Evolving Aluminum Technology for Vehicle Closures and Structures

J.P. McGuire

Global Director – Automotive, Commercial Transportation/Industrial, & Brazing Product Technology

Brian Tucker

Global Director – Automotive and Brazing Marketing

ARCONIC

Innovation, engineered.

Arconic at a Glance

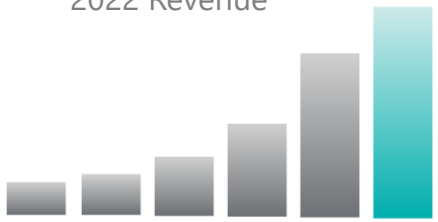
A global leader in aluminum sheet, plate and extrusions, as well as innovative architectural building products

3 Business Segments

- Rolled Products
- Building and Construction Systems
- Extrusions

$9.0B

2022 Revenue



~11.5k

Employees Globally

17

Countries

20

Major Manufacturing Locations*

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*Excludes service centers.

Arconic Products and Solutions Across Key End Markets

Aerospace

Ground Transportation

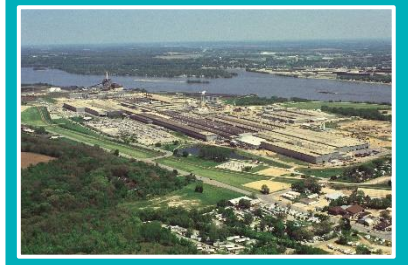
Packaging

Industrial Solutions

Building & Construction Systems

Arconic Portfolio of Assets with Wide Range of Capability for Auto Products

Davenport



- 6.5M sq. ft.
- ~2500 employees
- Premier automotive mill globally
- 220" mill and Very Thick Plate Stretcher enables production of the thickest and widest plate in the aluminum rolling industry - products only Arconic Corp. can manufacture
- A951 pretreatment, 2 continuous heat treat lines

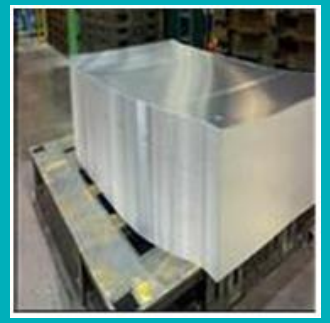
Tennessee

- 3.7M sq. ft.
- ~1100 employees
- Leading automotive sheet producer
- Recent industrial capacity extension enables significant new revenue opportunities
- Highly flexible facility able to produce auto, industrial, and packaging
- Continuous heat treatment line

Lancaster

- 1.4M sq. ft.
- ~950 employees
- North America's premier commercial transportation and industrial product producer
- Automotive non-heat treat
- Industry-leading high strength alloys to support demands on auto thermal management systems (brazing)
- Unique paint line capability

Danville



- 300K sq. ft.
- ~40 employees
- Automotive finishing location
- Continuous heat treat line
- Blanking line
- Automotive blanking operations

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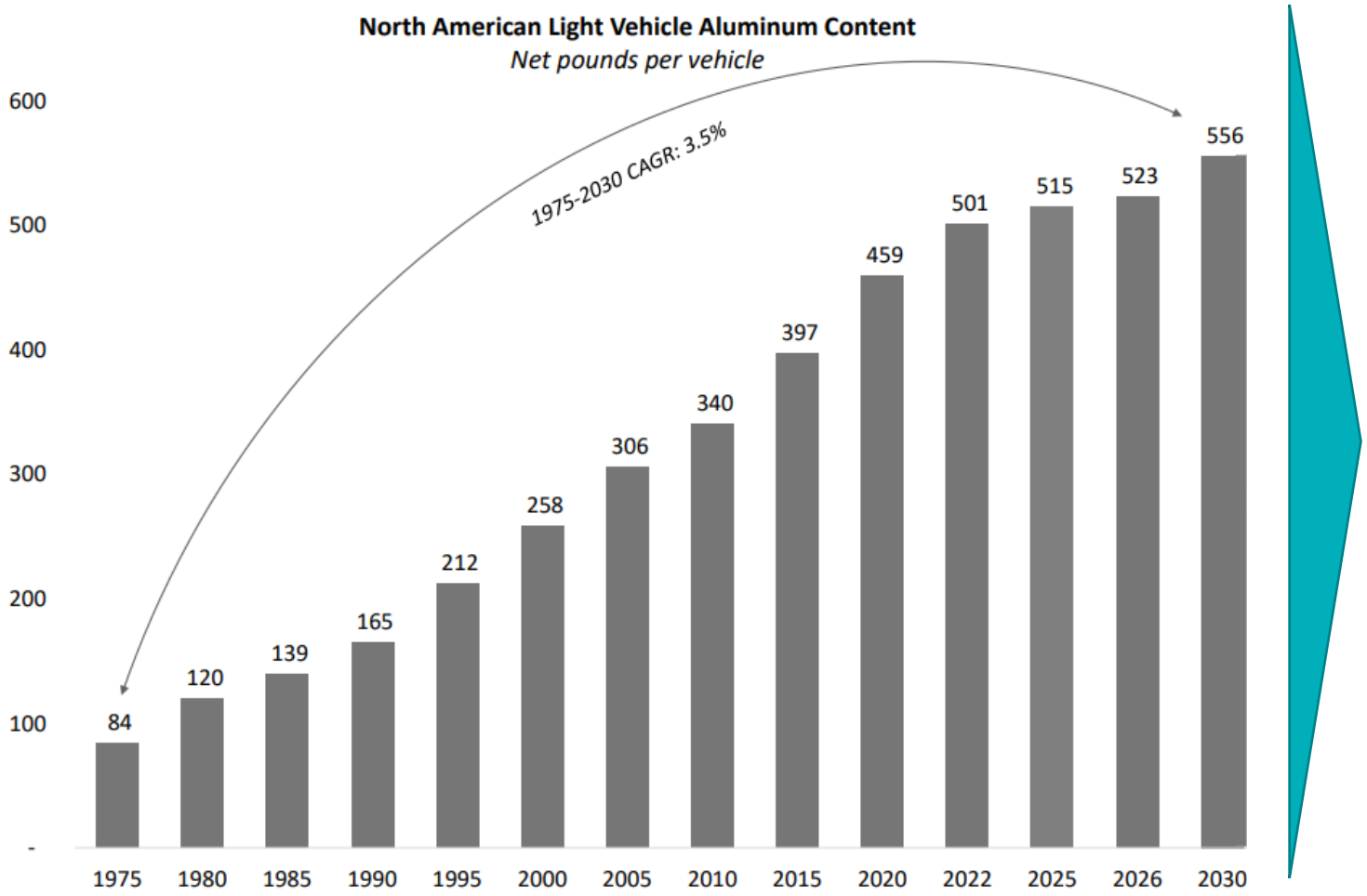
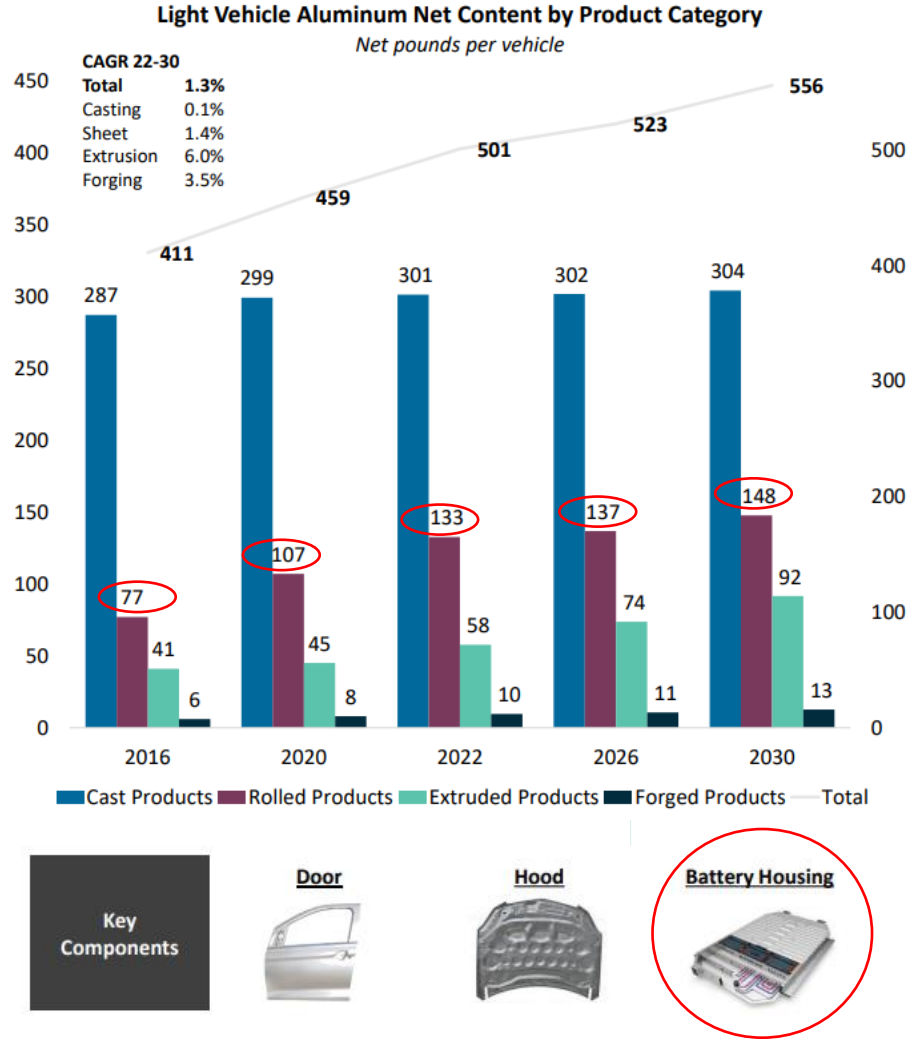
Aluminum forecasted to have 55 years of uninterrupted growth





