HIGH PERFORMANCE LASER WELDING SYSTEMS FOR THE PRODUCTION OF INNOVATIVE LASER WELDED AUTOMOTIVE COMPONENTS

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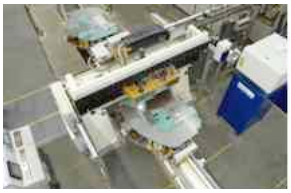
ThyssenKrupp Lasertechnik GmbH is leading in the development and manufacture of laser welding applications for the steel and automotive industry. Based on our know-how in plant construction, our laser welding systems have been developed for the production with optimized piece costs. Our engineering performance in the laser welding area is carried out in close cooperation with our customers. It comprehends the constant further development of existing and field-tested system concepts and - using all the resources provided by the ThyssenKrupp group companies - the new development of alternative system concepts. That is why our customers benefit from a closed experience chain with regard to the planning and realization of Tailored Blanks applications in the vehicle construction, but also in other applications like coil welding or manufacturing rotation-symmetric parts. With an experience since 1985, far more than 200 million blanks have been produced up to now by laser welding systems made by ThyssenKrupp Lasertechnik. The map below shows the geographical locations of ThyssenKrupp Lasertechnik production equipment

Tailored Blanks




Linear or non-linear seam
Conti laser welding systems for linear weld seams, gantry laser welding systems for non-linear weld seams. Depending on the production-specific requirements, the optimal solution can be chosen from a variety of system concepts.

High flexibility
The machine concept of the Conti laser welding system offers a maximum of flexibility for all possible blank forms and blank dimensions without any change of mechanical components.

Modular principle
The modular principle of our machines allows to start with a manual system with low capital expenditure, upgrading this system step by step to a complete system with fully automated handling, cutting edge preparation, dimple stamping for stacking, blank turnover etc.

Material handling
With the Conti laser welding systems, an exact positioning of the blanks is not necessary. The blanks will be adjusted automatically on their way to the weld position.

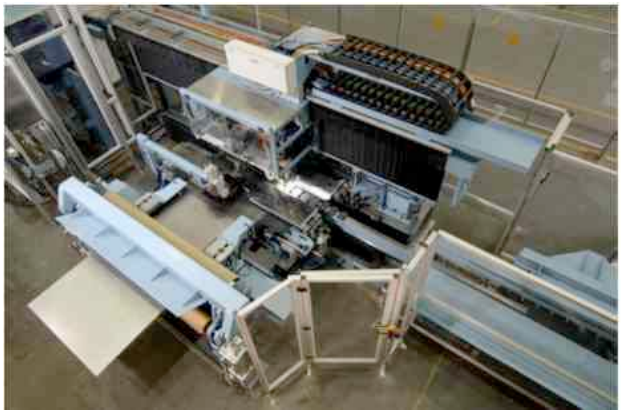
Productivity
Conti laser welding systems for linear weld seams captivate by highest flexibility and biggest output of all systems know worldwide. Gantry laser welding systems for linear and non-linear seams add to the program with regard to most different seam directions, part geometries and piece numbers.

Weld seam quality
The clamping and joining of parts on our laser welding systems is carried out without deformation of the raw material. The actual welding process does not alter the material quality beyond the welding zone.

Continuous improvement
By the feedback from the workshops, production-specific improvements are introduced continuously.

Quality assurance
Multi-sensor-systems allow on-line quality control of the Tailored Blanks.

Laser coil welding systems



Technology
Perfect joining of two coil ends in inspection and optimization lines or in continuously running coating plants. With laser cutting and laser welding in one system, joining most different materials – even high-strength – and different thicknesses is possible in the mix without any tool wear.

Weld seam quality
An automatic quality control can be integrated. There is no excess weld material upon welding. And an impression of the seam to adjacent layers is avoided. Like the seam of the Tailored Blanks, this seam can also be deep-drawn.

System concept
Due to the little space required by the very compact execution and erection on floor level, this system type is also suited to upgrade existing production systems. Compared with systems with mechanical cut, this system functions with a far more simple clamping technology.

Furthermore inductive annealing of the seam is possible and also an automatic quality control can be integrated.

Manufacturing of rotational-symmetric laser welded components

Technology
By the narrow and high-strength laser weld seams and the low heat input next to the joining zone, weld seams can be designed in the immediate vicinity of seals or running surfaces.

