

Factfile - Edition Number 6, Summer 2001

# How we build a car

A publication from Vauxhall's Education Service



**VAUXHALL**  
Raising the Standard

**Since the early 1980s, Vauxhall has become closely integrated with General Motors Europe. This partnership gives Vauxhall direct access to an extensive technical, purchasing and manufacturing network.**

In today's competitive motor industry, superb design alone is not enough to create a state-of-the-art car. A combination of traditional human skills, new manufacturing techniques, and advanced product design are key elements in Vauxhall's manufacturing philosophy.

Vauxhall builds cars at two assembly plants in Britain. The Luton plant, established in 1905, is some 35 miles north of London. Luton builds the Vectra model for the home market as well as export.

In 1962, Vauxhall established a new plant at Ellesmere Port in Cheshire. The plant manufactures Astra cars and vans for home and export markets as well as body panels, sub-assemblies for other GM manufacturing plants in Europe.

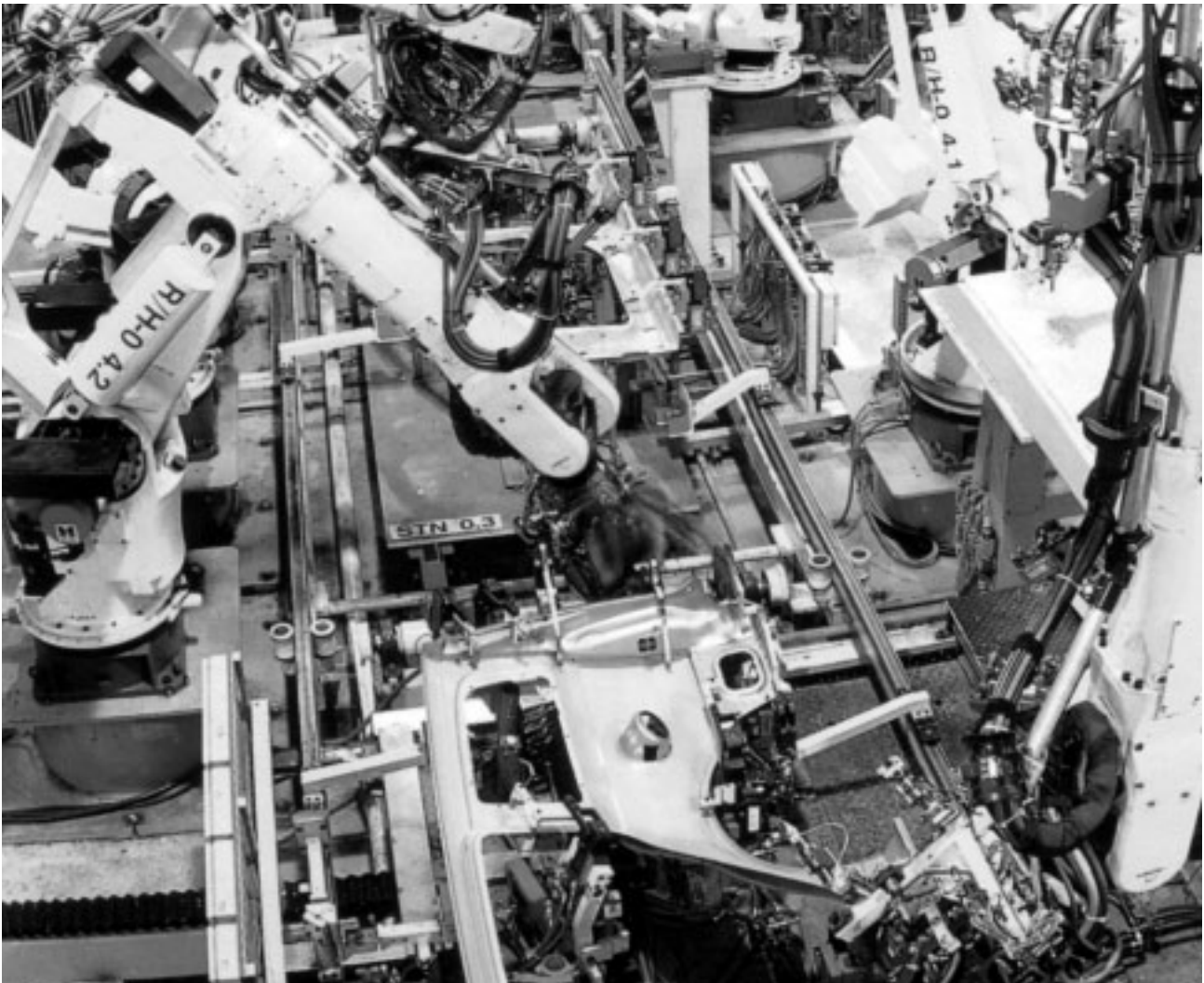
#### **Quality and environmental issues**

