

Volvo Car B.V.

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## THE VOLVO 480 ES:

### A DYNAMIC CAR

Starting with its international bow at Geneva this year, the Volvo 480 ES has been received with enthusiasm in all quarters. Already, even though it has so far only been available in Belgium, Austria and The Netherlands, the concept, performance and driving pleasure of Volvo's latest model have become a talking point in motoring circles. The month of the Paris motor show coincides with the introduction of the Volvo 480 ES in France and Italy. By year end 1986 the Volvo 480 ES will also be available in Spain, while introduction in the other European markets is scheduled for early 1987. This year about 3500 units will be produced at the company's Born assembly plant in the south of Holland.

### FOR DYNAMIC PEOPLE

The Volvo 480 ES was conceived, developed and brought to production readiness in six years. In that development period much thought was given to the profile of the potential buyers. From research and discussions the key profile characteristics that emerged were individualism and personality. People with a dynamic lifestyle. People who practise a sport for their leisure-time activities. People who appreciate the good things in life. Drivers who demand a car with dynamic good looks and up-to-date styling. And high levels of driving pleasure combined with sporting appeal. On the other hand, this emerging new group of drivers refuses to make concessions in the areas of safety, comfort or quality. For them - men and women between 25 and 40, probably with a higher than average education and with a career - the Volvo 480 ES is a natural choice.

### THE VOLVO 480 ES

For this new group of customers Volvo has designed what must be the ideal car. In sum, the Volvo 480 ES has the following specification.

- Modern, compact front wheel drive concept with unique low-slung styling.
- Inviting, tastefully appointed interior with sporting overtones.
- Comfortable accommodation for up to 4 adults.
- Complete and functional equipment package.

- 0 Well-endowed with advanced electronics.
- 0 Good performance.
- 0 Good fuel economy.
- 0 Only 10 hours service in the first 100,000 km, including oil changes.
- 0 8 years corrosion protection warranty.
- 0 Volvo's traditionally high standards of safety, reliability, build quality and finish.

As the first-ever front wheel drive Volvo, the 480 ES is essentially a drivers's car, yet it still makes full allowance for passenger comfort. It shows what innovative engineering can do within the space-efficient framework of the front wheel drive concept.

This specification is summarized in the following pages, with special attention to items of more than usual technical interest.

#### BODY STYLING

With the exception of the wind-tunnel tested door mirrors, the smooth body has no parts projecting outside the bodyline. Such a wind-cheating shape is naturally conducive to good fuel consumption, a low noise level and stable handling at elevated speeds. An under-bumper air intake is integrated in the front spoiler with a system of scoops to optimize air distribution over the radiator for good engine cooling. The positioning of the air intake enhances the aerodynamic effectiveness, and this is also true of the wrap-over design of the doors and the almost straight-backed rear end of the 480 ES. Uniside body panels are used - side walls made from a single pressing. This design gives exceptional strength and structural integrity, while at the same time reducing the number of weld seams and so eliminating possible rust-traps.

#### MODERN COMPOSITE MATERIALS

Modern materials and robotized engineering are used in production. Sheet Moulding Compound is used for the headlight pods, the front apron and the bonnet.

Other composite materials are used for stone-chip vulnerable parts such as the front wheelarch liners, the bumper skin, front spoiler, rear apron, windscreen surround and the fuel tank. 10% of the total bodyweight is in this impact-resistant material, which has a good crash behaviour and is of course the ultimate in rust prevention.

#### HIGH STRENGTH STEEL

A key design target was the lightest possible bodyweight while still satisfying Volvo's tough safety requirements. Weighing in at just over 1000 kg, the unitary-bodied 480 ES easily satisfies all international safety criteria. It does this by the comprehensive use of high strength steel. On account of the high strength, less material is needed. Altogether, 37.2 kg of this high-strength material is used. The Volvo 480 ES easily satisfies the tough USA safety regulations. It even passes some of these tests at double the required impact speed.

#### TWO SIDE INTRUSION BARS

Two side intrusion bars are sandwiched in each door, located at waist-level and at median bumper height. These tough steel bars protect the occupants from the effects of collisions in the flank.

