



Advanced High-Strength Steel Technology in the 2005 Jeep Grand Cherokee

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DaimlerChrysler Corporation
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Advanced High-Strength Steel Technology in the 2005 Jeep Grand Cherokee

Acknowledgements

John Siekirk – DCX ASME

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Chris Meloche – AZ Automotive





2005 Grand Cherokee

4-Wheel & Off-Road – 4x4 of the Year



Detroit Free Press – Truck of the Year

2005 Grand Cherokee



Truckin' SUV – SUV of the Year 2005 Grand Cherokee



Texas Auto Writers Association – Mid-Size SUV of the Year



Advanced High Strength Steel Applications

- AHSS Materials
 - Dual Phase 590
 - Hot Stamped Martensitic
- Crash Events
 - Crash Energy Management
 - Anti-Intrusion Control
- Product and Manufacturing Development
 - Formability Challenges
 - Dimensional Control Challenges
 - Tooling and Tool Wear Challenges



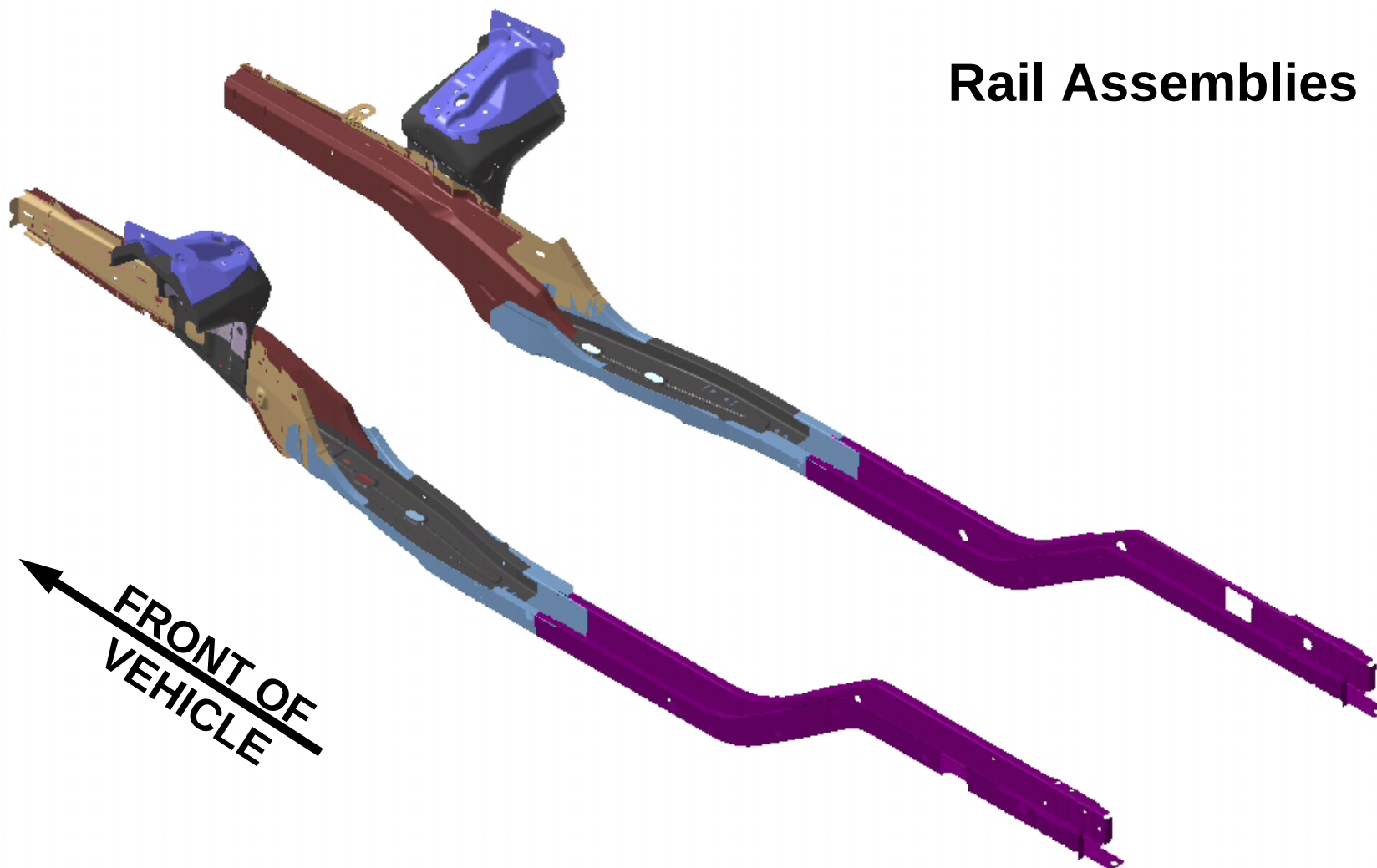
Advanced High Strength Steel Applications