In 1993, BS5750 approval was gained by all Vauxhall Motors' manufacturing facilities. This achievement has underlined the company's commitment to quality. Building quality cars that people want to buy is the primary objective.

Vauxhall is committed to reducing the impact of its manufacturing facilities on the environment. Significant progress has been made in waste management and energy conservation.

Vauxhall Motors achieved a world first for the motor industry by securing the BS 7750 (now ISO 14001) Environmental Management Standard at the Ellesmere Port Plant in 1995. In 1996 the Luton Plant also received the award. Vauxhall became the first car manufacturer in the UK to register both assembly plants under EMAS, the European Eco-Management Audit Scheme.

The fully-robotised welding facility at Ellesmere Port.



### Investment

All manufacturing facilities have received high levels of investment directly aimed at quality and efficiency improvements. A massive £200 million was invested in the Ellesmere Port plant, giving it the potential to produce 42 Astras per hour, or around 140,000 vehicles per year.

### The dealer network

Vauxhall customers are served by over 530 dealerships in the UK. Sales staff at these dealerships have been trained to advise customers about all aspects of the Vauxhall range of vehicles and accessories. Each dealership is committed to providing the very highest level of service covering all aspects of motoring, from purchase and delivery to aftersales.

### Built to order

Once the customer has decided on the model and specification and confirmed his or her order, the dealer places it with General Motors Europe Ordering

A transporter being loaded with Vectras bound for customers.

Scheduling System. The order details a car's full specification including any factory options such as an automatic gearbox, sunroof or special wheels. After processing, the order is transmitted to the appropriate plants in General Motors Europe's network of production facilities.

### Exports

The UK factories can also build left hand drive vehicles for other European or Asian countries. This translates into export business for Vauxhall, which, in 1993, received the Queen's Award for Export.

### At the Plant

The full specification of the vehicle is sent by the Order Scheduling System in Europe to the Data General Computer at the plant. This computer controls production, ensuring that a customer's order is adhered to strictly.

The Material Production Control (MPC) process ensures that components arrive on the production line in the right order, at the right time, and to the correct specification.



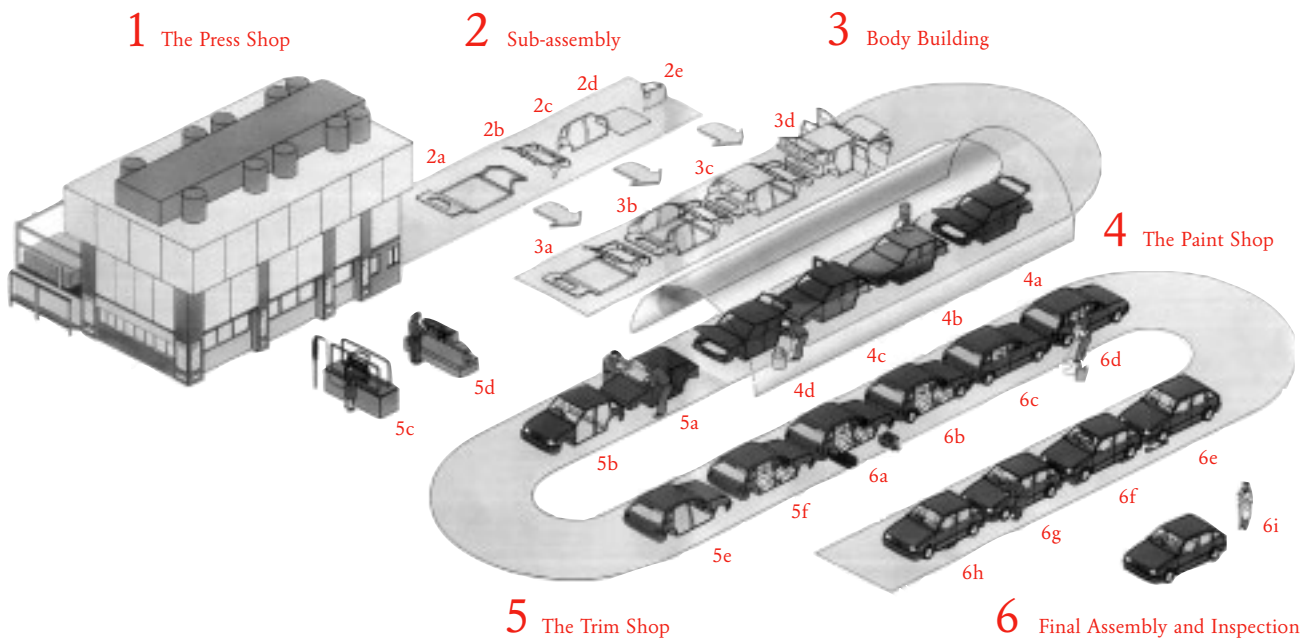
A modern Vauxhall dealership.

