SECTION : 303-04b Fuel Charging and Controls — Turbocharger

VEHICLE APPLICATION : 2008.0 Falcon

CONTENTS PAGE

SPECIFICATIONS

NOTE: Oil threads with engine oil.

NOTE: Do not oil threads that require thread sealant or thread locker.

Location	Part Number	Description	Installation Lubrication	Lower (Nm)	Upper (Nm)	Nominal (Nm)
Manifold to Head	W713247	BOLT M10x30	Patch lock- no oiling required	50	53	55
Manifold to Head (Lifting Eye)	W713246	BOLT M10x35	Patch lock- no oiling required	50	53	55
Turbo to Manifold	W713609	STUD M10x1.25x18 + M10x12	Tri-lobe lock – no oiling required	28	32	30
Turbo to Manifold	W708915	NUT M10	Deformed thread- no oiling required	44	50	47
Dump pipe to Turbocharger	W712418	BOLT	Tri-lobe lock – no oiling required	22	26	24
Dump Pipe braces to: • Dump pipe upper • Dump pipe lower	W712418	BOLT	Tri-lobe lock – no oiling required	14	18	16
Dump Pipe braces to: • Engine block upper • Engine block lower	V800153	BOLT M10x25	Patch lock – no oiling required	24	28	26
Heat shields to exhaust manifold	N605904	BOLT M8	Patch lock – no oiling required	17	24	20.5
Heat shields to dump pipe	W714210	BOLT M10x16	Patch lock – no oiling required	24	28	26
Oil feed to turbocharger		BANJO BOLT M12	Patch lock – no oiling required	22	26	24
Oil feed filter to block	3R23-9P424-A	Banjo adaptor and filter assembly	Patch lock – no oiling required	17	24	20.5
Oil feed filter nut to Banjo	WR2T-6N637-A	Oil pressure sender adaptor M14	Lubricate with oil	17	24	20.5
Oil return pipe to: • Turbocharger • Engine block	W708347	BOLT M8x15	Patch lock – no oiling required	17	24	20.5
Coolant feed & return to turbocharger		BANJO BOLT M14	Lubricate with oil	40	50	45
Coolant feed & return clamp	V890159	HOSE CLAMP 16-30mm	-	2.5	3.5	3

SPECIFICATIONS (Continued)

Torque Specifications (Intercooler & Ducting)

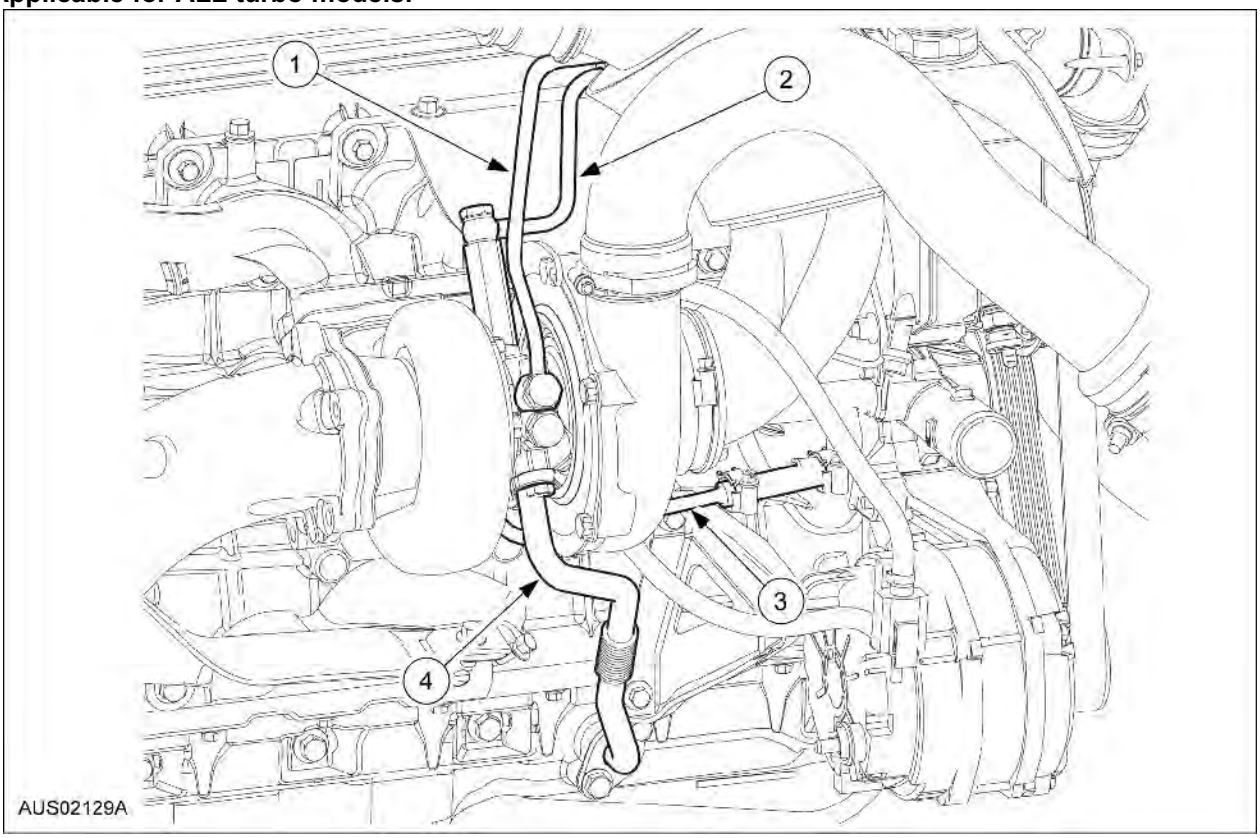
Description	Nm
Upper studs to crush tube (x2) (Intercooler)	20±3
Lower bolts to Intercooler Isolators (x2)	20±3
Upper and lower Intercooler brackets to RGOR*	20±3
Screw hose clamps on air ducting pipes & hoses	2.2 -3.0
RGOR* Duct (LH & RH) mounting hardware to RGOR*	10.5 ± 1.6
Boost pressure sensor screw	± 0.3
Wastegate solenoid bracket retaining screw	± 1.2
Cross-over duct nuts	10
RH RGOR* Duct mounting bracket to battery tray (x2)	20±3

* Reinforced Grille Opening Reinforcement

DESCRIPTION AND OPERATION

Turbocharger

Applicable for ALL turbo models.



