Henrob self-pierce riveting

Atlas Copco in figures

Customers in **180** countries

34000 employees in **90** countries

Established in **1873** Stockholm, Sweden

Turnover of nearly **86** B SEK / **9** B EURO

A decentralized group with **4** business areas

Part of the Atlas Copco group since 2014

Vacuum Technique

Atlas Copco Industrial Technique

Compressor Technique

Power Technique

Industrial Technique Service

Motor Vehicle Industry Tools and Assembly Systems

Industrial Assembly Solutions

General Industry Tools and Assembly Systems

Chicago Pneumatic Tools

SCA adhesive dispensing

Henrob self-pierce riveting

K-Flow flow drill fastening

Tightening

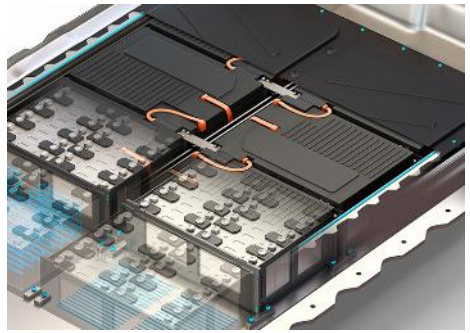
#1 Global joining partner

Hybrid joining

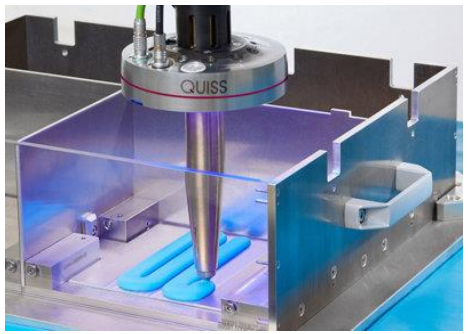
Battery assembly

Self-pierce riveting

Sound dampening



Quality Inspection



Sealing & adhesive dispensing

Flow drill fastening

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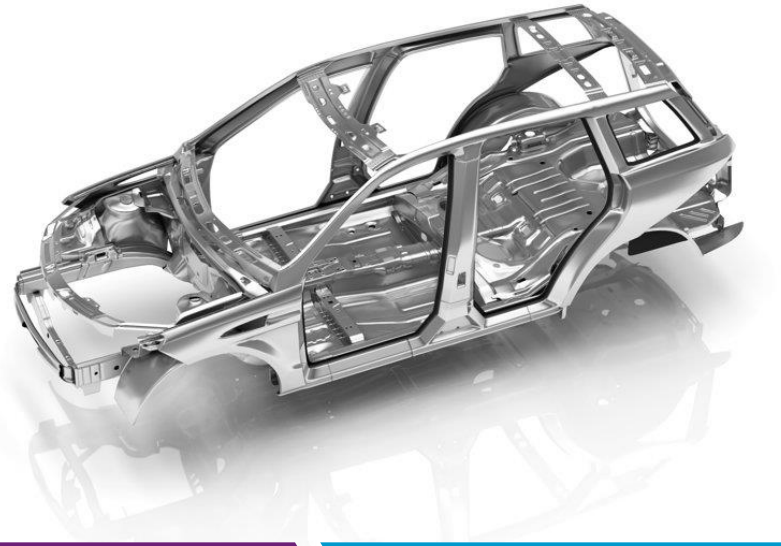
Customer challenges