#### FRONTAL CRASH TESTS

Volvo's own testing standards for injury prevention to occupants are higher than the safety criteria used by most international authorities, which are based on impact speeds up to 30 mph (48 km/h). Volvo has designed the 480 ES with overcapacity to satisfy these criteria even at 35 mph (56 km/h). The surplus of 5 mph (8 km/h) offers a considerable extra margin of protection to the occupants, for it represents an additional impact energy absorption of 36%.

#### REAR CRASH TESTS

As with the frontal crash tests, the Volvo 480 ES easily satisfies the international 30 mph (48 km/h) criteria for rear crash tests.

In Volvo tests with a moving barrier at this speed there is no fuel leakage, no parts are dislodged or broken off, the doors still open normally after the test, and forward displacement of the rear seats is minimal, minimizing the risk of severe leg injury for the rear seat passengers.

#### IMPACT-ABSORBING BUMPERS

Volvo's wraparound safety bumpers on the 480 ES comprise a tough inner core of high-strength steel coated with impact-cushioning honeycomb structure foam. A smooth outer skin of polyurethane covers this impact-cushioning construction and extends down to form the (flexible) front spoiler, which is virtually immune to damage by high kerbstones even at sub-zero temperatures. At a collision speed of 8 km/h there is no deformation of body panels. Nor does the bumper sustain permanent damage since it soon regains its original shape. And this is achieved without the need for extra shock absorbers or heavy cushioning pads.

#### BONDED WINDSCREEN

The High Impact laminated windscreen is bonded to the body and sealed with a low-profile bonding bead that offers minimal resistance to airflow. Aerodynamic effectiveness and low wind roar side, the bonding method enhances the the torsional stiffness of the body by about 10°0. Low-profile mouldings are used for all other glass areas.

#### WINDSCREEN WIPERS

For good aerodynamics, the 2-speed windscreen wipers are partly recessed between the scuttle and the engine bonnet, below the driver's line of sight. Apart from providing unrestricted forward view, this position also prevents water-creep over the windscreen, for example after the screenwash unit has been used. Intermittent wipe, screenwash-linked automatic wipe, and fingertip-action single sweep (both from rest and intermittent mode) are standard.

#### REAR SCREEN WIPER

The rear wiper has a streamlined arm to ensure efficient operation even at elevated speeds. There is a choice of 2 intermittent speeds: one sweep every 6 or 18 seconds. Operating the rear screenwash pump also triggers the rear wiper which then automatically makes 4 sweeps across the screen. When reverse gear is engaged, with either the windscreen wipers or the rear wiper switched on, or both, the rear wiper automatically moves into the continuous sweep mode.

#### CENTRAL LOCKING + BURGLAR ALARM

Unlocking the doors via the electrically operated central locking system automatically switches off the burglar alarm (standard equipment). The alarm is automatically re-armed by locking the car.

#### ILLUMINATED DOOR LOCKS

As soon as the exterior door handle is pulled, or for 15 seconds after leaving the car and closing the door, a light comes on in the keyhole. This makes it easy to find the lock (located above the handle) in the dark without searching or scratching the paint.

#### DRIVEWAY ILLUMINATION

When leaving the car, operating the headlight flash stalk switches on the long range headlights for 30 seconds. They switch off automatically after 30 seconds. In this way the auxiliary beams can be used to illuminate the driveway or garage door when parking at night.

#### FAIL-SAFE REAR LIGHT UNITS

For extra safety, the full-width rear light clusters have dual (2x2) tail lights and dual brake lights at each side. A warning lamp in the instrument panel lights up if any vehicle lighting bulb is defective.

### SPACIOUS INTERIOR

The inviting interior has individual body-contoured seats at front and rear, while the folding 50/50 split rear seats offer transportation versatility and extra load space. The driving position can be individually tailored with the height-adjustable steering column and multi-adjustable driver's seat, which includes independent height adjusters for the front and rear end of the seat cushion. Adjustable lumbar support in the front seats is standard, as too are padded head restraints, while the separate rear seats have individual backrest rake. There is an efficient air-mix heating and ventilation system, which includes time-switch controlled rear window heating (12 minutes or continuous operation) to avoid unnecessary power drain. The electrically operated and electrically heated door mirrors are in circuit with the rear demist. Customers can choose between two climate control systems, the choice depending on whether air-conditioning is required.