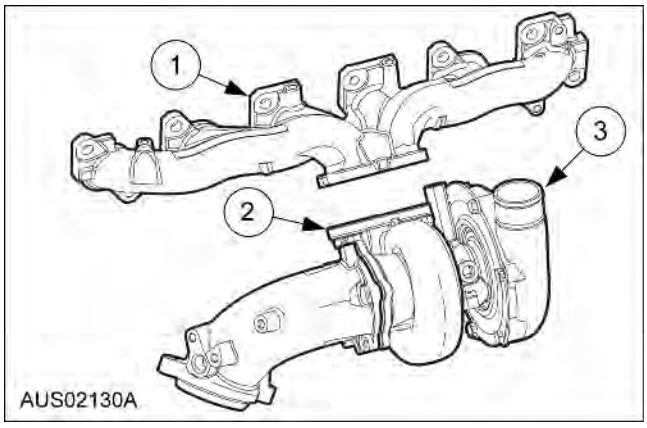
Item	Description
1	Coolant Supply Line
2	Oil Supply Line
3	Coolant Return Pipe
4	Oil Return Pipe

The turbocharger consists of two elements, a turbine and a compressor both installed on a single shaft and contained within housings.

The turbocharger bearings are supplied oil from the engine via the oil supply tube. This is returned to the oil pan via the oil return pipe.

The turbocharger housing also receives coolant from the engine cooling system, to assist with turbocharger cooling.

The turbine element of the turbocharger is mounted on the exhaust manifold and uses the energy of the exhaust gas to drive the compressor. The compressor feeds air to the engine via the intercooler.

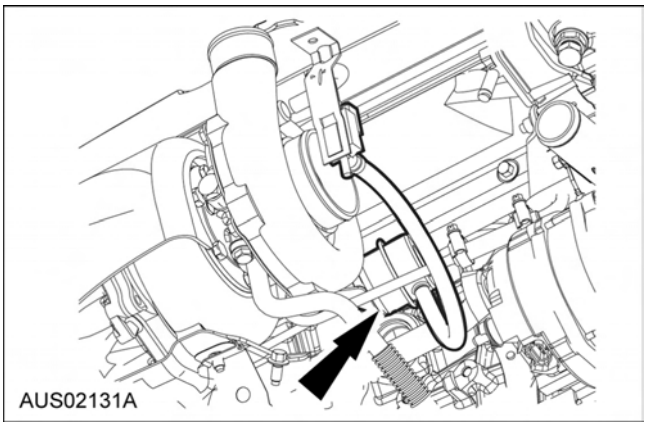


Item	Description
1	Exhaust manifold
2	Turbine side of turbocharger
3	Compressor side of turbocharger

DESCRIPTION AND OPERATION (Continued)

Boost Control

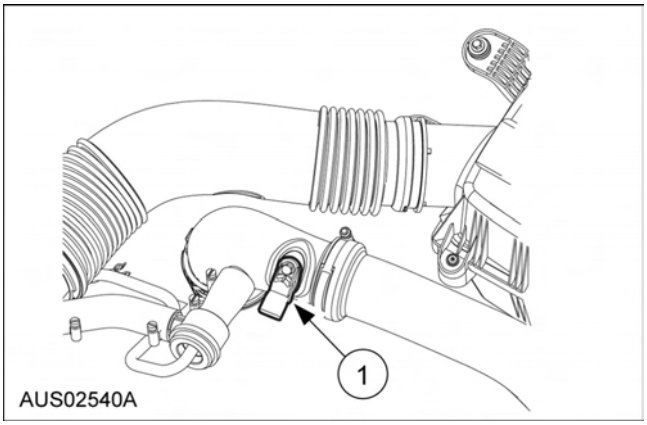
The turbocharger is governed by means of a wastegate valve. The wastegate valve diverts some of the exhaust gas past the turbine and therefore regulates the speed of the turbine. The wastegate valve is controlled by a pressure operated actuator. The actuator incorporates a diaphragm, and uses regulated air pressure to control the wastegate. This actuator is preset during manufacture and must not be tampered with.



The air pressure to the actuator diaphragm is regulated by use of a boost pressure sensor (BPS) and a wastegate control solenoid (WCS).

The boost pressure sensor is located on the ETB duct.

The wastegate control solenoid is mounted underneath the fuse box.



Item	Description
1	Boost Pressure Sensor

The BPS measures the absolute pressure of the pre-throttle intake system for cruise control and wastegate control strategy. The pressure sensing element in the BPS employs a piezo resistive sensor that outputs a voltage proportional to absolute pressure.

BPS Specification	
Absolute Pressure (kPa)	Signal Voltage (V)
10	0.22
50	0.95
100	1.88
150	2.8
200	3.7

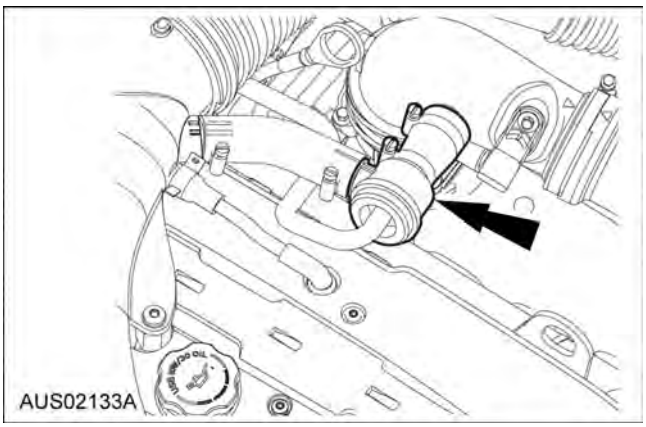
The PCM uses the BPS output voltage to control boost pressure, dependent upon engine load, temperature and RPM. The control system increases engine intake pressure by diverting excess pressure away from the wastegate actuator through the wastegate solenoid valve. The solenoid valve is controlled by the PCM's TURBO output.

CONNECTIONS AT PCM	
Pin B44	Boost Pressure Sensor (BPS) Signal
Pin B33	BPS Signal Return (SIGRTN)
Pin B19	TURBO
Pin B45	Vehicle Reference Voltage (VREF)

Intake air pressure is further controlled by a blow-off valve, which dumps excess pressure into the low pressure side of the intake system when the throttle is closed.

The blow-off valve is actuated by intake manifold pressure, via a rubber hose from the intake manifold.

The blow-off valve is situated in the cross-over duct on top of the engine.



