AUTOMOTIVE

A MAGAZINE FROM **ABB ROBOTICS**

JUNE **2008**

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Editorial

> In today's world of automobile manufacturing, flexibility is a given. Ever more base models and greater personalization are just part of the equation. As the industry expands globally, flexibility in production available today allows manufacturers to move their production even closer to their customers, outside of traditional car exporting countries. Brazil, Russia, India and China have become major markets – and producers – not to mention other developing countries in Eastern Europe and Asia.

Factories in these countries are not necessarily like their counterparts in the traditional automotive industrial world. The new factories are often smaller. Rather than providing a fixed element of the production, they tend to serve an automobile manufacturer with a wider range of production, and not always just for one brand but sometimes for two or even three.

These new production facilities – whether OEM or Tier 1 – also have different demands for their equipment suppliers. Unlike their long-established counterparts, they lack the same in-house expertise, nor do they plan to develop it, often. Instead, they rely on suppliers for innovative solutions and comprehensive service during operation.

The ideal supplier is not only experienced and highly competent when it comes to the application, but has a strong global presence. Those are exactly the strengths of ABB. We have a presence in almost every country with automobile manufacturing, and offices in most industrial city centers. And with our vast experience, we can provide standardized modular solutions that not only reduce costs and execution time, but lower the risks.

This issue of *Automotive* magazine features a wide range of examples where we have helped customers meet their needs with solutions that save time and money. As you look through the magazine, I hope that you will find stories that give you ideas on how you can improve your own production with flexible solutions that fit your needs.

Detlef Steck
Manager of Business Unit Systems,
ABB Robotics

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Calendar

2008

8-10 July
Internationaler Rohbau-Expertenkreis at Trumpf Laser-und Systemtechnik GmbH Ludwigsburg, Germany

8-13 September
IMTS 2008
Chicago, United States

23-24 September
Automotive Manufacturing Solutions Global Conference
Detroit, United States

24-25 September
Kunststoffenbeurs 2008
Veldhove, Netherlands

26–29 September
WeldExpo
Mississauga, Canada

6-7 October
Stamping Seminar, Automotive Circle International
Bad Nauheim, Germany

21-23 October
EuroCarBody 2008, Automotive Circle International
Bad Nauheim, Germany

11-12 November
ABB Customer Days (for Tier 1)
Mainz, Germany

NEW ASSEMBLY PLANT IN RUSSIA

> Stadco Ltd, the UK-based international Tier 1 supplier of automotive body-in-white (BIW) products and services has entered into a joint venture with Spain-based Gestamp utomoción to open a new BIW stamping and assembly facility in Vsevolozhsk, near St. Petersburg, Russia.

"As early as 2004 we realized that there was an opportunity for Stadco to offer the increasing number of incoming OEMs in Russia, modern facilities featuring the latest automated processes, which meet the international quality, cost and delivery standards expected by today's vehicle manufacturers," says Andrew Morriss, Managing Director at Stadco.

"By combining Stadco's world-leading BIW engineering and manufacturing capability with Gestamp's global scale and expertise, the JV will offer OEMs a unique and enhanced range of BIW services all from one, dedicated state-of-the-art facility in St Petersburg," says Morriss.

At the Vsevolozhsk assembly facility, ABB will be installing 14 robots for roller hemming of closures, as part of an order worth over USD 5 million. A production test will be done at the end of 2008. The roller hemming solution will be pre-assembled and tested in France and then transported to Saint Petersburg.

ABB's roller hemming solution includes a software program that allows for minimum programming time and rapid adjustment of parameters. The solution also includes force control, a special feature of the hemming tool developed and patented by ABB., that guarantees high quality. Also included is ABB's IRC5 robot controller, which reduces cycle times by controlling up to four robots at once.

ABB will also install seven robots at the Vsevolozhsk facility to provide automation to a press line in an order worth over USD 3 million. Four of the seven robots are with an external seventh axis to decrease cycle time and improve productivity. The robots will be equipped with StampWare software from ABB, designed specifically for press automation.

The Vsevolozhsk assembly facility, featuring the latest automated processes, will initially employ up to 200 people and production is expected to start in January 2009. Stadco and Gestamp predict rapid growth for the plant and anticipate that within six years it will employ around 800 staff.

Rendering of Stadco's new facility in Vsevolozhsk, outside St. Petersburg.

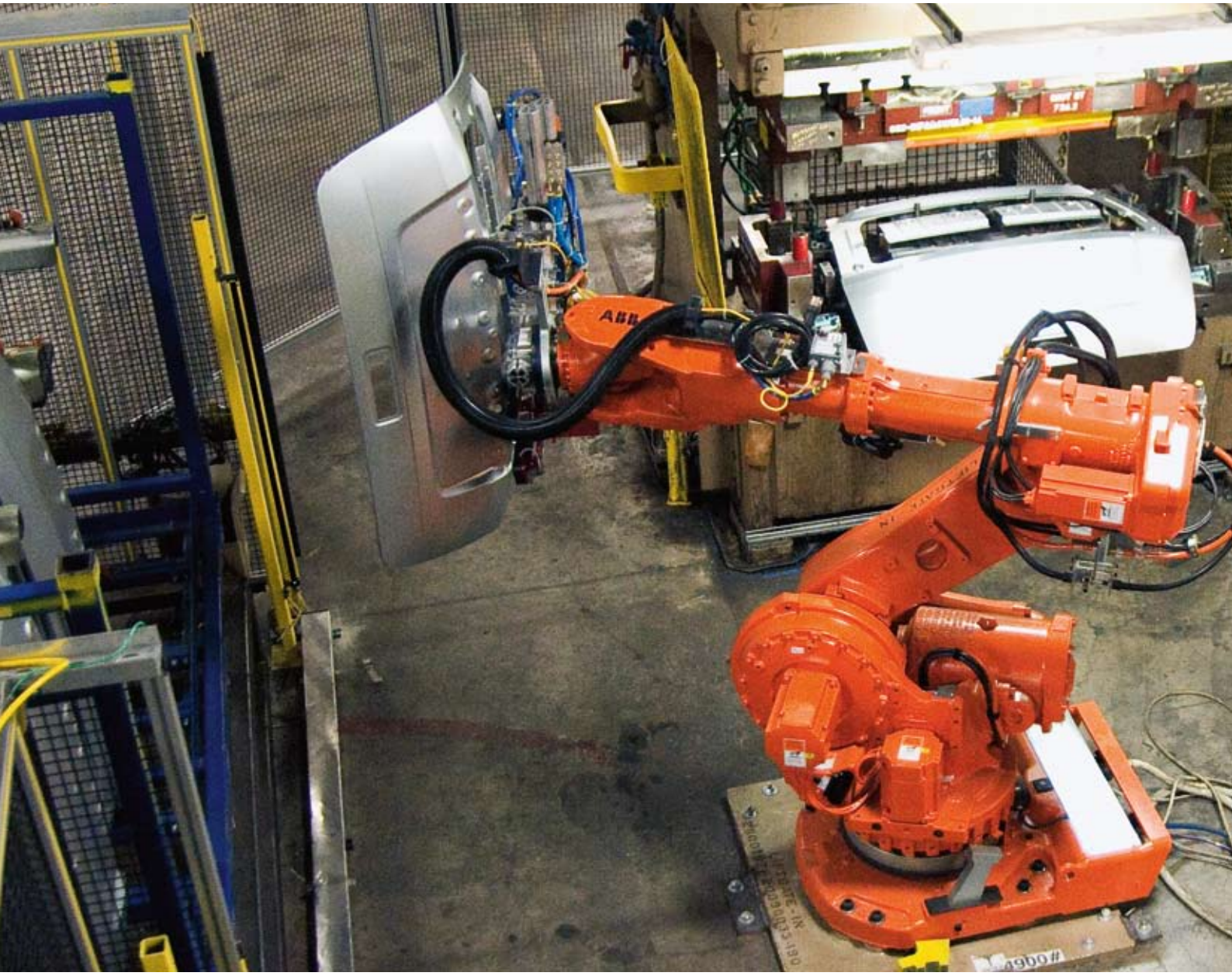
Six-fold increase in trim production

> Huaxiang Group in Ningbo China is a large auto interior and exterior trim supplier that ranks among the top 500 automobile parts companies in the world, with 80 percent of the global market share in auto front cover trimming and 80 percent of the Chinese market share in auto air-conditioning and plastic assembly parts. It is also a parts supplier to multinational auto giants such as General Motors.

Huaxiang supplies interior trim, including door panels and columns A, B and C to famous car makers such as VW, DCAD, FAW and Chery. Originally, ultrasonic welding for plastic trimming was handled by special machines or manually. But when this was no longer feasible, ABB tailored for Huaxiang a complete robotic ultrasonic welding system cell that includes an IRB 2400 robot, an ultrasonic welding machine and a positioner.

Overall productivity was significantly improved by integrating the welding head to the sixth axis of the IRB 2400 and making the robot drive the welding head to weld columns A and B for Ford and Audi. The production per day increased from 50 sets to 300, and enabled Huaxiang to cater for the needs of two to five car models per month with single equipment investment and lower production costs.

