

## SECTION : 206-06 Hydraulic Brake Actuation

VEHICLE APPLICATION : 2008.0 Falcon

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## SPECIFICATIONS

### General Specifications

Description	Specification
Brake Fluid (Ford)	Mobil ESZ - M6C55A

### Torque Specifications

Description	Nm
Adjuster Motor Retaining Bolts (adjustable pedal)	$5 \pm 0.5$
Pedal Box Housing	$22.5 \pm 3.4$
Brake Booster Retaining Nuts	$22.5 \pm 3.4$



## DESCRIPTION AND OPERATION

### Hydraulic Brake Actuation

#### Hydraulic Brake System

**⚠ WARNING:** Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes for 15 minutes with cold running water. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

#### Dual Hydraulic Brake System

The hydraulic brake system is a pedal operated, front/rear split, dual line brake system that consists of the following;

- Power brake booster
- Brake master cylinder
- Brake pressure control valves (where fitted)
- Front disc brake caliper assemblies
- Front disc brake rotors
- Rear disc brake calipers
- Brake pipes and hoses
- Anti-lock Brake System (ABS) components

#### Brake Master Cylinder

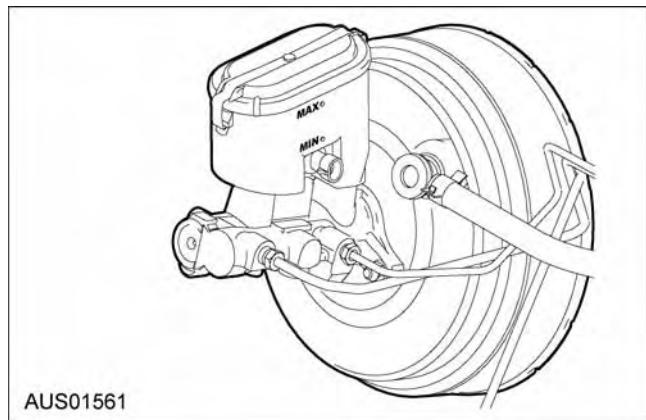
The brake master cylinder is a dual piston type. The master cylinder operates as follows;

- When the brake pedal is applied, pressure is transferred by mechanical linkage to the primary and secondary systems.
- Brake master cylinder pistons apply hydraulic pressure to the two circuits.

The master cylinder consists of;

- Primary and secondary pistons.
- Brake master cylinder reservoir with integral fluid level warning indicator (on all ABS cars and pressure differentiated switch on non ABS utes).
- Fixed proportioning valve on non ABS cars.

### Dual Master Cylinder Brake System (where fitted)



The system consists of a dual master cylinder which incorporates a 'fast fill' valve assembly and a switch. The fluid level switch activates a brake fail warning light, located on the instrument panel.

The primary system operates the front brakes and secondary the rears.

#### Fast Fill Valve

The 'fast fill' (fast pressure build up) valve provides reduced pedal travel by rapidly overcoming the large low pressure displacements associated with roll-back disc brakes that allow for the elimination of pad to rotor drag.

As well as a conventional secondary piston, the cylinder incorporates a stepped primary piston located nearest the booster.

The fluid moved by the larger diameter stepped piston is pushed over the primary seal of the smaller diameter primary piston so bringing the brakes into operation earlier.

The 'fast fill' valve incorporates a pressure seal in one direction, a one-way ball valve in the other and a by-pass bleed groove. In operation, the ball valve retains fluid in the master cylinder until a pre-set line pressure is reached, after which all further increases in pressure are exhausted back into the reservoir, reverting the operation of the master cylinder to that of a normal unit. Recuperation is achieved by fluid by-passing the pressure seal. The by-pass bleed groove allows fluid to by-pass the ball valve ensuring that a fluid passage is maintained between the brake pressure circuit and reservoir in the brakes-off position.

#### Fluid Level Warning Switch

All models have a fluid level warning switch.

The warning switch is dipped into the fluid reservoir and interacts with a float within the fluid. When the fluid level drops below a predetermined level the switch activates, resulting in a warning light on the instrument panel.



## DESCRIPTION AND OPERATION (Continued)

### Power Brake Booster

#### Description

Both 6 and 8 cylinder vehicles are equipped with a twin diaphragm brake booster.

The brake booster is a self-contained vacuum-hydraulic braking unit mounted on the engine side of the dash panel.

The brake booster is of the vacuum suspended type which utilizes engine intake manifold vacuum and atmospheric pressure for its power.

The booster unit is to be replaced, not repaired, if found to be defective.

#### Operation

The Booster Servo Unit is designed to assist the effort applied by the driver's foot on the brake pedal. It uses the vacuum created in the engine inlet manifold to boost force applied at the master cylinder push rod in an exact and controlled manner.

The assembly is mounted between the brake pedal and the master cylinder, with the push rod from the rear of the unit connected to the brake pedal, and a push rod from the front of the unit abuts the master cylinder piston.

The force which assists the pedal effort is obtained by admitting atmospheric pressure to one side of the diaphragm which is suspended in a vacuum. The difference in pressure moves the diaphragm/s and this movement is used in a controlled manner to augment the driver's pedal effort.

In the case of a vacuum failure, the valve and rod assembly of the servo and the master cylinder push rod act as a single push rod. The brakes will, therefore, work in the conventional manner, but more effort will be required on the brake pedal.

### Adjustable Pedal Box

#### Description

The pedal box assembly is a unit construction comprising a reinforced plastic structure upon which the pedals, switchgear and adjustment motors are mounted.

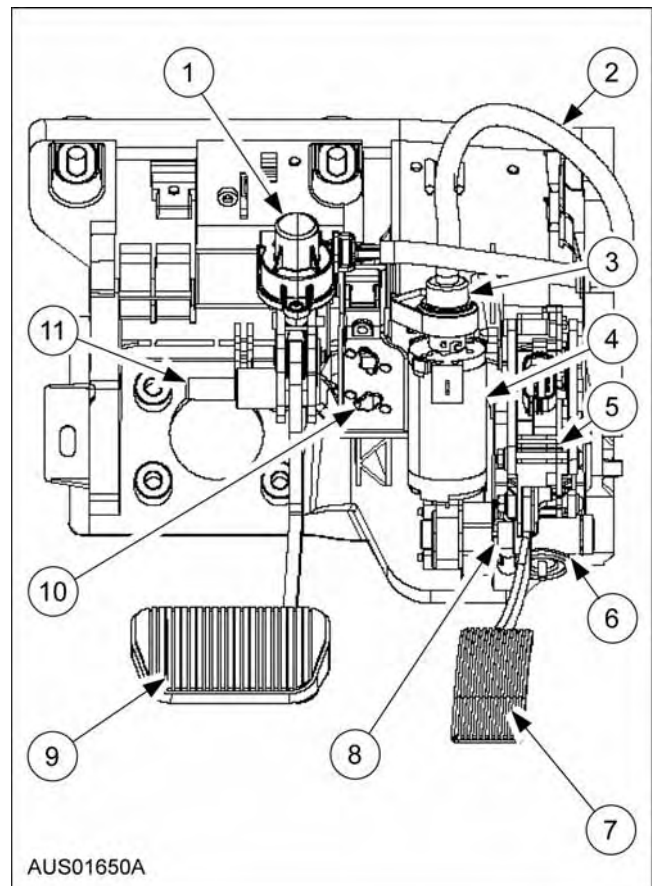
The complete pedal box assembly can be removed from the vehicle as a single unit.

The pedal assembly incorporates the ETC or drive by wire accelerator sender unit. In the adjustable version the brake and accelerator pedals are height adjustable via a switch on the side of the steering column.

Where applicable pedal adjustment is achieved by a single drive motor attached directly to the accelerator pedal with a drive cable running to a gear box on the brake pedal, adjustment of brake and accelerator pedals is simultaneous.

### Acronyms and Abbreviations

APM	Accelerator Pedal Module
PCM	Power Train Module
BEM	Body Electronic Module
Step Over	Height Difference Between Brake and Accelerator Pedal
MSC	Memory Seat Controller
PPS	Pedal Position Sensor



Item	Description
1	Brake Pedal Transmission
2	Adjusting Cable
3	Potentiometer (Memory Only)
4	Adjusting Motor
5	APM
6	Adjusting Motor Transmission
7	Accelerator Pedal
8	Transmission Drive Cable
9	Brake Pedal
10	Brake Lamp Switch / Cruise Control Cut Off Switch (Brake)
11	Brake Booster Rod Pivot



## DIAGNOSIS AND TESTING

### Hydraulic Brake Actuation

#### Inspection and Verification

##### Preliminary checks

**NOTE:** Always check the fluid level in brake master cylinder before carrying out the test procedures. If the fluid level is not at the correct level, fill the reservoir with specified brake fluid.

**NOTE:** Prior to carrying out any diagnosis, make certain that the brake warning indicator is functional.

Visually examine front and rear tires and wheel assemblies for damage such as uneven wear patterns, tread worn out or sidewall damage.

Make sure the tires are of the same size, type and, where possible, same manufacture. Install a new tire or wheel if it is damaged or excessively worn. Wheels and tires must be cleared of any foreign material and tire pressures adjusted to the correct specification.

If tires exhibit uneven wear or feathering, the cause must be corrected. Check steering and suspension components for damage or wear and, if necessary check and adjust front alignment.

A change in brake pedal feel is usually the first indicator of a brake concern. The change may only be normal ABS function, but maybe sufficient cause for further investigation. The brake warning indicator in the instrument cluster and the brake fluid level in the brake master cylinder reservoir are also indicators of the system concerns.

If the wheel is locked and the vehicle must be moved, open the bleeder screw at the locked wheel to let out enough fluid to relieve the pressure. Close the bleeder screw. This bleeding operation may release the brakes but it will not correct the locked wheel condition, repair the locked components before proceeding.

##### Brake Booster

Inspect all hoses and connections, all unused vacuum connectors should be capped. Hoses and their connections should be correctly secured and in good condition with no holes, soft or collapsed areas.

##### Road test


Perform a road test to compare actual vehicle braking performance with the standard performances expected by the driver. The ability of the test driver to make valid comparisons and detect performance deficiencies will depend on experience. The driver should have a thorough knowledge of brake system

operation and accepted general performance guidelines in order to make good comparisons and detect performance problems.

Select a road that is reasonably smooth and level. Gravel and bumpy roads, except to demonstrate ABS function are not suitable. The surface does not allow the tires to grip the road equally. Avoid crowned roads.

A key factor in evaluating brake concerns is the deceleration rate. This varies from vehicle to vehicle and with changes in operating conditions. It is evident how well the brakes are working after just a few applications.

