



## Clinching technique





## ECKOLD clinching technique – the joining method of the future

ECKOLD clinching is an innovative, proven technique for the joining of sheet metal and profiles. The workpieces are permanently joined by local cold forming – doing away with fixtures and auxiliary parts. The main advantage of this joining method lies in the fact that a positive joint is formed directly from the sheet metal material. The technique is also suitable for the joining of workpieces of different materials and thicknesses.

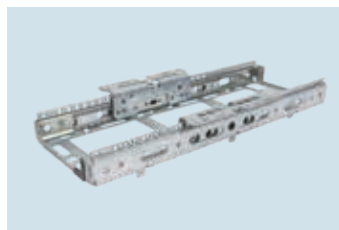
As there are many different requirements that joints must meet, ECKOLD offers tailor-made tools and machines, taking into account the specific applications of the customer. ECKOLD provides a huge variety of joining options and equipment, so that manufacturers can choose the best solution for their specific clinching tasks. ECKOLD clinching is a tried and tested method used worldwide in automated production plants with or without robots. ECKOLD also produces portable clinching tools for small series.

ECKOLD clinching is conquering the market, as the technique is not only suitable for oiled or coated sheet metal and stainless steel workpieces, but can also join sheet metal elements of varying thickness without problems. ECKOLD even offers solutions for workpieces made in brittle aluminium alloys and for the joining of non-forming metals such as spring steel with forming materials.

ECKOLD clinching is a sustainable technology that protects both the environment and workers. Its energy consumption is low, and workplace safety is enhanced, as there are no toxic emissions or high noise levels. Compared with conventional joining techniques, ECKOLD clinching allows for capital cost savings of up to 55 %, while operating costs are typically 25 % lower.

With its clinching technique, ECKOLD demonstrates once more its innovative power. After years of development, the ECKOLD clinching method was first launched in the 1980s. In the recent past, the company has time and again set new standards, for instance with its servo-motor clinching frames designed for industrial large-series production, another milestone on the road to future-proof joining.

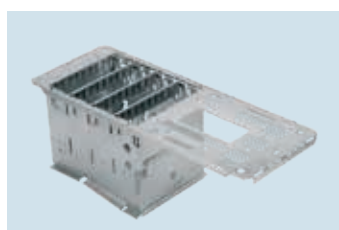
## Examples of applications



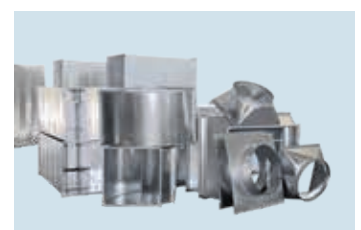
Steel furniture, shelf and storage solutions



