



**13. Carburising and carbonitriding**

Our CARBOFLEX® technology is designed to improve the quality and uniformity of your carburising and carbonitriding furnace atmospheres. CARBOJET® offers additional speed and quality gains by increasing the diffusion of carbon to the substrate.

**14. Nitriding and nitrocarburising**

We offer reliable gas supply solutions for operations involving nitriding and nitrocarburising processes.

**15. Sintering**

Our new SINTERFLEX® technology controls the carbon potential of your sintering furnace atmosphere to produce body parts with complicated geometries at the right carbon concentration. Continuous monitoring optimises your sintering results. This energy-efficient solution also supports the hardening step with impingement cooling.

**16. Thermal spraying**

Thermal spraying is used to improve wear, heat or corrosion resistance, to structure surfaces or fine-tune material properties. Under our LINSPRAY® brand, we offer the full range of equipment, gas mixtures and supply systems for all spraying needs, also supporting body manufacturers with application know-how and consulting.

**17. Neutral hardening**

We can help you improve the quality of your neutral hardening atmosphere with our CARBOFLEX technology. To increase your efficiency even further, you can rely on our CARBOJET solution to circulate your furnace atmosphere more uniformly.

**18. Annealing**

Our experts can help you improve the quality of your annealed body parts and reduce running costs with our HYDROFLEX and CARBOFLEX technologies. And our CARBOJET solution can improve production efficiencies and surface finish further by enhancing both your atmosphere composition and its distribution.

**19. Sub-zero treatment**

Our CRYOFLEX freezers and technologies are ideal for sub-zero treatments. Using the effective cooling power of liquid nitrogen, these freezers reduce cooling costs compared with mechanical freezing equipment.

**20. Pre- and post-weld cleaning**

A non-abrasive cleaning procedure, carbon dioxide snow is the ideal way to pretreat all types of metals before and after welding. Not only is it an environmentally friendly, cost-effective way to remove oil and other agents prior to welding, it is also effective for removing fume residue from the weld seam after welding.

**21. Pre- and post-bond cleaning**

Although bonding is a faster, more effective way of joining different materials such as metals and plastics, it presents more complex cleaning challenges. Carbon dioxide snow cleaning is the ideal way to remove tensile oil or anti-corrosion oil from contact areas.

**22. Infrastructure cleaning**

Dry ice blasting with carbon dioxide pellets or snow is the ideal way to maintain your production infrastructure such as ventilation systems. Our CRYOCLEAN® solution is a non-toxic, non-abrasive and easy-to-automate solution that accelerates and simplifies regular maintenance.

