

Great Designs in

STEEL



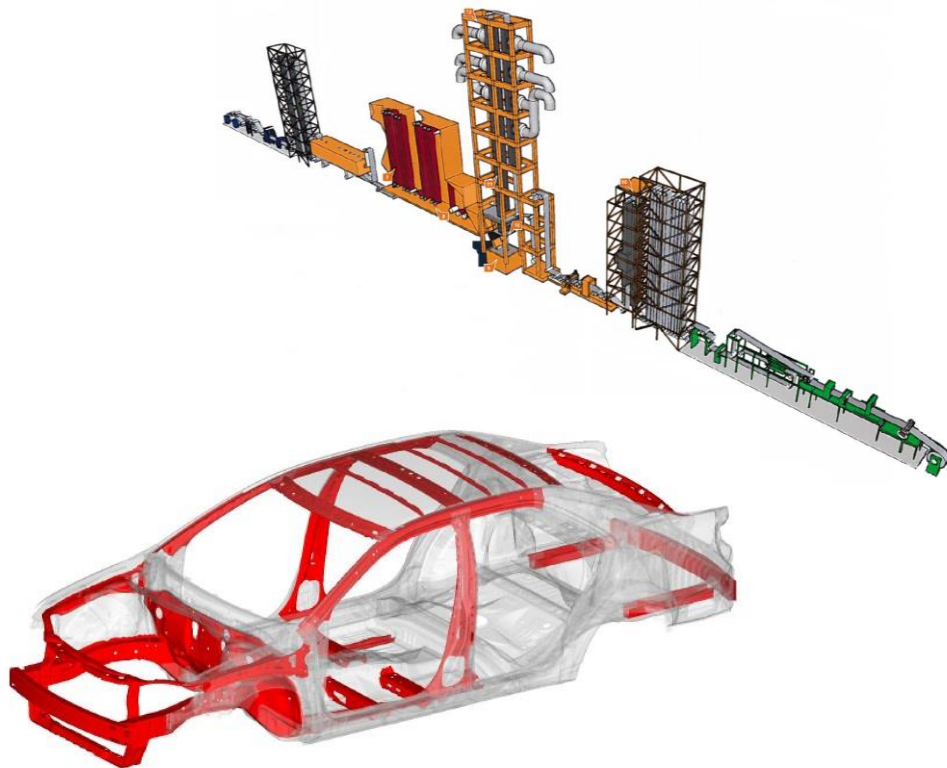
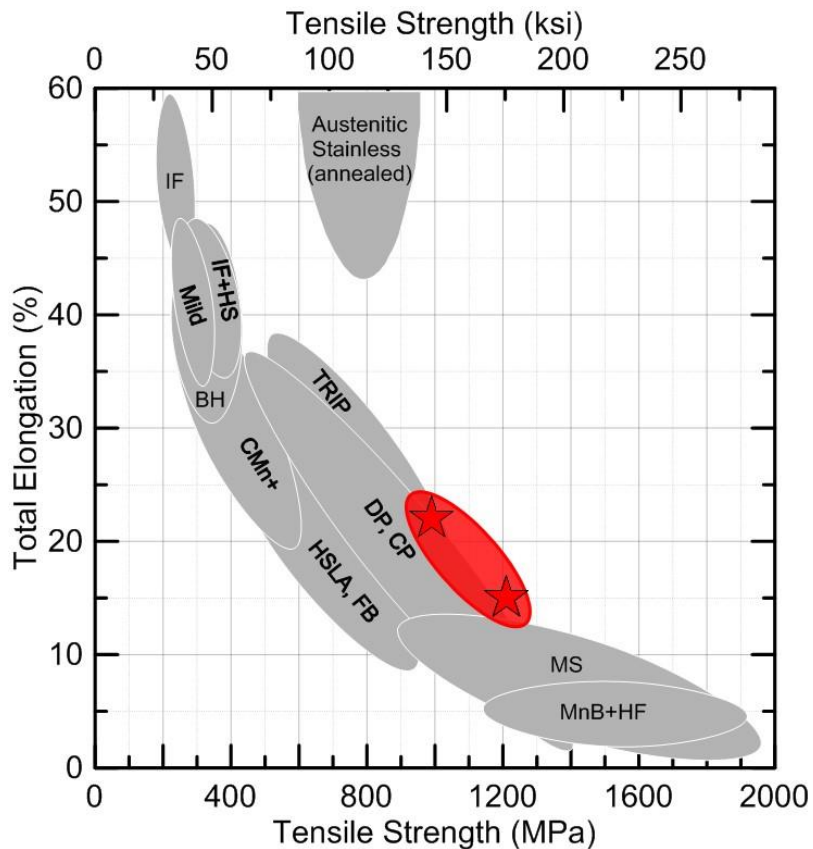
Validating NEXMET™ AHSS as a Lightweight Steel Solution

Scott Stevens

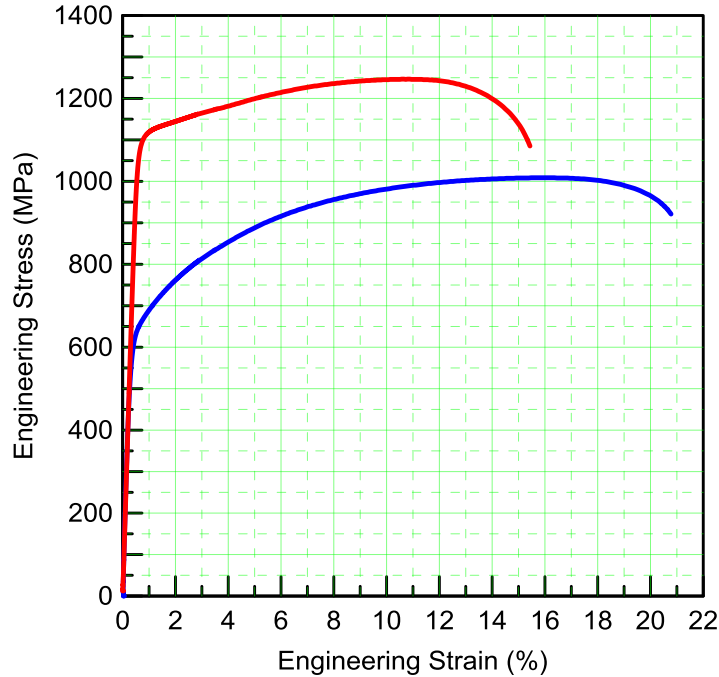
AK Steel Corporation

- Recap of NEXMET™ 1000 & 1200 AHSS
- Qualification & Characterization
- Applications under development
- Focused Study: Roof Bow & Door Beam
- Other considerations
- Q&A

