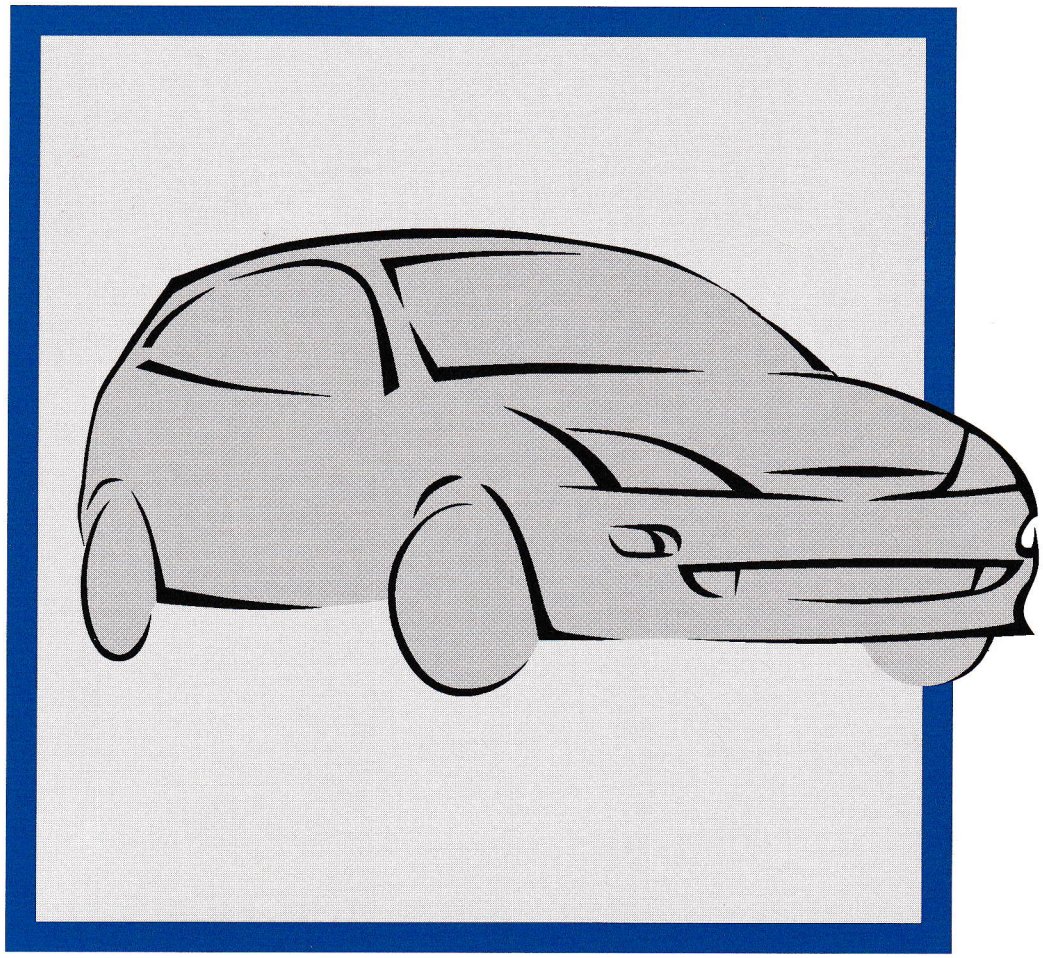
T5

Technical Service Training

Focus

New Product Introduction 00/273

Overview



Student Information

CG 7749/S en 6/98

With the 1999 model year the Escort is superseded by a new generation vehicle, the "FOCUS". This new innovative medium-sized vehicle incorporates the latest technical developments and modified components and systems from existing Ford vehicles.

The object of this New Product Introduction is to give you an **initial overview** of the entire vehicle and the new and modified systems and components. It is designed as a **self-study medium** in line with the new Ford global training concept.

The Student Information publication is divided into lessons. The six lessons cover body and safety, chassis, petrol engines, diesel engine, transmissions (including the 4F27E automatic transmission) and vehicle electrical and electronic systems.

At the start of each lesson there is a list of the objectives to be achieved in completing the lesson. At the end of the lesson there are a few test questions to check learning progress. The answers to the test questions are to be found at the end of the Student Information publication (behind the List of Abbreviations).

The individual systems are only described in outline. More detailed information and notes on servicing are to be found in the corresponding Student Information publications for the "Focus" course:

- New Product Introduction 00/269 "Focus", CG 7745/S
- New Product Introduction 00/270 "Focus – Body", CG 7746/S
- New Product Introduction 00/271 "Focus – 1.8L Endura-DI Turbocharged Intercooled Diesel Engine", CG 7747/S
- New Product Introduction 00/272 "Focus – 4F27E Automatic Transmission", CG 7748/S

Please remember that our training literature has been prepared solely for FORD TRAINING PURPOSES. Repair and adjustment operations **MUST** always be carried out according to the instructions and specifications in the workshop literature.
Please make extensive use of the training courses offered by Ford Technical Training Centres to gain extensive knowledge in both theory and practice.

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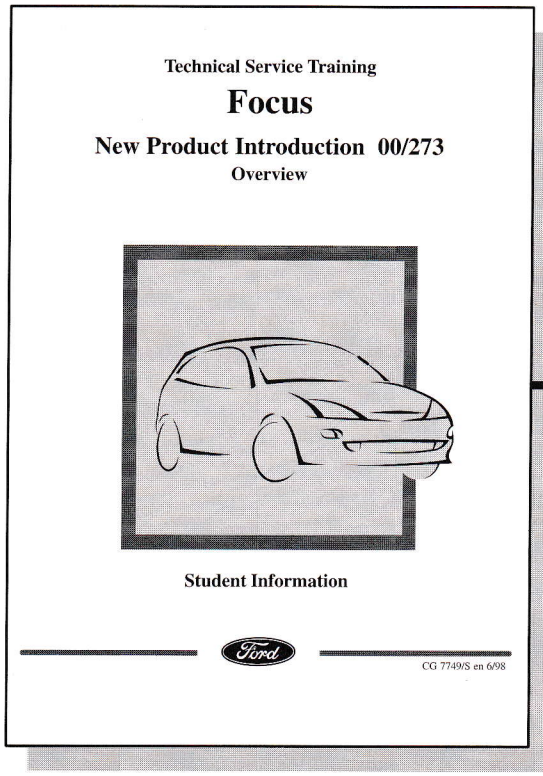

Student Information publications for the "Focus" course:

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New Product Introduction 00/271
"Focus – 1.8L Endura-DI Turbocharged Intercooled Diesel Engine", CG 7747/S

New Product Introduction 00/272
"Focus – 4F27E Automatic Transmission", CG 7748/S

Video
"Focus", CG 7751/V

Body and safety features

- Bumpers painted the same colour as the body
- Direct glazing, tinted glass
- Front and side air bags for driver and front passenger

Chassis

- Front suspension with MacPherson struts, transverse arms, sub-frame and stabiliser bar
- Multi-link rear suspension with stabiliser bar, drum or disc brakes depending on engine variant
- ABS with traction control and electronic brake force distribution (EBD)
- Optional electronic stability programme (ESP)

Engines

- Zetec-SE engines developing 55 kW (75 PS) and 73 kW (100 PS) (1.4 and 1.6L)
- Zetec-E engines developing 84 kW (115 PS) and 95 kW (130 PS) (1.8 and 2.0L)
- 1.8L Endura-DI direct injection turbocharged diesel engine developing 66 kW / 90 PS

Transmissions

- iB5 or MTX-75 manual transmission (depending on engine variant)
- 4F27E automatic transmission (optional for 1.6L Zetec-SE engine)
- Hydraulic clutch mechanism

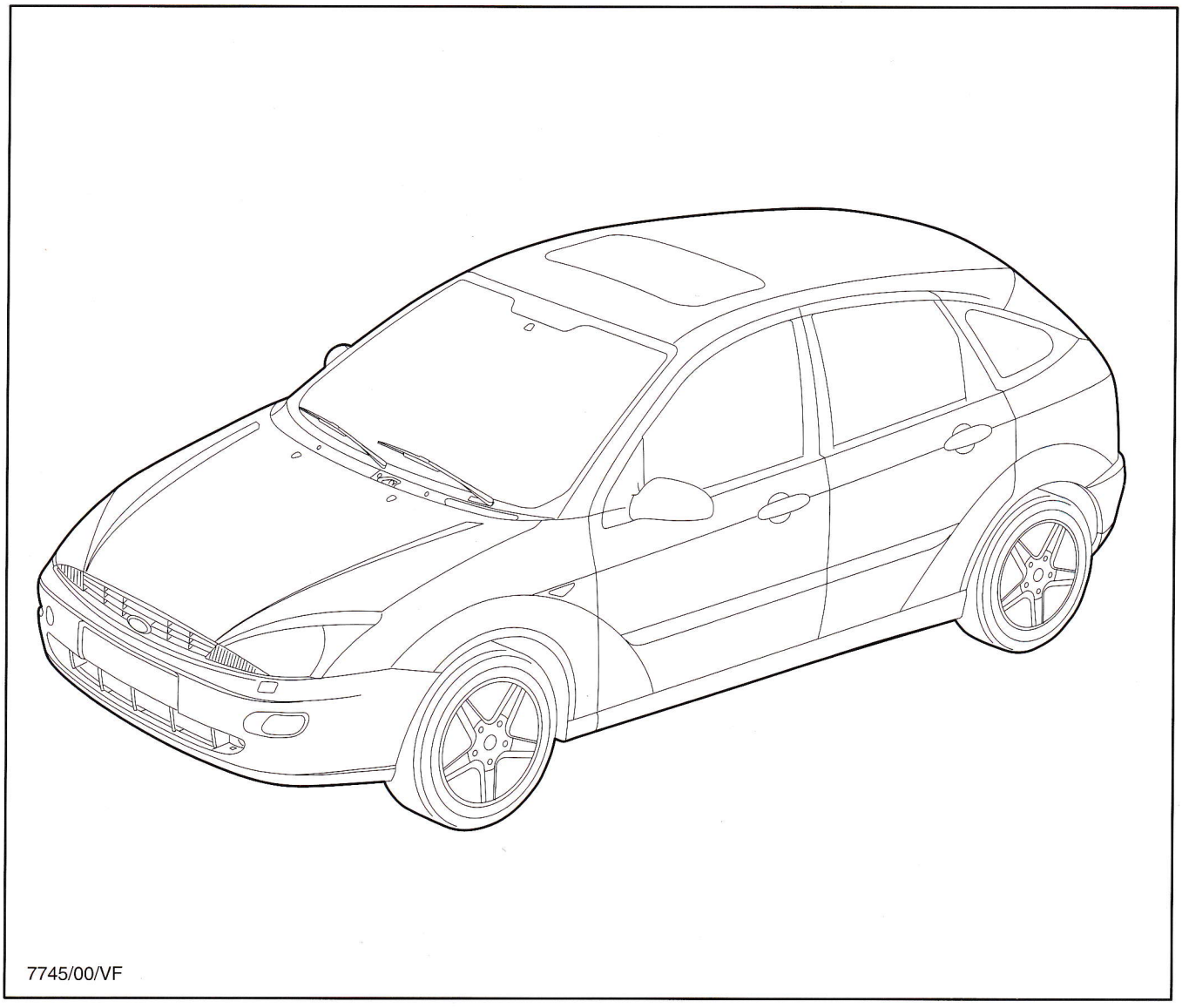
Vehicle electrical and electronic systems

- Multiplex data bus system
- Central timer module (CTM)
- PCM-controlled battery charging ("smart charging")
- Integral mobile telephone (optional)
- Travel assistance system (TAS) (optional)

Objectives

On completing this lesson, you will be able to

- describe the main body features of the Focus,
- describe the active and passive safety features of the Focus,
- name the measures taken to make the Focus environmentally compatible.



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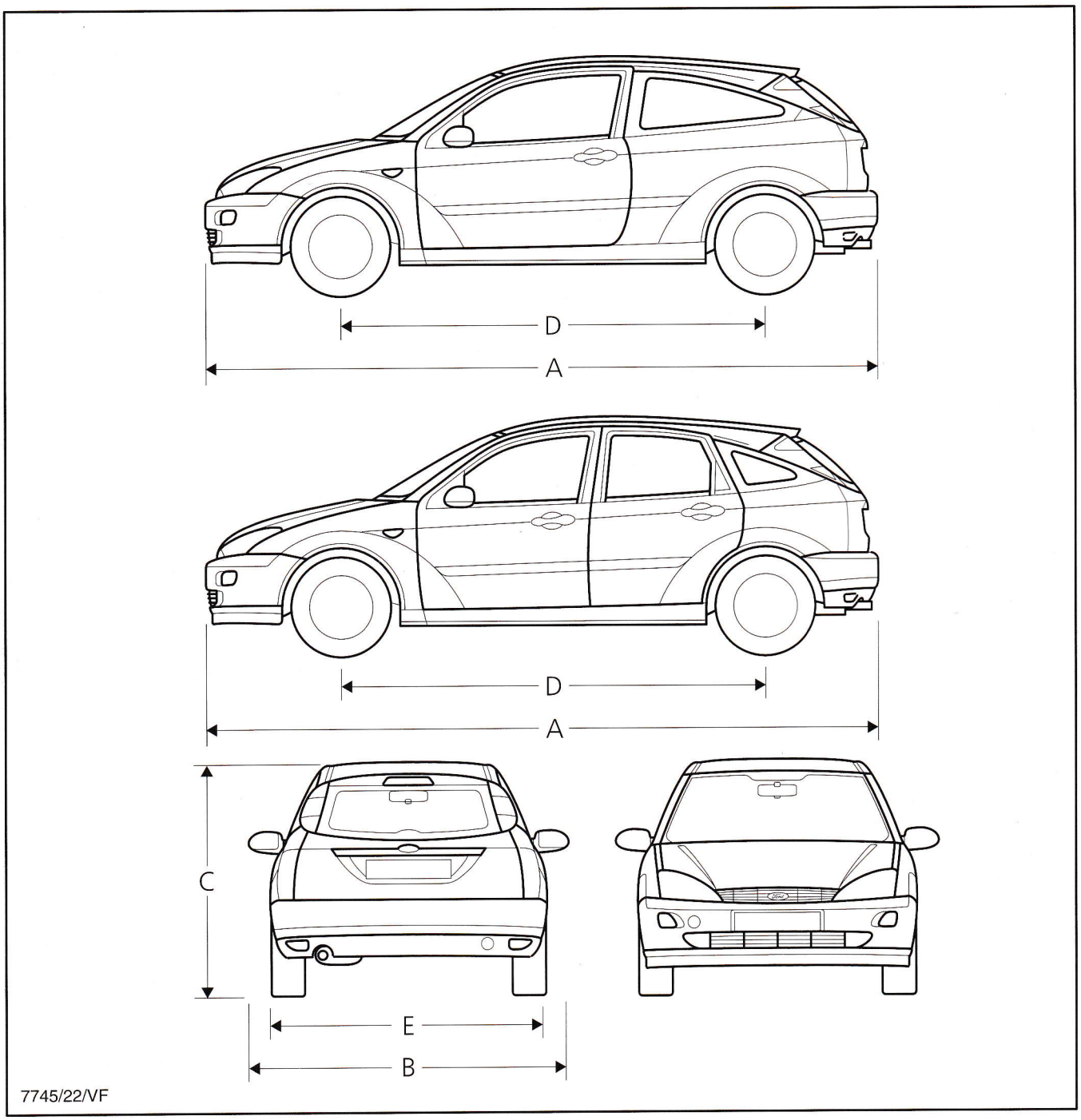
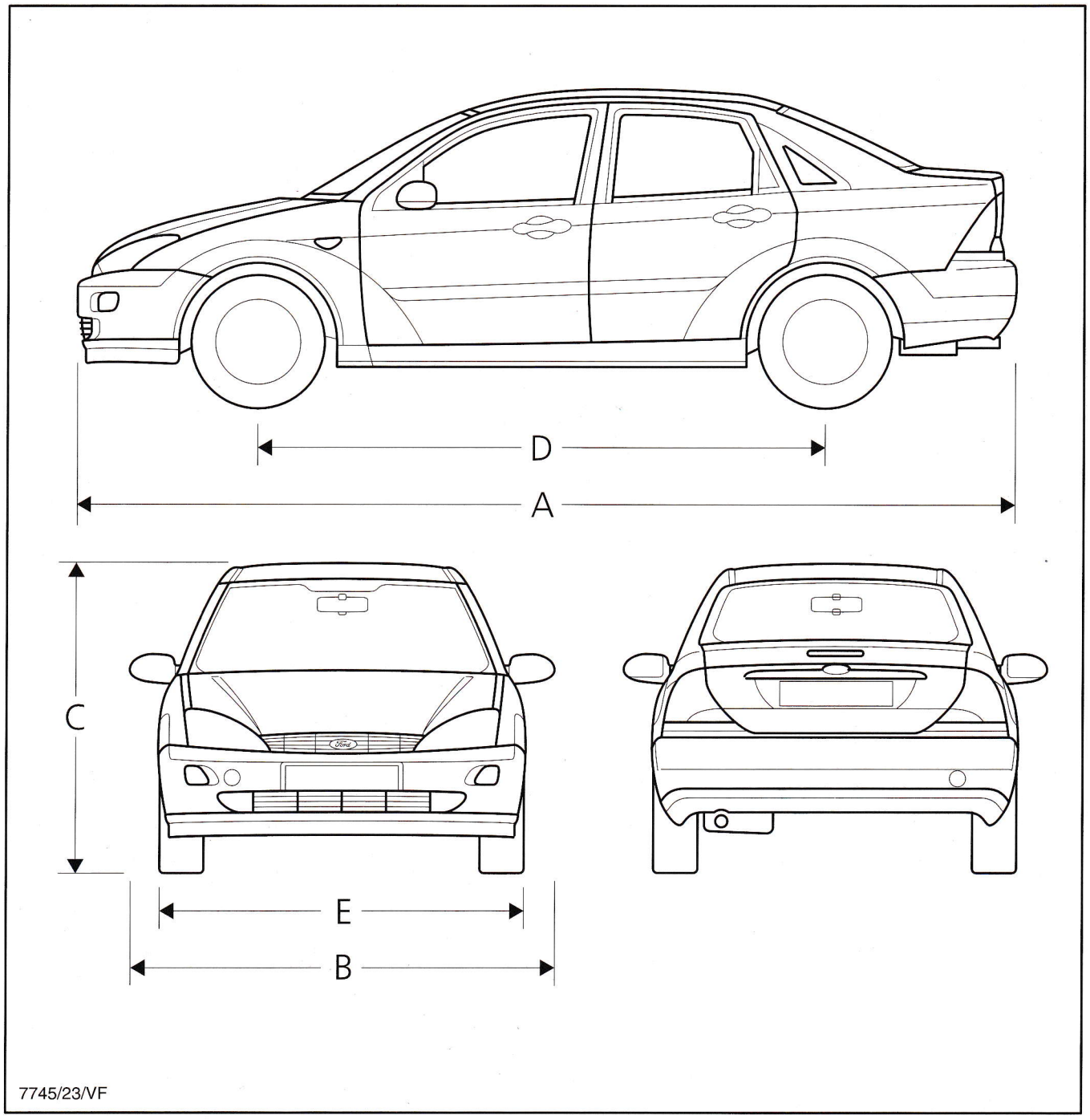
Vehicle dimensions – 3-door and 5-door variants



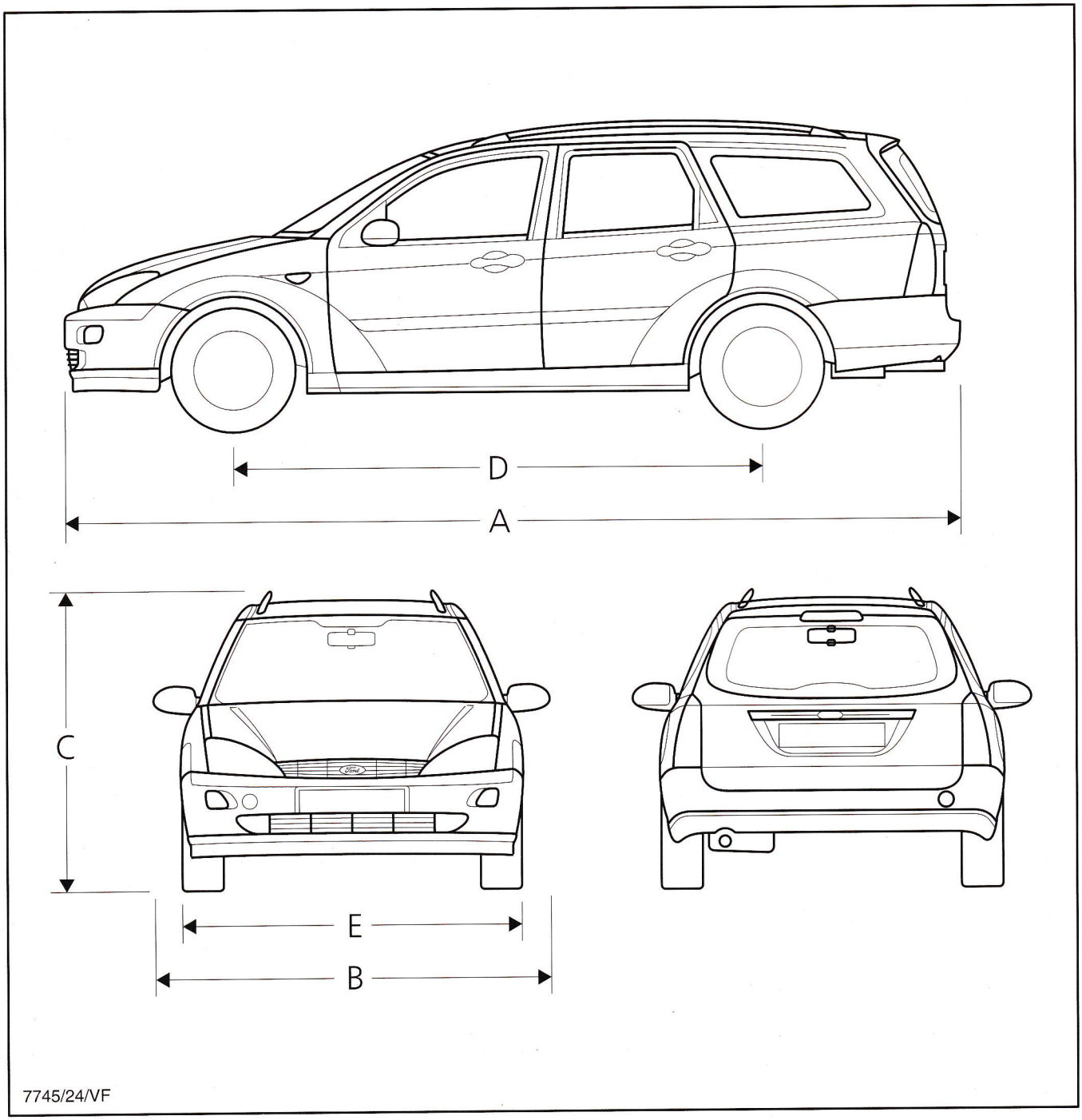
A	Maximum length	4152 mm
B	Maximum width	1695 mm
C	Overall height (unladen)	1430 mm
D	Wheelbase	2615 mm
E	Track at front/rear	1494/1497 mm

Vehicle dimensions – 4-door notchback



A	Maximum length	4295 mm
B	Maximum width	1695 mm
C	Overall height (unladen)	1430 mm
D	Wheelbase	2615 mm
E	Track at front/rear	1494/1497 mm

Vehicle dimensions – wagon

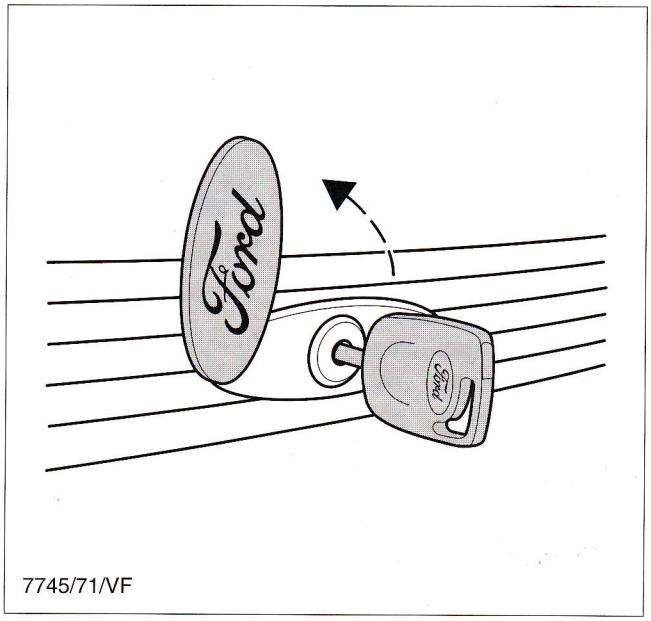


A	Maximum length	4438 mm
B	Maximum width	1695 mm
C	Overall height (unladen incl. roofrack)	1441 mm
D	Wheelbase	2615 mm
E	Track at front/rear	1494/1497 mm

Opening the hood

- Now, for improved security, the hood can only be unlocked with the vehicle key.
- The Ford emblem must be swung up to gain access to the lock cylinder.
- The hood is unlocked by turning the key first counterclockwise. The hood can now be lifted slightly but still cannot be opened completely.
- Turning the key clockwise then allows the hood to be opened.

NOTE: Remove the key immediately after opening the hood.



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NOTE: Refer to Student Information CG 7746/S "Focus – Body" for more detailed information on the body features.

Active safety

Active safety measures help to prevent an accident. On the Focus these include:

- Power-assisted steering
- New front and rear suspension
- ABS with traction control
- Electronic stability program (ESP)
- Air conditioning
- New headlamps with an improved light output
- Travel assistance system (TAS)

Passive safety

Passive safety measures help to avoid or minimize the consequences of an accident. On the Focus these include:

- Front air bags for the driver and front passenger and side air bags
- Height-adjustable safety belts
- Safety belt locks which prevent the belt slipping on the retractor
- Pyrotechnic safety belt pretensioners for the driver and front passenger
- Belt retractors with torsion bars
- Safety passenger cell with an instrument panel crossmember
- Height-adjustable head restraints front and rear
- Anti-submarine seats
- Hard foam padding in the interior of the doors to reduce the energy in a side impact
- Rounded and padded trim components in the immediate vicinity of the vehicle occupants
- Provision for fixing child safety seats (ISO FIX)

Air bag and belt pretensioner system

- The Focus is equipped with the latest Ford supplemental restraint systems. It has "full size" air bags for the driver and front passenger.
  - The 55 liter driver air bag is standard equipment in all territories.
  - The 100 liter front passenger air bag is standard equipment in many territories.
  - Side air bags which protect the head and chest of the front occupants from injury in a side impact are optional equipment.

⚠ **CAUTION:** When installing covers on seats with side air bags, always use only original correctly fitting covers. Also make sure that the correct covers are used for the driver and front passenger seats.

- All pyrotechnic supplemental restraint systems are monitored and actuated by a single module. This central control module is located on the central tunnel in the area of the handle of the parking brake control.
- Crash sensors are located on the floor on the left and right-hand side of the passenger compartment to provide additional monitoring for the side air bags.
- The firing current for the gas generators is now an alternating current and is passed through a capacitor. Both are designed to protect against unintential deployment of the supplemental restraint systems due to short-circuits or electrical faults.
- The pyrotechnic supplemental restraint system can be tested with FDS 2000.
- A warning indicator lamp in the instrument cluster indicates faults in the pyrotechnic supplemental restraint system.

Emissions

Exhaust

- All Focus engines meet the current European exhaust emission standards.

Exterior noise

- The Focus also meets the current EU standards as regards noise.

Protection of the ozone layer

- The air conditioning system of the Focus works with the CFC-free refrigerant R-134a.
- All the synthetic foams employed are manufactured without using CFCs.

Asbestos

- All friction linings (brake and clutch linings/pads) and sealing materials are free of asbestos.

Recycling

- The targets set for recycling of used vehicles in Europe for the year 2002 require manufacturers to ensure that their vehicles are at least 85% recyclable. The Focus meets these requirements.
- The components of the Focus have been developed so that components can be disassembled and the various materials separated easily and inexpensively.
- Almost 100% of the steel and ferrous materials can be recycled in the iron and steel industry.
- All light alloys can also be used again as raw materials after appropriate recycling processes.
- Plastic components are usually marked so that they can be sorted into types of material and reprocessed.
- The hardened glass used in the side and rear windows can be used to manufacture glass vessels.
- Rubber from tires, hoses, rubber bushings and insulators can also be used for energy recovery through combustion.

Tick the correct answer or fill in the gaps.

1. **How is the hood unlocked on the Focus?**

   ☐ a) By means of a lever in the interior and a cable
   ☐ b) With the vehicle key
   ☐ c) By means of a special switch in the facia
   ☐ d) By turning and pressing the Ford emblem

2. **The side air bags are deployed following signals from the** _____ **which are mounted on the vehicle floor.**

3. **On the Focus the air bags and pyrotechnic belt pretensioners are triggered by an** _____ **which is passed through a capacitor.**

4. **How many control modules are there in the supplemental restraint system on the Focus?**

   ☐ a) One
   ☐ b) Two
   ☐ c) Three
   ☐ d) Four

5. **The Focus already passes the European Union requirement for recyclability. How recyclable must a vehicle be in % by the year 2002?**

   ☐ a) 33%
   ☐ b) 50%
   ☐ c) 85%
   ☐ d) 100%

Objectives

On completing this lesson, you will be able to

- name the main chassis features on the Focus,
- describe how the electronic stability programme (ESP) works,
- describe the components of the ESP.

