

# Digital Sheet Metal Forming



# Why Figur?

## Replace traditional forming processes with digitally driven tools

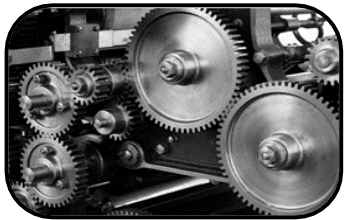
Metal forming, prevalent in all major industries, has not yet caught up to the digital manufacturing revolution.

- Elimination of metal forming dies will give manufacturers a competitive advantage in supplying customers with unique metal products quickly and without high development costs
  - Minimize CapEx without upfront expenditures on dies or stamping machines
  - Provide new agility to pivot with fast-changing industries like automotive or tech
- Better redundancy through smaller machines working in parallel instead of one large system
- Flexible, on-demand production opens new markets where stamping wasn't technically feasible or cost effective

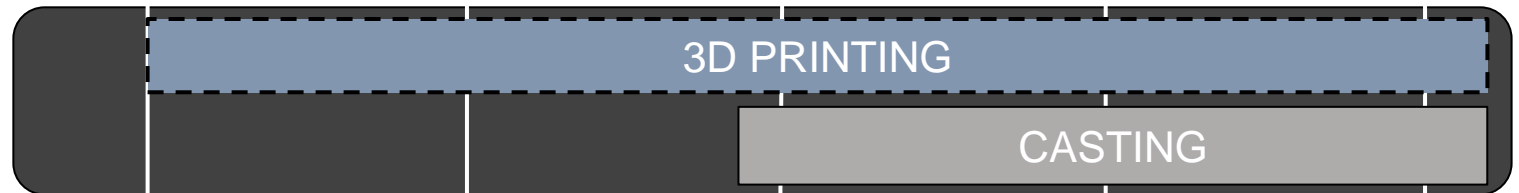
# Economies of scale and the shift to digital manufacturing



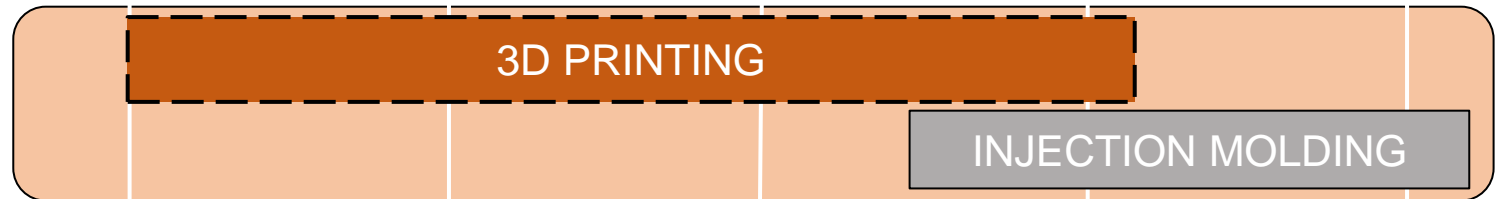
Sheet Metal



Solid Metal



Solid Plastics



1 10 100 1,000 10,000+

Ideal part quantity for production

# Shifting to Digital Sheet Forming

## Speed

- Fast production and first part delivery with as little as same-day turnaround

## Quality

- Controlled deformation for high surface quality

## Economical

- No upfront tooling investment

## No minimum orders

- On-demand production starting at quantities of one

## Compact

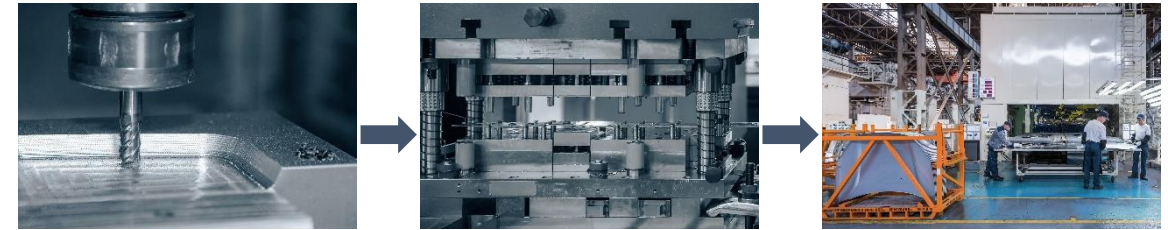
- Small footprint and low power requirements and quiet operation for use in light industrial space

