LIEBHERR

Transportation Systems
2018 – 2020

DE | **EN** | FR

From left to right: Holger Dörre, Adrian Gunis, Stefan Pachowsky, Dirk Junghans

Dear reader,

In the face of growing environmental awareness worldwide and the increasing changes in mobility, it seems likely that the transport of passengers and freight by rail will continue to play a significant role as part of the overall transportation systems of the future. However, the demands made in terms of reliability, efficiency and environmental compatibility are also increasing in parallel. The rail system must therefore be continuously further developed and made fit for purpose for the future so that it can survive in the long term as part of an integrated transportation network.

Liebherr-Transportation Systems is ready to face the associated challenges, and is consistently pushing forward with the development of innovative technologies and products with a high customer benefit in all product areas. In this context, this issue of our magazine is filled with a wide range of fascinating articles.

In the area of air conditioning, the development of environmentally friendly refrigeration technologies continues to form one of the essential pillars of our activities. There has been a rapid rise in demand for systems using natural refrigerants, not least because of the EU Regulation on Fluorinated Greenhouse Gases. We have therefore increased the level of our investment in these promising technologies, so that we can offer our customers a correspondingly broader range of products shortly. Alongside our air cycle air conditioning systems, which have proved their worth over many years, this will also include a further refined version with a far higher refrigeration capacity plus, for the first time, series-ready cold vapor systems using CO_2 as the refrigerant.

The outlook for our Hydraulics division is also very positive. In this sector, Liebherr has been able to expand its product portfolio considerably once again, including dampers for level regulation systems. In addition, we are also working within the framework of a research project with partners in the UK on the development of a system for the active radial suspension. The aim of this project is to considerably reduce wear on rails and wheels.

We have also further expanded our customer service activities, and not only in the well developed markets of Europe and North America. We are very pleased that our team in China has succeeded in gaining the first pioneering orders for the overhaul of complete air conditioning systems. This is particularly significant because of the continuing very dynamic, wide-ranging development of the transport sector in China.

Naturally, the development of our company is always closely interlinked with the dedication and skills of our employees. Without them, the successes described here would have been impossible. We would therefore like to take the opportunity to provide you once again in this issue with some interesting insights into the day-to-day work of our specialists.

We hope you enjoy reading our magazine.

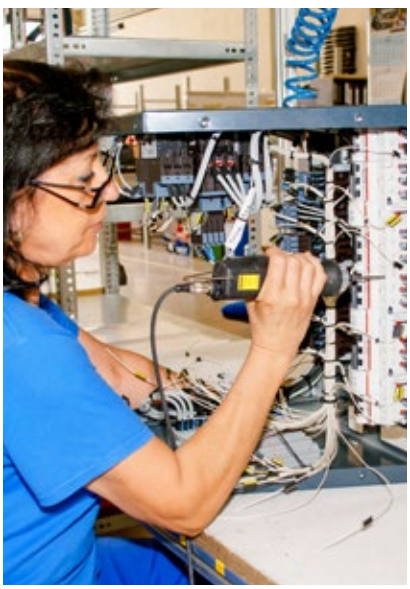
With very best wishes,

Holger Dörre
Managing Director,
Head of Research and Development

Adrian Gunis
Managing Director,
Head of Production and Supply Chain

Stefan Pachowsky
Managing Director,
Head of Finance and Administration

Dirk Junghans
Managing Director,
Head of Sales, Marketing & Customer Service



Impressions

Powerful technology on the one hand, skilled craftsmanship on the other – combined with highly qualified personnel, they form the basis for future-proof systems and solutions from Liebherr-Transportation Systems. The company never loses sight of the quality standards required, the comfort of the passengers and the precision and sensitivity needed to manufacture its special parts. To expand the skills within the company, knowledge transfer and team work are major priorities.

Experience

Learning by doing is a top priority at Liebherr-Transportation Systems. And so situations like this one, when experienced engineers pass on their knowledge to young colleagues, are a common sight. The transfer of knowledge also works the other way, of course. Thus, the company always has one eye on the future while also ensuring that it meets its own standards of consistently high quality.

Hot

Soldering is a classic technique which Liebherr also often uses. It is used every day in refrigeration and air conditioning technology in particular – in accordance with strict rules to ensure quality standards are maintained. These criteria apply for materials, procedures and monitoring. But they are also relevant for the “human factor”, because only well trained staff can manufacture products of a consistently high quality day after day.

Customized
High-quality materials processed and finished by experts: This is how quality products are made. Here we can see frames hand-made from metal sheet which are used for manufacturing air conditioning units, for example. Each of these frames involves numerous processing steps that are precisely coordinated with each other and ensure consistently high quality.

Heart

In regional trains or trams: Passengers on modern rail vehicles travel in comfort. And Liebherr takes its part in this: The various hydraulic systems produced by the supplier, for leveling, active roll compensation or yaw suspension and in anti-buckling systems for example, make sure that passengers travel safely and without unpleasant jolting wherever they are. The picture shows the heart of this electrohydraulic actuator system: the motor pump unit.

Technology

Environmentally Friendly Air Conditioning Systems Successful in Project with Federal Environmental Agency and Deutsche Bahn

What advantages are offered by air conditioning systems with natural refrigerants in comparison with traditional vapor cycle air conditioning systems operating with the refrigerant R134a, and how can the former sustainably cool and heat public transport vehicles? Liebherr-Transportation Systems successfully completed the project to examine and answer these questions as part of the Environmental Research Plan of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, Dessau-Roßlau (Germany). At the beginning of the year, the company, along with Deutsche Bahn (DB) and the Federal Ministry, presented the results of the project.

For the project, the air cycle air conditioning system developed by Liebherr-Transportation Systems was tested, measured and evaluated in Deutsche Bahn cars over a period of two years. The Liebherr technology is considered to be particularly environmentally friendly as it works without any traditional refrigerants at all. Instead, natural ambient air is used for cooling.

The “test vehicle” was a train from the ICE-3 fleet, series 403, the first model series in which individual cars were equipped with the air cycle air conditioning systems in the DB facility in Nuremberg. The train prepared for the trial phase started daily passenger operation at the end of June 2015. The Liebherr-Transportation Systems team had installed additional sensors and measuring systems for a long-term test in order to collect extensive operating data and thus allow a detailed analysis of the systems. The aim was to calculate the system’s energy consumption over its entire life cycle using data collected in real operating conditions and through all seasons. The focus was largely on the energy efficiency of the Liebherr systems in daily passenger service operation. The test train was kept under careful observation, particularly during the hot summer months of July and August. Together with the Federal Environmental Agency and DB, the Liebherr team thoroughly analyzed and assessed the data which was collected.

Reduced energy requirement and lower operating costs

Overall, when it came to annual energy consumption in realistic operating conditions, air cycle technology showed a clear advantage. Reduced energy consumption had an immediate effect in lowering the environmental impact of energy provision (depending on the power mix).

Another of the project's goals was to carry out a realistic total costs analysis in comparison with conventional systems operating with the refrigerant R134a. Here too, the air cycle technology came out in front: The lower energy requirement not only cuts environmental pollution, but also clearly reduces operating costs. In this context, the comparatively lower maintenance costs are a particular competitive advantage. As the entire air cycle air conditioning system comprises only a few components, it is very easy to maintain. And last but not least: While employees working in air conditioning system production and on rail operation need training in handling refrigerants, no special training is required for handling air.

Pioneering technology for environmental protection

With its innovative technology for air cycle air conditioning systems, Liebherr-Transport Systems is making an important contribution to sustainable passenger transport. At the presentation in Berlin, representatives from the Federal Environmental Agency were therefore very positive about the results of the joint project. Particularly as regards the EU's Fluorinated Greenhouse Gases Regulation no. 517/2014, which calls for a phase down of the volumes of partly fluorinated hydrocarbons (HFC) available on the market by the year 2030, the Liebherr technology represents an anticipatory alternative. It not only avoids greenhouse gases, but also remains available if the refrigerants are reduced to the required 21 percent, which could considerably limit the operation and maintenance of traditional systems in future.

Over 100 Liebherr-Transportation Systems air cycle air conditioning systems are already in use in Deutsche Bahn trains and have proved extremely successful in daily passenger service operation. For Liebherr, the encouraging results of the field data analysis are not just a confirmation but also driving factor to continue working on the further development of the environmentally friendly air conditioning of rail vehicles in a broader range of applications. With over ten years of operating experience, air cycle technology, which originally comes from aviation and has been developed for the rail industry by Liebherr, represents a reliable, environmentally friendly alternative.

Within the scope of the project, Liebherr-Transportation Systems was able to obtain useful information and insights that will enable it to meet its customers' needs and requirements even better in the future.

Liebherr air cycle air conditioning systems have proved reliable in everyday operation.

100 % Green: “Eco-Clim” Train on the Move in Occitania

Three years ago, the demonstrator of the Eco-clim air cycle air conditioning system was installed in a regional train operated by French rail company SNCF. After a trial phase lasting 24 months in total, the initial results are now available. The environmentally friendly system surpasses expectations in terms of passenger comfort, such as effective cooling output and the precision of the temperature regulation in the passenger compartment. The air conditioning system also stands out when it comes to reduction in maintenance costs.

The TER train will continue to run in the South of France until August 2019. Evaluation will continue on different routes here in order to cover a wide range of climatic conditions and altitudes, as in the past two years. “SNCF, as a group, is committed to improving its environmental performance. We wanted to test this technology in the TERs in Occitania in order to expand our set of data – both from a technical point of view and from a customer-experience point of view”, explains Jacques Rascol, Regional Manager of SNCF Mobility Occitania.