Chassis features

- Rack and pinion steering with power assistance (as standard)
- Strut and spring assemblies and suspension arms at the front
- Independent suspension at the rear with short and long arms (SLA)
- Torsion bar stabilizers at the front and rear
- 14 inch or 15 inch wheels (depending on engine)
- Disc brakes with sliding calipers at the front
- Internally ventilated brake discs at the front
- Drum brakes at the rear (disc brakes with ESP or 1.8 and 2.0 L engine; standard in D)
- ABS optional (standard in D, DK and N)
- Traction control system (TCS or BTCS with 1.4L Zetec-SE engine and 1.8L Endura-DI diesel engine) optional with ABS
- Electronic stability program (ESP) optional; ESP includes ABS and TCS

Wheel/tire combinations

NOTE: The wheel/tire combinations depend on vehicle, engine and equipment variant.

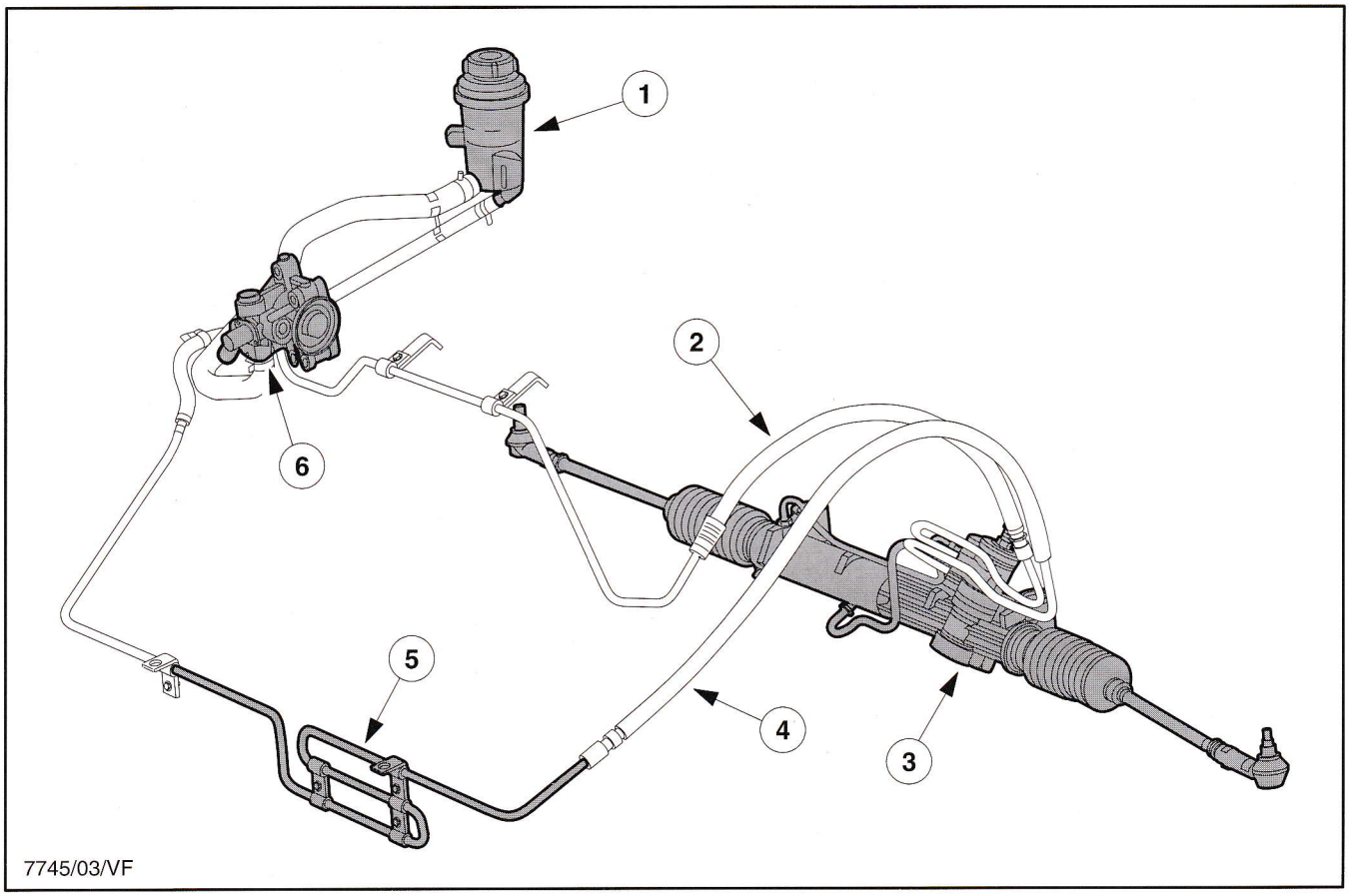
- Tires with optimized rolling resistance are used as standard. Standard tires may be used in service.

Wheel / Tire	5 1/2 J X 14 47.5 mm rim offset (steel)	6 J X 15 52.5 mm rim offset (steel)	6 J X 15 52.5 mm rim offset (light alloy)
175/70 R 14 T	●		
185/65 R 14 H	●		
195/55 R 15 H		●	●
195/60 R 15 V		●	●

- Snow chains may only be used on the driving wheels. If the vehicle is equipped with size 195/55 R 15 or 195/60 R 15 tires, snow chains may **not** be used.

General

- The Focus has rack and pinion steering. The power steering is standard equipment on all models.
- Two different hydraulic pumps are used which are distinguished by their housing:
  - grey cast-iron housing without a power steering pressure (PSP) switch for vehicles with a diesel engine;
  - light alloy housing with an integral PSP switch for vehicles with a petrol engine (the PSP switch is located in the high-pressure pipe with 1.4L engines).
- 3.0 turns of the steering wheel are necessary to turn from lock to lock.
- The turning circle of the Focus is 10.9 meters.
- The front axle steering geometry is designed to produce a toe-stabilizing negative steering offset.



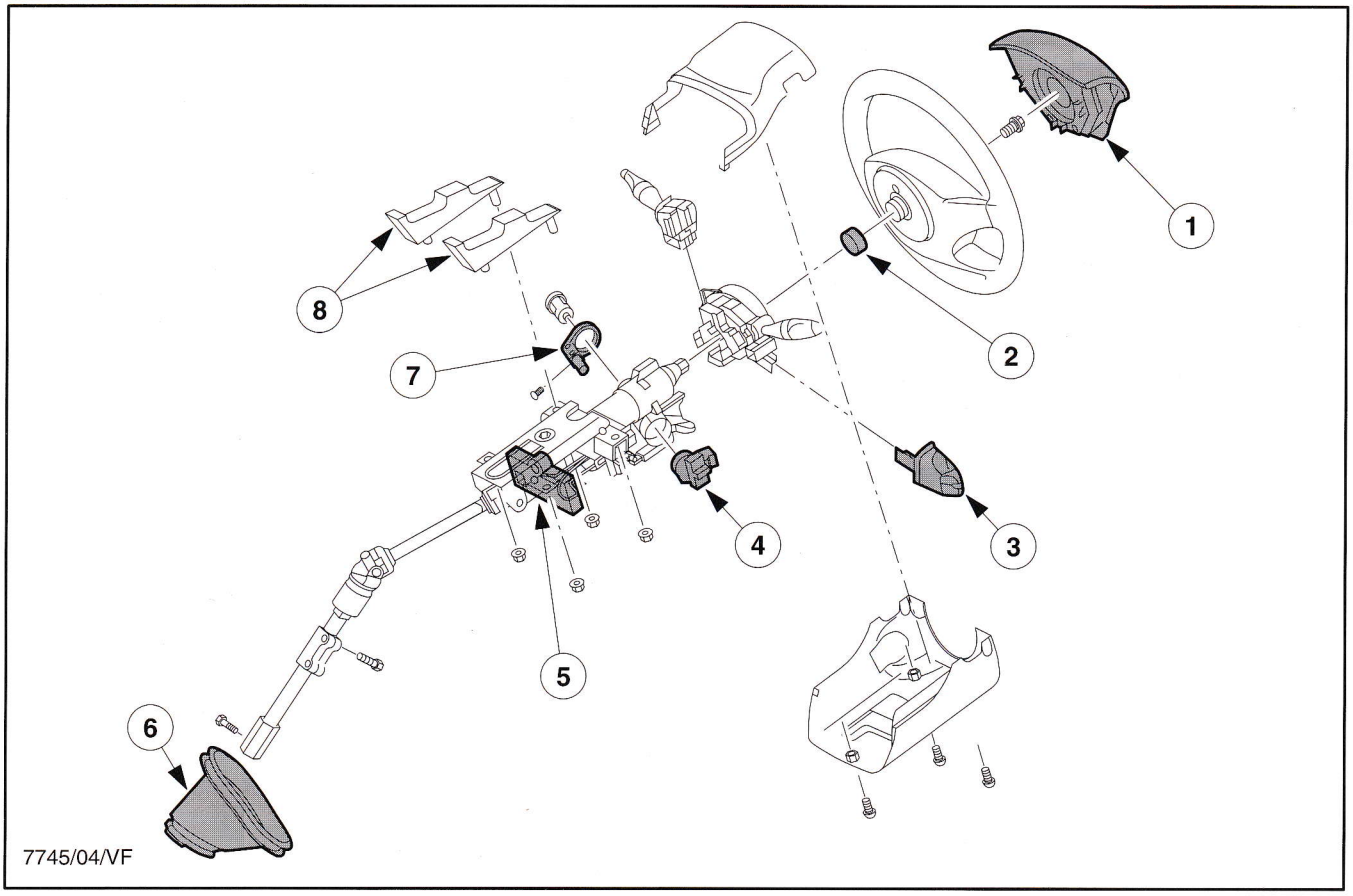
1 Power steering fluid reservoir
2 High-pressure pipe
3 Rack and pinion steering gear
4 Return pipe
5 Cooling loop (depending on model)
6 Power steering fluid pump

Steering column

- The steering column is adjustable for height and reach as standard.
- All the electrical components in the steering column are readily accessible and can be removed and installed easily.

⚠ **CAUTION:** No repair operations of any kind may be carried out on the mechanical components of the steering column. If the steering column is damaged, a complete new steering column must be installed.

- Different components of the steering column are connected together frictionally. In an accident they can collapse and thus dissipate energy.
- Since this changes the contact areas of the frictionally connected components and also the corresponding coefficients of friction, a repaired steering column would not have calculable crash characteristics.

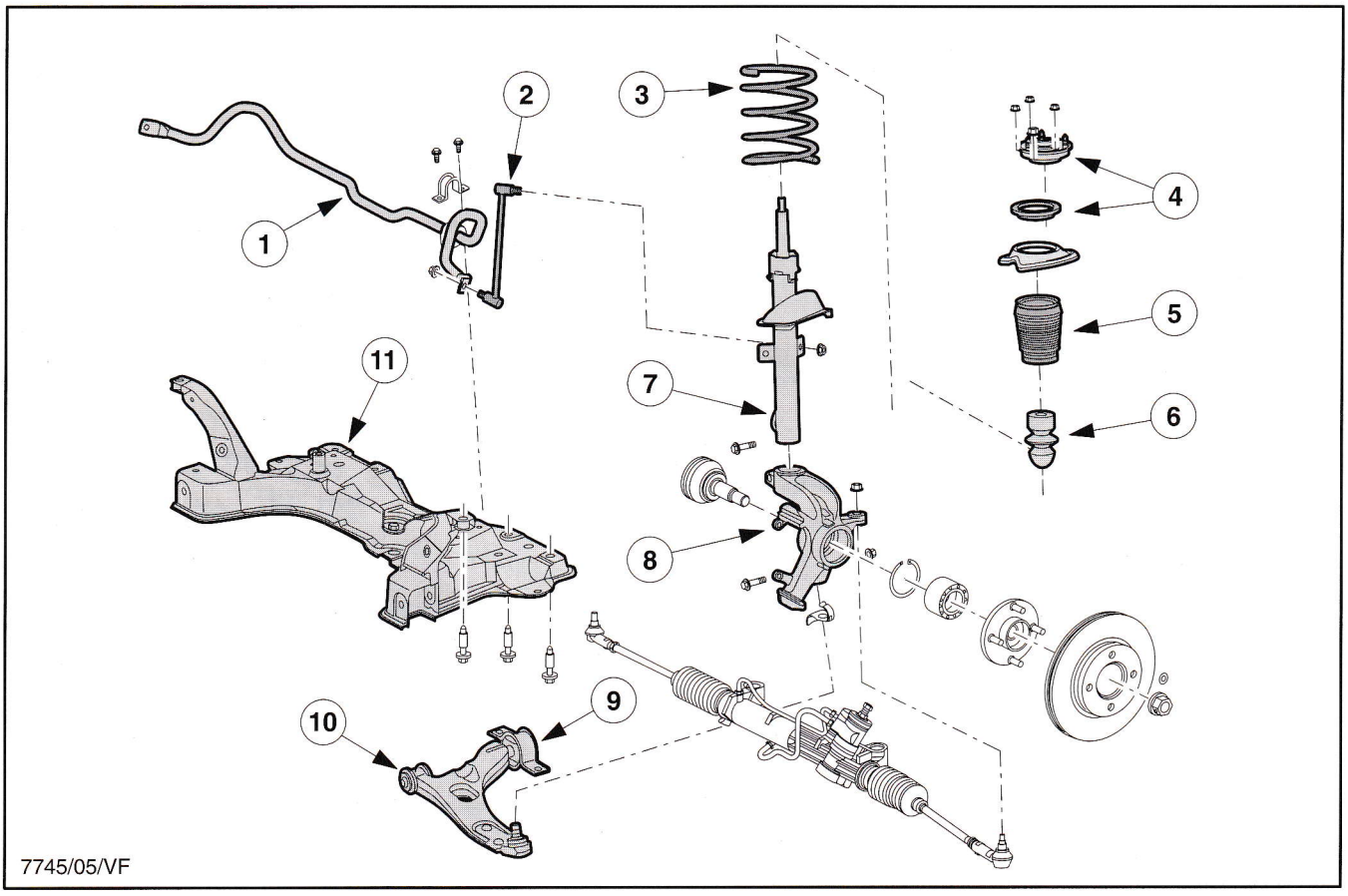


1 Air bag module
2 Tolerance ring (yellow)
3 Radio remote control stalk
4 Ignition switch
5 Steering wheel position sensor (in conjunction with ESP only)
6 Seal (clipped to steering gear)
7 Transceiver for PATS
8 Mounting on in-vehicle cross-beam

Features

- The front suspension of the Focus essentially consists of a crossmember, strut and spring assemblies, suspension arms and a torsion bar stabilizer.
- The A-shaped transverse arms are suspended from the crossmember on two horizontally disposed rubber bushings. These bushes provide stable lateral guidance and damp jolts/roughness in the longitudinal direction of the vehicle.
- The torsion bar stabilizer is coupled to the struts by link rods.
- No buckling forces whatsoever act on the struts due to the oblique angle of the springs (100% lateral load compensation).

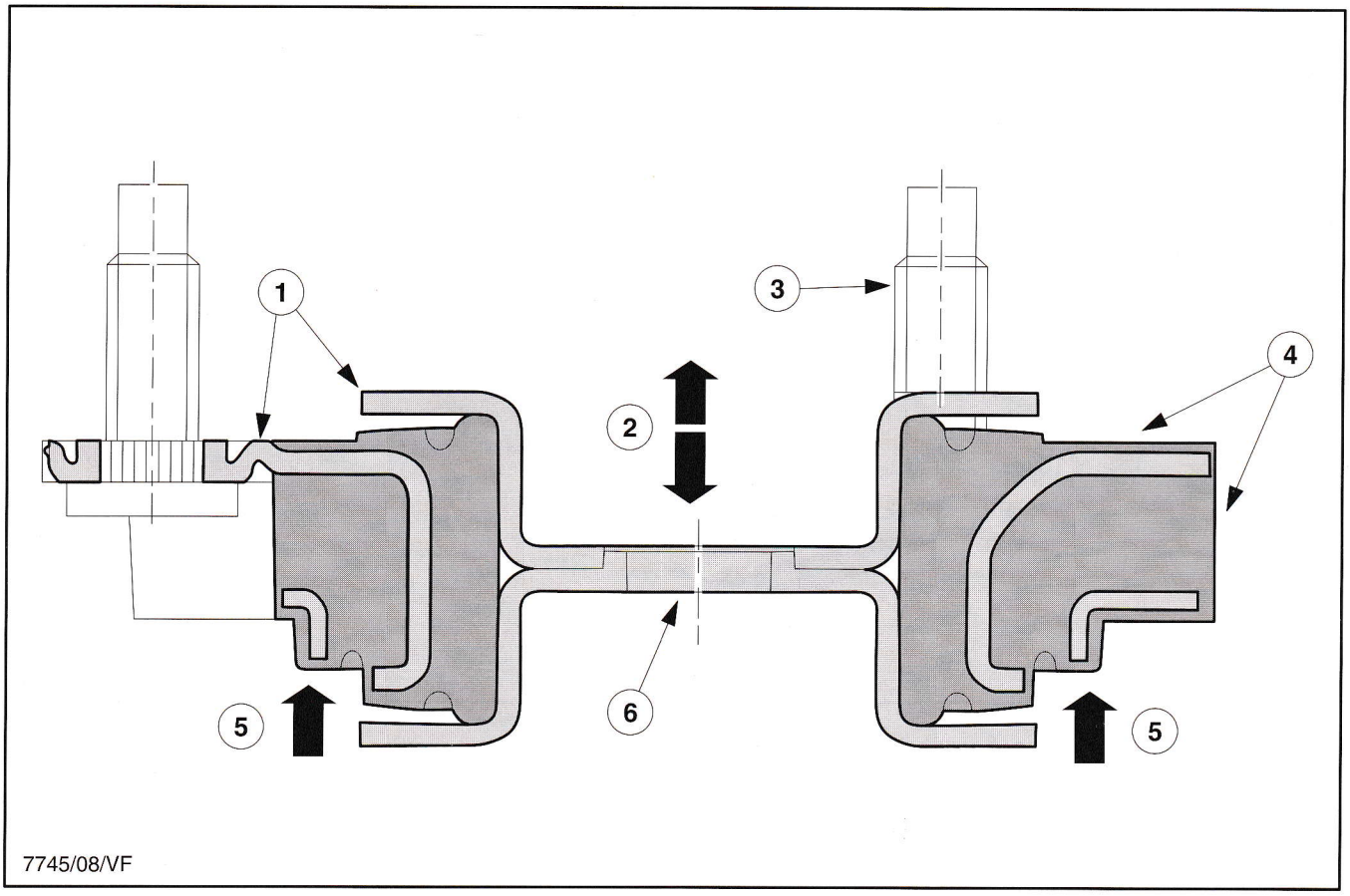
NOTE: The front springs **must** be installed with the paint mark at the **bottom**.



1 Stabilizer bar
2 Stabilizer bar link
3 Spring
4 Strut tower with thrust bearing
5 Boot
6 Rubber auxiliary spring
7 Strut
8 Wheel knuckle
9 Rubber bushing with retainer
10 Suspension lower arm
11 Crossmember

Strut tower

- Newly designed strut towers transmit the spring and damper forces into the body separately.
- The spring is braced on the outer part of the strut tower. The weight of the vehicle and forces occurring when the suspension is compressed produce a thrust loading on this part of the strut tower.
- Changing shear forces through the piston rod of the shock absorber act on the inner part of the strut tower.
- The outer and inner parts of the strut tower are connected together elastically.
- The advantage of such a design is that mountings can be developed for spring and damper forces individually.
- In addition, the life of the strut tower is increased as the high spring forces are transmitted directly into the body. The shear forces which occur are not high enough to cause premature damage to the strut tower.
- The strut towers of the rear suspension are constructed on the same principle.



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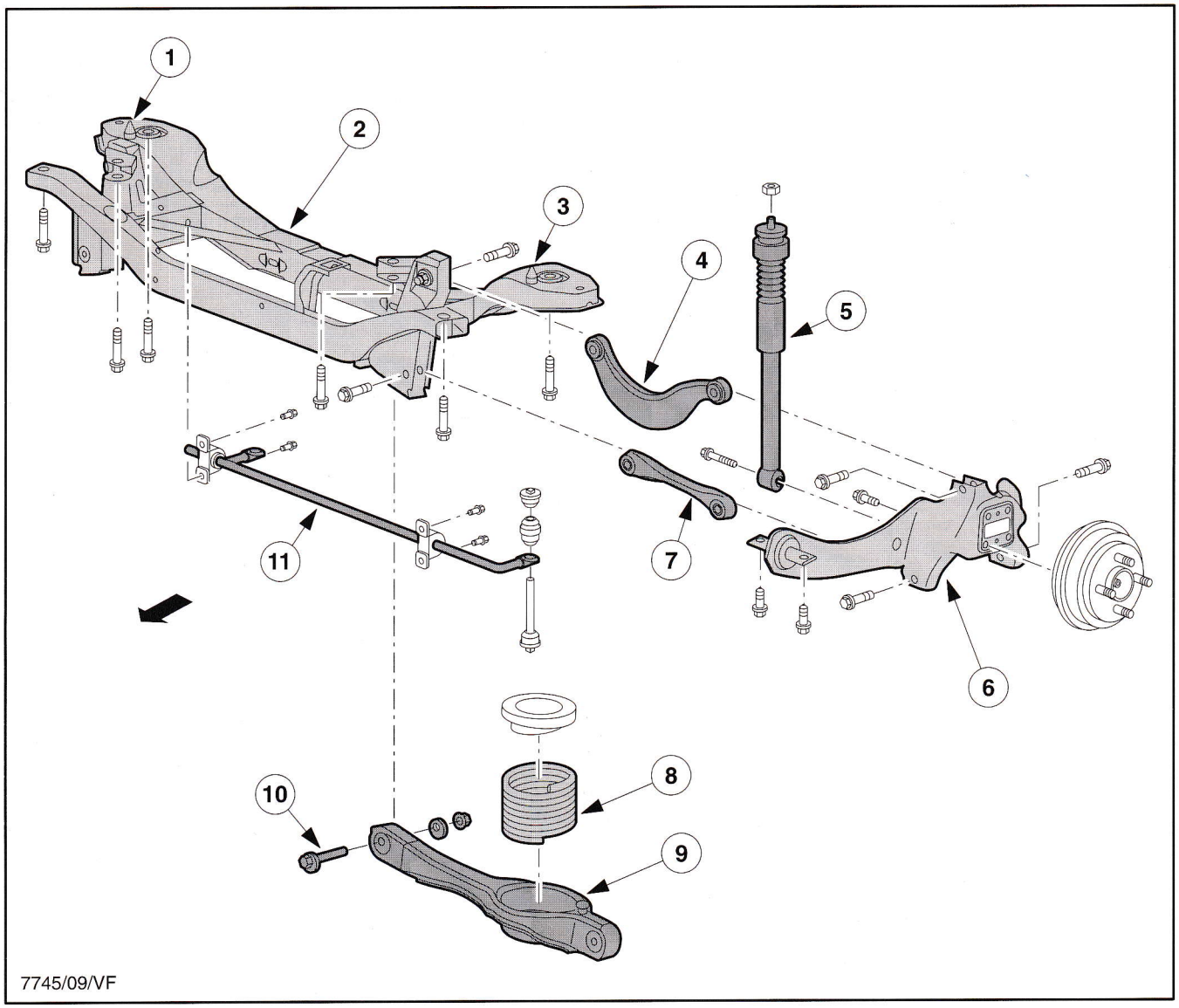
1 Metal
2 Shock absorber forces
3 Threaded pin
4 Rubber
5 Spring force
6 Opening for shock absorber piston rod

Features

- The Focus has an SLA rear suspension which is of similar construction to that on the Mondeo wagon.
- All the components of the rear suspension are mounted on a crossmember and can be detached from the vehicle underbody as a complete assembly.

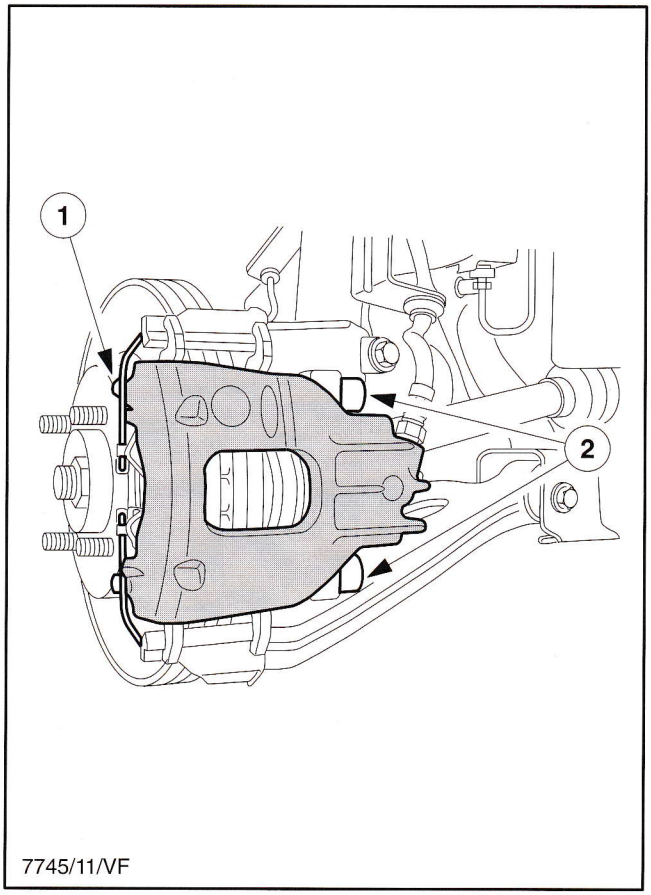


Rear suspension on 3-door, 4-door and 5-door variants

1 Right-hand locating lug
2 Rear axle crossmember
3 Left-hand locating lug
4 Upper arm
5 Shock absorber
6 One-piece tie rod/wheel knuckle
7 Front lower transverse arm
8 Spring
9 Rear lower arm
10 Eccentric screw for toe setting
11 Torsion stabilizer bar

Front brakes

- Disc brakes with sliding calipers are used on the front axle. The diameter of the brake discs is 258 mm, the thickness is 12 mm.

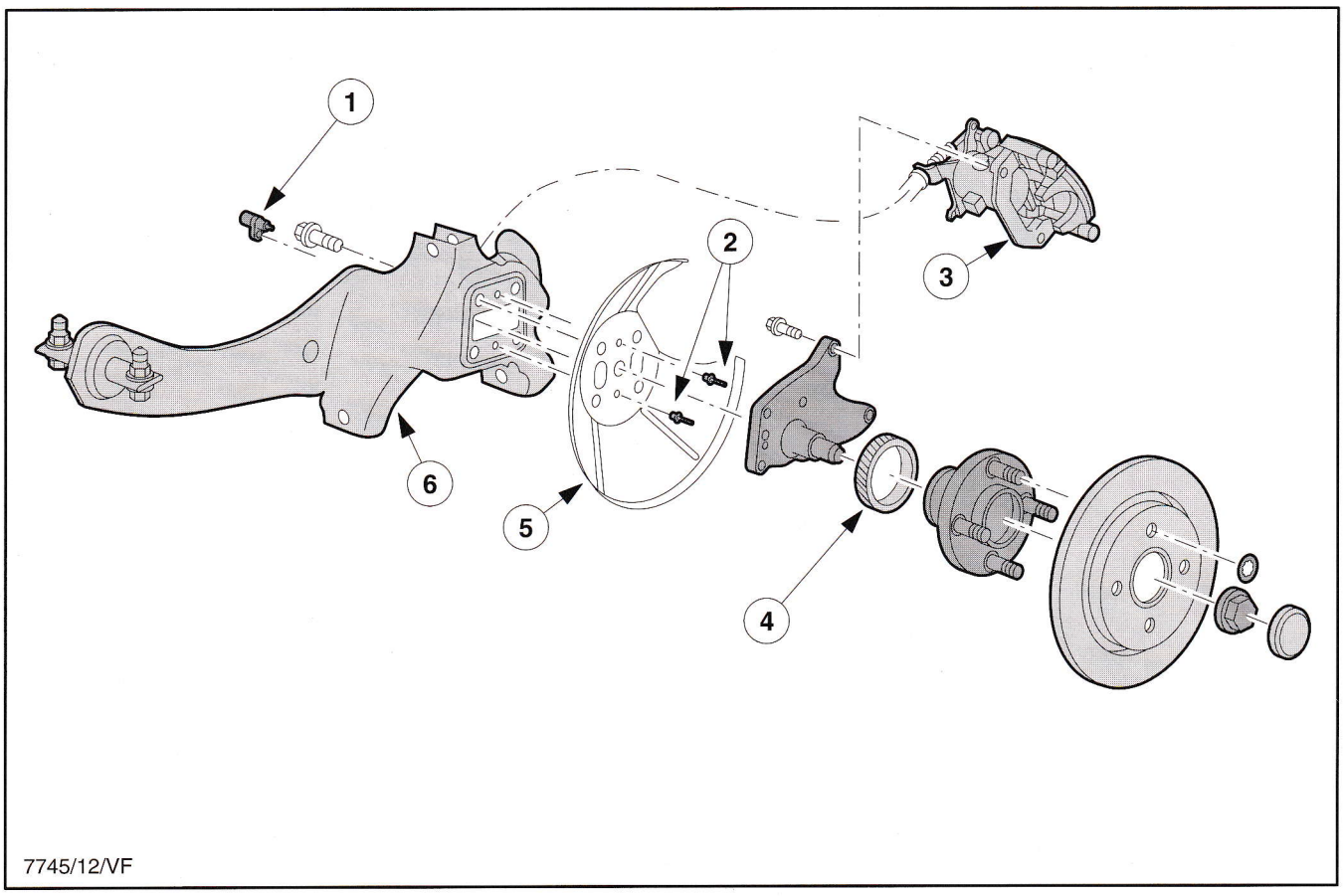


Front disc brake

1 Sliding caliper
2 Slide pins

Rear brakes

- 8 inch diameter drum brakes are used as standard on the rear axle.
- Disc brakes (253 mm in diameter/10 mm in thickness), carried over from the Scorpio are fitted to the rear axle of:
  - vehicles for the German market,
  - vehicles with ESP,
  - vehicles with a 1.8 or 2.0L Zetec engine and ABS.

