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Opening photo: An example of a lift by Ravaglioli Spa.



## FOCUS ON TECHNOLOGY

# A Unique Concept for the Cataphoresis + Powder Application Process of the Ravaglioli Group, thanks to the Technical Solutions Adopted

Monica Fumagalli **ipcm**<sup>®</sup>

Officine Meccaniche Sirio, based in Ostellato (Ferrara, Italy), is a company of the Ravaglioli SpA Group, a leading manufacturer of lifts, wheel balancers, tyre changers and wheel aligners for garages all over the world (ref. Opening photo). The new coating system installed at its premises occupies about two thirds of a plant that is almost as large as a soccer field (about 4400 m<sup>2</sup>). The layout of this new paintshop overcomes the concept of conventional coating lines.

“Such an investment was motivated by the changing needs of our customers,” says Flavio Villa, the Industrial Director of the Group (Fig. 1). “Until a few years ago, vehicle repair equipment was chosen based on high performance, but the aesthetic quality of products has now gained increasing importance even in this sector. Partly, this is due to the fact that the selection of garage equipment, which used to be totally managed by the private workshops, is now carried out by the large automakers, which impose the finishing parameters required for car components even

on these devices. High coating quality and longer service life were Ravaglioli's two main goals for the installation of a new plant and the implementation of a cataphoresis + powder application process. The new paintshop has become our best calling card, enabling us to be more competitive especially in the northern part of the world, where the massive use of salt on streets increases the chance of corrosion on the components of our machines."

This fully automated coated line, operational since January 2017, is majestic – it took months only for the creation of its foundations – and it is the result of perfect interaction between the suppliers of the plants, devices and products constituting it. They were coordinated by Radial Group Srl, a company based in Badia Polesine (Rovigo, Italy) with extensive experience in the design, construction and installation of industrial plants. The peculiarities of Ravaglioli's plant are as follows: treatment flexibility, achieved thanks to the ability to programme different cycles; efficiency of the production cycle, ensured by storage buffers placed strategically along the entire line in order to eliminate unnecessary waiting times; high safety degree, ensured by several technical tricks; and high energy efficiency, achieved thanks to the air and waste treatment systems designed to minimise energy consumption in compliance with all the environmental law requirements.



Figure 1: Flavio Villa, on the left, with Stefano Sartori.

### The start of a great project

Ravaglioli installed a coating plant at the headquarters of the Group, in Bologna, towards the end of the Eighties, followed by a second system selected in 1996 to handle up to 3 m long workpieces. The two plants,

**“We wanted the new line to meet three crucial requirements: a non-inline shotblasting plant, a cleaning system that could effectively remove the residues of the sheet metal laser treatments even from non-sandblasted parts, and a high performance cataphoresis plant.”**

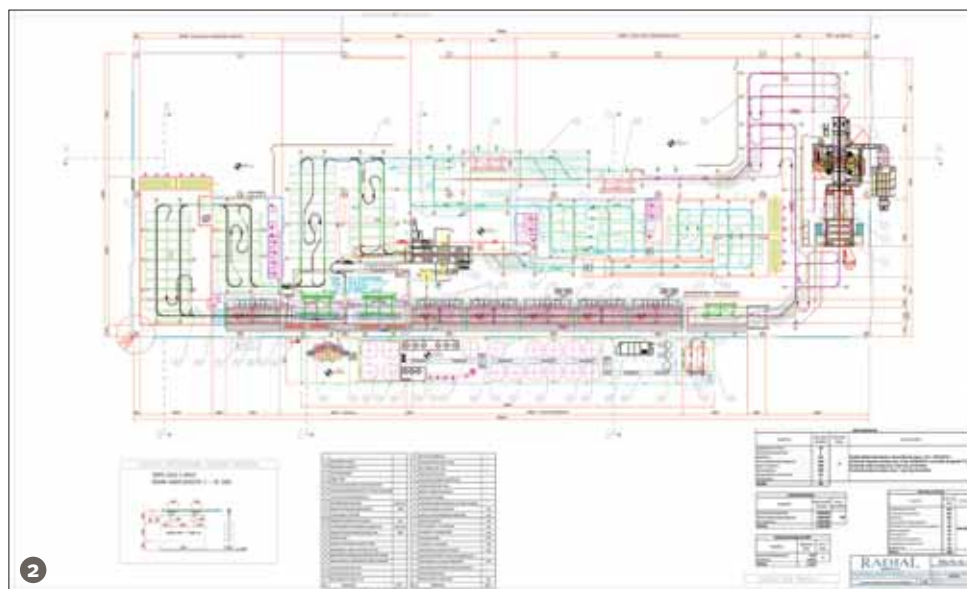


Figure 2: The layout of the coating line.

reconditioned several times over the years, apply one coat of primer with an immersion process and one of powder topcoat.

