Examining The Latest Advancements In The Use Of Aluminum Extrusion In Lightweighting

Examining The Latest Advancements In The Use Of Aluminum Extrusion In Lightweighting

ALMAG Aluminum
SMARTER · BETTER · FASTER

Rob Nelson
Director of Sales, US
rob.nelson@almag.com
www.almag.com

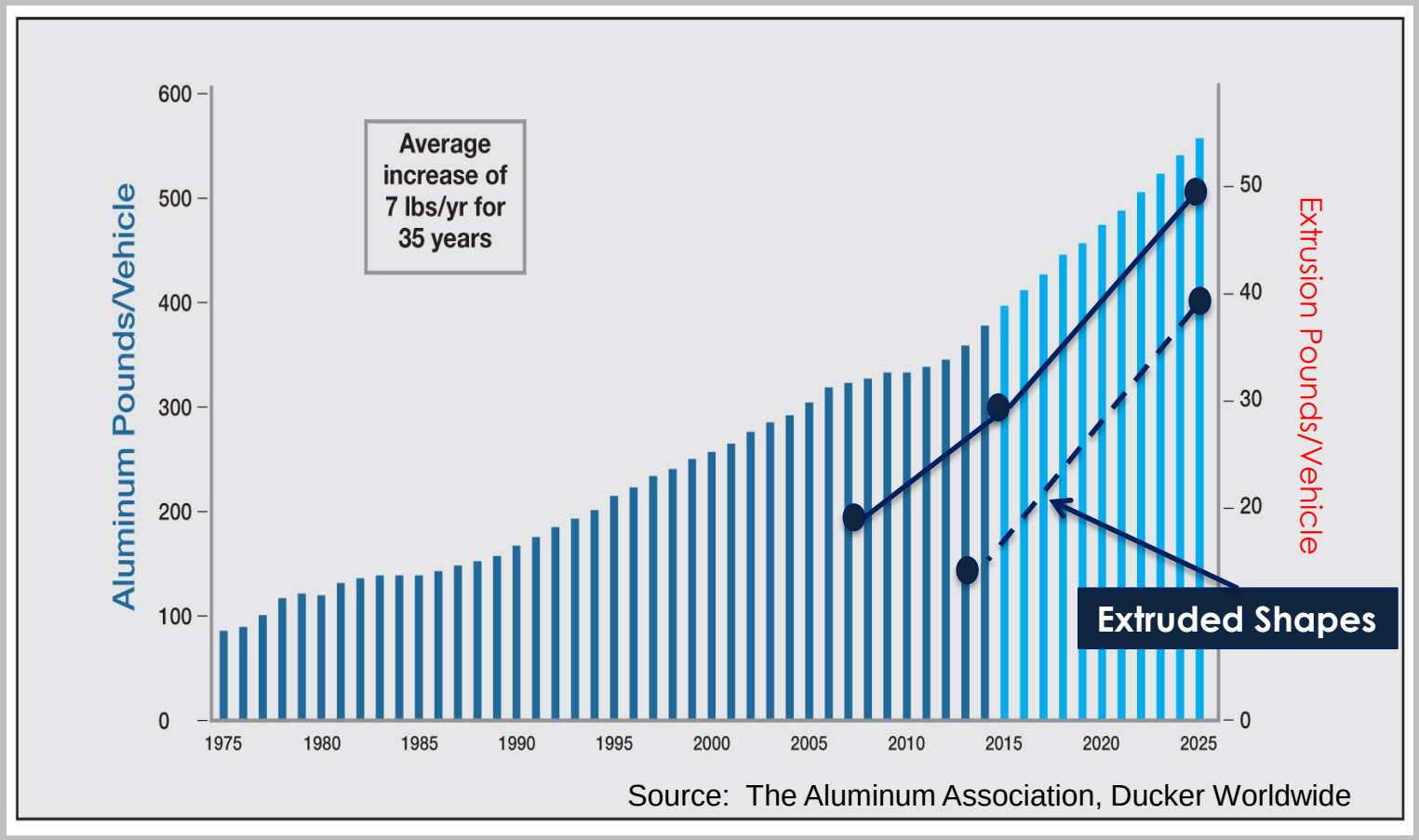
TABER
BROADEST CAPABILITIES IN THE ALUMINUM INDUSTRY

Joe Gibson
Vice President, Business Development
jgibson@taberextrusions.com
www.taberextrusions.com

AEC ALUMINUM EXTRUDERS COUNCIL

INTRODUCTION

While Aluminum has had a long steady increase in auto usage, extrusion – particularly extruded shapes – is only recently gaining momentum



