

## 1997 Ford Pickup F150

1997 ANTI-LOCK BRAKE SYSTEM Anti-Lock - RABS II - "F" Series Pickup

### 1997 ANTI-LOCK BRAKE SYSTEM

#### Anti-Lock - RABS II - "F" Series Pickup

## DESCRIPTION & OPERATION

**CAUTION:** See ANTI-LOCK BRAKE SAFETY PRECAUTIONS article in the **GENERAL INFORMATION** section.

**NOTE:** For more information on brake system, see **BRAKE SYSTEM** article in the **BRAKES** section.

The Rear Anti-Lock Brake System II (RABS II) is designed to prevent rear brake lock-up by controlling hydraulic fluid pressure to the rear wheel cylinders. The system consists of 2 warning lights (Red BRAKE and Yellow ABS), an anti-lock electronic control unit, an electrohydraulic RABS valve, stoplight switch, fluid level sensor, speed sensor and exciter ring.

### ABS CONTROL MODULE

The ABS control module continuously monitors rear (axle mounted) wheel speed sensor input. It compares the rate of deceleration with programmed normal stopping distance. If impending lock-up occurs, the control module energizes the RABS valve.

### RABS VALVE

The RABS valve contains an isolation and a dump valve operated by solenoids controlled by the ABS control module. The isolation valve prevents additional pressure from being fed to rear brake system and dump valve releases pressure from rear brake system.

The RABS valve will store "dumped" brake fluid until brake pressure is released and then releases it back to brake master cylinder reservoir.

### RABS SELF-TEST CAPABILITY

The anti-lock electronic control module performs a system test during start-up and normal operation. Red BRAKE warning light indicates low fluid level, parking brake applied or low vacuum (diesel models). If a problem is detected, the control module will be deactivated and a Yellow ABS warning light will be illuminated. Both warning lights should come on for about 2 seconds when ignition is turned on or when cranking engine.

When Yellow ABS warning light illuminates during normal operation, the system has detected a problem and stored a trouble code. Loss of power to control module will cause system to be deactivated and Yellow ABS light to be illuminated, but will not set a trouble code.

### SYSTEM DIODE/RESISTOR

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System diode together with an associated resistor are used to prevent a false Code 12 from being set when parking brake is applied.

### BLEEDING BRAKE SYSTEM

Hydraulic system bleeding is necessary whenever air enters system. If master cylinder lines have been disconnected or master cylinder has run dry, bleed master cylinder and brakes at all 4 wheels. Bleed brakes with pressure bleeding equipment or by pumping brake pedal. Always bleed brakelines in sequence. See **BLEEDING SEQUENCE**.

#### MANUAL BLEEDING

**CAUTION: DO NOT allow reservoir to run dry during bleeding operation. If brake fluid is spilled onto vehicle paint, rinse off immediately using water.**

##### Master Cylinder Bleeding (On Vehicle)

1. Using a line wrench, remove front brake line and master cylinder rear outlet brake line from master cylinder. Install short tubes in master cylinder and position them so they curve into master cylinder reservoir, and ends of tubes are submerged in brake fluid.
2. Fill master cylinder reservoir with new brake fluid. Have an assistant pump brakes until clear, bubble-free fluid flows from both brake tubes. Remove short brake tubes and reinstall front brake line and master cylinder rear outlet line on master cylinder. Bleed each brake line at master cylinder by having and assistant pump brake pedal 10 times and then hold firm pressure on brake pedal.
3. Loosen rear-most brake line fittings until a stream of brake fluid comes out. Have an assistant maintain pressure on brake pedal until brake line fitting is tightened again. Repeat procedure until clear, bubble-free fluid comes out from around fitting. Refill master cylinder reservoir as necessary. Repeat this bleeding operation at front brake line fittings.

##### Gravity Bleeding

Fill brake master cylinder with new brake fluid. Loosen both wheel cylinder bleeder screws and leave them open until clear brake fluid flows. Be sure to check master cylinder reservoir fluid level often and do not let it run dry. Tighten wheel cylinder bleeder screws. One at a time, loosen caliper bleeder screws. Leave bleeder screws open until clear fluid flows. Check fluid level often. Tighten caliper bleeder screws.

##### Manual Bleeding

1. Clean master cylinder cap and surrounding area. Remove cap. Vehicles are equipped with dual-type master cylinder. Bleed primary and secondary systems separately. Loosen primary or secondary master cylinder hydraulic line fitting.
2. Wrap a shop towel around brake lines to absorb escaping brake fluid. Slowly push brake pedal down to force out air. With pedal fully depressed, tighten fittings to prevent air from being sucked into master cylinder when pedal is released. Release brake pedal.
3. Repeat procedure until air is completely purged from master cylinder. When all air has escaped, tighten

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fittings with pedal down. Release pedal, and depress again. If pedal is not firm, repeat bleeding procedure.

4. Repeat procedure at bleeder fitting on RABS electrohydraulic valve (if equipped), each wheel cylinder and caliper. See **BLEEDING SEQUENCE** table under BLEEDING SEQUENCE. When bleeding is complete, fill master cylinder to proper level.

### PRESSURE BLEEDING

**NOTE:** The use of ABS Bleeder Box Adapter (T90P-50-ALA) and Jumper (T93T-50-ALA) is required in conjunction with pressure bleeding to bleed system when Hydraulic Control Unit (HCU) is replaced.

1. Clean master cylinder cap and surrounding area. Remove cap. With pressure tank at least 1/2 full of specified brake fluid and charged between 10-30 psi (.7-2.0 kg/cm<sup>2</sup>), use adapters to connect tank to master cylinder. Follow equipment manufacturer's instructions.

**CAUTION:** Never exceed 50 psi (3.5 kg/cm<sup>2</sup>) during bleeding.

2. Open pressure bleeder valve. Bleed master cylinder primary and secondary hydraulic lines individually. Put shop towels in place to catch brake fluid.
3. Open lines and allow brake fluid to flow out until all air is purged. Close bleed fitting and hydraulic line. Close pressure bleeder valve. Attach rubber drain hose to first wheel cylinder bleeder valve to be serviced. See **BLEEDING SEQUENCE** table under BLEEDING SEQUENCE.
4. Place other end of hose in clean glass jar partially filled with clean brake fluid so end of hose is submerged in fluid. Open pressure bleeder valve. Open bleeder fitting. Close bleeder fitting when fluid flow is free of bubbles. Repeat procedure on remaining wheel cylinder and calipers in sequence. See **BLEEDING SEQUENCE**.
5. When bleeding operation is complete, close pressure bleeder valve, and remove tank hose from adapter fitting. Check brake pedal operation. Ensure master cylinder is full of fluid.

### SERVICE TOOL BLEEDING

**NOTE:** The use of ABS Bleeder Box Adapter (T90P-50-ALA) and Jumper Cable (T93T-50-ALA) is required in conjunction with pressure bleeding, to bleed system when Hydraulic Control Unit (HCU) is replaced.

1. Connect ABS Bleeder Box Adapter (T90P-50-ALA) and Jumper Cable (T93T-50-ALA) to HCU.
2. Depress brake pedal and depress VALVES button on bleeder box adapter. Brake pedal height should drop. Release VALVES button and release brake pedal.
3. Repeat step 2) one more time. Depress MOTOR START button allow pump motor to operate for one minute, then proceed with pressure bleeding the brake system. See **BLEEDING BRAKE SYSTEM**.

### BLEEDING SEQUENCE

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Before bleeding system, remove all vacuum from power unit by depressing brake pedal several times. Bleed master cylinder first, followed in sequence by rear wheel cylinders, anti-lock system components and calipers. See **BLEEDING SEQUENCE** table.

### BLEEDING SEQUENCE

Application	(1) Sequence
All Models	RR, LR, RF, LF
(1) Bleed master cylinder first, then specified wheel.	

### DIAGNOSIS

**NOTE:** Always disconnect negative battery cable before checking resistance on RABS II system. Inaccurate measurements will result if battery remains connected. Before condemning circuit, check connectors for dirty or corroded terminals.

**CAUTION:** When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer have completed a relearn cycle. See **COMPUTER RELEARN PROCEDURES** article in the **GENERAL INFORMATION** section before disconnecting battery.

### COMPONENT LOCATIONS

#### COMPONENT LOCATIONS

Component	Location
ABS Control Module	Behind Center Of Dashboard
Diode/Resistor Element	On Wiring Harness, At Windshield Washer Reservoir
RABS Diagnostic Test Connector	Under Right Side Of Dash, Near Or Behind Kick Panel
Speed Sensor	Threaded Into Front Of Differential Housing
RABS Valve Assembly	Under Master Cylinder
Sensor Test Connector	On Firewall, Above Master Cylinder

### SYSTEM PRELIMINARY CHECK

#### Vehicle Setup

Before retrieving trouble codes, ensure vehicle is on a level area. Shift 4WD models into 2-wheel drive. On all models, transmission should be in Park (A/T) or Neutral (M/T). Turn ignition off. Set parking brake. Turn running lights on. Block front and rear wheels to prevent vehicle from moving. Release parking brake.

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### Red BRAKE Warning Light Check

Turn ignition switch to START position. Red BRAKE warning light should be on. If light is not on, go to **TEST A** under PRELIMINARY TESTS. Allow ignition switch to return to RUN position. Red BRAKE warning light should turn off. If light does not turn off, check parking brake switch. Repair/replace switch as necessary. If light remains on and parking brake switch is functioning properly, go to **TEST B** under PRELIMINARY TESTS.