This is quite an achievement when one car could be a red four-door saloon and the next a blue five-door diesel hatchback. The process of building a fully-inspected and tested Vauxhall car takes less than 30 hours. In the following pages we will look at each stage of the process.

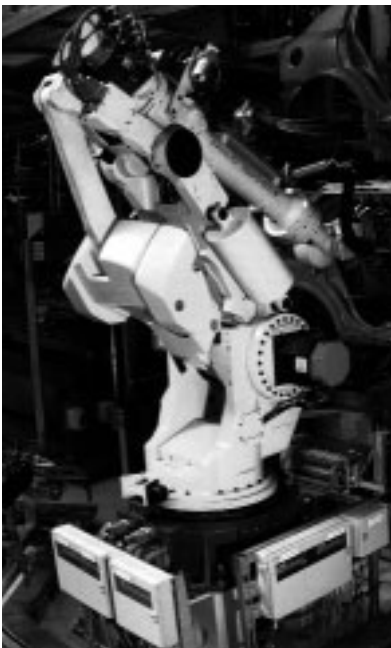


# The production process at Ellesmere Port

The modern motor car is assembled from as many as 9000 individual parts gathered from all over the world. Up to 70 per cent of the components used by Vauxhall are sourced in the UK. Hourly, truck-loads of materials arrive at Vauxhall's factories, where the components and raw materials are assembled into cars.



One of the state-of-the-art robots used to build Vauxhall Astras at Ellesmere Port.



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# 1 - The Press Shop - stamping out the body parts

**Car construction starts in the press shop, where coils and sheets of high quality steel are cut and formed into body panels.**

The Press Shop at Ellesmere Port covers 28,000 square metres, which is an area equivalent to three football pitches, and includes a 3,716 square metre steel store. Here, 64 machines, each the size of a house 'stamp-out' high quality pressed steel panels.

A substantial part of a £46 million investment in Ellesmere Port's press shop went into the installation of the High Speed Coil Cut Line which cuts the coil steel to the required sizes.

The cut steel is then loaded onto the Schuler Tri-Axis Large Transfer Press which can exert pressures of 3,200 tonnes. With improved efficiency

*The Schuler Tri-Axis Large Transfer Press at Ellesmere Port - capable of producing up to 1,000 panels per hour.*

and lower operating costs, the fully-automated Transfer Press is capable of producing 1,000 car body panels per hour - the same rate as four conventional press lines.

The steel is moved around by 15 radio-controlled overhead cranes, some capable of lifting 50 tonnes, the weight of an army battle tank.

All scrap steel is returned to the steel mill for reprocessing as part of Vauxhall's commitment to reduce waste and increase recycling as part of good environmental practice.

After careful inspection by skilled operators under special lighting the newly-formed steel panels move on to the next stage in the manufacturing process - sub-assembly.

*Body pressings are meticulously inspected by skilled operators.*



## 2 - Sub-assembly - putting the pieces together

**The component sub-assembly area builds the front and rear doors, tailgates, facing panels and roof assemblies on fully-automated production lines.**

The inner door panel assembly goes through an automatic, four-stage welding and transfer machine, while the outer panel is produced on a self-contained, multi-weld fixture. The two sections are then 'married' (clinched together by hemming and a final welding process) before passing through a special oven which sets the panel-to-panel adhesive.

