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RAKU-TOOL®
Metal Sheet Forming

New polymer materials for metal sheet forming

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Content

Application areas for new polymer materials

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- 2 - part forming tools (stamping tools)
- 3 - part forming tools with punch, blank holder and die
- Composite tools
- Hammer forms
- Stretch dies (aerospace industry)
- Fluid cell tools
- Hydroforming tools (only prototyping)

Classification and requirements of prototyping and short run tools

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	group A	group B	group C
Requirements	accuracy (form, contours, cut-outs)	accuracy stability	accuracy stability surface quality
Type of parts	non-structural interior parts	crash-energy absorbing structural parts	crash-energy absorbing body parts
Examples	protective metal sheet	structural sheet metal parts for passenger cars	passenger car door panel

Source: IFU, Stuttgart

Requirements

> Determination of the geometry of the subsequent short run production tools
> Grade/quality of the subsequent short run production parts
> Conclusion about the process safety of future production

Advantages of new polymer materials

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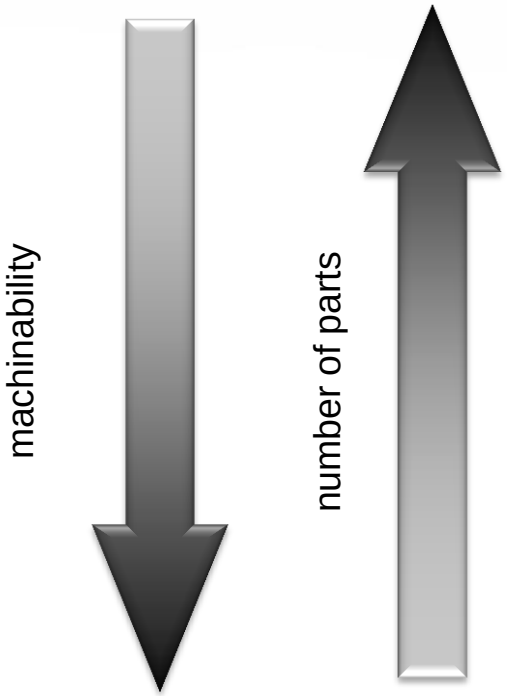
Mass Casting	Close Contour Casting	Boards
• Can be cast in thick layers and large volumes • Casting viscosity can be adjusted via filler addition • Low exothermic reaction for layer thickness >600-1000mm • Minimal shrinkage (3200 x 500 x 700 mm ca. 0.4%)	• Due to close contour shape, faster milling times and less wastage • The surface is seamless, smooth and very dense. • Fast delivery (ca. 5 – 10 working days) • High quality castings	• Fast build-up through bonding of boards • Boards can be supplied in various thicknesses / dimensions
Can be processed by hand or with mixing and metering equipment.	No handling of liquid products. Concentration on your strength, the milling process.	

> Excellent mechanical properties
> Excellent dimensional stability
> Easy to machine with HSC tools
> Tools do not have to be polished = time saving
> Good sliding properties
> Easy to repair and to modify.
> Faster lead times and lower costs in comparison to conventional materials
> Recyclable
> Easy transportation as relatively light weight when compared to conventional materials (e.g. Zamak, Cerotru)

Advantages of new polymer materials

Boards
Machinability vs number of pressed parts
Comparison between board material and metal

- Cast iron GG 25
- Zamak / Kirksite
- WB-1700
- WB-1600



WB-1700 is well suited for pressing aluminum and stainless steel because of its tribological characteristics.

New polymer materials

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Mass Casting

RAKU-TOOL®
PC-3403 / PH-3903 / AC-9004*

Close Contour Casting

RAKU-TOOL® CC-6504*

RAKU-TOOL® CC-6506**

Boards

RAKU-TOOL® WB-1600*

RAKU-TOOL® WB-1700**

* similar to **PH-3903 / PC-3403 / AC-9004 or CC-6504 or WB-1600**
** similar to **CC-6506 or WB-1700**

RAKU-TOOL®
mechanical and physical properties

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RAKU-TOOL	density (ISO 1183) g/cm3	hardness (ISO 868) Shore D	coefficient of thermal expansion (ISO 11359) 10-6 K-1	heat deflection temperature (ISO 75) ºC	compressive strength (ISO 604) MPa	compressive modulus (ISO 604) MPa	linear shrinkage (mm/m)
Mass Casting							
RAKU-TOOL® PC-3403 / PH-3903 (unfilled)	ca. 1.2	80	100	75-80	85-90	3,000	2,0
RAKU-TOOL® PC-3403 / PH-3903 / AC-9004	ca. 1.6	85	45-50	75-80	90-95	9,000	0,6
Close Contour Casting							
RAKU-TOOL® CC-6504	ca. 1.87	85-90	40	80	**90-100**	**10,000**	-
RAKU-TOOL® CC-6506	ca. 1.9	90-95	35	**110**	**120-130**	**13,000**	-
Boards							
RAKU-TOOL® WB-1600	ca. 1.6	85-90	45-50	75-80	**90-100**	-	-
RAKU-TOOL® WB-1700	ca. 1.7	85-90	45-50	**120-125**	**125-130**	-	-