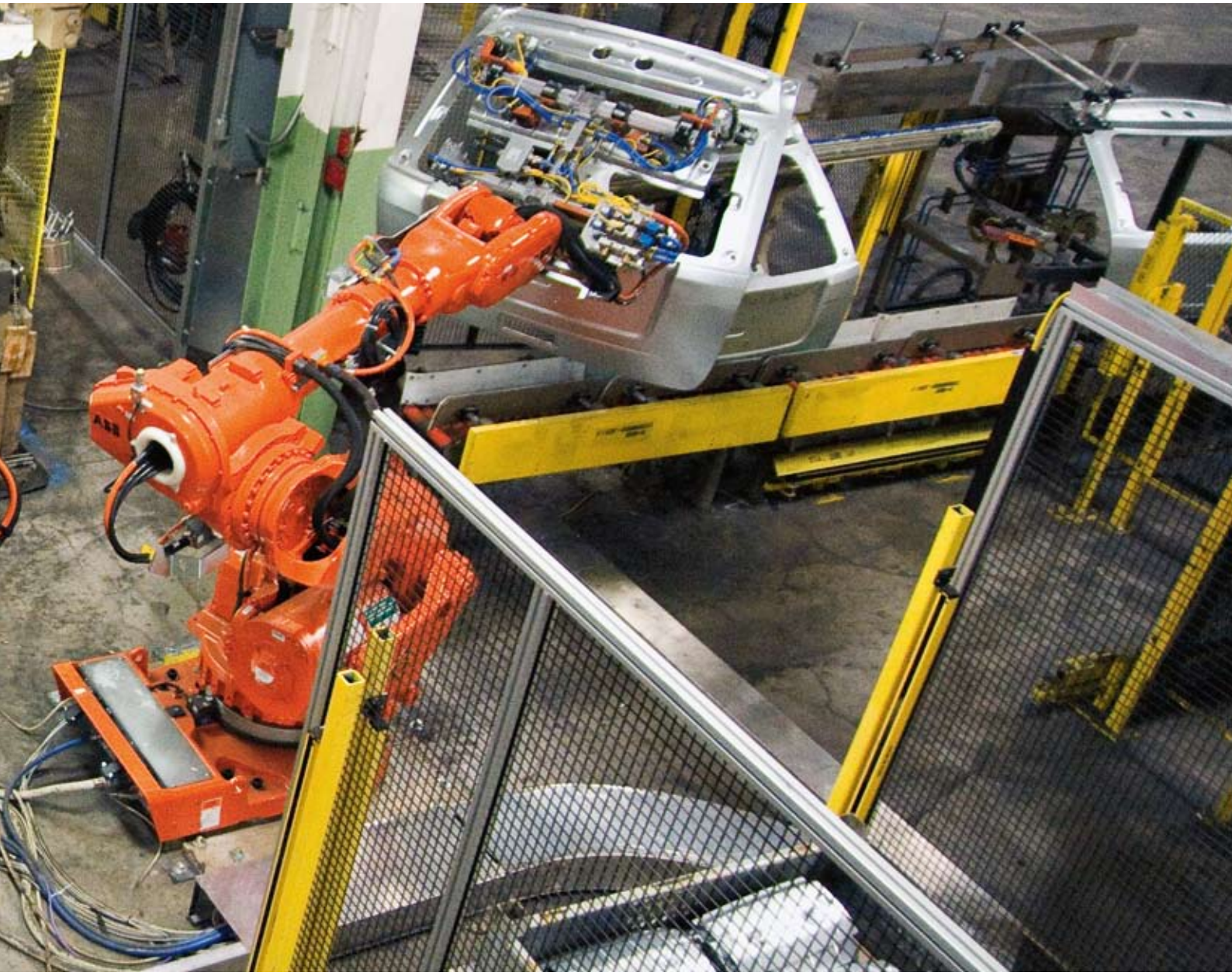
"ABB robots prove their major roles in many lines as well as ABB's advanced technology and perfect service quality. They are our only choice when we need more industrial robots in the future," says Zhou Minfeng, president of Huaxiang.



Smart sight makes for a smart system

A unique automation solution for racking and de-racking stampings is driving the future at Ford Motor Company's Buffalo Stamping Plant.

By Laura Pierce
Photos Ford



An IRB 6600 robot loading liftgates onto a robotic spot welding line at Ford Buffalo.

> Traditionally, automotive stamping facilities relied on manual labor to rack and de-rack stampings to and from robotic welding lines. Today, Ford Motor Company's stamping plant in Buffalo, N.Y. in the United States is shaking things up a bit by incorporating robot automation in a way not done before: incorporating automated guided vehicles (AGVs) and robots to complete the job, thus saving the manual labor previously required to bring stampings onto and off of the robotic welding lines.

In the past, Ford's Buffalo facility featured some automation, paired with two operators on a line. The AGVs would deliver racks to the operators, with one operator de-racking subcomponents and placing them onto the robotic resistance welding line and the other operator picking up the completed parts from the conveyor and racking them for shipment to the end-user.

Many of Ford's divisions were already incorporating solutions provided by ABB Robotics, including the Powertrain Division, which had up to 80 systems in operation. "This experience, combined with introducing other facilities to vision system prototypes, drove Ford to consider vision-guided robotics for the Buffalo stamping plant," says Russ Schenck, Ford account manager, ABB Robotics.

In April 2007, Ford Buffalo and ABB started the process of fully automating the stamping plant's subassembly lines, including hoods, lift gates, floor pans, ladder assemblies and dashboards, for several Ford and Lincoln models. "We were looking for a system that would maintain a high level of quality and a low Mean Time to Repair [ease of system recovery by our skilled trades]," says Paul Gawronski, assembly process engineer, Ford Buffalo.

The existing lines were retrofitted with robots for the racking and de-racking functions. ABB installed a total of 13 IRB 6600 robots on seven spot welding cells, incorporating ABB's TrueView vision-guided robotics technology to further enhance the automated solution. >

This solution puts Ford Buffalo at the forefront of automation: vision-guided robots working in tandem with AGVs. The Buffalo plant is the second automotive facility to recently incorporate AGVs and robots working together.

The process is simple: A TrueView vision-guided robot at the beginning of the line uses a single camera to capture the location of subcomponent stampings on a rack and then places each part onto the line for processing by a spot welding robot. At the end of the line, a second TrueView-enabled robot uses vision to both locate a rack and the completed part on the line, removes the part from the conveyor and fills the rack for shipment to an assembly plant's body shop. While some lines still require human assistance to deliver or pick up racks, four of Ford Buffalo's seven automated cells rely on AGVs to present racks to the robots at the end of the line.

"This solution puts Ford Buffalo at the forefront of automation: vision guided robots working in tandem with AGVs."

With TrueView, powered by Braintech's eVisionFactory software platform and single camera 3D guidance technology, the robots are able to "see" the parts and racks, eliminating Ford Buffalo's need for expensive precision equipment or rack locators. "Vision is especially helpful for capturing the location of the racks presented by the AGVs, as these vehicles are not able to stop accurately or in the same position with each rack presentation, typically stopping within a +/- 5-inch variance," says Eric Putnam, robot programmer, ABB Robotics.

With retrofitting the existing lines with new robots, modifications to Ford Buffalo's existing racks were minor. TrueView is able to recognize variations in the racks, such as different styles or inconsistent colors.

Additionally, because TrueView's single camera is mounted to the robot, there's less concern for the system being jostled and requiring calibration. "However, unlike multiple-camera systems, if Ford Buffalo does require calibration, the process is quick and easy, typically taking less than five minutes," says Putnam.

The robotic racking and de-racking systems were easy to install and commission. In fact, ABB and Ford Buffalo worked to deliver and install the cells during the plant's summer shutdown in July to minimize interference with production. To meet these tight deadlines, ABB pulled three cells ahead, installing them prior to the shutdown. "By installing select cells early, we were able to develop lessons learned and apply them to the installations before the summer shutdown crunch," says Schenck.

"We were able to install five robotic load cells and have them production-ready for start-up during our summer 2007 shutdown. The lessons learned from installation of earlier cells helped with integration to AGV systems, PLC programs and resource requirements," says Gawronski.

For easier integration, the systems were validated in a build shop. Before shipping the systems to Ford Buffalo, ABB utilized the eVisionFactory's AccuTest tool to test the process and generate reports defining how much variance the system could handle, thus maximizing the accuracy and performance of the systems once installed.

Meeting Ford Buffalo's requirement, the cycle time was maintained, while each vision-enabled cell has re-allocated production personnel to more value-added plant manufacturing positions.

An IRB 6600 works with an AGV to rack and de-rack stampings from a press line.

>FACTS

Top-rack solution

By using 13 IRB 6600 robots from ABB and automated guide vehicles to rack and de-rack stampings from the press line, Ford Buffalo has achieved a number of benefits, including:

- No expensive precision equipment or rack locators needed
- Personnel requirements re-allocated
- Easy installation meant some cells were in place before the major installation was made so lessons learned could be applied to the bigger installation
- Easy to use system with low mean time to repair

Paint by numbers

At Fiat, a car body painting line uses robots to apply eco-friendly water-based paints.

