RAMPF
discover the future

EN

RAMPF ADVANCED POLYMERS

Tooling & Modeling

Solutions for state-of-the-art model, mold, and tool engineering

RAMPF #DiscoverTheFuture

Chemical and Engineering Solutions

Advanced Polymers | Composite Solutions | Machine Systems | Production Systems

RAMPF Advanced Polymers is a company of the international RAMPF Group.
Find out more on page 20.

RAMPF Advanced Polymers
High-performance. Customized. Eco-friendly.

We have been developing and manufacturing reactive resin systems based on polyurethane, epoxy, silicone, and silane-modified polymers – for more than four decades.

Our portfolio includes
- Sealing systems, electro and engineering casting resins, edge and filter casting resins, and adhesives
- Board and liquid materials for model and mold engineering
- Chemical solutions for the manufacture of customized recycled polyols based on polyurethane, PET, and PIR residues

Our products and solutions are used globally and in a wide range of industries – from automotive and electromobility, electrics/ electronics, and white goods to aerospace, foundry, furniture, and mattresses.

We conserve resources and protect our environment, both in the development of our chemical products and in their manufacture and recycling.

Together with our customers and partners, we are working towards a successful and sustainable future.

Products and services

High-performance, customized, and resource-saving technologies for a sustainable future

Advanced Polymers

INNOVATIVE MATERIALS & BRAND DIVERSITY

Resin systems for sealing, design, insulating, bonding, protecting, and casting

RAKU® POX Epoxy	**RAKU® PUR** Polyurethane	**RAKU® SEAL** Sealing Adhesives	**RAKU® SIL** Silicone

Resin systems and solutions for state-of-the-art model, mold, and tool engineering

RAKU® TOOL
Polyurethane and Epoxy

Customized, high-quality recycling polyols

RECYPOL® Ether and Ester Polyols	**PETOL®** Ester Polyols	**Polyols based on renewable raw materials**

HIGH-PERFORMANCE & SUSTAINABLE

Ambition. Reality. Tradition.
Every day, we strive to make our products and solutions even more eco-friendly, from the selection of raw materials to the manufacturing process and delivery.

As a pioneer in the chemical recycling of polyurethane, we have been setting standards for over three decades. The raw materials obtained with our groundbreaking technologies are used in both our customers' products and our own.

It goes without saying that we procure energy sustainably – and use it intelligently. At our locations in Grafenberg and Pirmasens, we use only green electricity from renewable energy sources. A proactive environmental management system ensures that we never stand still but continuously improve our energy and environmental performance.

SERVICE TODAY & IN THE FUTURE

Customer-oriented. Competent. Committed.
We provide our customers with comprehensive support – from product development to market launch and sales. And we do this around the globe: With production facilities on three continents and a worldwide network of distribution partners, we are always there for our customers, wherever they are.

In all this, people are always at the center. Trusting and successful collaboration with our customers is our top priority. Together, we develop the solutions of tomorrow – and have been doing so for more than forty years.

Your industry | Your application

Quality, performance, and progress for all industries

AEROSPACE

- Cutting jigs
- Drilling fixtures & jigs
- Galvanobath models
- Interior fittings
- Lay-up tools
- Stretch forming tools / shaping dies

AUTOMOTIVE CONSTRUCTION AND MANUFACTURING

- Cutting jigs
- Data control models
- Fixtures & jigs
- Functional cubing
- Galvanobath models
- Hammer forms
- Lay-up tools
- Metal forming tools
- Pilot production
- Prototypes (parts)
- Show Cars
- Styling & design models

CERAMICS

- General mold engineering and negatives
- Membranes (pressing)
- Models for pressure casting molds (microporous acrylic resin molds)
- Models for plaster working molds

ELECTRICAL INDUSTRY

- Components
- Fixtures & jigs

FOUNDRY

- Cores
- Core boxes
- Master models
- Models, pattern plates
- Negatives

FURNITURE & BOOTH CONSTRUCTION

- Decorative panels
- Interior fittings
- Paneling / wall cladding

MARINE INDUSTRY

- Interior fittings
- Lay-up tools
- Master models
- Molds for laminating parts

MECHANICAL ENGINEERING

- Assembly jigs
- Fixtures & jigs
- Molds
- Machine parts
- Models
- Support casting

MEDICAL TECHNOLOGY

- Cutting jigs
- Fixtures & jigs
- Molds
- Models

PLASTICS PROCESSING

- Cutting jigs
- Fixtures & jigs
- Foam molding tools
- Prototypes (parts)
- UP forming tools
- Vacuum forming molds

SPORT AND LEISURE

- Cutting jigs
- Fixtures & jigs
- Lay-up tools for small-series
- Models
- Theme parks

WIND ENERGY

- Lay-up tools (RTM / resin infusion)
- Master models
- Models for laminating parts

+ YOUR BENEFITS

- > World's largest producer of styling, modeling, and working boards
- > Extensive, eco-friendly product range
- > Comprehensive technical support
- > Made in Germany
- > High quality and stringent quality control

RAKU® TOOL Board Materials
Mill it. Finished.

ECO-FRIENDLY

RAKU® TOOL boards contain up to 30% raw material components from chemical recycling.

Up to 50% of our production residues are recycled using a chemical recycling process developed by RAMPF.

COMPLETE PACKAGE SOLUTION

comprising boards, matching adhesives, and repair pastes.

CUSTOMIZED PRODUCTS

Your partner for customized solutions.

HIGH-PERFORMANCE RANGE OF STANDARD PRODUCTS

which can be quickly adapted to meet changing market needs.

PRODUCTS & SERVICES

RAKU® TOOL Board Materials

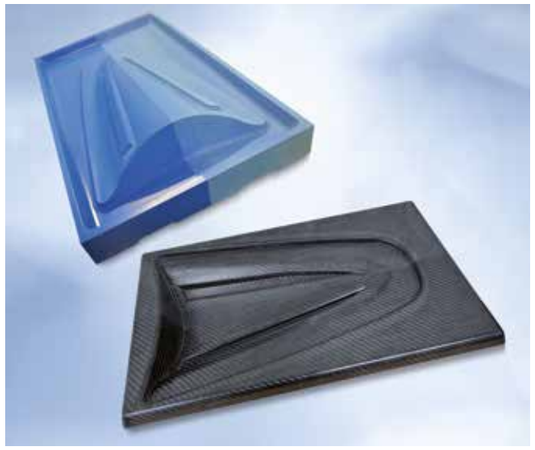
At a glance

RAMPF has been developing and manufacturing board materials for over four decades. We are the market leader with the world's largest production of styling, modeling, and working boards.

High-performance RAKU® TOOL Boards

AREA	KEY APPLICATIONS	KEY PROPERTIES	DENSITY G/CM³ 0.08–0.47	0.5–1.0	1.1–1.7
Styling Design	· Program proving · Supporting structures · Design studies · Negative molds	· Fine surface · Easy to process · Dimensionally stable	•		
Modeling	· Cubing · Show cars · Data control models · Functional cubing · Lay-up tools · Jigs & fixtures	· Very fine surface · Easy to machine · Dimensionally stable		•	
Prototyping / Small series	· Hammer forms · Lay-up tool · Rapid Prototyping casting molds · Flanging tools · Welding fixtures	· Good mechanical properties · Easy to machine · Impact and edge strength			•
Foundry	· Pattern plates · Core boxes · Models · Negatives · Auxiliary tools	· Excellent abrasion resistance · Good temperature resistance · Low thermal expansion · Eco-friendly and sustainable		•	•
Ceramics	· Models · Appliance and working models · Negatives · Auxiliary tools	· Excellent surface · Good styrene resistance		•	•
Composites	· Models · Lay-up molds · Prepreg lay-up tools	· Good impact strength · Chemical resistant · Can be polished to a high gloss	•	•	•

Applications Board Materials



RAKU® TOOL
Close Contour Products

+ YOUR BENEFITS

- > Close Contour shape
- > Rapid milling
- > Less waste
- > Seamless, fine surface

Seamless modeling pastes. Ready to mill castings.

