux residues that are both time-consuming to clean and have a negative effect on the environment as well as the performance and quality of the final product.

## **ENGINEERED FOR BETTER BRAZING**

TRILLIUM® is a material containing a braze liner with the optimal amount of flux within, enabling better brazing with uniform joint formation, improved yields, and minimal post-braze surface residues. The excellent quality of brazed products made with TRILLIUM® promotes innovation and the design of more complex heat exchanger configurations, than can be achieved with conventional processes.

## **AN ART OF ANCIENT HISTORY**

Just like many other metal working procedures, brazing dates back several millennia. The technique can be traced all the way back to craftsmen in ancient Egypt, who used a charcoal furnace and a blowpipe to create statues and jewelry.\*

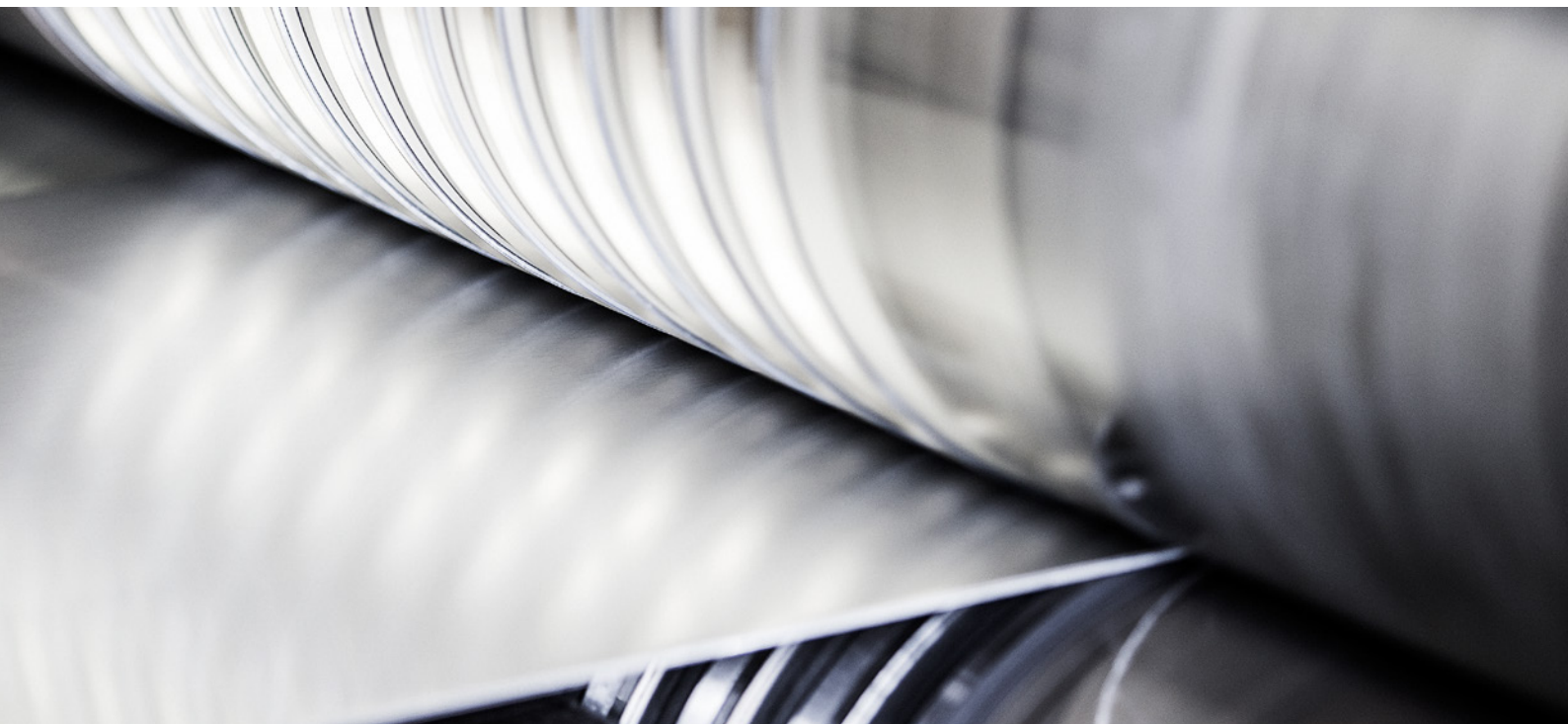
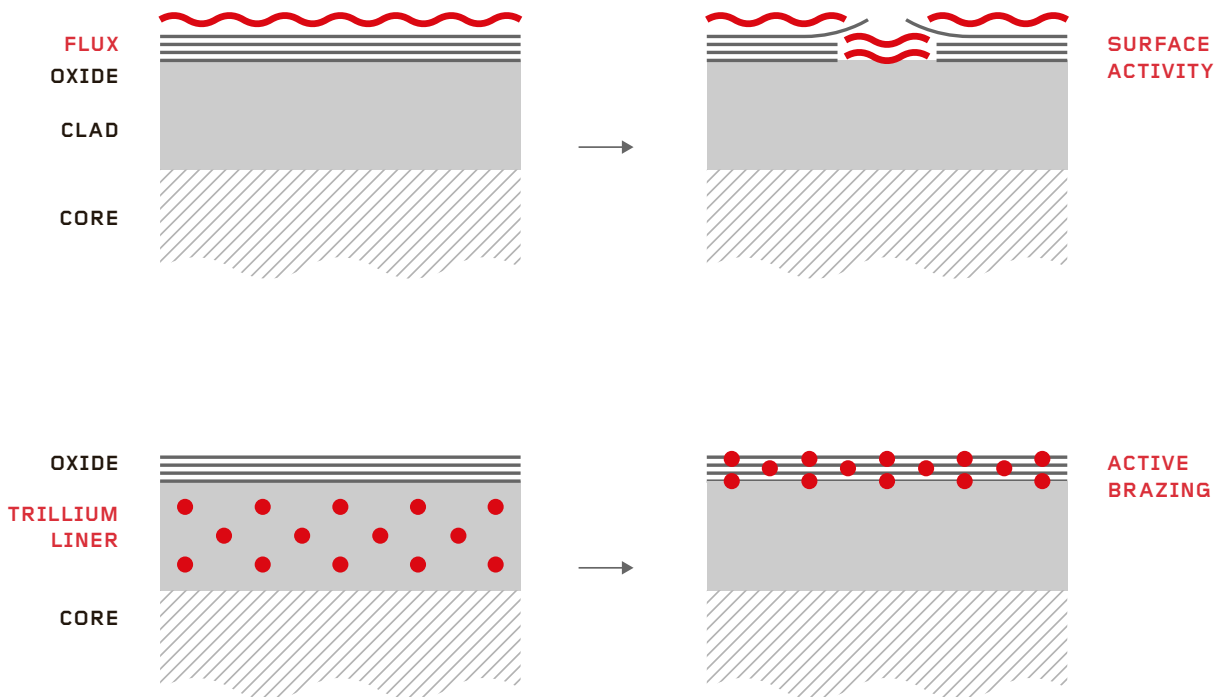
The foundation of today's Gränges was laid in Grängesberg, Sweden, in 1896. After establishing mining and iron-working businesses, the Gränges Group then evolved to develop and produce aluminium heat exchanger strips in Finspång from 1972. After a number of structural changes over the years, the company reclaimed the Gränges name in 2013, and focused solely on rolled aluminium products.