By Claudia Magli
Photos courtesy Fiat

> The painting of cars may not be the most important process of production, but for consumers, the end result is probably the most important part of the car visually. For manufacturers, to get the painting right requires finesse and smart automation.
So when Fiat started a new car body painting line with eco-friendly paints for cars at its Mirafiori factory in Turin, it turned to ABB.

The interior and exterior surfaces of seven different body models of the Fiat/Lancia range are painted at Mirafiori using 25 painting robots and 14 special mechanical hands for the automatic opening and closing of the doors, the hood and trunk. Soon to be added will be painting of the Alfa Romeo Junior and four-door models, production of which is due to begin shortly.

The composition of the line layout includes six stations: two for interior base painting; one for the first-coat exterior base painting; one for second coat exterior base painting; one for the interior varnish >

>FACTS

More robots, more support

Over the last three years ABB has also implemented the painting lines of the SEVEL factory situated in Val di Sangro in the province of Chieti in Italy. Three production lines, with a total of 25 robots for the painting of interiors and exteriors, produce approximately 1,100 Ducato vans per day, working three shifts per day, six days a week. This amounts to almost 300,000 vans per year. A further six ABB handling robots carry out the sealing and the application of the protective PVC on the underbody.

ABB's collaboration with SEVEL has also progressed far beyond the simple supply and implementation of automated lines: The factory has requested the active collaboration of ABB which has led to an assistance and maintenance contract. The contract relies on a team of five technicians who, in rotation covering all of the production shifts, guarantee a very high technical efficiency thanks to their know-how, combined with the onsite availability of all of the spare parts required for the fastest possible resolution of any problem which may arise during the production phase.

The painting line of the factory in Termini Imerese in the province of Palermo is also currently in the full production phase. Some 14 robots are carrying out the automatic painting of the Lancia Ypsilon model in all of its versions, including the two-tone version.

Fiat alone is now using more than 120 ABB robots for the processing of its products in the paint shops of its factories in Italy.

and one for the exterior varnish. The average cycle time of each individual treatment is 87 seconds for a line productivity of approximately 250 bodies processed per shift. 64 production shifts per month bring the production capacity of the line to approximately 180,000 vehicles per year.

The interior surface painting stations operate on the stop&go principle. In exactly the same way as a team of Formula 1 mechanics, the robots wait until the body is in position before beginning work. The first to move are the four door openers and the hood and trunk opener, which prepare the body for painting. In continuous contact with the four painting robots, the openers communicate and carry out the operations required to enable the robots to reach all of the surfaces to be painted. The average cycle time for all seven models, 87 seconds, includes the conveyance time, during which the body is maneuvered, painted and sent to the next station.

The robots used for painting the exterior surfaces, on the other hand, operate on the principle of tracking conveyance. In simple terms, the robots are synchronized with the body moving on the conveyor and paint the surfaces which pass through their working area. The stations related to the painting of the first base coat and of the varnish are equipped with ABB electrostatic sprayers supplied by ABB Japan (see story on page 17).

This technology enables the paint particles to be charged, meaning that, following the spraying carried out by means of the 30,000 rpm rotation of the turbine cup, they are attracted to the sheet metal of the body.

By using the electrostatic application technology, the efficiency of transfer of the product increases from approximately 35 percent to more than 80 percent. The main advantage to this is less paint waste while still achieving the required application thicknesses.

The disadvantage when applying the base coat for metallic paints is that the charged particles are distributed in such a way that they are all oriented in the same direction which makes the body appear extremely glossy or extremely matt depending on the direction from which it is viewed. This is why a second coat is necessary in which the paint is applied using the conventional technology.

The final result of the metallic paints is a load, relative to the total thickness, of 70 percent on the first coat and 30 percent on the second coat.

The application of pastel paints, on the other hand, due to the absence of metal in the paint itself, does not require the second coat and therefore the bodies are processed fully with a single coat applied with electrostatic technology at the first station.

At the varnish painting station, with solvent-based one-part resin, the same process is used as for the pastel paints. As the product does not contain metal, no further finishing is necessary following the electrostatic application.

The arrangement of all of the process components on the arm of the IRB 5400 robot, the management of the application integrated in the control unit of the robot itself and the simultaneous management of 30 water-based colors all provide further advantages in terms of reducing paint consumption.

Each of the six different stations is interfaced with a Movicom/Shop Floor Editor graphic station, latest-generation software from ABB that permits "real time" control of the application process by means of

The main advantage is less paint waste while still achieving the required application thicknesses.

the continuous display and correction of the painting parameters without ever having to "distract" the robot from its work.

This powerful software even permits off-line modification of the working trajectories of the robot, by means of graphic display of the path on the body, permitting rapid modifications. Without the software, it would require hours of on-line work and consequent significant shutdowns of production.

The six stations are also connected to each other via a protected ethernet which allows the entire installation to be viewed from any of the monitoring PCs positioned on the line, enabling rapid checking of the operating status of any of the stations.

In testament to the effectiveness of the line, Fiat ordered a further 10 robots for base/varnish exterior painting which are currently in full production on a second production line where the historic "job one," the first painted and approved body, has already been achieved within the time allocated. The Mirafiori factory has, to date, 61 ABB robots installed in the paint shop alone.

Production statistics

- Production statistics
- Average cycle time 87 seconds
- Approximately 250 bodies processed per shift
- Yearly capacity 180,000 vehicles
- Movicom/Shop Floor Editor graphic station offers real-time control of the robots and prevents downtime by providing off-line programming
- Electrostatic application technology from ABB means 80 percent of paint adhesion versus 30 percent without

Six successful stations

The painting stations at Mirafiori include:

- **Interior Base Zone 3:**
9 robots using conventional guns with stop&go conveyance
- **Interior Base Zone 4:**
9 robots using conventional guns with stop&go conveyance
- **First Coat Exterior Base Zone 5:**
4 robots using electrostatic cups with tracking conveyance
- **Second Coat Exterior Base Zone 6:**
3 robots using conventional guns with tracking conveyance
- **Interior Varnish Zone 7:**
8 robots using conventional guns with stop&go conveyance
- **Exterior Varnish Zone 8:**
6 robots using electrostatic cups with tracking conveyance

By Hans P. Fritsche
Photos ABB

German vehicle tester ACTS uses the innovative Force Control technology from ABB to develop further testing innovations.

Force felt with care

The IRB 6600 uses Force Control to test car seats.

> Wear and fatigue testing of functional components costs time, materials and money. It is all the more important to achieve test results that are reliable and as realistic as possible from such investigations. With the new F.R.I.T.S. (Force-controlled Robotic Intelligent Test System) system, German vehicle testing company ACTS offers a robot-supported, more flexible, more attractively priced and far more productive process.

ACTS GmbH & Co KG, a company in the Bavarian municipality of Sailauf and a subsidiary of Magna International, is one of the world's most modern development and test centers for vehicle safety. Crash facilities and crash-simulation systems, component testing stations for head impact and anchoring tests form the basis of a great variety of tests. The company's testing expertise is now highly valued by more and more customers from other branches of industry, in addition to the automobile industry. One of the reasons is the company's process skills.

Targeted testing requires very precise knowledge of the object to be examined and the forces acting on it in practical use. This is the only way the correct parameters can be established and a problem-based test concept can be developed.

Meeting the demands made of test technology using conventional testing methods often takes a huge effort. This usually means installation of numerous pneumatic cylinders, various systems for measuring force and distance and other sensors. The pieces must be adapted each time to new testing assignments. With the increasing complexity of the test set-up, such systems' susceptibility to faults also increases.

ACTS experts are therefore concentrating on developing testing systems that reduce such complexity. The company began using and developing robot-supported test processes at an early stage. The result is the F.R.I.T.S. system, which allows robots to test components in accordance with the real conditions of human use. Thus a wide variety of systems can be tested more efficiently and above all more realistically with regard to endurance properties and wear behavior.

The core of this technology is ABB Robotics' IRB 6600 industrial robot with the option Force Control (FC) Machining. FC is an innovative system comprising intelligent software and sensitive sensors, specially developed by ABB for mechanical working of parts using robotically guided tools. A particular highlight is the robot's simplified manual teaching mode. Instead of using complicated programming, the operator merely has to guide the robot's arm to the approximate location of items to be worked at a later stage. Deviations in precision of a few millimeters are insignificant. The robot gathers this data independently in a subsequent adaptive process by probing the actual contours of the workpiece. Whereas manual programming takes hours or even days, robots can do this work in a few minutes. ACTS' engineers have recognized the potential and have adapted the technology to their specific requirements.

