Great Designs in Steel

Advanced High-Strength Steels in Mercedes-Benz Passenger Cars

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Advanced High Strength Steels in Mercedes-Benz Passenger Cars

- Introduction
- New High Strength Steels
- Application in Mercedes-Benz Cars
- Multi-Material Concept
- Conclusion
Objectives for Material Evolution

- Improvement of crash resistance
- Reduction of fuel consumption
- Optimization of recycling, emission etc.
- Robust processes for high volume production at reduced costs
Motivation for Weight Savings

Reduction of Fuel Consumption

- DC-AG Self Commitment: -30%
- ACEA Self Commitment: -25%

Weight Increase of BIW

- C-Class: 126%
- S-Class: 109%
- S-Class Coupé: 103%

* Percentage of Diesel Engines approximately ~ 20%
Overview of Different Steel Grades

- Deep Drawing Steel
- Structural Steel
- HSLA Steel
- Dual Phase Steel
- TRIP Steel
- Hot Stamped Steel
- Complex Phase Steel
Dual Phase Steel (DP 500/600)

Current applications:
• Former E-Class: Reinforcement shocktower
  Hinge reinforcement door
• C-Class: Engine cross member
• E-Class/SLK: Engine cradle rear cross member

Properties:
Ferrite, Martensite
• Good stretch forming properties due to high strain hardening
• Good fatigue resistance
• Possible for visible parts (continuous yielding)
Complex Phase Steel (CP 800)

Current application:
• S-class coupé: B-post reinforcement cross member

Properties:
Ferrite, Martensite and Bainite
• Only hot rolled available
• High yield strength
• Limited formability
• Hardened and coated dies necessary
• Special steels for cutting necessary
• High press forces necessary
TRIP Steel (Transformation Induced Plasticity)

Will be used:
Next A-class, S-class, C-class

Properties
Retained Austenite, Ferrite & Martensite
- High workhardening potential
- Good formability (relative to tensile strength)
- High springback
- High press forces necessary
- Problems with secondary forming
For optimum weight savings, simulation of stamping process is necessary.
TRIP Steel
Stamping Try-out

• High forces for cutting necessary.

• **Cracks after secondary forming.**

• Cracks in areas of rectangular blank-cutting after first forming.

• Springback:
  - Mild Steel  +0%
  - DP500      +250%
  - TRIP 700   +310%
  - TRIP 800   +420%
Martensitic Steel
Side Impact Beam

Advantage

Weight reduction compared to tube
1.2 kg/vehicle
Martensitic Steel, Cold Stamped

ThyssenKruppStahl, MSW 1200
Martensitic Steel
Hot Stamped

Will be used:
Next M-class, S-class, C-class

Properties:
• Martensite structure (after hot forming and quenching in the die)
• Forming at 900 °C in one step with no blank holder
• Little forming forces necessary
• Relatively complex parts can be formed
• Maximum strength through martensitic structure
• No springback due to cooling in the closed die

TRIP 700 ZE 75/75 PH
DP 500 ZE 75/75
THM 280 Z140
ZStE 340 ZE 75/0
ZStE 180 BH ZE 75/75
Hot Stamping Process
Production Line of Sofedit, France

Possible Applications
1. 22MnB5, Hot Dip Aluminized
2. Heating 900°C
3. Forming and Hardening
4. Punching
Better Performance Through Adhesive Bonding

- Graph showing force (F) vs. elongation (s) for different bonding methods:
  - Clinching
  - Spotwelding
  - Adhesive Bonding
  - Spotwelding + Adhesive Bonding
  - Clinching + Adhesive Bonding

- Adhesive: BM 1494
- Substrate: Mild Steel Bonazinc/Elo-Zink
- V = 10 mm/min
Multi-Material Concept
S-Class Coupe

- Steel
- Aluminium
- Magnesium
- Plastic
Strong Increase of Aluminum Usage
Introduction of New E-Class
Conclusion

• Strong Increase of Advanced High Strength Steels in Future Mercedes-Benz Cars Means:
  • Weight Savings with Moderat Cost Increase
  • Higher Tolerances for Press Parts (High Springback)
  • Higher Forming Forces
  • Adopted Joining and Corrosion Protection Technologies Necessary

• Challenging Objectives for Weight-Savings Can Only be Met With Multi-Material Concept
“GREAT DESIGNS IN STEEL”

„How much further are these new ideas going to take us?“