Front and rear floors come together to form the underbody assembly. They are processed through two sets of multi-weld machines before being joined by the frame that will support the engine and transmission.

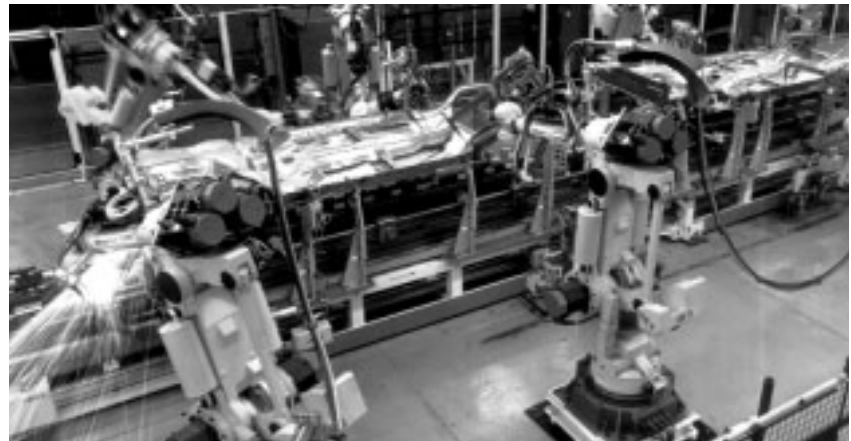
As elsewhere in the process, precision welding and handling techniques are utilised in bodyside production.

Part-welded sides are loaded into a carousel-type frame that is designed specifically for each body type and is jig-built to guarantee consistently accurate build quality.

As the assembly moves from station to station, robots carry out their programmed welding tasks. Each robot has a self-monitoring system to check its weld position and quality. Manual work is limited to the application and loading of the inner part of the assembly.

The underbody is placed on a conveyor skid, which will transport the car to the various assembly and production processes throughout the plant. It is here that a transponder is attached to the underbody so that the car can be tracked throughout the plant. This electronic device interacts with the production control computer identifying the specific components required for that customer's order. A written manifest also accompanies the car, so that physical checks can be made at any time during the manufacturing process.

Robotic spot welding of the Vectra wheel arch.



The robotised underbody line at Ellesmere Port.

Laser welding a Vectra bonnet. The Luton Plant was one of the first vehicle manufacturing plants outside Japan to employ laser welding in high volume production line operation. Laser welding is so precise that heat does not reach the outer skin of the panel where it can distort and discolour the surface.

# 3 - Body building

**The completed sub-assemblies now progress to the computer-controlled body framing line where they are welded together to form the complete body.**

The body shop houses sophisticated automatic equipment that assembles parts and bodies. With over 150 robots performing a variety of recurrent tasks, a body will receive nearly 4,500 robotised welds during its construction. As many as 2,200 spot welds and as much as 2.1 metres of continuous weld are used to assemble over 100 individual pressings that make up the body of a car.

People in harmony with robotics weld the body parts together to an accuracy of less than 100th of a millimetre. By the end of 1995 the company had over 400 robots in service at the Luton plant.

## Construction

Initially, the underbody, front and body sides are pieced together to form the skeleton of the vehicle. These components come together on the computer-controlled body framing line. This part of the process relies on human skills with men and machines working together through thorough checks to ensure the dimensional quality and the perfect fit of panels. The bodyside framing unit

Robotic welding of the Vectra body.



includes a robotic welding station featuring three pairs of side gate fixtures to cater for the range of body styles.

The roof panel is then presented to the body before reaching the welding station where two pairs of robots tack the front and rear joints, then weld the sides. Twelve more robots, supplemented by manual welding complete the framing by tacking spots not reached by the jig-welding operators.

## The Body in White

At the end of the framing line, the body receives the doors, bonnet, tail-gate and front wings which have been built separately. The completed body is now in the state known as “body in white”.

Once the main structure of the body is complete, preparation of the metal surface for painting can begin. Highly skilled and experienced operators use a combination of sight and touch to detect and then eliminate any imperfection.

Quality, a key factor in Vauxhall’s building process, is exemplified by the Computerised Coordinate Measuring Machine or CMM. This equipment is able to measure build accuracy to within 100th of a millimetre at an infinite

The body in white line where the sub-assemblies are added to form the complete body.



number of locations on the body. To ensure build consistency, regular samples taken from the production line are measured by the CMM in over 150 locations around the body.

