Meeting Modern Automotive Manufacturing Demands with Tubular Hydroforming

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GREAT DESIGNS IN STEEL™

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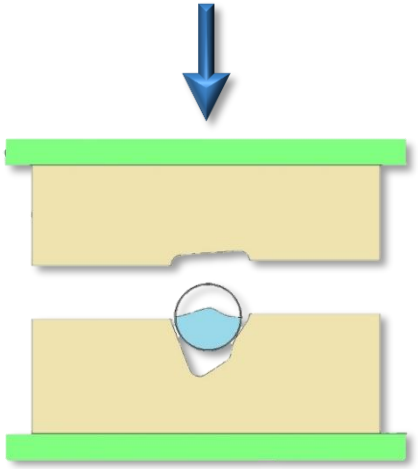
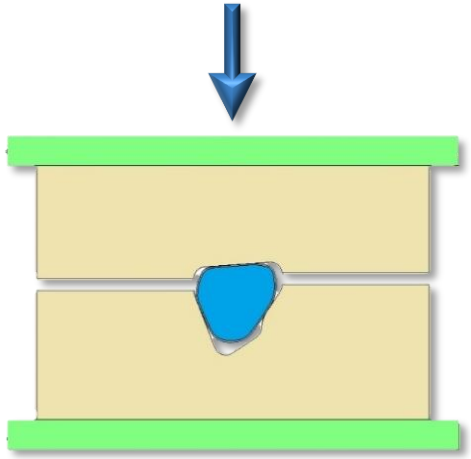
Loading Stage



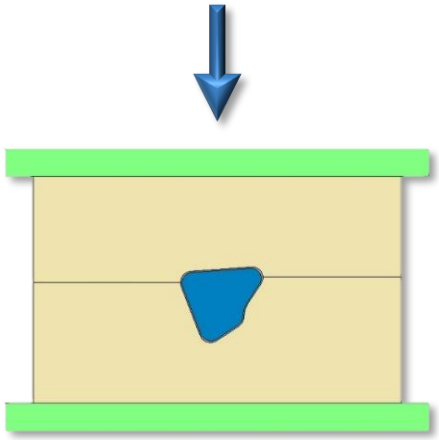
Steel tube is loaded into the Hydroform die/press and filled with water

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 1,000-3,000bar* for forming. All holes are then pierced.

* Dependent on material and part design

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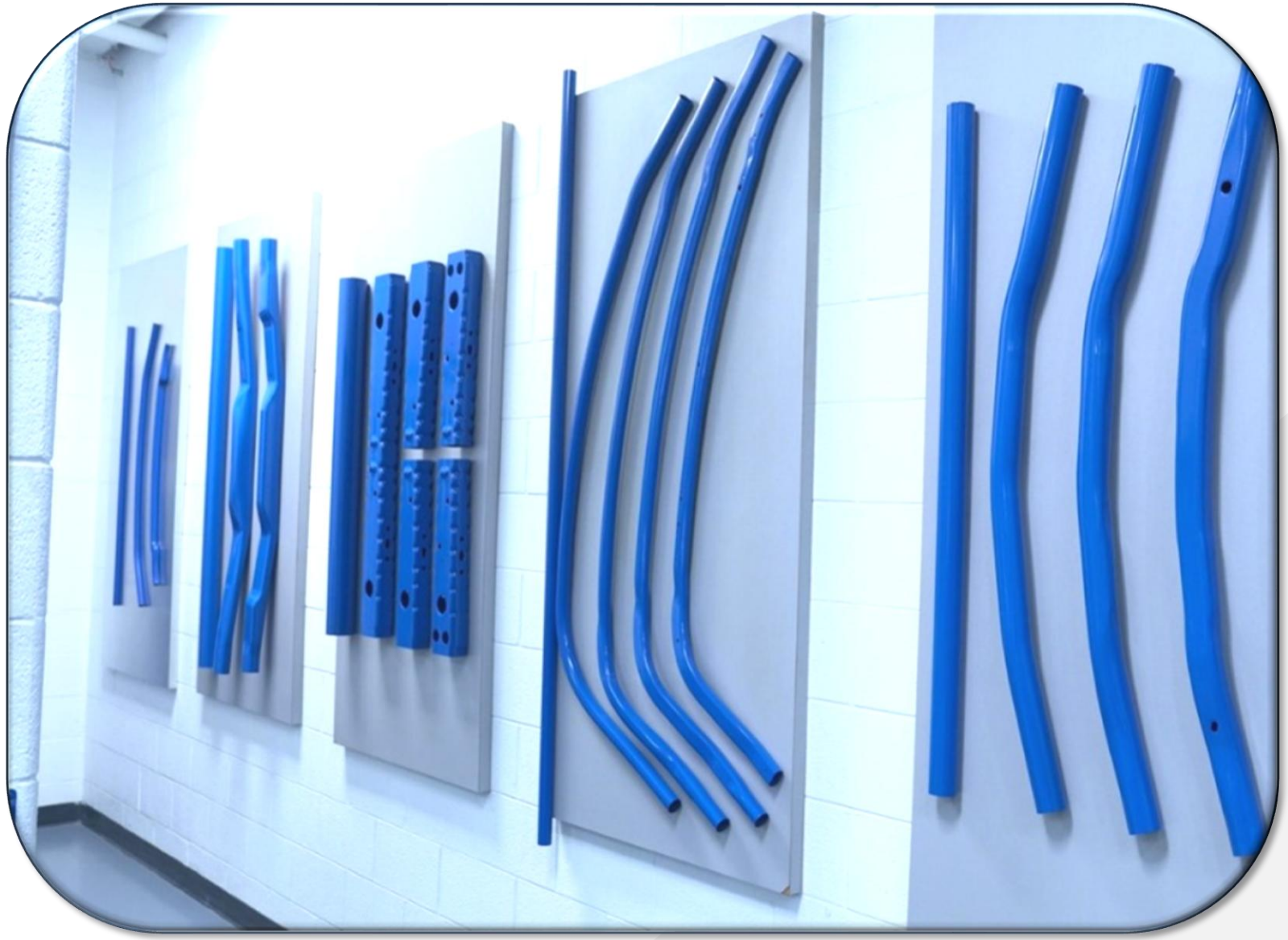

