COVER STORY

MERMEC Ferrosud installed two 9-axis articulated robots for coating diagnostic trains

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Integrating robotics into an existing paint booth and automating the coating of a railway vehicle measuring about 25 metres in length has required a bespoke solution: for MERMEC Ferrosud, CMA Robotics developed a system based on two 9-axis GR6150 articulated robots, ensuring high operational flexibility, improved process repeatability, and consistent coating quality.

Diagnostic trains are now a strategic component of the modern railway ecosystem, enabling continuous, high-precision monitoring of infrastructure conditions. They are highly specialised vehicles equipped with advanced measurement systems, including lasers, inertial sensors, optical systems, and high-frequency data acquisition units, which analyse key parameters in real time, such as track geometry, rail wear, contact line conditions, and overall network integrity.

Their development aligns with the paradigm of predictive maintenance, which relies on the systematic collection and analysis of data to anticipate signs of deterioration and plan targeted interventions. The reliability of diagnostic trains is therefore a critical factor: any reduction in instrument accuracy or vehicle availability can have direct consequences for the safety and operational continuity of the railway network.

Alongside the technological complexity of the on-board systems, a fundamental role is played by the structure of the train itself and, above all, by the protection of the carbody. During their service life, these vehicles are indeed subjected to highly variable environmental conditions, characterised by temperature fluctuations, humidity, rain, atmospheric contaminants, and abrasive dust. These conditions can trigger corrosive reactions that progressively compromise metal surfaces, with both aesthetic and structural consequences. Processes such as electrochemical corrosion, accelerated oxidation, and corrosion under coating can lead to material loss, weakened joints, and increased maintenance costs. That is why the choice of high-performance industrial coating systems is key to ensuring the durability of the protective layer, limiting corrosion, and preserving the reliability of the rolling stock throughout its life cycle.

These requirements formed the basis for the investment made by MERMEC Ferrosud (Matera, Italy) to install two articulated robots from CMA Robotics (Pavia di Udine, Italy) for coating the bodies of its diagnostic trains. This system has been integrated into an existing 30-metre-long booth to increase production capacity, improve coating quality, and ensure greater process repeatability.

Two industrial stories converge: the founding of MERMEC Ferrosud

MERMEC Ferrosud's industrial origins stem from the convergence of two distinct backgrounds: MERMEC S.p.A., a company specialising in railway diagnostics and signalling, and Ferrosud, a factory established to manufacture railway vehicles. "The former was founded in the 1960s as Meridional Meccanica, initially a Lamborghini Trattori dealership. The decisive turning point came in the 1980s, when it entered the railway sector and began designing and manufacturing vehicles for track maintenance. In 1988, it became a public limited company, and over the following decade it developed and patented its first diagnostic train, an autonomous railway vehicle capable of monitoring infrastructure condition and detecting defects and micro-cracks measuring just a few millimetres, even at speeds of 300 km/h," says Sante Cammisa, Investments and Special Projects at MERMEC Ferrosud.

The Ferrosud plant, founded in 1963 as part of an industrial development programme for Southern Italy, saw its history unfold around the same time. Over the years, it underwent several corporate changes, becoming part of Breda Ferroviaria in 1980 and of AnsaldoBreda in 1992. Following privatisation in 2002, Ferrosud entered a difficult period that led to a gradual reduction in production, until the turn of events in October 2022, when MERMEC acquired it and embarked on a path of industrial revitalisation.

This marked the birth of present-day MERMEC Ferrosud, which resumed operations in mid-2023 after an urgent redevelopment phase. “We had to restore everything essential to get operations up and running again, from the extraction and lighting systems to the most severely affected production areas. Only then did we launch an investment plan to modernise the factory’s technology. We implemented several new automated solutions, including the two GR-6150 coating robots from CMA Robotics.”

A state-of-the-art industrial hub for the manufacture of diagnostic trains

The MERMEC Ferrosud facility is now one of the largest railway manufacturing hubs in Europe, with a total area of about 230,000 m², of which 55,000 m² are covered. The facility features a highly specialised internal infrastructure, including 1.4 km of track and a direct rail link to the national network, enabling the movement and dispatch of rolling stock without special road transport. “This plant was designed to handle large-scale railway products and complex production flows. Here we can build a complete train, from the metal carbody to the powered and trailing bogies, while our parent company, MERMEC S.p.A., supplies the diagnostic systems that are subsequently installed and integrated into the vehicle,” explains Cammisa.

