T 444E ENGINE
CHECK ENGINE OIL LEVEL

FROM FORM EGED–130–1

1. CHECK ENGINE OIL LEVEL

- Check for contaminants (fuel, coolant)
- Correct grade/Viscosity

Method	Check
Visual	

☐ If idle quality is poor after extended running, refer to Test 14

PURPOSE

To determine if the crankcase and oil reservoir contain engine oil of sufficient quantity and quality to enable the injection control pressure system to function properly.

TEST PROCEDURE

1. Park vehicle on level ground. Check oil level with oil level gauge. If there is no oil or very little oil in the crankcase the fuel injectors will not operate.

If the oil level on the gauge is over full, it is possible the engine was incorrectly serviced or fuel is diluting the oil and filling the crankcase. If a substantial amount of fuel is in the oil, it will have a fuel odor.

2. Inspect oil for color. A milky white oil indicates possible coolant contamination and will have an ethylene glycol odor.
3. Check service records for correct oil type and viscosity for the temperature (environment) the vehicle is operating in. Single weight or 15W 40 oil is not recommended for cold ambient temperatures. Oil that has had extended drain intervals will have increased viscosity (become thicker) and will make engine cranking more difficult and starting less reliable at temperatures below freezing. Refer to lube oil chart in the operator's or service manual for the correct oil selection for temperature conditions.
4. Check oil level in reservoir. **Figure 2.3–1.**

POSSIBLE CAUSES

- Oil level low Oil leak, oil consumption, incorrect servicing.
- Oil level high Incorrect servicing, fuel dilution from lift pump or defective injector "O" rings.
- Oil Contamination with Coolant Oil Cooler, head gasket, porosity, (accessories i.e. water cooled air compressors.)
- Low reservoir level Engine built dry (not pressured lubed), prolonged period of not running, leaking check valve in high pressure pump.

TOOLS REQUIRED

1/4" drive ratchet or breaker bar to remove inspection plug.

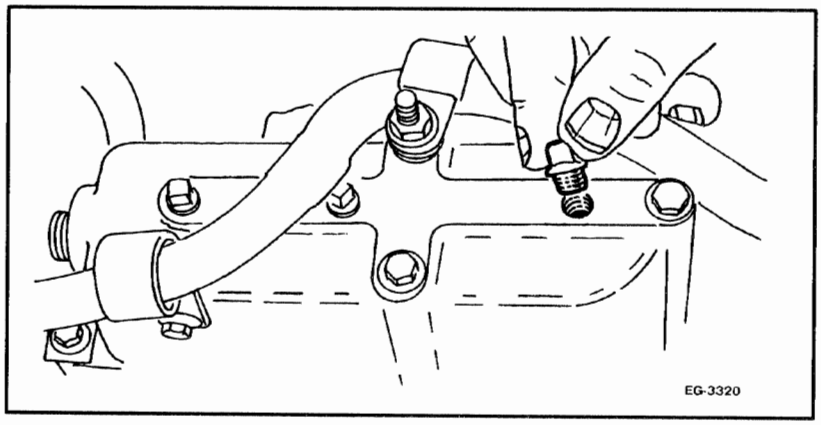

Figure 2.3–1. – Checking Oil Level in Reservoir

PERFORMANCE DIAGNOSTICS

T 444E ENGINE
SUFFICIENT CLEAN FUEL

FROM FORM EGED–130–1

2. SUFFICIENT CLEAN FUEL

- Check at tank(s), drain sample from fuel filter while cranking engine.

Method	Check
Visual	

PURPOSE

To determine if the fuel system is getting sufficient clean fuel to start and operate the engine.

TEST PROCEDURE

1. Route a hose from the fuel drain tube **(Figure 2.3–2.)** to a clear container and open the drain.
2. Crank the engine and observe the fuel flowing into the container. Stop cranking the engine when the container is half full.

Fuel flow out of the drain tube should be a steady stream. Insufficient flow could indicate fuel supply or fuel system problem.

3. Inspect fuel in container. It must be clean and free of air, contaminants, water, icing or clouding. The fuel should be straw colored. Fuel dyed red or blue indicates an off highway fuel.
4. Check fuel odor for the presence of other fuels such as gasoline or kerosene.

If engine oil is present in the fuel, it may indicate an injector "O" ring leak and subsequent loss of injection control pressure. If that is suspected, check injection control pressure during engine cranking. Use the Electronic Service Tool (EST) or follow procedure outlined in **Test 9C.**

NOTE: SOME SEDIMENT AND WATER MAY BE PRESENT IN THE FUEL SAMPLE IF THE FUEL FILTER HAS NOT BEEN SERVICED OR DRAINED FOR A PROLONGED PERIOD OF TIME. A SECOND SAMPLE MAY BE REQUIRED TO DETERMINE FUEL QUALITY.

LOW OR NO FUEL
POSSIBLE CAUSES

- No fuel in tank.
- If equipped with a inline fuel valve, it could be shut off.
- Fuel supply line from tank(s) could be broken or crimped.
- Fuel could be waxed or jelled (most likely in cold weather with #2 fuel), the pickup tube in tank could be clogged or cracked. If there is excessive water in the tank, it could freeze preventing the fuel from being drawn to the engine.

If the vehicle is equipped with supplemental filters or water separators, check for plugged filters or leakage that could allow the engine to draw air.

Cloudy fuel indicates that the fuel may not be a suitable grade for cold temperatures. Excessive water or contaminants in fuel may indicate that the tank and fuel system may need to be flushed and cleaned.