### Yellow ABS Warning Light Check

1. Follow procedure for RED BRAKE WARNING LIGHT CHECK. When ignition switch returns to RUN from START position, Yellow light should stay on for 2 seconds and then turn off. If Yellow light turns back on but does not flash, check for stored trouble codes. See **RETRIEVING TROUBLE CODES**. If Yellow light does not turn on, go to **TEST C** under PRELIMINARY TESTS.
2. Depress brake pedal 1-2 seconds, then release. Yellow light should not flash. If Yellow light begins to flash, go to **TEST D** under PRELIMINARY TESTS.

## PRELIMINARY TESTS

### Test A - Red BRAKE Warning Light Does Not Self-Check

1. Turn ignition on. Engage parking brake. If Red BRAKE warning light comes on, release parking brake and go to next step. If Red BRAKE warning light does not come on, repair open in circuit or fuse to Red BRAKE warning light. After repairs, perform **SYSTEM PRELIMINARY CHECK**.
2. Disconnect brake fluid warning switch harness connector. Using a jumper wire, jumper brake fluid level warning switch terminal No. 3 (Dark Green/Yellow wire) to ground. If Red BRAKE warning light comes on, go to next step. If Red BRAKE warning light does not come on, repair circuit between switch and warning light or circuit to diode/resistor element. See **WIRING DIAGRAM**. After repairs, perform **SYSTEM PRELIMINARY CHECK**.
3. Jumper brake fluid level switch harness connector terminals No. 2 (Tan/Light Green wire) and No. 3 (Dark Green/Yellow wire). See **WIRING DIAGRAM**. If Red BRAKE warning light comes on, replace brake fluid level warning switch. If Red BRAKE warning light does not come on, check for open in Tan/Light Green wire circuit. If circuit is okay, replace ignition switch. After repairs, perform **SYSTEM PRELIMINARY CHECK**.

### Test B - Red BRAKE Warning Light Stays On When Ignition Is In RUN Position

1. Ensure parking brake is disengaged. Turn ignition switch on. If both Red BRAKE and Yellow ABS warning light stays on after bulb-check, retrieve codes. See **RETRIEVING TROUBLE CODES** and diagnose affected code(s). If both warning lights turn off after bulb-check, go to next step.
2. Disconnect parking brake switch. If Red BRAKE warning light comes on, repair short to ground in Purple/White wire or Light Green/Red wire circuits. See **WIRING DIAGRAM**. After repairs, perform **SYSTEM PRELIMINARY CHECK**. If Red BRAKE warning light did not come on, replace parking brake switch. After replacing switch, perform **SYSTEM PRELIMINARY CHECK**.

### Test C - Yellow ABS Warning Light Does Not Self-Check

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1. Check ABS warning light fuse. If fuse is okay, go to next step. If fuse is blown, replace fuse and check for short to ground in circuit No. 640 (Red/Yellow wire). See **WIRING DIAGRAM**. After repairs, perform **SYSTEM PRELIMINARY CHECK**.

**NOTE:** Always disconnect battery cable to starter relay when checking resistance in ABS system.

2. Disconnect negative battery cable. Disconnect ABS control module harness connector. Check resistance between ground and ABS control module harness connector terminal No. 4 (Light Green/Yellow wire). See **Fig. 1**. If resistance is less than 5 ohms, reconnect battery cable and then go to next step. If resistance is not less than 5 ohms, repair Light Green/Yellow wire circuit. After repairs, perform **SYSTEM PRELIMINARY CHECK**.
3. Check voltage between ground and ABS control module harness connector terminal No. 7 (Dark Green wire). If voltage is not greater than 10 volts, go to next step. If voltage is greater than 10 volts, replace control module. After replacing control module, perform **SYSTEM PRELIMINARY CHECK**.
4. Disconnect instrument cluster harness connector. Check resistance on Dark Green wire between instrument cluster harness connector terminal and ABS control module harness connector terminal. See **WIRING DIAGRAM**. If resistance is less than 5 ohms, diagnose instrument cluster. See **INSTRUMENT PANEL** article in the **ACCESSORIES & EQUIPMENT** section. If resistance is not less than 5 ohms, repair Dark Green wire circuit. After repairs, perform **SYSTEM PRELIMINARY CHECK**.

### Test D - Yellow ABS Warning Light Self-Checks Okay, But Automatically Begins Flashing

1. Observe if Yellow ABS light is flashing a DTC (short and long pulses). If DTC is being flashed, diagnose affected DTC(s). If DTC is not being flashed, go to next step.
2. Turn ignition off. Disconnect ABS control module harness connector. Turn ignition on. Check voltage between ground and ABS control module harness connector terminal No. 12 (Black/Orange wire), while wiggling harness. See **Fig. 1**. If voltage is greater than 10 volts, go to step 3). If voltage is not greater than 10 volts, repair Black/Orange wire circuit. After repairs, perform **SYSTEM PRELIMINARY CHECK**.
3. On all models, turn ignition off. Disconnect negative battery cable. Check resistance between ground and ABS control module harness connector terminal No. 4 (Light Green/Yellow wire), while wiggling harness.
4. If resistance is 5 ohms or less and steady, replace control module harness connector. After repairs, perform **SYSTEM PRELIMINARY CHECK**. If resistance is not steady and greater than 5 ohms, repair Light Green/Yellow wire. After repairs, perform **SYSTEM PRELIMINARY CHECK**.

### Test E - Yellow ABS Warning Light Self-Checks Okay, But No DTCs Retrieved When Diagnostics Are Started

1. Turn ignition on. Depress brake pedal and observe stoplights. If stoplights come on, go to next step. If stoplights do not come on, replace stoplight bulbs or brake switch. After repairs, perform **SYSTEM PRELIMINARY CHECK**.
2. Turn ignition off. Disconnect ABS control module. Depress brake pedal. Check voltage between ground and ABS control module harness connector terminal No. 11. See **Fig. 1**. If voltage is 10 volts or greater, go to next step. If voltage is less than 10 volts, repair open in Light Green wire. See **WIRING**

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### **DIAGRAM.**

3. Turn ignition on. Check voltage between ground and ABS control module harness connector terminals No. 1 (Light Blue Pink wire) and No. 9 (Light Blue/Pink wire). If voltage is 10 volts or greater, go to next step. If voltage is less than 10 volts, repair Light Blue/Pink wire circuit. After repairs, perform **SYSTEM PRELIMINARY CHECK.**
4. Observe Yellow ABS warning light. If Yellow ABS warning light is on, repair short to ground in Dark Green wire between ABS light and control module. See **WIRING DIAGRAM.** After repairs, perform **SYSTEM PRELIMINARY CHECK.** If Yellow ABS warning light is not on, go to next step.
5. Turn ignition off. Check resistance between ground and ABS control module harness connector terminal No. 12 (Black/Orange wire). If resistance is 5 ohms or less, replace ABS control module. After replacing module, perform **SYSTEM PRELIMINARY CHECK.** If resistance is greater than 5 ohms, repair Black/Orange wire between control module and fuse block. See **WIRING DIAGRAM.** After repairs, perform **SYSTEM PRELIMINARY CHECK.**

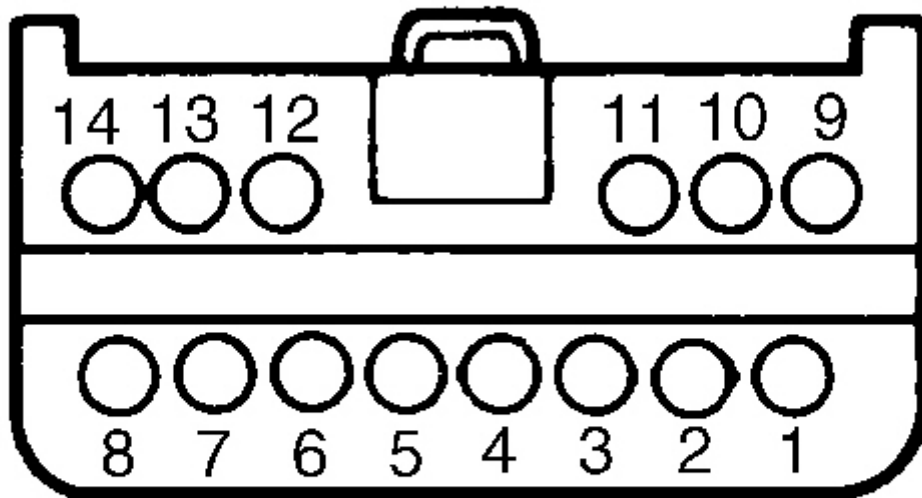
### **RETRIEVING TROUBLE CODES**

**NOTE:**        **When retrieving trouble codes, connect only the Black/Orange wire to ground. Connecting mating connector wire to ground will blow fuse.**

1. Turn ignition on, with engine off. Locate Black RABS test connector. See **COMPONENT LOCATIONS.** Connector has 2 mating halves. One has a Black/Orange wire; other has a Red wire. Disconnect connector. Connect jumper wire to connector terminal with Black/Orange wire. Ground other end of jumper wire for at least one second. When ground circuit is completed and then broken, Yellow ABS warning light will flash trouble code.
2. Code will repeat until ignition is turned off. Trouble code consists of a number of short flashes followed by one long flash. Count each flash, short and long, to determine code number. For example: short, short, long, is Code 3. Perform appropriate code test after retrieving code. A Code 16 indicates system is operating properly. If Yellow light does not flash, go to **TEST E** under PRELIMINARY TESTS.

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**Fig. 1: Identifying ABS Control Module Connector Terminals**

Courtesy of FORD MOTOR CO.

