

# Individualization of leather and leather products by ultrasonicsupported embossing with plastic tools

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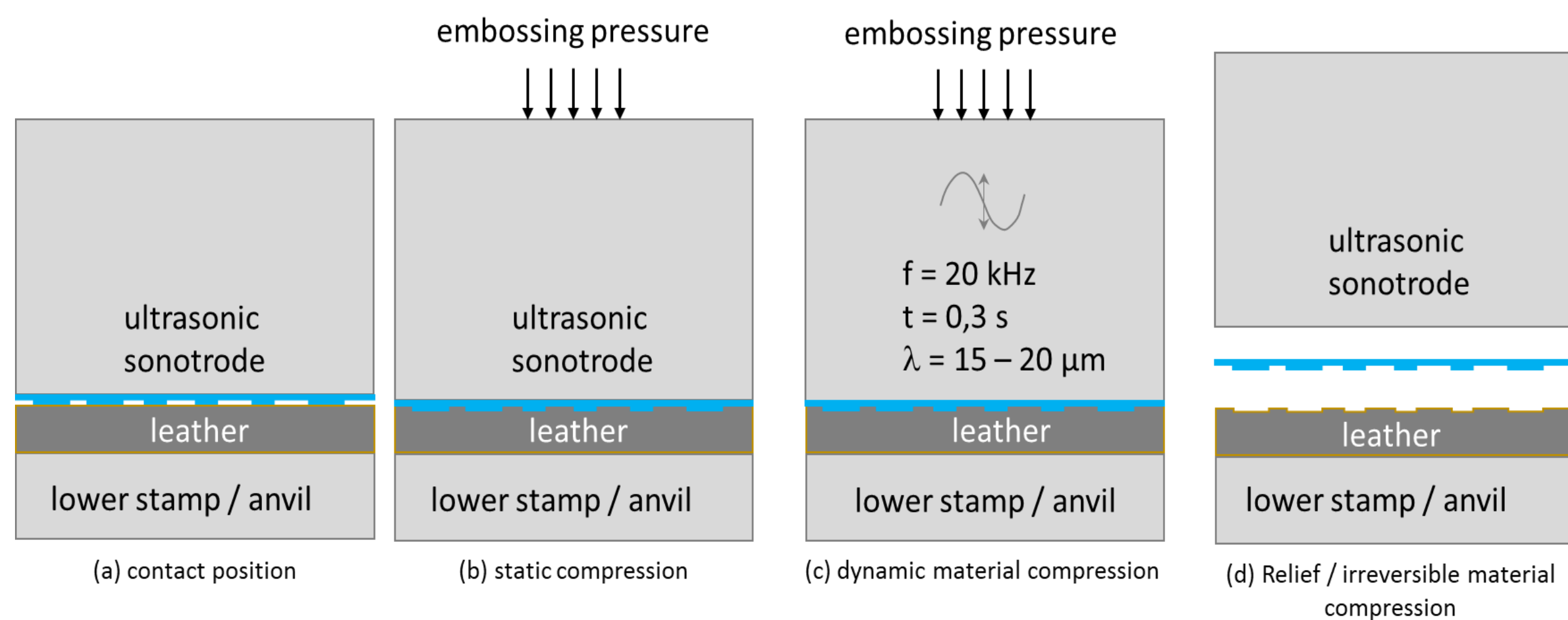
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## Introduction

Traditional leather embossing has primarily been carried out using metal embossing tools. In order to achieve the desired patterns, the tools (dies for flat embossing or embossing rollers for rotary embossing) are made of high-quality steel or special alloys using precise processes such as milling or engraving. The heatable embossing tools can withstand the high forces and temperatures involved in embossing. They are therefore characterized by low wear and thus long service lives in recurring embossing series.

For quick pattern changes, highly customized embossing in small series or even single pieces, plastic embossing tools should be used, which can be efficiently manufactured using additive manufacturing. The temperature required for the deformation process in the leather is generated directly in the embossing zone by ultrasonic waves. A novel process has been developed that enables plastic tools to produce embossings of the highest quality in leather.