\* Source: Encyclopedia Britannica ([britannica.com](http://britannica.com))



## ACTIVE BRAZING

On a conventional brazing sheet the fluxing action takes place on the surface, with the flux applied onto the oxide and clad. In a composite clad brazing sheet like TRILLIUM<sup>®</sup>, the fluxing agents work from within the material, presenting more durable and uniform results. This process is what we call active brazing. Since the built-in flux is less affected by the furnace atmosphere and surface contamination, TRILLIUM<sup>®</sup> is more resilient and resistant than conventional brazing sheets, especially in severe brazing environments with higher oxygen and humidity levels.





## **TRILLIUM® SOLID**

With its unique formation of uniform salt and silicon particles, TRILLIUM® carries numerous advantages inside. When launched in 2010, TRILLIUM® Solid represented a major leap in brazing technology. Produced through spray forming, TRILLIUM® Solid features excellent brazing activity, robustness in sub-optimal atmospheric conditions, and flux residues of less than 4 g/m<sup>2</sup>.



## **TRILLIUM® LEAN**

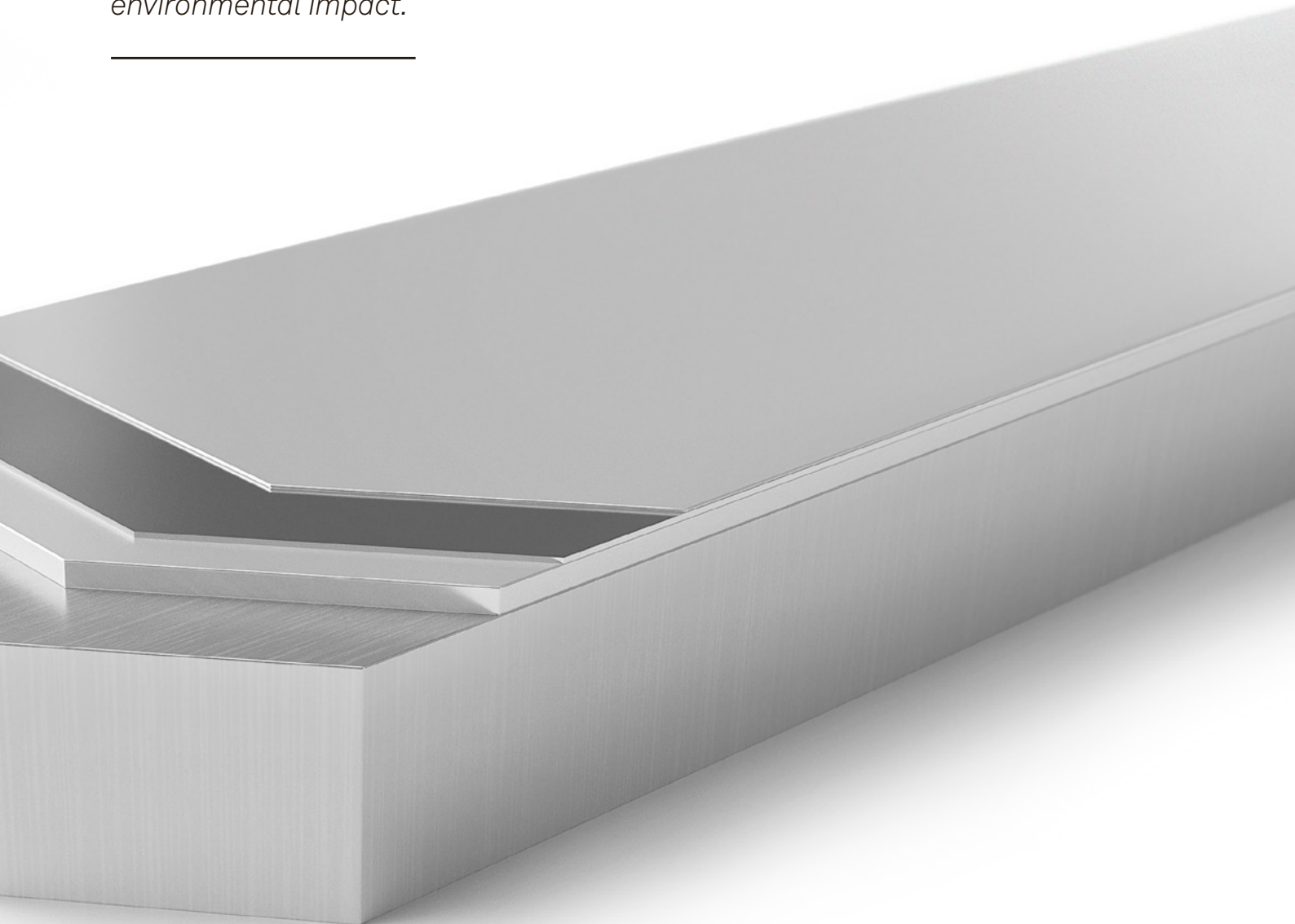
Our latest addition to the TRILLIUM® family is TRILLIUM® Lean. With unique properties, enabling outstanding brazing results, even in exceptionally challenging product applications, the new technology means that a very wide range of needs can be covered. TRILLIUM® Lean is produced through a combined SF/DC casting method that protects the flux underneath a lid, allowing even lower and designable post-braze flux residues of less than 1 g/m<sup>2</sup>.



# THE TECHNOLOGY EXPANDS: TRILLIUM<sup>®</sup> SOLID AND TRILLIUM<sup>®</sup> LEAN.

*TRILLIUM<sup>®</sup> technology continues on the successful route; introducing TRILLIUM<sup>®</sup> Lean, a new multi-layer material with enhanced potential for especially challenging applications. Together, TRILLIUM<sup>®</sup> Solid and TRILLIUM<sup>®</sup> Lean help our customers to reduce costs, create new designs, and reach a higher level of profitability – while reducing their environmental impact.*