TOOLS REQUIRED

Clear container approximately 1 quart.

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T 444E ENGINE
SUFFICIENT CLEAN FUEL (Continued)

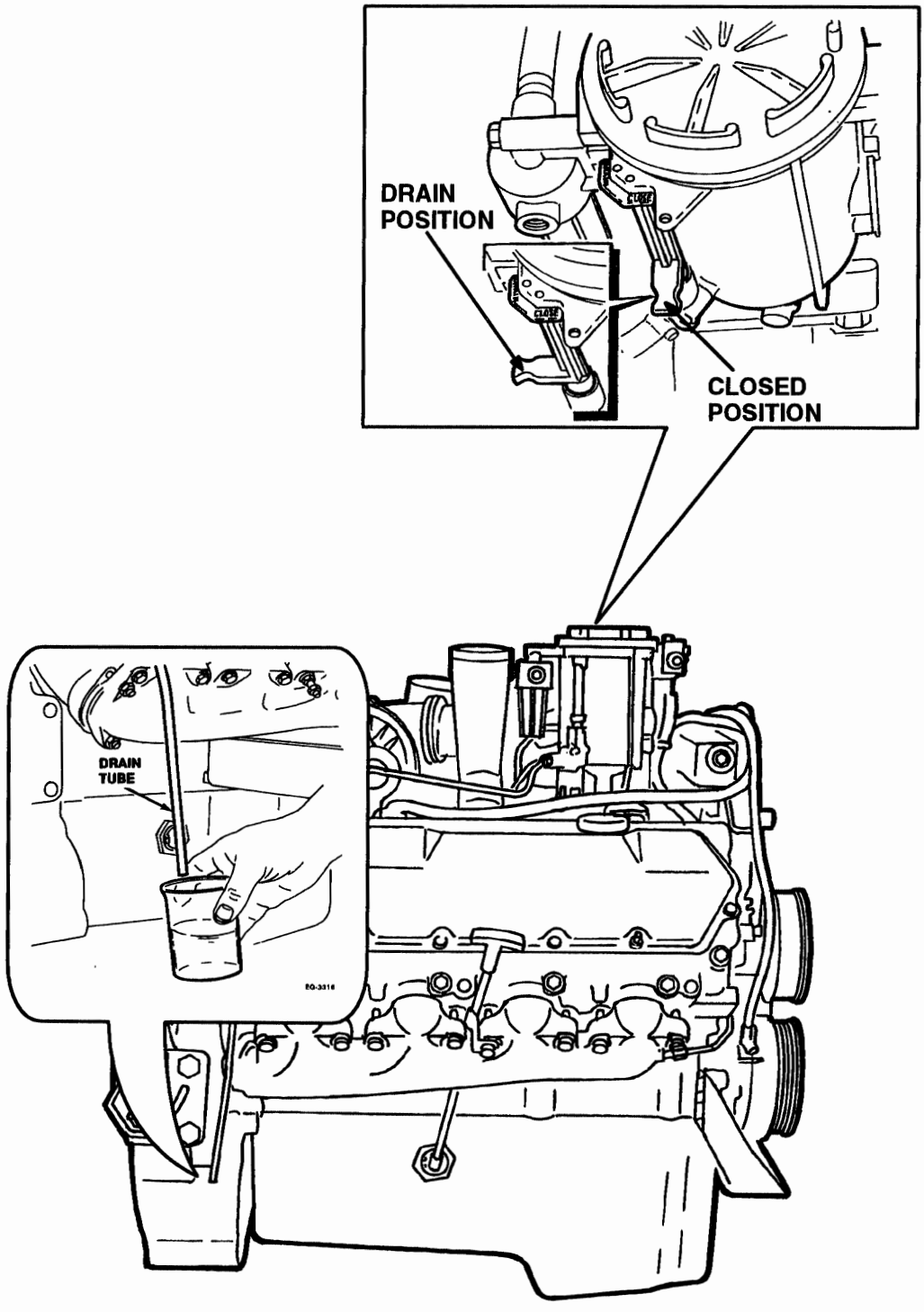


Figure 2.3–2. – Fuel Drain

PERFORMANCE DIAGNOSTICS

T 444E ENGINE
EST–TOOL FAULT CODES

FROM FORM EGED–130–1

3. EST–TOOL FAULT CODES

- Install Electronic Service Tool

Active	
Inactive	

- ☐ See Electronic Diagnostic form for codes

PURPOSE

To determine if the Electronic Control Module (ECM) has detected any fault conditions that would cause an engine performance problem.