Possibilities with Close Contour Casting

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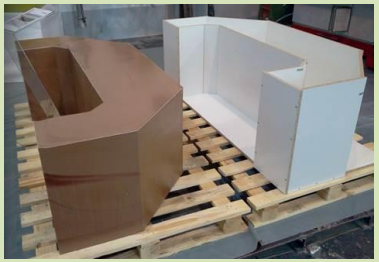
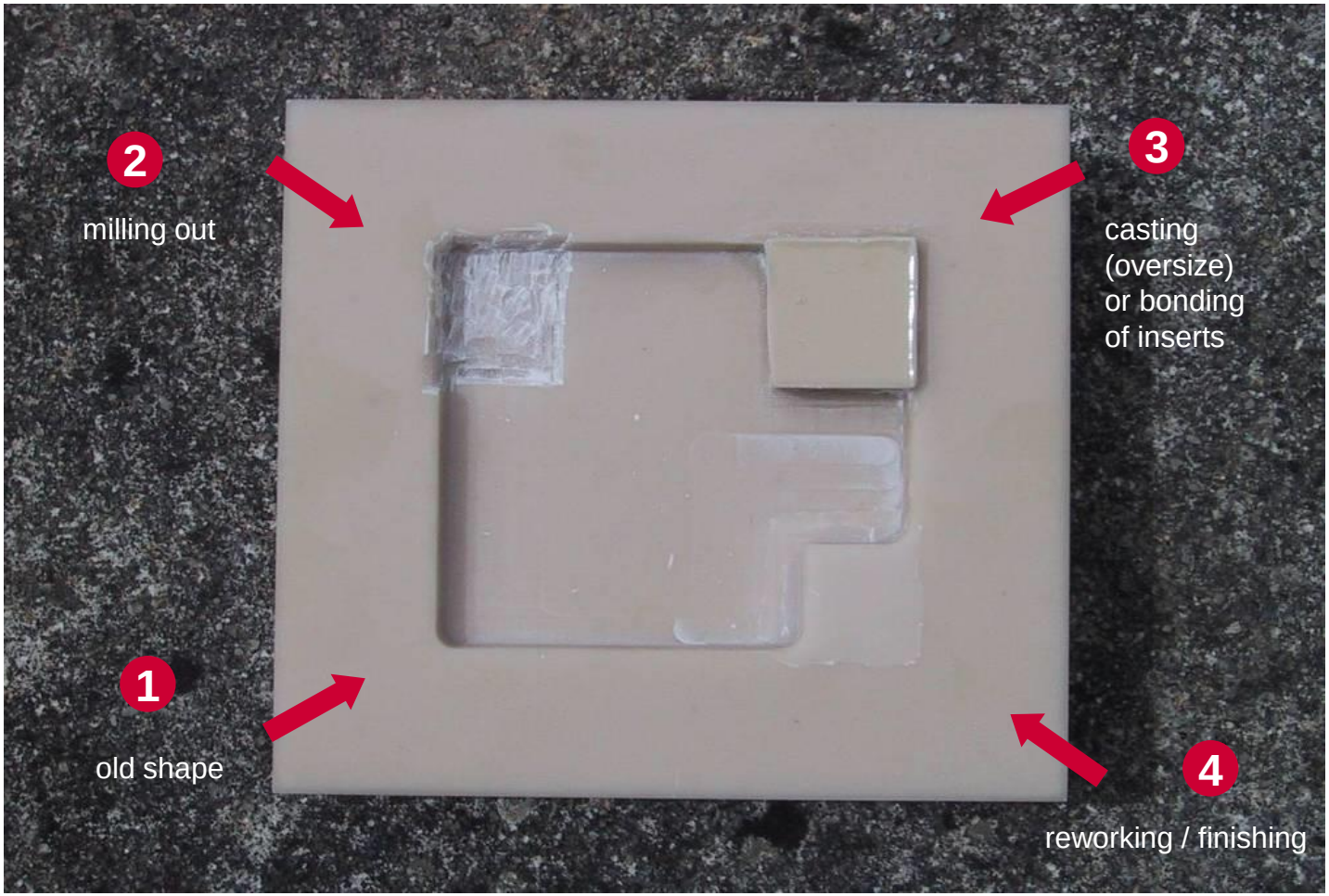
Close Contour Blocks (CB)	Customized Castings (Close Contour Castings, CC)		
Close Contour Blocks are supplied as customized, rectangular and unmachined blocks.	Castings in different shapes and sizes, customized according to the customer's request.		
Basic, rectangular molds made from laminated chipboard (cost of material in liter)	**Basic molds** made from laminated chipboard (cost of mold + cost of material in kg)	**Molds made according to data without a core** (cost of mold + cost of material in kg)	**Molds made according to data , incl. a core** (shell casting) (cost of mold + cost of material in kg)
			

Modification / Repair

RAKU-TOOL® polymer tools can be
quickly and easily repaired or modified.

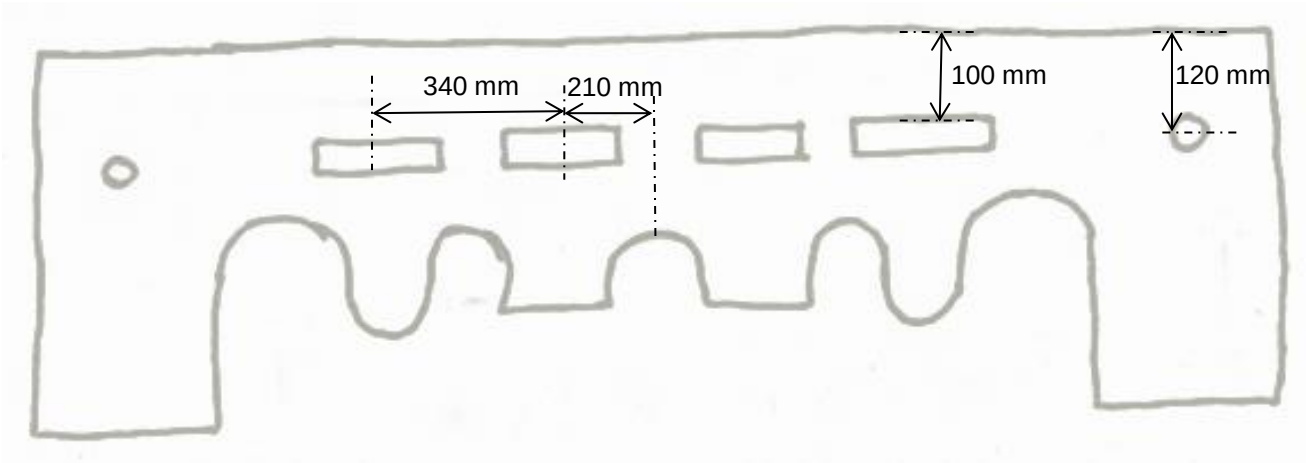


Transportation and clamping

RAKU-TOOL® PH-3903/PC-3403/AC-9004 (80:100:400 pbw) and CC-6504

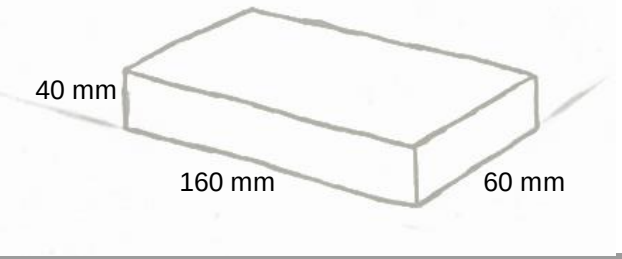
Test results from tensile test after 15 h RT cure

clip 26Ø x 90mm clamping slots 160 x 60 x 45 mm	122 KN no break, test aborted
thread M 16 x 40 mm	43,1 KN