NEXMET™ 1000 & 1200 AHSS



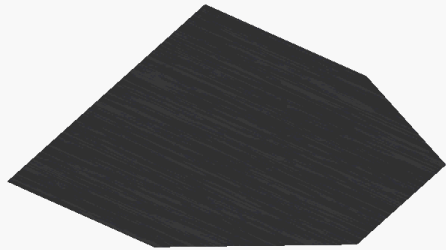
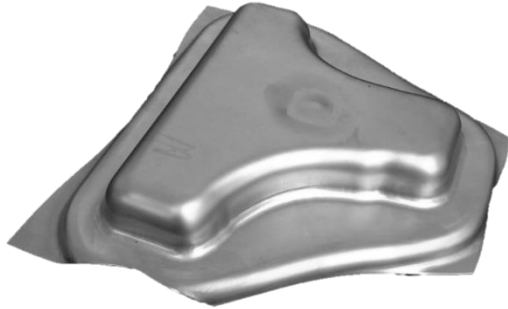
HDGI Mechanical Properties



Grade	Yield Strength, MPa	Tensile Strength, MPa	Total Elongation, %	Uniform Elongation, %	n-value (4-6%)	n-value (10%-uniform strain)
NEXMET™ 1000	740	1025	21	15	0.17	0.16
NEXMET™ 1200	1070	1230	15	11	0.13	0.11

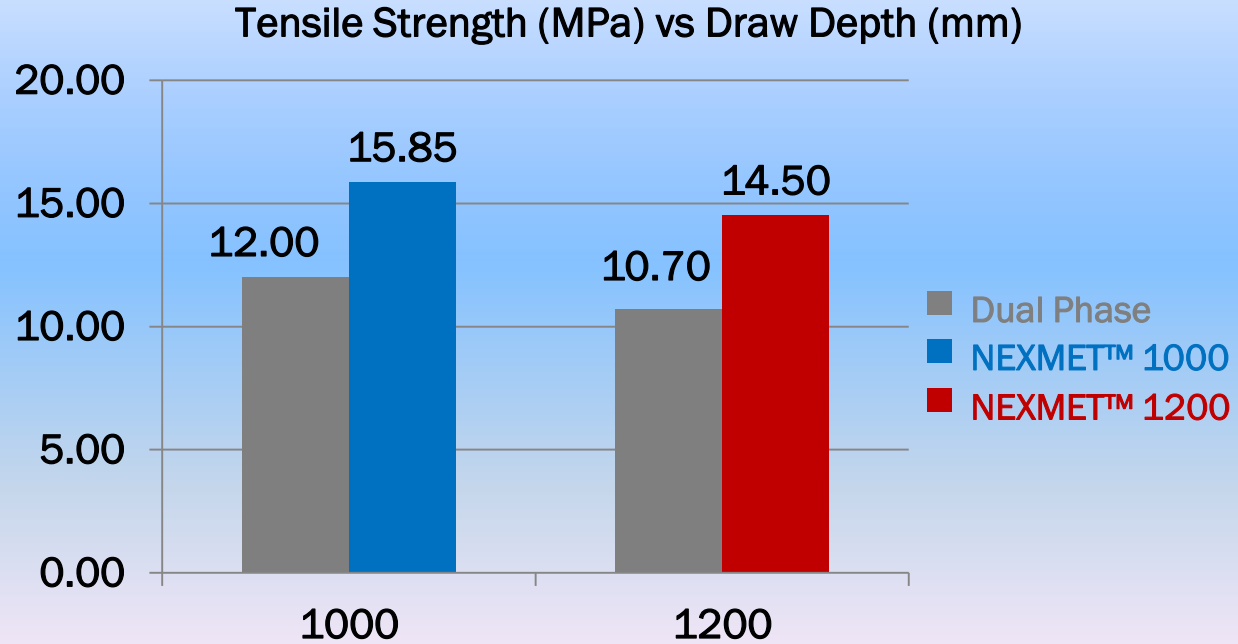
Grade	90° Bend, Pass at r/T		VDA Bend Test		Hole Expansion Ratio, %
	Parallel	Normal	Parallel	Normal	
NEXMET™ 1000	2	1.4	120	103	22
NEXMET™ 1200	1.5	1.1	77	91	31

