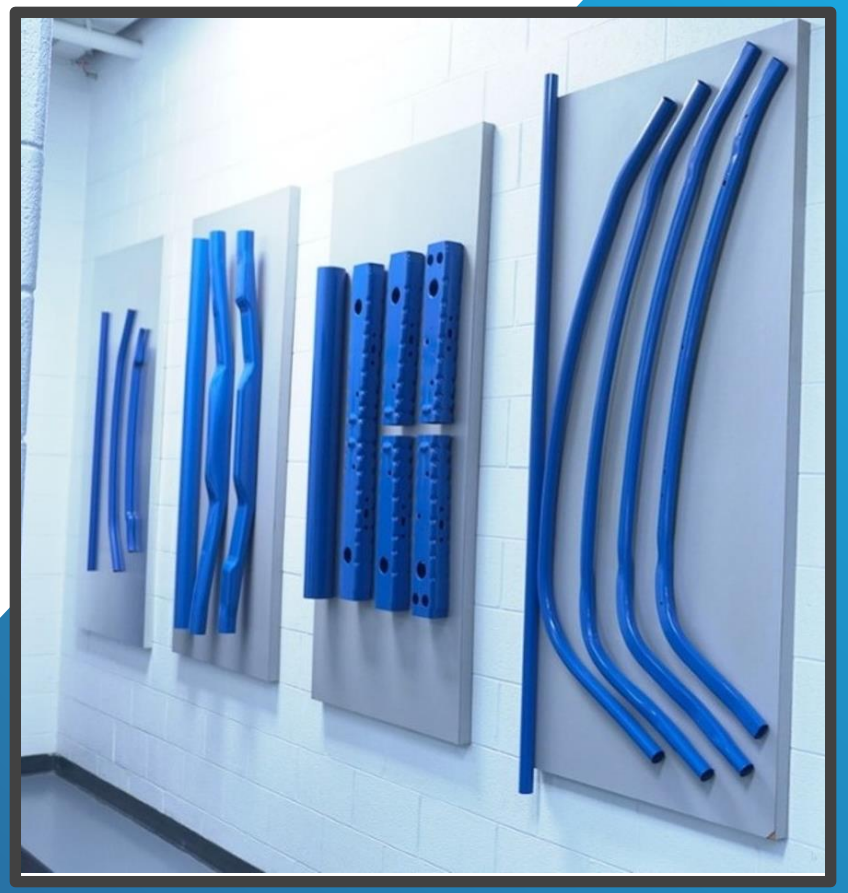
Advancing Automotive Manufacturing Through Tubular Hydroforming



Chris McMahon
Hydroforming Sales Manager
ANDRITZ Schuler Inc.

GREAT DESIGNS IN STEEL™

Advancing Automotive Manufacturing Through Tubular Hydroforming

1. What is Tubular Hydroforming?
2. Tubular Hydroforming Applications
3. Development of a Part
4. Design Considerations Based on Material Type
5. Conclusion

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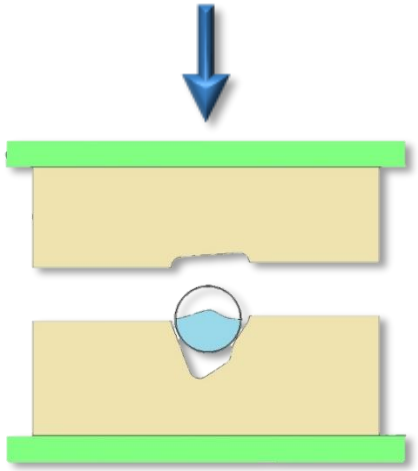
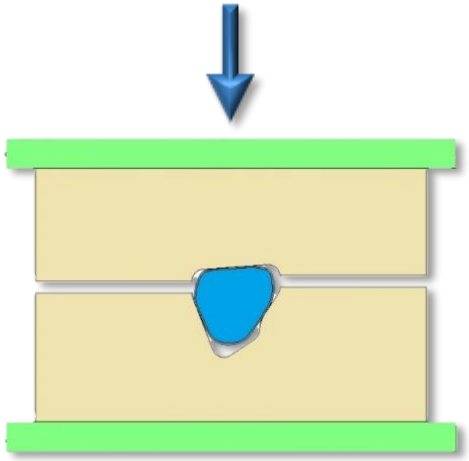
Loading Stage



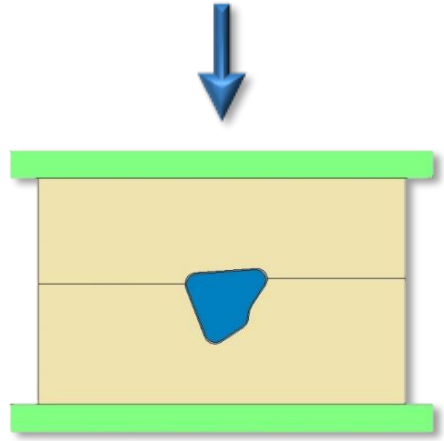
Steel tube is loaded into the hydroform die/press and filled with water

Low Pressure Stage



Press stops approximately 5 to 10mm from bottom and the pressure is increased to 100-300 bar*

High Pressure Stage



Die completely closed and pressure is increased to 1,000-3,000 bar* for forming – all holes are then pierced

**** Dependent on material and part design***

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Hydroform Process

- Bending*
- Preforming*
- **Hydroforming** ***(including piercing)***
- Post-Hydroform cutting*