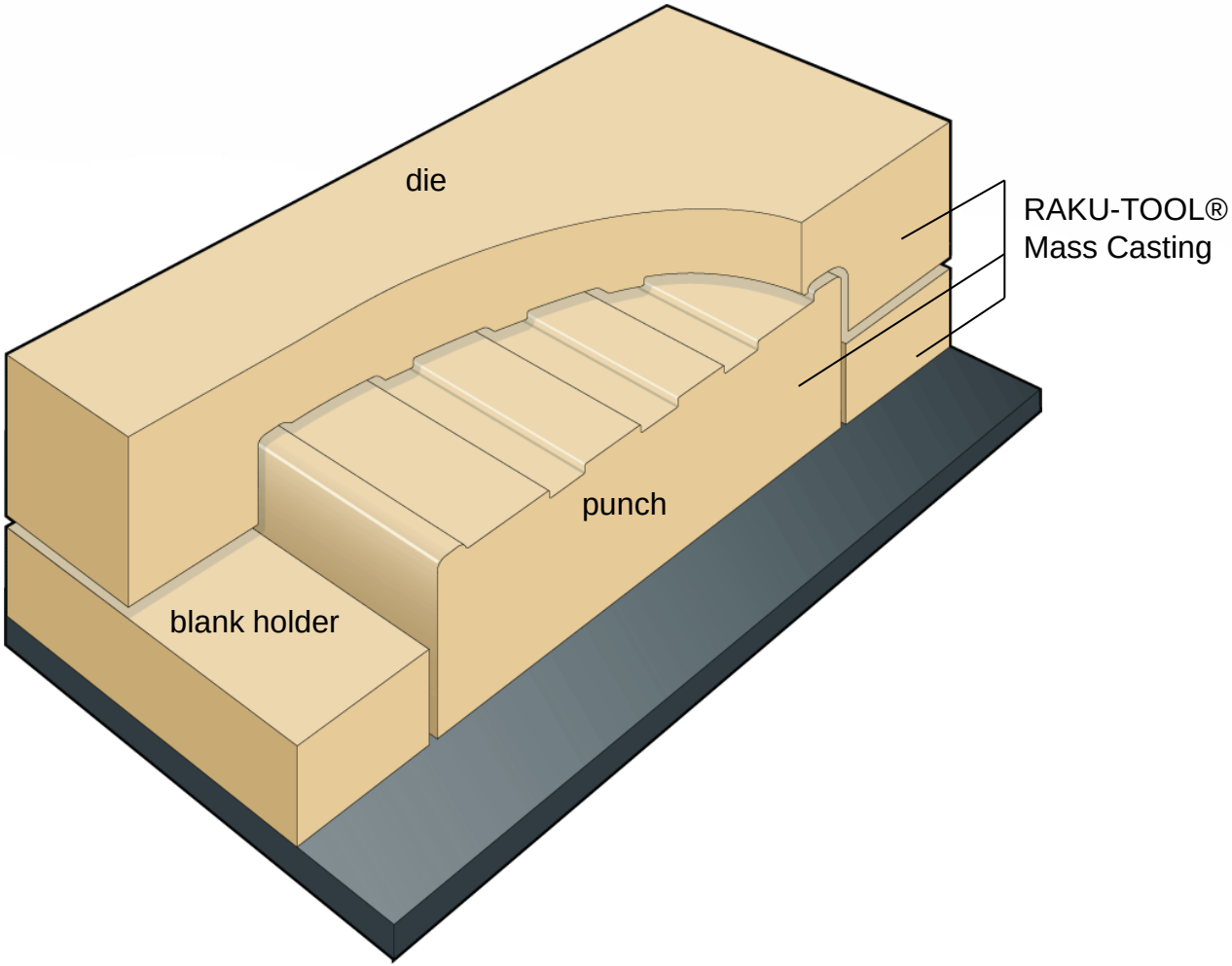
clip 26Ø x 90mm
clip 36Ø x 120mm

clamping slots



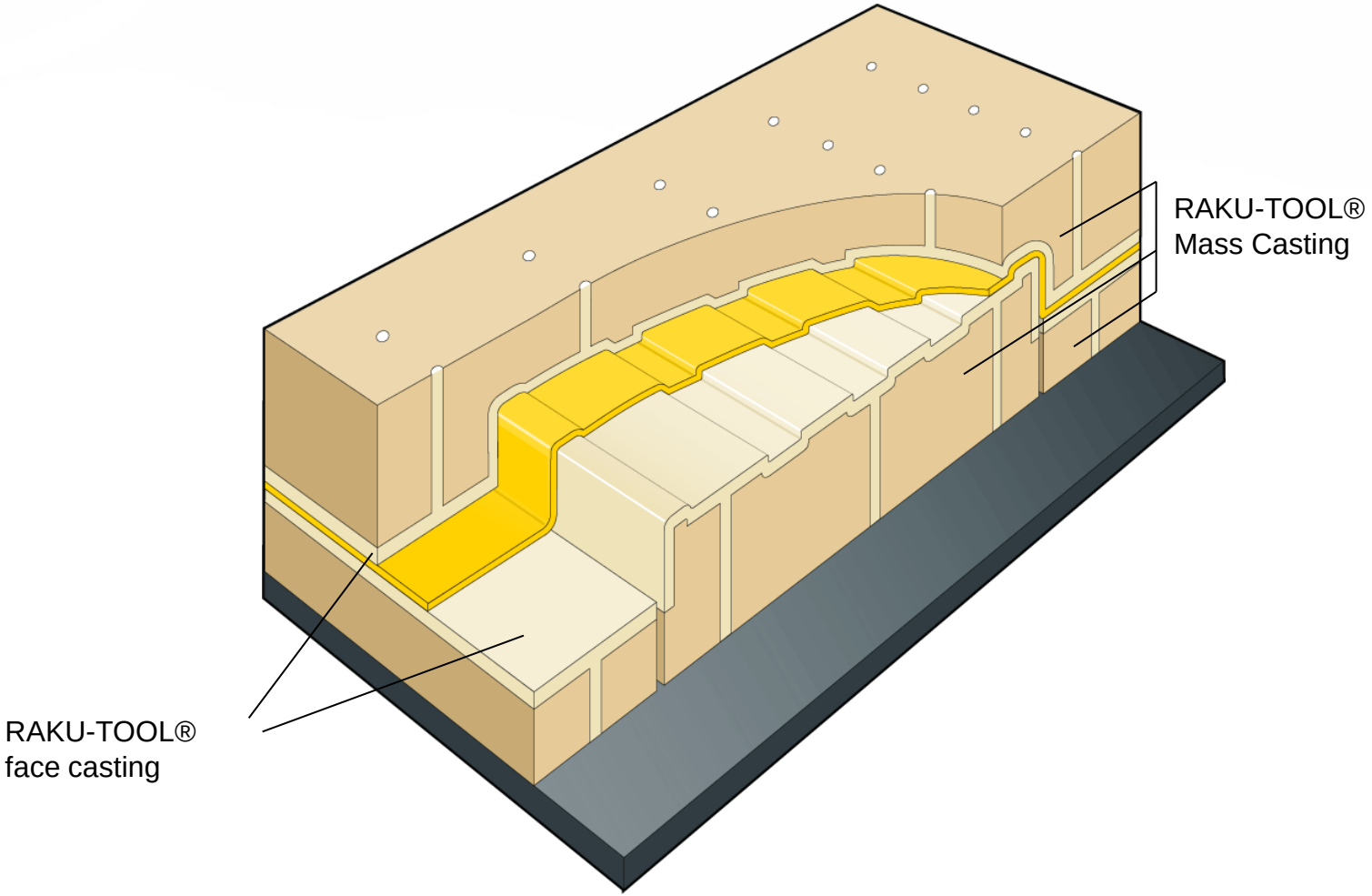
Tool building

> Direct casting of plastic tools



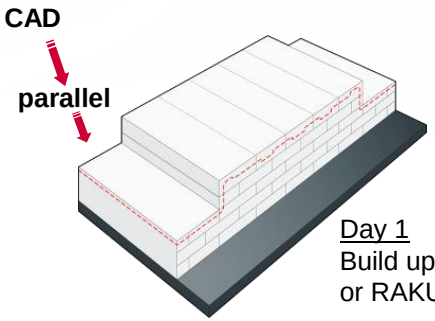
Tool building

> Face casting of plastic tools

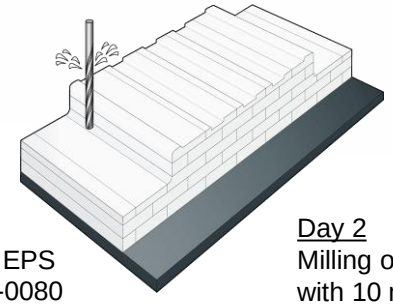


Tool building

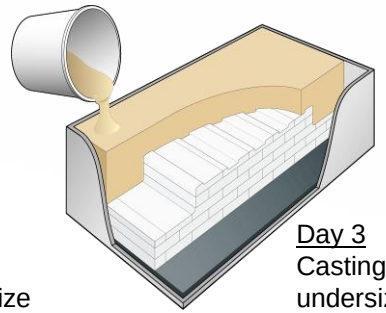
> New RAMPF metal sheet forming tooling route, build-up time max. 8 – 10 days (for in-house casting)