### CLEARING CODES

To clear codes stored in Keep Alive Memory (KAM), turn ignition off, while ABS test connector halves Black/Orange wire and Red wire are separated. Reconnect ABS test connector to provide power to KAM.

### TROUBLE CODE DIAGNOSIS

**NOTE:** After disconnecting battery, drive vehicle 10 miles in order to allow Powertrain Control Module to relearn its adaptive strategy.

### CODE 2

1. Turn ignition off. Disconnect and reconnect diagnostic connector (Black/Orange wire) and its mating half (Red). Turn ignition on. If Yellow ABS warning light comes on, go to next step. If Yellow ABS warning light does not come on, DTC is an intermittent fault, go to **INTERMITTENT DIAGNOSIS**.
2. Turn ignition off. Disconnect RABS valve and ABS control module harness connector. Check resistance between ABS control module harness connector terminal No. 13 (Pink/Light Green wire) and RABS valve harness connector terminal No. 4 (Pink/Light Green wire). See **Fig. 1**. If resistance is 5 ohms or less, go to next step. If resistance is not 5 ohms or less, repair open in Pink/Light Green wire circuit. After

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repairs, perform **SYSTEM PRELIMINARY CHECK**.

3. Check resistance between RABS valve terminals No. 3 and 4. See **WIRING DIAGRAM**. If resistance is 3-6 ohms, go to next step. If resistance is not 3-6 ohms, replace RABS valve. After repairs, perform **SYSTEM PRELIMINARY CHECK**.
4. Check resistance between RABS valve terminal No. 4 and RABS valve housing. If resistance is greater than 10,000 ohms, replace ABS control module. After replacing module, perform **SYSTEM PRELIMINARY CHECK**. If resistance is not greater than 10,000 ohms, replace RABS valve. After replacing valve, perform **SYSTEM PRELIMINARY CHECK**.

### CODE 3

1. Turn ignition off. Disconnect and reconnect ABS diagnostic test connector. Turn ignition on. If Yellow ABS warning light comes on, go to next step. If Yellow ABS warning light does not come on, fault is intermittent. Go to **INTERMITTENT DIAGNOSIS**.
2. Turn ignition off. Disconnect ABS and RABS valve harness connectors. Check resistance between RABS valve harness connector terminal No. 1 and ABS control module harness connector terminals No. 8 and then No. 14. See **Fig. 1**. If resistance is 5 ohms or less, go to next step. If resistance is not as specified, repair open in Yellow/Light Green wire circuit between ABS control module and RABS valve. See **WIRING DIAGRAM**.
3. Check resistance between RABS valve terminals No. 1 and 3. If resistance is 5 ohms or less, replace ABS control module. After replacing module, perform **SYSTEM PRELIMINARY CHECK**. If resistance is greater than specified, replace RABS valve. After replacing valve, perform **SYSTEM PRELIMINARY CHECK**.
4. Check resistance between RABS valve terminal No. 1 and valve housing. If resistance is greater than 10,000 ohms, replace ABS control module. If resistance is not greater than 10,000 ohms, replace RABS valve. After repairs, perform **SYSTEM PRELIMINARY CHECK**.

### CODE 4

1. Turn ignition off. Disconnect and reconnect diagnostic test connector (Black/Orange wire) from its mating half (Red wire). Turn ignition on. If Yellow ABS warning light comes on, go to next step. If Yellow warning light does not come on, DTC is an intermittent fault, go to **INTERMITTENT DIAGNOSIS**.
2. Turn ignition off. Disconnect ABS control module and RABS valve harness connectors. Check resistance between ABS control module harness connector terminal No. 6 (Light Blue/Red wire) and RABS valve harness connector terminal No. 2 (Light Blue/Red wire). See **Fig. 1**. If resistance is 5 ohms or less, go to next step. If resistance is not 5 ohms or less, repair open in Light Blue/Red wire between control module and RABS valve. After repairs, perform **SYSTEM PRELIMINARY CHECK**.
3. Check resistance between ground and RABS valve harness connector terminal No. 3 (Black/White wire). If resistance is 5 ohms or less, go to next step. If resistance is not 5 ohms or less, repair open in Black/White wire between control module and RABS valve. After repairs, perform **SYSTEM PRELIMINARY CHECK**.
4. Check resistance between ground and ABS control module harness connector terminal No. 6 (Light Blue/Red wire). If resistance is greater than 10,000 ohms, go to next step. If resistance is not greater than 10,000 ohms, repair short in Light Blue/Red wire between ABS control unit and RABS valve. After

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repairs, perform **SYSTEM PRELIMINARY CHECK**.

5. Check resistance between ground and RABS valve harness connector terminal No. 2 (Light Blue/Red wire). If resistance is 10,000 ohms or greater, replace ABS control module. After replacing module, perform **SYSTEM PRELIMINARY CHECK**. If resistance is not 10,000 or greater, replace RABS valve. After replacing valve, perform **SYSTEM PRELIMINARY CHECK**.

### CODE 5

1. Turn ignition off. Disconnect and then reconnect diagnostic connector (Black/Orange wire) from its mating half (Red wire). Turn ignition on. If Yellow ABS warning light comes on, go to next step. If Yellow ABS warning light does not come on, go to **INTERMITTENT DIAGNOSIS**.
2. On 4WD models, place vehicle in 4WD mode. On all models, check voltage between ground and ABS control module harness connector terminal No. 5. See **Fig. 1**. If voltage is one volt or less, go to next step. If voltage is not one volt or less, repair or replace 4WD indicator switch (4WD models) or check for short in Light Blue wire between ABS control module and transmission. See **WIRING DIAGRAM**. After repairs, perform **SYSTEM PRELIMINARY CHECK**.
3. Turn ignition off. Turn off air suspension system (if equipped). Raise and support vehicle. Ensure all wheels are off the ground. Connect DVOM between ABS control module harness connector terminals No. 3 and 10. Manually turn wheels at about 5 MPH. Voltage reading should be greater than 650 millivolts AC RMS and steady. If voltage reading is as specified, reconnect ABS control module harness connector and go to next step. If voltage reading is not as specified, go to **CODE 6**. After repairs, perform **SYSTEM PRELIMINARY CHECK**.
4. Start engine while observing Yellow ABS warning light. If Yellow ABS light will self-test properly, go to next step. If Yellow ABS light does not self-test properly, go to **TEST C** under PRELIMINARY CHECK TESTS.
5. Activate air suspension system (if equipped) and lower vehicle. Disconnect ABS control module harness connector. Drive vehicle at about 20 MPH. Perform normal traffic stops. If rear wheels lock-up, go to **SYMPTOM DIAGNOSIS**. If rear wheels do not lock-up, go to next step.
6. Drive vehicle at about 10 MPH on dry pavement. Apply brakes hard enough to lock-up all 4 wheels. Observe left rear wheel through side mirror. If rear wheels lock-up (momentary lock-up is okay), replace RABS valve. Reconnect ABS control module and test drive vehicle. If rear wheels do not lock-up, go to next step.
7. Turn off air suspension system (if equipped). Raise and support vehicle on axle hoist. Ensure wheels are off the ground and vehicle is in 2WD mode (4WD vehicles). Start engine. Place transmission in low (A/T) or first gear (M/T). Accelerate to about 10 MPH. Apply brakes hard enough until wheels lock-up. If wheels first locks up and then spins, repeat **SYSTEM PRELIMINARY CHECK**. If wheels do not lock-up or locks up but does not spin after locking up, replace ABS control module. After repairs, reactivate air suspension (if equipped) and test drive vehicle.

### CODE 6

1. Turn ignition off. Disconnect and then reconnect diagnostic connector (Black/Orange wire) from its mating half (Red wire). Turn ignition on. If Yellow ABS warning light comes on, go to next step. If Yellow ABS warning light does not come on, go to **INTERMITTENT DIAGNOSIS**.
2. Turn ignition off. Check ABS sensor wire routing and inspect for damage. Repair as necessary. After

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repairs, perform **SYSTEM PRELIMINARY CHECK**. If circuit is okay, go to next step.

3. Disconnect ABS control module harness connector. Check resistance between control module harness connector terminals No. 3 and 10 while wiggling harness. See **Fig. 1**. If resistance reading is steady and at 900-2500 ohms, go to next step. If resistance is not 900-2500 ohms, replace rear ABS sensor. After replacing sensor, perform **SYSTEM PRELIMINARY CHECK**.
4. Check resistance between ground and control module harness connector terminals No. 3 and 10. If an open circuit is not indicated in either circuit, repair short to ground in affected circuit. After repairs, perform **SYSTEM PRELIMINARY CHECK**. If an open is indicated on both circuits, go to next step.
5. Remove rear ABS sensor from differential case. Check for metal shavings and chips on sensor magnetic pole. If metal shavings/chips are present, drain and clean differential and then go to next step. If metal shavings/chips are not present, go to next step.
6. Turn off air suspension system (if equipped). Raise and support vehicle on axle hoist. Ensure wheels are off the ground. Manually turn wheels about 5 MPH. Check voltage at ABS control module harness connector terminals No. 3 and 10. If voltage reading is steady and at 650 millivolts AC RMS, go to next step. If voltage reading is not as specified, replace ABS sensor. After replacing sensor, activate air suspension system (if equipped) and perform **TEST DRIVE**.
7. Drain differential and remove case cover. Carefully inspect each tooth on ABS sensor ring, behind ring gear. If any sensor ring tooth is missing, replace sensor ring. After repairs, reactivate air suspension system (if equipped) and repeat **SYSTEM PRELIMINARY CHECK**. If sensor ring is okay, replace ABS control module. After repairs, reactivate air suspension system (if equipped) and repeat **SYSTEM PRELIMINARY CHECK**.