The robot guides the test dummy along the pre-programmed path until it registers a defined resistance through force measurement. By means of a comparison between target and actual forces the

>FACTS

More on Force Control

The F.R.I.T.S. system's innovative use of the option Force Control Machining is hardly the only application for the technology. Force Control Machining can also be used for a variety of other machining applications and provides a wide range of benefits, including:

- Improved process results and quality - secure controlled contact force in grinding (FC Pressure) applications give improved and consistent product quality
- Reduced programming time – 80 percent faster to program grinding (FC Pressure) applications by allowing the robot to "feel" the surface
- Shorter cycle time – 20 percent faster deburring applications as the robot adapts to surface defects
- Longer tool life – up to 20 percent longer tool life as there is consistent wear by avoiding tool and work-piece collisions

robot calculates whether or not it is providing the requisite force for the planned path. It continues until it has reached the prescribed value. Otherwise it stops or changes its movement depending on the application program. This "learning process" on the part of the robot is the key to a completely different control technology. Alexander Martellucci, ACTS' manager for service business line testing, gets to the heart of the matter: "The combination of 'genuine' force control with a robot's freedom of movement. The ABB option Force Control is unique. It helps to realize even the most complicated of test processes."

Thus, for example, the tension of springs decreases over time with repeated use of selective pushbutton switches for shutting mechanisms. This manifests itself in an extension of the shutting paths. Under such circumstances, humans automatically press harder to reach the pressure point for opening or closing, unconsciously reacting in a force-led manner to the changed situation. We are capable of this thanks to our sense of touch and our brain, which delivers the requisite feedback. Mechanical testing systems have not hitherto possessed the properties of such a self-regulating system, but the robot does attain these capabilities after the learning process, thus opening up a new dimension of test technology.

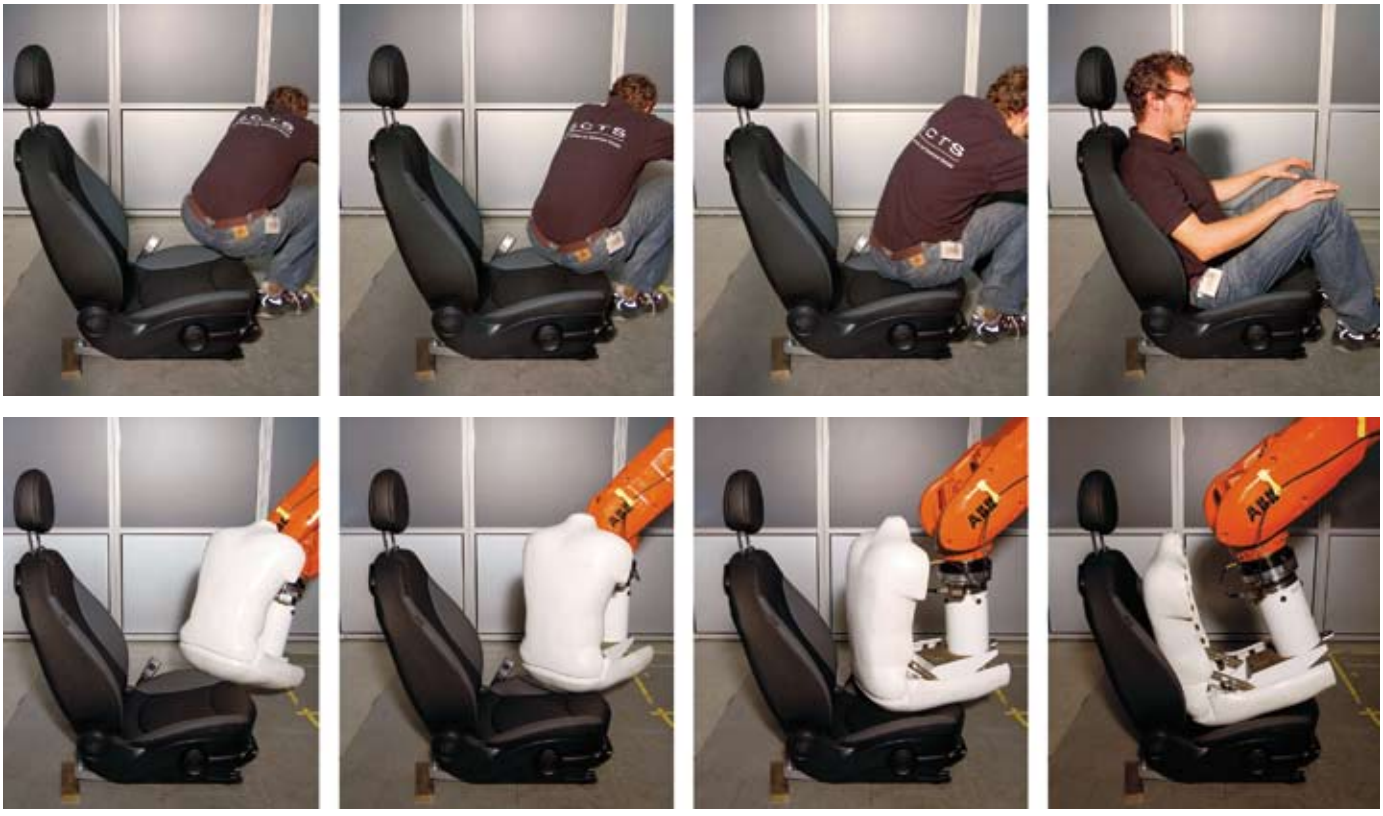
Application examples include pressurized closing systems for bottle holders, closing mechanisms for CD/DVD players, switch operation, opening and closing processes for lids and shells of electronic equipment, forces acting on steering-wheel columns and steering wheels and testing of car seats. The latter is a particular technical challenge. A poor car seat causes stress and fatigue, thus constituting a safety risk. With the test described here it is not, however, this stress that is meant, but the fatigue of the material.

To simulate the act of people lowering themselves into the driver's seat of a car, the robot has to carry out a highly complex sequence of different movements. To obtain precise data on the forces arising when the driver sits down, the testers first placed pressure-distribution mats on the seats and got test subjects to do sitting-down tests. The paths and forces measured form the basis of the test robot's test program. With the aid of a dummy, the robot simulates humans' precise movements and dynamics when sitting down, whereby its movements are not force guided but force-controlled. This is a significant difference, as is shown by a comparison between robots' two types of operation.

A conventionally equipped robot without Force Control travels the prescribed path of movement and measures the force attained. After each cycle it then compares the actual result with the target value and corrects the path for the next cycle. It takes a few cycles until it achieves the target value. This method denotes force-guided robotic movement, and its disadvantage is that changes only take place after completion of a phase. The time losses arising from the many steps increase if the component gradually experiences changes as a result of stressing, such as in the sitting-down test. This happens, for example, when upholstery's tension or elasticity decreases.

With F.R.I.T.S., on the other hand, the robot reacts faster thanks to Force Control. Its force control reacts during the phase in question – practically in real time – to changes in the object being tested. Thus the test process is not only faster but also more precise and more realistic.

With the aid of a test dummy, the robot simulates the precise movements of a person sitting in a car seat.



At Volkswagen's Anchieta plant outside São Paulo, models such as Polo (above), Gol, Europa Fox, Saveiro and Kombi are made.

Pressed to perfection

Using a new robotic system, Volkswagen in Brazil increases its stamping production from 170 to an astounding 3,880 pieces per day.

By Jonathan Wheatley
Photos Volkswagen

> These are extraordinary times for car makers in Brazil. The industry produced a record 2.4 million vehicles during 2007 and production continues to rise this year. Low inflation, rising wages and cheaper credit are driving a consumption boom, and as more Brazilians move up from the lower to the middle income brackets, demand for cars looks set to keep rising.

Car makers have moved quickly to adapt. Volkswagen of Germany has been in the country since the middle of the 20th century, one of Brazil's four big traditional car makers (the others are Ford and General Motors of the US and Fiat of Italy) that were joined from the 1990s by others from Europe and Asia in a wave of expansion and modernization. At its enormous Anchieta plant on the outskirts of São Paulo, aging production lines have been overhauled to introduce the most modern automated systems.

One of the plant's latest innovations, completed in December, is the introduction of IRB 6650S robots with a seventh axis from ABB in a line of six presses in VW's metalworking facilities. The presses were previously used to make panels for the front and roof of VW's ubiquitous Kombi multi-use van or minibus. VW builds about 100 Kombis a day and the presses, fed by hand, had little difficulty churning out 170 pieces a day – meaning they would lie idle for about half the week.

As production of other vehicles has been ramped up, that kind of productivity was no good any more. In April 2008, VW was getting ready to launch a new compact car known only as 23X NF. The Kombi line had to make way.

"We needed to automate the process," says Paulo Henrique Barbosa, the engineer and process analyst responsible for the project. The results speak for themselves. From 170 pieces a day, the same line of presses is now producing 3,880 pieces a day in eight different families of parts, with the same 30 employees that formerly worked one shift three or four times a week now manning the line round the clock in three shifts, seven days a week.

The turnover system alone has saved three to four seconds per operation...