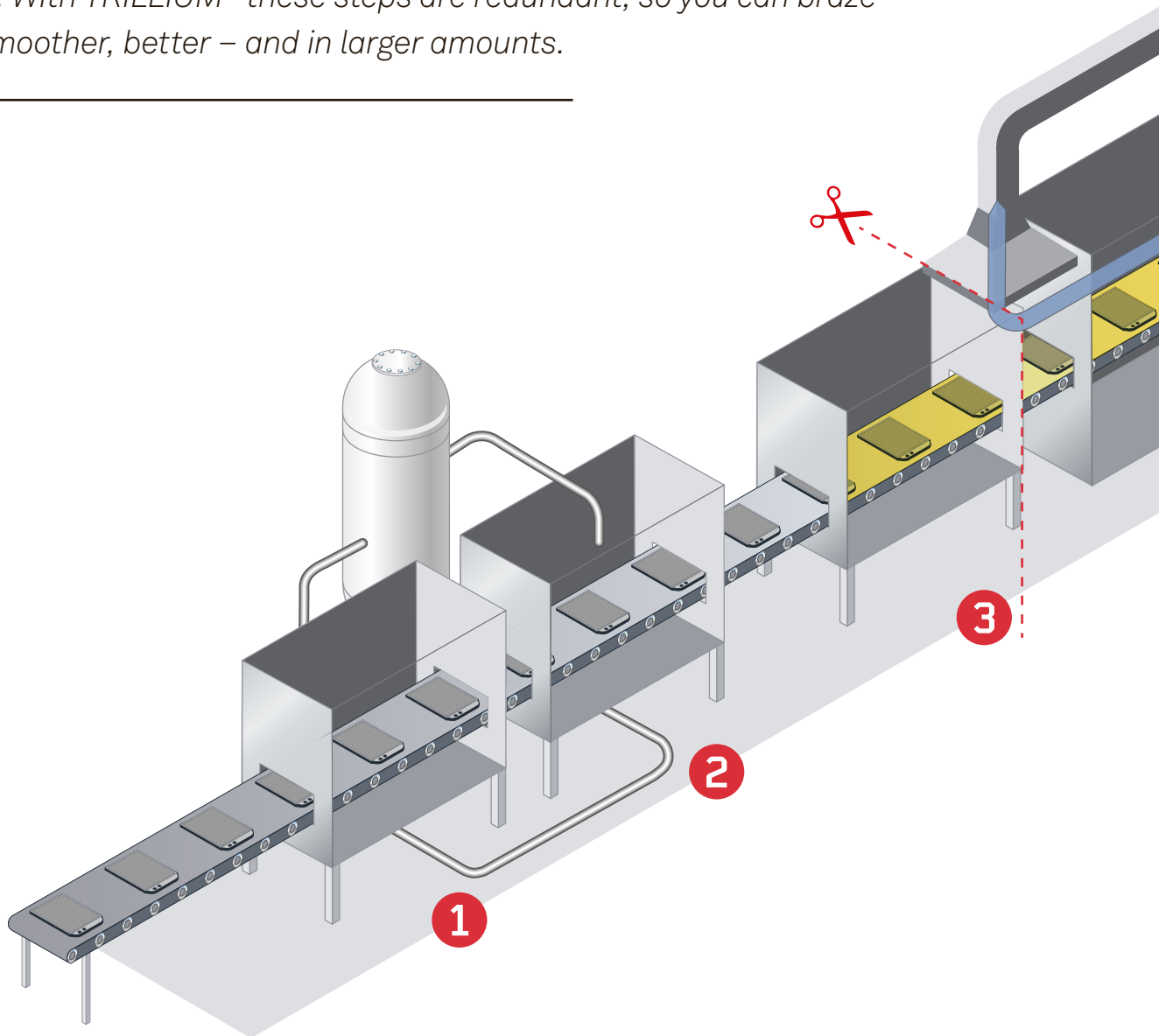
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