Sheet metal sub contractors



Computers, electronics and lighting industries



Ventilation and ducting industries

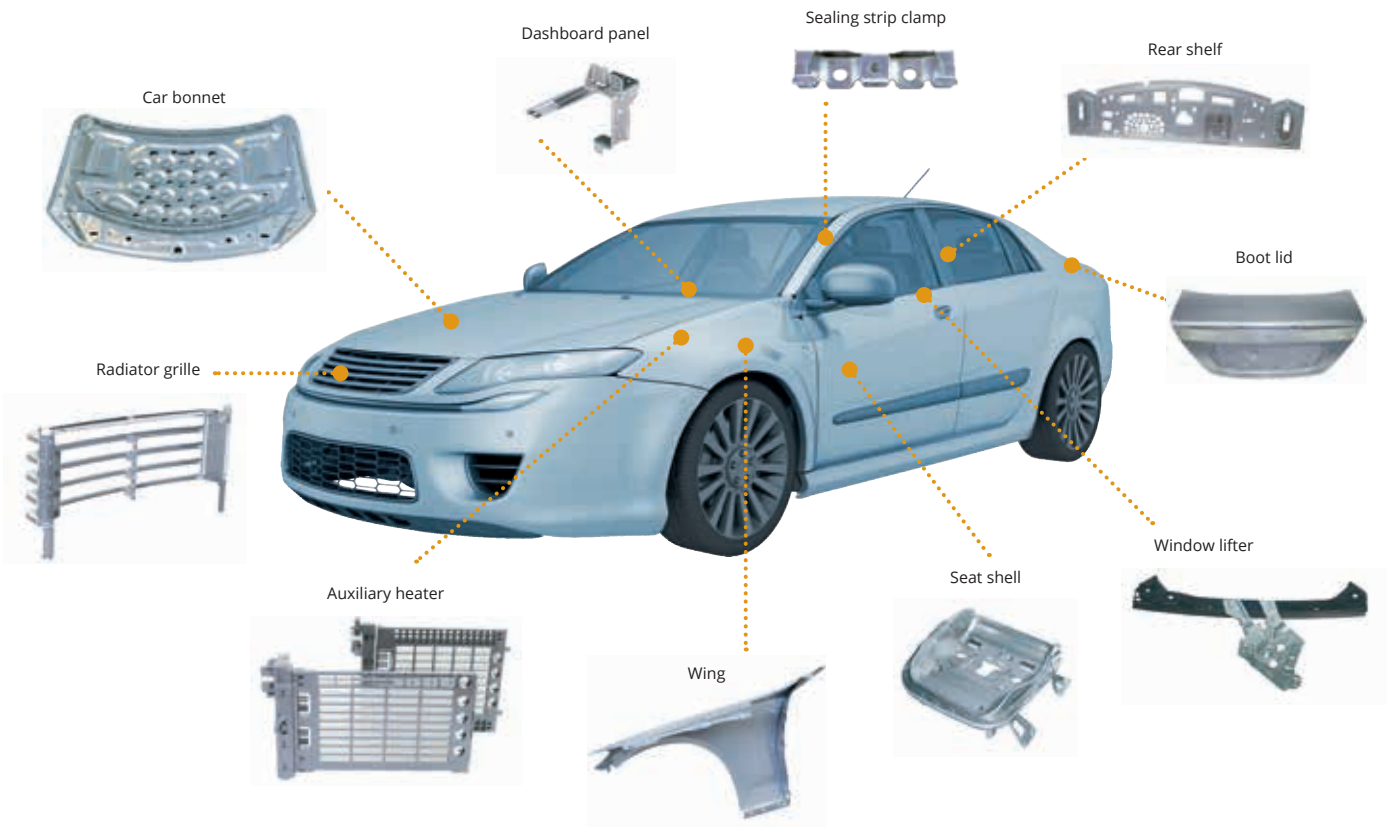
# Joins that last



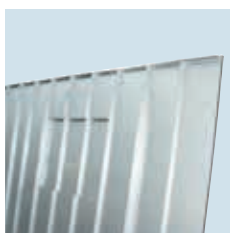
The sheet metal connection

- Available clinching types
  - Standard clinching S-DF
  - Round clinching R-DF
  - Round clinching with rigid die G-DF
  - Clinching with prepunched hole CONFIX
  - Shear clinching
- Single layer thickness 0.5 – 4 mm / depending on clinching type
- Total thickness 1.0 – 6.0 mm / depending on clinching type
- 2 – 4 sheet metal layers
- Hybrid joining (steel / adhesive / aluminium)

- Trendsetter in clinching technology
- Decades of experience
- Worldwide service network



White goods industries



General fabricators



Battery production

### Target sectors



# The key to our success: our comprehensive product programme ...

... including many tool options and versions and a complete range of machines from standard units to turnkey production plants.



Large choice of clinching tools



Hand-held portable devices with pneumohydraulic drive



Cordless devices

Hand-held portable devices, pneumatically powered



Pressing tools

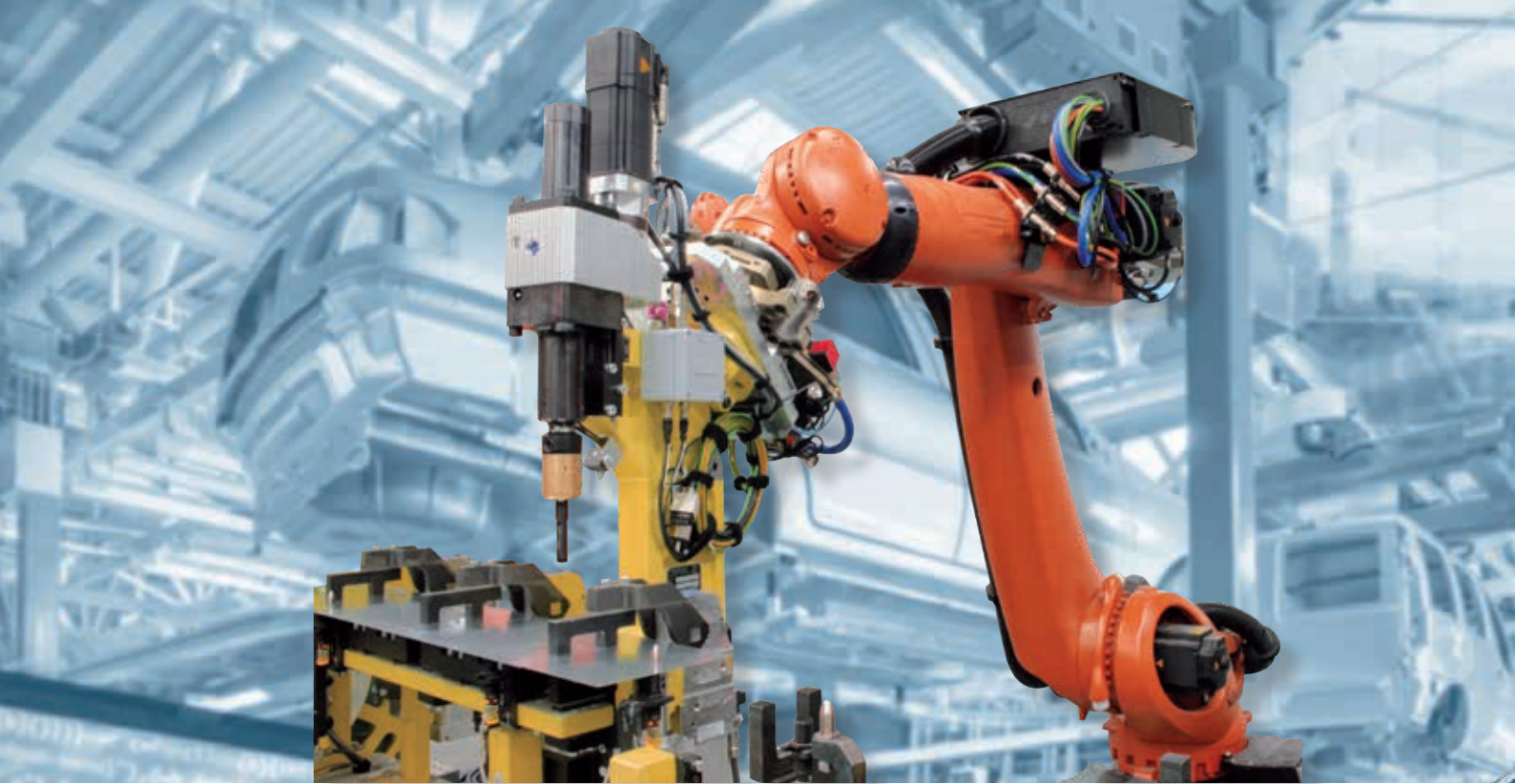


Stationary, pneumohydraulically powered machines



Stationary, servo-motor driven machines

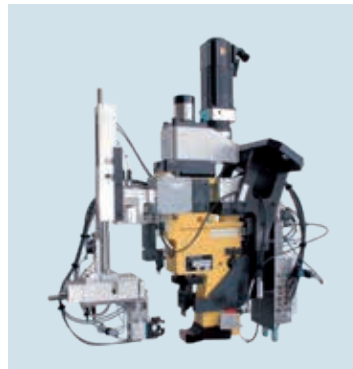




Servo motor-driven clinching system with process monitoring and visualisation

## Tailor-made solutions

- Servo motor-driven clinching systems
- Lightweight frames
- Clinching devices and plants



