HERON
TECH

FLUSH SELF-PIERCE RIVETING TECHNOLOGY

Sample Testing

HT FSPR®: Riveting Solutions For High-Strength Performance & Lightweighting Applications

Innovative Joining

Welding | Clinching | Riveting | Industry 4.0

Comparison: SPR vs FSPR

Rivets	Self-pierce Rivet(SPR) 	Flush Self-pierce Rivet(FSPR) 
Measurements of the typical rivets	Φ = 3 – 3.35mm Rivet length 3.5 – 5.0mm Φ = 5 – 5.3mm Rivet length 4.0 – 9.0mm	Φ = 4.7mm Rivet length 1.9 – 2.8mm Φ =6.3mm Rivet length 4.2 – 9.1mm Φ =7.9mm Rivet length 5.5 – 8.1mm
Material strength	< 1600MPa	< 1800MPa
Material ductility requirements	≥10%	≥3%
Typical number of sheets	2 – 3	2 – 7
Pull strength (typical)	Up to 2.5KN	Up to 4KN
Shear strength (typical)	Up to 4.3KN	Up to 19KN
Multirange capacity (different joining tasks)	low	very good
Flush surfaces	punch side	two sides
Minimum flange width	18mm	12mm
Gas-tight	yes, die side	yes
Liquid-tight	yes, die side	yes
Layers cut	all except on die side	All
Minimum sheet thickness on die side	1.0mm	0.5mm
Punched piece (slug) removal	×	√
Electrical conductivity	average	average
Joined Materials	Hot-stamped steel (Softening treatment required)	Hot stamped steel
	High strength steel (≥1000 MPa)	High strength stee (≥1000 MPa)
	Die-cast aluminium (Elongation ≥ 10 %)	Die-cast aluminium (Elongation ≥ 3 %)
	Aluminium alloy	Aluminium alloy
	Carbon brazing(high risk of cracking)	Carbon brazing
	Low and medium strength steel	Low and medium strength steel
	Universal steel	Hot stamped steel
	Galvanised sheet	Galvanised sheet
	-	Die-cast magnesium
	-	Magnesium alloy
	-	PP material

Sample Combinations

FSPR

The Optimal Riveting Technology for Lightweight Vehicle

▲ Make Material Joining Simple

Enables joining of Al alloys, HSS (High-Strength Steel), and UHSS (Ultra-High-Strength Steel), while being compatible with heterogeneous combinations like CFRP (Carbon Fiber Reinforced Polymer) , cast Al and cast Mg , breaking the bottleneck in lightweight material joining.

▲ Make Vehicle-Design Flexible

Supports riveting of 2-4 material layers, suitable for complex multi-layer structures such as body frames and battery packs.

▲ Make Quality Reliable

Adapts to a stacked thickness of 2.6-8.0mm, ensuring stable joining from thin materials to thick materials for axles and girders.

Material	Stack-ups Thinkness/ mm	Max. Layer	Max. Shear Strength/ KN	Max. Pull strength/ KN
Al(+Cast Al)	4.2-8.0	3	19	5
Cast Al +HSS	4.35-4.8	3	7	3.6
Al+HSS/UHSS	3.2-5.2	4	9	11
Al+Cast Mg	3.9-6.0	3	10	4
Cast Al+ Galvanized Steel	3.65-5.1	3	7	2.5
Cast Mg(+Steel)	3.7-5.0	2	3	1.6
Carbon Fiber	2.6	2	1	0.3

Sample Combinations for Al

The trend of automotive lightweighting has driven a continuous increase in the usage of Al alloys and die-cast Al. However, Al alloys—especially die-cast Al, which has an elongation of only 3%-10%—are prone to cracking, poor joining, and other issues during the joining process, plaguing numerous auto OEMs and Tier 1s.

Developed specifically for the joining of lightweight materials like Al, the FSPR technology not only enables crack-free and reliable joining of Al alloys and die-cast Al, but also performs exceptionally well in combinations of hard-to-join dissimilar metals, such as multi-layer Al alloys, Al with high-strength steel (HSS), and Al with die-cast Mg.

Compared with traditional SPR, it further breaks through the upper limit of riveting thickness, reaching up to 8.0mm, perfectly meeting the joining needs of lightweight vehicle bodies.

Al

AL ALLOY
DIE-CAST AL

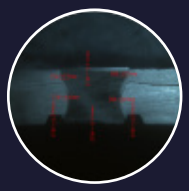
TENSILE STRENGTH: 90-690MPA
ELONGATION: 1-30%

TYPICAL RATIO:
>8%

- Varies significantly by vehicle model
- New energy vehicle models have a higher proportion due to lightweighting requirements

Car doors, engine hood, bumper, front and rear shock towers, torsion box, front and rear longitudinal beams, sill beams, seat cross members, instrument panel frame, battery pack frame, floor, front bulkhead, etc.

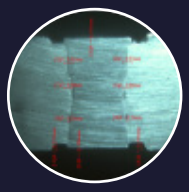
Sample Combinations



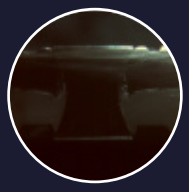
H8
Al(5182-O) 1.2mm
Al(7075) 3.0mm
Shear Strength:10KN
Pull Strength:1KN

H 7-195
Steel 1.0mm
Galvanized Steel 0.65mm
Cast Al 1 3.0mm
Shear Strength:4KN
Pull Strength:2KN

H8
Al(6014) 1.0mm
Cast Mg(Am50)3.0mm
Shear Strength:10KN
Pull Strength:2KN



H11-334
Al Alloy(6111-BH2)2.0mm
Al(S650)3.0mm
Al(7075)3.0mm
Shear Strength:19KN
Pull Strength:4KN



H11
Galvanized Steel 0.7mm
Galvanized Steel 1.4mm
Cast Al 3.0mm
Shear Strength:7KN
Pull Strength:2KN

H9
Al(5182) 1.2mm
Cast Mg(Am50)3.0mm
Shear Strength:8KN
Pull Strength:2KN

Sample Combinations for HSS

HSS, with its core advantages of high strength, excellent fatigue durability, and outstanding cost-effectiveness, has become a mainstream material in vehicle body manufacturing, widely supporting the demands for lightweighting and safety.