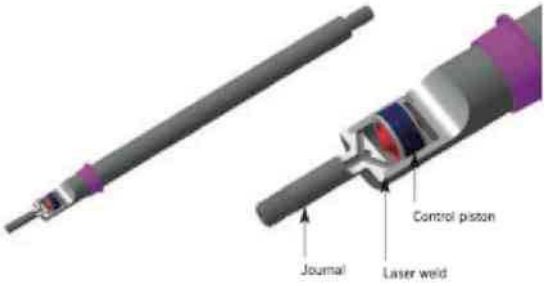
Quality assurance
Special parts require special test methods:
- automatic seam geometry measurement
- concentricity inspection
- process and quality data recording.

System concept
A great variety of different diameters or lenghts of the parts in combination with a variable number of weld seams can be treated. The modular execution allows the enlargement by joining operations and the integration of further function elements like cleaning or conservation stations. Fully automated handling with separation of bulk material or from loading equipment guarantee highest productivity.

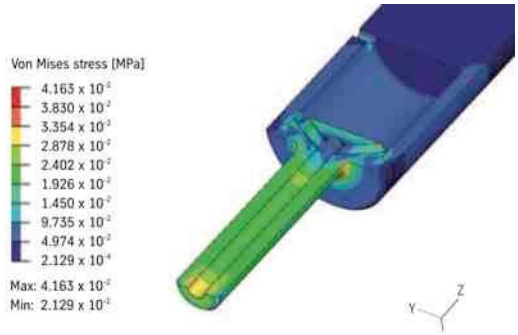
Tailored Orbitals – custom-made components for the automobile industry
Until now, rotation symmetrical automobile components have usually been made from starting materials such as tube or wire. Tailored Orbitals are starting materials that are made from combinations of materials of different thicknesses or types, or with different coatings. These tailored products can generate added value, as they do in the field of body manufacture, thanks to features such as lower weight, improved function and a possible reduction in cost. The advantages are realizable even for highly dynamically stressed components. Further applications can be expected in the areas of chassis, engine, transmission, powertrain and steering. ThyssenKrupp Tailored Blanks has established a service center for Tailored Orbitals at ThyssenKrupp Bilstein Suspension.

Advantage of laser orbital welding
Laser-welded components offer great functional potential in damper construction. The low heat input into the welded components associated with this joining process facilitates the manufacture of parts that are fitted with thermally sensitive components such as electromagnets and shock-absorbing elastomers like piston rods for active shock absorbers. The requirements for this component, which is important for safety (wheel guidance in the McPherson front suspension), are a controlled production process and a low heat input so that an elastomer component fitted into the piston rod, as used in the Mercedes A- and B-Class,

suffers no damage. These requirements for the A- and B-Class gave rise to various approaches. Welding was the optimal process from the viewpoint of process reliability. The next step was to carry out benchmarking of the various welding processes in close coordination with the end customer Mercedes-Benz. Various processes such as capacitor discharge welding, electron beam welding, MAG (Metal Active Gas) welding and plasmatron welding were available and were all put to the test. From the point of view of process reliability and heat input, capacitor discharge welding, MAG and plasmatron welding processes were rejected after the initial trials. Because the pilot project Mercedes-Benz A-/B-Class represents mass production of 1.4 million units/year, the process has to be attractive from the viewpoint of the cycle time and the cost of production over and above the requirements mentioned earlier. Laser welding was thus the process of choice. The development of laser-welded piston rods for the A- and B-Class was carried out in close collaboration with the end customer as well as the Group companies ThyssenKrupp Tailored Blanks, ThyssenKrupp Bilstein Suspension and ThyssenKrupp Lasertechnik, as the assembly specialist for parts handling. The optimal welding parameters and geometries were determined using FEM (Finite Element Method) simulations and trials. Finally, the laser-welded piston rods were qualified with the aid of component trials and vehicle endurance runs.



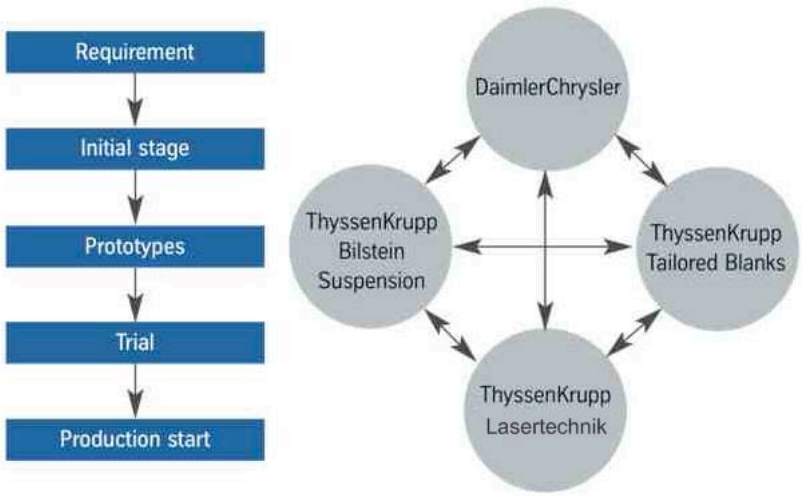
Details of the DampMatic piston rod with control piston and journal joined by laser welding



FEM analysis of stress distribution in the component

Procedure

The cross-segment collaboration between ThyssenKrupp Bilstein Suspension and ThyssenKrupp Tailored Blanks has helped both sides to break new ground and thereby extend their horizons for new ideas Fig. 3.