Source: Light Vehicle Aluminum Content and Outlook Study Ducker 2023

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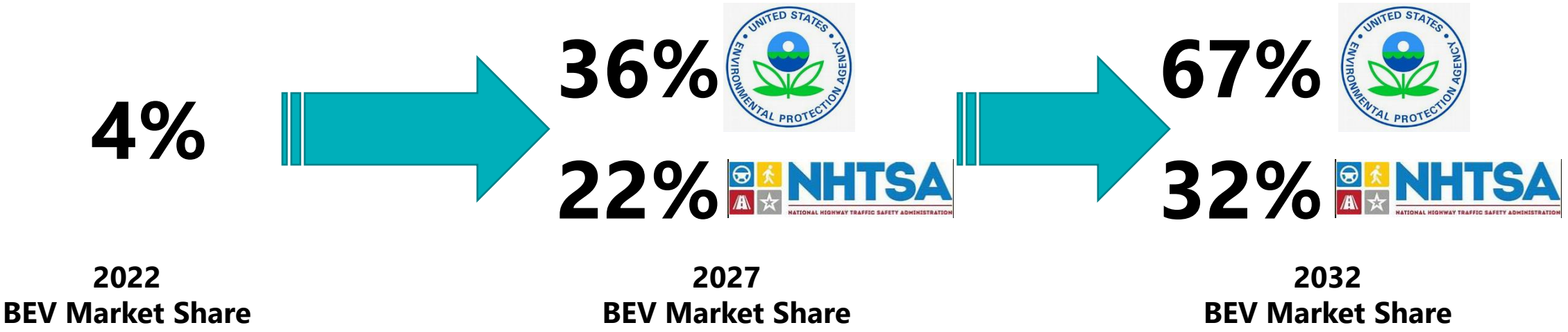
As BEV share grows to lower tailpipe emissions, so does the need for lightweighting

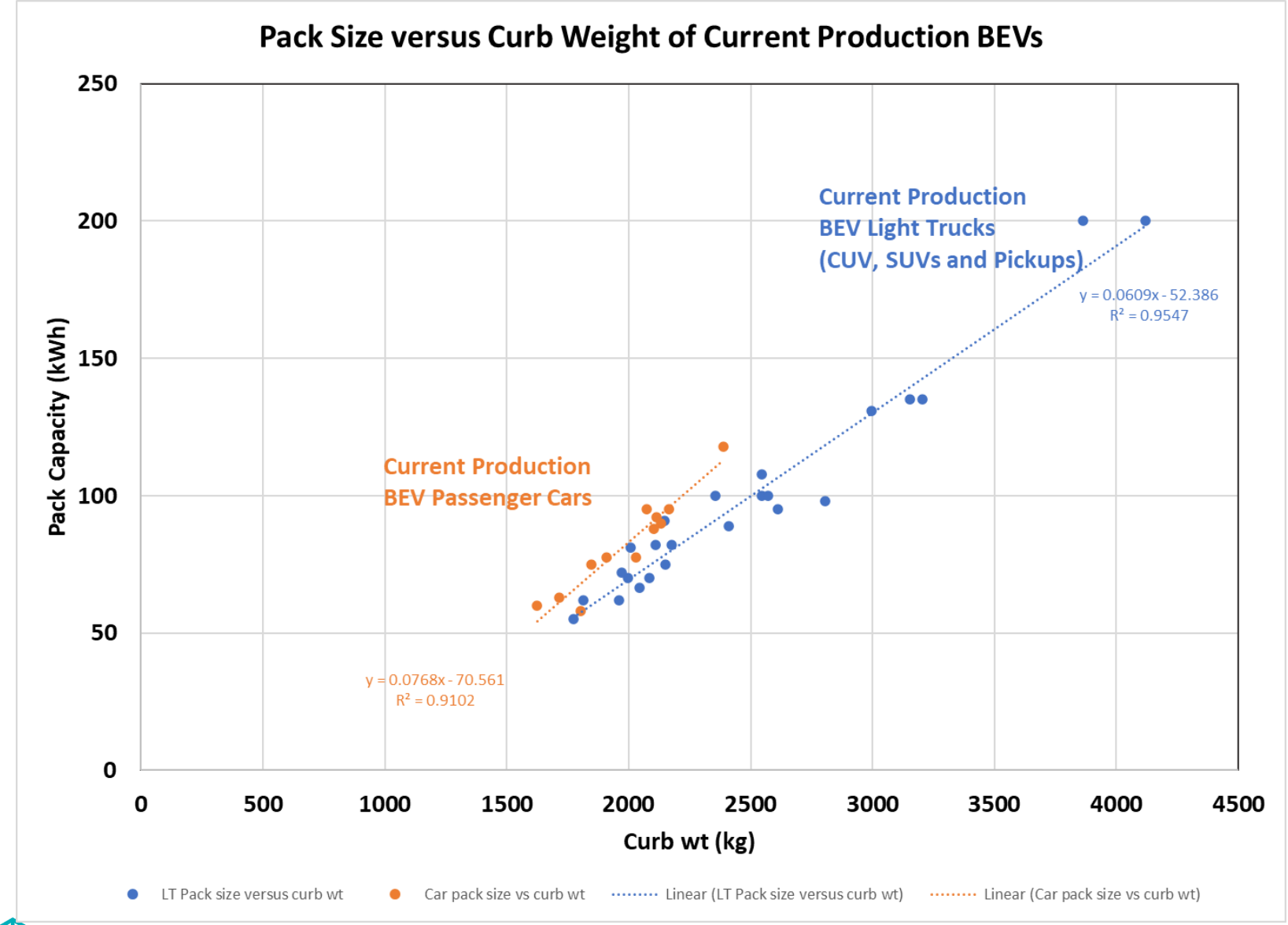
BEV market share of U.S. Automotive Sales



Regardless of forecasted BEV share, ***aluminum lightweighting solutions*** *will be required to provide optimal vehicle range*

Source: Light Vehicle Aluminum Content and Outlook Study Ducker 2023, EPA, NHTSA

BEV Lightweighting Reduces Battery Pack Costs and Can Maintain Similar Range



Example
3800 kg Pickup with 180 kWh battery pack

300 kg weight reduction (Al Closures & BIW) = 162 kWh battery pack

= **162 kWh Battery pack =118 kg less weight**

= **Weight savings = 418 kg**

= **Cost savings possible in all cases of aluminum lightweighting**

= **Additional mass compounding possible**

Arconic's current product development portfolio addresses BEV needs

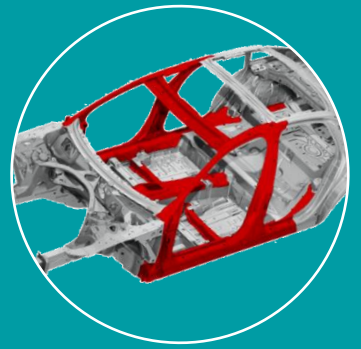
Evolving Alloy Portfolio Well Aligned to BEV Product Needs

