



MACHINA LABS

UNLOCKING MANUFACTURING WITH AI + ROBOTICS

ROBOFORMING™



Leveraging precise industrial robotics and AI-driven process control, Roboforming™ rapidly shapes sheet metal into large, complex parts that are extremely expensive and slow to produce with conventional manufacturing tools.

Video available at www.MachinaLabs.AI



ROBOSCANNING™

A robot-mounted laser scanner creates a 3D map of the surface of the part and then Machina software compares this to the CAD model to determine accuracy across every dimension. Any deviations are compensated for in our AI-powered process model to optimize the next manufacturing iteration until the part is within spec.

Video available at www.MachinaLabs.AI

ROBOCUTTING™



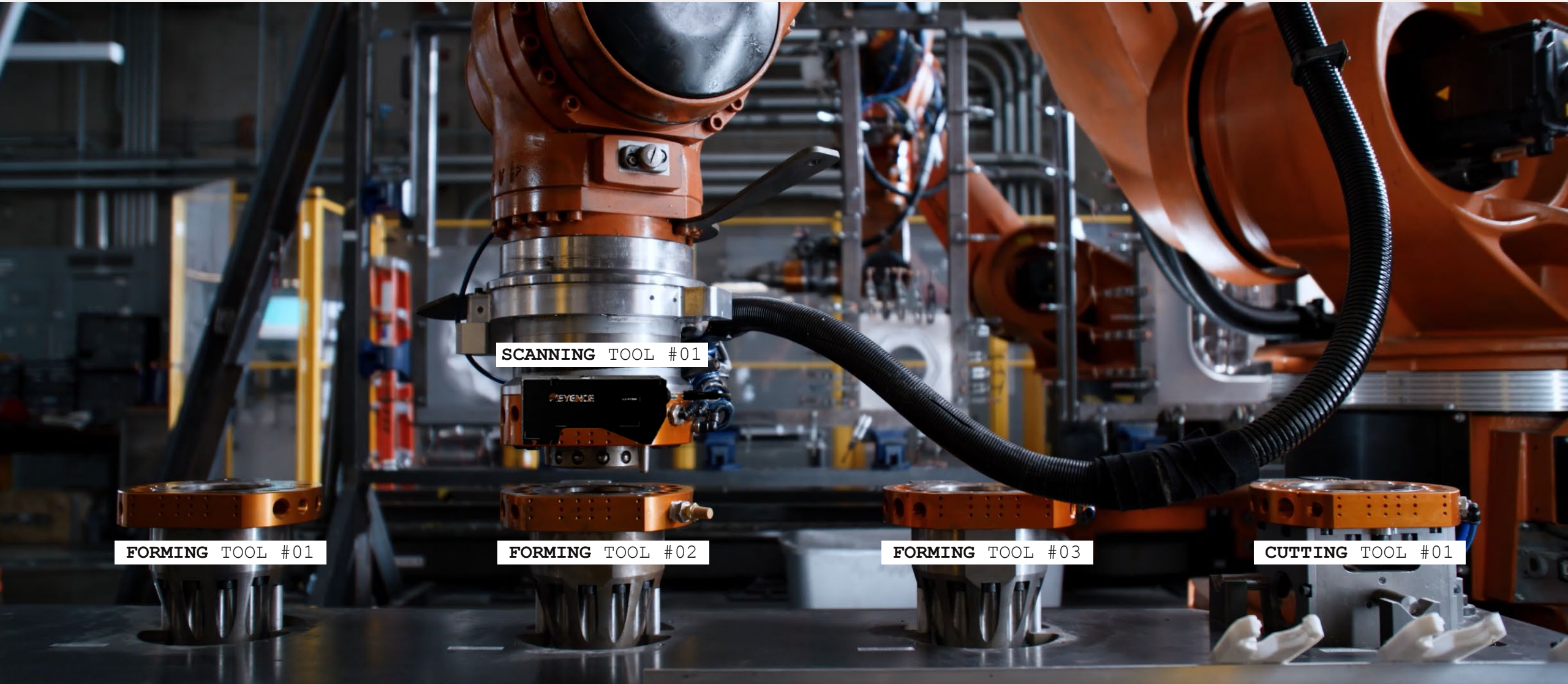
The 7-axis robots autonomously pick up and precisely manipulate cutting tools to remove material, drill holes, and trim the part geometry from the surrounding sheet. Data from the prior part scan provides an exact datum to the formed surface for an accurate, adaptable toolpath.

Video available at www.MachinaLabs.AI



TECHNOLOGY & CAPABILITIES

Autonomous Roboforming™, Scanning, Cutting, Finishing, and more...