The Eco-clim air conditioning system is based on air cycle air conditioning technology, initially used by Liebherr in the aerospace industry, which uses ambient air as a coolant instead of conventional chemical refrigerants. This air conditioning technology can now be used in the next generation of trains. It is the next step on the way to tomorrow’s “green” trains.

The “Eco-Clim” air conditioning system does away with chemical refrigerants completely and uses pure air instead.

Double Saving Effect by Reducing Wheel and Track Wear

In many countries, rising passenger figures and increasing levels of goods transport are causing rail networks to suffer wear more quickly. To combat wear on the UK infrastructure, the Rail Safety and Standards Board (RSSB) invited applications for a subsidy which a consortium of Liebherr-Transportation Systems and New Rail, led by Grand Central Rail won on the basis of its idea: the development of an Active Radial Suspension System. This reduces wear on the wheels and tracks and enables the operators of rail vehicles to save on track fees and maintenance costs.

Liebherr-Transportation Systems, in association with its consortium partners, the UK rail company Grand Central Rail (part of Arriva Group) and NewRail (Center for Railway Research at Newcastle University), was awarded a grant from the RSSB – along with a funding from the UK Department of Transport – to develop an Active Radial Suspension System (ARSS) which can be retrofitted to an existing bogie. The aim of this technology is to reduce wear on both the infrastructure and the vehicles. The ARSS uses electro-hydraulic actuators to actively steer wheels on rail vehicle bogies, thus reducing wheel and track wear.

In the UK, the reduction of track wear is of particular significance, as track wear is a notable contributor to the Variable Usage Charge (VUC) train operators pay to operate trains on the UK rail infrastructure. The ARSS solution is expected to considerably reduce track wear, and the project aims to validate this, and its potential reduction of VUC.

The electrohydraulic actuators set the wheels with millimeter precision, depending on the curve radius. “In comparison to the passive control systems already available today, the active system is much more effective, since it can be optimally adapted to the track-wheel geometry and the different regional conditions of the tracks”, explains Paul Hofbauer, Product Manager Hydraulics at Liebherr-Transportation Systems.

Liebherr-Aerospace developed the technology of electrohydraulic actuators around 30 years ago for aerospace application. They are a good example of how Liebherr transfers technologies between its Aerospace and Transportation division. In 2007, the actuators were adapted for use in rail transport, and they have been used as standard in various applications since 2011, for example, for roll compensation or for active lateral suspension, which can allow higher train speeds with improved traveling comfort.

During the project, the consortium will first model the effects of retrofitting the Liebherr ARSS to an existing UK bogie design. Should the modelling demonstrate the expected benefits, the system will be installed on a trial vehicle and tested.

The project is expected to be completed by late 2019, which if successful could then be made available for commercial use by Liebherr, both in the UK and other world markets.

Seen economically, the installation of an ARSS for rail vehicle operators is doubly interesting. Firstly, driving in a way that reduces track wear will lower VUC. Secondly, the reduction in friction resulting from optimum curve running will also reduce wear on the wheels of rail vehicles. This will extend maintenance intervals, which means, for example, that expensive vehicle wheel replacement can be done much later than usual.

Modules are Key

People, goods and services flow seamlessly across the globe. Digitization is advancing and there seem to be no bounds to technological progress. This has an impact on the competitiveness of rail systems. As a supplier to train manufacturers, Liebherr-Transportation Systems is therefore constantly working on systems and solutions that will enable the rail vehicles of the future to be competitive. With the MACS 8.0, the air conditioning technology experts have developed an efficient HVAC system that can be flexibly configured with a high level of standardization.

MACS stands for "Modular Air Conditioning System" and is designed to meet the most sophisticated needs in the rail sector. Thanks to its modular architecture, this air conditioning system can be used in a range of very different rolling stock applications. The nominal cooling and heating power of each module is 8 kW. Thus, with a cooling power requirement of 24 kW, three modules are used. The modules can be freely integrated into the relevant vehicle design to meet the cooling power requirement. MACS 8.0 can be used for air conditioning both the passenger cars and also the drivers' cabs.

With their low installation height of 220 mm and weight of just 125 kg each, the modules can easily be integrated into various rail vehicles. They consume less power, since modules can simply be switched off, especially in low-load operation. Multiple cycle redundancy ensures maximum availability and the system also continues to work reliably even if one module shuts down. Thus unplanned downtime is kept to an absolute minimum.

Support throughout the entire life cycle

The nature of the modules and their easy handling allow cost-effective "off-car" repair, not least because of the low weight. For this, the module in question is simply replaced by a new one in the shortest possible time. The train can then continue with passenger operation while the faulty MACS module is repaired in the customer's workshop or on Liebherr's premises. In addition, Liebherr also offers its customers a customized spare parts supply concept. The integration of MACS 8.0 modules therefore offers considerable advantages in ongoing operation. In addition, the total cost of ownership is around 10 % lower than that of a comparable HVAC system. Liebherr's life-cycle engineering approach provides regular product upgrades. In this way, Liebherr consistently maintains the high maturity level of the product design.

A future-proofed standard product for maximum competitiveness

The modular architecture of MACS 8.0 will enable a simple changeover to CO_2-based air conditioning in the future, with the same operating safety and maintenance intervals. The system is a concept that will make rail vehicles even more competitive. And Liebherr-Transportation Systems' activities as a supplier to the industry cover more than this. With its air cycle air conditioning systems (air cycle technology), Liebherr is taking a major step towards 100 % environmentally friendly air conditioning of trains (read more on the next page).

Environmentally Friendly Refrigeration

Air and carbon dioxide (CO_2) are environmentally friendly alternatives to the traditional refrigerants that have been used in the air conditioning systems of rail vehicles until now. Liebherr-Transportation Systems is working hard to develop more sustainable solutions. The first CO_2 air conditioning system is currently being tested in real conditions in everyday rail transport, the second generation of air cycle technology has been triggered and the engineering team in Korneuburg is also researching into options for existing systems that are friendlier to the environment.

The European F-gas Regulation is what has focused attention on air conditioning technology using ecological refrigerants. In order to lower environmental pollution through fluorinated greenhouse gases, it will severely restrict the volume of standard commercial refrigerants that can be sold in the future. By the year 2030, only a fifth of the volume still circulating in 2010 will be available.

Cooling with only air

One ecological alternative is air cycle systems which only use the natural air around us for refrigeration. This process, originally developed for the aviation industry, is standard today. “Liebherr was the first company to take this technology from the air to the rail. We now have over 15 years of operating experience with air cycle air conditioning systems in trains and – like our customers – are very happy with the performance of the systems over this long period of time”, reports Dirk Junghans, Managing Director, Head of Sales, Marketing & Customer Service in Korneuburg. The next generation of air cycle systems aims to produce a higher refrigeration capacity with a smaller volume. The more compact design means that a smaller installation space is required. This continued development is a good example of the inter-divisional cooperation within the Liebherr Group.

The heart of an air cycle air conditioning system is the motorized cooling turbine that runs at 30,000 to 40,000 rpm. It is being designed by Liebherr-Aerospace Toulouse SAS, the competence center for air management system, customized to the requirements at Korneuburg. “Within our Group, we have all the necessary expertise to produce a comfortable climate in the passenger area and the driver’s cab and to manufacture all the important individual components. We have direct access in the Group to various technologies from different industries, which makes development faster and more cost-effective”, says Junghans.

Safer and more efficient CO_2 cooling

CO_2 technology is also climate-friendly, because the natural gas has a much lower greenhouse potential than traditional refrigerants. As part of a joint development project with Austrian partners, including the Austrian state railway company ÖBB, a CO_2 air conditioning system has been on trial in regular rail operation since the spring of 2018. The measurement data provide information about how the individual components and the entire system behave in real conditions. “This modern CO_2 demonstrator is a flagship project. One of the particular challenges when using CO_2 is the high pressure level in the refrigeration cycle. To monitor this, we have designed the safety architecture in line with all the standards agreed throughout the industry. A high level of efficiency is also guaranteed by the heat pump incorporated into the system, which can be operated outstandingly well with CO_2”, explains Junghans. In this way, a high level of heating energy can be saved when the outside temperatures are cooler. If the cycle is reversed, heat can be produced in a way that safeguards resources more effectively than electric heating rods.

The EU Regulation also applies for the operators of existing systems. The prices of traditional refrigerants have already risen significantly and there may be supply shortages in the future because of the limits imposed by the legislation. The life cycle of air conditioning systems in trains is between 30 and 40 years. “We are supporting our customers in keeping their existing systems operating safely and over the long term. For this reason, we are also actively seeking more climate-friendly options in this area”, says Junghans. One possibility would be alternative synthetic refrigerants, whose global warming potential (GWP) is lower than that of the chemical refrigerants R 134a and R 407c. But before this, investigations must be carried out into how replacing the refrigerants would affect the air conditioning systems so that they can continue to function to the same high level of quality as usual. Liebherr is therefore pursuing a twin-track strategy in its research so that both new and existing air conditioning systems can cool in a way that is more environmentally friendly in the future.

Without chemicals: Air cycle systems only use natural ambient air for cooling.

Sites

Continuous Service for the Current Fleet

As a Product Life Cycle Engineer, Richard Regner has many talents. At the Liebherr plant in Saline, Michigan (USA), he is an important link between the system manufacturers (OEM) and operators, providing support and assistance on all matters that could arise in connection with the Liebherr systems operated in the USA and Canada during the working life of the product. Speed, expertise and curiosity are the characteristics he needs. What he learns and experiences is then incorporated into subsequent product development.