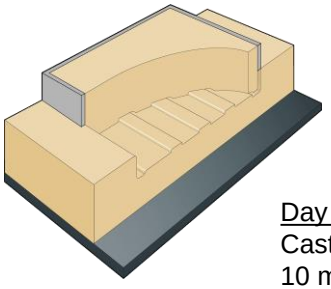
Day 1
Build up of pattern in EPS or RAKU-TOOL® SB-0080



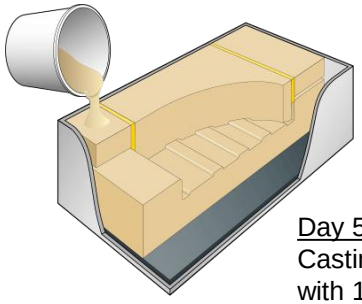
Day 2
Milling of die with 10 mm oversize



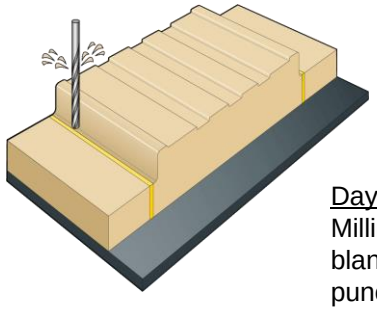
Day 3
Casting of die with 10 mm undersize



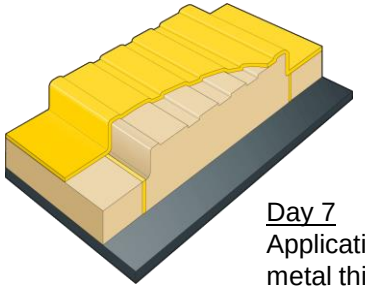
Day 4
Casting of punch with 10 mm oversize



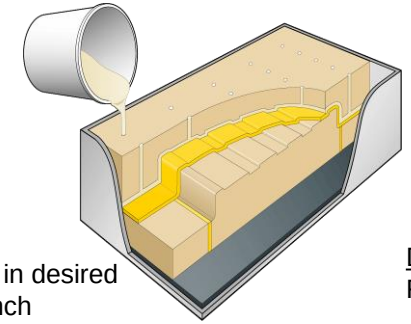
Day 5
Casting of blank holder with 10 mm oversize