The line works as follows: Flat steel sheets are delivered on pallets to an area next to the first robot, which lifts them off one or two at a time (depending on the size of the piece to be made) and puts them onto a loading platform made up of narrow conveyor belts. If necessary, the sheets are fed through an oiling machine to facilitate complex pressing. Then a second robot collects them – but not before a vision system relays their exact position to the second robot, which makes minute adjustments before picking them up in just the right position for delivery to the first press. This vision system was built by Schleifstein of Germany and supplied by ABB.

The first, 1,800 ton press gives the piece its shape. Then comes the first complication. Because the force is applied from above, the piece emerges as a convex structure. Subsequent pressings, which punch holes and make other refinements, must be made from the other side. So the piece must be "flipped" between presses one and two.

Using one robot, this is a complex movement that involves several changes in direction including a full 180 degree arc on the vertical axis. In the early days of automation this was quite acceptable. But as pressure on volume production has increased, such a maneuver is unacceptably time-consuming. ABB's solution was to use two robots in what is known as a turnover system – one machine hands the piece to the other in a movement that is kept low and fast.

"While the second robot is putting the piece into the second press, the first one is already back at the first press to collect the next piece," explains Henrique.

"It's all a question of saving cycle time," says Tania Duque, automotive segment manager at ABB Robotics in Brazil. The turnover system alone has saved three to four seconds per operation – not much to the layman, but a huge difference on a production line already producing more than two pieces per minute and aiming for a target of three.

Between the subsequent presses, just one robot is needed. But each has another innovation introduced at VW on this line: a "seventh axis," an extension attached to the end of each robot's main arm. Like the turnover system, this also speeds the movement from one press to the next and keeps the weight more evenly distributed, reducing troublesome vibration.

VW has two lines of presses at its São Paulo plant. Paulo Henrique hopes to automate the second one soon. Meanwhile, he hopes the impressive results already achieved will earn him one personal satisfaction: the automation process is up for an award under VW's internal recognition program.

Pressing at the VW plant in Anchieta

>FACTS

ABB's new robot line

Project implemented: August to December 2007

- Productivity: increased from 170 pieces a day to 3,880 pieces a day
- Cycle time: maximum measured to date is 2.80 parts per minute, right hand panel of Saveiro – up from 1.5 per minute on an earlier robot line
- Parts produced: left and right side of Saveiro, left and right side of Polo Hatch, roof of Polo Sedan and Polo Hatch, engine support for Polo, Fox, 23X NF

Volkswagen Anchieta at a glance

Inaugurated in 1959 – the first VW factory outside Germany

- "Nova Anchieta" (New Anchieta) production lines installed from 2002 as the most modern in Brazil in a BRL 2 billion (USD 565 million) investment
- Total area: 1.96 million square meters
- Capacity: 1,600 vehicles per day
- Employees: 15,000 (10,000 Volkswagen, 5,000 third parties)
- Products: Gol, Fox Europa, Polo Hatch, Polo Sedan, Saveiro, Kombi

By Fanny-Yi Wan
Photos ABB

More cars mean more robots

At Shanghai Volkswagen, a new system for body in white and roller hemming will help the company meet increased demand.

> China has become a powerhouse when it comes to the production of automobiles, and its growth doesn't look to be slowing anytime soon. Already in 2006, according to the *Financial Times*, China overtook the U.S. in production of passenger cars – 5.2 million for China versus 4.4 million for the U.S.

"A customized solution and a competitive price are key to the success..."

Li Gang, Head of ABB Robotics Automotive Industry China

One of the largest modern car manufacturing bases in China, Shanghai Volkswagen Co. Ltd. (SVW) has an annual capacity of 450,000 cars. With two brands – Volkswagen and Skoda, SVW sold some 436,000 cars in 2007. The company produces six different models, including Santana, Santana 3000, Passat, Polo, Touran and the coming Skoda Octavia, with tens of varieties on five platforms.

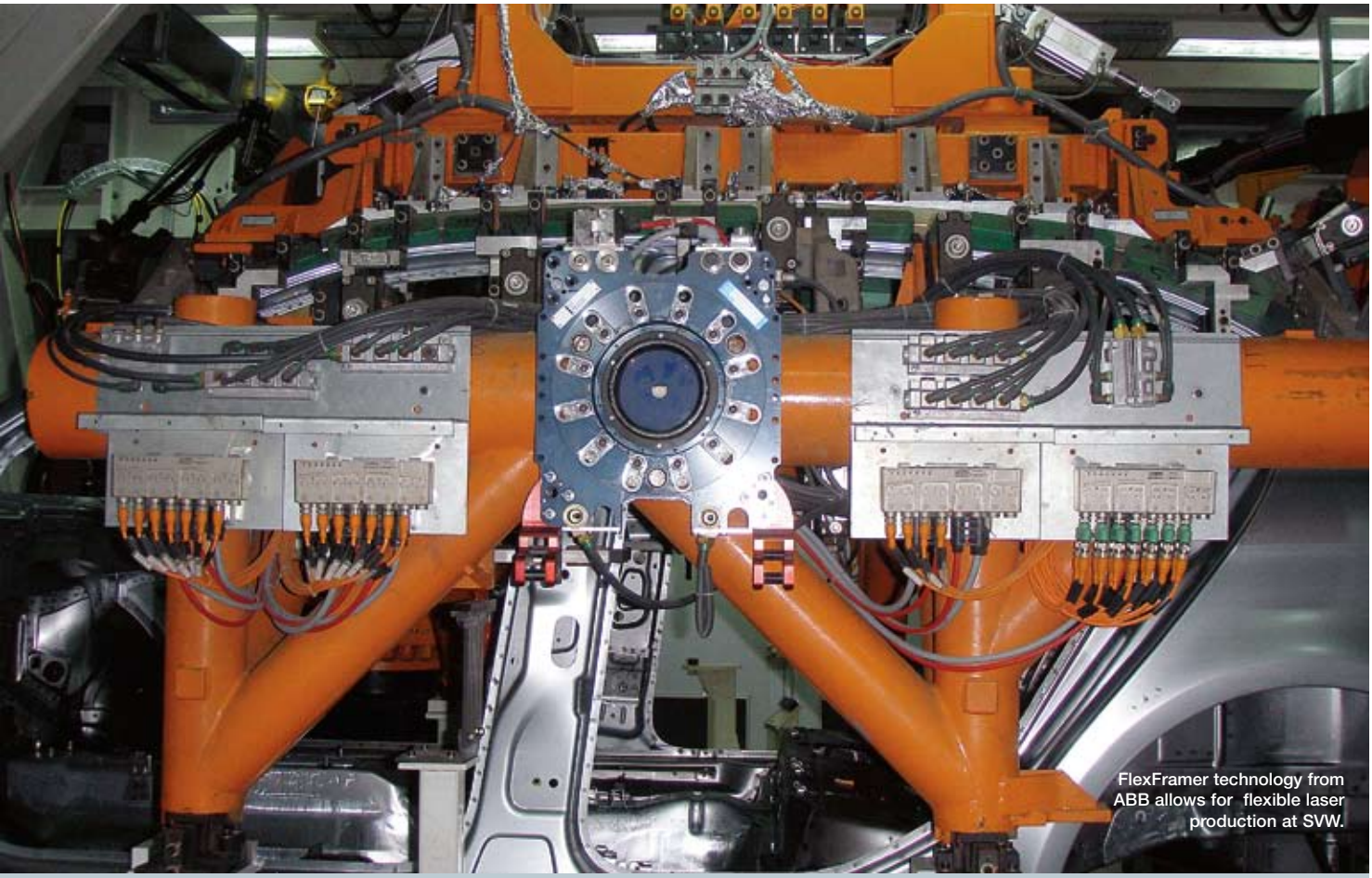
Naturally, producing in such volumes requires the best technology and cutting-edge automation. To meet the demand, SVW turned to ABB for its car body general assembly and welding line.

ABB has provided SVW with a complete body-in-white framing welding line and sunroof hemming station for SVW's new production line. The line includes robotic workstations, robotic hemming technology, ABB FlexTrack, Audi flexible drive system for framing, laser welding station, fixtures and service, among other items. The lines were put into service in July 2007 and into production in April 2008, with a capacity of 24 cars per hour and a planned output of 100,000 cars per year.

"The Project Team, with great support from the engineering team at our global lead center in France help SVW to overcome the technical challenges on this project," says Herve Chevalier, head of ABB Robotics AI BIW China. The AUDI flexible drive system for framer technology applied in this project is standardized for VW's body production line roof and panel position welding process.

This project is the first time where ABB uses the technology from Audi combined with ABB FlexFramer technology to create unique BIW flexible laser production equipment within VW plants worldwide. The development of the inherent technology broke many technical barriers, says Chevalier, and created a unique technical solution, proven to be fully adaptive to and flexible for SVW's production lines.

Key to the choice of ABB was its "customized solution and competitive price in defeating the competitors and winning this order," Says Li Gang,Head of ABB Robotics Automotive Industry China.



FlexFramer technology from ABB allows for flexible laser production at SVW.