Global Formability

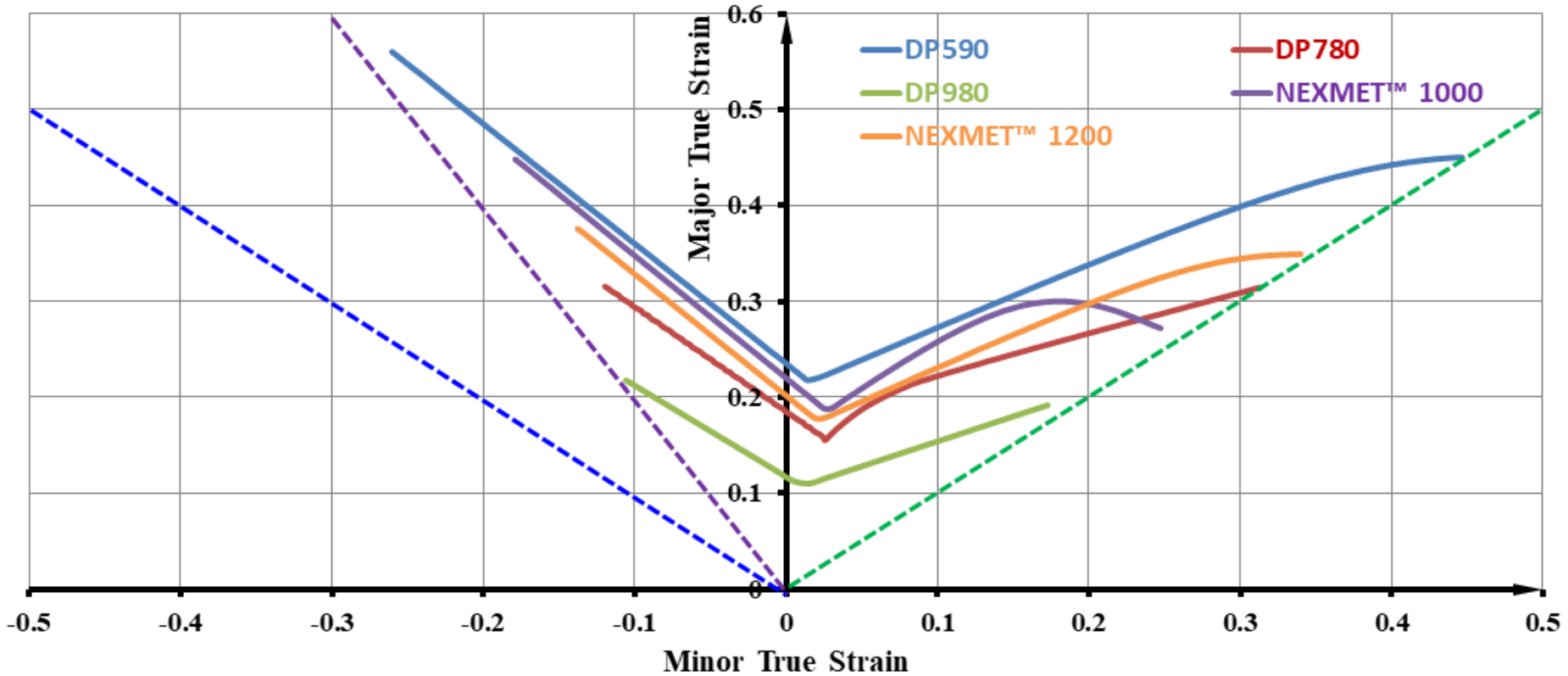


3_Nano
Distance to Bottom: -100.00 mm
Operation Step: D-20 Gravity
Middle Layer

Potential Splits Safe Insuff Stretch Potential Wrinkles

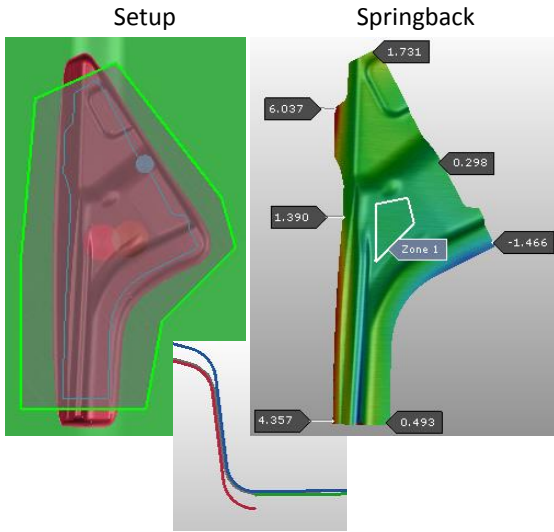


FLC Comparison

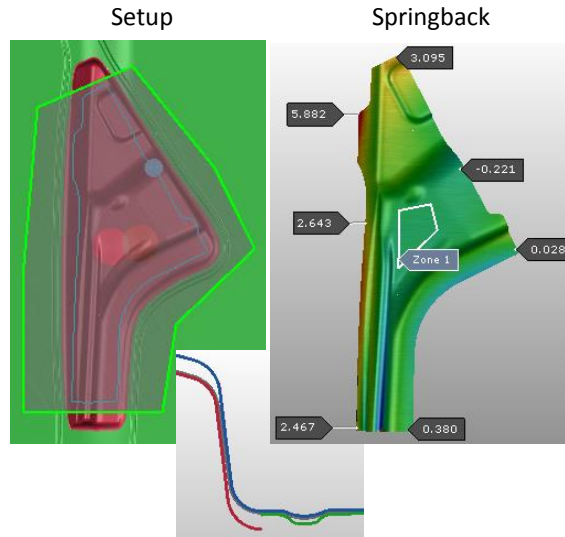


Springback

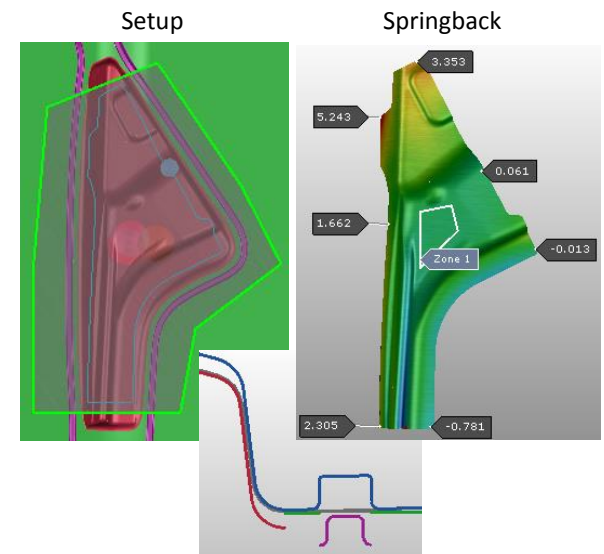
Forming with no bead



Forming with draw bead