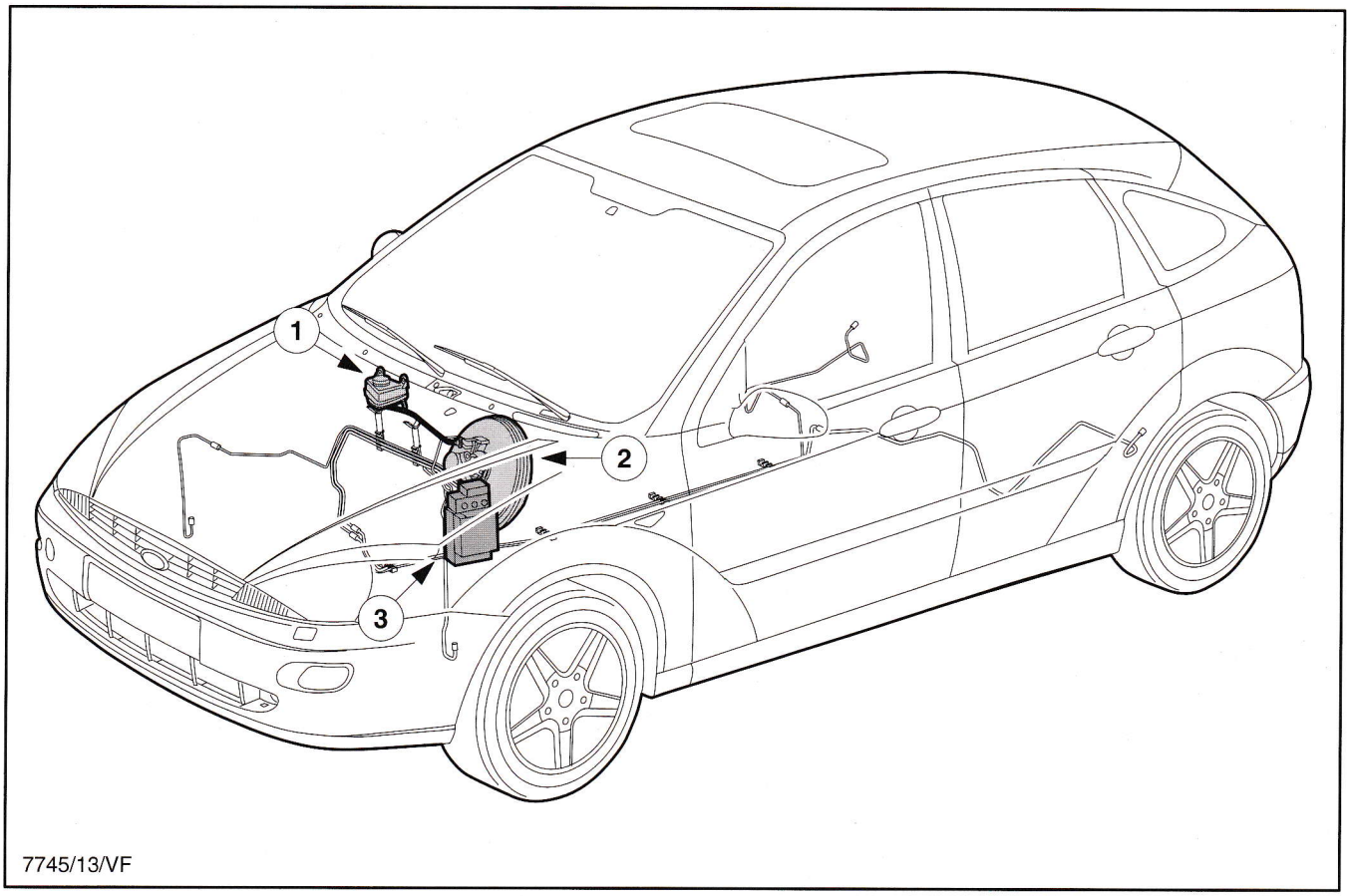


Rear disc brake

1 Wheel speed sensor
2 Rivets for securing guard to one-piece tie-rod/ wheel knuckle
3 Brake caliper
4 Wheel speed sensor rotor
5 Guard
6 One-piece tie rod/wheel knuckle

Brake hydraulics

- An ITT type Mk 20E-I 4-channel anti-lock braking system is available as standard in D, DK and N (but optional in other territories).
- A traction control system (TCS or BTCS with the 1.4L Zetec-SE engine and the 1.8L Endura-DI diesel engine) is optional equipment in conjunction with ABS.
- The electronic stability program (ESP) is also available as an option. ESP includes ABS and TCS.
- Pressure conscious brake pressure regulating valves (PCRVs) are installed on all 3-door, 4-door and 5-door variants and on wagon variants with Zetec-SE engines and normal payload without ABS. They are located directly on the brake master cylinder at the connections for the rear brake pipes.
- A load apportioning valve (LAV) is used on all other wagon variants without ABS.
- All vehicles with ABS also have electronic brake force distribution (EBD). EBD supersedes the LAV and the PCRV.



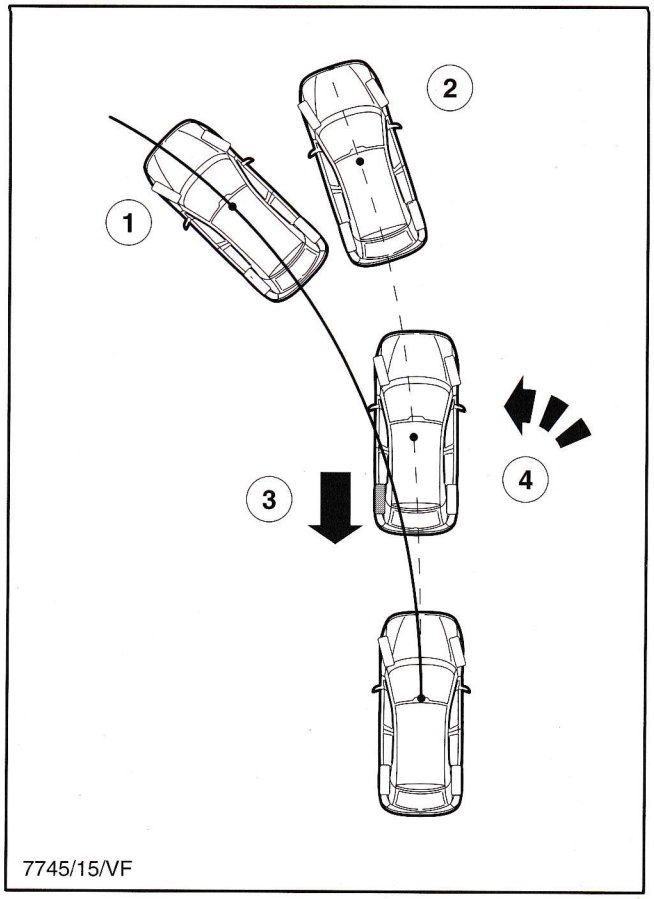
1 Remote reservoir
2 Brake booster with brake master cylinder (on the right-hand side on RHD variants)
3 ABS module

Operation

- The Focus is one of the first vehicles of its class which can be equipped with an electronic stability program (ESP). ESP is available with petrol engines of 1.6 liters capacity and upwards.
- ESP determines the intentions of the driver through the steering wheel position sensor on the steering column and the wheel speed sensors.
- At the same time the behaviour of the vehicle is monitored. This is done with the aid of sensors for the yaw rate and lateral acceleration and also the wheel speed sensors.
- ESP is capable of keeping a vehicle threatening to break away on line by braking individual wheels and reducing the torque through the engine management system.
- In the process ESP module builds up a pressure of 130 – 180 bar within milliseconds. This pressure is passed to a specific brake cylinder by the ESP module.
- When individual wheels are braked, a turning moment is produced which acts on the center of gravity of the vehicle. The vehicle is turned in a controlled manner in the direction in which the driver is steering.
- ESP is able to act on the engine management system. If necessary, the engine torque can be reduced. This means a reduction in the destabilising forces.
- The combined use of individual brakes and action on the torque brings the vehicle back under the control of the driver.

Operation of ESP during understeer

- As a rule, a vehicle gets out of control either by understeering (when the front of the vehicle breaks away) or by oversteering (when the rear of the vehicle breaks away while cornering).
- As soon as the front of the vehicle breaks away to the right when negotiating a left-hand bend, the ESP activates the left-hand rear brake.
- This produces a counterclockwise turning force which turns the vehicle back in the direction of the bend.
- Since the front wheels have insufficient grip when understeering, ESP mostly uses the brakes of the rear axle as more grip is available here.

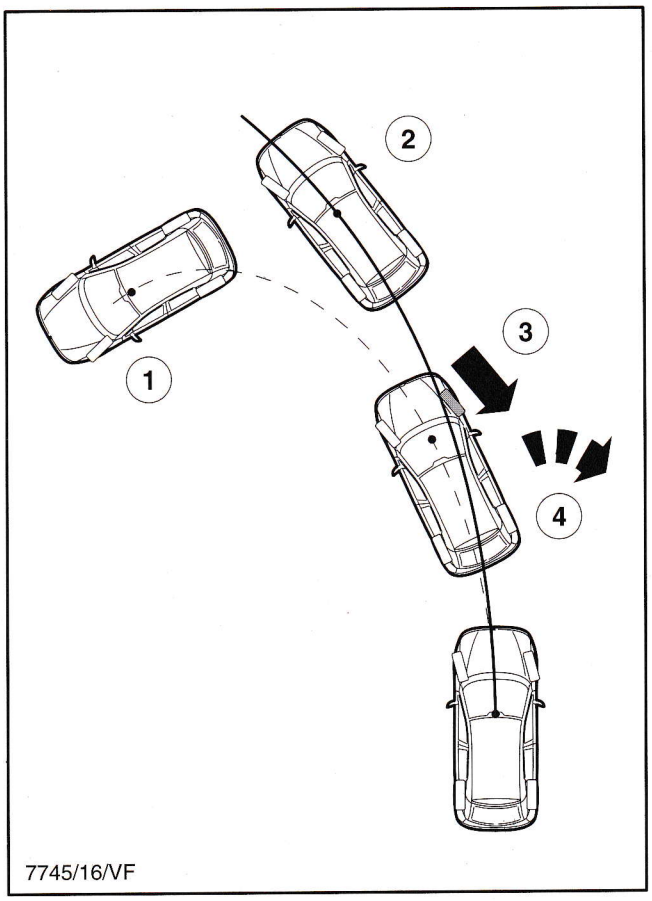


Intervention of ESP during understeer

1 With ESP
2 Without ESP
3 Braking force
4 Offsetting yaw movement

Operation of ESP during oversteer

- As soon as the rear of the vehicle breaks away to the right while negotiating a left-hand bend, ESP activates the right-hand front brake.
- This produces a clockwise turning force which turns the vehicle back in the direction of the bend.
- Since the rear wheels have insufficient grip during oversteer, ESP mostly uses the front brakes as there is more grip available here.



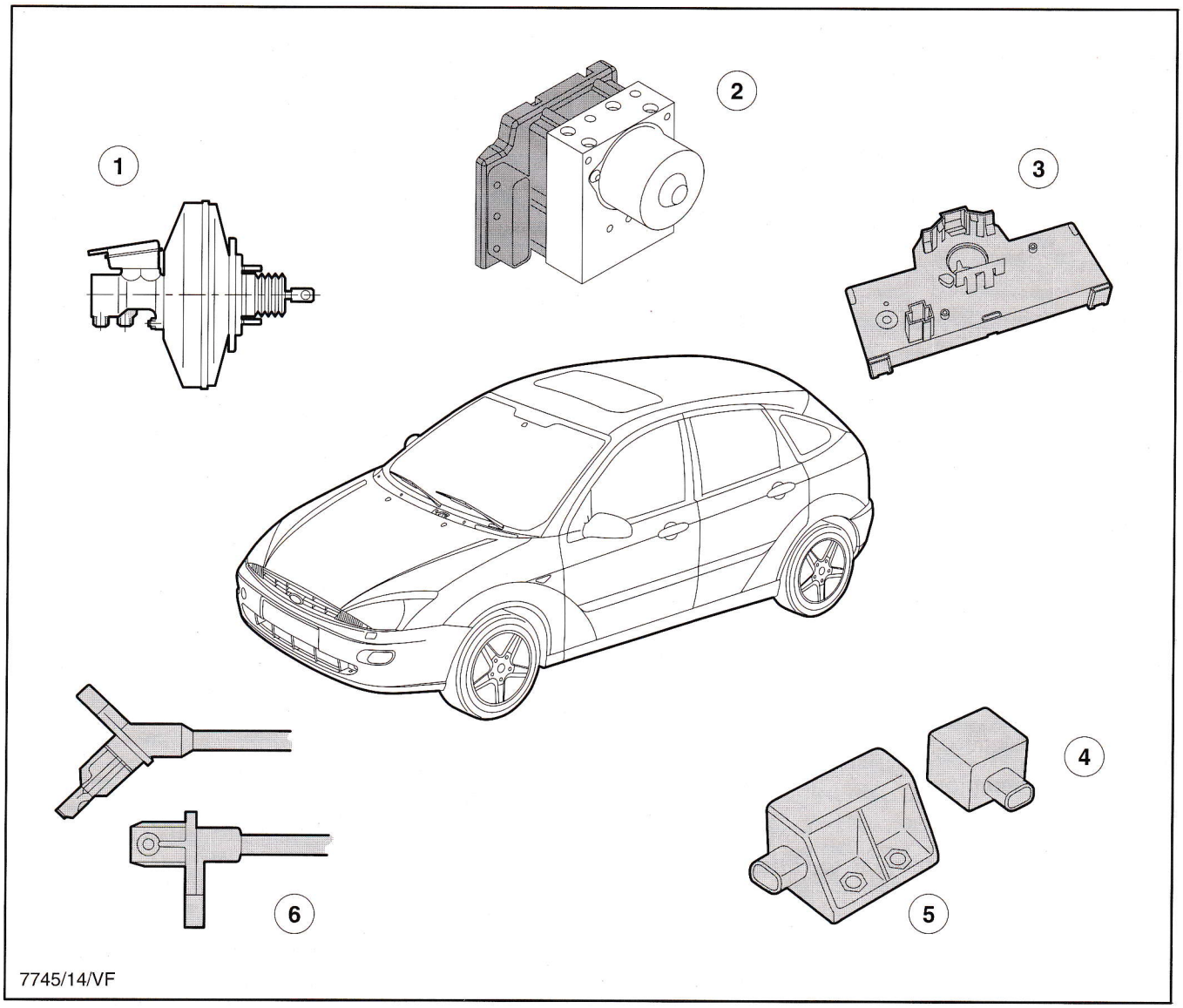
ESP intervention during oversteer

1 Without ESP
2 With ESP
3 Braking force
4 Offsetting yaw movement

NOTE: When ESP intervenes this is indicated by a flashing indicator lamp in the instrument cluster.

NOTE: When the ESP indicator lamp is illuminated continuously, this means that ESP has been switched off with the TCS switch or that there is a fault in the ESP system.

Overview of components



ESP system overview

1 Active brake booster with pressure sensors on brake master cylinder
2 ESP with electronic controller and integral ABS and TCS
3 Steering wheel position sensor
4 Lateral acceleration sensor
5 Yaw rate sensor
6 Wheel speed sensors

NOTE: Refer to Student Information CG 7745/S "Focus"for more detailed information on ESP.

Tick the correct answer or fill in the gaps.

1. **Which particular feature characterises the power steering hydraulic pumps of Focus variants with 1.6L, 1.8L and 2.0L petrol engines?**

   ☐ a) Power steering pressure switch in high-pressure pipe
   ☐ b) Integral power steering pressure switch in light alloy housing
   ☐ c) Integral power steering pressure switch in grey cast iron housing
   ☐ d) Two power steering pressure switches, one integral, one in the high-pressure pipe

2. **When installing the front springs on the Focus, in which direction must the paint marks face?**

   ☐ a) In the direction of travel
   ☐ b) Towards the rear
   ☐ c) Towards the top
   ☐ d) Towards the bottom

3. **The SLA rear suspension on the Focus is similar to that on the**

   ☐ a) Puma
   ☐ b) Mondeo
   ☐ c) Mondeo wagon
   ☐ d) Scorpio

4. **How does ESP determine the intentions of the driver?**

   ☐ a) With the aid of the trip computer
   ☐ b) From signals from the steering wheel position sensor and the wheel speed sensors
   ☐ c) Solely with the aid of the wheel speed sensors
   ☐ d) From signals from the yawing rate sensor and the transverse acceleration sensor

5. **ESP establishes that a vehicle is understeering in a right-hand bend. Which wheel should ESP brake to stabilise the vehicle best?**

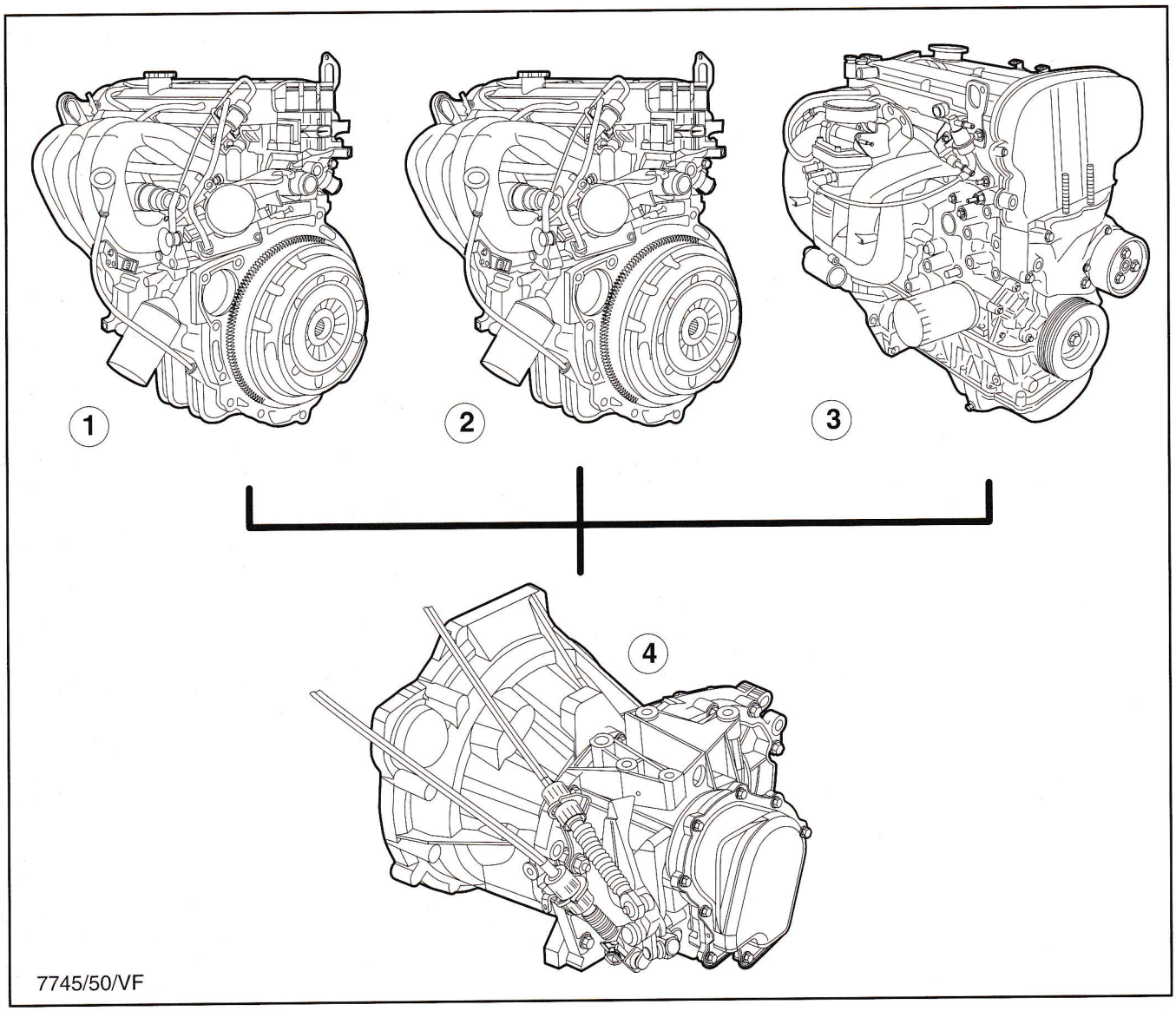
   ☐ a) Left-hand front wheel
   ☐ b) Right-hand front wheel
   ☐ c) Left-hand rear wheel
   ☐ d) Right-hand rear wheel

Objectives

On completing this lesson, you will be able to

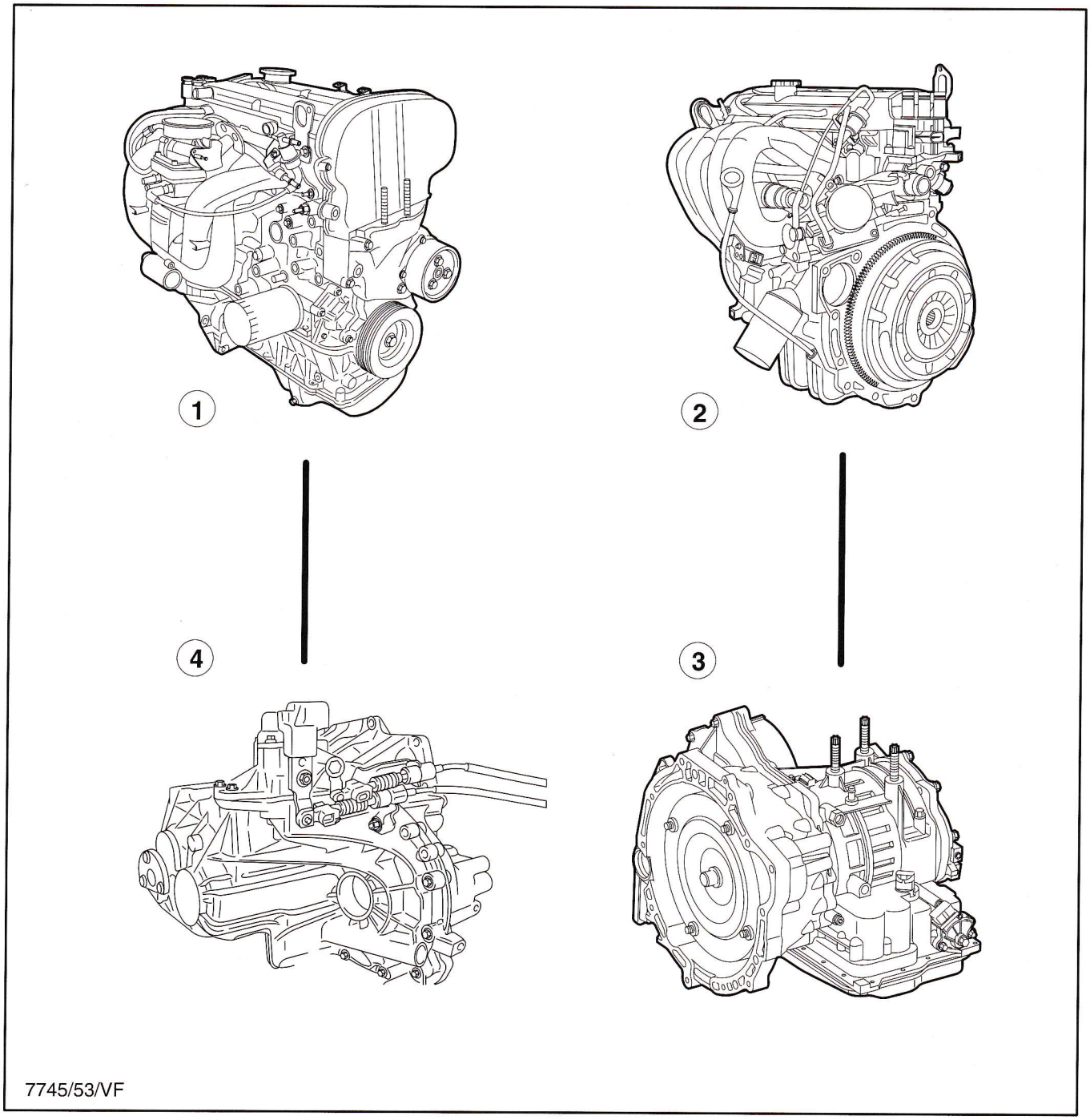
- name the engine/transmission combinations in petrol-engined Focus variants,
- describe the new features of the petrol engines in the Focus,
- describe the new/changed engine management components.

Engine/transmission combinations with petrol engines

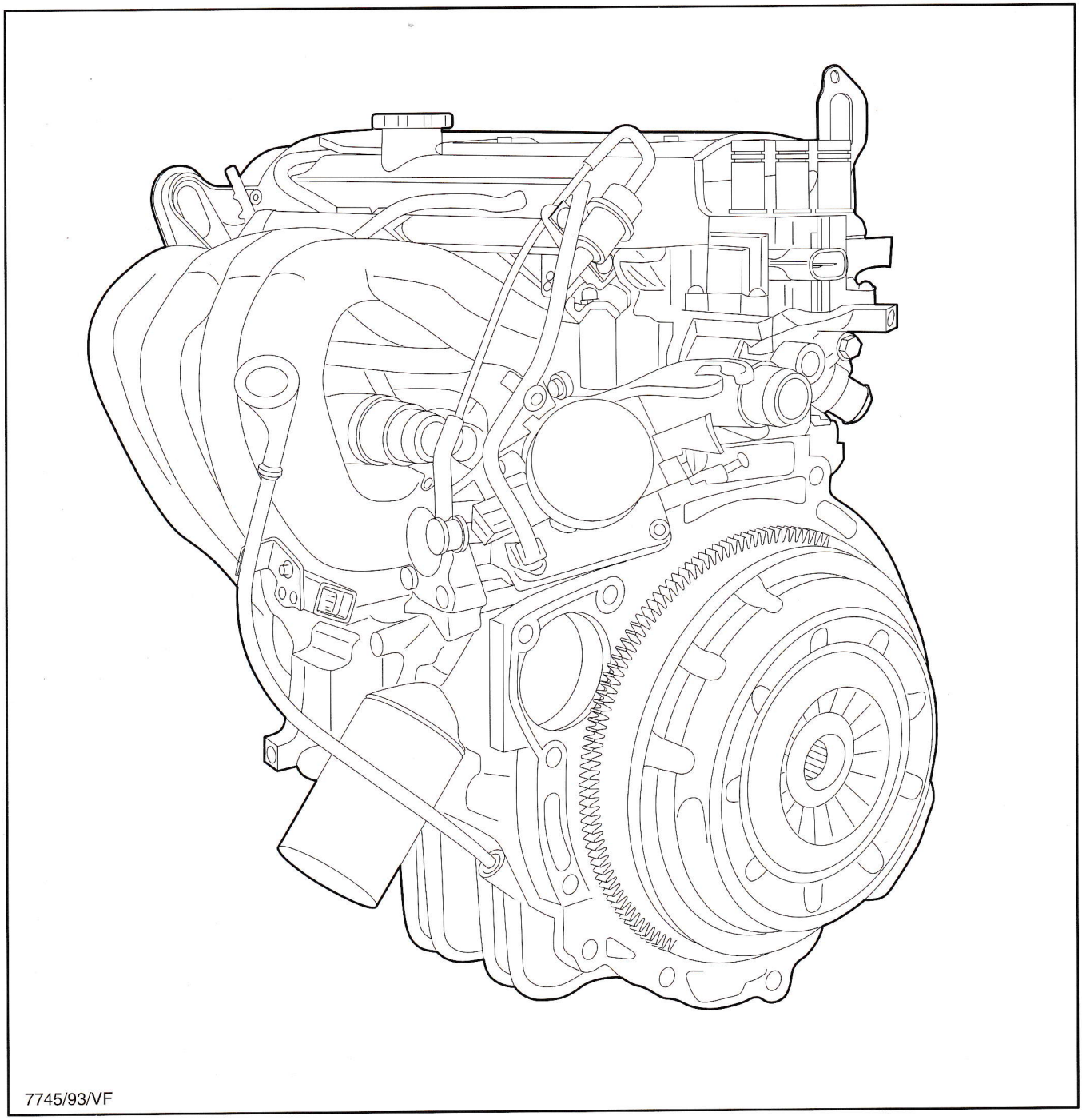


1 1.4L Zetec-SE engine
2 1.6L Zetec-SE engine
3 1.8L Zetec-E engine
4 iB5 manual transmission

Engine/transmission combinations with petrol engines (continued)



1 2.0L Zetec-E engine
2 1.6L Zetec-SE engine
3 4F27E automatic transmission
4 MTX 75 manual transmission



7745/93/VF

1.6L Zetec-SE engine

- The 1.4L and 1.6L engines used in the Focus come from the range of Zetec-SE engines used in the Fiesta and Puma.
- The 1.4L Zetec-SE engine has the same dimensions as the 1.4L Zetec-SE engine used in the Fiesta and the Puma. However, for the Focus the power output of the engine has been reduced and the torque adjusted to requirements.