SCANNING TOOL #01

FORMING TOOL #01

FORMING TOOL #02

FORMING TOOL #03

CUTTING TOOL #01



SYSTEM CAPABILITIES

Machina Labs' ROBOCRAFTSMAN™

12 x 5 x 4 ft part size

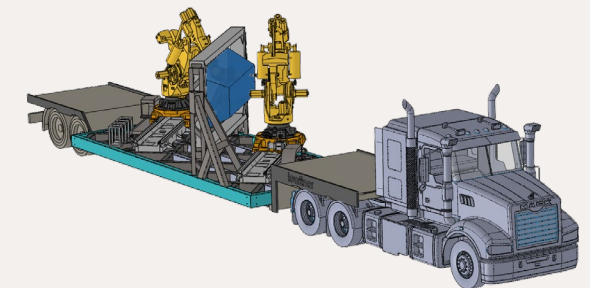
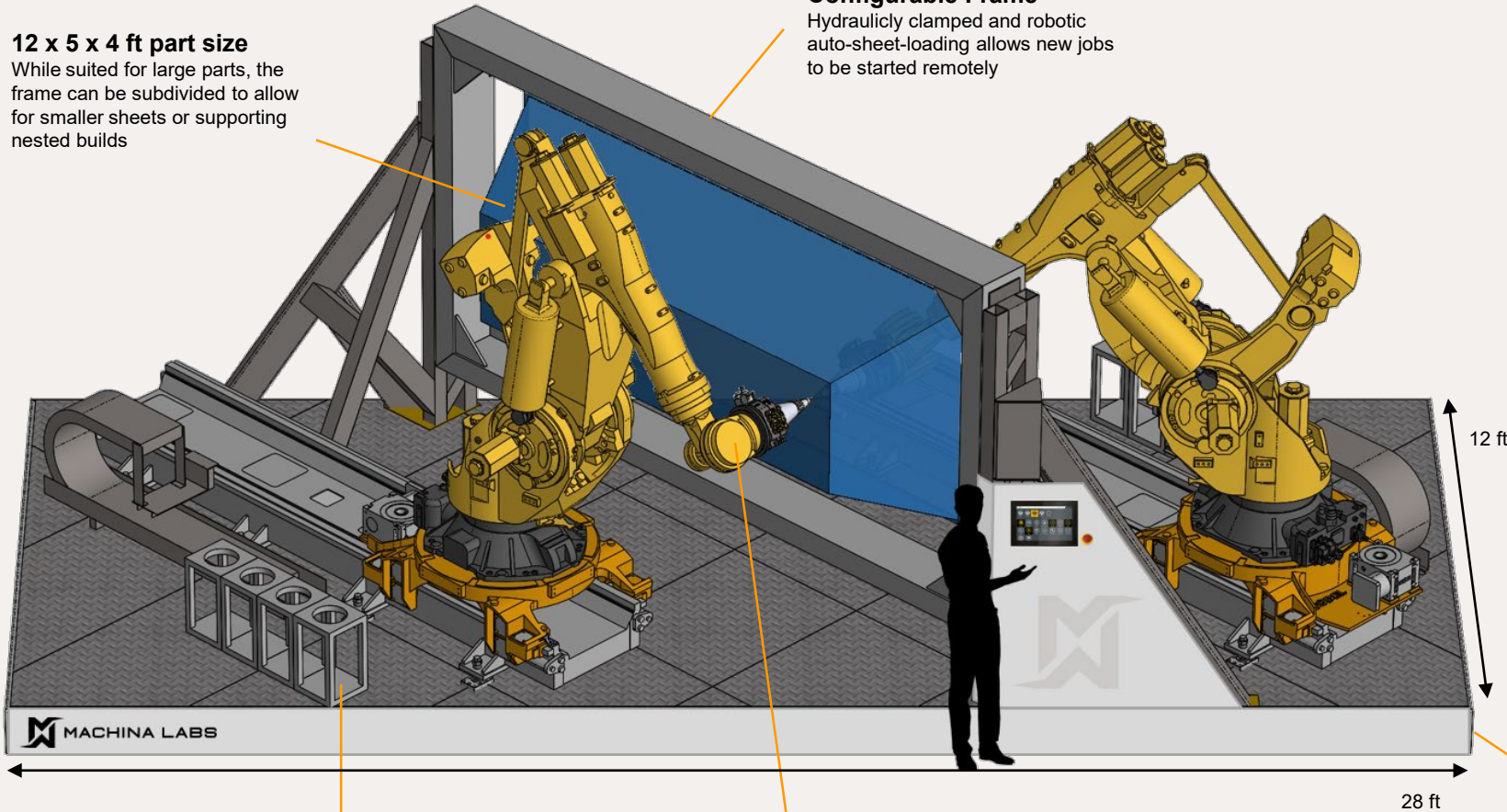
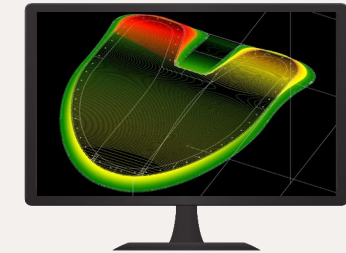
While suited for large parts, the frame can be subdivided to allow for smaller sheets or supporting nested builds

Configurable Frame

Hydraulically clamped and robotic auto-sheet-loading allows new jobs to be started remotely

AI-driven Process Control

Proprietary software stack drives process from CAD to final inspection. AI Machine learning models constantly improve process



Tool changing Corral

Holds forming, trimming, and other tools, enabling the robot to automatically switch between them

7 axes Robotics

6-axis precise industrial robots + rail system allow for ultimate spatial freedom for optimal poses and material processing

Portable Platform

Mounted to its own base, the self-contained system is easy to deploy to any geography or environment

MACHINA LABS DESIGN GUIDE

4/4/2023

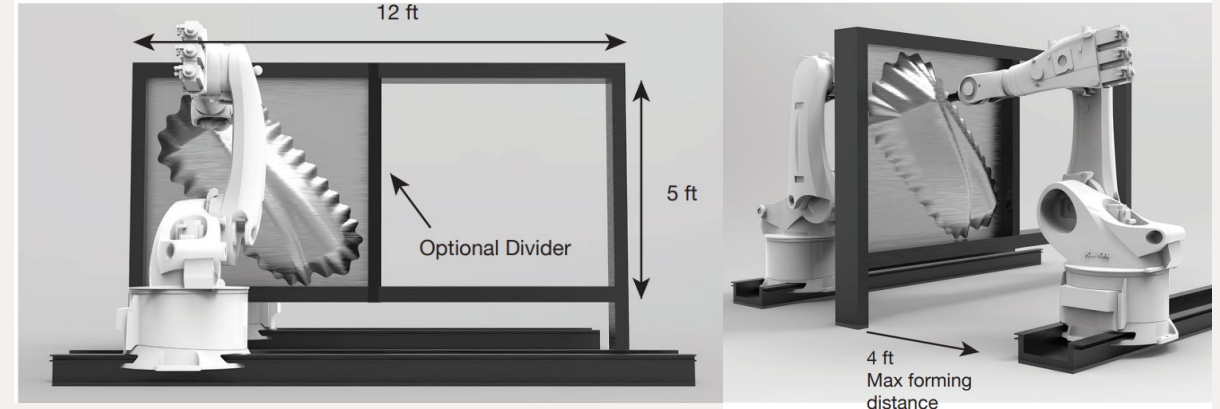
Process video and more information available at www.machinalabs.ai

Reach out with any specific questions, requirements, or for design feedback: info@machinalabs.ai Machina is rapidly developing and expanding capabilities including new materials and geometries.