****If necessary***

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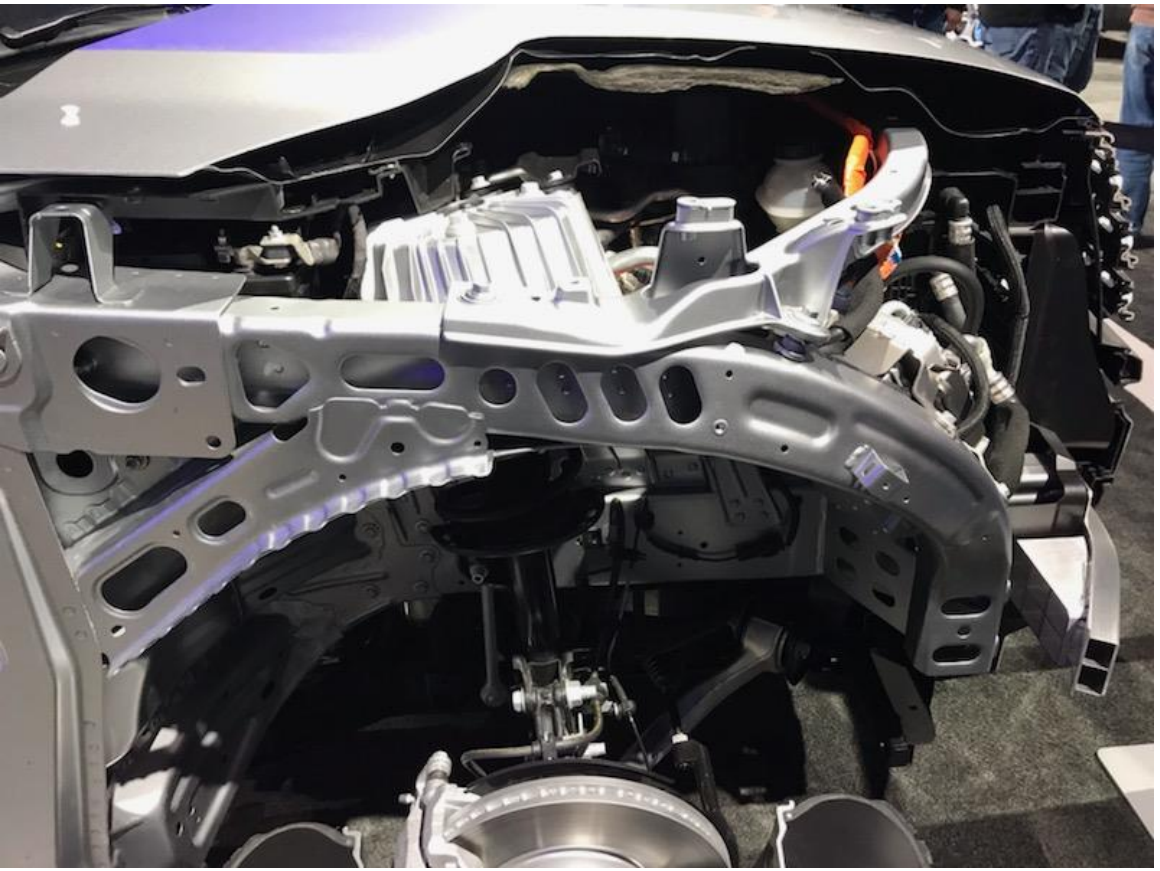

Alternative Processes

Stamped Clam Shell

- Increased manufacturing complexity
- Possible distortion from welding
- Less repeatability

Roll Forming

- Requires less complex cross sections
- Less ability to add formations to the tube
- Limited to one cross section per part

Hydroforming

- Increased strength
- High repeatability
- Mating surface features can be formed directly into the tube
- Multiple different parts can be formed in the same tool
- Ability to run multiple thicknesses of the same part in the same tool