CONFIX frames



Lightweight frames



Workstations



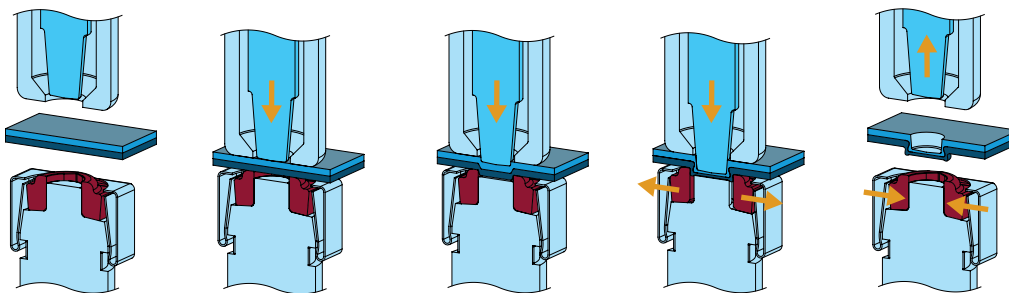
Clinching fixtures and plants

## How does clinching work?

- Clinching is a forming process for the joining of thin workpieces, tubes and / or profiles made in steel, stainless steel, non-ferrous metals (in particular aluminium).
- Clinching allows for the connection of two or more overlapping workpieces by means of local cold forming.
- The main advantage of this joining method lies in the fact that a positive joint is formed directly from the sheet metal material. There is thus no need for auxiliary materials or fixtures such as soldering flux or rivets.
- In the clinching process, the sheet materials are partly pushed through each other and then pressed together to plastically form an interlock between two or more sheets.



Cross-section of optimised clinching element



Steps of round clinching process (R-DF)

### Versatile technology

Customised punch and die combinations allow for the clinching of workpieces made from different materials and of different thickness. To determine the most suitable tool combination, ECKOLD performs extensive trial runs to ensure optimum joint quality.

### Corrosion resistance

Corrosion tests commissioned by ECKOLD show that clinched joints are no more susceptible to corrosion than the joined materials themselves.

This has also been proven for galvanised sheet metal elements and clinching without cutting.

### Fatigue strength

Studies comparing the fatigue behaviour of clinched and resistance spot welded joints confirm that clinching elements can withstand significantly greater dynamic loads.

This is due to the fact that quick melting and solidification during spot welding leads to a brittle structure and a much greater notch sensitivity, and thus a lower fatigue strength.

## Durability and strength

The retention strength of a joint depends on the geometry of the clinched connection (bar-shaped or round) and the direction of stress forces relative to the connection.

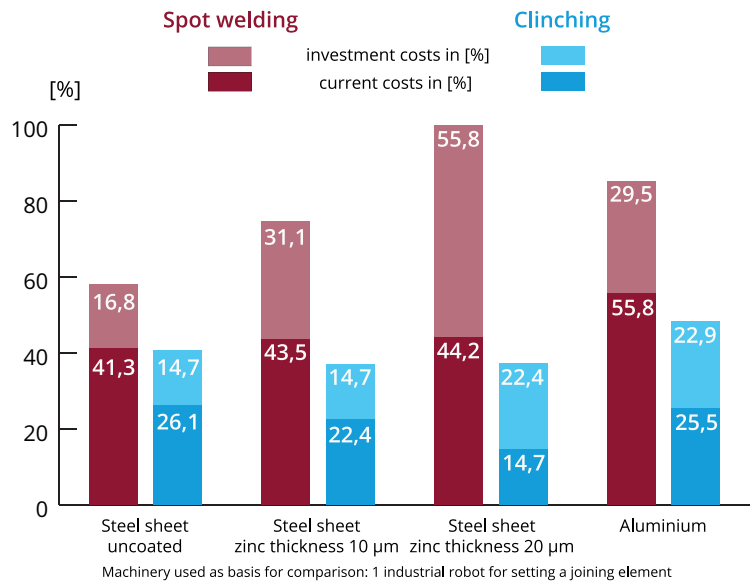
As clinched connections are made from the materials of the joined workpieces, there is a direct correlation between the mechanical properties of the workpiece materials, the thickness of the workpieces and the achievable retention forces. The retention strength is of course also determined by the clinching point diameter and the actual bottom thickness.

To optimise the retention strength when clinching workpieces of the same material but different thickness, the thicker element should face the punch side.

## Cost-effective method

Cost comparisons by customers and independent bodies show that ECKOLD clinching is significantly cheaper than any other joining technique.

Depending on the actual task and taking into account both capital and running costs, the total costs for the production of clinched components are up to 55 % lower than with spot welding.



## Sustainability



Everybody who has been exposed to toxic welding fumes, or knows how welding and personal protective equipment weigh down on the body appreciates the many advantages of ECKOLD clinching for workers. ECKOLD clinching protects the health of workers as there are no hazardous fumes, or heavy equipment to be transported. In addition, ECKOLD clinching is energy-efficient and does not produce industrial waste water. ECKOLD clinching is thus a truly clean, safe and user-friendly joining method.