Typical Hydroform Process Include

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

* If necessary

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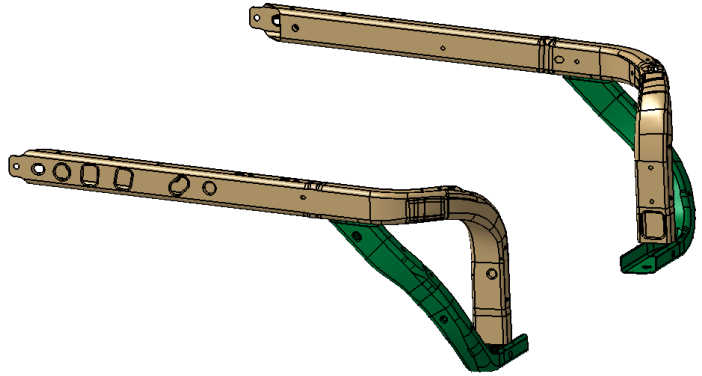

Why Choose Hydroforming?

Alternative Processes

Stamped Clam Shell

- Possible distortion from welding.
- Less repeatability
- Increased manufacturing complexity *(more operations required)*

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 *(i.e. RH/LH or even completely different parts)*
- Ability to run multiple thicknesses of the same part in the same tool

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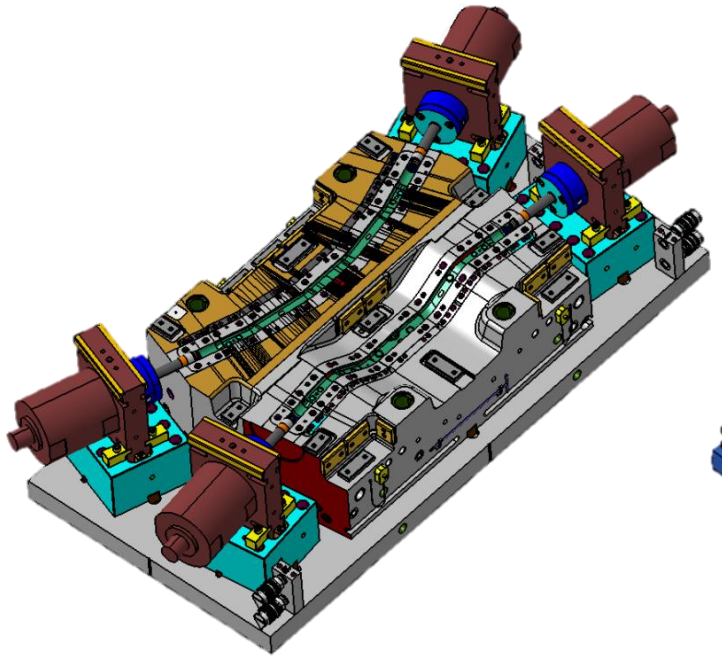
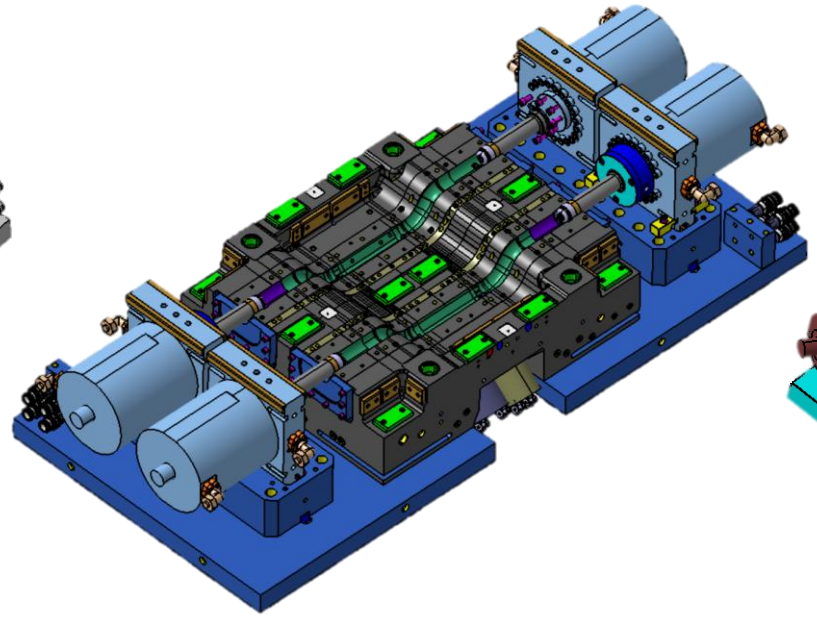
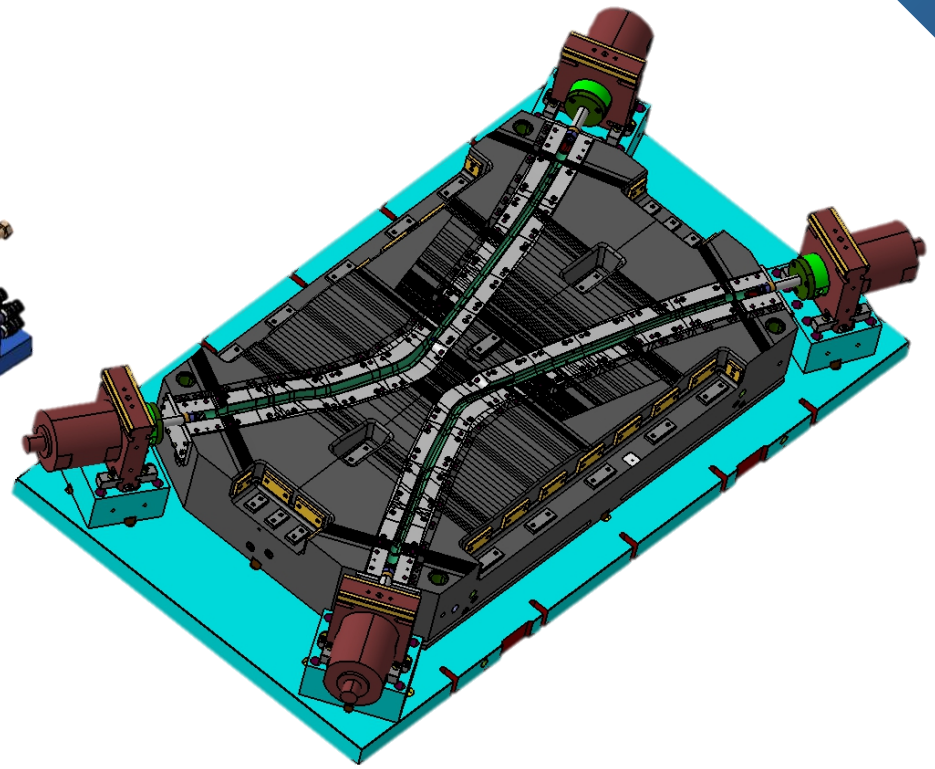
Two Unique Parts