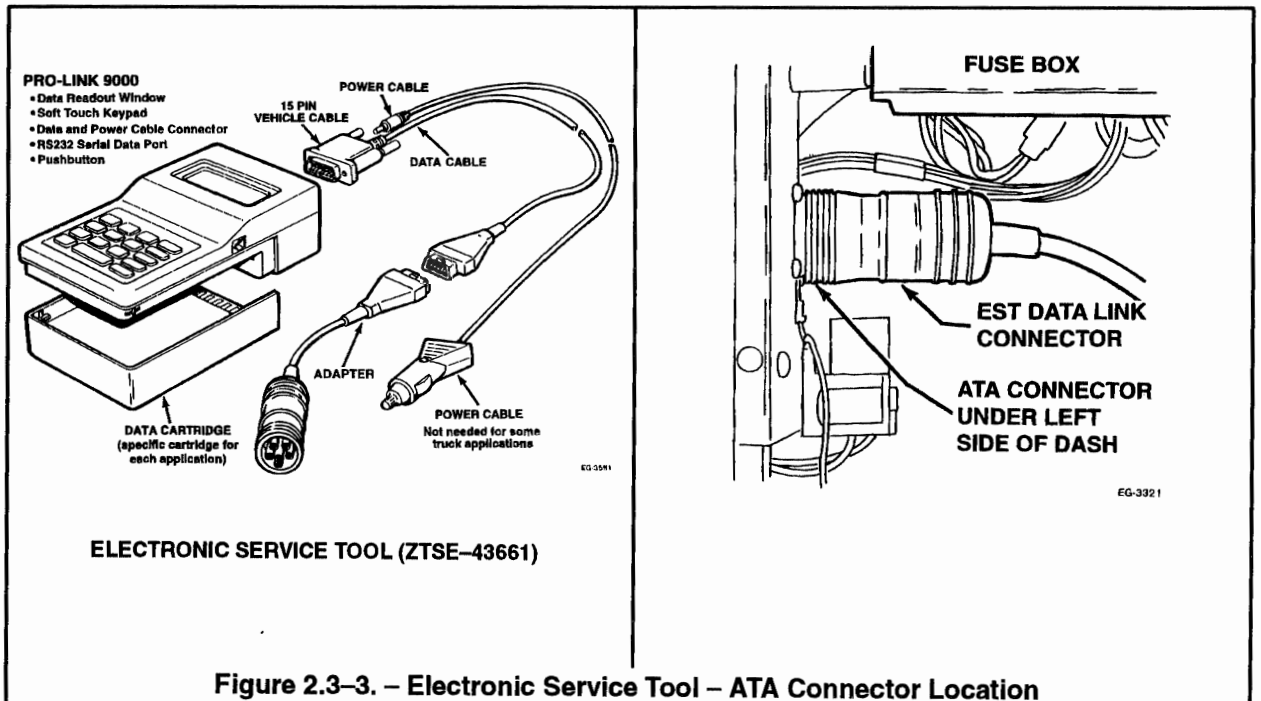
TEST PROCEDURE

NOTE: TURN ALL ACCESSORIES AND THE IGNITION OFF, BEFORE CONNECTING EST TOOL TO ATA DIAGNOSTIC CONNECTOR.

Connect the Electronic Service Tool (EST) to the American Trucking Association (ATA) diagnostic connector. The connector is located on the lower left kick panel **(Figure 2.3–3.)** inside the cab.

NOTE: THE ATA CONNECTOR SUPPLIES POWER TO OPERATE THE EST. THE EST WILL AUTOMATICALLY POWER UP AS SOON AS IT IS PLUGGED INTO THE ATA CONNECTOR. THE POWER CORD IS NOT REQUIRED AND IS FOR USE ONLY WHEN READING NON–VOLATILE MEMORY.

Turn the ignition switch to the "ON" position, but **do not start** the engine. This will allow the EST to receive data from the electronic control components on the truck. If no data is received, press **"ENTER"** to retry. The information received will be data showing the current status of the engine.



ELECTRONIC SERVICE TOOL (ZTSE–43661)

Figure 2.3–3. – Electronic Service Tool – ATA Connector Location

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T 444E ENGINE
EST TOOL–FAULT CODES (Continued)

To access the fault codes press the **"FUNC"** key to switch to the main menu.

NAVISTAR MRD
SELECT DESIRED
MENU
[ENGINE] ↔ PRO–LINK

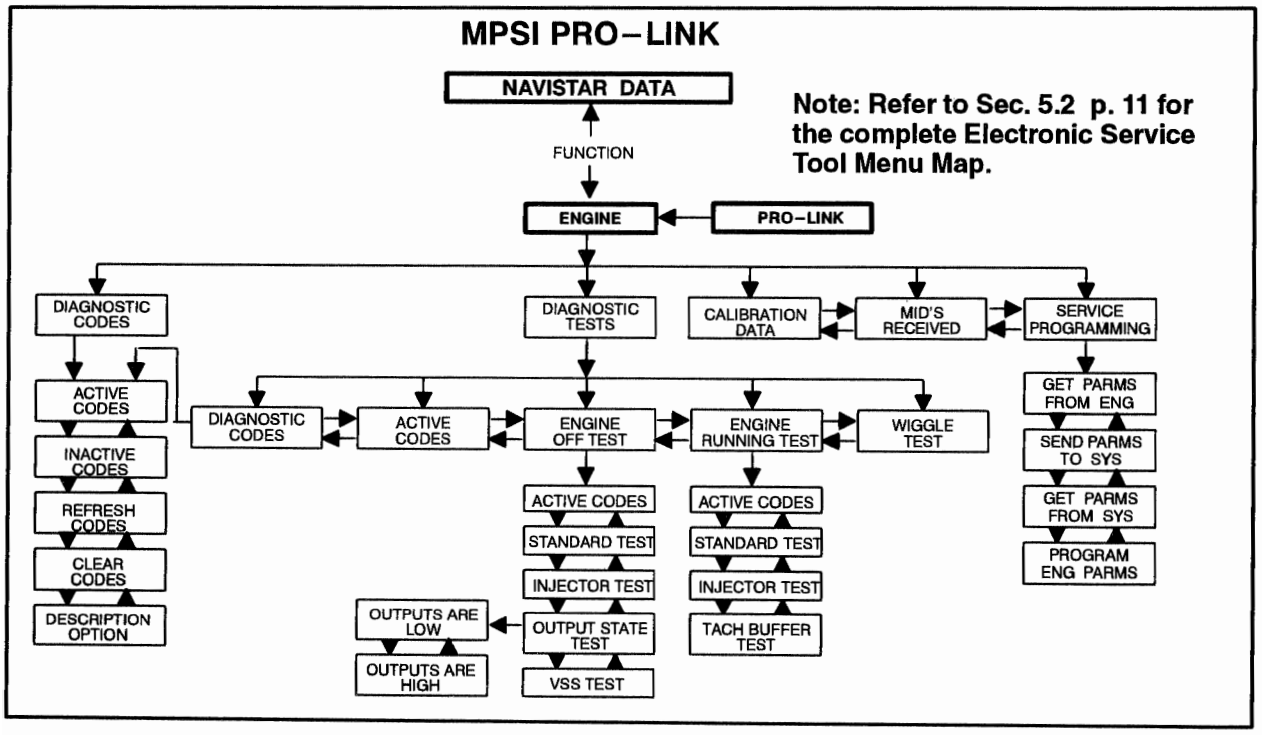
From the main menu select **"ENGINE"** by pressing the "←" key. This will cause the brackets to be placed around the "ENGINE" selection. Then press **"ENTER"**.