## Agile

- Flexible modern production and just-in-time inventory

## Accessible

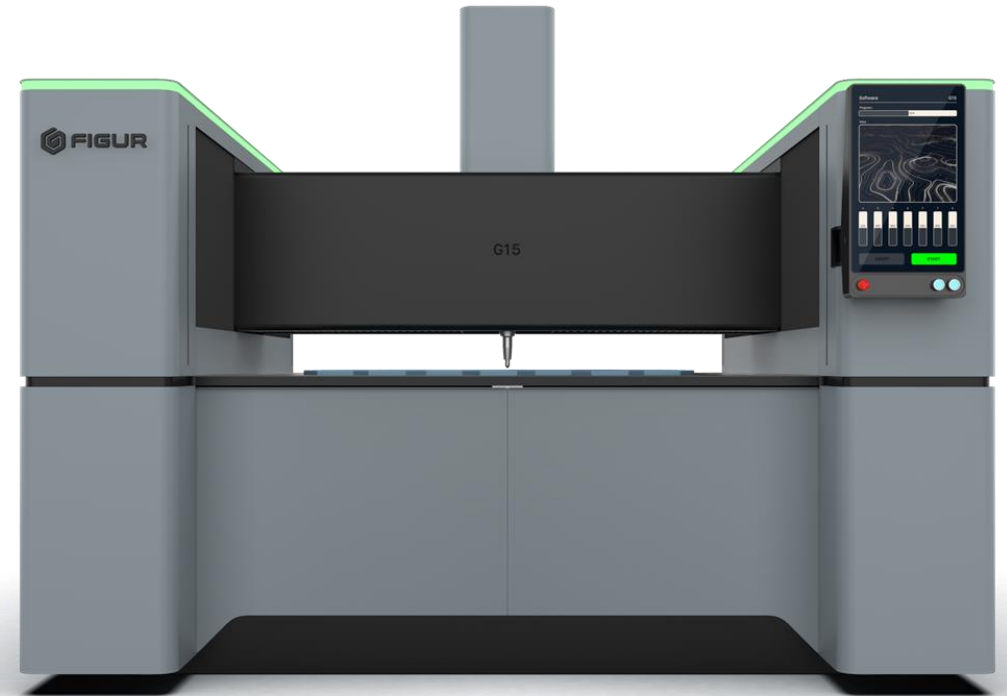
- Uses existing materials with minimal labor requirements



# Digital sheet forming from Desktop Metal

## Figur G15 Specs

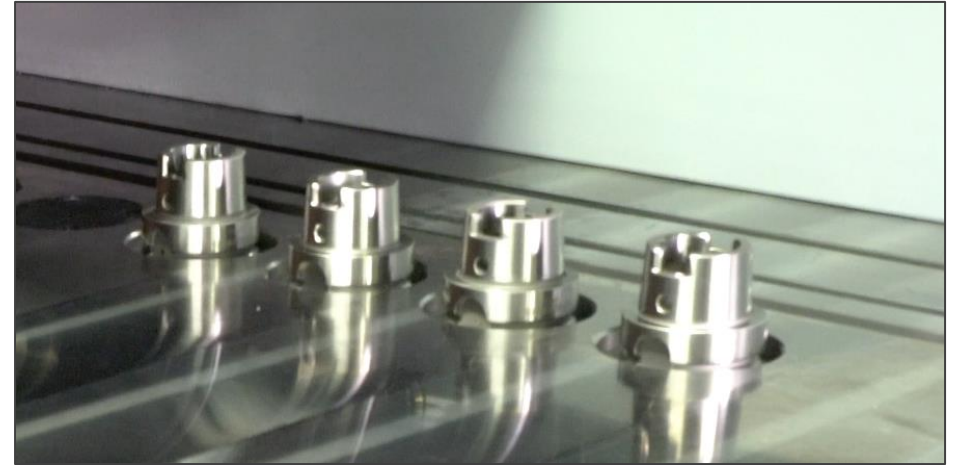
TECHNOLOGY	Digital Sheet Forming (DSF)
MAX SHEET SIZE	1,600 mm x 1,200 mm (63.0 x 47.2 in)
FORMING AREA	1,450 mm x 1,000 mm (57.1 x 39.4 in)
Z TRAVEL	400 mm (15.7 in)
FORMING FORCE	2,000 lbs X, Y & Z
FORMING SPEED	1 m/sec
CAPACITY	Aluminum: 2.5 mm (10 Ga) Steel: 2.0 mm (14 Ga)
POWER	480 V / 3 Phase / 20 kw
MACHINE DIMENSIONS	2.8 m x 2.2m x 1.8 m (110.2 x 86.6 x 70.9 in)
MACHINE WEIGHT	3,600 kg (8,000 lbs)