Close Contour pastes, Close Contour blocks, and Close Contour castings are high-performance products and the result of targeted development work and years of practical experience. We tailor our Close Contour products to your specific requirements quickly and effectively.

CLOSE CONTOUR CASTINGS

Encompassing advice and consulting
Our experienced team supports you during project planning and implementation.

Ordering, easy and quick
Simply provide us with the CAD data of the part / mold in igs file or stp file format, including machining allowance.

Mold construction, casting, and post-cure – no work for you!
We produce the casting mold based on your CAD data. The ensuing casting process involves specific heat treatment and quality control. The high mechanical properties of the final product are achieved through the post-cure process.

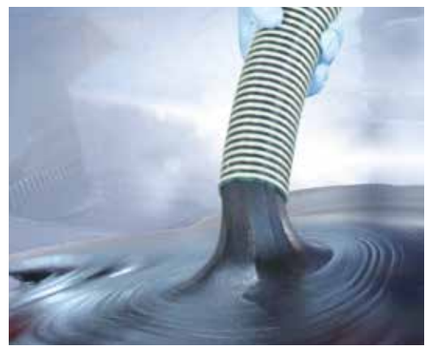
Delivery
We supply a ready-to-mill casting and you can concentrate on your key strength – milling.

CLOSE CONTOUR PASTES

The paste is applied to a close-contour-shape supporting structure, cured, and then machined according to CAD data.

CLOSE CONTOUR BLOCKS

Special blocks are produced in renown board quality according to customer specifications (L × W × H) and supplied as customized, rectangular, unmachined blocks.

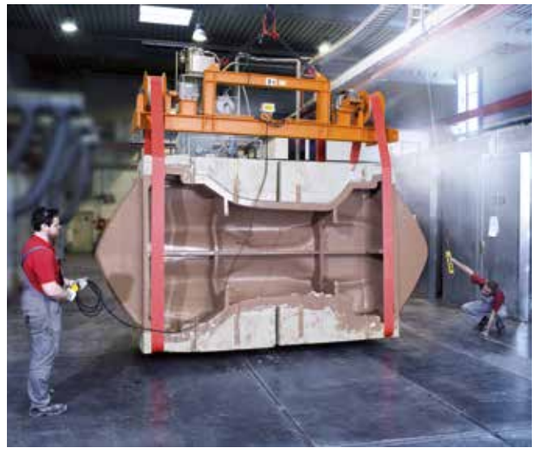


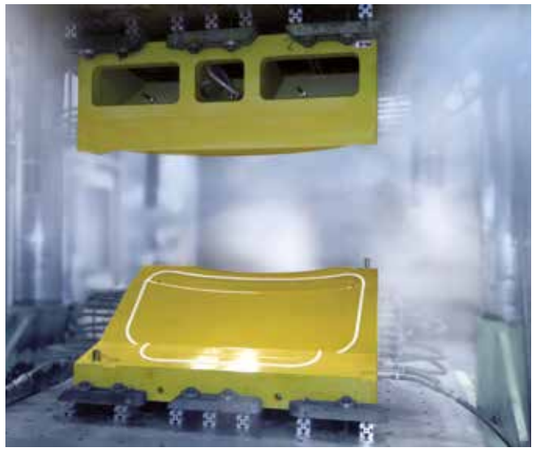
RAKU® TOOL Close Contour products at a glance

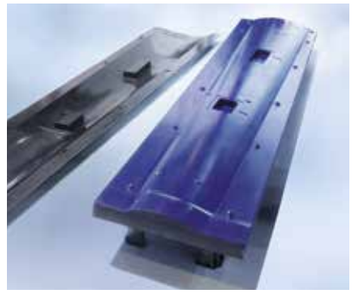
	CLOSE CONTOUR PASTES	CLOSE CONTOUR BLOCKS	CLOSE CONTOUR CASTINGS
KEY APPLICATIONS			
Design and styling	●		
Master models, cubing models	●	●	●
Molds	●	●	●
Jigs and fixtures	●	●	●
Tools	●	●	●
Foundry patterns		●	●
QUALITATIVE SELECTION CRITERIA			
Size of the models / tools	Medium to very large*	Small to medium	Medium to large*
Mechanical properties / depending on product	See data sheet	See data sheet	See data sheet
ECONOMIC SELECTION CRITERIA			
Minimal waste	●	●	●
Quick machining due to close contour shape	●	●	●
Light, cost-effective supporting structures	●		
No handling of liquid products		●	●
Delivery time	Immediate	Approx. 5 days	Approx. 10 days
Equipment costs	●	None	None
Work hygiene / exposure	Marginal	None	None
Special features	Seamless surface	Seamless surface	Seamless surface

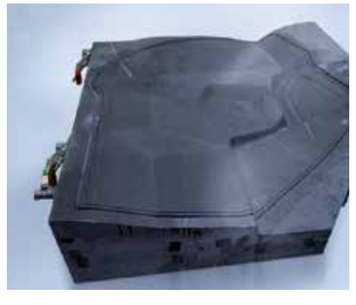
*With large models / molds build-up in segments possible

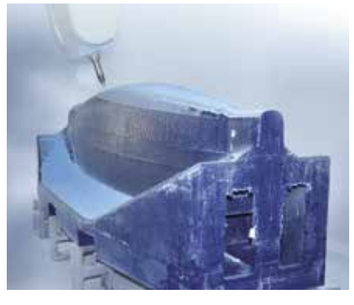
Applications Close Contour Products











RAKU® TOOL
Liquid Materials

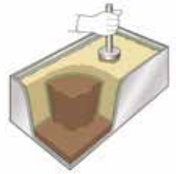
Gelcoats, Laminating, Casting, and Multipurpose Systems.

RAKU® TOOL liquid products offer a large selection of innovative and efficient gelcoat, laminating, casting, and multipurpose systems for various manufacturing techniques, build-up methods, and applications.

