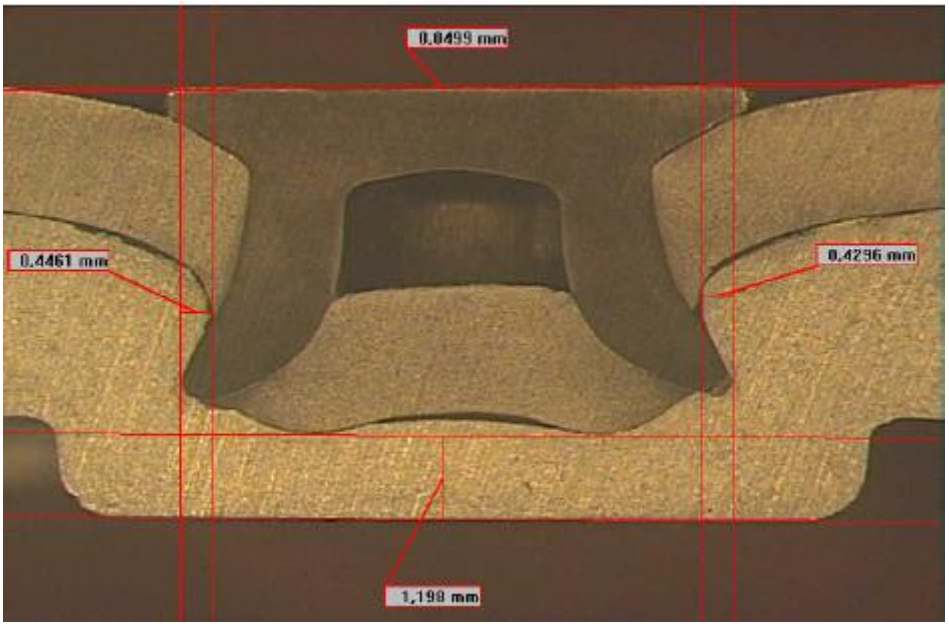
Development of Mechanical Joining Technology for Light Weight Car Body Concepts



Project within: Sustainable Production / Vehicle Development

Author:
Björn Carlsson
Volvo Personvagnar Aktiebolag, Karosskomponenter / Olofström
Telephone +46-454-264818
bjorn.carlsson@volvocars.com

Date: 2013-01-31

Content

FFI in short

FFI is a partnership between the Swedish government and automotive industry for joint funding of research, innovation and development concentrating on Climate & Environment and Safety. FFI has R&D activities worth approx. €100 million per year, of which half is governmental funding. The background to the investment is that development within road transportation and Swedish automotive industry has big impact for growth. FFI will contribute to the following main goals: Reducing the environmental impact of transport, reducing the number killed and injured in traffic and Strengthening international competitiveness. Currently there are five collaboration programs: **Vehicle Development, Transport Efficiency, Vehicle and Traffic Safety, Energy & Environment and Sustainable Production Technology.**

For more information: www.vinnova.se/ffi

1. Executive summary

The project's goal was to enable the industrial implementation of the mix and multi-material design for the next generation of cars, with the main objective to reduce weight while maintaining performance for both stiffness and strength.

The project focused on the following:
Evaluation of process capability for various types of adhesive in combination with mechanical joining. Evaluation of how joining speed affects joining quality. Targeted support for product related mix-material solutions driven by product development eg. mixed materials on hang on parts (Bonnet, Boot lid and doors), aluminum applications in body structure, aluminum-intensive solutions for hang on parts.
The project would provide basic process knowledge with respect to new combinations of materials and process conditions in order to support product development in its early concept stages. Another possible result, was the opportunity to make a qualified planning of flexible cost effective equipment solutions for assembly lines, and optimized joinings for various lightweight applications.

The Project "Development of Mechanical Joining Technology for Lightweight Car Body Concepts" has shifted over time. Start-up of 2010 was focused on basic research creating an overview of joinings suitable for self-piercing riveting or clinching with good results. Material matrixes were developed. We got answers to proper selection of material combinations. The project then soon went to a more product-oriented development instead of focusing on application tests.

After implementation of the project, we have been able to recommend rivets and dies to the product development, which are suitable for a number of new products to be developed for the new car projects that will come in the near future.
The products can´t be specified because it´s confidential information.