Closures

- C4A8
- C1A0
- C3A0
- 5754
- 5182

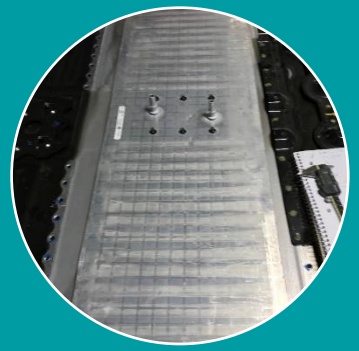
Battery Trays

- C8A2
- C1A0
- 6111
- 6061



Structures

- C7A5
- C8A2
- C7M7
- C3A0
- 6111
- 5754
- Arconic 951™

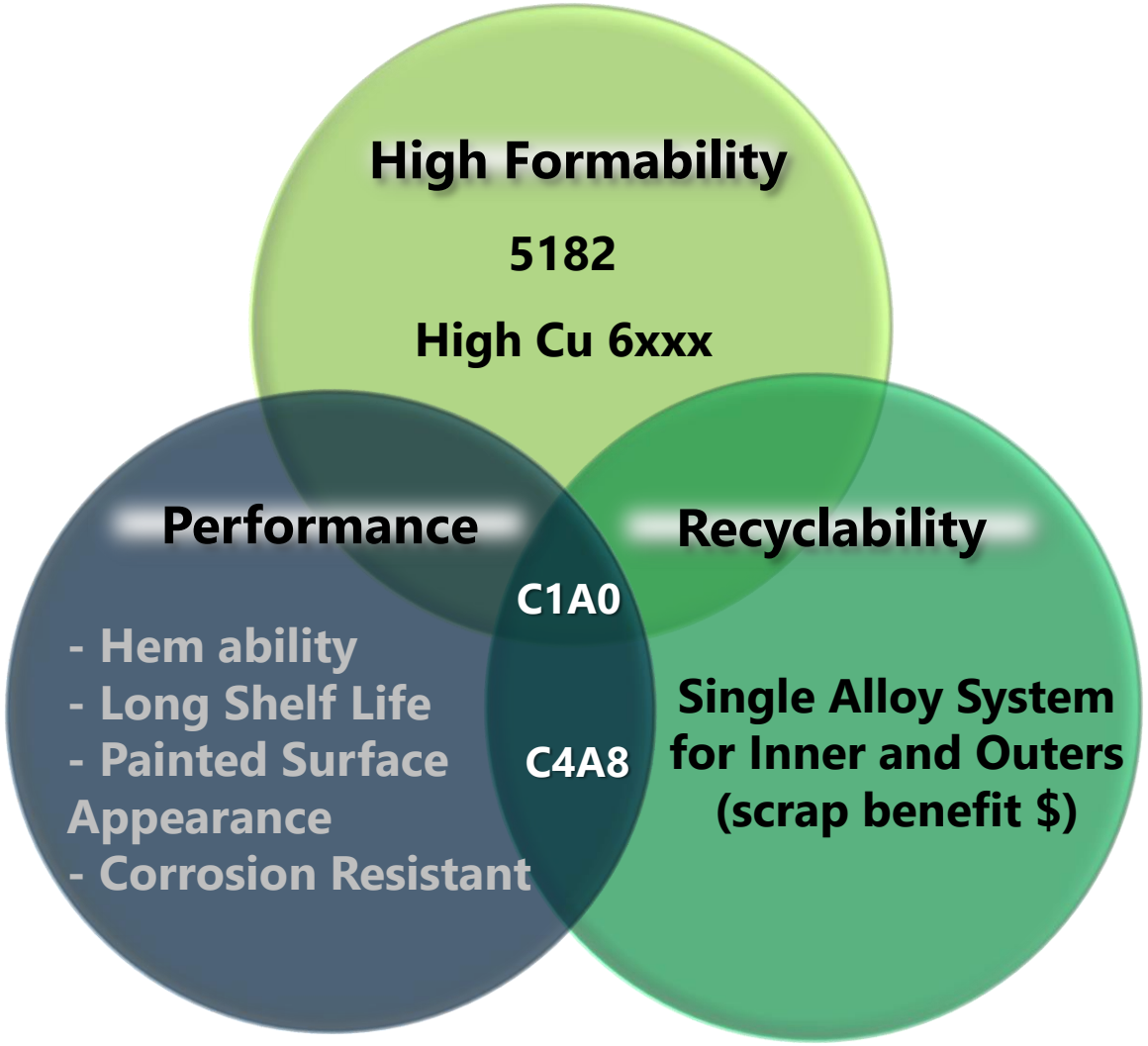


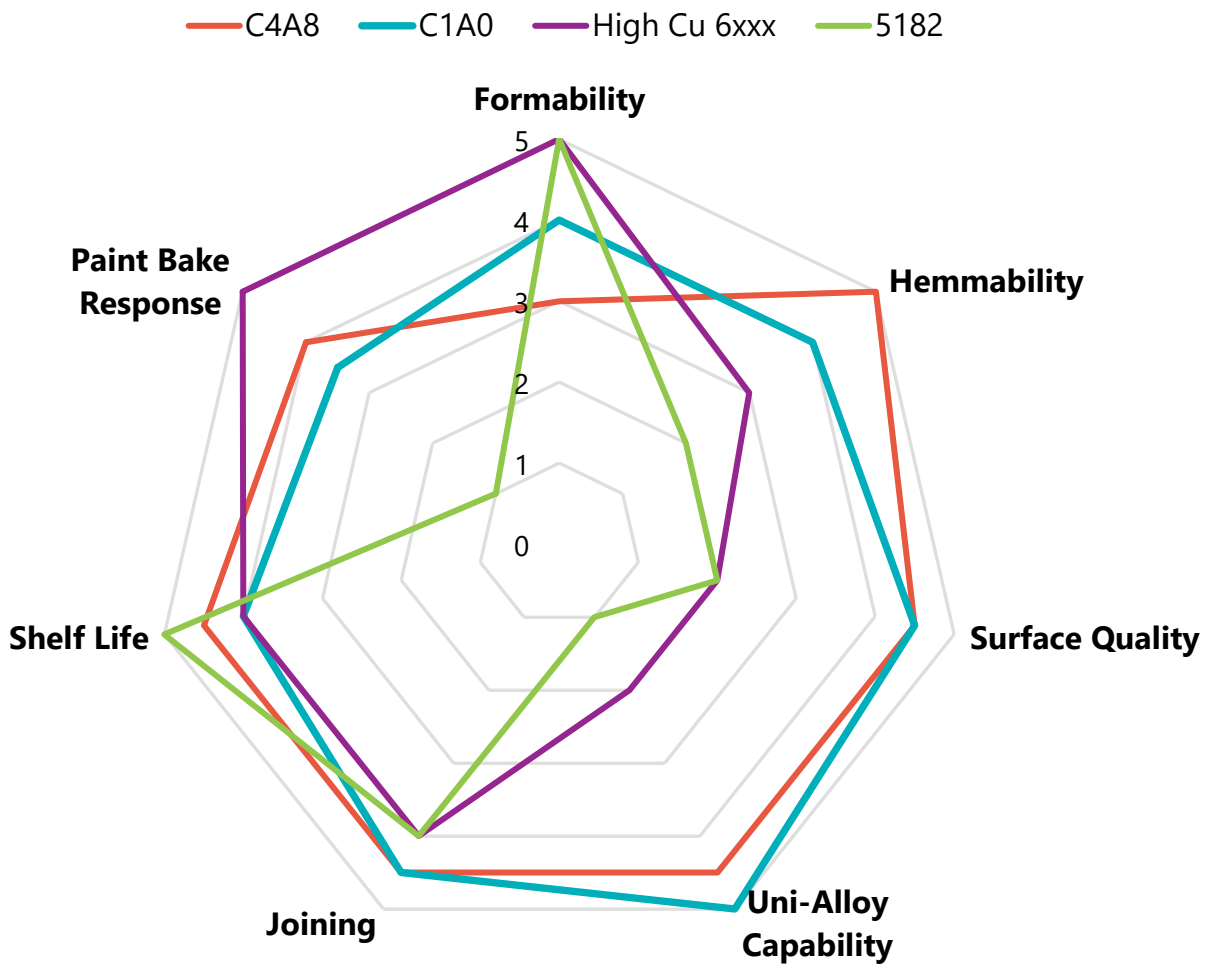
Battery Thermal Management

- C663J (New 6xxx core composite)
- High strength 3xxx core composites
- Flux free composites (Tunable to customer needs)

C1A0 & C4A8 enables uni-alloy solution for optimal systems recycling

From Design to End of Vehicle Life Offers Most Efficient Recycling and Product Performance





New High Form C1A0 enables styling and up to 50% weight savings

High Form C1A0 compared to CR5 Steel

Reference. High Form 6000 trial in production die designed for IF steel.

- **+50% weight savings going from steel to aluminum**
- **30 Lbs. saved per vehicle on this BSA example**

Steel vs. High Form 6000 Aluminum Design

	IF CR5 Steel	C1A0 Aluminum
Thickness (mm)	0.60	0.90
Density	7.85	2.83
Final Yield Strength (MPa)	~170 (2% pre stretch)	~175 (0% pre stretch at 185 C) ~215 (2% pre stretch 185 C)
Weight Savings Potential	Base	~50%

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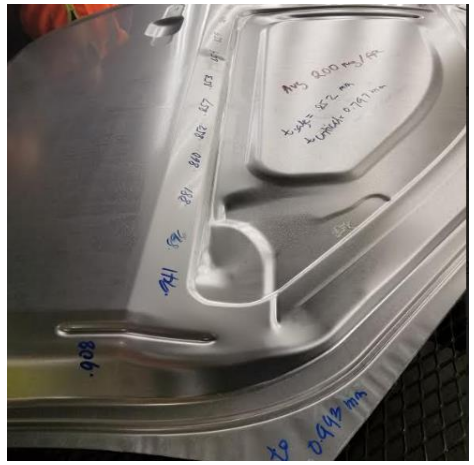
C1A0 High Form 6000 Offers Improved Local Formability for Exterior/Interior Closures

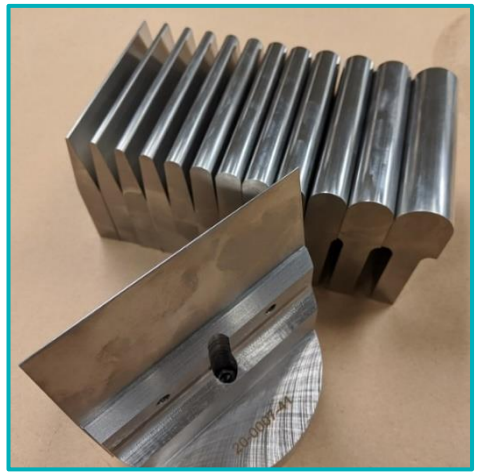
From Design to End of Vehicle Life Offers Most Efficient Recycling and Product Performance