LAY-UP

Gelcoats

Backing / Full casting



Backing / Tamping

Laminating with fibers

Laminating with pastes

CASTING

Full casting

Face casting

At a glance

GELCOATS
Epoxy, Polyurea

LAMINATING AND MULTIPURPOSE SYSTEMS
Epoxy

LAMINATING PASTES
Epoxy

INFUSION SYSTEMS
Epoxy

CASTING SYSTEMS
Epoxy, Polyurethane, Polyurea

RAPID PROTOTYPING SYSTEMS
Polyurethane

FAST CAST
Polyurethane

REPAIR PASTES
Epoxy

ADHESIVES
Epoxy, Polyurethane

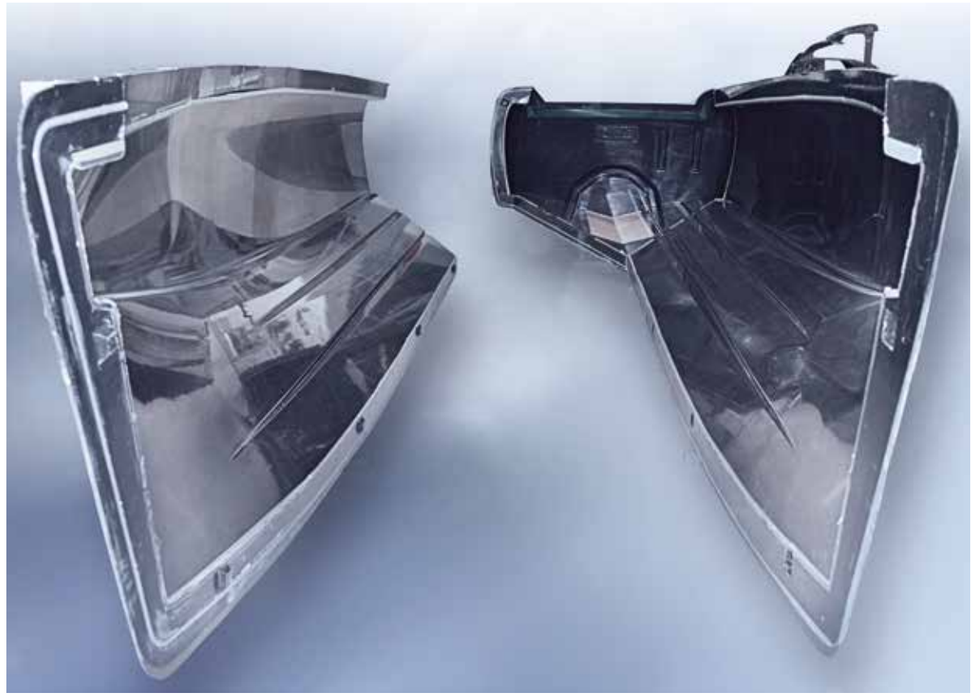
AUXILIARIES
Release agents, Fillers

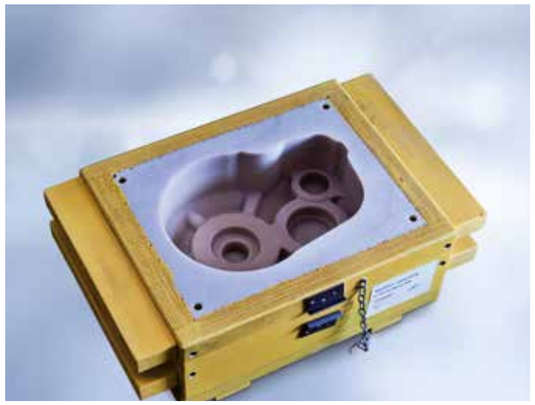
+ YOUR BENEFITS

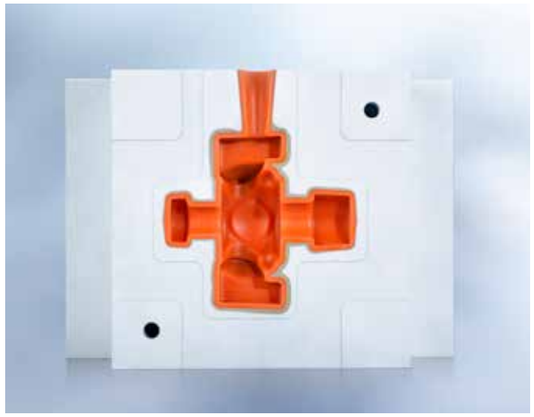
- Comprehensive product portfolio
- Systems with varying temperature resistances (RT – 190 °C)
- Rapid availability

Applications
Liquid Materials

Examples of products and solutions
from the marine, foundry, wind energy, automotive, and motor sport industry.







We are inventors. Team players. And a strong partner.

RAMPF stands for pioneering chemical solutions and visionary engineering. Worldwide.

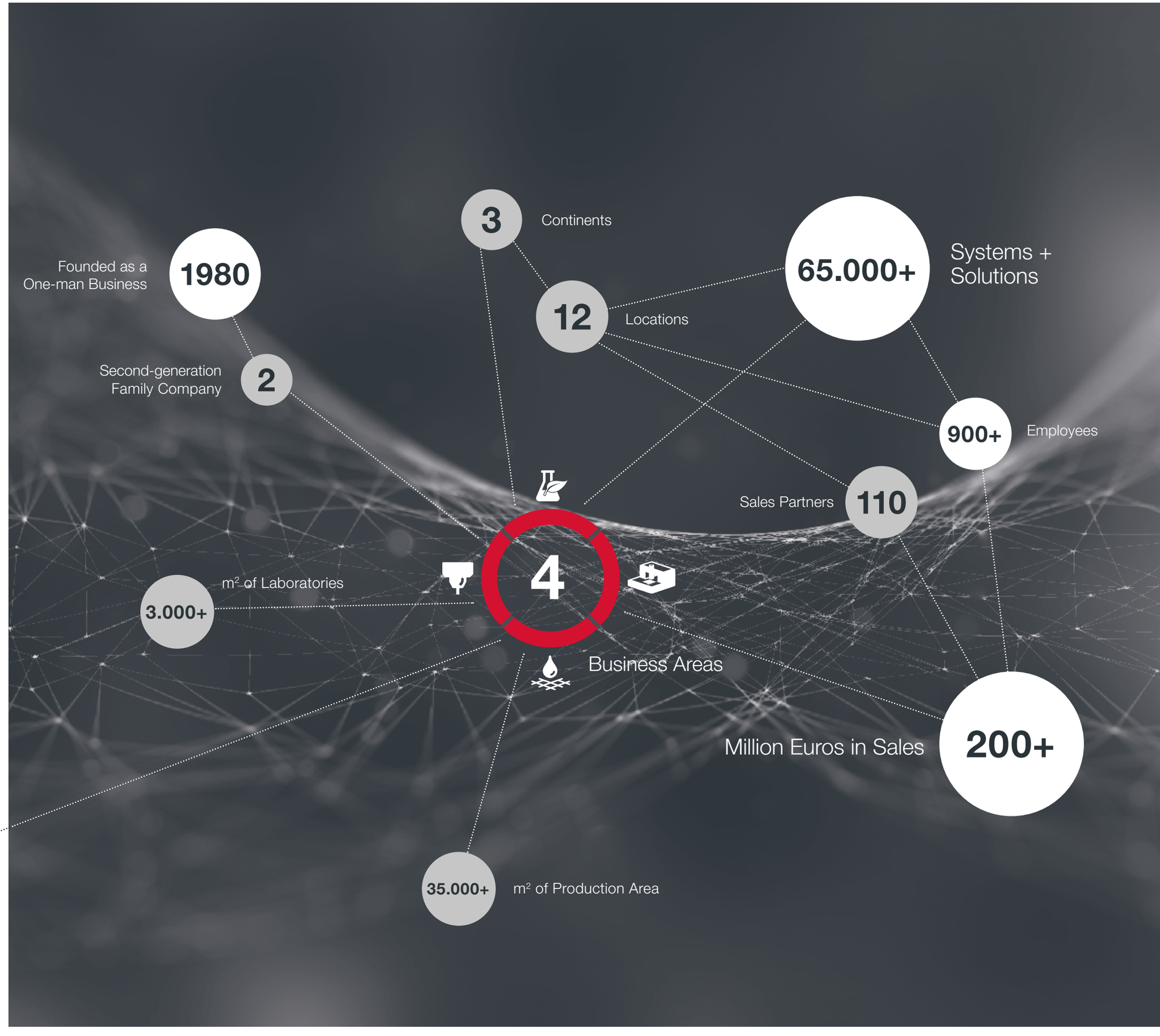
From a one-man operation to an international group with twelve sites spread across three continents – with our products and solutions centered around reactive resins, machine systems, and lightweight construction with composites, we rank among the market leaders in a whole host of industries.

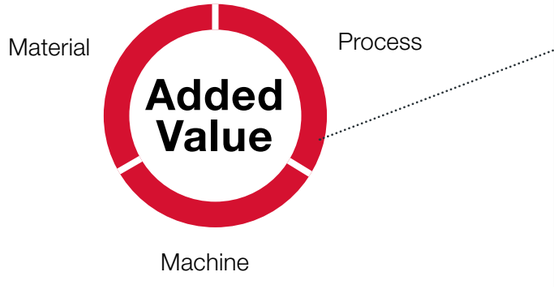
Discover the future – this is both our corporate slogan and the foundation of our long-standing success story. In close cooperation with our customers and partners, we develop tomorrow's products and solutions today – for the decisive competitive advantage.

Sustainability has been a priority right from the outset. This is no mere buzzword but an integral part of our day-to-day activities. As pioneers of chemical recycling, we have been contributing to an effective circular economy for decades. The raw materials that we recycle are used both by our customers and within our Group.