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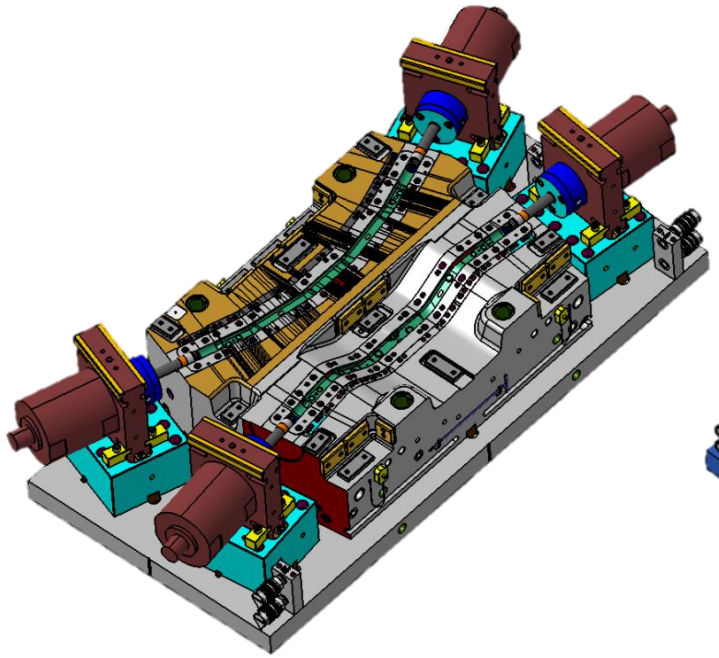
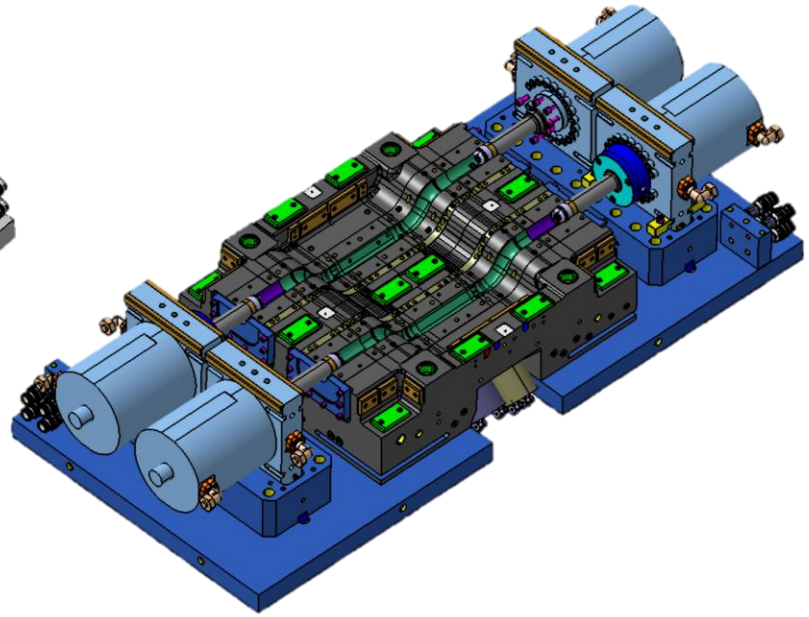
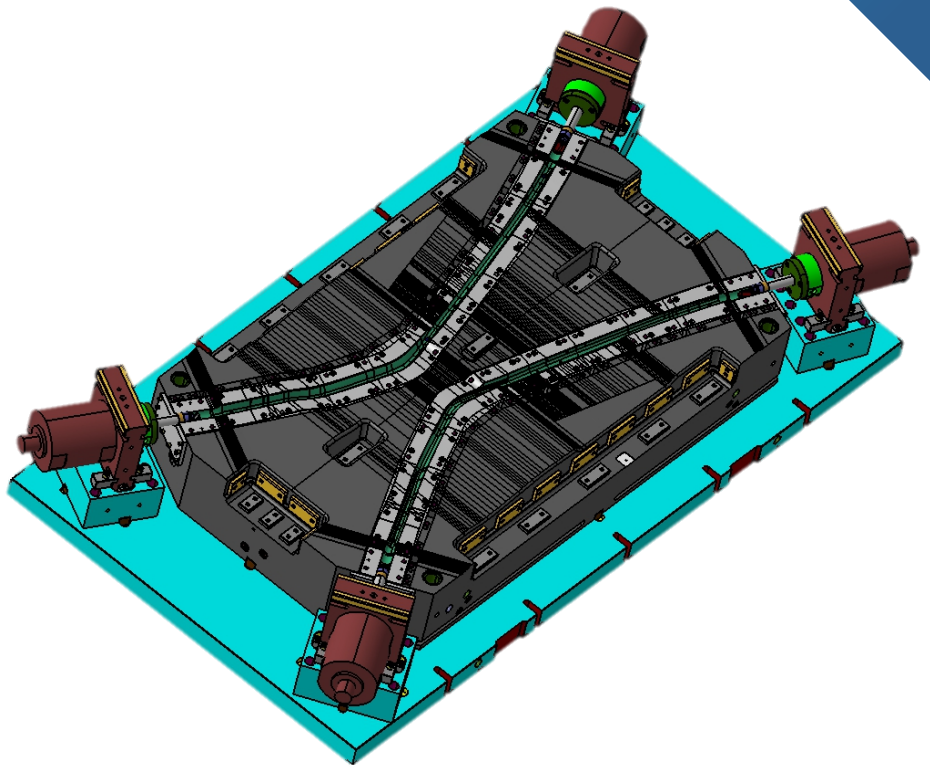
Two Unique Parts



Two Cavities Same Part



One RH / One LH Part



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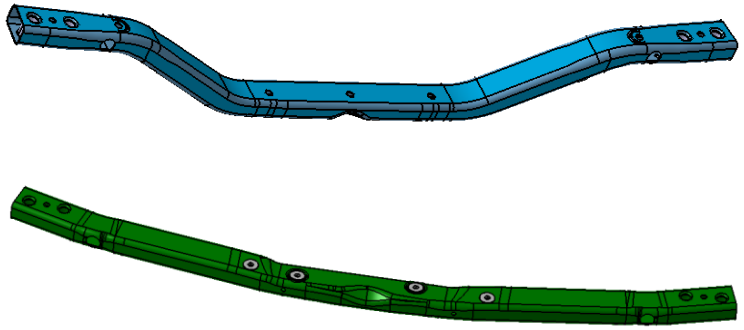
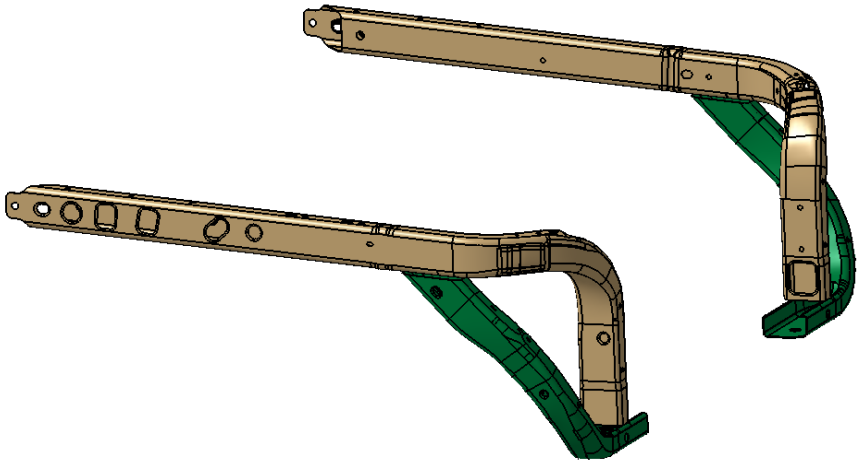
FEM Support



