



Vehicle Repairability
Committee
Scottsdale, AZ

July 22, 2008



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Advanced High Strength Steels

ASH01 presented with permission from I-CAR

- OEM's are using stronger & lighter steel
 - ◆ Dual Phase Steel (DP)
 - ◆ Transformation Induced Plasticity (TRIP)
 - ◆ Complex Phase Steel (CP)
 - ◆ Martensitic Steel (MART)
 - ◆ Boron Steel (BOR)



AHHS

- Latest in steel metallurgy for unibody & full-frame construction
- Use increase - fuel economy, side impact and roll-over protection
- Thinner/Lighter vs. Thicker/Heavier
- Concerns about Repairability
- high-tension steel, extra-high-strength steel, higher-strength steel, etc.



Tensile and Yield Strength

- Tensile strength (or ultimate tensile strength) is defined as the measurement of the amount of force necessary to tear a piece of steel apart.
- Yield strength is the amount of stress a material can withstand without permanent deformation.



Megapascals & Total Elongation

- Strength is typically measured in megapascals (MPa) or thousand pounds per square inch (ksi)
- Stretched to double the original size without breaking would have a total elongation value of 100%.

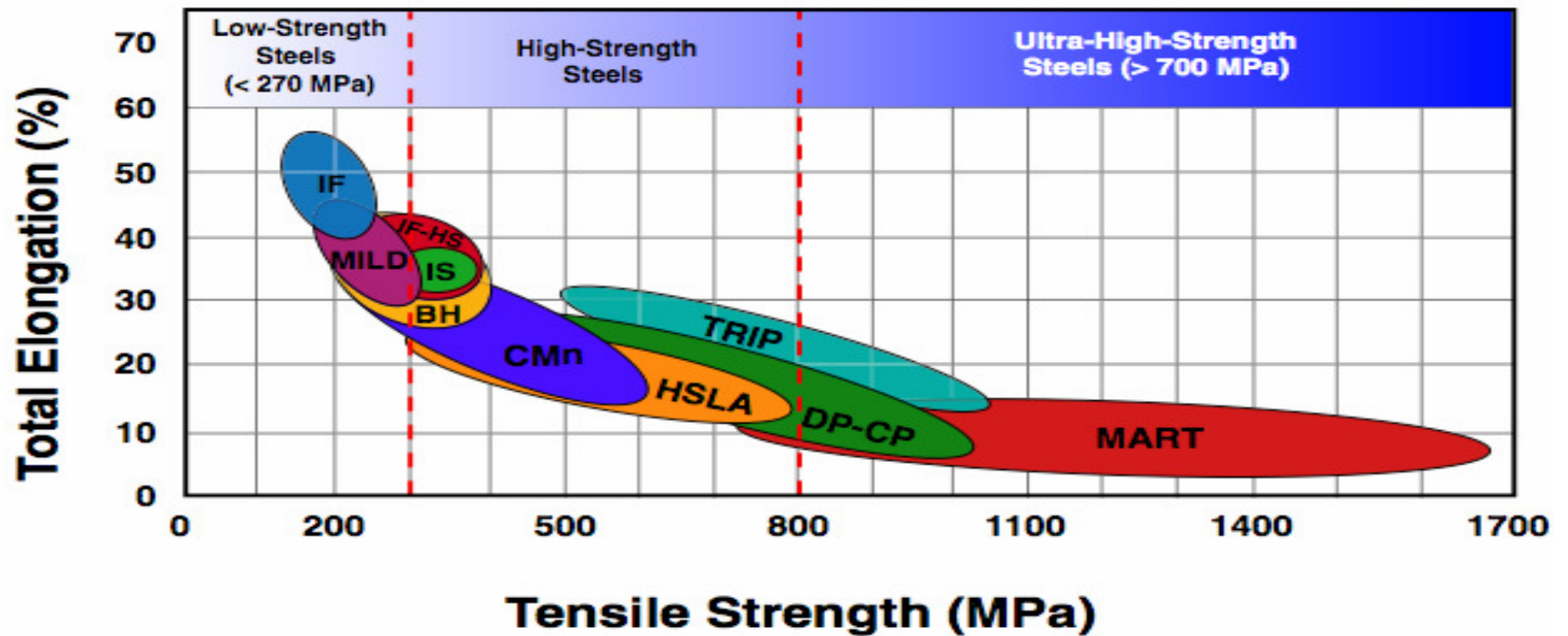


Making Steel Strong

- As a general rule heat and alloying play a major part in determining the strength of UHSS (cooling also plays a part in determining steel strength)
- Mild and HSS receive most of their strength from alloying alone
- Adding alloying elements affects steel hardness