### CODE 7

1. Turn ignition off. Disconnect and reconnect diagnostic connector (Black/Orange wire) from its mating half (Red wire). Turn ignition on. Observe if Yellow ABS warning light comes on, go to next step. If Yellow ABS warning light does not come on, go to **INTERMITTENT DIAGNOSIS**.
2. Turn ignition off. Disconnect ABS control module harness connector. Check resistance between ground and control module harness connector terminal No. 13. See **Fig. 1**. If resistance is 3-6 ohms, replace ABS control module. After replacing module, repeat **SYSTEM PRELIMINARY CHECK**. If resistance is not 3-6 ohms, check Pink/Light Green wire circuit between control module and ABS control valve. See **WIRING DIAGRAM**. If circuit is okay, replace ABS control valve.

### CODE 8

1. Turn ignition off. Disconnect and reconnect diagnostic connector (Black/Orange wire) from its mating half (Red wire). Turn ignition on. Observe Yellow ABS warning light. If warning light comes on, go to next step. If warning light does not come on, go to **INTERMITTENT DIAGNOSIS**.
2. Turn ignition off. Disconnect ABS control module harness connector. Check resistance between ground and control module harness connector terminals No. 8 and 14. See **Fig. 1**. If resistance is 1-3 ohms on both terminals, replace ABS control module and repeat **SYSTEM PRELIMINARY CHECK**. If resistance is not 1-3 ohms on either terminal, go to next step.
3. Disconnect RABS valve harness connector. Check resistance between RABS valve terminals No. 1 and 3. If resistance is 3-6 ohms, go to next step. If resistance is not 3-6 ohms, replace RABS valve and repeat **SYSTEM PRELIMINARY CHECK**.

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4. Check resistance between ABS control module harness connector terminal No. 14 and RABS valve terminal No. 1 (Yellow/Light Green wire). If resistance is less than 5 ohms, repeat **SYSTEM PRELIMINARY CHECK**. If resistance is not less than 5 ohms, repair Yellow/Light Green wire circuit. After repairs, repeat **SYSTEM PRELIMINARY CHECK**.

### CODE 9

1. Turn ignition off. Disconnect and reconnect diagnostic connector (Black/Orange wire) from its mating half (Red wire). Turn ignition on. Observe Yellow ABS warning light. If warning light comes on, go to next step. If warning light does not come on, go to **INTERMITTENT DIAGNOSIS**.
2. Inspect circuit for damage. Ensure wires are properly routed. Repair as necessary. After repairs, repeat **SYSTEM PRELIMINARY CHECK**. If circuit and wire routing are okay, go to next step.
3. Turn ignition off. Disconnect ABS control module harness connector. Check resistance between control module harness connector terminals No. 3 and 10, while wiggling harness. See **Fig. 1**. If resistance is 900-2500 ohms and steady, go to next step. If resistance is not 900-2500 ohms, replace ABS sensor and go to step 5).
4. Check resistance between ground and ABS control module harness connector terminals No. 3 and 10. If resistance on both pins and ground is 10,000 ohms or greater, replace ABS control module. After repairs, repeat **SYSTEM PRELIMINARY CHECK**. If resistance is less than 10,000 ohms, repair short to ground in Red/Pink wire or Light Green/Black wire. After repairs, repeat **SYSTEM PRELIMINARY CHECK**.
5. Turn ignition off. Disconnect ABS sensor harness connector. Check resistance between sensor terminals. If resistance is 900-2500 ohms, repair open in Light Green/Black wire or Red/Pink wire. After repairs, repeat **SYSTEM PRELIMINARY CHECK**. If resistance is not 900-2500 ohms, replace ABS sensor.

### CODE 10

1. Turn ignition off. Disconnect and reconnect diagnostic connector (Black/Orange wire) from its mating half (Red wire). Turn ignition on. Observe Yellow ABS warning light. If warning light comes on, go to next step. If warning light does not come on, go to **INTERMITTENT DIAGNOSIS** for all affected circuits.
2. Turn ignition off. Disconnect ABS sensor and control module harness connectors. Check resistance between ABS control module harness connector terminals No. 3 and 10. See **Fig. 1**. If resistance is indicated, repair short between Light Green/Black wire and Red/Pink wire. After repairs, repeat **SYSTEM PRELIMINARY CHECK**. If resistance is not indicated, go to next step.
3. Check resistance between ground and ABS control module harness connector terminal No. 3 (Light Green/Black wire) and No. 10 (Red/Pink wire). If a resistance value is indicated, repair short to ground in either Red/Pink wire or Light Green/Black wire. After repairs, repeat **SYSTEM PRELIMINARY CHECK**. If a resistance value is not indicated, go to next step.
4. Check resistance between ABS sensor terminals. If resistance is 900-2500 ohms, go to next step. If resistance is not 900-2500 ohms, replace ABS sensor and then repeat **SYSTEM PRELIMINARY CHECK**.
5. Check resistance between ground and either of the ABS sensor terminals. If a resistance value is indicated, replace sensor. After replacing sensor, repeat **SYSTEM PRELIMINARY CHECK**. If a resistance value is not indicated, replace ABS control module. After replacing control module, repeat

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### **SYSTEM PRELIMINARY CHECK.**

#### **CODE 11**

1. Turn ignition off. Disconnect and then reconnect diagnostic test connector (Black/Orange wire) from its mating half (Red wire). Turn ignition on. Observe Yellow ABS warning light. If warning light comes on, go to next step. If warning light does not come on, fault is intermittent. Go to **INTERMITTENT DIAGNOSIS.**
2. Turn ignition off. Depress brake pedal and observe stoplights. If stoplights come on, go to step 5). If stoplights do not come on, go to next step.
3. Check stoplight bulbs. Replace as necessary and then repeat **SYSTEM PRELIMINARY CHECK.** If light bulbs are okay, go to next step.
4. Check stoplight fuse. Replace as necessary and check/repair short in brake switch circuit. See **WIRING DIAGRAM.** If fuse is okay, go to next step.
5. Disconnect ABS control module harness connector. Depress brake pedal. Check voltage between ground and ABS control module harness connector terminal No. 11 (Light Green wire). See **Fig. 1.** If voltage reading is 10 volts or greater, replace control module. After replacing control module, repeat **SYSTEM PRELIMINARY CHECK.** If voltage reading is less than 10 volts, repair Light Green wire circuit. See **WIRING DIAGRAM.** After repairs, repeat **SYSTEM PRELIMINARY CHECK.**

#### **CODE 12**

1. Turn ignition off. Disconnect and then reconnect diagnostic test connector (Black/Orange wire) from its mating half (Red wire). Turn ignition on. Observe Yellow ABS warning light. If warning light comes on, go to next step. If warning light does not come on, fault is intermittent. Go to **INTERMITTENT DIAGNOSIS.**
2. Turn ignition off. Check master cylinder brake fluid reservoir. If fluid level is okay, go to next step. If brake fluid is low, check for leaks in brake system and repair as necessary. After repairs or refilling brake fluid, repeat **SYSTEM PRELIMINARY CHECK.**
3. Remove master cylinder cap and push reservoir float to bottom of reservoir. Float should return to top of reservoir. If float returns to top, go to next step. If float does not return to top, replace master cylinder reservoir. Bleed brake system and repeat **SYSTEM PRELIMINARY CHECK.**
4. On all models, disconnect brake fluid level switch harness connector. Check resistance between ground and brake fluid level switch terminal No. 3 (Dark Green/Yellow wire). If resistance is 5 ohms or less repair Dark Green/Yellow wire circuit and then repeat **SYSTEM PRELIMINARY CHECK.** If resistance is greater than 5 ohms, go to next step.
5. Apply parking brakes. Check resistance between ground and brake fluid level switch terminal No. 3 (Dark Green/Yellow wire). See **WIRING DIAGRAM.** If resistance is 5 ohms or less, replace resistor/diode element. After repairs, repeat **SYSTEM PRELIMINARY CHECK.** If resistance is greater than 5 ohms, go to next step.
6. Disconnect ignition switch harness connector. Check resistance between ground and brake fluid level switch harness connector terminal No. 2 (Tan/Light Green wire). If resistance is 5 ohms or less, repair Tan/Light Green wire circuit. See **WIRING DIAGRAM.** After repairs, repeat **SYSTEM PRELIMINARY CHECK.** If resistance is greater than 5 ohms, reconnect ignition switch harness connector and go to next step.

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7. Disconnect ABS control module harness connector. Check resistance between ground and control module harness connector terminal No. 2 (Tan/Light Green wire). See **Fig. 1**. If resistance is 5 ohms or less, replace ignition switch. After replacing switch, repeat **SYSTEM PRELIMINARY CHECK**. If resistance is not 5 ohms or less, reconnect brake fluid level switch and go to next step.
8. Check resistance between ground and ABS control module harness connector terminal No. 2 (Tan/Light Green wire). If resistance is 5 ohms or less, replace brake fluid level switch. If resistance is not 5 ohms or less, replace ABS control module. After replacing control module, repeat **SYSTEM PRELIMINARY CHECK**.

### CODE 16 - System Okay

This code should be used to verify if system is okay. If Keep Alive Memory (KAM) fuse is blown, Yellow ABS warning light will flash Code 16 or another trouble code is set. Check KAM fuse when diagnosing complaints of Yellow ABS warning light flashing.