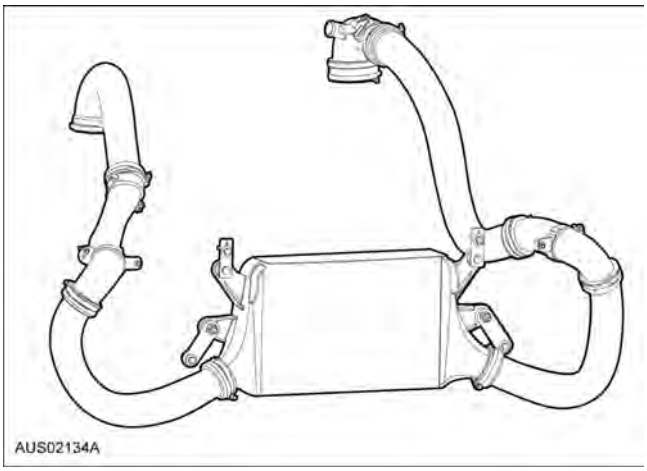
DESCRIPTION AND OPERATION (Continued)

Charge Air Cooler (Intercooler)

The Charge Air Cooler (CAC) is an air-to-air cooler. The compressed air from the turbocharger flows through the cooler, and is cooled by outside air flowing over the vanes of the CAC.

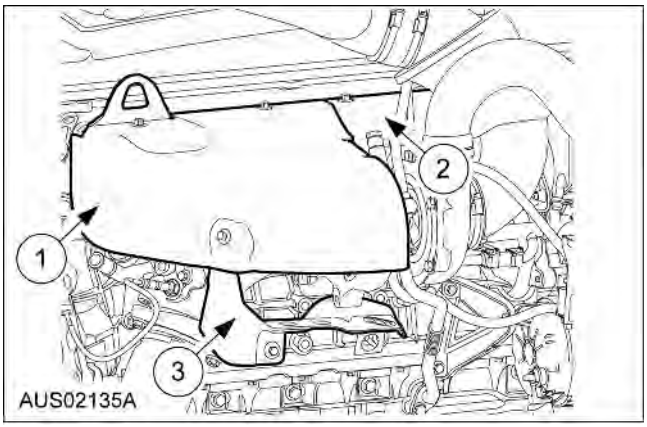
The lower temperature of the charge air increases its density, so giving improved engine efficiency and power.

The CAC is mounted in front of the radiator with four rubber isolated mounts.



Heatshielding

Three heatshields cover the exhaust manifold and the turbocharger, to protect surrounding engine bay components from heat damage.



Item	Description
1	Rear exhaust manifold heatshield
2	Front exhaust manifold heatshield
3	Steering Shaft / Engine mount heatshield

DIAGNOSIS AND TESTING

Turbocharger

Inspection and Verification

NOTE: It is normal for a small amount of combustion gas to pass into the crankcase. These 'blow-by' gases are scavenged into the air intake system through the positive crankcase ventilation (PCV) system.

Some engine oil, in the form of a vapour is carried into the air intake system with the blow-by gases. This means that a small amount of oil will collect inside the air intake components and the turbocharger. This is not an indication that the turbocharger oil seal has failed. The turbocharger oil seal will not fail unless the bearings fail first, which will cause the turbocharger to become noisy or seize.

Do not install a new turbocharger due to oil inside the turbocharger or the air intake components. If a leak is detected in the oil supply or return tubes or connections, locate and rectify the source. Do not install a new turbocharger due to an oil leak.

1. Verify the customer concern.
2. Visually inspect for the following obvious signs of mechanical and electrical damage:

Visual Inspection Chart

Mechanical	Electrical
• Oil leak(s) • Air cleaner element • Air cleaner outlet pipe • Air cleaner intake pipe • Turbocharger oil supply or oil return tube • Turbocharger coolant supply or return tube • Wastegate valve and actuator • Turbocharger housings • Turbocharger turbine wheel blades • Turbocharger compressor wheel blades • Charge Air Cooler • Ducting to and from the Charge Air Cooler	• Wiring harness • Electrical connector(s) • PCM • Boost Pressure Sensor • Wastegate Control Solenoid

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to Symptom Chart.

DIAGNOSIS AND TESTING (Continued)

Symptom Chart

NOTE: The wastegate actuator diaphragm unit is a fixed part of the turbocharger and cannot be adjusted or renewed.

Condition	Source	Action
• Blue smoke with excessive turbocharger noise	• Turbocharger compressor rubbing on housing walls. • Turbocharger turbine rubbing on housing walls. • Turbocharger bearings and oil seal(s) damaged.	• Go to PinPoint Test A.
• Excessive turbocharger noise without blue smoke	• Turbocharger oil supply tube blocked or damaged.	• Go to PinPoint Test A.
• Blue smoke without excessive turbocharger noise	• Turbocharger oil return tube blocked or damaged.	• Go to PinPoint Test B.
• Poor engine performance	• Wastegate control valve vacuum line(s).	• CHECK all vacuum line(s) are installed and no signs of air leaks are present. REPAIR as necessary.
	• Unauthorized adjustment of the wastegate control valve actuator rod.	• The turbocharger boost pressure is factory set and must not be adjusted. CHECK that the wastegate actuator valve and rod have not been tampered with. If there is evidence of tampering, INSTALL a new turbocharger. REFER to Removal and Installation - Turbocharger
	• Wastegate valve actuator rod.	• CHECK the wastegate valve actuator rod moves freely. If the wastegate valve actuator rod does not move freely. CHECK for signs of damage or signs of foreign material. REPAIR as necessary. Go to PinPoint Test C

DIAGNOSIS AND TESTING (Continued)