C1A0 door press trials met tighter radii requirements

jeep.com/wagoneer

Rivian.com/R1T

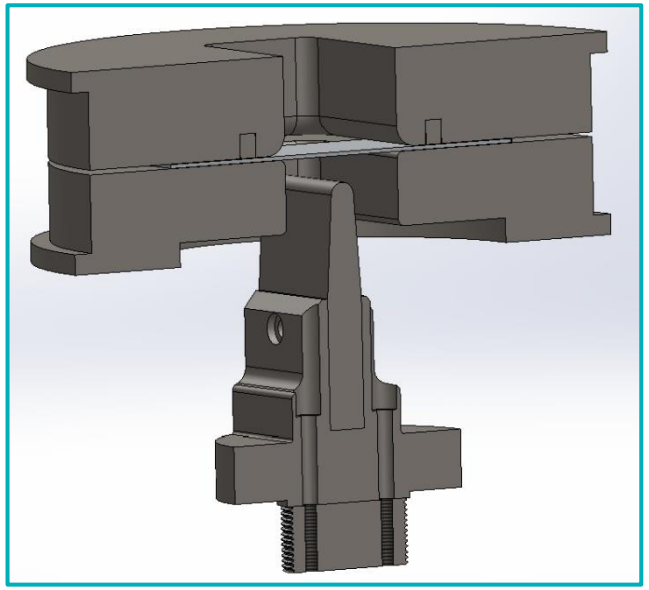


C1A0 best performer in stretch bend testing

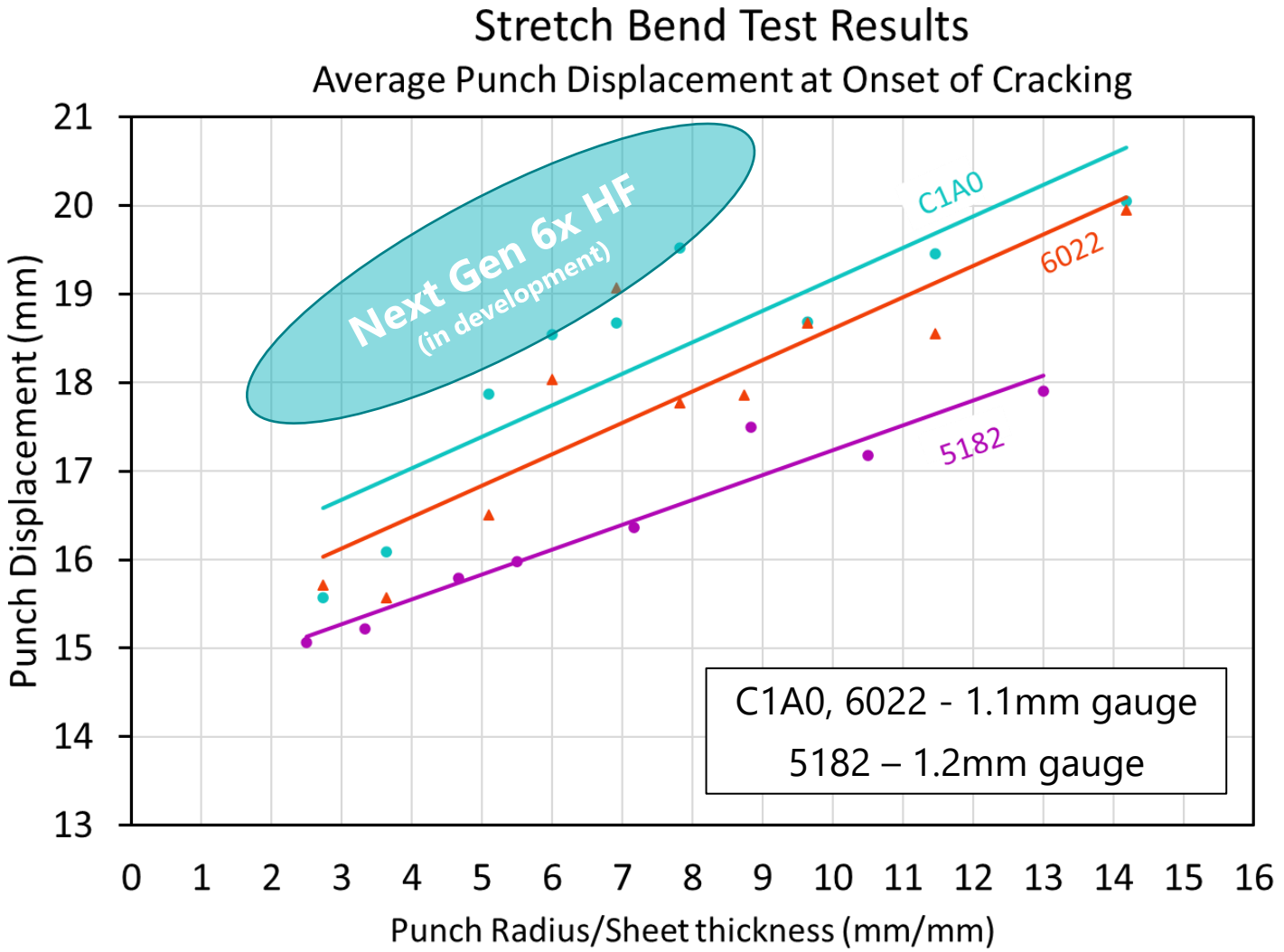
Rivian.com/R1S

C1A0 exhibits improved stretch bend capability over 6022 & 5182

C1A0 displacement was about 0.5mm to 1mm greater than that of C4A8 and 1.5mm to 2mm greater than that of 5182