From the next menu select "**DIAGNOSTIC CODES"**. The selection will have the "↑↓" symbol on the screen. This means there are other selections available. By pressing the "↓" key the other selections will display on the screen. Press "↓" until **"DIAGNOSTIC CODES"** appears on the screen. Next press **"ENTER".** This causes the EST to enter the diagnostic codes section. From this point, diagnostic codes can be accessed.

NAVISTAR MRD
ENGINE MENU
↑ DIAGNOSTIC CODES ↓

The first option that will appear is **"ACTIVE CODES"**. By selecting this option, the fault codes that have occurred during this key "ON" cycle will be displayed. Press **"ENTER"**. If there are any "Active Codes", the first one will appear on the screen along with a description of the code. If there are any additional codes "Active" the "↑↓" symbol will appear on the screen. Press "↓" key to access additional codes. If there are not any codes "Active", **"NO ACTIVE CODES"** will appear on the screen.

NAVISTAR MRD
DIAGNOSTIC CODES
↑ ACTIVE CODES ↓



PERFORMANCE DIAGNOSTICS

T 444E ENGINE
EST TOOL–FAULT CODES (Continued)

To access "Inactive Codes" press the **"FUNC"** key. This will access the last prior selection. Then press the "↓" key to select **"INACTIVE CODES"** Press the **"ENTER"** key.

NAVISTAR MRD DIAGNOSTIC CODES		
↑	INACTIVE CODES	↓

Inactive codes are faults that have occurred in the past, and are now stored in memory. An "Active Code" will become an "Inactive" code if the key is shut off even if the malfunction no longer exists (such as an intermittent problem).

Record all fault codes that are found. If there are any fault codes found, refer to "Electronic Control System Diagnostics" section of the manual.

NOTE: ALL CURRENT FAULT CODES MUST BE REPAIRED (CLEARED), BEFORE PROCEEDING WITH FURTHER DIAGNOSTIC TESTING.

POSSIBLE CAUSES

Electronic malfunctions which can be detected by the ECM on a continuous monitor basis.

TOOLS REQUIRED

PRO–LINK 9000 (ZTSE–43661)

SUPPLEMENTAL DIAGNOSTICS

If fault codes are set, refer to Electronic Diagnostic form EGED–135–1 and fault code diagnosis.

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T 444E ENGINE
EST TOOL–ENGINE OFF TESTS

FROM FORM EGED–130–1

4a. EST TOOL–ENGINE OFF TESTS

- Select "Engine Off" test or "Self Test" from diagnostic test menu

Faults Found	

☐ See Electronic Diagnostic form for codes

PURPOSE

To determine if there are any electrical malfunctions that can be detected by the Electronic Control Module (ECM) during an on demand self test.

TEST PROCEDURE

NOTE: ACCESS "DIAGNOSTIC CODES" MENU IN EST AND CLEAR ALL FAULT CODES BEFORE PERFORMING ENGINE OFF TESTS.

Access the **"ENGINE OFF TESTS"** in the **"DIAGNOSTIC TESTS"** section of the Electronic Service Tool (EST).

Press the **"FUNC"** key repeatedly, until the main menu appears on the screen.

```
NAVISTAR MRD
SELECT DESIRED
MENU
[ENGINE] ↔ PRO–LINK
```

Move the brackets to engine selection by pressing the "←" key, then press **"ENTER"**

Next select the **"DIAGNOSTIC TESTS"** menu by pressing the "↓" key, until **"DIAGNOSTIC TESTS"** is shown on the screen. Press **"ENTER"** to make this selection.

```
NAVISTAR MRD
ENGINE MENU

↑    DIAGNOSTIC TESTS    ↓
```

Press the "↓" key, until the **"ENGINE OFF TESTS"** is shown on the screen. At this point, press **"ENTER"**

```
NAVISTAR MRD
DIAGNOSTIC TESTS

↑    ENGINE OFF TESTS    ↓
```

After the **"ENTER"** key is pressed, the EST will command the ECM to perform a self test.

When the test is complete, the screen will display the number of faults found in the self test. If there are any additional faults found, press **"ENTER"** and the faults will be displayed. If there is more than one fault that was found during the test, the "↑↓" symbol will be shown on the screen. Press the "↓" key to access any additional faults.