We are also a sustainable employer. RAMPF grows with its employees – we invest in our staff and are keen for them to work with us in the long term. We achieve this by openly showing appreciation and offering extensive training and development opportunities.

A forward-looking, sustainable, and value-creating family-run business – as a partner to industry and as an employer, we attach the greatest of importance to trust and reliability. These qualities are an absolute must when it comes to establishing long-term, successful partnerships.





RAMPF – Chemical and Engineering Solutions. Utilize our wide-ranging innovative potential for Added.Value.

RAMPF –
discover the future

Developing the Solutions
of Tomorrow – Today.

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Mass production?
Not at RAMPF.

We engineer
made-to-order solutions.

www.rampf-group.com

24-12-0003/1EN

RAMPF
discover the future

RAKU® TOOL Boards

	RAKU® TOOL SB-0080	RAKU® TOOL SB-0140	RAKU® TOOL SB-0240	RAKU® TOOL SB-0301	RAKU® TOOL SB-0351
	Styling Boards				
Color	off-white	light green	apricot	apricot	apricot
Density (ISO 1183) g/cm³ ca.	0.08	0.14	0.24	0.30	0.35
Applications	> Design studies > CAM program proving models > Substructures for Close Contour pastes > Substructures for clay	> Interior mockup > Design and styling models	> Interior and exterior mockup > Molds for composite prototype parts > Wind tunnel models	> Design and styling models > Laminating molds	> Cutting jigs > Design and styling models
Key Properties	> Stable during milling > Temperature resistant up to 100°C > Solvent resistant > Homogeneous foam structure	> Fine foam structure with low density > Temperature resistant up to 100°C > Large size boards > Stable during milling	> Good chip formation during milling > Large and standard size boards > Very fine foam structure > Very stable during milling	> Fine surface structure > Easy to machine, minimal dust	> Hard surface with low density > High dimensional stability > Very stable during milling
Hardness (ISO 868) Shore D	–	–	–	–	–
Coefficient of thermal expansion (ISO 11359) 10^{-6} K^{-1}	–	–	–	65 – 70	60 – 70
Deflection temperature (ISO 75) °C	–	–	60 – 70	60 – 70	65 – 75
Compressive strength (ISO 604) MPa	0.5 – 1.0	1.5 – 2.0	2 – 4	5 – 8	7 – 10
Flexural strength (ISO 178) MPa	–	–	4 – 6	6 – 9	7 – 10
Dimensions mm (Length x Width x Height)	2500 x 1000 x 100 2500 x 1000 x 200 2500 x 1000 x 300 2500 x 1000 x 400	2000 x 1000 x 100 2000 x 1000 x 200 2000 x 1000 x 300 2000 x 1000 x 400	1500 x 500 x 50 1500 x 500 x 100 1500 x 500 x 200 2000 x 1000 x 50 2000 x 1000 x 100 2000 x 1000 x 200	2000 x 1000 x 100 2000 x 1000 x 200	1500 x 500 x 50 1500 x 500 x 75 1500 x 500 x 100 1500 x 500 x 150 1500 x 500 x 200
Bonding with RAKU® TOOL		**> EP-2305 / EH-2904-1**	**> EP-2305 / EH-2904-1**	**> EP-2305 / EH-2904-1**	**> EP-2305 / EH-2904-1**
Mix ratio (pbw)	–	100 : 30	100 : 30	100 : 30	100 : 30
Color		apricot	apricot	apricot	apricot
Pot life 500 ml (min)		25 – 35	25 – 35	25 – 35	25 – 35
Minimum curing time (h)		16	16	16	16
Repair with RAKU® TOOL		**> EP-2305 / EH-2936-2**	**> EP-2305 / EH-2936-2**	**> EP-2305 / EH-2936-2**	**> EP-2305 / EH-2936-2**
Mix ratio (pbw)	–	100 : 50	100 : 50	100 : 50	100 : 50
Color		apricot	apricot	apricot	apricot
Pot life 100 ml (min)		15 – 20	15 – 20	15 – 20	15 – 20
Minimum curing time (min)		90 – 120	90 – 120	90 – 120	90 – 120

SB = Styling Board I MB = Modeling Board I WB = Working Board. Special sizes available on request.

	RAKU® TOOL SB-0470	RAKU® TOOL MB-0600	RAKU® TOOL MB-0670	RAKU® TOOL MB-0720
	Styling Boards	**Modeling Boards**		
Color	apricot	brown	brown	brown
Density (ISO 1183) g/cm³ ca.	0.47	0.60	0.67	0.72
Applications	> Architectural models > Interior and exterior mockup > Master models > Molds for composite prototype parts > Thermoforming tools > Water channel models > Wind tunnel models	> General purpose master models > Models and molds > Trimming jigs	> Master models > Master models for composite molds > Molds for composite prototype parts > Architectural models > Wind tunnel models > Water channel models > Thermoforming tools for prototypes	> Data control models > Master models for tires > Thermoforming tools for prototypes > Molds for composite prototype parts > Architectural models > Assembly jigs for plastic parts > Checking fixtures for plastic parts
Key Properties	> Easy to seal and varnish > Finest foam structure > Good chip formation during milling > Very stable during milling	> Fine surface structure > Easy to shape and machine > Easy to seal and varnish > Wide range of thicknesses	> Fine surface structure > Excellent milling characteristics > Easy to seal and varnish > Good temperature resistance > Standard modeling board > Wide range of thicknesses	> Very fine surface structure > Excellent milling characteristics > High edge strength > Wide range of thicknesses > Good dimensional stability > Good temperature resistance
Hardness (ISO 868) Shore D	–	50 – 55	60 – 65	60 – 65
Coefficient of thermal expansion (ISO 11359) 10^{-6} K^{-1}	70 – 75	50 – 55	50 – 55	50 – 55
Deflection temperature (ISO 75) °C	75 – 80	70 – 75	75 – 80	75 – 80
Compressive strength (ISO 604) MPa	10 – 15	15 – 20	15 – 20	20 – 25
Flexural strength (ISO 178) MPa	10 – 15	15 – 20	20 – 25	25 – 30
Dimensions mm (Length x Width x Height)	1500 x 500 x 50 1500 x 500 x 75 1500 x 500 x 100 1500 x 500 x 150 1500 x 500 x 200	1500 x 500 x 25 1500 x 500 x 30 1500 x 500 x 50 1500 x 500 x 75 1500 x 500 x 100 1500 x 500 x 150 1500 x 500 x 200	1500 x 500 x 25 1500 x 500 x 30 1500 x 500 x 50 1500 x 500 x 75 1500 x 500 x 100 1500 x 500 x 150 1500 x 500 x 200	1500 x 500 x 25 1500 x 500 x 30 1500 x 500 x 50 1500 x 500 x 75 1500 x 500 x 100 1500 x 500 x 150 1500 x 500 x 200
Bonding with RAKU® TOOL	**> EP-2305 / EH-2904-1**	**> EP-2306 / EH-2904-1**	**> EP-2306 / EH-2904-1**	**> EP-2306 / EH-2904-1**
Mix ratio (pbw)	100 : 30	100 : 30	100 : 30	100 : 30
Color	apricot	brown	brown	brown
Pot life 500 ml (min)	25 – 35	30 – 40	30 – 40	30 – 40
Minimum curing time (h)	16	16	16	16
Repair with RAKU® TOOL	**> EP-2305 / EH-2936-2**	**> EP-2306 / EH-2936-2**	**> EP-2306 / EH-2936-2**	**> EP-2306 / EH-2936-2**
Mix ratio (pbw)	100 : 50	100 : 50	100 : 50	100 : 50
Color	apricot	brown	brown	brown
Pot life 100 ml (min)	15 – 20	15 – 20	15 – 20	15 – 20
Minimum curing time (min)	90 – 120	90 – 120	90 – 120	90 – 120

SB = Styling Board I MB = Modeling Board I WB = Working Board. Eco-friendly.