Components and Material Selection

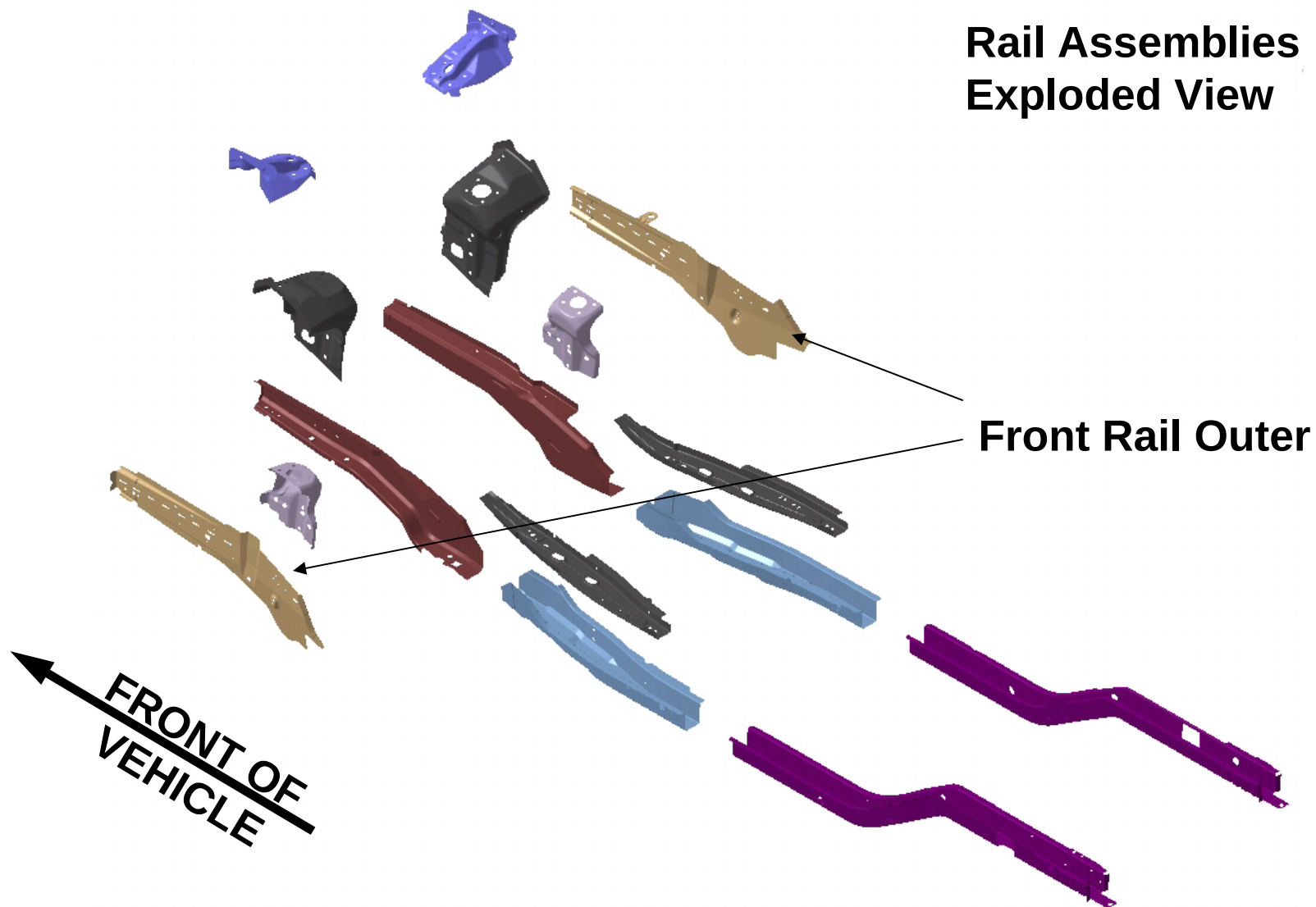
Dual Phase 590



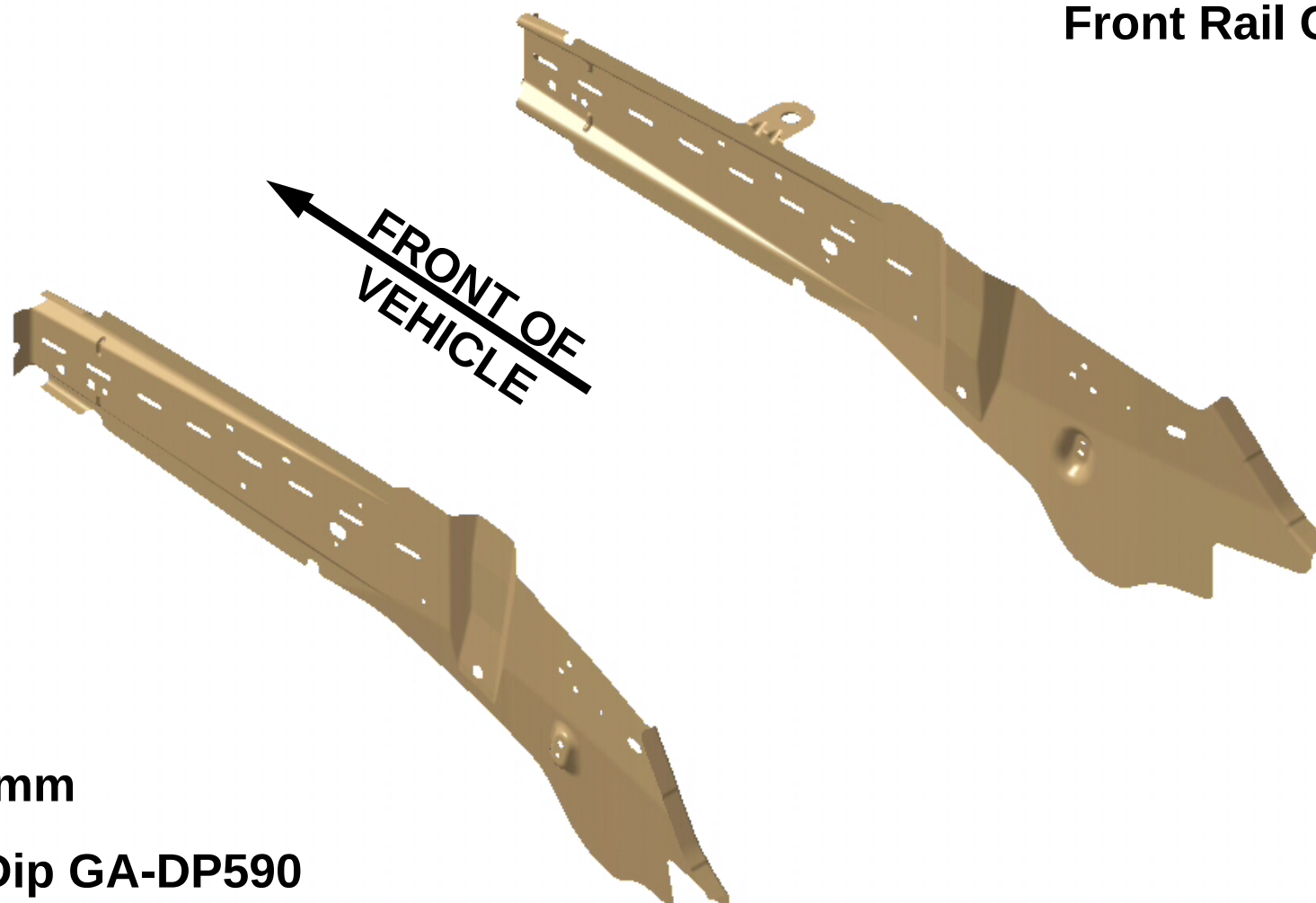
Rail Assemblies



Rail Assemblies Exploded View



Front Rail Outer

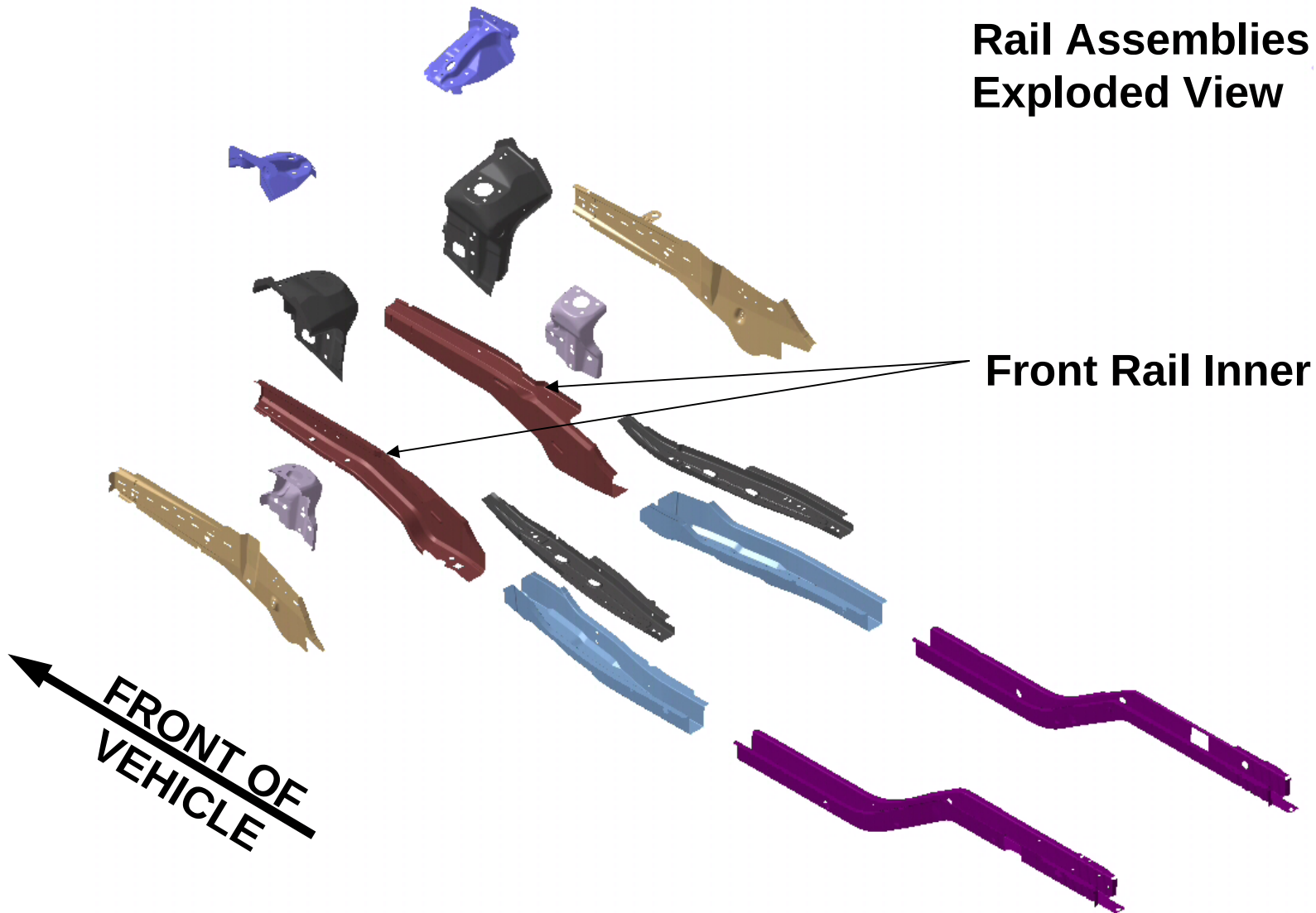


1.85 mm

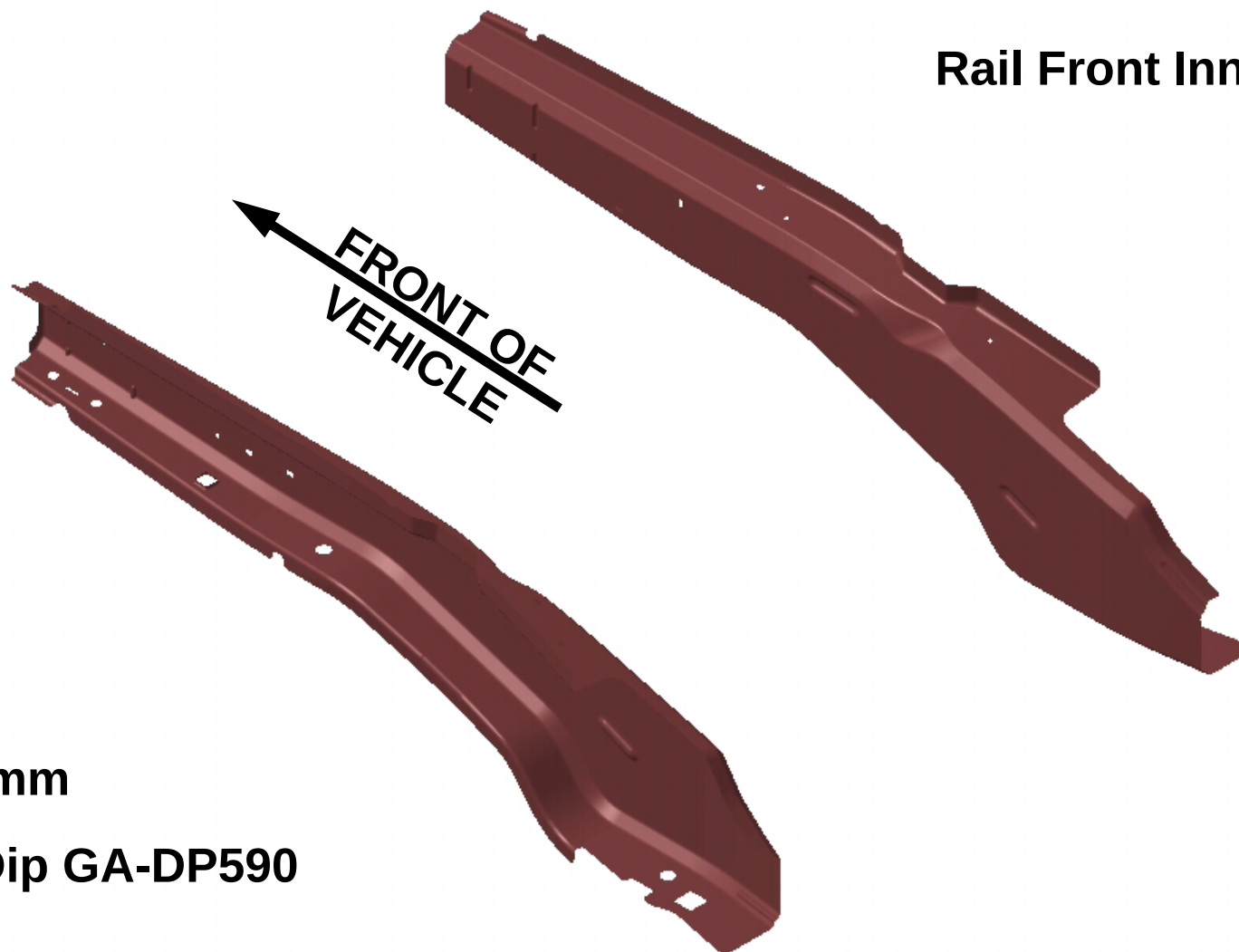
Hot Dip GA-DP590