Pinpoint Tests

PINPOINT TEST A : NOISY TURBOCHARGER WITH BLACK OR BLUE EXHAUST SMOKE

Test Step		Result / Action to Take
A1	**INSPECT THE TURBOCHARGER COMPRESSOR VANES FOR DAMAGE**	
	• Carefully disconnect the turbocharger compressor inlet air supply duct from the turbocharger. • Inspect the turbocharger compressor wheel blades for damage. • **Is there visible damage to the compressor wheel?**	**Yes** Go to **A2** and install a new turbocharger. REFER to Removal and Installation - Turbocharger. TEST the system for normal operation. **No** Go to **A3**
A2	**CHECK FOR FOREIGN MATERIAL IN THE INTAKE AIR SYSTEM COMPONENTS**	
	• Check the intake air system components for signs of foreign material. • **Are there any signs of foreign material?**	**Yes** CLEAN the intake air system components. **No** Go to **A4**
A3	**CHECK THE TURBOCHARGER BEARINGS FOR EXCESSIVE MOVEMENT**	
	NOTE: A small amount of movement in the bearings is normal. • Make sure the turbocharger rotor spins freely within the housing. While slowly turning the rotor assembly by hand, push the shaft radially and axially. • **Does the rotor spin freely within the housing?**	**Yes** Go to **A4** **No** INSTALL a new turbocharger. REFER to Removal and Installation - Turbocharger. TEST the system for normal operation.
A4	**CHECK THE TURBOCHARGER OIL SUPPLY TUBE FOR BLOCKAGE**	
	NOTE: New sealing washers should be installed when refitting the oil pipe. • Disconnect the oil supply tube from the turbocharger. • Attach a small piece of known good hose to the oil supply tube and gently blow down the hose. • INSPECT the banjo bolt and turbo oil gallery for signs of blockage or oil clotting. • **Are there any signs of blockage?**	**Yes** INSTALL a new turbocharger oil supply pipe and/or banjo bolt. TEST the system for normal operation. **No** Go to **A5**
A5	**INSPECT THE TURBOCHARGER TURBINE WHEEL FOR DAMAGE**	
	• Remove the exhaust pipe and the dump-pipe from the turbocharger. • Inspect the turbine wheel blades for damage. • **Are there any signs of damage?**	**Yes** INSTALL a new turbocharger. REFER to Removal and Installation - Turbocharger. SOURCE and rectify the cause of the damage to the turbine blades. TEST the system for normal operation. **No** Go to **A1**

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST B : BLUE EXHAUST SMOKE WITHOUT EXCESSIVE TURBOCHARGER NOISE

Test Step		Result / Action to Take
B1	**CHECK THE TURBOCHARGER OIL RETURN PIPE**	
	NOTE: New sealing gaskets should be installed when refitting the oil return pipe. • Disconnect the turbocharger oil return tube from the turbocharger and from the engine sump • Remove the turbocharger oil return tube. • Check the turbocharger oil return tube for a blockage or signs of damage. • **Is the turbocharger oil return tube OK?**	**Yes** Go to **303-01A** for further blue smoke diagnostics. **No** INSTALL a new turbocharger oil return tube. TEST the system for normal operation.

PINPOINT TEST C : POOR ENGINE PERFORMANCE

Test Step		Result / Action to Take
C1	**CHECK THE WASTEGATE ACTUATOR CONTROL HOSE**	
	• Remove the wastegate actuator control hose. • Check that the hose has no cracks or holes, and that it is not blocked. • **Is the hose damaged?**	**Yes** INSTALL a new wastegate actuator control hose. TEST the system for normal operation. **No** Go to **C2**
C2	**CHECK THE WASTEGATE ACTUATOR DIAPHRAGM FOR LEAKS**	
	NOTE: The wastegate control actuator is factory set and must not be adjusted or modified. If the wastegate control actuator is not operating correctly, the complete turbocharger assembly must be replaced. • Connect one end of the wastegate actuator control hose to the wastegate actuator. • Connect the other end of the wastegate control actuator hose to a hand pressure pump. • Using the hand pressure pump apply 45-50 kPa to the wastegate actuator. • **Does the wastegate actuator rod move and hold its new position until the pressure is released?**	**Yes** Go to **C3** **No** INSTALL a new turbocharger. REFER to Removal and Installation - Turbocharger TEST the system for normal operation.

DIAGNOSIS AND TESTING (Continued)

Test Step		Result / Action to Take
C3	**CHECK THE WASTEGATE CONTROL SOLENOID**	**Yes** REPLACE the wastegate control solenoid. REFER to Removal and Installation - Wastegate Control Solenoid. TEST the solenoid. **No** Go to **C4**
	NOTE: The wastegate control solenoid is factory set and must not be adjusted. **NOTE:** If a fault develops in the turbo wastegate control system, a standby function is carried out. The wastegate solenoid is forced fully open (0% duty cycle) allowing minimum mechanical boost to be delivered. If the boost pressure is still higher than desired, torque-limiting by cylinder cut-out will occur. The appropriate trouble code will be logged in memory for retrieval during Self Test mode. • Connect a IDS tester to the diagnostic connector. • Check for Diagnostic Trouble Codes at: - Key-On-Engine-Off (KOEO) - Key-On-Engine-Running (KOER) - Engine Running (cont) • **Is the solenoid operation faulty?**	
C4	**CHECK THE BOOST PRESSURE SENSOR**	**Yes** REPLACE the boost pressure sensor. REFER to Removal and Installation - Boost Pressure Sensor. TEST the sensor. **No** Go to **C5**
	NOTE: The Failure Mode Effects Management (FMEM) strategy will, in most cases, ensure reasonable operation of the vehicle in the event of a BPS failure. If the BPS signal is not within the normal operating range, the PCM will substitute a default value for pre-throttle absolute pressure and use MAP for boost control. The appropriate trouble code will be logged in memory for retrieval during Self Test mode. • Connect a WDS tester to the diagnostic connector. • Check the Parameter Identification (PID) value of the BPS. At Key-On-Engine-Off (KOEO) the value should be between 1.8 - 2.0 Volts. • **Is the PID value within the specified limits?**	
C5	**CHECK THE BOOST PRESSURE**	**Yes** Go to **C6** **No** REPLACE the boost pressure sensor. REFER to Removal and Installation - Boost Pressure Sensor. TEST the sensor.
	NOTE: The boost pressure is factory set and must not be adjusted. • Start and run the engine until normal operating temperature is achieved. • Connect a WDS tester to the diagnostic connector. • Run the engine at idle and observe the Parameter Identification (PID) value of the BPS. The value should be between 1.8 - 2.0 Volts. • **Is the PID value within the specified limits?**	
C6	**CHECK THE CHARGE AIR COOLER AND DUCTING**	**Yes** Unblock or replace components as required. REFER to Removal and Installation - Charge Air Cooler. TEST the system for normal operation. **No** TEST the fuel system. REFER to Section 310-00.
	• Remove the air ducting that runs to and from the charge air cooler. REFER to Removal and Installation - Charge Air Cooler. • Inspect the components for cracks, leaks or blockages. • Remove the charge air cooler. REFER to Removal and Installation - Charge Air Cooler. • Inspect the cooler for cracks, leaks or blockages. • **Are any blocked or damaged components evident?**	