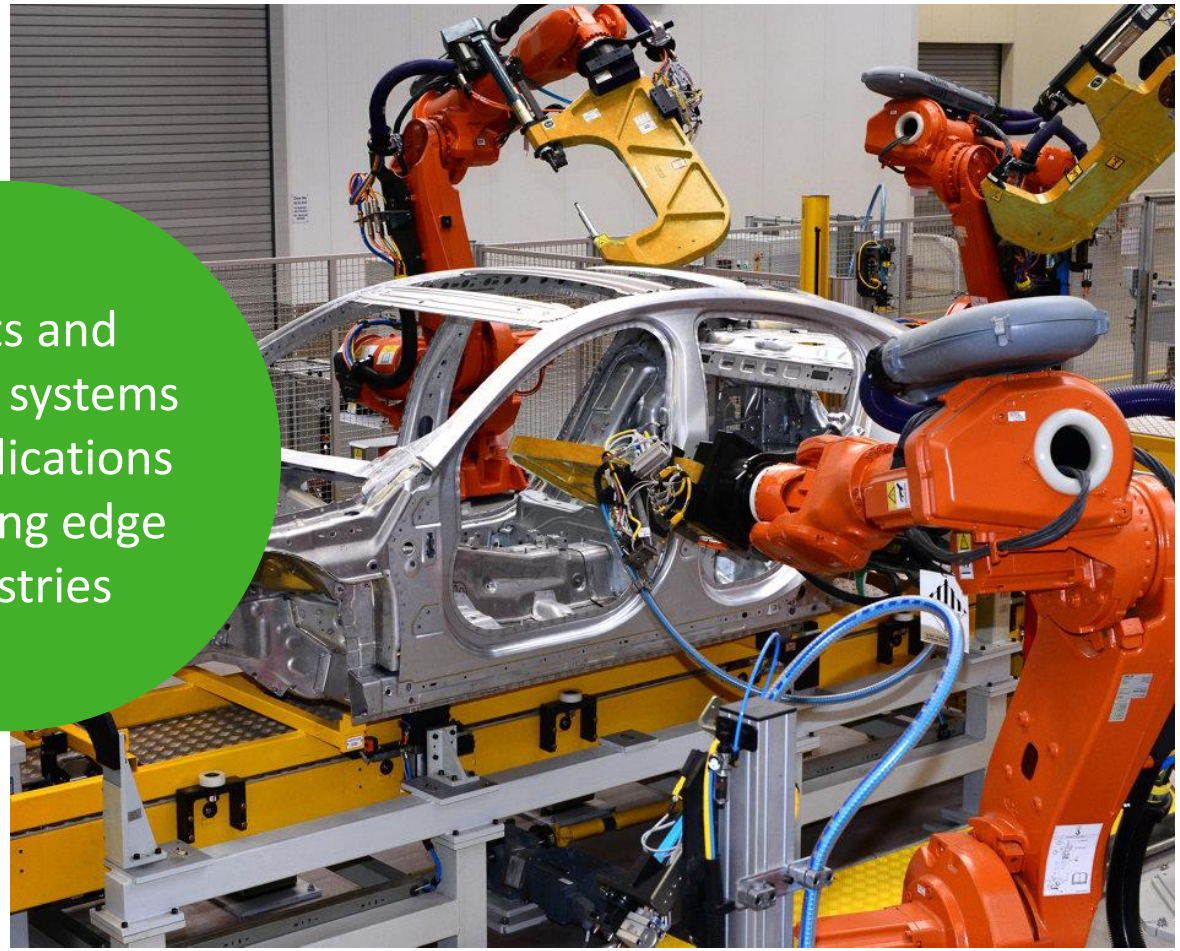
Increased need for innovative joining



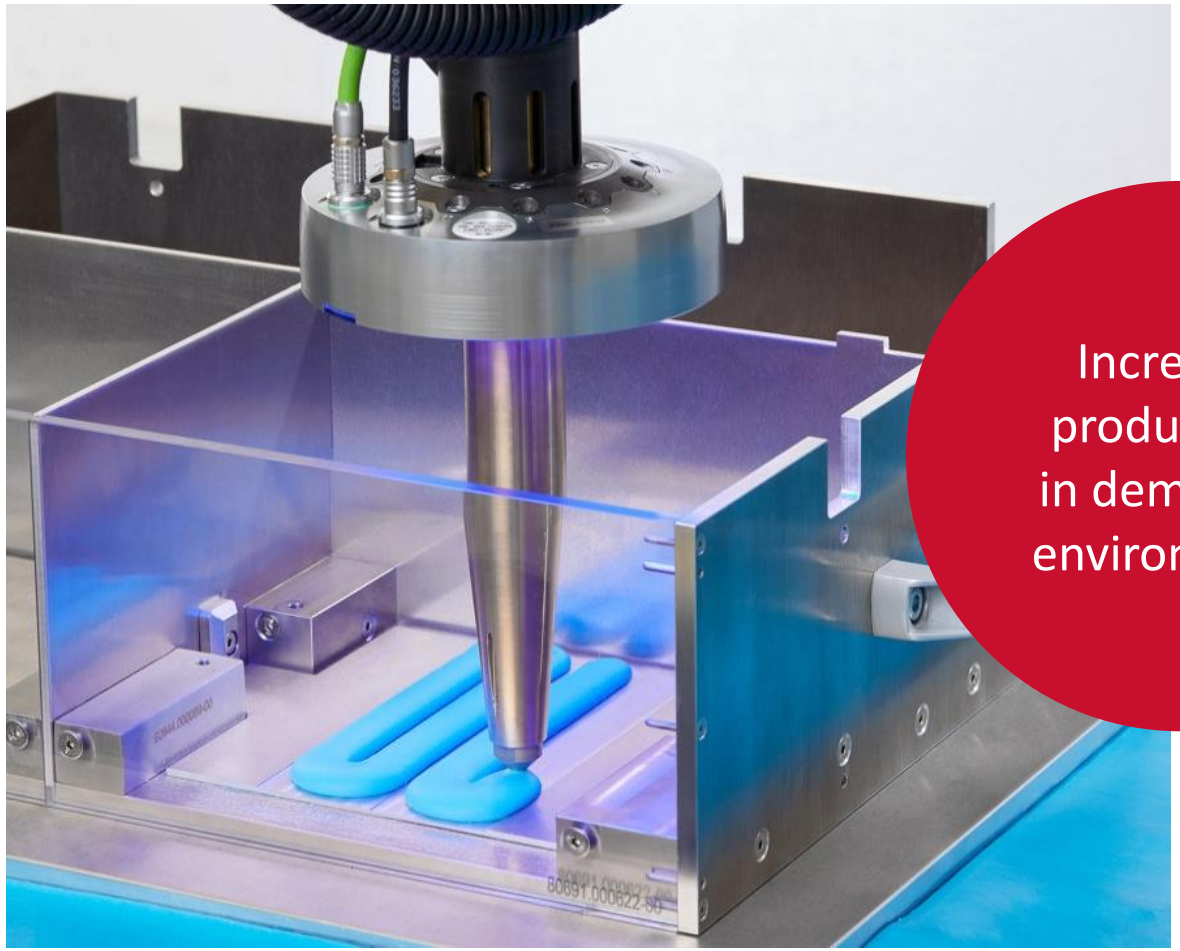
Global market drivers	Trends	Customer challenges	Our solution
▪ Lowering of emissions ▪ Improving energy efficiency	▪ Increasing usage of lightweight materials in car bodies ▪ Electric vehicles	▪ Combining many different materials to a strong and light car body ▪ Environmental legislation	▪ Innovative joining technologies tailored to customer needs

Henrob self-pierce riveting

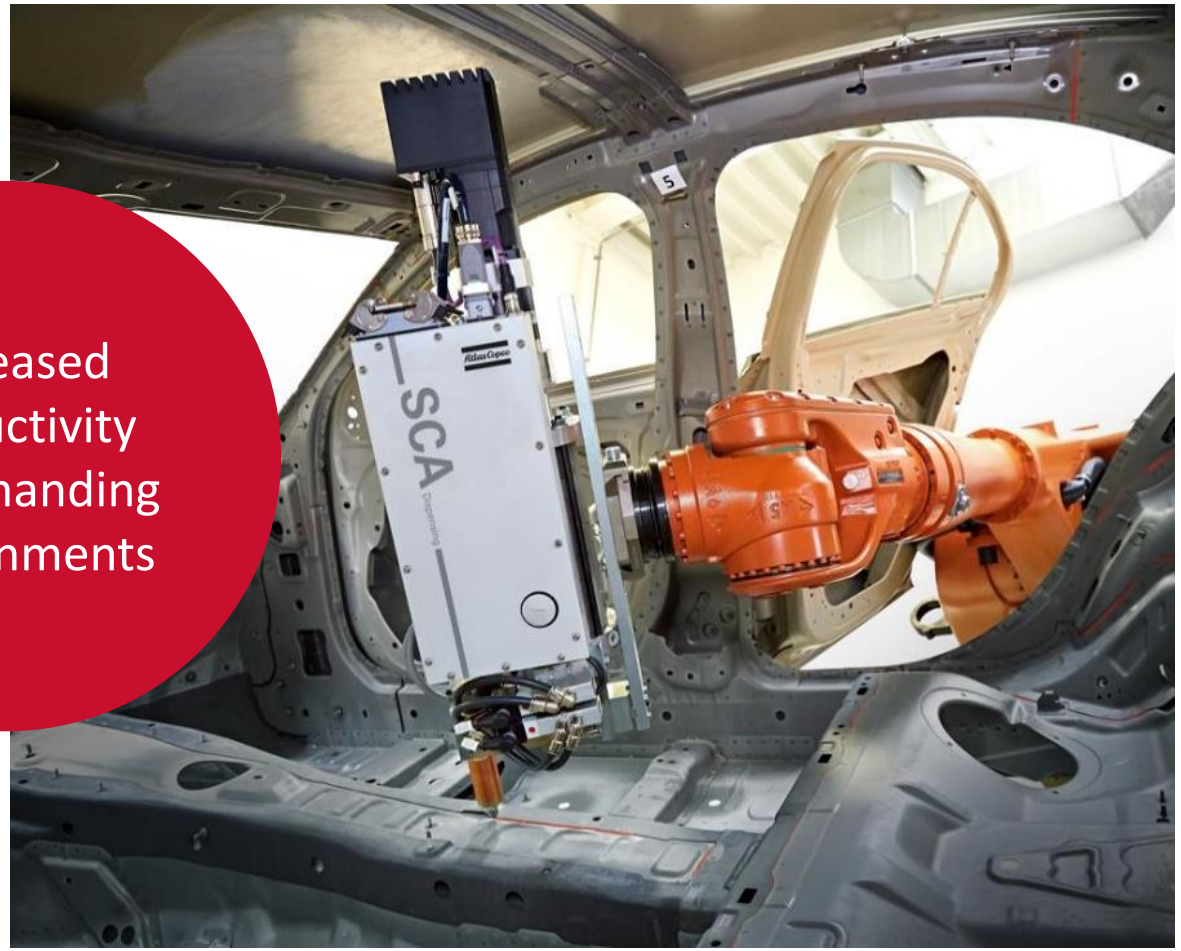
Rivets and riveting systems for applications in cutting edge industries