Steel Families

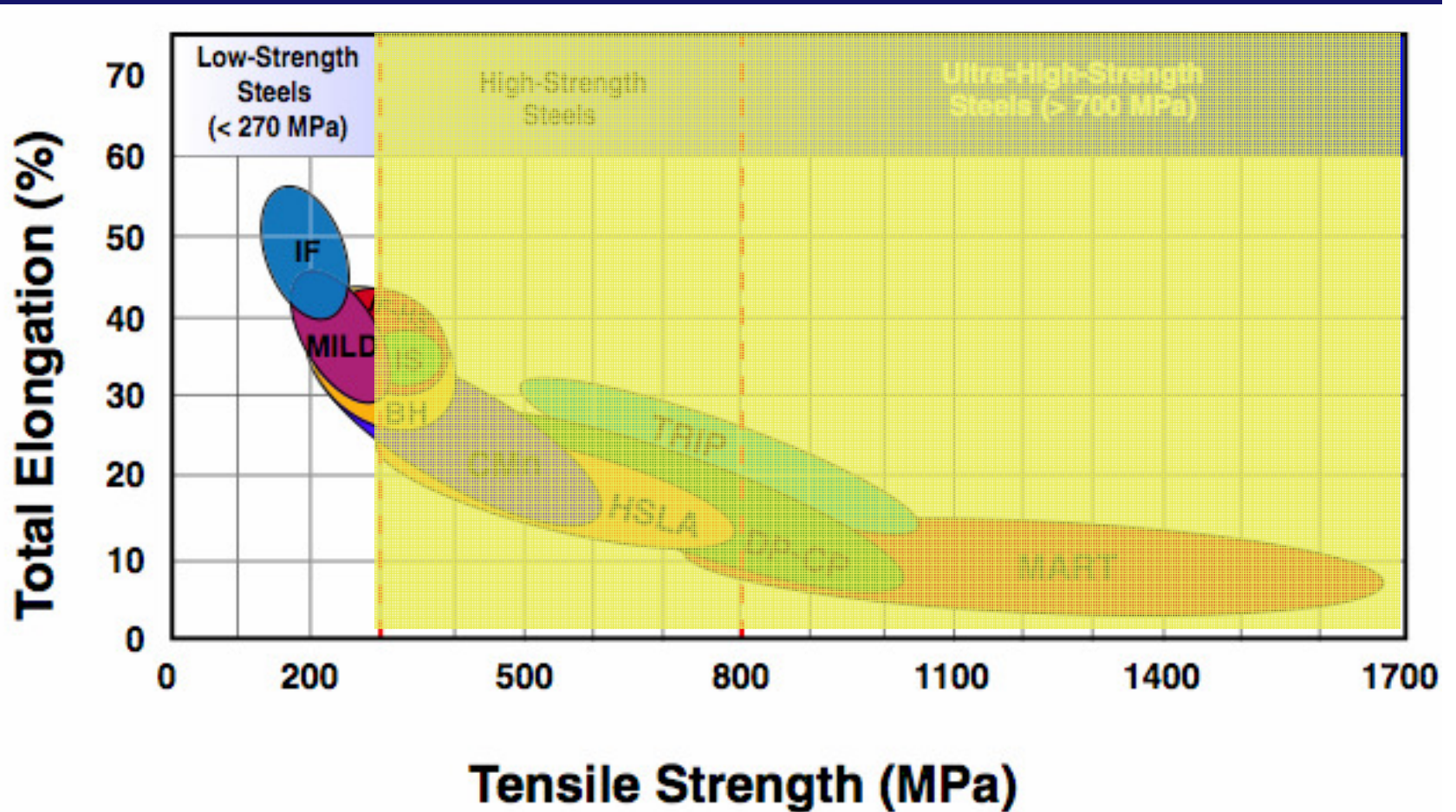


This chart provides a look at the different strengths of steel compared with one another.

