Advances in Roll Forming Ultra-High-Strength Car Body Components

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Dreistern Company Profile

- Sales: 36,6 Mil €
- Employees: 230
- Foundation: 1949
- 40 - 50 Roll Forming machines / tube mills per year
- Core competencies:
  - Roll Forming complex sections
  - Integration of auxiliary processes
  - Fast product change-over
- More information on www.dreistern.com
Advanced roll forming technologies for the automotive industry

- Product change-over techniques
- Highly flexible line concepts
- Process validation and implementation
Steel remains the preferred material for high volume cars for cost reasons.

Luxury & low volume car bodies are increasingly based on material mix for performance reasons.

Source: Prof. R. Singer, Institute of Material Science and Technology, University Erlangen-Nürnberg
Ultra-high strength steel (UHSS) with heavily varying material properties such as spring back, poor flatness / straightness require advanced roll forming techniques.
Roll Forming Principles for UHSS

- Fully controlled bending (requires additional passes / stations)
- Control of critical dimensions and quick compensation of deviations of material properties
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Large notched areas critical for roll forming require in-line post-operations
Embossing in areas which are in contact with forming rolls require in-line post-operations.
Many car body components require pre- and post-punching or embossing
Case Study: MSW 1300 Rocker

- Martensitic steel with 1300 MPa tensile strength
- Flatness (range) of strip material 4.5 mm
- Sometimes severely changing springback from one coil to the next
- Result: guaranteed max. deviation from nominal ± 1,0 mm

Flatness of MSW 1300
M1 0,09
M2 -0,172
M3 -0,103
M4 -0,34
M5 0,328
M6 -0,148
M7 -0,027
M8 -0,261
M9 -0,133
M10 0,25

M21 -0,155
M22 -0,002
M23 -0,081
M24 -0,265
M25 0,429
M26 -0,17
M27 0,076
M28 -0,217
M29 -0,158
M30 0,193

M31 -0,06
M32 -0,075
M33 -0,305
M34 -0,397
M35 0,524
M36 0,032
M37 -0,078
M38 -0,445
M39 -0,168
M40 0,138

Range ± 0.5 mm
Case Study DP 1400 Bumper

- Dual phase steel with 1400 MPa tensile strength
- Sweep (bending radius) 3,300 mm
- Sheet metal thickness 1.4 mm
- Shape & positional tolerances critical for mounting crash box
Conventionally Roll Formed Bumpers

- Waves in flanges due to pressure strain
- Consecutive plastic deformation during bending
- Deviation from nominal at profile ends (end flare) ± 3.9 mm
- Required shape & position tolerance cannot be met
Improvements by UHSS Roll Forming

- Waves in the flanges completely removed
- End flare reduced from ± 3.9 mm to +/- 0.5 mm
- Shape deviation on entire envelope guaranteed max. ± 1.0 mm

No waves
End flare on profile ends reduced to ± 0.5 mm
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Product Change in 10 Minutes

- TWIN roll former allows for a ultra-fast product change-over
- While one product is still in production the TWIN roll former is prepared for the next product
- During change-over the TWIN roll former is only moved into working position 2
Product Change in 5 Minutes

- Change between product variants with different length without tool change
- Individual punching modules are automatically positioned according to the new punch pattern
Additional Processes in 10 Minutes

- Flexible integration of additional operations such as bending requires mobile units, which can quickly & easily be placed inside a production line.
Advanced roll forming techniques for the automotive industry

Product change-over technologies

Highly flexible line concepts

Process validation and implementation
Conventional Machine Concept

- **Fixed capacities** for pre-punching, roll forming and post-operations optimized for only one or very few products

- Retrofitting conventional equipment for additional products expensive, time consuming, requiring additional footprint
Rapidly Changing Requirements

- Rapidly changing customer demands are requiring a much more flexible machine concept, which can be easily adapted to future demands without extra cost.
Replacing a roll forming module by an intermediate punching module to get a highly, accurately positioned hole into the pre-formed shape.
Multifunctional Roll Forming Machine

- Replacing a roll forming module by a laser welding cell to produce a closed section
Mobile Laser Welding Cell

- The Mobile Laser Welding Cell allows flexible positioning of the laser at different machines at any location.
- The flexible beam guiding device provides fast connecting to the laser cell on the machine.
Multifunctional Roll Forming can transform the roll former into a highly flexible sheet metal production cell by placing roll forming, punching or welding modules at any position within the roll forming machine.
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- Process validation and implementation
Process Validation & Implementation

- Feasibility studies and process simulation
- Identifying critical process parameters and suitable solutions
Process Validation & Implementation

- Assessment of material and forming process on try-out machine
  
  Result:
  - Required tolerances are achieved with given material
  - Production of sample parts made on production tooling
  - No cost for additional try-out tools
Summary

- New roll forming techniques permit demanding tolerances of UHSS BIW parts.
- Roll forming can contribute efficiently to economical weight reduction of today´s and future cars.
- Multifunctional Roll Forming Technology enhances the flexibility of roll forming lines enabling them to run in product mix operation.
Present Development Activities

- Increasing weld speed for laser welded bumpers by optimizing cross section and weld seam geometry
- New integrated bending process for variable sweep radii with significant improved tolerances for open and welded bumpers
- Partial in-line hardening of automotive components for a further substantial weight reduction at very competitive cost
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