Day 6
Milling of actual shape of blank holder and punch



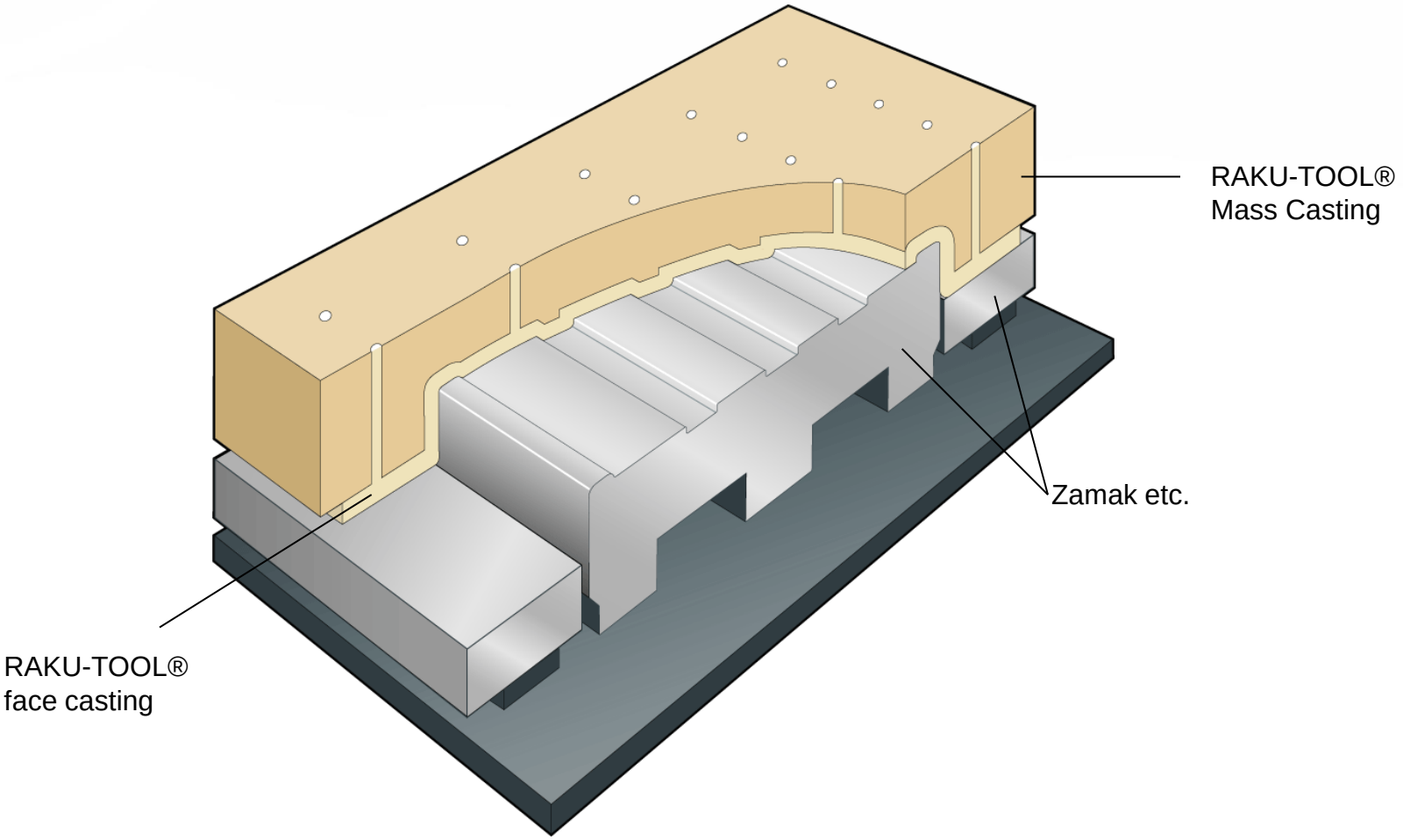
Day 7
Application of wax sheet in desired metal thickness over punch