##### Check these items before entering Diagnostics.

Topic	Specification
Brake Fluid Reservoir	Ensure that the Reservoir is Filled to the Max Point. Use Ford Approved Brake Fluid Mobil ESZ - M6C55A.  <b>CAUTION: Do not allow brake fluid to contact vehicle paint work.</b>
Vehicle Test Drive to Confirm Fault	Ensure That Your Local State Speed Limits are Not Exceeded
Battery Voltage	Must be Greater Than 12 Volts
Obstructions	Check for Any Obstructions at the Brake Pedal Area, Such as Floor Mats and Wiring Harnesses

##### Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> <li>• Brake Pedal</li> <li>• Pedal Pad</li> <li>• Adjustment mechanism</li> </ul>	<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Relay(s)</li> <li>• Wiring harness</li> <li>• Electrical connector(s)</li> <li>• Brake pedal switch</li> <li>• MSC</li> </ul>



**DIAGNOSIS AND TESTING (Continued)****Function Test**

Condition	Possible Source	Function Test	Pin Point Test
Pedal Feel	<ul style="list-style-type: none"> <li>Pedal Slow or does not return</li> <li>Binding / Raspy pedal</li> <li>Worn Pedal Pad</li> </ul>	Manual Application Test of the Brake Pedal to confirm Manual Test Visual Inspection	206-06-B 206-06-B
Brake Lamp Switch	<ul style="list-style-type: none"> <li>Not Functioning</li> <li>Adjustment</li> </ul>	Visual Inspection Visual Inspection	206-06-C
Lack of Braking Efficiency	<ul style="list-style-type: none"> <li>Excessive Force Required</li> <li>Master Cylinder Leakage</li> <li>Brake Booster</li> <li>Tyre Wear</li> <li>Tyre Pressure</li> </ul>	Manual Application Test of the Brake Pedal to confirm Visual Inspection Manual Application Test of the Brake Pedal to confirm Visual Inspection Pressure Check	
Adjustable Pedal	<ul style="list-style-type: none"> <li>Memory</li> <li>Adjustment Motor Fault</li> <li>No Pedal Response</li> <li>Adjustment Cable</li> <li>Brake and Accelerator Pedal Heights Incorrect</li> </ul>	Manual Application Test of the Brake Pedal to confirm Measurement	206-06-E 310-02-C5 & 6

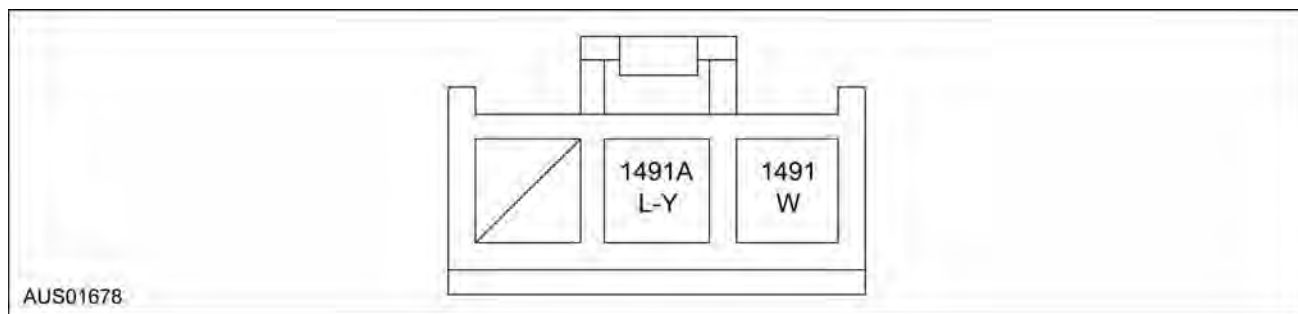
**Symptom Chart**

Condition	Source	Action
<ul style="list-style-type: none"> <li>Pedal Feel</li> </ul>	<ul style="list-style-type: none"> <li>Brake Pedal Not Returning on Release</li> </ul>	<ul style="list-style-type: none"> <li>Go to Pin Point Test 206-06-B</li> </ul>
	<ul style="list-style-type: none"> <li>Excessive Pedal Travel</li> </ul>	<ul style="list-style-type: none"> <li>Braking System Diagnosis. Refer to this section.</li> </ul>
	<ul style="list-style-type: none"> <li>"Raspy" feel</li> </ul>	<ul style="list-style-type: none"> <li>Go to Pin Point Test 206-06-B</li> </ul>
	<ul style="list-style-type: none"> <li>Pedal Binding at Pivot</li> </ul>	<ul style="list-style-type: none"> <li>Go to Pin Point Test 206-06-A</li> </ul>
	<ul style="list-style-type: none"> <li>Pedal Pad Worn</li> </ul>	<ul style="list-style-type: none"> <li>Replace Brake Pedal Pad. Refer to procedure in this section.</li> </ul>
	<ul style="list-style-type: none"> <li>Obstruction at Pedal</li> </ul>	<ul style="list-style-type: none"> <li>Go to Pin Point Test 206-06-B</li> </ul>
<ul style="list-style-type: none"> <li>Poor Braking Efficiency</li> </ul>	<ul style="list-style-type: none"> <li>Faulty Brake Booster</li> </ul>	<ul style="list-style-type: none"> <li>Braking System Diagnosis. Refer to this section.</li> </ul>
	<ul style="list-style-type: none"> <li>Brake Disc Pads Worn</li> </ul>	<ul style="list-style-type: none"> <li>Refer to Brake section 206-03, 206-04.</li> </ul>
	<ul style="list-style-type: none"> <li>Booster Rod Disconnected</li> </ul>	<ul style="list-style-type: none"> <li>Go to Pin Point Test E.</li> </ul>
	<ul style="list-style-type: none"> <li>Vacuum Poor, Leaking or disconnection at the Brake Booster</li> </ul>	<ul style="list-style-type: none"> <li>Refer to Braking System Diagnosis. Refer to this section.</li> </ul>
<ul style="list-style-type: none"> <li>Cruise Control not turning off when brake applied</li> </ul>	<ul style="list-style-type: none"> <li>Brake Master Cylinder Leaking / Faulty</li> </ul>	<ul style="list-style-type: none"> <li>Refer to Braking System Diagnosis. Refer to this section.</li> </ul>
	<ul style="list-style-type: none"> <li>Stop Lamp/Cruise Control Switch Faulty / Plug Disconnected</li> </ul>	<ul style="list-style-type: none"> <li>Go to Pin Point Test D</li> </ul>

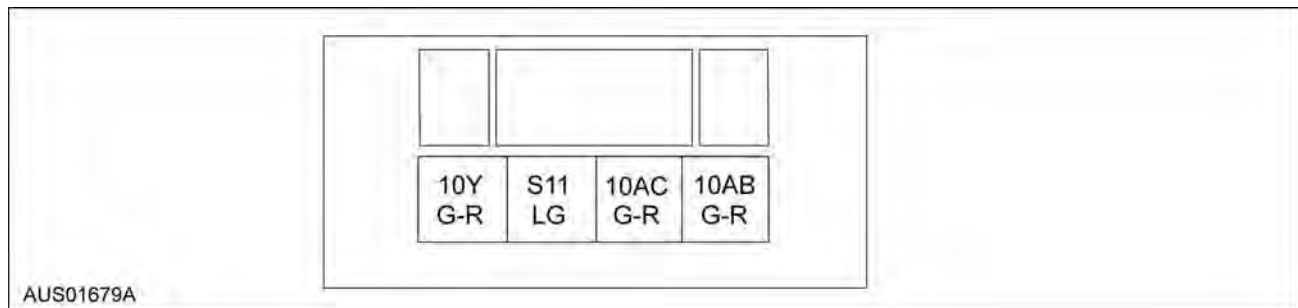


**DIAGNOSIS AND TESTING (Continued)**

Condition	Source	Action
• Adjustable Brake Pedal	• Cannot Adjust Pedals	• Go to Pin Point Test E
	• Faulty Memory	• Go to Pin Point Test E
	• Pedal "Step Over" Height Incorrect	• Go to section 310-02, Pin Point Test C.
• Stop Lamp Switch	• Stop Lamp Switch Faulty	• Go to Pin Point Test C

**Connector Circuit Reference****CONNECTOR C - 378 PEDAL POSITION SENSOR (POTENTIOMETER)**

Pin Number(s)	Circuit Designation/Description	Normal Condition/Measurement
1	BLANK	
2	1491A (Blue / Yellow) Pedal Position Sensor A	Resistance / Voltage
3	1491 (White) Pedal Position Sensor B	Resistance / Voltage

**CONNECTOR C - 191 BRAKE LAMP/CRUISE CONTROL SWITCH**

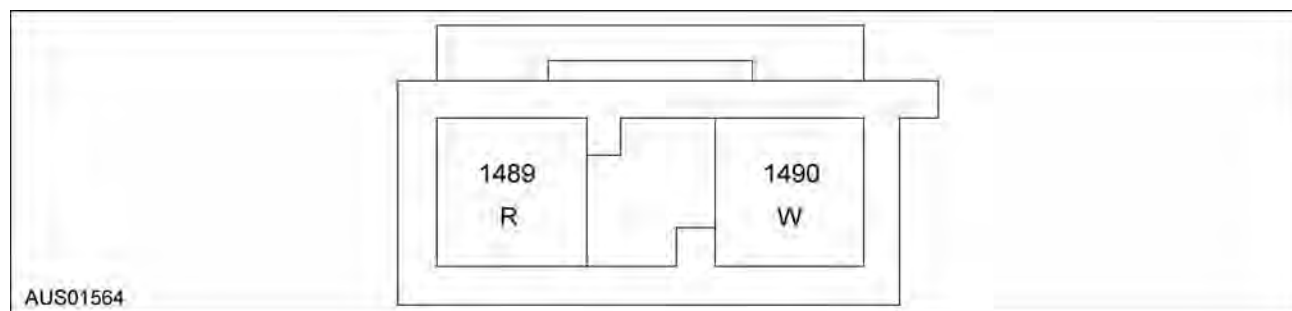
Pin Number(s)	Circuit Designation/Description	Normal Condition/Measurement
4	10AA (Green / Red) Brake Switch High	Ohms - Continuity (only with pedal depressed)
1	10Y (Green / Red) Brake Switch Signal	Ohms - Continuity (only with pedal depressed)
3	10AC (Green/Red) Cruise Control - High	Ohms - Continuity
2	511 (Blue/Green) Cruise Control - Signal	Ohms - Continuity

**CONNECTOR C - 379 PEDAL ADJUSTING MOTOR**

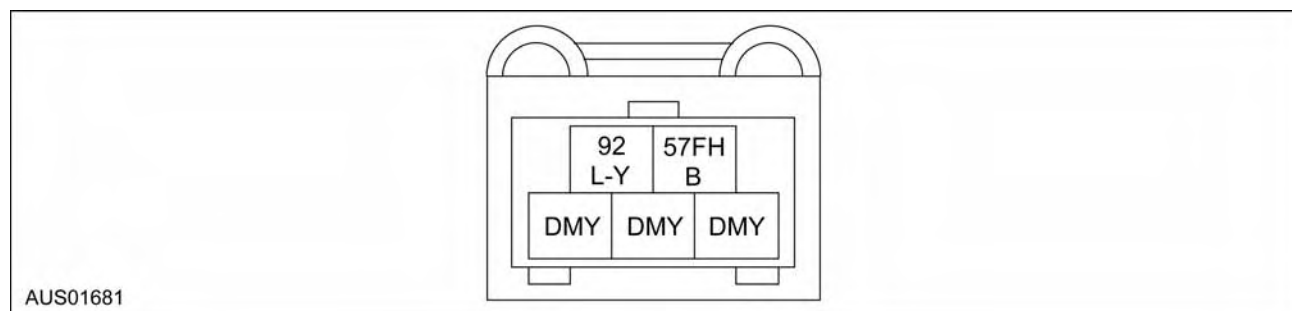
**NOTE:** Ignition to be "ON" for Voltage Tests.

**NOTE:** Battery to be disconnected for resistance checks.



**DIAGNOSIS AND TESTING (Continued)**

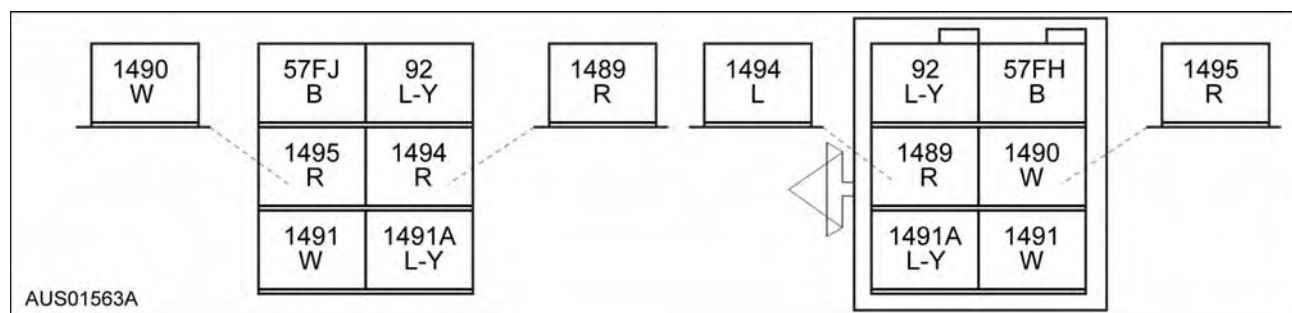
Pin Number(s)	Circuit Designation/Description	Normal Condition/Measurement
1	1489 (R), 1494 (L)	Voltage less than 2 Volts
2	1490 (W), 1495 (R)	Voltage less than 2 Volts

**CONNECTOR C - 111 CRUISE CONTROL SWITCH (CLUTCH)**

Pin Number(s)	Circuit Designation/Description	Normal Condition/Measurement
1	10AC (Green/Red) Cruise Control - Signal	Ohms - Continuity (Yes - nominal state)
2	57FH ((Blue) Cruise Control - High	Ohms - Continuity (Yes - nominal state)

**CONNECTOR C - 395 PEDAL BOX HARNESS**

**NOTE:** Depending on the vehicle level some of the terminals listed below will be blank. High series connector shown. Values given are with connector C-395 connected, ignition on and back probing the terminals.