However, its high strength (≥700 MPa) and high hardness also present significant challenges for joining processes.

Developed specifically for lightweight materials, FSPR technology not only achieves crack-free and reliable joining of HSS, but also efficiently addresses the joining needs of complex dissimilar hard-joining metal combinations such as multi-layer HSS, HSS-to-Al, and HSS-to-cast Al, perfectly meeting the joining needs of lightweight vehicle bodies.

HSS HIGH STRENGTH STEEL

TENSILE STRENGTH: 700-900MPA
(Ahss Reaches 1800-2000MPA)

ELONGATION: 10-20%
(Low-carbon Steel: 30-40%)

TYPICAL RATIO:
60%

- Differs significantly between different vehicle models, gradually increasing as cars become lighter

The chassis, body frame, A-pillars, B-pillars, door impact beams, roof frame, center tunnel, rear impact beams, and other components that bear significant external forces and ensure the structural integrity of the vehicle body.

Sample Combinations

H10

HSS 1mm
Galvanized Steel 0.65mm
Die-Cast Al 3mm
Adhesive

Shear Strength:6KN
Pull Strength:3KN

H10

HSS 0.7mm
Galvanized Steel 0.65mm
Die-Cast Al 3mm
Adhesive

Shear Strength:4KN
Pull Strength:2KN

H10

HSS 1mm
HSS 0.65mm
Die-Cast Al 3mm

Shear Strength:6KN
Pull Strength:3KN

H10

HSS 1mm
Galvanized Steel 0.65mm
Die-Cast Al 3mm

Shear Strength:6KN
Pull Strength:3KN

H10

HSS 0.7mm
Galvanized Steel 0.65mm
Die-Cast Al 3mm

Shear Strength:4KN
Pull Strength:2KN

Sample Combinations for Magnesium

As a high-quality lightweight material, magnesium alloy has the advantages of low density, high specific strength and excellent shock absorption, with remarkable lightweight effect. It is the core future trend of automotive body lightweighting, and has been applied to various key structural components.

However, magnesium alloy has low elongation (usually only 5%-8%) and poor plasticity, which easily leads to cracking and insufficient joint strength during joining, becoming a core challenge restricting its large-scale application in the automotive field.

FSPR technology can effectively solve the joining problems of magnesium alloy. At present, it has been successfully verified to achieve reliable connection of aluminum + die-cast magnesium, steel + die-cast magnesium and die-cast magnesium + die-cast magnesium, providing support for its large-scale application.

Mg

MG ALLOY
DIE-CAST MG

TENSILE STRENGTH: 165-205MPA
ELONGATION: 5-8%

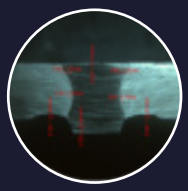
TYPICAL RATIO:
<5%

- Mainly used in high-end or performance vehicles

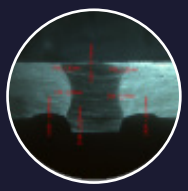
Steering wheel skeleton, instrument panel bracket, powertrain, side door inner panel, etc.

Sample Combinations

H7
Al(5182) 1.5mm
Cast Mg(Am50) 2.5mm
Shear Strength:2.7KN
Pull Strength:1KN



H8
Al(6014) 1.0mm
Cast Mg(Am50) 3.0mm
Shear Strength:10KN Pull Strength:2KN



H8
Al(6014) 0.9mm
Cast Mg(Am50) 3.0mm
Shear Strength:10KN
Pull Strength:2.4KN

H8
Steel 0.7mm
Cast Mg 3.0mm
Shear Strength:1.5KN
Pull Strength:0.7KN

H10
Steel 1.5mm
Cast Mg 3.0mm
Shear Strength:1.7KN
Pull Strength:1.3KN

H10
Cast Mg(Am50) 2.5mm
Cast Mg(Am50) 2.5mm
Shear Strength:3.2KN
Pull Strength:1.6KN

Sample Combinations for Carbon Fiber

As the advancement of vehicle body lightweighting accelerates, carbon fiber demonstrates enormous market potential in automotive manufacturing, thanks to its core advantages of high strength and extreme lightweight properties.

However, carbon fiber exhibits significant brittleness (with an elongation of only 1%-2%), which leads to issues such as cracking and joint failure during the joining process—becoming a key bottleneck restricting its large-scale application.

Developed specifically for lightweight materials, the FSPR technology can efficiently solve the joining challenges between carbon fiber and other materials, providing core support for the innovation of future lightweight vehicles.

C

CARBON FIBER

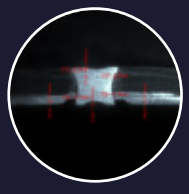
TENSILE STRENGTH: 3,500-4,500MPA
ELONGATION: 1-2%

TYPICAL RATIO:
<5%

- Mainly used in high-end or performance vehicles

Body panels, chassis components, roofs, doors, etc. can significantly reduce vehicle weight and improve performance.

Sample Combinations



H10

CFRP Similar 2mm
Steel 0.6mm

Shear Strength:1KN
Pull Strength:0.3KN

Heron: World Class Machines

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