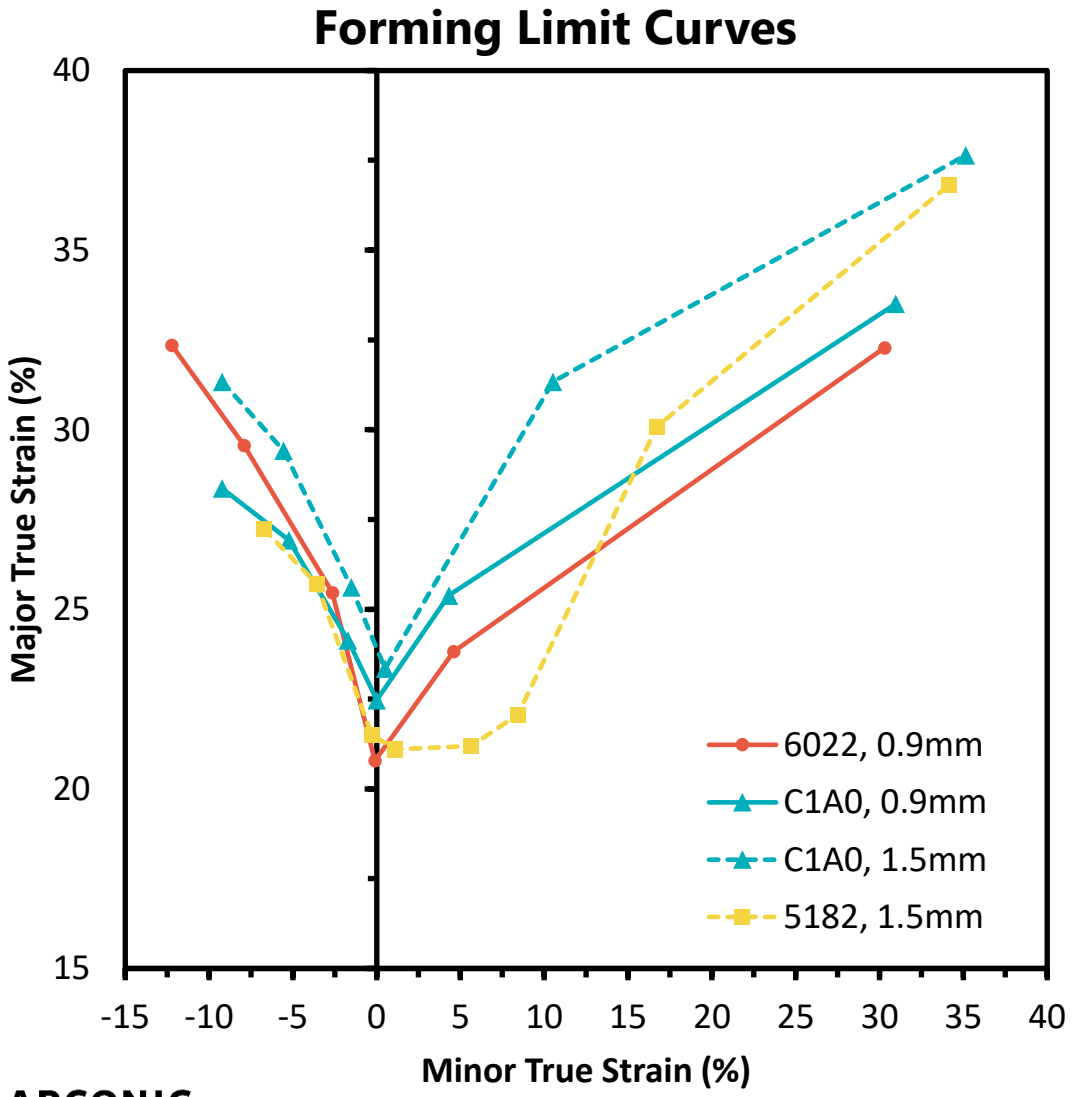


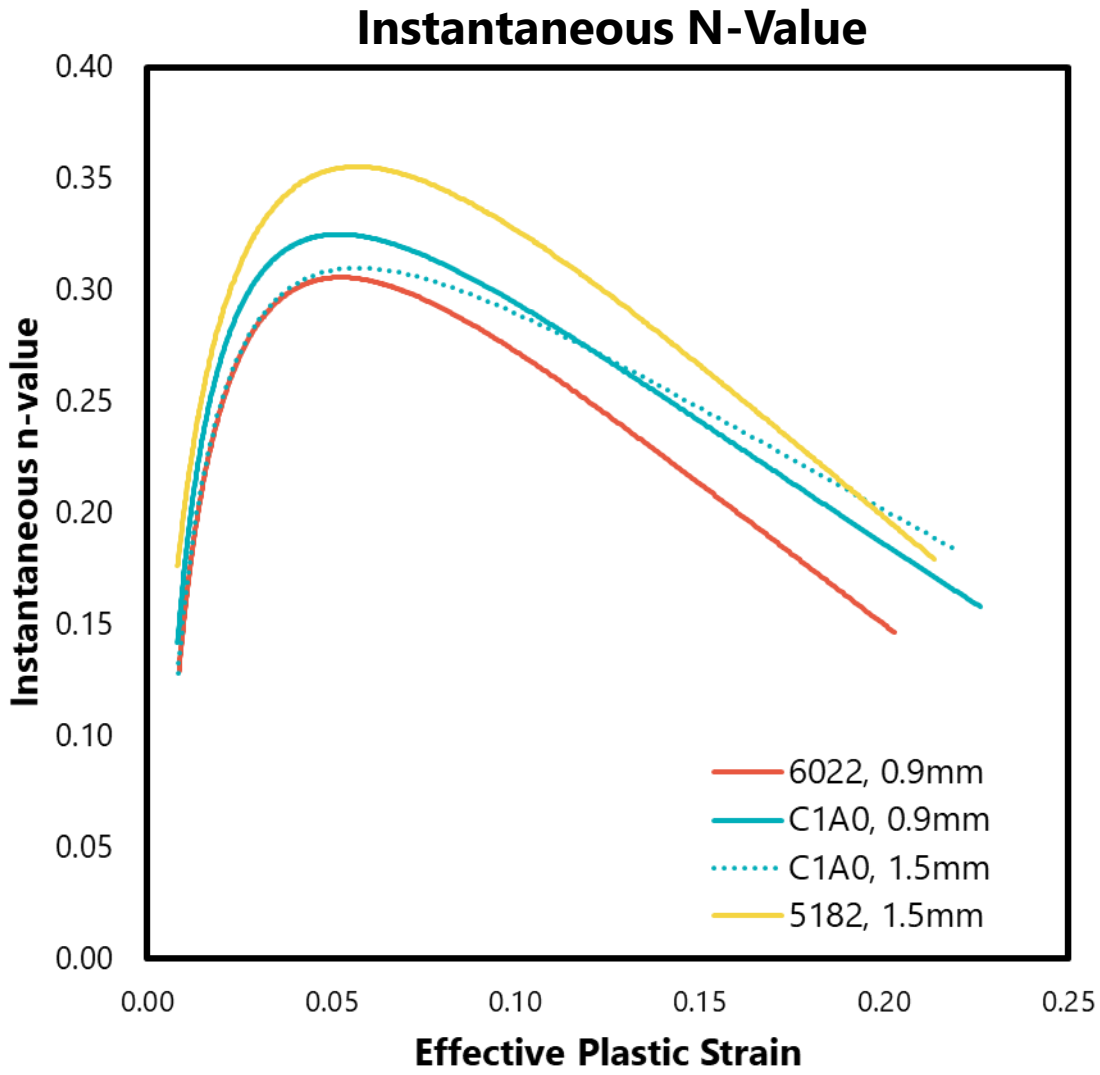
Assembly - Stretch Bend Apparatus



C1A0 exhibits improved FLD_o for inner and outer applications

Comparison of L-Direction Forming Limits and Instantaneous N-Value at 1mo Natural Age





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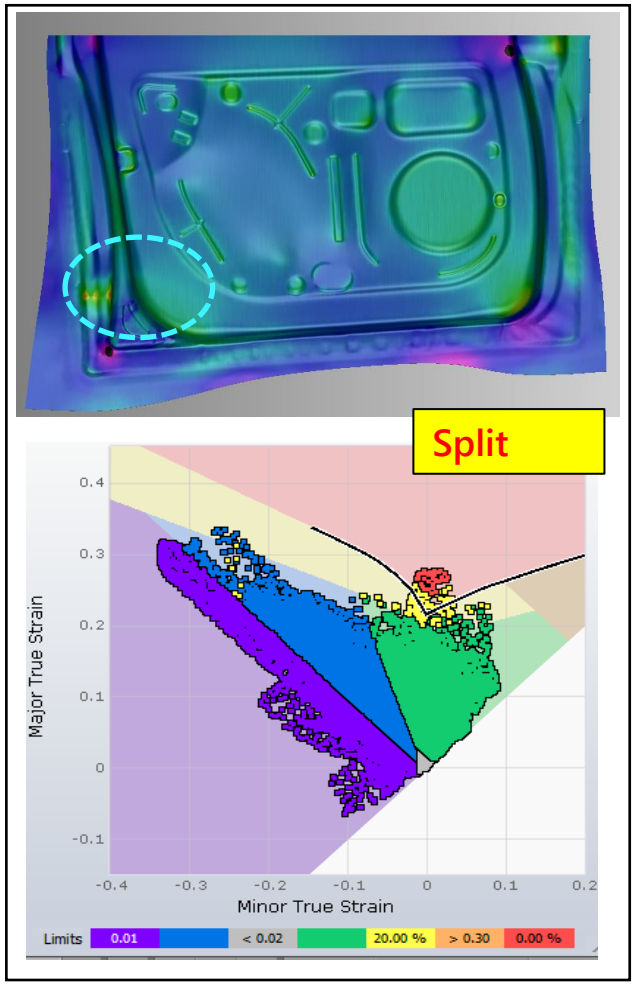
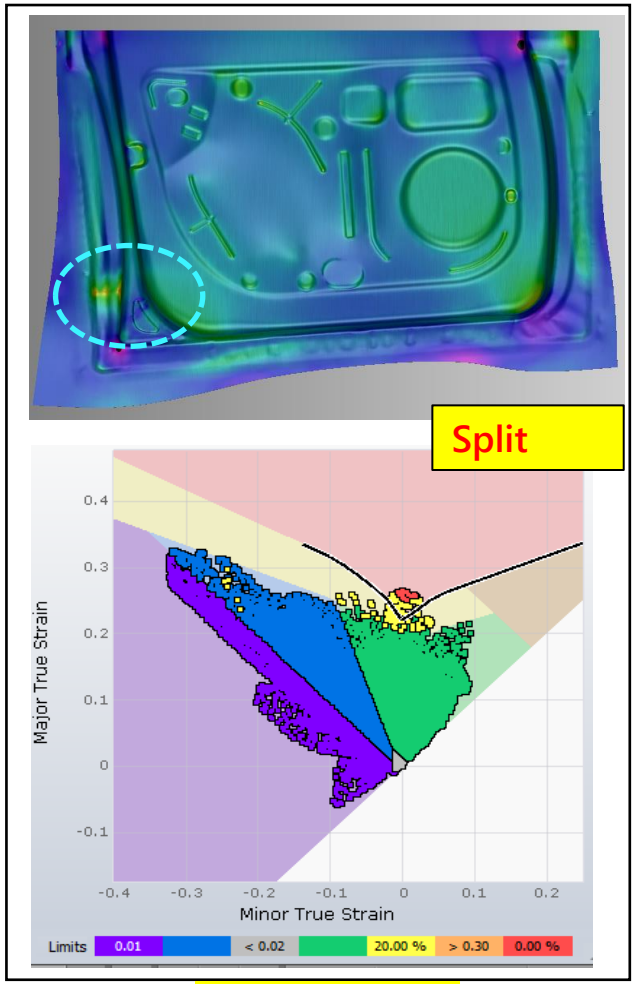
Arconic Next Gen 6000 Formability Improvement Model Correlation