### COCKPIT DESIGN

Based fully on ergonomical design, the cockpit area in the 480 ES is both functional and comfortable, with the dashboard centre console angled towards the driver and with all the controls close at hand. The multi-function steering column stalks are angled upwards towards the natural driving position of the hands, allowing hands-on operation. Full instrumentation includes an analog rev-counter, speedometer, odometer with trip recorder, an analog oil pressure gauge and voltmeter, a digital clock with stopwatch function and a unique monitoring unit for the operation status: the Electronic Information Centre.

### FULL INTERIOR LIGHTING SYSTEM

The very comprehensive interior lighting includes a dome light with timer function, 2 individually controlled map reading lamps in the central dome, and lighting for the rear compartment, ignition switch (with timer), ash-tray, dashboard locker, boot and engine compartment.

#### LUGGAGE AND STOWAGE SPACE

The space-efficient engineering of the front wheel drive concept has allowed in-car space to be optimized. There is a hinged compartment/armrest between the front seats, a lockable and illuminated dashboard locker and two large door bins. A handy coin holder for such things as parking fees and road tolls is also included. The rear compartment has stowage bins in the side trim panels and a lockable central locker between the rear seats. Extra space for small items is offered by a well in the boot floor and bins in the boot side walls. A cover is provided for the luggage areas.

#### 1.7-LITRE LOW FRICTION ENGINE

The sohc fuel-injected engine in the Volvo 480 ES is a 4 cylinder in-line watercooled unit with a displacement of 1721 cm<sup>3</sup>, transverse mounted in unit construction with the gearbox, clutch and final drive. Fuel metering is by electronic multipoint fuel injection while ignition timing is looked after by a three-dimensional Electronic Ignition Mapping system. Power output at 5800 r/min is 80 kW ISO with max. torque of 140 Nm at 4000 r/min, delivered through a five-speed manual gearbox to the front wheels. The minimum octane requirement is 95 RON lead-free.

#### SEPARATE FRONT SUBFRAME (ENGINE)

The drive train is mounted on a separate front subframe by three flexible mountings: two hydro-elastic mountings at the front and one soft rubber pad at the rear. The subframe also serves as the mounting platform for the lower wishbones and steering gear. In turn, the subframe itself is attached to the unitary body by four flexible pads with a lower coefficient of elasticity than the engine-subframe mountings. This design damps out unwanted vibrations from the drive train and suspension and limits the mechanical noise transmitted to the interior. Also, the ride and handling properties are enhanced by containing engine block displacement when powering on and off.

#### HERON HEAD

A completely flat light alloy cylinder head is used on the B 1BE engine. This is made possible by using machined bowls in the piston crowns (bowl-in-piston construction). As the combustion chambers can be machined to very close tolerances, variations in combustion volume are virtually eliminated. This allows a relatively high compression ratio (10.5:1) and good waterflow management, which in turn leads to better thermal efficiency and an enhanced power output/fuel consumption ratio.

#### IDLE SPEED COMPENSATOR

An idle speed compensator ensures regular idling irrespective of varying barometric pressure or high power drain, i.e. smooth idling even when all power consumers are switched on, or when the (optional) air-conditioning is in operation, or when driving at high altitude.

#### LONG-LIFE EXHAUST SYSTEM

The tuned-length welded exhaust manifold, the vibration damper coupling and the tailpipe are made of stainless steel. The rest of the exhaust system is of aluminized steel. Apart from considerable weight-savings, these materials give these parts a comparatively longer average life.

#### EXPANSION TANK

The expansion tank is incorporated in the primary cooling circuit. This 'hot bottle' system eliminates the risk of cavitation in the cylinder head since the primary system builds up pressure very quickly. Other benefits are fast engine warm-up and no sudden surge of cold water into the cooling system (which would negatively influence water management and thermal efficiency).

#### OIL COOLER

As the engine oil is used not only for lubrication but to cool the piston crowns as well, the excess heat is extracted by means of an oil cooler located between the engine block and the oil filter. This lengthens the effective life of the oil.



