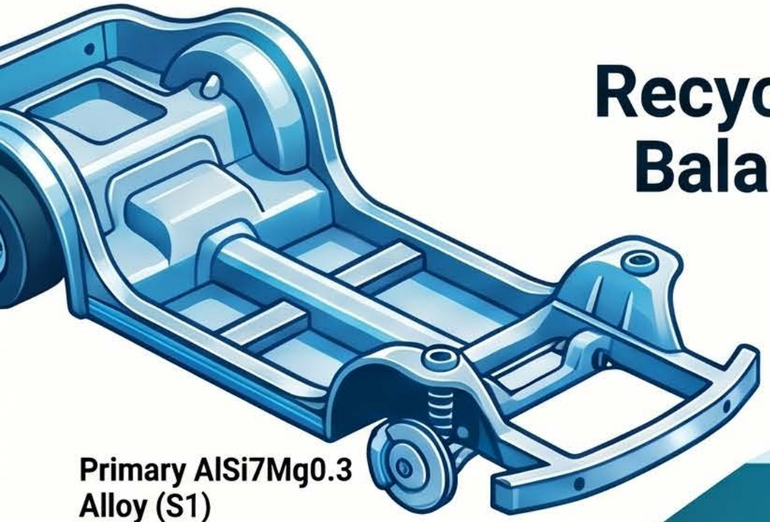
Recycled Aluminium in Automotive Casting: Balancing Sustainability and Performance

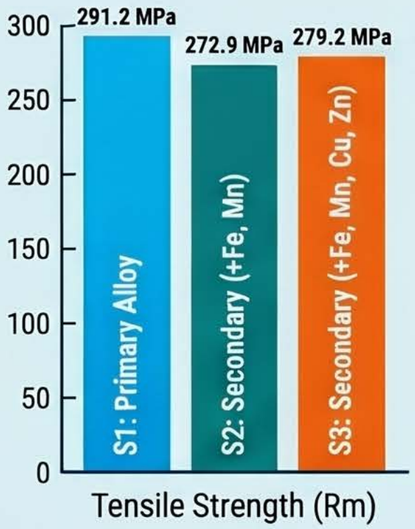
Evaluates the transition from primary alloys to secondary (recycled) variants , highlighting the trade-offs between increased strength and significantly reduced ductility in recycled materials to reduce carbon footprint.



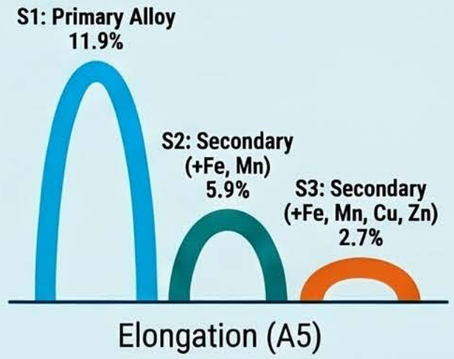
Primary AlSi7Mg0.3 Alloy (S1)

Recycled Alloy (S3) (+Fe, Mn, Cu, Zn)

Mechanical Properties & Microstructure



Strength and Hardness vs. Ductility:
Recycled alloys (S3) show higher hardness (108.2 HV30) but a 70% drop in ductility.



The Impact of Intermetallic Phases:
Needle-shaped iron precipitates in recycled alloys slightly increase strength strength but severely limit elongation.

Significant Drop in Elongation:
Elongation at fracture (A5) decreases from 12% in primary alloys to 3% in recycled.

Fatigue Performance and Application

High-Cycle Fatigue Advantage:
In high-cycle regimes, secondary alloys exhibit comparable or higher fatigue strength than primary alloys.

Primary Alloys Excel in Crash Scenarios:
Primary alloys remain superior for components facing extreme loads, impacts, or plastic deformation.

Enhanced Lightweight Potential:
Recycled alloys have narrower scatter bands, allowing engineers to reduce component wall thickness safely.