

# Steel R&D technologies

## Solutions for a technology-driven marketplace

**Carmaking has a high-technology image for good reason – over the past 100 years, almost every aspect of a car’s function has either been enhanced or newly introduced, in many cases as a result of new materials technologies.**

Today’s carmakers and their suppliers face significant technical challenges in proving out the benefits and implementation of the higher performance grades of steel that they have been seeking. R&D expertise and supporting services are essential to optimise the use of the grades and gauges of steel required for existing and new car product lines.

These are all areas in which the best steelmakers are involved, in partnership with their carmaker customers.

### **A technology commitment**

Corus invests £75m every year in research and development, looking at materials science, steel-manufacturing technologies and specific application technologies.

More than 900 researchers and industry experts at facilities in the UK and the Netherlands combine world-class innovation, cutting-edge technology and market knowledge, to offer Corus customers a truly unique combination of materials and application solutions.

Corus collaborates with universities, research institutes and its customers, to deliver innovative steel solutions and services for a constantly changing world.

### **Optimum materials selection**

Choosing the most cost-effective materials and manufacturing processes to make a new car can mean the difference between financial success and failure. Added to these challenges is the constant pressure to reduce the time taken

to bring a new car to market.

Therefore, the ability to choose the right materials for the task, based upon reliable engineering analysis and properties data, is critical to an efficient development cycle.

Many aspects of a part’s performance must be considered: How light can it be made? Will it ‘form’ correctly into an accurate shape? Will it split or tear during manufacture? Can it be joined with other parts? Will it corrode? How will it be dismantled at the end of the car’s life? Will it be durable in service? Can one material be substituted for another?

Corus Research, Development and Technology operations offer the in-depth knowledge, experience and facilities needed to provide answers for all of these questions.

### **Design and engineering**

Corus Automotive offers advanced technical services to help customers select the right materials. Corus services and expertise in structural performance optimisation for crashworthiness and durability, for example, enable rapid evaluation and characterisation of material properties for proposed or in-service components. Strength and stiffness, fatigue strength, high-speed impact properties, machinability and dent resistance must all be considered.



We use our experimental facilities to characterise materials and performance and generate specific experimental data for use by customers. Extensive use of computer-aided engineering design and analysis methods is made by Corus in areas such as Value-Analysis, Value-Engineering and other advanced methods to prove out a design’s durability, weight, manufacturing feasibility and true cost.

From these activities come new methodologies, such as the development of an integrated weld optimisation tool to improve the placement and length of seam welds on chassis subframes.

Studies such as ‘design for dismantling’ are also carried out to assess how easily materials can be recovered and re-used once the car has reached the end of its life.



Find out more: [www.corusautomotive.com/automotive\\_applications](http://www.corusautomotive.com/automotive_applications)

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### Applied research expertise

Researchers at Corus RD&T in IJmuiden, the Netherlands, and Rotherham, UK, offer advanced material data models to engineers in car companies who are charged with proving out formability. Tools like this are essential to simulate new design ideas and support decisions about which grades and thicknesses of steel to use in which parts – the virtual prototype. Like every other material, every gram of steel needs to justify its use in the modern car



### Enabling a smarter use of materials

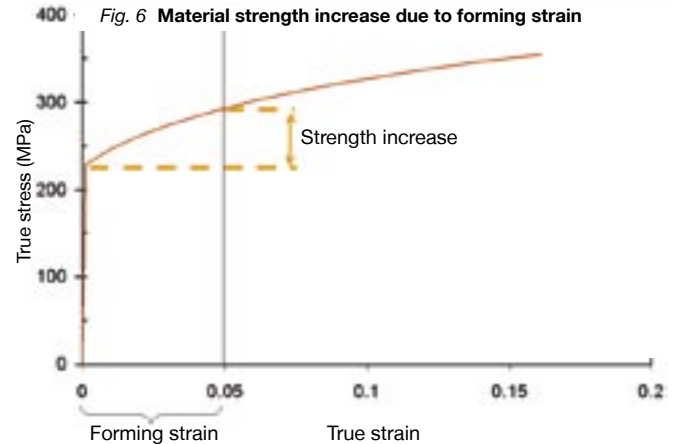
It is not just the applications for steel sheet that are researched, new steel chemistries for parts that must be highly durable at high temperatures such as engine valve-spring steels or the steels used to make transmission gears are also studied. New steels that are dimensionally stable during carburising (hardening) are just one example of this work.