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RAMPF
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RAKU® TOOL Boards

	RAKU® TOOL WB-0801	RAKU® TOOL WB-0691	RAKU® TOOL WB-0700	RAKU® TOOL WB-0890	RAKU® TOOL WB-1000	
	Working Boards					
Color	gray	blue	light green	dark blue	beige, also available in gray (WB-1001)	
Density (ISO 1183) g/cm³ ca.	0.80	0.69	0.70	0.89	1.00	
Applications	> Foundry models for prototypes > Jigs and fixtures for plastic parts > Thermoforming tools	> Lay-up tools for low temperature prepregs > Thermoforming tools	> Lay-up tools for prepregs > Thermoforming tools	> Lay-up tools for low temperature prepregs > Thermoforming tools	> Architectural models > Checking fixtures > Foundry models > Thermoforming tools	
Key Properties	> Good solvent resistance > High heat deflection temperature with low density > High mechanical strength with low density > Low linear coefficient of thermal expansion	> Temperature resistant up to 110°C > Low linear coefficient of thermal expansion > Low odor during milling > Stable during milling > Fine surface structure	> Temperature resistant up to 130°C > Dimensionally stable after post-cure > Low linear coefficient of thermal expansion > Excellent milling characteristics > Very fine surface	> Very fine surface structure > Good dimensional stability > Temperature resistant up to 110°C > Excellent milling characteristics	> Easy to mill > Low linear coefficient of thermal expansion > Very fine surface structure	
Hardness (ISO 868) Shore D	65 – 70	70 – 75	70 – 75	75 – 80	75 – 80	
Coefficient of thermal expansion (ISO 11359) 10^{-6} K^{-1}	45 – 50	35 – 45	35 – 45	35 – 45	50 – 60	
Deflection temperature (ISO 75) °C	85 – 90	100 – 110	130 – 140	100 – 110	70 – 80	
Compressive strength (ISO 604) MPa	40 – 45	50 – 60	60 – 70	60 – 70	45 – 50	
Flexural strength (ISO 178) MPa	35 – 40	25 – 35	40 – 50	40 – 50	45 – 50	
Dimensions mm (Length x Width x Height)	1500 x 500 x 25 1500 x 500 x 50 1500 x 500 x 75 1500 x 500 x 100	1500 x 500 x 50 1500 x 500 x 75 1500 x 500 x 100 1500 x 500 x 150	1500 x 500 x 50 1500 x 500 x 75 1500 x 500 x 100 1500 x 500 x 150 1500 x 500 x 200	1500 x 500 x 50 1500 x 500 x 75 1500 x 500 x 100 1500 x 500 x 150	1500 x 500 x 25 1500 x 500 x 50 1500 x 500 x 75 1500 x 500 x 100	
Bonding with RAKU® TOOL	**> EP-2306 / EH-2904-1**	**> EP-2303 / EH-2934-1**	**> EP-2304 / EH-2934-1**	**> EP-2303 / EH-2934-1**	**> PP-3310 / PH-3905**	**> EL-2210 / EH-2910-1***
Mix ratio (pbw)	100 : 30	100 : 20	100 : 20	100 : 20	100 : 50	100 : 60
Color	brown	blue	light green	blue	beige	clear
Pot life 500 ml (min)	30 – 40	50 – 60	50 – 60	50 – 60	5 – 8	50 – 60
Minimum curing time (h)	16	16	16	16	4	16
Repair with RAKU® TOOL	**> EP-2306 / EH-2936-2**	**> EP-2303 / EH-2936-2**	**> EP-2304 / EH-2936-2**	**> EP-2303 / EH-2936-2**	**Repair with adhesive bonded inserts**	
Mix ratio (pbw)	100 : 50	100 : 50	100 : 50	100 : 50		
Color	brown	blue	light green	blue		
Pot life 100 ml (min)	15 – 20	15 – 20	15 – 20	15 – 20		
Minimum curing time (min)	90 – 120	90 – 120	90 – 120	90 – 120		

SB = Styling Board I MB = Modeling Board I WB = Working Board. *Different mix ratios for special mixtures see technical data sheet. Eco-friendly.

	RAKU® TOOL WB-1222		RAKU® TOOL WB-1250		RAKU® TOOL WB-1258		RAKU® TOOL WB-1404		RAKU® TOOL WB-1460	
	Working Boards									
Color	green		light green		orange		olive		light green	
Density (ISO 1183) g/cm³ ca.	1.22		1.25		1.20		1.40		1.46	
Applications	> Checking fixtures for metal parts > Foundry pattern plates > Hammer tools		> Foundry core boxes > Foundry models > Foundry pattern plates		> Pattern plates > Core boxes		> Checking fixtures for metal parts > Foundry models > Foundry pattern plates and core boxes > Hammer tools > Models and molds for composite applications > Models and molds for polyester applications > Molds for low pressure RIM > Thermoforming tools		> Foundry models > Foundry pattern plates	
Key Properties	> Good abrasion resistance > Low wear of milling tools > Most proven working board on the market > Resistant to amine > Resistant to dry ice cleaning		> Easy to mill > Low wear of milling tools > Resistant to dry ice cleaning > Excellent abrasion resistance > Excellent amine resistance		> Excellent abrasion resistance > High impact resistance > High edge strength > Excellent milling characteristics > Excellent resistance to chemicals		> Polishable > Good abrasion resistance > Good amine resistance > Good styrene resistance > Low coefficient of thermal expansion > Resistant to dry ice cleaning		> Good abrasion resistance > Made with recycled polyol > Resistant to amine > Resistant to dry ice cleaning	
Hardness (ISO 868) Shore D	75 – 85		77 – 83		80 – 85		85 – 90		80 – 85	
Coefficient of thermal expansion (ISO 11359) 10^{-6} K^{-1}	80 – 85		70 – 75		70 – 75		50 – 55		65 – 75	
Deflection temperature (ISO 75) °C	80 – 90		80 – 85		70 – 75 (Tg)		75 – 80		75 – 80	
Compressive strength (ISO 604) MPa	60 – 70		70 – 80		90 – 100		85 – 95		70 – 80	
Flexural strength (ISO 178) MPa	70 – 80		90 – 100		100 – 110		80 – 90		70 – 80	
Dimensions mm (Length x Width x Height)	1000 x 500 x 30 1000 x 500 x 50 1000 x 500 x 75 1000 x 500 x 100		1000 x 500 x 30 1000 x 500 x 50 1000 x 500 x 75 1000 x 500 x 100		1000 x 500 x 30 1000 x 500 x 50 1000 x 500 x 75 1000 x 500 x 100		1000 x 500 x 30 1000 x 500 x 50 1000 x 500 x 75 1000 x 500 x 100		1000 x 500 x 30 1000 x 500 x 50 1000 x 500 x 75 1000 x 500 x 100	
Bonding with RAKU® TOOL	**> PP-3311 / PH-3905**	**> EL-2210 / EH-2910-1***	**> PP-3350 / PH-3905**	**> EL-2210 / EH-2910-1***	**> PP-3358 / PH-3905**	**> EL-2210 / EH-2910-1***	**> PP-3314 / PH-3905**	**> EL-2210 / EH-2910-1***	**> PP-3311 / PH-3905**	**> EL-2210 / EH-2910-1***
Mix ratio (pbw)	100 : 50	100 : 60	100 : 50	100 : 60	100 : 50	100 : 60	100 : 50	100 : 60	100 : 50	100 : 60
Color	green	clear	light green	clear	orange	clear	olive	clear	green	clear
Pot life 500 ml (min)	5 – 8	50 – 60	5 – 8	50 – 60	5 – 8	50 – 60	5 – 8	50 – 60	5 – 8	50 – 60
Minimum curing time (h)	4	16	4	16	4	16	4	16	4	16
Repair with RAKU® TOOL	**Repair with adhesive bonded inserts**		**Repair with adhesive bonded inserts**		**Repair with adhesive bonded inserts**		**Repair with adhesive bonded inserts**		**Repair with adhesive bonded inserts**	
Mix ratio (pbw)										
Color										
Pot life 100 ml (min)										
Minimum curing time (min)										

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25-00241EN. 2/3. Errors excepted. Subject to change.