Uncomplicated, helpful and open – this is the first impression that Richard Regner gives in conversation. And these are the ideal characteristics for his career as a Product Life Cycle Engineer which he took up at the company's location in Saline, Michigan (USA) four years ago. However, he has actually been working in various functions for Liebherr for a total of 17 years. Previously, Richard Regner worked in Lindenberg (Germany) in the Aerospace Division. Then the opportunity arose for him and his American wife to move to Saline. "I found it exciting to work in a new area and explore new tasks", he recalls. Where Regner had previously worked in the area of electronics, controls and sensors, he immersed himself in the world of hydraulics in Saline. "You'll get really dirty there, my colleagues warned me. But I didn't mind that", he laughs. He was attracted by the direct contact with customers and the wide range of different tasks involved. Since then, he has worked on behalf of Liebherr-Transportation Systems, Korneuburg (Austria) on products in service in the USA and Canada. His work can take him as far afield as Chicago, Toronto or San Francisco. In this, he is the initial point of contact for system operators. At the same time, however, he also supports vehicle manufacturers such as Bombardier, Stadler or Siemens in commissioning and integrating Liebherr products.

As a Product Life Cycle Engineer, Richard Regner supports operators of Liebherr systems in the USA and Canada throughout the product life cycle.

For the product's working life

The working life of Liebherr systems and the rail vehicle manufacturer's product series is at least 30 years. Regner's job starts after they have been delivered. He is the point of contact for everything, deals with questions or problems, and sends feedback from his experience with systems back to Liebherr Product Development and to the OEMs so that existing and new products can be improved. Sometimes identical replacement parts are no longer available for products that have been in operation for a long time. If this happens, Regner works with his colleagues in Korneuburg to find the right alternative.

When there are questions, Richard Regner (white helmet) and Ian Fetterolf, Technical Support (blue helmet) provide active support for operators' employees, as shown here at the Chicago Transit Authority (CTA).

In addition, every five to seven years, the operators carry out a regular overhaul of systems. For this, Regner trains staff on site, offers advice, shows them ideas or finds special tools. "We've even organized whole test rigs for our customers", he reports.

And even when all the systems in operation are running well – there are no quiet spells for Regner. Because apart from advising customers, he is also responsible for organizing and continuously improving repairs at the facility in Saline. Damage and defects in hydraulic units, dampers, actuators or simple electronics components can be quickly repaired on site. The Product Life Cycle Engineer prepares the necessary documentation and instructs the technicians.

Looking for challenges

Things will probably start hotting up for Regner again with the introduction of Liebherr's new leveling systems in the Chicago Transit Authority's (CTA) 7000 Series urban rail vehicles produced by CRRC Sifang America, which is planned from 2020 onwards (find out more on page 28). "This is very exciting, because it's something else new. My experience shows that cooperation with customers is very intense in the start-up phase. But Chicago is only four hours away from us by car – so it's possible to get there any time at short notice". And variety is what Regner loves about his job.

Double Premiere in USA

Liebherr-Transportation Systems presented its entire portfolio at APTA Expo in Atlanta, Georgia (USA) for the first time in October 2017. And it also showed the MACS 8.0 modular air conditioning system for the first time in the USA – two premieres at one go, and a successful exhibition debut.

MACS 8.0, the latest product from Liebherr-Transportation Systems, adopts a completely new approach to the standardization of air conditioning systems. The new system, which is suitable for rail vehicles of all types, appeals because of its minimized weight and very low installation height. Its particular design also makes it extremely flexible and at the same time guarantees maximum availability and a long working life. In addition, it is particularly economical in terms of energy consumption.

"At APTA Expo last autumn, we were able to demonstrate our commitment to our customers and partners in North America as well as worldwide. At the same time, the exhibition was an excellent opportunity to showcase our state-of-the-art and innovative products", explains Nicolas Bonleux, Managing Director and Chief Commercial Officer, Liebherr-Aerospace & Transportation SAS. Further highlights on the exhibition stand included a moving electro-hydraulic actuator used for the active lateral suspension of rail vehicles. This reduces wear on the wheel/rail interface whilst also improving travel comfort for the passengers.

HVAC systems re-discovered

Interested visitors were able to discover how the reliable HVAC systems developed by Liebherr-Transportation Systems function at the Liebherr stand in the Georgia World Congress Center: VR glasses and video animations provided some fascinating insights.

Partners in Rapid Development

Transport and infrastructure are areas that are booming in China. This is both an opportunity and a challenge for rail vehicle manufacturers and their tier 1 suppliers such as Liebherr-Transportation Systems. Because in parallel with the ongoing customer orders, the company also needs to develop its own skills further in order to counter market developments and requirements with innovative solutions. And it needs to do this directly on site.

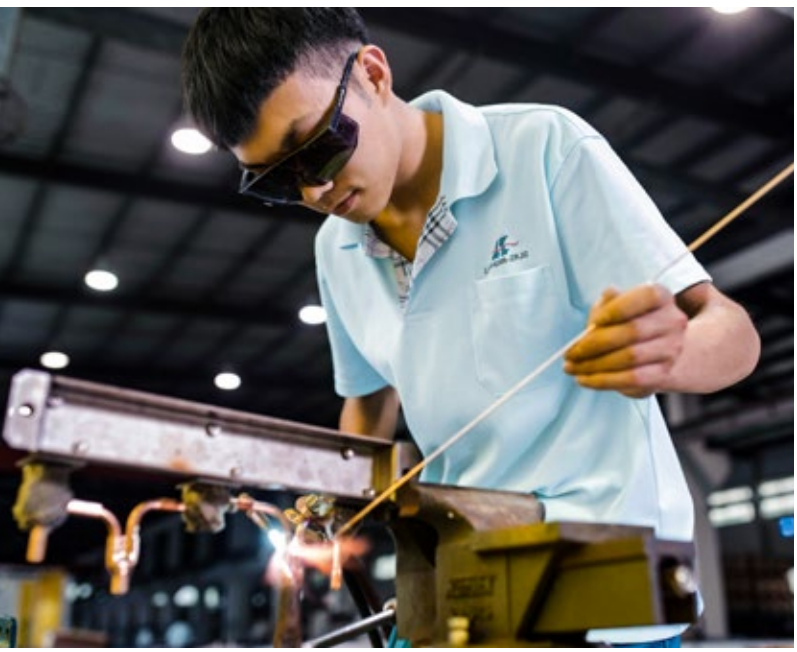
It's early in the morning and the working day at Zhejiang Liebherr Zhongche Transportation Systems in Zhuji has only just begun. The company site covers nearly 25,000 m^2 and houses the factory buildings, comprising production, test stands and workshops, plus the five-story administration building incorporating Customer Service and Development. In one of the meeting rooms there, Song Lixin, Technical Director HVAC, and his engineers and designers are already sitting in a meeting, talking and developing ideas. They are discussing adapting an air conditioning system to the customer's individual requirements and to the design specifications of the customer's rail vehicles.

Zhejiang Liebherr Zhongche Transportation System Co., Ltd. specializes in heating, ventilation and air conditioning (HVAC) systems for rail vehicles and their components. It is a joint venture through which the Liebherr Group has been supplying rail vehicle manufacturers in China since 2007. The company, which is certified under ISO 9001:2015 und ISO/TS 22163:2017, has a workforce of 120 people. One of them is Shi Shaojie. The young welder assembles copper tubes that are part of a component in the cooling circuit. He guides the solder wire and blow torch with a steady hand as he joins the materials together with a bluish-white flame. At another work station, his colleague Li Yanjie is busy assembling electric cables and plug contacts using crimping pliers. A few meters on in Production, an electrical team is fitting a control cabinet with a whole series of different cables. The air is full of concentration.

Massive expansion for infrastructure

1,500 HVAC units leave the factory each year. They can be installed in all types of rail vehicle: heavy rail vehicles, trams and metros. In a country defined by cities populated by millions, these forms of transport are an important factor in ensuring that public transport systems run smoothly. To guarantee the mobility of the masses of commuters, the state therefore invests hugely in these areas. On the one hand, a whole rank of cities of a million still need a metro network, and on the other, suburban districts also need to be linked to the cities.

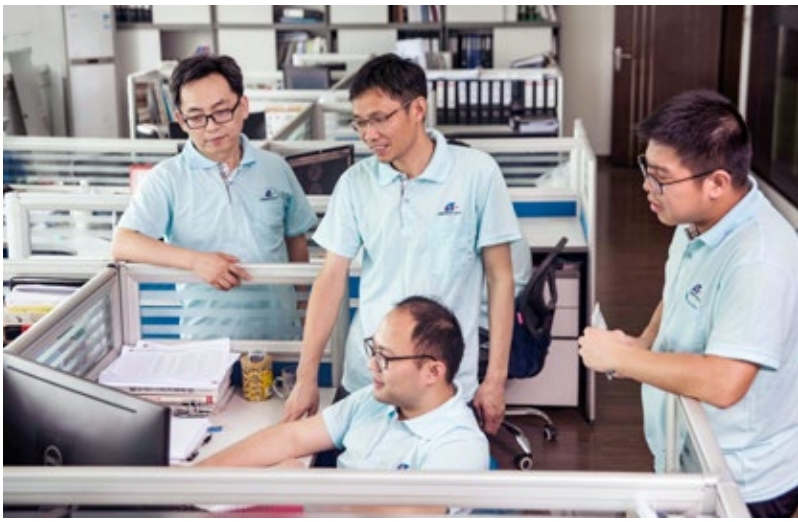
Liebherr-Transportation Systems wishes to help China in expanding this infrastructure by offering innovative solutions. The air conditioning technology specialist focuses on new



Welder Shi Shaojie assembles copper tubes using a blow torch.

The atmosphere in the production hall is full of concentration.

Quality testing is an essential aspect of the production of air conditioning systems.