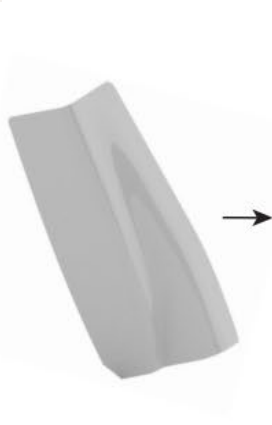


Materials	Thickness	Wall Angle	Radius	Accuracy
Aluminum	0.5 – 6.0 mm 0.02 – 0.25 “	Max: ~60°	Minimum: 3-5x sheet thickness or 6 mm / 0.25”	Minimum: ± 0.3% of max dimension or ± 1 mm / 0.04”
Steel (stainless & HS)	0.5 – 3.0 mm 0.02 – 0.12 “	Max: ~70°		
Steel (mild) Invar, Inconel	0.5 – 5.0 mm 0.02 – 0.20 “			
Titanium	0.5 – 3.0 mm 0.02 – 0.12 “	Max: ~50°		

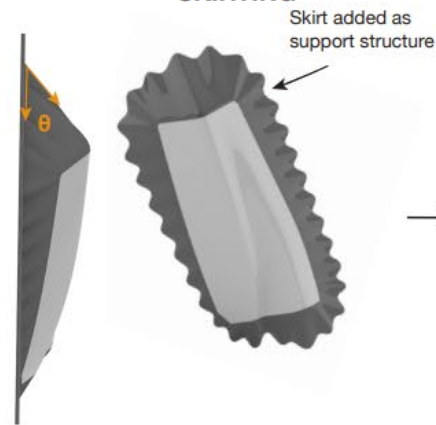
Maximum Part Size (12 x 5 x 4 ft):



1 CAD DESIGN

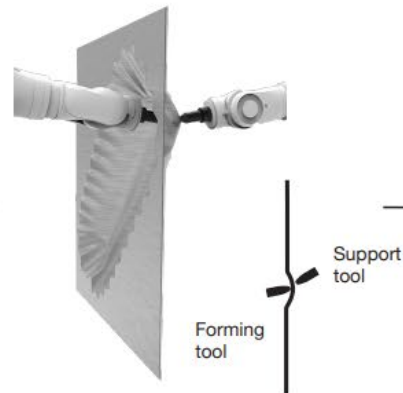


2 ORIENTATION AND SKIRTING



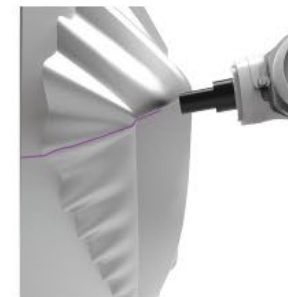
Orient to minimize wall angle and skirt area

3 ROBOFORMING



Incremental forming with two robots that can interchange roles as forming and support tools

4 SCANNING



Formed sheet metal design scanned in cell to measure accuracy and deviation from CAD design

5 TRIMMING



Final part trimmed from the skirt and unformed sheet

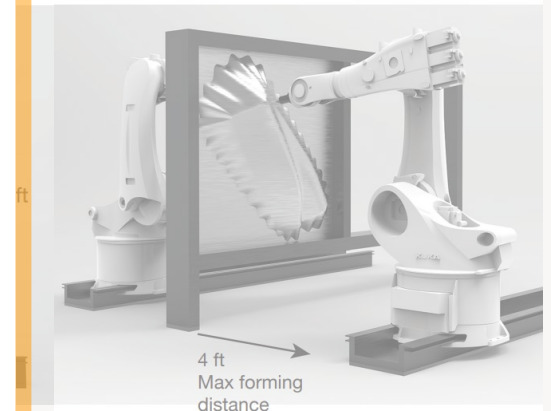
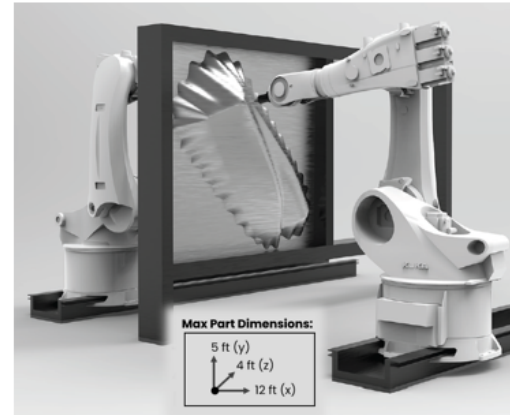
6 FORMED DESIGN



Materials	Thickness	Wall Angle
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Titanium	0.5 – 3.0 mm 0.02 – 0.12 “	Max: 60°