Front Structure



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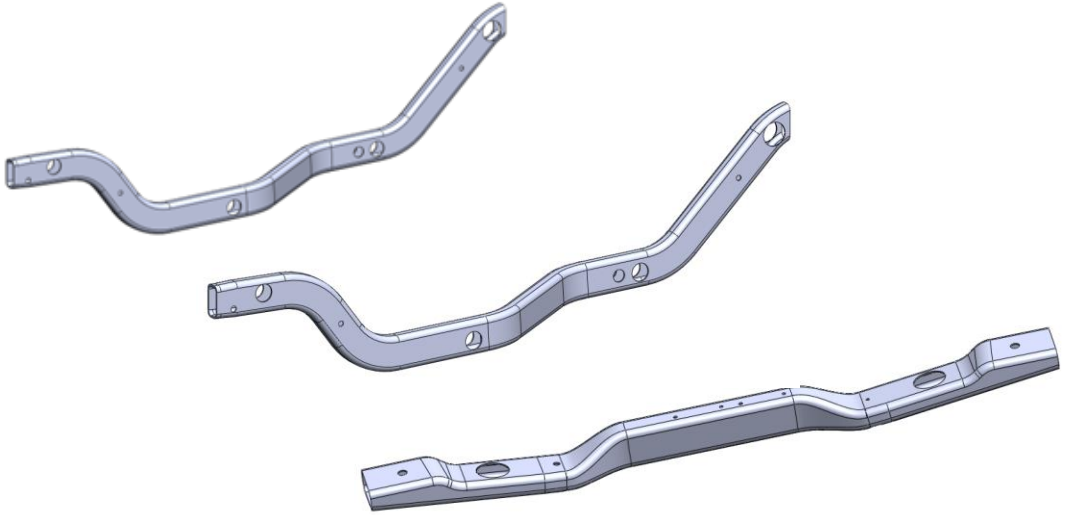
Frame Components



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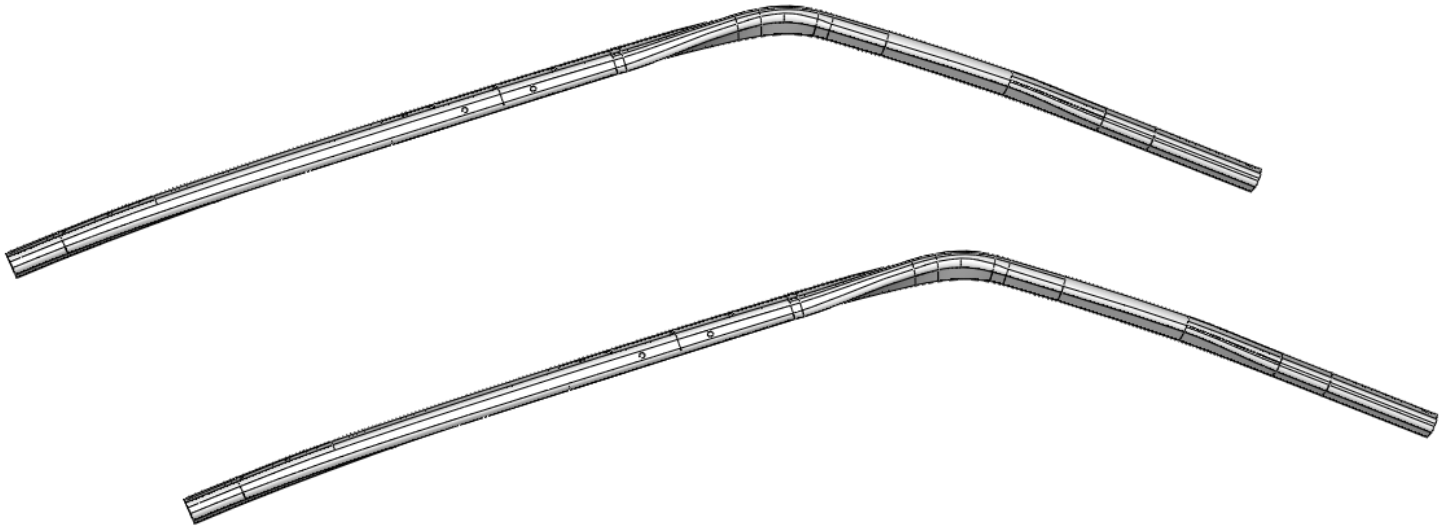
A Pillar / Roof Structure