Teamwork is a top priority at Zhejiang Liebherr Zhongche Transportation Systems in Zhuji.

technologies such as environmentally friendly air cycle air conditioning systems. There is considerable interest in these on the part of rail vehicle manufacturers, as this technology, which does not use the usual chemical coolants, protects the climate. And importantly, it is low-maintenance. This is an unbeatable argument for operators who are responsible for trouble-free transport services. However, the hydraulic actuation systems offered by Liebherr-Transportation Systems are also becoming increasingly significant for vehicle manufacturers in China.

Certified quality

Technical Director Song Lixin and his engineering team, who are responsible for the HVAC units, also ensure that the air conditioning systems actually do what their product description promises in the regular cycles of everyday operation. Before a product leaves the production plant, it is – of course – thoroughly checked and tested. And naturally, the results of the comprehensive tests are not just filed away; they are also analyzed so that they can form the basis for continuous improvements. It is therefore quite common to see Song Lixin and the product managers, electricians and, if necessary, specialist staff standing by an air conditioning unit at the end of the production line in the hall, going through a checklist to make sure that all the individual elements meet the customer's requirements.

Offering individual added value

The Liebherr Group has had sales offices and production plants at various locations in China since 1978. Thanks to this long-standing experience and its willingness to keep on developing its own products and adapt them to local needs, it is well positioned in the various market segments of this massive country. Local production according to Liebherr's own high standards is particularly important. This is why Liebherr-Transportation Systems is also continuing to work hard on training at its factories in China. The aim is to offer customers there additional added value, both as an initial supplier and in the areas of after-market and maintenance in what is currently a very dynamic market landscape.

And so the morning's project meeting continues into the second round in the early afternoon. This time, however, there are slightly different participants, and they are all sitting in front of a screen showing the CAD model of the air conditioning system to be modified. Engineers, designers and specialist department managers are discussing the morning's results and how best to implement them. They bring expertise and passion to the job – and are also a little under pressure. After all, the client is waiting for the ideal solution. And if there is one thing that's rare in this country that's dashing headlong towards the future, then it's time that's idly wasted.

Racing Into the Future

Professor Peter Mnich is a proven expert in railway technology and rail transport. He is also regarded as one of the pioneers in maglev (magnetic levitation) technology used in urban, regional and long-distance transport. As the Senior Representative of the German Railway Industry Association (VDB) in China, he seeks to promote cooperation between industrial companies from Germany and Chinese industry. In this interview, he talks about the dynamic development of the Chinese transport system, the latest trends and the opportunities for Western companies in this market.

Why is the Chinese transport market in particular so exciting and so important at the moment?
Since the many maglev research projects, especially in the 1990s, I have been working on creating stable bonds in the Chinese market. At that time, many major companies exported their products to China and expanded the existing rail transport network. This phase of pure product export, or product-associated cooperation with Chinese partners, is over. Since then, a new phase of collaboration between equals has started – which also represents a further opportunity for European companies in many respects. Because the Chinese transport technology market is the most dynamic market in the world, and is characterized by a clear delight in innovation. Here, many future-oriented technologies are being modified and, most importantly, applied. This is shown by the clear shift toward electromobility, the progress made with the high-speed network and its expansion, the commercial use of magnetic levitation technology – initially in urban and regional transport up to 200 km/h, later at up to 600 km/h in long-distance transport – and the interlinking of the various intermodular transport options via digital service providers.

Anyone who is familiar with China will know about its ultra-modern rail network and high-tech trains such as the Fuxing Hao high-speed train they have developed themselves. But manufacturers are also developing very modern vehicle concepts in Europe – what makes the difference?
The scale or the structures in which people think and operate. In Germany, for example, there is no widespread funding

for investing in innovation projects and high-tech solutions or for testing them. In China, on the other hand, various modes of transport are being innovatively driven forward at the same time. This development work goes way beyond the creation of new vehicles. And let us not forget that these reference projects form an important basis for successful marketing worldwide.

Can you give us some specific examples?
Firstly, there is the high-speed wheel/rail line between Beijing and Shanghai; today, the travel time for this 1,300 km route is four hours. On a comparable magnetic levitation train, the distance could actually be covered in three hours. This means that the connection, as an intermodular door-to-door trip, would be an unbeatable option in terms of time, costs, punctuality and reliability to the present combination of rail and flight connections.

Then there are the high-speed trains operated by the China Railway Rolling Stock Corporation (CRRC), which will be running from 2020 at speeds of 400 km/h instead of the present 300 to 350 km/h. The Chinese train manufacturer CRRC Zhuzhou Institute Co. Ltd., in turn, has developed a self-driving metro train: Known as Autonomous Rail Rapid Transit (ART), it is a mixture of bus and tram. It operates without rails and travels on rubber wheels. And as if that was not enough to turn the transport system upside down, China's engineers are working intensively on self-driving electric vehicles. In the past year alone, 770,000 new electrical vehicles, i.e. road vehicles with purely electric or hybrid drive, have been registered in China.

And we must not forget that the consortium Commercial Aircraft Corporation of China (Comac) is developing its own family of passenger aircraft, the C 919, thus entering into direct competition – at least in Asia – with the two world market leaders to date.

And all the modules can be used easily, thanks to advanced digitization …
It its attempts to integrate the various modes of transport in a way that is more user-friendly for end customers, China is years ahead of Central Europe. Digitization here is already an integral part of people's everyday lives – partly thanks to transport applications such as DiDi. This car sharing platform, which is similar to Uber, can be used not only to order taxis in China. Payment is also made digitally – using WeChat. Alongside pure Instant Messaging, the app offers various additional services such as the WeChat Pay payment service and is an essential part of the lives of the Chinese, who organize almost everything using WeChat.

The Liebherr Group has been active in China for around 40 years: initially with construction machines, then later in aviation and transport technology. Is the Group well equipped to deal with the upcoming challenges of the Chinese market?
As far as I can see, medium-sized and family-run companies like Liebherr recognized the importance of the Chinese market at an early stage. In addition, I can see that they are reconsidering or envisaging that China will increasingly be in the spotlight as a possible center of development. Which could be at least partly due to the high number of good graduates in rail transport engineering coming out of the universities of Southwest Jiaotong in Chengdu or Tongji in Shanghai, for example. In addition, however, the country itself is trying hard to achieve intense research cooperation so that it can also become a recognized leading market in this area too. In my view, this overall development is also reflected in Liebherr's activities in the areas of aviation, rail transport and, more extensively, in electromobility too. The company would do well to build up its own resources in terms of engineering services in research and development so that it can continue to participate in the long term in the dynamic development of the Chinese market and for the world market. And particularly with a view the other way, to the future of the rail industry when it comes to applications in Europe.

Prof. Dr.-Ing. Peter Mnich
has been special expert advisor for the German rail engineering industry and its companies and distinguished expert at the Tianjin Research Institute for Advanced Equipment at Tsinghua University since 2016. In the middle of May 2018, the graduate in electrical engineering also assumed the function of the "VDB Chief Representative" for the German Railway Industry Association (VDB) in China. In June 2018, he was appointed to the Chinese "High Level Foreign Experts/ Talents" program. His involvement in China was preceded by a number of (guest) professorships and teaching positions, including the universities of Dresden, Berlin and Nanjing. In addition, Peter Mnich worked as an expert, consultant and director for various institutions and projects such as the Transrapid test plant and the maglev project.

Efficient Cooperation Across National Borders

There are more than 1,000 km between Heinz Holzer's two workplaces – which is quite a distance for a commuter. For the last ten years, the overall production coordinator at Liebherr-Transportation Systems Marica EOOD has spent four days a week in Radinovo (Bulgaria) and one in Korneuburg (Austria), the headquarters of Liebherr-Transportation Systems GmbH & Co KG. He thus plays a major part in ensuring that the two independent companies cooperate as closely with each other as if they were one unit.

Heinz Holzer (2nd from left) in a discussion with two colleagues from Production in the Radinovo plant

Both locations focus completely on heating, ventilating and air conditioning (HVAC) systems. While Liebherr-Transportation Systems is responsible for the development and construction of prototypes, responsibility for the complete series manufacture of the systems lies with the Bulgarian plant. One of the important milestones for series manufacture was the building of the new production hall covering an area of 1,500 m^2 which has now been in operation for more than a year. "This expansion provides us with the space we need to continue to grow. For example, we want to manufacture even higher volumes in the future and are currently in the process of planning a new business model for this", explains Heinz Holzer. At the moment, around 2,300 HVAC systems are produced on average each year. Different lines run very flexibly alongside each other, producing anything from small series of just 30 a year to major projects of 700 systems of one type each year.

High standard of quality confirmed again

Heinz Holzer plans and coordinates projects and personnel, investments and costs – in fact, everything relating to the location's capacity. He is able to bring decades of experience in production planning across national borders to this. The company's certification under IRIS (International Railway Industry Standard), the yardstick for quality management in the rail transport industry which it has held for years, proves just how well this

complex task has succeeded in Bulgaria. “We reach our high standard of quality through investments and thanks to our employees, many of whom have been with us since the company was founded 14 years ago. This consistency within the team allows more and more knowledge to be built up, and we are able to use this to optimize our production”, says Heinz Holzer. This includes working according to the basic principle of the Continuous Improvement Process (CIP) throughout production across the board so that improvements can be made all the time.

But growth at the Marica plant also means building up other skills alongside series manufacturing, such as operational purchasing. Korneuburg has passed this activity to Marica. Since then, the team in Bulgaria has been organizing HVAC material not only for its own requirements, but also for the plant in Austria. “This ensures that series manufacture can also continue to run very efficiently for customers in future”, is how Heinz Holzer describes the advantages of this. The cross-border collaboration also proceeds smoothly because communication is very good, with very few language problems or translation requirements. Alongside English, many of the Bulgarian employees also speak German. Liebherr also encourages staff to learn a foreign language. This mutual understanding is also at least partly based on Heinz Holzer’s alternating presence at both locations. The overall coordinator is able to learn about various viewpoints personally and is thus able to communicate them across national borders in the best possible way.

