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Prediction of the failure in bending for the valorization of the 2nd and 3rd generation of steels for hot stamping.

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KEY WORDS:**materials, high-strength steel sheet, weight reduction/mass reduction**

ABSTRACT: With the expansion of AlSi-coated-1.5Gpa-PHS on anti-intrusion applications, carmakers have to manage an increased risk of local failures in bending. AlSi-coated-High-Bending-PHS developments aim at reducing the risk of failure in bending, allowing further thickness reductions on anti-intrusion applications, and offering new weight saving opportunities on energy absorption applications. A method is proposed to correctly predict the failure in bending, in membrane and in heat-affected-zones. AlSi-coated-1.0GPa-PHS achieve an extremely high fracture strain and offer more weight saving on applications which are strongly deformed during the crash. Reaching the ductility in local bending of a PHS1000 with a tensile strength at 1500 MPa will allow huge weight saving opportunities, which can be capture with the crash simulation with a reliable prediction of the local bending failure.

KEY WORDS:**hot stamping, failure prediction, crash, simulation, local bending, membrane, high bending PHS**

Steel is a material of choice for the BIW, because it is cheap, sustainable, crash resistant and because its constant development allowed to continuously generate new opportunities of weight saving thanks to higher strength levels with satisfying ductility. The development of the hot stamping of coated PHS in 2001 was an important step with breakthrough weight savings on complex parts, combining the robustness and the simplicity of the direct hot stamping process. With the introduction of breakthrough strength levels (1500 MPa), new failure modes have been observed and had to be described with new failure models to allow their prediction and their management in the crash simulation. In addition to the failure in membrane observed on parts with a strength below 700 MPa, it is now possible to predict the failure in bending and the failure in heat affected zones thanks to advanced material cards. The reliable prediction of these two new failure modes is necessary to design safe applications with the new generation of hot stamping steels and to be able to capture the weight saving potential of new high bending PHS. In using the local bending failure prediction, ArcelorMittal R&D could demonstrate a weight saving potential close to 30% on a B-pillar compared to the weight reached with the first generation of coated PHS (PHS1500 + PHS500), in considering a high bending PHS1500 concept if the B-pillar is designed for zero failure in crash. In this paper, we propose:

- to describe the different failure modes managed in the crash simulations,
- to share validation works based on crash tests on lab components
- and to illustrate how a reliable failure prediction allows to estimate the weight saving potential of material concepts with an increased local ductility in bending.