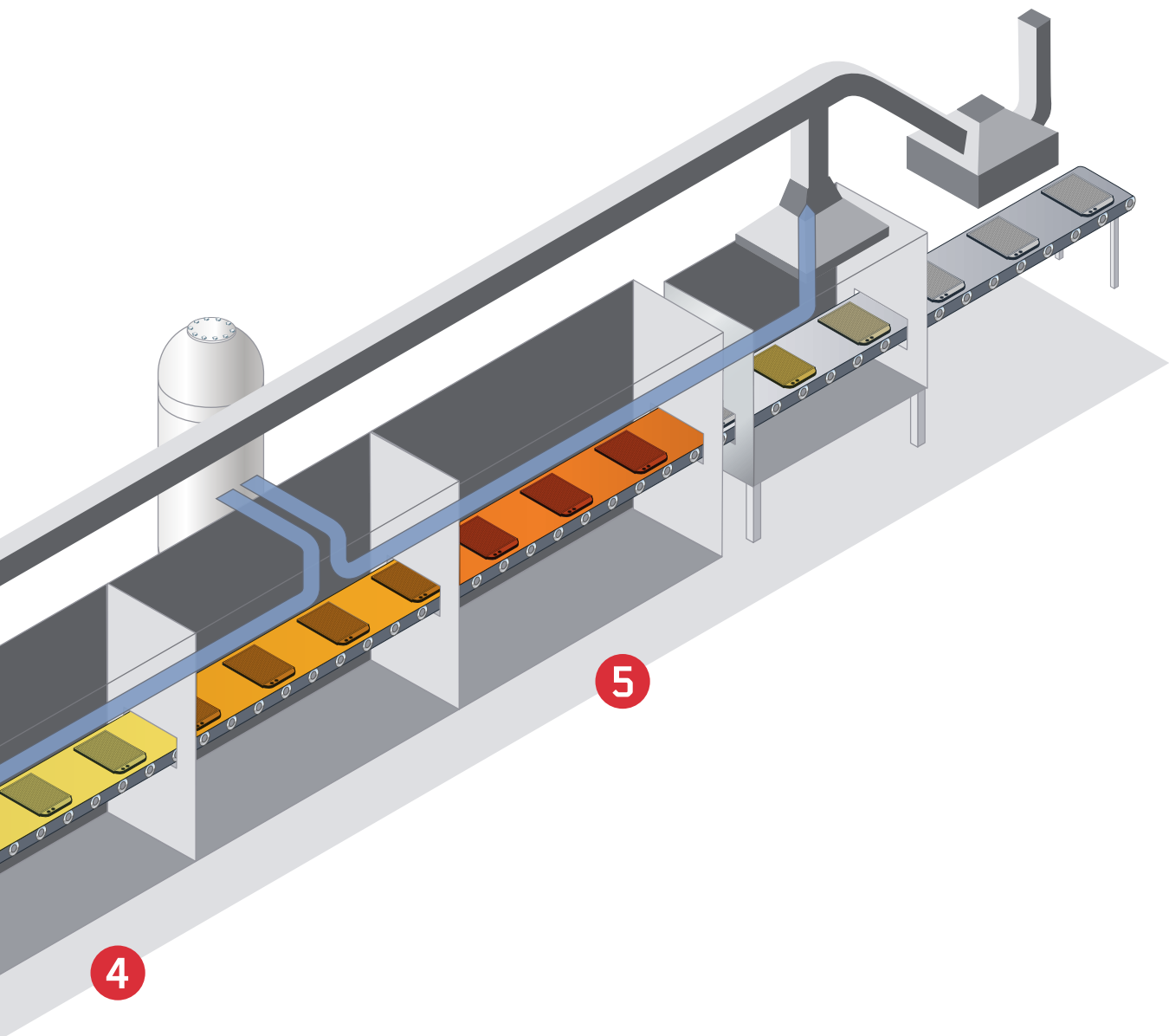