# Figur G15 vs G15 Pro

**Figur G15 Pro** has several added features that are geared for customers that are doing small series of parts. Various features allow for easier part setup, tool measurement, and reduced user maintenance. In addition to the base G15, the Pro includes

- **Automatic Toolchanger** – G15 can hold up to 5 tools and automatically switch between them.
- **Tool Measurement Probe** – automatically measures the forming tool
- **Automatic Part Lubrication** – up to 3 different lubricants can be applied through / around the tool.
- **Automatic Machine Lubrication** – all precision linear components (linear rails, ballscrews, etc) get automatic lubrication through a central grease pack system



Automatic Toolchanger Rack



Tool Measurement Probe



Auto Machine Lubrication

# Sheet Forming – Materials

## Currently Supported Materials

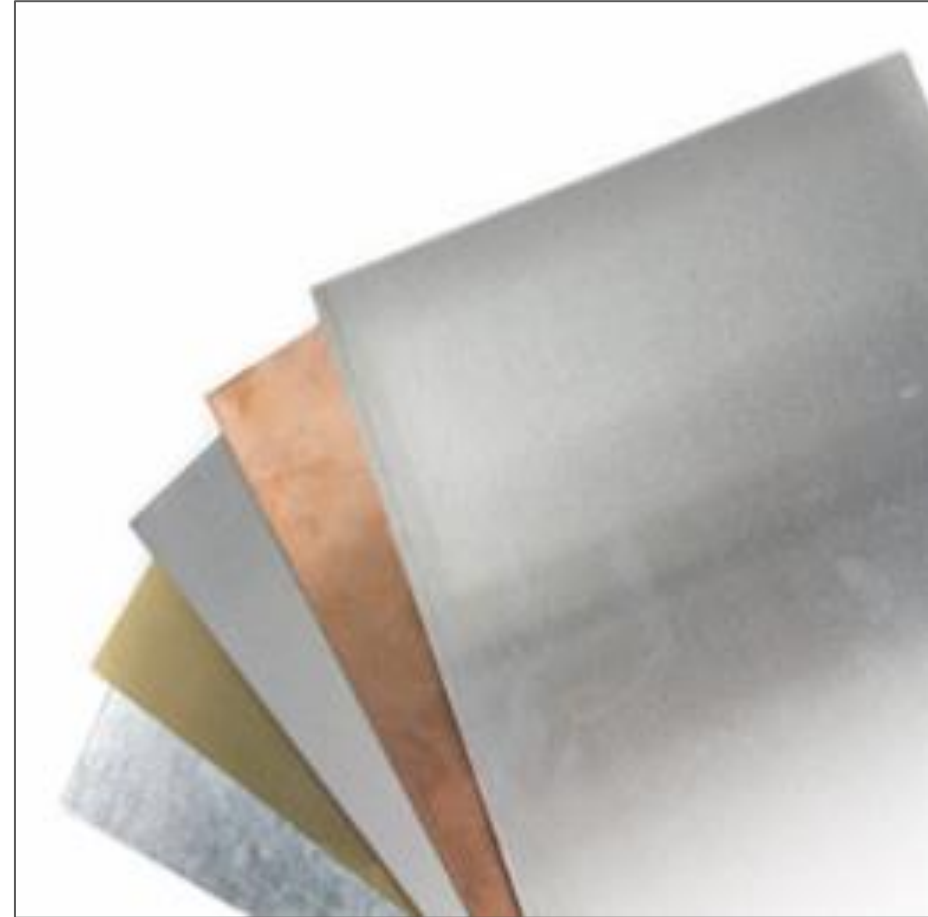
- Cold Rolled Steel - 1008
- Alloy Steel – 1045, 4140