### ASBESTOS-FREE CLUTCH LININGS

Asbestos-free material is used for the friction linings in the single-disc dry plate clutch. This material offers the same advantages as that of the brake pads: a long operating life and no harmful asbestos fibres are released to atmosphere.

### FRONT SUSPENSION

Front suspension is independent by MacPherson struts and eccentrically located coil springs, with a two-in-one strut top bushing and lower wishbones located on a rubber-mounted subframe (see below). This innovative top bushing separately controls the semi-static spring load and dynamic shock absorber reactions, absorbing vibrations and helping to insulate against road roar. For fast steering response the struts are interconnected by an anti-roll bar and non-compliant parallel links. To ensure good ride comfort with smooth return of the steering wheel (low friction) and a long useful life, the shock absorber piston and strut top bushing are Teflon-coated.

### SEPARATE FRONT SUBFRAME (SUSPENSION)

The lower wishbones, steering gear and drive train are mounted on a separate front subframe - a construction that provides optimum accuracy of the steering geometry and allows fast removal and installation of these components. By mounting the subframe on the unitary chassis with only 4 flexible mounting pads almost all engine and suspension vibrations are filtered out - enhancing the level of ride comfort.

### SAME-LENGTH DRIVE SHAFTS

The final drive gear is bell-shaped and this allows the differential gears to be fitted virtually in the centre-line of the car. Thanks to this, almost identical length drive shafts can be used. These car connected to the crankshaft via the final drive unit by CV joints. A torsional vibration damper is fitted on the right-hand shaft.

With same-length drive shafts there is no tendency for the car to pull to one side when accelerating (a traditional drawback of most front wheel drive cars with transverse engine location).

#### AUTOMATIC STEERING CORRECTIONS

Kidney-shaped wishbone mounting pads are used, designed to deform slightly when lateral and longitudinal forces are imposed on the front wheels. In gusting cross-winds, or with lateral forces resulting from hard cornering, the controlled compliance of the front wheel geometry automatically corrects these effects.

#### REAR SUSPENSION

Rear suspension is by a lightweight constant track beam axle on coil springs located by two longitudinal Watt linkages and a Panhard rod, with a stabilizer located between the axle and the body to absorb body-roll. Biasing the coil spring location towards the axle centre-line in the vertical and horizontal axis gives all the benefits of independent suspension - such as wheels which stay perpendicular to the road and a constant track. This positioning also relieves all stress on the flexible mountings of the Watt linkages, allowing softer rubber to be used and so contributing to ride comfort and insulating the passenger compartment from road roar.

#### POWER ASSISTED STEERING

The power assisted rack and pinion steering works on the drooping flow principle, i.e. the faster the engine speed the lower the servo assistance. At elevated speeds, therefore, there is practically no hydraulic assistance. This gives the driver good feel with the road and the steering is not oversensitive to slight movements of the steering wheel. With decreasing engine speed the power assistance increases, providing effortless driving in town. Full servo assistance is obtained at parking speeds.

#### DISC BRAKES FRONT AND REAR

With four disc brakes, the diagonal split dual circuit brake system gives good stopping power for a car of this relatively low weight. Sliding calipers are used all-round, with asbestos-free brake pads. For fast renewal, the front brake discs are bolted to the wheel hubs. The rear brake discs, which require no routine servicing, form a single casting with the wheel hub and cannot be removed separately; rear discs usually last as long as the car since there is far less wear at the rear (less energy to dissipate).

#### AUTOMATIC HANDBRAKE SLACK ADJUSTER

The handbrake is incorporated in the rear calipers and has an automatic wear take-up mechanism on each rear wheel. This low-weight design is virtually maintenance-free and assures consistent braking effort and constantly short handbrake lever travel.

#### FUNCTIONAL ELECTRONICS

The Volvo 480 ES makes functional use of computer technology.

- 0 The Electronic Information Centre gives a continuing overview of vital operating functions that could require an executive decision from the driver.
- 0 The Engine Management System ensures optimum performance and fuel consumption in all conditions. It comprises an Electronic Ignition Mapping system for optimum ignition timing and multipoint fuel injection for consistently accurate metering of the injected fuel quantity.
- 0 The Central Electronic Module monitors all the time-based functions, translates driver commands into automotive action, and even guards the car when it is left unattended.