“The experience we have gained thanks to these two plants that are still operating,” Villa adds, “has provided us with the tools to accurately and precisely determine the details of the new line. In Sirio's plant, we treat every product with a cataphoresis + powder coating process, including some of the

steelwork components manufactured by other companies of our Group.” However, not all that is produced in Sirio's plant undergoes this cataphoresis + powder application process: the lifters' components need such a treatment because they are

subject to corrosion problems, but the tyre changers and the wheel balancers can be finished with powder only.

“For our new coating plant,” Villa says, “we have focused on the anti-corrosion efficacy that a cataphoresis treatment is able to guarantee: we are convinced that

it is the ideal way to decidedly solve all the problems related to corrosion resistance and to the coating of difficult-to-reach areas with good aesthetic results. When, back in 2015, we had to choose the characteristics of the new system, which had become necessary to cope with the production spikes that the two plants in Bologna were no longer

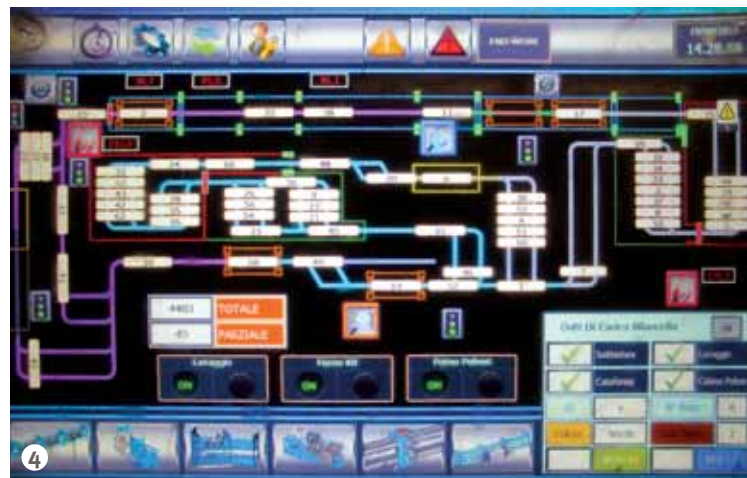


**Figure 3: The loading area with the Power & Free conveyor and the descenders supplied by Futura Convogliatori.**

able to handle, we turned to Radial Group Srl, which had already dealt with the revamping of the systems installed at our Bologna premises.

“We wanted the new line to meet three crucial requirements: a non-inline shotblasting plant, a cleaning system that could effectively remove the residues of the sheet metal laser treatments even from non-sandblasted parts, and a high performance cataphoresis plant. The line also had to be placed in a pre-existing environment. Radial Group Srl’s cooperation has led to the realisation of an important project not only in terms of dimensions, but also of complex integration among different systems. They have been able not only to identify the exact features of the equipment to be provided by other suppliers, but also to integrate them to achieve the high yield required by Sirio-Ravaglioli.”

“After the design of the initial project, we spent a few months perfecting the structure to get the definitive design of the plant,” says Francesco Soragni, the owner of Radial Group Srl. “Meanwhile,



**Figure 4: The touch screen for programming the treatment cycles.**

we continued to gather information and visit companies to select the ones that would have formed the coating line team. The choice of Sirio-Ravaglioli fell on each field’s leading company and was motivated more by their reliability than by economic reasons.”

### The loading stage and the programming of the treatment process

The layout of the new coating plant is characterised by a number of storage buffers that contribute to making the production flow more fluid and cancelling the waiting times due to any stoppage in the handling of the parts (Fig. 2). The Power & Free conveyor installed by Futura Convogliatori Aerei (Robecco Pavese, Pavia, Italy) can handle 62 loading bars – a number that will soon increase. These carry the Sirio lifters’ components with a chain speed of 8 m per minute and an interval of 5 minutes per bar. The workpieces are up to 6500 mm long, 1200 mm large and 2700 mm high; each bar can carry a weigh up to 2000 kg.