Experienced operators use sight and touch to detect any imperfections.



## Cooling System

Welding equipment reaches very high temperatures and must be cooled to maintain efficiency. This is achieved by pumping water continuously through the equipment.

At the Luton Plant, much of the nine million litres of water used for this purpose are pumped from a reservoir in hills above the factory where it cools and is re-circulated back to the plant. This system ensures that an absolute minimum of water is drawn from the town’s supply. The same reservoir also provides the fire protection system for the plant.

# 4 - The Paint Shop

Vauxhall's six-year anti-perforation warranty on its new cars, has been made possible through attention to design, high build quality and extensive investment in paint processes.

The bodyshell is now transferred to the continuous conveyors that will carry it throughout its journey. The metal surface must be completely clean before any paint can be applied. After being cleaned by hand to remove any grease deposits, it enters the Phosphate Plant where it passes through four timed processes - two degreasing dips followed by a spray and immersion rinse and then the phosphate dip. In this final process corrosion resistance as well as paint adhesion are improved when zinc phosphate crystals are deposited onto the metal surface while it is immersed in an acidic bath.

The last stages of preparation involve the bodyshell being passed through a chromate rinse no less than four times to even out the crystal deposits left by the phosphate dip. The demineralised rinses use pure water from Vauxhall's own purification plant. Water is continuously recirculated to filter out impurities.

The next stage is to blow-dry the body until it is slightly damp rather than bone dry, saving even more energy.

## Electro-deposition

Electro-deposition of polymers, 'ELPO' for short, is Vauxhall's 'state-of-the-art' process designed to ensure that every part of the body is coated with a water-based, anti-corrosive primer. The use of water-based paints is part of the company's environmental policy.



The Facility Monitoring and Control System provides detailed and instantaneous information on the status of all Paint Shop operations.

During the electro-deposition the body is again completely immersed, this time in a mixture of primer and demineralised water. An electrical charge created between the body and

A bodyshell emerges from the ELPO tank.

the immersion tank, forces the particles of primer out of the water and onto the metal surface to create an even, run-free film.

When the bodyshell leaves the immersion tank it passes through a series of water rinses to remove any loose particles. It is then baked so that the primer particles are bonded together to form a tough even coating.

After being allowed to cool, the bodyshell is given a moist sand after which a PVC finish is applied to the weld seams and areas of the underbody vulnerable to stone chipping. Automated sprayers complete this stage, with skilled workers performing the more intricate work using special spray guns.

In this same area, sound insulation panels are applied to the floor of the body as it continues its journey to the top-coat areas.

The paint mix room at Ellesmere Port automatically delivers waterborne primer.



### Clean-room technology

Contamination by airborne particles is of great concern in the Paint Shop. Vauxhall has invested heavily in "clean-room technology" to ensure the highest standard of paint finish.

Filtered air is used to slightly pressurise the spray booths, providing an airflow out of the spray area.

This technique, which is similar to that used in a modern hospital operating theatre, restricts the entry of airborne particles. As a further precaution all Paint Shop personnel wear special lint-free garments to avoid the risk of clothing fibres being released into the paint spraying areas.

### The first coat of paint

The body now moves through a series of spray booths where the transponder, attached during the framing process, triggers the required spray programme for each customer's order. Any sequence of colours and finishes can be accommodated by the Paint Plant. This means that it is possible for one vehicle to be sprayed metallic blue, another pearlescent red, the next a solid colour such as yellow or even white. In practice, metallic and pearlescent finishes are applied in dedicated booths.

Each spray booth contains eighteen computer-controlled 'spinning bell' spray heads. These rotate at 28,000 rpm to atomise the paint, which is then electrostatically charged at 90,000 volts to cause the paint to be attracted to the earthed car body.

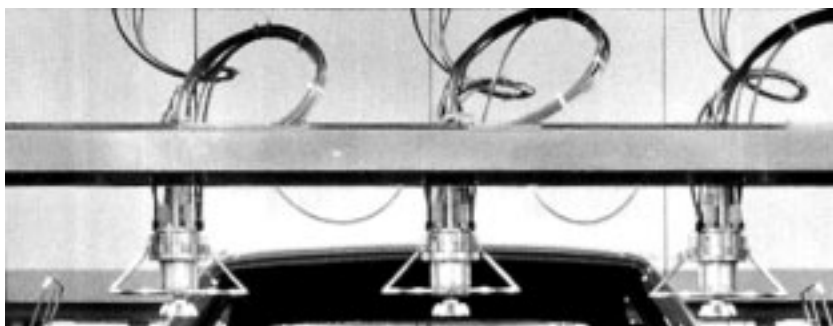
The Paint Shop ovens have a heat recovery system to save energy.