## Materials Profiles in Development

- Titanium – Grade 2 & Grade 5
- Stainless Steel
- Aluminum - 2000,3000,5000,6000 series

## Future

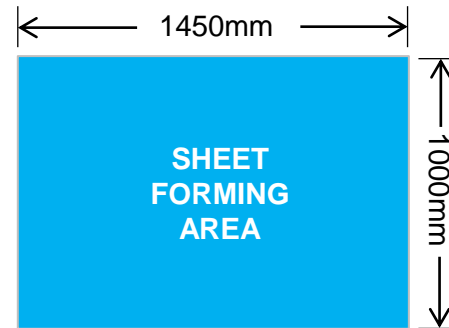
- Copper
- Inconel



# Sheet Forming – Best Practices

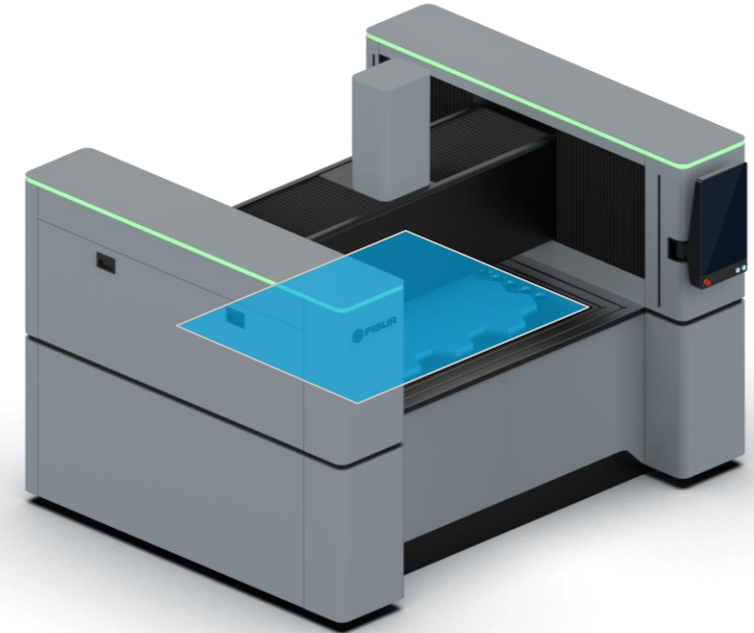
## Forming Area

- Forming Area - 1450mm x 1000mm\*  
63.0 x 47.2in
- Sheet Size – 1600mm x 1200mm  
57.1 x 39.4in



## Forming Geometry

- Draw Depth – 400mm
- Wall Angle 60 deg (30deg draft)\*\*

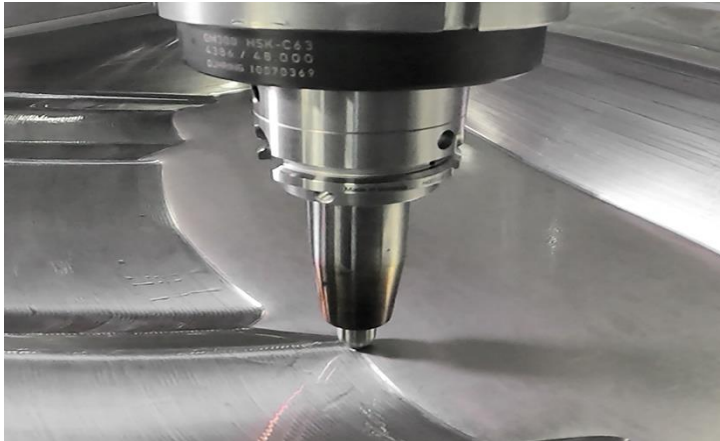


\*Toolchanger uses some of the machine travel space, toolchanger rack can be temporarily removed for maximum forming area

