

## **Lightweight construction meets crash resistance**

**System competency for reliable sheet metal joinings of all kinds in sheet metal assemblies and car bodies – this is how the ideal symbiosis of lightweight construction and optimal crash behaviour can be realized.**

New materials and material combinations in automotive engineering can only be used in a cost-effective way if there also exist appropriate and above all efficiently applicable technologies and processes for joining and connecting the sheet metal units. More than ever before it is important in modern automotive engineering to marry off such contrary subjects like energy efficiency, lightweight construction, comfort, and above all, a calculable crash behaviour. Particularly the arrays lightweight construction and crash resistance – arrays which are generally understood as conflicting arrays – are an immense challenge for automotive engineers. This is mainly due to the fact that the predetermined cost limits must be basically met. In this respect, it is of special importance to take into consideration the so-called hybrid solutions like units consisting of materials having different thicknesses and/or high-strength steel materials, units of aluminium and steel, as well as combined joining, clinching, and glue connections of the components. There are many answers in direct connection with all these questions, but only a few of them serve can at the very end be used for industrial production because the requirements of joining and connection technique cannot be satisfactorily realized in each case, i.e. with regard to a safe process, crash resistance and, what's most important, economy.

### ***Complex requirements***

Normally it is not only the question of realizing reliable sheet metal joinings by using special technologies and processes, but also of offering a maximum of stability of units and assemblies to endure crash situations. Here not only a maximal rigidity and stability are expected, but also a defined deformation behaviour. Sheet steel to sheet steel, standard sheet steel to high-strength sheet steel, thin sheets to thick sheets, aluminium sheets to sheet steel, sheets made of equal or different materials, washed, dried, or oiled, with or without coating, up to insulating material and foils used as intermediate layers – there is a diversity of requirements. And all the mentioned (hybrid) sheets shall be continuously joined to assemblies in a reliable way, safe in process and resistant to crash. Conventional thermal joining and assembling processes may be applied in a very restricted way, and even laser, as universal tool, reaches its limits soon, and this specially if different materials have to be combined or if coatings as well as intermediate layers must not be damaged in order to avoid corrosion. Conventional joining and connecting methods like screwing or riveting offer themselves as alternatives from the technical point of view, but they require comparatively high expenditures for production and assembly equipments and they need additional elements.

## ***Audi relies on TOX® joining solutions with its TT***

Consequently the specialists of automotive industry and its component suppliers are almost permanently engaged in the complete complex if problems regarding the optimization of the production of sheet steel parts and bodies are at stake. So also the construction and production engineers of the automotive manufacturer Audi AG in Neckarsulm, Germany when the development of the new generation of the sportcoupés Audi TT took place and the decisions on the selection and/or the determination of the appropriate production equipment had to be taken. Based on very good experiences made during the last years and at present with various vehicle series, the TOX®-Round Point metal joining technology was also taken into consideration for the TT and finally selected as efficient and economic solution for the production. TOX®-Clinching is applied to the bodies but also to several important sheet metal assemblies of the vehicle variants Audi TT Coupé and Audi TT Roadster. Besides this, a special pressing device for punching nuts is used so that TOX® PRESSOTECHNIK GmbH & Co. KG, D-88250 Weingarten, could bring in its innovative complete solutions for joining and connecting techniques at a total of eight assembly groups and body positions. In detail, the setting of rivet nuts on the fender bench, the joining and TOX®-Clinching of a hinge reinforcement with a deformation element and pressing of punching nuts in the spoiler. In addition, the joining of the hinge reinforcements and the inner part of the bonnet, as well as the joining of a reinforcement of the adjustable buffers also with the inner part of the bonnet. Hereto must be added the punching of the antenna hole and the joining and connecting of guide rails with the doors. Special attention must be paid to the most different combinations of materials and thicknesses, and there is also used a joining/clinch process in connection with glue application. On the one hand there are connected sheet steels of different thicknesses. But also the mentioned pressing and punching nuts must be set and holes must be punched.

## ***Highly efficient glue and clinching connections and more***

In case of Audi TT, the special joining of the inner side of structure 1 of the body constructions requires special attention. Here the B-pillar outside is joined with most different sheet parts of aluminium and steel, for example the wheel-house outside, B-pillar inside, top box (Roadster), and the extruded aluminium profile of the sill, and this is done with the combined process of glueing/ TOX®-Clinching. Here a highly automated production cell with robot-guided clinching tongs from TOX® PRESSOTECHNIK is used. In this case it must be specially emphasized that the TOX® technology is applied to the Audi TT in literally all zones of the body and thereafter also in the so-called crash zone. The highlight of the TOX®-metal joining system is not only the fact that the technology combines glueing and clinching here, as with only one TOX® tool set (punch and die) the total of 11 partly most different sheet metal combinations can be joined for the models Coupé and Roadster. The joining takes place with a washed aluminium plate, 1.3 mm thick, with steel plates of thickness 0.7 to 1.0 mm, with aluminium sheets of thicknesses 1.3 to 2.0 mm, and an extruded aluminium profile having a wall thickness of 2.0 mm.

## Summary

The tool combination is of the advantage because the otherwise needed number of different robot guns can be considerably reduced, and this is due to the high flexibility of application where no time is spent for tool change and set-up work with the necessary downtimes. Besides this, the expenditure for procurement and maintenance, as well the investment and repair costs are reduced. It must also be mentioned that TOX® PRESSOTECHNIK has not only supplied the TOX® metal joining technology, but also complete subassemblies for the plant, ready for joining/clinching and pressing/punching. These are, for example, robot tongs for holding and driving the TOX® clinching tool sets, and electromechanic driving cylinders for force/stroke motions, and the axis controllers for the electromechanic driving cylinders TOX®-ElectricDrive. The volume of supply included also the corresponding software, the process monitoring system, the spray systems for the TOX® tools, and last not least the spare tool sets for a quick change in case of tool rupture or wear. With the manifold joining, connecting, pressing and punching solutions for vehicles of series Audi TT Coupé and Roadster, the technology enterprise TOX® PRESSOTECHNIK GmbH & Co. KG has once again proven its comprehensive competency for system solutions by delivering to its customer Audi AG a through-going solution from one single and responsible source.

### Description of illustrations:

Fig.1 shows model Audi TT

Fig. 2 shows the TOX® robot tongs with electromechanic drive TOX®-ElectricDrive in the robot station

Fig. 3 shows the TOX® robot tongs clinching the B-pillar in the door entrance area

Fig. 4 shows a TOX® C-frame press CMB with pneumo-hydraulic drive TOX®-Powerpackage for pressing the punching nuts in the spoiler

Fig. 5 shows the manual working place for pressing the punching nuts in the provided spoiler

Fig. 6 shows the manual working place for the TOX®-Clinching of a hinge reinforcement to a deformation element. The clinching of two versions (left/right) is possible. The preselection of the type is done with a selector switch.

Fig. 7 shows the manual working station for pressing a rivet nut in the fender bench, left or right side

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