Rail Assemblies Exploded View



Rail Front Inner

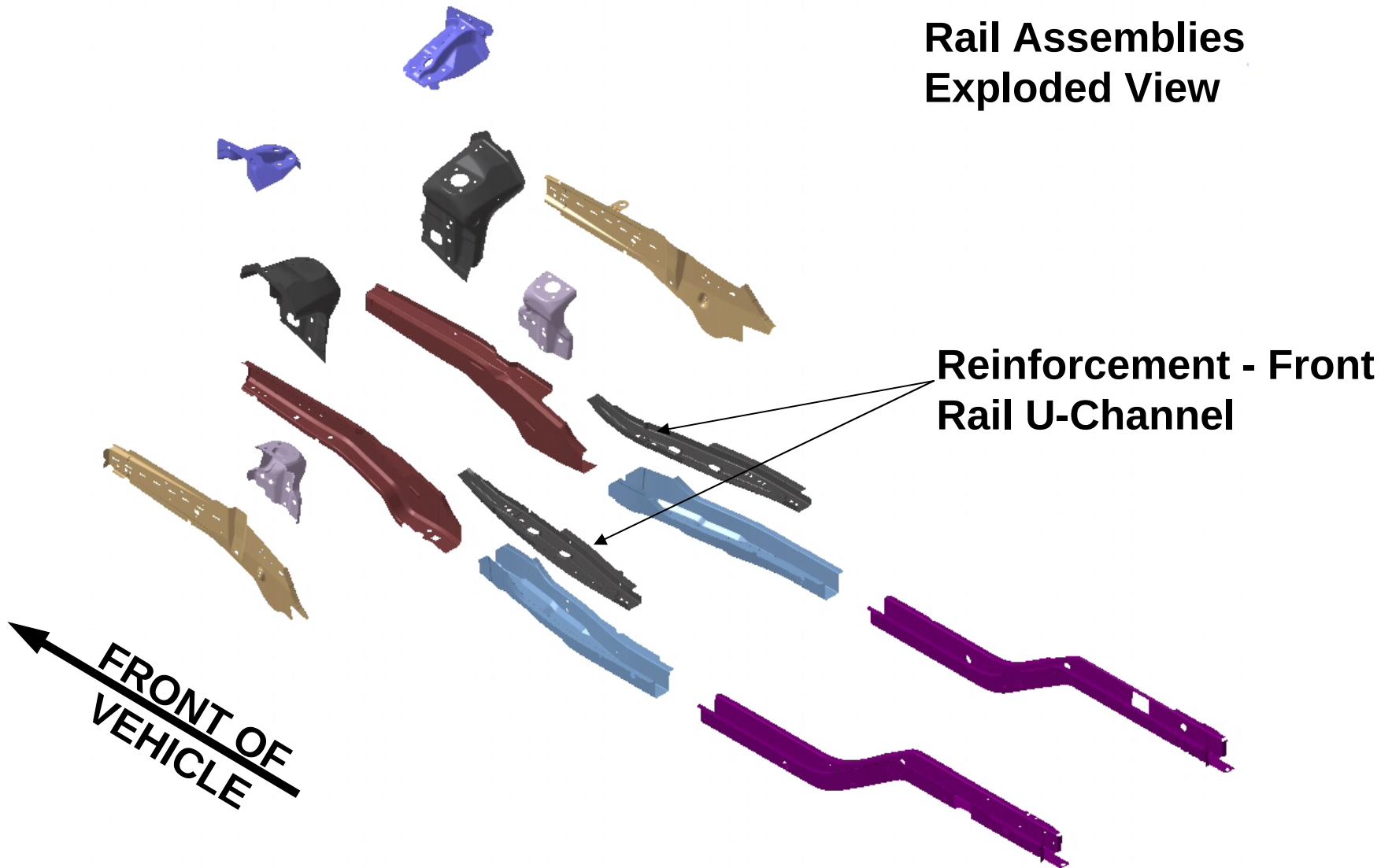


1.95 mm

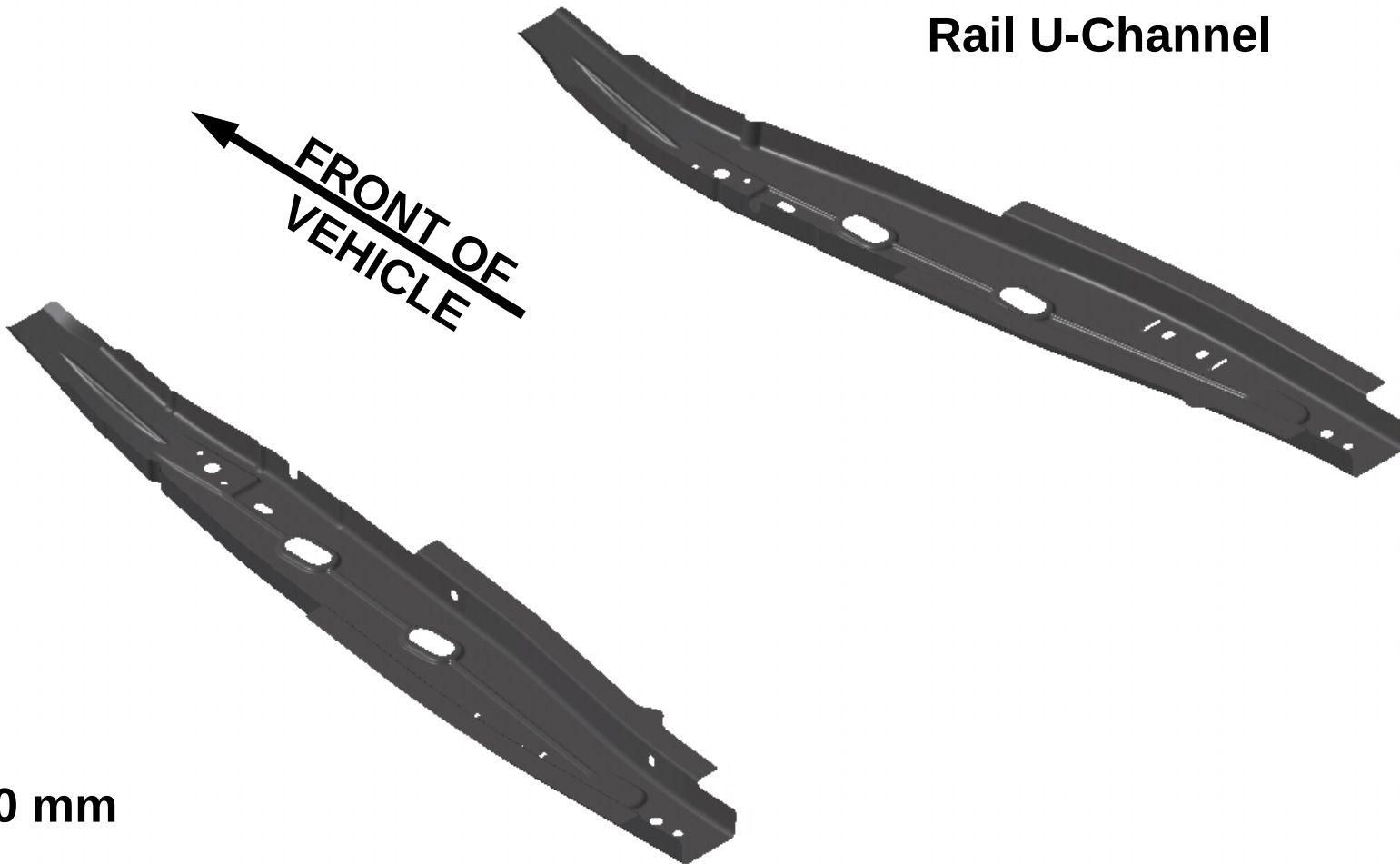
Hot Dip GA-DP590



Rail Assemblies Exploded View



Reinforcement – Front Rail U-Channel

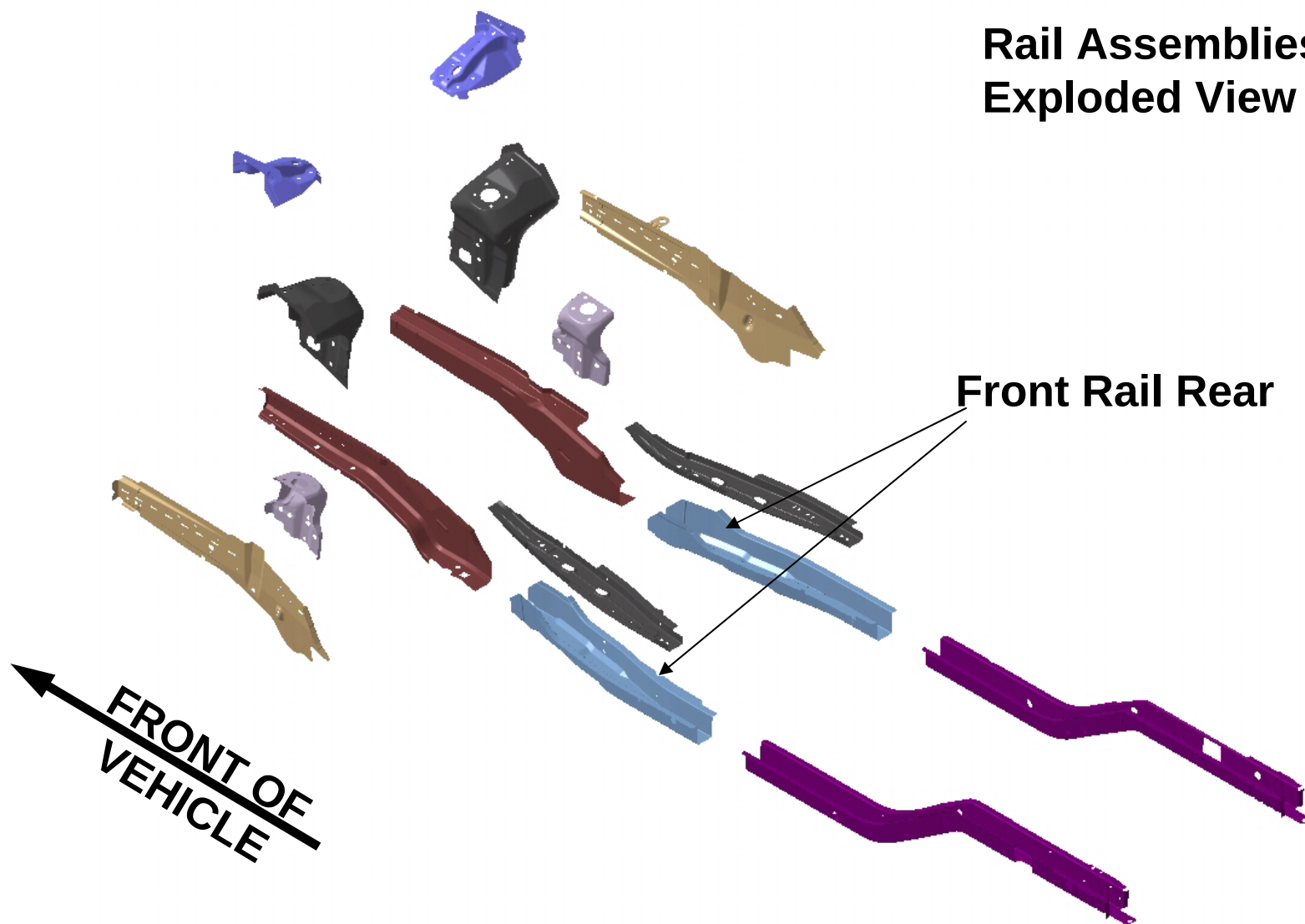


1.80 mm

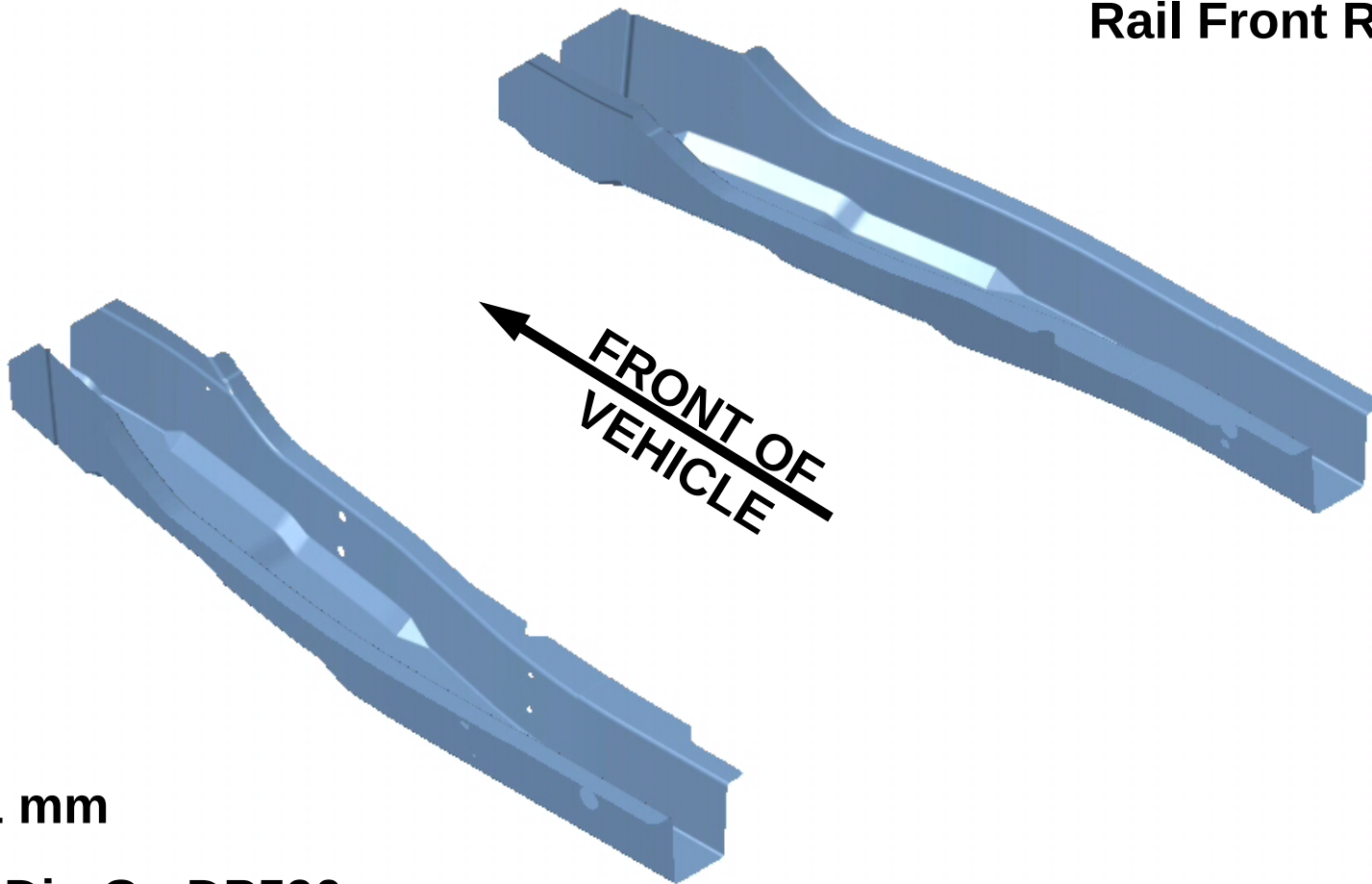