### TEST DRIVE

#### Verification

This test drive is a generic test used to verify repair of system, attempt to recreate an intermittent problem or attempt to detect a symptom when trouble code or symptom is not known.

1. Turn ignition on. Observe Yellow ABS light self-check. If ABS light self-checks normally (turns on and then off after ignition on), go to next step. If Yellow ABS light does not self-check (light off), check light bulb or replace Keep Alive Memory (KAM) fuse. After repairs, repeat **SYSTEM PRELIMINARY CHECK**.
2. Wet an area where stop is to be performed. Drive vehicle at about 10 MPH. Drive over wet area and apply brakes hard enough to lock all 4 wheels while observing rear wheels. If one or both of rear wheels lock-up (momentary lock-up is permissible), go to next step. If no other symptoms are detected, go to **SYMPTOM DIAGNOSIS**. If Yellow ABS warning light does not come on, go to step 4). If Yellow ABS warning light comes on and stays on, repeat **PRELIMINARY TESTS**.
3. Ensure wipers are turned off during this test. Drive vehicle at about 20 MPH on dry pavement. Perform a normal traffic stop. Feel for pulsation in brake pedal anytime during the stop or within 10 seconds after vehicle has stopped. If pulsation was felt, repeat **SYSTEM PRELIMINARY CHECK**. If Yellow ABS warning light did not come on, go to next step. If ABS warning light comes on and stays on, repeat **PRELIMINARY TESTS**.
4. Turn ignition on. Depress brake pedal. Check if stoplights come on. If stoplights come on, repeat **SYSTEM PRELIMINARY CHECK**. If stoplights do not come on, go to [CODE 11](#).

### SYMPTOM DIAGNOSIS

#### Symptom "A" - Unwarranted RABS Activity

1. If a premature loss of speed sensor signal during deceleration is suspected, check for:
  - Metal chips on pole piece.

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- Gap between speed sensor and sensor ring greater than 0.050" (1.27 mm).
  - Gap between speed sensor and sensor ring less than 0.005" (0.13 mm).
  - Missing or damaged speed sensor ring teeth.
2. If intermittent speed sensor signal to control module during deceleration is suspected, check for:
    - Intermittent open or short in speed sensor circuit.
    - Intermittent open speed sensor circuit at intermediate connections, specially at firewall.
    - Chafed wire insulation or pinched wire due to improper routing, causing intermittent short.
    - Underhood RABS data link connector shorted.
  3. If misadjusted rear brakes or grabby brake linings are suspected, check for:
    - Rear brake adjustment too tight.
    - Linings are grabby.

#### Symptom "B" - One Or Both Rear Wheels Lock-Up

1. If valve assembly failure is suspected, check for:
  - Damaged valve assembly reset switch.
  - Leaky dump valve.
  - Hydraulically inoperative valve assembly.
2. If speed sensor output low or loss at lower vehicle speeds is suspected, check for:
  - Gap between speed sensor and sensor ring greater than 0.050" (1.27 mm).
  - Speed sensor or speed sensor ring does not produce sufficient voltage (650 millivolt AC RMS) output.
3. If basic brake mechanical problem is suspected, check for:
  - Brake related problems such as damp or contaminated rear brake linings, stuck or leaking wheel cylinder, or overadjusted rear brakes.
  - Hung-up parking brake.
  - Leaking rear axle seal.
4. If a 4WD system mechanical/electrical problem is suspected, check for:
  - Hubs engaged although shift lever is in 2WD position.
  - Faulty 4WD indicator switch or short to battery voltage in 4WD circuit.
5. If a vehicle electrical problem is suspected, check for:
  - Stoplight input to control module missing.
  - Stoplights inoperative.

#### Symptom "C" - Hard Or Soft Brake Pedal

1. If valve assembly problem is suspected, check for:
  - Stuck closed isolation valve (hard pedal).
  - Leaky dump valve (soft pedal).

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2. If vehicle electrical problem is suspected, check for:
  - Brakelight switch always on while vehicle is driven.
3. If basic brake hydraulic problem (soft pedal) is suspected, check for:
  - Hydraulic leak in brakeline or hose, fitting, master cylinder, wheel cylinder, or caliper.
  - Air in brake system.
4. If basic brake mechanical problem (hard pedal) is suspected, check for:
  - Brake related problems such as little or no vacuum boost, stuck or inoperative wheel cylinder or caliper, or pinched or crimped brakeline or hose.

#### Symptom "D" - Lack Of Deceleration During Medium/Hard Brake Applications

1. If valve assembly inoperative problem is suspected, check for:
  - Leaky dump valve.
  - Stuck closed isolation valve.
2. If speed sensor input to control module is intermittent or problem is suspected, check for:
  - Short or open in frame or instrument panel harness, control module connector (terminals No. 3 and 10), speed sensor connector, bulkhead connector or other connection, pinched or worn wires, or shorted data link connector.
  - Metal chips on speed sensor.
  - Borderline high speed sensor-to-sensor ring gap, excessive speed sensor ring radial runout, or damaged or missing speed sensor ring gear teeth.
3. If vehicle electrical problem is suspected, check for:
  - Low vacuum switch inoperative (diesel engine only).
4. If basic brake hydraulic problem is suspected, check for:
  - Hydraulic leak in brakeline or hose, fitting, master cylinder, wheel cylinder, or caliper.
  - Air in brake system.
5. If basic brake mechanical problem is suspected, check for:
  - Little or no vacuum boost, stuck or inoperative wheel cylinder or caliper, pinched or crimped brakeline or hose, or ineffective brake shoe or pad linings.

#### INTERMITTENT DIAGNOSIS

1. Reinstall any components previously removed. Reconnect any connectors previously disconnected. Clear all codes. See **CLEARING CODES**. Turn ignition on. If Yellow ABS light does not self-check or stays on, go next step. If Yellow ABS light does self-check, go step 3).
2. Check all component connectors for bent terminals, damaged connector terminal locks or damaged connector wedge. Repair as necessary. If any of these conditions are found, check affected circuit wire length. If wire length is short, repair as necessary to prevent problem from recurring.
3. Ensure ignition is on. Observe Yellow ABS warning light. Starting at one component, wiggle connector by connector until whole circuit has been tested. If Yellow ABS warning light does not come on, go to next step. If Yellow ABS warning light comes on, repair wire terminal or connector as necessary. After

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repairs, go to step 5).

4. If a trouble code is being serviced, perform step 3) on all circuits affected. If all affected circuits have been tested, go to step 6).
5. Retrieve trouble codes. See **RETRIEVING TROUBLE CODES**. If code is different than one being serviced, go to appropriate code under **TROUBLE CODE DIAGNOSIS**. If code is not different than one being serviced, repair wire, terminal or connector as necessary and go to step 7).
6. Verify all appropriate diagnostic procedures have been performed. If **SYSTEM PRELIMINARY CHECK** tests have been completed and a code received, and all tests for that code under **TROUBLE CODE DIAGNOSIS** have been performed, repeat test for appropriate code under **TROUBLE CODE DIAGNOSIS**. If **PRELIMINARY TESTS** or test for appropriate code have not been completed, return to procedure not yet performed.
7. Clear all codes. See **CLEARING CODES**. Turn ignition off. Retrieve trouble codes. See **RETRIEVING TROUBLE CODES**. If Code 16 is present, problem has been corrected. If previous code still exists, go to step 4). If a different code is present, go to appropriate test under **TROUBLE CODE DIAGNOSIS**.

## REMOVAL & INSTALLATION

**CAUTION:** When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See **COMPUTER RELEARN PROCEDURES** article in the **GENERAL INFORMATION** section before disconnecting battery.