## 1. Ultrasonicsupported embossing process and its advantages



### Conventional embossing process

Temperature profil:

- Preheated embossing tool (100 °C)
- Temperature on the leather surface up to 100 °C
- Static load and temperature load for 2 – 5 seconds
- Risk of thermal damage to the leather surface
- Not suitable for sensitive and difficult-to-emboss leathers

### Ultrasonicsupported embossing process

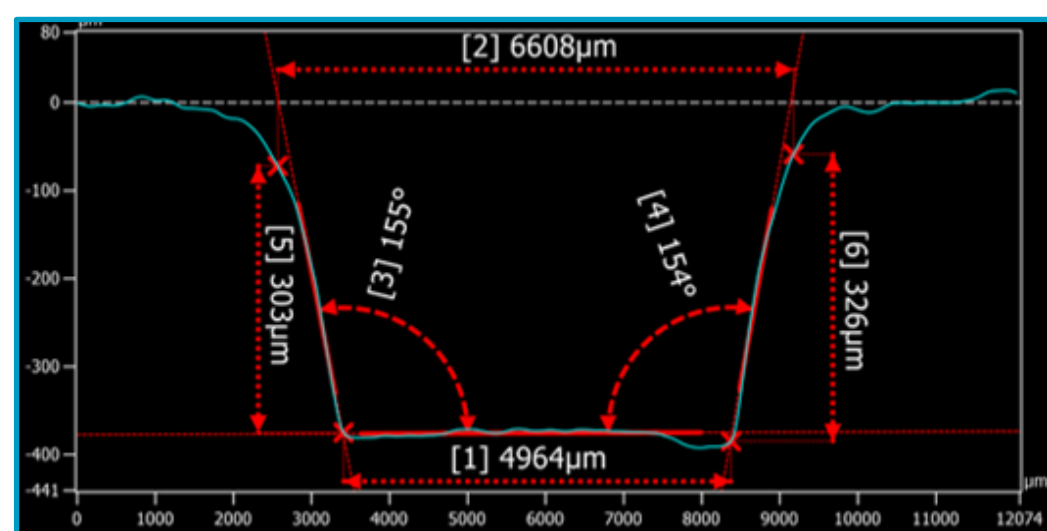
Temperature profil:

- Plastic embossing tool (23 °C)
- Temperature build-up in the leather and spread from inside to the outside (max. 60 °C)
- Static load and temperature load for only 0.3 seconds
- Gentle embossing with minimal risk of damage to the leather

## 2. Evaluation of embossing quality and impression accuracy

Parameters used for evaluation :

- flank angle [3,4]
- lower edge length [1]
- upper edge length [2]
- embossing depth [5,6]



Determination of **quality value** for each measured parameter

$$\text{Quality value}_i = \frac{\text{Actual value embossing in the leather}[\mu\text{m}]}{\text{Target size tool}[\mu\text{m}]}$$