Pin Number(s)	Circuit Designation/Description	Normal Condition/Measurement
1	57 (Black) Clutch Switch Ground	
2	1490 (White) or 1495 (Red) Non memory pedal adj motor/memory pedal adj motor	Using adjustment switch - Centre =0 Volts, Upwards = 12-14 Volts. Downwards = 0.1 Volt
3	1491 (White) Pedal position sensor B	
4	92 (Blue/Yellow) Clutch switch - signal	N/A





**DIAGNOSIS AND TESTING (Continued)**

Pin Number(s)	Circuit Designation/Description	Normal Condition/Measurement
5	1489 (Red) or 1494 (Blue) Non memory pedal adj motor/memory pedal adj motor	N/A
	1491A (Blue/Yellow) Pedal position sensor - A	

**Pinpoint Tests****PINPOINT TEST A : EXCESSIVE BRAKE PEDAL MOVEMENT AT PIVOT**

Test Step		Result / Action to Take
<b>A1</b>	<b>PEDAL MOVEMENT CHECK</b>	<b>Yes</b> Go to <b>A2</b>  <b>No</b> Okay
	<ul style="list-style-type: none"> <li>Grasp the Brake pedal pad area with your hand.</li> <li>Move the pedal from side to side to check for movement at the upper pivot area.</li> <li>Carry out check in the applied and not applied brake pedal position.</li> <li><b>Is the pedal movement more than the maximum of <math>\pm 3.5</math> mm?</b></li> </ul>	
<b>A2</b>	<b>PIVOT PIN HOUSING DAMAGE</b>	<b>Yes</b> Replace the pedal box assembly. Refer to removal and installation instructions in this chapter.  <b>No</b> Okay
	<ul style="list-style-type: none"> <li>Carry out this check the same as described in test step A 1.</li> <li>Using a Torch visually inspect for any cracks around the pivot pin housing as the pedal is moved side to side and applied towards floor.</li> <li><b>Were any cracks found?</b></li> </ul>	

**PINPOINT TEST B : PEDAL FEEL INCORRECT**

**CAUTION:** Step B2, Remember to tighten the Booster retaining nuts to (22.5 +/- 3.4 NM) when the test is completed.

Test Step		Result / Action to Take
<b>B1</b>	<b>OBSTRUCTIONS AT PEDAL</b>	<b>Yes</b> Remove the obstruction and recheck  <b>No</b> Go to <b>B2</b>
	<ul style="list-style-type: none"> <li>Check for obstructions at and / under the brake pedal, such as a floor mat or wiring harness fouling the upper mechanism.</li> <li><b>Did you find an obstruction?</b></li> </ul>	
<b>B2</b>	<b>BRAKE PEDAL RETURN</b>	<b>Yes</b> Replace the pedal box assembly. Refer to removal and installation instructions in this chapter.  <b>No</b> Go to the brake booster. Refer to removal and installation instructions in this chapter
	<ul style="list-style-type: none"> <li>Loosen the Four nuts used to retain the brake booster to the pedal box.</li> <li>Remove the pin used to retain the booster rod to the brake pedal.</li> <li>Detach the booster rod from the brake pedal.</li> <li>Move the brake pedal up and down slowly, looking for evidence of binding.</li> <li><b>Did the brake pedal bind when moving up and down?</b></li> </ul>	



## DIAGNOSIS AND TESTING (Continued)

### PINPOINT TEST C : STOP LAMP SWITCH

Test Step		Result / Action to Take
<b>C1</b>	<b>STOP LAMP OPERATIONAL CHECK</b>	<b>Yes</b> Stop lamp circuit Okay  <b>No</b> Go to <b>C2</b>
	<ul style="list-style-type: none"> <li>Ignition ON.</li> <li>Apply brake pedal.</li> <li>Do the rear Stop lamps illuminate?</li> </ul>	
<b>C2</b>	<b>STOP LAMP CIRCUIT FUSE</b>	<b>Yes</b> Replace Fuse and recheck. <b>NOTE:</b> If Fuse blows again, this could indicate an electrical system fault.  <b>No</b> Go to <b>C3</b>
	<ul style="list-style-type: none"> <li>Check the 15 Amp Fuse # 7.</li> <li>Was Fuse blown?</li> </ul>	
<b>C3</b>	<b>PCM CHECK</b>	<b>Yes</b> PCM issue. Refer to Section 303-14.  <b>No</b> Go to <b>C4</b>
	<ul style="list-style-type: none"> <li>Disconnect PCM connector C301</li> <li>Ignition ON.</li> <li>Apply brake pedal.</li> <li>Do the rear stop lamps now illuminate?</li> </ul>	
<b>C4</b>	<b>ABS CHECK</b>	<b>Yes</b> PCM issue. Refer to Section 206-09.  <b>No</b> Go to <b>C5</b>
	<ul style="list-style-type: none"> <li>Disconnect ABS connector C150</li> <li>Ignition ON.</li> <li>Apply brake pedal.</li> <li>Do the rear stop lamps now illuminate?</li> </ul>	
<b>C5</b>	<b>STOP LAMP SWITCH CONTINUITY</b>	<b>Yes</b> Stop lamp switch Okay  <b>No</b> Replace the stop lamp switch. Refer in this Section.
	<ul style="list-style-type: none"> <li>Remove the Stop lamp switch. Refer to Section 417-01.</li> <li>Carry out a continuity test.</li> <li>With the stop lamp switch plunger Out = Continuity.</li> <li>Push the stop lamp switch plunger Inwards = Open circuit.</li> <li>Is the stop lamp switch continuity check Okay?</li> </ul>	

### PINPOINT TEST D : CRUISE CONTROL BRAKE PEDAL CUT OFF SWITCH

Test Step		Result / Action to Take
<b>D1</b>	<b>STOP LAMP CIRCUIT FUSE</b>	<b>Yes</b> Replace Fuse and recheck. <b>NOTE:</b> If Fuse blows again, this could indicate an electrical system fault.  <b>No</b> Go to <b>D2</b>
	<ul style="list-style-type: none"> <li>Check the 15 Amp Fuse #7</li> <li>Was Fuse blown?</li> </ul>	



**DIAGNOSIS AND TESTING (Continued)**

Test Step		Result / Action to Take
<b>D2</b>	<b>CRUISE CONTROL SWITCH CONTINUITY</b>	<b>Yes</b> Go to <b>D3</b>  <b>No</b> Replace the cruise control switch. Refer to Section 303-14.
	<ul style="list-style-type: none"> <li>Remove the cruise control switch, colour Green. Refer to Section 303-14.</li> <li>Carry out a continuity test.</li> <li>With the switch pin Out = Open circuit.</li> <li>Push the switch pin Inwards = continuity.</li> <li><b>Is the cruise control switch continuity check Okay?</b></li> </ul>	
<b>D3</b>	<b>SWITCH EARTH CIRCUIT CONTINUITY</b>	<b>Yes</b> PCM issue. Refer to Section 303-14.  <b>No</b> Check and repair wiring or terminal fault
	<ul style="list-style-type: none"> <li>Disconnect PCM connector terminal C301.</li> <li>Ignition ON.</li> <li>Apply brake pedal.</li> <li><b>Was there continuity?</b></li> </ul>	

**PINPOINT TEST E : ADJUSTABLE PEDAL ISSUES**

**NOTE:** The Pedal adjustment motor is equipped with a Thermal cutout feature. If the motor is operated for an extended period this Thermal cutout will open circuit (trip). In this case wait for 5 Minutes to allow resetting of the Thermal cutout device.

Test Step		Result / Action to Take
<b>E1</b>	<b>NO ADJUSTMENT RESPONSE - PART 1</b>	<b>Yes</b> Go to <b>E2</b>  <b>No</b> Reconnect the connector and retest
	<ul style="list-style-type: none"> <li>Check to see if the electric wiring connector C-379 is connected, to the pedal adjustment motor.</li> <li><b>Is C-379 connected?</b></li> </ul>	
<b>E2</b>	<b>PEDAL BOX HARNESS</b>	<b>Yes</b> Go to <b>E3</b>  <b>No</b> Reconnect the connector and retest
	<ul style="list-style-type: none"> <li>Check to see if the electrical wiring connector C-395 is connected.</li> <li><b>Is C-395 connected?</b></li> </ul>	
<b>E3</b>	<b>NO PEDAL RESPONSE</b>	<b>Yes</b> Go to <b>E4</b>  <b>No</b> Electrical issue at the vehicle harness. Refer to Section 418-00 & Wiring Supplement.
	<ul style="list-style-type: none"> <li>Remove the electrical connector C-379 from the pedal adjustment motor.</li> <li>Ignition On.</li> <li>Using a multimeter, check the Voltage at the terminals, Red (+) and White (-) wires at the vehicle harness connector C-379.</li> <li><b>Is the Voltage less than 2 Volts?</b></li> </ul>	



**DIAGNOSIS AND TESTING (Continued)**

<b>Test Step</b>		<b>Result / Action to Take</b>
<b>E4</b>	<b>ADJUSTMENT SWITCH VOLTAGE CHECK</b>	
	<ul style="list-style-type: none"> <li>Remove the electrical connector C-379 from the pedal adjustment motor.</li> <li>Using a multimeter, check the Voltage at the terminals, Red (+) and White (-) wires at the vehicle harness connector C-379.</li> <li>Ignition On. Hold down the Brake pedal adjustment switch (at steering column).</li> </ul> <p><b>NOTE:</b> The voltage polarity will change when the switch is held in the opposite direction.</p> <ul style="list-style-type: none"> <li><b>Is the voltage reading equal to or greater than 12 volts?</b></li> </ul>	<p><b>Yes</b> Go to <b>E5</b> (reconnect connector C-379).</p> <p><b>No</b> Go to <b>E6</b></p>
<b>E5</b>	<b>BRAKE PEDAL ADJUSTMENT SWITCH</b>	
	<ul style="list-style-type: none"> <li>Ignition On.</li> <li>Ensure that the "thermal cutout has not "tripped" (will have to wait 5 Minutes for reset).</li> <li>Operate Pedal adjustment switch.</li> <li><b>Does the motor emit a "click" sound when the switch is operated?</b></li> </ul>	<p><b>Yes</b> Go to <b>E7</b></p> <p><b>No</b> Replace the Adjustment Motor. Refer to procedure in this section.</p>
<b>E6</b>	<b>PEDAL ACTIVATION SWITCH</b>	
	<ul style="list-style-type: none"> <li>Remove the lower section of the steering shroud. Refer to Section 211-04.</li> <li>Disconnect the electrical connector from the activation switch harness.</li> <li>Push the activation switch to the forward position. Using an Ohms meter check for continuity between the Black, Blue/Black and Blue/Orange wires.</li> <li>Push the activation switch to the downwards position. Using an Ohms meter check for continuity between the Black, Yellow and Blue/Orange wires.</li> <li><b>Did the activation switch have continuity in the forward / downward Ohms check?</b></li> </ul>	<p><b>Yes</b> Carry out vehicle wiring harness testing. Refer to the appropriate wiring diagram.</p> <p><b>No</b> Replace the pedal activation switch. Refer to Section 211-05.</p>
<b>E7</b>	<b>MEMORY FUNCTION NOT OPERATING (MEMORY UNIT ONLY)</b>	
	<p><b>NOTE:</b> Pedal position sensor faults should have been set by error code from the memory seat control.</p> <ul style="list-style-type: none"> <li>Disconnect the Potentiometer electrical connector C-378 from the adjustment cable.</li> <li>Using a multimeter, check the resistance at the terminals, L - Y (+) and White (-) wires at the vehicle harness connector C-378.</li> <li>Reconnect connector C-378.</li> <li><b>Was the resistance less than 1.5 K<math>\Omega</math>?</b></li> </ul>	<p><b>Yes</b> Replace the adjustment cable assembly. Refer to procedure in this section.</p> <p><b>No</b> If the resistance reading was greater than 10 K <math>\Omega</math>. Replace the adjustment cable. Refer to procedure in this section. Otherwise. Go to <b>E8</b></p>