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	RAKU® TOOL WB-1600		RAKU® TOOL WB-1700
	Working Boards		
Color	ivory		dark gray
Density (ISO 1183) g/cm³ ca.	1.60		1.70
Applications	> Jigs and checking fixtures for metal parts > Metal sheet forming tools > Thermoforming tools		> Jigs and checking fixtures for metal parts > Metal sheet forming tools > Preform tools for RTM > Prototyping RTM tools > Thermoforming tools
Key Properties	> Good mechanical properties > Low linear coefficient of thermal expansion		> Polishable > Temperature resistant up to 120°C > Low friction resistance > Excellent mechanical properties > Very low linear coefficient of thermal expansion
Hardness (ISO 868) Shore D	85 – 90		85 – 90
Coefficient of thermal expansion (ISO 11359) 10^{-6} K^{-1}	45 – 50		45 – 50
Deflection temperature (ISO 75) °C	75 – 80		120 – 125
Compressive strength (ISO 604) MPa	90 – 100		125 – 130
Flexural strength (ISO 178) MPa	55 – 65		80 – 85
Dimensions mm (Length x Width x Height)	750 x 500 x 50 750 x 500 x 75 750 x 500 x 100		750 x 500 x 50 750 x 500 x 75 750 x 500 x 100
Bonding with RAKU® TOOL	**> PP-3310 / PH-3905**	**> EL-2210 / EH-2910-1***	**> EL-2210 / EH-2910-1***
Mix ratio (pbw)	100 : 50	100 : 60	100 : 60
Color	beige	clear	clear
Pot life 500 ml (min)	5 – 8	50 – 60	50 – 60
Minimum curing time (h)	4	16	16
Repair with RAKU® TOOL	**Repair with adhesive bonded inserts**		**Repair with adhesive bonded inserts**
Mix ratio (pbw)			
Color			
Pot life 100 ml (min)			
Minimum curing time (min)			

SB = Styling Board I MB = Modeling Board I WB = Working Board. *Different mix ratios for special mixtures see technical data sheet.

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RAKU® TOOL Close Contour Products

Resin	Hardener	Stock level	Mix ratio (pbw)	Color	Pot life 25°C (min)	Max. layer thickness (mm)	Density g/cm³ (ISO 1183) ca.		Key Properties	Applications
RAKU® TOOL Close Contour Pastes (machine applied)					1000 ml					
CP-6060	CP-6060	A	100 : 100	gray	30 – 40	25	0.6		Very fine and homogeneous surface, easy to machine, low dust, low exotherm, can be machined after 9 h RT cure	Large-scale models, wind turbine blade models, boat models
CP-6070	CP-6070	A	100 : 100	brown	30 – 40	40	0.75		Fine, homogeneous surface, easy to machine, can be machined after 10 h RT cure	Design and styling models, master models, molds
CP-6070	CP-6072	A	100 : 100	brown	100 – 120	40	0.75		Very smooth, homogeneous surface, easy to machine, very little dust, can be machined after 18 h RT cure	Design and styling models, master models, molds
CP-6083	CP-6083	B	100 : 100	gray	50 – 60	25	0.85		Good edge strength, high compressive strength, high temperature resistance, fine and homogeneous surface, easy to machine, little dust, low exotherm, can be machined after 10 h RT cure	Large-scale models, wind turbine blade models, boat models
CP-6083	CP-6084	B	100 : 100	gray	60 – 70	25	0.85		Good edge and high compressive strength, easy to machine, little dust, low exothermic,slump resistant on vertical surfaces in layers up to 25 mm thickness	Large-scale models, wind turbine blade models, boat models
RAKU® TOOL Repair Systems for Epoxy Close Contour Pastes					100 ml					
CP-6060	EH-2936-2	B	100 : 60	gray	15 – 20		0.7		> Slump resistant on vertical surfaces in layers up to 20 mm thickness > Sufficient pot life with rapid cure > Similar mechanical properties to those of cured Close Contour Pastes	Repair of Close Contour Paste CP-6060 R/H
CP-6070	EH-2936-2	B	100 : 50	brown	15 – 20		0.75			Repair of Close Contour Paste CP-6070 R/H
CP-6083	EH-2936-2	B	100 : 45	gray	15 – 20		0.85			Repair of Close Contour Paste CP-6083 R/H
RAKU® TOOL Epoxy Pastes (hand applied)					500 ml					
EP-2301	EH-2931	A	100 : 100	brown	40 – 45	40	0.7		Easily shaped with wood working tools, good adhesion to most supporting structures	Styling and design models, master models, patterns

A = available in stock, B = please check with customer service
CP Close Contour Paste (R= Resin, H= Hardener)
EH Epoxy Hardener
EP Epoxy Paste/Resin

RAKU® TOOL Close Contour Casting (CCC) / Close Contour Blocks (CB)										
	Color	**Stock level**	**Density g/cm³ (ISO 1183) ca.**	**Shore Hardness D (ISO 868)**	**Coefficient of thermal expansion 10^{-6} K^{-1} (ISO 11359)**	**Deflection temperature °C (ISO 75)**	**Compressive strength MPa (ISO 604)**	**Compressive modulus MPa (ISO 604)**	**Key Properties**	**Applications**
CC-6010 / CB-6010	brown	A	0.80	65 – 70	65 – 70	75 – 80	35 – 40	1300 – 1600	> Fine surface structure > Easily machined > Similar properties to RAKU® TOOL modeling boards	Master models, cubing models, patterns
CC-6503 / CB-6503	blue	A	1.85	85 – 90	40 – 45	80 – 85	95 – 105	9500	> Very dense structure > Very homogeneous, fine surface and as a result, very good surface of nickel bowl, i.e. little finishing required and therefore large cost savings > Easily machined like board material WB-1600 > Low coefficient of thermal expansion	Galvanobath models, lay-up tools, RIM tools
CC-6506 / CB-6506	dark gray	A	1.90	90 – 95	35	110 – 115	120 – 130	13000	> Very dense surface structure > Can be polished > Good heat resistance > High compressive strength > Good resistance to chemicals > Time savings through direct milling of mold via surface data > Better pressing of sheet metal parts	Molds for ceramic pressure casting, Metal sheet forming, vacuum forming tools, Lay- up tools
CC-6507 / CB-6507	olive	A	1.40	85 – 90	50 – 55	75 – 80	85 – 95	3500 – 4000	> Dense surface structure > Very easily machined > Good dimensional stability > Good abrasion resistance and impact strength	Pattern plates and core boxes, Machined negatives and positives, Models, molds and tools, Hammer forms and jigs
CB-6700	light green	A	0.70	70 – 75	35 – 45	130 – 140	60 – 70	2300 – 2800	> Epoxy based material > Very fine surface structure > Excellent machinability > Good dimensional stability > Heat resistant up to 130 °C	Lay-up tools for prepreg, vacuum forming molds, high temperature applications

CB Close Contour Block is supplied as a customized size of a rectangular, unmachined block.

Offset requirements for CB products: The general rule is that RAMPF Tooling Solutions only adds an offset for shrinkage to the dimensions indicated on the customer's order. The customer has to assess how many mm machining/processing offset is needed for the unmachined block he receives. We recommend a machining/processing offset of minimum 10 mm. Dimensions ordered = dimensions supplied, within the specifications. Close Contour Blocks are unmachined, only basic cleaned cast blocks. Some release agent residue on the surface is possible. Sharp edges are milled due to risk of injury.