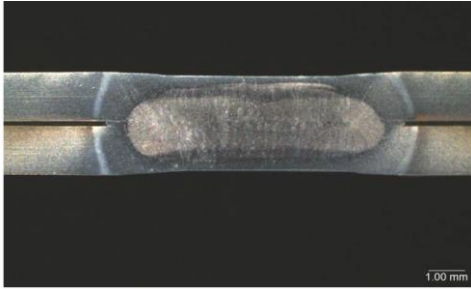


Forming with stake bead

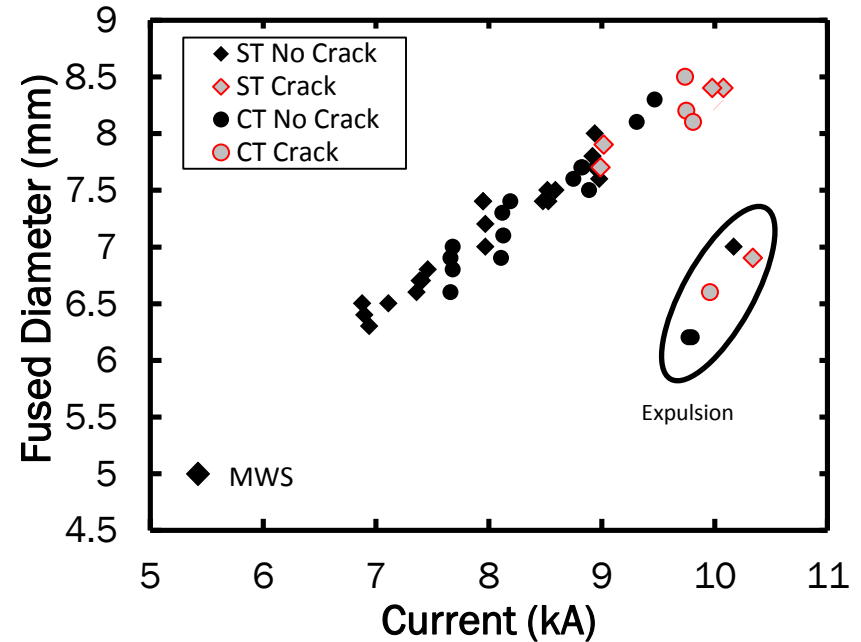
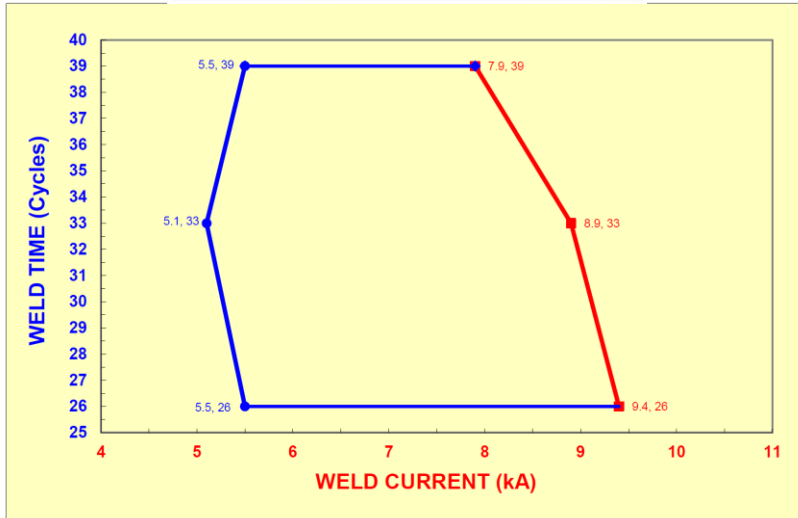


Forming with stake bead shows the best springback control

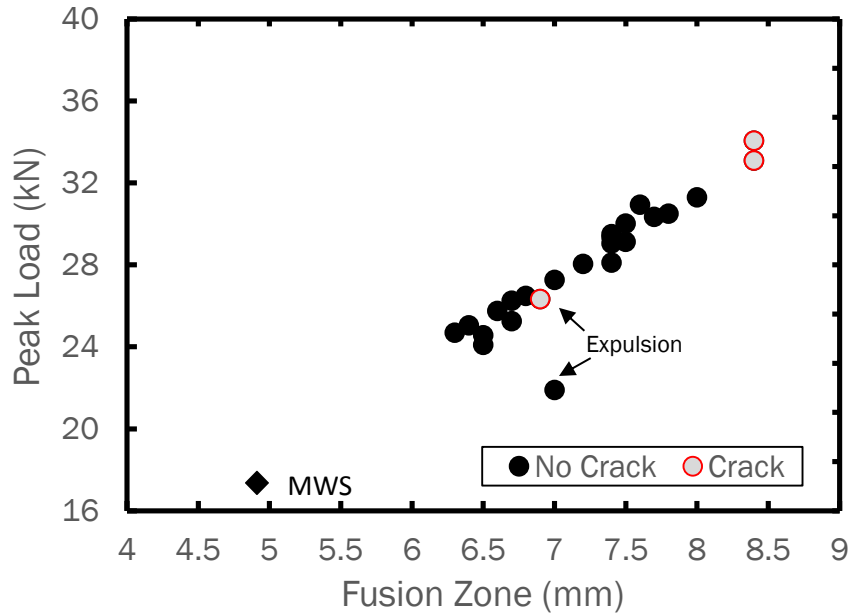
Weld Testing



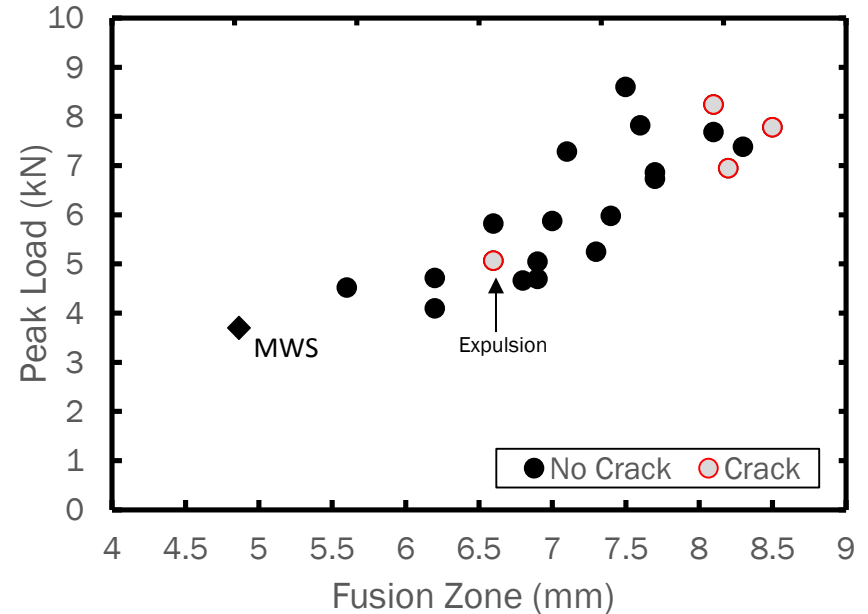
- Good current range and electrode life
- Occasional LME cracking at highest current