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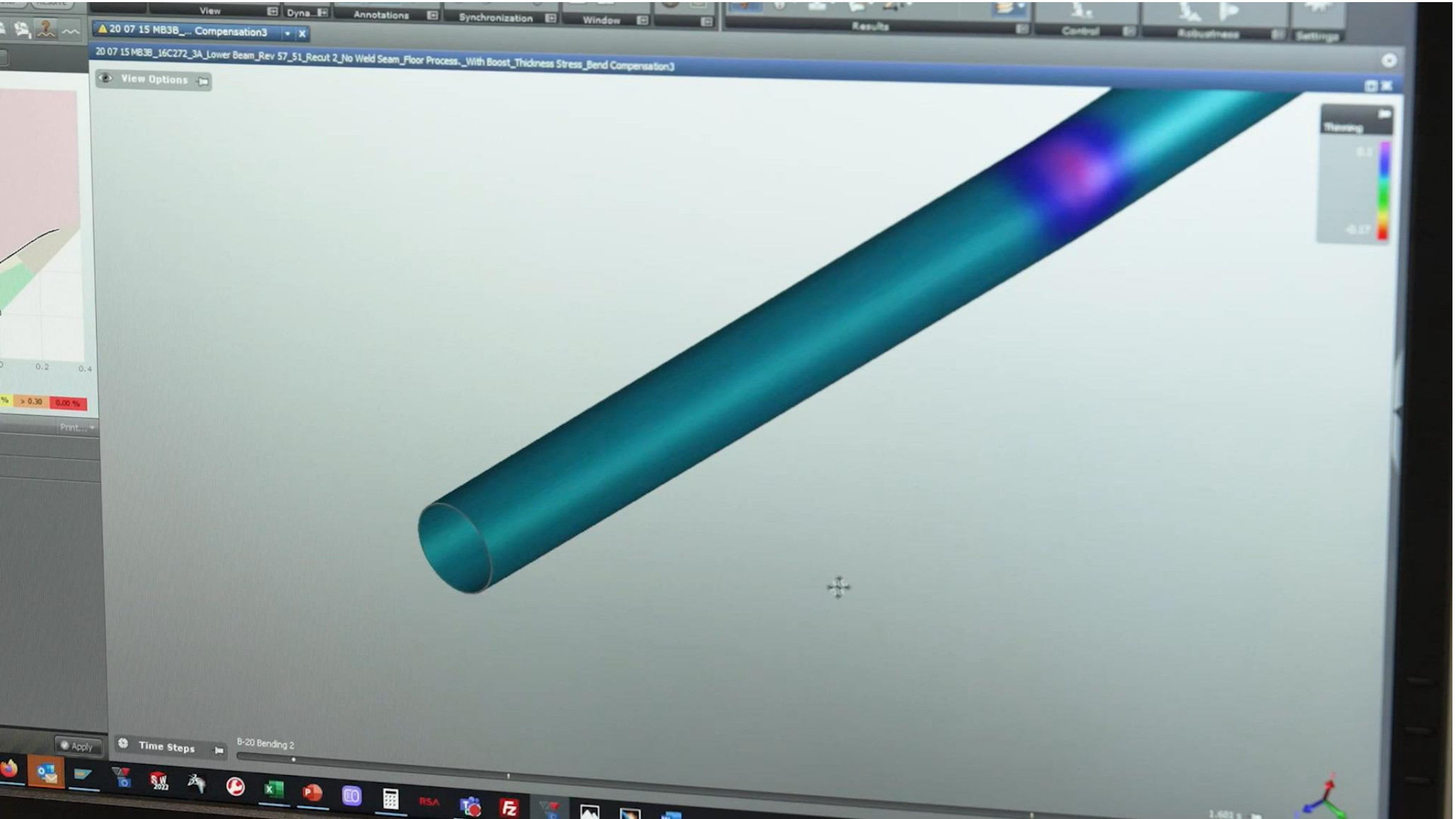

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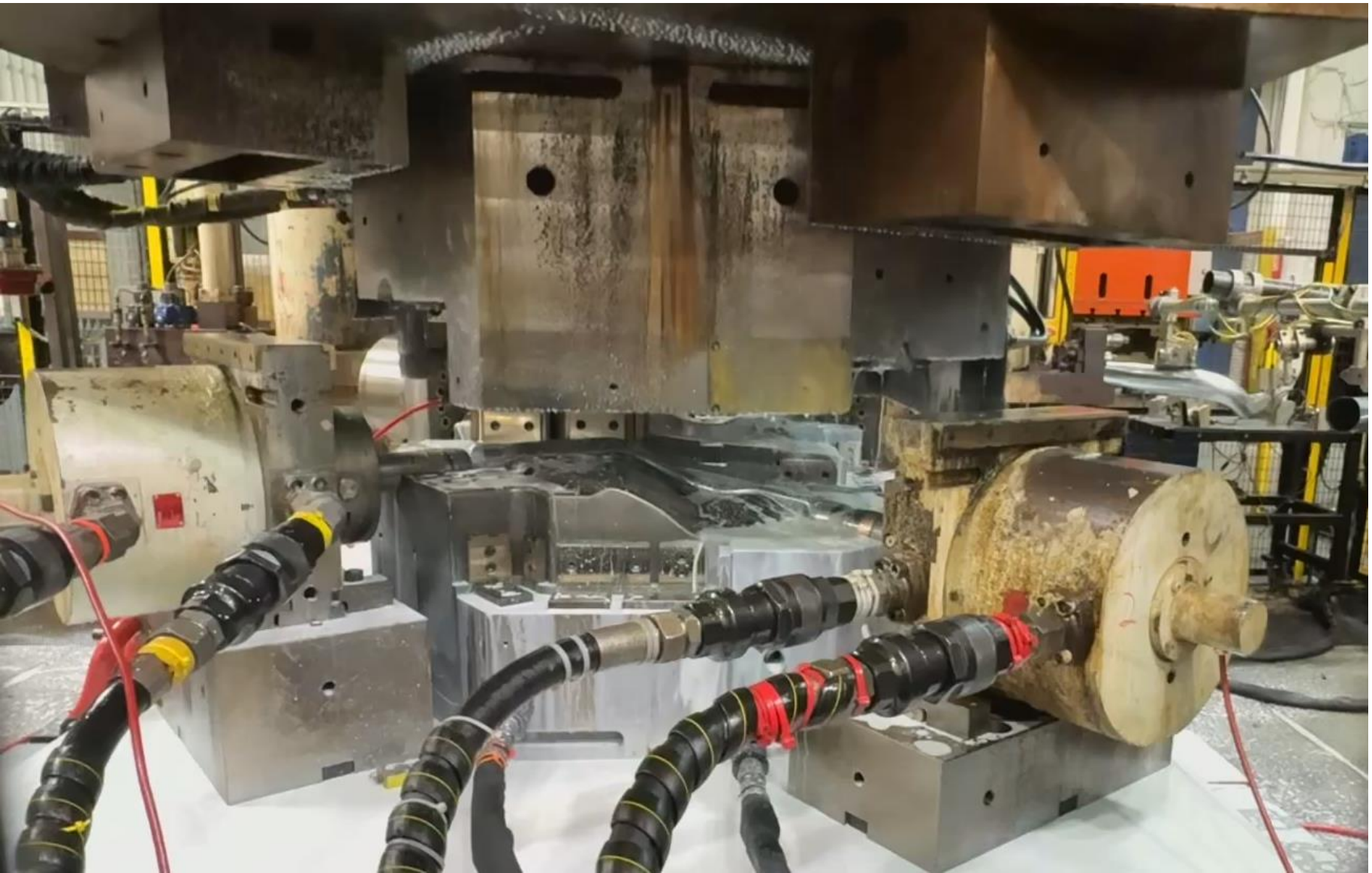