Production line of HVAC systems in Radinovo

Heinz Holzer contributes a great deal to the close relationship between Korneuburg and Radinovo.

Liebherr-Transportation Systems Marica EOOD in Radinovo

The Liebherr Group has been represented in the Bulgarian market for many years. Liebherr-Hausgeräte Marica EOOD has been manufacturing high-quality cooling and refrigeration devices in Radinovo in the south of Bulgaria since 1999. The Liebherr-Transportation Systems success story began with a “little corner” in this factory in 2004. What started with an area of 300 m^2 and a workforce of 7 has now become an independent production company with more than 270 employees and production areas covering over 10,000 m^2. Which was sufficient capacity to take over the complete series manufacture of heating, ventilation and air conditioning (HVAC) systems in 2016.

Customer Service

Service Expanded in Switzerland

In order to provide Swiss rail vehicle manufacturers and operators with even faster and better support, Liebherr-Transportation Systems has opened a new service location in the Canton of Lucerne. The experienced service team has set up an office in Reiden at the premises of Liebherr-Baumaschinen AG. The site offers ideal conditions for providing customers with tailor-made services for their air conditioning and hydraulic systems efficiently.

Alongside preventive and corrective maintenance, it also offers system optimizations, warranty support and spare parts management. “Our principle is to be wherever our customers need us”, says Wolfgang Boettcher, Director Customer Support at Liebherr-Transportation Systems GmbH & Co KG. “Our service facilities throughout the world stand for high-quality customer service with short response times, and we are delighted that we can now offer our customers in Switzerland even more added value when it comes to looking after their fleets.”

Also in the service portfolio: The TWINDEXX Express double-deck carriages from Bombardier operated by the Swiss State Railway company SBB incorporate active roll compensation from Liebherr.

Technology for a Power House on Rails

Liebherr-Transportation Systems has won a contract from Siemens AG for the supply of active yaw dampers. They will be installed in the Vectron locomotives which Siemens produces for Austrian state railways (ÖBB). The contract awarded by Siemens marks the first time that the systems have been used in series in locomotives.

The active yaw damper is a compact, completely enclosed, maintenance-free hydraulic system with a cylinder, position sensor, pump, valves and oil reservoir connected with an ingenious electronic control. It fulfills the function of a conventional yaw damper and at the same time is an actuator that actively supports the bogie when turning. When the locomotives travel along tight track curves, the active yaw damper reduces the transverse forces between the wheels and the rail. Apart from reducing wear to the wheel and rail, it also has a positive effect on pulling power.

In March 2018, ÖBB presented its first locomotive of the 1293 series in Vienna – a power house nearly 19 m long and 90 metric tons in weight which shows its quality in both goods and passenger transport. The Vectron reaches speeds of up to 160 km/h, or up to 200 km/h if modified. ÖBB will receive a total of 30 locomotives from Siemens in its first call-down of a 200-vehicle framework contract. Test and trial runs have successfully demonstrated the function of the active yaw damper in operation.

As a multi-system locomotive which can operate in many different countries and under varying technical conditions, the Vectron sets new standards in cross-border goods and passenger transport. Designed for use with the four most important power systems in Europe, the new ÖBB locomotives will run from Austria and Hungary to Italy, Croatia, Poland, Rumania, Slovakia, Slovenia, the Czech Republic and Germany.

ÖBB's new Vectron locomotive weighs 90 metric tons. Liebherr's active yaw dampers are on board.

Programs & Contracts

Barrier-Free Boarding in the “Windy City”

Liebherr-Transportation Systems is delighted to have found a new customer who has placed a major order: The company is to develop and deliver 400 hydraulic level control systems for CRRC Sifang America, Inc., which has its headquarters in Chicago Illinois (USA). The order also includes the option of up to 446 further level control systems. Liebherr is thus consolidating its position as the leading supplier of level control systems in the North American market.

The system adjusts the vehicle’s floor to the height level of the platform at the urban rail stations in Chicago, enabling barrier-free boarding and disembarking for passengers with reduced mobility.

They are expected to come into operation in 2020, in the Chicago Transit Authority’s (CTA) modernized 7000 series urban rail vehicles. They will initially replace the 2600 series vehicles there, which currently travel on the lines connecting the two airports Chicago O’Hare International Airport and Chicago Midway Airport with downtown Chicago.

Reliable Service of Air Conditioning in Ningbo Metro

Zhejiang Liebherr Zhongche Transportation System Co., Ltd., in Zhuji (China) has been awarded the contract to maintain and repair 264 passenger compartment air conditioning units. The customer is the Chinese company Ningbo Rail Transit Group Co., Ltd. The air conditioning units ensure comfortable traveling in 132 metro vehicles manufactured by CSR Zhuzhou Electric Locomotive Co., Ltd. (China). The vehicles are used on Ningbo Metro Line 1.

Line 1 was taken into operation in the coastal city of Ningbo in the eastern Chinese province of Zhejiang in 2014. The line stretches over 46 km and includes 29 stations, starting in Gaoqiao, which lies in the West, in the Haishu district of the megacity, and running to the Xiapu metro station in the district of Beilun.

“This new order underlines the trust that the Ningbo Rail Transit Group places in both the technology and the customer support provided by Liebherr in China”, says Dr. Yuan Lue, General Manager of Zhejiang Liebherr Zhongche Transportation System Co., Ltd.

More Comfortable Rides on the Trams in Mile

Liebherr-Transportation Systems is fitting nine light railway vehicles with anti-buckling systems. They will be used in local public transport in Mile, a city of over 500,000 inhabitants in the Province of Yunnan in Southern China. The customer is CRRC Zhuzhou Electric Locomotive Co., Ltd. and the contract is being carried out via Zhejiang Liebherr Zhongche Transportation Systems Co., Ltd. This company is a joint venture of Guangzhou Zhongche Railway Vehicles Equipment Joint Stock Co., Ltd. and Liebherr and is located in Zhuji (China).

Anti-buckling systems increase ride comfort and reduce wear on the wheels.

The hydraulic anti-buckling system developed by Liebherr-Transportation Systems ensures that the specific clearance profile is kept at all times and under any operating conditions which may occur. This system is monitored by a standard electronic controller BK3 integrated by Liebherr. The anti-buckling system substantially improves ride comfort and reduces wear on the wheels as the position of the bogies is simultaneously controlled by a common hydraulic system.

“The contract with CRRC Zhuzhou Electric Locomotive Co., Ltd. highlights the competitiveness of the solutions we offer in the field of hydraulic actuation for rail vehicles”, explains Dirk Junghans, Managing Director, Head of Sales, Marketing & Customer Service of Liebherr-Transportation Systems GmbH & Co KG in Korneuburg. “We are not only responsible for equipping the trams with our anti-buckling systems; we also maintain them throughout the whole life cycle of the trams.”

Comfortable Commuting for Metro Users in Wuhan

Liebherr-Transportation Systems has won an order from Wuhan CRRC Co., Ltd. (China) to supply air conditioning systems for the rolling stock for the Wuhan Metro line. 372 air conditioning units and 62 driver‘s cabs ventilation units in total will be integrated into 31 trains, ensuring that passengers and drivers can commute in comfort.

The Wuhan Metro is an elevated and underground urban metro system in the city of Wuhan in Hubei Province (China). It is operated by Wuhan Metro Co., Ltd., which intends to use the vehicles in the district of Caidian for the Wuhan Metro Line 4 project.

The air conditioning was customized in line with Wuhan Metro vehicle technical specifications and the related standards. It regulates the interior temperature and humidity level in the trains. The system consists of two parts: One part comprises two roof-mounted packaged saloon units located in the first and third quarter of each car. These supply the interiors below them with air. The second part is a ventilation unit in the driver’s cab, which absorbs the air after treatment from the neighboring saloon units.

Further Development of E-Mobility

When you touch the charging plug of an electric vehicle, you might suddenly flinch. The reason? The heat that can develop at the cable and plug during charging. To prevent this from happening, Liebherr-Transportation Systems has developed a special active cooling unit just for charging stations. The initial prototypes of these thermal conditioning units (TCU), as they are called, have already been tested by ITT Cannon in Weinstadt, one of the leading manufacturers of plugs and plug connections, together with Efacec Electric Mobility, S.A., Moreira da Maia (Portugal). They have now been installed in the first network of high-power chargers (HPC) in the USA and in Europe. The network has an output rating of 350 kW, a maximum power of 350 A and a high voltage of 1,000 V. Feedback has been very positive. Liebherr's technology cools the high-performance charger cable and the charger plug reliably in all environmental conditions.

© ITT Cannon

With the development of these active cooling units, Liebherr is opening up a new product range and is already working on other units for the world's growing demand for charger facilities. A further solution in the field of cooling and electromobility is cooling units for the batteries of electric buses, which Liebher also provides.

Comfort for Commuters in the Île-de-France Region

Bombardier commissioned Liebherr-Transportation Systems to equip 52 NAT (Nouvelle Automotrice Transilien) regional trains with compact air conditioning systems. The trains, also known as "Francilien" run from the Paris Saint-Lazare, Paris-Nord and Paris-Est stations to the entire Île-de-France region, connecting the towns and suburbs with the French capital.

© Bombardier C. Recoura

The highly efficient and reliable air conditioning systems offer optimal comfort for the drivers and passengers on the seven-part end-to-end accessible trains. In total, Liebherr is providing 104 systems for driver's cabs and 364 systems for passenger compartments. The trains are being built in the Bombardier plant in Crespin, in the north of France near the Belgian border. The 52 new NAT will replace among others the model series Z 6100 and VB 2N. The delivery of the air conditioning systems to SNCF is scheduled to take place between June 2019 and mid-2020.