## Stainless steel and non-forming materials

- Austenitic stainless steel is difficult to join in a cost-effective manner.
- To join sheets made from brittle aluminium alloys or non-forming materials (e.g. spring steel) with sheets made from a forming material, we recommend the CONFIX type.

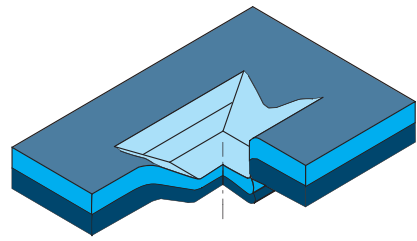
## Special clinching technology requirements for the automotive industry

- High joining rates → short process times
- No negative effect of workpiece finish on joining result
- No negative effect of workpiece quality on joint quality
- Method must be suitable for various material combinations (composite workpieces)
- Method must cater for hybrid joining (combined gluing and clinching)
- Clinching elements must be able to withstand high mechanical and thermal stress as well as corrosion
- Option to integrate clinching tool into press
- Reproducible joint quality

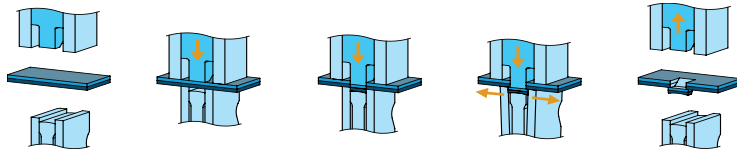
# Unrivalled range of options for customer-specific applications

## Clinching type S-DF

- Low-cost tools
- Torsion-proof element
- Also suitable for joining more than two sheet metal layers
- Recommended for workpieces of different forming behaviour (e.g. steel / aluminium)



Clinching type S-DF, beam-shaped clinching element

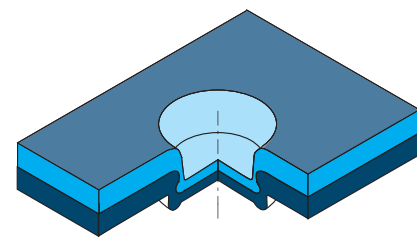


Steps with clinching option S-DF

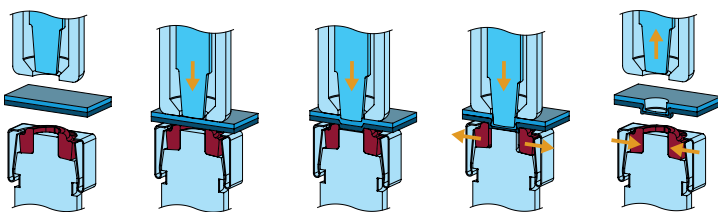
	Shear strength, transverse <sup>1)</sup>		Shear strength, longitudinal <sup>1)</sup>		Cross tension strength <sup>1)</sup>	
	aluminium	mild steel	aluminium	mild steel	aluminium	mild steel
S-DF punch width						
2 mm	1150 N	1400 N	1100 N	1150 N	380 N	580 N
3 mm	1380 N	1900 N	1280 N	1400 N	420 N	720 N
4 mm	1750 N	2400 N	1600 N	2000 N	620 N	900 N

## Clinching type R-DF

- Circular, fluid-tight clinching element
- Suitable for various material thickness combinations
- Symmetric shear strength
- Particularly recommended for workpieces of different forming behaviour (e.g. steel / aluminium) and hybrid joints (metal / adhesive)



Clinching type R-DF, round clinching element



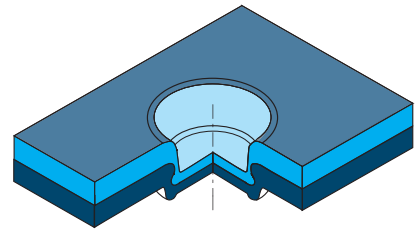
Steps with clinching option R-DF

	Preparation of workpieces to be joined	Clinching element geometry	Requirements regarding tool holders
S-DF	Both workpieces cut	Beam-shaped	Tools centred along one axis
R-DF	No workpiece cutting	Round	Tools centred along two axes
G-DF	No workpiece cutting	Round	Tools centred along two axes
CONFIX	One workpiece prepunched	Round	Tools centred along two axes
Shear clinching	One workpiece cut	Round	Tools centred along two axes

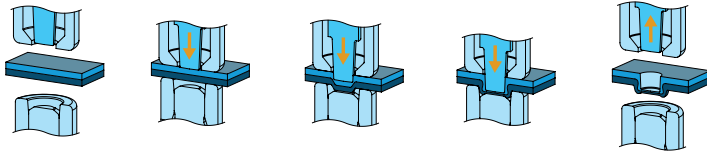


## Clinching type G-DF

- Circular, fluid-tight clinching element
- Symmetric shear strength
- Minimum workpiece deformation
- More compact than opening tools (R-DF)
- Particularly recommended for workpieces of different forming behaviour (e.g. steel / aluminium)
- Particularly recommended for workpieces of poor forming behaviour (e.g. die-cast aluminium)



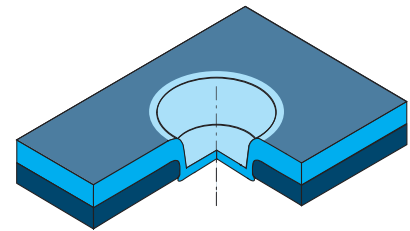
Clinching type G-DF, round clinching element



