RIVCLINCH®

Metal joining without fasteners
RIVCLINCH® - General principles

The clinching process is a method of joining sheet metal by localised cold-forming of the material. This produces an interlocking joint between two or more layers of material.

Coated and painted sheet metals can also be joined together without altering the surface finish.

The RIVCLINCH® joining technique can be used to join steel and stainless steel materials as well as aluminium and/or non-ferrous materials based on a cost effective, environmentally friendly process.

Depending on the RIVCLINCH® joining tool selected, the resulting clinch will either be round or rectangular:

- The SR round joint, without cutting through the material, is gas tight. Consequently, it protects the coating better and provides high corrosion and fatigue resistance.
- The ST rectangular clinch joint is the product of a combined cutting and deforming process. It is primarily suited to multi-layer (up to 5 and more) and harder materials such as stainless steel.

Avantages

- Joints can be checked without damage
- No consumable items
- Low energy use
- No thermal load on joining zone
- No damage to surface finishes on the work piece
- Low maintenance costs
- Interim layers of film or adhesive can be incorporated in most cases
- Environmentally friendly workplace
- No fumes, no sparks, very little noise
- No pre/post treatment required, e.g. no pre-cleaning or subsequent removal of spray deposits around the joint

The Clinch Joint

In the RIVCLINCH® joining process, the materials to be joined are firstly forced into the die with the punch. As soon as the lowest material is resting on the die anvils, it starts flowing sideways under the pressure being exerted by the punch. The movable die sections are pushed outwards and the flow of material forms this button-like joint. The punch is then returned to its starting position by the operator or by a hydraulic press which removes the force. The jointed part can now be removed and the side sections of the die are pulled back together by a spring.

The RIVCLINCH® joining system can be incorporated into existing press systems or custom built machines. It can be used to simultaneously set one or several points and can be integrated within manual machines and robotic equipment and systems.

Influential variables on the quality of a clinch Joint

Compared with other joining techniques, clinching is characterized by 4 essential parameters:

- Material ductility: in general, the required ductility values are 20% for a rectangular (partial cut) joint and 30% for a round joint.
- Access from both sides: needed for pressing the material between the punch and the anvil
- Better joint feasibility and strength with the punch on the thick side, when joining sheet metal with different thicknesses
- Once the joint is formed, the most relevant parameter is the residual bottom thickness, “St”, which is directly related to the interlocking effect and consequently the joint strength.

Clinch Joint parameters and control

The RIVCLINCH® joint can be easily tested without being damaged, by measuring the residual base thickness, “St” and the joint diameter “D” on the side of the joint.

These values are predetermined in laboratory tests for each application and recorded, with a test number, in a report. These parameters will be subsequently measured during production and compared with the reference data, thus guaranteeing reliable quality control of the RIVCLINCH® joint.

The residual base thickness, “St”, is measured by hand using a calliper, as shown in the photograph. This allows quality checks to be carried out on random samples without interrupting production.

Process Monitoring

An electronic, “smart”, process controller can be used to check the joining process for automated or mass production. The signals from a force sensor, installed on the C-frame, in conjunction with a displacement sensor measuring the tooling position, yield a force-displacement curve in real time for every clinch joint. The software allows the machine, in conjunction with the C-frame, in conjunction with a displacement sensor measuring the tooling position, yield a force-displacement curve in real time for every clinch joint. The software allows check “windows” to be programmed along the curve, the last one being the final value of the completed joint. If the signal deviates from the reference windows, an error signal can be sent to the line controller or to the robot to stop the machine and for statistics analysis.

Strength value of RIVCLINCH® Joints

The shear and the cross-tension strength are a good means of comparing clinching with other joining methods such as spot welding, riveting or screwing. The graph on the right hand side shows the most current values for the standard tooling and mild steel.

<table>
<thead>
<tr>
<th>Material</th>
<th>Steel plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength</td>
<td>300 N/mm²</td>
</tr>
<tr>
<td>1. SR 504, Ø 5 mm</td>
<td></td>
</tr>
<tr>
<td>2. SR 604, Ø 8 mm</td>
<td></td>
</tr>
<tr>
<td>3a. ST 432, placed transversal to load direction</td>
<td></td>
</tr>
<tr>
<td>3b. ST 432, placed longitudinal to load direction</td>
<td></td>
</tr>
</tbody>
</table>

There is a directional dependency involved when making a rectangular joint (ST). To achieve a greater strength, the load direction in the case of the rectangular joint should be transversal to the joining element, (3a) in the graph, rather than longitudinal (3b). The graph above also shows that the widening the joint diameter (1 to 2) also increases in strength.
The RIVCLINCH® tooling family

The central component of the RIVCLINCH® joining system is the tooling, or "tool kit". These are available for round clinch joints with nominal diameters of 3, 4, 5, 6, 7, 8 and 10 mm and rectangular point joints with nominal widths of 3, 4, 4.3, 5 and 6 mm. Non standard dimensions are generally available from diameters of 1.0 to 10 mm.