Engine

- Transversely installed 16-valve DOHC engines:
  - 1.4 l cubic capacity developing 55 kW (75 PS)
  - 1.6 l cubic capacity developing 75 kW (100 PS)
- Valve gear with mechanical bucket tappets
- Compression ratio of both engines 11.0 : 1
- Aluminium alloy cylinder block and head

Engine management

- EEC V engine management
- Sequential multi-port fuel injection (SFI) through 4-hole fuel injectors with a vertical fuel inlet
- Mass air flow (MAF) sensor with integral intake air temperature (IAT) sensor in a new plastic housing
- Knock control
- Cylinder head temperature (CHT) sensor to measure the engine operating temperature
- Controlled battery charging

Emission control

- 94/12/EC ('96 EEC exhaust emission standard) without exhaust gas recirculation (EGR)
- 3-way catalytic converter with heated oxygen sensor
- Evaporative emission (EVAP) management system
- 1.6L engine in conjunction with 4F27E automatic transmission with exhaust gas recirculation (EGR) and additional downstream heated oxygen sensor

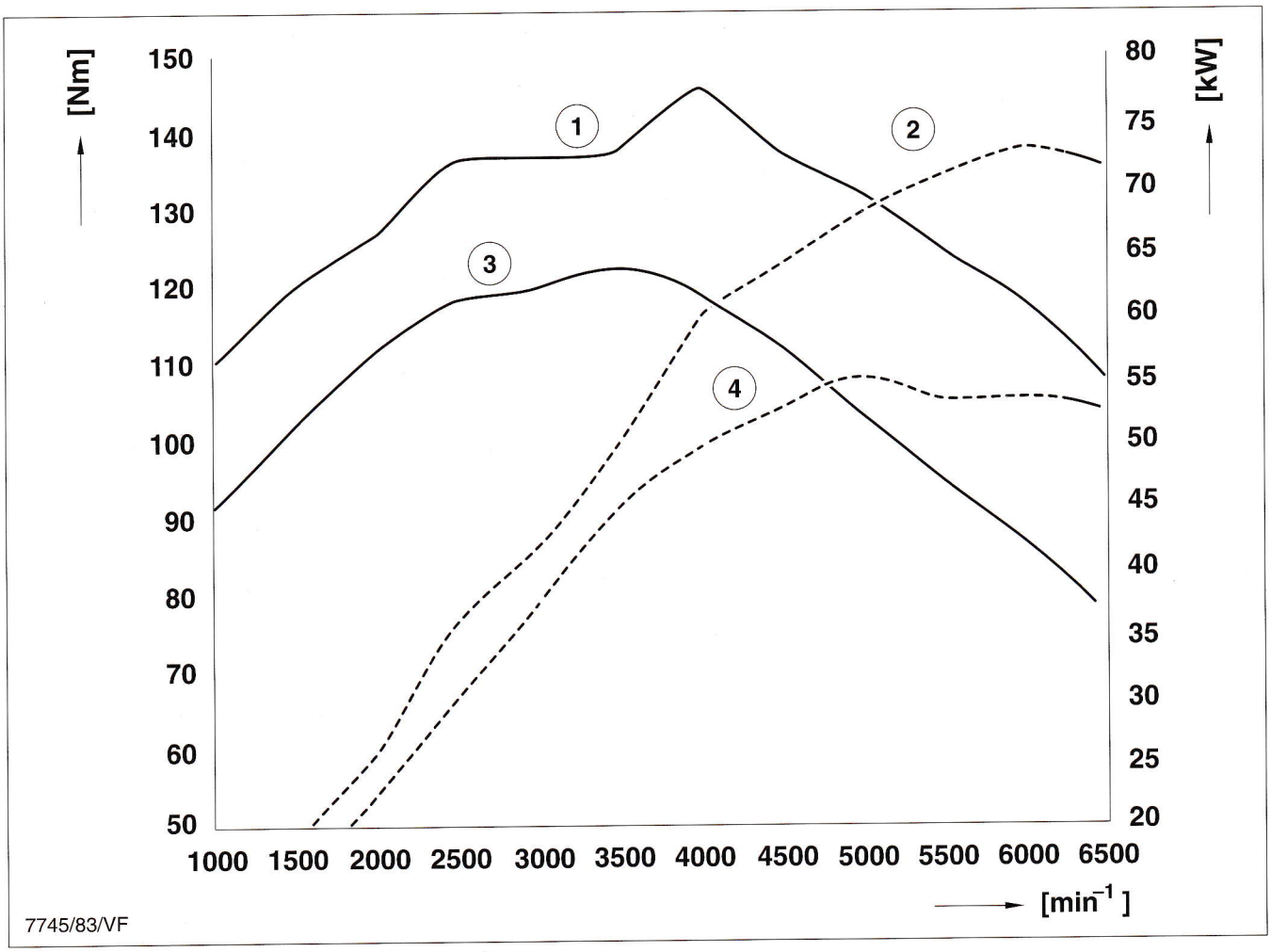
Diagnosis and testing

- Diagnosis and testing through data link connector (DLC) in passenger compartment

Technical data

	1.4L Zetec-SE	1.6L Zetec-SE
Cubic capacity	1388 cc	1596 cc
Stroke	76.5 mm	81.4 mm
Bore	76.0 mm	79.0 mm
Compression ratio	11.0 : 1	11.0 : 1
Max. power output	55 kW (75 PS) at 5000 rpm	74 kW (100 PS) at 6000 rpm
Max. torque	123 Nm at 3500 rpm	145 Nm at 4000 rpm

Engine power output and torque



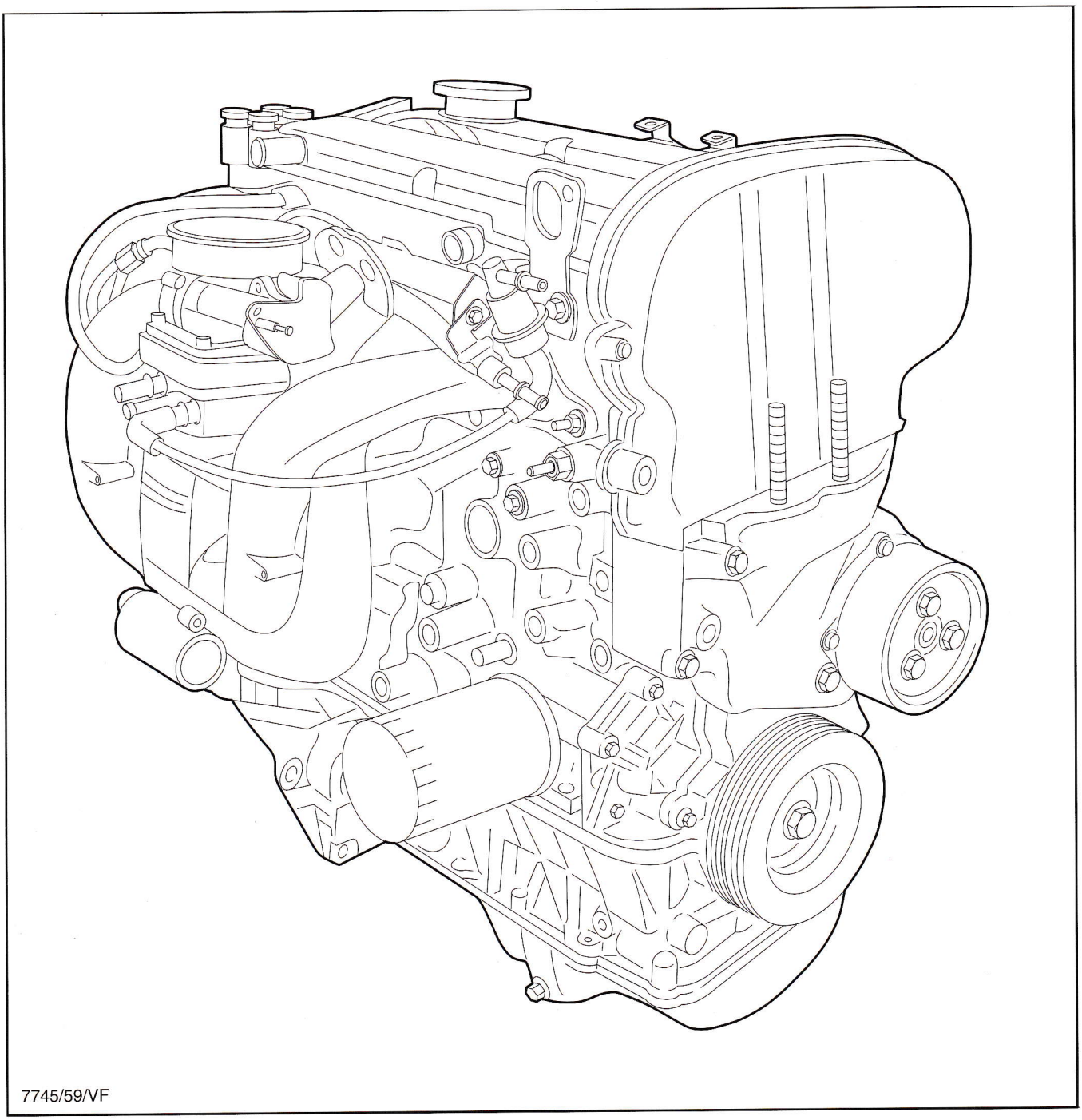
1 Torque – 1.6 L Zetec-SE engine
2 Power output – 1.6 L Zetec-SE engine
3 Torque – 1.4 L Zetec-SE engine
4 Power output – 1.4 L Zetec-SE engine

Modifications

- The following modifications have been made to the Zetec-SE engine range:
  - changed oil intake pipe made of plastic
  - increased oil fill capacity for the 1.6L Zetec-SE engine
  - changed cylinder head gasket
  - increased exhaust valve clearance for the 1.6L Zetec-SE engine
  - right-hand engine mounting with integral engine lifting eye and integral generator bracket (one component)
  - knock control by means of knock sensor (KS)
  - changed fuel rail with vertical fuel inlet
  - cylinder head temperature (CHT) sensor in place of the engine coolant temperature (ECT) sensor to measure the engine operating temperature
  - modified coolant outlet housing
  - no EGR system needed to meet the current exhaust emission standards
  - plastic throttle housing with changed TP sensor
  - mass air flow (MAF) sensor in plastic housing with integral intake air temperature (IAT) sensor

NOTE: Refer to Student Information CG 7745/S "Focus" for more detailed information on the changes.

General



7745/59/VF

- The Zetec-E engines used in the Focus come from the "Zetec upgrade" range of engines introduced in the Mondeo and Cougar.
- The 1.8L and 2.0L Zetec-E engines are used in the Focus.

Engine

- Transversely installed 16-valve DOHC engines:
  - 1.8 l cubic capacity developing 85 kW (115 PS)
  - 2.0 l cubic capacity developing 97 kW (130 PS)
- Valve gear with mechanical bucket tappets
- Compression ratio of both engines 10.0 : 1
- Aluminium alloy cylinder head and crankcase reinforcement

Engine management

- EEC V engine management
- Sequential multi-port fuel injection (SFI) with 4-hole fuel injectors with a vertical fuel inlet
- Mass air flow (MAF) sensor with integral intake air temperature (IAT) sensor in new plastic housing
- Plastic throttle housing with progressive venturi
- Cylinder head temperature (CHT) sensor to measure engine operating temperature
- Controlled battery charging

Emission control

- 94/12/EC ('96 EEC exhaust emission standard) without exhaust gas recirculation (EGR)
- 3-way catalytic converter with heated oxygen sensor
- Evaporative emission (EVAP) management system

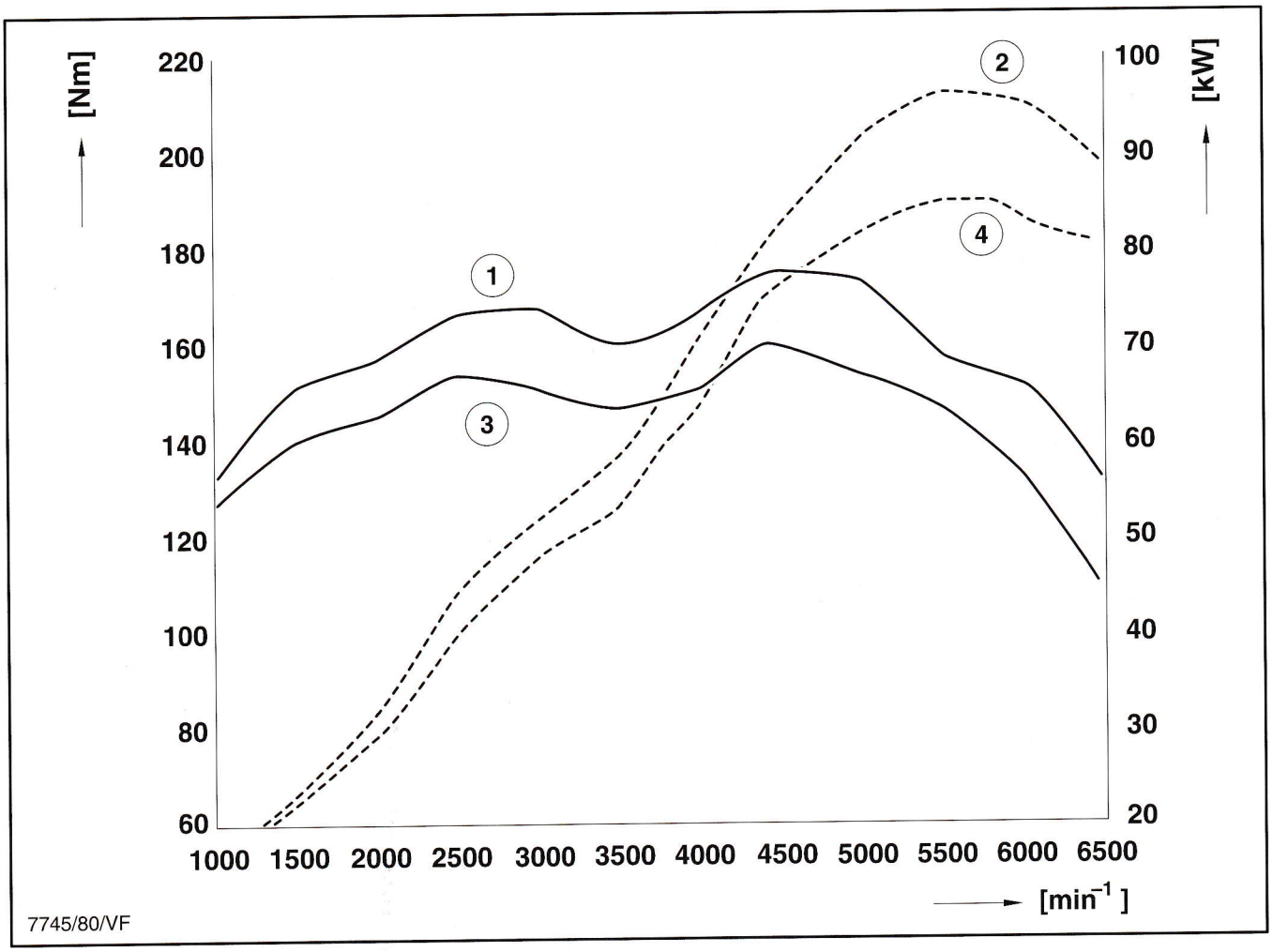
Diagnosis and testing

- Diagnosis and testing through data link connector (DLC) in passenger compartment

Technical data

	1.8L Zetec-E	2.0L Zetec-E
Cubic capacity	1796 cc	1989 cc
Stroke	88.0 mm	88.0 mm
Bore	80.6 mm	84.8 mm
Compression ratio	10.0 : 1	10.0 : 1
Max. power output	84 kW (115 PS) at 5750 rpm	96 kW (130 PS) at 5750 rpm
Max. torque	158 Nm at 3750 rpm	174 Nm at 3750 rpm

Engine power output and torque

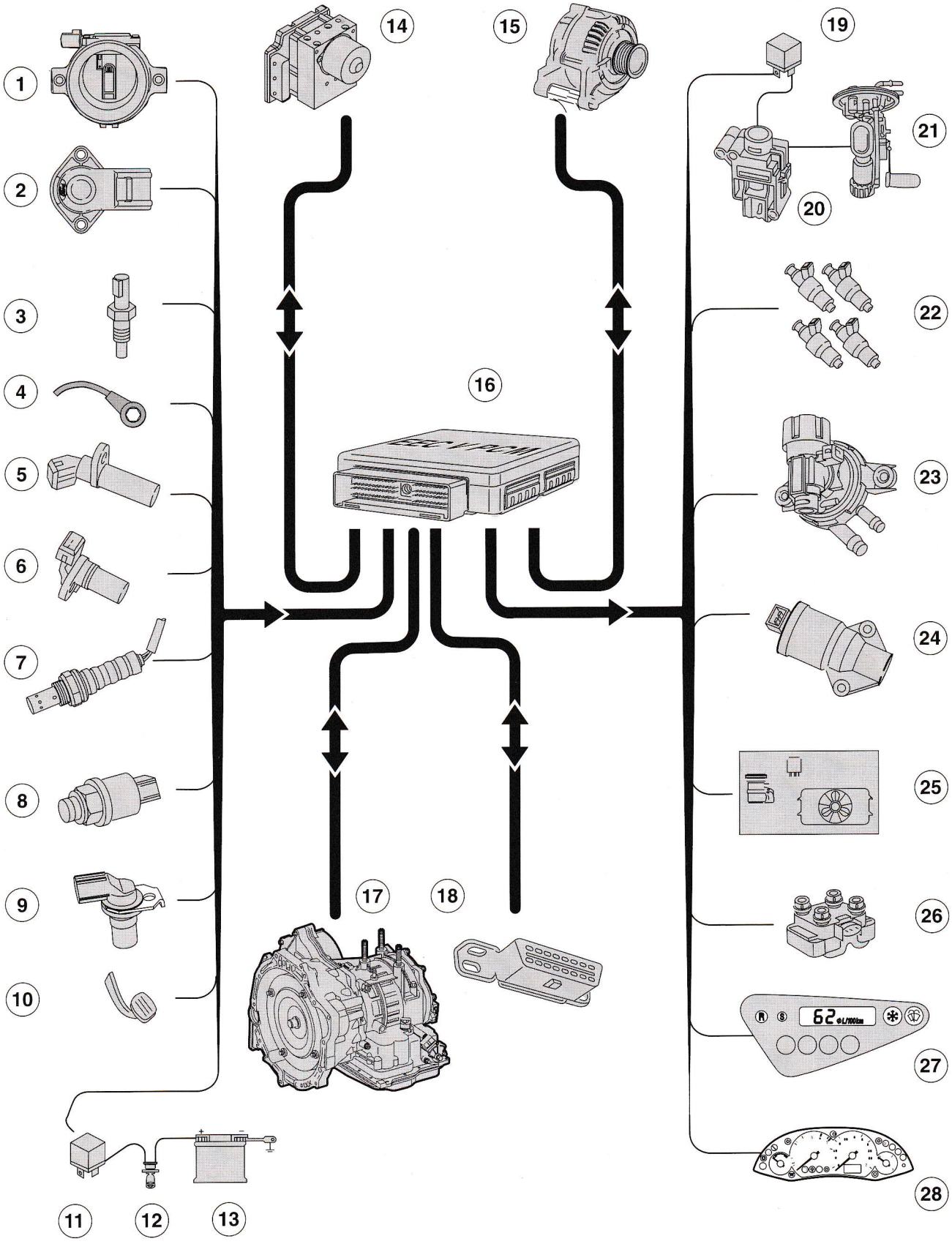


1 Torque – 2.0L Zetec-E engine
2 Power output – 2.0L Zetec-E engine
3 Torque – 1.8L Zetec-E engine
4 Power output – 1.8L Zetec-E engine

Modifications

- The following modifications have been made compared with the engines used in the Mondeo and Cougar:
  - changed oil pan
  - changed oil intake pipe
  - close-coupled tri-metal catalytic converter
  - changed exhaust manifold
  - changed intake manifold
  - no EGR system needed to meet the current exhaust emission standard
  - changed throttle body
  - use of a cylinder head temperature (CHT) sensor instead of an engine coolant temperature (ECT) sensor
  - modified thermostat housing

NOTE: Refer to Student Information CG 7745/S "Focus" for more detailed information on the changes.



7745/67/VF

Key to the illustration opposite

1 Mass air flow (MAF) sensor with integral intake air temperature (IAT) sensor

2 Throttle position (TP) sensor

3 Cylinder head temperature (CHT) sensor

4 Knock sensor (KS) (Zetec-SE engines only)

5 Crankshaft position (CKP) sensor

6 Camshaft position (CMP) sensor

7 Heated oxygen sensor (HO2S)

8 Power steering pressure (PSP) switch

9 Vehicle speed sensor (VSS)

10 Clutch pedal switch

11 Power supply relay

12 Ignition switch

13 Battery

14 Mk 20E-I control unit

15 Generator

16 EEC V PCM with integral PATS

17 Automatic transmission (only 1.6L Zetec-SE)

18 Data link connector (DLC)

19 Fuel pump (FP) relay

20 Inertia fuel shutoff (IFS)

21 Fuel pump (FP)

22 Fuel injectors

23 EVAP canister purge solenoid valve

24 Idle air control (IAC) valve

25 Air conditioning compressor clutch/cooling fan circuit

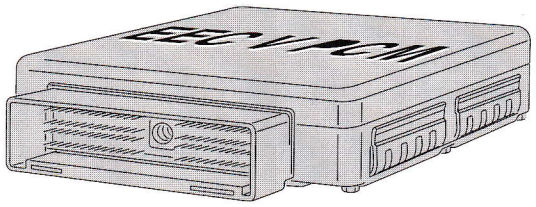
26 Electronic ignition (EI) coil

27 Multifunction display

28 Instrument cluster

EEC V powertrain control module (PCM)

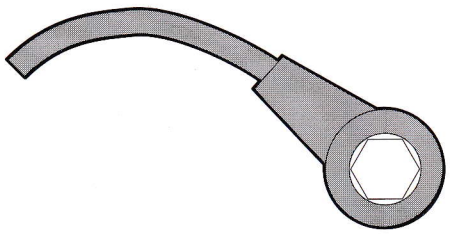
- Zetec-SE and Zetec-E engines are only used in the Focus with 60-pin EEC V powertrain control modules (PCM).
- The exception is the 1.6L Zetec-SE engine when combined with the 4F27E automatic transmission which has a 104-pin EEC V PCM since this also incorporates the transmission control.



7745/68/VF

Knock sensor (KS) (Zetec-SE engines only)

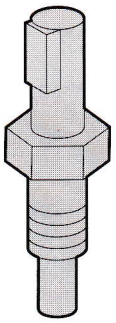
- The high compression ratio of the Zetec-SE engines (11.0 : 1) can lead to knocking depending on engine load and speed.
- Therefore, a knock control system was introduced to prevent engine damage.



7745/81/VF

CHT sensor

- The CHT sensor measures the temperature of the cylinder head directly. The CHT sensor eliminates the need for an engine coolant temperature (ECT) sensor as the engine temperature is indicated directly.



7745/82/VF

Engine overheating safety function

- The use of a cylinder head temperature (CHT) sensor has made it possible to incorporate a safety function in the engine management system to protect against engine damage due to the engine overheating in the event of loss of coolant.

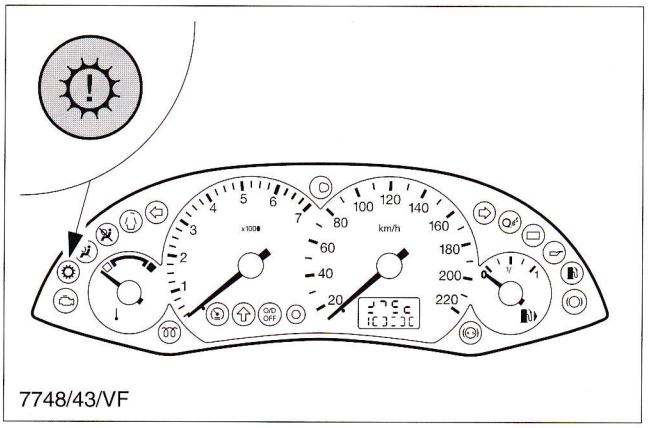
- If the CHT sensor finds that the cylinder head temperature is too high, the PCM switches to the "engine overheating safety function" mode. In this mode

  – initially the powertrain warning indicator in the instrument cluster is illuminated.

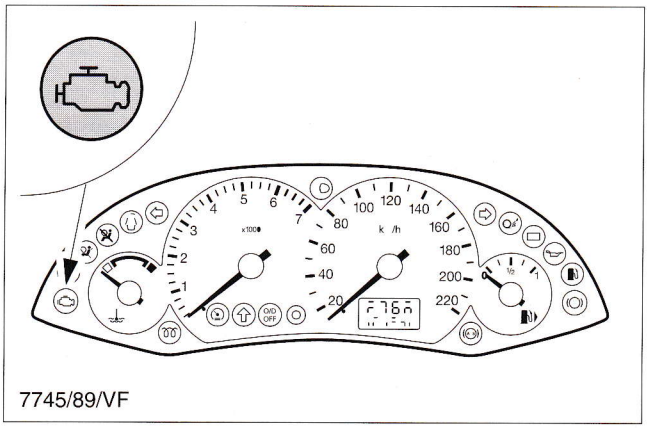
  – if the temperature continues rising, the PCM switches on the engine management warning indicator in the instrument cluster and systematically deactivates cylinders by shutting off the fuel supply. The driver will notice severe bucking and power loss.

  – if the temperature continues rising, a flashing powertrain warning indicator indicates that the engine will stop completely after 30 seconds.

NOTE: Refer to Student Information CG 7745/S "Focus" for more detailed information on the engine management components.



Powertrain warning indicator



Engine management system warning indicator

Tick the correct answer or fill in the gaps.

1. With which engine is the 4F27E automatic transmission combined in the Focus?

- ☐ a) 1.4L Zetec-SE engine
- ☐ b) 1.6L Zetec-SE engine
- ☐ c) 1.8L Zetec-E engine
- ☐ d) 2.0L Zetec-E engine

2. With which engine is the MTX 75 manual transmission combined in the Focus?

- ☐ a) 1.4L Zetec-SE engine
- ☐ b) 1.6L Zetec-SE engine
- ☐ c) 1.8L Zetec-E engine
- ☐ d) 2.0L Zetec-E engine

3. The high _____ makes it necessary to have the knock sensor with the Zetec-SE engines in the Focus.

4. Which sensor becomes superfluous through the introduction of the CHT sensor?

- ☐ a) ECT sensor
- ☐ b) MAF sensor
- ☐ c) Heated oxygen sensor
- ☐ d) IAT sensor

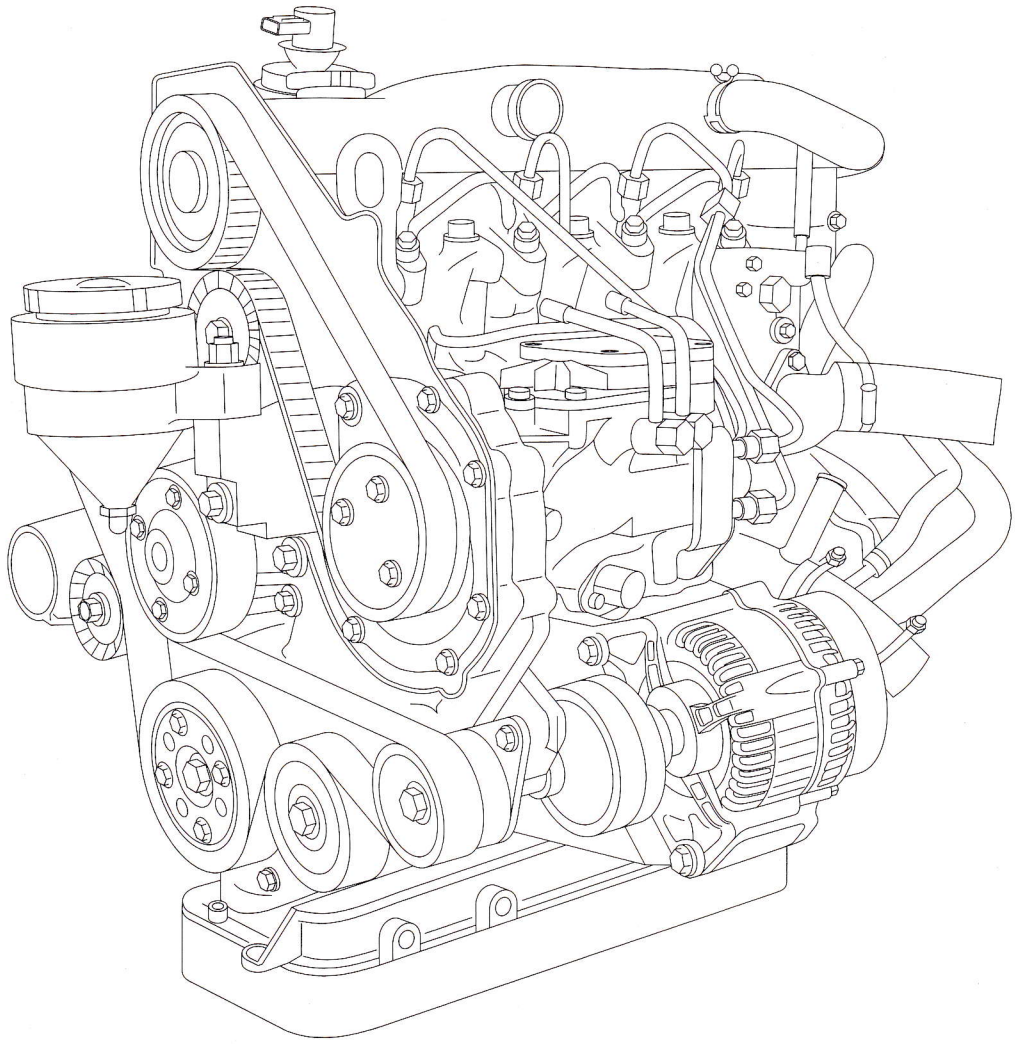
5. On the basis of what information does the PCM switch to the 'engine overheating safety function' mode?

