RAMPF Tooling GmbH & Co. KG
Matthias Traxel / 15.02.2017

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Thermoforming with RAKU-TOOL®

(vacuum forming)

Introduction thermoforming

A thermoplastic film is formed under the influence of heat , vacuum , compressed air or mechanically in a tool .

Process steps :

Feeding and clamping of the thermoplastic film

Heating the thermoplastic film

Molding, reshape

Cool down

Trimming (cutting, sawing, CNC, water jet, laser)

The advantage of thermoforming is the high degree of design freedom. Easy undercuts are possible, support frames are not possible without being visual from the outside. Edges mostly done in radius.

Semi-finished products for thermoforming

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Designation	Usage for TF	Typical Applications
PVC	Very good	To 1990, the most common plastic
PS	Very good	Food Packaging, Refrigerators
PP	Good	Today most common packaging material
A-PET	Very good	Transparent parts
C-PET	Good	High heat packing up to ca. 250°C
PE	Poor	Packaging for deep frozen
ABS	Very good	Technical Parts
PC	Good	Transparent clear technical parts
BAK	Good	Compostable packaging
Fabrics	Good	Composites

Adolf Illig (Hrsg.): *Thermoformen in der Praxis*. Hanser, München 2008, ISBN 3-446-40794-4

Forming temperature of semi-finished products

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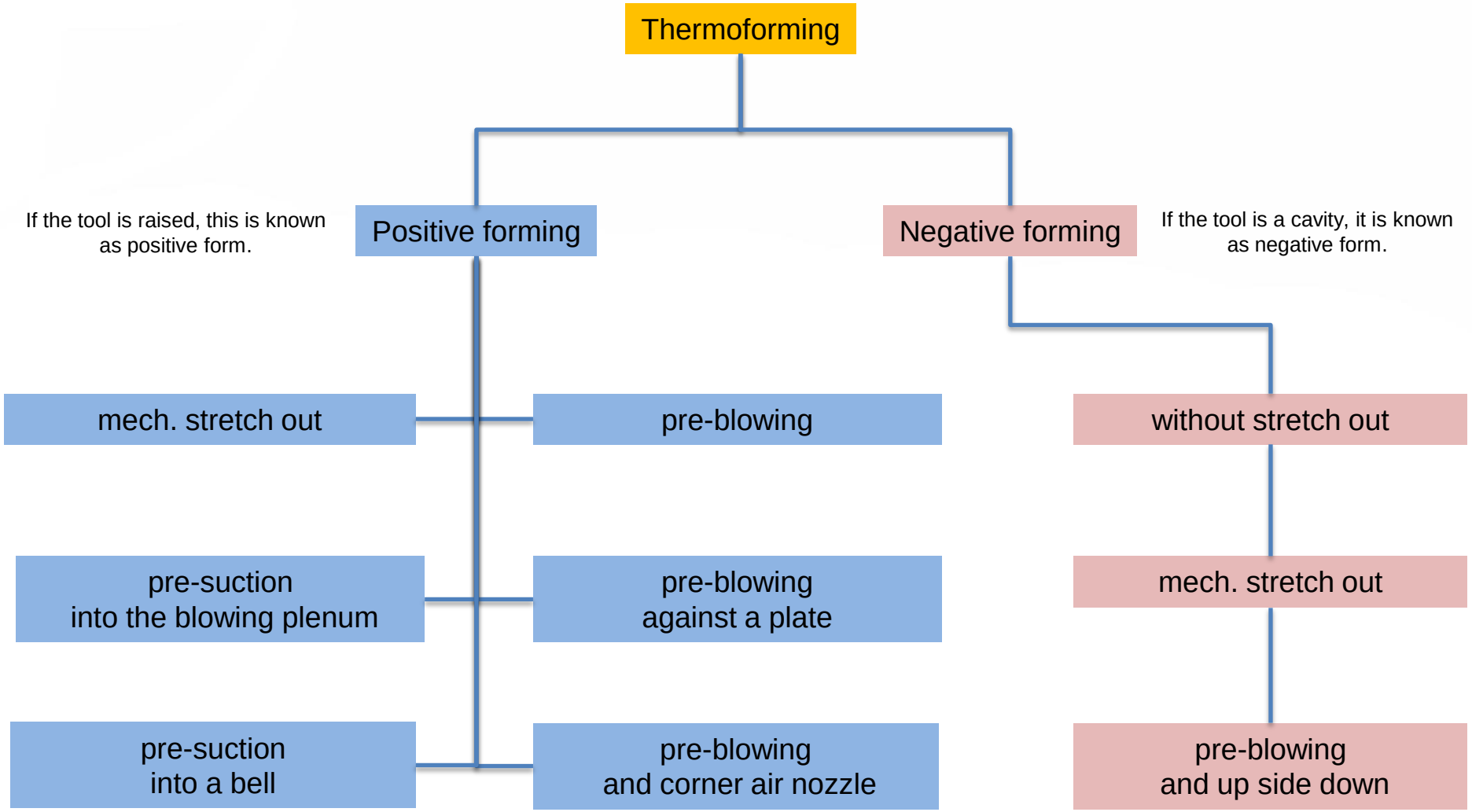
Designation	Material Temperature	Tool Surface Temperature
PVC	100-140°C	60-80°C
PS	105-135°C	65-85°C
PP	160-180°C	75-95°C
PE	130-140°C	75-95°C
ABS	140-150°C	90-100°C
PP	170-200°C	50-80°C