Weld Mechanical Properties

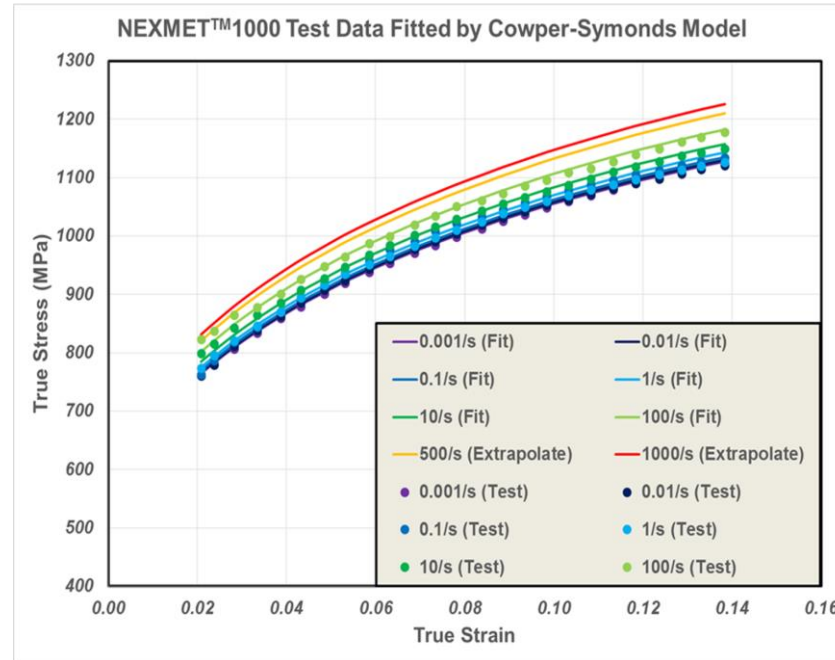


NEXMET™ 1000 Shear Tension



NEXMET™ 1000 Cross Tension

High Strain Rate Testing



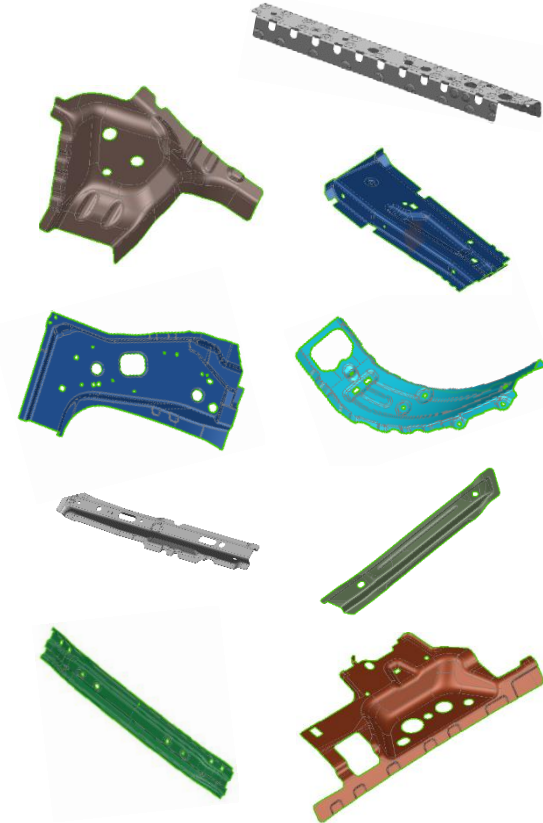
Zwick HMT16020 High Strain Rate Test Frame

- Early-Adopter OEM Qualifications complete by mid-year
- Full Commercialization to coincide
- CR/Uncoated – To follow HDGI later this year
- GA – In development



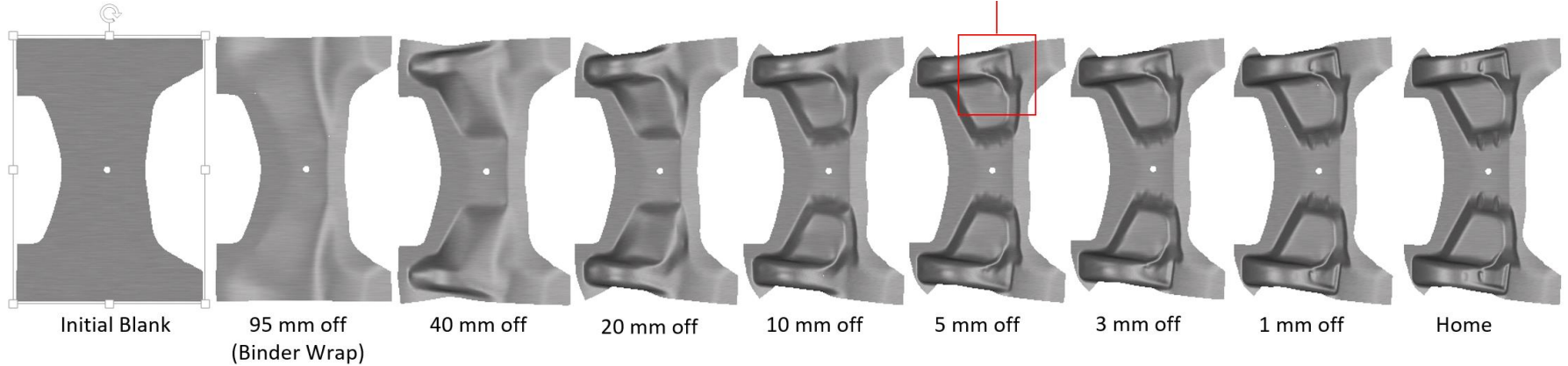
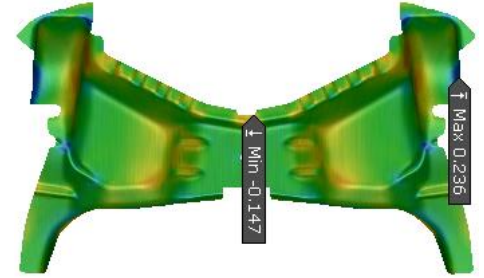
Applications Under Development