Hot Dip GA-DP590



Rail Assemblies Exploded View



Rail Front Rear

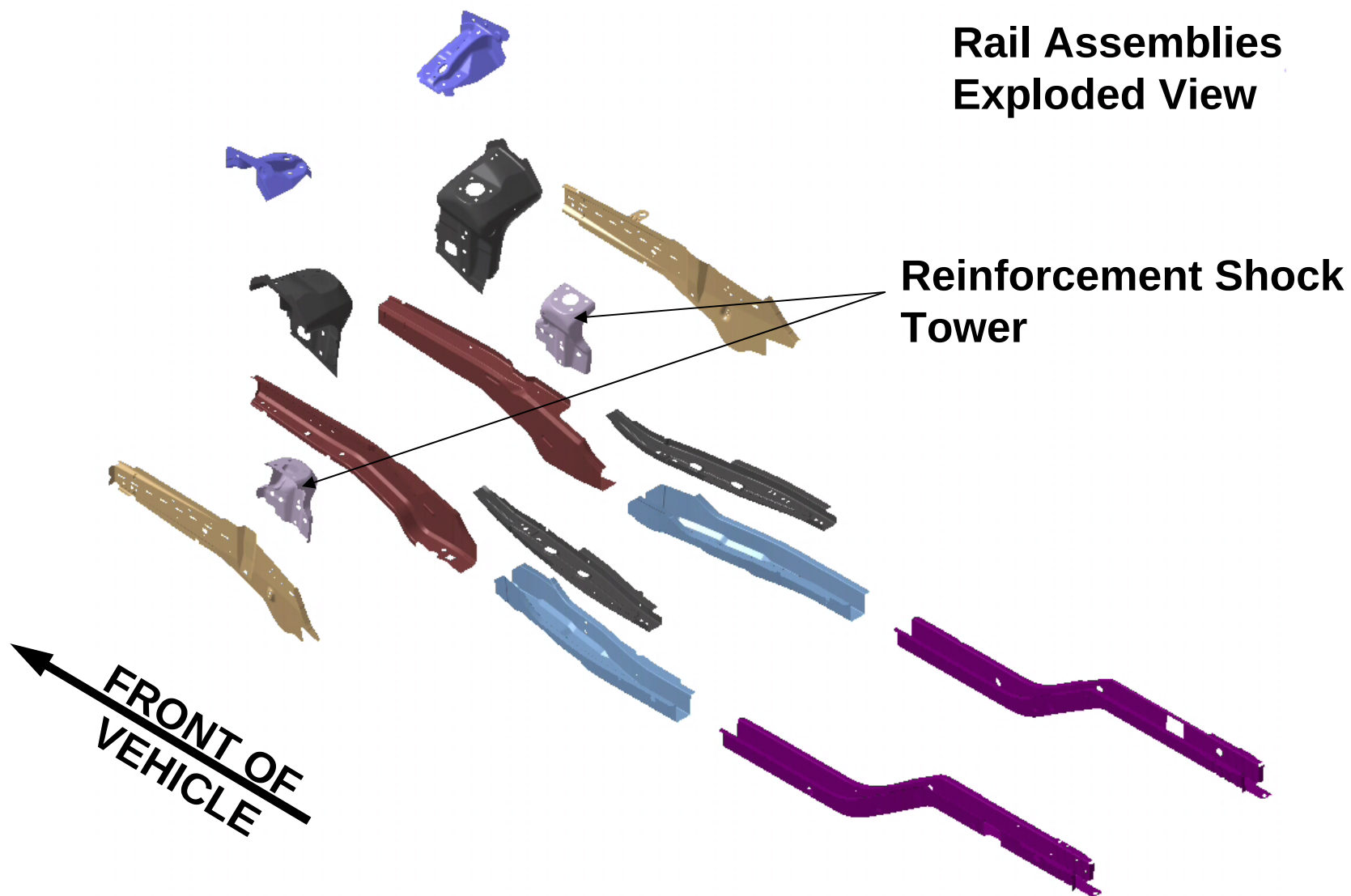


2.21 mm

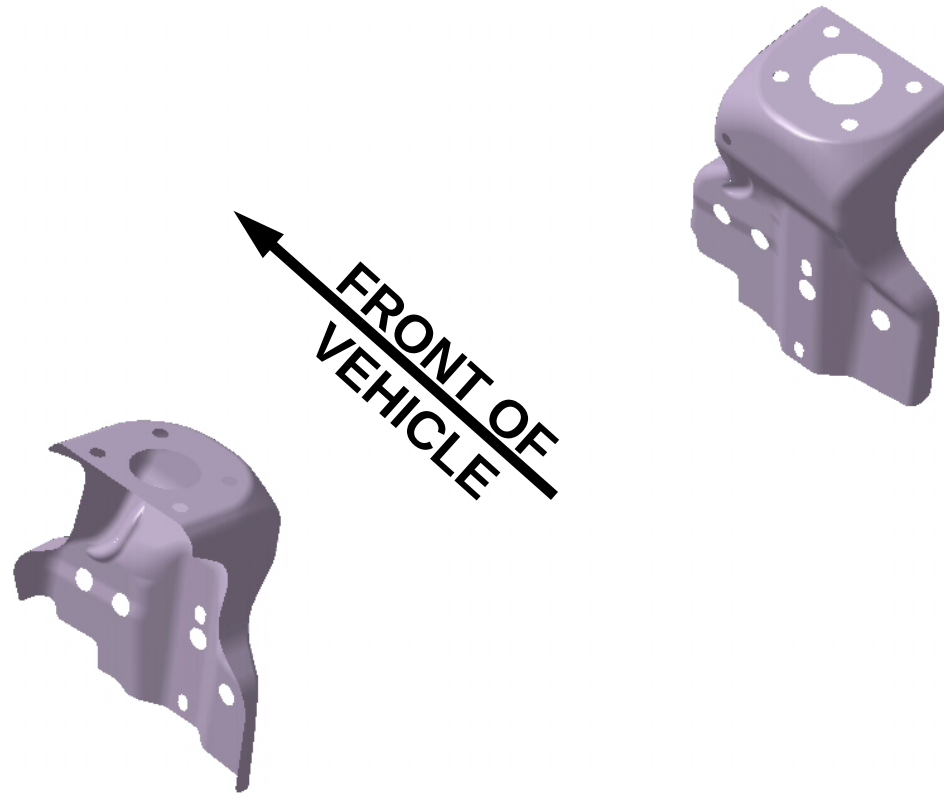
Hot Dip Ga-DP590



Rail Assemblies Exploded View



Reinforcement Shock Tower

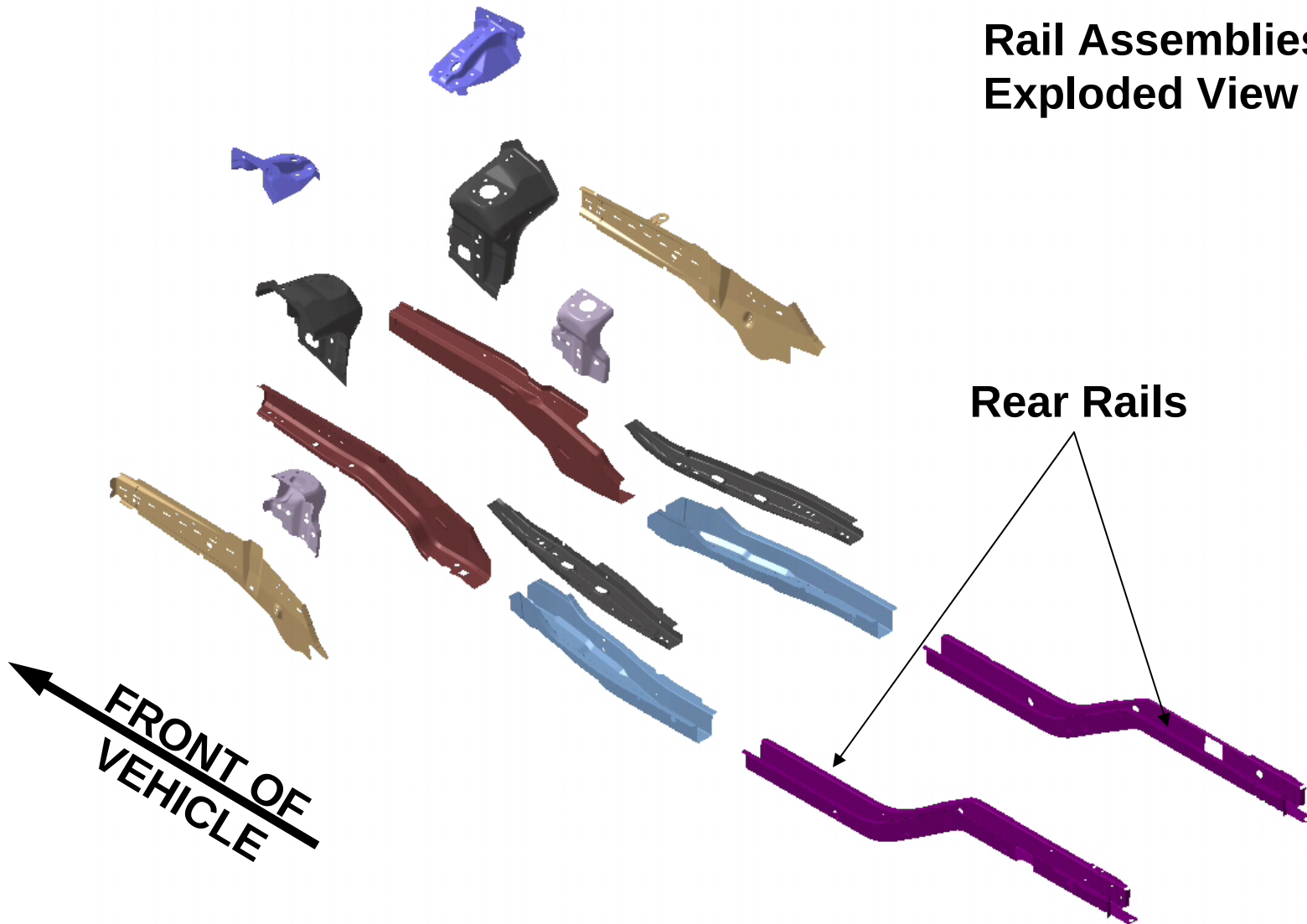


1.40 mm

Hot Dip GI DP590