6022



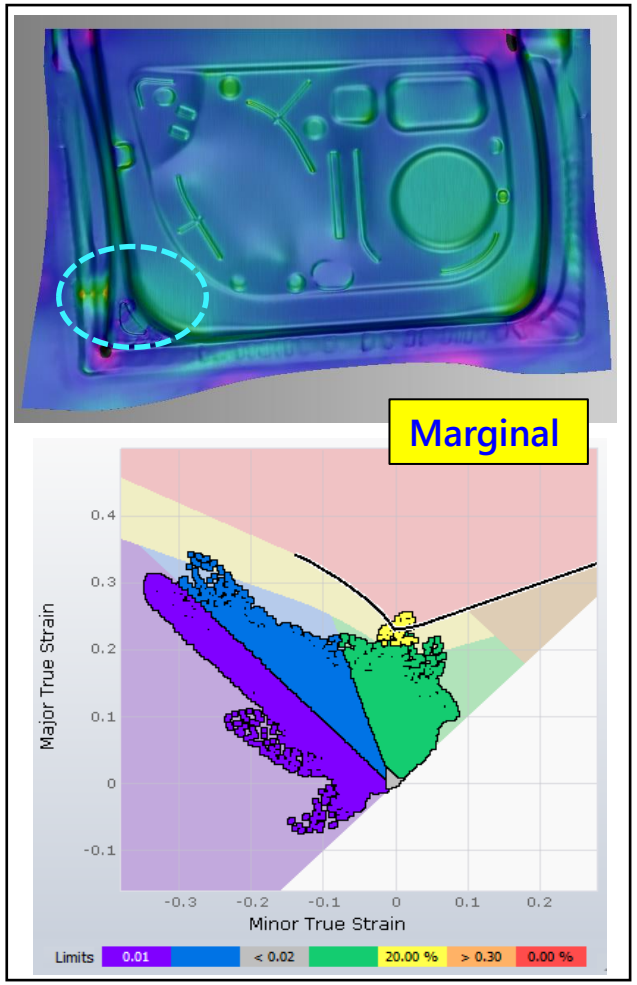
$FLD_0 = 0.215$

C4A8



$FLD_0 = 0.219$

C1A0

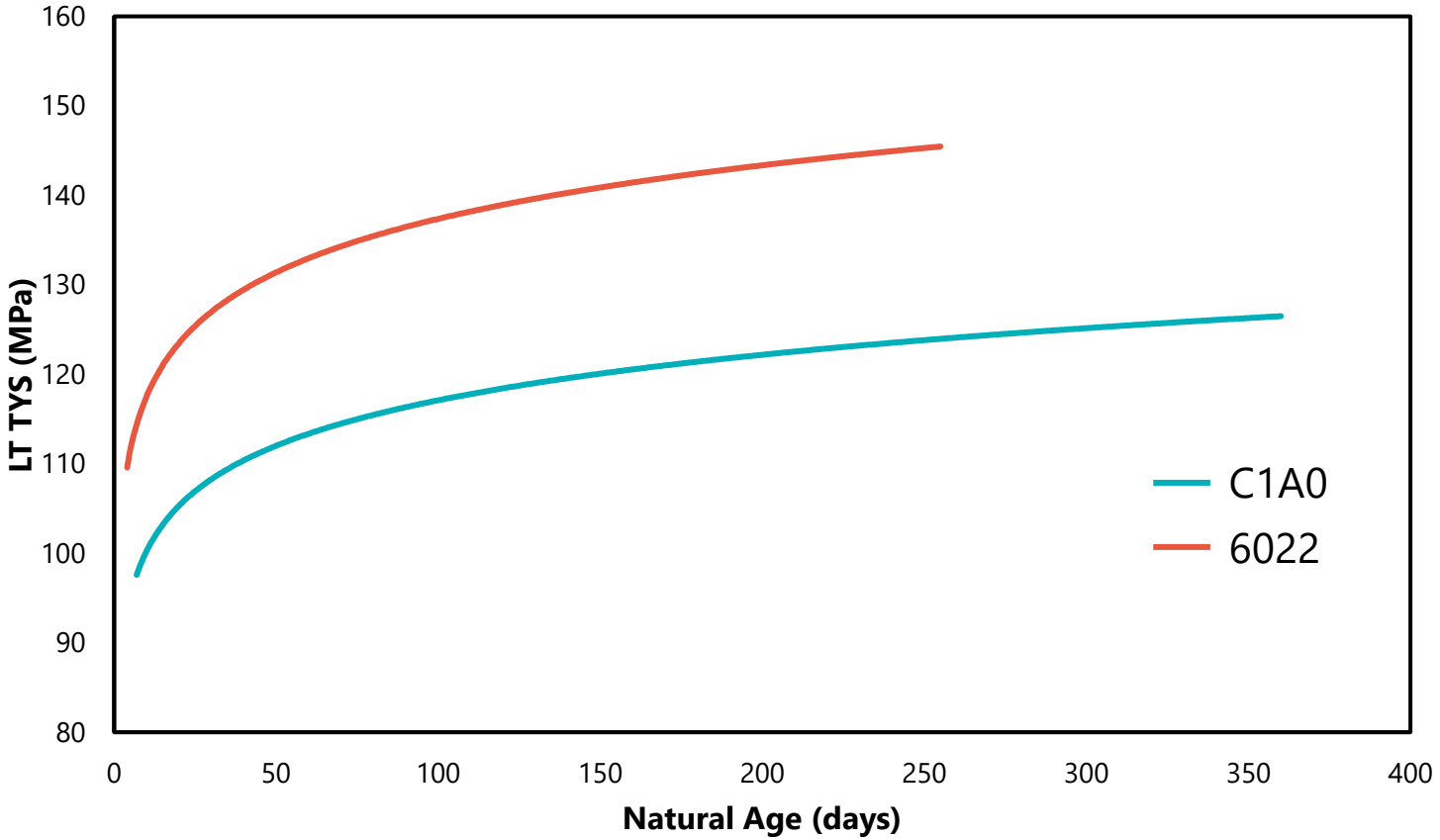


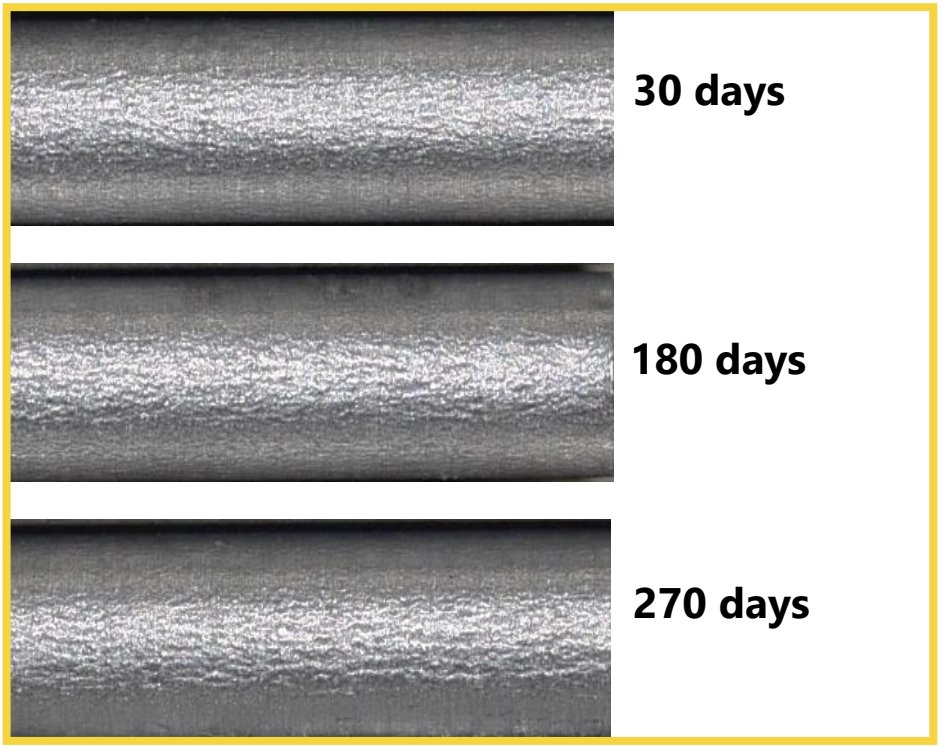
$FLD_0 = 0.229$

Thinning Strains/FLC @ bottom/end of the stroke

C1A0 exhibits low TYS, good hemming at extended natural ages

Extended Natural Age Properties of C1A0 – LT TYS and L-Hemming





Source: Arconic Technical Center Test Data

Battery Electric Vehicles will assume significant market share in the near future

Impact of Electrification on Heat Exchanger Content

Key:

Existing – Still Required

New content

- Electrification will increase the heat exchanger content

EV HVAC

EVs starting to adopt heat pump systems which require similar content.

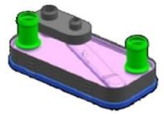
Liquid Cooled Condenser

Heater Core

Evaporator

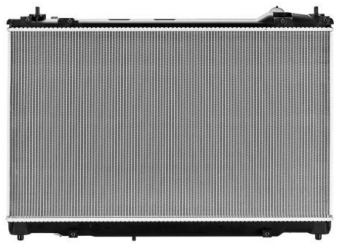
Condenser

EV Battery Cooling

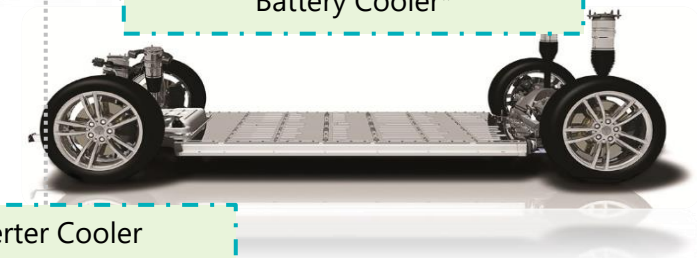


Chiller

Low Temperature Radiator

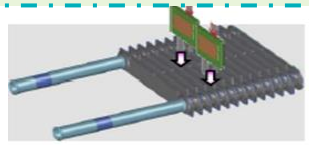


Battery Cooler*



Oil Cooler

Inverter Cooler



Battery technology use will drive need for plate style vs. immersion cooling

EV Powertrain

Source: Google shareable images

High strength aluminum sheet for BIW structures will be needed to protect batteries

BEV Structures More Demanding Than ICE

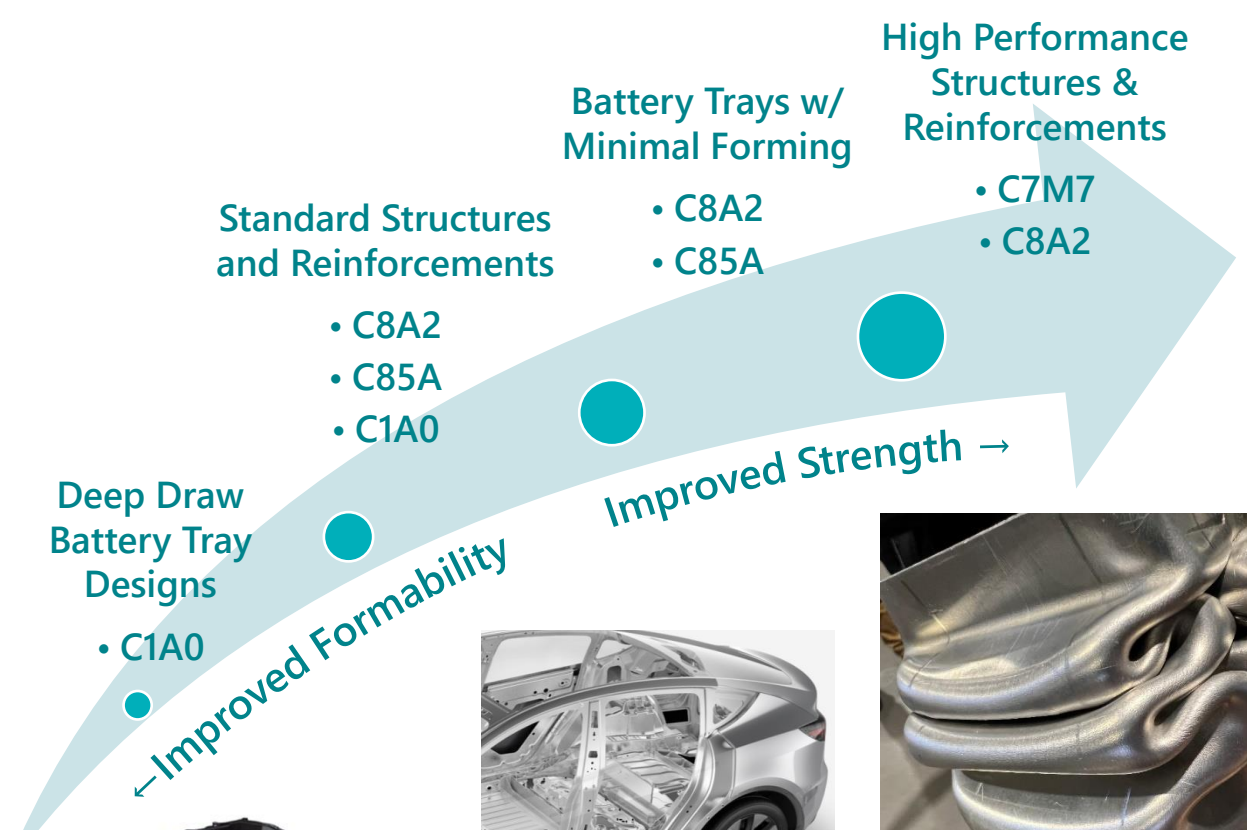
- Front rails of a BEV have to absorb 30-40% more energy than ICE version because of added weight and less intrusion allowed past dash panel
- Side impact intrusion cannot contact battery cells. Side impact energy must be absorbed in ~ 200 mm which is less than allowable intrusion in an ICE vehicle
- Higher strength materials needed