Air Conditioning Comfort for Hungarian State Railway

In 2018, Liebherr-Transportation Systems will supply a total of 20 underfloor air conditioning units for new type IC+ InterCity passenger cars (Bpmz series) to the Hungarian state railway operator MÁV-START Zrt. in Budapest. The cars will be used initially on domestic and international routes including the Budapest – Debrecen – Nyiregyhaza connection and then in Sopron and Szombathely as well as Pecs, Kaposvar, Dombovar and Miskolc.

The coaches were developed at the MÁV-START repair workshop in Szolnok. Ten will be second-class saloon cars, and the other ten will be multi-purpose carriages. “We have been a partner to the eastern European rail industry for many years. Orders like this confirm to us that we are on the right track with our portfolio of services”, says Pascal Rapp, Director of the Eastern Sales Region of Liebherr-Transportation Systems. “We are delighted that our Hungarian partners trust in our products and expertise.”

Maintenance of Combino Roll Couplings in Basel

© BVB

Liebherr-Transportation Systems has received an order from Basler Verkehrs-Betrebe (Switzerland) to provide maintenance for the hydraulic roll couplings of 28 Siemens Combino low-floor trams until 2020. The work will be performed on 156 control cylinders and 78 hydraulic accumulators. The systems were developed for Combino vehicles by Siemens in Basel and Bern in collaboration with Liebherr.

The system reduces the strain on the car body structure and chassis components on uneven or winding tracks, because the car bodies can rotate independently of each other. In order to prevent the car bodies from rolling in to each other, a transverse coupling bar has been installed between the bodies in the roof area of each vehicle. A patented circuit configuration automatically corrects any misalignments. The system thus provides greater protection against derailing due to twisting and considerably contributes towards increasing the service life and reliability of the low-floor trams.

Reliable Air Conditioning in Slovakian Trains

The Slovakian rail vehicle manufacturer ŽOS TRADING s.r.o, Vrútky, has asked Liebherr-Transportation Systems to supply air conditioning and heating systems. The under-floor split air conditioning systems will be installed in open saloon cars belonging to the Slovakian passenger rail company Železničná spoločnosť Slovensko (ZSSK), Bratislava. Each unit comprises an air processing and cooling unit as well as the necessary refrigerant ducting and a system controller installed in an electrical cabinet. The equipment complies with the latest fire protection standard EN 45545 HL2. Delivery of the systems started in December 2017. The last units will leave Liebherr’s manufacturing plant by the end of 2020.

Liebherr-Aerospace

3D Printing Technology Made by Liebherr: The Next Milestones

In March 2017, an Airbus A380 test aircraft flew for the first time with a spoiler-actuator valve block made by Liebherr-Aerospace using a 3D printer. Since then, a lot has happened in additive manufacturing at Liebherr-Aerospace – and development is advancing at a fast pace.

While long-term experience with the technology is gained during the flight test on the A380, Liebherr-Aerospace in Lindenberg has been working mainly on optimizing and documenting the individual process steps. In the fall of 2017, the team reached a key milestone: Liebherr-Aerospace Lindenberg GmbH is one of just three companies in Germany to be authorized by the German Federal Aviation Office (Luftfahrtbundesamt, LBA) to produce flight components using the additive manufacturing technique. This great success means that Liebherr is a recognized pioneer and trusted partner in the aircraft world. Specific plans are already underway for the industrial launch of non-safety-critical mountings for landing gear sensors and flight control systems. In the medium term, more complex and also safety-critical components will be produced, which fully utilize the potential of additive manufacturing. Partly for this reason, the Lindenberg site recently acquired a second 3D printer. There are also plans for the company's own product designers to be trained by colleagues in additive manufacturing, to establish a shared understanding of the technology.

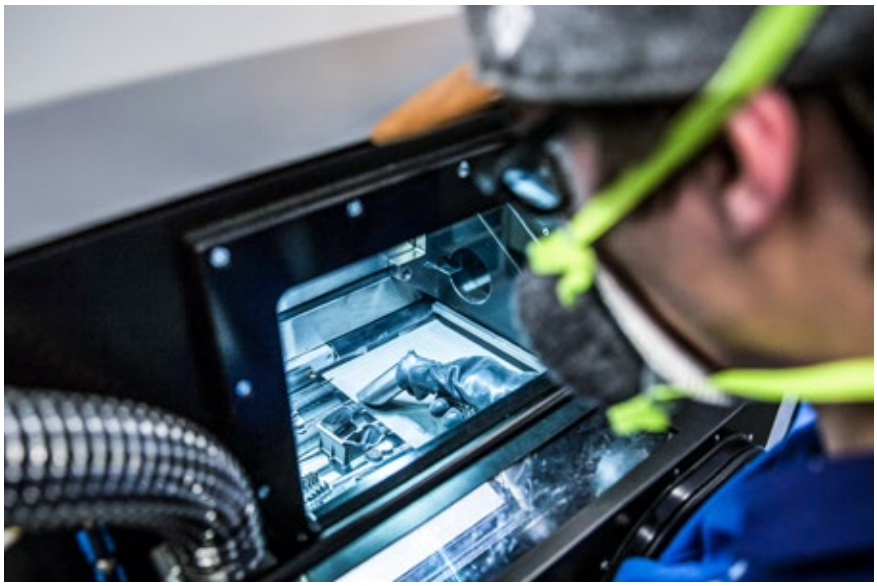
Liebherr-Aerospace Toulouse SAS, in Toulouse (France), is driving development forward with nickel alloy 718: a serial part from the 3D printer is currently undergoing qualification in an engine bleed air valve on an ATR 42/72. The first deliveries of the equipment are scheduled for the end of 2018. In 2017, the team in Toulouse also made parts from an aluminum alloy using the 3D printing process, with the result that Liebherr-Aerospace in Toulouse now has a wider available selection of 3D materials that are suited to its requirements. Furthermore, the company is working in partnership with a number of aircraft manufacturers on more complex and more critical high-value air system components, which could be offered for their future platforms.

Two sites – one common strategy

Both Aerospace sites are pursuing a common strategy across all their activities. Constant communication

Semi-finished valve bodies from Toulouse with production stands that are removed in a later processing step

is therefore an important part of their work, to gain from synergy effects. This applies for example to the creation of necessary technical documentation so that some of their own components can go into series production. At the same time, experts in Lindenberg and Toulouse are identifying a shortlist of components that could similarly benefit from additive manufacturing in terms of weight savings or multifunctionality. Both teams are working in close consultation with aircraft manufacturers – not only to enhance or develop new components, but also to streamline and optimize processes. This too is a top priority since it is a key factor in cost-efficient production. The experts in Toulouse have their sights firmly set on the future milestones: additive manufactured nickel alloy components need to be ready to put into service in aircraft, and they are also working on producing more complex and flight-critical components, as well as external supplier qualification. With a fast-growing number of providers of new processing machines and powder manufacturers, this is a highly dynamic field.



Looking into the production chamber of the 3D printer in Lindenberg

Discover more:
www.liebherr.com/3d-printing

Award for 3D Printing

In March 2017, Liebherr made aviation history: a 3D printed spoiler actuator valve block flew on a flight test A380 for the first time. This is the first 3D printed primary flight control hydraulic component ever flown on an Airbus aircraft. Liebherr-Aerospace developed the hydraulic component in close cooperation with Airbus and Chemnitz University of Technology. The project was partly funded by the German Federal Ministry of Economic Affairs and Energy. For this development achievement, the aircraft manufacturer presented its Tier 1 supplier with the prestigious Airbus System Supplier Award, the “Golden Concept Plane”.

Alexander Altmann (center) from Liebherr-Aerospace accepts the Airbus “Golden Concept Plane” award.

Power Gearbox in the Rolls-Royce UltraFan® Engine Sets New Record

70,000 horsepower – this was the record-breaking level of power achieved last year by what is the world's most powerful aerospace gearbox. It is a key component of the new Rolls-Royce UltraFan® engine, which is expected to be ready for service from 2025. Compared with the first-generation Trent engine, it will use at least 25 per cent less fuel and emissions will be correspondingly lower.

In order to develop manufacturing capability and capacity for manufacturing the new power gearbox, Rolls-Royce is working with Liebherr-Aerospace through the "Aerospace Transmission Technologies" joint venture, based in Friedrichshafen, Germany.

The power gearbox is a key component of the future UltraFan® engine. It allows the fan (which is massive and easily visible on the front of the engine) to operate in a low speed range which is ideal aerodynamically and acoustically.

The gearbox is being developed primarily at Rolls-Royce in Dahlewitz, where tests are taking place on a new test rig. It is being designed to run at up to 100,000 horsepower, which makes it the world's most powerful aerospace gearbox.

Paul Stein, Chief Technology Officer at Rolls-Royce, commented on reaching 70,000 horsepower in the tests as follows: "Setting this record is a great achievement for the team and I'm proud we've managed to get there so quickly. Our power gearbox technology is central to the success of the next generation of Rolls-Royce engines and I'm pleased to see us setting new standards with our work." It is easier to imagine the massive forces involved if the horsepower figure is converted: The power gearbox in the new system needs to be capable of managing the equivalent power of around 500 family cars. When running at maximum power, each pair of teeth on the gearbox will transmit more power than an entire grid of Formula 1 cars between them, with the complete gearbox with all five planets thus handling roughly as much power as 100 Formula 1 cars. "Reaching this milestone and impressive performance is proof of the great cooperation of all parties involved and especially of the expertise that accumulates in our joint venture with Rolls-Royce," commented Arndt Schoenemann, Managing Director, Liebherr-Aerospace Lindenberg GmbH, confidently.