Method for thermoforming



www.kunststoff-know-how.de

Wall thickness distribution

As a semi-finished product is present with uniform wall thickness at the start, the results will end in a component with reduced wall thickness depending on the draw ratio . The wall thickness is different over the entire component . Shape and mold materials, drawing speed significantly influence the distribution of wall thickness of the component. The aim is to achieve a very homogeneous distribution of material over the entire component .

Wall thickness distribution

Differential heating

This can be done via different radiator temperatures or heat shield can be used between heating and thermoplastic film

Pre-blowing or pre-suction

Depending on the process (positive or negative) thermoplastic film can pre-blown with compressed air (with positive tools) or by vacuum sucked (for negative tools) before laid into the tool.

Use of punch

The punch can mechanically form the thermoplastic film, before it is laid by vacuum and / or compressed air into the tool. The geometry and material of the punch play a very important role. Punch are mainly used for negative tools.

Use of holder

In positive tools, the thermoplastic film can be divided mechanically by holders in “single segments" .

Materials for thermoforming

SB-0470	Prototyping Easy Shape
WB-0670	Prototyping
WB-0720	Prototyping Fine rips and thin walls
WB-0801	Double compressive strength then standard modelling boards. No cloudy surface if used for transparent blister foils
WB-0700	Very high heat resistance Good mechanical properties
WB-1000	Closed surface Abrasion resistance
WB-1404	Very good edge stability, though, abrasion resistance For fine rips and thin walls
WB-1600	High mechanical properties Low coefficient of thermal expansion
WB-1700 „The stone“	High heat resistance High mechanical properties Low coefficient of thermal expansion

RAKU-TOOL® CC-6010

Application:

> Vacuum thermoforming mold for headlamp diffuser made from acrylic glass XT

Target:

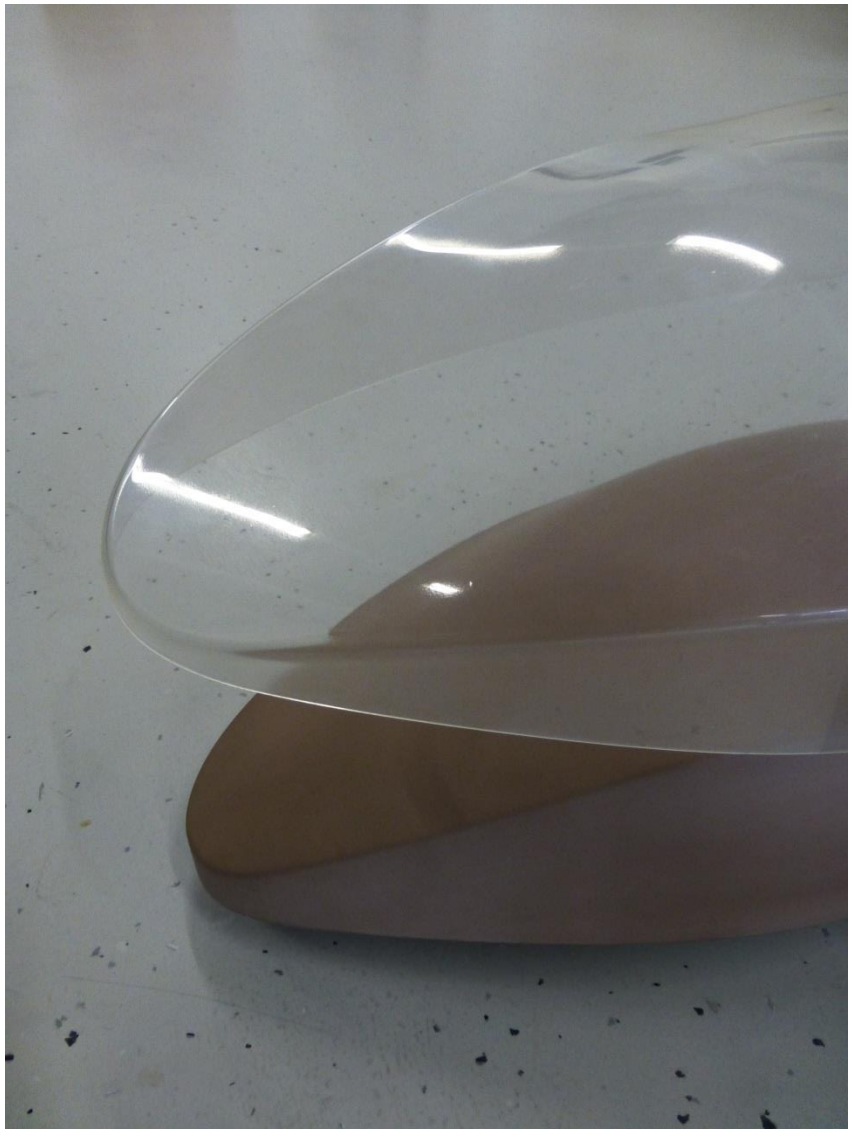
> Prototype

Requirement:

> Edge stability
> Dimensional stability
> No irritations on surface

Improvements / Optimization:

> Seamless
> Close Contour



RAKU-TOOL® WB-0801

Application:

> Blister packaging

Target:

> Prototype, short run production

Requirement:

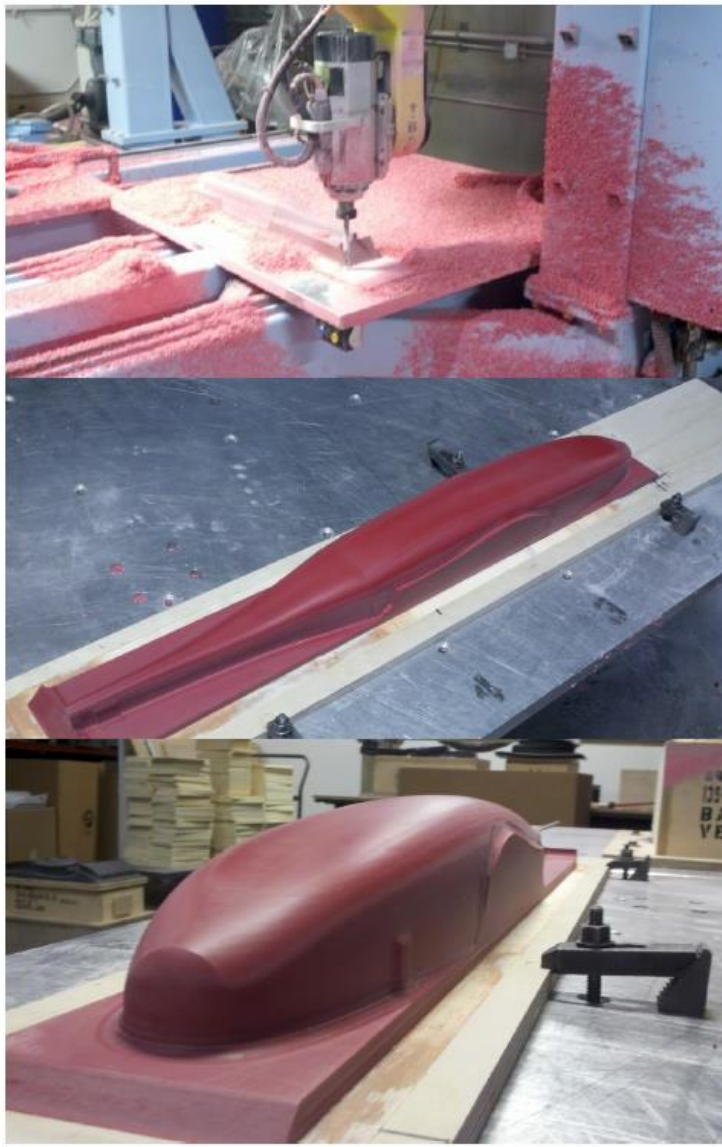
> No irritation on part surface

Improvements / Optimization:

Raytheon Drone

- **Customer:** Raytheon & Aerofoam
- **Application:** Vaccum form tool for Raytheon Drone
- **Product:**
  Working Board RAKU-TOOL® WB-1405

- **Advantages:**
  - Excellent surface
  - Hard surface
  - Dimensionally stable
  - Formation of clear part
  - Consumption: 125 liters



Toyota FT-1 Concept Vehicle

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- **Customer:** Calty Design
- **Application:** Concept model and vacuum form tools for Toyota FT-1
- **Products:**
  Styling Board RAKU-TOOL® SB-0470,
  Modeling Board RAKU-TOOL® MB-0720,
  Close Contour Casting RAKU-TOOL® CB-6700

- **Advantages:**
  - **Concept Model**
    - Lightweight
    - High surface quality
    - Cost effective
    - Dimensionally stable
  - **Vacuum form tool (wheels)**
    - Hard surface
    - Withstand heat
    - Dimensionally stable
  - **Vacuum form tool (clear lens)**
    - Resist out gassing during vacuum forming
    - Withstand heat
  - Consumption: ~500 liters Board

RAKU-TOOL® WB-1404

Application:

> Cover

Target:

Prototype, first run production

Requirement:

Low thermal expansion, no warping

Improvements / Optimization:

Even Wall thickness distribution

Quelle: YouTube

RAKU-TOOL® CC-6507

Firma: VonRoll Infratec

> Parts for vRone

Target:

> First run production of 1000 part
> rapid series production and market introduction

Requirement:

> Edge Stability
> Dimension Stability
> No irritation at Surface

Improvements / Optimization:

> Seamless
> Close Contour

Thermoforming provides advantages of creative freedom in shape, color and surface.
In the context of product development and optimization it is often a need, to change something or do a replacement. With CC- 6507 this can be done easily.

RAKU-TOOL® EG-2105/EH-2950 EC-2404/EH-2952-1

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Company: Mediadent

> Display

Target:

> first run production

> rapid series production and market introduction

Requirement:

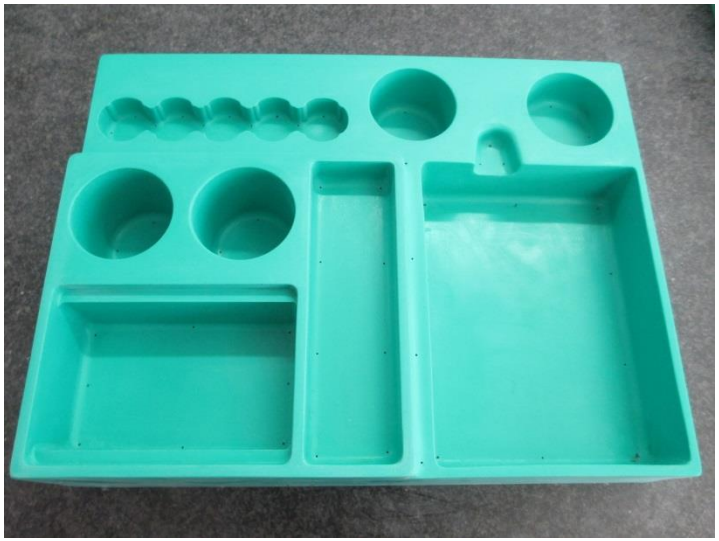
> Edge Stability

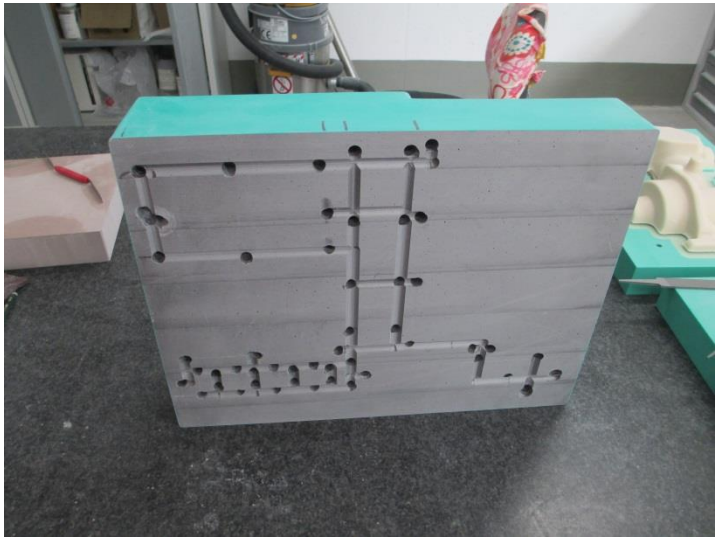
> Dimension Stability

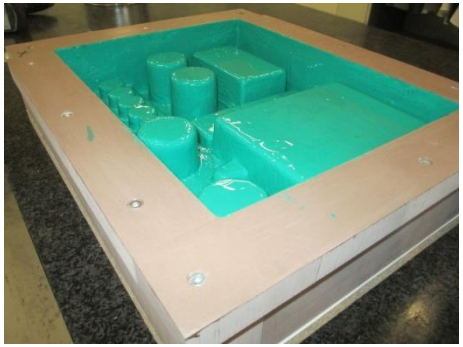
> No irritation at Surface

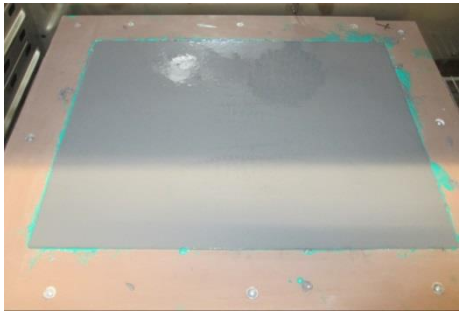
Improvements / Optimization:

Most common materials can be molded









Vacuum Jig

> Vacuum clamping is particularly suitable for flat, with conventional tools difficult to fix workpieces. These include thin-walled workpieces that are damaged during conventional clamping. Also workpieces, with plan area and circumference can be processed more effectively in one setting.
> The clamping device could be a flat plate with grooves for vacuum, in the simplest case. For complicated pieces, the vacuum jig is the negative shape of the workpiece.
> Experience shows, that milling on suitable vacuum jigs, higher cutting data can be driven than in conventional clamping.

> **Advantages of vacuum clamping**
> By using vacuum clamping, up to 5 sides can be machined in one set. Lowest warping is ensured by uniform pressure over the entire surface of the workpiece. Steps in the milled surface or marks from clamps do not appear. Low vibration during milling process, by applying the full surface of the workpiece to the vacuum jig, very high accuracy by clamping, part by part, ensure a consistent quality of the components.
> The very high accuracy by clamping, results in a reduction of downtime. Due to the lower number of setups also a higher process reliability is achieved. Errors due to cumulative deviations do not occur.