3 Point Bend Test **(High Strength 7000)**

Arconic C7M7-T7x
TYS = 473 MPa

Arconic offerings provide versatile options for battery tray and structural applications

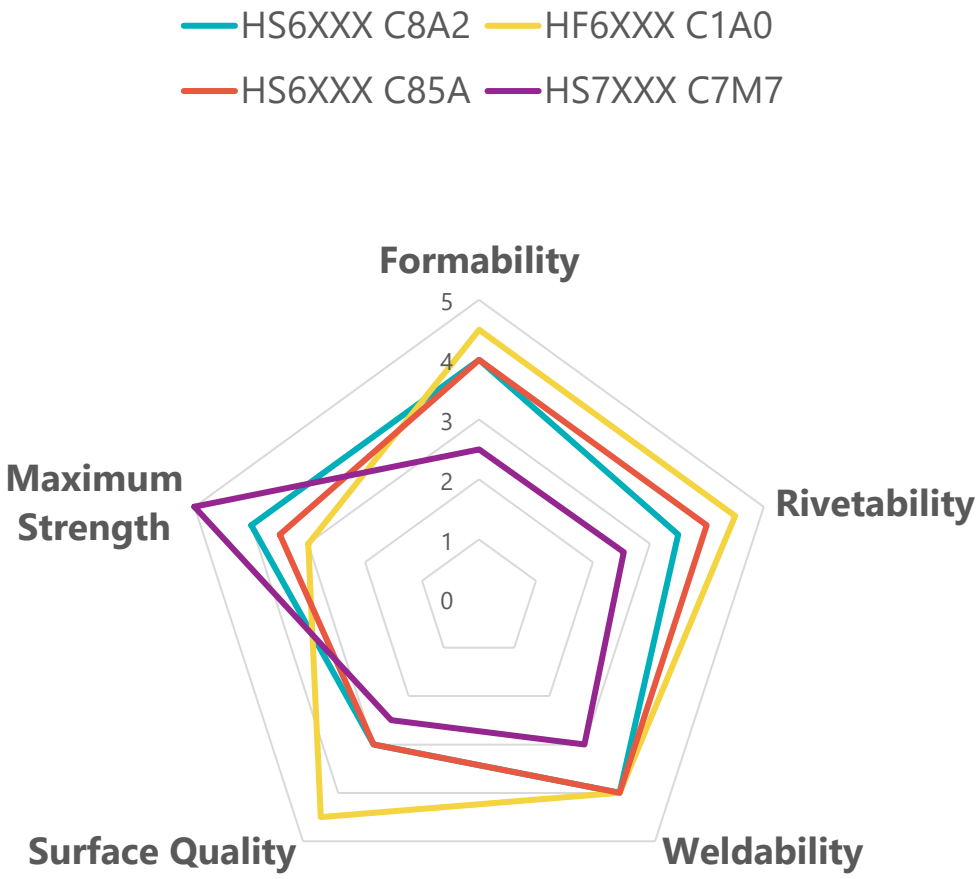
Product Comparison: HF6XXX C1A0, HS6XXX C85A, HS6XXX C8A2, HS7XXX C7M7



www.tesla.com/modely

C8A2-T82

333 MPa TYS, 2.5 mm



*C7M7 typically requires warm forming or hot forming

Aluminum Value Chain

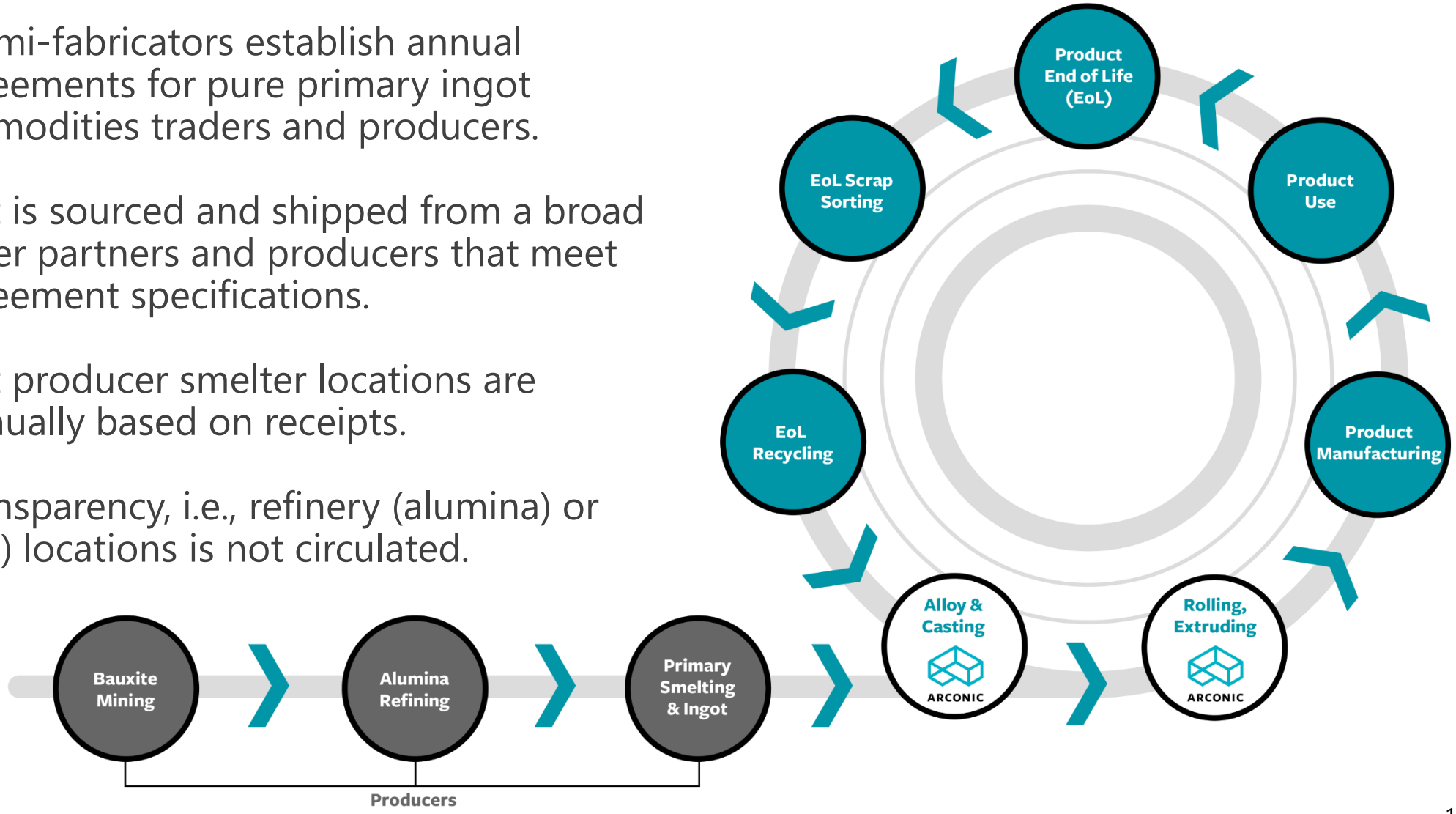
Purchasing and Transparency

Aluminum semi-fabricators establish annual purchase agreements for pure primary ingot through commodities traders and producers.

Primary ingot is sourced and shipped from a broad range of trader partners and producers that meet purchase agreement specifications.