CUSTOM FORMED SHEET METAL IN UNDER 1 WEEK

PRODUCTIONIZED CAPABILITIES FOR RAPID MANUFACTURING

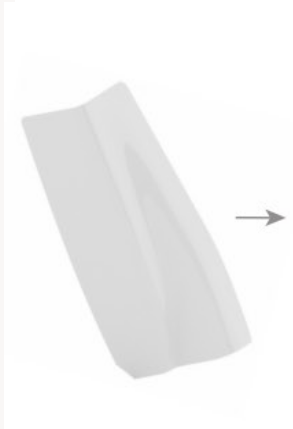


Materials	Thickness	Wall Angle	Radius	Accuracy
Aluminum 1/2/3/4/5/6/7xxx* <i>*soft tempers only</i>	1-5 mm 0.04-0.2”	Max: 60°	Minimum: 5x sheet thickness Or 6 mm/0.25”	± 1% of max dimension Or ± 2.5 mm / 0.1”
Mild Steel A36/1011/1018/1045	0.5-4 mm 0.02-0.16”	Max: 70°		

- First sample parts produced within **1 week of PO and Material** (assumes no heat treat or trimming)
- Heat treat and trimming usually add at least 1 week each
- To get started right away, we stock materials:
 - Aluminum 5052 H32 (2 mm)
 - Mild Steel A36 (1 mm)
- You can provide the sheet metal or we can source it for you
- Machina maintains a \$9,950 minimum total project size

Contact our experts for a quote and design review today: bd@machinalabs.ai

1 CAD DESIGN



2 ORIENTATION

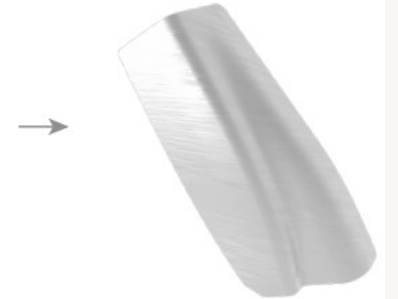


Orient to minimize wall skirt area

5 TRIMMING



6 FORMED DESIGN



Trimmed from the skirt formed sheet



APPLICATIONS & CASE STUDIES



BUSINESS CASE


Rapid Sustainment of Aging Aircraft (MRO)

Maximizing Fleet Readiness through rapid, on-demand fulfillment of long lead time spare parts

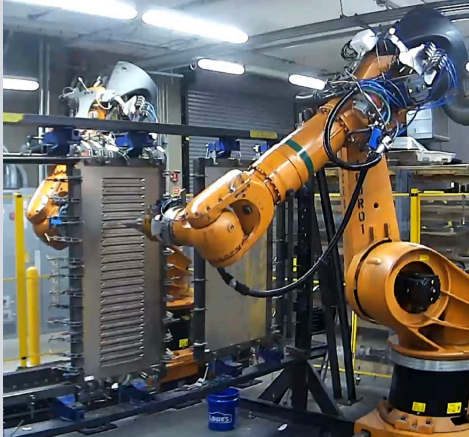
Fully automated manufacture of complex sheet metal parts that are difficult or impossible to source. No custom setup or tooling required.

Dozens of Machina Systems (right) being deployed by DoD starting in October 2023.




 **DEFENSE LOGISTICS AGENCY**

Case Study #1
F16 Aileron Inner Structure
Lead time reduced from 1 year to 2 weeks



→

NSN: 1560-00-162-7236
NAME: PANEL, STRUCTURAL, AI
PART NO: 5-96733-4
CAGE: 82918



 **U.S. AIR FORCE**

Case Study #2
C130 Landing Gear Door
Lead time reduced from 4 years to 4 weeks



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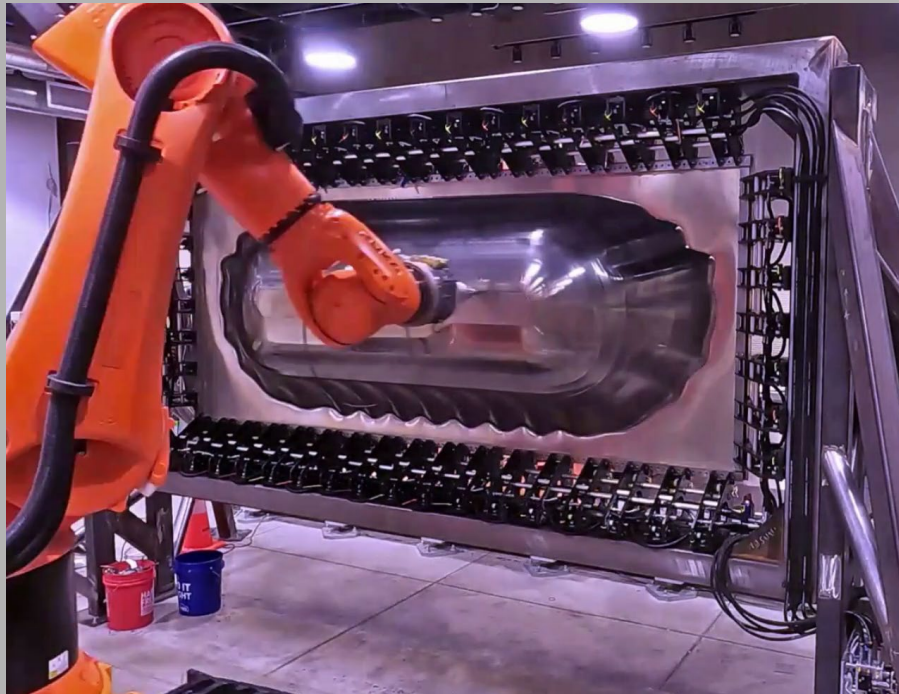