**DIAGNOSIS AND TESTING (Continued)**

Test Step		Result / Action to Take
E8	POTENTIOMETER - RESISTANCE FEED BACK STAGE-1 (MEMORY ONLY)	<b>Yes</b> Go to <b>E9</b>  <b>No</b> Replace the adjustment cable. Refer to procedure in this section.
<ul style="list-style-type: none"><li>Adjust pedals to the fully forward position.</li><li>Using a multimeter, check the resistance at the terminals, L - Y (+) and White (-) wires at the vehicle harness connector C-378.</li><li>Adjust pedals to the fully rearward position.</li><li>Using a multimeter, check the resistance at the terminals, L - Y (+) and White (-) wires at the vehicle harness connector C-378.</li><li>Is the resistance value between the fully forward and rearward positions greater than 600 Ω?</li></ul>		
E9	POTENTIOMETER - RESISTANCE FEED BACK STAGE-2 (MEMORY ONLY)	<b>Yes</b> Go to <b>E10</b>  <b>No</b> Adjustment cable incorrectly adjusted. Refer to procedure in this section.
<ul style="list-style-type: none"><li>Using the resistance readings taken in E 7.</li><li>Was the resistance reading for "full forward " position between 1.5 and 4.5 KΩ?</li></ul>		
E10	ADJUSTMENT CABLE	<b>Yes</b> Remove the adjustment cable. Refer to procedure in this section. Grasp the inner cable to see if it turns freely, if not replace the cable. Refer to procedure in this section or the cause of twisting, jamming etc.  <b>No</b> Go to <b>E11</b>
<ul style="list-style-type: none"><li>Check the adjustment cable for jamming, crushed, twisted or caught condition.</li><li>Did any of the above occur?</li></ul>		
E11	BRAKE PEDAL ADJUSTMENT TRANSMISSION / CABLE	<b>Yes</b> Go to <b>E12</b>  <b>No</b> Replace pedal box assembly. Refer to procedure in this section.
<ul style="list-style-type: none"><li>Gently disconnect the drive cable from the adjustment motor transmission (located top of brake pedal).</li><li>Using your fingers fully rotate the inner cable 10 times clockwise and 10 times anticlockwise.</li><li>View the brake pedal for movement while turning the inner cable.</li><li>Clockwise - Rearward pedal movement, anticlockwise - Forward pedal movement.</li><li><b>NOTE:</b> When turning the inner cable the pedal will only move very slightly. Care should be taken when viewing movement.</li><li>Does the pedal move when cable turned?</li></ul>		
E12	ACCELERATOR ADJUSTMENT TRANSMISSION. PART - 1	<b>Yes</b> Go to <b>E14</b>  <b>No</b> Go to <b>E13</b>
<ul style="list-style-type: none"><li>Disconnect the brake pedal transmission drive cable from the brake pedal transmission.</li><li>Ignition On.</li><li>Operate the adjustment switch.</li><li>Does the accelerator pedal move?</li></ul>		



**DIAGNOSIS AND TESTING (Continued)**

Test Step		Result / Action to Take
<b>E13</b>	<b>ACCELERATOR ADJUSTMENT TRANSMISSION. PART-2</b>	
	<ul style="list-style-type: none"> <li>Remove the pedal box assembly from the vehicle. Refer to procedure in this section.</li> <li>Remove the adjusting motor. Refer to procedure in this section.</li> <li>Using your fingers, fully rotate the accelerator pedal transmission "short" cable 10 times clockwise and 10 times anti-clockwise. View the accelerator pedal for movement while turning the cable.</li> </ul> <p><b>NOTE:</b> When turning the cable the accelerator pedal will only move very slightly. Care should be taken when viewing pedal movement.</p> <ul style="list-style-type: none"> <li><b>Did the cable turn?</b></li> </ul>	<p><b>Yes</b> Pedal adjustment transmission operating okay. Replace the adjusting motor. Refer to procedure in this section.</p> <p><b>No</b> Replace the pedal adjustment transmission. Refer to procedure in this section.</p>
<b>E14</b>	<b>STEP OVER HEIGHT CHECK PART 1</b>	
	<ul style="list-style-type: none"> <li>Measure the Step over height between the Brake and Accelerator pedal.</li> <li><b>Is the measured height distance more than 40mm?</b></li> </ul>	<p><b>Yes</b> Rectify the pedal Indexing. Refer to procedure in this section.</p> <p><b>No</b> Go to <b>E15</b></p>
<b>E15</b>	<b>STEP OVER HEIGHT CHECK PART 2</b>	
	<ul style="list-style-type: none"> <li>Measure the Step over height between the Brake and Accelerator pedal.</li> <li><b>Is the measured height distance less than 30mm?</b></li> </ul>	<p><b>Yes</b> Rectify the pedal Indexing. Refer to procedure in this section.</p> <p><b>No</b> Step Over height okay, no further work required.</p>



## GENERAL PROCEDURES

### Adjustable Brake Indexing

1. Refer to Section 310-02.

### System Bleeding

1. Refer to Section 206-00.

### Power Brake Booster Testing

1. Check the hydraulic brake system for leaks or insufficient fluid.
2. With the transmission in neutral, stop the engine and apply the parking brake. Depress the brake pedal several times to exhaust all vacuum in the system.
3. With the engine shut off and all vacuum in the system exhausted, depress the pedal, and hold it in the applied position. Start the engine. If the vacuum system is operating, the pedal will tend to fall away under foot pressure and less pressure will be required to hold the pedal in the applied position. If no action is felt, the vacuum booster system is not functioning.
4. Remove the vacuum hose from the brake booster check valve connection. Manifold vacuum should be available at the check valve end of the hose with the engine at idle speed and the transmission in neutral. Be sure that all unused vacuum outlets are properly capped, hose connectors properly secured, and that vacuum hoses are in good condition. When it is established that manifold vacuum is available to the booster, test the check valve and replace if necessary. With the engine shut off disconnect the vacuum hose from the check valve. Connect a piece of tubing to the check valve and blow into the check valve. No air should pass through the valve. Connect the vacuum hose to the booster and repeat Step 3. If no downward movement of the brake pedal is felt, replace the brake booster.
5. Operate the engine a minimum of 10 seconds at fast idle. Stop the engine and let the vehicle stand for 10 minutes; then, depress the brake pedal with approximately 80 N force. The pedal feel (brake application) should be the same as that noted with the engine operating. If the pedal feels hard (no power assist), replace the brake booster.

**NOTE:** If the brake pedal movement feels spongy, bleed the hydraulic system to remove air from the system.

### Hydraulic Line Repair

Always bleed the applicable primary or secondary brake system after hose or line replacement.

Install the lines and retaining clips as shown on the illustrations.

### Brake Hose Replacement

A flexible brake hose should be replaced if it shows signs of softening, cracking, leaks or abrasion.

When installing a brake hose, position the hose to avoid contact with other chassis parts.

Brake hoses should be installed as shown on the installation drawings.

Hoses must not be twisted.

New copper gaskets must be installed in all applicable locations.

### Brake Tube Replacement

If a section of the brake tubing becomes damaged, the entire section should be replaced with tubing of the same type, (special doublewall steel tubing conforming to specification ASTM-A 254-6T), size, shape and length. Copper tubing should not be used in a hydraulic system.

Brake lines should be installed as shown on the installation drawings.

Use Special Tools when bending brake tubing to fit underbody or rear axle contours. Be careful not to kink or crack the tube.

All brake tubing should have the ends formed identical to the existing ends (using Special Tools) to provide leak-proof connections. Clean the brake tubing by flushing with clean brake fluid before installation.



## REMOVAL AND INSTALLATION

### Pedal Box Assembly

#### Removal

**⚠ WARNING:** Wait at least one minute after disconnecting the battery ground cable before disconnecting any electrical connector.

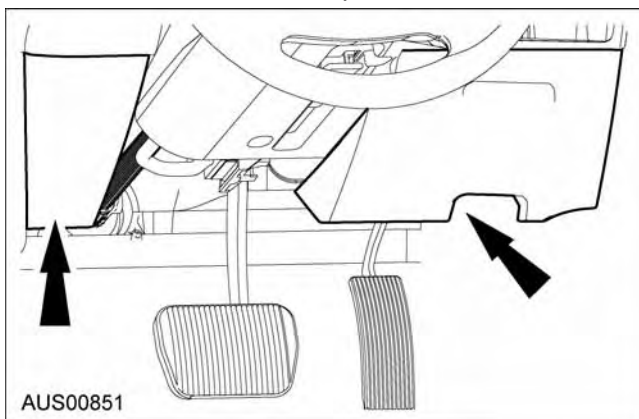
**⚠ CAUTION:** Battery must be disconnected prior to removing brake box assembly.

**NOTE:** This is not a dealer serviced item. Pedal box must be replaced if brake pedal requires replacement because this is a safety critical assembly.

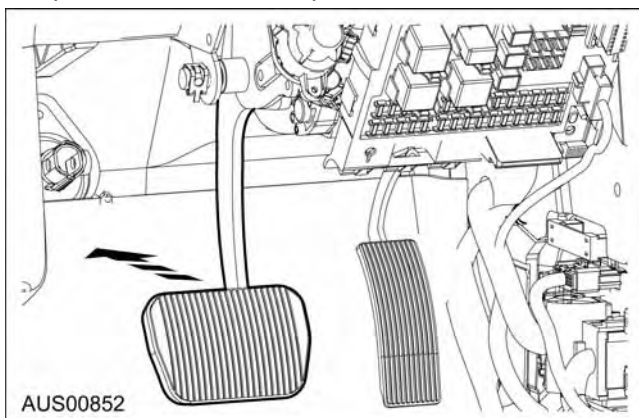
**NOTE:** There are four variants of the pedal box, which include three variants to the brake pedal. Removal and replacement is similar for all pedal boxes. Removal of pedal box assembly is required to service components.

**NOTE:** The steering column must first be removed to allow removal of the pedal box.

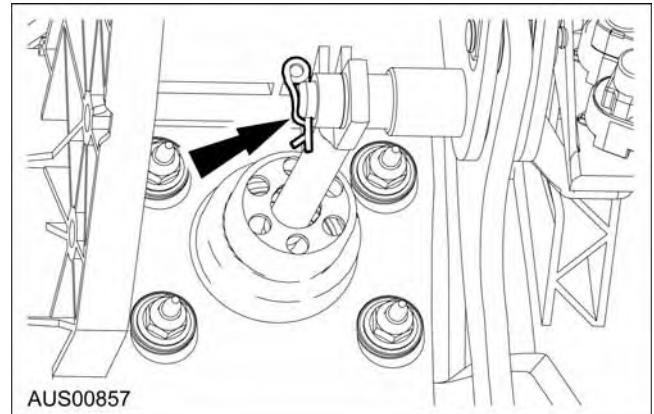
1. Remove the lower dash panel.