CC Close Contour Casting is supplied as a three dimensional shape which is already a close contour of your final shape.

Offset requirements for CC products: For a dimension of up to 1000 mm, an offset of 20 mm per surface to be worked on must be added. All larger dimensions need to have a shrinkage offset of 0.5-2 % (dependant on product) + offset for processing of minimum + 10 mm per surface. However, each project still needs to be discussed with the responsible project manager at RAMPF Tooling Solutions.

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RAKU® TOOL Epoxy Liquid Systems

Epoxy Resin	Epoxy Hardener	Stock level	Mix ratio (pbw)	Color	Pot life 25°C (min)	Layer thickness (mm)	Density g/cm³ ca. (ISO 1183)	Key Properties	Applications
RAKU® TOOL Epoxy Gelcoat Systems					250 ml				
EG-2100	EH-2901-2	A	100 : 18	light blue	15 – 20	–	1.4	RT curing, thixotropic, can be polished and sanded, good interlayer adhesion, fast reactivity	Negatives, models, jigs and fixtures
	EH-2950-1	A	100 : 13	light blue	30 – 35	–	1.4	RT curing, thixotropic, can be polished and sanded, good interlayer adhesion, slow reactivity	
EG-2101	EH-2901-2	A	100 : 15	white	30 – 35	–	1.4	RT curing, thixotropic, polishable, easy to apply, fast reactivity	Negatives, models, jigs & fixtures, plaster working molds (ceramics)
	EH-2950-1	A	100 : 12	white	50 – 60	–	1.4	RT curing, thixotropic, polishable, easy to apply, slow reactivity	
EG-2102	EH-2901-2	A	100 : 10	blue	25 – 30	–	1.8	RT curing, abrasion resistant, chemical resistant, fast reactivity	Foundry patterns, foam molds, UP forming tools, tools and tooling aids
	EH-2950-1	A	100 : 8	blue	50 – 60	–	1.8	RT curing, abrasion resistant, chemical resistant, slow reactivity	
EG-2104	EH-2950-1	A	100 : 10	black	35 – 45	–	1.6	Temperature resistant (105°C), very easy to apply, can be polished to a high gloss	Gelcoat for laminate structures and other build-up methods, vacuum forming molds, RTM molds
EG-2105	EH-2901-2	B	100 : 25	green	15 – 20	–	1.3	Temperature resistant (105°C), excellent styrene resistance, easy to apply, can be polished to a high gloss	Gelcoat for laminate structures and other build-up methods, vacuum forming molds
EG-2105	EH-2950-1	A	100 : 20	green	40 – 50	–	1.3	Temperature resistant (120°C), excellent styrene resistance, easy to apply, can be polished to a high gloss	Gelcoat for laminate structures and other build up methods, vacuum forming molds, UP-laminated molds/press tools, RTM molds
EG-2107	EH-2950-1	A	100 : 14	black	120 – 150	–	1.7	Temperature resistant (180°C), easy to apply, good workability	Gelcoat for high temperature molds, prepreg lay up tools
RAKU® TOOL Epoxy Coupling Layer					500 ml				
EL-2209-2	EH-2950-1	A	100 : 10	gray	20 – 30	–	1.75	Prefabricated, two component coupling coat, temperature resistant (100°C)	Production of tools, molds and tooling aids with various systems like epoxy and polyurea
RAKU® TOOL Epoxy Laminating Systems					500 ml				
EL-2200	EH-2900	A	100 : 20	clear	70 – 90	8	1.1	RT curing, unfilled, low viscosity, good compatibility with glass fibers and fillers	General tool building and tooling aids, binder for various fillers
EL-2200	EH-2904-1	A	100 : 40	clear	40 – 50	8	1.1	RT curing, good wetting properties with glass fibers and fillers, impact resistance	General tool building and tooling aids, binder for various fillers, laminating system for the construction of flexible laminate structures
EL-2200	EH-2950-1	A	100 : 16	clear	50 – 60	8	1.1	Long pot life, good wetting properties, room temperature curing, temperature resistant up to 85°C	General tool building and tooling aids, does not attack EPS, supporting structures for Close Contour Pastes
EL-2201	EH-2904-1	A	100 : 50	clear	25 – 30	8	1.16	RT curing, unfilled, high mechanical properties at RT cure, fast reactivity	Jigs, foundry patterns, tooling aids, UP lay up tools, backing structures
	EH-2905-1	A	100 : 50	clear	60 – 70	8	1.16	RT curing, unfilled, high mechanical properties at RT cure, medium reactivity	
	EH-2906-1	A	100 : 50	clear	120 – 140	8	1.16	RT curing, unfilled, high mechanical properties at RT cure, slow reactivity	

Epoxy Resin	Epoxy Hardener	Stock level	Mix ratio (pbw)	Color	Pot life 25°C (min)	Layer thick-ness (mm)	Density g/cm³ ca. (ISO 1183)	Key Properties	Applications
RAKU® TOOL Epoxy Laminating Systems					500 ml				
EL-2203	EH-2952-1	A	100 : 30	clear	50 – 60	8	1.17	Temperature resistant (120°C), unfilled, low viscosity, very good wetting properties, fast reactivity	Laminated molds, RTM or RIM tools, glass or carbon fiber laminates, resin infusion
	EH-2953-1	A	100 : 30	clear	70 – 80	8	1.1	Temperature resistant (120°C), unfilled, low viscosity, slow reactivity	
RAKU® TOOL Epoxy Laminating Pastes					500 ml				
EL-2207-3	EH-2907-3	A	100 : 12	gray/green	30 – 35	15	1.0	Room temperature curing, can be used with a layer thickness of up to 15 mm, easy to apply by hand	Reinforcement of molds and tooling aids, backing structures, jigs, fixtures
EL-2207-3	EH-2912	B	100 : 12	gray/green	80 – 100	15	1.0	Room temperature curing, can be used with a layer thickness of up to 15 mm, easy to apply by hand	Reinforcement of molds and tooling aids, laminated shells, jigs and fixtures
RAKU® TOOL Epoxy Casting Systems					1000 ml				
EC-2400	EH-2952-1	A	100 : 7	blue	120 – 150	60	1.9	Abrasion resistant, temperature resistant (110-115°C), slow reactivity	Foundry patterns, copy models, foam molds
EC-2401	EH-2904-1	A	100 : 20	beige	40 – 50	10	1.6	With mineral filler, flows very well, fast reactivity	Foundry patterns, copy models, direct casting (negatives), jigs, fixtures, galvanobath models, working models for the ceramics industry
	EH-2905-1	A	100 : 20	beige	70 – 80	20	1.6	With mineral filler, flows very well, medium reactivity	
	EH-2906-1	A	100 : 20	beige	170 – 200	80	1.6	With mineral filler, flows very well, slow reactivity	
EC-2402	EH-2904-1	A	100 : 15	black	35 – 45	10	2.4	RT curing, with metal fillers, workable hard surface, fast reactivity	Foundry patterns, copy models, metal forming, general modeling
	EH-2905-1	A	100 : 15	black	70 – 80	20	2.4	RT curing, with metal fillers, workable hard surface, medium reactivity	
	EH-2906-1	A	100 : 15	black	200 – 230	80	2.4	RT curing, with metal fillers, workable hard surface, slow reactivity	
	EH-2902-1	A	100 : 15	black	180 – 210	40	2.2	RT curing, with metal fillers, impact resistant	
EC-2404	EH-2952-1	A	100 : 11	gray	100 – 120	60	1.7	Temperature resistant (120°C), aluminum filled, chemical resistant	Vacuum forming molds, jigs, injection molds, foam molding tools
RAKU® TOOL Epoxy Infusion Systems					500 ml				
EL-2203	EH-2970-1	A	100 : 30	clear	50 – 60	8	1.1	Low viscosity, no degassing under vacuum, excellent wetting properties, flows very well, cures well at room temperature, temperature resistant up to 120°C	Resin Infusion
EI-2500	EH-2953-1	B	100 : 30	clear	60 – 80	8	1.1	Room temperature curing, fast cure, good wetting properties, temperature resistant up to 110°C	Resin Infusion, RTM
EI-2500	EH-2970-1	A	100 : 30	clear	50 – 60	8	1.1	Temperature resistant (115°C), flows well, unfilled, low viscosity, good wetting properties	Resin Infusion, RTM
	EH-2971	A	100 : 30	clear	70 – 80	8	1.1		
EI-2500	EH-2973	B	100 : 32	yellowish	70 – 80	8	1.1	Room temperature cure, no brittleness after room temperature cure overnight, easy de-molding, good wetting properties, flows very well under vacuum, temperature resistant up to 130°C	RTM, Resin Infusion
EI-2504	EH-2974	B	100 : 32	clear	210 – 270	8	1.1	Excellent wetting properties, flows very well, temperature resistant up to 170°C	Resin Infusion

