Robots bring improved flexibility to Vauxhall

ABB Flexible Automation has supplied 447 robots to Vauxhall Motors as part of a major refurbishment programme for its Luton (UK) plant, where it produces the new Vectra car. As a result of this investment capacity has been increased from 48 to 60 cars per hour. A further benefit is that subassemblies, such as doors, underbodies, bonnets and tailgates, which previously came from Belgium and Germany, can now be manufactured at Luton.

All the robots at *Vauxhall* are from ABB, the vast majority being IRB 6000s. 432 of these are employed in body-in-white construction and 6 in final trim and assembly, where they carry out automatic glazing operations. In addition, there are nine IRB 2000s in the paint shop for seam sealing and underbody coating.

Modular design of the IRB 6000 robot

The IRB 6000 robot is of modular construction 1 so that it can be readily configured to meet a variety of applications and customers' needs, a feature that has been fully utilized at *Vauxhall*. Several versions are used, including robots with the standard reach of 2.4 m and a load capacity of 120 kg, robots with a heavy-duty wrist capable of handling 150 kg, and ones with longer arms to extend the reach to 2.8 m and 3 m.

For areas where floor space is at a premium and access is required from above, the shelf-mounted IRB 6000 is used. This has an off-set envelope that allows it to reach under itself.

The modularity of the IRB 6000 was exploited even after installation. Should there be a product or system design change, the robot can be reconfigured in the field. To change an arm or a wrist only 8 bolts have to be unscrewed, a task that takes less than an hour. Thus, it was possible to match the robot specification exactly to each task.

Certain subassembly operations employ the IRB 6000PE robot, which is designed for poke welding – a spot-welding operation in which the robot manipulates a single electrode gun whilst the other half is in a fixed position. Unlike spot welding with a twin-electrode counterbalanced gun 2, poke welding requires the robot to supply the force applied by the gun. The IRB 6000PE is able to 'hold' a maximum force of 5000 N when the wrist is within 65° of the vertical.

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Mechanical structure and features of the IRB 6000

The design of the mechanical structure and electric drives of the IRB 6000 ensures high rigidity plus easy maintenance. The mechanical stiffness, coupled with the direct drive AC motors and integral brushless resolvers, results in a precise machine that can reach its programmed position with a repeatable accuracy of ± 0.4 mm, in accordance with the ISO/TC 184/SC standard. Also, it is capable of high acceleration/deceleration, so that short movements are completed rapidly to minimize cycle times. For example, the upper arm/wrist can travel 50 mm in less than 0.3 seconds, or 300 m in under 0.7 seconds.

The modules of an IRB 6000 robot 1

Versatility in use

The versatility of the IRB 6000s is demonstrated by the number of process tasks that they perform at Vauxhall. By far the most are employed in component handling, involving accurate positioning in jigs, insertion into subassemblies, or dispatching of the parts onto moving overhead conveyors. They also manipulate parts under pedestal weld guns and sealant/glue guns.

The robots also handle process tools, such as calliper and poke weld guns, sealant/adhesive guns and stud weld guns **3**. In some cases, they handle both parts and tools. In each of the four door subassembly cells, one robot positions the part in a holding jig before picking up a glue gun and a spot welding gun.

One of the more unique robot tasks at Luton is laser welding of the reinforcement panels to the outer skin of the bonnet **4**. This process is designed to ensure there is no cosmetic damage to the outer surfaces. The task of the robot is to manipulate the laser head, which is linked to the CO_2 power source through an articulated guide tube with gold-plated mirrors. The robot produces 20 stitch welds, each 20 mm long, in 30 seconds.