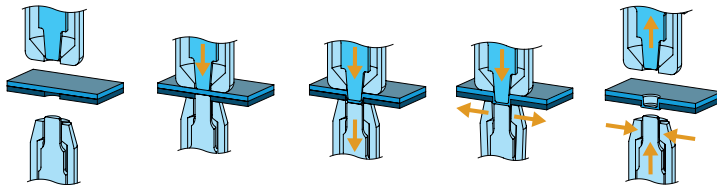
Steps with clinching option G-DF

## Clinching type CONFIX

- Round element with small or no die-side protrusion
- Symmetric shear strength
- Joining of workpieces where die-side element is made from material with poor forming properties (e.g. spring steel)
- Joining of workpieces of different thickness (e.g. 1.0 mm in 4.0 mm)



Clinching type CONFIX, round clinching element



Steps with clinching option CONFIX

	Shear strength <sup>1)</sup>		Cross tension strength <sup>1)</sup>	
	aluminium	mild steel	aluminium	mild steel

### R-DF die-side element diameter

6 mm	1200 N	1800 N	700 N	1300 N
8 mm	1800 N	3000 N	1000 N	1450 N

### G-DF die-side element diameter

6 mm	1700 N	1950 N	600 N	1500 N
8 mm	2650 N	3400 N	750 N	1450 N

### CONFIX anvil diameter, depending on prepunched hole diameter or standard series

5 mm	1680 N	2400 N	600 N	1280 N
6 mm	1820 N	3000 N	1000 N	1500 N

### Shear clinching

on request

1) The holding forces stated relate to workpieces made of steel (DC01) or aluminium (AlMg3) of 1.0 mm single layer thickness and are only given as a guideline. Differing values may be obtained where other qualities and thicknesses of material are used.

2) The max. total thickness refers to steel and aluminium alloys with good forming properties, a total elongation  $A_{30} \geq 12\%$  and a yield ratio  $R_{30.2} / R_m \leq 0.7$ . Examples: steel: DC04 • DX56 • CR180BH; aluminium: AlMg3 • AlMg4.5Mn0.4 • AlMg0.4Si1.2(T4). Deviations from these workpiece thickness combinations might be possible. For details, contact ECKOLD.

Permissible single layer thicknesses <sup>2)</sup>      Permissible total thicknesses <sup>2)</sup>

### S-DF punch width

2 mm	0.5 - 2.0 mm	1.0 - 3.0 mm
3 mm	0.5 - 2.5 mm	1.0 - 4.5 mm
4 mm	0.5 - 3.0 mm	1.0 - 6.0 mm

### R-DF die-side element diameter

6 mm	0.5 - 2.0 mm	1.0 - 3.5 mm
8 mm	0.5 - 2.5 mm	1.0 - 4.5 mm
10 mm	0.6 - 3.0 mm	1.2 - 5.0 mm
12 mm	0.8 - 3.5 mm	1.6 - 6.0 mm

### G-DF die-side element diameter

4 mm	0.4 - 1.5 mm	0.8 - 2.5 mm
6 mm	0.5 - 2.0 mm	1.0 - 3.5 mm
8 mm	0.5 - 2.5 mm	1.0 - 4.5 mm
10 mm	0.6 - 3.0 mm	1.2 - 5.5 mm
12 mm	0.8 - 3.5 mm	1.6 - 6.0 mm

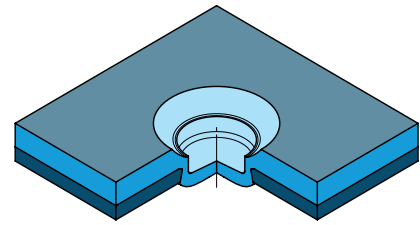
### CONFIX anvil diameter, depending on prepunched hole diameter or standard series

5 mm	0.5 - 4.0 mm	1.0 - 5.0 mm
6 mm	0.5 - 5.0 mm	1.0 - 6.0 mm

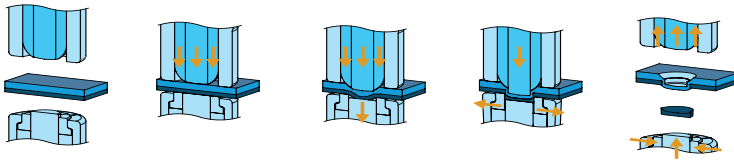
Shear clinching 7 mm	punch-side 1.15 - 3.5 mm	2.0 - 4.5 mm
	die-side 0.8 - 2.0 mm	

## Clinching type shear clinching

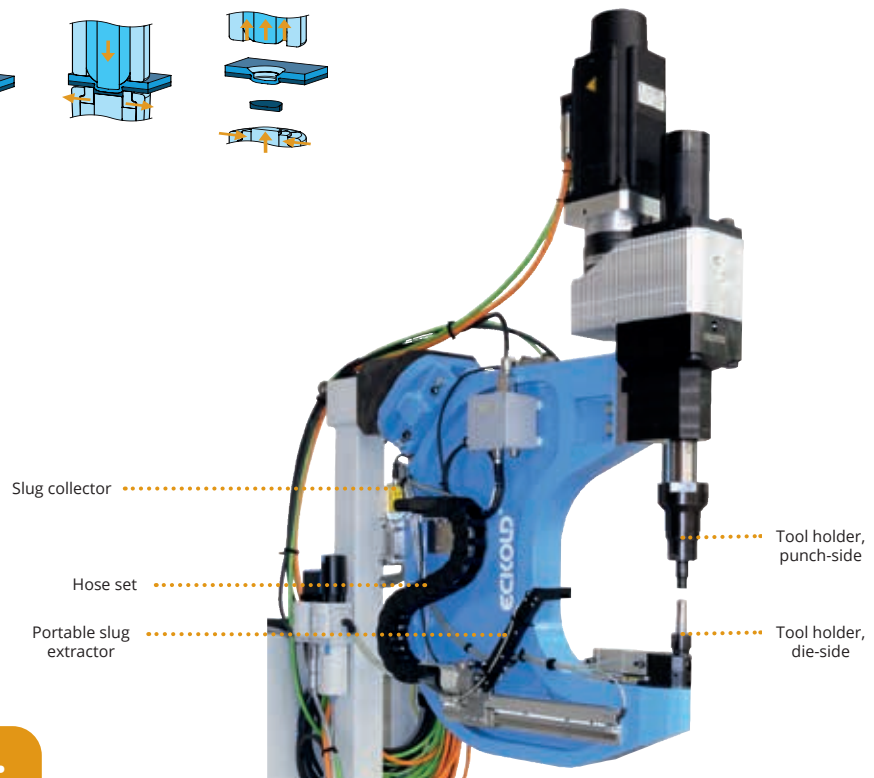
- Round element with small or no die-side protrusion
- Symmetric shear strength
- Joining of workpieces where die-side element is made from material with poor forming properties (e.g. press-hardened steel)
- Joining of workpieces of different thickness
- No need for pre-punching
- Slug extractor required