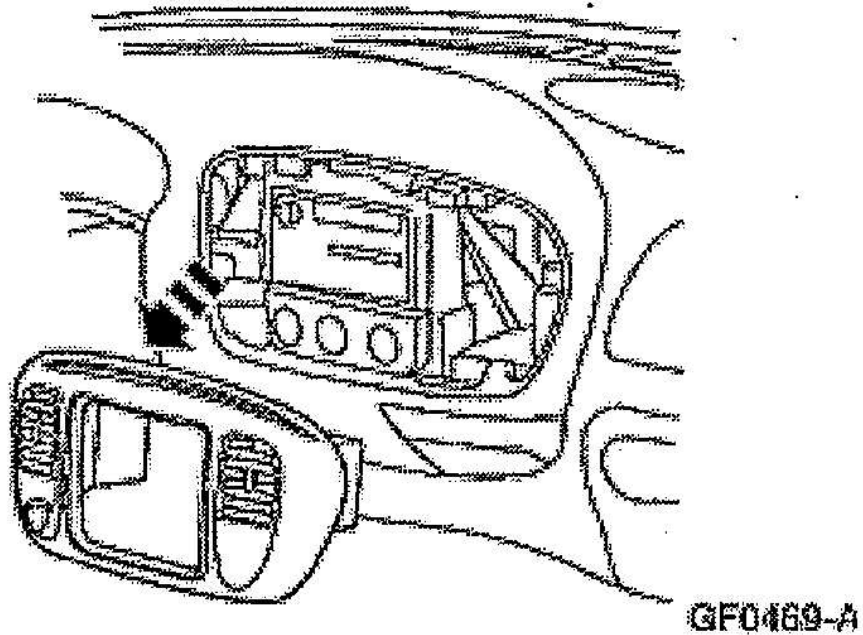
### ABS CONTROL MODULE

#### Removal

1. Disconnect battery ground cable.
2. Remove the center instrument panel finish panel.

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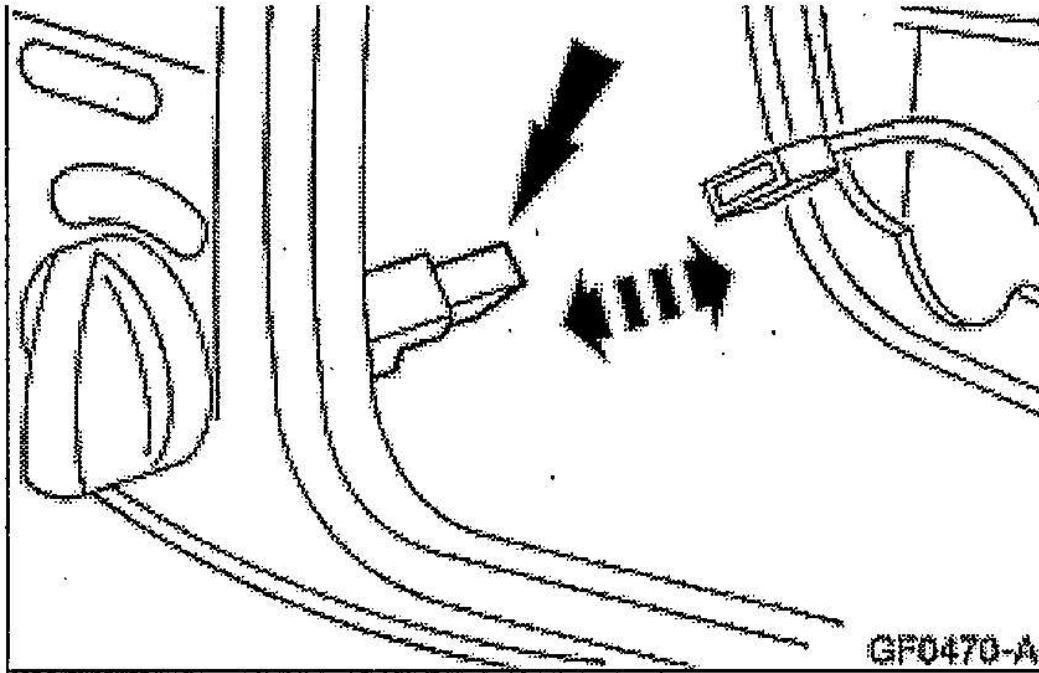


**Fig. 2: Removing Center Finish Panel**  
Courtesy of FORD MOTOR CO.

3. If equipped disconnect the transfer case rotary control switch electrical connector.

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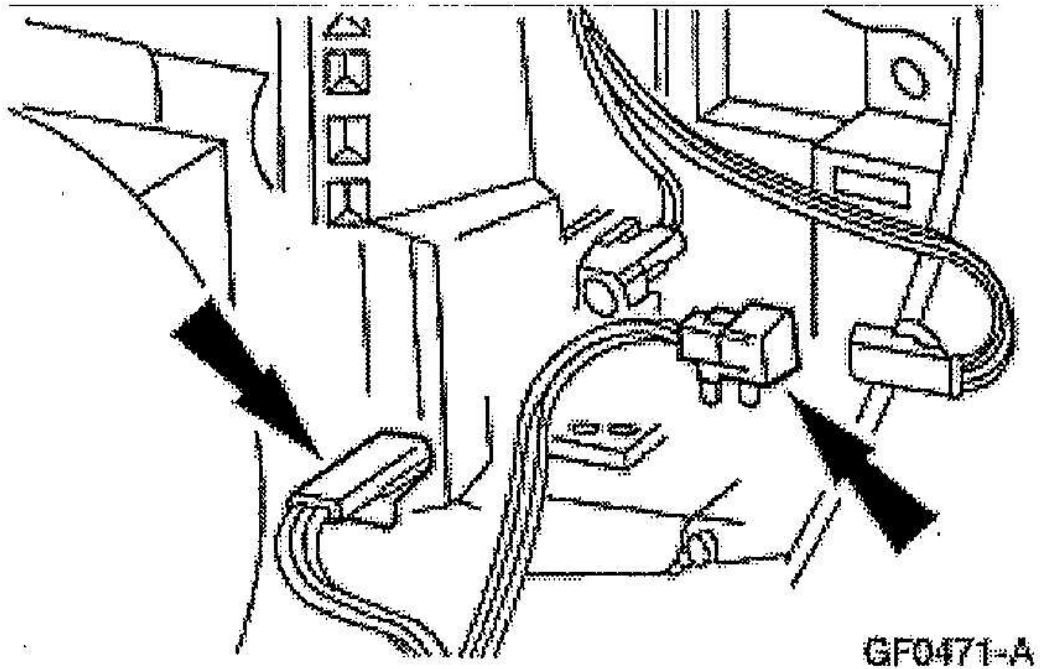


**Fig. 3: Disconnecting Rotary Control Switch Electrical Connector**  
Courtesy of FORD MOTOR CO.

4. Disconnect the two passenger air bag defeat switch electrical connectors.

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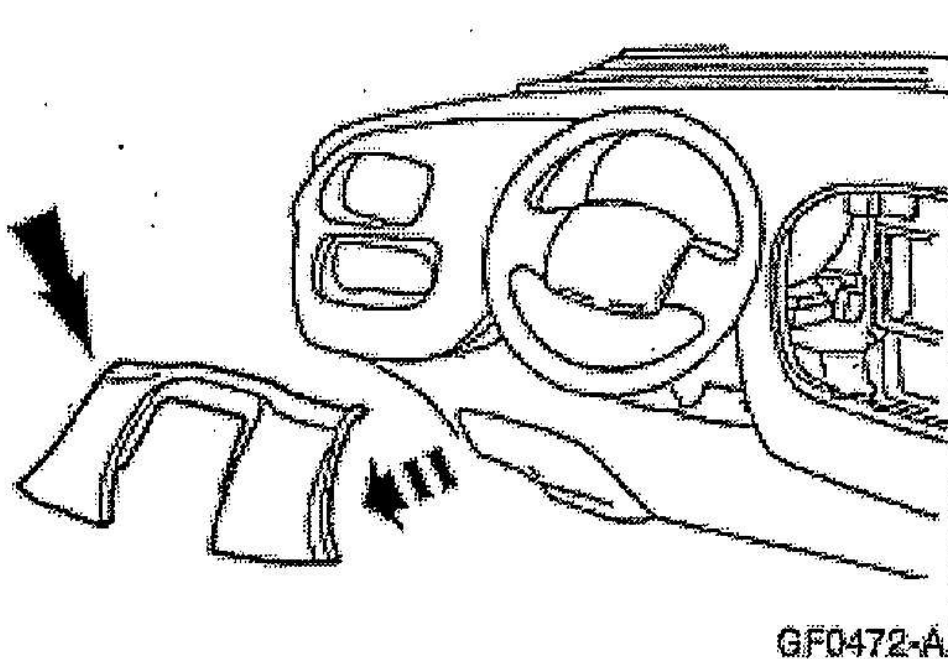


**Fig. 4: Identifying Two Passenger Air Bag Defeat Switch Electrical Connectors**  
Courtesy of FORD MOTOR CO.

5. Remove the steering column cover trim panel.

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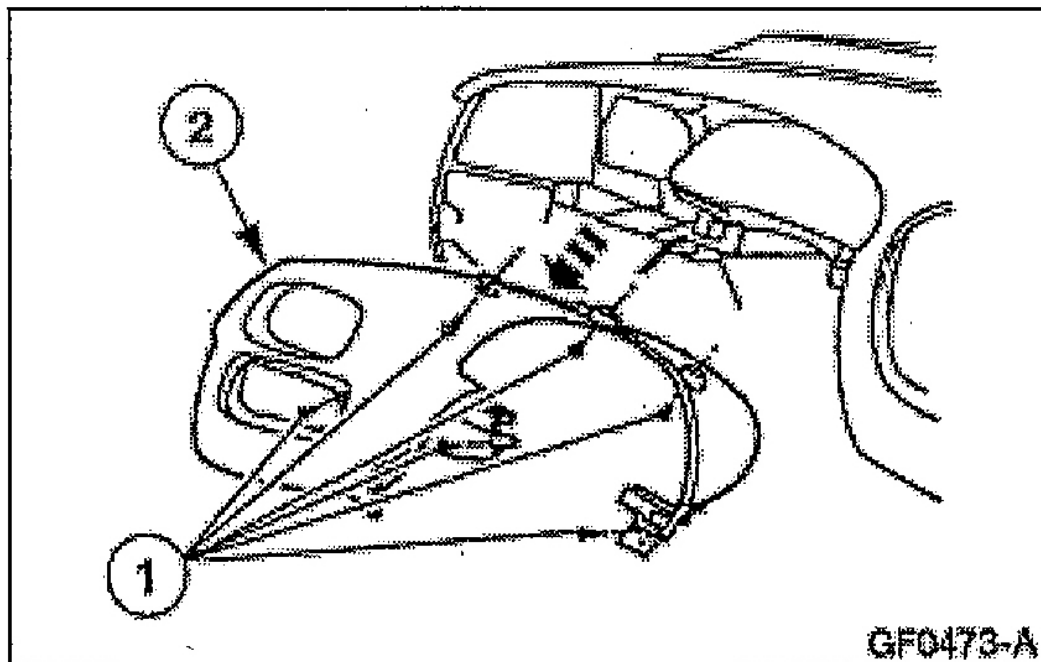


**Fig. 5: Removing Steering Column Cover Trim Panel**  
Courtesy of FORD MOTOR CO.

6. Remove the headlamp switch. Refer to **HEADLIGHT SWITCH** under REMOVAL & INSTALLATION in INSTRUMENT PANEL - ANALOG article in ACCESSORIES & EQUIPMENT.
7. Remove the LH instrument panel finish panel.
  1. Remove the screws.
  2. Remove the instrument panel finish panel.