## Getting ahead through innovation.

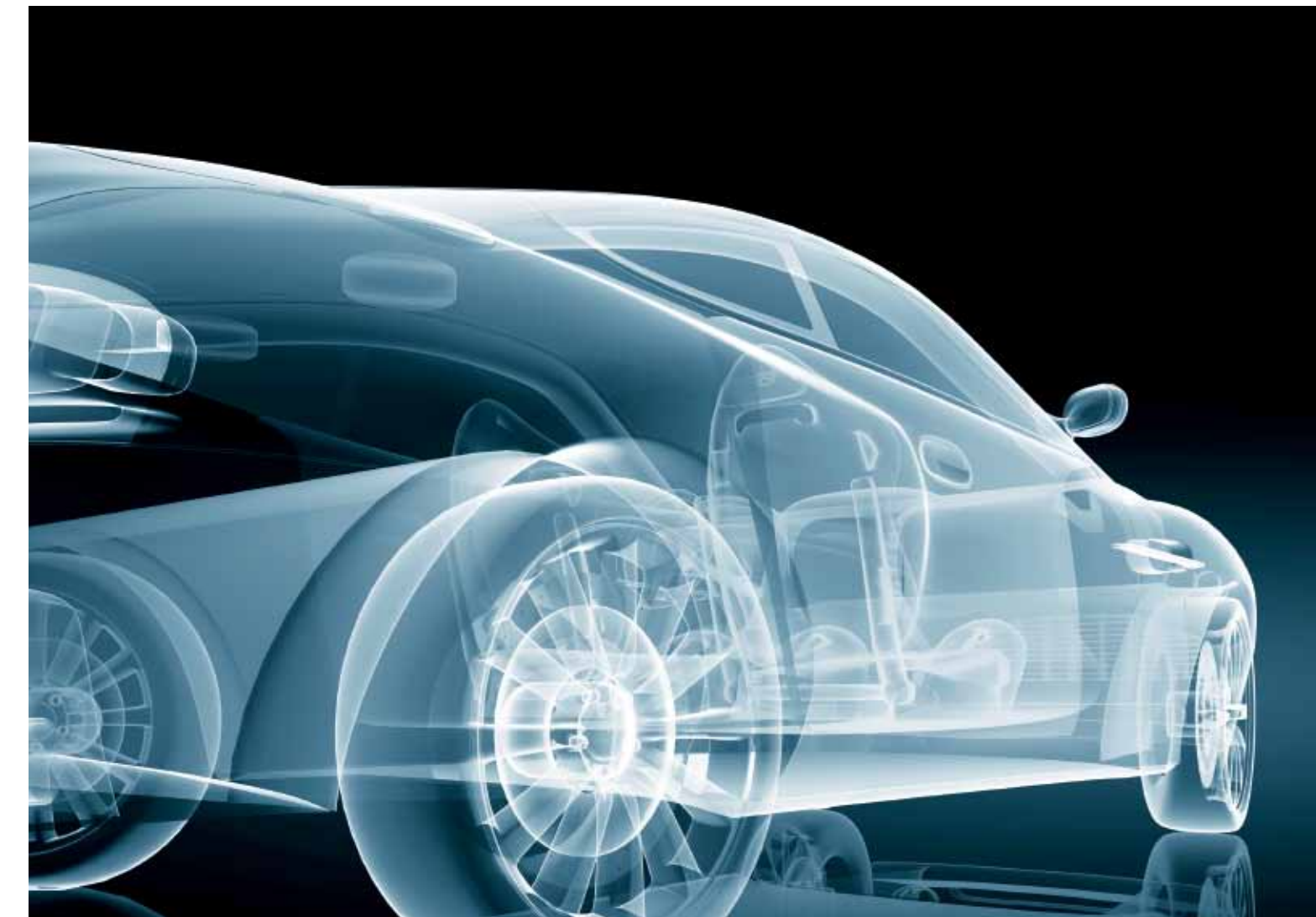
With its innovative concepts, Linde is playing a pioneering role in the global market. As a technology leader, it is our task to constantly raise the bar. Traditionally driven by entrepreneurship, we are working steadily on new high-quality products and innovative processes.

Linde offers more. We create added value, clearly discernible competitive advantages and greater profitability. Each concept is tailored specifically to meet our customers' requirements – offering standardised as well as customised solutions. This applies to all industries and all companies regardless of their size.

If you want to keep pace with tomorrow's competition, you need a partner by your side for whom top quality, process optimisation and enhanced productivity are part of daily business. However, we define partnership not merely as being there for you but being with you. After all, joint activities form the core of commercial success.

Linde – ideas become solutions.

# Automotive excellence. A frame for success.



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# Partner of choice for the automotive industry. Supporting car body manufacturing processes.

## Defining driving dynamics

The car body, including the chassis, plays a defining role in vehicle dynamics, safety performance, general comfort and fuel efficiency. It has evolved significantly over past decades to meet rising demands for higher strength and safety, lower weight and increased fuel economy. These demands can often be best met through the tailored application of different and new materials – often in multimerial designs combining high-strength steels and lightweight alloys, for instance. Although these innovative and multimerial designs can increase competitiveness, they also present new challenges for various metal fabrication and heat treatment steps, including cutting and joining.

## Putting our expertise to work for you

At Linde, we have vast, cross-application expertise in the various gas-enabled production steps involved in fabricating car bodies. With a solid, hands-on understanding of the latest multimerial and processing challenges, our application engineers are committed to enhancing the productivity and cost efficiency of all your gas-related processes. They can even advise you on the process technologies best suited to your design goals for each region of the car. Building on the latest laser welding and cutting techniques, our experts can help you leverage the lightweight benefits of advanced, enhanced-strength

steel sheets to reduce sheet metal thickness and lower the carbon footprint of your vehicles. We can also show you how to optimise material properties and surface finish for greater structural strength and impact resistance.