2. Background

In the automotive industry joining and assembly technologies for lightweight solutions are highly protected and because of that the spread of knowledge is very limited. Presentations from competitors at international conferences never give out any concrete results, data or conclusions in respect to protect their own know-how and advantage in product development over competitors. In connection with this, Volvo Cars must work actively with product and process development on their own to assert themselves against an increasingly tough global competition on a competitive market.

3. Objective

The main objective is to reduce the weight of the car while maintaining the performance on both stiffness and strength.

4. Project realization

The project objectives have been achieved through internal testing and testing by the supplier Emhart Technologies. To evaluate the internal tests we have been using Predire test center. Extensive tests have been made in order to provide the best possible process parameters, and specification of rivets and dies intended to future production. One of the goals was to minimize the number of variants for rivets and dies, for respectively product. This has been realized so far.

5. Results and deliverables

After implementation of the project, we have been able to recommend rivets and dies, which are suitable for a number of new products to be developed for the new car projects that will come in the future.
The products can´t be specified because it is confidential information.

5.1 Delivery to FFI-goals

2.2. The program's specific objectives
The goal for the “Sustainable Production Program” is to contribute significantly to reducing the emissions of fossil CO2 and other emissions from safe road vehicles and machinery by creating conditions for the production of innovative, environmentally friendly and safe products. The program also aims to contribute significantly to reducing all losses in the production processing and significantly reduce the environmental impact from the manufacturing process. This especially by a sharp increase in the use of virtual tools such as rapidly and thoroughly impact studies and production optimizations.
The fulfillment of the above objectives is considered to strengthen and further develop the Swedish automotive industry's competitiveness. The program is expected to significantly contribute to achieving the following product-related goals 2010-2015:

- Product requirements for lighter weight and increased passive safety, which in turn require new or improved materials and manufacturing processes are complied with,
  The following has been achieved in the project.
  We have been able to make a weight reduction per car by approximately 25 kg.

- using tools for virtual manufacturing preparation in order to perform fast and accurate impact and optimization studies has increased rapidly,
  The following have been used in the project.
  Process simulation software in the form of Process Designer / Process Simulator has been used for optimization of detailed solutions and process structures.

- manufacturing flexibility and procurement of production sizes for customized manufacturing solutions in order to significantly increase the manufacturing process and sustainability (from an ecological and economic perspective) has increased.
  The following has been achieved in the project.
  Because we use more self piercing riveting as joining instead of spot welding in the process, gives us less power consumption. We will invest in about 30pcs new self piercing rivet equipment for future projects.

- production of vehicles with conventional and new powertrains will take place in the same production system.
  The project has contributed to making it possible to easily adapt one of the products for different powertrains, this is done by a minor adjustment on some parts for the planned product. This means that they can be manufactured in the same process.

6. Dissemination and publications

We have worked intensive for most of the project period, with weekly reconciliation and reporting internally within manufacturing and product development. During November 2010 we organized an internal seminar for Volvo's process engineers.
Within the welding commission AG50 group of Mechanical joining we have presented non-confidential results. We also tried to generate interest in further development by being proactive in the Swedish trade magazine "Verkstäderna".

6.1 Knowledge and results dissemination

Internally, through seminars at Volvo Cars.
Externally, we can not present any considering confidentiality.

6.2 Publications

Only internal reports.

7. Conclusions and future research

The project has also provided ideas for new projects, ie a continuation of the development of mechanical joining. New solution for joining with self piercing riveting with mixed material combinations are under investigation. In addition, a project started up for making analysis on riveted joinings by CT scan (New FFI-project).

Learning of the FFI project has been great.
We can now recommend which rivets and dies, that are suitable for new products to be developed for the new car projects that will come in the future.
The material which has been tested for self piercing riveting with adhesive, are new for the car industry. Examples of new materials used, is the die casted aluminum.
Investments have also been made in the project, a self piercing rivet equipment (electric power). The machine was specifically designed to handle the material combinations which have been tested in the project.

8. Participating parties and contact person

Stefan Svensson
Lab Leader
Predire Testcenter AB
Bruksgatan 1
S-293 38 Olofström
Sweden
---------- We Test to Stretch the Limits..
Direct: +46 (0)456 820 086
Switchboard: +46 (0)456 820 080
Fax: +46 (0)456 410 90
stefan.svensson@predire.com
http://www.predire.com