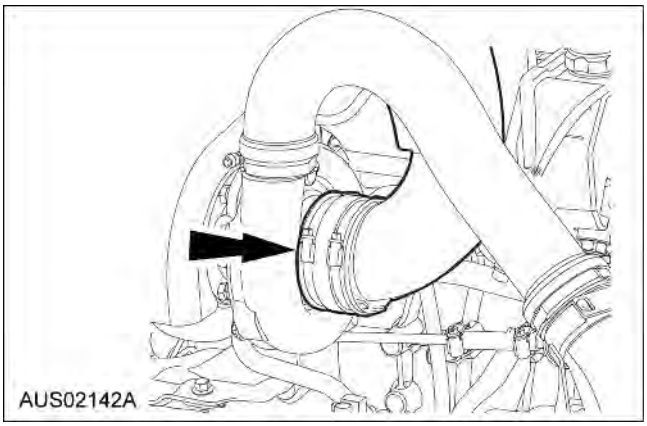
REMOVAL AND INSTALLATION

Turbocharger

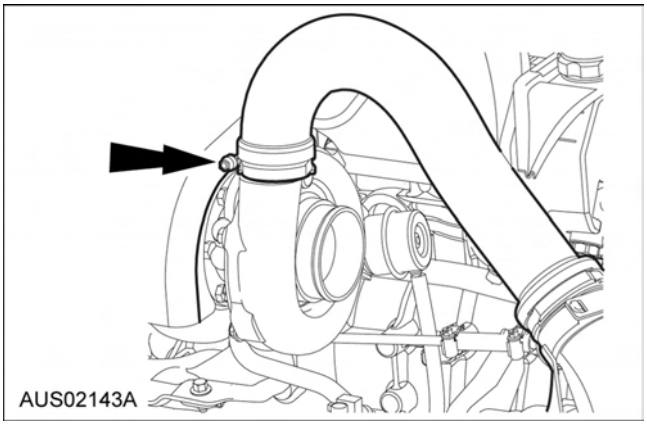
Removal

All vehicles

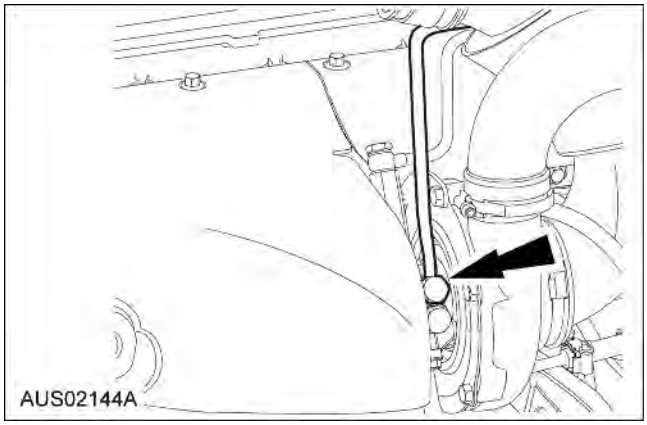
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01.
2. Remove the fresh air duct from the turbocharger.
   1. Unscrew the hose clamps.
   2. Remove the pipe.



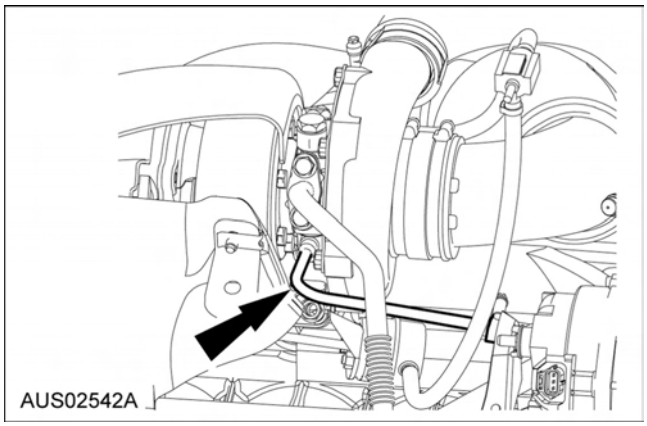
3. Detach the charge air cooler intake duct from the turbocharger.
   1. Unscrew the hose clamp.
   2. Remove the duct.



4. Disconnect the HEGO sensor wiring connector at the flex plate.
5. Disconnect the water inlet tube from the turbocharger.
   1. Discard the sealing washers.

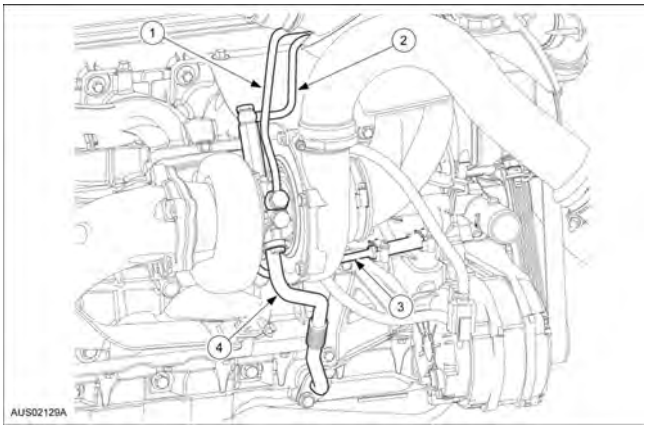


6. Disconnect the water outlet tube from the turbocharger.
   1. Discard the sealing washers.



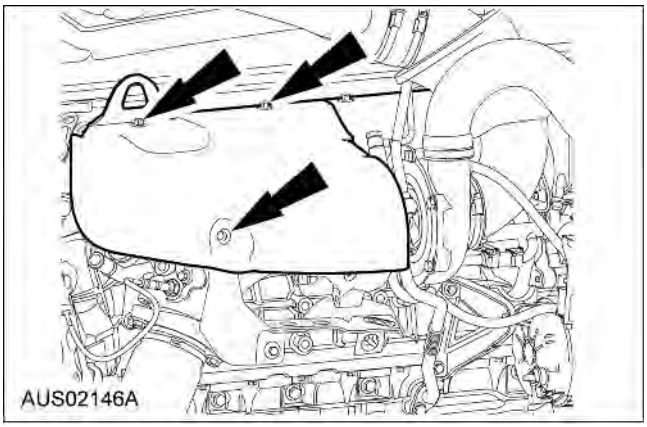
REMOVAL AND INSTALLATION (Continued)

7. Disconnect the oil supply tube from the turbocharger.
   1. Discard the sealing washers.
8. Disconnect the oil return tube from the turbocharger.
   1. Discard the gasket.