The metal carbodies, the vehicles’ main load-bearing structures, and the powered and trailing bogies designed to support the rolling stock are manufactured in the metalworking department, which covers around 8,000 m². After machining and welding, the bodies are taken via a transfer car to the automated shot blasting booth, where oxides, scale, and surface contaminants are removed, and then to one of two 30-metre-long booths devoted to finishing the rolling stock bodies. The robotic system developed by CMA Robotics is installed in one of them.

Downstream of the coating process, the car bodies move to the final assembly department, a space of approximately 6,500 m² equipped with four parallel railway tracks, where they are coupled with their respective bogies, previously processed in dedicated departments. The production cycle ends with quality controls and functional tests, including dimensional and geometric checks of the welded structures, roughness checks after shot blasting, measurements of paint film thickness, and verification of the coatings’ characteristics. In addition, tests are carried out on the complete vehicle, including brake tests, electrical checks, and watertightness tests under simulated rain conditions.

At present, the robots handle the application of the anti-rust primer, the acrylic primer, and the top coat. They are each equipped with three coating guns assigned to the different products, but they are designed to accommodate a fourth gun for applying the epoxy filler if required in the future.

The coating cycle

In the coating booth that was the subject of the recent investment, MERMEC Ferrosud applies a multi-layer coating system comprising four main products: an anti-rust primer, an epoxy filler, a sandable acrylic primer, and a polyurethane top coat. The process begins with the application of the anti-rust primer using the CMA robots, followed by a drying phase in the oven. The epoxy filler is then applied manually to level and prepare the surface before the sanding stage. Once this process is complete, the body undergoes automated application of the sandable acrylic primer and, afterwards, the polyurethane top coat. Both stages are followed by an oven-drying phase, necessary to ensure the coating stabilises correctly and the protective system achieves its final performance characteristics.