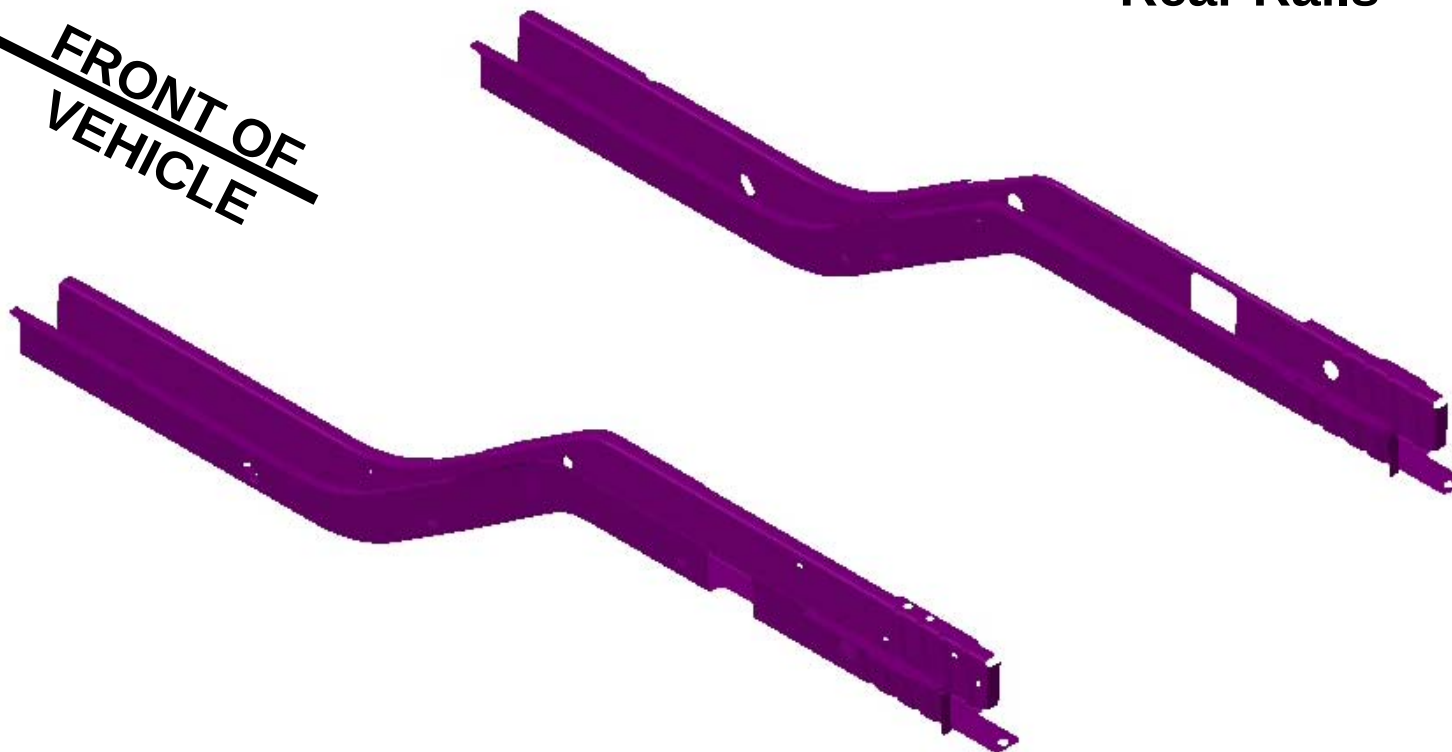


Rail Assemblies Exploded View



Rear Rails

FRONT OF
VEHICLE



2.01 mm

Hot Dip GA-DP590



A-Pillar Front Upper

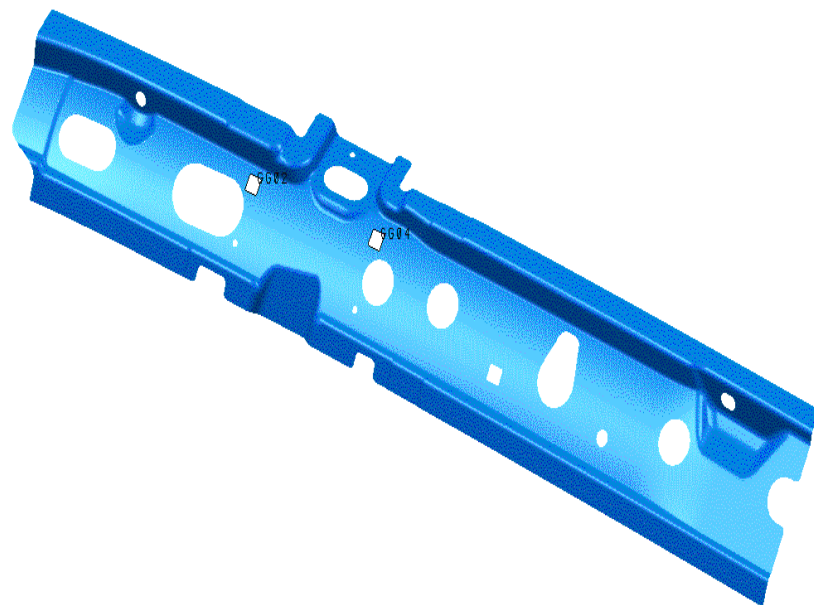


1.70 mm

Hot Dip GA DP590



A-Pillar Rear Upper Extension



1.70 mm
Hot Dip GA DP590





Front Rail Outer	1.85 mm	GA DP590
Front Rail Inner	1.95 mm	GA DP590
Rnf-Front Rail U-Channel	1.80 mm	GA DP590
Front Rail Rear	2.21 mm	GA DP590
Rear Rail	2.01 mm	GA DP590
Rnf-Shock Tower	1.40 mm	GI DP590
A-Pillar Front Upper	1.70 mm	GA DP590
A-Pillar Rear Upper Extension	1.70 mm	GA DP590
Rnf-Sill Inner Bracket	2.01 mm	GA DP590
Brkt-Cradle Mounting Front	1.40 mm	GA DP590