ALUMINUM EXTRUDERS COUNCIL

INTRODUCTION

Structural applications are expected to drive Extrusion use

Aluminum Extrusion Pounds per Vehicle

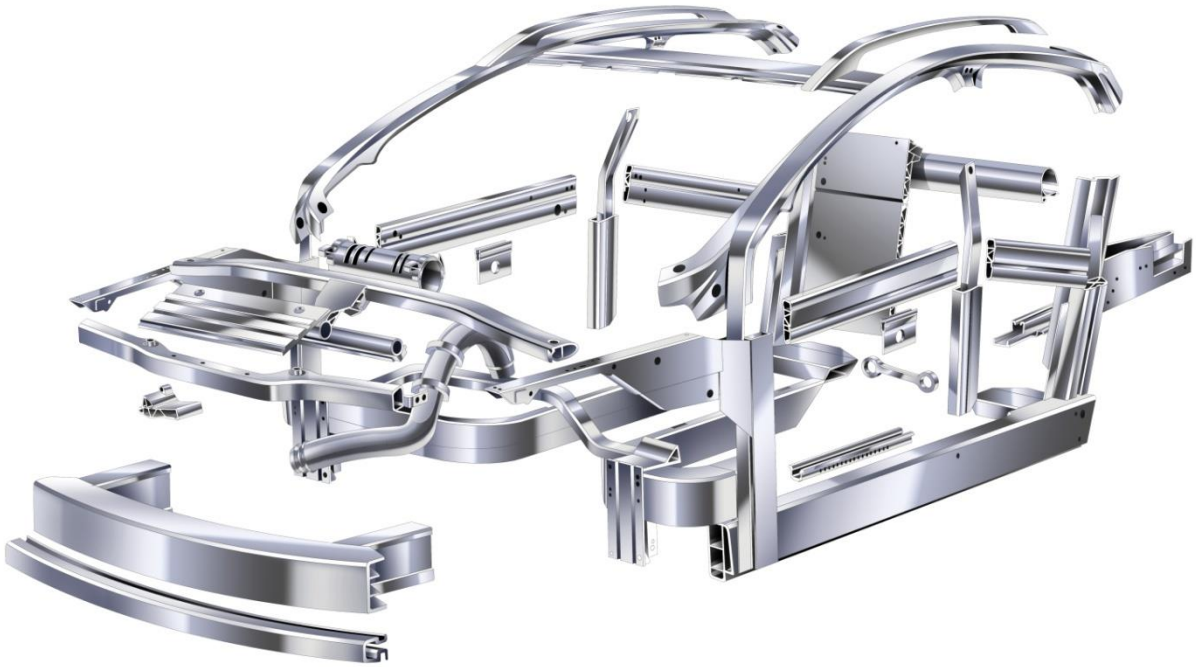
Type	Example	2012	2017	2025	Incr. in #/yr*	%
Shapes	Interiors, Seats, Trim, Sunroof, Others	1	1.2	2	15mm	67%
Shapes	Exterior	3	3.2	4	15mm	25%
Shapes	Bumpers	4	5.5	6	9mm	9%
Shapes	Body Structures	1	4	17	**234mm**	**325%**
Shapes	Steering & Brakes	3	3	4	18mm	33%
Tube	Drive Shafts	1	1	1		
Rod & Bar	Transmission	4.5	4.5	4.5		
Shapes	Mounts	1.5	2	2.5	9mm	25%
Tube	Heat Exchangers	5.3	5.3	5.5		
Shapes	Suspension / Links / Chassis	1	2	3	18mm	50%
Total		25.3	31.7	49.5	318mm	

Source: Ducker Worldwide

INTRODUCTION

Engineers are increasingly familiar with the key extrusion design variables

1. **Alloy selection and modification**
2. **Geometry, or Profile Shape**
3. **Tolerances**
4. **Fabrication/Joining**



ABOUT ALMAG

Since 1953, ALMAG has built a reputation as an industry leader in extruding complex, thin-walled, high-visual, custom aluminum extrusions.

Pushing the limits of industry standards, ALMAG provides 4 pillars of service; **DESIGN, EXTRUDE, FABRICATE** and **FINISH.**

PRIMARY INDUSTRIES – Automotive, Healthcare, Lighting and Office Furniture.