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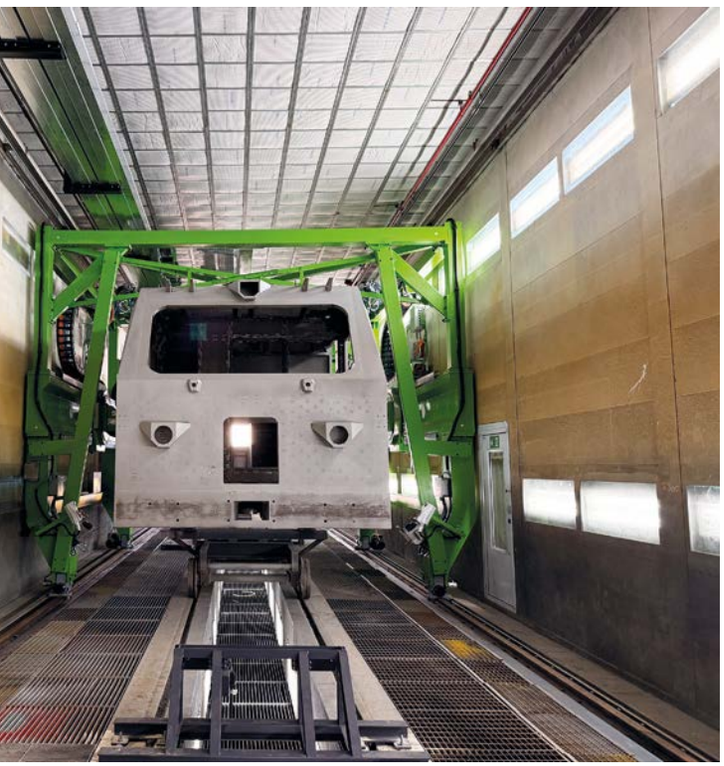
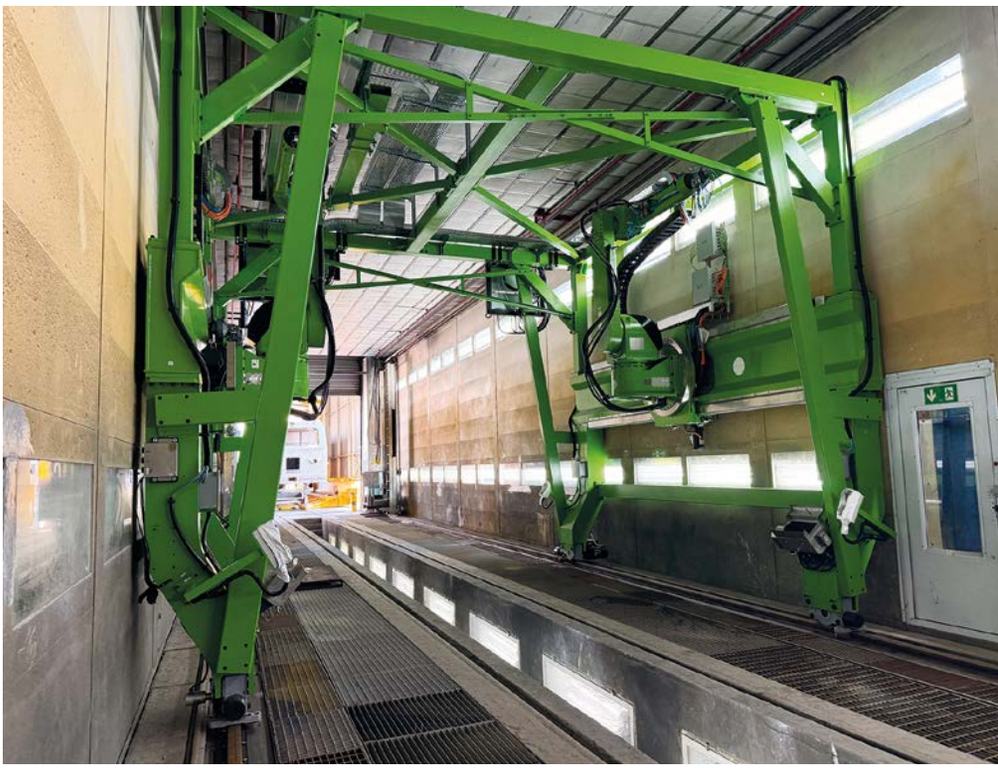




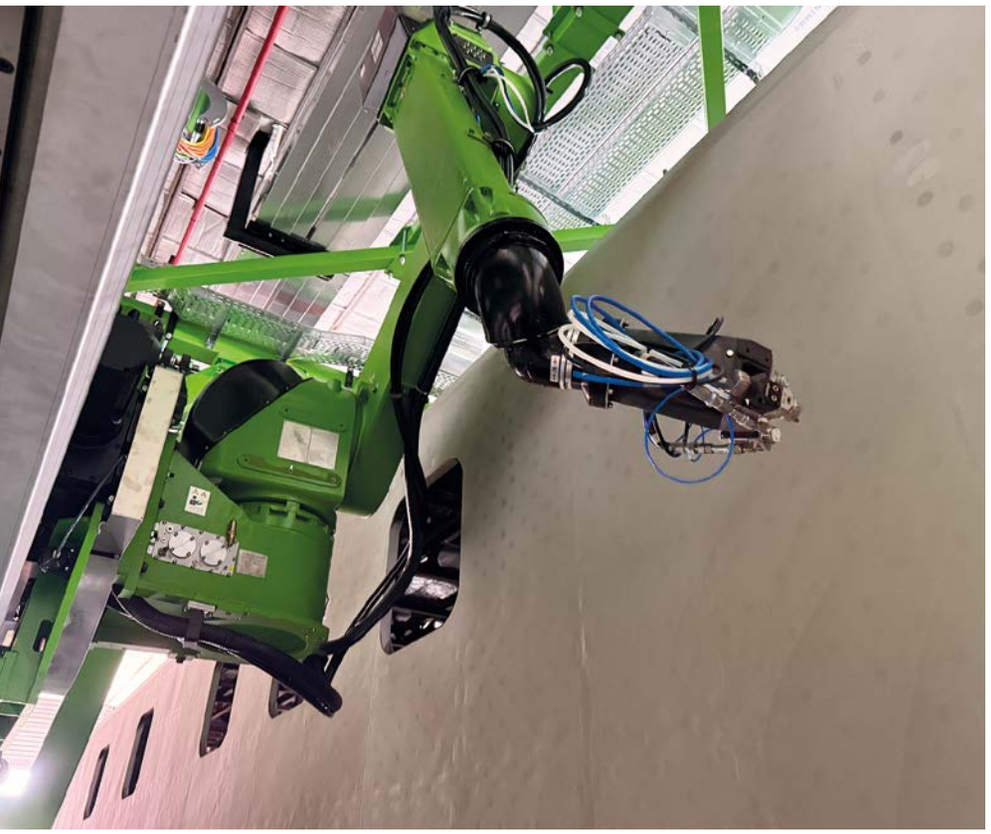
In the coating booth, MERMEC Ferrosud uses robots to apply an anti-rust primer, a sandable acrylic primer, and a polyurethane top coat. On the left, the metal gantry equipped with two 9-axis GR-6150 articulated robots from CMA Robotics.