Our broad portfolio of gases, gas mixtures, supply solutions and gas management services covers everything from welding, cutting and bonding through brazing and sintering to thermal spraying and heat treatment. We also offer effective cleaning solutions before and after welding and bonding, along with automated tool and equipment cleaning innovations. In addition, you can rely on our experts to help you explore ways of refining the individual steps in your process chain to increase your competitiveness even further. In the following, you can read how we can support various steps in the body manufacturing workflow.

## Complex workflow

Our application technologies extend along even the most complex, multimerial automotive process flows. Regardless of your material challenge, we have the ideal answer, accompanying you every step of the way – from the initial cutting, pressing and perforating steps through module assembly right up to final cleaning, coating and painting.

## 1. Laser cutting

Most of the flat-sheet, high-strength materials in a car such as roofs, doors and bonnets are precision cut with lasers. Our LASERLINE® range of high-quality gases uses oxygen and nitrogen to bring you the full speed, precision, flexibility and quality benefits of laser cutting.

## 2. Oxyfuel cutting

Oxyfuel cutting using propane and – in some cases – acetylene is employed to manufacture the axle on a car body. The high flame efficiency and heat transfer of our oxyfuel cutting solutions help increase the productivity and cost efficiency of your cutting operations.

## 3. Plasma arc cutting

Plasma cutting is a cost-effective and versatile option for customising body-in-white cuts, trimming pillars and panels and cutting 3D profiles, often matching the precision offered by laser cutting. We supply argon/hydrogen mixtures and high-purity nitrogen for optimum cutting results.

## 4. Arc welding – carbon steels

Carbon steel is used to make various body parts. We deliver a range of tried-and-tested CORGON® shielding gases tailored to gas metal arc (GMA) welding processes for all sorts of carbon steel. These argon-based mixtures use active gases in different concentrations to increase your productivity and weld quality.

## 5. Arc welding – aluminium

Our VARIGON® series is the perfect choice for metal inert gas (MIG) and tungsten-electrode inert gas (TIG) welding of body and exterior parts made from aluminium. These gases contain minimal amounts of oxidising agents with helium added for superior performance, faster welding speeds and higher process stability.

## 6. Arc welding – stainless steel

To suit all stainless steel welding and purging needs, we offer a wide range of CRONIGON®, VARIGON and FORMIER® shielding gas mixtures. These are designed to enhance the quality of your car body by enhancing wetting and penetration.



## 7. Laser welding

The speed, quality and precision advantages of laser welding make it an increasingly popular choice for roof seams, tailored blanks and body joints. Our LASGON® series of laser process gases was designed specifically to improve welding speed and weld quality.

## 8. Shrink-fitting

Shrink fitting is a convenient technique to assemble axle parts, for instance, when the tolerances between pieces are very close or there is an interference fit (negative tolerances). Our CRYOFLEX® technology and freezers provide precise, controlled cooling power to shrink shafts and complete the assembly.

## 9. Furnace brazing

Our HYDROFLEX® furnace brazing solution optimises your furnace atmosphere to achieve uniform heat transfer with optimum gas composition and consumption, thus reducing costs and improving the quality of your brazed seat components. Our experts can advise you on how to best analyse and control your brazing atmosphere.

## 10. Arc brazing

We can advise you on the active shielding gases, coatings, filler wires and process parameters guaranteed to maximise your benefits from arc brazing. These include lower heat input and less coating burn-off, minimal spatter formation, virtually no corrosion of the seam, low deformation and good gap bridging.

## 11. Laser brazing

Laser brazing is used for joints in the visible area of the body such as the bonnet lid. Laser brazing with coated mild steel does not require a gas, but aluminium and alloyed steels require the use of argon. We can support all your laser brazing needs.

## 12. Tempering

Tempering involves heating hardened or mechanically worked metals in the car body or powertrain in order to soften them and remove residual stress. We can support all of your tempering heating needs.