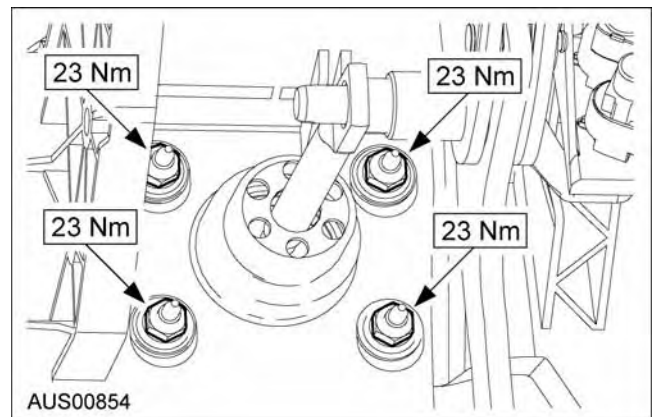
2. Remove side kick panel (Refer to Section 501-12).
3. Remove steering column (Refer to Section 211-04).
4. Where adjustable pedal box is fitted, adjust brake pedal down to lowest position as shown.



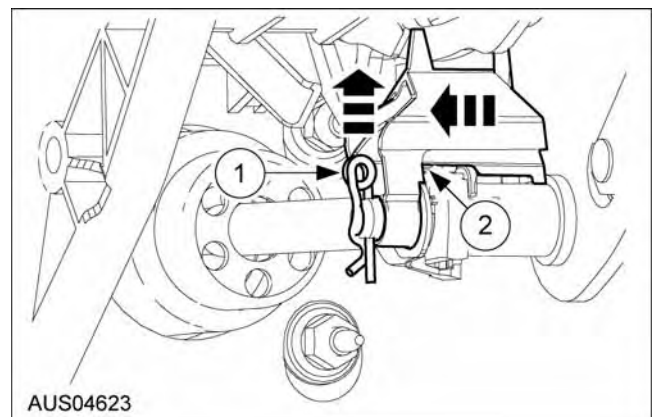
5. Dislodge brake booster pin clip by pulling rear and upward.



6. Remove rotator de-coupler.
7. Undo four brake booster mounting bolts.



8. Disconnect booster rod from brake pedal by sliding the booster rod toward the passenger side of the vehicle.



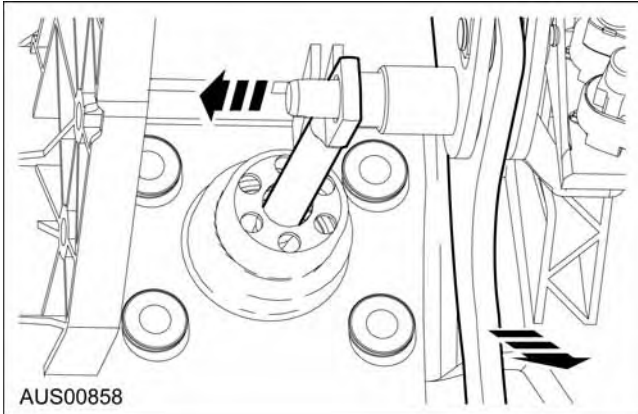
Item	Description
1	Pin Clip
2	Rotator De-coupler



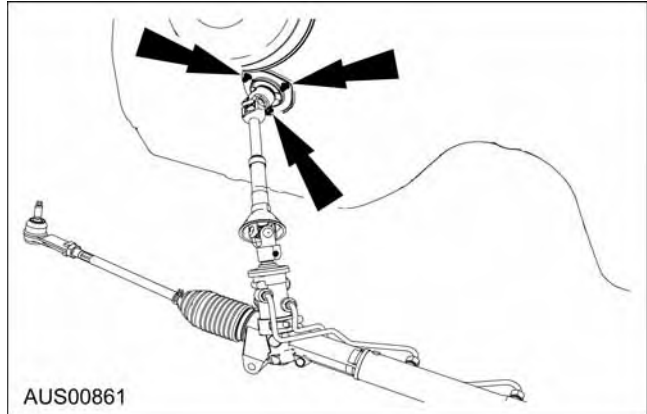


**REMOVAL AND INSTALLATION (Continued)**

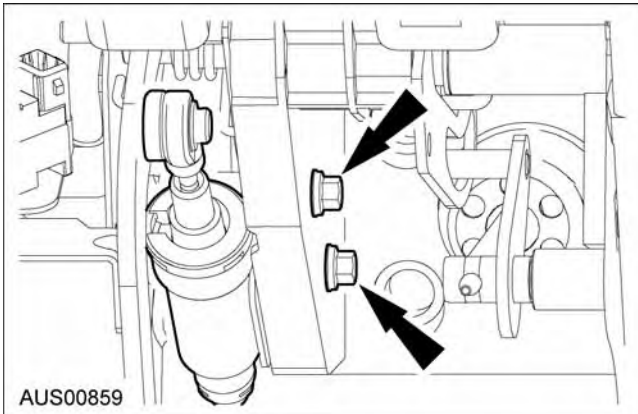
9. Lightly pull brake pedal away from floor until clear of booster rod.



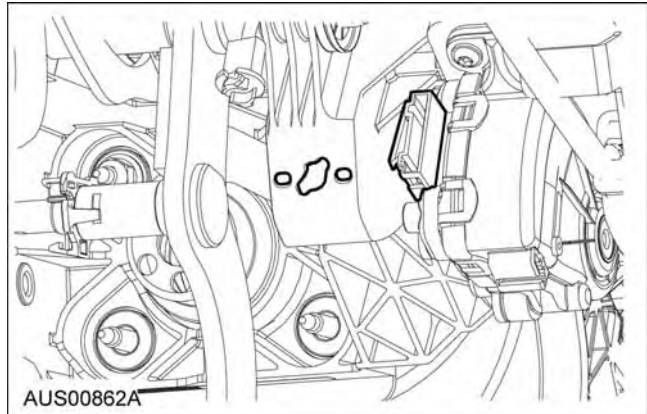
12. Unbolt steering intermediate shaft and pull forward (away from firewall).



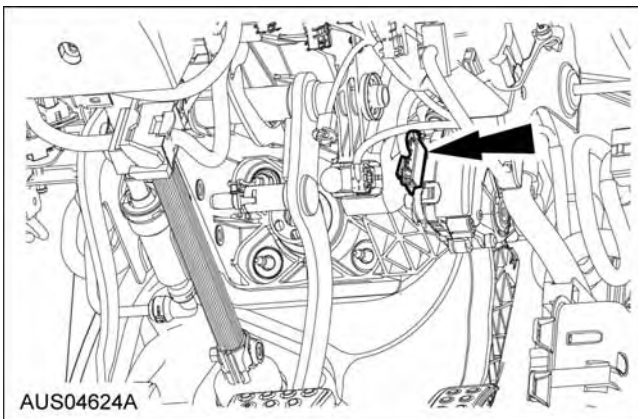
10. If the vehicle has a manual transmission then undo two clutch master cylinder bolts.



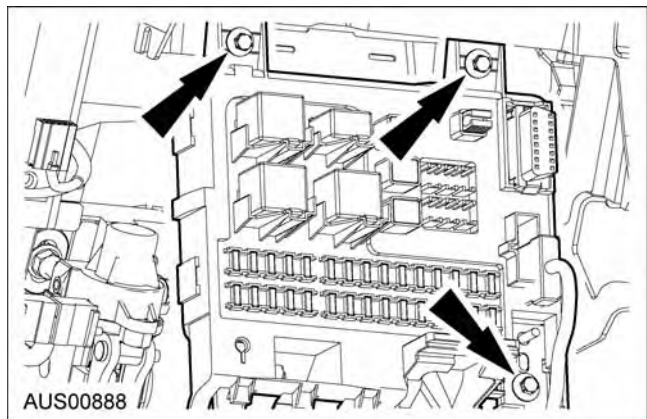
13. Disconnect connectors C-317 and C-379 from pedal box assembly.



11. Disconnect accelerator electrical connection.

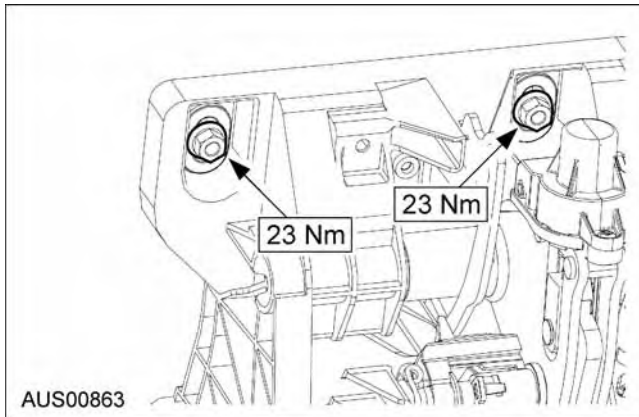


14. Remove fuse box out of the way.

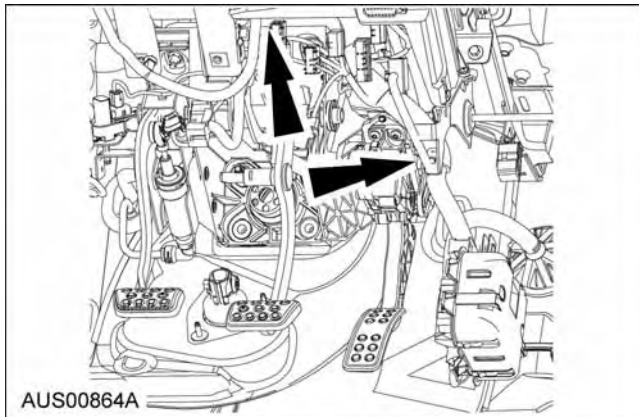


## REMOVAL AND INSTALLATION (Continued)

15. Undo two nuts holding pedal box to body.



16. Carefully remove pedal box assembly by pulling from the points shown on the diagram.



**⚠ WARNING:** Do not apply loads on the accelerator, brake pedal or accelerator when removing the pedal box assembly from the vehicle. Loading pedals during installation or removal can misalign or damage components.

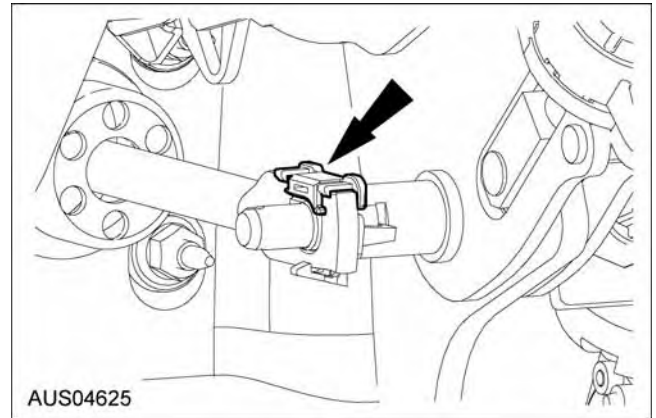
**⚠ WARNING:** Remove and install pedal box carefully and ensure that fingers are not pinched in the process.

### Installation

1. Install components in reverse order.

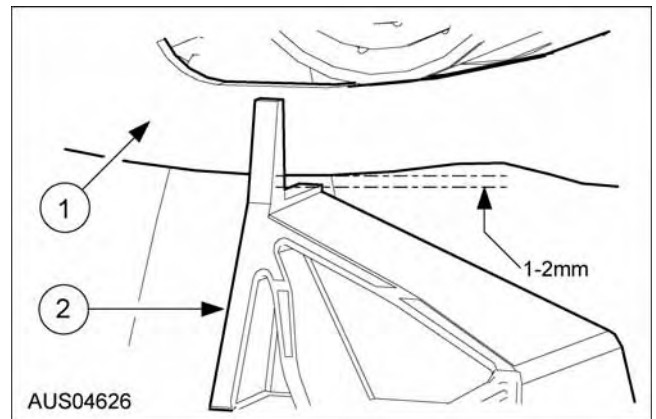
2. Ensure yellow plastic clip is in place and not damaged during assembly.