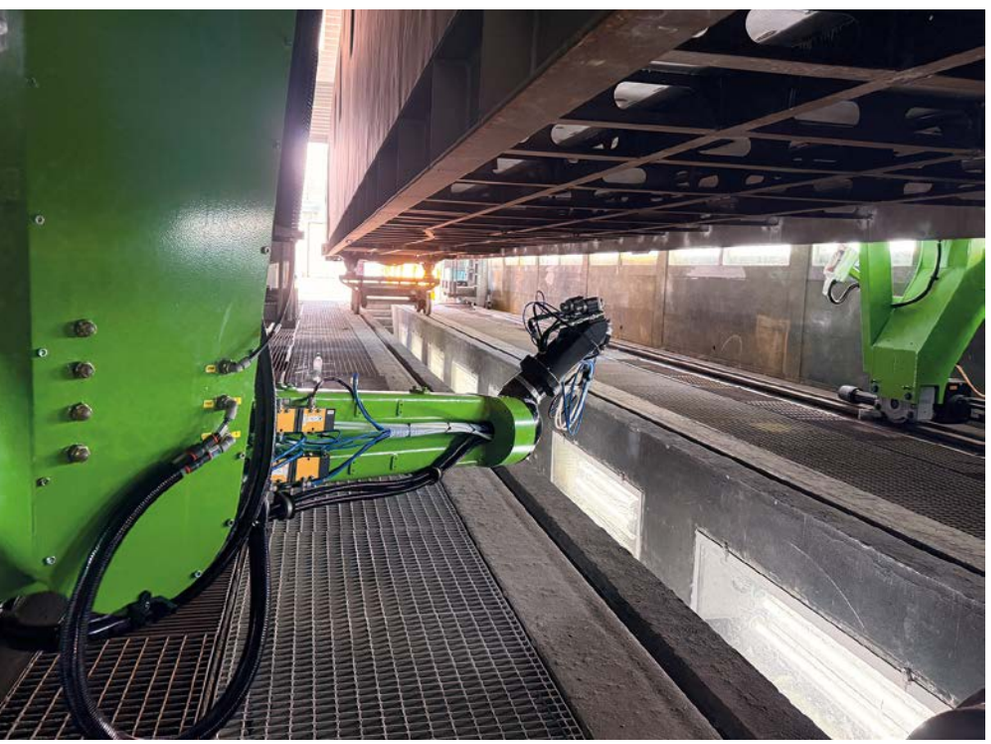
experience still ensures optimal control over surface levelling and overall results," indicates Cammisa. "The carbody coating process ends with the application of an intumescent paint, a fire-retardant product currently applied manually to the underbody of the railway vehicles and to interior areas. As these are diagnostic trains rather than passenger trains, their interiors contain a great deal of equipment, including batteries, servers, computers, and electrical systems, which require specialised protection," adds.