Two Cavities Same Part



One RH /One LH Part



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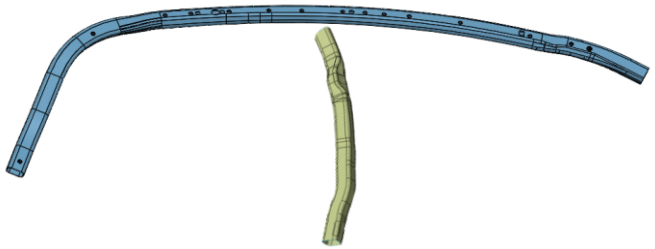
Hitch Tubes

Roof Rails & B- Pillars



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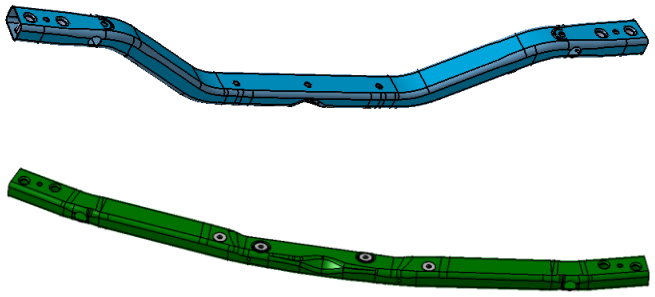
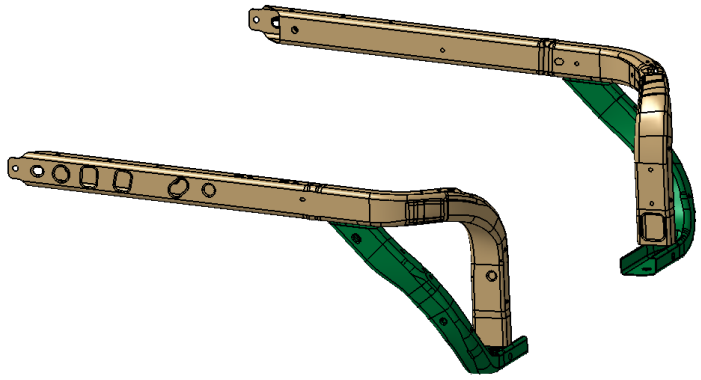
FEM Supports