At the Rolls-Royce test center in Dahlewitz

A new test rig for the extensive tests

Comfortable Temperatures Inside the Helicopter

The team at Liebherr-Aerospace Toulouse has been selected by Airbus Helicopters for the development, production and qualification of heating valves for the H160 helicopter program and for servicing them.

The system manufacturer supplies two valves for the helicopter's heating system which regulate the supply of warm air into the cabin. The warm air ensures, on the one hand, that the temperature on board is comfortable for the passengers and crew. On the other hand, it demists the window panes of the helicopter.

In the development of the highly reliable heating valves, Liebherr-Aerospace incorporated its latest innovations from the field of high-precision electro-mechanical controls. The valves are made from light-weight aluminum and contribute to the optimization of the helicopter's operating costs.

The contract to supply heating valves is actually the second order that Liebherr-Aerospace has received for the H160 helicopter program. Back in September 2012, the company had been chosen to supply the main rotor actuator for the medium twin engine aircraft designed to be the successor to the Dauphin helicopter.

Liebherr-Aerospace supplies flight control, landing gear and air management systems or components for almost all of Airbus Helicopters' programs.

© Airbus Helicopters – A. Pecchi

Labeled with "Best Innovator Overall" by Airbus

Airbus Defence and Space has chosen Liebherr-Aerospace from its over 10,000 suppliers worldwide as the winner of its "Best Innovator Overall". The award was presented at the 4th Supplier Annual Conference in Munich in November 2017. The manufacturer paid tribute to the system supplier for its strong, reliable technology-driven achievement in offering innovative solutions and aligning technology roadmaps – especially for its next generation of air management and cooling systems and future-oriented flight control and actuation systems.

Just-in-Time: Landing Gear Assembly in Canada

At Liebherr's Laval site in Canada, final assembly and inspection of landing gear system components for the Airbus A220 (former Bombardier C Series) started on schedule in August 2017. As Liebherr-Canada Ltd. expands, the Laval site is developing new offerings in addition to service and assembly. Customers in the rail vehicle sector are also being serviced here.

Assembly of landing gear in Laval (Canada)

Following the official opening of a new assembly hall in Laval, near Montreal, in October 2017, the Aerospace and Transportation Systems division at Liebherr-Canada is now able to handle just-in-time deliveries directly to the customer's aircraft assembly line. Liebherr invested around €2.9 million in the new building, which offers 1,400 m^2 of space for seven final assembly cells as well as test equipment for the Airbus A220 landing gear system. C Series Aircraft Limited Partnership (CSALP) fits the landing gear to the aircraft at their Mirabel site, about 35 km away. Liebherr-Aerospace is responsible for the extended logistics as well as final assembly and testing of the landing gear and air management system.

Certified quality and environmental standards

The quality management system applicable to the Aerospace and Transportation Systems Division at Liebherr-Canada Ltd. was recently recertified to the latest AS9120 Rev B and ISO 9001:2015 standards. A stringent audit preceded the recertification. The Aerospace and Transportation Systems team spent several months updating documentation for internal processes and procedures to meet the high certification requirements. This work was rewarded with a confirmation that the quality management system meets all current requirements for the distribution of products for the aerospace and defense industries. Liebherr-Canada's Aerospace and Transportation Systems team also updated the documented information as was necessary for the recertification of their environmental management system to ISO 14001:2015, which is expected shortly.

Shorter routes and faster response times

With a population of almost 423,000, Laval is the third-largest city in the Canadian province of Quebec. It enjoys a favorable strategic location close to CSALP and Bombardier Aerospace's sites in Mirabel and Montreal, for which Liebherr-Canada offers technical and logistical support. The new assembly hall cuts the response time for customer inquiries, and further optimizes material flow. In the hall, components of the A220 landing gear system from Liebherr-Aerospace in Lindenberg, Germany, as well as parts from suppliers in Canada and the U.S. are brought together, assembled and inspected. Then they are shipped to the customer. Mid March 2018, the final assembly and inspection of the 50th landing gear system component was completed in Laval.

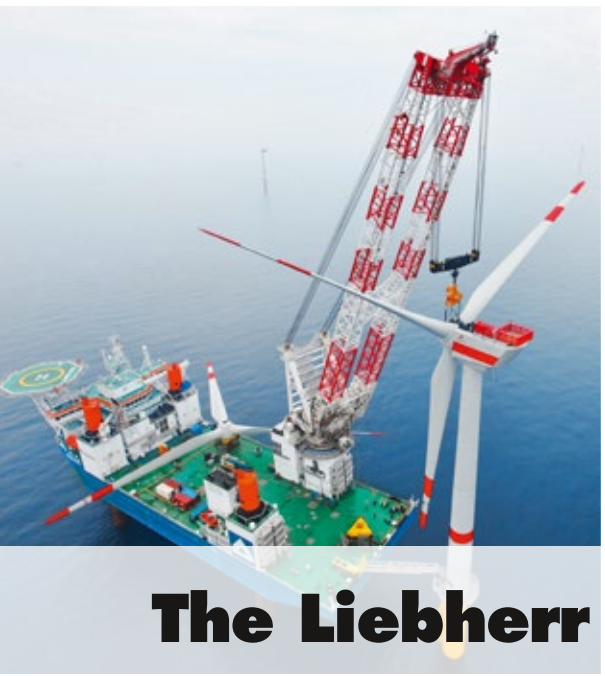
"Expanding into an assembly site brings us still more opportunities," says Stéphane Rioux, General Manager for the Aerospace and Transportation Systems Division at Liebherr-Canada. "We are already using part of the new building for maintenance and repair work for our customers in the rail vehicle sector and we want to continue expanding our offerings in this field as well."

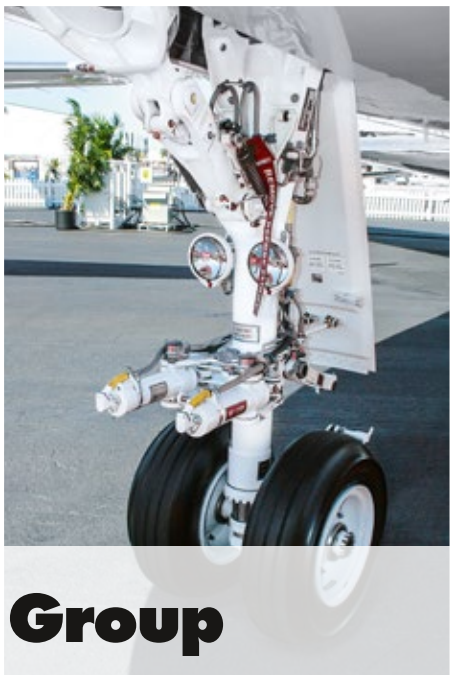
Customer Service Center in Shanghai Expands Range of Services

To ensure the availability of spare parts and rapid repair for all customers in China, Liebherr-Aerospace is continuously further expanding its portfolio in the Liaison and Customer Service Center in Shanghai. The site has also recently acquired a new test stand so that it can test, maintain and repair bleed valves of air management systems. The Chinese aviation authority has officially certified the test rig, which means that Liebherr is authorized and able to offer its customers an additional service in the area of repair and maintenance. In addition, Liebherr-Aerospace is planning to complete a test stand for air cycle machines later this year, so that the "heart" of the air conditioning systems can be also maintained directly in China.

With the aim of supporting aircraft operators even more efficiently and reliably at local level, Liebherr-Aerospace is also using a new software specially developed for repair work. Shorter communication routes and an extensive range of services are the standards that the company sets for itself too.

Specially trained skilled workers ensure reliable customer service.





The Liebherr Group

In 2017, Liebherr achieved the highest turnover in the Group's history, of €9,845 million.

There were marked differences in sales performance between the various regions. In Western Europe, Liebherr's most important sales region, turnover increased significantly. This was due in part to renewed growth in Germany, Liebherr's largest market, as well as to upward trends in France. In the UK, turnover remained at the previous year's level.

Sales performance in Eastern Europe, particularly in Russia, was encouraging. In Poland, by contrast, a decline in turnover was recorded. In the Far East / Australia and America, revenues were also above the previous year's level. The Near and Middle East and Africa, however, recorded a fall.

2017 saw a further increase in the workforce. The Liebherr Group had 43,869 employees worldwide. This represents an increase on the previous year of 1,561 or 3.7 %. The number of people employed by Liebherr companies will again rise slightly in 2018.

The Group has traditionally emphasized the importance of making regular investments in its production facilities and its global distribution and service networks. Last year, the Group invested € 749 million, a slight decrease of 0.3 %. Offset against this was depreciation of € 485 million. The Liebherr Group will also continue to invest substantially in its international production facilities and in its distribution and service network.

According to current forecasts, the global economy will grow even more strongly this year than it did last year. Growth, in the newly industrialized and developing countries in particular, will increase, while economic growth in the industrialized countries will remain at the previous year's level. The Group expects a further increase in turnover for 2018. Liebherr anticipates growth in the construction machinery and mining segment, as well as in the other product areas. Appreciable gains are forecast in the Mining, Concrete Technology, Machine Tools, Automation Systems and Earthmoving divisions.

Discover more:
www.liebherr.com

Gear Technology

Skiving Machine – Tool – Process

Liebherr makes skiving a more reliable process with the new LK 300 and LK 500 gear-skiving machines. The principle of gear skiving was invented over a century ago. Yet in practice the highly dynamic kinematics involved in this method frequently caused major problems. Up to now, the process was very unfavorable for the tools. The skiving tools are very complex and an incorrectly designed tool has a negative impact tool life and machining quality.