ISO 9001 – 2008 Certified

CANADA'S BEST MANAGED COMPANIES

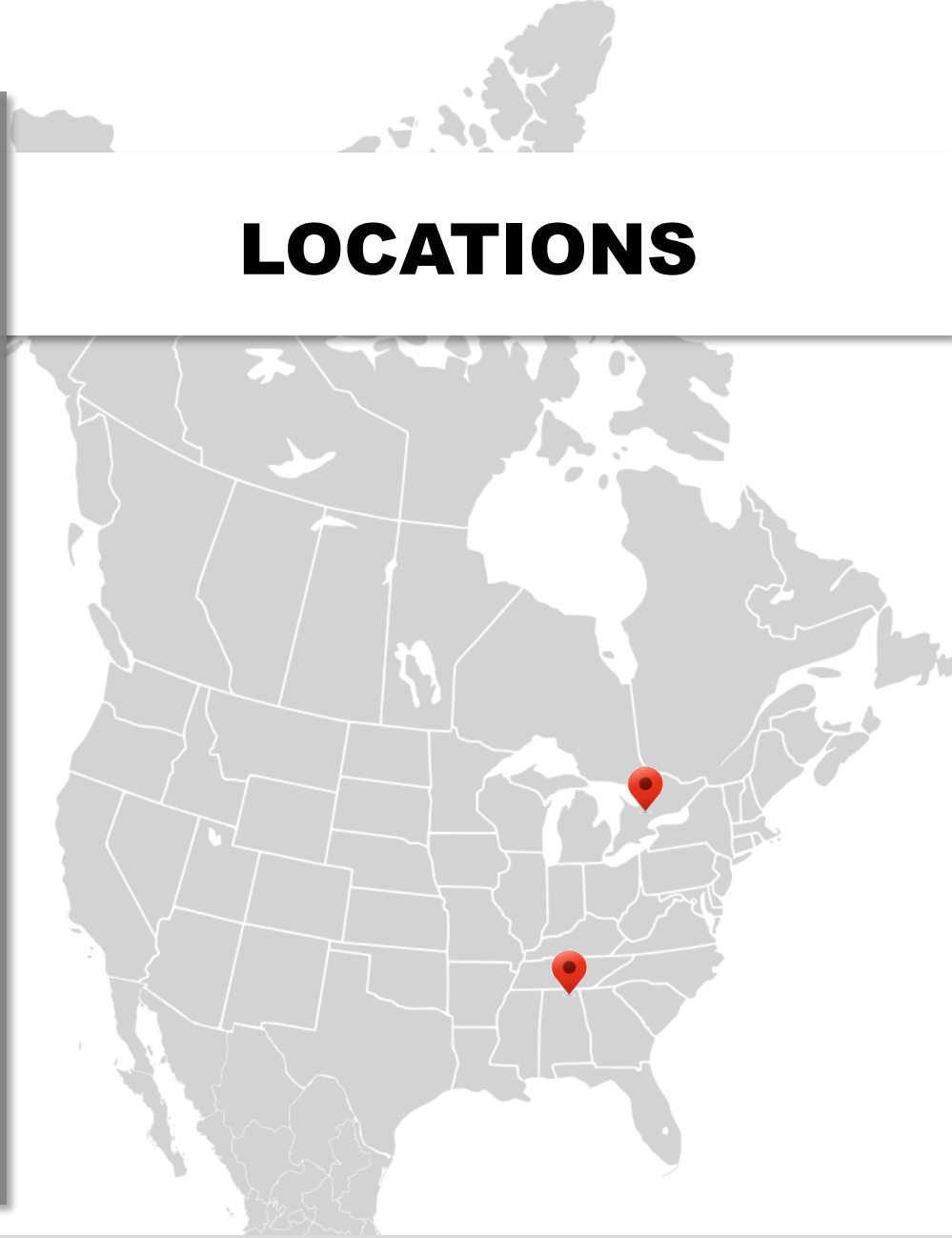
AEC ALUMINUM EXTRUDERS COUNCIL

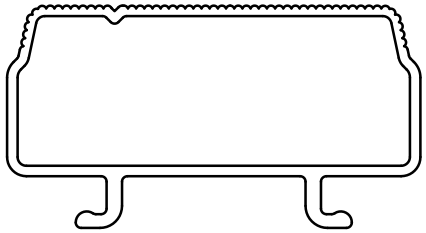
LOCATIONS

BRAMPTON ONTARIO is ALMAGs primary manufacturing and distribution location. Now more than 100 times its original size, Brampton encompasses 3 buildings with a total size of **175,000 square feet**.

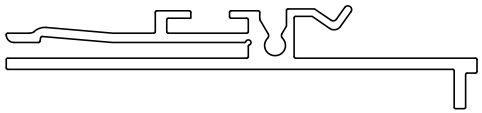
ARDMORE ALABAMA, our **30,000 square foot facility** was established in 2011 and primarily services **fabrication** and **warehousing** for key ALMAG Customers.

North American Distribution.