Turning 4 year lead time to 4 weeks



1 Initial Forming



2 Feature Restriking

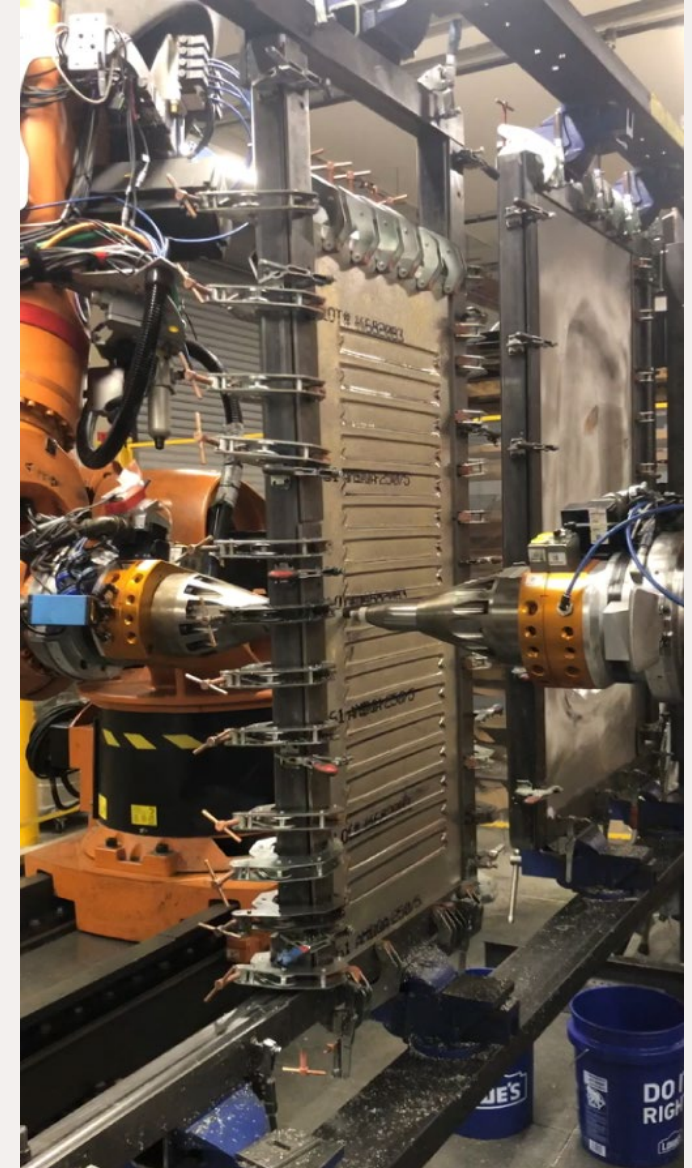




Expedited 24-hour Turn Around (no tooling) Enabling Rapid Testing and Design Iterations



Design received at 2:30 pm, forming started before leaving office (AA2024-0)





Sheet Metal Composite Molds

Faster, lighter, and more economic

Machina Labs' manufactured tooling has demonstrated high dimensional stability during autoclave cycling tests performed by independent laboratories in partnership with USAF



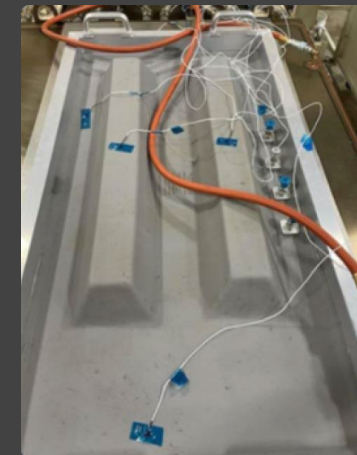
- > 10x Lighter
- > 10x Shorter Lead Time
- > 3x Lower Cost

Benefits of Machina sheet tools for composite layup:

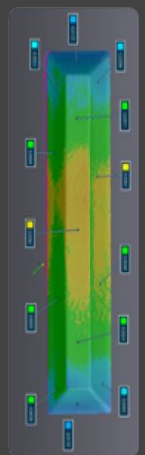
- Lead times of days vs months+
- 90+% lighter than exiting tools = easier, manual handling
- Faster autoclave cycles enabled by thinner molds with lower thermal mass
- Available materials: Aluminum, Steel, and Invar
- Scalable to 12 x 5 ft today and much larger in future



In autoclave processing



out-of-autoclave processing





BUSINESS CASE

Hypersonics & Next-Gen Materials

Machina technology uniquely enables **rapid manufacturing of high-performance superalloys** - such as titanium, nickel and niobium - which are **needed for extreme Hypersonic environments. Conventional manufacturing of these materials requires very expensive, long lead time tooling.**



"China has tested hundreds of hypersonic missiles, while the U.S. has only tested a few"

- Vice Chair, Joint Chiefs, Gen. John Hyten

"...the greatest risk for the United States stems from our inability to change at the pace required by the changing strategic environment"