NOTE 1: IF FAULT CODES WERE NOT CLEARED BEFORE RUNNING ENGINE OFF TESTS, ALL IDM FAULTS AND ASSOCIATED CODES RECORDED DURING THE TEST WILL BE STORED AS "INACTIVE" CODES BY THE EST. TO READ THE CODES, ACCESS THE "INACTIVE" CODE MENU.

NOTE 2: THE PROGRAM IN THE EST WILL ONLY ALLOW THE ENGINE OFF TESTS MENU TO BE ACCESSED ONCE. TO REPEAT ENGINE OFF TESTS, SELECT "SELF TEST" TO RERUN THE ENGINE OFF TESTS.

POSSIBLE CAUSES

- Defective electrical components or circuitry.
- Injection Pressure Regulator (IPR) output circuit check fault.
- Fuel Demand Command Signal (FDCS) and Cylinder Identification (CI) output circuit check faults.

TOOLS REQUIRED

PRO–LINK 9000 (ZTSE–43661)

SUPPLEMENTAL DIAGNOSTICS

If fault codes are set, refer to Electronic Diagnostic Form EGED–135–1 and fault code diagnosis.

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PERFORMANCE DIAGNOSTICS

T 444E ENGINE
EST–INJECTOR "BUZZ TEST"

FROM FORM EGED–130–1

4b. EST–INJECTOR "BUZZ TEST"

NOTE: Engine Off Test must be performed first in order to gain access to the Injector "Buzz Test"

- Select "Injector Test" from diagnostic test menu

Faults Found	

☐ See Electronic Diagnostic form for codes

PURPOSE

To determine if the injectors are electronically functioning correctly, by energizing each injector in a programmed sequence. The Electronic Control Module (ECM) and Injector Drive Module (IDM) will monitor this test and transmit fault codes if any injector(s) or electrical circuitry are not functioning properly.

TEST PROCEDURE

NOTE 1: ACCESS "DIAGNOSTIC CODES" MENU IN EST AND CLEAR ALL FAULT CODES.

NOTE 2: ENGINE OFF TEST MUST BE PERFORMED FIRST IN ORDER TO ACCESS THE INJECTOR "BUZZ" TEST.

After the **"Engine Off Tests"** have been completed, press the "↓" key to access the **"INJECTOR TEST"**. If the tool is not on a menu screen, i.e. displaying of fault codes etc., press the **"FUNC"** key. This will access the **"DIAGNOSTIC TESTS"** menu. Press **"ENTER"** to begin the test.

NAVISTAR MRD
DIAGNOSTIC TESTS

↑ INJECTOR TEST ↓

During this test, the injector solenoids will produce an audible clicking sound when actuated. It is possible to detect a malfunctioning injector(s) by listening for the absence of the solenoid clicking sound.

NOTE: IF FAULT CODES WERE CLEARED BEFORE THE INJECTOR "BUZZ" TEST, FAULT CODES DISPLAYED WILL BE ACTUAL FAULTS FOUND DURING THE TEST. IF CODES WERE NOT CLEARED BEFORE TESTING, ACCESS "INACTIVE" FAULT CODES FROM EST MENU TO RETRIEVE FAULTS FOUND DURING THIS TEST.

At the completion of the Injector Test, any faults that have been detected will be displayed. If there is more than one fault the "↑↓" symbol will be displayed. These additional faults can be accessed by pressing the "↓" key.

Record any faults found and refer to the Electronic Control System Diagnostics, Section 3.5.

POSSIBLE CAUSES

- Bad wiring harness connection at injector solenoid.
- Open or shorted engine wiring harness to injector(s).
- Defective injector solenoid(s).
- Defective IDM.

TOOLS REQUIRED

PRO–LINK 9000 (ZTSE–43661)

SUPPLEMENTAL DIAGNOSTICS

If fault codes are set, refer to Electronic Diagnostic Form EGED–135–1 and fault code diagnosis.

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T 444E ENGINE
STI BUTTON–FLASH CODES

FROM FORM EGED–130–1

5. STI BUTTON–FLASH CODES

- Depress and hold "Engine Diagnostics" switch, then turn the ignition switch to the "ON" position.

Faults Found	

Refer to Electronic Diagnostic form if fault code(s) set

PURPOSE

To read faults detected by the Electronic Control Module (ECM), if the Electronic Service Tool (EST) is not available or the EST cannot receive "Self Test Input" data due to communications or component failures.

The Self Test Input (STI) switch is located on the vehicle dashboard **(Figure 2.3–4.)** and is identified as the "ENGINE DIAGNOSTICS" switch. Depressing the STI switch on the vehicle dashboard while turning the ignition switch to the "ON" position, will signal the ECM to start the Self Test Input diagnostics to check output circuits. If any faults are detected, the ECM will flash the "WARN ENGINE" light to indicate which faults have been detected.

NOTE: SELF TEST INPUT DIAGNOSTICS WILL NOT FLASH VPM FAULT CODES.

TEST PROCEDURE

Depress and hold the STI switch (located on vehicle dash). Turn the ignition switch to the "ON" position. **Do Not Start The Engine.** The ECM will begin to perform the self test to check the output circuits.

When the test is completed, the ECM will flash the **"OIL/WATER"** and **"WARN ENGINE"** lights to signal the fault codes.

NOTE: FAULT CODES CAN BE ACCESSED AT ANYTIME BY DEPRESSING AND HOLDING THE STI SWITCH WHILE TURNING THE IGNITION SWITCH TO THE "ON" POSITION. (DO NOT START ENGINE.)