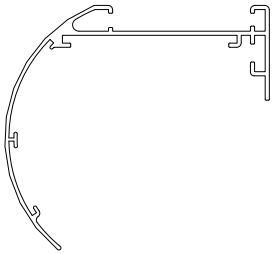




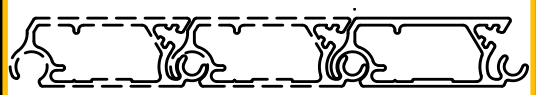
Window Application 0.0185” Wall



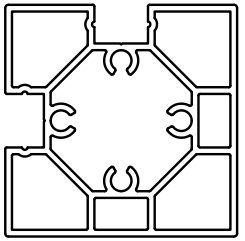
Lighting Application 17:1 Tongue Ratio



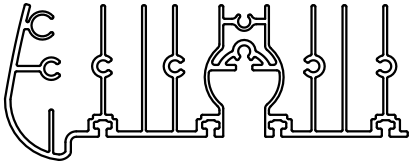
Shade Application



Roll up Fire Truck Door - High Visual



Store Fixture



Lighting Application

EXTRUSION PRESS

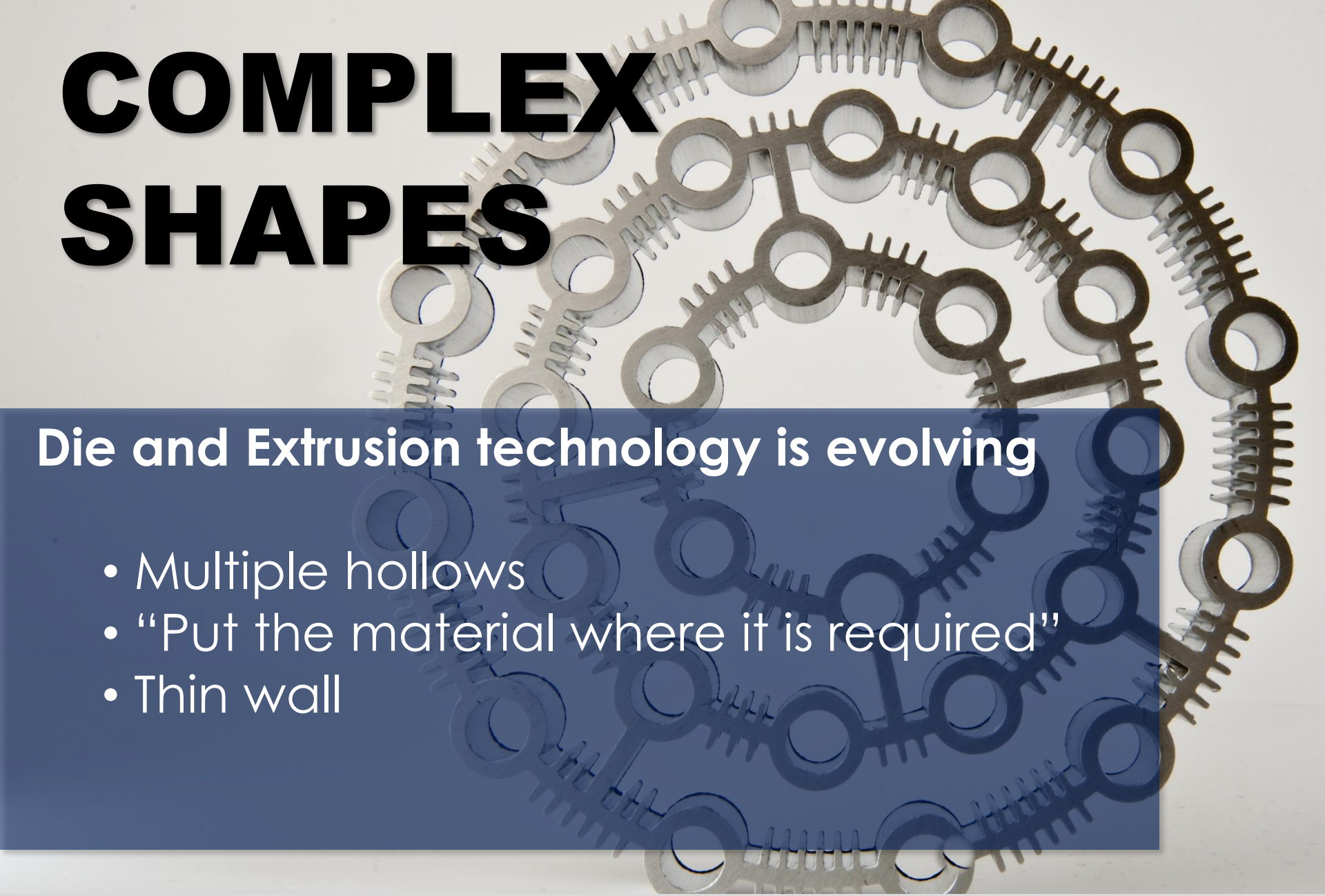
CAPABILITIES

FABRICATION & FINISHING

- PUNCHING
- PIERCING
- CNC MACHINING
- BENDING
- WELDING
- FORMING
- ADHESIVE BONDING

- ALODINING
- E-COATING
- POLISHING
- BRITE DIP
- ANODIZING
- WET PAINT
- POWDER COAT