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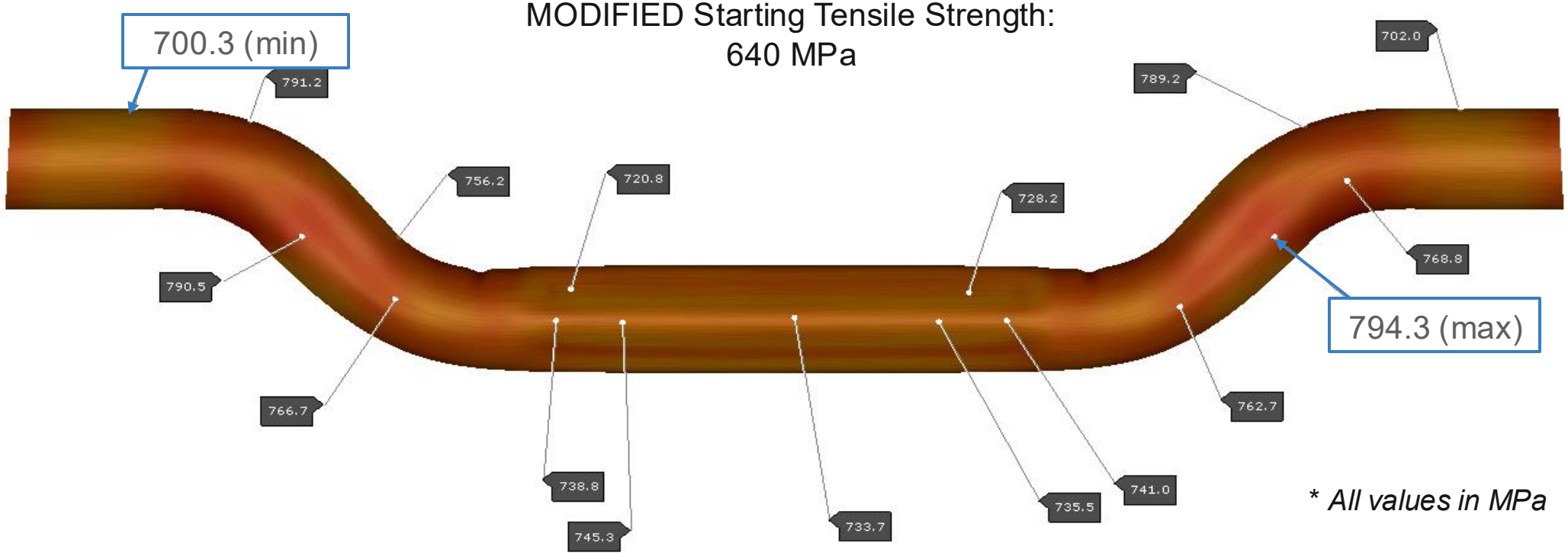
Hardening Stress

Material: MS5002-LAH550Y620T
MODIFIED Starting Tensile Strength:
640 MPa



** All values in MPa*

Hydroforming is a great way to take advantage of work hardening steel. This can be beneficial by downgrading material types and work hardening back to a higher strength, or by down-gauging and work hardening to achieve properties comparable to a thicker, unrestrained part.