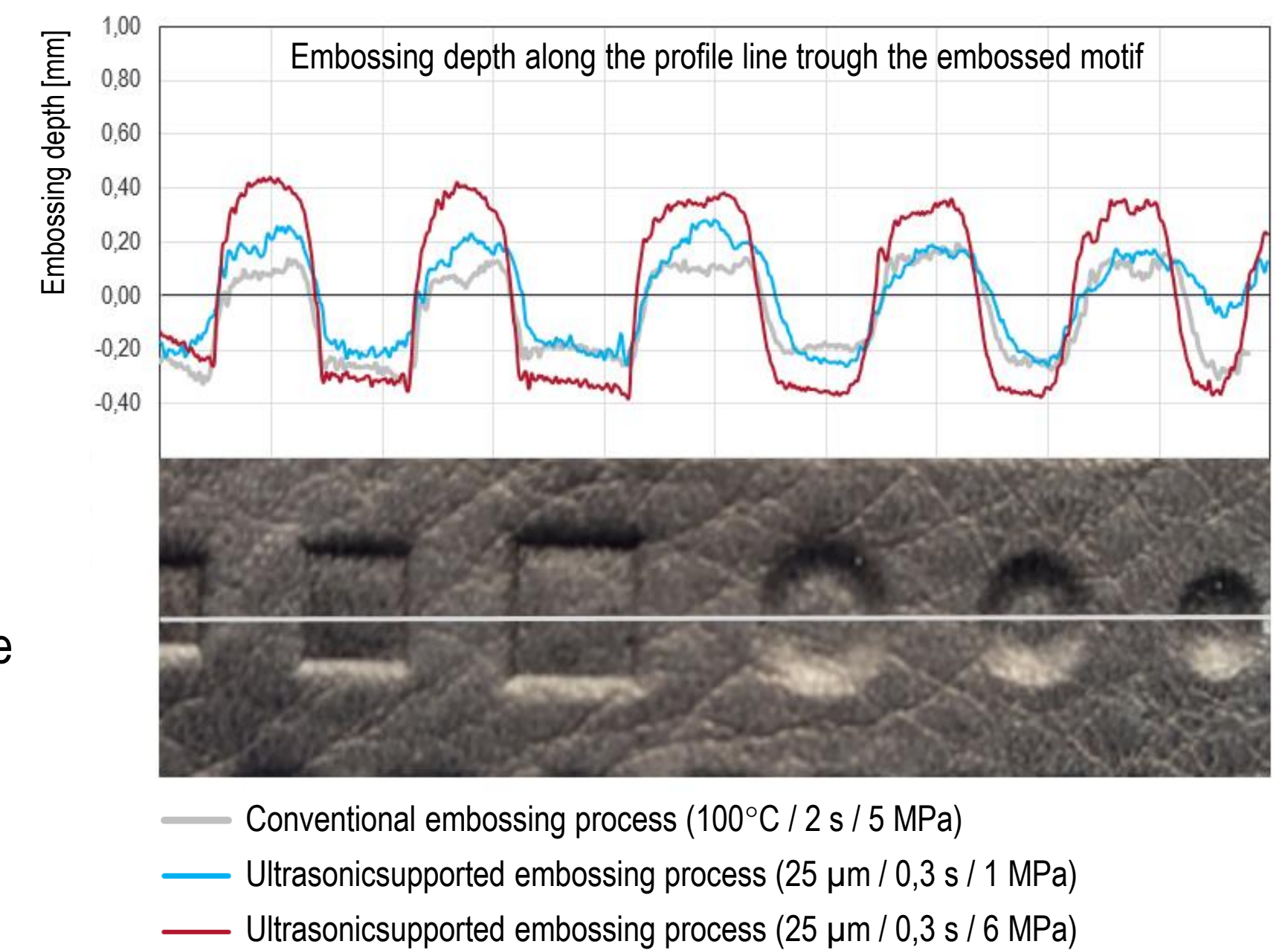
Calculation of the **impression accuracy**

$$IA = \left\{ \frac{QV_{ED} + QV_{FA} + QV_{uEL} + QV_{IEL}}{4} \right\}$$

A direct comparison between conventional static embossing and ultrasonic embossing yielded the following **results**:

The same embossing depth in leather can be achieved with ultrasonic support, but with significantly **reduced static pressure** (from 5 MPa to 1 MPa). This is particularly important when embossing very sensitive leather.

A **deeper embossing effect** can be achieved on leather through uniform embossing pressure and additional ultrasonic action. This makes it possible to apply high-quality embossing even to leather that is difficult to emboss.