Front Structures



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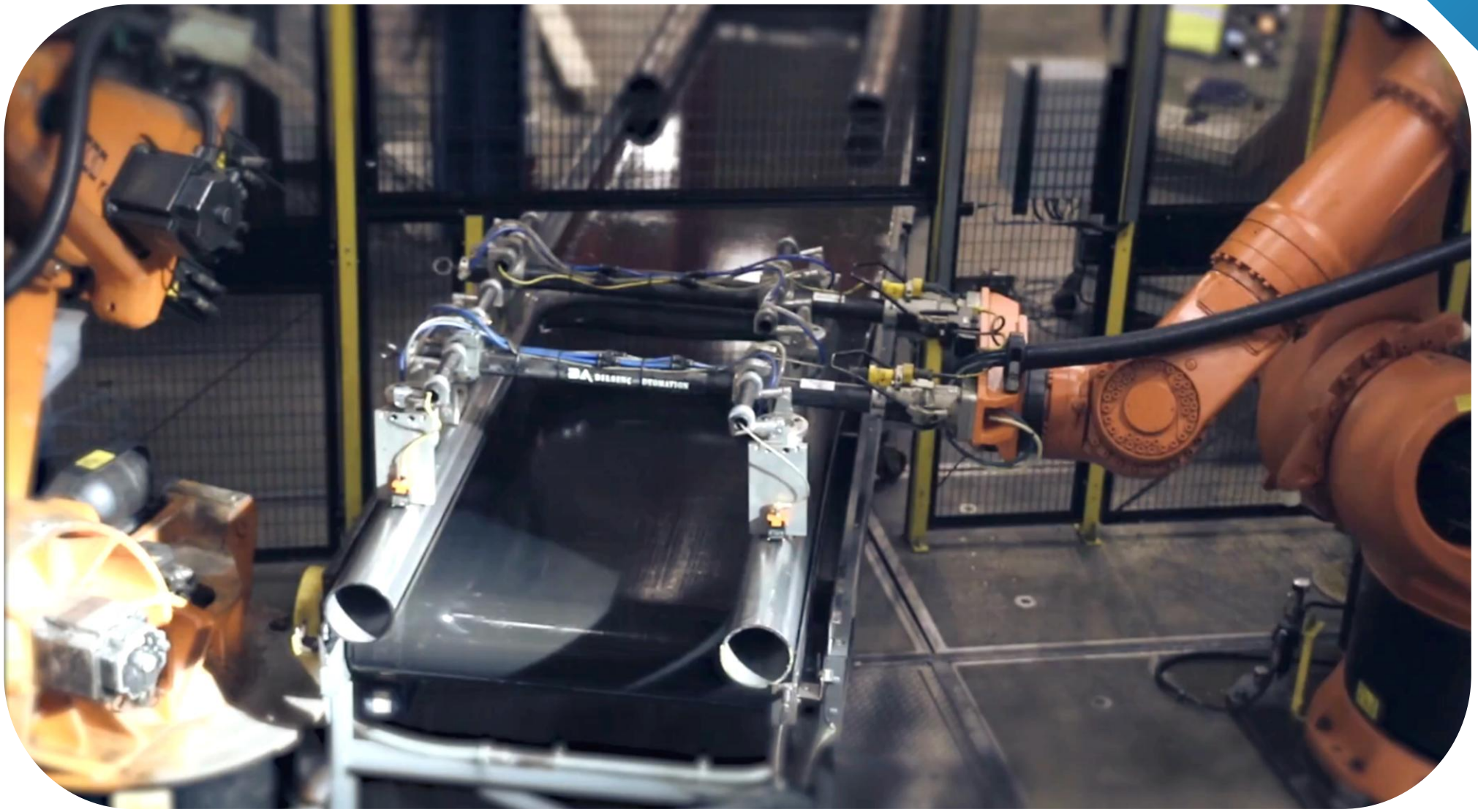

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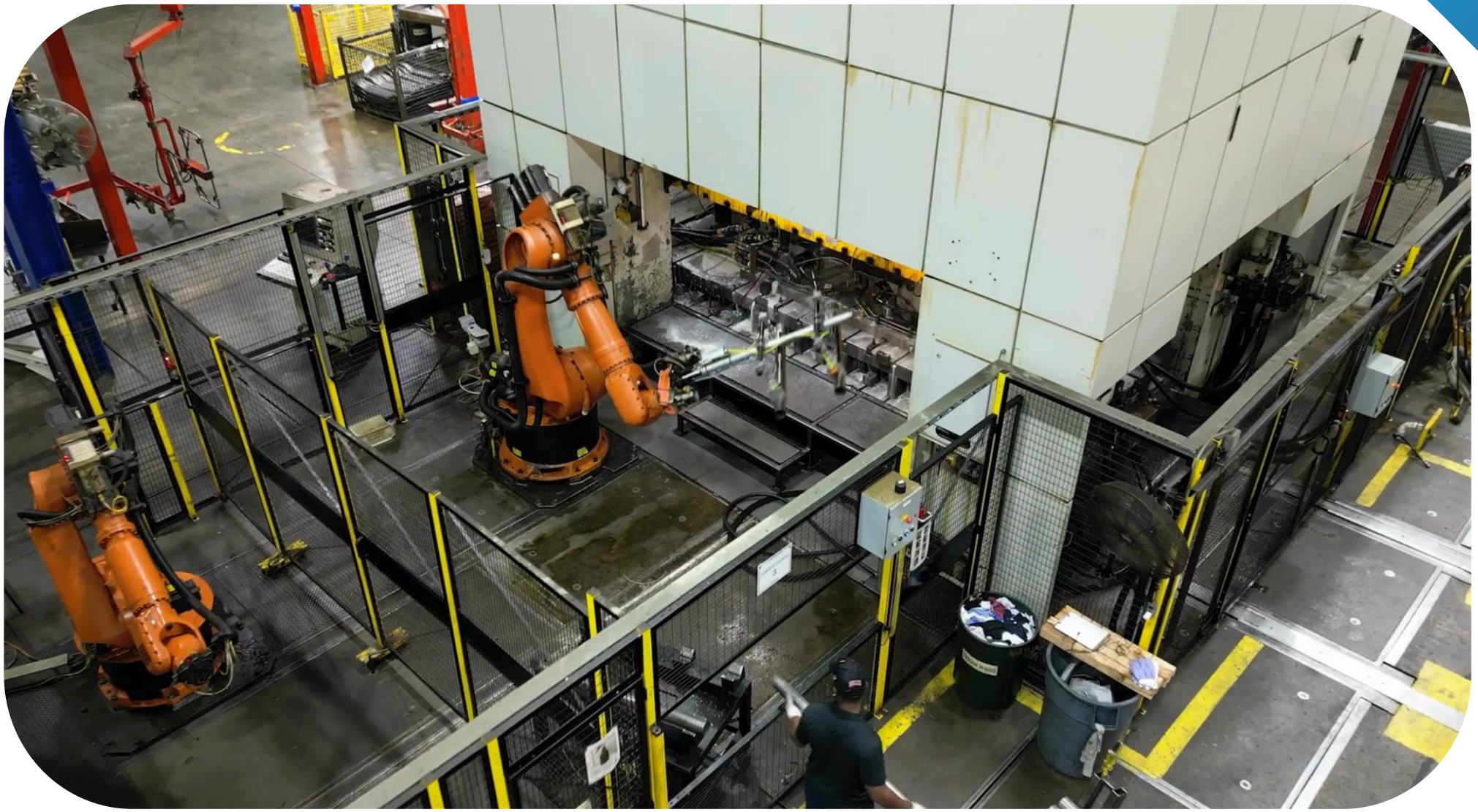