>FACTS

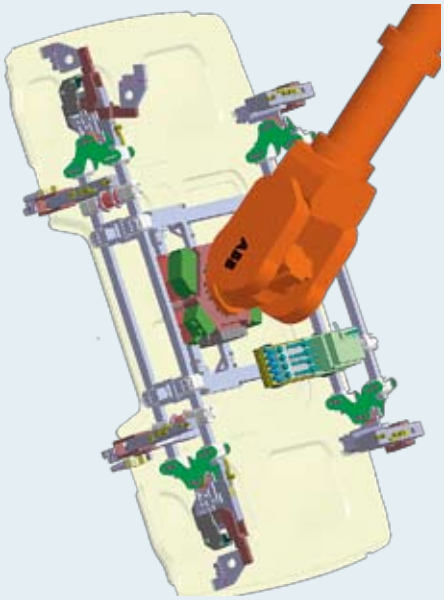
Increase in robots for China

ABB China BIW Team has received a series of orders since its establishment in 2004, including a flexible welding and assembly line system for BBDC's Chrysler 300C and Chrysler Sebring, a body production line and robotic hemming system for DPCA's new family cars such as C-Triumph, Peugeot 206 and its upgraded edition, and a welding and assembly shop system for SAIC Roewe 750.

Firm grip on grippers

Grippers with standardized parts make for efficient production.

> Modular solutions that are simple to design, easy to use and install and at a cost-effective price are key to efficient production. ABB has responded to the needs of the industry with its LWLC (Light Weight Light Cost) gripper range, designed with automotive production in mind. The LWLC gripper was developed initially for use in stamping applications, introduced in 2002 with 3000 units sold. Since then, it has been further developed for body-in-white applications, with the first grippers sold in 2007 with 25 units sold in October. "The LWLC grippers can be used for other products as well," says Stephane Petrequin, ABB technical manager.



The LWLC grippers are built with an aluminium profile with composite parts. All parts are standardized, which allows not just for easy use, but easy adaptation when new products are to be produced. "The LWLC range of grippers allows you to reduce delays because the stock components mean that you can easily and quickly supply anticipated launches," says Petrequin. In addition, the grippers require only very quick maintenance, and changing a component is easy and takes less than five minutes.

Whether you are a solutions developer and integrator of production lines, or an automobile manufacturer using grippers in your production, the IRB gripper range is designed to simplify the development of your assembly processes, decrease the amount of delays, minimize assembly and control times and provide very good repeatability when components need to be exchanged.

The LWLC grippers can be made in the standards DIN, CNOMO, NAAMS with different brands of clamping modules and can be equipped with tool changers. The range includes grippers for interpresses, unloading and handling among other applications.

Gripper Range

	Small	Medium	Large	Extra Large
Weight of the parts carried	1-10 kg	5-30 kg	20-80 kg	60-90 kg
Weight of the tooling	20-50 kg	40-90 kg	80-120 kg	90-150 kg
Number of binding and pilot	1-2	3-4	5-6	6 +

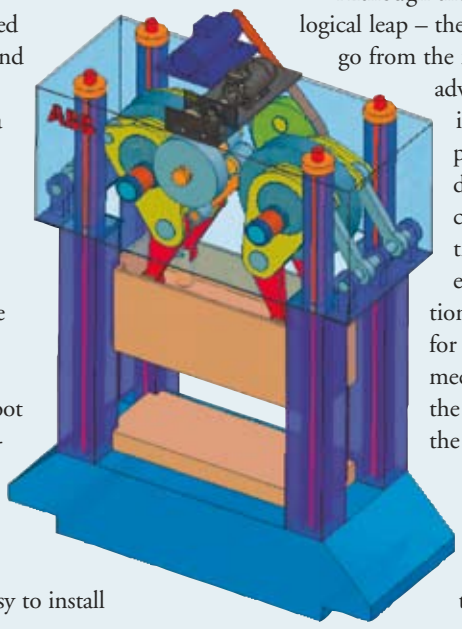
Pressed to perfection

New technology from ABB makes for faster opening and closing of press machines without compromising the pressing itself.

> The press shop may be the most capital intensive area of the factory. The body of a car is typically assembled from several hundred metal parts, most of which are made in presses. Unfortunately, increasing the overall speed of the actual pressing compromises quality. But time can be gained by speeding up press actions in between actual pressing. This is the purpose of ABB's Dynamic Drive Chain (DDC) technology.

The solution uses servo motors to reduce cycle times and can be added to existing lines, decreasing risk and protecting previous investments.

The new DDC technology essentially allows the press to open and close faster, while maintaining the original speed for pressing. It is even possible to start the pressing at a lower speed than used today and still gain productivity. Even with a rather small servo motor size, a productivity increase between 10 and 30 percent can be achieved using the servo technology alone. Combined with the latest robot automation developments, even higher increases can be achieved.



ABB's Press Upgrade Kit is easy to install – well within the time frame of a usual one-month summer shutdown – and is reversible: The DDC servo presses have been designed with a switch that can completely disable the new technology. When switched off, what remains is a classical mechanical press.

Although the DDC represents a technological leap – the R&D innovations involved go from the new press topologies to the advanced control software – it is built on existing ABB products such as the ACS800 drive and the IRC5 robot controller. ABB's servo solution involves much smoother acceleration and deceleration than the clutch and brake for which the current press mechanisms were designed, so the servo will actually increase the life time of the press.

The servo press drive also has a peak power that in most cases does not require re-dimensioning of the factory's power grid.

Simulation software a smart choice

Offline programming means less downtime, greater safety and faster startups with ABB's RobotStudio.

> A robot is only as good as the software used to program it. And one of the key advantages for using ABB robots is RobotStudio software. RobotStudio provides the possibility for offline programming, which means greater flexibility and ultimately, money saved.

First and foremost, RobotStudio means that downtime can be significantly reduced. With RobotStudio, simulations can be made ahead of time and minimize initial operation times. When new products were added at German parts manufacture Benteler, for example, previously there was too much downtime. Offline programming has saved the company time when they have had to quickly start up new products. RobotStudio also allows the company to undertake modeling that was previously not possible. "We can check many things ahead of time and it is certainly an advantage for us. We can also design the program organization, simulate the process and many other things that we had to do on site in the past."

RobotStudio also allows for robots doing applications formerly done by hand, such as the deburring done by Toyota Motorsport GmbH, which produces Formula 1 cars from start to finish. "Since the robot has taken over the task, the work process has become very smooth and quick. With RobotStudio, we achieved the goal of trimming and the accuracy required by Formula I," says Wolfgang Steinfeld.

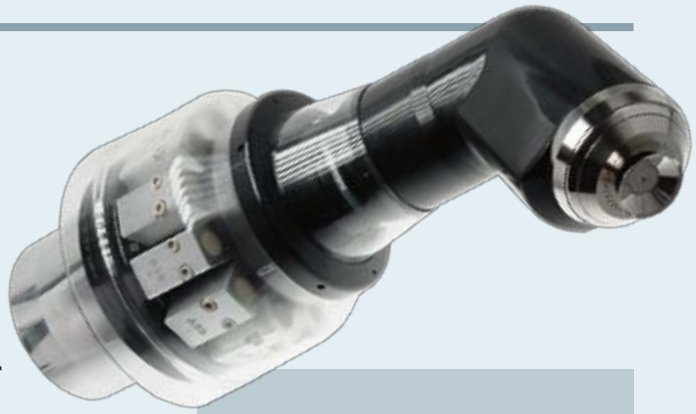
Ease of use is key to RobotStudio. At Volvo Construction Equipment Cabs AB, the programming used to require climbing on large ladders, which was time-consuming and risky. Offline programming changed all this. "We chose RobotStudio as an offline programming tool in our latest project because it is easy to use and maintain, among other things," says Anders Nilsson.

Once offline programming has been done, making sure that programs are not lost is also important. ABB's webware saves time because it automatically backs up programs, not just for safety's sake but also so they can be compared with newer versions. And it doesn't have to be done manually, which takes time and involves many risks, a big plus for Saab when it started using WebWare for hundreds of its robots. Not only that, Saab appreciates that the program can be accessed from any specified place.

Having the information available on one system instead of on scattered diskettes was also important to Valmet's choice of webware for its welding of Porsche automobiles. Not only has product quality improved, just as importantly the company has improved its delivery times.

Less paint, more efficiency

Less wasted paint plus less wasted solvent for cleaning makes for a cheaper and more environmentally friendly atomizer for paint applications.



> What could be more efficient than an atomizer that not only requires less paint and less solvent to clean? ABB's ROBOBEL 951-2K atomizer uses pattern control to improve paint efficiency by some 20 percent, and has a smaller total area to be flushed, thus reducing the amount of cleaning solvent needed. Thus, you save money by using both less paint and less solvent to clean up afterwards.

An innovative part of the design is that the 2K mixing unit is mounted internally: The static mixer and valves to mix 2K paints are mounted inside the atomizer body. This means that an important advantage of the new atomizer is that the total amount of solved used for paint circuit flushing is reduced to one-third compared with the existing system. This enables a substantial reduction in cost of solvent. Plus, it is an environmentally-friendly atomizer, which contributes to a decrease in VOC emissions.