Day 8
Face casting of die

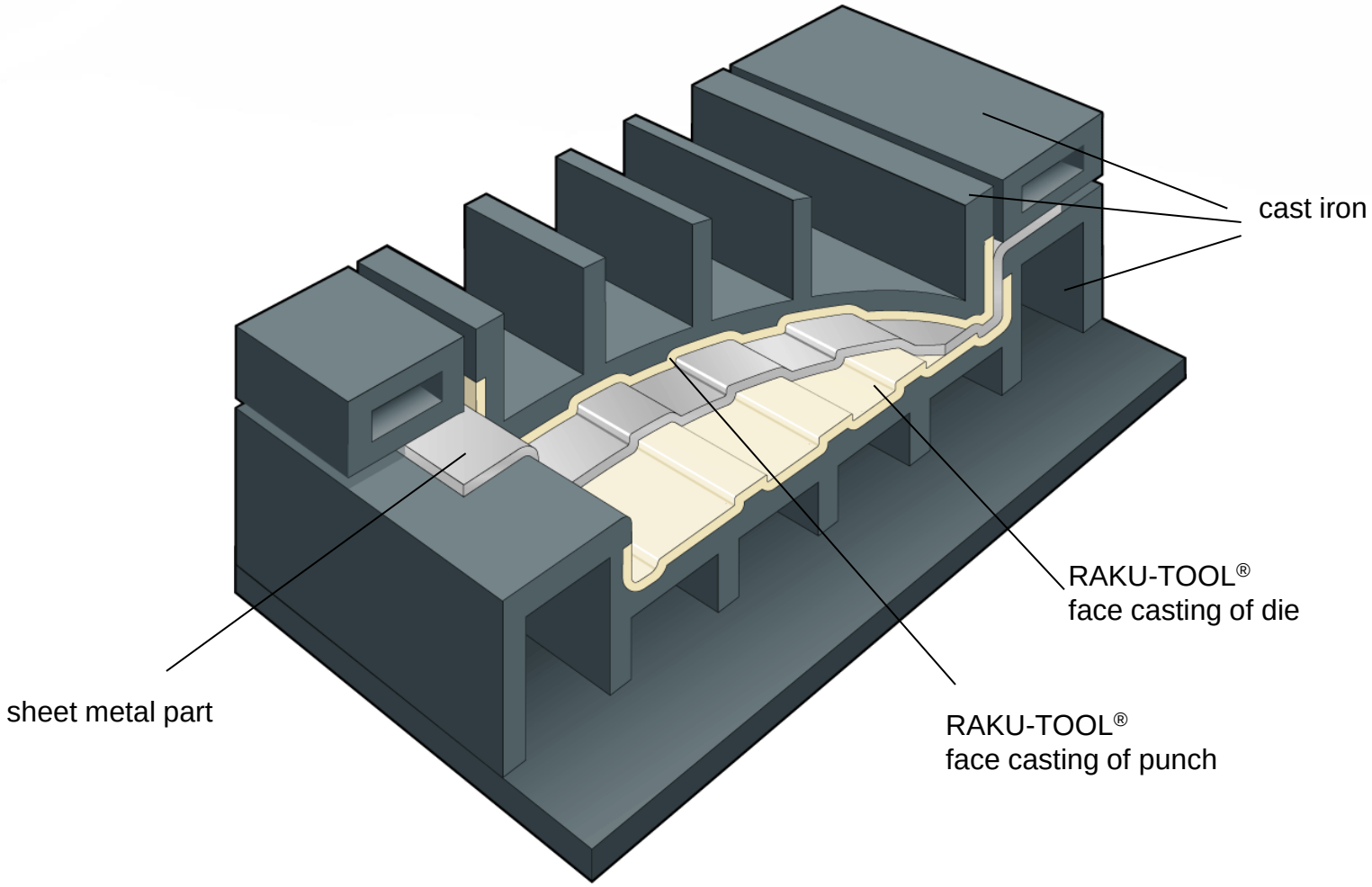
Tool building

> Composite tools made with Zamak (Kirksite) and Mass Casting



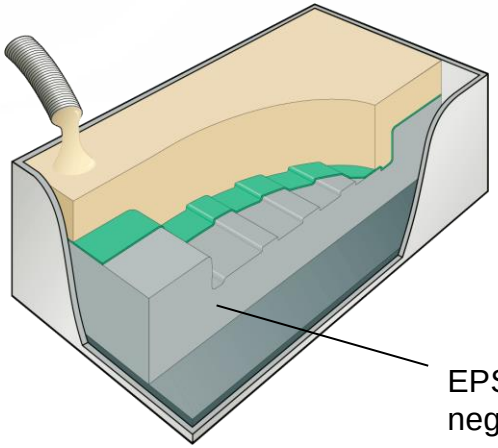
Tool building

> Composite tools made with cast iron GG 25 and face casting with Mass Casting



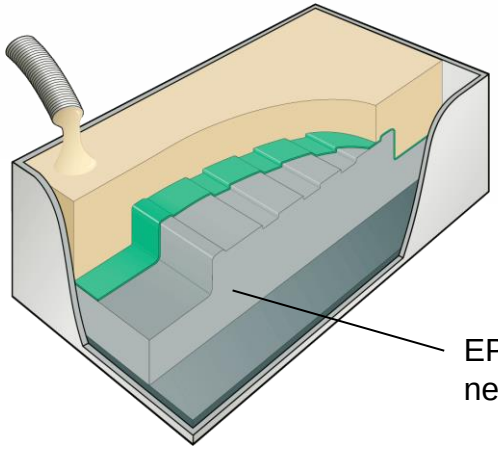
Tool building

> Close Contour Casting



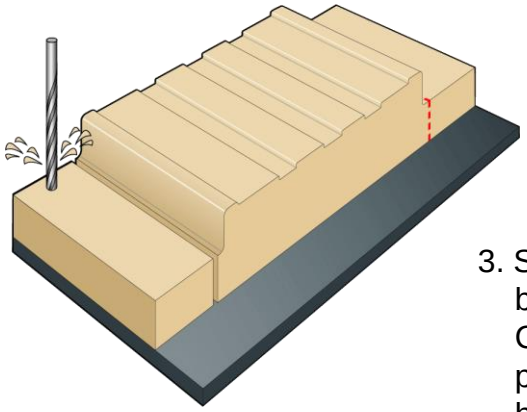
1. Mass Casting of punch and blank holder

EPS or SB-0080 negative

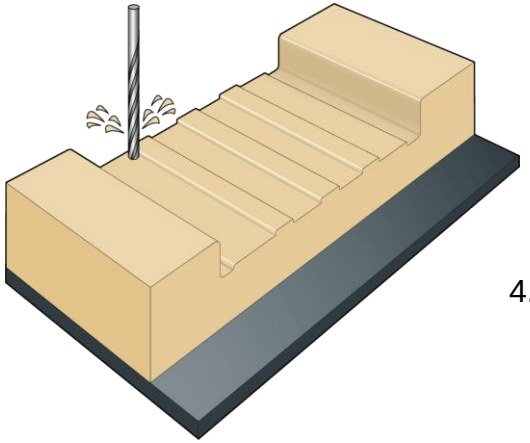


2. Mass Casting of die

EPS or SB-0080 negative



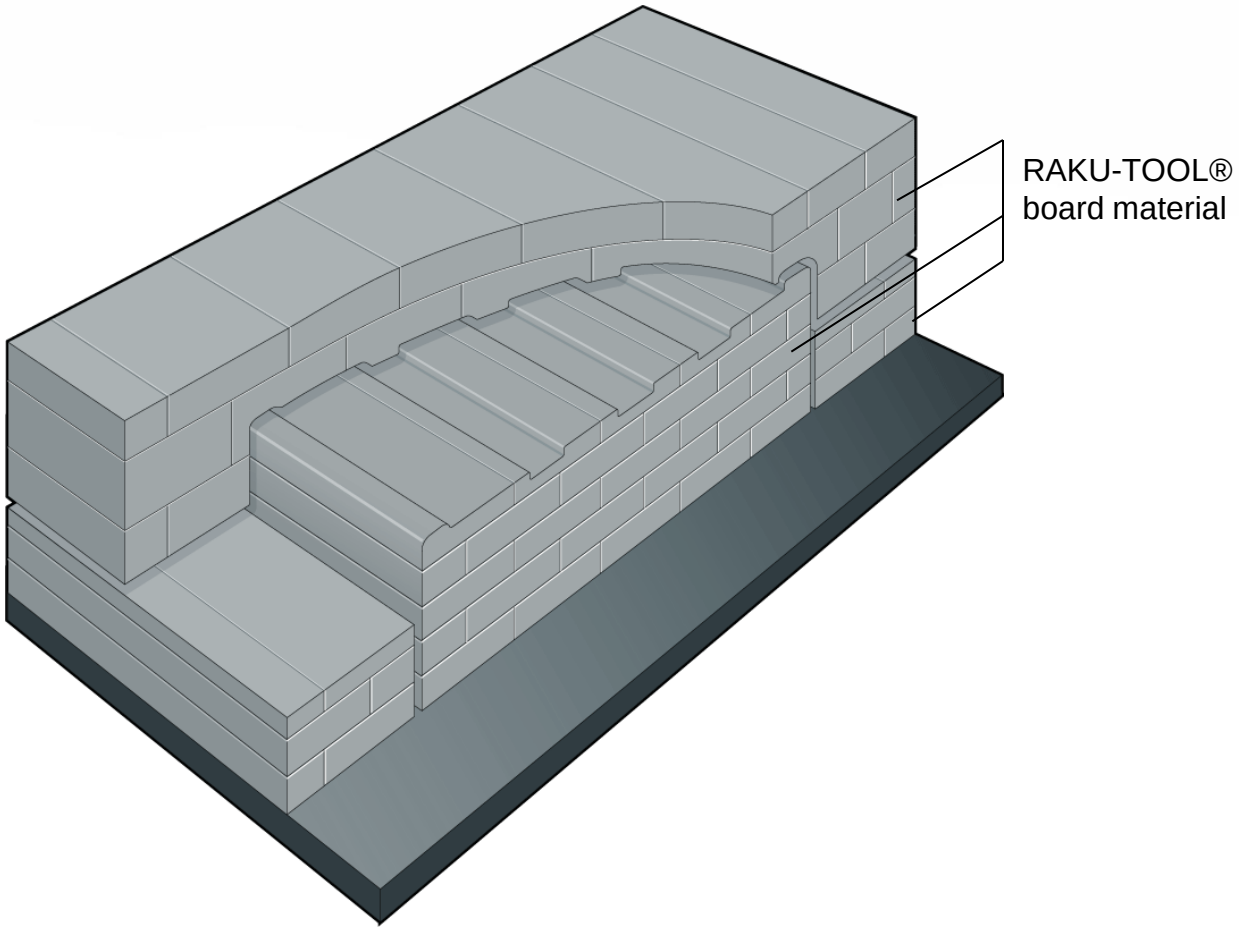
3. Separation of blank holder and CNC milling of punch and blank holder