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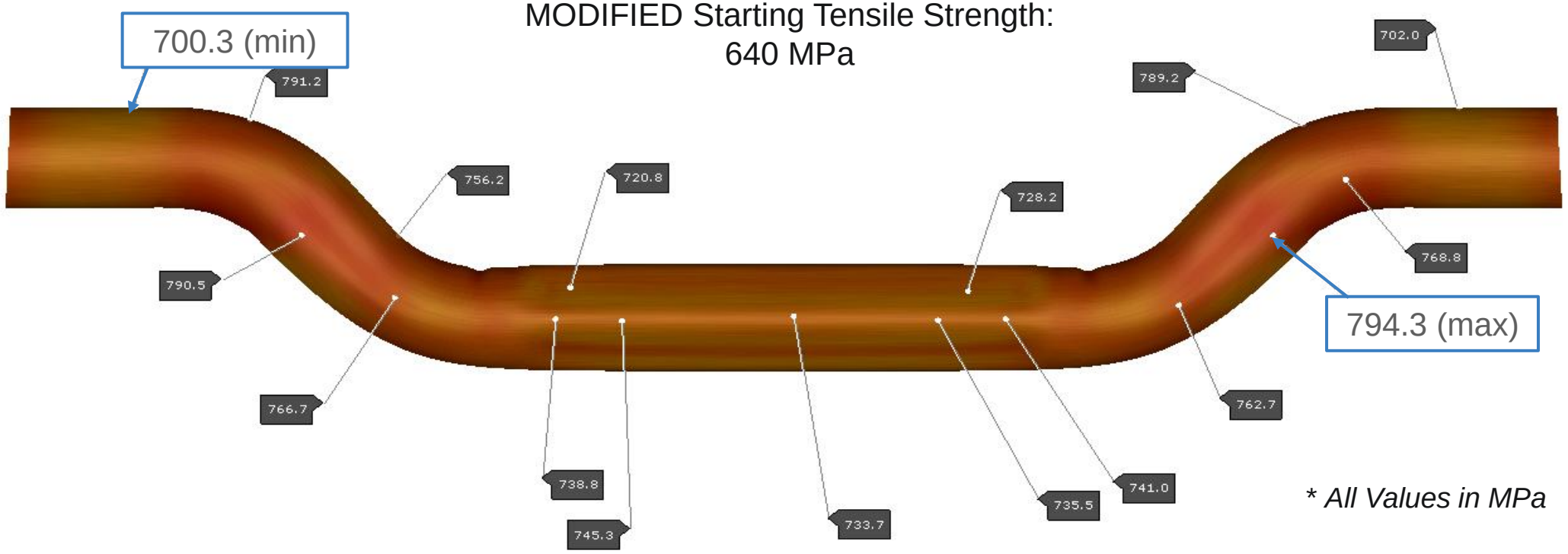
Hardening Stress

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. Two of the main ways this can be beneficial is via downgrading material types and work hardening back up to a higher strength or down gauging and work hardening to achieve comparable results to a thicker unstrained part.

