

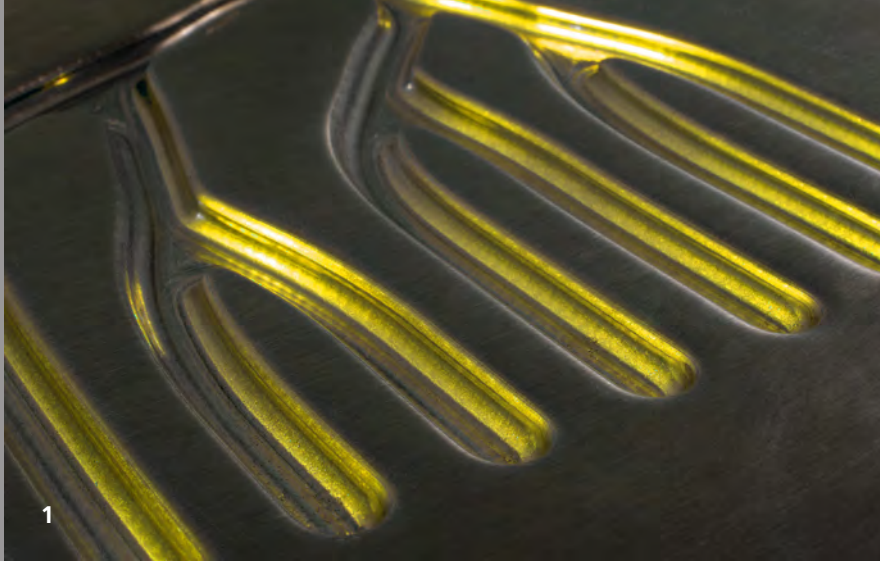


Fraunhofer
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FRAUNHOFER INSTITUTE FOR MACHINE TOOLS AND FORMING TECHNOLOGY IWU

INCREMENTAL SHEET METAL FORMING





Strategy for small and medium quantities

Incremental sheet metal forming is a forming process for the manufacturing of complex components in small quantities. In comparison to conventional drawing methods complex tools can be dispensed. This reduces tool costs and the time to the first finished part. These advantages predestine incremental sheet metal forming for number of pieces in the range of 1 to 1,000 parts.

The process variants used at Fraunhofer IWU enable achieving significantly higher natural strains than with conventional methods.

Implementation process at Fraunhofer IWU

At Fraunhofer IWU several methods of incremental sheet metal part manufacturing are available. The term "incremental" already describes that the final shape is produced by successive movements. In detail, these movements are carried out by a forming stylus. This part is moved along one CNC path or several consecutive CNC paths. The part geometry itself can be directly influenced by the programmed path.

Simple geometries (truncated pyramids, cones, ...) can be generated completely without corresponding tools. More complex component shapes are formed using simple counter tools. For the production of these tools low-cost materials and construction methods can be applied. Thus the resulting advantages in terms of cost and production times represent a further competitive advantage.

Due to its approach Fraunhofer IWU also focuses on solutions related to mechanical engineering. So several tailored solutions are available for incremental sheet metal forming. On a specially adapted portal machining center formed parts can be "drawn" in two opposite directions. This unique environment allows forming of parts using dies or using male molds to achieve the best forming strategy possible for each component.

Furthermore there are different ways of clamping the sheets (rigid/driven) in different dimensions. Complex geometries can be produced safely by using various and specialized styluses.

Temperature-assisted incremental sheet metal forming

Another process variant consists in temperature-assisted incremental sheet metal forming. By intelligently using heated fluids, sheet metals with dimensions of up to two square meters can be kept at constant elevated temperature ranges during the forming process. This method provides an optimal process window at 250 °C for magnesium materials and difficult-to-form aluminum alloys. In addition to the excellent results when using these two lightweight materials, the selected process version also opens up the possibility of forming non-metallic materials such as thermoplasts or material composites with plastic contents.

1 *Specific media channels in a titanium heat exchanger*

2 *Cup geometries in various materials (from top to bottom: brass, copper, aluminum)*



Incremental processing of large components

The component dimensions formable at Fraunhofer IWU are worldwide unique. The maximum dimensions formable are approximately 3,000 millimeters by 4,000 millimeters, which means that even forming of a complete side panel of a tramway is feasible. Incremental forming of individual shaped elements or segments of larger component dimensions is often significantly more cost-efficient compared to the application of conventional manufacturing processes. Based on a preform, e.g. a deep-drawn engine compartment cover, it is possible to manufacture an individualized component using specific shaping.

The possibilities of incremental forming also allow replacing of complete assembly groups by a formed part, e.g. in the case of housings. Thus laborious joining processes and subsequent treatment are omitted.

Component evaluation

Incremental sheet metal forming is a production process strongly based on experience. Due to the duration and cost of finite-element simulations, practical tests are often preferred to theoretical considerations. For this reason it is even more decisive to have the relevant expertise.

Fraunhofer IWU has conducted research in the field of incremental sheet metal forming for more than twenty years, so the institute can fall back on this extensive experience. Thus it is possible to estimate the feasibility of complex geometries already in the design stage. This evaluation can then be used to derive the corresponding process parameters. In order to check the suitability of new sheet metal materials for incremental forming, simulative calculations are carried out using simplified test geometries. Numerous measuring and testing processes are available at Fraunhofer IWU in order to verify component quality. Tactile or optical measuring processes are used to determine the component geometry. Processes of

Your advantages

- Cost efficiency from quantity of 1
- All from a single source
- Components in the shortest time possible
- Complete manufacturing or processing

Our options

- Parts of dimensions up to:
 - 4,000 x 3,000 mm (cold)
 - 2,000 x 1,000 mm (max. 250 °C)
- Sheet thicknesses up to 5 mm (Al)
- A wide range of sheet materials
- Complete production of formed parts and manufacturing of design-geometries
- Rough and finish machining
- Surface structuring
- Component design
- Tool design and construction
- Process design
- Machine design/construction

visioplasticity are applied to determine strains and stresses with a spatial resolution. Furthermore a fully equipped laboratory for metallography can be utilized to determine hardness profiles and distribution of sheet metal thickness. Various devices are available for characterizing the component.

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