\*\*Tools are in development for steeper walls and specific materials

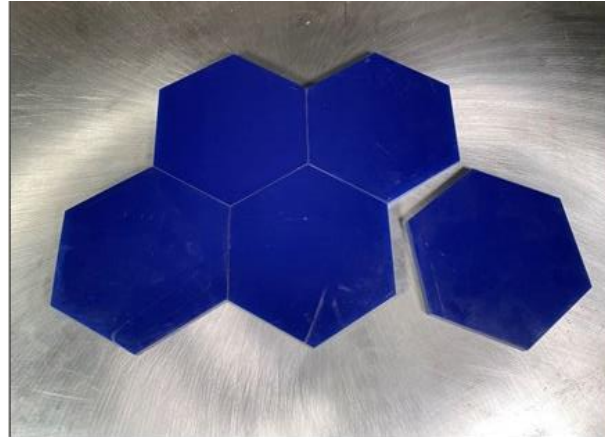


# Features of the patent-pending Digital Sheet Forming process



## Forming tool

A proprietary ceramic forming toolhead reduces wear while providing for a pristine surface finish



## Backing system

Magnetic urethane backing controls deformation of the sheet for quality and precision



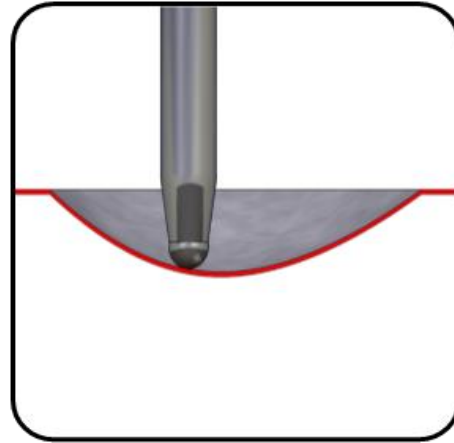
## Adjustable width

Different sheet sizes can be processed without swapping out fixturing for manufacturing flexibility

# Current incremental sheet forming methods

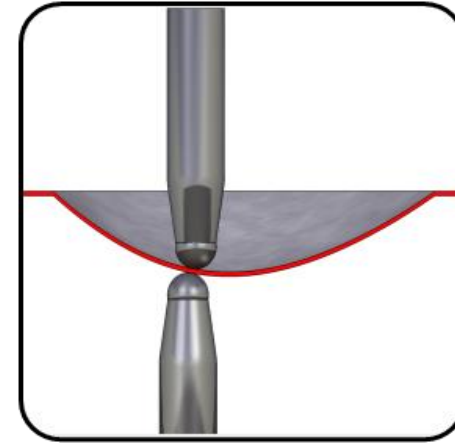
A major challenge with digital approaches has been controlling forming forces that radiate across the sheet metal as the force is applied at the tooling point, causing deformation of the sheet that is difficult to predict and impedes accuracy.

Figur's patent pending process replaces die stamping with modern, flexible, on-demand manufacturing.



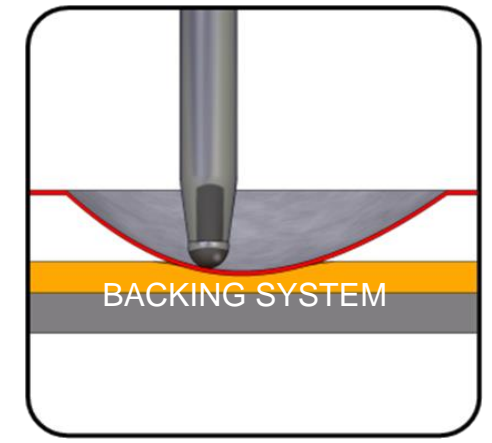
**Single ball tool**

- Two decades of research
- Poor consistency
- No complex shapes
- Not commercialized



**Dual ball tool**

- Complex to control
- Difficult to program
- More complex machine with 6-12+ axes