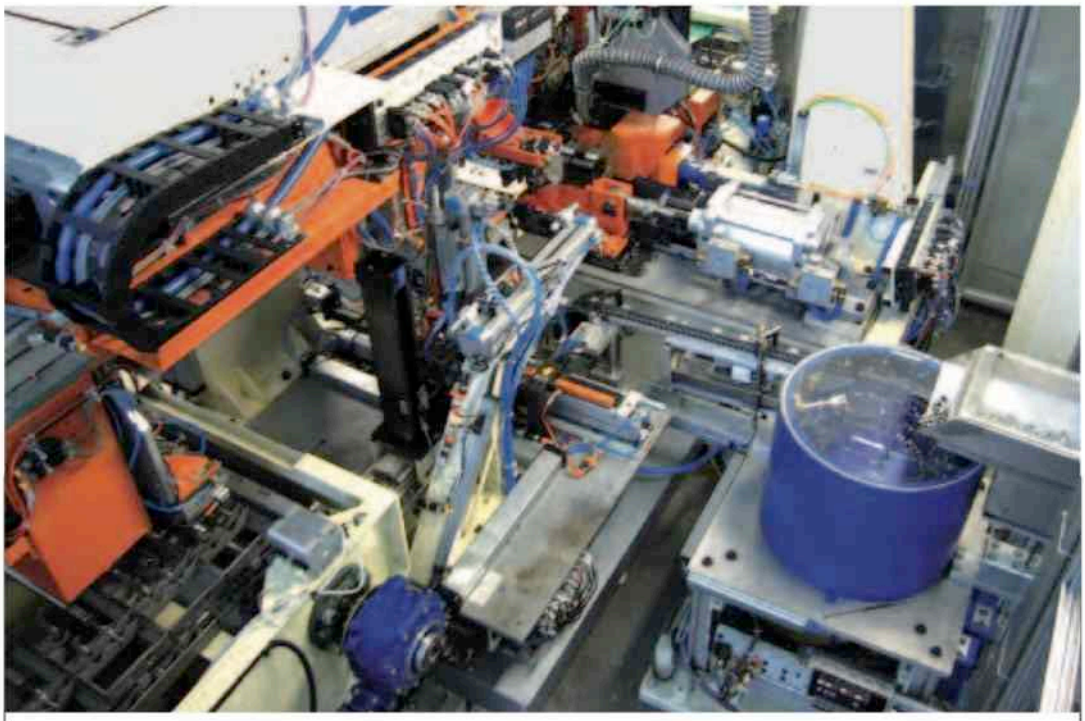


Collaboration of the development partners for the end customer Mercedes-Benz

The planning and manufacture of the production equipment by ThyssenKrupp Lasertechnik forms an additional building block in the cross-segment utilization of the Group's resources. In addition to the initial project of the A-/B-Class, ten additional applications in the field of piston rods and damper tubes for the Mercedes S- and M-Class were identified by ThyssenKrupp Bilstein Suspension and were brought to production within a span of one year Fig. 4.

ThyssenKrupp Tailored Blanks product range – Mandern plant; from left: Mercedes M-Class tube, 2 x Mercedes S-Class tube, 2 x Mercedes S-Class piston rod, 2 x Mercedes A- and B-Class piston tube.