**⚠ WARNING:** The yellow plastic clip is part of the pedal anti-intrusion system and **MUST** be refitted if the brake booster rod has been detached from the pedal shaft.



3. Check that the rotator de-coupler is correctly positioned on the pedal pin. The decoupling mechanism must be correctly positioned as shown, with 1-2 mm clearance between the lower end of the de-coupler blade and the rotator de-coupler.

**⚠ WARNING:** After any service procedures that involve removal of the pedal box. It is important to check that the breakaway components have not been dislodged.



Item	Description
1	De-coupler Blade
2	Rotator De-coupler

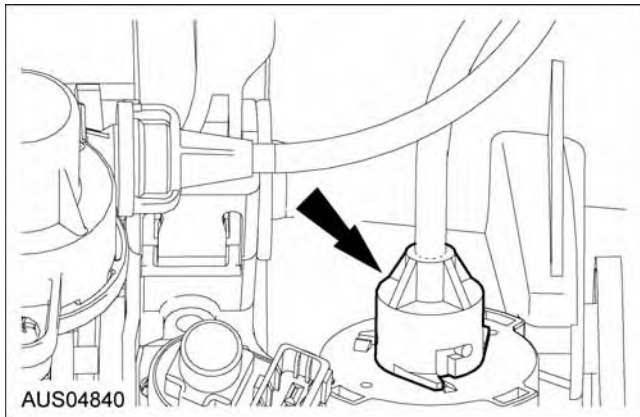


## REMOVAL AND INSTALLATION (Continued)

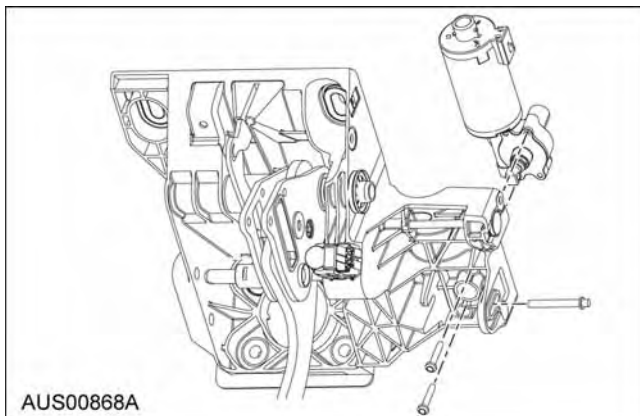
### Brake Pedal Adjustment Motor

#### Removal

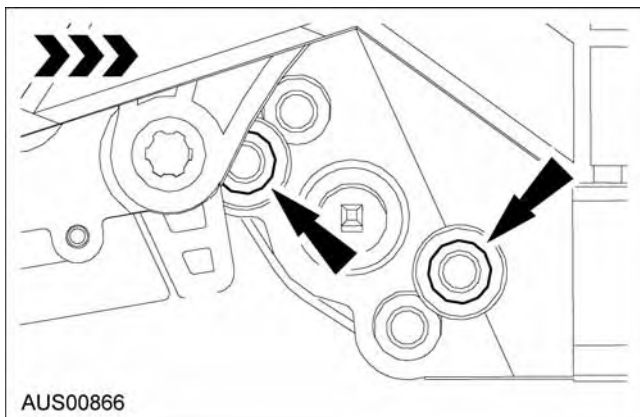
1. Remove pedal box assembly from car Refer to Section 206-4.
2. Remove Accelerator assembly Refer to Section 310-02
3. Rotate cable connect plug anti-clockwise and pull plug out of motor as shown.



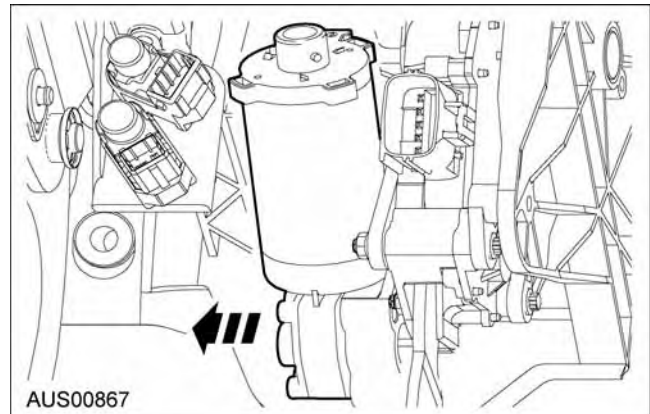
4. Remove gear box assembly from pedal box.



5. Remove two screws holding motor to pedal box.



6. Remove motor, ensure inserts remain in place.



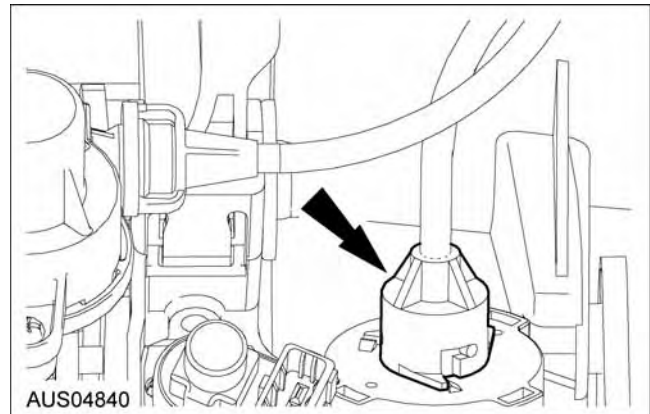
#### Installation

1. Install components in reverse order.

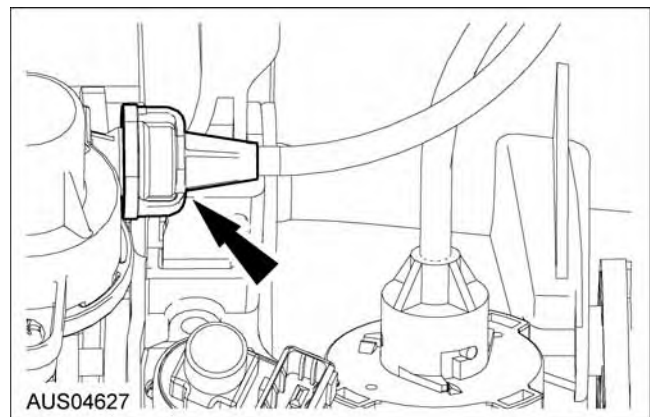
### Brake Pedal Motor Cables

#### Removal

1. Rotate cable connect plug anticlockwise and pull plug at motor end as shown.



2. Disconnect plug at brake pedal end as shown using pliers.



#### Installation

1. Install components in reverse order.

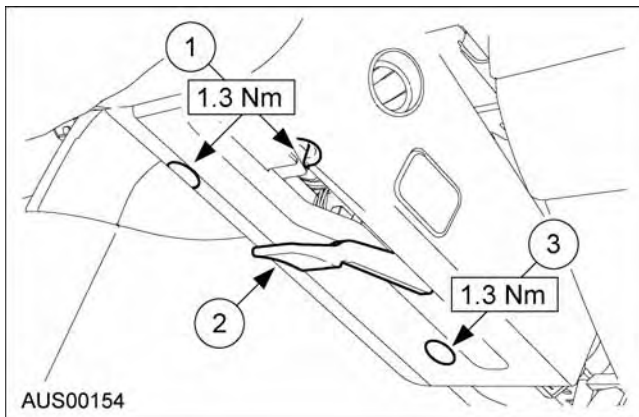


## REMOVAL AND INSTALLATION (Continued)

### Brake Pedal Control Switch (where fitted)

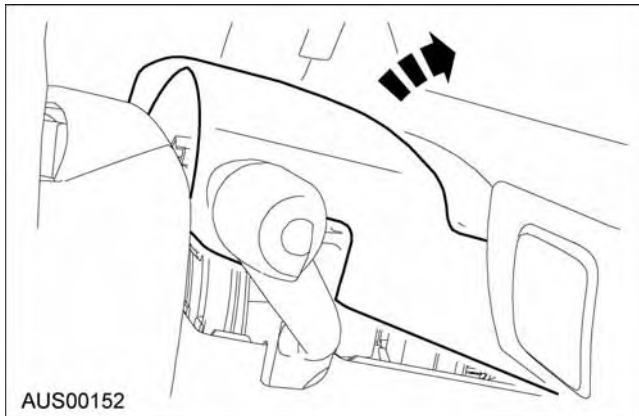
#### Removal

1. Undo three screws underneath the lower shroud. Move the steering column adjustment lever about half way through its travel. Gently spread the lower shroud to clear the key illumination ring.



Item	Description
1	Screw
2	Adjustment lever
3	Screw

2. Slide the shroud down and rearwards, ensuring the adjustment lever passes through the aperture in the lower shroud. Unclip the wire harness for the adjustable pedal switch.



3. Remove pedal adjust switch from the shroud by deflecting the steel retaining clips and pushing the switch outwards.

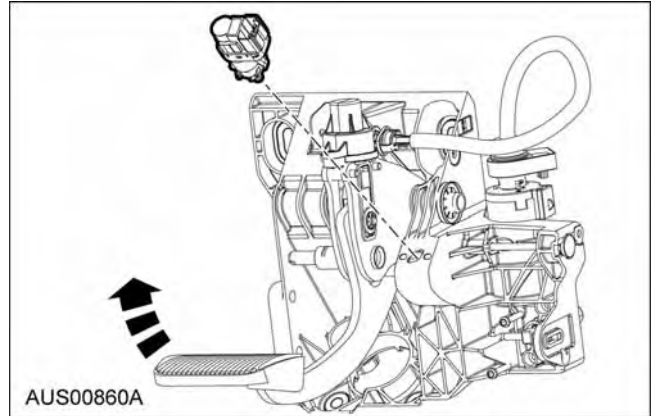
#### Installation

1. Install components in reverse order.  
**NOTE:** Ensure the steering column adjustment lever passes under the pedal switch wire harness when installing the lower shroud.

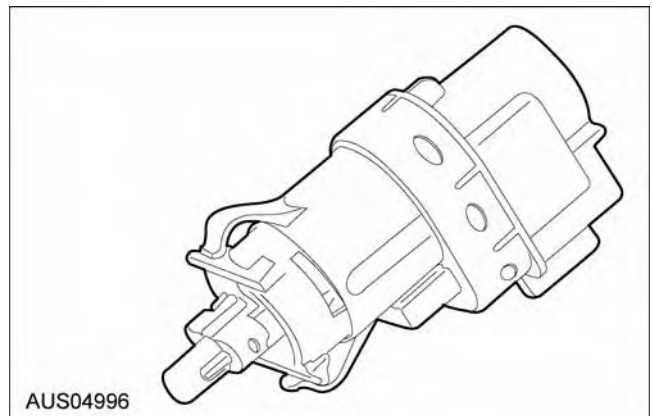
### Brake/Cruise Pedal Switch Setting

#### Removal

1. Remove switch assembly from mount by rotating to release **while pulling back on pedal**. (Switch needs to be depressed to allow rotation.)



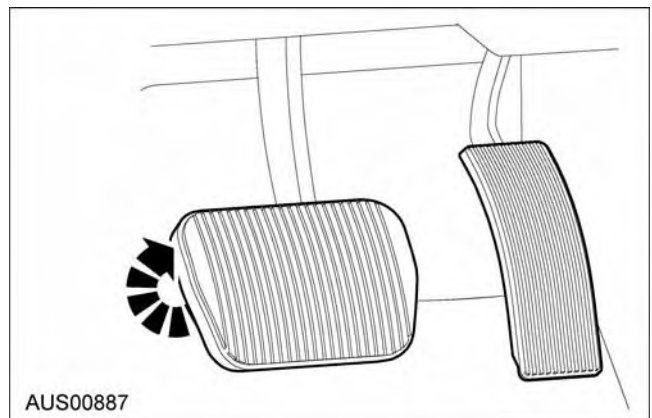
2. Refit the switch reinserting switch into housing and rotating to lock into position.