State-of-the-art spray booth at Luton.

This method of spraying is established technology. However, a new and more compact overhead line tracking system has been installed for the new Vectra. Because this system offers greater reach than before, the spray

rior, boot and under-bonnet. After each spray booth the bodies pass through an oven where the paint is cured at 175 degrees C.



Spinning bells rotate to atomise the paint.

head can extend further into the gap between each vehicle and give greater paint coverage of the front and rear of the body. The major benefits of this system are the increased line rate and reduced need for hand spraying.

Some spraying however is still done by hand in areas such as the inte-

### Time for the badges

At the end of the paint process, the body is absolutely clean and humidity/temperature conditions are ideal for the application of contact adhesives. Consequently the body side mouldings and badges, which were previously applied in the Trim Shop, are now fitted before the body leaves the Paint Shop.

Badges and mouldings are now applied in the paint shop.



# 5 - The Trim Shop

## Traditional skills and automation combine in the Trim Shop.

### More anti-corrosion treatment

Just prior to entering the Trim Shop, the body goes through another stage in Vauxhall's extensive anti-corrosion process. Two automated machines inject as much as 15 litres of anti-corrosion wax into the underbody box sections. This sophisticated process aligns 80 nozzles with the underbody before delivering the correct amount of wax, then the overhead lifting device gently rocks the body fore and aft to distribute the wax evenly.

### Into the Trim Shop

The body now enters the Trim Shop where the doors are removed to improve access for the assembly line

team. The exterior components such as bumpers and lights are carefully fitted, together with all the interior components including the steering, airbag and electrical systems.

In 1984, Vauxhall's Ellesmere Port plant became the first UK car manufacturing facility to use 'off-line' assembly techniques in the trim shop area. A major advantage of this system, now employed in all Vauxhall trim areas, is the ability to test the various modules before attachment to the car. The instrument panel and doors are examples of modules that are fully assembled and tested off the main car assembly line utilising 'Just in Time' principles.



Preparing a Vectra cockpit module for installation.

The instrument panel components arrive at the plants shortly before being sub-assembled and checked by an umbilical tester known as ECOS (Electrical Check Off System). The fully-tested modules are then ready to be installed.

# 6 - Final assembly and inspection

## The fully-trimmed car joins the 'marriage conveyor'.

It is here that the car unites with the major mechanical assemblies such as the engine and transmission unit, suspension, wheels and brakes. This stage is monitored by computer, thus ensuring that the right mechanical components are fitted to the appropriate car.

The body is now raised well above the ground and special carriers carefully raise the engine and transmission into their locations, where the assembly line team position and fix them into place.

The car progresses on through final assembly where fully-prepared road wheels and tyres are added. It is at this point that the exhaust system and catalytic converter are also installed.

The doors, originally removed at the start of the trim process, are now re-attached, fully trimmed and tested.

### Final inspection

With oil, water and fuel added, the car is finally capable of moving under its own power. A series of comprehensive

checks and final adjustments must now be completed before the car can be released.

Roller-testing monitors mechanical specification and exhaust emissions, while Assembly Line Diagnostic Links (ALDLs) ensure engine management systems and anti-theft alarms are functioning correctly.

Brakes are checked and water tests confirm the integrity and fit of door, window and sunroof seals.

In addition, the ECOS system executes a final inspection of the electronic components and the extended ECOS System examines models fitted with automatic transmission and anti-lock brakes with integrated self diagnostics.

Finally, a protective film of wax is applied to the vehicle before it leaves the factory. Vehicles destined for export go directly to the sea ports. Vehicles for the domestic market are delivered to dealers from one of Vauxhall's five Regional Distribution Centres.



The 'Marriage' of a Vectra Estate body and its mechanical units.

Every effort was made to ensure that the contents of this publication were accurate and up-to-date at the time of publication.

As part of Vauxhall's policy of environmental care, this publication was printed on paper manufactured using Totally Chlorine Free Pulp from specially farmed, sustainable timber resources.

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