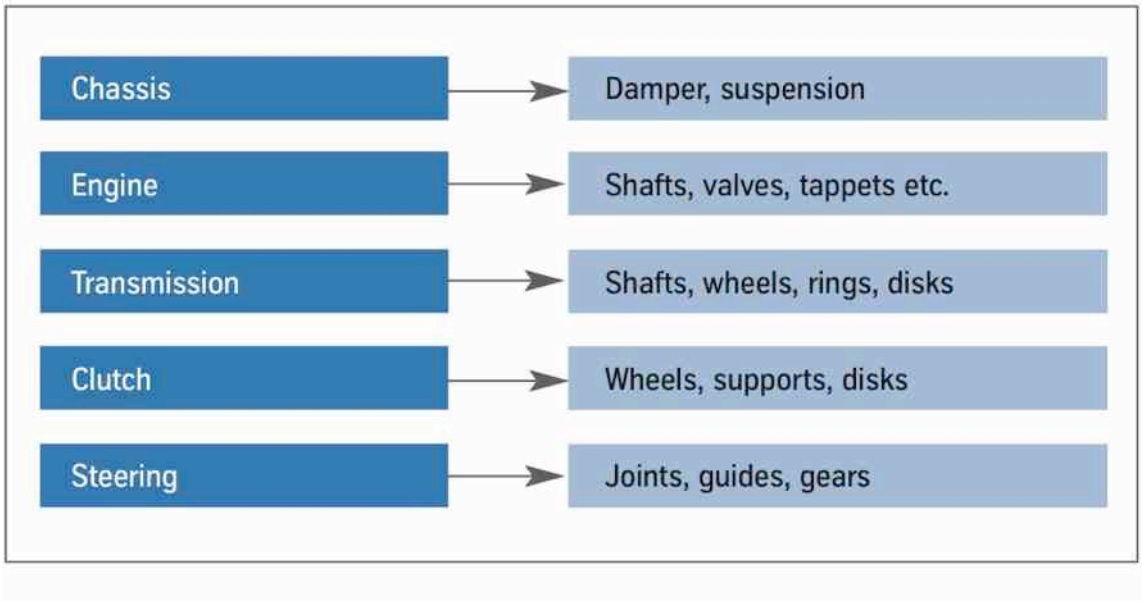
This resulted in an annual production volume of over 2 million units of the finished product. It proved possible to utilize a great deal of ThyssenKrupp Tailored Blanks' product experience in the area of body manufacture in this process. New business area for ThyssenKrupp Tailored Blanks The number of products in production requires a logistical optimization of the processes. Because the starting materials, with very few exceptions, originate from ThyssenKrupp Bilstein Suspension, the production carried out at the existing site of ThyssenKrupp Tailored Blanks was stopped and shifted completely to a newly founded laser services center at the main production location of ThyssenKrupp Bilstein Suspension in Mandern Fig. 5.



Location:	Mandern
Products:	Tailored Orbitals – rotation symmetrical products for automotive applications (dampers, chassis, engine, transmission)
Equipment:	3 welding lines for rotation symmetrical parts

Welding and assembly line for piston rods for the Mercedes A and B-Class, below: Specifications of the Mandern plant for the new business area

These measures optimized the production costs and increased the speed of the implementation of new projects. ThyssenKrupp Tailored Blanks has thus created a new business area in automotive technology for components such as dampers, chassis and powertrain. Previously, rotation symmetrical automobile components have been made from starting materials such as tubes or wires. Tailored Orbitals are starting materials that are made from combinations of materials of different thicknesses, grades or coatings. Tailored products in a modified form can generate added value, as they do in the body manufacturing sector Fig. 6. The customer benefits arising from the products can be presented as follows: New functions can be integrated into existing products (see DampMatic from ThyssenKrupp Bilstein Suspension). Improved functionality through lower weight or greater stiffness; Different materials, thicknesses and coatings can be combined. Larger number of variants guarantees application potential in different business areas.



Possible applications of Tailored Orbitals

As previous applications show, the advantages can also be realized for components subject to high dynamic loads. Of particular significance are products, which were only made possible through innovative laser joining technology, such as the DampMatic piston rods from ThyssenKrupp Bilstein Suspension described above.

Conclusion

ThyssenKrupp Tailored Blanks has established a new business area for Tailored Orbitals and operates a service center at ThyssenKrupp Bilstein Suspension. Thanks to joint know-how, this technology can be used in the ThyssenKrupp Group for cross-segment improvements to the product range. Tailored Orbitals can also be sold directly to end customers. With wider use of laser technology, additional tailored blank service centers both inside and outside the Group are conceivable. ThyssenKrupp Bilstein Suspension in collaboration with ThyssenKrupp Tailored Blanks has started to make intensive use of laser welding technology and is currently examining further areas of application in shock absorbers. These include sheet metal bolt-on components such as spring collars or the welding of sheet metal stops to shock absorbers that have already been filled and sealed. Furthermore, the existing products are continually subjected to technical design optimization and the manufacturing process is being constantly improved in order to attain the quality and cost targets of the OEMs (Original Equipment Manufacturers).

Reference

DR.-ING. KLAUS ZIMMERMANN, Plant Manager Mandern, ThyssenKrupp Tailored Blanks GmbH, Mandern
DIPL.-ING. ANDREAS MAI, Concept Development, ThyssenKrupp Bilstein Suspension GmbH, Ennepetal
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Top picture: Material flow from left (tube and base not welded) to the middle (welding station) to right (finished material).
Bottom picture: Laser-welded piston rods for Mercedes A- and B-Class.

ThyssenKrupp
Lasertechnik

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