Clinching type shear clinching, round clinching element



Steps with clinching option shear clinching



• INNOVATIVE •  
*Made by ECKOLD®*



## Four-segment die

With the four-segment die, ECKOLD offers a new tool for universal use. This die type is particularly suitable for the machining of workpieces whose material has become brittle or aged. The effect of frame positions and transverse loads on the clinching process is minimized, while the risks of cracks in the die-side metal sheet is significantly reduced.

### Characteristics and advantages

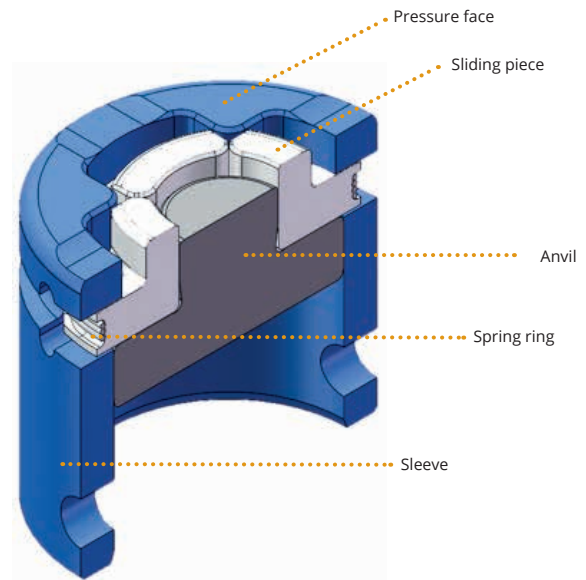
- Improved joining of brittle and aged materials
- Protruding die sleeve and well-defined sheet support surfaces reduce the impact of inclined positions and transverse loads on the clinching result
- Bevelled sliding pieces minimise the risk of cracks in the die-side metal sheet
- Easy cutting pattern creation thanks to even number of sliding pieces



• INNOVATIVE •  
Made by ECKOLD®



Four-segment round die



Two-segment R-DF die with hood spring



G-DF die



CONFIX die



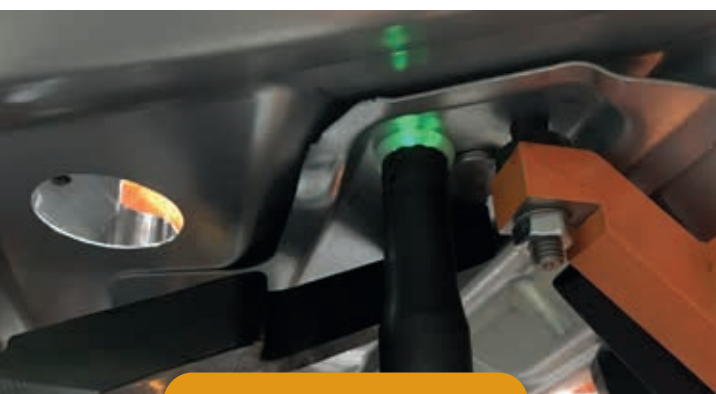
S-DF expanding die



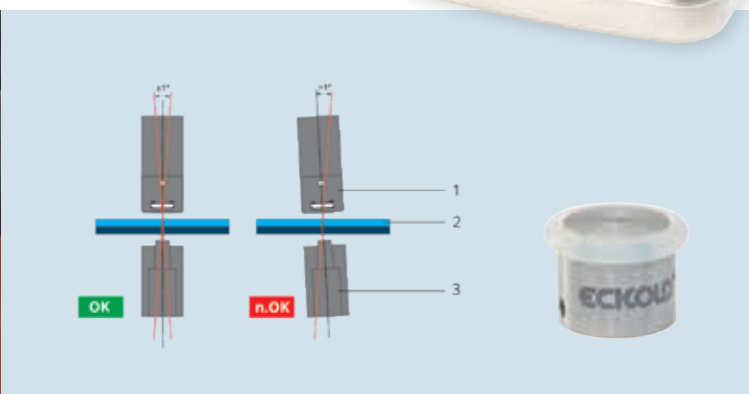
S-DF expanding die with folding sleeve

## ECKOLD TeachCap - Fast teaching of robot-guided clinching frames in the automated industry

- Shorter setup and programming times
- Faster teaching of robots
- Improved quality of initial teach-in processes
- Rubber ring serves as distance guide to interfering edges and radiuses
- Prolonged tool service life
- Easy handling: simply replace the die with the TeachCap
- Efficient optimisation of production process