The atomizer is also easy to maintain. The on/off valves are visible, as a transparent cover is used for the mixer and valves The valves are fastened by only two bolts, making it possible to change the valves easily and quickly.

Of course, one of the most important aspects of the atomizer is that less paint is used because of its innovative pattern control function. The ROBOBEL 951 2K atomizer finely controls the spray pattern by the width of the painting area, improving paint efficiency by 20 percent when compared with existing models without pattern control function. It also reduces paint loss by 25-30 percent. And just as using less solvent means fewer VOC emissions, so does using less paint.

>FACTS

ROBOBEL951-2K

- **Paint Flow Rate**
  400cc/min
- **Flushing Solvent**
  Max. 10-15cc/min, in 2-3 sec
- **Rotation Speed**
  Max.70,000rpm
  (regular use 60,000rpm)
- **Lenght**
  540mm (atomizer body only)
- **Weight**
  7.5kg
- **Applicable Paint**
  Solvent 2K clear
- **Solution / Process**
  Automobile exteriors and interiors, Automobile bumpers and plastic parts, Other industrial products using 2K paints.

By Hubert Labourdette
Photo and illustration ABB

Energy savings, less pollution

A new system uses air recirculation to improve the process of painting and saves energy in the bargain.

> The application of paint is a difficult industrial process. Many paints contain organic solvents that are hazardous to human health and the environment. As companies are under pressure to reduce emissions and decrease their operating costs, a crucial area of optimization is the paint booth. ABB has responded with the development of an air recirculation system combined with solvent disposal and a state-of-the-art energy saving process.

The new paint booth air recirculation process, which is designed for use with only robotized automation, begins after the washing stage. The polluted air is not vented outside. Instead, it is 90 percent recycled in the booth after it has been treated. This recirculation system not only allows air reutilization, but the solvent concentration in the booth has a ratio that is in line with full optimization of the solvent burning process, and the solvent concentration in the booth is monitored and maintained within safe limits.

The solution uses a specific air duct that extracts 10 percent of the air flow and sends it to a regenerative thermal oxidizer (RTO). This extraction is counterbalanced by a small flow of air from the outside. This process is very stable with very little influence from outside conditions. However, it requires a very efficient washing process and a specialized dust filter.

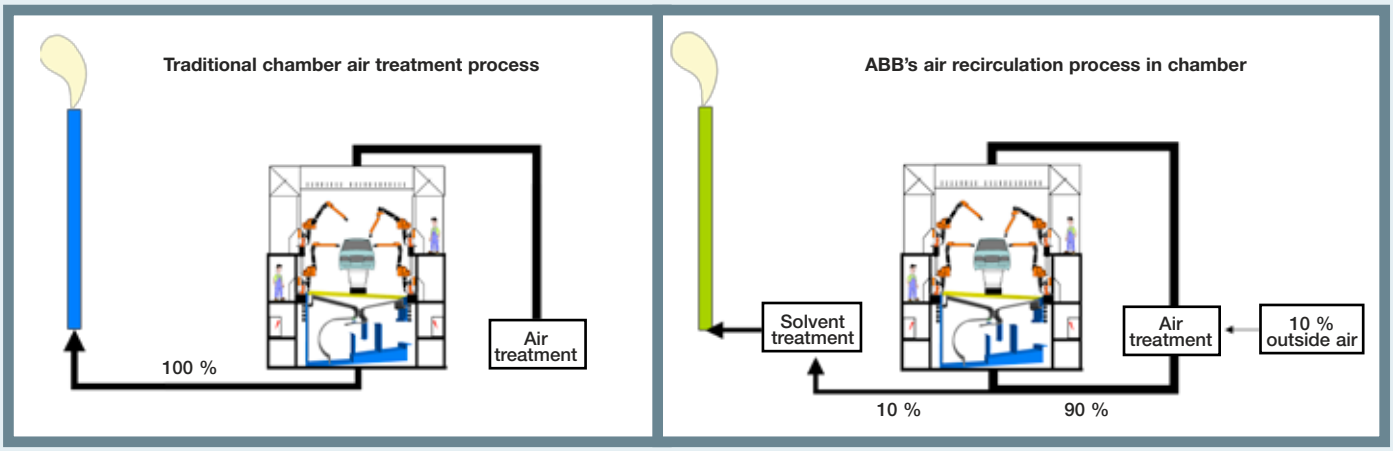
Thanks to this recirculation process, the air is solvent saturated. It then goes through a high temperature ceramic chamber, where its temperature is raised to 780 °C after which it enters a combustion chamber. At this temperature level, the solvents autocombust and are fully eliminated. This solvent-free air flow – with a temperature of 835 °C – is then sent through a second ceramic chamber where it is cooled to + 60 °C before being vented to the outside.

With the exception of the start-up phase, the amount of energy consumed by this system is close to zero, and thermal efficiency is close to 95 percent. The air flow is periodically inverted to increase the ceramic temperature. The process fully conforms to environmental laws in application in almost all countries.

Another significant source of savings is in the outside air conditioning process. Compared to a traditional scheme, ABB's process reduces the quantity of fresh air used – and hence the energy consumed – by a factor of 10. The closed-loop system for water used at this stage also provides savings.

The system is modular and uses a plug and play approach so it is easy to install, has a small footprint and is fully compliant with environmental regulations. The energy savings can be up to 30 percent when compared with existing lines, which represents a 9 percent reduction in the total annual operating cost of the paint process. Not to mention by automating the process entirely, no employees are exposed to hazardous materials.

The air circulation chamber, in the middle of the diagram below, is where the solvents autocombust.



The amount of energy consumed by ABB's system, at right, is close to zero, and thermal efficiency is close to 95 percent. The recirculation system requires a fully robotized process which produces further savings: It reduces paint consumption (and thus cost) and hence environmental impact.

By Srinivas Nidamarthi
Illustration ABB

Human touch goes robotic

A special solution for producing torque converters for automatic transmission provides precision that saves time and money – and workers' health.

> Ever wonder how an automatic transmission in your car shifts gears without a clutch? This is made possible through an important device in transmission called a torque converter, which essentially keeps the engine running independent of the transmission.

The production of torque converters is no easy task, however. Heavy fluid coupling – above 18 kg – typically requires carrying by one or two workers. During assembly, workers must align three stages of gears and splines by "feeling" for a proper fit.

The heavy and repetitive assembly of automatic transmissions has caused elbow and wrist tendon injuries at several automakers. In the year 2000, a United Auto Workers (UAW) union's ergonomic safety officer contacted Ford Advanced Engineering in search of an automated process alternative.

At that time no feasible method existed to automate the torque converter assembly process due to several random uncontrolled positions of parts that are assembled by "human feeling for force" and the trail-and-error nature of the assembly process.

Research teams from Ford and ABB worked together to automate the torque converter assembly. Robot handling of the part wasn't the problem, it was replacing the important "human feeling for force."

This led to the development of Force Control, which makes the robot path adaptable to sensing 3D forces and torques at the end of its arm. Using a force and torque sensor on the gripper, the robot is programmed to imitate human processes. The robot controller accommodates the force feedback, with programming to control and guide its path.

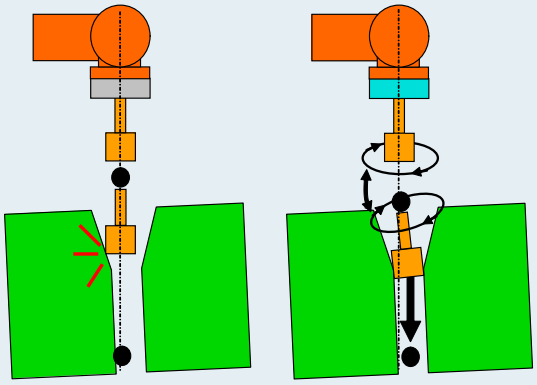
In a typical position control, the assembly path is fixed according to pre-determined geometrical coordinates. The variations in parts manufacturing and tolerances inevitably led to uncontrolled forces in assembly. In the case of Ford, the manual torque converter assembly caused a 3-percent reject rate due to high contact forces.

In a force-controlled robot assembly, the robot instead adapts its path, keeping the contact force to its limit as programmed, preventing such waste.

Automotive torque converters typically have three distinct sub-assembly stages required to complete the overall assembly: a turbine spline hub over the splined turbine shaft, a stator spline hub over the splined stator shaft, and the pump impeller feature that drives the transmission pump as the engine turns.

ABB has developed a programming tool to monitor and optimize assembly parameters, such as force and position, so that both contact forces and cycle times are minimized in all these three stages of assembly. This monitoring and control of forces enable built-in quality during the assembly process. The built-in quality was a very important factor to control the force during the assembly rather than finding out the part was assembled wrong at the end of the line.