### ELECTRONIC INFORMATION CENTRE

Unlike some other on-board computers, the Electronic Information Centre has 3 main monitoring functions: 1. Pre-start check, 2. Normal running check, 3. Automatic warning. With this advanced electronic monitoring unit, essential running information can be viewed on the digital display simply by selecting any one of 7 monitoring stations with a rotary switch on the dashboard.

#### 1. Pre-start check

The Electronic Information Centre automatically makes 3 checks for the driver as soon as the ignition is switched on. A display shows the engine oil level, the remaining action radius with the fuel still in the tank, and the ambient air temperature if there is a possibility of icy roads.

#### 2. Normal running check

After the pre-start checks the Electronic Information Centre switches over automatically to the selected monitoring station. These monitoring stations are: 1. ECON (momentary fuel consumption), 2. FUEL (average fuel consumption), 3. SPEED (average speed), 4. RANGE (remaining action radius), 5. OIL (engine oil temperature), 6. WATER (coolant temperature), 7. AIR (ambient air temperature).

#### 3. Automatic warning

An automatic override on the selected station immediately flashes a warning to the driver if a problem should occur in a non-monitored sector while the engine is running. These override functions are priority-graded on a "get-you-home" basis.

#### CENTRAL ELECTRONIC MODULE

All driver commands are routed through a Central Electronic Module located in the engine compartment, which translates these commands into functions. The Central Electronic Module also governs all the time-based functions of the 480 ES in a logic way. A test function for the workshop mechanic is included in the module. Examples of these time-based functions are the direction indicators (with automatic flash frequency compensation for towing), the windscreen wipers and rear wiper (which are sweep-synchronized) and the interior lighting functions.

#### ELECTRONIC ENGINE MANAGEMENT SYSTEM

Basically, the Engine Management System consists of two memory banks which are linked to a central microprocessor. This small computer scans the memory banks of the three-dimensional Electronic Ignition Mapping and multipoint fuel injection systems and instantly computes the optimum ignition timing point and cylinder charge/fuel-air mix. The basic elements of this computation are engine speed, inlet manifold depression and the position of the pistons in the cylinders. The computed result is then fine-tuned with supplementary data from sensors which constantly record the coolant temperature, induction air temperature, (full) throttle opening, barometric pressure, idle speed, battery/system voltage and detonation tendency.

#### KNOCK SENSOR

Even when inferior grade fuel is used, a knock sensor prevents possible pinking damage to the engine. The knock sensor continuously monitors the ignition timing and can retard this by steps of  $1^{\circ}$ . In the case of serious detonation tendency it can retard the timing by steps of  $5^{\circ}$ ,  $10^{\circ}$ , or even  $15^{\circ}$ . Once the threat of knocking is over, the timing is restored by steps of  $1^{\circ}$  to the original setting. The result is optimum fuel atomization and almost complete combustion, giving remarkably good fuel economy.

Stringent emission requirements are also easily met, while the lack of deposits in engine gives all vital engine parts a comparatively longer life expectancy.

#### 'LIMP MODE'

Reliability is enhanced by a get-you-home limp mode, which comes into operation if 'false' signals are received; for example, if the wiring harness or the sensors for the induction air or coolant temperature transmit a value which is outside the specified limits: the micro-processor then takes over and enters an 'average value'. This limp mode helps to make the Volvo 480 ES extremely reliable, because the engine will always start and run - and get the driver to the nearest Volvo dealer - even if one or more sensors are defective.

#### VOLVO QUALITY

With the new materials and robotized production facilities used for the 480 ES, Volvo crosses new frontiers of quality. Extensive use is made of rust resistant zinc coated steel and non-rusting composite materials. In 1984 Volvo made a multi-million dollar investment in high-tech automation at its Dutch assembly plant, where robotized production is now a major feature of the press shop, the paint shop and the body line. At this ultramodern facility - the most modern 'paint shop' of its kind in Europe - the coachwork of the Volvo 480 ES is protected by a 22-stage paint and body protection programme, computer controlled for consistently high quality.