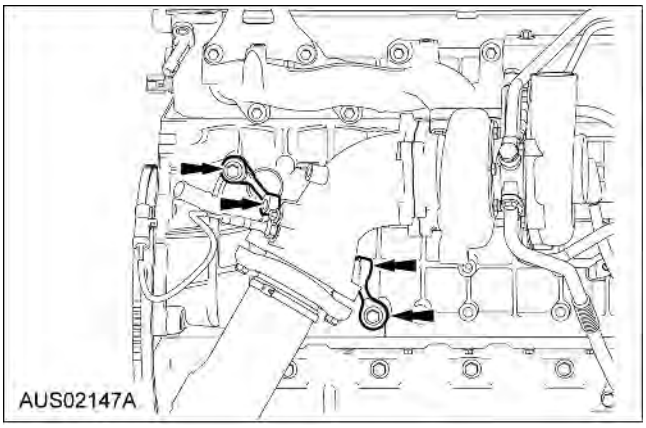


Item	Description
1	Coolant Supply Line
2	Oil Supply Line
3	Coolant Return Pipe
4	Oil Return Pipe

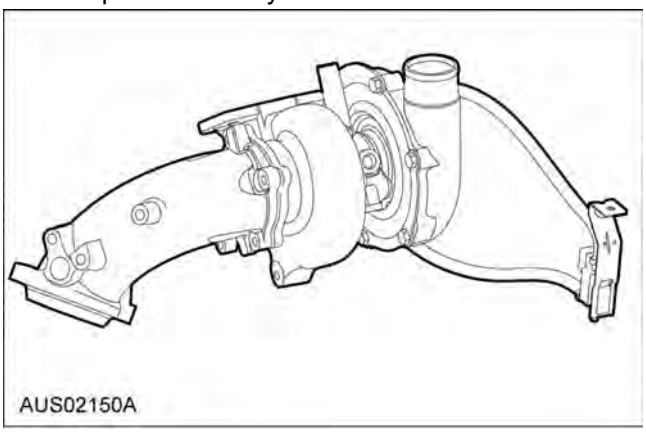
9. Remove the rear turbocharger heatshield:
   1. Remove and discard the three heat shield bolts.
   2. Remove the rear turbocharger heat shield.



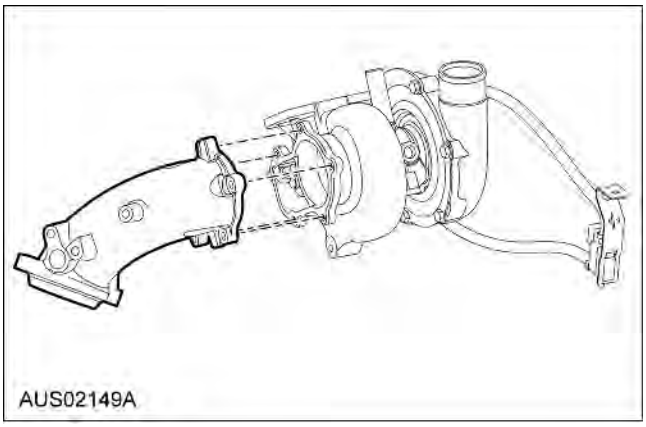
10. Disconnect the exhaust catalyst pipe from the dump-pipe.
11. Remove and discard the dump pipe upper & lower pencil brace bolts from dump pipe and engine block.



12. Remove and discard the four turbocharger to manifold nuts.
13. Remove turbocharger and dump-pipe as a complete assembly.



14. Remove and discard the turbocharger to dump pipe studs.
15. Remove the dump-pipe:
    1. Remove and discard the five retaining bolts.
    2. Discard the gasket.



REMOVAL AND INSTALLATION (Continued)

Installation

All vehicles

NOTE: Install a new dump-pipe gasket.

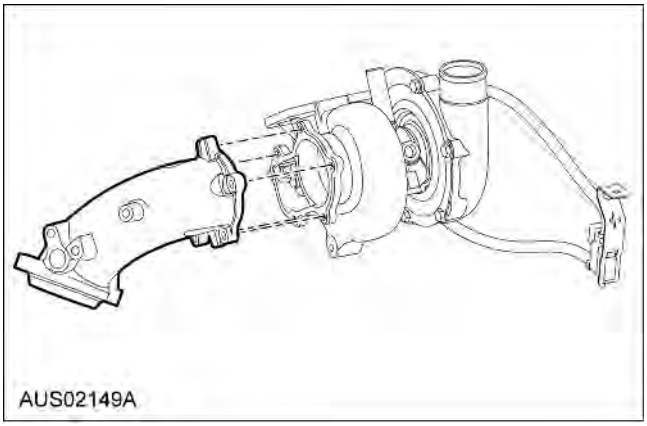
NOTE: Install a new oil return line gasket (x2).

NOTE: Install new oil supply line sealing washers (x2).

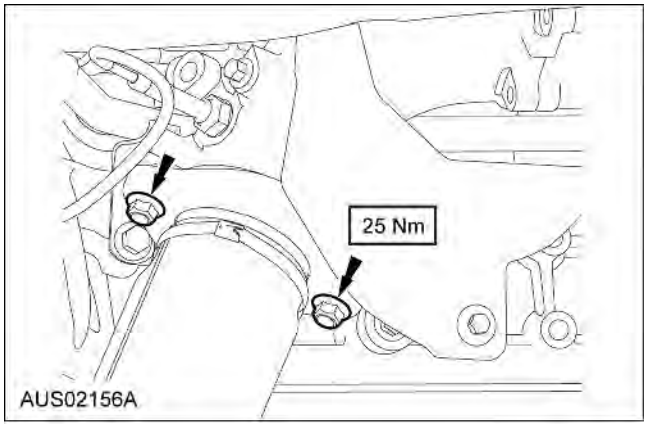
NOTE: Install new coolant supply line gaskets (x2).

NOTE: Install new coolant return line gaskets (x2).

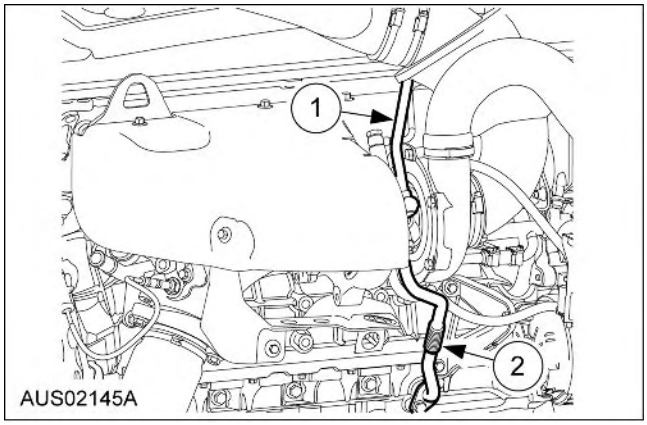
1. Refit the dump-pipe to the turbocharger.
   1. Fit a new dump-pipe gasket.
   2. Use new dump pipe to turbocharger bolts - torque to specification.