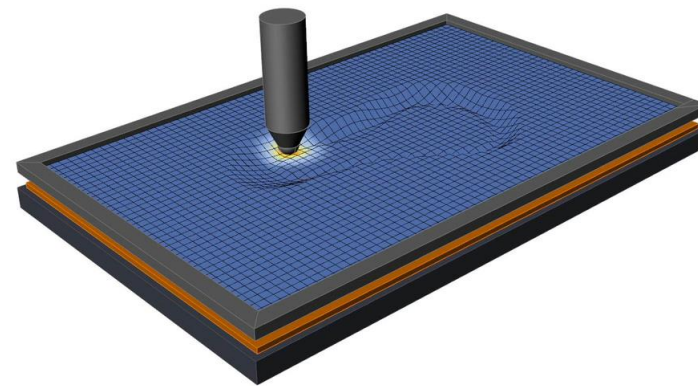
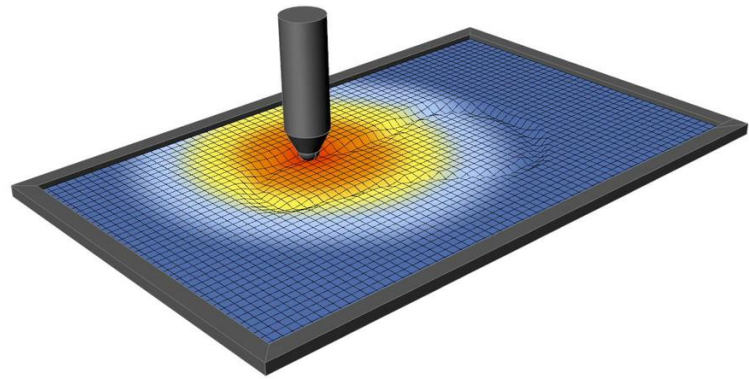


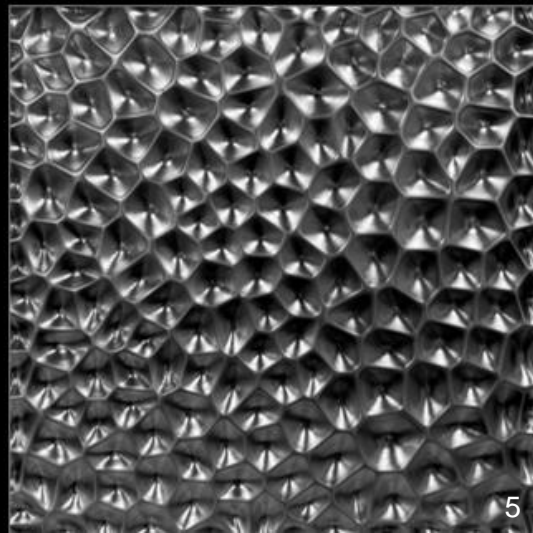
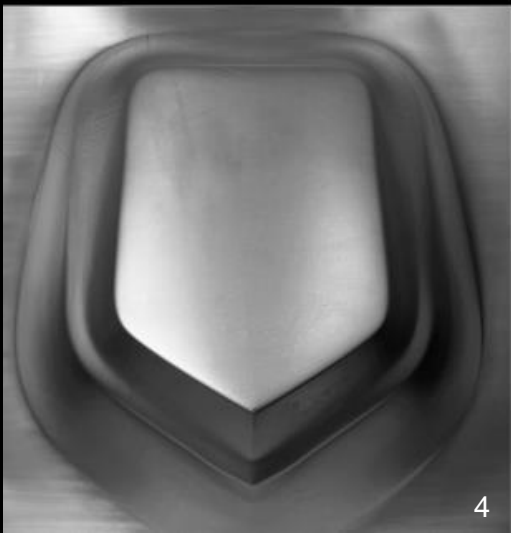
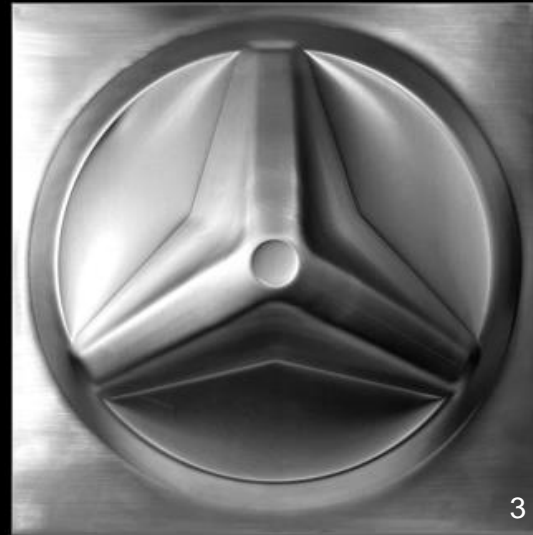
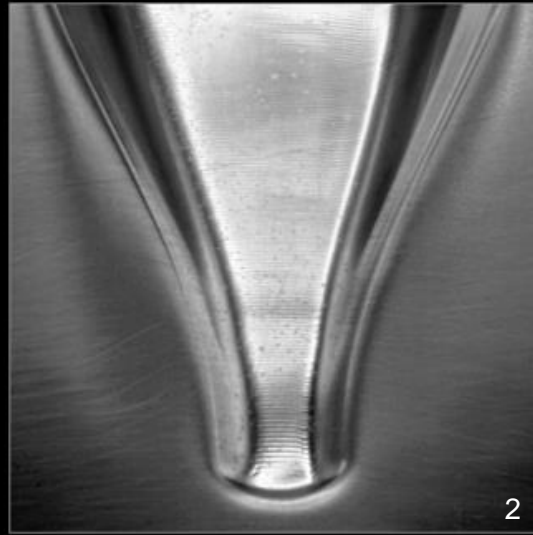
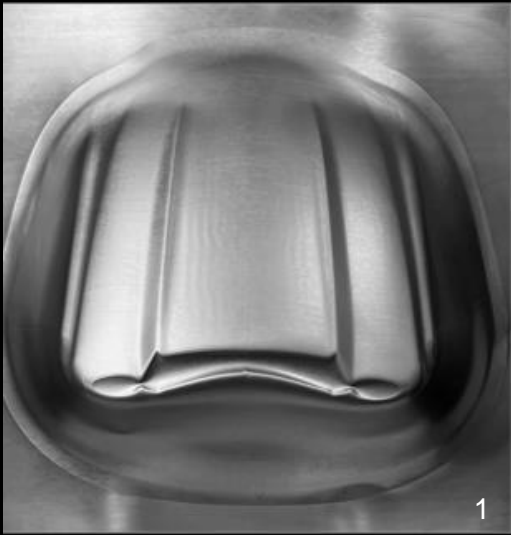
**Figur**