Advanced High Strength Steel Applications

Components and Material Selection

Hot Stamped Martensitic Components



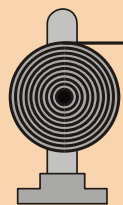
Steel Grade – SAE 15B22 Modified

Carbon – 0.20/0.25%

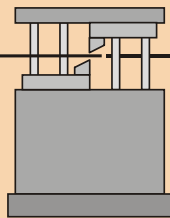
Manganese – 1.0/1.3%

Boron – 0.0015/0.0050%

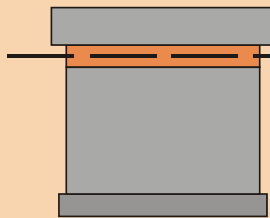
Direct hot stamping



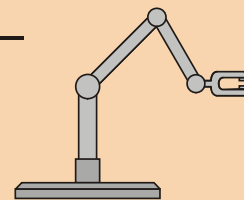
Coil



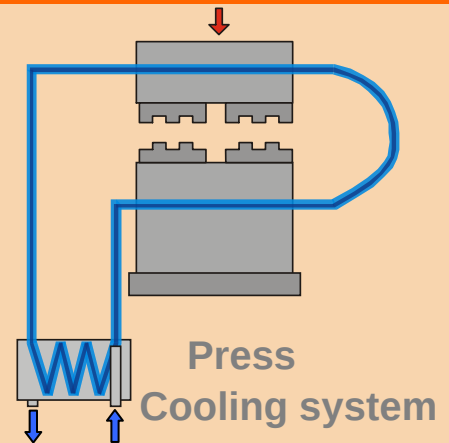
Blank



Furnace



Robot

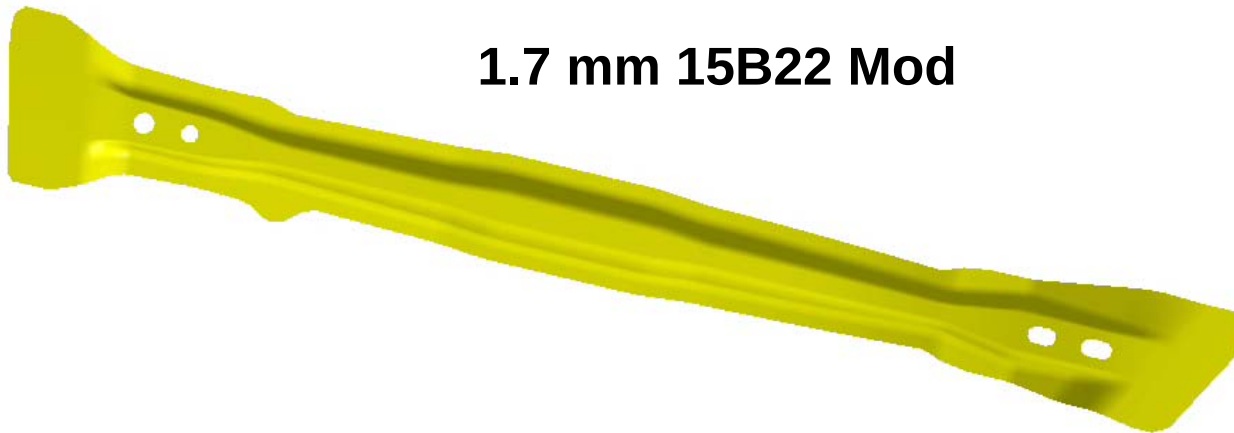


Front Door Impact Beam



2.1 mm 15B22 Mod

1.7 mm 15B22 Mod



**Rear Door
Impact Beam**





WK Front Impact Beam





WK Rear Impact Beam





Advanced High Strength Steel Applications

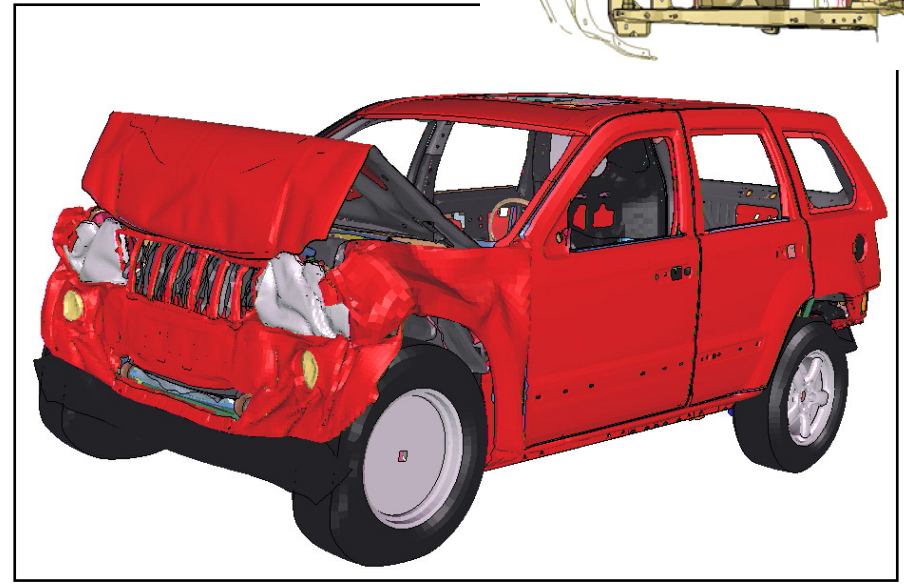
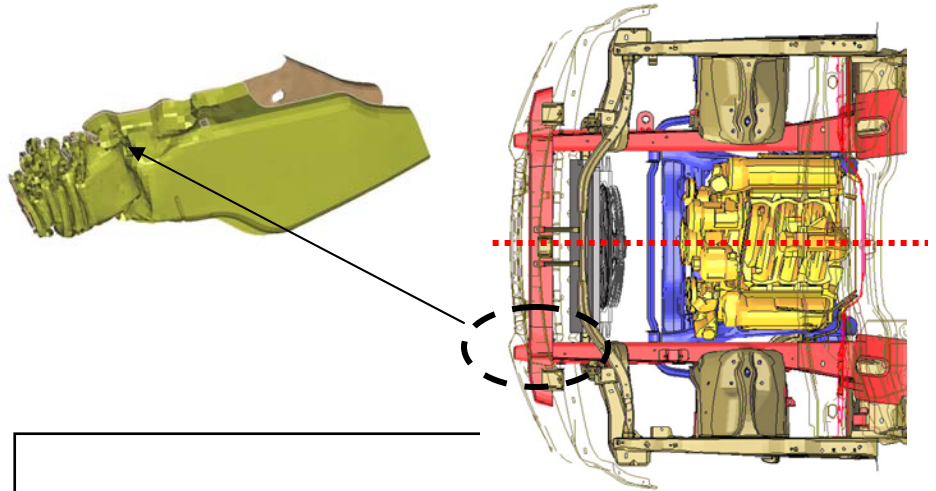
Crash Events

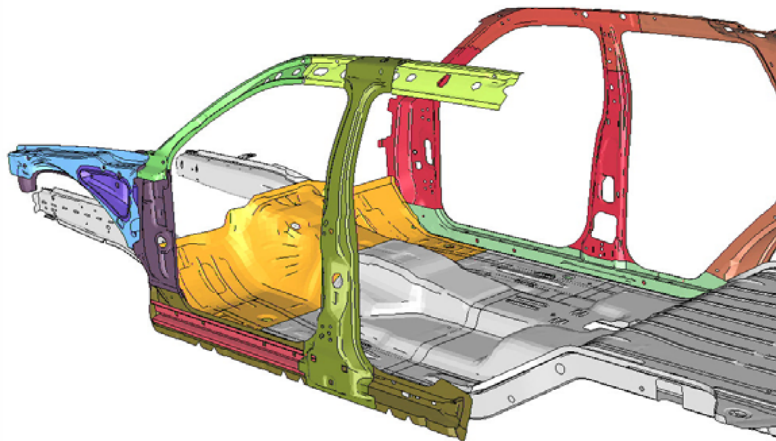
Crash Energy Management



35 mph Flat Frontal

- Accordion crush of DP590 Rail Tip
- Low Intrusion





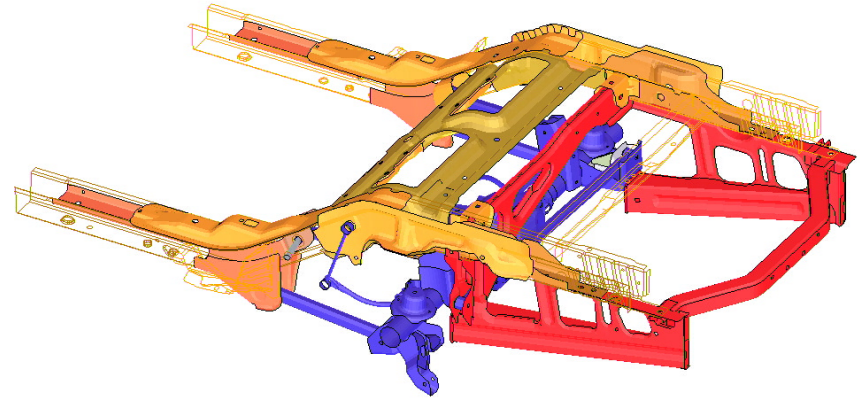
40 mph Front Offset

- Body Cage Intact
- DP590 A-Plr Reinf.
- Low Intrusion



50 mph Rear Offset

- DP590 Rear Rails
- Rear Load Path
- Protected Zone



Advanced High Strength Steel Applications

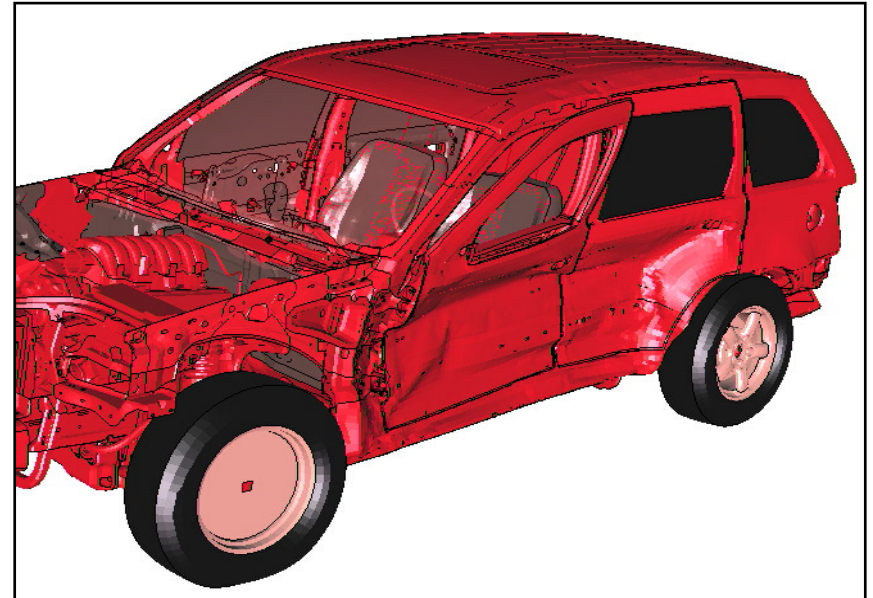
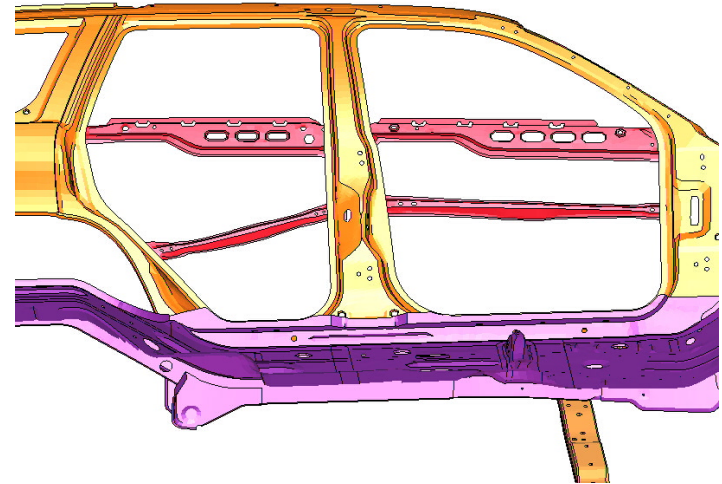
Crash Events