Part	Base Material	Base Gauge	New Material	New Gauge	Pass FEA	Prototype	Attribute
Front Panel	DP590	1.2 mm	NEXMET™1000	1.2 mm	Yes	Yes	Performance
Roof Bow	DP980	1.8 mm	NEXMET™1200	1.6 mm	Yes	Yes	Mass Saving
PNL BD Lower	DP780	1.6 mm	NEXMET™1000	1.4 mm	Yes	TBD	Mass Savings
Front Member	DP780	1.6 mm	NEXMET™1000	1.4 mm	Yes	TBD	Mass Savings
Cross Bar	DP780	1.6 mm	NEXMET™1000	1.4 mm	Yes	Yes	Mass Savings
Door Beam	PHS	1.8mm	NEXMET™1200	1.8 mm	Yes	Yes	Performance
Striker Anchor Plate	DP980	1.6 mm	NEXMET™1200	1.6 mm	Yes	Yes	Formability / Springback
Reinf RKR INR	DP980	1.8 mm	NEXMET™1200	1.6 mm	Yes	Yes	Mass Savings



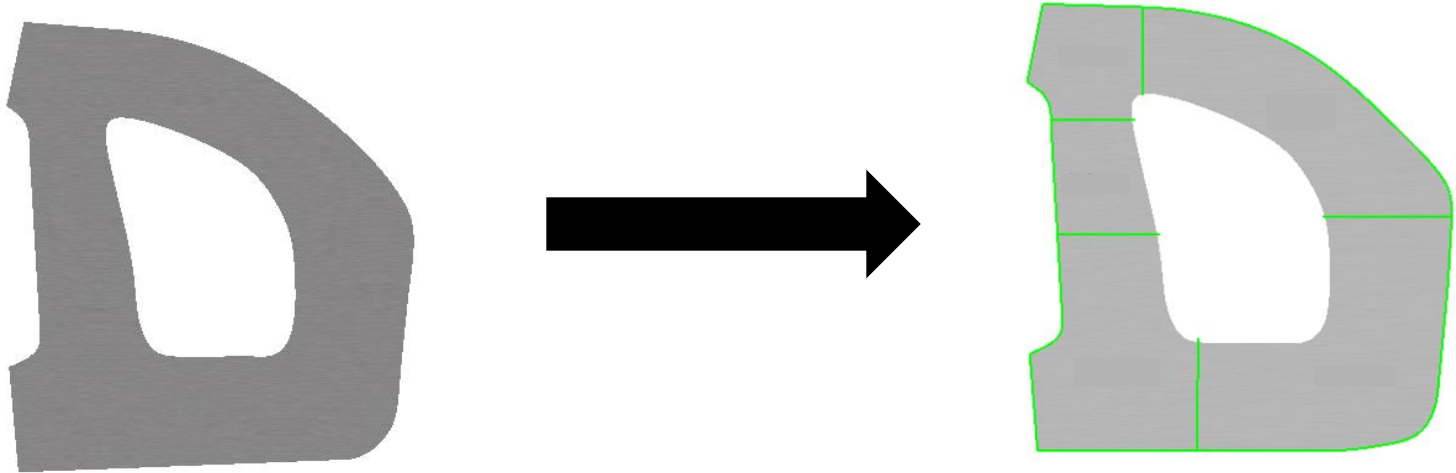
Additional Work, OEM Directed

- Forming Feasibility for Stamped Parts



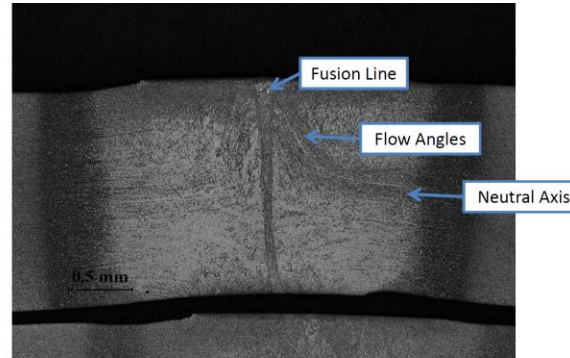
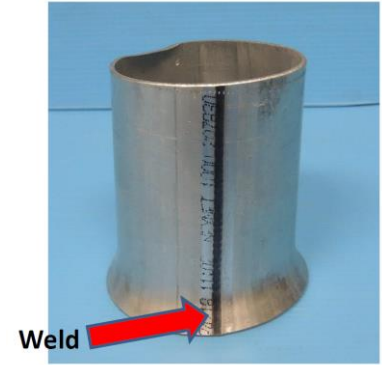
Additional Work, OEM Directed

- Forming Feasibility for Stamped Parts
- **Laser Welding and Blank Development**



Additional Work, OEM Directed

- Forming Feasibility for Stamped Parts
- Laser Welding Development
- **Tubing and Hydroforming**

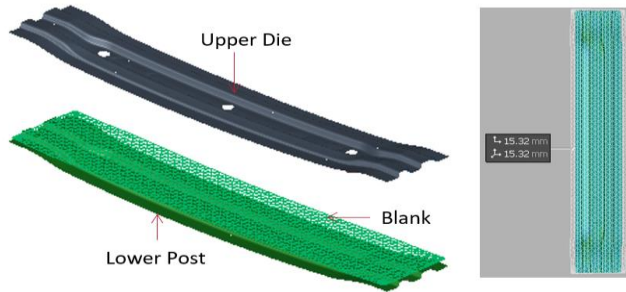


NEXMET™ 1200 Tube Prior to Final Sizing

Roof Bow Application

- Stamping FEA and Correlation
- Springback Prediction and Correlation
- Performance Comparison
 - 3 Point Bend Modeling, Testing & Correlation
- Gauge Optimization
- Total Mass Savings