COMPLEX SHAPES



Die and Extrusion technology is evolving

- Multiple hollows
- "Put the material where it is required"
- Thin wall

ALUMINUM EXTRUDERS COUNCIL

TIGHT TOLERANCE

Extruders know what is required

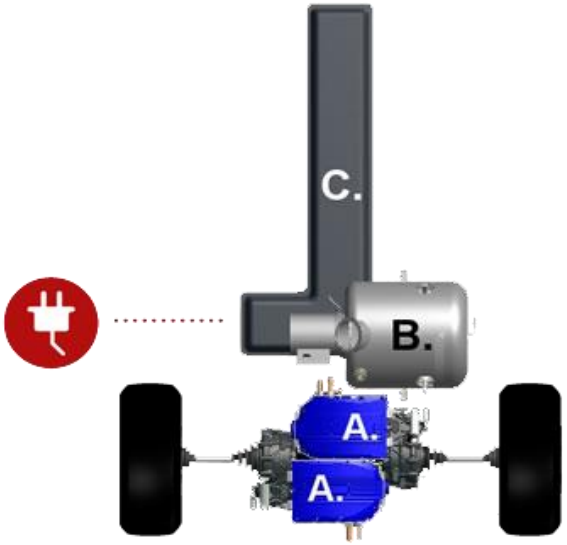
Standard vs Precision Tolerances

Stronger alloys without compromising tolerance

ALUMINUM EXTRUDERS COUNCIL

WRIGHTSPEED POWERTRAINS

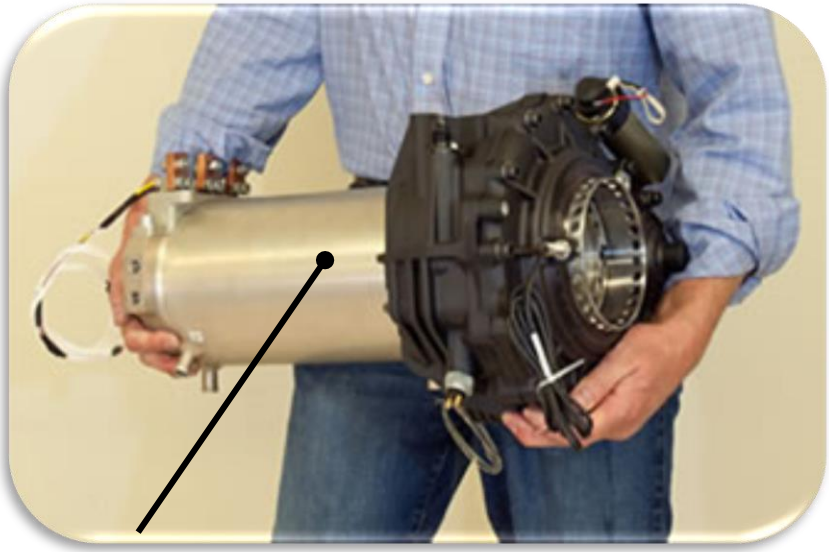
AUTOMOTIVE CASE 1



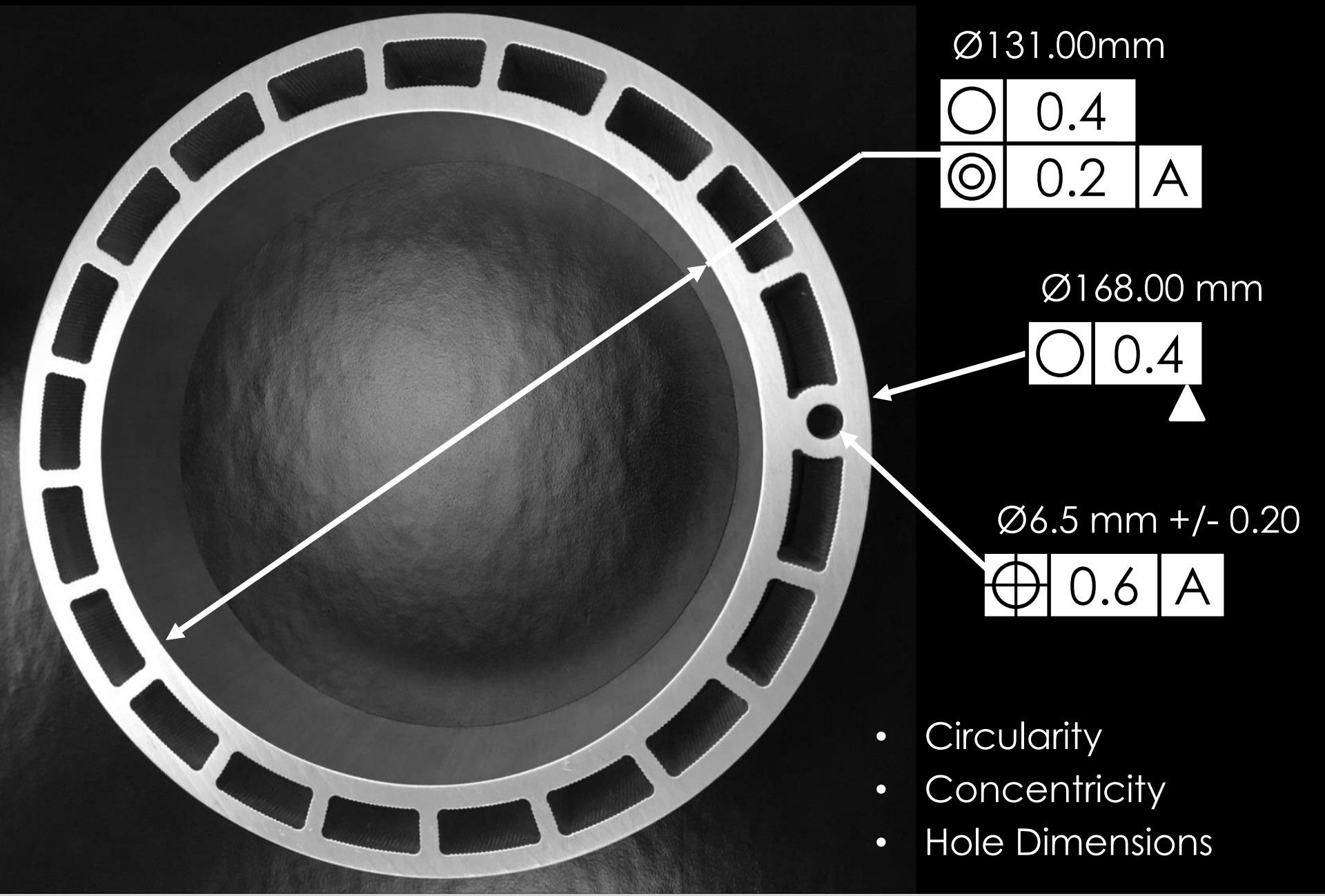
The Circuit™

Gear Traction Drive (GTD)

- All wheel drive and all wheel control
- 250hp Electric Motor controls each wheel