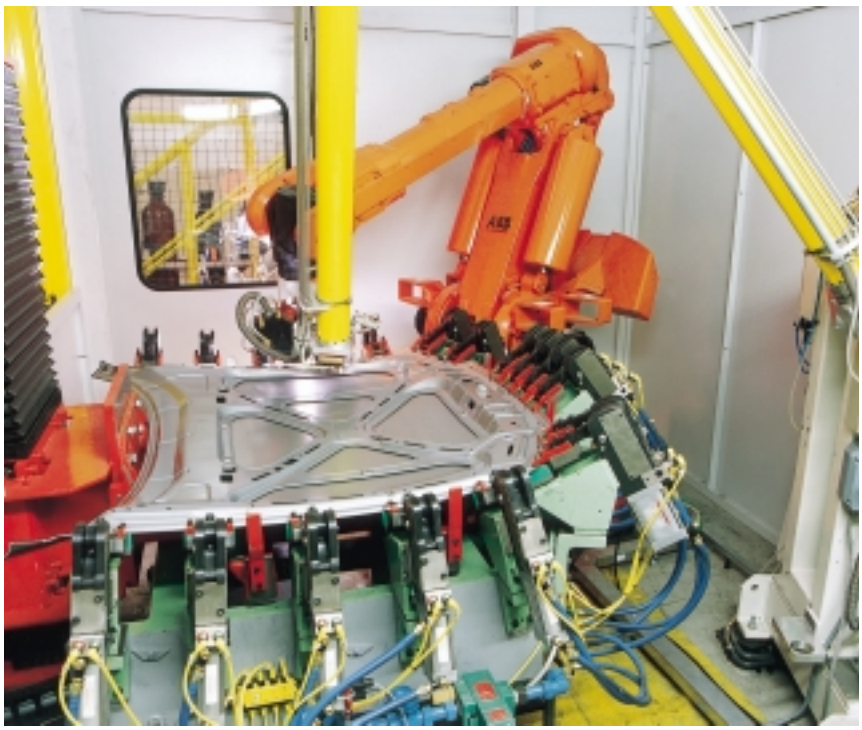
Welding body sides of the Vauxhall Vectra at Luton, UK **2**

Robots used for final trim and assembly

The mounting of the front and rear windscreens into the Vectra is a precision operation carried out in the final trim and assembly area **5**. For this operation the automatic glazing cell uses four IRB 6000s. In addition, it is isolated from other parts of the plant to avoid the transmission of vibration. The robots work in two pairs, one on the front windscreen and one on the rear, the sequence being similar in each case.

A bead of heated adhesive is applied by one robot manipulating the screen below a gun, which is rotated about its axis – its seventh – under robot control to ensure that the triangular section of the bead is maintained around the corners. The second robot then picks up the screen and places it into the screen aperture, the actual position of which has been measured by a vision sensing system and the data transmitted to the robot's controller. Once the screen has been positioned, it is held in place for 10 seconds by the robot, which applies a constant pressure to ensure proper bonding. Two further robots have been installed to insert the rear quarter glass on either side.

Final body respot line for the Vectra 3



Laser welding of bonnets for the Vauxhall Vectra. The IRB 6000 robot manipulates the laser head and articulated light-guide tube. 4

Underbody coating with IRB 2000 robots

In the paintshop area, nine IRB 2000 robots in two cells coat and apply sealant to the underbody. Bodies are transported to the cells on an overhead carrier and clamped in position above the robots. Laser range finders locate the body position in 3D space precisely and transmit the data to the robot's controller to generate positional off-sets in the robot program.

The first cell was originally installed for the car model previously produced at Luton, the Cavalier. The robots were positioned so that two applied sealant and the underbody coating to the front of the car and another two the same to the rear, including the wheel arches. The fifth robot, in the center, applied sealant to seams in the mid-section of the body. Following the introduction of the Vectra, this cell was reconfigured and reprogrammed to apply only sealant.

The second IRB 2000 cell, which employs four robots and was installed specifically for Vectra, is dedicated to the application of underbody coating.

In both cells, accurate metering of the sealant supply is ensured by pressure regulation on each robot. Also, the sealant temperature is precisely controlled with a heating and cooling system to minimize any changes in material viscosity. As a result, the robots ensure high quality as well as consistency in material application.

An ABB robot automatically inserts a front windscreen into the Vauxhall Vectra under the guidance of a vision sensing system. 5

Easy reprogramming for new tasks

The robots are not affected by changes in component design that may affect production, as they can be programmed. Even complete model changes can be accommodated in this way. For instance, 35 of the IRB 6000 robots at Luton were originally installed (in 1993) for the Cavalier. When the new Vectra was introduced, they were simply reprogrammed for their new tasks.

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