A multiple tool holder can be used to integrate tool sets into corresponding RIVCLINCH® portable units, modular work heads or a press.

Design of the segmented die body

The RIVCLINCH® die comprises a basic die body and individual die segments, which are held in position by a steel spring. A surrounding raja permanently secures the separate sections to the die body preventing them from falling out. The die cavity can be formed by 2, 3 or 4 segments with die designs being selected depending on the application requirements.

Punch Strippers

The stripper has two essential functions: keeping the sheet metal flat while clinching and pushing the sheet metal out of the punch during the return motion of the tooling. A number of standard strippers are available, given that accessibility conditions may vary for each application. Special executions may be supplied if necessary.

Criteria for selection

Selecting the tooling is the first step involved when studying a new clinching application, because it will determine the pressing force and therefore the size of the clinching force unit and work head. This choice will depend on:

- Sheet metal thickness and material: each tooling has its own range of thickness per material type.
- Compatibility of tooling with the machine
- Punch Strippers
- The RIVCLINCH® work heads are designed to accommodate the various standard tooling. A corresponding force unit with appropriate setting force exists for each die diameter. This makes it quite simple to select the clinching machine. Irrespective of the die diameter or width, a suitable work head is available in the portable or in the modular range.

Compatibility of tooling with the machine

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Tool selection based on clinch area and material thickness

The main parameter for selection is the clinch area, in general defined by the edge of the sheet metal wall. The width or the diameter of the die must match the edge width (A) so that the die’s outer dimension is at least equal to the sheet metal edge. On punch side, the limiting dimension will be the width of the stripper front piece. A special stripper front piece may be provided in case of limited access.

<table>
<thead>
<tr>
<th>Tooling type</th>
<th>Geometry of clinch area</th>
<th>A (mm)</th>
<th>B (mm)</th>
<th>C (mm)</th>
<th>D (mm)</th>
<th>Total thickness (mm)</th>
<th>Setting force (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR303</td>
<td>8.0 8.0 22.0 3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5 – 2.0</td>
<td>18</td>
</tr>
<tr>
<td>SR402</td>
<td>8.0 8.0 22.0 4.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5 – 2.5</td>
<td>25</td>
</tr>
<tr>
<td>SR502</td>
<td>10.0 10.0 22.0 5.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0 – 3.0</td>
<td>35</td>
</tr>
<tr>
<td>SR602</td>
<td>12.0 12.0 25.0 6.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0 – 3.0</td>
<td>40</td>
</tr>
<tr>
<td>SR403</td>
<td>14.0 14.0 13.0 4.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.8 – 2.5</td>
<td>25</td>
</tr>
<tr>
<td>SR503</td>
<td>14.0 14.0 14.0 5.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0 – 3.0</td>
<td>32</td>
</tr>
<tr>
<td>SR603</td>
<td>16.0 16.0 16.0 6.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0 – 4.0</td>
<td>45</td>
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<tr>
<td>SR703</td>
<td>18.0 18.0 18.0 7.0</td>
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<td></td>
<td></td>
<td></td>
<td>1.0 – 4.0</td>
<td>60</td>
</tr>
<tr>
<td>SR704</td>
<td>18.0 18.0 18.0 7.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.5 – 4.0</td>
<td>60</td>
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<tr>
<td>SR804</td>
<td>22.0 22.0 22.0 8.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.0 – 6.0</td>
<td>75</td>
</tr>
<tr>
<td>SR1004</td>
<td>22.0 22.0 22.0 10.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.5 – 8.0</td>
<td>100</td>
</tr>
<tr>
<td>ST300</td>
<td>3.0 3.0 20.0 3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5 – 2.5</td>
<td>25</td>
</tr>
<tr>
<td>ST432</td>
<td>10.0 10.0 22.0 4.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0 – 3.0</td>
<td>35</td>
</tr>
<tr>
<td>ST502</td>
<td>12.0 12.0 22.0 5.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.5 – 4.0</td>
<td>50</td>
</tr>
<tr>
<td>ST502</td>
<td>21.0 21.0 30.0 6.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.0 – 6.0</td>
<td>75</td>
</tr>
</tbody>
</table>