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RAKU® TOOL Polyurethane / Polyurea Liquid Systems

PUR Resin	PUR Hardener (Isocyanate)	Stock level	Mix ratio (pbw)	Color	Pot life at 25°C (min)	Layer thickness (mm)	Density g/cm³ ca. (ISO 1183)	Key Properties	Applications
RAKU® TOOL Polyurea Gelcoat Systems					250 ml				
PG-3159-1	PH-3958	B	100 : 125	green	20 – 25	–	1.2	High wear resistance, high impact resistance	Foundry patterns, pattern plates, core boxes, impact protection
RAKU® TOOL Polyurea Casting Systems					1000 ml				
PC-3410	PH-3911-1	B	100 : 300	black	45 – 50	50	1.1	Hand cast, good moisture resistance, long pot life, no skull and crossbones label, high elongation at break. Shore A 40-45	Structural molds, closed plaster molds for the ceramics industry, concrete molds, vibration absorption, assembly jigs, impact protection
PC-3411	PH-3911-1	A	100 : 1000	black	30 – 35	50	1.1	Hand cast, good moisture resistance, long pot life, no skull and crossbones label, high elongation at break. Shore A 80-85	
PC-3458	PH-3958	A	100 : 500	orange	10 – 15 7 – 8 (40°C)	10	1.18	Excellent abrasion resistance, high number of castings, high impact strength, components are not toxic, no/little sand adhesion, can be cast by hand or machine dependent on system choice, good imprint accuracy	Foundry patterns, pattern plates, core boxes
PC-3459	PH-3958	A	100 : 250	beige	15 – 20	10	1.18		
RAKU® TOOL Polyurethane Casting Systems					1000 ml				
PC-3403	PH-3903	A	100 : 80	beige	30 – 40	20	1.2	Mass casting system for face casting	Metal forming tools, molds for prototyping, prototypes and backing for foundry patterns
	PH-3903 AC-9004	A	100 : 80 (380 – 400)	beige	60	> 300	1.6 – 1.7	Mass casting system with filler AC-9004 for large volume castings	
PC-3406-1	PH-3906	A	100 : 80	gray	15 – 20	–	1.24	Filled, easy to pour, low shrinkage, very accurate reproduction of finest patterns and details	Structural molds for formwork, concrete molds, plastic molds for the ceramics industry e.g. wash basin, sinks
PC-3412	PH-3923	A	100 : 17	white / opaque	2 – 3	100	1.11	Hand cast, components are nontoxic	Structural molds, assembly jigs, impact protection, production of flexible parts, fixtures
PC-3413-1	PH-3923	A	100 : 45	white / opaque	20 – 25	100	1.11	Hand cast, low moisture sensitivity, long pot life	Structural molds, impact protection, holding fixtures / jigs, production of flexible parts
PC-3414	PH-3915	A	100 : 20	beige	60 – 75	100	1.7	Can be cast in thick layers, low exotherm reaction in thick layers, superior interlayer adhesion, easily repaired or modified, can be filled additionally. Low-viscosity	Backing casting of models, molds, negatives and general support aids, direct casting of foundry patterns, jigs

RAKU® TOOL Polyurethane / Polyurea Liquid Systems

PUR Resin	PUR Hardener (Isocyanate)	Stock level	Mix ratio (pbw)	Color	Pot life at 25°C (min)	Layer thick-ness (mm)	Density g/cm³ ca. (ISO 1183)	Key Properties	Applications
RAKU® TOOL Polyurethane Rapid Prototyping Systems									
					(sec) 100 ml				
PR-3602	PH-3905	A	100 : 80	black	50 – 90	4	1.14	Simulates PE / PP, good impact strength, temperature resistant (90ºC), fast demold time	Functional prototype parts & bumpers, short run production, rapid prototyping
PR-3608	PH-3905	A	100 : 80	black	50 – 60	4	1.19	Simulates PP / ABS, short demold time, temperature resistant (130-135ºC), Shore D 75-80	Functional prototype parts, short run production, rapid prototyping
PR-3608	PH-3908	B	100 : 75	black	50 – 60	4	1.18	Simulates PP / ABS, impact resistant, fast demold time, no brittle phase	Functional prototype parts, short run production, rapid prototyping
PR-3654	PH-3905	A	100 : 55	black	50 – 60	4	1.35	Simulates PP / ABS, short demold time, temperature resistant (130ºC), glass fiber filled, Shore D 80-85	Functional prototype parts, short run production, rapid prototyping
PR-3654	PH-3908	B	100 : 53	black	50 – 60	4	1.30	Simulates PP / ABS, high temperature resistance (100°C), impact resistant, no brittle phase, glass fiber filled	Functional prototype parts, short run production, rapid prototyping
RAKU® TOOL Polyurethane Fast Cast Systems					1000 ml				
PF-3700-2	PH-3977	A	100 : 100	white	3 – 4	10	1.0 – 1.1	Fast cure and fast demold, unfilled, very low viscosity, good temperature resistance, improved moisture resistance, high fill rate possible, very high strength	Foundry patterns, core boxes, negatives, pattern plates, checking casts, replicas, vacuum forming molds, jigs
	PH-3977 (AC-9004)	A	100 : 100 (300)	beige	4 – 5	60	1.6 – 1.7	With filler AC-9004	
PF-3701-2	PH-3977	A	100 : 100	white	5 – 6	20	1.0 – 1.1	Fast cure and fast demold, unfilled, very low viscosity, very good temperature resistance, improved moisture resistance, high fill rate possible, very high strength	
	PH-3977 (AC-9004)	A	100 : 100 (300)	beige	6 – 7	80	1.6 – 1.7	With filler AC-9004	

RAKU® TOOL Accessories									
AC-9002		A		gray		–	0.60 – 0.85	Light mineral filler, bulk density 0.35-0.4 g/cm3, light filler	Filler for EP- and PU systems
AC-9004		A		white		–	2.4	Inorganic filler, bulk density 1.6 g/cm³	Filler for EP- and PU systems
AC-9102		A		white		–	0.8	Paste release agent, wax based, can be polished	For general applications
AC-9103		A		white		–	0.72	Liquid release agent, wax based, can be polished	For the release of general and detailed mold surfaces

EG	Epoxy Gelcoat/Resin	PG	Polyurea Gelcoat Resin	PE	Polyurethane Foam Polyol
EL	Epoxy Laminating/Resin	PC	Polyurethane or Polyurea Casting/Polyol or Resin	AC	Ancillaries
EC	Epoxy Casting/Resin	PR	Polyurethane Rapid Prototyping/Polyol		
EI	Epoxy Infusion/Resin	PF	Polyurethane Fast Cast/Polyol	A = available in stock,	
EH	Epoxy Hardener	PH	Polyurethane/Isocyanate	B = please check with customer service	

temperature resistant up to 105°C | temperature resistant up to 135°C
temperature resistant up to 115°C | temperature resistant up to 190°C
temperature resistant up to 120°C

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