Aerospace

Application:
Cutting jigs for a helicopter

Product:

Close Contour Casting RAKU-TOOL® CC-6508

Advantages:

> No micro porosity
> Vacuum sealed
> Fast lead time and quick milling

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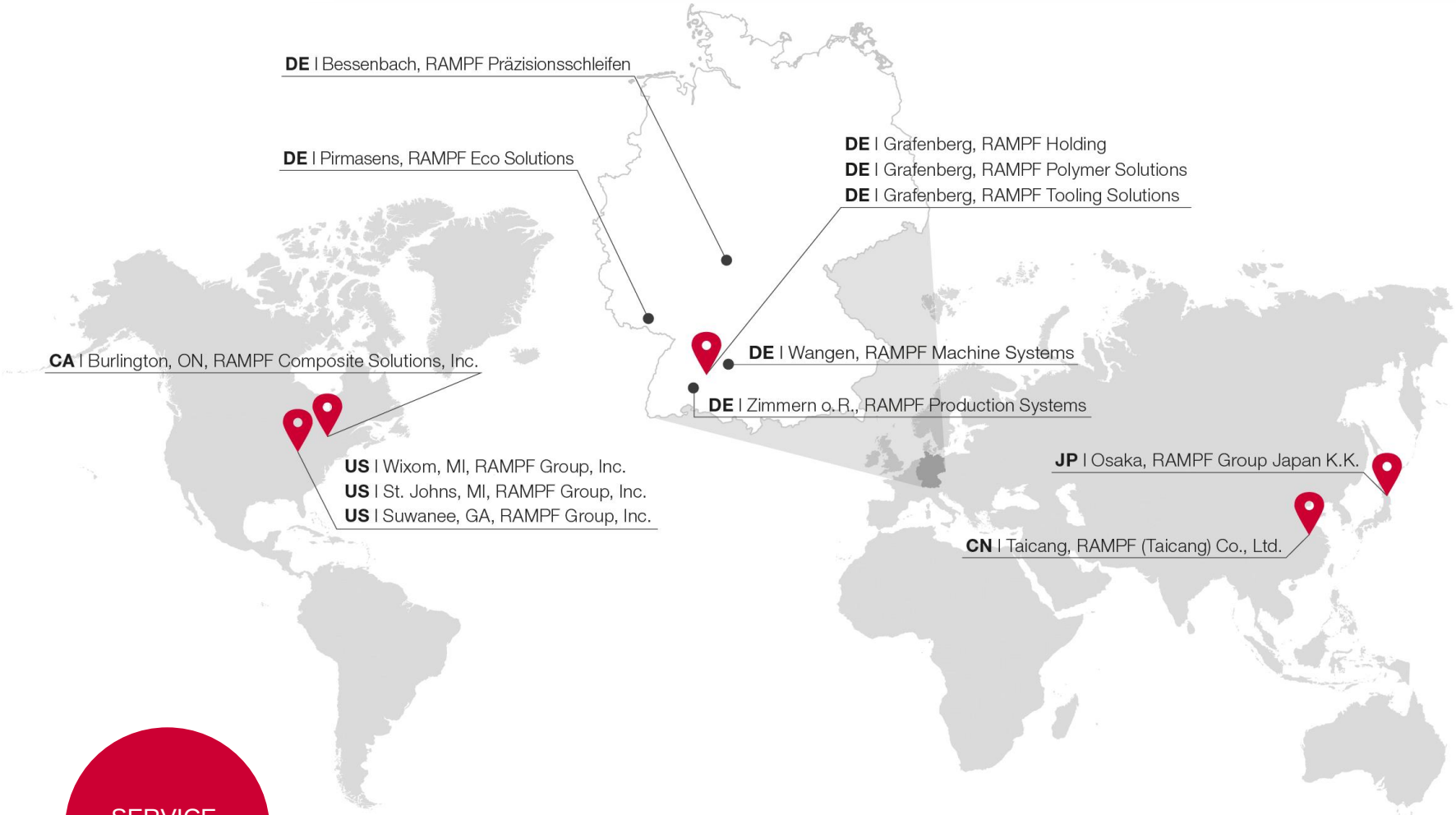

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