To read the fault codes it will be necessary to count the number of times the **"ENGINE WARN"** light flashes. The following sequence of events occur each time the STI switch is depressed to obtain the fault codes:

1. The **"OIL/WATER"** light will flash one time to indicate the beginning of **Active** fault codes.
2. The **"WARN ENGINE"** light will flash repeatedly signaling the active fault codes.

NOTE: All FAULT CODES ARE THREE DIGITS AND CODE 111 INDICATES "NO FAULTS" HAVE BEEN DETECTED.

3. Count the number of flashes in sequence. At the end of each digit of the code there will be a short pause. Three flashes and a pause would indicate the number 3. Therefore, two flashes, a pause, three flashes a pause, and two flashes a pause would indicate the code 232. If there is more than one fault code, the **"OIL/WATER"** light will flash once indicating the beginning of another active fault code.

After all the active codes have been flashed, the **"OIL/WATER"** light will flash twice to indicate the beginning of **INACTIVE** codes. Count the number of flashes from the **"WARN ENGINE"** light. If there is more than one inactive code, the **"OIL/WATER"** light will flash once in–between each fault code.

After all codes have been sent, the **"OIL/WATER"** light will flash three times indicating "END OF MESSAGE".

To repeat transmission of fault codes, depress the "ENGINE DIAGNOSTICS" switch which will signal the ECM to resend all stored fault codes.

If fault codes are set, refer to Electronic Diagnostic Form EGED–135–1 and fault code diagnosis.

POSSIBLE CAUSES

- Electronic component or circuitry failures.

TOOLS REQUIRED

None.

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PERFORMANCE DIAGNOSTICS

T 444E ENGINE
STI BUTTON–FLASH CODES (Continued)

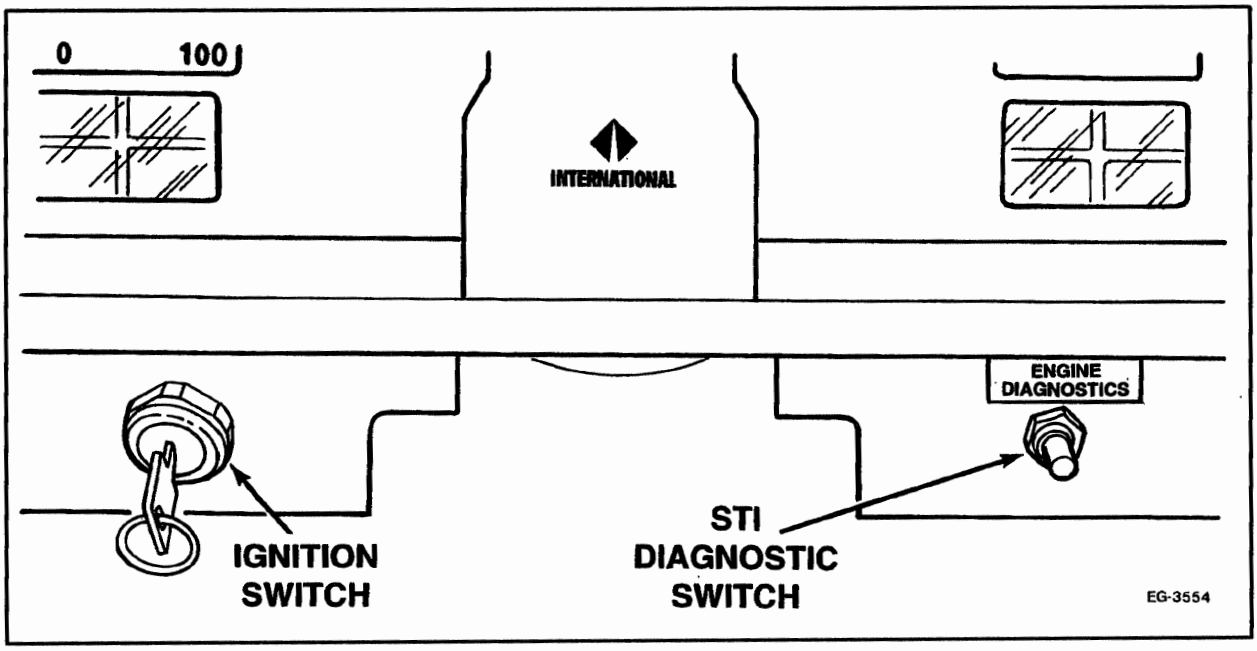

Figure 2.3–4. – Self Test Input (STI) Diagnostic Switch Location on Vehicle Dash

T 444E ENGINE
INTAKE RESTRICTION

FROM FORM EGED–130–1

6. INTAKE RESTRICTION

- Check filter minder if equipped
  (If yellow band is latched @ 25"H_20, replace filter)
- Measure at High idle & no load
- Use manometer or magnehelic gauge

Instrument	Spec.	Actual
Filter Minder	25 " H_20	
Manometer or Magnehelic Gauge	12.5 " H_20 Max..	

PURPOSE

To determine if an intake/air cleaner restriction exists. Often a low power and poor fuel economy complaint is simply due to a dirty air cleaner element. In this test, the gauge is inserted in the air cleaner housing. As the air cleaner element accumulates dirt, restriction to air flow increases. If restriction exceeds specifications, replace the air cleaner element or elements.

NOTE: A HIGH INTAKE RESTRICTION MAY CAUSE A CONSIDERABLE AMOUNT OF BLACK OR BLUE SMOKE WHEN STARTING THE ENGINE.

INSPECT AIR INTAKE RESTRICTION INDICATOR

1. Refer to appropriate "Operation and Maintenance Manual" "Air Cleaner Restriction Gauge and Indicator", for detailed information.