In addition to the achieved safety and ergonomics, and cost savings from automation, the Force Control automation also achieved higher throughput and zero rejects, thereby lowering unit product costs. And Force Control can be applied to several other assembly applications, most notably for powertrain assembly automation. The end result was a successful installation of torque converter assembly that made both Ford and UAW happy. Today Ford recognizes this process as "Replication Ready" – that is, a tested, proven and repeatable process, and applies it at all new torque converter assemblies.



Position Control
- – Fixed path
- – Fixed speed
- – Uncontrolled contact force
- – Potential part damage
- – Potential assembly failure
- – Potential tool failure

Force Control
- + Adaptive path
- + Adaptive speed
- + Controlled contact force
- + Built-in-quality
- + Eliminate part damage
- + Reduce assembly failure
- + Extend tool life

>FACTS

Better with Force Control

The new solution for torque converters and powertrain assembly provides a wide range of benefits for Ford:

- Number of rejects reduced from 3 percent to zero
- Product unit costs lowered
- Workers no longer subjected carrying a heavy and repetitive job, thus lessening elbow and wrist tendon injuries
- Robot controller handles the difficult job of monitoring force and position

Nicolas Branowski, Renault Truck Project Manager for the new line, left, with ABB Project Manager Philippe Bridon.

Fewer robots for four times the work

When designing a new body-in-white line for truck cabs at Renault, reliability, efficiency and safety were key factors in choosing the robotic solution.

By Anna McQueen
Photos Alistair Miller and ABB

> When the Renault Truck factory at Blainville-Sur-Orne in the Normandy *department* of Northern France, decided to add an additional body-in-white truck cab manufacturing line, the choice of which robots to use was not lightly made. But when production begins in November of this year, the line will be sporting 14 brand new ABB IRB 6600 robots, 13 track-motions and 18 IRC5 robot controllers.

"We've never used ABB robots before but there are several reasons why we're going to make the switch," says Alain Condon, Body-in-White Manufacturing Manager at Renault Trucks Blainville. "ABB has a very good technical reputation and they also have a very good relationship with our parent group AB volvo, but two of the main drivers were the complete package we're getting from ABB, and the fact that the system can be developed and reconfigured for future use," he explains.

"We wanted a supplier who could offer geographical proximity to Blainville for better service, from installation to operation and after-sales care," says Nicolas Branowski, Project Manager for the new line. The ABB offer covers the project from conception to installation, complete with a full training package and a year's guarantee supported from its Beauchamp site, just outside Paris.

"Being able to reconfigure the system in the future for other purposes is also absolutely key to deals of this magnitude," says Branowski.

The project for the new line was agreed at the end of 2006, the dossier presented to the board in February 2007, and the go-ahead given by AB volvo the following month. The line is currently being installed and will ramp up in September, and will be at full production by November 2008.

The new line will have five production cells. Three will be preparation cells using ABB's Module Flex technology, the first making the underbody, the second making the rear wall and header and the third making the sides of the cab. The cabs will

>FACTS

- The Blainville-Sur-Orne factory is located 10 minutes outside the Normandy city of Caen in Northern France on an 85-hectare site
- Renault Trucks Blainville is Lower Normandy's largest private employer with 2,650 employees and over 600 temporary and contract workers
- In 2007, the site produced 72,000 truck cabs for all Renault Truck models and for Volvo FE, Volvo FL, DAF and others
- Production target for 2010: 100,000 cabs
- Number of IRB 6600 robots: 14
- Number of IRC5 controllers: 18
- Number of track-motion : 13
- Cycle time: 12 minutes
- Number of tasks: 3-4
- Total cab production time: between 3.5-4 hours
- Total weekly production after ramp-up: 1,950 cabs
- Weekly production increase: 200 cabs

then move to the two remaining ABB FlexFramer cells, the first where the underbody will be completed and the second where the whole cab will be finished. Three of the cells were built by ABB at the Beauchamp site near Paris. The other two are being assembled in situ.

The current line produces 1,750 cabs a week, mainly for Renault, but also for Volvo, DAF and other truck manufacturers, but the team has been working weekends to keep production at this level. The introduction of the new line will mean that they can stop working weekends as well as increasing production to 1,950 cabs per week.

The challenge for the new line is the increased workload. "The new line will only produce a limited range of medium-duty truck cabs, so we'll only be using 14 robots compared to 72 on the existing line," says Branowski. "But each robot will be doing four times the work, with a cycle time of 12 minutes compared to three, and as the cycle time increases, the reliability risk increases," he adds. Renault Trucks' existing robots do one or two tasks, but the new ones will do three or four.

Security was also a key consideration in the project. "The body-in-white production line uses six operators for loading per shift," says Condon. "We analyzed what they do and we defined some 93 different potential working situations, and working with an expert, we designed the new line to improve the ergonomics of these 93 situations," he explains. "Safety must always be the supreme criteria for any work space, and the ergonomics of a situation are the key vector in production security."

But because they have not used ABB robots before, there is naturally some caution among the team. "I'm yet to see the proof of the reliability of ABB products," says Condon. "I just hope the IRC5 is up to the job – the whole performance of the line depends on the controller which is why Renault spent a lot of time validating it," he explains. "It's a gamble for us, but we're playing to win."

By Holger Walch
Photos Luca Siermann

Paint to order

At Mercedes-Benz's Wörth truck plant in Germany, robots play a crucial role in a new top-coat spraying line that uses special water-based paints.

> When demand for Mercedes-Benz trucks increased, the company naturally responded by increasing capacity at its factory in Wörth in Rhineland-Palatinate in Germany. Last fall, Mercedes-Benz began operating a spraying line, converting an existing filling line into a fully automated top-coat spraying line for water-based paints. The company wasn't merely raising its capacity however: the aim of the investment was a significant reduction in solvent emissions during spraying of the truck cabs. This is made possible with mono-hydro top coat paints, in which the solvents in the paint are over two-thirds water.

While the No. 2 top-coat spraying line, which went into operation in 2002, has a highly flexible color-supply system for over 250 colors, on the new Line 3 the "highrunner" colors - those shades most frequently ordered - are at the forefront. Interestingly, more than every second truck leaving the world's biggest assembly plant for commercial vehicles is white.

As with the existing line and the previous filling line, with the new top-coat spraying line ABB is responsible for the color supply and for automation. For the field of automation the paint-technology experts from the town of Friedberg in Hesse supplied eight IRB 5400 painting robots and four IRB 5300 robots, which act as door openers, including the relevant travel axles. Application equipment and vision systems for all the robot stations plus documentation and quality-assurance systems complete the delivery.

The new line comprises a total of six stations: a cleaning station, four connected robot stations and a

manual station. In the stations, the cabs for many types of Atego- and Actros-model trucks are painted, along with various components of both metal and synthetic materials. The cycle time per station is three minutes.

The cabs, which are attached to transportation sleds, are brought into the cleaning station after the filler painting process. At the station, they are given a thorough manual cleaning. Then comes the internal painting station – the first of four completely automated, robot-supported painting stations. With each new cab brought in, a vision system measures its location in the room, recognizes whether components are present and passes the data on to the robots. After the opening of the doors by the two ABB handling robots, the two paint robots enter the interior, paint the door rails and folds and the actual doors, and finish with the external painting.

In the following underbody station, the cab is lifted to a height of about 1.70 meters, and two IRB 5400 robots paint the underbody area and the add-on parts. At the next station, parts of the interior and the outer skin of the cab are again coated, using two paint robots and door openers. In the final automated station, two IRB 5400 robots perform the final application on the outer skin. In the touch-up station, a visual inspection is carried out, the final step in this part of the process.

The cartridge system for painting applications is a key part of the application. The innovative concept guarantees both relatively simple potential division during electrostatic valve (ESTA) atomizer application of water-based paints and reduced paint losses during color changes. With ABB's FlexBell system, a color cartridge is immediately combined with the high-rotation atomizer, so that only the atomizer has to be cleaned using solvents. The cartridge contains only the amount of color actually needed for one painting process. This means nearly loss-free color changes are possible, with the expensive rinsing of leads during color changes avoided.

>FACTS

MERCEDES-BENZ TRUCKS

The Merceds-Benz plant in Wörth am Rhein is the world's biggest truck assembly works. It has an area of 2,463,186 square meters and a developed area of 544,729 square meters. Average daily production is over 400 CBU (Completely Built-Up) units as of 31 December 2007. Approximately 10,000 employees work at the Wörth factory.

Careful spraying of the underbody, above, and the interior, below. At right, ABB FlexShield provides continuous painting with internal charge of waterborne paint.

Modular, simple, flexible
Just Lean!

Produce cars with ABB Lean Solutions

Your customers demand different variants of cars and more options. So you need more flexibility in your production lines. They also need to be as lean as possible to reduce cost and increase productivity. ABB has the answer to these challenges. We provide constant innovation in manufacturing system design and operational excellence in their realization. ABB is a global leader in Body-in-White systems, Paint Process automation, Powertrain Assembly lines and Press automation. All based on a high quality robot range backed up with professional service. **ABB's automotive manufacturing systems are innovative, flexible and lean.**

To find out more about ABB Lean Solutions visit - www.abb.com/automotive

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