- Air Force General, Glen D. VanHerck

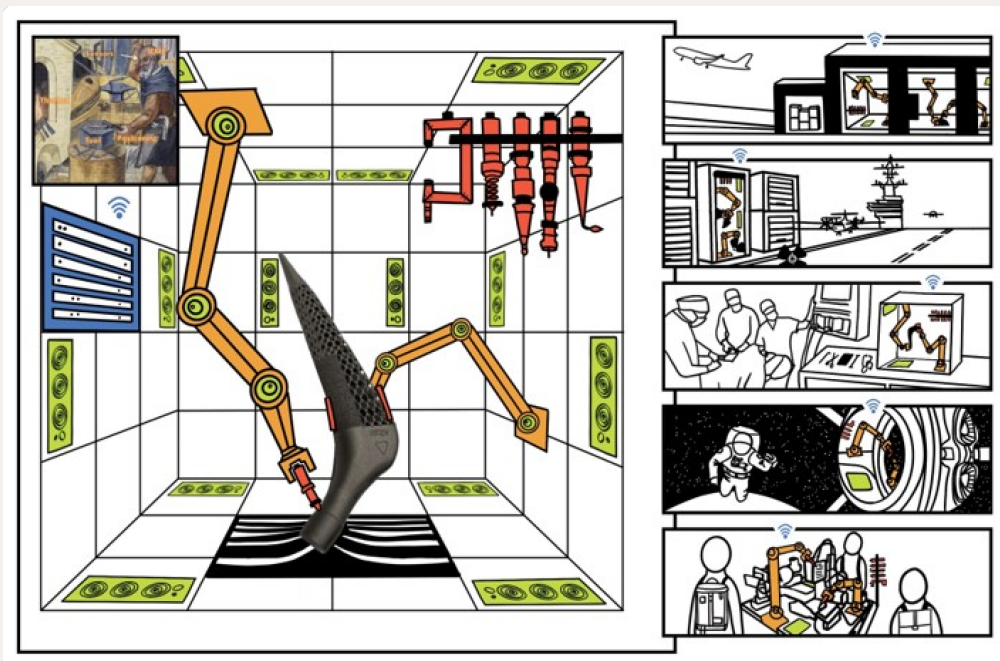
"One of the things that's limiting us is how fast we can develop and test Hypersonics"

- George Nacouzi, Senior Engineer, RAND Corporation

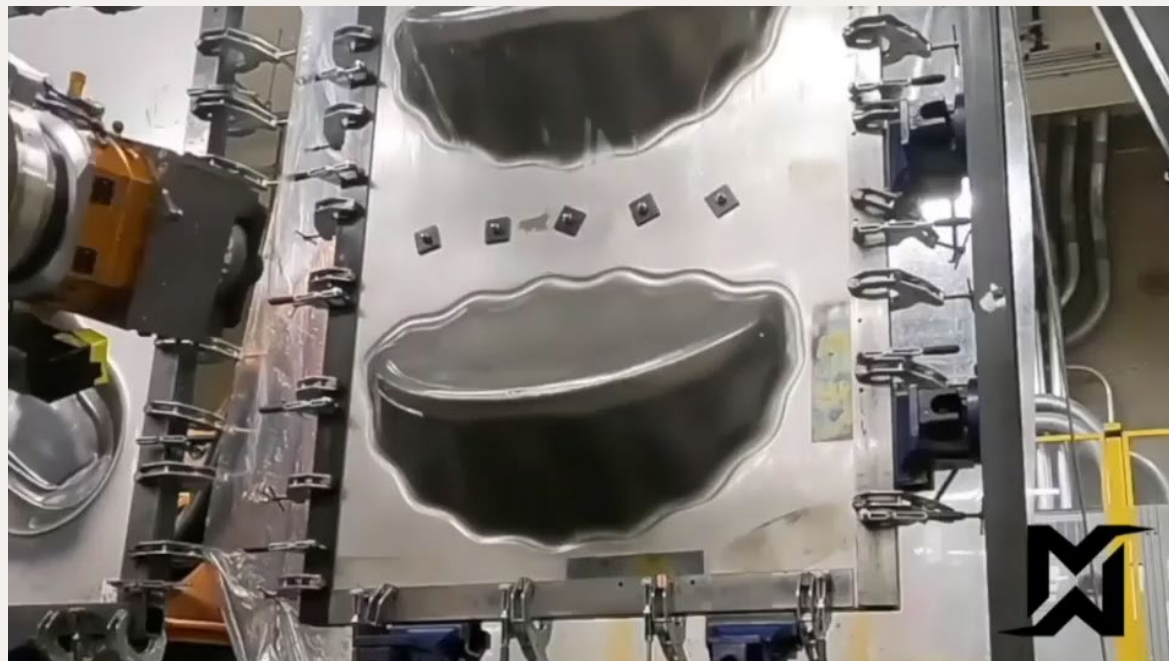
FY2024 DoD budget includes \$145 billion for R&D, \$11 billion of which is directed for Hypersonics development and procurement.



Forming is just the beginning



- Robotics
- Tools
- Sensors
- Data/ICMEs



[Click here to open the video in the browser](#)