**Figure 5: The sandblasting plant.**



**Figure 6: The storage buffer preceding the pre-treatment process.**

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The coating process starts in the loading area, equipped with a multi-level descender that enables to hang the material in the upper part of a bar and also in the lower part of the following one, in case the 5-minute interval is not enough (Fig. 3). “When loading the bar,” Soragni says, “the operator also defines the processing parameters for the components (Fig. 4). It is even possible to select mixed cycles, including or excluding sandblasting, phospho-pickling during pre-treatment, and



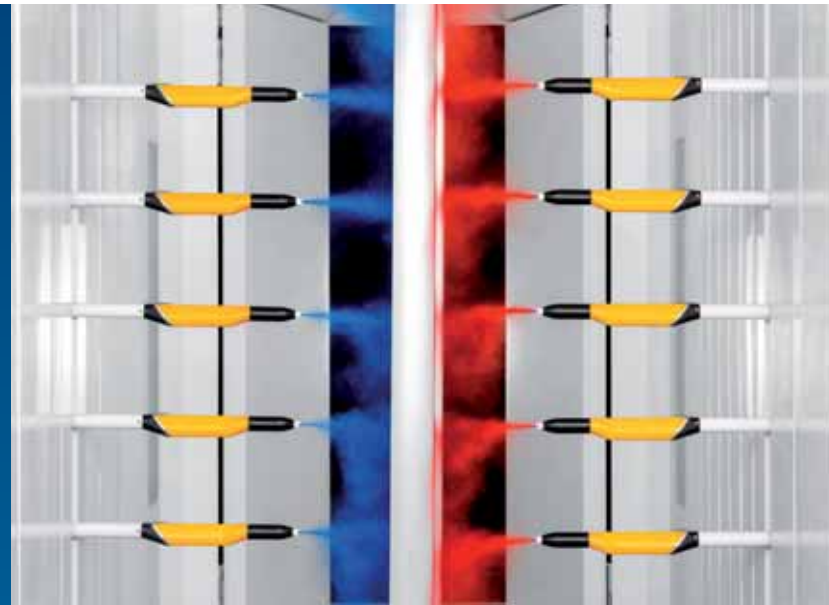
Figure 7: The first pre-treatment stage is an immersion alkaline degreasing process.

cataphoresis.” Futura Convogliatori Aerei’s conveyor automatically manages the bars’ flow according to the parameters set. Here, the conveyor splits in two for the first time. One branch takes the components that cannot be shotblasted due to their characteristics and shape directly to the pre-treatment line, running to the side of the shotblasting system. The other branch takes the other workpieces to the shotblaster, supplied by Cogeim Europe (Casorezzo, Milan, Italy, Fig. 5).”

### Sandblasting as a guarantee of corrosion protection

“The machining operations we carry out on sheet steel with our laser cutting machines,” so Stefano Sartori, Ravaglioli Group’s Technology Manager, “leave difficult-to-remove residues on the surfaces. Moreover, due to space, storage and handling issues, most of

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Figure 8: The pre-treatment tunnel.

our workpieces are stocked outdoors. We knew we needed a sandblasting treatment in order to increase the cleanliness of our substrates and their subsequent protection and weathering resistance.”

The Cogeim GTU shotblasting system consists of a tunnel divided into four sections:

- an inlet area with rubber curtains to prevent any leakage of grit;
- a shotblasting chamber in which the parts are exposed to the media flow generated by high efficiency centrifugal turbines;
- an outlet area with multiple rubber curtains to prevent any leakage of grit;
- a blow-off station where the operation is performed with a nozzle by an operator, in order to remove any dust or grit remaining on the workpieces.

There are 12 turbines installed, each with a power of 15 kW. The plant is equipped with a system featuring an auger and a lifter for the automatic recycling and cleaning of media. The chamber’s ventilation and dust collection system is equipped with a self-cleaning cartridge filter.

### Effective pre-treatment for a thorough surface cleaning

After loading, the conveyor splits in two, thus creating two storage buffers devoted, respectively, to the shotblasting system and to the pre-treatment tunnel.



Figure 9: One of the fumes extraction chimneys of the pre-treatment tunnel.

Then, it reunites in one branch located before the tunnel itself (Fig. 6). The bars loaded with non-shotblasted components precede the others.