SCA dispensing



Increased productivity in demanding environments



K-Flow fastening

Reliable and reversible joint with one-sided access

Atlas Copco

Quiss vision system

Quality inspection of dispensing applications

Competence in our customers’ processes

Partnership with the automotive industry

Simultaneous engineering

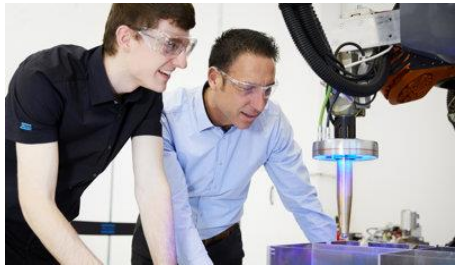
Body shop

Paint shop

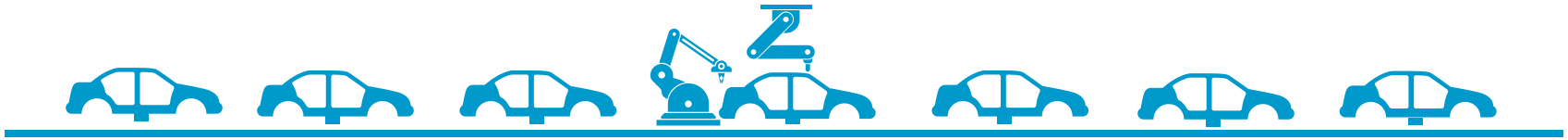
Powertrain

Final assembly

Quality assurance



Service



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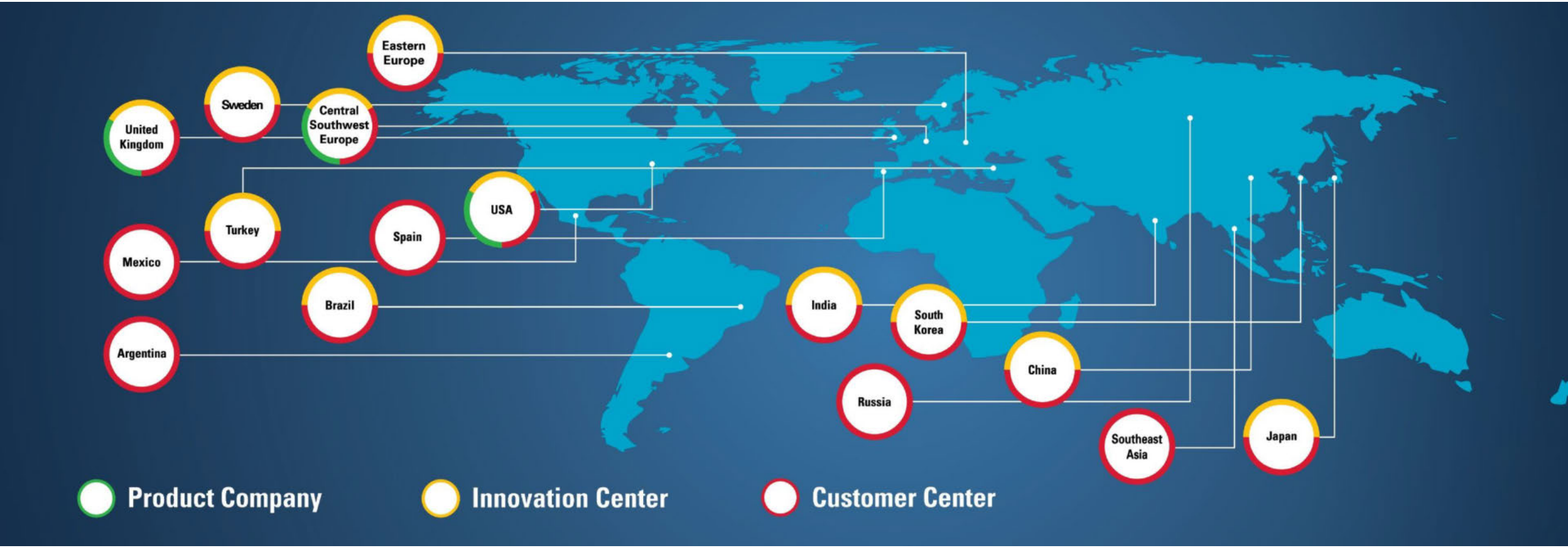
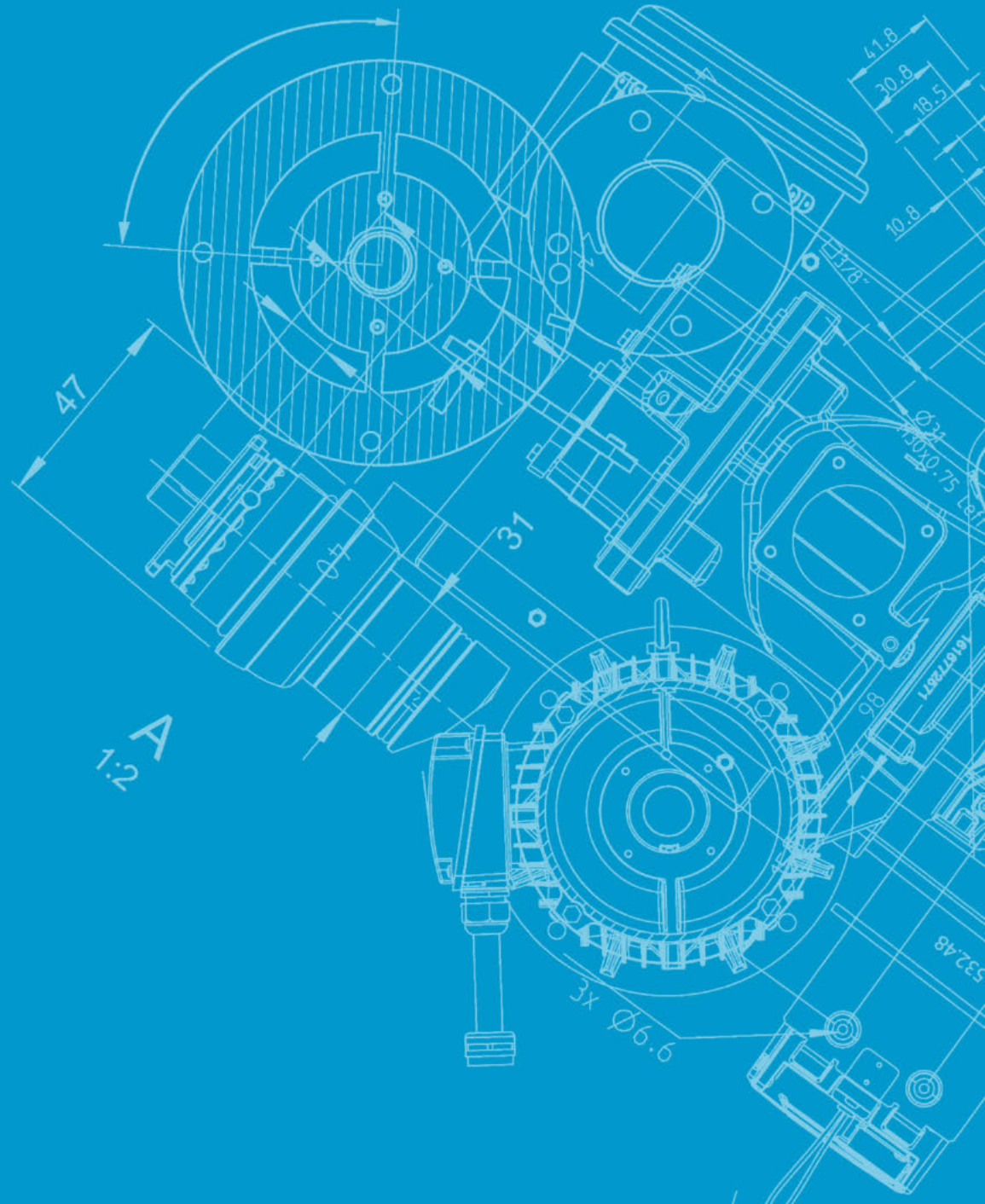
Global presence



Henrob self-pierce riveting



Manufacturing facilities

New Hudson, MI, USA and Deeside, UK

Rivet production capability:
10 billion / year

Over 600 employees

In-house plant production:

Tooling assembly
Cold forging
Heat treatment
Plating

Over 8,500 systems in operation globally

44,000m² of manufacturing space

Industry segments and applications

Motor vehicle

Steel frame housing

Heavy truck

Solar panels

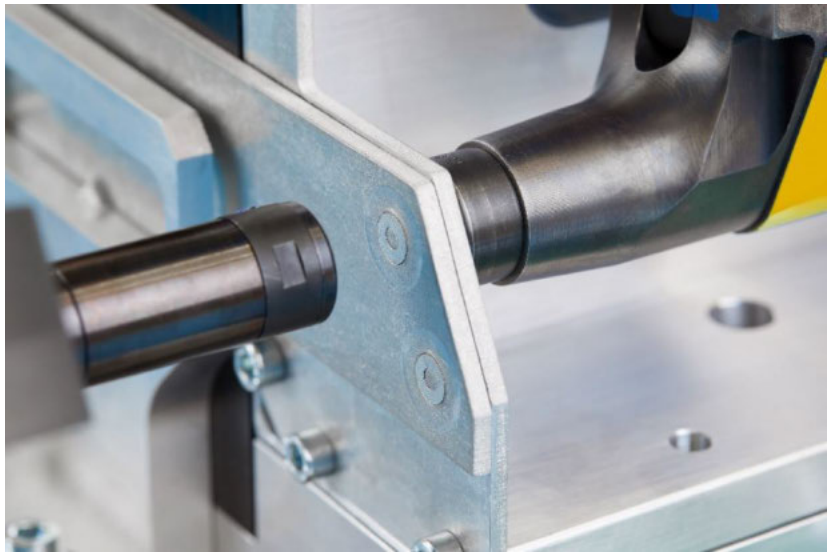
Recreational

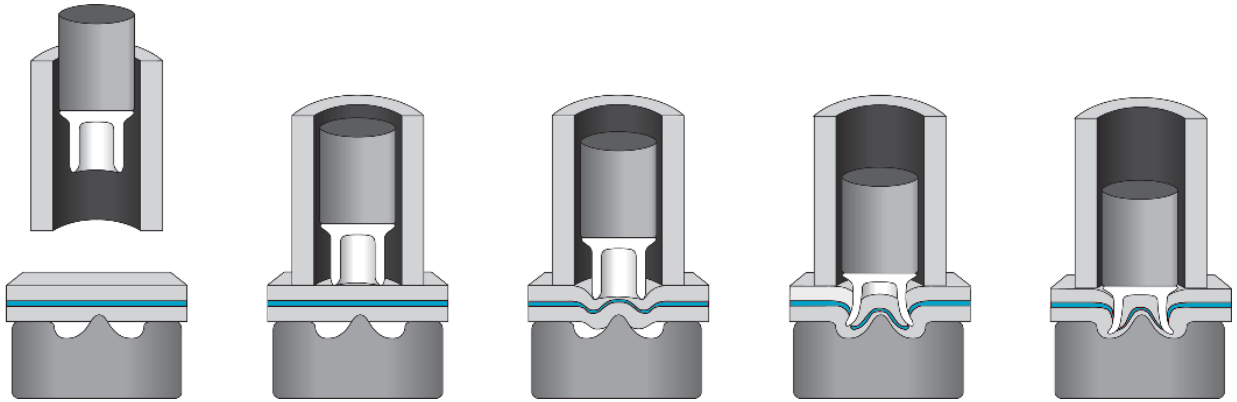
HVAC ducting

What is self-pierce riveting?