4. CNC milling of die

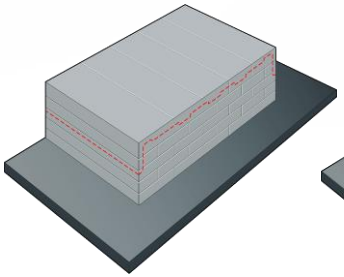
Tool building

> Plastic tools made with RAKU-TOOL® boards

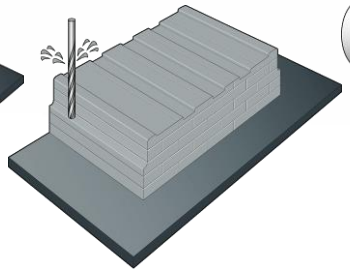


Tool building

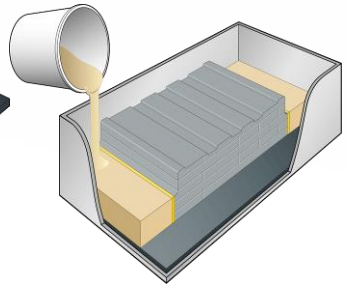
> Composite tools made with RAKU-TOOL® boards and Mass Casting



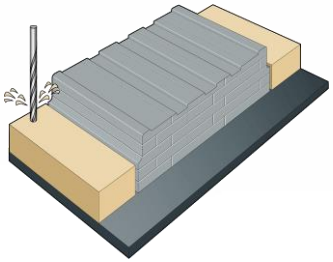
1. Punch (raw): bonding of RAKU-TOOL® board material



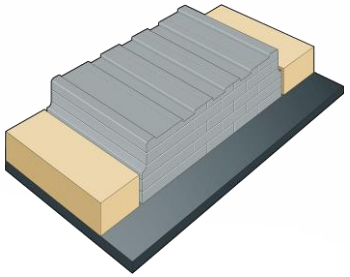
2. CNC milling of punch



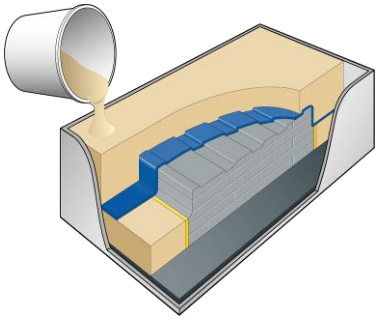
3. Casting of blank holder with filled Mass Casting



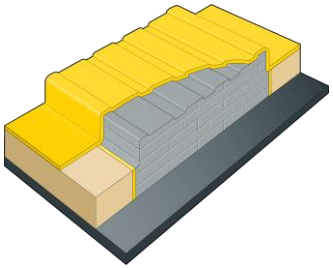
4. CNC milling of blank holder



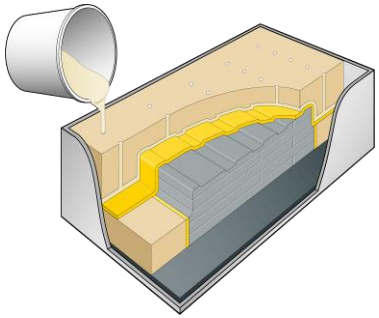
5. Assembly of punch and blank holder



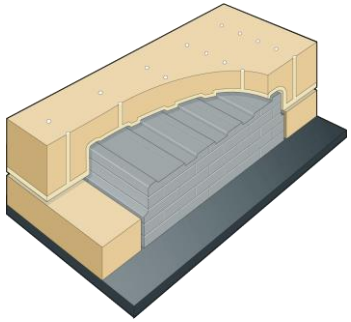
6. Casting of core for the die



7. Application of wax sheet in desired sheet metal thickness to punch and blank holder



8. Face casting of die with filled Mass Casting



9. Assembly and finishing of tool

Time / cost comparison

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New polyner materials vs metal	Boards	Close Contour Casting	Mass Casting	Cerotru	Zamak	GG25
Mechanical properties	+	+	+	—	+(+)	++
Tool build	+	+	+	—	—	—
	in house	in house/ RAMPF	in house	foundry		
No. of parts	500-5000			20-30	>10.000	>20.000
Machining	++	++	++	+	+	+—
Weight to/m³	1.2 – 2.0			8.6	6.8	7.2
Repair / modifications	++	++	++	—	—	—
Average time saving vs GG25 (%)	20-50[3)]	50	45			
Average cost saving vs GG25 (%)	20-50[3)]	30-40	40			
Average time saving vs Zamak (%)	20-40[3)]	50	40			
Average cost saving vs Zamak (%)	30-50[3)]	30-50	30-50			
Material price €/ltr	8	7.50[2)]	5[1)]	?	15-20[4)]	8
Recycling	+	+	+	++	++	++

1) only material cost 2) complete delivery ex RAMPF 3) dependent on mold size
4) New Zamak: 130 €/l Source: Daimler-Chrysler, Sindelfingen / daily price