#### A VOLVO WITH A ZINC COAT

On the Volvo 480 ES zinc-coated steel - either uncoated or coated on both sides - accounts for 38°0 of the bodyweight. This zinc coating protects the underlying steel from atmospheric corrosion caused by stone-chip damage or penetration of the top-coat.

EXTRA STONE-CHIP COATING

For extra protection of the side walls against damage by stone-chips and other road debris, a special coating is applied between the primer layer and the top-coat. This extends from the bottom of the doors and side panels to the contour line just under the tumblehome.

## Technical specifications\*

<b>Engine</b>	
Type	4 cyl. in line, transverse mounted
Capacity	1721 cm <sup>3</sup>
Bore x stroke	81 x 83.5 mm
Compression ratio	10.5 : 1
Octane rating	<b>95 W</b>
Max. power ECE	80 kW / 5800 rpm
Max. torque ECE	140 Nm / 4000 rpm
Fuel system	multi-point injection, computer controlled
Oil capacity	5.5 litres incl. water-oil heat exchanger
<b>Cooling system</b>	
Type	water cooled - closed system, with electro fan
Capacity	7 litres
<b>Electrical system</b>	
Ignition system	electronic ignition mapping system
Battery	12V/55Ah
Alternator	70W/14V
<b>Transmission</b>	
Type	5-speed manual gearbox
Reduction ratios	1. 3.091:1 2. 1.842:1 3. 1.320:1 4. 0.967:1 5. 0.758:1 R. 3.545:1
Final drive reduction	4.067
<b>Steering system</b>	
Type	power assisted rack and pinion steering
Reduction ratio	21.3
Steering wheel turns	3.12 lock to lock
Turning circle	between kerbs 10.1 m
<b>Wheel suspension</b>	
Front	independent by separate subframe and MacPherson struts, wishbones
Rear	lightweight constant track beam axle on coil springs, located by two longitudinal Watts linkages and a Panhard rod, a stabilizer rod and gas-pressurized shock absorbers
<b>Brake system</b>	
Type	power assisted diagonal split system, load conscious reducing valves in rear circuits, 4 discs front and rear
Handbrake	integrated in rear brake calipers
<b>Wheels and tyres</b>	
Wheels	light alloy wheels, 6"J x14"
Tyres	185/60 HR 14"
<b>Weights</b>	
Kerb weight	998 kg
Max. permissible weight	1355 kg
<b>Performances</b>	
Top speed	> 190 km/h
Acceleration 0-100 km/h	9.5s
Fuel consumption according to ECE	urban cycle 10.61/100 km 90 km/h 5.91/100 km 120 km/h 7.31/100 km combined 7.91/100 km

## Standard and optional equipment\*

Tinted glass	●
High impact laminated windscreen	●
Intermittent wipe (continuous at full throttle)	●
Intermittent wiper rear (continuous in R-gear)	●
Automatic wash/wipe combination front and rear	●
Power windows front	●
Remote controlled exterior mirrors	●
Electrically controlled and heated exterior mirrors	○
Door key-hole light	●
Central doorlocking	●
Burglar alarm	●
Remote controlled fuelcap lid	●
Halogen pop-up headlights	●
Headlights jet-wash	○
Long-range light	●
Front fog lights	●
Reversing lights	●
Rear warning fog lights	●
Adjustable steering column	●
Oddments box/armrest front and rear	●
Lumbar support at front seats	●
Electrically heated front seats	●
Adjustable head restraints front	●
3 point inertia reel safety belts front and rear	●
Seat belt reminders light + buzzer	●
Adjustable backrests on rear seats	●
Rear passengers footwell heating	●
Interior light time delay	●
Rheostat controlled dash-illumination	●
Search-find illumination switches	●
Cruise control	○
Rev counter	●
Electronic Information Centre	●
Airconditioning	○
Oil pressure gauge	●
Voltmeter	●
Glove box illumination	●
Luggage compartment illumination	●
Engine compartment illumination	●
Headlight warning buzzer	●
● = standard ○ = optional * = to be market adapted	

### Warranty:

1 Year warranty without mileage limitations.  
8 Year warranty against corrosion with no demands on post-treatment of the car. All that is required is that inspections are carried out during the 3rd and 6th year.