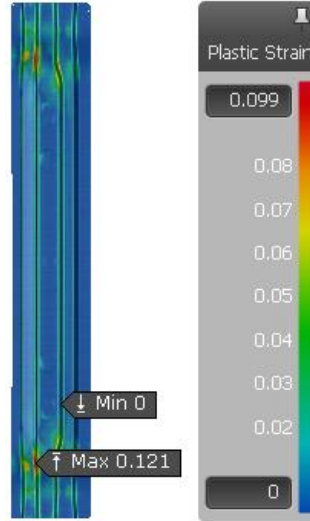
Stamping Feasibility



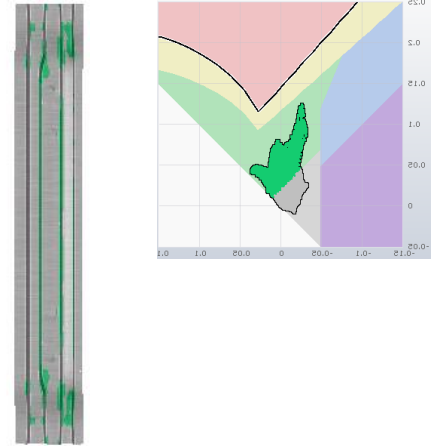
Die Design



NEXMET™ 1200 FLC

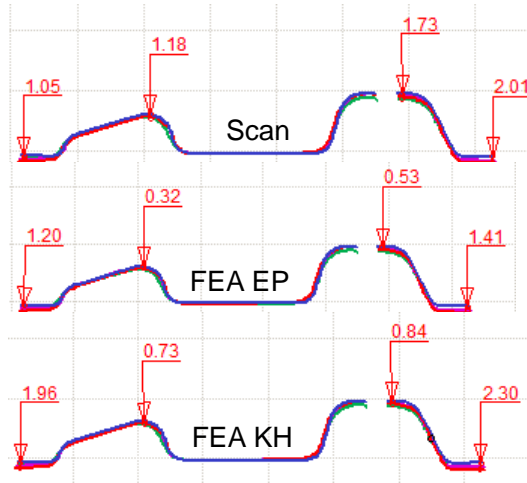
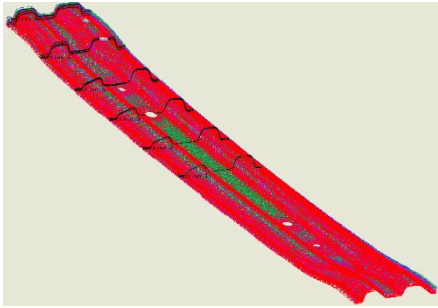


Plastic Strain Max: 0.121

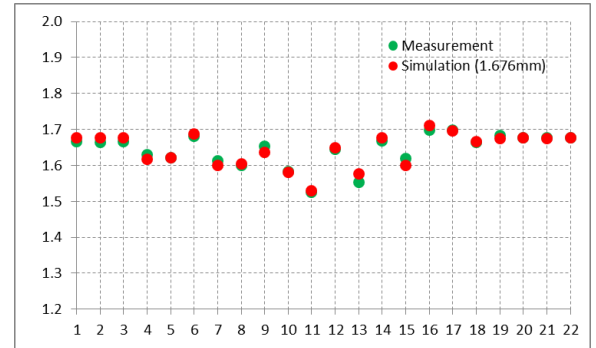


Formability

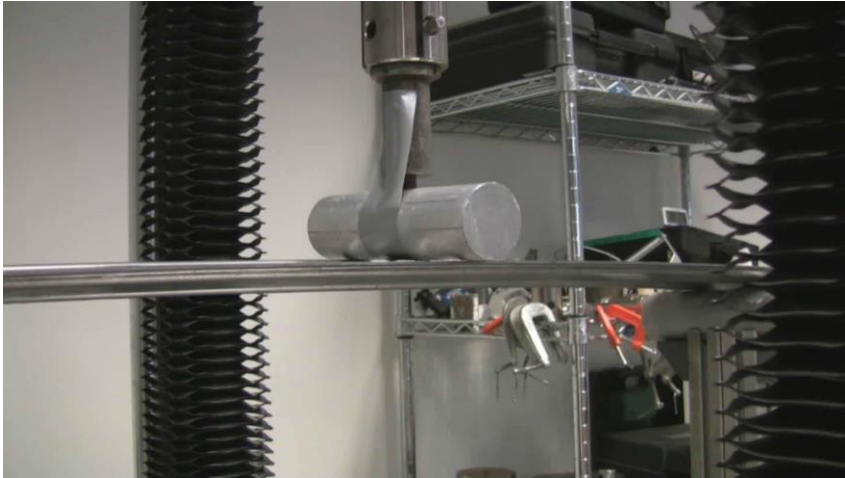
Stamping Springback Correlation



Thickness Changes - Simulation vs. Tryout

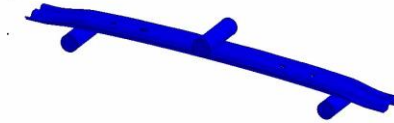


3 Point Bend Test and CAE Simulation



Time = 0
Contours of Resultant Displacement
min=0, at node# 8
max=0, at node# 8

Resultant Displacement
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00

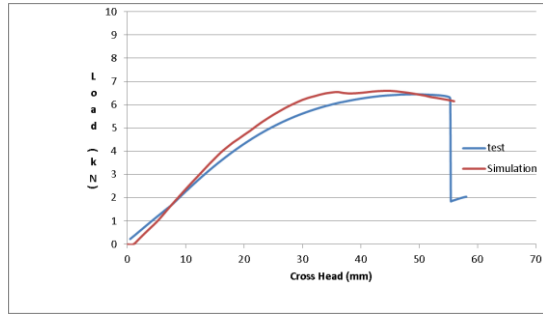


Not Actual Speed

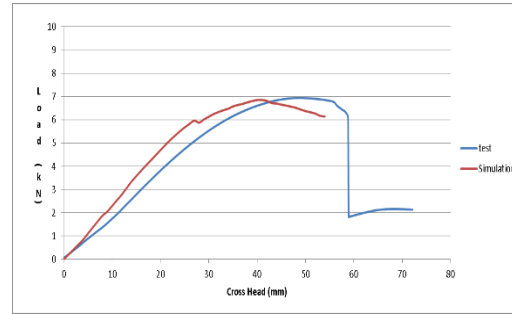
- 3 Point Bend Test 3 DP980 @ 1.8 mm
- 3 NEXMET™1200 @ 1.6 mm
- 3 PHS @ 1.8 mm