Self-pierce riveting (SPR) is a method of joining two or more pieces of material using a rivet without the need for a pre-drilled hole.

The basic self-pierce riveting process involves driving a rivet at high force through the material layers to be joined, into a die which causes the tail of the rivet to flare out and form a joint.





Advantages of SPR

- Fast cycle times
- Ability to use with coated or painted surfaces
- No pre-drilling required
- Low energy demands
- High strength with a visibly checkable joint
- Operator and environment friendly
  - No debris or filings
  - No heat
  - No excessive noise
  - No fumes
  - No sparks
- Compatible with adhesives and lubricants
- Joins multiple similar or different material combinations
  - Plastics
  - Aluminum
  - High strength steel (HSS)
  - Composites

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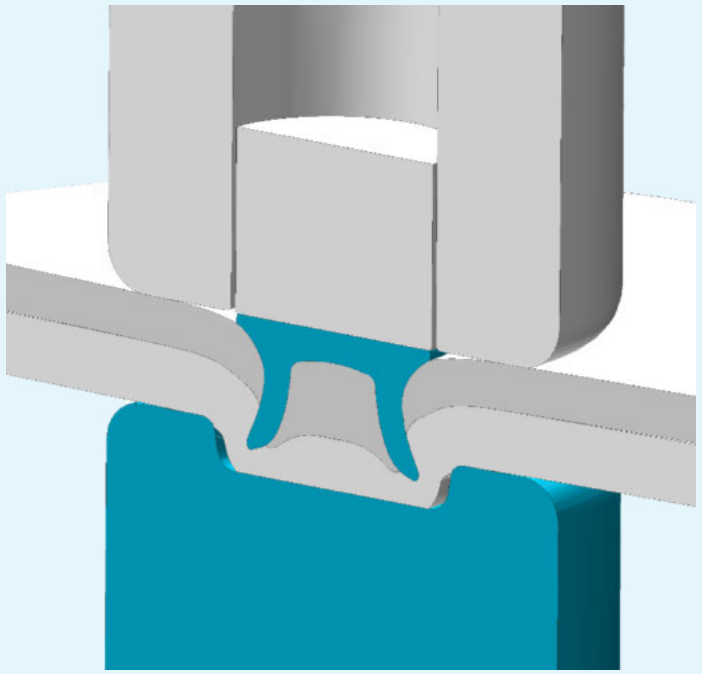
Components of a reliable SPR joint



Rivet length

· Longer rivets required to pierce multiple layers · Determined by thickness of material to be joined

Rivet geometry

· Body style · Wall thickness · Tip geometry · Determined by material type being joined

Rivet diameter

· ø3mm for thin material · ø5mm for structural · Determined by application

Rivet hardness

· Influences rivet flare · Determined by hardness of material being joined

Rivet head style

· Flush heads for mating panels · Thicker heads for UHSS · Determined by application

Die volume

· Increases with rivet size · Influences rivet performance · Determined by material ductility

Die geometry

· Influences rivet flare · Determined by material type

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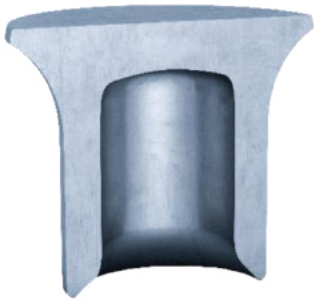
Leading the way in rivet designs

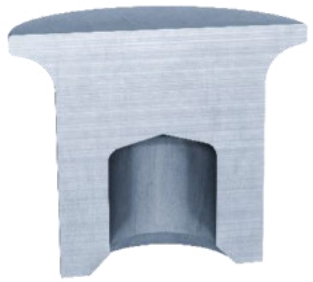


C, J, and K-Rivets
- Used in the widest range of applications

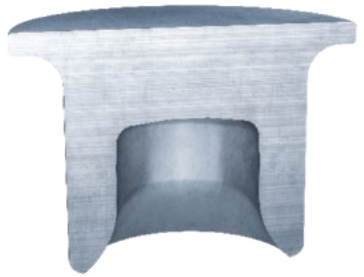
T-Rivets
- Designed for low-ductility *thick* Al joints
- Enables smaller die volumes

Self-piercing studs
- High impact resistance
- High torque
- Low electrical impedance

A-Rivets
- Designed for low-ductility *thin* Al joints
- Enables smaller die volumes



PG-Rivet
- Piercing 1100MPa steel <1.5mm thick
- HSS to HSS

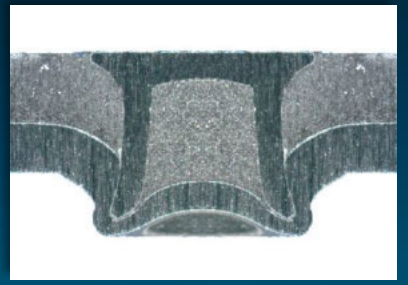


BG-Rivet
- Ideal for castings
- Optimized for mixed materials
- HSS / UHSS to Aluminum