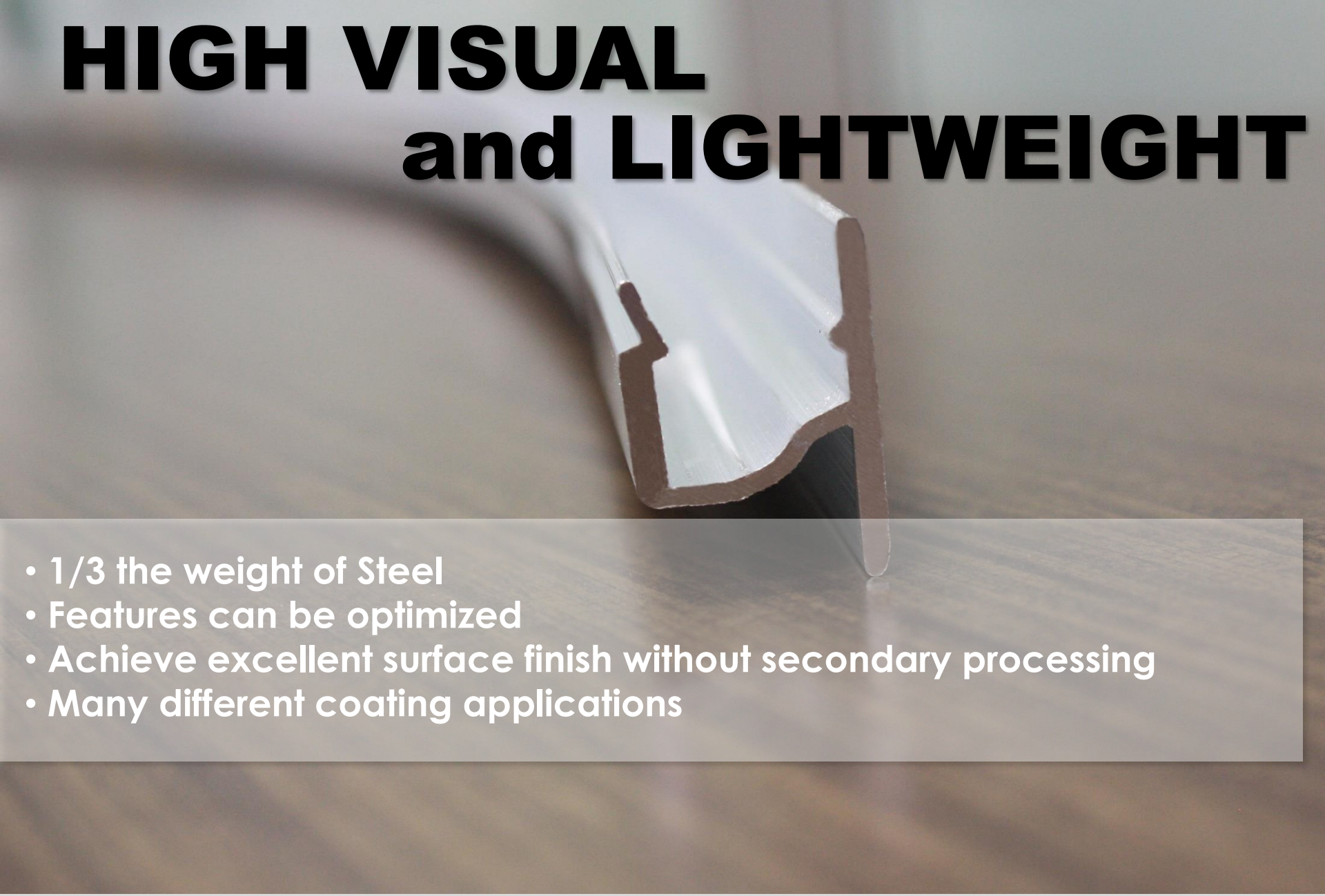


ALUMINUM EXTRUSION



- Circularity
- Concentricity
- Hole Dimensions

HIGH VISUAL and LIGHTWEIGHT

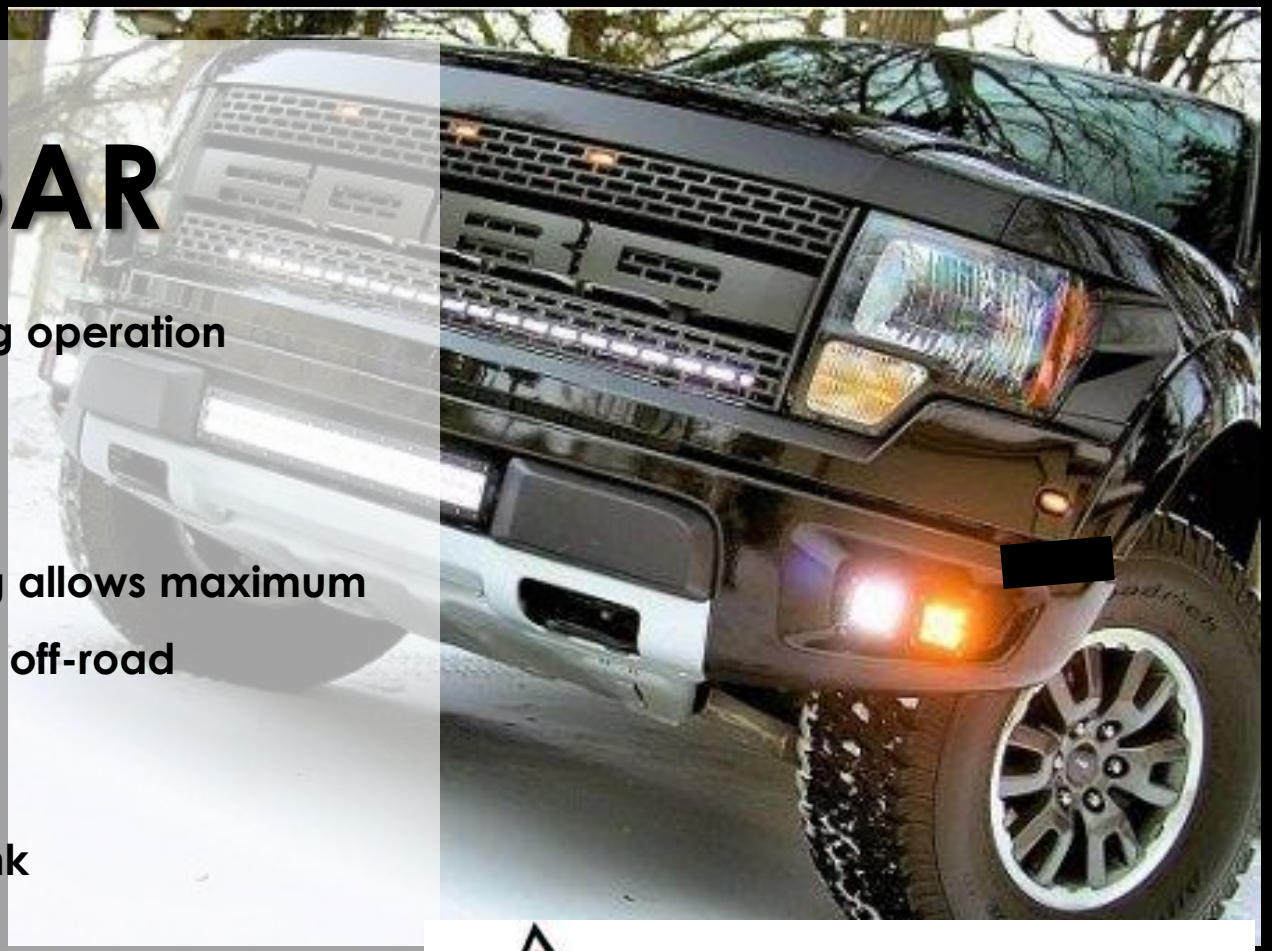


- 1/3 the weight of Steel
- Features can be optimized
- Achieve excellent surface finish without secondary processing
- Many different coating applications