- ☐ a) Engine management warning lamp illuminated
- ☐ b) Intake air temperature too high
- ☐ c) Engine coolant level too low
- ☐ d) Cylinder head temperature too high

Objectives

On completing this lesson, you will be able to

- describe the features of the 1.8L Endura-DI engine,
- describe the new/changed components of the engine management system used with the 1.8L Endura-DI engine,
- explain the main features of the Bosch VP-30 fuel injection pump.



7749/10/VF

Engine

- Transversely installed 1.8L 4-cylinder direct injection turbocharged diesel engine
- Garrett GT15 turbocharger with intercooler
- Camshaft driven from the fuel injection pump by a toothed belt
- Fuel injection pump driven from the crankshaft by a twin chain
- Fully electronic Bosch VP-30 distributor-type fuel injection pump
- 5-hole fuel injectors with two-spring nozzle holder
- G-rotor oil pump mounted on the crankshaft

Engine management

- EEC V engine management (controlling fuelling, fuel injection timing, exhaust gas recirculation)
- PCM with 104 pins and integral passive anti-theft system (PATS)
- New cylinder head temperature (CHT) sensor
- Controlled battery charging

Emission control

- 96 EEC exhaust emission standard
- Electronically controlled exhaust gas recirculation (EGR)
- Oxidation catalyst

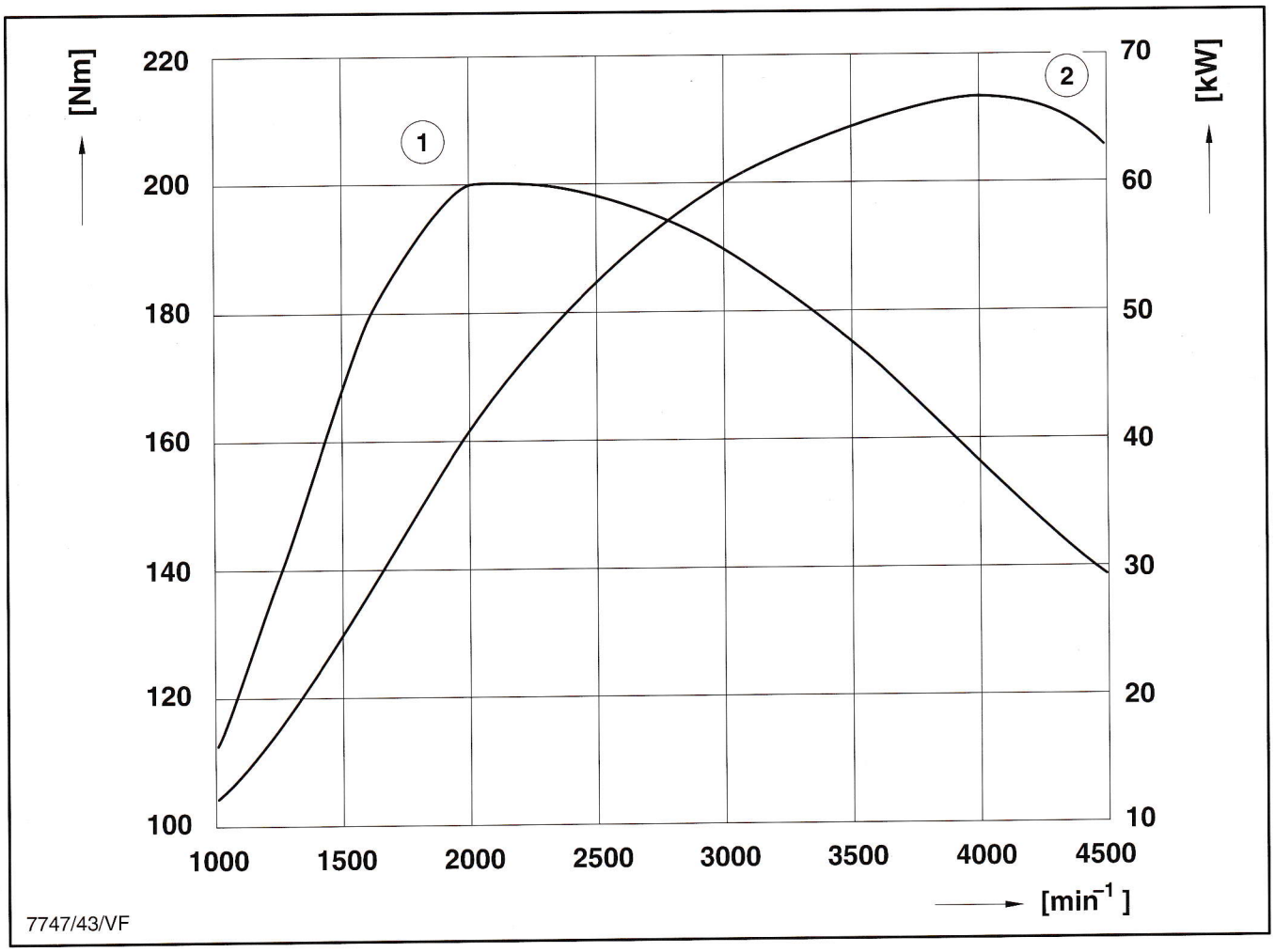
Diagnosis and testing

- Data link connector (DLC) for FDS 2000

Technical data

Engine	Data
Cubic capacity	1753 cc
Stroke	82 mm
Bore	82.5 mm
Stroke/bore ratio	0.994
Max. power output (DIN/EEC)	66 kW at 4000 rpm
Max. torque (DIN/EEC)	200 Nm between 2000 and 2400 rpm
Compression ratio	19.4 : 1

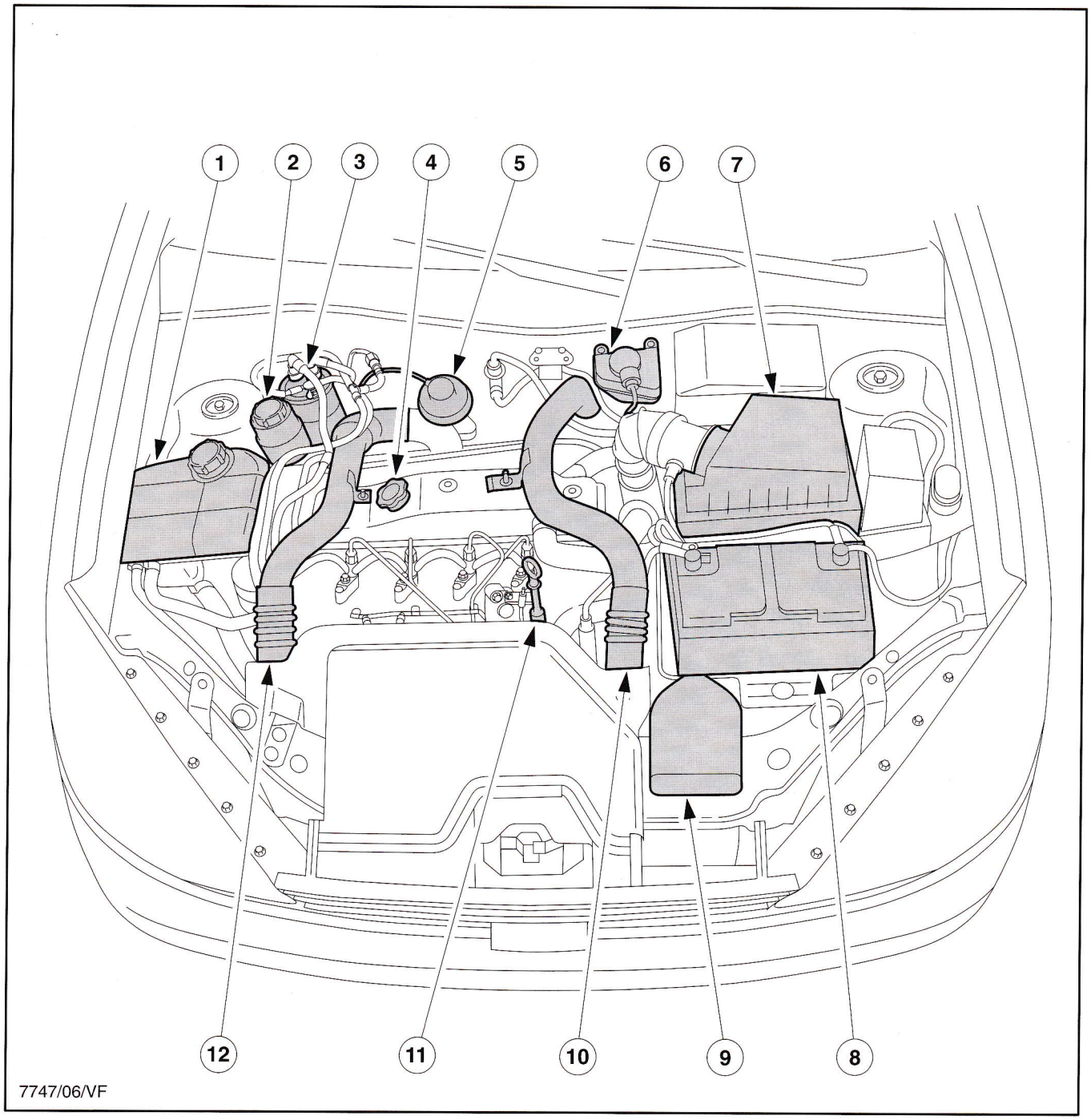
Engine power output and torque



1 Torque curve

2 Power output curve

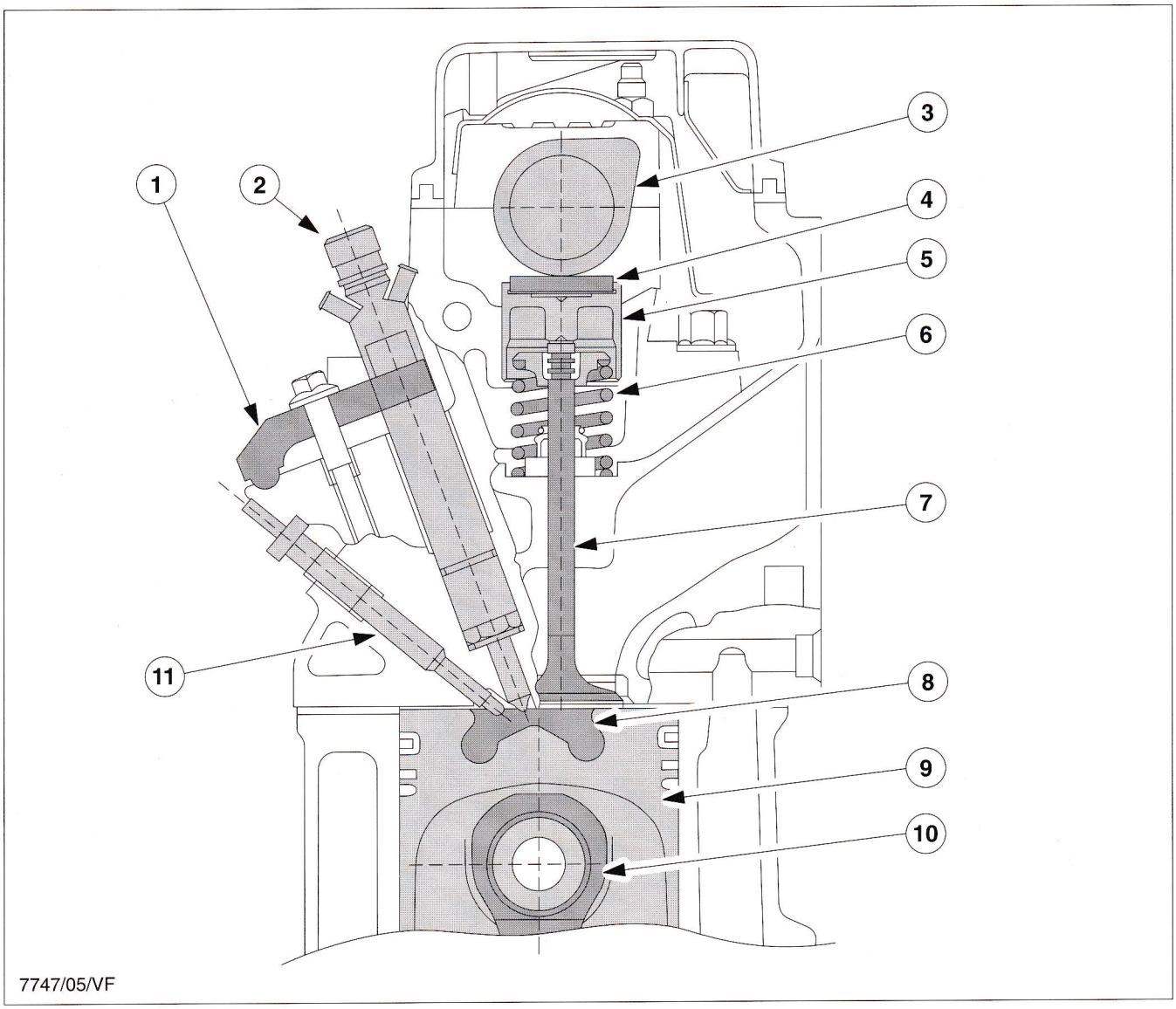
Under the hood



1 Coolant expansion tank
2 Power steering fluid reservoir
3 Fuel filter
4 Oil filler cap
5 EGR valve
6 Brake fluid reservoir
7 Air cleaner housing
8 Battery
9 Air intake
10 Air ducting from turbocharger to intercooler
11 Oil dipstick tube
12 Air ducting from intercooler to intake manifold

Valve gear

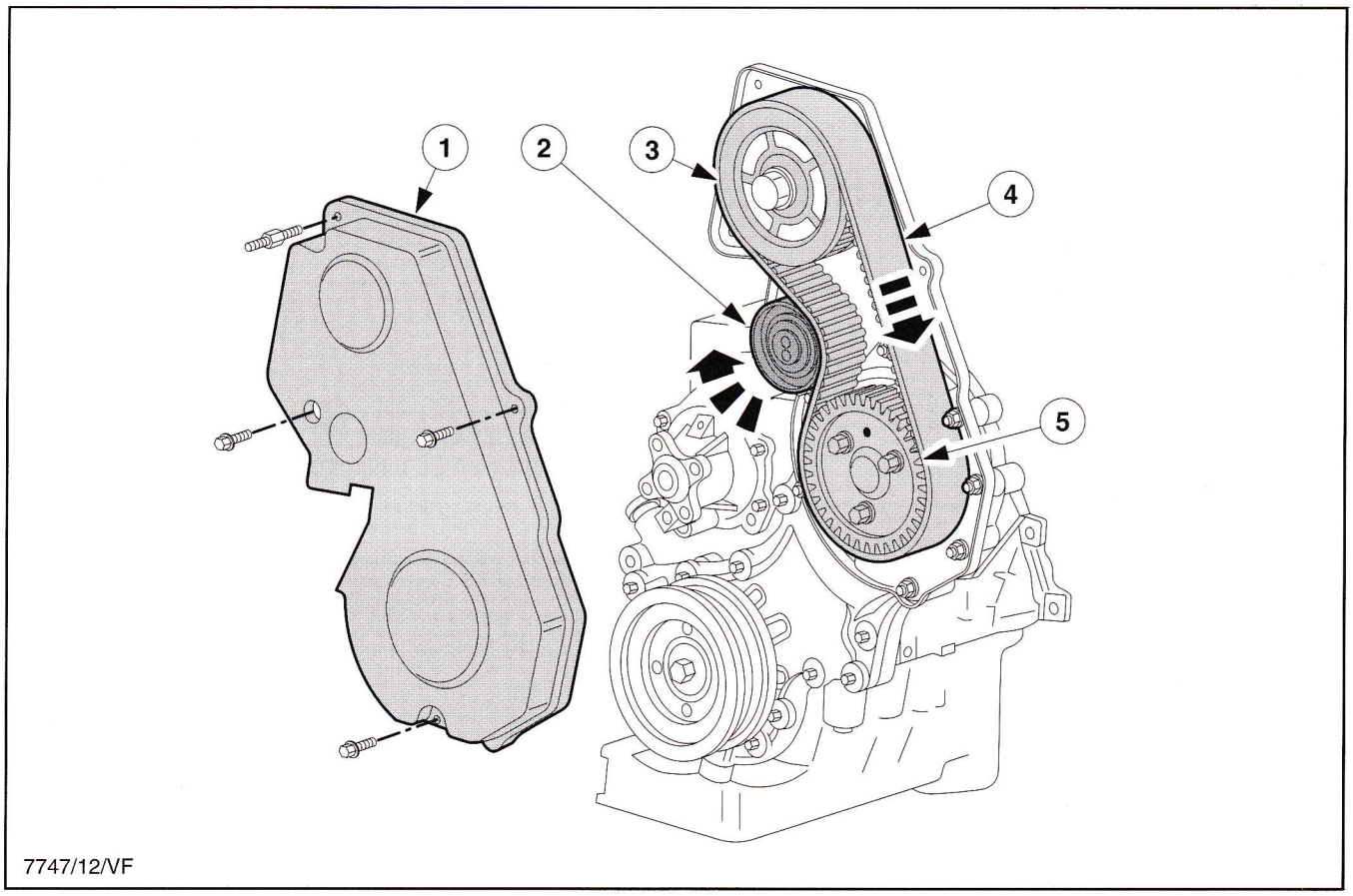
- The cylinder head is made of cast iron and based on the head of the Endura-DE. It accommodates the pencil-type glow plugs, fuel injectors and valve gear.
- The positioning of the pencil-type glow plugs and fuel injectors is new due to the recess in the piston crown.
- The fuel injectors are a push-fit and held in position by a retainer.



1 Retainer for fuel injector
2 5-hole fuel injector
3 Camshaft
4 Shim
5 Bucket tappet
6 Valve spring
7 Valve
8 Recess in piston
9 Piston
10 Connecting rod
11 Pencil-type glow plug

Camshaft drive

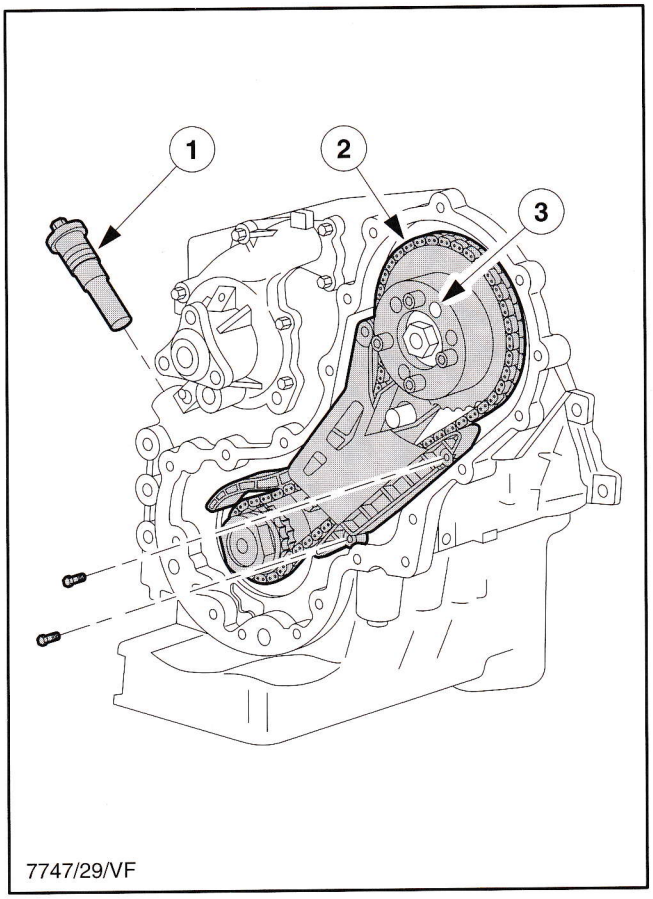
- The camshaft drive has been completely redesigned on the Endura-DI. The camshaft is driven from the fuel injection pump by a toothed belt.
- The toothed belt can only be installed one way round. It must be installed with the arrow pointing in the normal direction of rotation of the engine.
- The camshaft timing pulley is secured on the camshaft with a tapered seat. A special tool is used to remove it.



1 Outer timing belt cover
2 Timing belt tensioner
3 Camshaft timing pulley
4 Timing belt
5 Timing belt driving pulley

Fuel injection pump drive

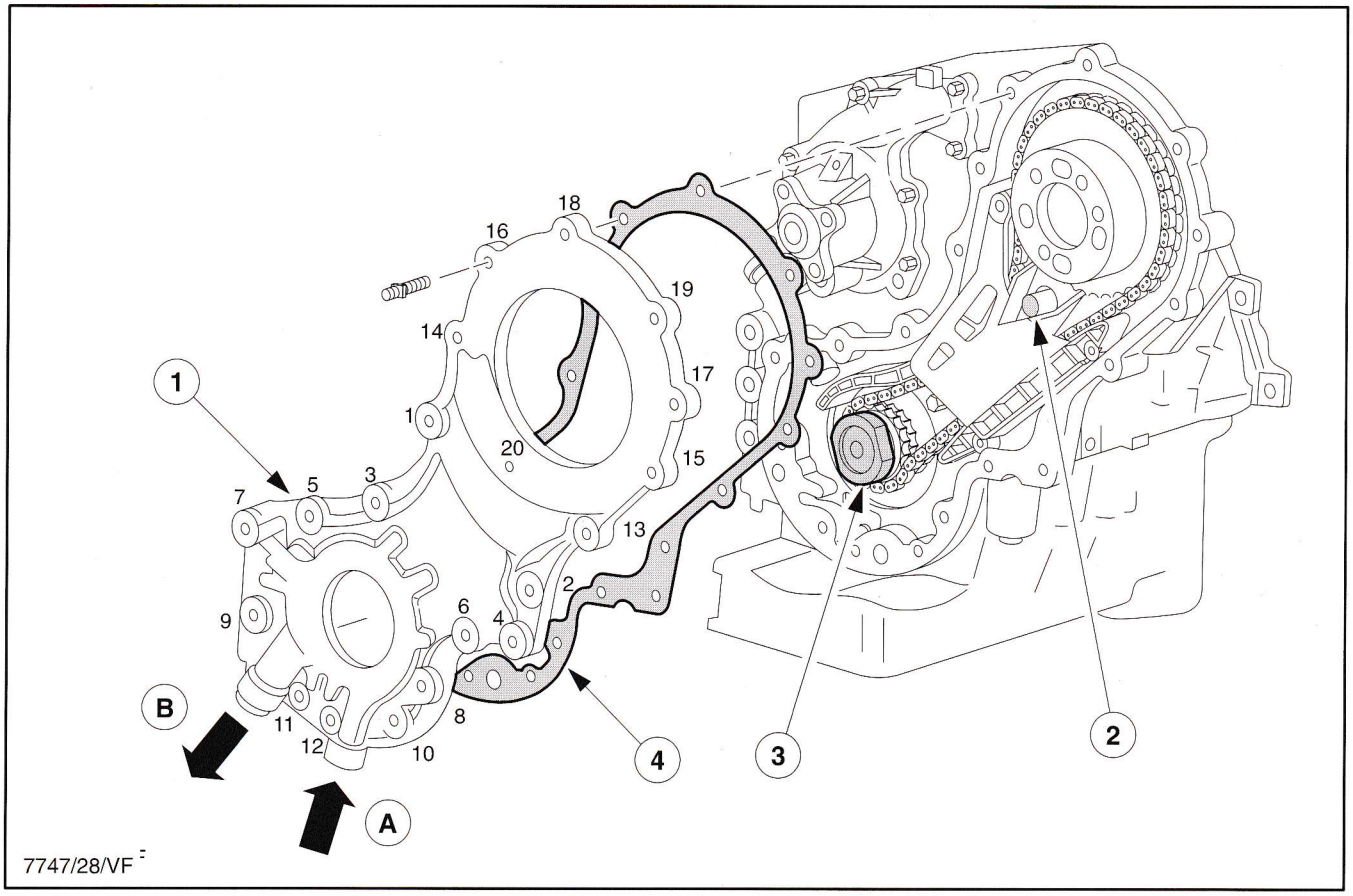
- The fuel injection pump is driven from the crankshaft by a chain drive with a ratio of 2 : 1.
- The chain drive consists of two chains (twin chains) which run next to one another offset by half a link. The twin chains are connected to one another.
- The chain drive can only be changed as a complete unit (sprockets, guide and twin chain). Components cannot be changed individually.
- The chain is tensioned by means of a hydraulic chain tensioner which is connected to the engine oil circuit.
- There is a hole in the fuel injection pump sprocket to set the timing.



1 Hydraulic chain tensioner
2 Chain drive unit
3 Hole for setting timing

Oil pump

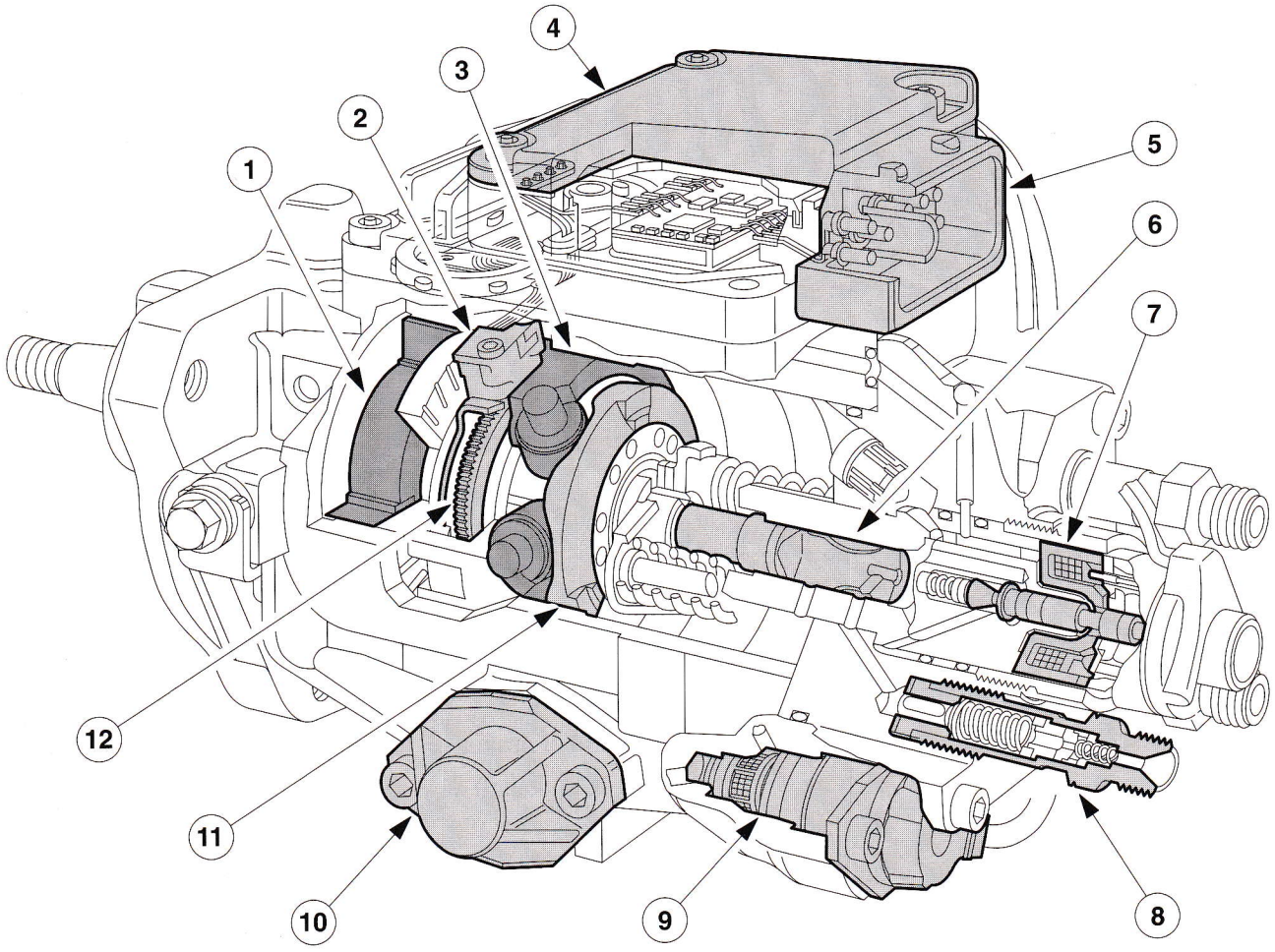
- The oil pump is a G-rotor pump. It is driven directly from the crankshaft.
- A new special tool must be used to center the oil pump when installing it.