• INNOVATIVE •  
Made by ECKOLD®

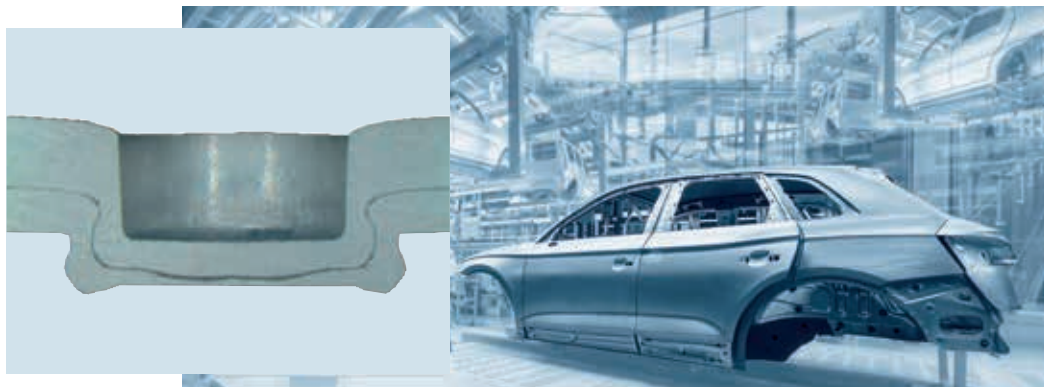


Optimised angle position of joining axis to workpieces vs. angle position deviation greater than 1°  
1 = Die | 2 = Workpieces | 3 = Punch

## Joining innovative materials with R-DF 10

Newly developed materials require innovative joining techniques, especially in the automotive industry. To reduce the weight of car bodies, manufacturers use for instance aluminium die-cast structural components, which are generally difficult to clinch.

ECKOLD has responded to these new demands by offering solutions for the joining of aluminium die-cast workpieces with other materials such as aluminium, also catering for large total joining thicknesses. For such tasks, clinching type R-DF 10 is the recommended solution.



Optimised R-DF 10 clinching element



# There are many good reasons that speak for ECKOLD clinching

## Advantages and characteristics

- No thermal stress at joining point
  - No interference with workpiece material properties
  - No deformation in workpieces
- Joining of workpieces of different thickness and made from different materials
- Flexibility with regard to joining direction
- Various workpiece thickness combinations can be machined with a single tool set
- Suitable for hybrid joining (combination of gluing and clinching)
- No need to prepare workpiece surfaces
- Joining of coated workpieces (metallic, organic coats) without damage to coating
- No need for preparation or reworking of joints (drilling, deburring, grinding)
- Irregular sheet metal thickness is not a problem
- Excellent conductivity of joining point
- Quality control by means of non-destructive testing of bottom thickness and outside diameter with gauges, and online process monitoring
- Cost-effective method for the joining of austenitic stainless steel



### Comparison with thermal methods (e.g. welding)

- No need to prepare workpiece surfaces
- No thermal stress at joining point
  - No interference with workpiece material properties
  - No deformation in workpieces
- No hazardous gases and fumes
- Workpiece contact resistance has no effect on joining quality
- Changing process conditions do not affect result
- Low energy consumption
- Low capital expenditure and running costs
- Cost savings of up to 55 % over spot welding

### Comparison with self-piercing riveting (semi-tubular and solid rivets)

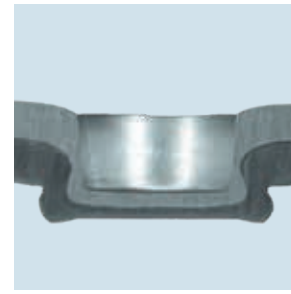
- No need for auxiliary material
  - No time-consuming rivet handling
  - No risk of contact corrosion between rivet and workpieces
  - Fewer quality assessment parameters (rivet foot compression, cracks in rivet, etc.)
- No need for slug removal
- Beam-shaped clinching elements prevent rotation; with riveting, this requires two rivets
- Low capital expenditure and running costs

# Quality assurance and process monitoring

For quality assurance, ECKOLD offers a manual method as well as an online process monitoring tool. For the manual assessment of the clinching element quality, the bottom thickness and the element width need to be examined.

The online process monitoring system allows for seamless and continuous 100 % quality control, for instance in series production plants. Our special software solution **ECKOLD VISU** visualises both the machine control and all processes that need to be monitored on a single human machine interface (HMI). For process monitoring, the system compares the current machine signals with reference monitoring signals.

The results of these comparisons are visualised in three different ways for in-depth analysis. The monitoring system detects process and machine errors, e.g. use of incorrect workpieces or incorrect machine settings. The process monitoring system allows operators to configure, parameterise, monitor and document the clinching process online. This makes production much more efficient and cheaper, as problems can be detected and eliminated promptly to prevent downtimes and reduce the number of rejects.