Speciality tooling

BOLLHOFF provides optimized and advanced clinching solutions for specific industries, notably:

- **Micro clinch tooling**, which have been used in the electronic and watch industries for 15 years, with a small record die diameter of 1.0 mm
- **Tooling for electric contacts**, with diameters ranging between 2 to 3 mm
- **Tooling for filters**, ST432, accepting high filtering fabric material thickness in the ventilation industry
- **Tooling for ventilation ducts**, which enables fast lateral displacement of machine
Installation of a portable clinching machine

The booster and the balancer should be installed on a combined running cradle to avoid collisions, while maintaining the suspension cable of the work head perfectly vertical over the whole work zone.

The air supply must be dry, filtered and regulated, with a minimum size of ½” for ensuring the shortest possible cycle time.

All the RIVCLINCH® systems are designed for operation without lubricator on the air preparation unit.

How to select the machine

Once the tooling has been selected (see page 5) the choice of the work head will be dictated mainly by the geometry of the product to be clinched, and by accessibility to the clinch area.

Small edges: the examples here show assembly of the external edges of cabinets, housings and walls of large size products. This choice is advantageous given the high speed, light weight and the mobility of the tool which offers exceptional productivity.

Medium range: the assembly of profiles or folded edges which require a larger jaw opening. The quick and safe closing jaw of the IP models is a perfect solution for such products.

Large structures: it is quite often necessary to set the clinch joint further away from the edge, or for passing over steps. Working from the top of a product or accessing a more confined box is often necessary.

This type of machine is the best solution in this case as various C'frame dimensions and geometries can be supplied using the same force unit.

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Portable RIVCLINCH® Modular systems for integration and automation

The modular program is intended for line builders and integrators and for people requiring efficient tools which enable rapid creation of customized solutions and suited to a wide variety of clinching assembly tasks. The solutions can involve bench mounted or stand alone machines, special assembly work stations, automatic assembly lines or robot stations.

The systems are composed of cost effective standard hydraulic work heads, powered by air-to-oil pressure boosters simply connected to compressed air, for unlimited combinations of force unit capacity, stroke length, C’frame depth and work heads.

Multiple work head stations can be easily designed and built with pre-adjusted components, and without the use of a complicated electro-hydraulic power installation, and can be immediately operational. The limited oil volume also prevents large oil leakages and the inevitable dirtiness of usual hydraulic installations over time.

Once the tool kit type, dimension and setting force are defined as function of the application (see page 3 and 4), there will always be the right work head to power it and to build the clinching installation.

Accessories include boosters, tool holders, punch strippers, die protections, compensated supports for adaptation to automatic operation, hand triggers and foot pedals, various sensors for automatic control, optimized cycle controller and process monitoring device for full production control. Some portable applications are also based on modules, with the aid of accessories like balancing devices and gyroscopic suspensions with appropriate load capacity.

The PASS solution for long stroke

As described on page 7 for portable machines, a long pre-stroke can be provided by a small pneumatic cylinder, which eliminates the need for large of flows. Therefore only one pressure booster can power several work heads by just acting during the work stroke. Another advantage of the PASS solution is to save cycle time when making several clinch joints in a row without having to activate the long approach and return strokes. Each module range, from 35 kN to 300 kN, can be equipped with the PASS option.

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Robotic PASS work heads

New range of compact clinching machines with integrated pneumatic-hydraulic force unit for use as:
- Bench mounted (manually operated)
- Automatic lines (integrated clinching heads)
- Robot mounted

Simply powered by a 6 bar (85 psi) air compressed air line, they offer exceptional performance in terms of cycle time (up to 80 joints per minutes), of energy saving (the full power is only activated during the minimum work stroke), of flexibility (with a pre-stroke of 52 mm (2”) for easy accessibility, and of possibilities of various pre-installed sensors for process control.

RIVCLINCH® Modules

The work heads are grouped according to their maximum joining force.

Series RC P35 / P50 S

With 35 or 55 kN joining force, light C’frames, all possible dimensions up to 1300 mm are available. The PASS option is available for all modules.

It uses standard tool kits: see corresponding setting force and sheet metal thickness on page 5.

Series RC P75 / P100 S

With 75 or 105 kN joining force. For thick sheet metal (up to 8 mm total thickness) and for multiple tooling configuration. Special strippers adapted to the application may be supplied.

The PASS option is available for all modules.