Joining capabilities

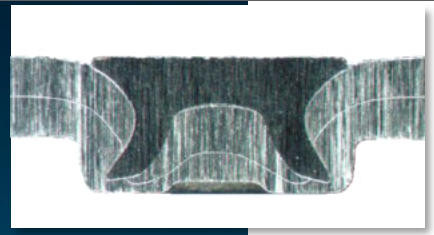
Composites

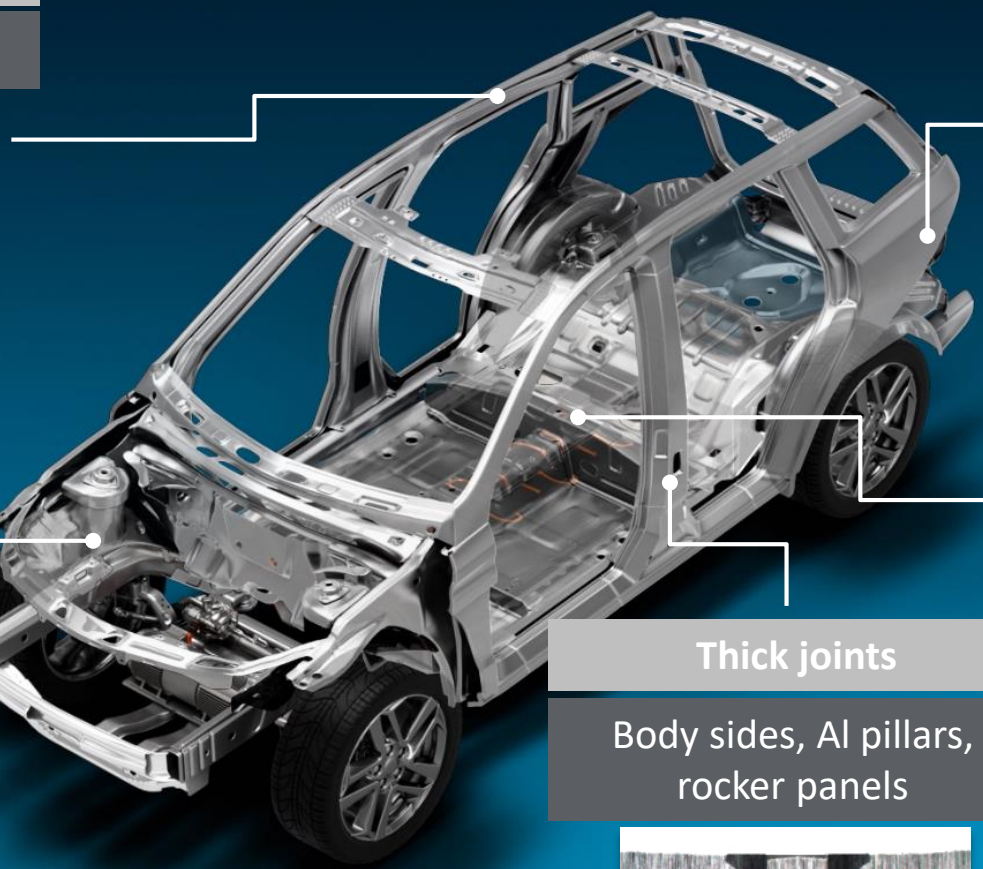
Sunroof



Thin joints

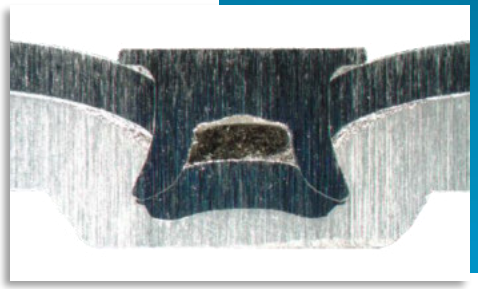
Hood, fender & closures





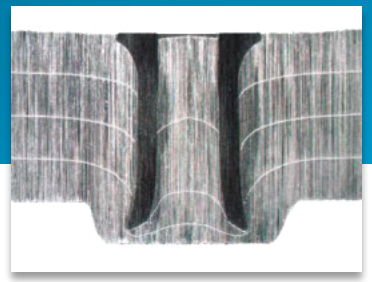
High strength steel

Shock towers, pillars & rails



Thick joints

Body sides, Al pillars, rocker panels



Aluminum joining

Floors, dash & cowl panels, body sides, pillars

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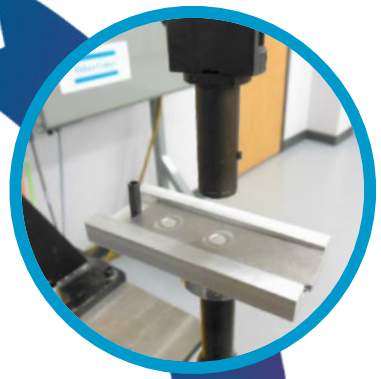
Rivet manufacturing

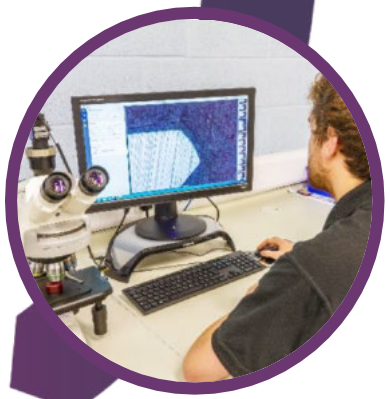
All steps of rivet manufacture in-house

SPR joint development

Adhesive application (optional)



Create test coupons



Joint analysis

Tensile testing

Corrosion testing

Customer materials

Facilities to test large (full BIW) or small scale projects

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Joint development

Testing conducted on customer supplied material offers the opportunity to trial and validate riveting parameters. Rivets and dies chosen to join a specific material combination can be assessed for suitability:

- Ensure the rivet correctly flares and engages in the materials
- Determine how strong the joint will be
- Simulate production variation to establish joint design robustness

Joint attributes

Visual inspection & cross sectional analysis

Joint strength

Tensile testing

Joint repeatability

Head height range testing

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Joint development evaluation

Joint attributes: Visual inspection of head height & button appearance

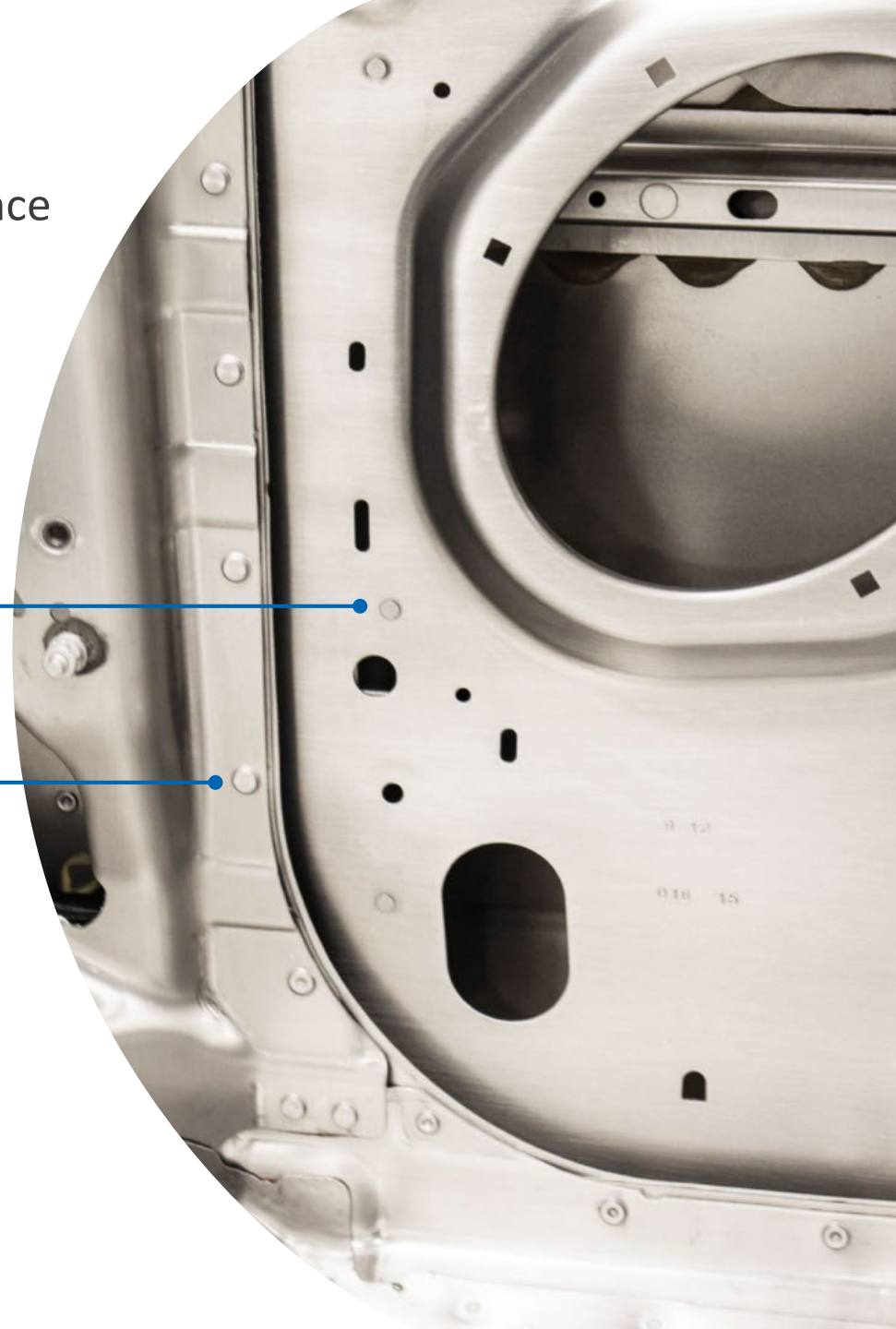
Determine process parameters to operate nominally at **0.00mm**

Head height

Head height is a simple measurement which can be useful as a non-destructive indicator of whether a joint is performing as expected

Button appearance

Visual inspection of the rivet button can indicate any potential issues and whether further joint analysis should be conducted