Optimised R-DF clinching element

Clinchparameter

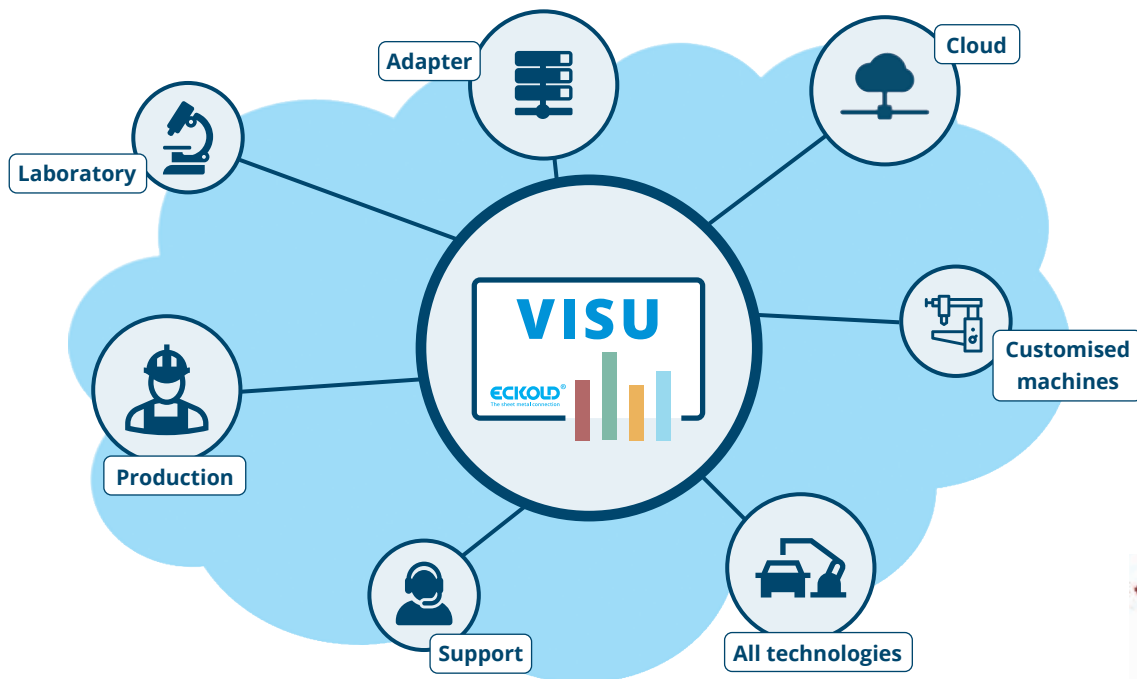
ECKOLD		Einbaulage 2-erflge Matrize	
<b>Benennung</b>		Clinchhöhe	
Typ	DFB-1177-00-000		
Ident-Nr.	0000009648		
Fabrik-Nr.	90017765		
Produkt-Nr./Station-Nr.			
PLM-Nr.			
Erstelldatum Dokument	20.09.2017		
<b>Werkstoff-Dicken-Kombination</b>		-	-
Probbericht-Nr.		1234	1235
<b>Werkstoff</b>	Werkstoffbezeichnung	AL5.LDR.TZ.E	AL5.LDR.TZ.E
	Dicke l <sub>1</sub> [mm]	1,50	1,70
<b>Microspitzen-Medium</b>	Werkstoffbezeichnung	RM1630	RM1630
	Dicke l <sub>2</sub> [mm]	-	-
<b>Klebstoff</b>		-	-
<b>Microspitzen</b>	Werkstoffbezeichnung	AL5.LDR.TZ.U	AL5.LDR.TZ.U
	Dicke l <sub>3</sub> [mm]	0,70	0,70
	Microspitzen-Medium	-	-
<b>WerkzeugparameterTyp</b>		R-GRS	R-GRS
Stempel (Benennung)	645.481	645.481	645.481
Stempel (Ident-Nr.)	1000005480	1000005480	1000005480
Matrize (Benennung)	277.10	277.10	277.10
Matrize (Ident-Nr.)	1000007164	1000007164	1000007164
Bosendicke l <sub>4</sub> [mm]	0,80	0,80	0,80
Toleranz l <sub>4</sub> [mm]	+0,05 / -0,1	+0,05 / -0,1	+0,05 / -0,1
<b>Kombination Werkzeugpaar</b>			
Stempelverdrück	-	-	-
Dicke Abstremscheiben [mm]	3	3	3
Niederhalterfederkraft [N/mm]	380	380	380
Niederhaltervorspannung	120N/mm	120N/mm	120N/mm

All machines and tools are shipped with clinching parameter sheets stating the recommended parameter values for the envisaged clinching task



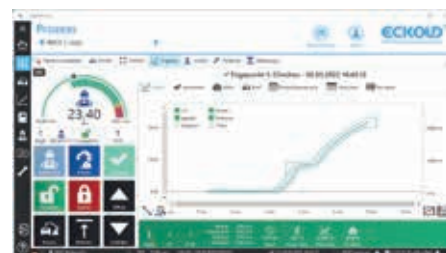
## Visualisation ECKOLD VISU: One for all

Our innovative in-house software solution is based closely on user requirements and we can implement optimisations or custom adaptations, if desired. If multiple technologies such as clinching and self-piercing riveting are used within a production cell, **only one** ECKOLD visualisation is necessary, and it also communicates with multiple control cabinets as required.



### Features and benefits

- Modern and functional design
- Intuitive user interface
- Password protected access levels
- Component-specific profile display
- Process monitoring with different methods such as window or envelope technique
- Import function for joining tasks
- Archiving of measurements, saving of data on the PLC or the system computer
- Support archive and remote access
- Interfaces to customer cloud / databases, etc.
- PLC updates via VISU
- Drag and drop function for VISU updates
- Custom input masks, also with special functions, to be implemented by the manufacturer
- No installation of additional operating system components necessary



Visualisation



Process monitoring methods: Envelope (1), window (2) and trend monitoring (3)

## Service von A-Z

- Tests and analyses for our customers
- Creation of sample sheets/components
- Preparation of feasibility studies for the design of moulds
- Concept development and constructive realisation of the technical solution
- Production in our own factory
- Commissioning at the customer's premises
- Carrying out regular maintenance
- Support with optimisations in the customer's process
  - Support with the robot position teaching process
  - Creation of micrographs / evaluation of clinching point quality
  - Online support

Start-up support after commissioning up to SOP

Training of system operators/maintenance staff/experts

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## Facts and figures

- Founded in 1936
- Products in use in over 100 countries
- Over 25 sales partners worldwide
- Sales companies in Great Britain, Hungary, USA
- Certified according to ISO 9001:2015
- Certified according to ISO 14001:2015