Nonlinear analysis using LS-Dyna to predict the load vs. deflection behavior in test

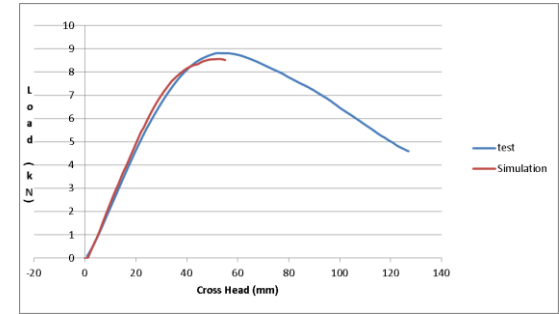
Test to CAE Correlation



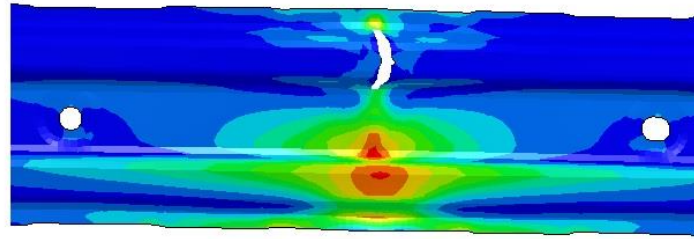
DP980 1.8 mm



NEXMET™ 1200 1.6 mm



PHS 1.8 mm



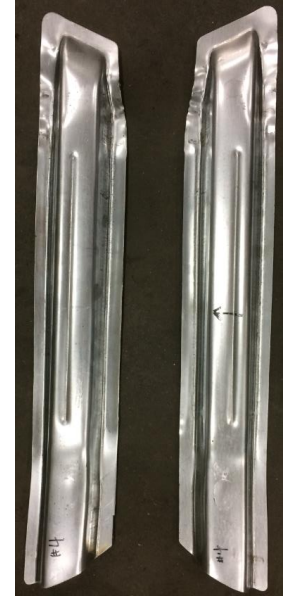
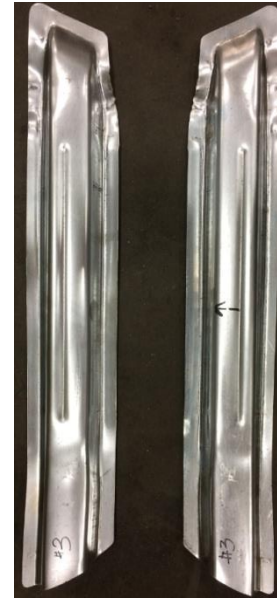
Optimization Results

MATERIAL	PEAK LOAD (kN)	
	TEST	SIMULATION
DP 980 1.8 mm	6.5	6.6
NEXMET™ 1200 1.6 mm	6.9	6.9
PHS 1.8 mm	8.8	8.6

GAUGE OPTIMIZATION						
MATERIAL	GAUGE (mm)	WEIGHT (Kg)	WEIGHT REDUCTION (Kg)	WEIGHT REDUCTION %	PEAK LOAD (KN)	
					TEST	SIMULATION
DP 980 Baseline	1.8	2.68	-	-	6.5	6.6
NEXMET™ 1200	1.55	2.31	0.37	13.9	-	6.6
PHS	1.50	2.23	.45	16.7	-	6.6

Door Beam Study

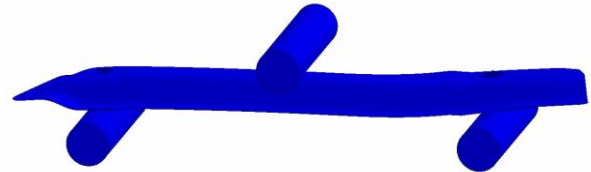
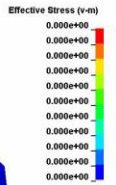
- Cold Stamping NEXMET™ 1200 in Hot Stamp Die



3 Point Bend Test and CAE Simulation



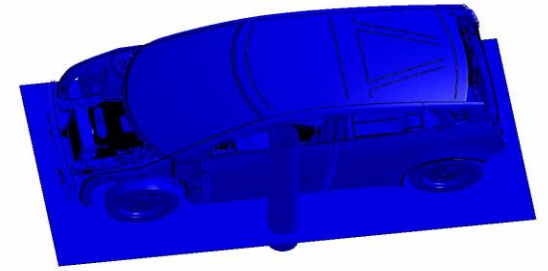
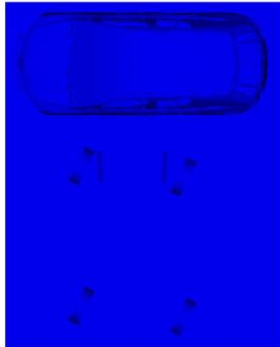
Time = 0
Contours of Effective Stress (v-m)
reference shell surface
min=0, at elem# 4337
max=0, at elem# 4337



1: VENZA_ft_usncap_056kph initial run baseline
Loadcase 1: Time = 0.000000 : Frame 1

LS-DYNA keyword deck by LS-PrePost
Time = 0
Contours of Resultant Displacement
min=0, at node# 804947
max=2.25648, at node# 460646

Contour Plot
Displacement(Mag)
Analysis system
2.310E+03
2.053E+03
1.796E+03
1.540E+03
1.283E+03
1.026E+03
7.699E+02
5.132E+02
2.586E+02
0.000E+00
■ No result
Max = 2.310E+03
Node 10016969
Min = 0.000E+00
Node 25111793



- GI NEXMET™ 1000 & 1200 AHSS
 - Qualified & Commercially Available by Mid-Year ✓
 - Formability & Springback Correlated ✓
 - Performance Verified ✓
 - Alternative to PHS ✓
 - Mass Savings Confirmed ✓

Committed to Automotive

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