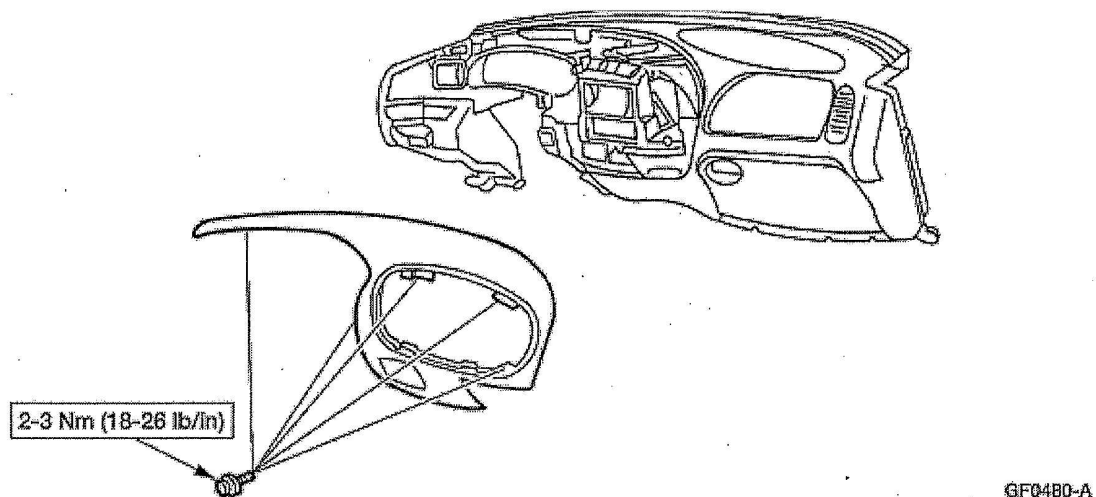
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**Fig. 6: Identifying LH Instrument Panel Finish Panel**  
Courtesy of FORD MOTOR CO.

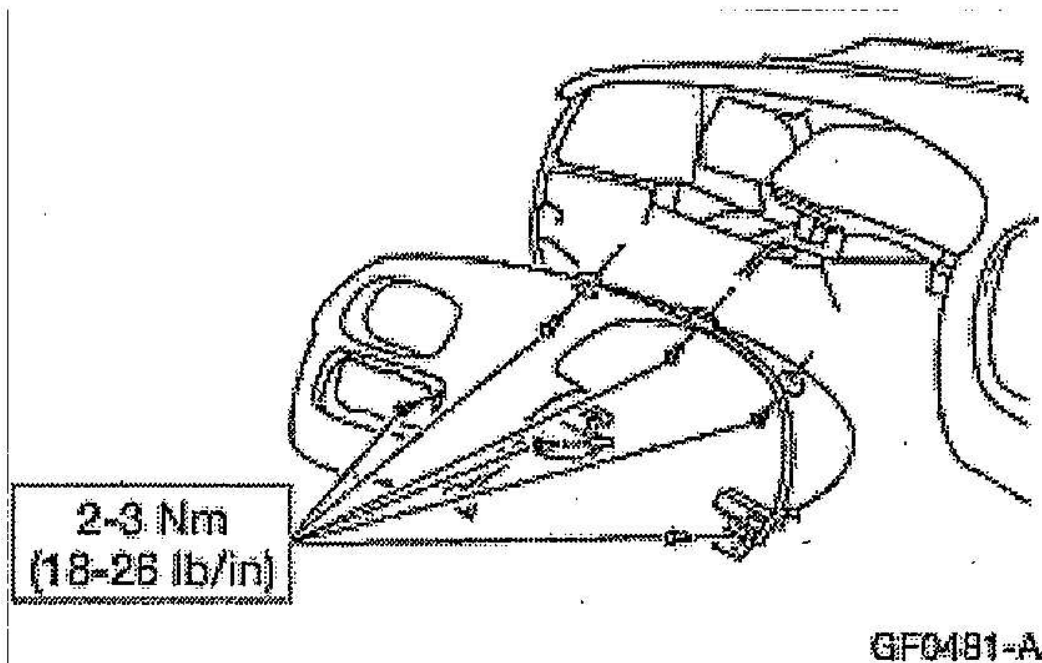
8. Remove the instrument cluster panel.
  1. Remove the screws.
  2. Remove the instrument cluster panel.



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**Fig. 7: Removing Instrument Cluster Panel - (1 Of 2) With Torque Specifications**  
Courtesy of FORD MOTOR CO.



**Fig. 8: Removing Instrument Cluster Panel - (2 Of 2) With Torque Specifications**  
Courtesy of FORD MOTOR CO.

9. Remove the anti-lock electronic control module.
  1. Remove the two anti-lock electronic control module bolts.
  2. Remove the anti-lock electronic control module.
  3. Disconnect the anti-lock electronic control module electrical connector.

### Installation

1. To install, reverse the removal procedure.

### ABS SPEED SENSOR

#### Removal & Installation

Disconnect ABS speed sensor harness connector. See **COMPONENT LOCATIONS** under DIAGNOSIS. Remove hold-down bolt and sensor. To install, clean axle mounting surface. Ensure "O" ring is positioned on sensor, and sensor tip is clean of all metal particles. Lightly lubricate "O" ring with engine oil. Install sensor. DO NOT use force to install sensor. Install hold-down bolt. Ensure air gap is between .005-.045" (.127-1.14

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mm). Tighten hold-down bolt to specifications. See **TORQUE SPECIFICATIONS**.

### EXCITER/SENSOR RING

#### Removal & Installation

Remove differential case from axle housing. See appropriate article in the DRIVE AXLES section. Press exciter/sensor ring from differential ring gear. Discard exciter/sensor ring. To install, reverse removal procedure. Use a NEW exciter/sensor ring.

### RABS VALVE

#### Removal & Installation

Disconnect and plug brakelines connected to RABS valve. See **COMPONENT LOCATIONS** under DIAGNOSIS. Unplug harness connector. Remove retaining bolts. Remove RABS valve. To install, reverse removal procedure. Tighten to specifications. See **TORQUE SPECIFICATIONS**. Bleed brakes. See **BLEEDING BRAKE SYSTEM**.

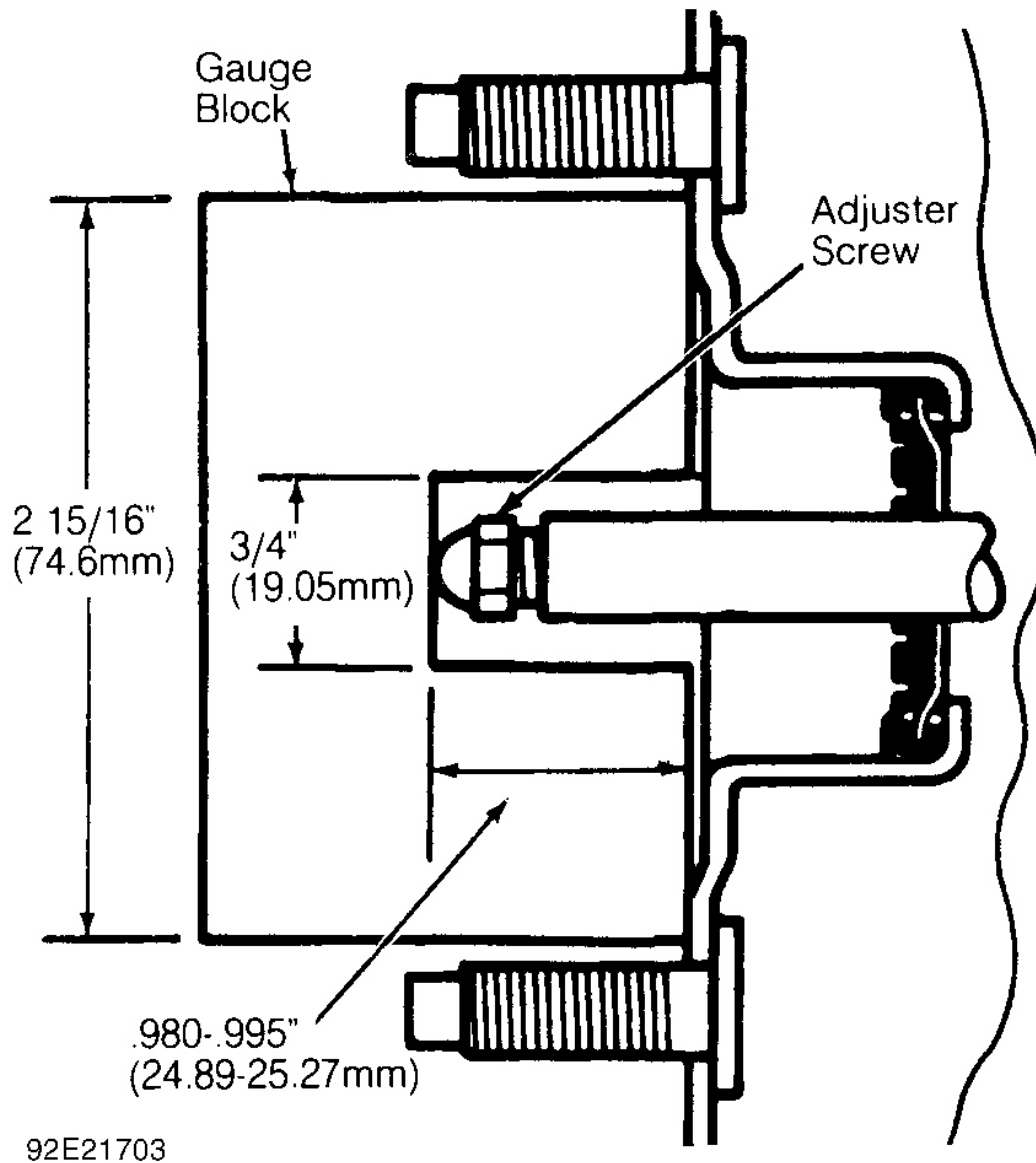
## ADJUSTMENTS

### MASTER CYLINDER PUSH ROD

Remove master cylinder. See BRAKE SYSTEM article in the BRAKES section. Fabricate a gauge with dimensions shown. See **Fig. 9**. Ensure vacuum hose remains connected to brake booster. Start engine. Place gauge against booster. Turn push rod adjuster screw until end of screw just touches gauge.