2. Ensure bolt holes on exhaust manifold flange are re-tapped to M10 x 1.5 - 6g
3. Refit the turbocharger and dump pipe onto the exhaust manifold.
   1. Fit new turbocharger studs to the exhaust manifold - torque to specification.
   2. Place the turbocharger and dump pipe onto the studs.
   3. Fit new turbocharger nut to the studs - torque to specification.
      NOTE: There is no gasket between the exhaust manifold and turbocharger.
   4. Use new bolts to fit the upper and lower dump pipe braces to the dump pipe and engine block - torque to specification.
4. Reconnect the HEGO sensor wiring.
5. Connect the exhaust catalyst to dump-pipe.
   1. Use new studs.
   2. Use new catalyst pipe nuts.
   3. Torque nuts to specifications.



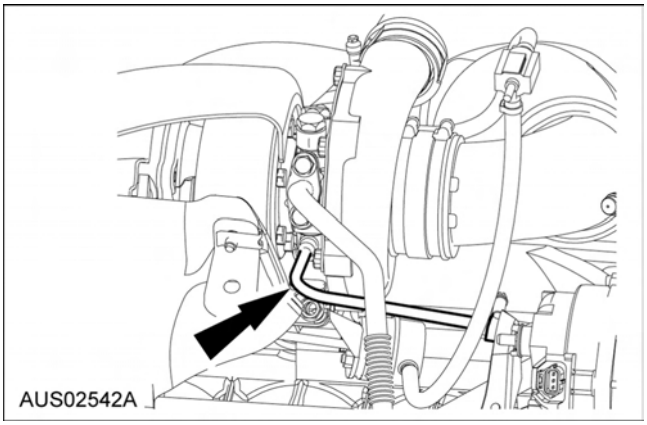
6. Connect the oil return tube to the turbocharger.
   1. Install a new oil return line gasket.



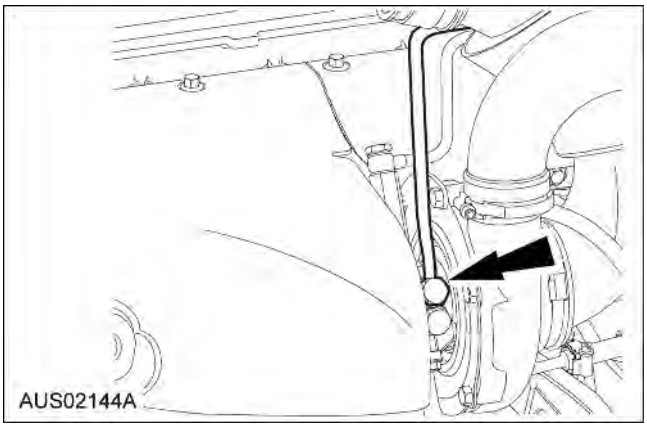
Item	Description
1	Oil supply line
2	Oil return line

REMOVAL AND INSTALLATION (Continued)

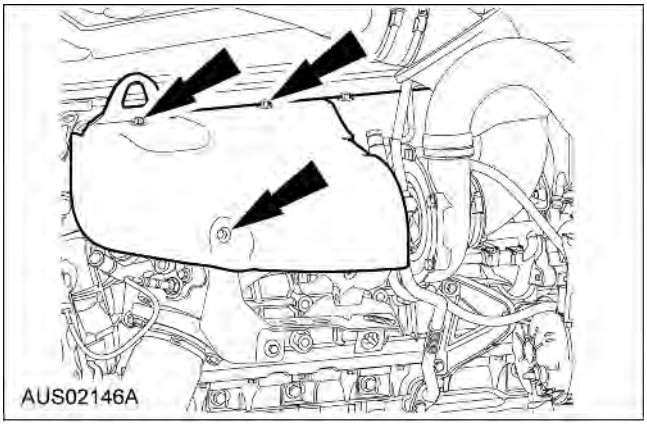
7. Connect the coolant outlet tube to the turbocharger.
   1. Install a new coolant outlet line sealing washers - torque banjo bolt to specification.



8. Connect the coolant inlet line to the turbocharger.
   1. Install a new coolant inlet line sealing washers - torque banjo bolt to specification.

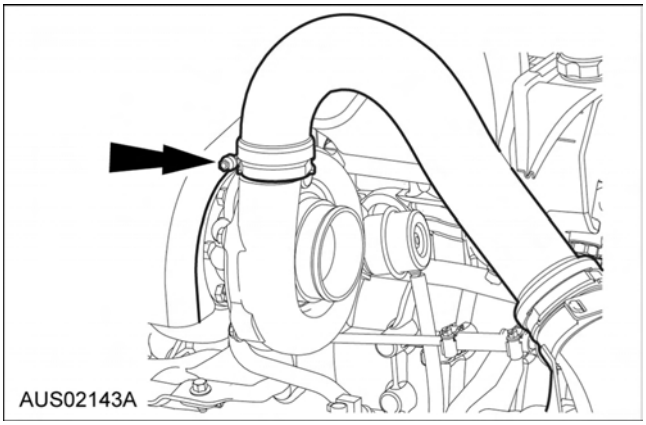


9. Install the rear turbocharger heat shield.
   1. Use new bolts to fit the rear heat shield, hand start all bolts then torque to specification.

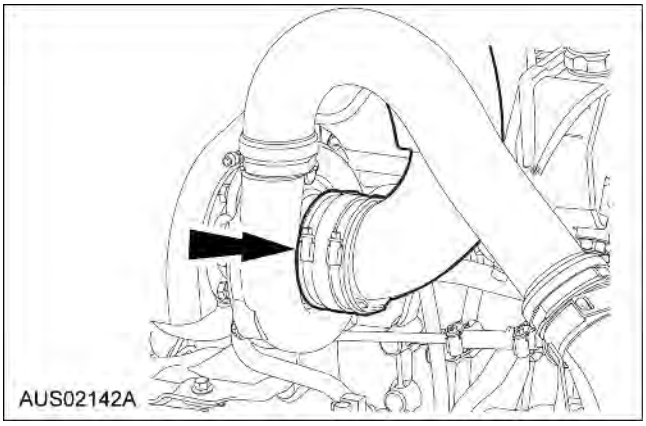


10. Connect the charge air cooler intake pipe.

    CAUTION: Make sure that the inside of the charge air cooler intake pipe is clean and free from any residue as this will reduce the installation grip of the pipe to the charge air cooler. Failure to follow this instruction may result in engine damage.
    1. Install the pipe to the turbocharger.
    2. Refit the two hose clamps and tighten to specification.