### Brake Pedal Pad

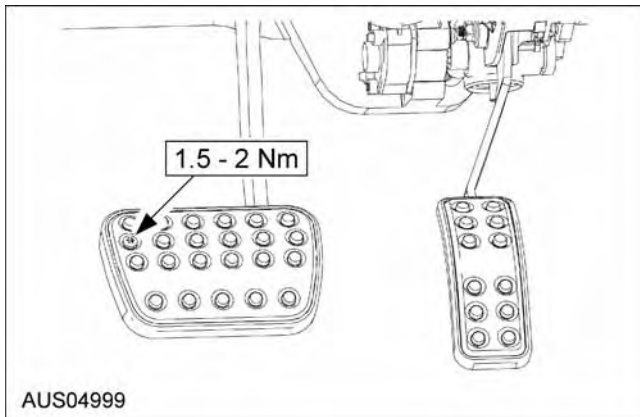
#### Removal

1. Remove brake pad by peeling rubber from the pedal plate.



## REMOVAL AND INSTALLATION (Continued)

2. (Note for models fitted with sports pedals, first remove the M4 screw and retaining nut fitted on brake and clutch pedals).



### Installation

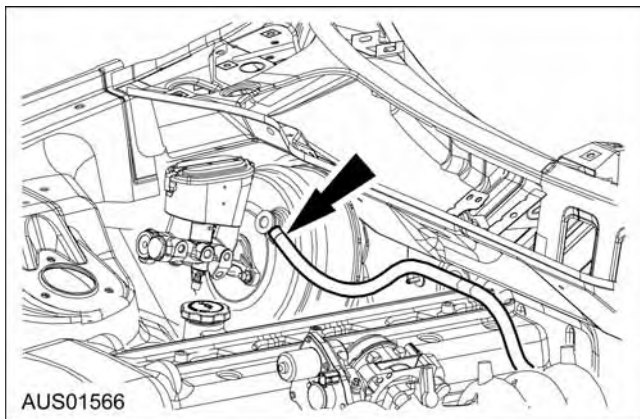
1. Install components in reverse order.  
**NOTE:** Heating the pad will assist replacement.

## Power Brake Booster

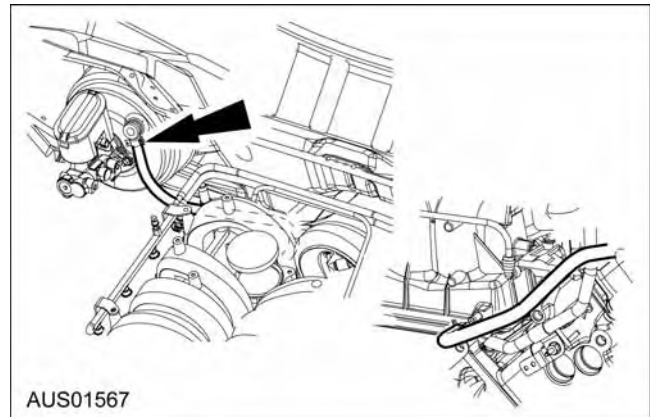
### Removal

1. Remove nuts attaching master cylinder to booster and remove master cylinder.
2. Disconnect vacuum hose from vacuum check valve.

### 6 Cylinder



### 8 Cylinder



3. Disconnect pushrod (part of booster assembly) from brake pedal.
4. Remove four nuts securing booster to firewall and pedal box.
5. Remove assembly.

### Installation

1. Attach booster to dash panel/pedal box with nuts.
2. Attach push rod (part of valve assembly) to brake pedal.
3. Connect vacuum hose to vacuum check valve.
4. Attach master cylinder with nuts to booster front shell.



## REMOVAL AND INSTALLATION (Continued)

### Dual Master Cylinder

**NOTE:** Special rubber components are used in this master cylinder, therefore the cylinder must be repaired using only genuine kits. These kits include new rubber components. Ensure all sections of the cylinder are repaired. For cleaning of internal parts of master cylinder use clean brake fluid or methylated spirits.

When removing the master cylinder from the booster, care must be taken not to disturb the pushrod and not to depress the brake pedal after the cylinder is removed. Failure to observe this caution may result in the output rod becoming dislodged inside booster.

#### Removal

1. Remove the brake tubes from the outlet ports of the master cylinder. Disconnect the plug from the warning light switch.
2. Remove the two nuts attaching the master cylinder to the brake booster assembly.
3. Slide the master cylinder forward and upward from the vehicle.

#### Installation

1. Position the master cylinder assembly over the booster push rod and onto the two studs on the booster assembly.
2. Install the attaching nuts and torque to specification.
3. Install the front and rear brake tubes to the master cylinder outlet fittings. Connect the warning light switch.
4. Fill the master cylinder with the specified brake fluid to the level marked on the side of the dual reservoirs. Use Motorcraft approved Brake Fluid. Do not mix low temperature brake fluids with the specified fluids for the disc brake system as specified in Section 206-00.
5. Bleed the brake system. Refer to Hydraulic System Bleeding in this section for the proper procedure. While bleeding brake system, check the brake failure warning light operates and resets.
6. Operate the brake several times, then check for external hydraulic leaks.



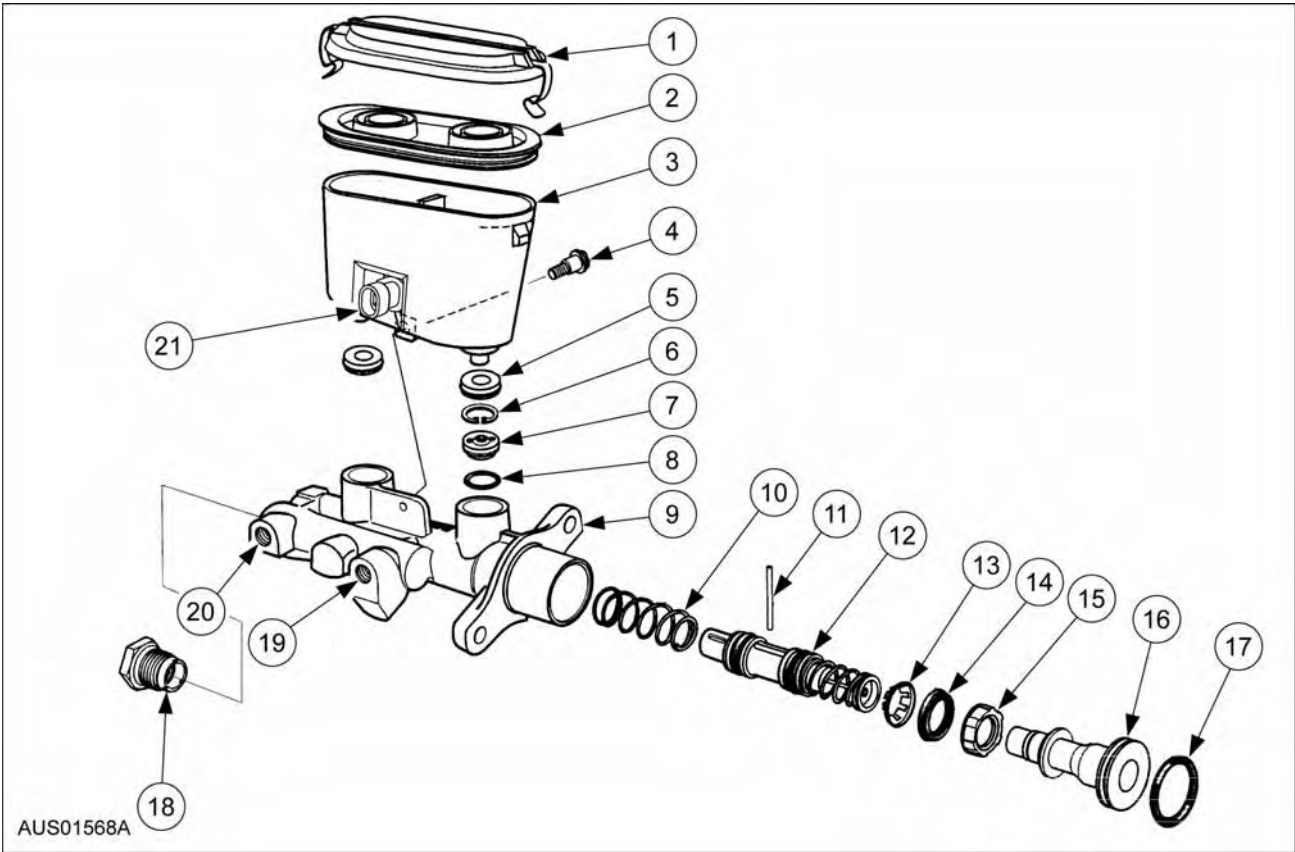
DISASSEMBLY AND ASSEMBLY

Electronic Throttle Control Module

1. Refer to Section 310-02.

Dual Master Cylinder

Disassembly  
Main Bore



Item	Description
1	Reservoir cap
2	Reservoir seal
3	Reservoir
4	Reservoir retaining screw
5	Reservoir seal
6	Circlip
7	Fast fill valve
8	'O' Ring
9	Master cylinder body
10	Secondary spring
11	Secondary piston assembly
12	Secondary piston stop pin
13	Cup retainer
14	Primary cup
15	Recuperating guide

Item	Description
16	Primary piston
17	'O' Ring
18	End plug
19	Primary port
20	Secondary port
21	Brake Fluid Level Switch

1. Clean the outside of the master cylinder and remove reservoir cap. Pour out and discard any brake fluid that remains in the cylinder.
2. Unscrew reservoir-to-body retaining screw located at base of reservoir.
3. Separate, by hand, the plastic reservoir from the body. Remove the reservoir sealing grommets.



## DISASSEMBLY AND ASSEMBLY (Continued)

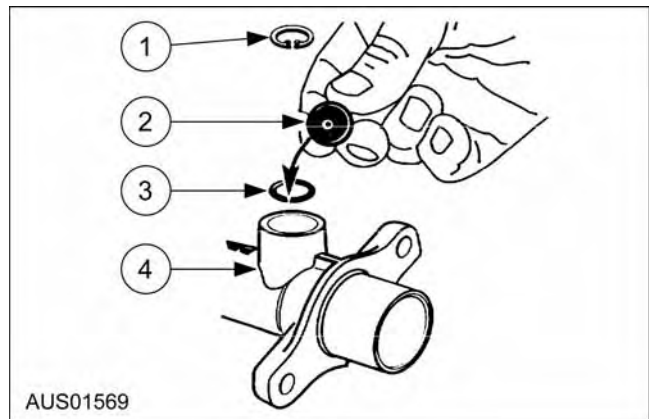
4. Invert the cylinder so that the reservoir wells face down. Depress the primary piston with a rod of wood dowel until fully bottomed in the bore. The secondary piston stop pin should freely fall out; if not, remove with long nose pliers.

**⚠ CAUTION: Slowly return pistons to avoid primary piston from syringing out of the bore.**

5. Carefully remove primary piston assembly from main bore of master cylinder.
6. Remove secondary piston and return spring by using compressed air or lightly tapping the open end of the cylinder bore squarely onto a soft piece of wood.
7. Separate the secondary return spring from the secondary piston locating spigot.  
**NOTE:** The caged spring on the secondary piston has been set to a pre-determined length. DO NOT attempt to adjust the screw or remove the caged spring. If cups are damaged or badly worn, the complete secondary piston assembly **MUST BE REPLACED** (as supplied in repair kit).
8. Remove the seal retainer from the primary piston by using a small screwdriver to carefully pry apart the seal retainer legs.
9. Remove the recuperating guide and seal from the primary piston.
10. Remove the O ring from the other end of the piston taking **EXTREME CARE** not to damage the piston.