Joint development evaluation

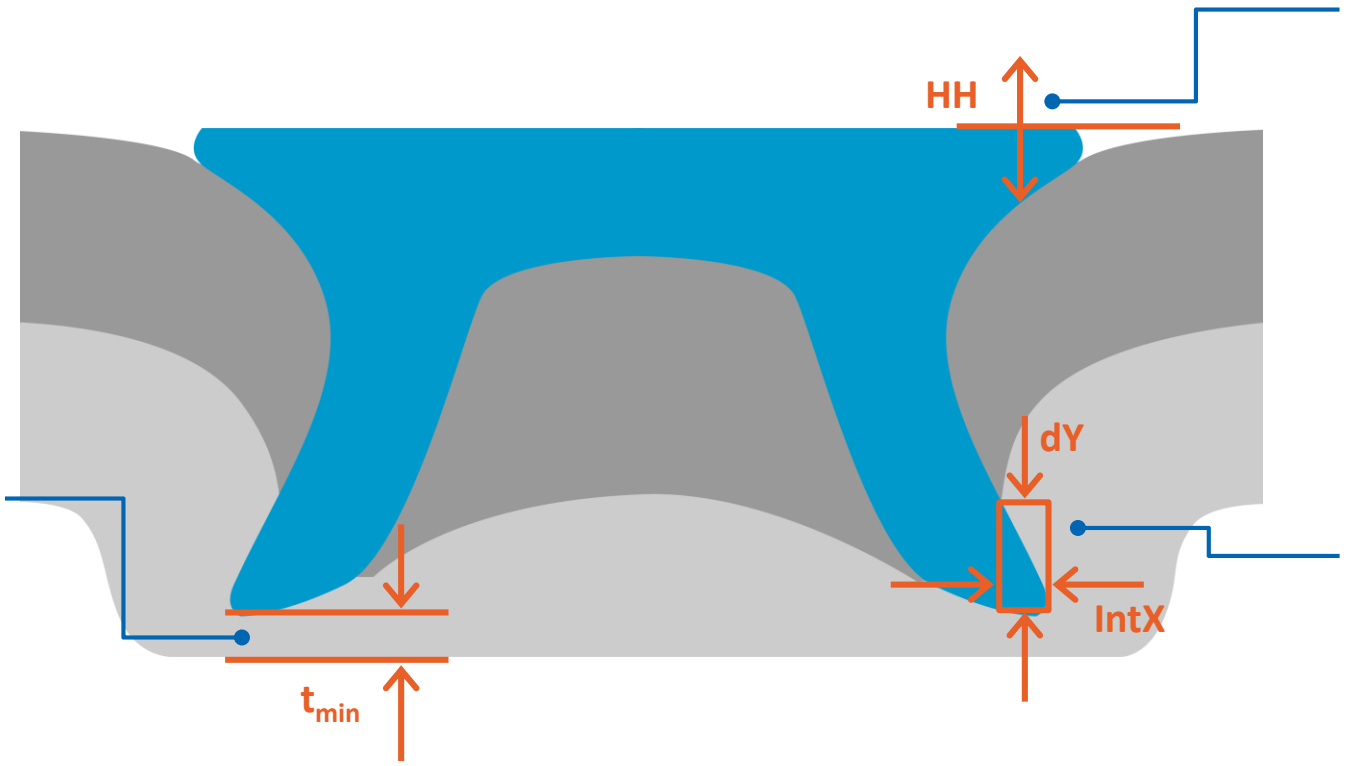
Joint attributes: Cross-section analysis

Joint symmetry

- Indication of joint stability
- Robust joint performance

t_{min}

- Minimum bottom layer thickness
- Corrosion protection
- Bottom sheet completely encapsulates rivet



Head flushness (HH)

- Flush with top sheet
- Sealed under-head
- No crevice points

Interlock (IntX & dY)

- Engagement of rivet legs into bottom sheet
- Indicator of strength
- Legs flare evenly without buckling

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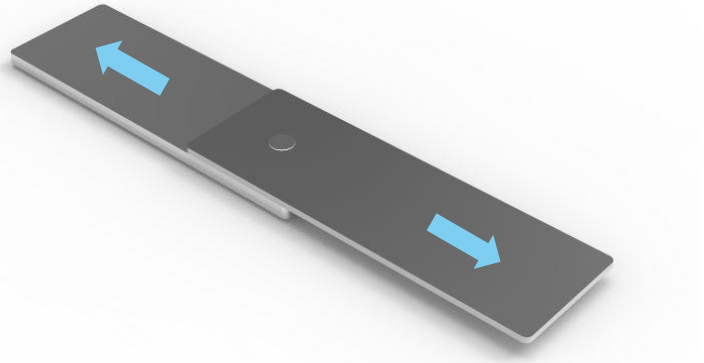
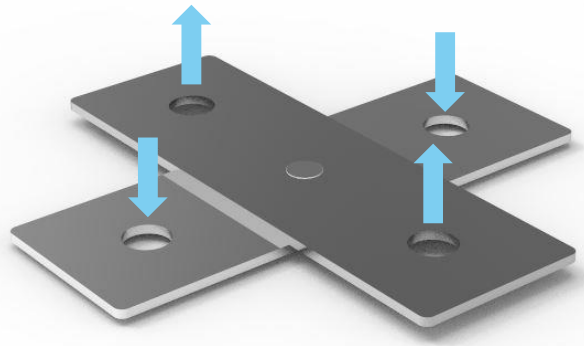
Joint development evaluation

Joint strength: Tensile testing



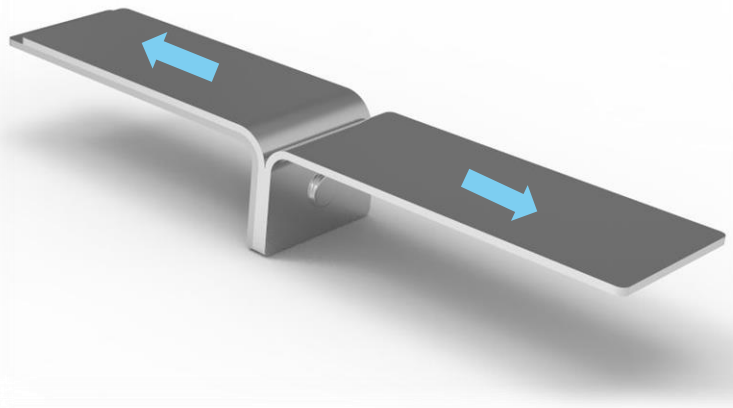
Lap shear test

Lap shear joints rotate during testing, applying a combination of shear and peel loading



Cross-tension peel test

Peel load is distributed all around the rivet head



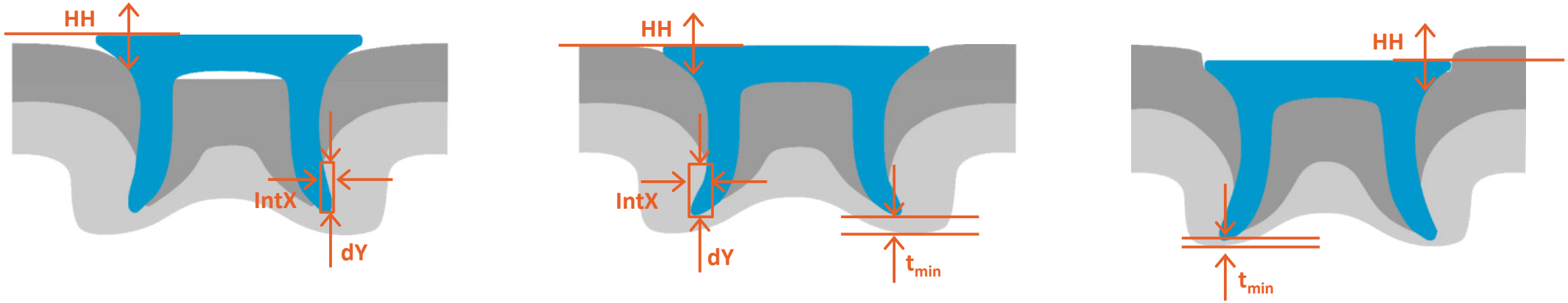
Coach peel test

Peel load is concentrated in one area of the rivet head. Also referred to as a “T peel”

Joint development evaluation

Joint repeatability: Head height range testing

Changes in parameters such as material thickness and composition can result in a variation of head height (HH). Our Fixed Energy process allows us to use HH as an indicator of the joint integrity. A simple gauge check is then a robust non-destructive test method of joint performance.