# SIMPLIFIED PROCESS, MULTIPLE GAINS.

*The conventional brazing process includes several labour-intensive steps, like degreasing, fluxing, drying, and thorough cleaning to remove flux residues. With TRILLIUM® these steps are redundant, so you can braze faster, smoother, better – and in larger amounts.*

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**1 NO DEGREASING**

In a conventional brazing process, the thermal or chemical degreasing phase can be carried out separately. With TRILLIUM® none of this is necessary.

**2 NO FLUXING**

Whether the flux is applied using electrolysis or a selective method, it is an energy-intensive process requiring the handling of both flux waste water and residues. TRILLIUM® has all the fluxing agents within the material, enabling this step to be completely omitted.

**3 NO DRYING**

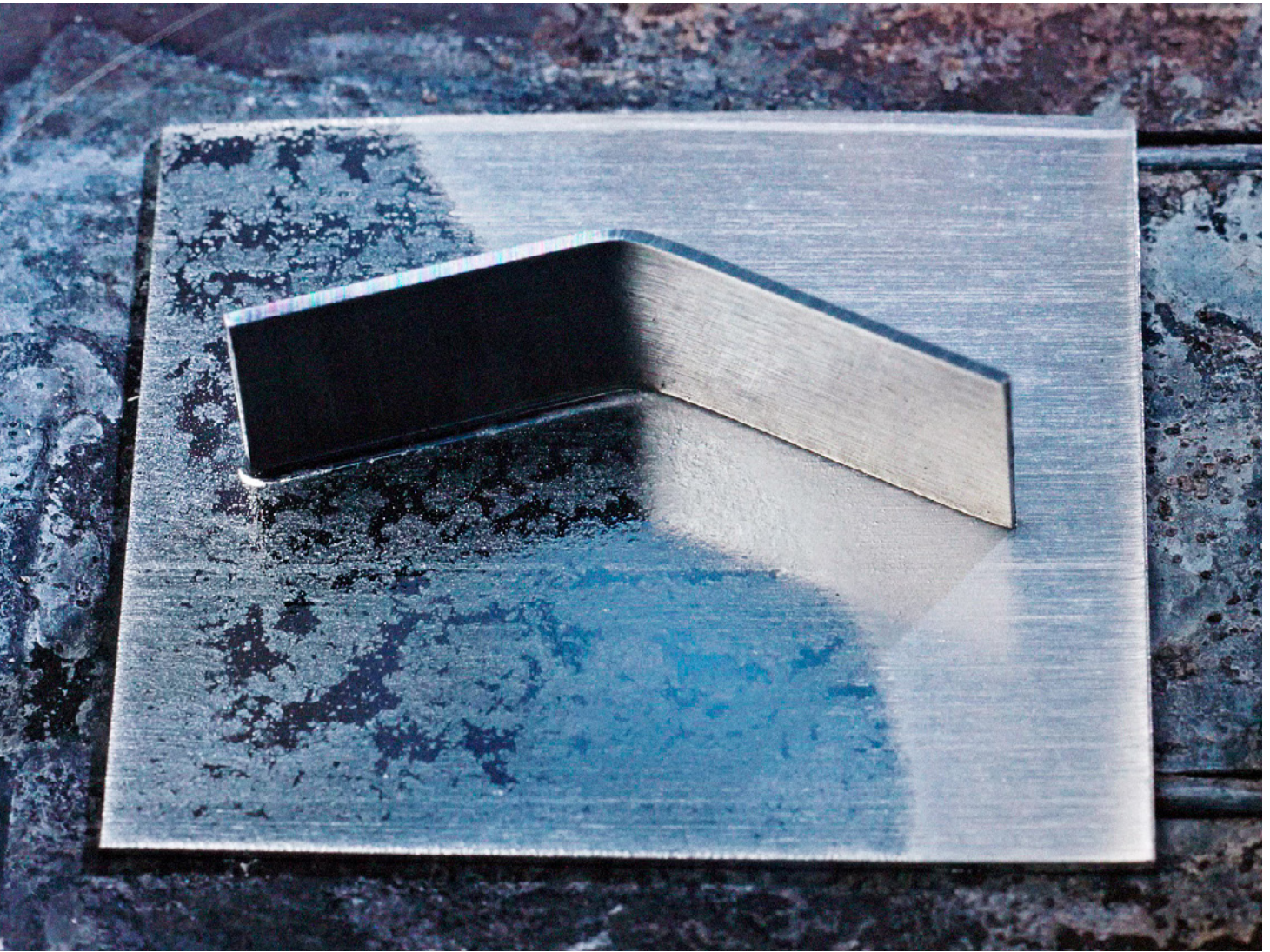
As no fluxing is needed with TRILLIUM®, the drying stage is also removed.