NOTE: THE AIR CLEANER IS TO BE REPLACED WHEN THE RESTRICTION REACHES THE MAXIMUM ALLOWABLE LIMIT. THE RESTRICTION CAN BE MEASURED BY A SERVICE INDICATOR, WATER MANOMETER OR MAGNEHELIC GAUGE.

2. Inspect the element(s) for damaged gaskets or dents. If they exhibit either they should be replaced.

SINGLE ELEMENT AIR CLEANER

Measure air cleaner restriction as follows:

1. Attach the restriction test gauge (**Figure 2.3–5.**) at air cleaner housing tap location.
2. Run engine at high idle RPM.
3. Replace the air cleaner element when the test-gauge shows a restriction greater than 12.5 in. H_2O (3.13 kPa).

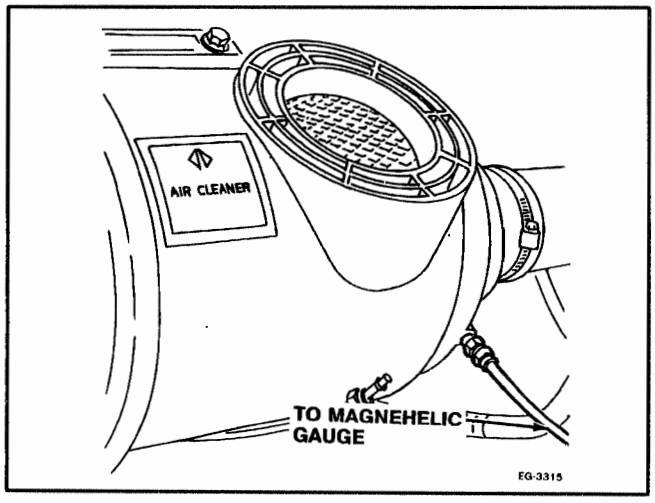

Figure 2.3–5. – Restriction Test Location

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PERFORMANCE DIAGNOSTICS

T 444E ENGINE
INTAKE RESTRICTION (Continued)

NOTE 1: THE TRUE MAXIMUM AIR CLEANER RESTRICTION CAN ONLY BE OBTAINED WHEN OPERATING THE ENGINE AT FULL LOAD AND RATED SPEED. THE VEHICLE MOUNTED INDICATOR OR VACUUM GAUGE WILL SENSE MAXIMUM RESTRICTION. WHEN 25 IN. H_2O (6.22 KPA) IS SENSED ON THE VEHICLE MOUNTED GAUGES, REPLACE THE AIR CLEANER ELEMENT. FOR CONVENIENCE, AIR CLEANER RESTRICTION CAN BE MEASURED AT HIGH IDLE (NO LOAD); HOWEVER, THE ELEMENT MUST BE REPLACED WHEN 12.5 IN. H_2O (3.13 KPA) IS MEASURED.

NOTE 2: HIGH AIR CLEANER RESTRICTION CAN CAUSE TURBOCHARGER SEALS TO UNSEAT, CAUSING OIL TO BE DRAWN THROUGH SEALS AND INTO THE ENGINE.

DUAL ELEMENT CLEANER

The dual element air cleaner provides a large primary (outer) filter element and an optional small secondary (inner) filter element. The secondary element should be used in dusty environments.

The dual element air cleaner assembly air cleaner restriction connection **(Figures 2.3– 6. and 7.)** is located between the primary and the secondary element in the bottom of the air cleaner housing. This arrangement allows only the primary (outer) element to be sensed by the restriction indicator or dash mounted vacuum gauge. **THE INNER ELEMENT IS NOT RECORDED ON THE RESTRICTION INDICATOR OR DASH MOUNTED VACUUM GAUGE.**

To determine inner element restriction use the:

Visual Check Procedure

Visually inspect the restriction indicator built into the inner element or inner element retaining nut.

NOTE: TWO DIFFERENT INDICATORS ARE THE RESULT OF TWO DIFFERENT SUPPLIERS. REPLACE THE ELEMENT WHEN THE GREEN DOT DISAPPEARS FROM THE ELEMENT OR FROM THE WINDOW IN THE RETAINING NUT.

IMPORTANT

EACH SUPPLIER'S RETAINING NUT REQUIRES A DIFFERENT TORQUE. REFER TO FIGURES 2.3– 6. AND 7.

