

EWI Forming Center – Joint Industry Program on Forming of Lightweight Sheet Materials

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Lightweighting is a popular keyword of most manufacturing products today from mobile electronics to bicycles to automotive to ships to airplanes that operate with energy consumption. It often represents higher energy efficiency, better design, enhanced structure integrity and improved functions. Figure 1 illustrates the mixture of various lightweight materials being used in a modern automotive body structure.

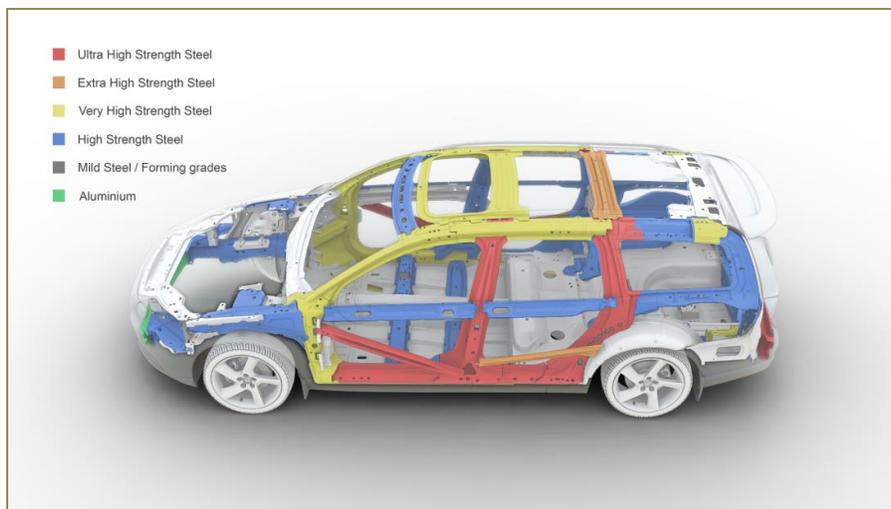


Figure 1. The lightweighting material mix for automotive body structure

Forming of lightweight materials requires increased control of material quality and properties, more expensive die materials and coatings, and often more rigid tool structure and a larger capacity forming press to handle the increased strength and low formability of these materials. The scrap rate tends to be higher than it is with conventional materials due to more frequent failures like severe springback, trimmed edge-cracks, necking and splitting. These materials include aluminum, titanium, magnesium alloys and advanced high-strength steels (w/ thinner gages).

These emerging lightweight materials are increasingly used or considered for new product designs in today's industry to improve the performance and/or manufacturing costs of products, the forming industry often experiences *a gap between materials formability specifications and production results with these less-familiar materials*. To address and identify technical challenges in forming of these lightweight materials, EWI Forming Center (EWI-FC) and the Ohio State University Center for Precision Forming (OSU-CPF) jointly held two workshops on advanced sheet metal forming technologies in November 13-14, 2012 and March 21-22, 2013. One of the major conclusions drawn from the industry group discussions of the workshop on March 21-22, 2013, was that *"ASTM standard formability tests are not sufficient to provide the industry-needed formability data and the material data for predicting the local failures often experienced with these materials in production"*.

Industry is seeking practical knowledge of forming processes and tooling designs for these new emerging materials, including:

- Practical testing methods to evaluate formability
- More accurate prediction capabilities with reliable failure criteria
- A way to access the knowledge through the use of available software.

To respond to these urgent needs, the EWI-FC and OSU-CPF team recently launched to develop some of this information through a Joint Industry Project (JIP) with Honda R&D, KTH Parts and Shiloh Industries. The project team has substantial experience in forming, lubrication, process modeling, and failure predictions with these emerging materials, including aluminum 5182, advanced high-strength steels (AHSS) – 780/980/1180 tensile strength materials. In addition, EWI-FC and OSU-CPF are currently collaborating on evaluations of friction and fracture of aluminum alloys with the EWI Internal Research Development (IRD) Project. The project team will apply both experimental and numerical methods and related knowledge to achieve project goals.

The objective of the proposed effort is to develop practical formability evaluation methodology and reliable failure criteria of the selected sheet metals, enabling us to:

- Evaluate the material formability in major forming modes as shown in Figure 2 (i.e., bending, stretching, drawing, and hole-flanging)
- Predict the failures of materials in different forming modes
- Establish material formability and failure models with selected materials.

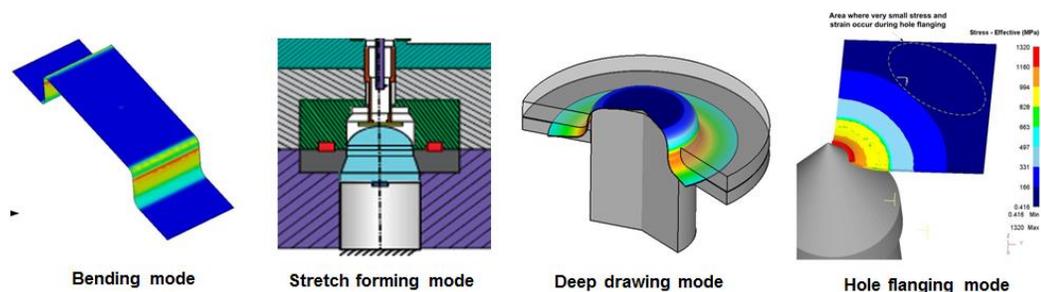


Figure 2. Various Forming Tests to Evaluate Failure Criteria in JIP of EWI-FC

At the conclusion of this project, it is expected that the industry partners participating in this JIP will gain the following benefits:

- Detailed information of testing methods, tooling design, and procedures, along with the evaluated material data
- Reliable failure criteria in stamping of the selected sheet materials

EWI-FC plans to hold the next workshop on Advanced Metal Forming Technology at EWI in Columbus on November 13-14, 2013. As experienced in previous two successful workshops, this workshop will bring together interested individuals (e.g. OEMs, stampers, material producers, forming equipment builders, lubricant suppliers and academics) to discuss important issues related to the current practice and advancement of metal forming technology. Technical presentations and the panel discussion will be made by eminent industry speakers from Chrysler, Dayton Progress, EWI-FC, FIA, Honda, Nucor Steel and Novelis. This workshop is also being held in conjunction with a new course, “Fundamentals and Applications of Sheet Metal Forming” at EWI-FC on November 12-13.

Learn More

To learn more about EWI-FC and the upcoming workshop & new course, contact the author, Dr. Hyunok Kim, Technical Director at EWI-FC at hkim@ewi.org or 614.688.5239

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