**4 NO THERMAL DEBINDING**

This delicate process can cause cracks, blisters and other damage to the material, but is also redundant when using TRILLIUM®.

**5 BRAZING FURNACE**

The brazing takes place in a controlled high-pressure atmosphere with nitrogen. TRILLIUM® can be used in an atmosphere with less nitrogen and more oxygen, reducing both costs and environmental impact.



< 1 G/M<sup>2</sup>

FLUX RESIDUES WITH TRILLIUM® LEAN

# ADDED VALUE FROM EVERY ANGLE.

*The benefits of TRILLIUM® can be summarized in the following five categories:*

## **DESIGN FREEDOM**

TRILLIUM® offers greater design freedom and more compact configurations. Brazing of highly complex units with challenging surfaces can be carried out with minimum effort. The material also provides excellent gap-filling capabilities and outstanding joint formation in internal and enclosed areas.

## **PERFORMANCE IMPROVEMENT**

The advantages of TRILLIUM® in terms of performance are significant. Through numerous brazing tests of sheet material, radiators and evaporators, TRILLIUM® has shown exceptional results. For instance, substantially lower reject rate and significant reduction of flux residues. In addition, the tests also proved a higher burst pressure average with lower spread and outstanding results regarding vibration and braze joint quality.

## **PRODUCTION FLEXIBILITY**

The use of TRILLIUM® enables a smoother and faster production process with uniform joint clad melting and joint formation, as well as an increased overall quality of the end product. TRILLIUM® also allows lower solidification enthalpy, which means decreased time in the furnace and reduced energy input. Moreover, TRILLIUM® units can be re-brazed and are subject to a much lower reject rate.

## **COST SAVINGS**

Since several steps of the brazing process can be omitted, the benefits of investing in TRILLIUM® are clear. The elimination of fluxing itself leads to a number of savings: no flux salt and filter costs, no labour costs for manual fluxing, and no operator protection costs. Then add the reduced maintenance of fluxer, dryer, water treatment and scrubber equipment, as well as the energy savings and increased floor space. Furthermore, as no chemicals are required for the brazing of TRILLIUM®, the associated costs of storage, handling, and protection equipment are removed.

## **ENVIRONMENT, HEALTH AND SAFETY**

Sustainability and environmental concern are central elements of our R&D, as well as our operations. Through continuous streamlining of production processes, environmentally-conscious product development, and a focus on safety, Gränges contributes to a more sustainable society. We recognise our responsibility to minimise our environmental impact by continuously increasing the use of recycled aluminium and strive to reduce our energy usage, emissions and carbon footprint.

# R&D: INNOVATION PAYS.

*The team of innovators behind TRILLIUM® technology includes world-leading designers, engineers, technicians, chemists and other specialists in rolled aluminium for heat exchanger applications. In close cooperation with our customers, Gränges Research & Innovation constantly develops smarter materials and more effective production processes.*

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## **LOCAL COMPETENCE, GLOBAL REACH**