(Courtesy of American Iron and Steel Institute)



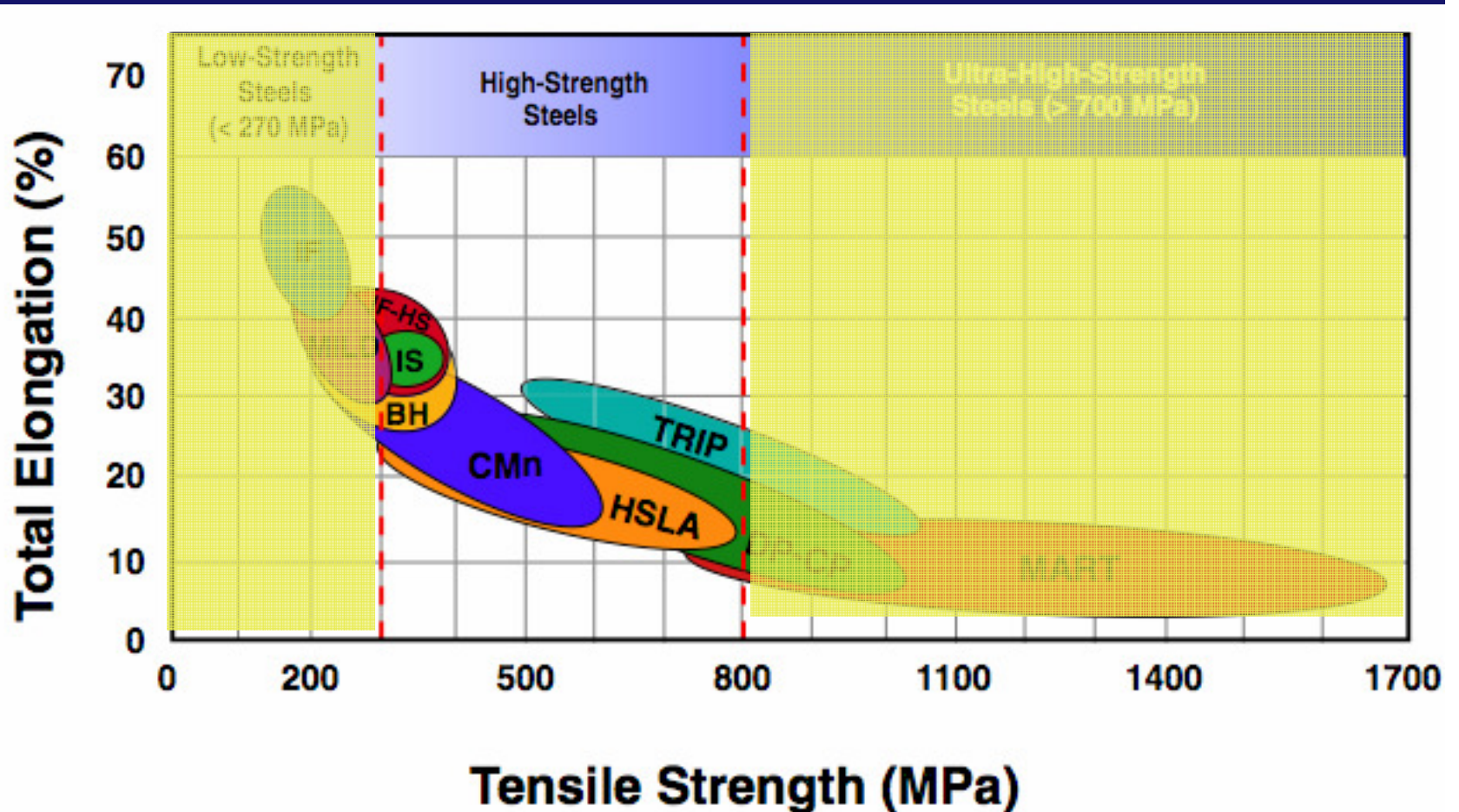
Low-Strength Steel



(Courtesy of American Iron and Steel Institute)