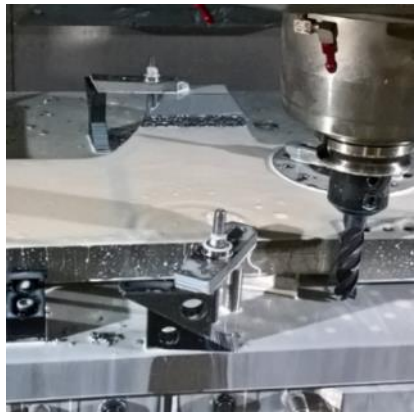


Repeatability testing in the lab validates a range of head heights for use on the production line

System manufacturing

Design

Machining



Tool build

System test

Lean manufacturing

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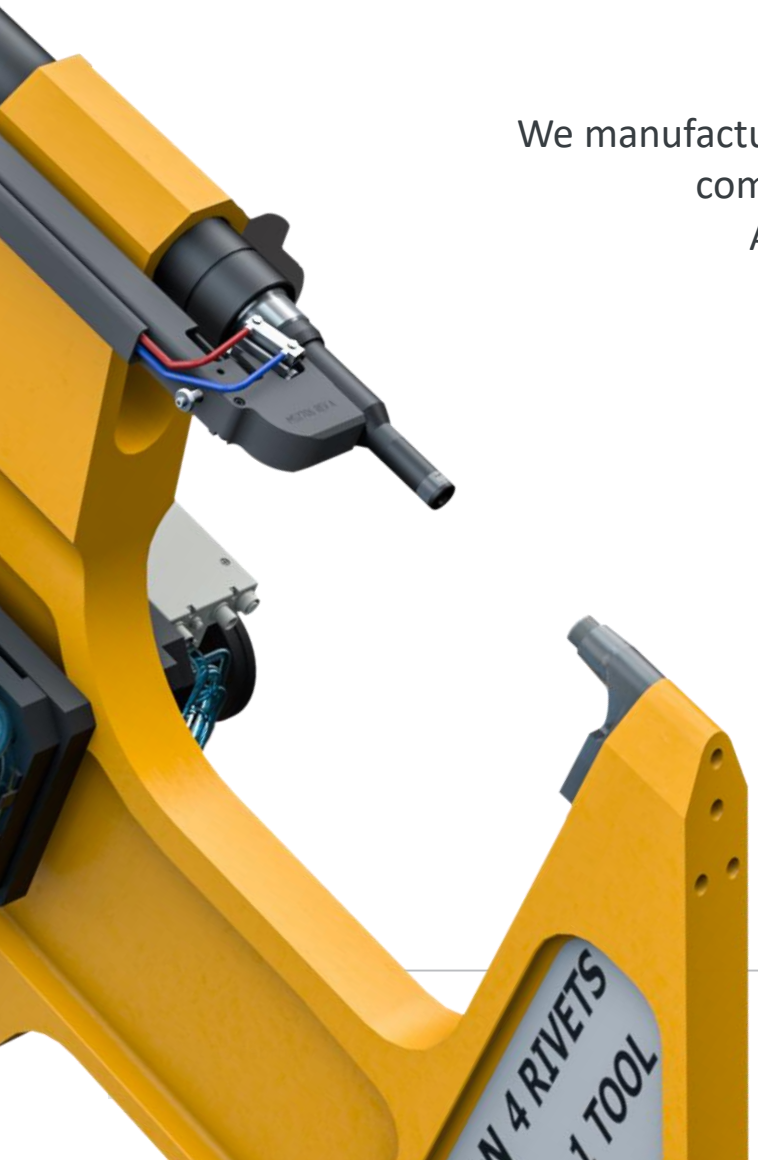
Upset die manufacturing

In-house manufacturing of more than 144 die types



We manufacture upset dies in-house to be able to offer comprehensive solutions for your SPR needs. A two-step operation with robotic loading and unloading finishes with rigid quality inspection.

Optional poka-yoke posts are available for your lean manufacturing processes to prevent using an incorrect die.

Self-piercing rivet systems

Largest range of application specific systems

RivLite

- Battery powered hydraulic pump
- Fixed range
- Tape feed
- 5 sec cycle time
- Rivet setting and removal

Manual Servo Electric

- Inertia system
- Fixed or manual
- Multi axis hangers
- Tape feed
- Limited size range
- 2-5 sec cycle time

Hydraulic

- Hydraulic actuation
- Fixed or suspended
- Manual or auto applications
- Double Acting or Pre-clamp
- Tape or loose feed
- 2 sec cycle time

Auto Servo Electric

- Inertia system
- Fixed or robot-mount
- 85mm - 780mm size
- Tape or loose feed (2-4 rivets)
- 1 sec cycle time

Rivet feeding

Application-specific feed systems

Tape feed

- Pneumatic feed system
- Sprocket holes in tape
- Poka-yoke spools available
- Trigger, sensor and anti-pullback make it ideal for low or high actuation automated systems

Loose feed

- Magazine in robot tools
- Direct blow to pedestals
- T-tube feed for consistency
- RFID poka-yoke containers available
- Magazine ideal for high actuation robot-mounted systems

SPR system accessories

Die camera & die changer

The optional Die Check Camera inspects dies for integrity. A broken die will trigger a NOK.

The Henrob Die Changer for robot-mounted riveting tools enables an upset die to be changed out automatically, without the need for operators to enter an automated cell.

Automatic die changing allows for flexible manufacturing which lowers the overall cost of operations.

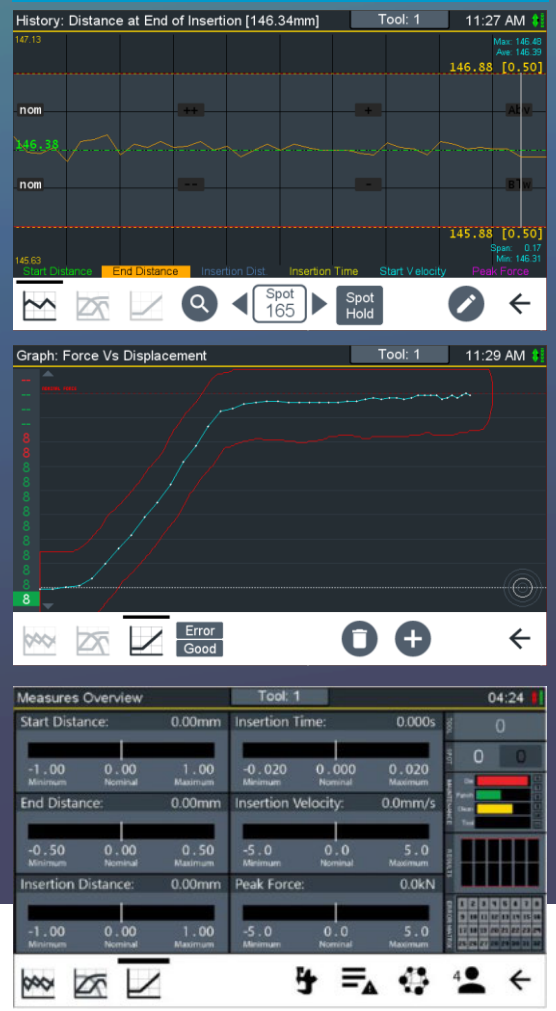
Multiple robots for each process are not needed and more processes can be performed at one station.

System controls and software

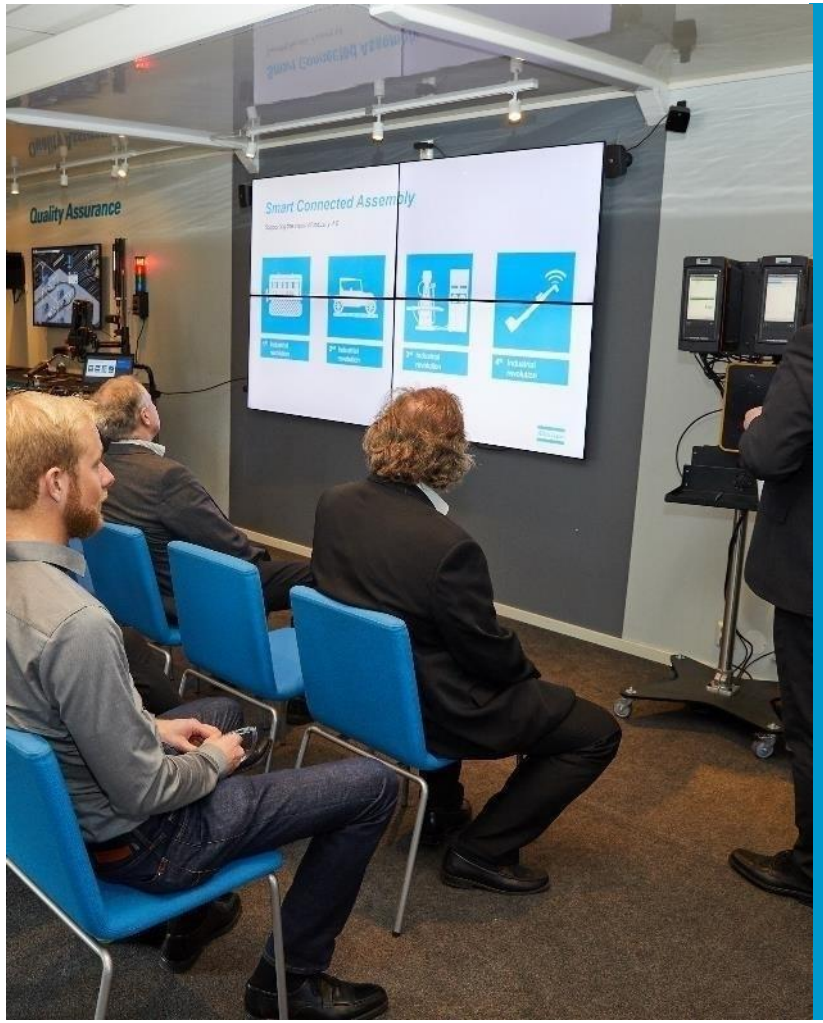
Individual control panels with interconnectivity