A Suction side
B Pressure side
1 Oil pump
2 Gasket
3 Steel gasket
4 Crankshaft

Bosch VP-30 distributor-type fuel injection pump

- The VP-30 distributor-type fuel injection pump is based on the fuel injection pump used on the Transit and Scorpio.
- The VP-30 meets the following requirements optimally:
  - low emissions
  - increased economy and improved driveability
  - precision and flexibility as regards engine adaptation and engine management



7747/15/VF

1 Vane pump
2 Rotation angle sensor
3 Roller ring
4 Pump control unit (PCU)
5 Connection for plug
6 Axial piston
7 High-pressure solenoid valve
8 Pressure valve
9 Fuel injection timing solenoid (FITS) valve
10 Fuel injection timing device
11 Cam ring
12 Pulse rotor

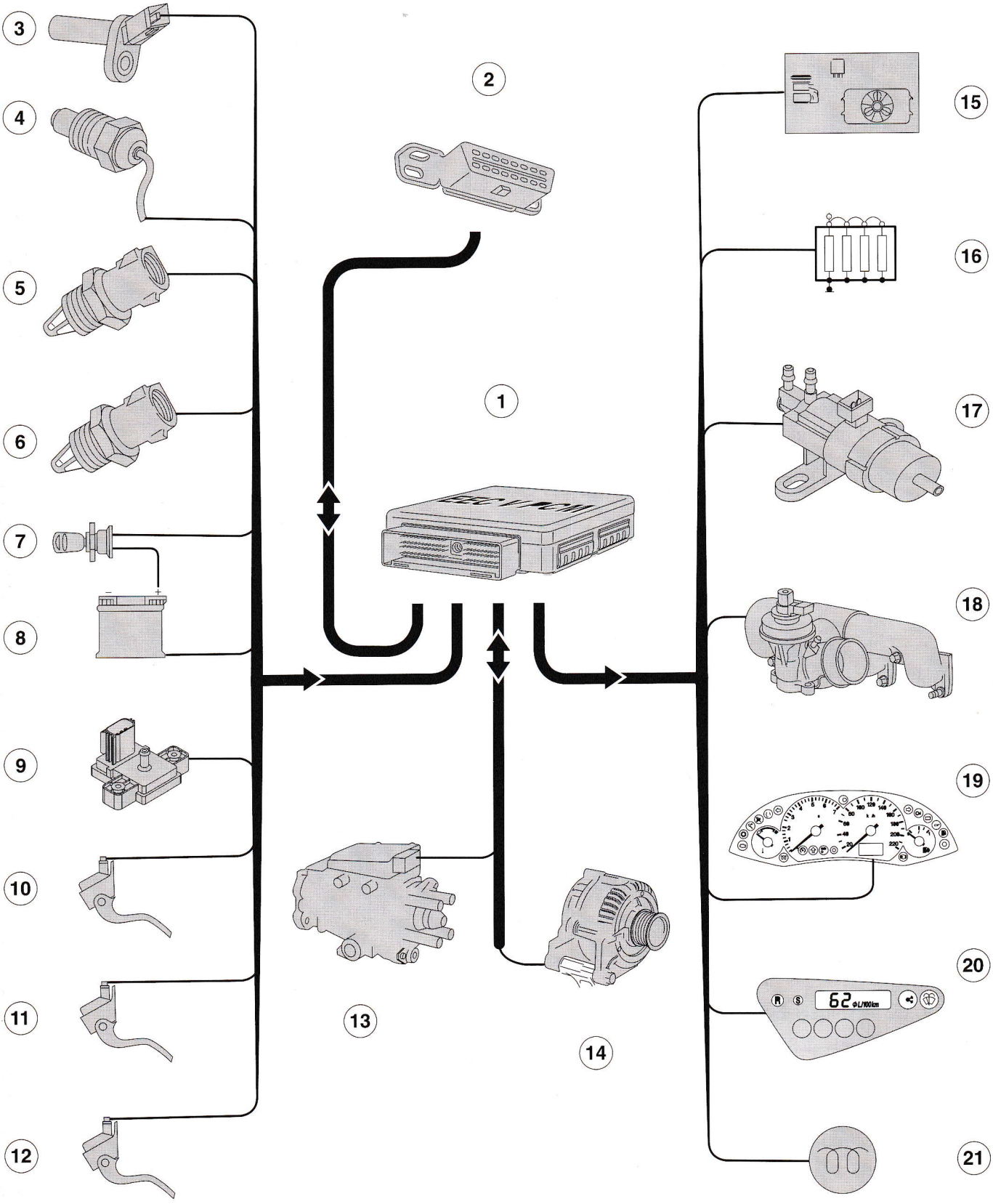
Bosch VP-30 distributor-type fuel injection pump (continued)

- The VP-30 fuel injection pump is a very compact distributor-type fuel injection pump controlled by a high-pressure solenoid valve.
- The high pressure is produced mechanically with an axial piston as in earlier Bosch fuel injection pumps.

- The following components have been **eliminated** in the VP-30:
  - the control slide which was responsible for the quantity of fuel injected
  - the mechanical link from the accelerator pedal to the fuel injection pump
  - the electromagnetic shut-off valve
  - the needle lift sensor (NLS)

- The following components are **new** in the VP-30:
  - the pulse rotor and rotation angle sensor
  - the high-pressure solenoid valve for the quantity of fuel injected and for the fuel shut-off
  - the fuel injection timing solenoid (FITS) valve for the point of injection and duration of injection
  - the pump control unit

NOTE: Refer to Student Information CG 7747/S "Focus – 1.8L Endura-DI Turbocharged Intercooled Diesel Engine" for more detailed information on the VP-30 fuel injection pump.



7747/56/VF

Key to the illustration opposite

1 EEC V powertrain control module (PCM) with 104 pins and integral PATS

2 Data link connector (DLC)

3 Crankshaft position (CKP) sensor

4 Cylinder head temperature (CHT) sensor

5 Intake air temperature (IAT) sensor in intercooler

6 Intake air temperature (IAT) sensor in front of turbocharger

7 Ignition switch

8 Battery

9 Manifold absolute pressure (MAP) sensor

10 Accelerator pedal (AP) sensor

11 Clutch pedal position (CPP) sensor

12 Stop light switch

13 Bosch VP-30 distributor-type fuel injection pump and pump control unit (PCU)

14 Controlled battery charging (smart charging)

15 Air conditioning (A/C) controller

16 Pre-heat module

17 EGR vacuum regulator (EVR)

18 Exhaust gas recirculation (EGR) valve with EGR position sensor

19 Trip computer

20 Instrument cluster

21 Glow plug indicator lamp

Tick the correct answer or fill in the gaps.

1. How much is the maximum torque of the 1.8L Endura-DI and in what engine speed range is it produced?

- ☐ a) 180 Nm – between 1800 rpm and 2000 rpm
- ☐ b) 200 Nm – between 1800 rpm and 2000 rpm
- ☐ c) 200 Nm – between 2000 rpm and 2400 rpm
- ☐ d) 180 Nm – between 2000 rpm and 2400 rpm

2. Which fuel injection pump is used with the 1.8L Endura-DI?

- ☐ a) Lucas mechanical distributor-type fuel injection pump with a radial piston
- ☐ b) Bosch fully electronic distributor-type fuel injection pump with an axial piston
- ☐ c) Bosch mechanical distributor-type fuel injection pump with an axial piston
- ☐ d) Bosch fully electronic distributor-type fuel injection pump with a radial piston

3. Which statement is correct?

- ☐ a) The 5-hole fuel injector is a push-fit in the cylinder head.
- ☐ b) The 3-hole fuel injector is screwed into the cylinder head.
- ☐ c) The 5-hole fuel injector is screwed into the cylinder head.
- ☐ d) The 3-hole fuel injector is a push-fit in the cylinder head.

4. Which powertrain control module (PCM) is used with the 1.8L Endura-DI?

- ☐ a) EDC with 60 pins
- ☐ b) EEC IV with 104 pins
- ☐ c) EEC V with 104 pins
- ☐ d) EEC V with 60 pins

5. The camshaft is driven from the fuel injection pump by

- ☐ a) a toothed belt.
- ☐ b) a single chain.
- ☐ c) a twin chain.
- ☐ d) gears.

Objectives

On completing this lesson, you will be able to

- describe the new features of the iB5 manual transmission in the Focus,
- describe the new features of the MTX 75 manual transmission in the Focus,
- explain the main features of the 4F27E automatic transmission.

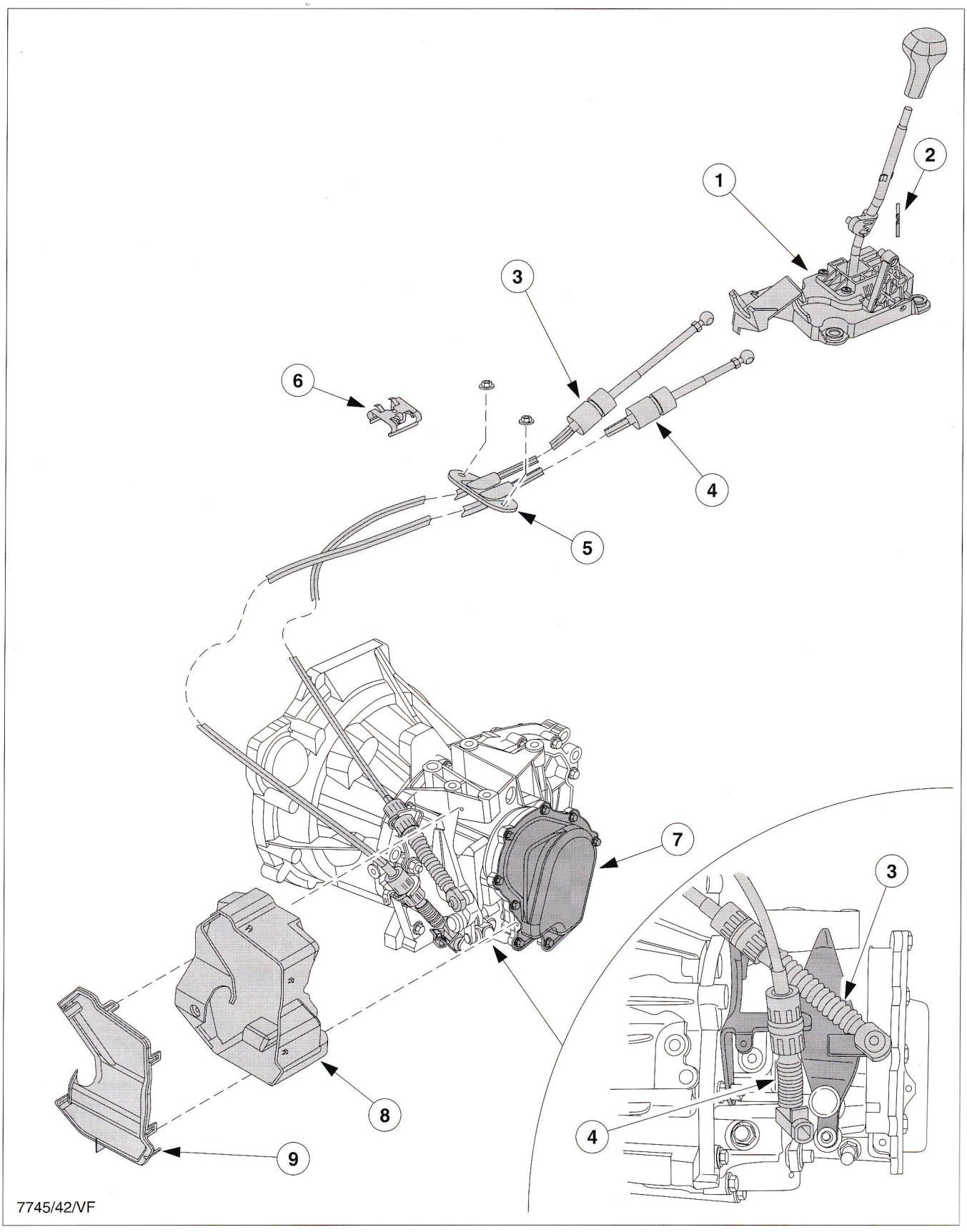
Changes to the iB5 manual transmission

- The Focus has an iB5 transmission with a cable-operated shift mechanism in place of the shift rod-operated mechanism used until now.
- The cables are color-coded:
  - shift cable – white
  - selector cable – black
- The internal shift mechanism has been changed because of the cable mechanism.
- A liquid sealer has taken the place of the gasket between the two housing halves.
- A liquid sealer has also taken the place of the cork gasket for the 5th gear blanking cover. A new black 5th gear blanking cover is used with the introduction of the liquid sealer.
- 1st and 2nd gears have double synchronisers.
- Vehicles with petrol engines are equipped with a VSS sensor (Hall sensor) like the '98 model year Mondeo.

NOTE: Refer to Student Information CG 7745/S "Focus" for more detailed information on the changes to the iB5 manual transmission with a bearing on service.

Key to the illustration opposite

1 External shift mechanism
2 3 mm drill bit (required for adjustment procedure)
3 Shift cable
4 Selector cable
5 Body seal
6 Cable retaining clip
7 5th gear blanking cover
8 Cable housing cover
9 Cable housing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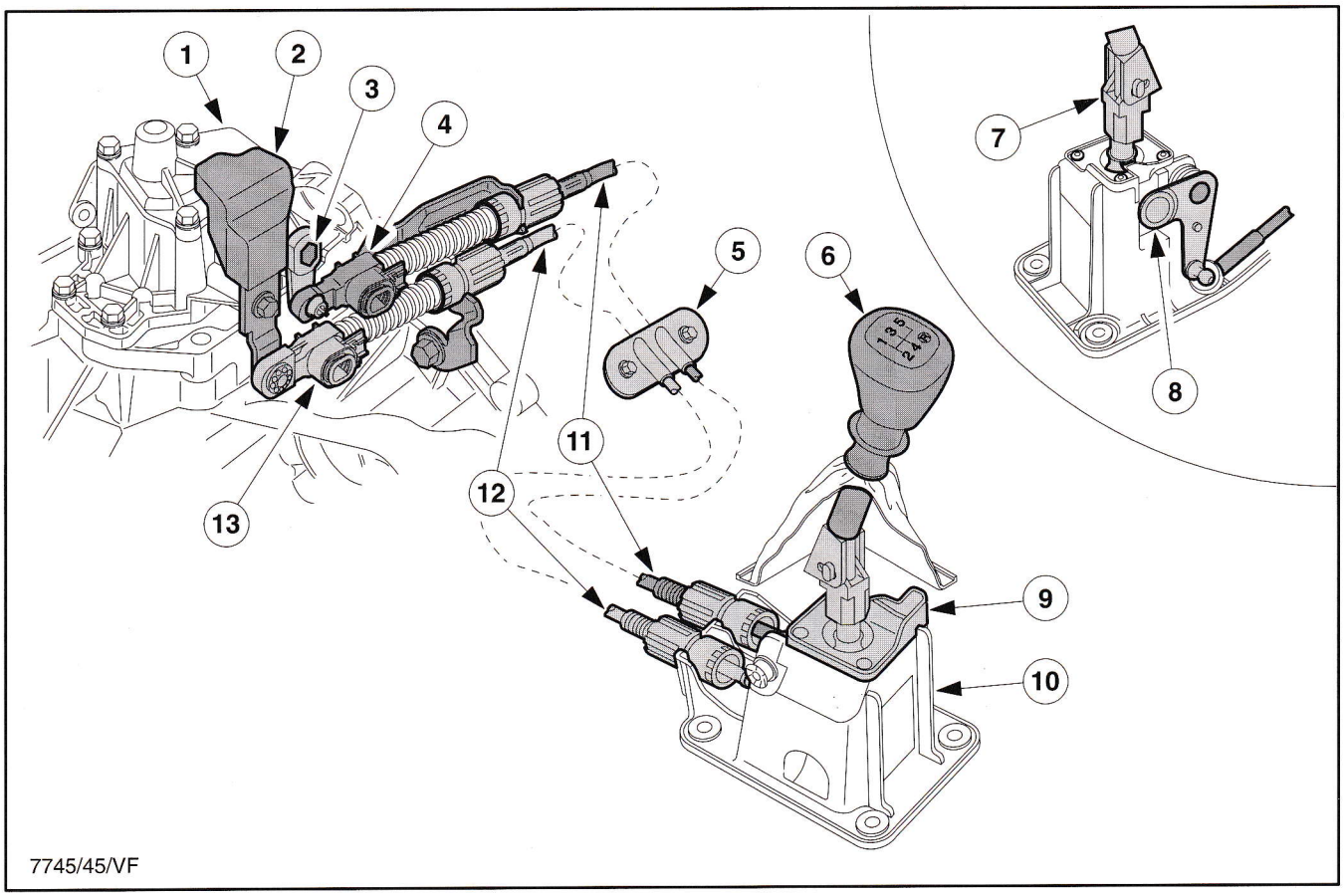
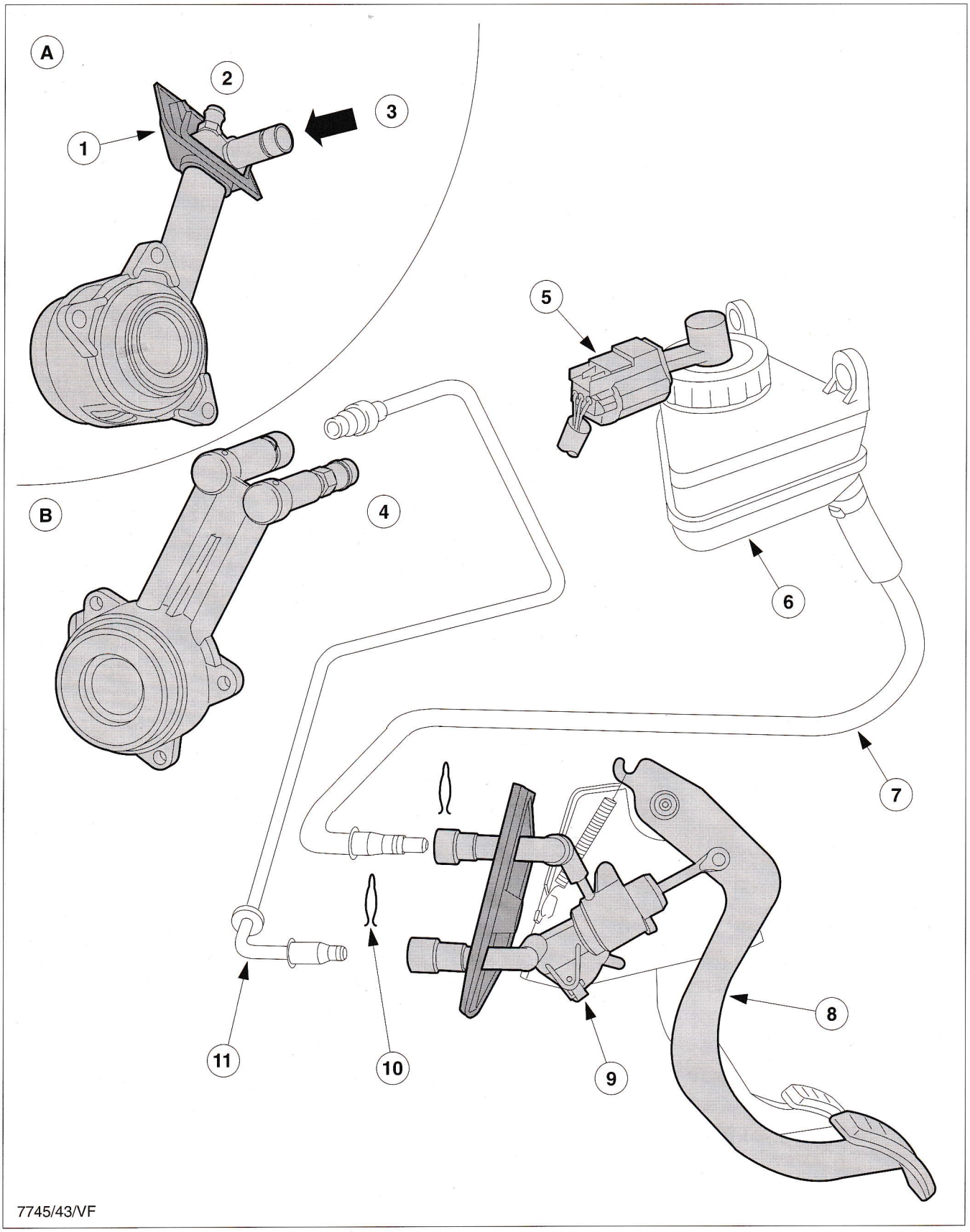
7745/42/VF

Changes to the MTX-75 manual transmission

- The MTX-75 transmission from the Mondeo '97 with the cable operated shift mechanism is used in the Focus instead of the MTX-75 transmission with the shift rod linkage used until now.
- Vehicles with petrol engines are equipped with a VSS sensor (Hall sensor) like the 1998 model year Mondeo.
- The external shift mechanism shown in the diagram is made of plastic and is used from the 1999 1/4 model year onwards. The first vehicles have the external shift mechanism from the Mondeo '97.
- The selector cable is colour-coded black, the shift cable colour-coded white. The end fittings of the cables are of different types to avoid confusion during installation.



1 Internal shift mechanism housing
2 Damper weight
3 Selector lever shaft
4 Adjusting mechanism for selector cable
5 Body seal
6 Shift lever
7 Reverse gear lock
8 Angled lever
9 Reverse gear locking device
10 External shift mechanism housing
11 Selector cable (black)
12 Shift cable (white)
13 Adjusting mechanism for shift cable


A
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7745/43/VF

Key to the illustration opposite

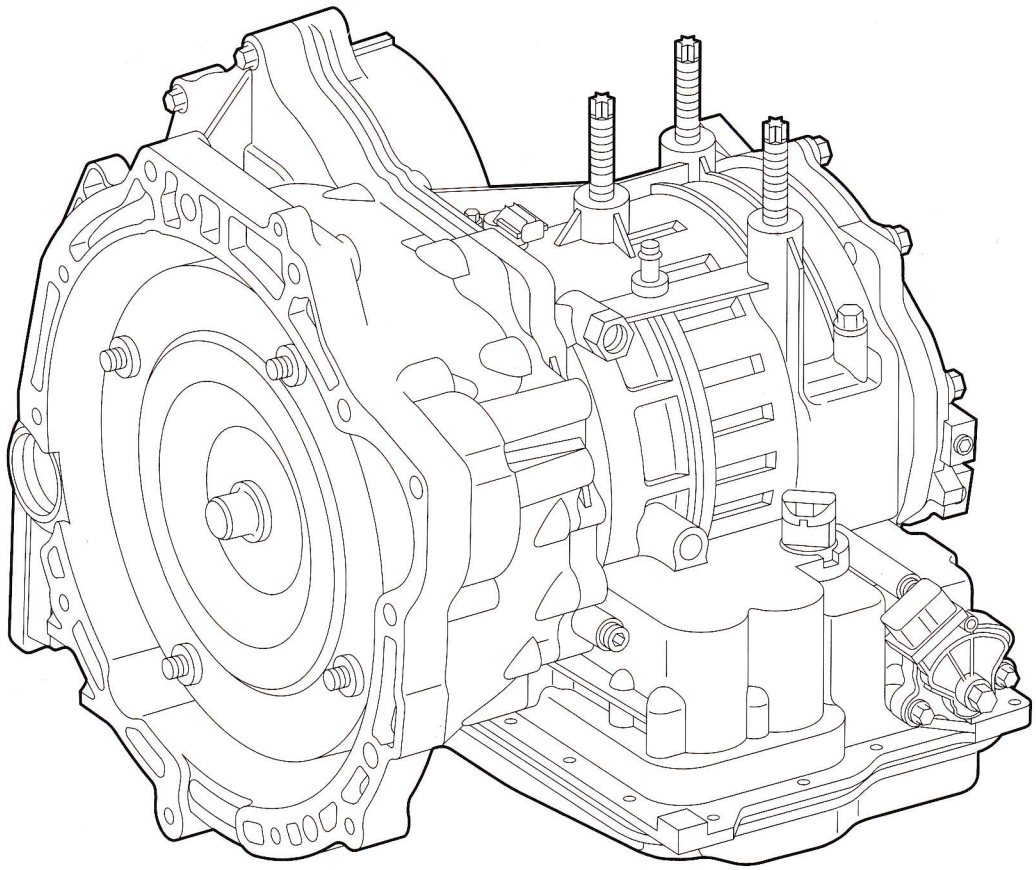
A MTX-75 transmission – slave cylinder with integral release bearing

B iB5 transmission – slave cylinder with integral release bearing

1 Plastic boot
2 Venting connection
3 Feed
4 Venting connection
5 Brake fluid level switch
6 Brake fluid reservoir
7 Top-up pipe
8 Clutch pedal
9 Master cylinder
10 Retaining clip
11 Pressure pipe

General

- Both transmissions, the MTX-75 and the iB5, are equipped with a hydraulic clutch mechanism.
- The master cylinder is the **same** on both systems. The master cylinder has plastic extensions to make it easier to install the pipes. The pipes can be disconnected from the engine compartment by pulling out the retaining clip.
- The slave cylinders are **different** due to the different locations of the input shaft oil seals and the different front transmission housing halves on the MTX-75 and iB5 transmissions.