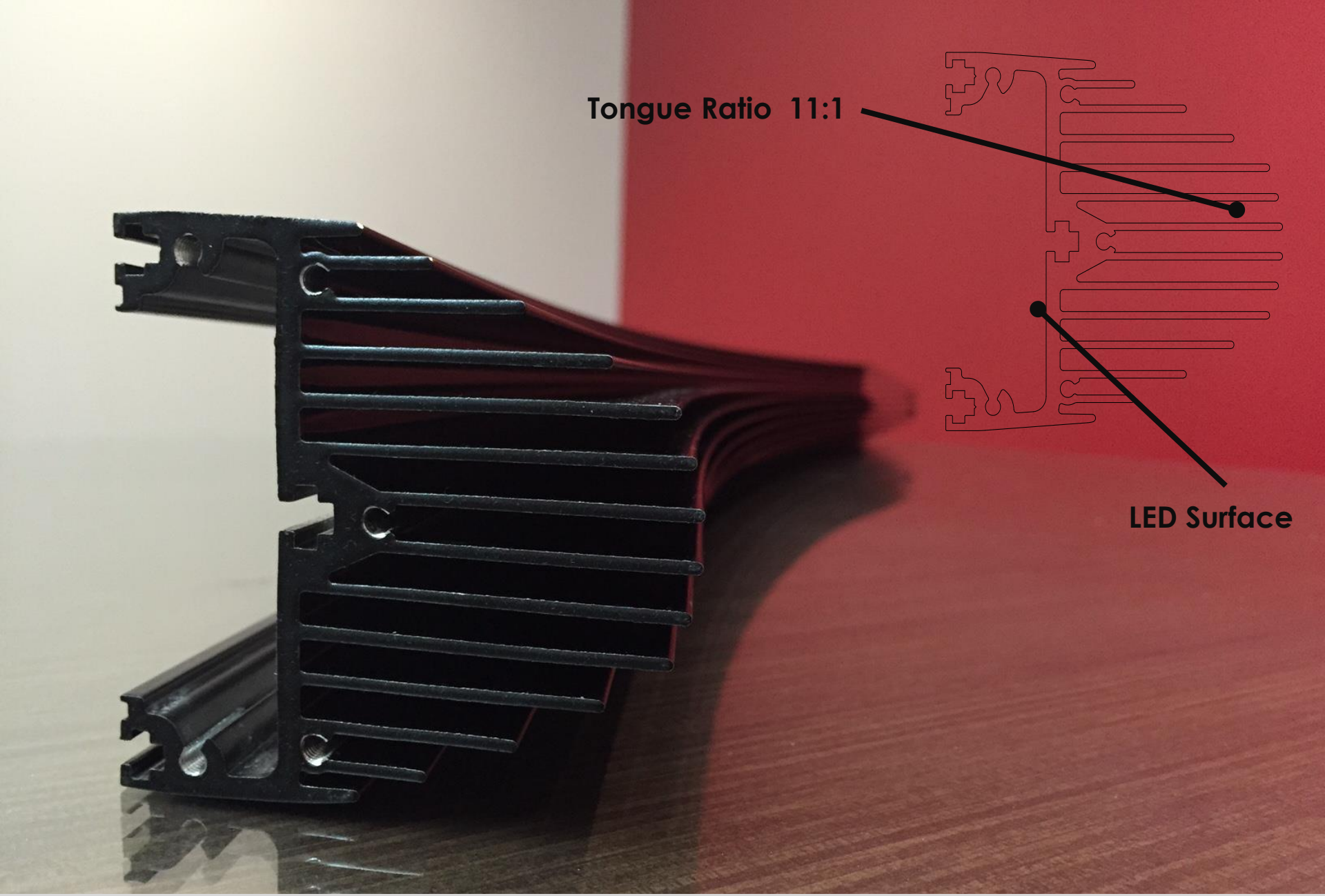
ALUMINUM EXTRUDERS COUNCIL

LIGHT BAR

- Complex bending operation
- Convex plain
- Thermal shedding allows maximum lumen output for off-road racing/driving
- Bend into heat sink



AUTOMOTIVE CASE 2



ALUMINUM EXTRUDERS COUNCIL

EXTRUDE

QUENCH

STRETCH

Material Bent in T4

TEMPER

Extrusion is stretch bent over a form

Material – 6360 T6

Increased Thermal Conductivity
Good Machining
Tight tolerances


ALUMINUM
EXTRUDERS
COUNCIL

About Taber

Part of National Material, LP.

Product Offering:

Customers:

About Taber

BROADEST CAPABILITIES IN THE ALUMINUM INDUSTRY

Taber Extrusions (Russellville, Arkansas and Gulfport, Mississippi)

- Casthouse
- 3 Extrusion Presses: 1800 ton to 8600 ton
  - Rounds: 7", 9", 11", 16", 20"
  - Rectangular: 10" x 28"
- 2XXX, 5XXX, 6XXX and 7XXX alloy series
- Various Fabrication and Value Added Manufacturing Processes

About Taber

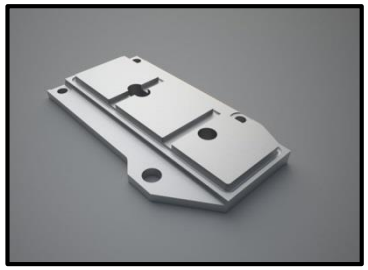
Typical Products

- Wide & Heavy Profiles
- Marine Grade 5000 Series
- Armor Grade 5000 Series
- Various Extruded 5000 Series Components