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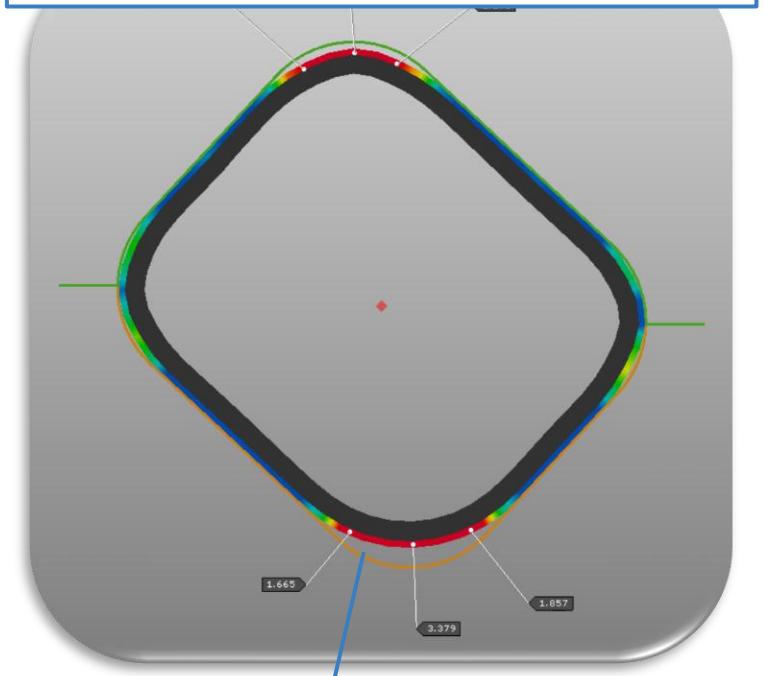
Case study 1: Utilizing Work Hardening

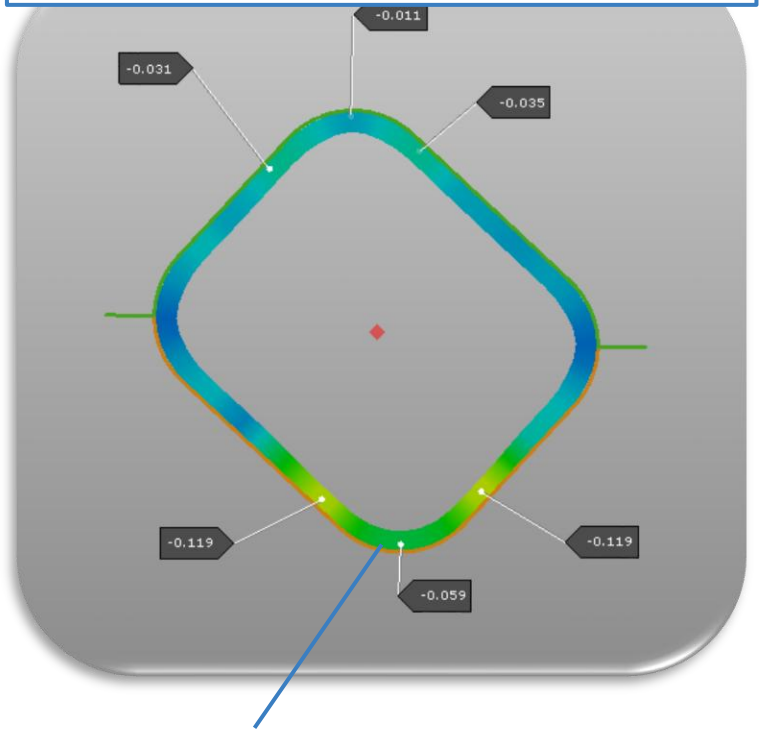
Areas of high thinning and poor part fill out



Customer wanted a higher strength material but forming this material was not possible with the current design. Large design changes would have been required to move forward with this material

Solution:
Downgraded
Material

Thinning and part fill out improved



New material was more formable and with the strain hardening from hydroforming the tube still achieved and even exceeded the strength requirements

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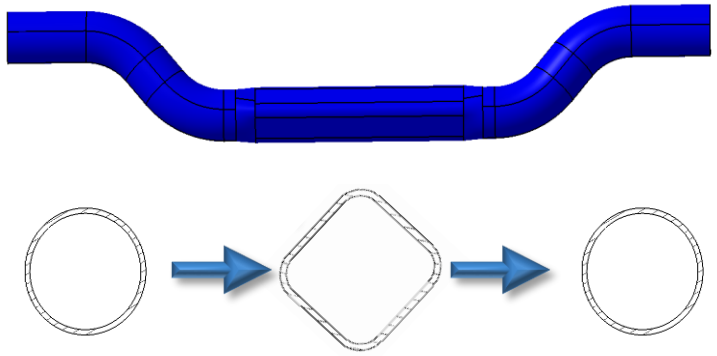
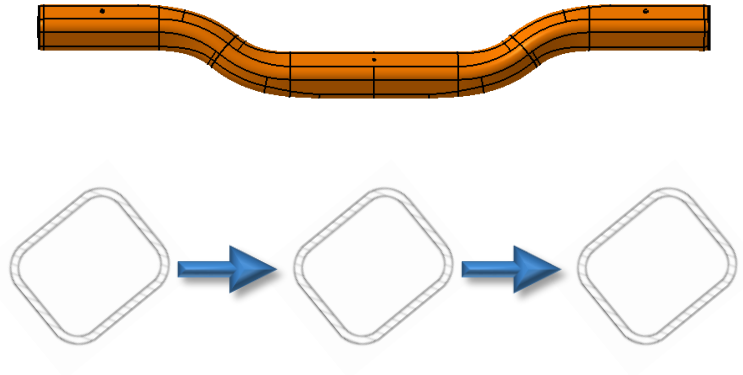
Design Flexibility With Hydroforming

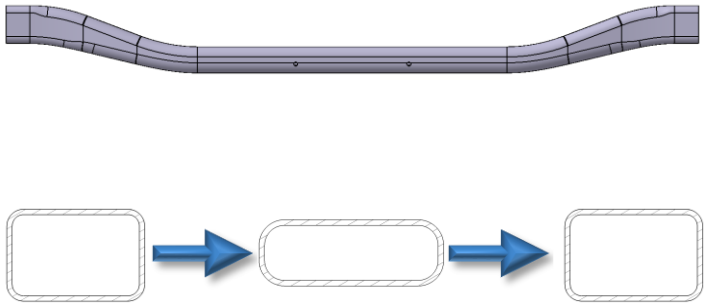
With hydroforming, you have great flexibility to change cross sections or add mating features multiple times in the same part to fit the design constraints of the overall assembly. Shown below are multiple different designs for hitch tubes that all perform the same function but are completely unique due to different packaging constraints and overall vehicle designs.