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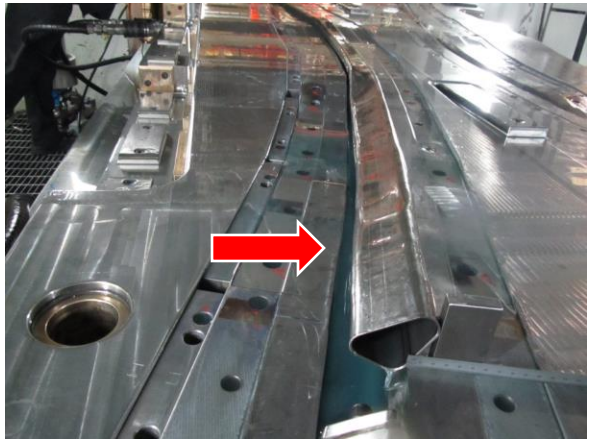
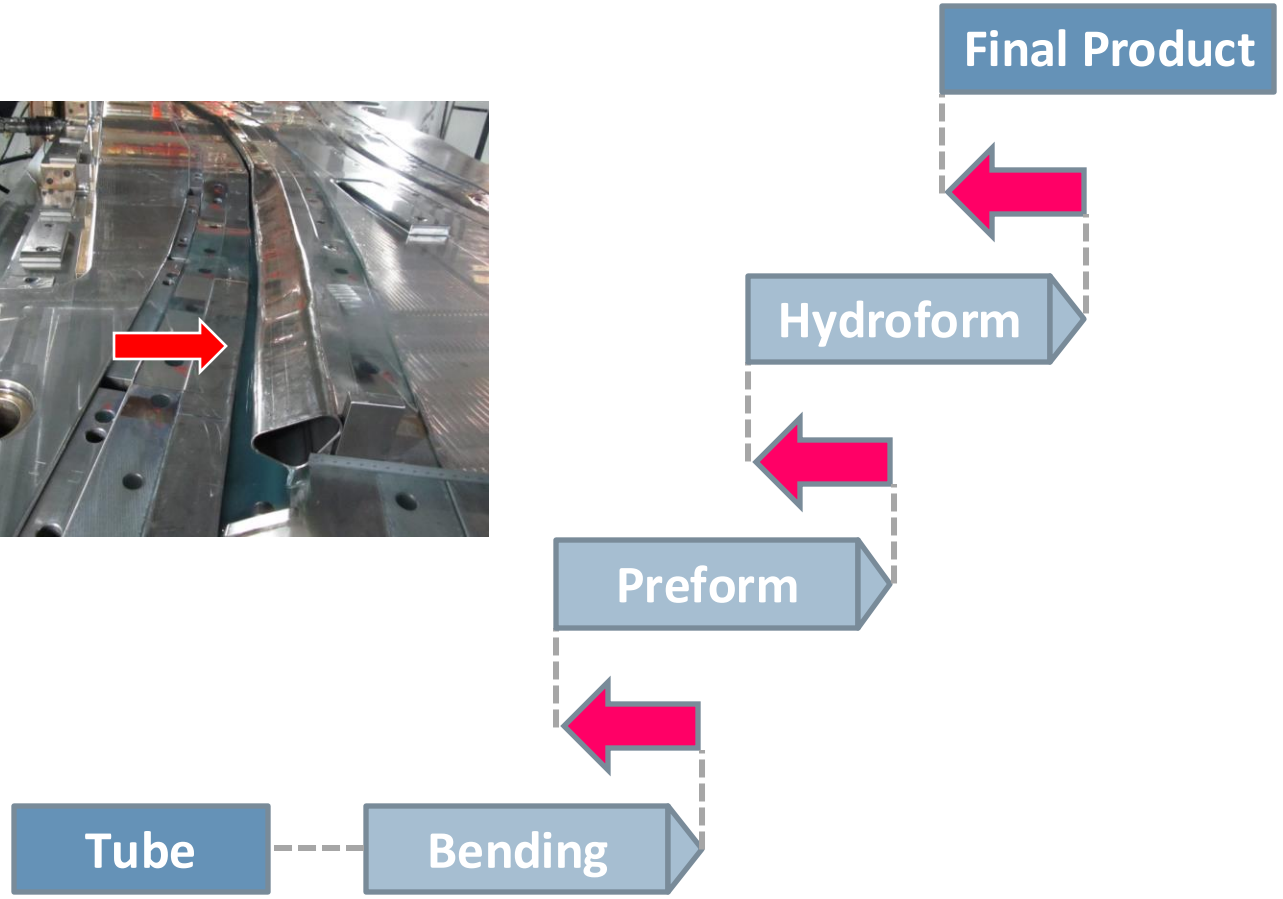
Springback

Each forming step creates springback, which needs to be carefully considered and compensated.





* Dependent on material

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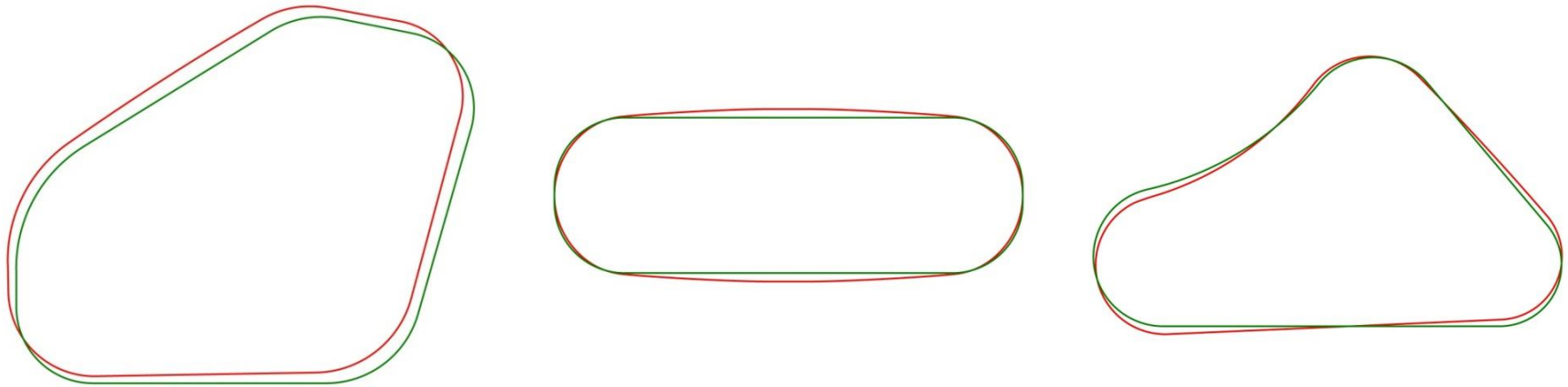
Springback Effects in Hydroforming