5XXX Alloys

While 6xxx and 7xxx are frequently used in Auto applications, we'll explore 5xxx

Alloy	Major Alloying Elements and Alloy Characteristics
1000 Series	**Minimum 99% Aluminum** High corrosion resistance. Excellent finish ability. Easily joined by all methods. Low strength, poor machinability. Excellent workability. High electrical conductivity.
2000 Series	**Copper** High strength. Relatively low corrosion resistance. Excellent machinability. Heat treatable.
3000 Series	**Manganese** Low to medium strength. Good corrosion resistance. Poor machinability. Good workability.
4000 Series	**Silicon** Not available as extruded products
5000 Series	**Magnesium** Low to moderate strength. Excellent marine corrosion resistance. Very good weld ability.
6000 Series	**Magnesium & Silicon** Most popular extrusion alloy class. Good strength. Good corrosion resistance. Good machinability. Good weld ability. Good formability. Heat treatable.
7000 Series	**Zinc** Very high strength. Poor corrosion resistance. Good machinability. Heat treatable.

Today's Focus

5XXX Alloys

5XXX Alloys used at Russellville and Gulfport plants								
Chemistry								
Alloy	**Si**	**Fe**	**Cu**	**Mn**	**Mg**	**Cr**	**Zn**	**Ti**
5456	0.25	0.4	0.1	0.50-1.0	4.7-5.5	0.05-0.20	0.25	0.2
5454	0.25	0.4	0.1	0.50-1.0	2.4-3.0	0.05-0.20	0.25	0.2
5086	0.4	0.5	0.1	0.20-0.70	3.5-4.5	0.05-0.25	0.25	0.15
5083	0.4	0.4	0.1	0.40-1.0	4.0-4.9	0.05-0.25	0.25	0.15
Composition as Max unless shown as a range.								

- 5XXX series alloys are **non-heat-treatable** , and derive their strength from addition of Mg (up to 6 wt..%) Mn (up to 1 wt.%) and Cr (up to 0.2 wt. %).
  - Mg – corrosion resistance
  - Strength – added by cold working the material
- Most widely used shipyard alloys are 5086, 5083 and 5456 for excellent combination of strength, corrosion resistance and weld ability.
- Excellent Mechanical Properties after welding, and better corrosion with high strength in 5456 are extensively used in marine grade application.

5XXX alloy/ Temper Mechanical Properties					
	UTS, ksi		**YTS, ksi**		**%Elongation**
Alloy	**Min**	**Max**	**Min**	**Max**	**Min**
5456-O	41	53	19	-	14
5456-H111	42	-	26	-	12
5456-H112	41	-	19	-	12
5454-O	31	41	12	-	14
5454-H111	33	-	19	-	12
5454-H112	31	-	12	-	12
5086-O	35	46	14	-	14
5086-H111	36	-	21	-	12
5086-H112	35	-	14	-	12
5083-O	39	51	16	-	14
5083-H111	40	-	24	-	12
5083-H112	39	-	16	-	12
5083 Cl I	45	-	35	-	9

5XXX Alloys

Extrusion Versus Rolled Plate: 5083 Series

- Similar Mechanical properties
  - Standard Rolled or Plate
    - 5083 H131: 335 MPa UTS ; 250 MPa yield – 8 % min elongation.
    - 5083 H116: 317 MPa UTS ; 230 MPa yield - 17% min. elongation
  - Extrusion:

5XXX alloy/ Temper Mechanical Properties					
	UTS, MPa		YTS, MPa		%Elongation Min
Alloy	Min	Max	Min	Max	
5083-O	269	352	110	-	14
5083-H111	276	-	165	-	12
5083-H112	269	-	110	-	12
5083 Cl I	310	-	241	-	9

- Benefits of Extrusions versus Rolled Products
  - Material Savings-Near next shape versus standard rolled shapes
  - Increased Productivity of machining or downstream manufacturing operations
  - Tooling is less expensive and has shorter leadtimes

5XXX Alloys & Laser Welding

The Process

- Laser beam generator
- Beam-directing optics to transport the beam to the work and focus it to the required spot size and power density
- Workstation containing work piece handling equipment that may feature manual or automatic loading and unloading

Advantages of Laser Welding with 5083

- The process exhibits good repeatability; is easy to automate.
  - Typical travel speeds for production laser welding processes range from 40 to 400 inches per minute (IMP)
- The deep penetration characteristic of laser welds usually allows single-pass welding and generally does not use filler material.
- A high-power laser welding assembly system allows the manufacturer to join similar and dissimilar materials, and stocks of different thickness that results in a high integrity weld with minimal heat affected zones (HAZs).
  - The high travel speeds used in laser welding minimize diffusion of heat into the surrounding metal. Therefore, heat affected zones (HAZs) are narrow, and because the laser welding process uses minimum heat input, distortion is maintained at a minimum.

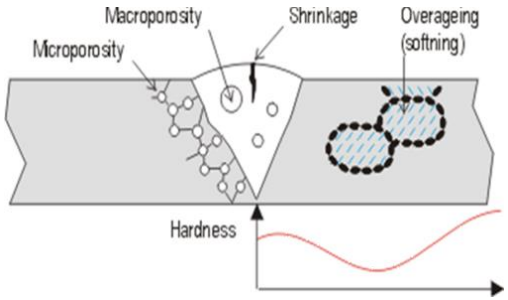


Fig 1: Possible quality problems in fusion welds

- Courtesy: fig 1 Robert Dean