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Edward Mehr

CEO & Cofounder

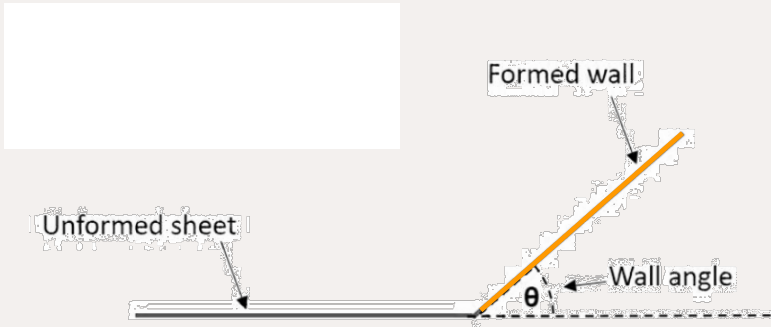
ed@MachinaLabs.ai



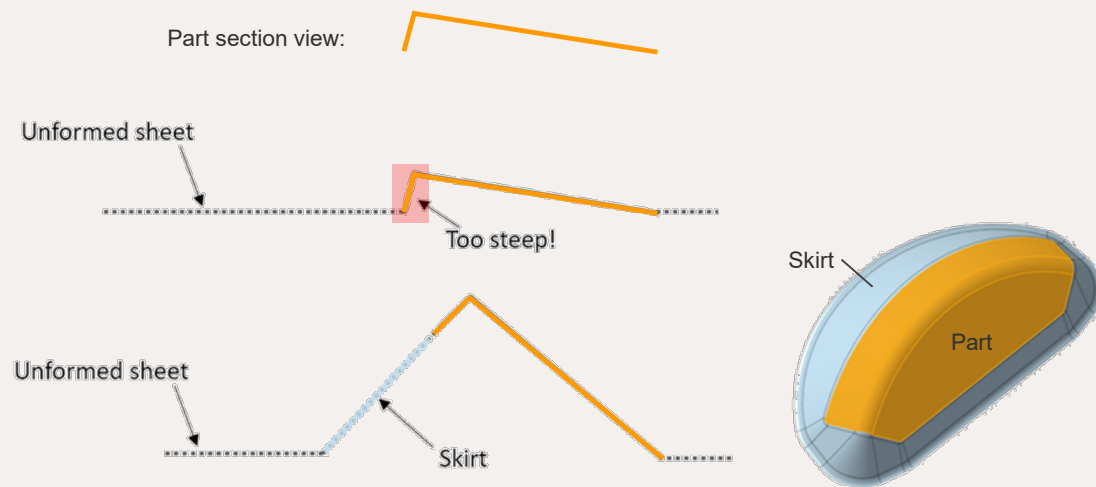
MACHINA LABS



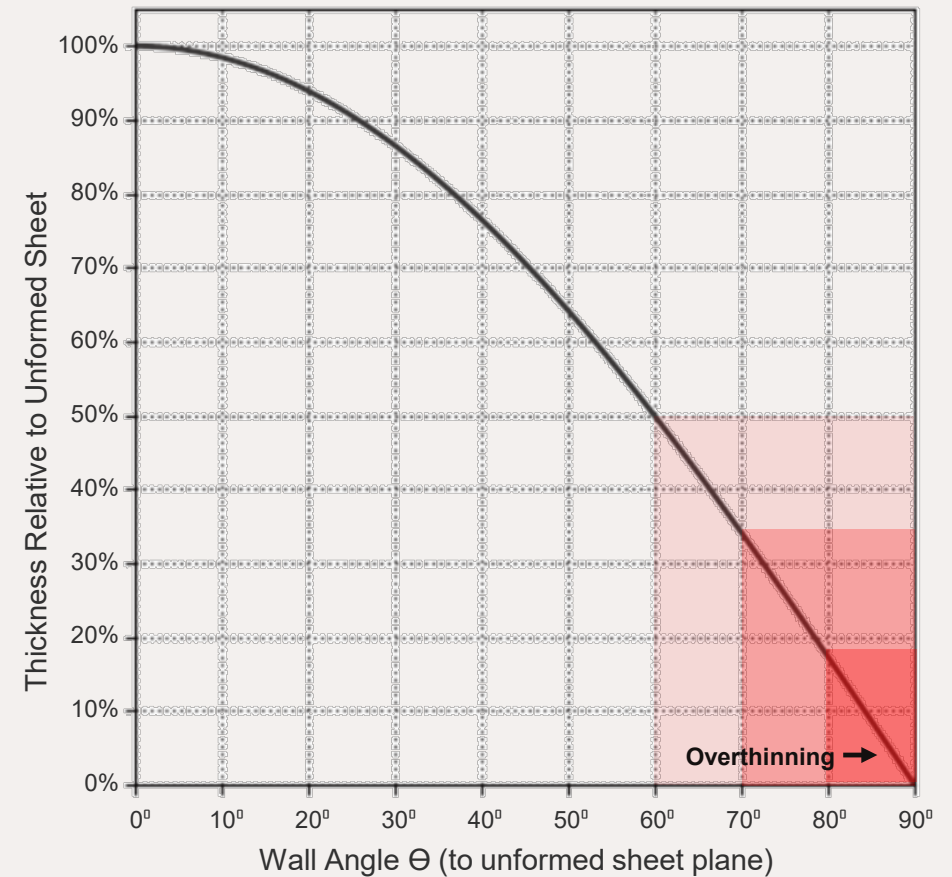
Wall Angle is a Critical Design Factor:



Part Orientation & Skirt Design:



Thinning as a Function of Wall Angle:



Surface Finish

As formed surface finish dependent on material, thickness, tool radius, design, orientation, and process parameters. Brushed and polished finishes can be applied as secondary operations and will be automated in the future.