### Technologies for manufacturability

Deep drawing, bending, roll forming, hydroforming and warm/hot-stamping, are all processes that can change the physical properties of a material. For components to become truly production-feasible, it is essential that carmakers have a solid understanding of how steel will behave as it is formed into shape within the press and other tools.

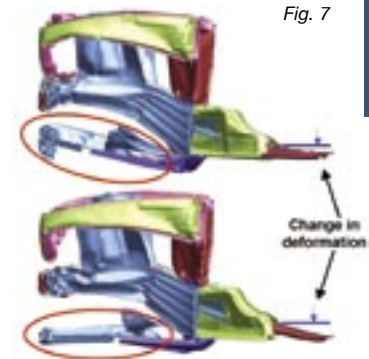
With growing use of high-tech steels and greater part complexity, Corus is increasingly called upon to help optimise the production of stamped parts on existing equipment. As virtual-prototype simulation models are now being used to produce products with shorter development times, it is essential to understand the material properties for those critical components that must withstand, for example, in-service crash and durability loads.

Corus has developed the unique and advanced Corus-Vegter material model. When combined with other specialist analysis techniques, including F2C<sup>®</sup> (Forming to Crash), F2F<sup>®</sup> (Forming to Fatigue) and F2S<sup>®</sup> (Forming to Strength), much more accurate crash and durability simulation results can be achieved – enabling a smarter use of the available material and design space. (See Fig. 6 and Fig. 7 opposite).



**Fig. 6** Simply using the standard factory-coil material properties can introduce inaccuracies in the prediction of intrusion in the subsequent crash analysis. F2C<sup>®</sup> improves accuracy by including in the crash analysis the predicted forming-induced strength and thickness changes, introduced by the manufacturing steps. This gives more reliable simulation results and provides opportunities to reduce weight.

**Fig. 7** This illustrates the differences in predicted intrusion performance of a vehicle front-end structure in a crash, which resulted when the formed properties were/were not included in the crash analysis. These subtle inaccuracies can easily mean the difference between a pass and a fail for the finished car design.



Top - Standard crash analysis

Bottom - Crash analysis including formed properties in subframe extension

Source of Fig. 6 & Fig. 7: Corus

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### Technologies for pilot production

Corus has developed advanced tools and techniques to validate and troubleshoot formability (including springback) in stamping, press-tool geometry review and tube-forming feasibility.

To speed this process, Corus has co-developed a portable troubleshooting tool for strain assessment, called Phast™. This is used to understand and visualise how a material flows as it is stamped into physical parts. A second, complementary technology, called In-Form™, uses a state-of-the-art laser device to scan and capture the 3D surface of a part or stamping tool. This enables accurate geometry data from the actual tools that will be used to be fed into a forming simulation model. Together, these tools ensure accurate press performance and low scrap rates once full-scale production begins.



### Technologies to enhance finish quality

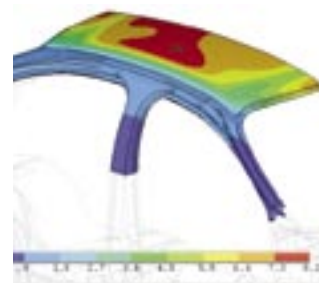
A great deal of the image projected by a car depends upon the accuracy of part dimensions, the quality of joints and the corrosion-resistance and adhesion properties of its surfaces. New coatings and methods for joining metals have been a key area of Corus research for many years.



### Coating technologies

Knowledge and application of surface technology has been used by Corus to improve corrosion resistance, enhance coating performance and engineer the surface appearance of metal parts for many customers over the years.

This expertise enables Corus to design the surface and substrate of its products as an entire system, delivering cost-effective performance enhancement. The company's knowledge of its customers' coating processes is a critical factor, enabling Corus to support them in optimising their own processes to achieve the best end-product properties. With the advent of alternative fuels and fuel-cell power generation, this is an area of metals technology that is expected to become increasingly important.



### Welding and joining technologies

The ability to make reliable metal joints is an essential technology in the assembly of a vehicle Body in White. Corus researches most joining techniques used in car manufacturing, from riv-bonding and laser welding for steel to fluxless aluminium laser-brazing. Our researchers also use finite-element modelling to study weld optimisation and the effects of different chemistries and coatings on joinability and post-weld corrosion proofing. Corus can also help its customers with weld-facility implementation.

#### Did you know?

Steel sheet used on the outer panels of a vehicle is around 0.7mm thick – about as thick as a fingernail.