

Automotive Spot Welding Cheat Sheet

Body-in-white RSW, limits and multi-material joining

ENGINEERING
CHEAT SHEET

Key equations

Quantity	Equation	Notes
RSW electrical input	Up to 100,000 A at about 10 V	Low-voltage, high-current pulse through copper electrodes
Spots per body-in-white	1,500 to 5,000	Intro says 1,500 to 5,000; FAQ and body text say 2,000 to 5,000
Robot speed and accuracy	≈ 1.5 s per spot; ≈ 1 mm	Why RSW is robot-friendly and low cost
Thickness ratio rule	$t_{\max} / t_{\min} \leq 3 : 1$	Larger mismatch keeps sheets from fusing
Steel-aluminum IMC limit	Layer $\leq 1.5 \mu\text{m}$	FeAl_2 , Fe_2Al_5 , FeAl_3 ; above this the joint is very weak
Modulus mismatch	$E_{\text{steel}} \approx 3 \times E_{\text{Al}}$	Same thickness, axial load: stress concentration at interface

Key takeaways

- Copper electrodes have low resistance; the steel sheets resist current, which creates the heat. Pressure is held after current stops (hold time).
- Low carbon, uncoated steel is the baseline. Higher carbon forms hard, brittle welds prone to cold cracking in the heat-affected zone.
- Steel and aluminum cannot be reliably fusion or spot welded because their melting points differ and brittle IMC forms.
- Dissimilar joints: thread fastening, self-piercing rivets (SPR), clinching, flow-drill screws (FDS).
- Cost driver is re-tooling of shared assembly lines; automakers often pre-assemble fastened sub-assemblies at suppliers.
- Match stiffness by adjusting relative thickness; also check thermal expansion mismatch (Arizona heat to Alaska cold).
- Conflict to resolve: the 3:1 rule here differs from the 5:1 in the spot welding best practices post. Spot count range is also stated two ways.