Application example – automotive industry
RAKU-TOOL® PC-3403 / PH-3903 / AC-9004

car side panel – part of the tool

car side panel – pressed part

Application example – automotive industry
RAKU-TOOL® CC-6504

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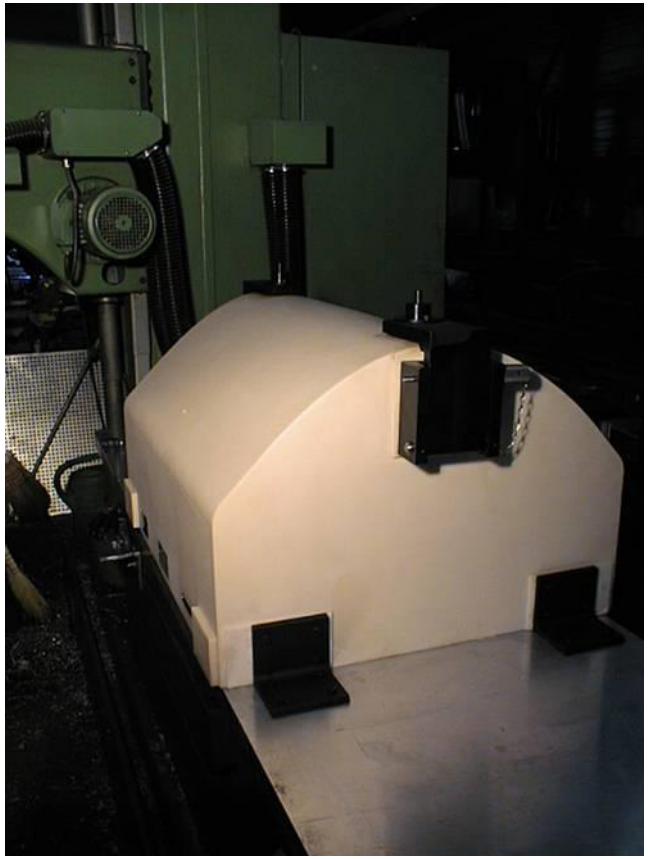
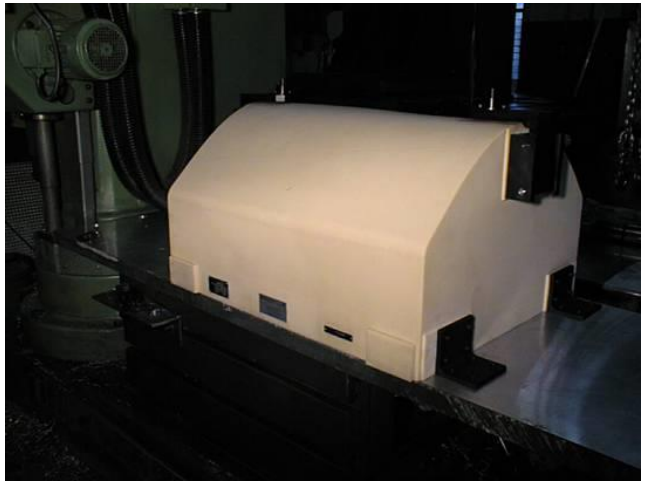
car roof - mold

car roof – cast part

Application example – aerospace industry
RAKU-TOOL® CC-6504



stretch die



stretch dies

Application example – automotive industry
RAKU-TOOL® CC-6504

Punch and die for metal forming tool

Application example – automotive industry
RAKU-TOOL® CC-6506

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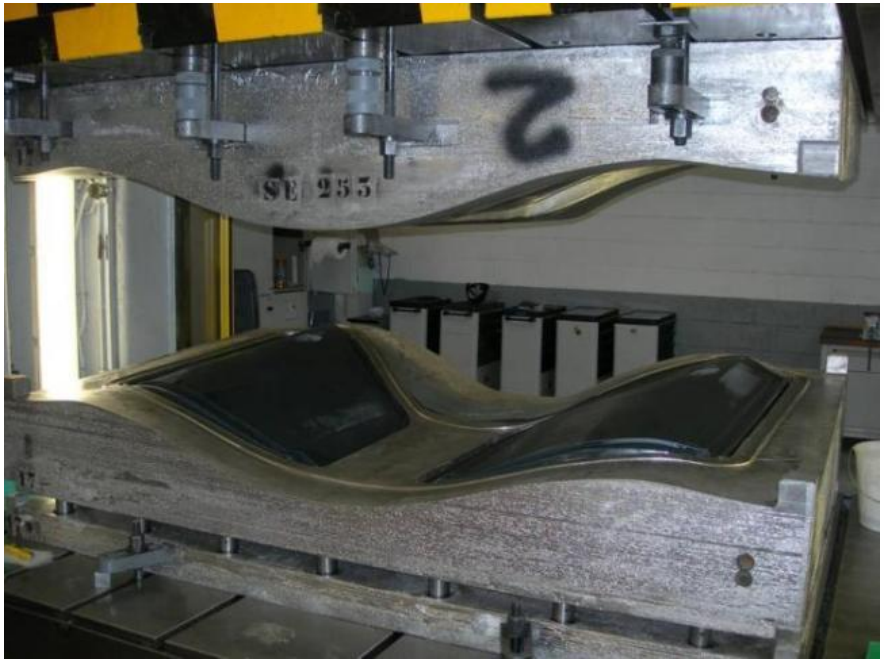
engine housing

Application example – automotive industry
RAKU-TOOL® CC-6506



Hybrid tool for metal forming (punch made from CC-6506, die and blank holder made from Cerrotru)

Finished metal part (side door)

Application example – household
RAKU-TOOL® CC-6506

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cooker plate - tool

cooker plate – pressed part

Application example – aerospace industry
RAKU-TOOL® CC-6506

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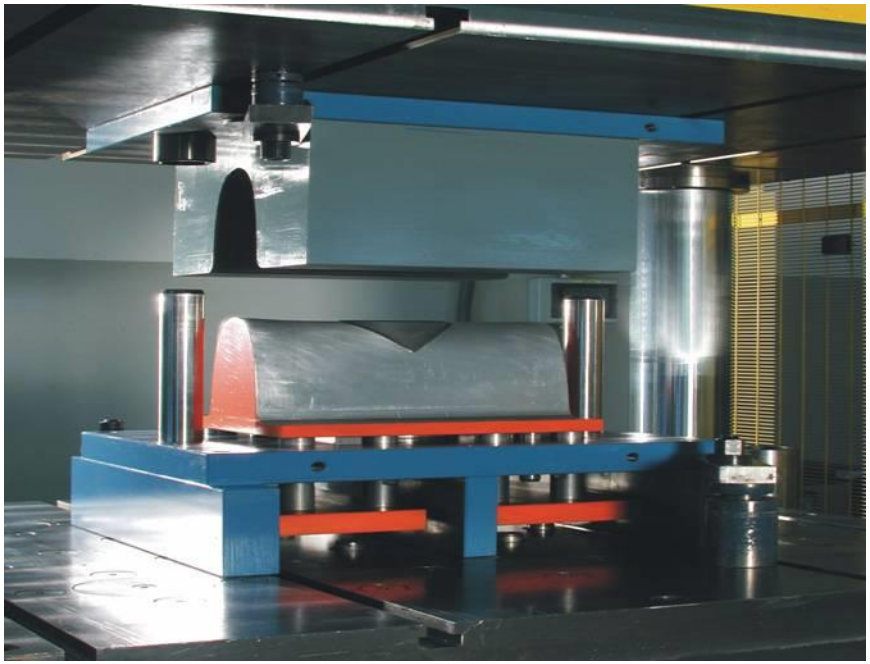

part of an airplane engine - tool

part of an airplane engine – pressed part

RAMPF Tooling Solutions – your partner for metal sheet forming

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Complete systems supplier for polymer materials:

- Casting systems since 2006
- Close Contour Casting since 2002
- Modeling boards since 1982
  Complete board range (styling, modeling and working boards) since 1993

Technical support locally or in the innovation center