Simulation and Reliability Analysis of Laser-Welded Blanks after Metal Surface Finishing Process

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ABSTRACT

Currently there is a huge competition amongst the OEMs and manufacturers in the auto industry to reduce the weight of the car. A few design modifications or use of different size and grades of materials solves this problem greatly. This paper focuses upon the metal finishing process of Laser Welded Blanks (LWB) with simulation and reliability as well as new process development. These blanks are of same gauge-same gauge or different gauge-different gauge materials. The main aim of this process was to remove the visible portion of the weld on the blank, so that it can be used as a body-outer. A new process was developed using expert knowledge and automated machinery tools. A simulation model was developed to compare with the actual developed method and to detect the bottlenecks and optimize the process. Reliability was a major concern during laser-welded blank operations. The paper addresses prediction of the amount of material removed based on the failed parts and visibility of the weld. This approach could provide competitiveness in the weight of the car which is directly related to fuel efficient and long term survival.

Keywords: Auto Industry, Automotive, Laser Welded Blanks, Manufacturers, Simulation

1. INTRODUCTION

Today the auto industry is under a great pressure to come up with material savings to reduce the overall weight of the car. In the auto industry today we see a big competition amongst the OEMs and Manufacturers to do the same. A few design modifications or use of different size and grades of materials solves this problem to a great extent. There has been a tremendous amount of research carried out in past decade or so on different materials as well as different manufacturing processes. OEMs use different grades of steel and aluminum which constitute a major portion of the body of the car. The overall body consists of many parts and individual
components but, ‘Body in White’ or ‘BIW’ refers to the stage in automobile manufacturing in which the car body sheet metal (including doors, hoods, and deck lids) has been assembled or designed but before the components (chassis, motor) and trim (windshields, seats, upholstery, electronics, etc.) have been added. The largest components of this BIW consist of ‘Body Inner’ and ‘Body Outer.’ There is one ‘Body Inner’ and one ‘Body Outer’ on each side of the car. It’s a one single component of sheet metal, starting from fender till the headlight-front bumper joint connection. As each section is a cut out of a large role of sheet metal, to reduce the scrap while manufacturing, OEMs has to come up with an optimum design. When we say optimum, it includes its strength, rigidity, elasticity, etc. which engineers needs to handle carefully while designing. Figure 1 shows a body-in-white (BIW) of a car.


Laser welding is a technique which bonds two same gauge-same gauge or different gauge-different gauge materials. It also allows us to weld two portions of different metals and also of different grades. OEMs use these different combinations for the laser welding process for different body components. So laser welding helps in reducing scrap and at the same time it gives us freedom to design for the required condition. This laser welding process is used in many industries today where the weight savings is a must. In auto industry, this laser welding process is used to manufacture many body components including Body Inner. But the major drawback of this process is that the weld line is

Figure 1. Body in white
The Diffusion Absorption Refrigerator Operation and Performance
Lorenzo De Pascalis, Giuseppe Starace and Federica Carluccio (2015). Handbook of Research on Advances and Applications in Refrigeration Systems and Technologies (pp. 36-84).
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