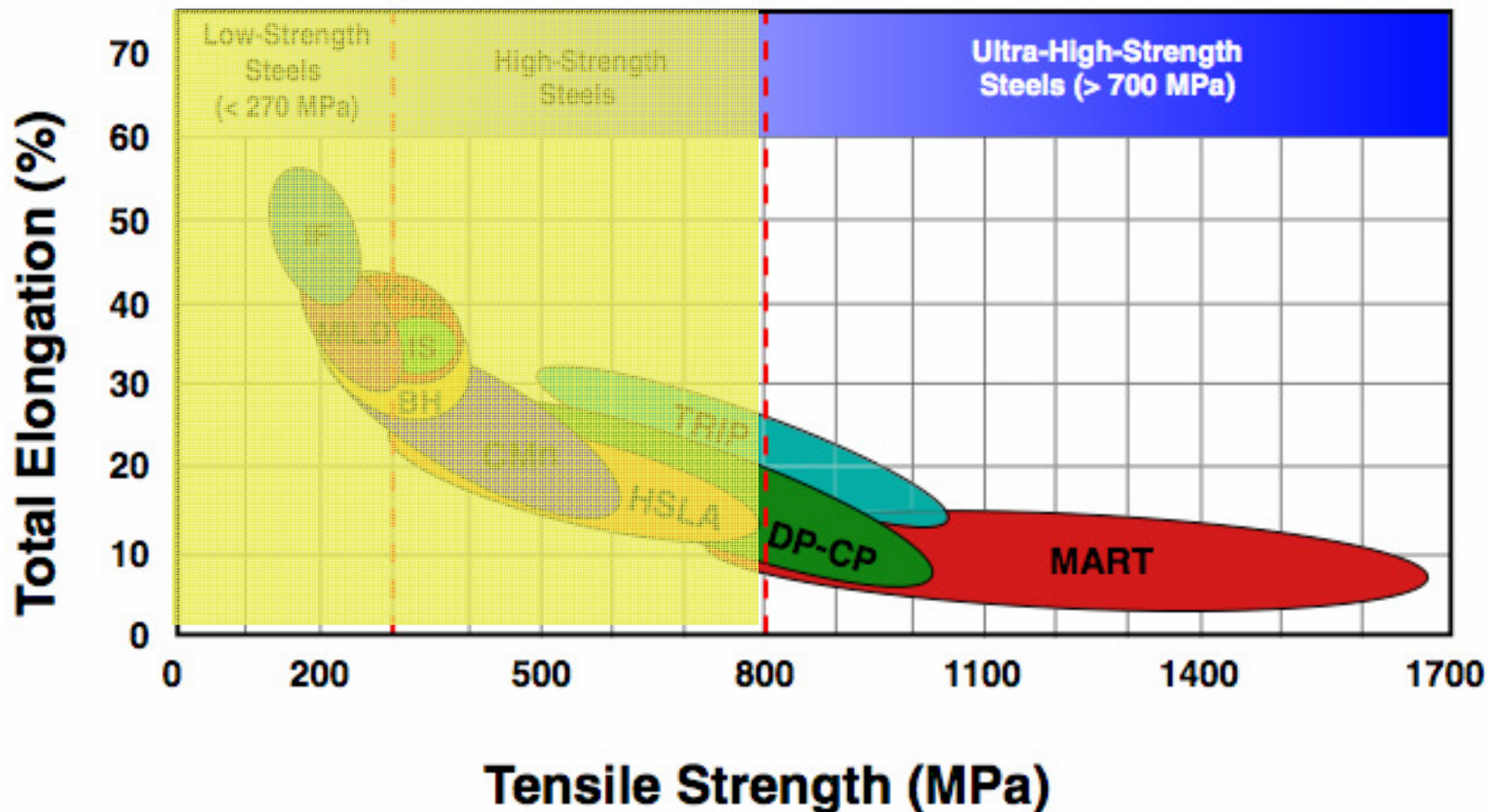
High-Strength Steel



(Courtesy of American Iron and Steel Institute)