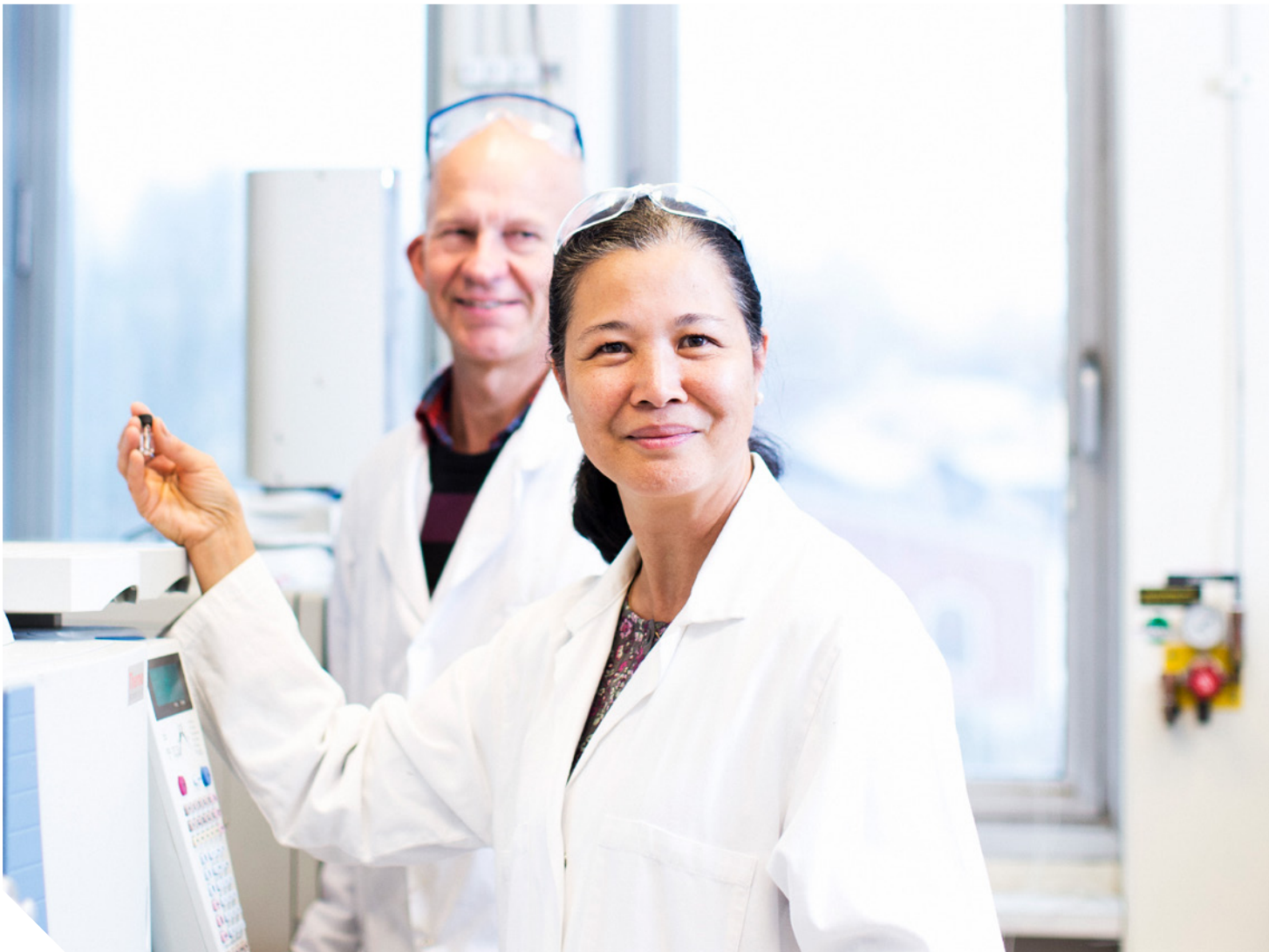
The work of Gränges R&I is coordinated globally, and often takes place in regular collaboration with research institutes, universities and schools of technology. New alloys are initially tested through pilot rolling in laboratories and via computer simulations, before full-scale production takes place. In this way, we create more effective high-precision production processes.

