Henrob self-pierce riveting
Atlas Copco in figures

- Customers in 180 countries
- 34,000 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
- Self-pierce riveting
- Quality Inspection
- Sealing & adhesive dispensing
- Sound dampening
- Flow drill fastening
- Battery assembly
Customer challenges

Increased need for innovative joining

Global market drivers
- Lowering of emissions
- Improving energy efficiency

Trends
- Increasing usage of lightweight materials in car bodies
- Electric vehicles

Customer challenges
- Combining many different materials to a strong and light car body
- Environmental legislation

Our solution
- 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
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
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
- No debris or filings
- No heat
- No excessive noise
- No fumes
- No sparks
- High strength with a visibly checkable joint
- Operator and environment friendly
- Joins multiple similar or different material combinations
- High strength steel (HSS)
- Composites
- Plastics
- Aluminum

- Compatible with adhesives and lubricants
- Joins multiple material stacks

- Operator and environment friendly
- No heat
- No excessive noise
- No fumes
- No sparks
- High strength with a visibly checkable joint
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
Leading the way in rivet designs

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

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

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

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

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

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

High strength steel
- Shock towers, pillars & rails

Composites
- Sunroof

Thick joints
- Body sides, Al pillars, rocker panels

Thin joints
- Hood, fender & closures

Aluminum joining
- Floors, dash & cowl panels, body sides, pillars
Rivet manufacturing
All steps of rivet manufacture in-house

- Wire stock
- Cold forging
- Heat treat
- Packaging
- Plating
- Visual inspection / sorting
SPR joint development

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

Customer materials

Adhesive application (optional)

Create test coupons

Corrosion testing

Joint analysis

Tensile testing

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

Customer materials

Adhesive application (optional)

Create test coupons

Corrosion testing

Joint analysis

Tensile testing
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 development evaluation

Joint attributes: Visual inspection of head height & button appearance

**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.

Determine process parameters to operate nominally at 0.00mm

**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

Head flushness (HH)
- Flush with top sheet
- Sealed under-head
- No crevice points

$\text{t}_{\text{min}}$
- Minimum bottom layer thickness
- Corrosion protection
- Bottom sheet completely encapsulates rivet

Interlock (IntX & dY)
- Engagement of rivet legs into bottom sheet
- Indicator of strength
- Legs flare evenly without buckling
Joint development evaluation

Joint strength: Tensile testing

<table>
<thead>
<tr>
<th><strong>Lap shear test</strong></th>
<th><strong>Cross-tension peel test</strong></th>
<th><strong>Coach peel test</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lap shear joints rotate during testing, applying a combination of shear and peel loading</td>
<td>Peel load is distributed all around the rivet head</td>
<td>Peel load is concentrated in one area of the rivet head. Also referred to as a “T peel”</td>
</tr>
</tbody>
</table>
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
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

<table>
<thead>
<tr>
<th>RivLite</th>
<th>Manual Servo Electric</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Battery powered hydraulic pump</td>
<td>• Inertia system</td>
</tr>
<tr>
<td>• Fixed range</td>
<td>• Fixed or manual</td>
</tr>
<tr>
<td>• Tape feed</td>
<td>• Multi axis hangers</td>
</tr>
<tr>
<td>• 5 sec cycle time</td>
<td>• Tape feed</td>
</tr>
<tr>
<td>• Rivet setting and removal</td>
<td>• Limited size range</td>
</tr>
<tr>
<td></td>
<td>• 2-5 sec cycle time</td>
</tr>
</tbody>
</table>

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 pok-a-yoke containers available
- Magazine ideal for high actuation robot-mounted systems
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.

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

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