Ultra-High Strength Steel

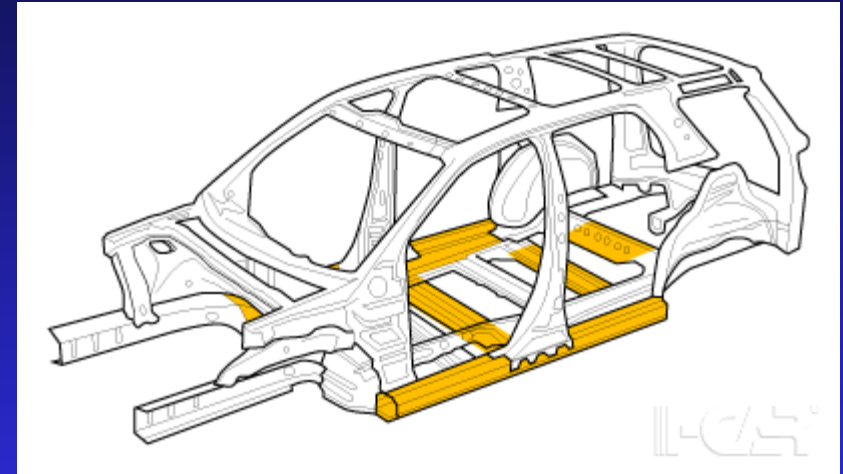


(Courtesy of American Iron and Steel Institute)



Other types of AHHS

GM uses Martensitic steel in the outer rocker panel and vehicle underbody on the Lambda body structure.

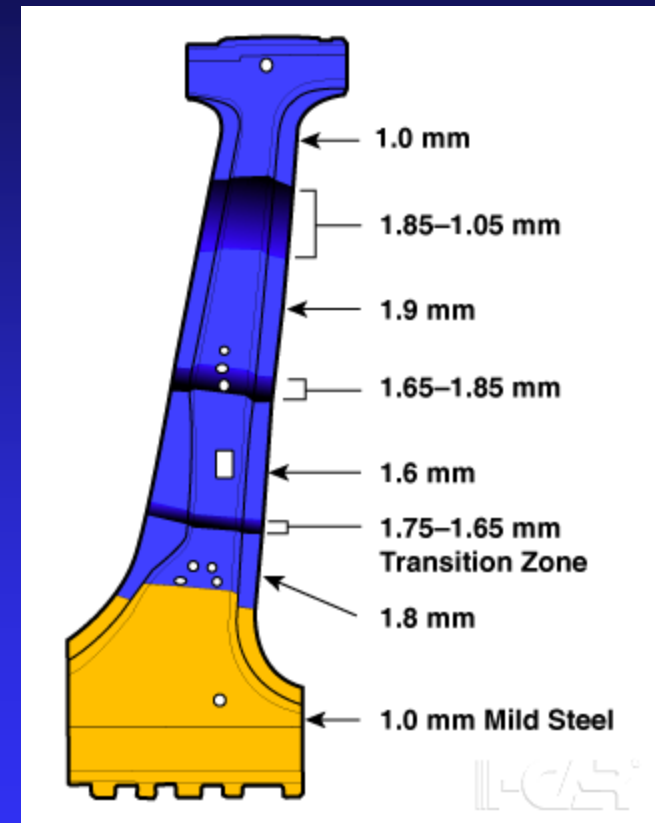


The outer rear body panel on the 2005 Volvo XC90 is made from boron-alloyed steel.



Part Forming Process

- **Tailor-Rolled Blanks**
- **Tailor-Welded Blanks**
- **Hydroforming**



The 2007 Dodge Caliber has a tailor-rolled hot stamp B-pillar reinforcement.



Common Locations of AHHS

- A-Pillars*
 - B-Pillars*
 - Front lower rails
 - Rear rails
 - Crossbeams
 - Rocker panels
- * Receiving the most attention because NHTSA is upgrading the side impact protection standard



Vehicle Maker AHSS Application

- Chrysler Group: DP600, '08 & later Boron
- Land Rover: A & B pillars with UHSS
- Audi: Variety of HSS & UHSS
- Ford: '08 Taurus 40% HSS or AHSS
- Honda: '06 – '08 Civic 38% DP590
- Volvo: Since '99 Boron steel used in rear body panels.

Vehicle Maker AHSS Application



Volvo uses the boron-alloyed steel for the inner B-pillar reinforcement on the XC90 to help meet the side impact standard.



Repair Recommendation

- Straightening: A bend may be unreparable
- Drilling and Cutting: No high-speed drills or saws. Cobalt drills (hard bit spot weld remover), cutoff wheels, plasma-arc cutter
- Heat Effect on AHSS: can seriously weaken the steel structure



AHSS Attachment Methods

- Squeeze-Type Resistance Spot Welding
- MIG Brazing
- GMA (MIG) Welding
- Welding Thinner Gauge Steel
- GMA (MIG) Welding Concerns
- Adhesive Bonding
- Rivet Bonding



AHSS Attachment Methods



Making a brazed joint requires a copper/silicon or copper/aluminum alloy filler wire with 100% argon shielding gas.