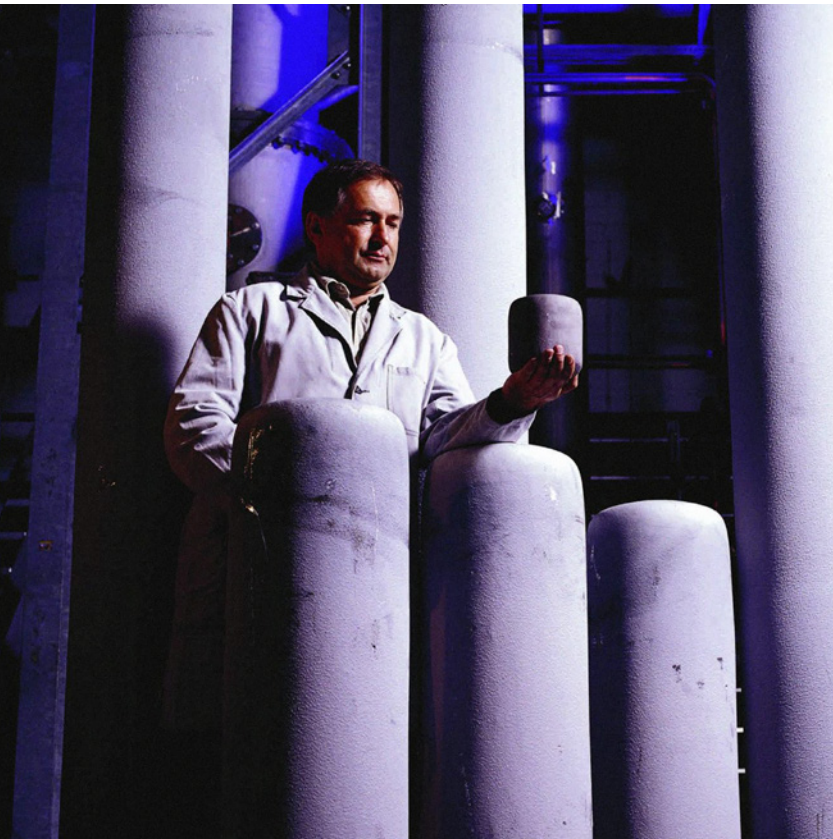
## **CUSTOMISED APPLICATIONS**

In Asia, Europe, and North America, we also have product developers and technicians who specialise in optimising the interaction between Gränges' products and our customers' own machinery, processes and applications. To support this work, Gränges has an application centre that can replicate our customers' forming and brazing processes.

# 60

MORE THAN 60 METALLURGISTS,  
ENGINEERS, CHEMISTS, AND  
TECHNICIANS IN GRÄNGES  
RESEARCH & INNOVATION.





WITH A GLOBALLY  
COMPETITIVE OFFER,  
WE ADD VALUE FOR  
OUR CUSTOMERS  
BY PROVIDING  
VIRTUALLY UNLIMITED  
OPPORTUNITIES  
FOR CUSTOMISED  
SOLUTIONS,  
REGARDLESS OF  
APPLICATION.





# RESPONSIBILITY FROM IDEA TO END PRODUCT.

*By owning the supply chain of spray-formed materials, we control all areas from raw material supply to service and support. Acquisitions of other companies and operations are strategically important and in line with our target of being the market leading in all geographical regions by 2020.*

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Having the right raw material at the right time is the key to maintaining efficient and sustainable operations. With a well-established global supply chain, we are able to streamline purchasing routines, production processes, and sustainability standards, as well as create excellent opportunities for continued profitable growth.

The Gränges facility in Finspång, Sweden, has specialised in aluminium products for brazed heat exchangers since 1972. In line with Gränges' goal to meet demanding customer requirements across the globe, we have fortified our global footprint and established advanced operations in all regions.

## **EVEN STRONGER CUSTOMER OFFERING**

Our latest acquisition is the forming of GETEK GmbH, a company located in Germany. The company produces aluminium billets using advanced spray-forming technology. Through this company Gränges secures competence and continued development, well-suited for the next generation of materials.



# MULTIPLE BENEFITS, ONE TECHNOLOGY.

*Raal was an early adopter of TRILLIUM® Solid, having been introduced to the concept after meeting Gränges' technicians at the European Aluminium Conference, 2011. "Right from the start, we thought this could really benefit us," says Cornelia Cocian, Chemical Engineer, Raal.*

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"In 2013, we started with a sample and conducted trials," says Cocian. "The results in terms of the quality of the brazing were very good. We were very satisfied with the material." From 2015 Raal used TRILLIUM® Solid in serial production in gauges ranging from 0.5–0.8 mm and in 2016 introduced 1.5-mm gauge strips.

#### **GREAT RESULTS FROM THE START**

"The main advantages we have seen with TRILLIUM® technology are reduced labour and production costs," adds Cocian. "We also achieve much better fluxing and brazing quality and uniformity, especially in complex structures. Additionally, there are significantly reduced levels of flux residue in the final product, and by eliminating fluxing and drying, we save on energy and chemical costs."

#### **DESIGNED FOR CHALLENGING APPLICATIONS**

In keeping with its strategy of continuous improvement to the production process, Raal has already tested, verified and put into serial production TRILLIUM® Lean. The company has initially used this material on its most challenging applications.

"We have successfully introduced TRILLIUM® Lean for production of plate and bar products, namely large water and oil coolers for the transport industry where exceptionally low flux residues are required," says Cocian.

"Given the positive results with TRILLIUM® Lean, we are now looking to expand our use of the material, especially for complex cooling structures that are traditionally difficult to flux, as well as completely new application areas."

# RAAL

Raal is a leading manufacturer of heat exchangers made of aluminium alloys and stainless steel for global brands in the industrial, agricultural, automotive, and construction industries. The company has been working with Gränges since 2005, a relationship that started with Gränges supplying clad foils for fin production.

# LET'S DO LESS TOGETHER.

We'd like to share all the benefits that TRILLIUM® can bring to your operations. Visit [www.granges.com](http://www.granges.com) for more information.

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**GRANGES**

[www.granges.com](http://www.granges.com)