The first pre-treatment stage is an immersion alkaline degreasing process performed through a descender at 50°C for 3 minutes, in order to remove any surface residue (Fig. 7). “Ravaglioli treats a large amount of tubes,” Soragni states. “That is why the parts are loaded on the bars obliquely: when the workpiece is

immersed, water passes through the tube by cleaning it on the inside, where iron slags resulting from the sawing operations may remain”.

Then, the parts enter a 5-stage spray pre-treatment tunnel built by Silvi (Lesmo, Monza e Brianza, Italy, Fig. 8). The first step includes a spray alkaline degreasing process at 50°C and two rinses with fresh water. Then, a spray phospho-pickling stage is performed at 50°C, followed by one rinse with fresh water and one with



Figure 10: The cataphoresis tank and, in the background, the dialysis cells.

“The pickling stage, enables us to remove any laser machining residue from the parts that cannot be sandblasted. On the other hand, if the components have already been sandblasted and the phospho-pickling process has been excluded during the initial programming phase, the pumps do not turn on and the workpieces remain for 5 minutes in that section of the tunnel without undergoing any treatment.”

demineralised water. All the pre-treatment chemicals are provided by Chemetall.

“The pickling stage,” Stefano Sartori adds, “enables us to remove any laser machining residue from the parts that cannot be sandblasted. On the other hand, if the components have already been sandblasted and the phospho-pickling process has been excluded during the initial programming phase, the pumps do not turn on and the workpieces remain for 5 minutes in that section of the tunnel without undergoing any treatment.

“The last step is the spray application of a nanotechnology passivation product, Oxsilan. This is able to act on the metal sheet by creating an about 60 nm thick conversion layer based on metal oxides, which improves the adhesion of the paint and significantly increases the corrosion resistance of the parts.” The pre-treatment ends with a last rinse with demineralised water. The suction system of the pre-treatment tunnel has been designed so that, before reaching

the extractor fan, the fumes pass through a cyclone that lets them decant and makes the water mass fall into the tunnel itself, in order to recover as much product as possible (Fig. 9).



Figure 11: The outside of the cataphoresis tank.

**“This oven has the peculiarity that, even though it consists of one chamber, in the first two stations the temperature does not rise above 110°C, while the following station already operates at 180°C. This enables the cataphoretic coating to begin to flash-off and the component to absorb heat more gradually, thus avoiding any blistering on the surface.”**

### The cataphoresis process and the curing oven: technical arrangements

At the end of the pre-treatment tunnel, the bars enter the cataphoresis plant, also built by Silvi. Here, the descender picks up the still wet workpieces and immerses them directly into the 8.5 m long cataphoresis tank with a capacity of 60 m<sup>3</sup> (Fig. 10 and 11). Depending on the selected cycle, the descender may move down and start the cataphoresis process or, if this treatment is not required, stand still while waiting for the parts to leave towards the following stage. The product used is the grey CathoGuard<sup>®</sup> epoxy coating supplied by Basf, characterised by high thickness, excellent edge protection and the absence of lead and tin in its formulation.

After cataphoresis, the parts undergo an immersion and a spray rinsing stage with ultrafiltrate. A demineralised water tank with a closed



Figure 12: The hydraulic seals' flow panel on the pumps.



Figure 13: The storage buffer preceding the powder coating application area.

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loop system and a special pump feeds the pumps involved in the flow of the hydraulic seals on the ultrafiltration module's coating feeding pumps and on the cleaning pumps after cataphoresis. Each hydraulic seal is fitted with two needle valves for pressure regulation and a pressure gauge (Fig. 12).

The following station is an oven for the curing of the cataphoretic coating at 180°C or, if the cataphoresis process has not been

performed, for the drying of the components. Futura's conveyor splits into two parallel branches within the oven in order to enable the storage of the bars and reduce any obstruction, thus lowering the consumption of energy. The bars enter the oven every 5 minutes.

"This oven," Soragni states, "has the peculiarity that, even though it consists of one chamber, in the first two stations the temperature does not rise above 110°C, while the following station already operates at 180°C. This enables the cataphoretic coating to begin to flash-off and the component to absorb heat more gradually, thus avoiding any blistering on the surface. In order to achieve this result, we have designed a combination of controlled drive shutters that bring in fresh air and mix it with the warm one by opening and closing, thus changing the chamber temperature and protecting the workpieces against

**“After the cooling tunnel, Futura has added a 9-bar storage buffer that we use to empty the cleaning tunnel and the cataphoresis tank at the end of the process. Every morning, the conveyor turns on and takes the bars to the powder coating station. This eliminates any waiting time for arrival of the first bar from the cooling tunnel.”**



Figure 14: Gema Europe's OptiCenter powder management unit with powders supplied by Inver-Valspar.

any thermal shock during the curing of the cataphoretic coating. This is possible thanks to the independence of the ventilation systems of the two separate temperature zones. Another important element for the proper functioning of the system is the fact that, even if there was only one bar in the oven, this could not exit before the end of the 50-minute time cycle.”