3 Different Types of Springback: Global – Crowning – Twisting*

Green: Target cross section

Red: Actual cross-section after forming



Global Springback | Crowning | Twisting

** Dependent on material*

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Typical Tolerances

	Mild to Medium Strength, incl. HSLA	UHSS
Repeatability	+/- 0.2 mm*	+/- 0.3 mm
Overall Tolerance	+/- 0.7 mm*	+/- 1.5 mm

**** Dependent on material***

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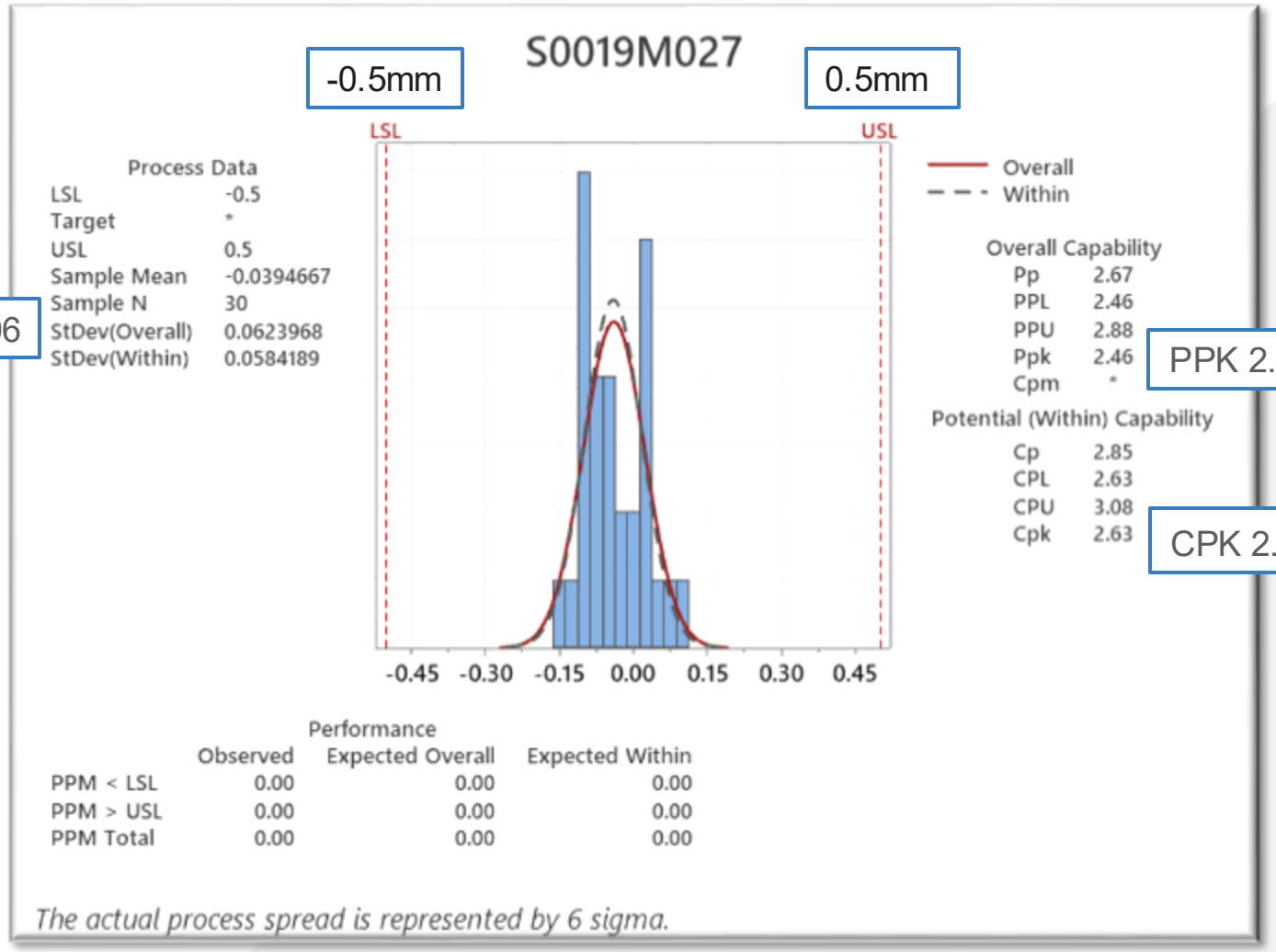
Capability

Current Production HSLA Part

Very low standard deviation

StDev 0.06



PPK 2.46

CPK 2.63

Highly capable

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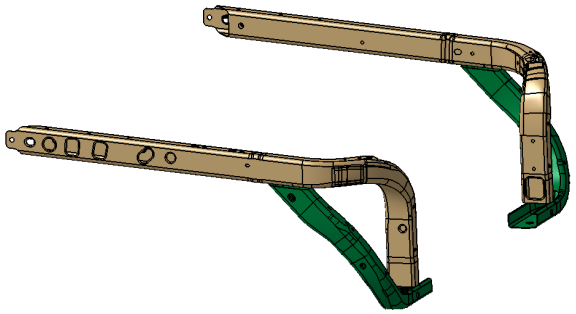
Conclusion



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Thank You!

Chris McMahon

chris.mcmahon@andritz.com

(248) 453-4552

ANDRITZ Schuler Inc.

7145 Commerce Blvd

Canton, MI 48187