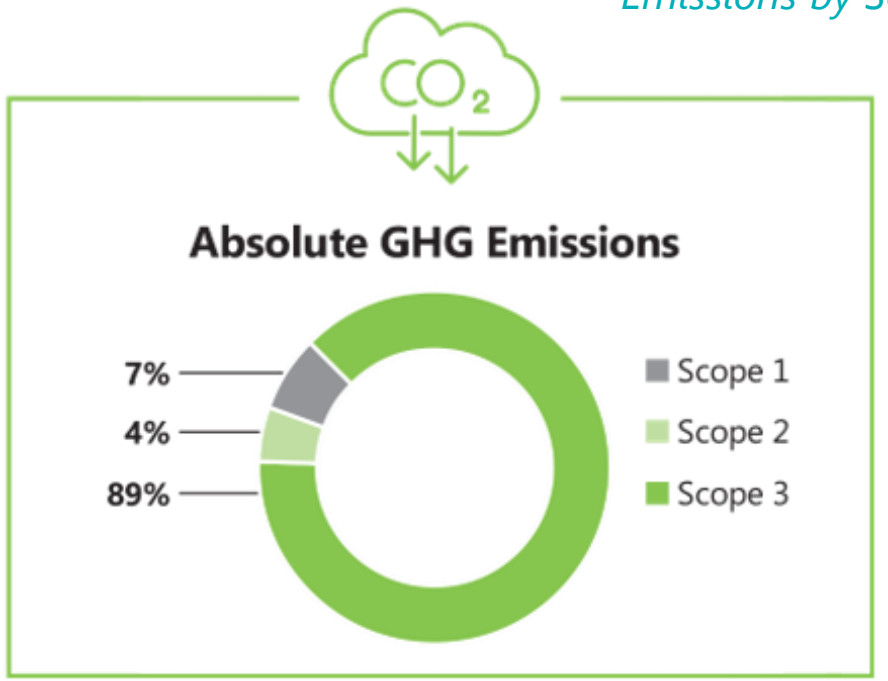
Primary ingot producer smelter locations are identified annually based on receipts.

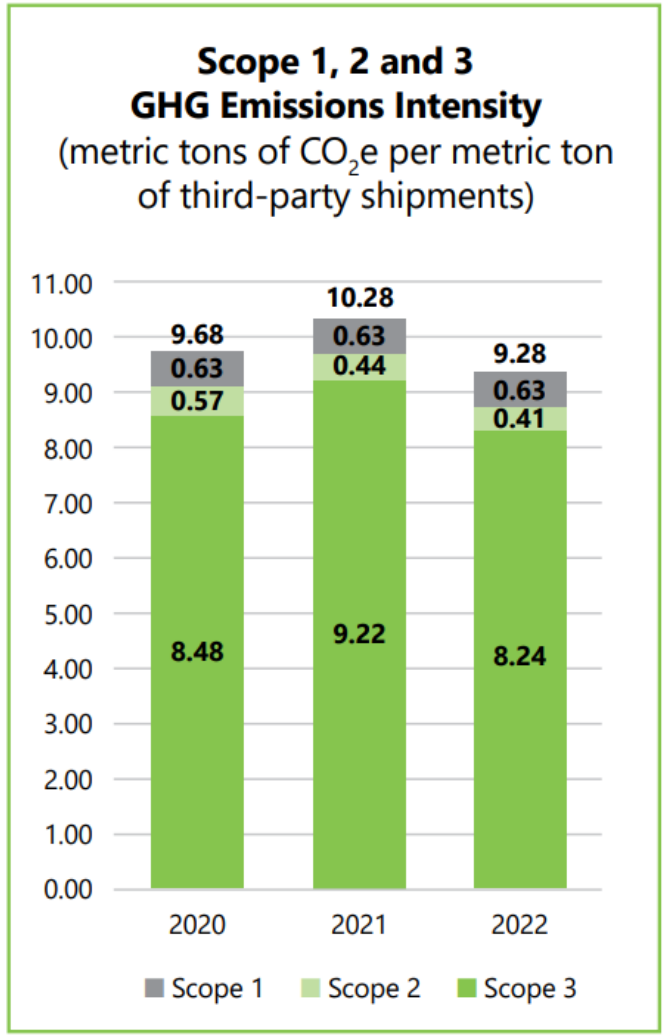
Upstream transparency, i.e., refinery (alumina) or mine (bauxite) locations is not circulated.



Current Status: Greenhouse Gas Emissions

Emissions by Scope





- The largest portion of our absolute emissions portfolio is Scope 3
- Purchased Goods - prime, scrap, alloying materials - are largest portion of our Scope 3 emissions intensity (79% of our carbon footprint)
- Sourcing low carbon prime and increasing recycled content will have the greatest reduction impact

C3A0 for 6xxx structures and reinforcements: Potential for high systems recyclability

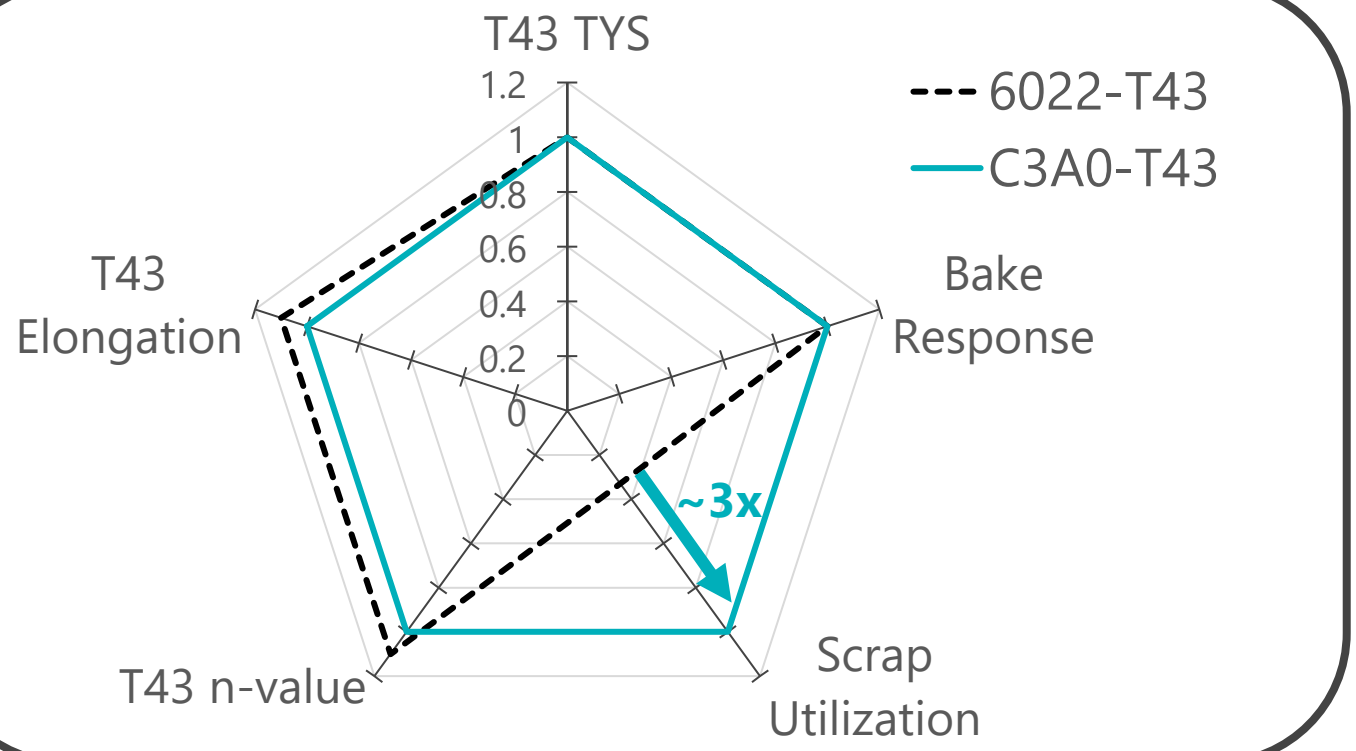
Arconic C3A0 alloy – 2023 International Automotive Body Conference

Designed to accommodate higher levels of Fe and Mn versus conventional low-Cu 6xxx

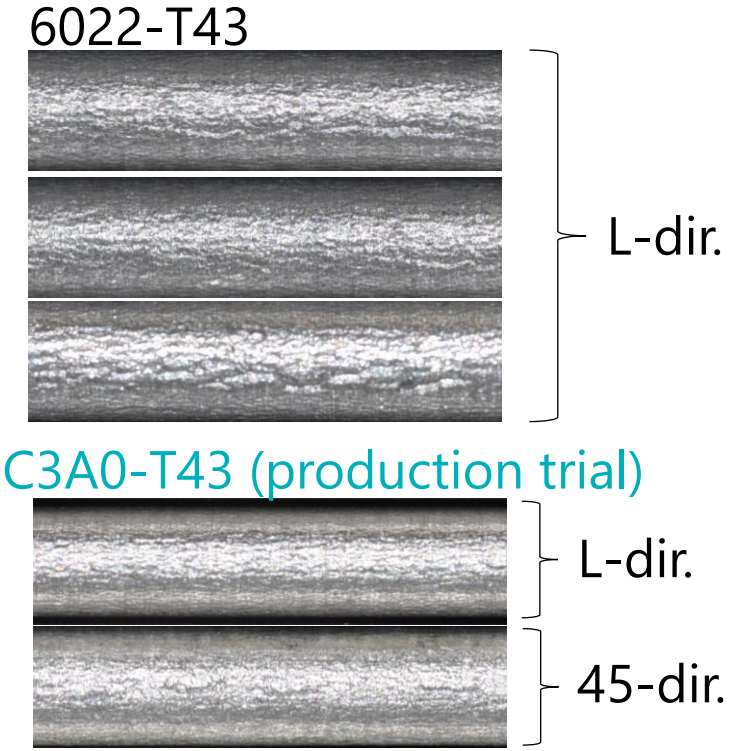
- *Up to 3x external scrap utilization* versus 6022-T43, depending on scrap source

TYE performance, paint bake response, and bend characteristics are comparable to 6022-T43

C3A0-T43 vs. 6022-T43 – relative performance



Flat Hem (4 months + 7% pre-stretch)



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