In the forced cooling tunnel, the outside air is sucked in and sent to a lower plenum where the cooling blow cones are lined with sheet metal to ensure staff safety during maintenance. “After the cooling tunnel,” Sartori adds, “Futura has added a 9-bar storage buffer that we use to empty the cleaning tunnel and the cataphoresis tank at the end of the process. Every morning, the conveyor turns on and takes the bars to the powder coating station. This eliminates any waiting time for arrival of the first bar from the cooling tunnel. Another storage buffer has been placed just before the spray paint booth, again to avoid any loss of productivity (Fig. 13).”



Figure 15: The manual pre-retouching operation.

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## The powder coating process and a particular masking device

The powder coating booth has been provided by Gema Europe (Trezzano sul Naviglio, Milan), a well-established supplier of Ravaglioli's plant (Fig. 14). It features reciprocators with 6 guns per side operating with the Venturi technology as well as

a station for any manual touch-up before and after coating (Figs. 15 and 16). Sirio performs, on average, 3 colour change operations per day, with a maximum peak of 6. In case the powder application is unnecessary because the cataphoresis treatment is enough, the bars are carried directly to the unloading area. Officine Meccaniche Sirio applies a particular kind of masking on its components.

"Immediately after coating, we carry out some sort of "reverse" masking," Sartori explains. "In other words, we remove the powder where it is not needed before curing. Ravaglioli had already applied this method to other plants. We use a particular aspirator with interchangeable special-shaped nozzles that remove the powder coating product from the areas that do not need be covered." The coating station is followed by two air gelation stations and an oven, where maximum 10 bars can stay for 50 minutes at 180°C (Fig. 17). The next cooling stage is performed with blow cones using outside air. A servo-

controlled shutter system connected to an external temperature probe enables the extract air to be sent to the outdoor or the indoor environment. If the outdoor probe detects a temperature below 15 °C, during the winter months, the air is recovered and used to heat the plant (Fig. 18); with an outside temperature greater than 15 °C, the air is ejected.

Futura Convogliatori has also created a "parasitic" branch of the conveyor to take the bars needing to be inspected outside the line.

## The technical compartment

The uniqueness of this new coating plant also lies in a few technical arrangements

designed to ensure maximum safety for Sirio's employees working on the line. A "technical compartment" has been built outside the plant where the line service equipment is installed. This houses Riello boilers with a heat exchanger to warm the alkaline and pickling baths; a wastewater treatment system and tanks for the distillates supplied by KMU Loft (Bolzano, Italy, Fig. 21).

The wastewater treatment plant is a closed-loop system: all liquid waste, except for paint, flow into it. The storage tanks are devoted, respectively, to the active baths (alkaline degreasing, phosphating and passivation), the eluate of the demineralisation plant and the cataphoresis anolyte.

The rinsing liquids are stored in separate tanks. In another tank, the rinsing liquids are mixed with the active bath ones, and the pH value is adjusted. Subsequently, wastewater is aspirated through a DESTIMAT LE 1000 evaporator, featuring an evaporation capacity



Figure 16: The post-retouching station after the powder application booth.



Figure 17: The gelation oven.

Finally, the bars reach the unloading area (Fig. 19). "Between the loading and the unloading descenders," Soragni says, "we have built a footbridge for the storage of empty bars and a hook-holding grille underneath it (Fig. 20)."