Cross section goes from round on both ends to square in the middle for mounting of the hitch assembly brackets



This hitch assemble went with rectangular cross sections throughout to achieve the desired result



This version of a hitch assembly is completely different than the others. It is two different rectangular cross sections and is turned 90 degrees in the assembly and the hitch receiver mounts directly through the tube.

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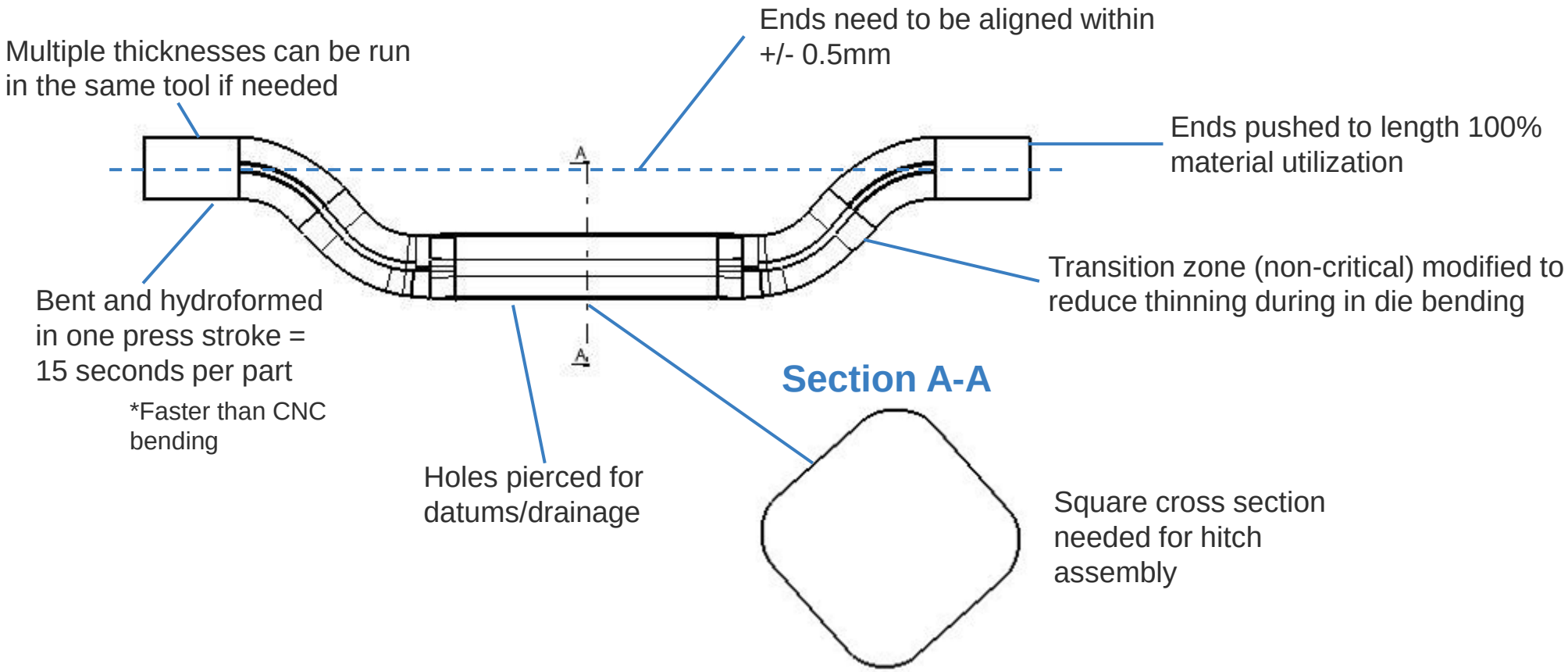
Case study 2: Designing a hydroformed tube to meet customer needs