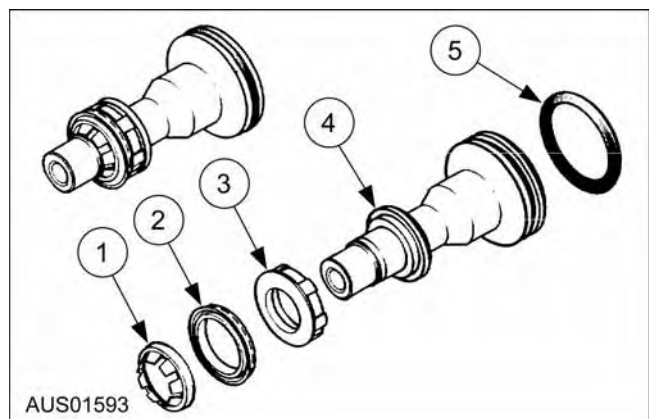
### Fast-Fill Valve

1. Using suitable circlip pliers, remove circlip retaining the fast-fill valve in the primary reservoir port of the master cylinder.
2. Face reservoir port down to allow the valve to fall out. If valve is stuck in position, lightly tap cylinder on piece of wood to assist valve removal.
3. Remove the valve sealing 'O' ring from bottom of reservoir port. The by-pass bleed groove allows fluid to by-pass the ball valve. This ensures that a fluid passage is maintained between the brake pressure circuit and reservoir in the Brakes Off position.



Item	Description
1	Circlip
2	Fast fill valve
3	O-Ring
4	Master Cylinder Body

### Assembly Primary Piston



Item	Description
1	Cup retainer
2	Primary cup
3	Recuperating guide
4	Primary piston
5	Large 'O' Ring

1. Assemble the large 'O' ring onto the end of the primary piston.  
**NOTE:** All hardware must be correctly installed and torqued to specification.
2. Install primary seal onto the end of the primary piston, with sealing face away from guide already assembled. The primary seal can be identified by the 6 shallow grooves around the seal's outer surface.

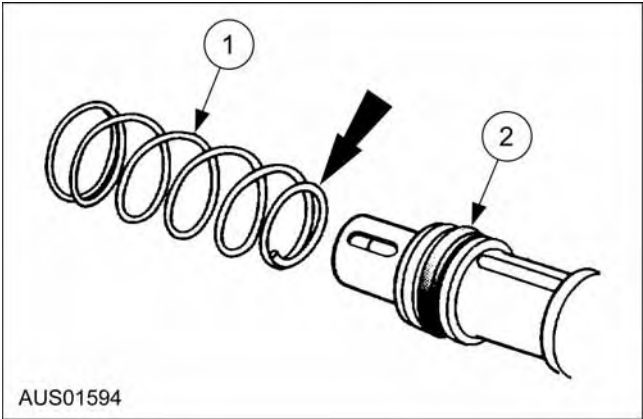




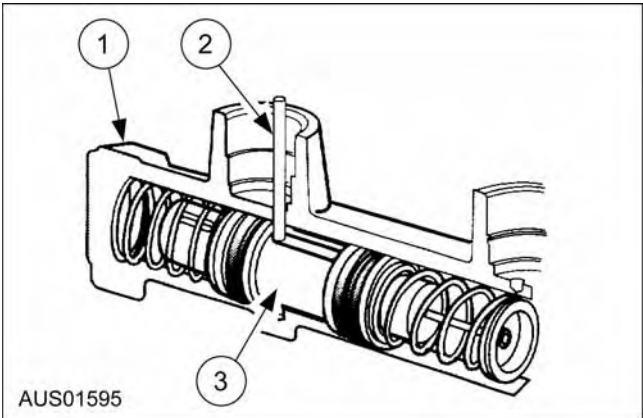
DISASSEMBLY AND ASSEMBLY (Continued)

3. Assemble the cup retaining ring onto the primary piston. Using a small screwdriver clip the retainer legs into the groove on the piston. Care should be taken to avoid damage to the piston or seal.

Secondary Piston



Item	Description
1	Secondary spring
2	Secondary piston



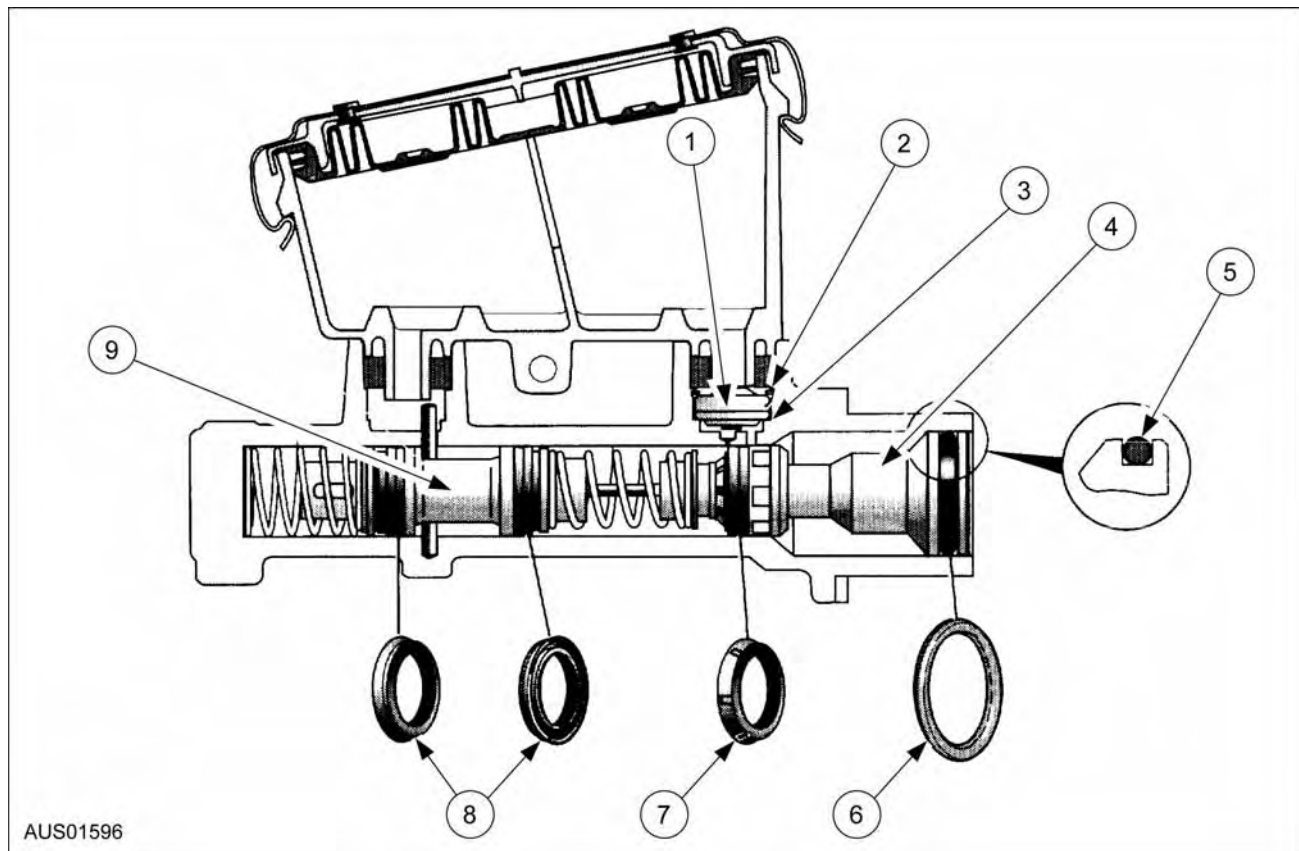
Item	Description
1	Master cylinder body
2	Secondary piston stop pin
3	Secondary piston assembly

1. Assemble the small end of the secondary piston spring over the end of the secondary piston. This should be a slight interference fit.
2. To assemble the secondary piston assembly into the body, align the slot in the secondary piston with the reservoir wells. This must be done so that the stop pin can be inserted into the master cylinder body.



## DISASSEMBLY AND ASSEMBLY (Continued)

### Master Cylinder



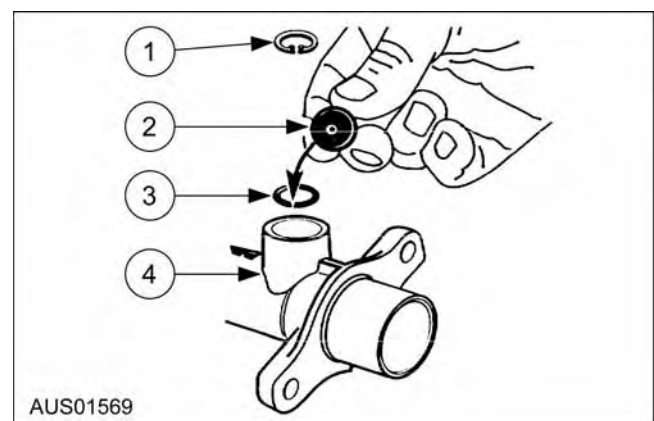
AUS01596

Item	Description
1	Fast fill valve
2	Circlip
3	'O' Ring - Larger
4	Primary piston
5	Split line
6	'O' Ring
7	Primary cup
8	Secondary cup - 'L' Type
9	Secondary piston

- Carefully insert the secondary piston, (caged spring end last), through the large bore and into the smaller bore until the spring "bottoms". Ensure the secondary spring is not dislodged from the piston assembly during this operation. Fully stroke the secondary piston using a soft dowel and while held at the bottom of the bore install the piston stop pin. The piston pin should easily fit in through the larger hole of the 2 holes in the secondary reservoir well. The top of the stop pin should not protrude more than 6 mm above the bottom of the well.
- Insert the primary piston into the main bore and against the secondary piston. Then carefully push both pistons down the bore until the primary piston is flush with the bore opening.

- Stroke pistons and check primary piston fully returns to end of bore at end of each stroke. Ensure movement is not sticky.

#### Fast-Fill Valve



AUS01569

Item	Description
1	Circlip
2	Fast fill valve
3	'O' Ring
4	master cylinder body

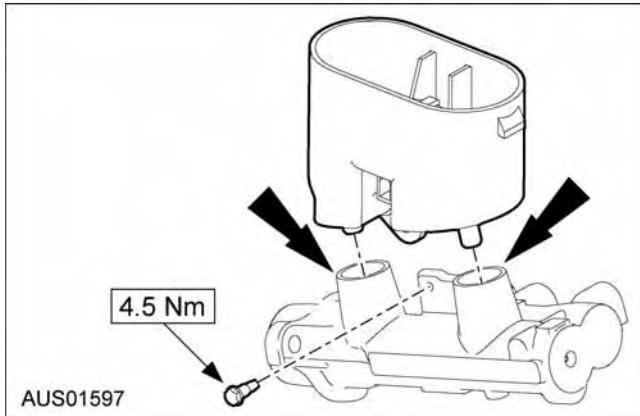
- Carefully install the valve 'O' ring in the bottom shoulder of the primary reservoir port.



## DISASSEMBLY AND ASSEMBLY (Continued)

2. Fit the fast-fill valve, ensuring the rubber base with 6 dimples if faced downwards, and secure with circlip.

### Reservoir



1. Lightly smear reservoir bores and grommets with clean brake fluid.
2. Carefully assemble grommets into reservoir bores to locate against the shoulder in each bore.
3. Assemble reservoir into grommets.
4. Push on reservoir to align the retaining screw hole in the reservoir and cylinder body. Then assemble retaining screw, and tighten to 4-5 Nm. Screw should just protrude from hole in the master cylinder body.

**NOTE:** Both reservoir and master cylinder holes must be aligned to avoid cross threading. Assemble new reservoir seal into reservoir cap.

5. Lubricate inside of reservoir lips with clean brake fluid to accept reservoir cap seal.
6. Push cap and seal assembly onto reservoir and secure by pressing clip at each end to locate on reservoir lugs. Caps should be fitted so that lettering on cap is correct way up when viewed from side of vehicle.