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“The uniqueness of this new coating plant also lies in a few technical arrangements designed to ensure maximum safety for Sirio’s employees working on the line.”

of 1 m<sup>3</sup>/hour and working according to the principle of mechanical recompression of vapours; it uses 60 kWh to purify 1 m<sup>3</sup> of wastewater. The plant is fully automatic, including the chemical cleaning of the tube bundle and the dosage of the defoaming agent carried out by a special system. From here, the distillate is transferred to a coalescence separator where the volatile hydrocarbons left in the distilled product are removed; then, it is pumped to the storage reservoirs. The treated liquid is recirculated to the pre-treatment plant with a cascade in the rinsing tank. The residual concentrate is then disposed of. The technical compartment also houses the demineralisation plant installed by Water Energy (San Pietro in Casale, Bologna, Italy, **fig. 22**). “We have installed two 10 m<sup>3</sup>/hour demineralisers,” says Sartori, “so that when one is being regenerated, the other can keep operating. In the technical compartment, we have also placed the cataphoretic paint storage



Figure 18: The cooling area for the treated components.

“The whole plant is surrounded by a protective fence and access is only allowed through one opening. Operators do not run any risk within this new department, neither during the production phases nor when performing maintenance tasks. This is another reason for satisfaction and proves the validity of such a large investment.”

drums to be used when the tank needs maintenance and the suction filter of the Gema booth, which we chose to locate outside the plant. The outside location of these systems has been designed together with IM.TECH (Bologna), which has dealt with all safety aspects in cooperation with Radial. The whole plant is surrounded by a protective fence and access is only allowed through one opening. Our operators do not run any risk within this new department, neither during the production phases nor when performing maintenance tasks. This is another reason for satisfaction and proves the validity of such a large investment.”



Figure 19: The unloading area.



Figure 20: The hook collection area.



Figure 21: The evaporator provided by KMU Loft.



Figure 22: The demineraliser installed by Water Energy.

“Another interesting aspect of the plant is the zero discharge concept. The wastewater treated with KMU Loft’s system is recirculated to the pre-treatment tunnel, while the evaporator concentrate is conveyed into tanks and then disposed of,” Sartori states. “Also regarding emissions, IM.TECH provided us with the necessary information to fully meet all reference standards already during the line design stage.”

### Conclusions

“I can state that we have realised a cutting-edge project for Sirio,” Villa says, “especially given the technical solutions adopted to obtain optimal finishing results in adequate production times while ensuring the health security of our operators. This is the result of a strict and accurate selection of our suppliers and, above all, of the high-level cooperation among the companies that

have participated in the implementation of this project. The project has fully met our demands for an efficient and productive coating line that will still be technically advanced even in the future.”

### The Four Cornerstones of Ravaglioli SpA

Ravaglioli SpA is one of the world’s top-ranking companies in the garage equipment industry. It is Europe’s leading manufacturer of lifts and among the major producers of tyre and test equipment (vehicle testing and wheel alignment). Established in Bologna in 1958, it has devoted its production to the construction of equipment for the assistance and repair of means of transport, developing all aspects of vehicle lifting for both cars and commercial vehicles.

In 1981, it moved to its current plant in Pontecchio Marconi, housing the production site as well as the executive, technical and administrative offices, a show room and several rooms for meetings and training courses. Subsequent extensions and upgrades carried out on its 80,000 m<sup>2</sup> wide

premises have led to the creation of a 32,000 m<sup>2</sup> covered area.

Four companies are currently part of the Ravaglioli group: the parent company Ravaglioli, Butler Engineering & Marketing SpA, Officine Meccaniche Sirio Srl and Space Srl. Each one specialises in the production of a particular line of products. Sirio has joined the Ravaglioli group in 1997 as a new production unit with an area of 60,000 m<sup>2</sup>, 9,800 of which were covered – they became 18,000 in 2006. Here, there are the production lines of tyre changers and wheel balancers as well as a large area devoted to the processing of metal sheets and hydraulic cylinders. Another unit, Space Srl, is operational since 1998. It specialises in the production of wheel aligners and revision lines and it is based in Trana, in the province of Turin, with an area of 10,000 m<sup>2</sup>, 4,500 of which are covered. The plant of Butler SpA, in the province of

Reggio Emilia, has been added to the Group more recently. It specialises in the design and production of top range tyre changers and accessories for tyre specialists.

In order to ensure the high quality of its products, the company invests a significant percentage of its turnover in research and design and it has a highly professional and experienced technical staff.

The over 270,000 two-post lifts sold until now, together with the several thousand four-post, scissor and mobile column lifts supplied for cars, industrial vehicles and motorcycles, testify to the specialisation degree and the importance gained by Ravaglioli, currently present in 130 Countries outside Italy with a capillary distribution network. Its garage equipment is approved by the most important international automakers, including BMW, Citroën, Renault, Mercedes, Ferrari, Maserati, Lamborghini and many more.