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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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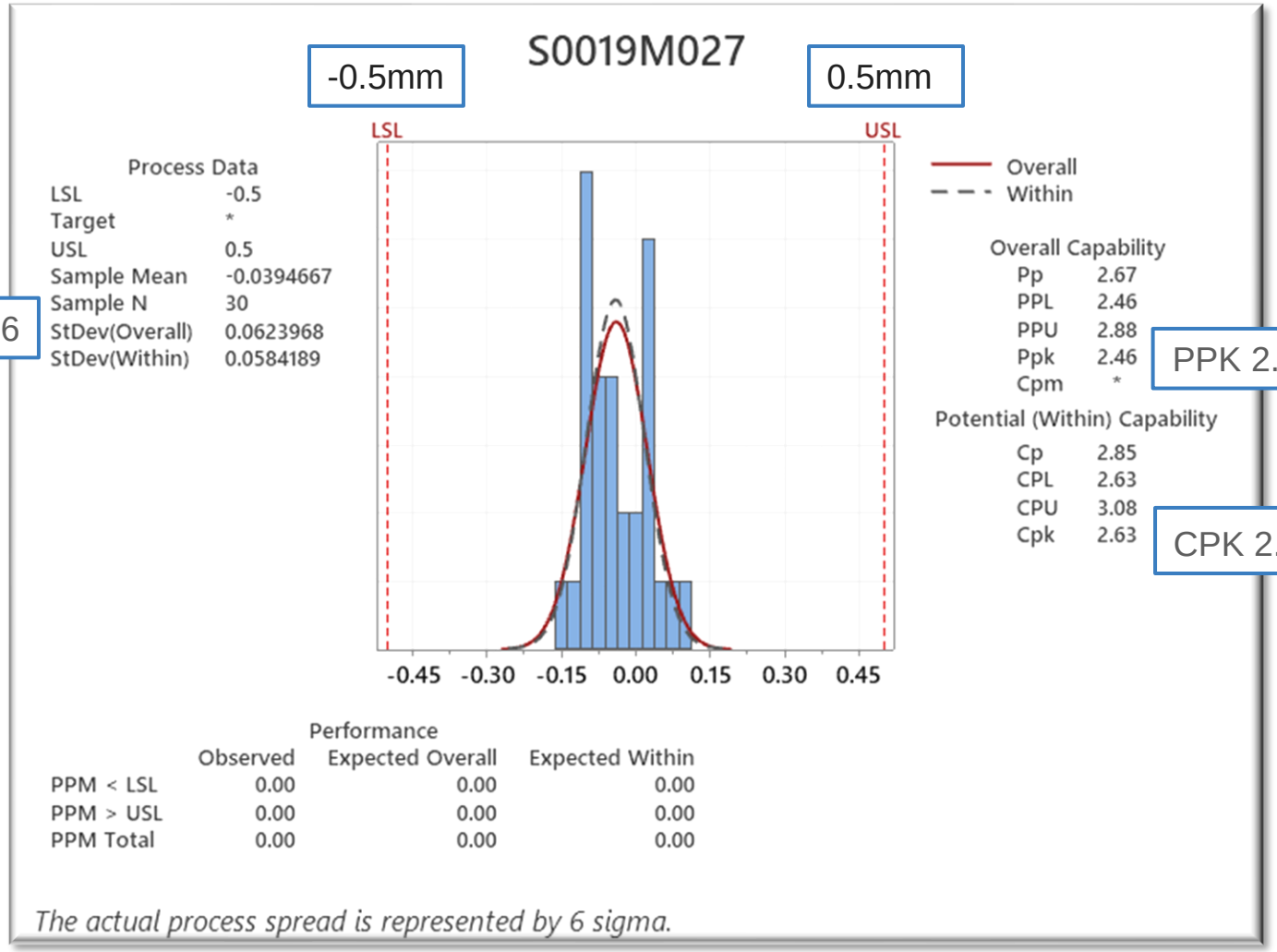
Capability

Current production HSLA part



Very low standard deviation

StDev 0.06

PPK 2.46

CPK 2.63

Highly Capable

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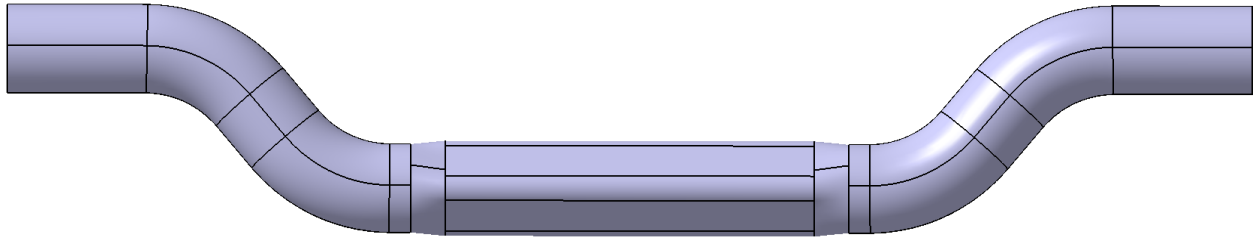

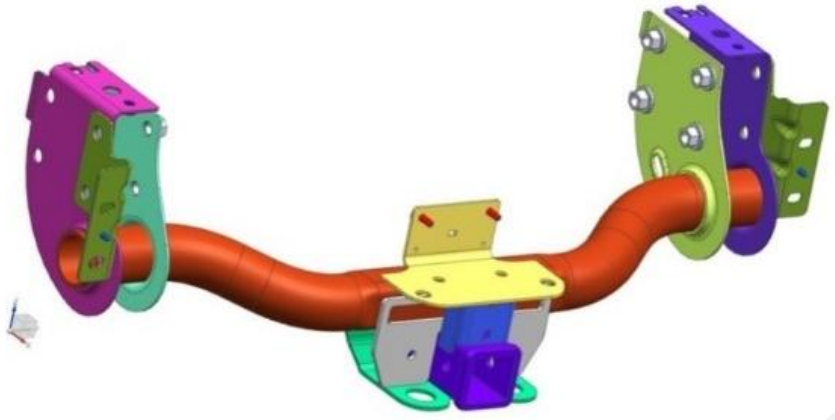

Summary

Hydroformed hitch tubes

- Tubes are press bent, hydroformed, Pierced(holes) and pushed to length in one operation
- 100% material utilization, no post op required
- Work-hardened via down gaging, or down
- grading material

Thank you!

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SCAN ME