11. Install the fresh air inlet duct to the turbocharger.
    1. Install the pipe duct.
    2. Tighten the hose clamps to specification.



12. Connect the battery ground cable. For additional information, refer to Section 414-01.
13. Start engine and check all connections for oil/water/air leaks.

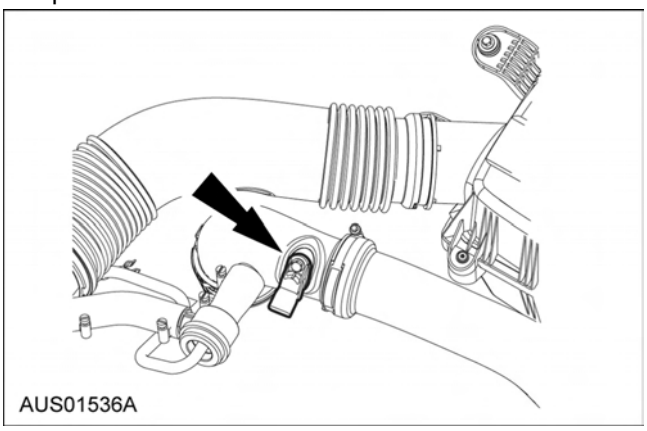
Boost Pressure Sensor

Removal

1. Disconnect the wire harness from the BPS connector.
2. Undo the retaining bolt.

REMOVAL AND INSTALLATION (Continued)

3. Gently pull the sensor out vertically from the plastic duct.



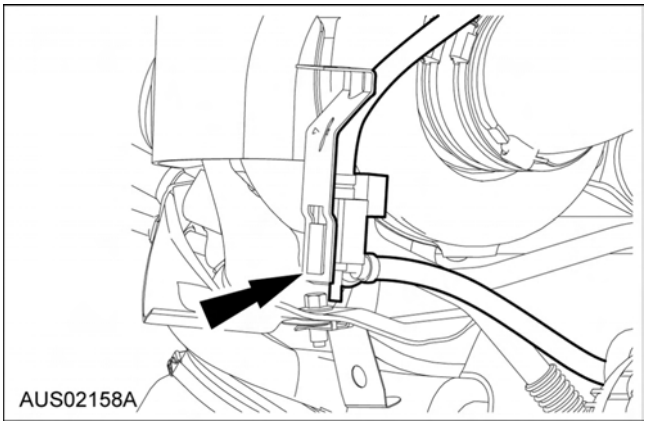
Installation

1. Push the new BPS into the plastic duct.
2. Refit the retaining bolt and tighten.
3. Reconnect the harness to the BPS.

Wastegate Control Solenoid (WCS)

Removal

1. Disconnect the wire harness from the WCS connector.
2. Disconnect the hose that runs from the turbocharger compressor to the WCS.
3. Disconnect the hose that runs from the WCS to the wastegate actuator on the turbocharger.
4. Undo the retaining bolt.
5. Withdraw the wastegate control solenoid.



Item	Description
1	Hose WCS to turbo compressor
2	WCS electrical connection
3	Hose turbocharger actuator to WCS
4	Wastgate control solenoid (WCS)

Installation

1. Fit the wastegate control solenoid into position.
2. Refit the retaining bolt and tighten.
3. Connect the hose that runs from the WCS to the wastegate actuator on the turbocharger.
4. Connect the hose that runs from the turbocharger compressor to the WCS.
5. Reconnect the harness to the WCS.

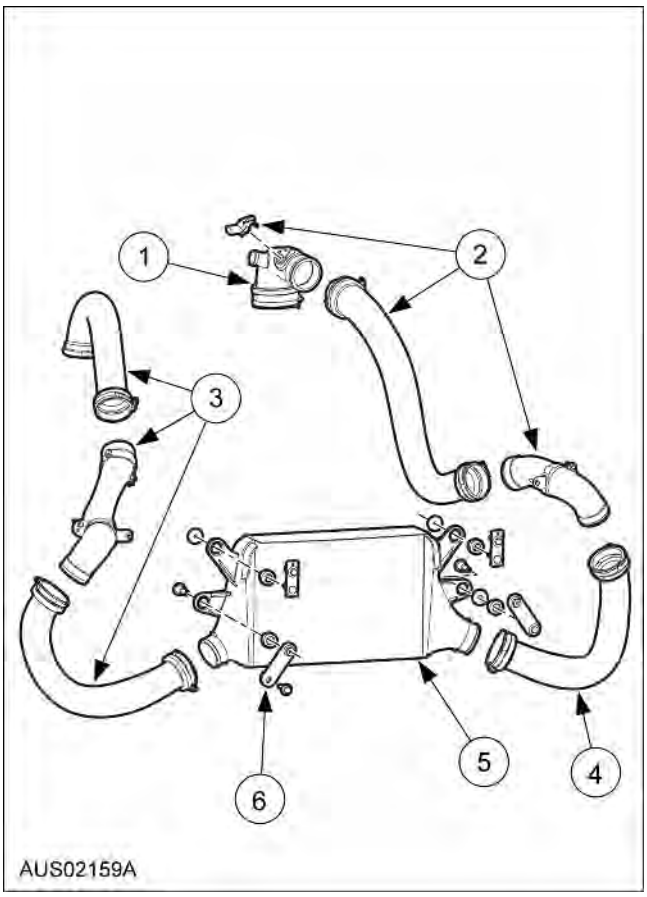
Charge Air Cooler (Intercooler)

Removal

1. Remove bumper and grille, Refer Section 501-19 of this workshop manual.
2. Undo the hose clamps and disconnect the inlet/outlet tube that runs from the intercooler to the adjoining ducts.
3. Remove the bolts holding the intercooler to the plastic reinforced grille opening reinforcement (RGOR)
4. Remove the intercooler and brackets together.
5. Remove the nuts holding the intercooler bracket to the intercooler.

REMOVAL AND INSTALLATION (Continued)

6. Remove the isolators and crush tubes from the intercooler ends.



Item	Description
1	Cool air to intake manifold inc BPS (ETB duct)
2	Cool air ducting
3	Hot air ducting
4	Cool air hose from intercooler
5	Intercooler
6	Intercooler mounting brackets

Installation

1. Installation is the reversal of the removal procedure.
2. Check all connections to ensure there are no airleaks.