In the LK 300 and 500 gear skiving machines, process, tools and machine come from a single source, including tool changer and automation system. In Skiving[3], the delivery of an integrated solution for the customer is of primary interest. Skiving[3] is especially suited for internal gears of medium size and quantity, as it is much faster than shaping and more economical than broaching. The machine can be operated using the touch-based control system LH Geartec that intuitively leads the machine operators through the menus.

Domestic Appliances

Energy-efficient, Quiet and with Great Usable Volume

BluPerformance, Liebherr's most innovative appliance series, has some new additions. In the 70 cm width, the refrigeration and freezer appliances offer even more space for food storage. The integration of the refrigeration technology in the appliance plinth has created an additional 20 percent more usable volume. In combination with specially mounted compressors this innovation creates a further advantage: the appliances are particularly quiet in operation. And they consume even less energy. All BluPerformance appliances are available in the highest energy efficiency class A+++ and some are even 20 percent more economical. Nevertheless they also offer the latest refrigeration technology such as innovative BioFresh climate zones to keep food fresh for longer. High-quality materials, perfect workmanship down to the last detail, user-friendly and precise Touch electronics define the range. Within its new digitization strategy framework, Liebherr is presenting digital solutions to simplify food management. All refrigerators in the BluPerformance series can be equipped with the new generation SmartDeviceBox, a convenient solution for networking refrigeration and freezer appliances. It allows consumers to digitally interact with their Liebherr refrigerator and in the process opens up new dimensions in food and groceries management.

Maritime Cranes

The Largest Crane Ever Developed

With the HLC 295000, Liebherr has developed a heavy-lift crane with a load capacity of 5,000 metric tons at 35 meters and a maximum lifting height of up to 180 meters above deck. It is the largest crane ever developed by Liebherr. The first of its kind will be supplied for the Orion, a new wind farm installation and platform decommissioning vessel ordered by DEME from COSCO (QiDong) Offshore, a subsidiary of COSCO Shipping Heavy Industry. The crane will be delivered in spring 2019. “The diversification of our offshore crane portfolio in general purpose, subsea and heavy lift cranes opens the door to new markets,” says Daniel Poll, Sales Director Liebherr Ship and Offshore Cranes. “Winning this order is proof we are heading in the right direction. It will be another important step to provide access to new growth potential,” adds Leopold Berthold, Managing Director Maritime Cranes. The Group’s maritime hub in Rostock is perfectly suited for the manufacturing of such huge offshore machines. Steel construction, assembly, installation / loadout and testing will be fully processed in the facility on the Baltic Sea.

Hotels

Award-Winning Relaxation

The Liebherr Group owns six hotels: three in Ireland, two in Austria and one in Germany. It is their high quality standards that unites them. This can be seen in the award-winning 5,300 square meters spa of the Interalpen-Hotel Tyrol in Austria. The hotel offers a private spa after the redesign of the beauty and massage rooms. A massage in the luxurious spa suite, relaxing in the private sauna or in the well-being bath – privacy is a priority here.

Since June 2017, the 5-star superior hotel near Seefeld has offered a fully equipped Tyrolean alpine hut for exclusive events in an alpine atmosphere in addition to its eleven conference rooms. Whether a Tyrolean hut evening for a conference finale, a private party with live music or a cozy fondue evening: the charming alpine hut can accommodate up to 150 people and combines a relaxed atmosphere with a high-quality ambience and best service.

Largest Duty Cycle Crawler Crane in the Port of Piombino

Currently the largest duty cycle crawler crane of Liebherr, the HS 8300 HD, has recently carried out dredging work in Piombino. The aim of the project was to remove deposited sediment from the mouth of the port and also to increase the depth of the water. For this purpose, the hybrid duty cycle crawler crane was equipped with a hydraulic clamshell grab with a filling capacity of 22 m³.

With its capacity of 300 metric tons the HS 8300 HD is one of the largest duty cycle crawler cranes worldwide and the powerhouse has recently carried out dredging work in the Port of Piombino. Over the years, the depth of the water at the mouth of the port was reduced to as little as 8 meters through sediment. The work not only involved the removal of the sediment. The depth of the water was also increased to 14 meters in order to allow for larger vessels to run into the port. The importance of trouble-free shipping traffic is underlined by the fact that more than three million passengers pass through the port on their way to the Tuscan Archipelago, Sardinia or Corsica. The work in Piombino was carried out in a six-month project by the Italian dredging specialist Zeta S.r.l.

Material amounting to a total of 600,000 m³ had to be removed from the entrance to the port. With the duty cycle crawler crane type HS 8300 HD, the contractor Zeta S.r.l. found a real powerhouse. On the one hand, the challenge lay in achieving high levels of turnover and, on the other hand, in removing not only sediment but also larger stones. For this reason Zeta S.r.l. opted for a hydraulic clamshell grab from the Italian manufacturer Rossi with a filling capacity of 22 m³.

Zeta S.r.l. installed the HS 8300 HD without crawlers on its new dredger Maria Vittoria Z, on which a total of 3,000 metric tons of material can be loaded. Thanks to the large volume of the grab and also the short working cycles of only 45 seconds, the Liebherr duty cycle crawler crane handled 2,000 metric tons of material per hour meaning it required less than two hours to fully load the Maria Vittoria Z.

The duty cycle crawler crane is equipped with Liebherr's own hydraulic hybrid drive system Pactronic®. Through the storage and subsequent reactivation of surplus energy the turnover can be increased and, at the same time, the fuel consumption can be significantly reduced. In combination with Pactronic® the 725 kW diesel engine achieves a system performance that is comparable to a conventional drive system with 1,250 kW. Despite high levels of turnover, the duty cycle crawler crane has up to 50 % lower diesel consumption (60 l/h) in comparison to similar models. The work in the Port of Piombino clearly confirmed that the HS 8300 HD is a machine for heavy duty material handling.

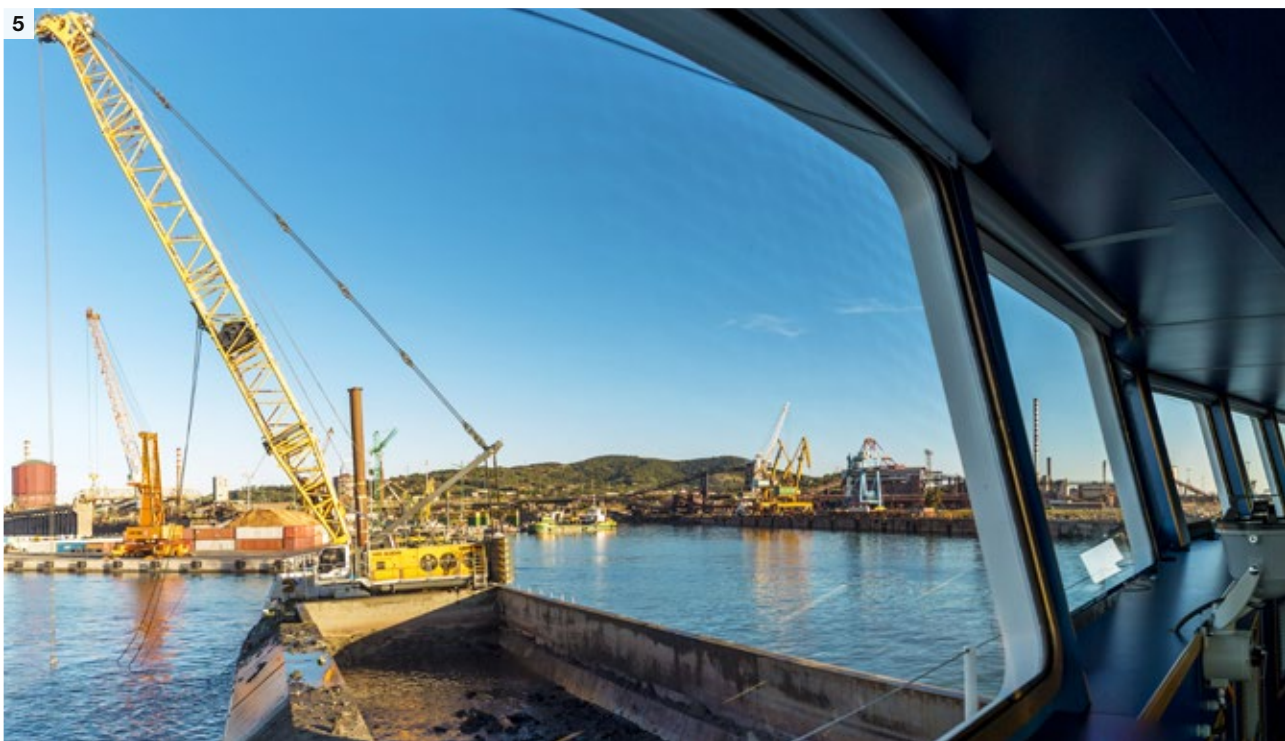
3

1. Green light for shipping traffic after the removal of deposited sediment. 2. Great tasks require great machines. 3. The vessel and duty cycle crawler crane work as one unit. 4. The HS 8300 HD allows a turnover of 2000 metric tons per hour. 5. Dredging assignment with a view, in the Port of Piombino.

1

2

4



5

LIEBHERR

Published by: Liebherr-International Deutschland GmbH · 88400 Biberach an der Riss · Germany

Bildnachweis / Copyrights: Hans Leitner (2, 4, 6, 8, 10), SBB CFF FFS (3, 26), DB AG (13), SNCF (14), ÖBB (27), CRRC Sifang America (28), ITT Cannon (30), Bombardier-C. Recoura (30), BVB (31), Schneeweiss (33), Airbus (33), 2018 Rolls-Royce plc (34), Airbus Helicopters-A. Pecchi (35)
www.liebherr.com

AER-10.161

Liebherr-Transportation Systems Magazine 2018-2020