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Transmission design

- 4-speed automatic transmission designed for front wheel drive vehicles
- Two single planetary gear sets connected one behind the other
- The components of the planetary gear sets are driven or locked hydraulically by means of multiplate clutches and brakes, a brake band and a roller one-way clutch
- Intermediate gear stage and final drive assembly incorporated in the transmission housing
- Electronically controlled, hydraulically closed torque converter lock-up clutch
- Stator made of synthetic resin (to reduce weight)

Gear ratios in the individual transmission ranges

- 1st gear: 2.816 : 1
- 2nd gear: 1.498 : 1
- 3rd gear: 1.000 : 1
- 4th gear: 0.726 : 1
- Reverse gear: 2.649 : 1

Transmission control

- Electronic synchronous shift control (ESSC)
- Transmission control incorporated in the EEC V PCM
- Overdrive (O/D) switch to select and deselect 4th gear

Diagnosis and testing

- Diagnosis and testing with FDS 2000 through the data link connector (DLC) in the passenger compartment

General

- The automatic transmission used in the Focus is a new development.
- It is a fully automatic, electronically controlled 4-speed transmission designed for front wheel drive vehicles.
- It is designated for short 4F27E which means:

  4 – 4-speed transmission

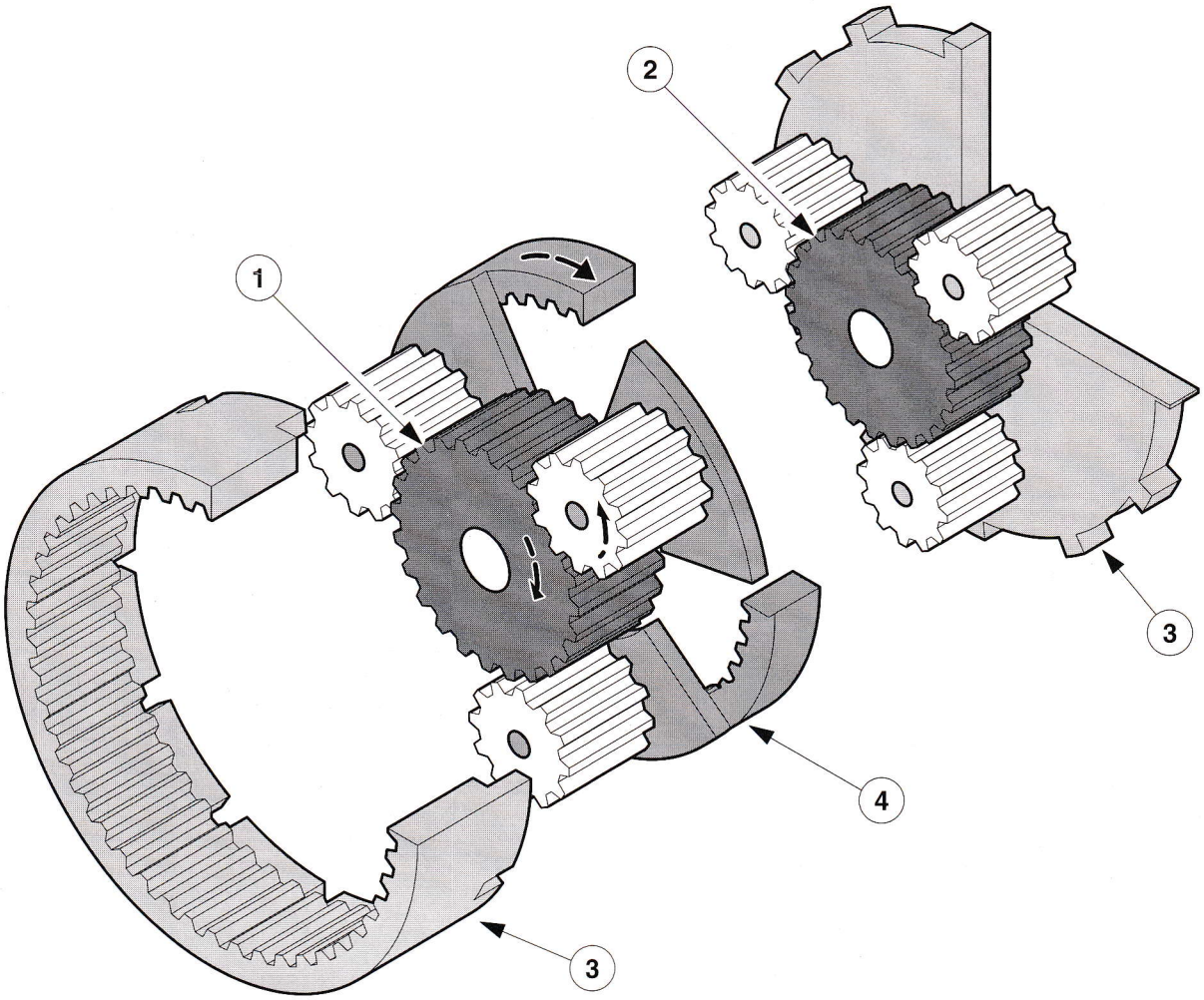
  F – front wheel drive

  27 – maximum input torque after the torque converter: 270 lb ft (365 Nm)

  E – fully electronic control

- Mazda in Japan developed the transmission specifically for use in the Focus. It is produced by Ford in Van Dyke, Michigan (USA).
- From the 1999 3/4 MY it will initially be available only in conjunction with the 1.6L Zetec-SE engine.
- The individual ratios are produced by two planetary gear sets connected one behind the other.
- The individual components of the planetary gear sets are driven or locked by means of three multi-plate clutches, one multiplate brake, one brake band and a roller one-way clutch.
- The torque is transmitted to the final drive assembly through an intermediate gear stage.
- The transmission fluid is designed to last the life of the transmission and must not be changed.
- The electrical and hydraulic functions are carried out by a 104-pin EEC V powertrain control module.
- With the shift lever the driver has a choice of "P", "R" and "N" plus the transmission ranges "1", "2" and "D".
- In transmission range "D" it is also possible to prevent the transmission shifting into 4th gear or to downshift into 3rd gear by pressing an O/D switch on the selector lever.
- To minimise fuel consumption, the PCM closes the converter lock-up clutch in 3rd and 4th gears depending on the throttle position and vehicle speed.
- The transmission has an electronic synchronous shift control (ESSC). This guarantees excellent shifting over the entire life of the transmission.
- If important electrical components fail, a hydraulic emergency operating program guarantees continued limited operation.
- The transmission can be tested with FDS 2000 through the data link connector (DLC) in the passenger compartment.

Planetary gear sets



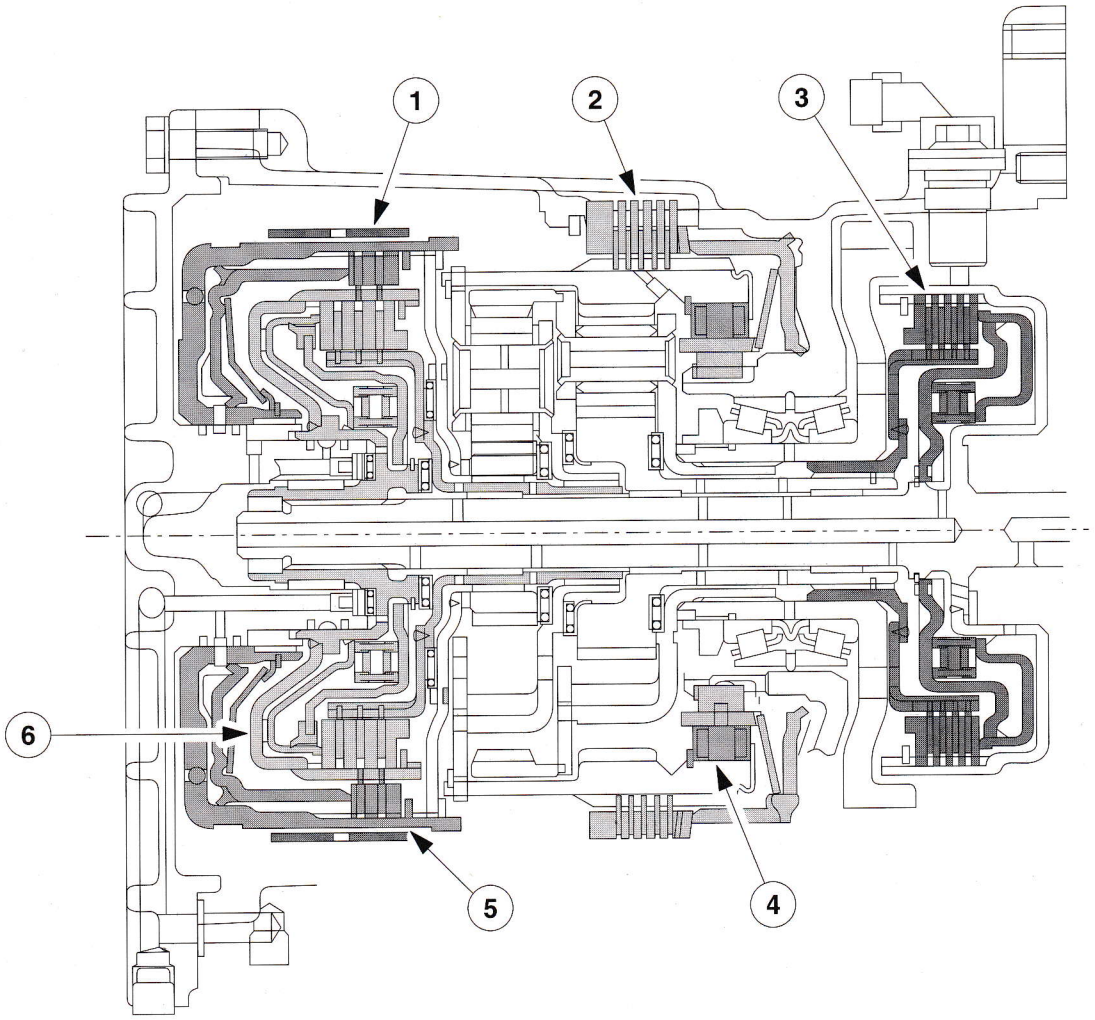
7748/11/VF

Illustration of principle

1 Sun wheel (1st set)
2 Sun wheel (2nd set)
3 Annulus (1st set) and planet carrier (2nd set)
4 Planet carrier (1st set) and annulus (2nd set)

- The individual gears are shifted by means of two single planetary gear sets connected one behind the other. The following fixed connections exist between the planetary gear sets:
  - planet carrier (1st set) – annulus (2nd set)
  - planet carrier (2nd set) – annulus (1st set)
- At the output end drive always passes through the planet carrier of the first planetary gear set to the primary gear of the intermediate gear stage.

Clutches and brakes

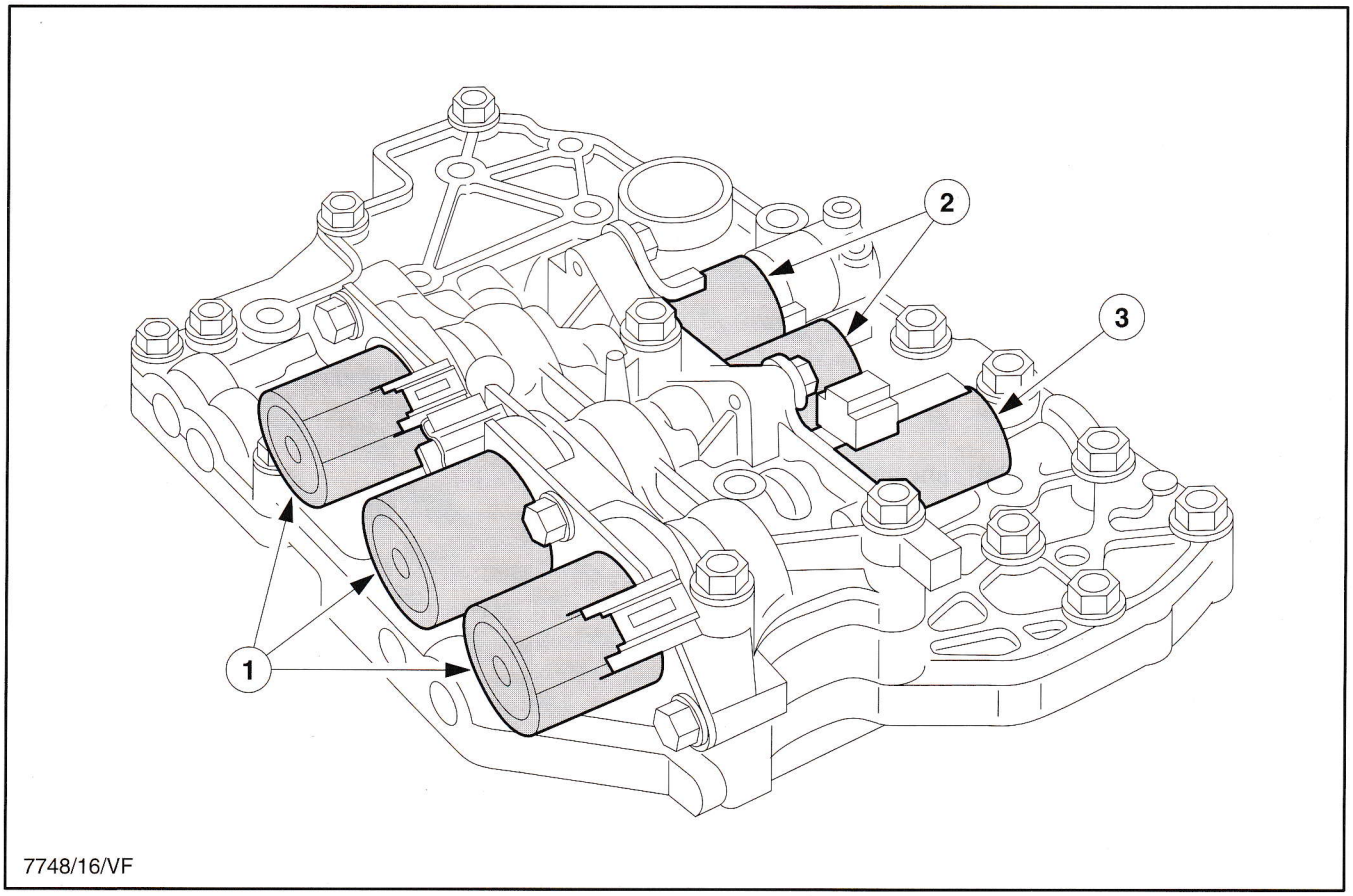


7748/10/VF

1 2nd/4th gear brake band
2 Reverse gear brake
3 1st – 3rd gear clutch
4 1st gear one-way clutch
5 Reverse gear clutch
6 3rd/4th gear clutch

- Three multi-plate clutches, a multi-plate brake, a brake band and a roller one-way clutch are used to select the individual ratios.
- The corresponding components receive the required pressure from pulse width modulation (PWM) solenoid valves.

Valve body



1 PWM solenoid valves
2 Shift (on/off) valves
3 Main regulating valve (variable force solenoid – VFS)

- The valve body incorporates six solenoid valves:
  - three PWM (pulse width modulation) solenoid valves,
  - two shift (on/off) valves,
  - one main regulating valve (variable force solenoid – VFS).
- The individual clutches and brakes are supplied with pressure and the gears are shifted with the PWM solenoid valves and the shift (on/off) valves.
- The PWM solenoid valves allow direct actuation of the clutches and brakes to be switched and ensure excellent shifting through precise pressure control.
- The shift (on/off) valves reduce the number of modulating valves required. They select the hydraulic path to the clutches and brakes.
- The main regulating valve (variable force solenoid – VFS) ensures that sufficient hydraulic pressure is available in all operating conditions.

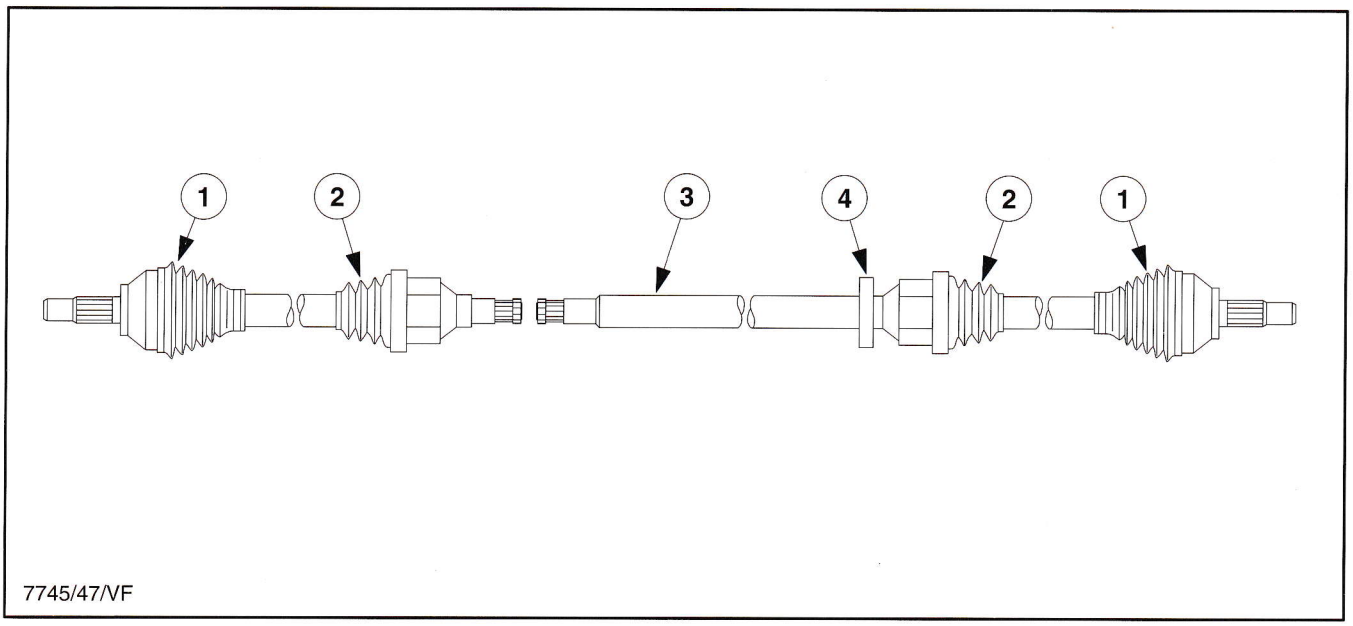
Control of shifting with ESSC

- An electronic synchronous shift control (ESSC) is used in the 4F27E automatic transmission.
- ESSC monitors the shift operations and is able to adjust these to component wear over the life of the transmission.
- This is possible as the individual shift components are actuated directly by the modulating valves or via accumulators.
- ESSC monitors firstly the shift time and secondly whether the shift operation is synchronous.
- When the PCM detects a difference compared with the stored settings for the shift time and synchronicity of the shift operation, the pressure build up or reduction is adjusted accordingly.

NOTE: Refer to Student Information CG 7748/S "Focus – 4F27E automatic transmission"for more detailed information on ESSC.

Changes to the halfshafts

- The Focus has halfshafts of the same length. An intermediate shaft with a center bearing connects the transmission to the right-hand halfshaft.
- The outer drive joints are optimised and made as small and light as possible.
- The outer drive joint boots are made of thermoplastic and are therefore particularly resistant to external effects such as chippings and permanent loading when the steering is turned.
- The positioning of the joint boot on the joint is determined by the shape.
- The joints are pressed on to the splines on the shafts. They are additionally secured by circlips. The press-fits significantly improve the uniformity of power flow as the connections are free of play.
- A different grease with improved friction reduction is used in the joints.



1 Outer joint boot made of thermoplastic
2 Inner joint boot made of rubber
3 Intermediate shaft
4 Intermediate shaft center bearing

Tick the correct answer or fill in the gaps.

1. Which shift mechanism is used with the iB5 manual transmission on the Focus?

- ☐ a) Shift rod-operated
- ☐ b) Hydraulic
- ☐ c) Cable-operated
- ☐ d) Pneumatic

2. The following components are used to shift the individual ratios in the 4F27E automatic transmission:

- ☐ a) two multi-plate clutches, two multi-plate brakes and a roller one-way clutch.
- ☐ b) three multi-plate clutches, one multi-plate brake and two brake bands.
- ☐ c) three multi-plate clutches, one multi-plate brake, two brake bands and one roller one-way clutch.
- ☐ d) three multi-plate clutches, one multi-plate brake, one brake band and one roller one-way clutch.

3. In the 4F27E automatic transmission the hydraulics are controlled by the following in addition to the main regulating valve or variable force solenoid

- ☐ a) three PWM solenoid valves and two shift (on/off) solenoid valves.
- ☐ b) three PWM solenoid valves.
- ☐ c) two PWM solenoid valves and three shift (on/off) solenoid valves.
- ☐ d) five PWM solenoid valves.

4. ESSC means

- ☐ a) electronic standardised shift control.
- ☐ b) electronic synchronous shift control.
- ☐ c) ice and snow driving programme.
- ☐ d) electronically-assisted hydraulic shift control.

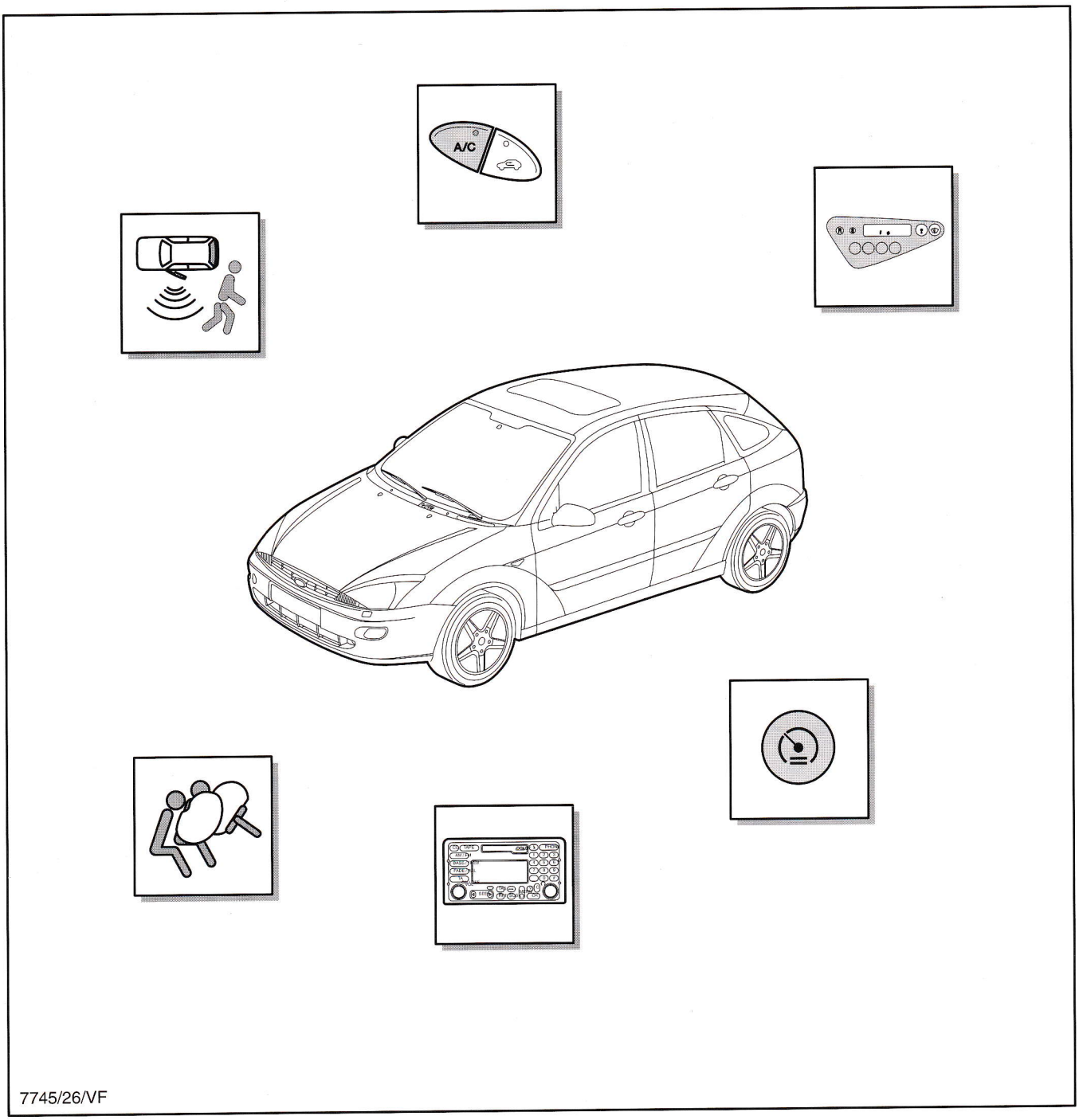
5. The advantage of ESSC lies in

- ☐ a) the monitoring and adjustment of the engine control.
- ☐ b) the monitoring of the converter lock-up clutch.
- ☐ c) the adjustment to the driving style of the driver.
- ☐ d) the monitoring and adjustment of the shift operations.

Objectives

On completing this lesson, you will be able to

- name the new/changed components in the general electrical systems in the Focus,
- describe the new/changed components in the security electronics in the Focus,
- explain the new/changed components in the comfort electronics in the Focus.



General electrical systems

- Central timer module (CTM)
- Modular vehicle wiring harness
- Multiplex data bus system
- Engine management with new 60-pin module or 104-pin module
- PCM-controlled alternator

Safety/security electronics

- Side and front air bags for driver and front passenger
- Pyrotechnic safety belt pretensioners for driver and front passenger
- Central locking with radio frequency remote control
- Variable code PATS
- Anti-theft alarm system

Comfort electronics

- Electrically operated windows with anti-trap protection
- Speed control system (basically the same as that on the Mondeo)

Audio and communications systems

- Integral mobile telephone
- Traveller assistance system (TAS)
- Multi function display

Air conditioning

Multiplex data bus system

- The Focus is equipped with a multiplex data bus system. This allows several vehicle systems access to a common data base.

- The multiplex data bus system allows the number of sensors to be kept relatively low. At the same time, the vehicle wiring harness on high-series variants remains comparatively compact. Both make a significant contribution to the reliability of the vehicle electrical system.

- Up to four data bus systems can be used in the Focus depending on the model and variant:

  – SCP (standard corporate protocol)
  The SCP data bus creates the connection between the engine management system (EEC V PCM), the vehicle dynamics systems (ABS/EBD/TCS/ESP) and the instrument cluster. The SCP data bus is also connected to the data link connector (DLC).

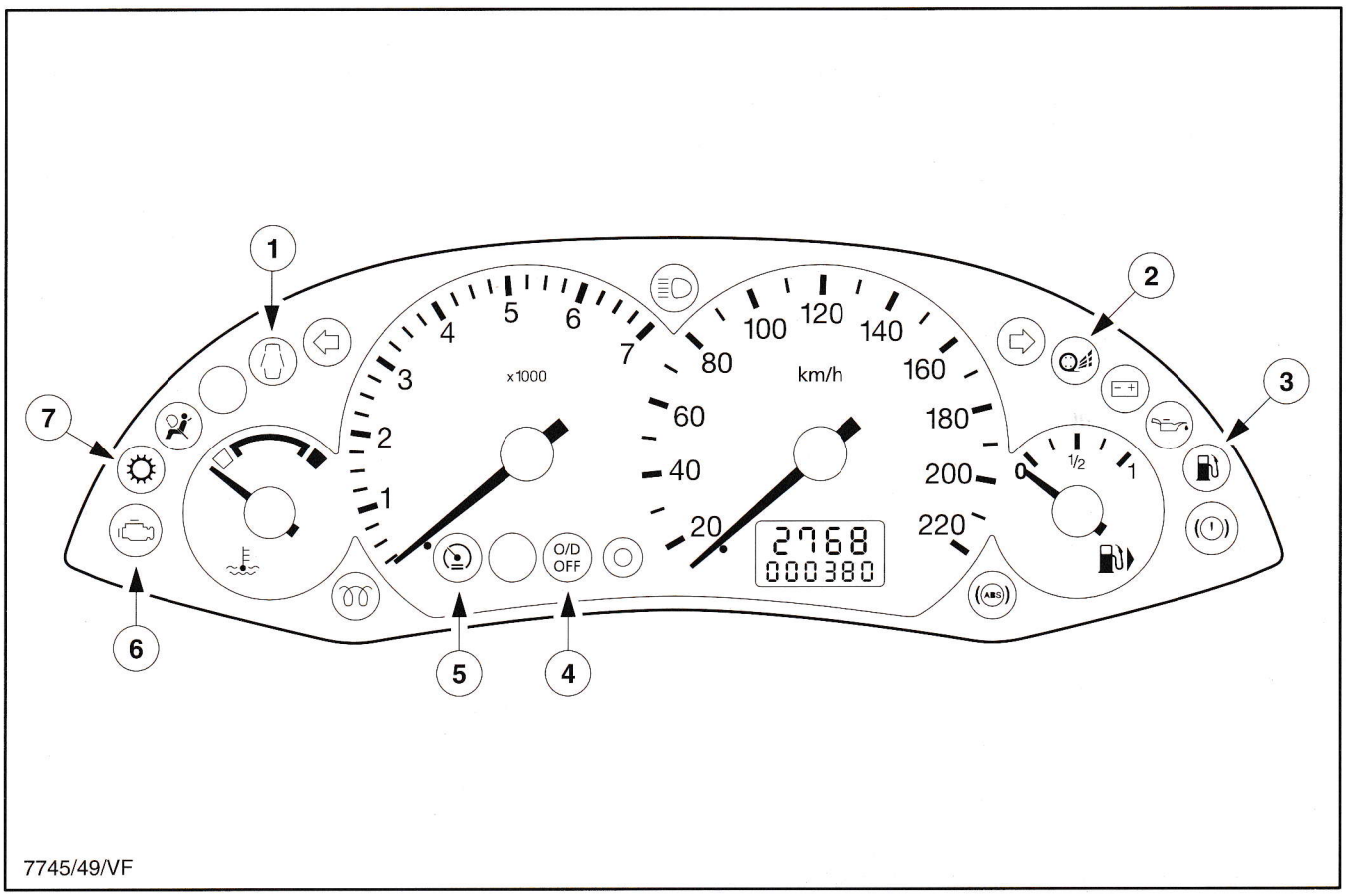
  – ISO 9141 diagnostic interface
  This data bus is used to check the booster heater (on the diesel engined variant), telematic system, central locking and anti-theft alarm system, central timer module (CTM), air bag module and trip computer.

  – CAN (controller area network)
  On diesel engined vehicles this data bus is used for the communication between the PCM and the pump control unit.

  – ACP (audio communication protocol)
  The audio unit controls the CD autochanger through this data bus. The ACP data bus is also used for transferring data between the audio system and the mobile telephone module.

Instrument cluster

- The instrument cluster communicates with the PCM through the SCP data bus. The PCM uses this to transmit the engine speed, engine coolant temperature and vehicle speed to the instrument cluster.
- In addition, the SCP data bus is used for diagnosis and testing and programming of the instrument cluster module using FDS 2000.
- Instrument cluster bulbs, instruments and housing can be changed separately. It is also possible to install a complete new instrument panel insert inexpensively.



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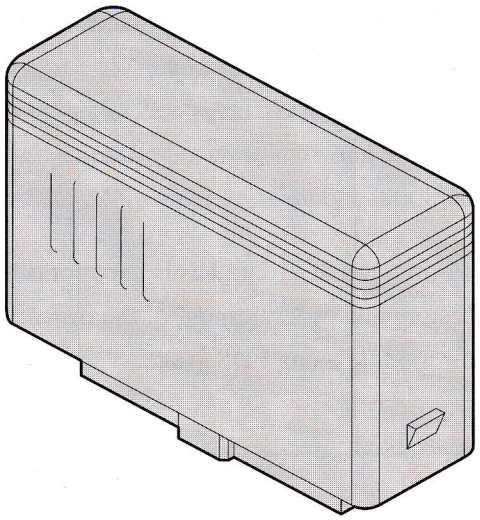
Instrument cluster

1 Door ajar warning lamp
2 TCS / ESP indicator lamp
3 Low fuel warning lamp
4 O/D indicator lamp
5 Speed control indicator lamp
6 Engine management system warning lamp
7 Powertrain warning lamp

Central timer module (CTM)

- The central timer module switches various electrical loads whose operation is timed.
- In addition, it monitors various systems which are designed to send a signal (acoustic warning and/or indicator) to the driver in certain situations.
- The central timer module plugs into the back of the central junction box (CJB).
- Two different modules are used for vehicles with a manual transmission and an automatic transmission.



