

EXECUTIVE SUMMARY

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Project Title: Design of Skid Line Simulation Machine for Sheet Metal Surface Quality Analysis

A skid line is a visually observable surface distortion band on the non-contact side of the portion of a stamped sheet metal panel which has been pulled over a tool radius. The ability to forecast the magnitude of a skid line during early product design stages is helpful in promoting high quality sheet metal stampings. There exists a need for a deeper understanding of the conditions under which skid lines develop. The objective of this project was to collect and analyze experimental data which can be used to help quantify the influence of tooling radii and back force on sheet metal skid lines for BH210 and mild steel materials. To this end, a novel design for a machine intended to measure directly various in-plane and contact normal forces acting upon a 1.8 in. x 16 in. sheet metal specimen during a stretch-bend-draw process was proposed. The new machine, called a Stretch-Bend-Draw Simulator (SBDS) was designed specifically to be integrated into a typical laboratory tensile testing machine. The SBDS was shown to be capable of collecting pulling force, back force, tool normal force, and the corresponding draw bead clamping force for a variety of prescribed settings. Analysis of the force data in conjunction with visual observations of the actual pulled specimens allowed researchers to ascertain the conditions under which skid lines arise. Both unpainted and painted cases were considered by Ford Motor Company, General Motors Corporation, and Chrysler, with each company applying its own judgment criterion for assessing the skid line severity; an index of 1 to 5 was used. The SBDS appears to be a promising new electro-mechanical laboratory device for improving researchers' knowledge of the physical phenomena associated with skid lines in sheet metal products created in stamping dies.