Proprietary controls hardware and software is used to operate the tools and communicate with a robot and/or the assembly cell controller

DDS process monitoring



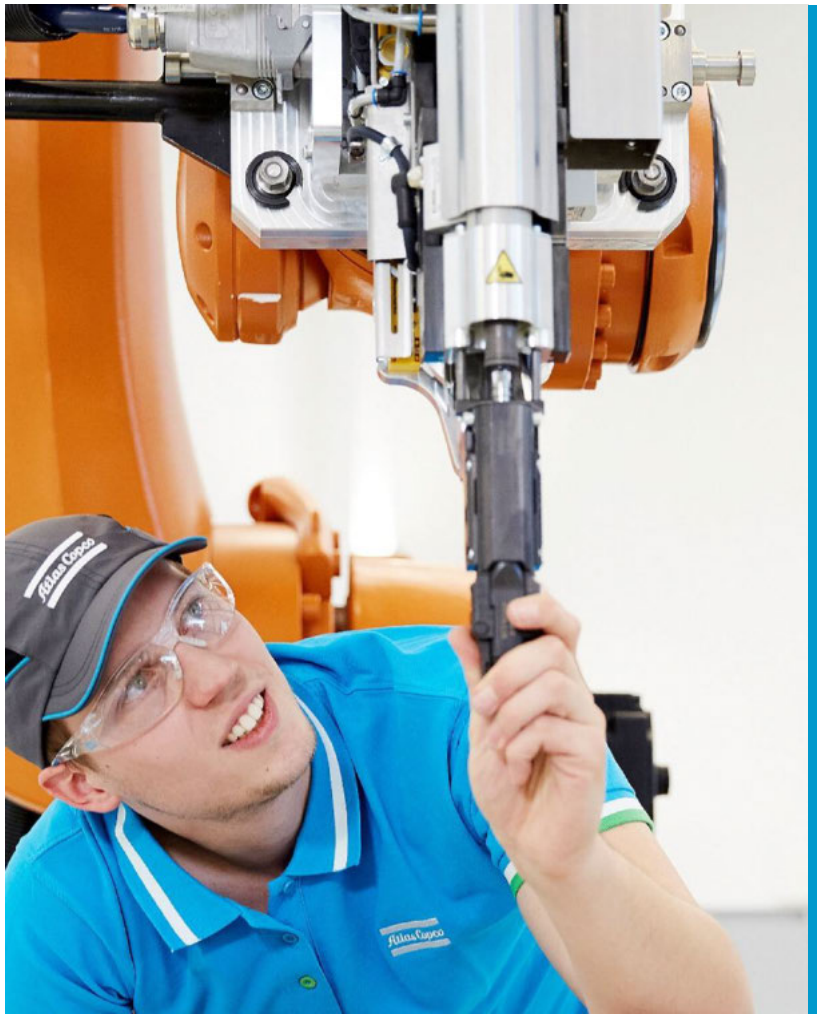
Visit an Innovation Center



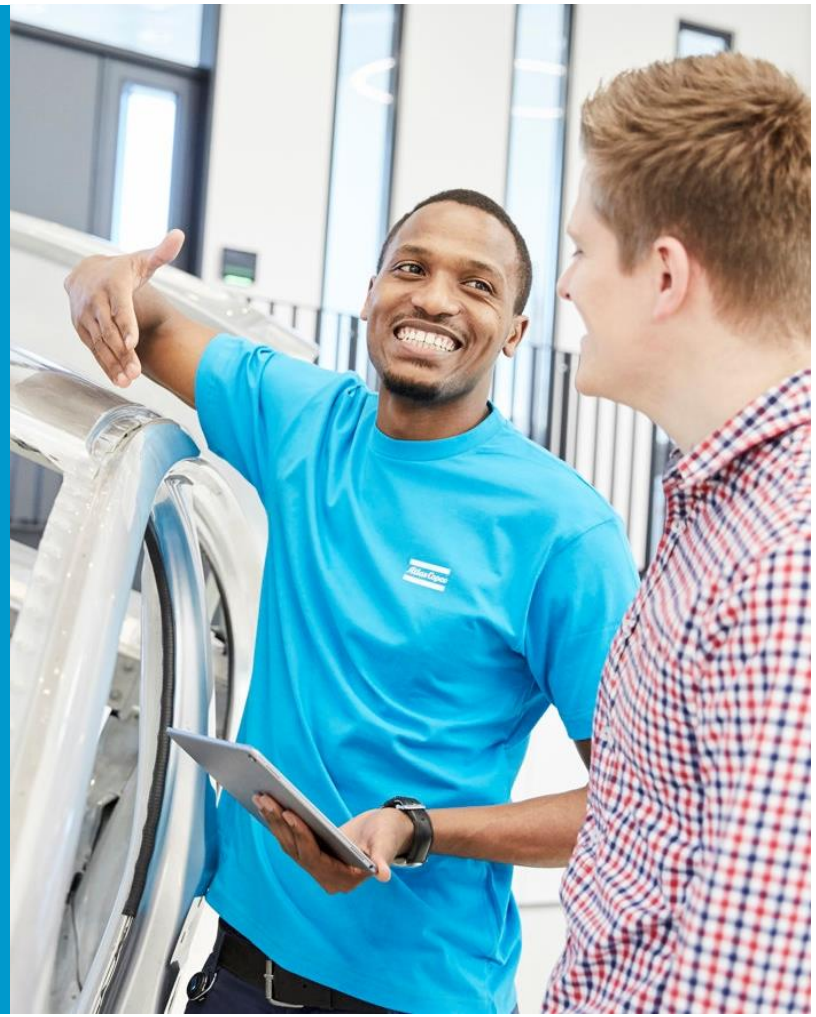
Deeside, UK
New Hudson, US
Bretten, Germany
Shanghai, China
Yokohama, Japan
Seoul, South Korea
Istanbul, Turkey
Puebla, Mexico

Atlas Copco

Your global service partner



> 200
field service
technicians



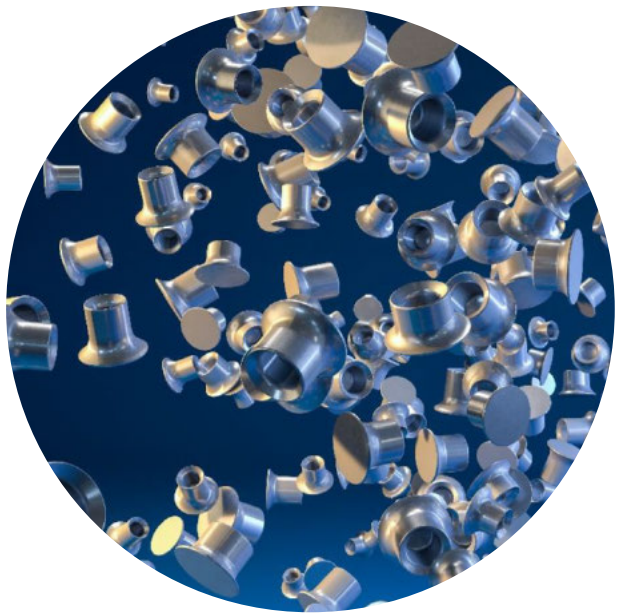
Our experience – your success

Global network

We are wherever you are.

Competence

Benefit from our process and application experience.



Innovative solutions

We can offer a solution to match your needs.

Atlas Copco