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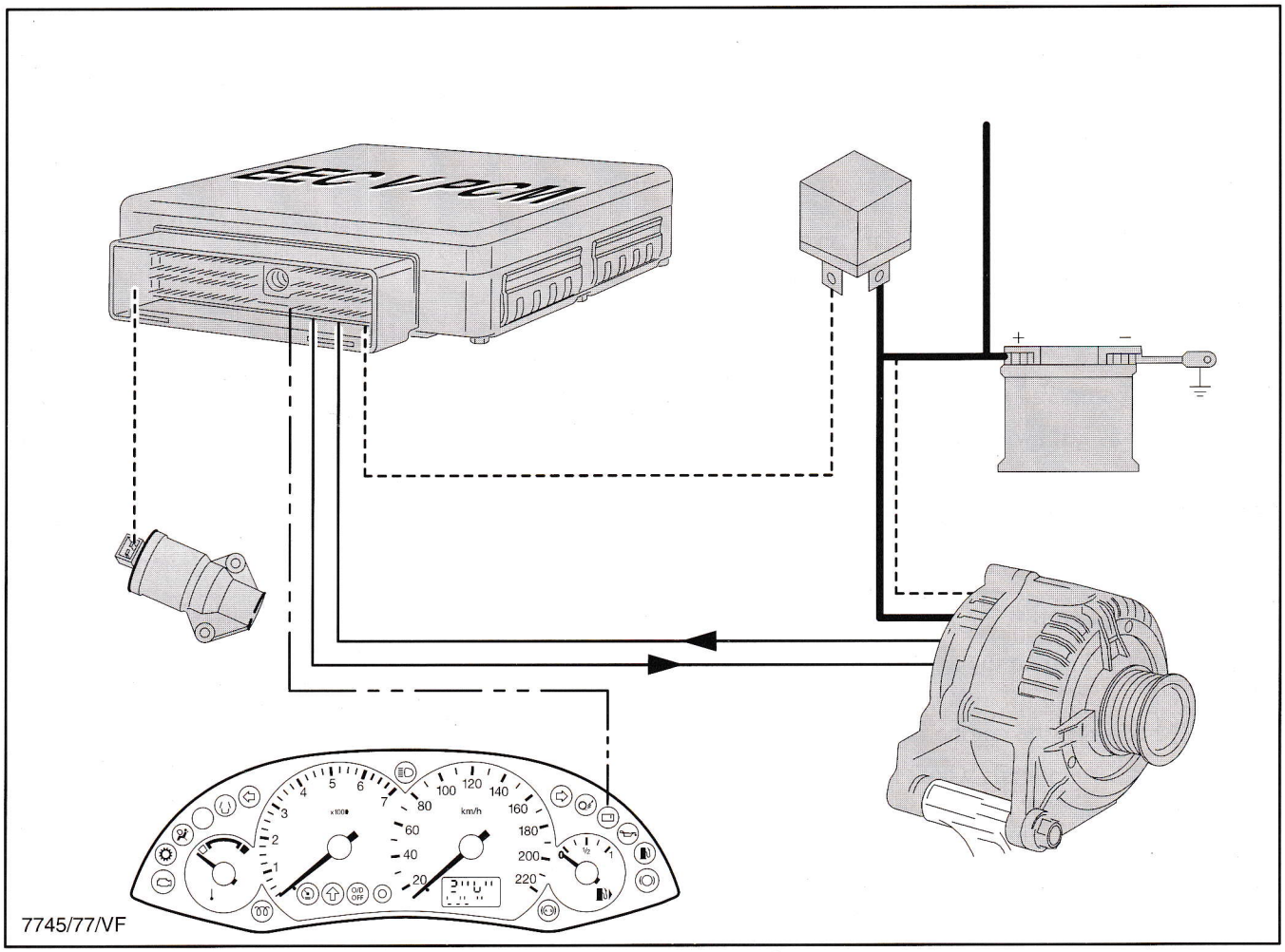
"Smart charge" power supply system



- The Focus is equipped with one of the most advanced vehicle power supply systems in the world. It ensures optimum vehicle battery charging at all times while supplying all the electrical loads which are switched on.
- Conventional alternators produce a predetermined voltage. The new power supply system in the Focus is controlled by the powertrain control module (PCM).
- The new "smart charge" power supply system only requires the following conventional components:
  - alternator with controllable voltage regulator
  - powertrain control module (PCM)
  - charge indicator in the instrument cluster
  - battery
  - engine run relay
- The PCM simultaneously controls and monitors the output of the alternator. Two electrical connections exist between the two components for this purpose.

Operation of the "smart charge" power supply system

- Since a vehicle battery can be best charged with a higher voltage when cold and with a lower voltage when warm, it is advantageous to adjust the charging voltage according to the temperature of the battery.
- For this, the PCM works out the data on the temperature of the electrolyte in the vehicle battery from the data on the intake air temperature (IAT).
- This data is compared with the values stored when the engine was last switched off.
- From this comparison the PCM calculates the temperature of the electrolyte in the vehicle battery.
- The PCM also controls the idle speed when this is reduced by the load on the alternator.
- The PCM actuates the engine run relay. This relay ensures that certain loads which have a high current consumption (such as the heated windshield) are only supplied with current when the alternator is working.
- The PCM switches the charge indicator in the instrument cluster on and off.
- The PCM-controlled alternator of the "smart charge" power supply system is not activated when starting. The alternator is only switched on electronically by the PCM after the engine has fired.

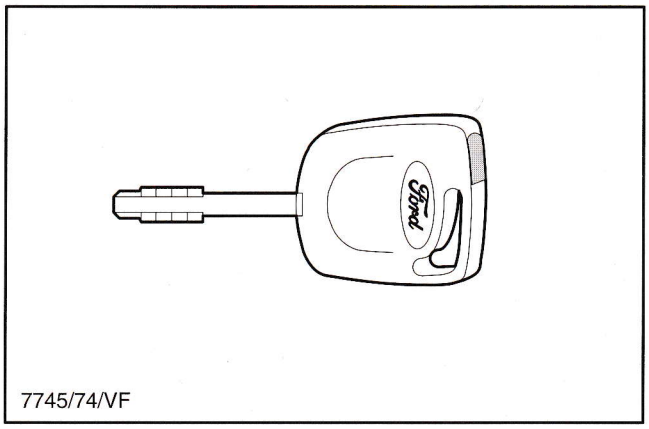
NOTE: Refer to Student Information CG 7745/S "Focus" for more detailed information.

Passive anti-theft system (PATS)

- All versions of the Focus have the passive anti-theft system (PATS).
- The PATS is incorporated in the PCM. There is no PATS module or PATS component inside the PCM. All the PATS functions are carried out by the PCM.
- The PATS LED is located above the clock.
- PATS now has a "crypto transponder" with an automatically changing code.
- The key for the new PATS can be identified by the blue mark.

NOTE: Red and blue marked keys cannot be used for systems with the other coloured mark.

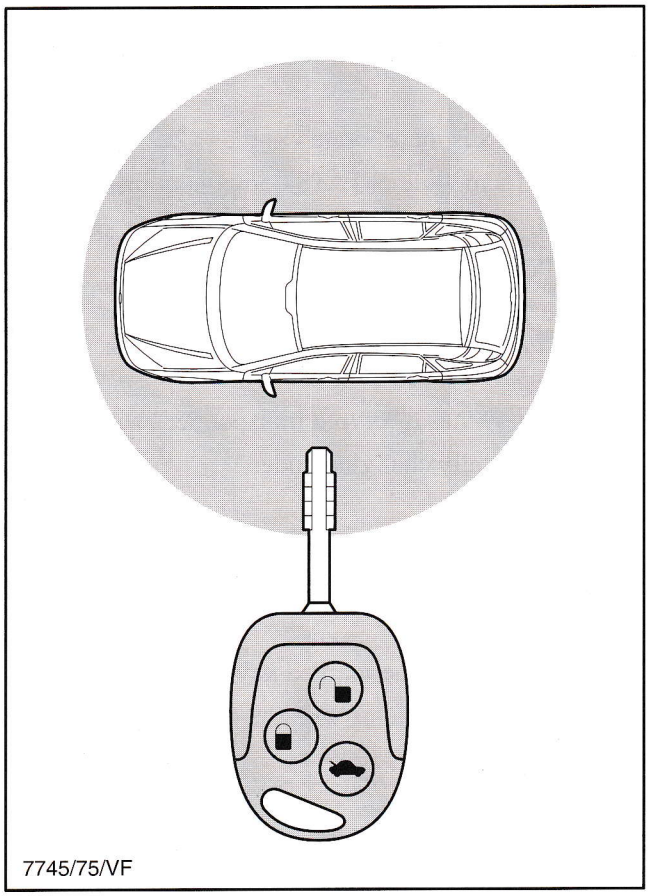
- If an attempt is made to start the vehicle with a key which is not programmed, the PCM initiates the "anti-scan" mode. This mode prevents vehicle starting for 20 seconds, even with the correct key.



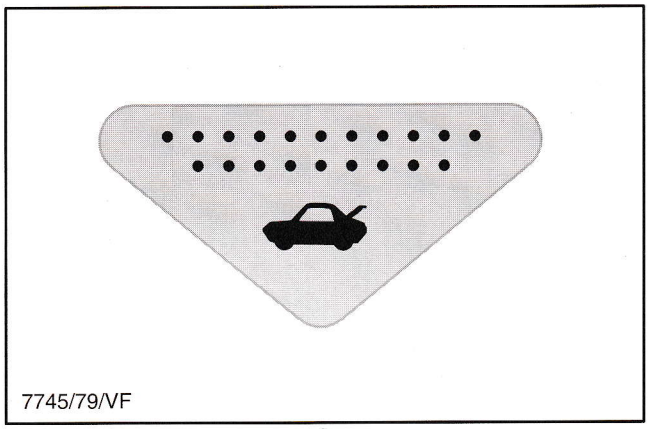
Key with blue mark

Central locking

- The Focus can be supplied with various locking systems:
  - central locking
  - central locking with radio frequency remote control
  - central locking with double locking and radio frequency remote control
  - central locking with double locking, radio frequency remote control and anti-theft alarm system
  - central locking with double locking, radio frequency remote control and anti-theft alarm system with interior monitoring
- The design and operation of the central locking and anti-theft alarm systems are largely the same as those of the current Mondeo.



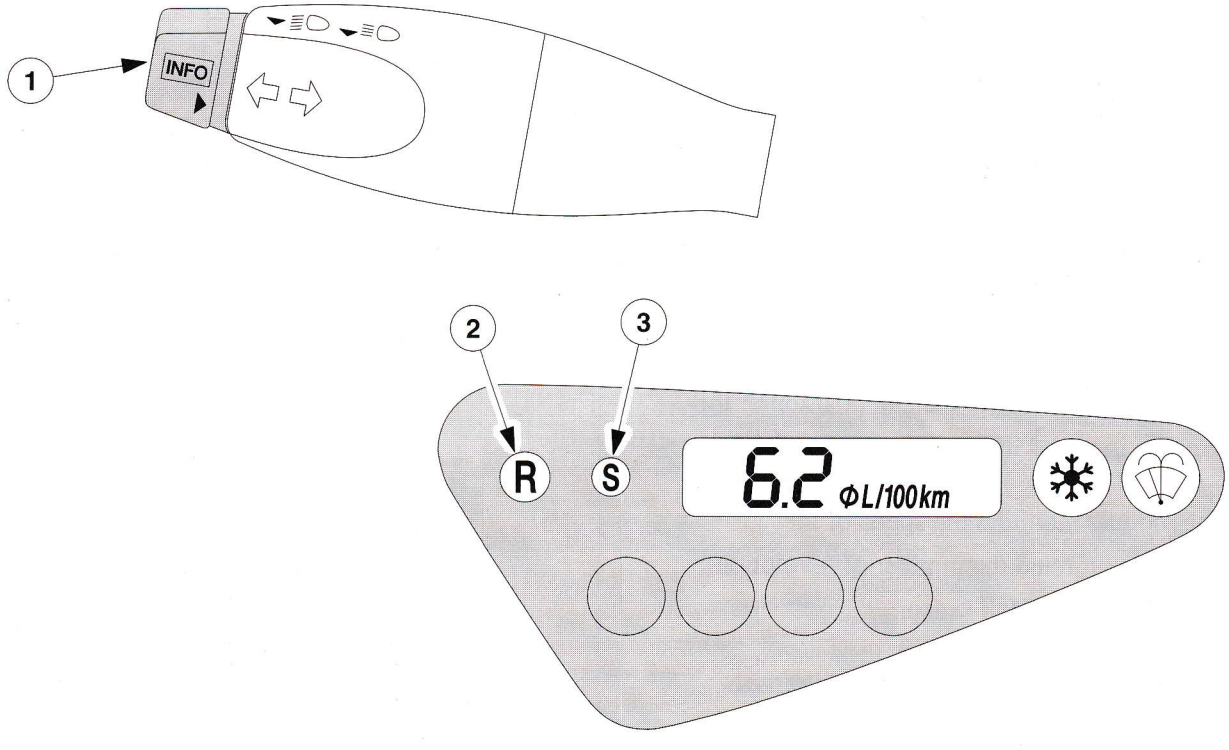
- The liftgate or luggage compartment lid can be unlocked with the vehicle key, the radio frequency remote control or the switch in the instrument panel.
- Unlocking with the switch in the instrument panel is disabled at vehicle speeds of more than 7 km/h (4 mph). Unlocking with the switch is also not possible when the vehicle is locked.



Switch for unlocking liftgate/luggage compartment lid

Multifunction display

- On high series variants a trip computer is incorporated in the instrument panel. It supplies the driver the following information:
  - instantaneous fuel consumption
  - average fuel consumption
  - range
    (with warnings at 80, 40 and 20 km)
  - exterior temperature
    (with warning at +5 °C)
  - low washer fluid
- The different functions can be called up in turn with an INFO button on the turn signal lever.
- The select and reset buttons are located next to the display.



7745/39/VF

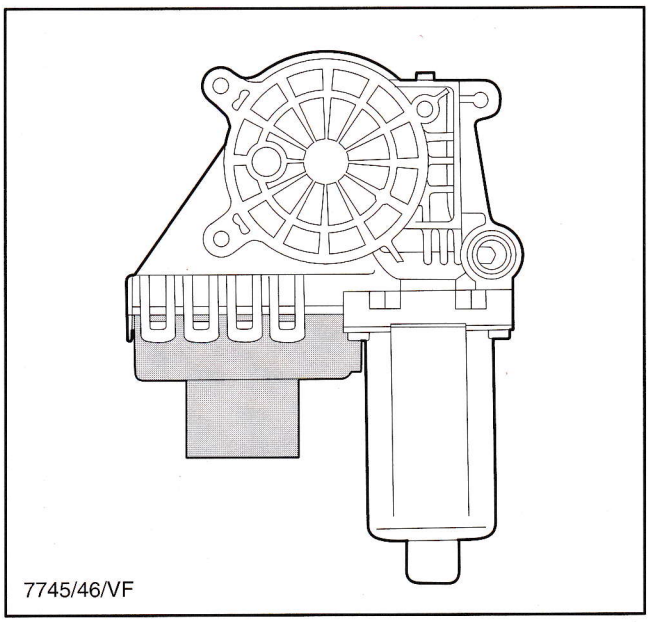
Multifunction display

1 INFO button on turn signal stalk
2 Reset button
3 Select button

Electrically operated windows with anti-trap protection

- Electrically operated windows on the front doors are standard on the Focus. Electrically operated windows for the rear doors are optional.
- The functions always include one-touch opening and closing for the driver door.
- Vehicles equipped with four electrically operated windows also have a function which closes the windows after pressing the switch once into the second position. This function is combined with anti-trap protection on all four windows.
- This anti-trap protection is active whenever windows are closed. If an object is trapped by the closing window, the pinching force generated must not exceed a specified value.

- Each electric window motor has an electronic module.
  - The information about the end position of the window is stored in the electronic module.
  - The module monitors the speed of the electric motor and the number of revolutions with the aid of a Hall sensor.
  - If the speed drops as the window begins to trap an object, the module causes the motor to stop the window and reverse it.



Power window module

NOTE: Refer to Student Information CG 7745/S "Focus" for more detailed information.

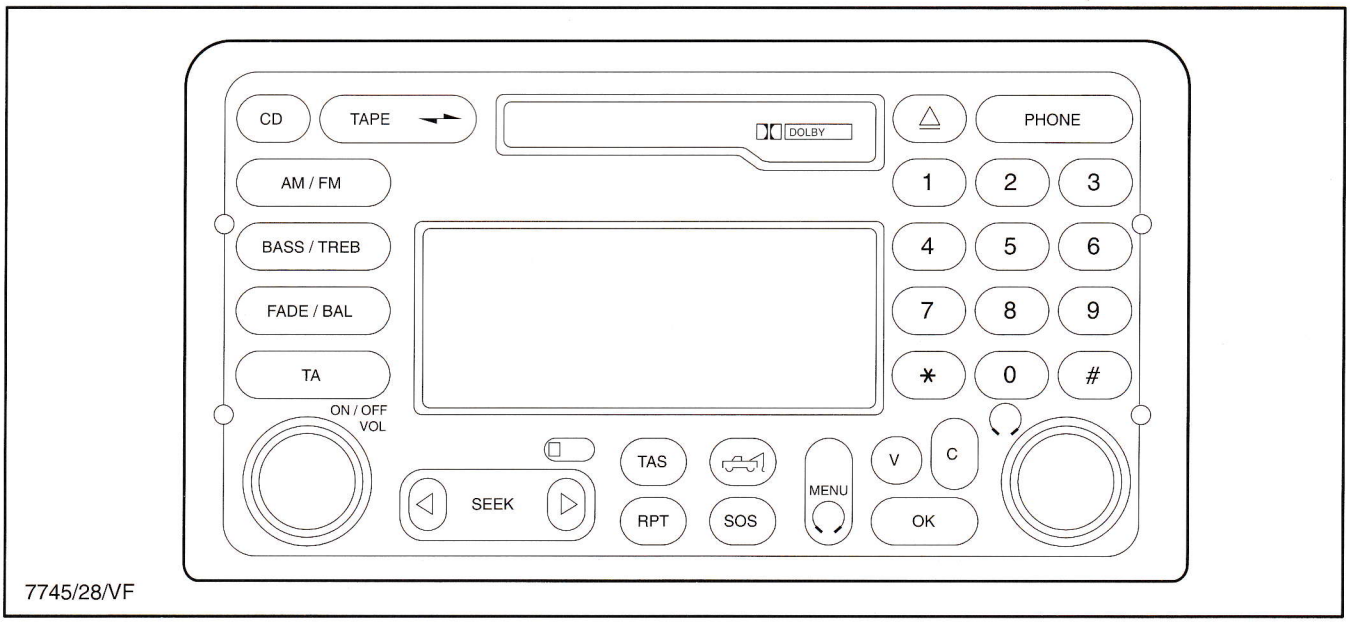
Traveller assistance system (TAS)

- The telematic system is an audio system with a traveller assistance service (TAS) using an integral mobile telephone and a GPS receiver.
- Two versions with different audio features are offered. There is a choice of radio/cassette (like the series 5000) and radio.
- There is a slot for insertion of the SIM card behind a detachable rocker switch ("SEEK" button). The customer signs the card agreement when buying the vehicle. The card is available at the time of the pre-delivery inspection.
- When the SIM card is first inserted, a commissioning operation taking approximately 10 minutes must be initiated, during which data specific to the territory and the code for transmission of the GPS co-ordinates are loaded by means of the telephone.

NOTE: During the initialisation, the vehicle should be in open ground and stationary.

- The telematic system also loads necessary updates automatically through the telephone.
- The telematic system allows the driver:
  - to make emergency calls ("SOS"),
  - to call up a breakdown service ("towing vehicle" symbol),
  - to establish the position of the vehicle,
  - to hold telephone conversations ("PHONE"),
  - to obtain route guidance,
  - to ask for traffic information,
  - to use services (such as hotel reservations).

NOTE: Refer to Student Information CG 7745/S "Focus" for more detailed information.

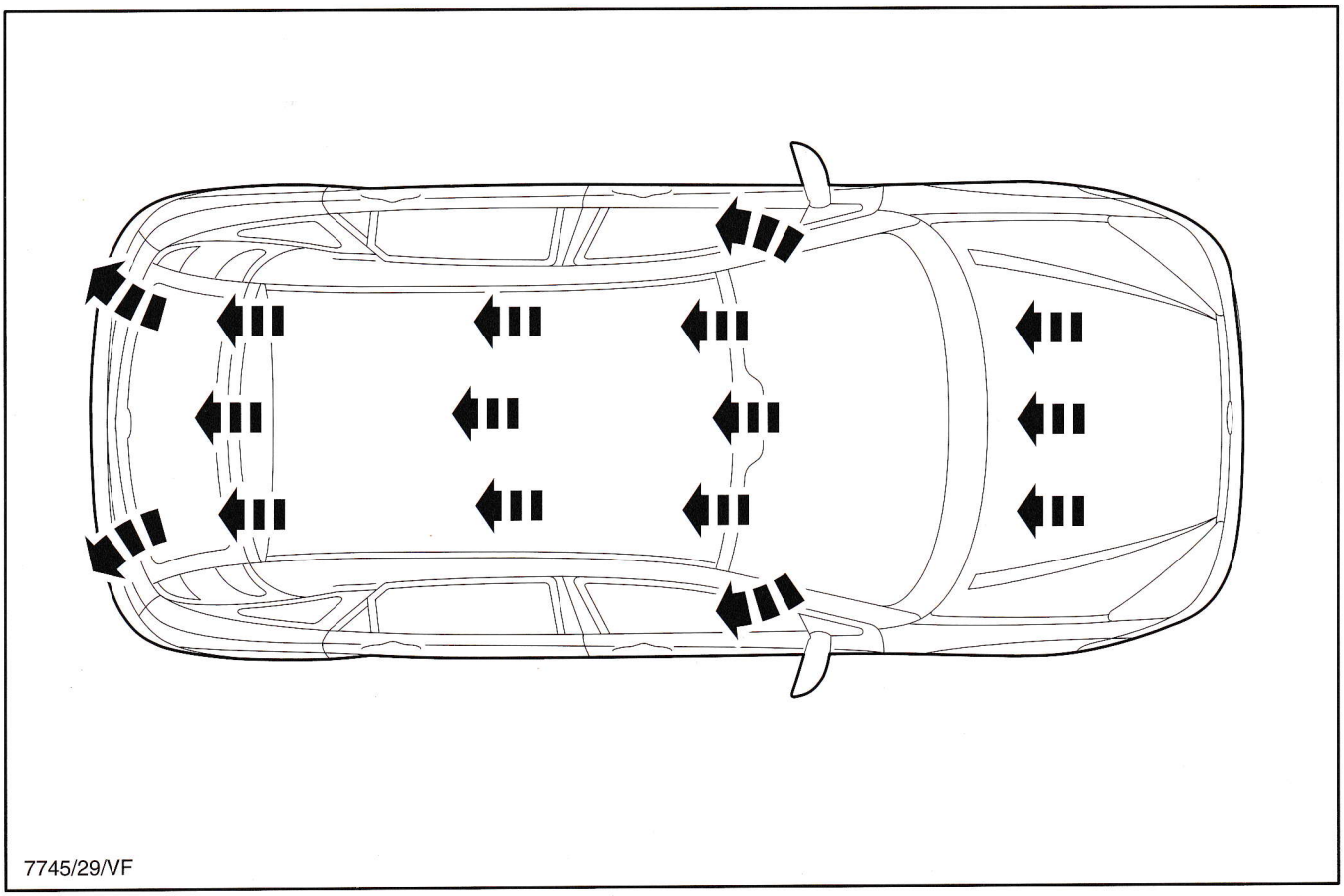


Travel assistance system Ford HelpNet 5100 RDS EON

General

- In most territories the pollen filter is standard equipment. In normal vehicle operating conditions it must be changed every 20,000 miles (30,000 km). If no pollen filter is installed, a plastic grille is fitted over the air inlet. It can easily be changed for a pollen filter
- Air is continuously directed to the windshield and side windows irrespective of the setting of the air distribution controls.
- All vehicles have an air recirculation function. If the air recirculation function is selected, it remains active after the ignition is switched off and on. The air recirculation function is activated automatically at blower speed "0".
- For the Scandinavian market vehicles with a diesel engine are equipped as standard with a fuel-operated booster heater of the kind also available for the Mondeo.
- The Focus can optionally be supplied with an air conditioning system. This works on the fixed orifice tube principle and is regulated manually by the user.

NOTE: Refer to Student Information CG 7745/S "Focus"for more detailed information on heating, ventilation and air conditioning.



7745/29/VF

Passage of fresh air through vehicle interior

Tick the correct answer or fill in the gaps.

1. Which data bus systems can be used in the Focus?

- ☐ a) SCP, ISO 9141, CAN and CAP
- ☐ b) ESP, ISO 9141, CAN and ISDN
- ☐ c) ESP, ISO 9141, CAN and ACP
- ☐ d) SCP, ISO 9141, CAN and ACP

2. The central timer module (CTM) is

- ☐ a) plugged into the back of the central junction box (CJB).
- ☐ b) located on the central tunnel in the area of the handle of the parking brake lever.
- ☐ c) an integral part of the instrument cluster.
- ☐ d) an integral part of the trip computer.

3. How does the PCM establish the temperature of the electrolyte in the vehicle battery?

- ☐ a) From the signals from the electrolyte temperature sensor (ETS)
- ☐ b) From the signals from the ambient temperature sensor (OTS)
- ☐ c) By calculation from the signals from the intake air temperature (IAT)
- ☐ d) By assuming fixed values for summer and winter operation in conjunction with time data from the central timer module (CTM)

4. Which colour is used to mark keys with the new "crypto transponder"?

- ☐ a) Yellow
- ☐ b) Red
- ☐ c) White
- ☐ d) Blue

5. On units with the telematic system the _____ button can be detached.

6. What does 'TAS' mean?

- ☐ a) Traveller assistance system
- ☐ b) Touring advice system
- ☐ c) Training assistance system
- ☐ d) Telematics alignment system

List of abbreviations

The abbreviations conform to standard SAE J1930 with the exception of those marked with an asterisk *.

ABS*	**A**nti-lock **B**raking **S**ystem
ACP*	**A**udio **C**ommunication **P**rotocol
BTCS*	**B**rake **T**raction **C**ontrol **S**ystem
CAN*	**C**ontroller **A**rea **N**etwork
CD*	**C**ompact **D**isc
CFC*	**C**hlorinated **F**luoro**c**arbon
CHT	**C**ylinder **H**ead **T**emperature
CJB*	**C**entral **J**unction **B**ox
CKP	**C**rank**s**haft **P**osition
CMP	**C**am**s**haft **P**osition
CTM*	**C**entral **T**imer **M**odule
DLC	**D**ata **L**ink **C**onnector
DOHC*	**D**ouble **O**ver**h**ead **C**amshaft
EBD*	**E**lectronic **B**rake Force **D**istribution
ECT	**E**ngine **C**oolant **T**emperature
EEC*	**E**uropean **E**conomic **C**ommunity
EEC V*	**E**lectronic **E**ngine **C**ontrol System 5
EGR	**E**xhaust **G**as **R**ecirculation
EI	**E**lectronic **I**gnition
ESP*	Electronic Stability Program
ESSC	**E**lectronic **S**ynchronous **S**hift **C**ontrol
EU*	**E**uropean **U**nion
EVAP	**Eva**porative Emission
FDS*	**F**ord **D**iagnostic **S**ystem
FP	**F**uel **P**ump
GPS*	**G**lobal **P**ositioning **S**ystem

HO2S Heated Oxygen Sensor

IAC Idle Air Control

IAT Intake Air Temperature

KS Knock Sensor

LAV* Load Apportioning Valve

LED* Light Emitting Diode

LHD* Left-Hand Drive

MAF Mass Air Flow

O/D* Overdrive

PATS* Passive Anti-Theft System

PCM Powertrain Control Module

PCRV* Pressure Conscious Regulating Valve

PCU* Pump Control Unit

PSP Power Steering Pressure

RDS* Radio Data System

RHD* Right-Hand Drive

SAE* Society Of Automotive Engineers

SCP* Standard Corporate Protocol

SFI Sequential Multiport Fuel Injection

SLA* Short And Long Arm (Suspension)

TAS* Traveller Assistance System

TCS* Traction Control System

TP Throttle Position

TPS* Themal Protection Switch

VSS Vehicle Speed Sensor

Lesson 1 – Body and safety

1. b)
2. Crash sensors
3. Alternating current
4. a)
5. c)

Lesson 2 – Chassis

1. b)
2. d)
3. c)
4. b)
5. d)

Lesson 3 – Petrol engines

1. b)
2. d)
3. Compression ratio
4. a)
5. c)

Lesson 4 – 1.8L Endura-DI diesel engine

1. c)
2. b)
3. a)
4. b)
5. a)

Lesson 5 – Transmissions

1. c)
2. d)
3. a)
4. b)
5. d)

Lesson 6 – Vehicle electrical and electronic systems

1. d)
2. a)
3. c)
4. d)
5. 'SEEK'
6. a)