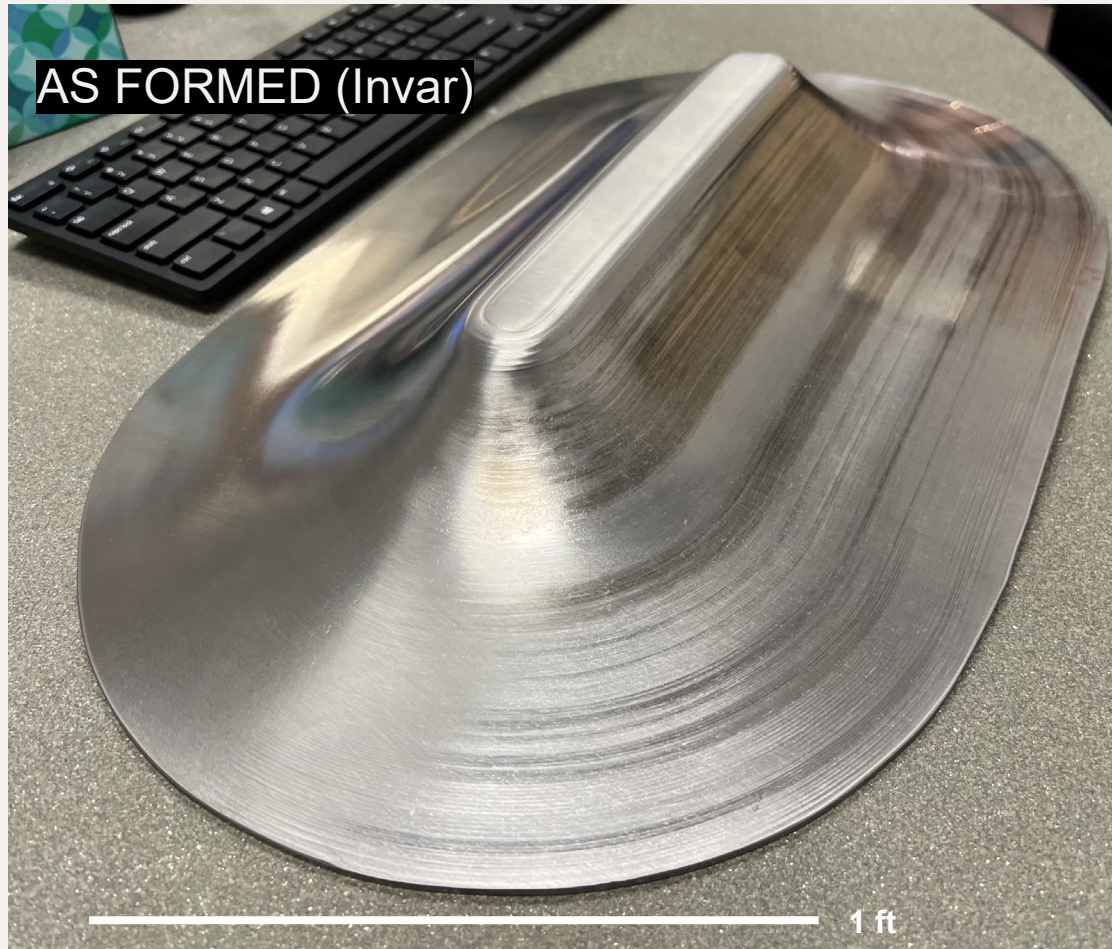
AS FORMED

BRUSHED

POLISHED

Surface Finish

As formed surface finish dependent on material, thickness, tool radius, design, orientation, and process parameters. Brushed and polished finishes can be applied as secondary operations and will be automated in the future.



AS FORMED (Aluminum)



BRUSHED



POLISHED

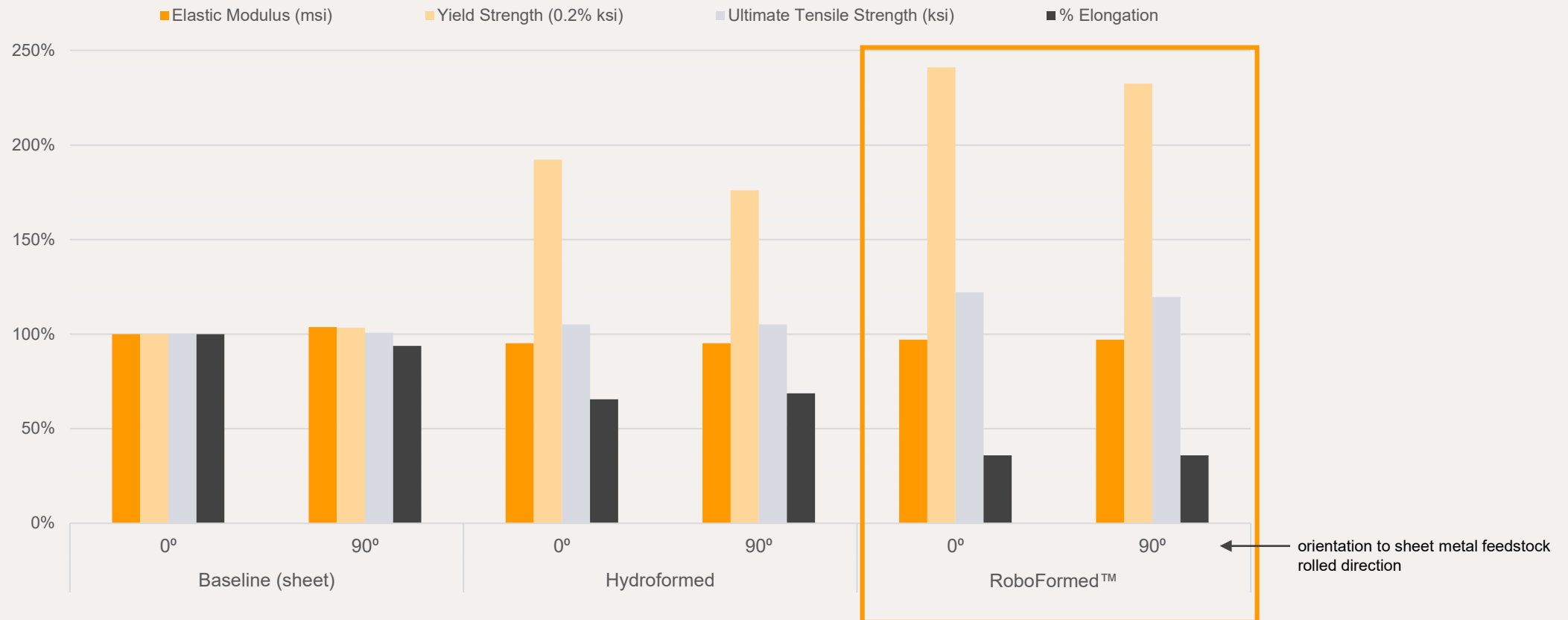




Machina Roboforming™ - Material Properties

Roboforming™ is performed at room-temperature and involves “cold-working” sheet metal by robotically and incrementally stretching and thinning it in a highly predictable and consistent process.

Tensile Test Data (Aluminum 2,6,7XXX alloys):



>21 data points per configuration