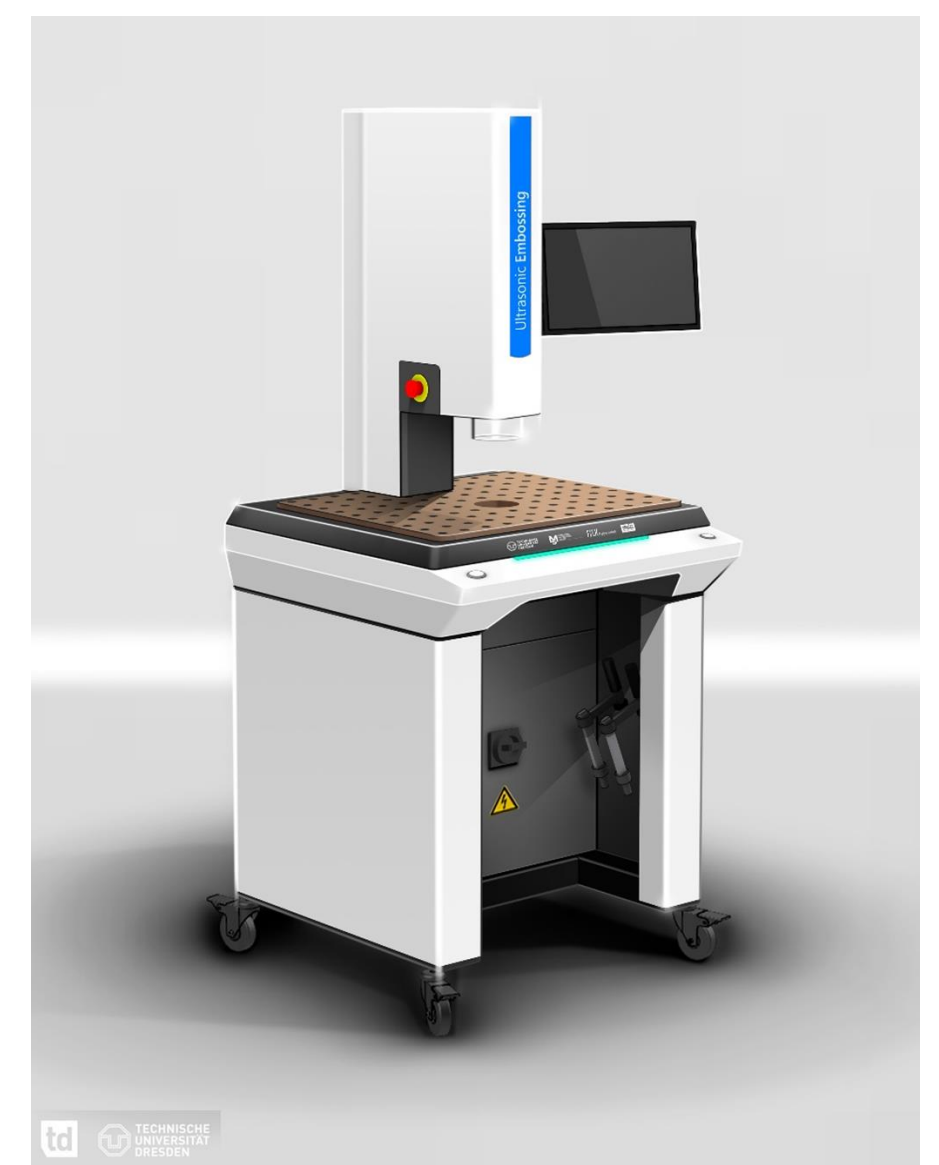
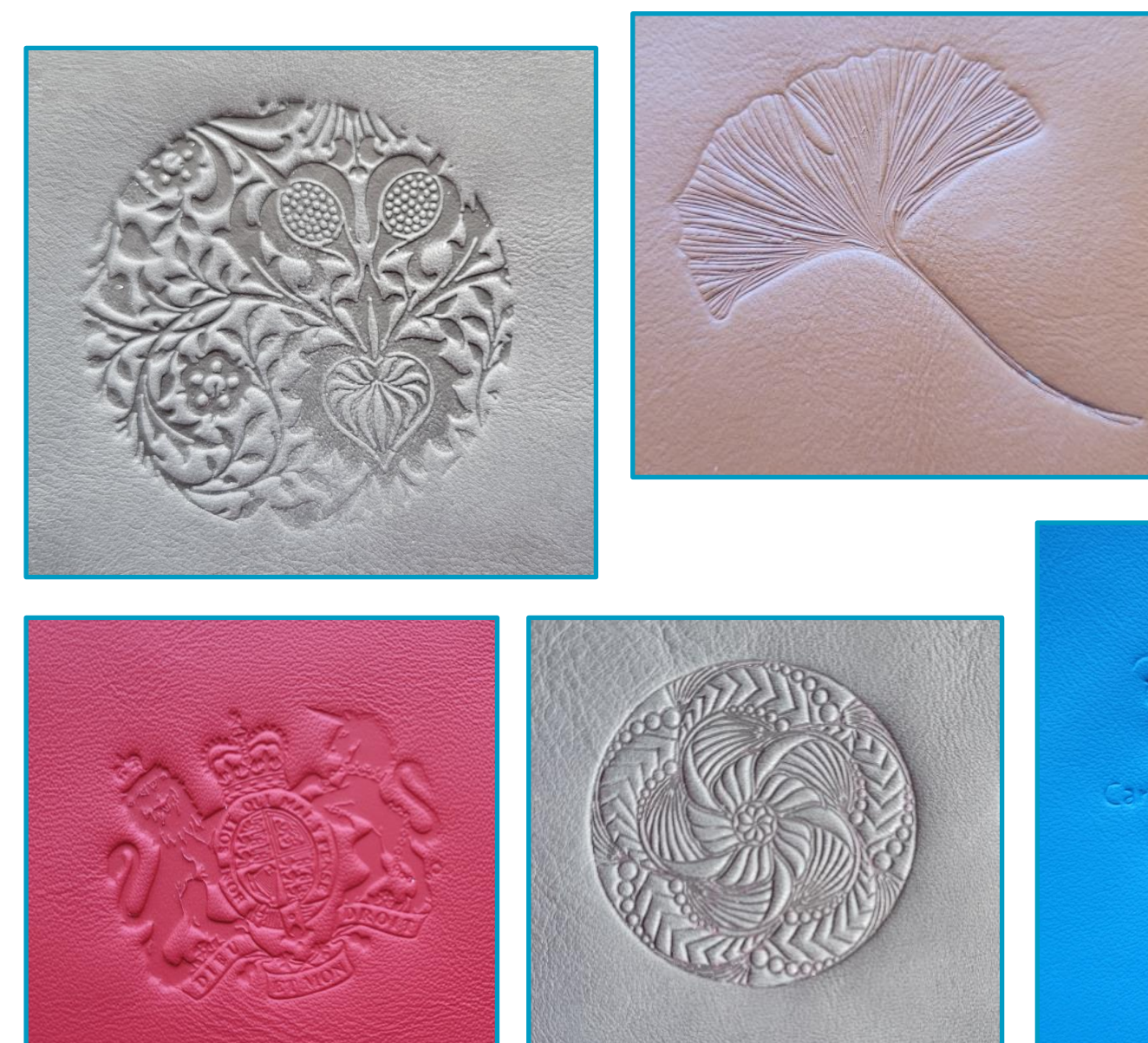
## 3. Manufacturing of embossing dies

- **Additive manufacturing** makes it possible to produce **customized embossing tools** from plastics. Stereolithography is proven for the production of embossing foils.
- **High pattern resolutions** can be achieved and almost all patterns can be transferred to an embossing tool. Line thicknesses of up to 0.1 mm and line spacing of up to 0.3 mm can be achieved on the embossing die and reproduced when embossing leather.
- Manufacturing of very individual embossing tools with **high efficiency** is possible (low material demand, low time and personal effort). In less than two hours, an image can be converted into a print file, a stamp can be produced as an embossing tool, and a customer-specific embossing can be carried out on leather.
- The **stability** of the embossing dies is sufficient for small series production. They can withstand the static pressure load and the temperatures generated by ultrasonic waves during embossing. The embossing dies can be used at least 10-15 times.



## 4. Individualization of leather

Demonstration facility was developed for the customization of leather cuts or leather products with the support of ultrasound



View the Ultrasonic embossing process as video



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