Intrusion Control



38.5 mph Crabbed Side Impact

- B-pillar Engagement
- Hot-stamped door beams
- Low Intrusion



Product and Manufacturing Development

Formability Challenges

Dimensional Control Challenges

Tooling and Tool Wear Challenges



Product and Manufacturing Development

Formability Challenges

- Splits
- Edge Cracking/Stretch Splits
- Shear Fracture



Front Rail Outer



Front Rail Rear



Front Rail Rear



Shear Fracture



Product and Manufacturing Development

Dimensional Control Issues

- Springback
- Sidewall Curl
- Twist



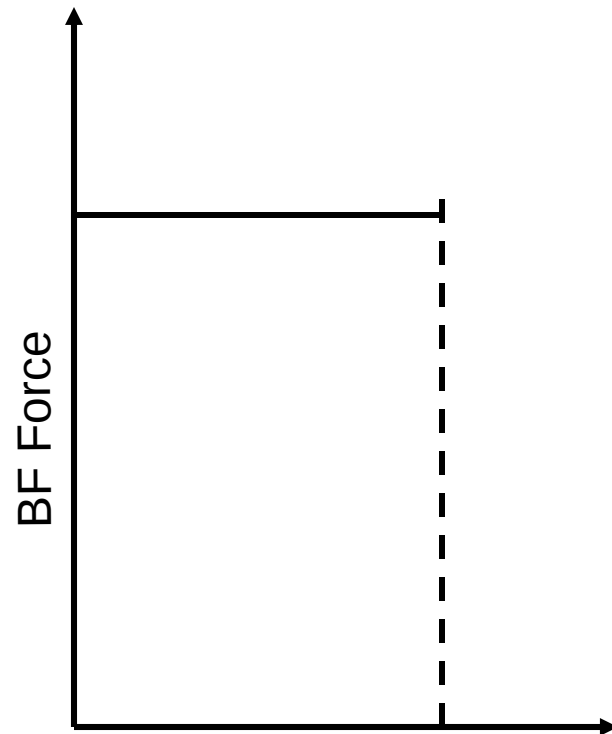
Rear Rail



Possible Solutions

- Tight radii
- Let it curl in draw and overstrike and allow to spring back to final required dimension
- Control curl by optimizing material flow
 - Variable Binder Control/Force

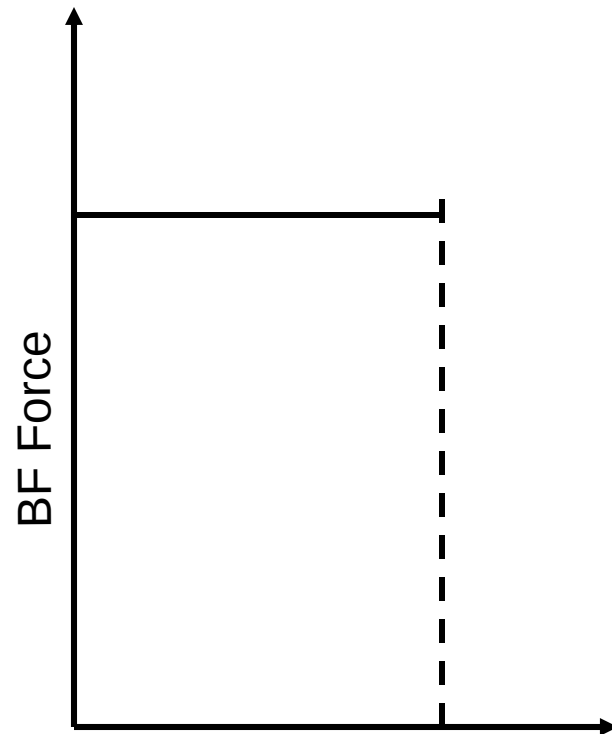




Binder Travel

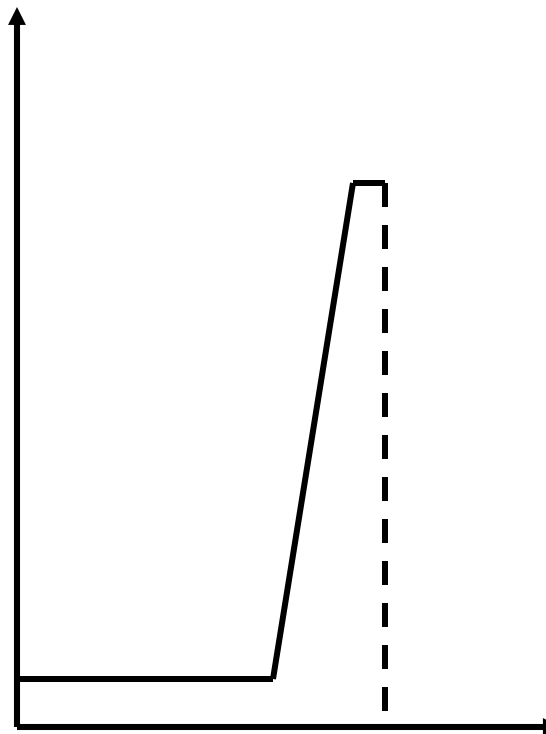
Case-1: CBF





Binder Travel

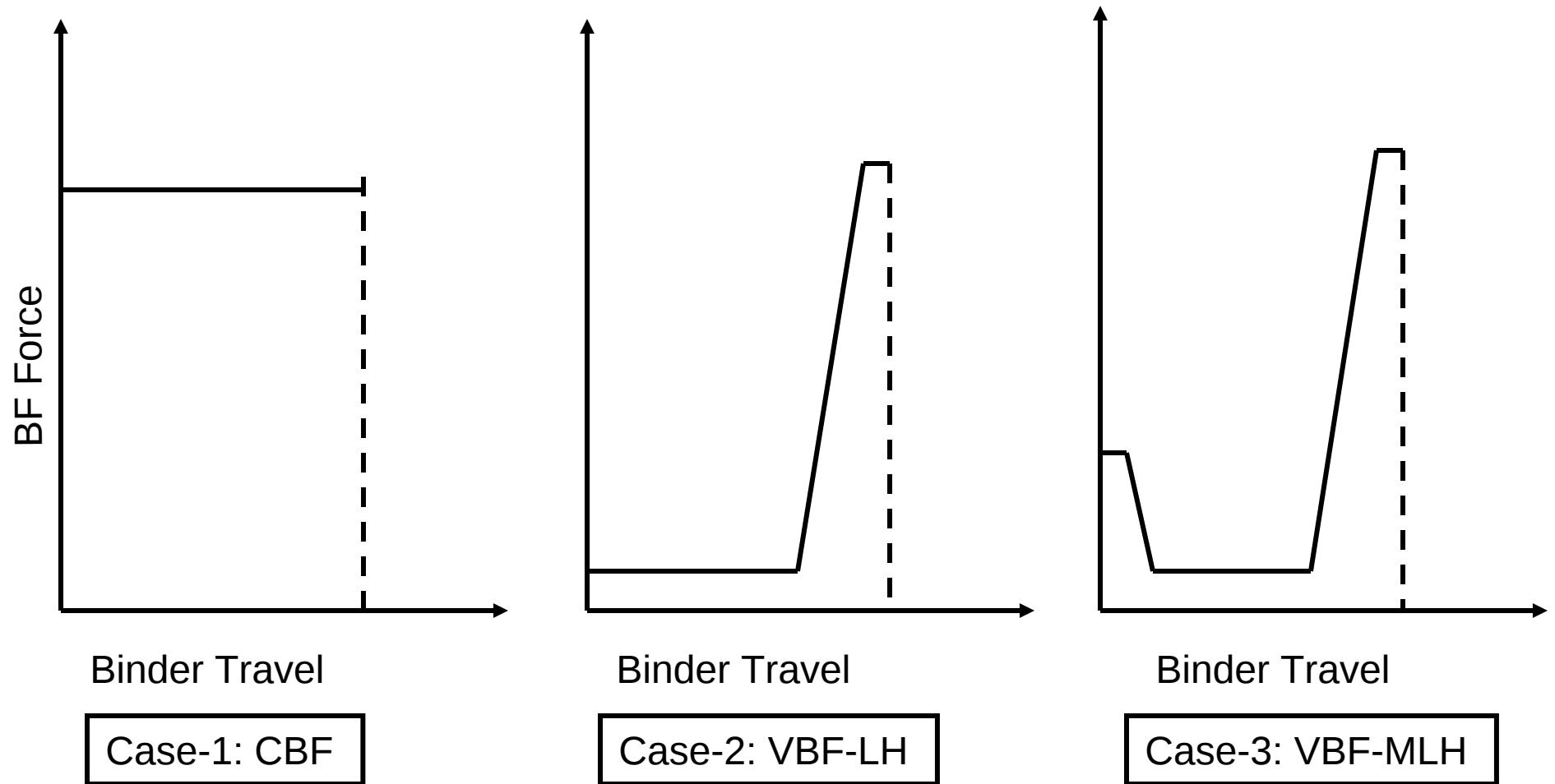
Case-1: CBF



Binder Travel

Case-2: VBF-LH





Constant Binder Force (CBF)



Variable Binder Pressure (M-L-H)



Product and Manufacturing Development

Tooling and Tool Wear Challenges

- Higher Forming Forces
- High Heat Generation During Stamping





Possible Solutions

- Die Materials
- Lubrication
 - Wet Lubes
 - Dry Film Lubes
- Die Treatments



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