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**Fig. 9: Adjusting Push Rod**  
Courtesy of FORD MOTOR CO.

## TORQUE SPECIFICATIONS

### TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Speed Sensor Hold-Down Bolt	25-30 (34-41)
Hydraulic Fittings	

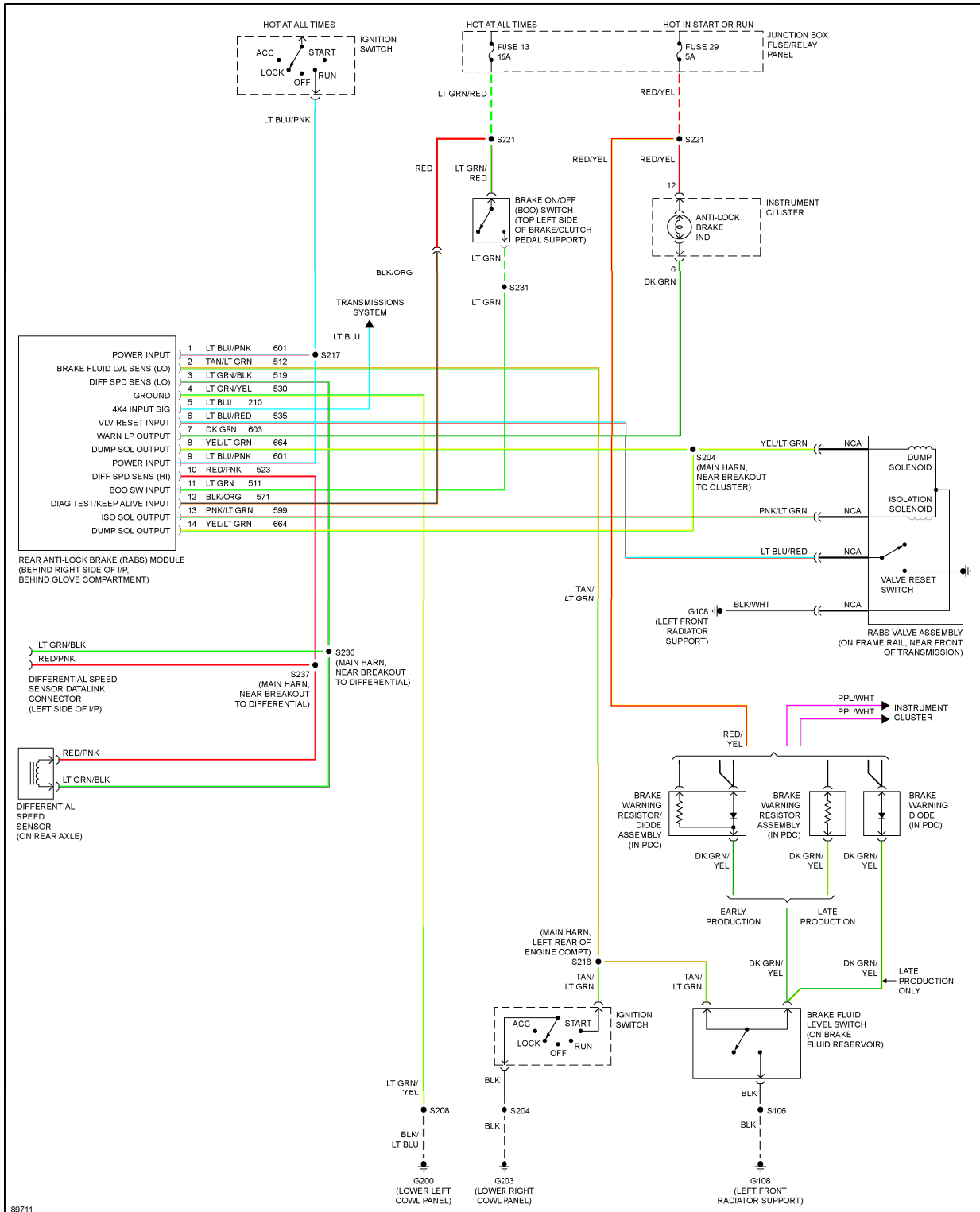
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1/2"-20	10-17 (14-23)
7/16"-24	10-15 (14-20)
3/8"-24	10-15 (14-20)
RABS Valve Mounting Bolts	12-17 (16-23)

## WIRING DIAGRAMS

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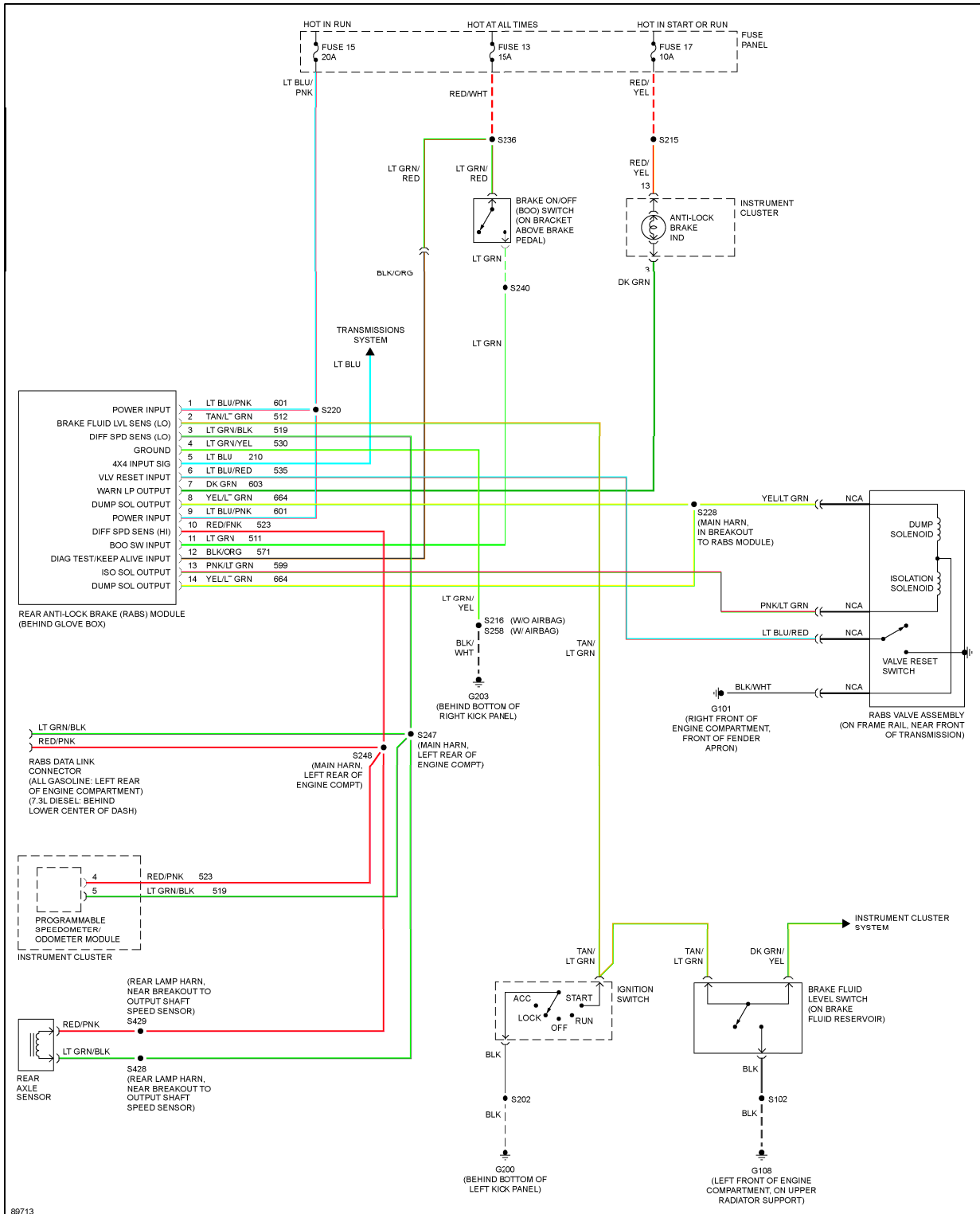


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**Fig. 10: Rear Anti-Lock Brake System Wiring Diagram (F150 & F250 Light-Duty - Rear Wheel)**  
Courtesy of FORD MOTOR CO.

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**Fig. 11: Rear Anti-Lock Brake System Wiring Diagram (F250 Heavy-Duty & F350 - Rear Wheel)**  
Courtesy of FORD MOTOR CO.