Audi Repair Recommendations

- Audi breaks down high-strength steel into three basic types
 - ◆ High-strength steels
 - ◆ Higher-strength
 - ◆ Ultra-strength panels (550–1,600 MPa)



Volvo Repair Recommendations

- Specific repair recommendations for AHSS on Volvo include:
 - ◆ using an open butt joint when sectioning structural parts.
 - ◆ sectioning joints are GMA (MIG) welded with ER70S-6 electrode wire.
 - ◆ do not section at laser-welded seams on a tailor-welded blank.



Chrysler Group Recommendations

- Extra-high-strength steel on Chrysler, Dodge, and Jeep vehicles may include:
 - ◆ A-pillars.
 - ◆ B-pillars.
 - ◆ rocker panels.
 - ◆ roof rails.
 - ◆ Specific examples of dual-phase steel usage in Chrysler vehicles include the 2007–2008 Chrysler Sebring in the front frame rails, inner rocker panels, and floor pan reinforcements.



GM Repair Recommendations

Recommended GM Steel Reparability Matrix

Steel ID Stamping Symbols ⁵	Grade	GM Specifications	Welding Method			Cold repair	Use of Heat for repair	Temp. Range	Maximum Heat
			MIG	RSW	MIG Braze ¹				
	Mild Steel	GM6409M (all) GMW2M (all)	Yes	Yes	Yes	Yes ²	Yes	Up to 1200 °F (650 °C)	90 sec. x 2
	Laminate steel		NO	Yes	NO	Yes ²	NA		
	Bake Hardened	GM6093M (all) GMW3032M(all)	Yes	Yes	Yes	Yes ²	Yes	Up to 1200 °F (650 °C)	90 sec. x 2
	Solid Solution-Strengthened		Yes	Yes	Yes	Yes ²	Yes	Up to 1200 °F (650 °C)	90 sec. x 2
	High Strength, Low Alloy	GM6208M (all), GM6218M(all), GM3032M(HR CR grades)	Yes	Yes	Yes	Yes ²	Yes	Up to 1200F (650 °C)	90 sec. x 2
DP	Dual Phase <=800 MPA UTS	GMW3032M (HR DP and CR DP grades) GMW3399M (HR DP, CR DP and HR HE grades with TS<800MPa)	Yes	Yes	Yes	Yes ²	No	N/A	N/A
DPX >800MPA	Dual Phase >800 MPA UTS ⁴	GMW3399M(all other HR DP, CR DP and HR HE Grades)	Yes ⁴	Yes	Yes	No	No	N/A	N/A
M B	UHSS ⁴ Martensitic ⁴ Boron ⁴	GM6123M (all) GMW3399M (all MS grades) GM W1400	Yes ⁴ Yes ⁴	Yes Yes	Yes Yes	No	No	N/A	N/A
TR	TRIP ⁴	GMW3399M (HR TR and CR TR grades)	NA	NA	NA	NA	NA	N/A	N/A

¹ Must use 8mm x16mm slotted holes

² Cold repairs can be performed if damage excludes kinks.

³Dual phase Steels up to DP 800 may be sectioned with a sleeve or backer plate.

⁴ Mig Plug Only, NO STITCH WELDING. These steels may NOT be used as a backer for stitch welding, NOTE. Deviation from this chart is ONLY allowed if there has been a crash analysis completed by the Design Engineer and a Service procedure has been written

⁵ ISO Symbol for repair.

Note: GM does not endorse repair of door impact beams



Land Rover Recommendations

- On the Land Rover Range Rover Sport, ultra-high-strength steel is used on:
 - A-pillars.
 - B-pillars.
 - ◆ remove spot weld from adjacent panel
 - ◆ Not an option; use plasma-arc or grinder
 - ◆ Install new A-pillar by brazing UHSS through slots that need to be cut into the new A-pillar



Summary

There is an increased presence of AHSS on most late model vehicles. Vehicle makers are creating specific recommendations on how to properly repair AHSS with minimal effect on a vehicle's structural integrity. This requires knowing what type of steel a part is made from before beginning repairs.



Thank you!

- See Russ Thrall for redemption codes for the on-line AHS01
- Thank you, I-CAR for releasing this vital information to the body of CIC
- Any Questions?