- Patent pending process
- Simple control system
- Easy programming
- Affordable and robust

# Revolutionizing incremental sheet forming

- Typical ISF forces are distributed through the sheet leading to difficult to predict, inaccurate results
- Figur method is faster, more predictable, and more accurate





1. Automotive part, 1m x 1m, 90min
2. Inlet Duct, 150 x 250mm, 15min
3. Washer Tub, 600mm x 600mm, 25min
4. Shaker Hood, 800mmx 700mm, 70min
5. Architectural panel, 600mm x 600mm, 120min
6. Historic Ceiling Panel, 600mm x 600mm, 25min

# Application success story

Application	Automotive exhaust muffler
Challenge	Traditional stamping production required a \$150,000 upfront die investment with a three-month lead time

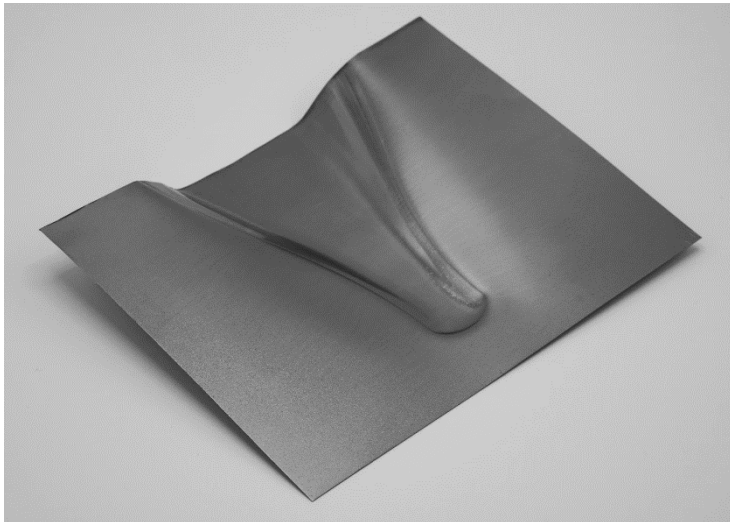
## Figur Digital Sheet Forming

Material	Cold rolled steel
Benefits	<ul style="list-style-type: none"><li>• \$0 up front cost without tooling and less than one week to produce the first part with additional parts on-demand</li><li>• Cost per part at a production quantity of 1,000 was \$10.20 with Figur, a savings of over 90%</li></ul>

Using Figur DSF technology, this muffler can be produced over 90% faster than traditional stamping for just 10% of the cost



# Aerospace applications



# Architectural applications

