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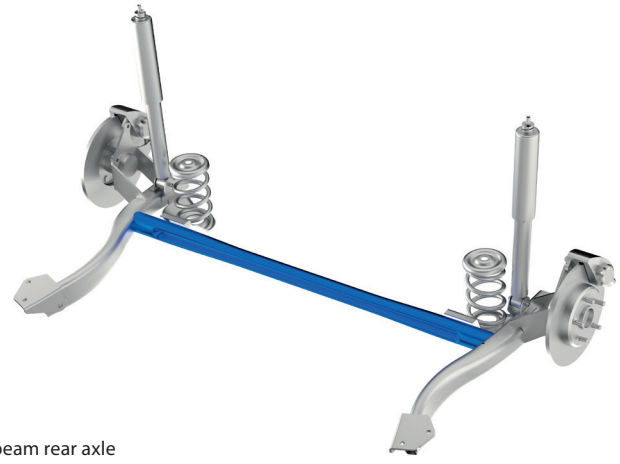
Lower the cost of tubular chassis applications by reducing production steps

Combining Tata Steel's soft forming tube process with the advanced high-strength steel grade, HR CP800-UC, tensile strength requirements for tubular chassis applications can be achieved without having to heat treat the tube. This eliminates costly process steps and reduces the total cost per part.

The challenge

A crucial element of vehicle design is meeting weight and performance targets within a tight overall budget. In the case of tubular chassis and suspension applications, such as the twist beam rear axle, important lightweighting and performance improvements have been achieved with the introduction of quenchable boron steels; a robust solution for applications requiring high yield and tensile strengths. However, further lowering the total cost of ownership of these parts – such as by decreasing process complexity for these quenchable boron steels – has proven to be challenging.



Twist beam rear axle

Tata Steel has addressed this challenge by combining the advanced high-strength steel (AHSS) grade, CP800-UC, with a soft tube forming manufacturing process. The resulting CP800-UC soft formed tube meets the lightweighting potential of quenchable boron steels, as well as the performance requirements of a twistbeam rear axle, whilse eliminating the need to hot form (quench and temper) the tube to achieve the required strengh level and complex shape.

HR CP800-UC tube

CP800-UC is a hot-rolled advanced high-strength steel with a very fine grained bainitic matrix microstructure. This microstructure is combined with small fractions of ferrite and martensite phases. The material fits Euronorm and VDA specifications for hot-rolled complex phase (CP) steel at a strength level of 800 MPa.

Table 1 details the mechanical properties of the CP800-UC material and a typical boron steel, as well as the mechanical properties of the two materials after the tube making process. Finished CP800-UC tube has superior formability (≥ 10%) compared to the hot formed boron steel tube (5-7%), and also has lower tensile and yield strength levels. However, the strength level of CP800-UC steel still meets the requirements for the rear twist beam.

Table 1: Mechanical properties of CP800-UC, CP800-UC tube, boron steel and boron steel tube

	R_p (MPa)	R_m (MPa)	A (%)
CP800-UC	660-830	≥ 760	≥ 10 (A_{80})
CP800-UC tube	670-780	≥ 760	≥ 10
Boron grade	340-440	500-580	21
Boron tube*	1025-1100	1420-1650	5-7

*After additional hot forming

Soft tube forming reduces production steps and cost

The mechanical properties of steel are subject to change during a tube forming process. This can affect material robustness and the remaining formability after tube making, but these changes are very limited if a soft tube forming process is used. The soft forming process provides nearly uniform straining around the tube's circumference, which ensures the retention of most of the mechanical properties of the AHSS with the addition of slightly enhanced yield strength levels. It also ensures there is the maximum amount of elongation left in the material to form complex shapes, such as twist beams.

The combination of the properties of CP800-UC and the soft form manufacturing process make it possible to produce the complex twist beam shape by cold forming the tube. Compared to the boron steel tube, it eliminates the necessity to heat treat the tube during or after forming, reducing the processing cost and increasing material robustness.

	Boron	CP800-UC tube
Relative price extra (€/per part)	baseline	+
Hot forming (€/per part)	++	eliminated
Scrap rate (%)	2%	eliminated

The above table summarises the differences between the production of the twist beam using the quenchable boron tube versus the optimised situation where the CP800-UC tube soft formed is made. The results show that the elimination of the hot forming process step and the reduction of the scrap rate result in significant savings per part.

Tata Steel
Automotive
PO Box 10.000
1970 CA IJmuiden
The Netherlands
connect.automotive@tatasteeleurope.com
www.tatasteeleurope.com/automotive

AM0217:200:EN:0318

www.tatasteeleurope.com