Designing a robotic system for an existing booth

Integrating the robotic system posed a significant design challenge, as the solution developed by CMA Robotics had to be fitted into an existing coating booth dating back to the 1970s, which had been revamped in 2023 to meet current safety standards and regulations. "The unique aspect of this project was the need to work on an existing structure, for which not all the original design documents were available. For this reason, we carried out detailed surveys and reconstructed the entire booth in a CAD environment, so as to develop a solution that would integrate perfectly into the available space," explains Marco Zanor, CEO of CMA Robotics. Based on the plant's digital model, the company developed a bespoke system for installation within the existing booth, including a metal gantry and robotic equipment, without altering the plant's original configuration. The two articulated robots were mounted on the right and left sides of the gantry, designed to operate in coordination along the entire length of the carbody. Each robot is mounted on a traversing slide that enables it to move within the metal structure and reach all surface areas to be coated. "The robot can move along a linear axis, allowing it to move along the gantry, while a dedicated slewing ring enables the rotation of the entire robotic unit, significantly expanding its working envelope. This configuration allows coating not only the entire length of the railway vehicle, normally approximately 25 metres, but also the upper and lower surfaces of the carbody, including the roof and the underframe," says Zanor.

"The robots can also operate in an inverted position, a solution developed specifically to achieve greater vertical reach and access even the most complex geometries of the vehicles." This improves access to the most critical areas and enables a more uniform coating of the entire surface of the rolling stock, without the need for additional vehicle movement or specialised equipment. "The ability to automatically reach even the uppermost parts of the carbody has, in fact, enabled us to reduce the use of equipment for working at height, significantly improving safety and ergonomics for our operators," notes Cammisa.





Detail of the robotic application phase. The robots are able to operate in an inverted position, thus painting the underbody areas and the most difficult-to-reach sections.

"To speak simply of an additional axis would be an oversimplification, because the system integrates multiple coordinated movements: in addition to the six axes of the articulated robot, there is a seventh linear axis enabling movement along the entire length of the booth, an eighth axis consisting of the slewing ring rotation, which extends the robot's range, and a further motion axis that further expands the system's overall working envelope," says Daniele Donato, project manager at CMA Robotics.
Another distinctive feature concerns the system for detecting the position of the workpieces within the booth. The carbody is moved by a temporary transfer car used exclusively for internal handling between production departments: CMA Robotics has used this equipment as a reference for automatic positioning, integrating a limit switch unit that, once it has detected that the transfer car has entered the booth correctly, sends an enable signal to the control software to start the coating cycle.

A successful partnership for the evolution of coating processes

The decision to partner with CMA Robotics stemmed from the need to support MERMEC Ferrosud's growth by engaging a technology partner with experience, reliability, and design expertise in automating coating processes. "With the acquisition of this facility, we began handling a completely different volume of orders than before. Given its strategic importance, we therefore needed to innovate the coating process, and we could not afford to entrust such a complex project to partners lacking the necessary experience," says Cammisa.
The choice was also backed by endorsements from the other partners in the project, including the suppliers of the paint products and the mixing system. Indeed, the project went beyond installing robots to integrating various technologies into the existing booth. "The automation devices, the paint management equipment, and all the existing systems had to be harmonised. CMA also supported us in identifying technical solutions beyond the scope of its own supply, demonstrating a great capacity for collaboration," emphasises Cammisa. Although the system is still in the final testing phase, initial feedback has been extremely positive.

"The automation solutions, along with the new paint mixing unit, ensure greater control over material consumption and waste, more consistent management of application parameters, and more uniform coatings compared with manual processes."
A further advantage is process repeatability. Using CMA Robotics' Efort Paint Studio offline programming software, application patterns can be defined and reproduced with a high degree of precision, ensuring consistency even in future production runs involving vehicles with different configurations or multiple carbodies.
Finally, the introduction of this new technology also constituted an investment in human capital. "We are training technicians and operators in the management, programming, and testing of the robotic cell. Our goal is not merely to introduce a new machine, but to develop in-house expertise that will enable us to fully exploit this technology's potential," states Cammisa.
In the final commissioning phase, the technical teams from MERMEC Ferrosud and CMA Robotics are now defining and optimising the coating programmes by configuring the application patterns and fine-tuning the process parameters for the various surfaces of the railway carbodies, in preparation for the plant's full-scale operation.

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