It uses standard tool kits: see corresponding setting force and sheet metal thickness on page 5. Add the force of all tool kits in order to select the corresponding work head.

Series RC P200 / P300 S

With 200 or 300 kN joining force. Clinching presses with customized tooling arrangement (multiple tool kits) and C’ frame depth according to the application. The PASS option is available for all modules.

It uses standard tool kits: see corresponding setting force and sheet metal thickness on page 5. Add the force of all tool kits in order to select the corresponding work head.

Technical descriptions for all our machines are available upon request.

### RIVCLINCH® Modules

<table>
<thead>
<tr>
<th>Type</th>
<th>Setting Force (Kn)</th>
<th>Piston Stroke (mm)</th>
<th>C’frame depths (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P35 S</td>
<td>35</td>
<td>8 - 50</td>
<td>35 - 70 - 110 - 200 - 300 - 650</td>
</tr>
<tr>
<td>P35 PASS</td>
<td>55</td>
<td>8 - 50</td>
<td></td>
</tr>
<tr>
<td>P50 S</td>
<td>55</td>
<td>8 - 50</td>
<td></td>
</tr>
<tr>
<td>P50 PASS</td>
<td>55</td>
<td>8 - 50</td>
<td></td>
</tr>
</tbody>
</table>

* Only with hydraulic power pack at 250 bars

### Setting Force

<table>
<thead>
<tr>
<th>Type</th>
<th>Setting Force (Kn)</th>
<th>Piston Stroke (mm)</th>
<th>C’frame depths (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P75 S</td>
<td>75</td>
<td>8 - 100</td>
<td>100 - 160 - 250 - 400 - 650</td>
</tr>
<tr>
<td>P75 PASS</td>
<td>75</td>
<td>8 - 100</td>
<td></td>
</tr>
<tr>
<td>P100 S</td>
<td>105</td>
<td>8 - 25</td>
<td></td>
</tr>
<tr>
<td>P100 PASS</td>
<td>105</td>
<td>8 - 100</td>
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</tbody>
</table>

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### Piston Stroke

<table>
<thead>
<tr>
<th>Type</th>
<th>Setting Force (Kn)</th>
<th>Piston Stroke (mm)</th>
<th>C’frame depths (mm)</th>
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</thead>
<tbody>
<tr>
<td>P200 S</td>
<td>240</td>
<td>8 - 25</td>
<td>100 - 200 - 300</td>
</tr>
<tr>
<td>P200 PASS</td>
<td>240</td>
<td>8 - 100</td>
<td></td>
</tr>
<tr>
<td>P300 S</td>
<td>300</td>
<td>8 - 100</td>
<td></td>
</tr>
<tr>
<td>P300 PASS</td>
<td>300</td>
<td>8 - 100</td>
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</tr>
</tbody>
</table>

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### C’frame depths

<table>
<thead>
<tr>
<th>Type</th>
<th>Setting Force (Kn)</th>
<th>Piston Stroke (mm)</th>
<th>C’frame depths (mm)</th>
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</thead>
<tbody>
<tr>
<td>P200 S</td>
<td>240</td>
<td>8 - 25</td>
<td>100 - 200 - 300</td>
</tr>
<tr>
<td>P200 PASS</td>
<td>240</td>
<td>8 - 100</td>
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<tr>
<td>P300 S</td>
<td>300</td>
<td>8 - 100</td>
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<tr>
<td>P300 PASS</td>
<td>300</td>
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Examples of RIVCLINCH® Joint applications

Building sector

Garage doors  Scaffolders  Door frames

Heating, Ventilation, Air Conditioning (HVAC)

Ventilation ducts  Solar collectors  Ventilation filters

Appliances

Stoves  Washing machines  Electric contacts

Automotive sector

Heat shields  Window mechanisms  Bonnets/hoods - Boot/trunk

BOLLHOFF of Ecublens/Lausanne, Switzerland, is a manufacturing company, leading in the domain of clinching, a technology for sheet metal “fastening without fasteners”.

BOLLHOFF offers a large range of tooling and machines worldwide based on unique RIVCLINCH® clinching and joining techniques.

BOLLHOFF is represented throughout the world by a network of competent partners, distributors and agents.

BOLLHOFF success stems from more than 30 years’ experience in most of the sheet metal assembly sectors throughout the world. Its engineering team is the pioneer in Europe. This success is also based on its ability to offer solutions to most applications, a network of highly qualified partners, distributors and agents, and on an uncompromised Swiss quality.

For more information, see the list of our locations on the website: www.bollhoff.com

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