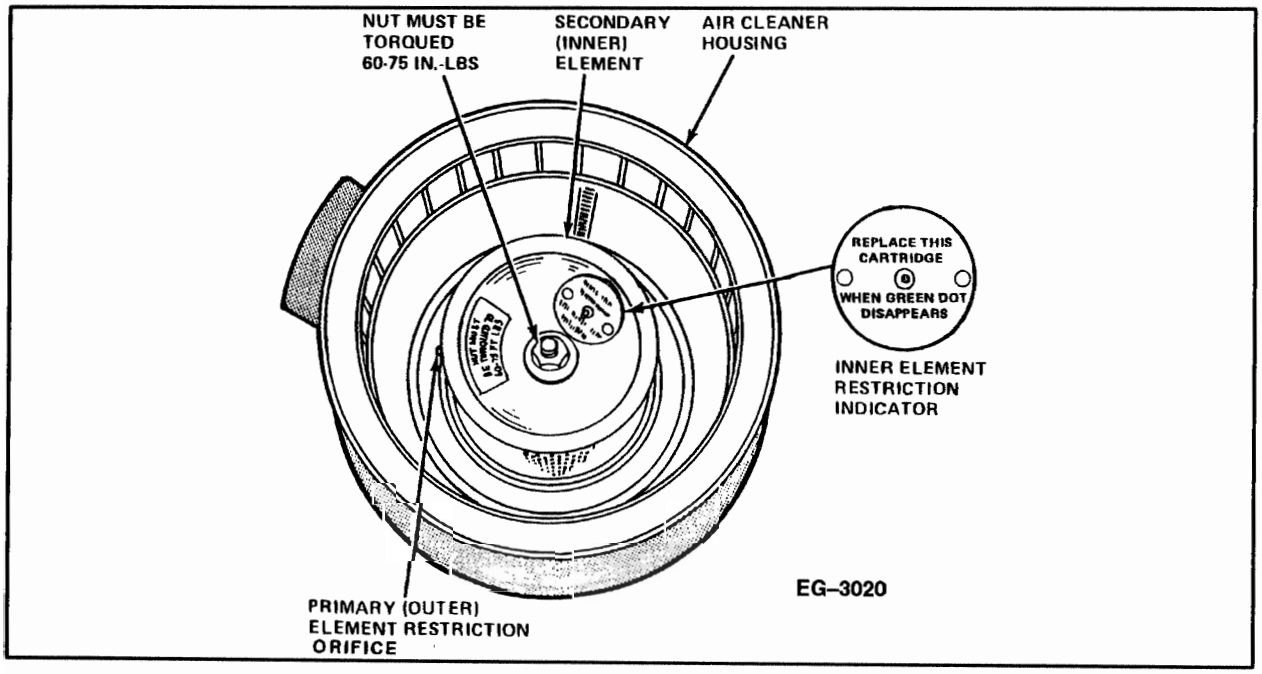

Figure 2.3–6. – Dual Element Air Cleaner With Indicator in End Cap

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T 444E ENGINE
INTAKE RESTRICTION (Continued)

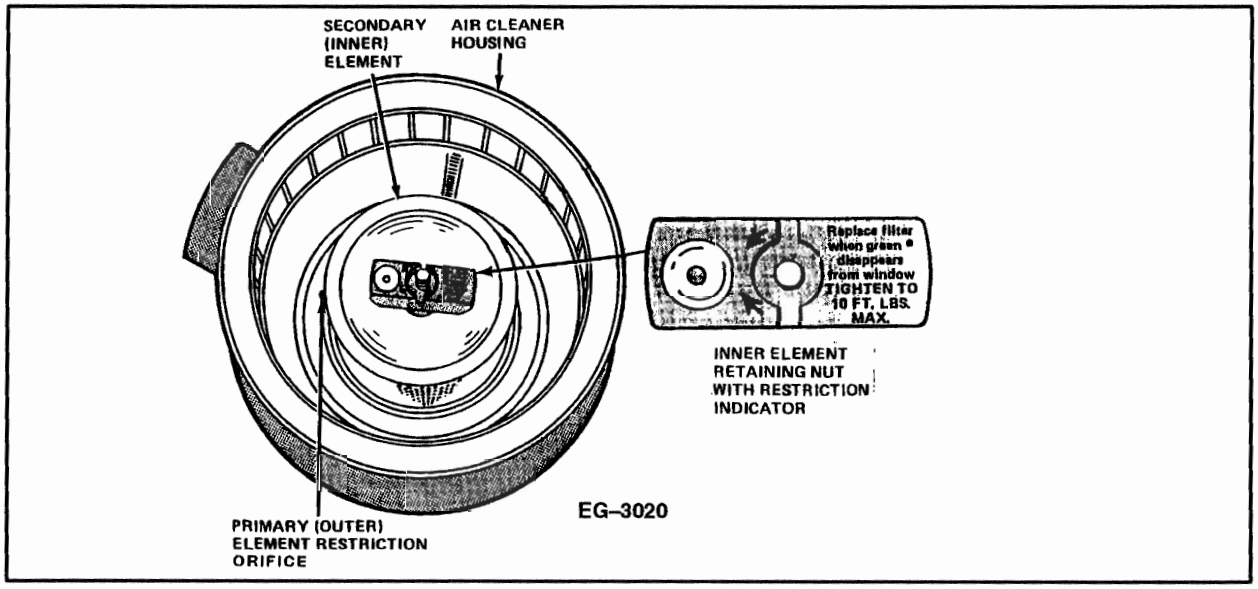

Figure 2.3–7. – Dual Element Air Cleaner Retaining Nut Indicator

POSSIBLE CAUSES

- Dirty air cleaner element.
- Snow, plastic bags or other foreign material may restrict air flow at the air cleaner inlet. On engines recently repaired, rags or cap plugs may have been inadvertently left in the intake system.

TOOLS REQUIRED

Model D–200 Pressure Test Kit (ZTSE–2239), magnehelic gauge or water manometer.

PERFORMANCE DIAGNOSTICS

T 444E ENGINE
EXHAUST RESTRICTION

FROM FORM EGED–130–1

7. EXHAUST RESTRICTION

- Visually inspect exhaust system for damage
- Check if EBP device is closing at High idle
  With breakout box pins 49+ and 46 – or "TEE"
  Green + and Black – (If so equipped)
- Measure at High idle

Instrument	Spec.	Actual
DVOM	< 2.0 Volts	

PURPOSE

To determine if a restriction exists in the exhaust system which would cause an engine performance problem.

VISUAL INSPECTION

1. Visually inspect entire exhaust system for obvious physical damage.
2. If exhaust system damage is not present, start engine and warm to operating temperature.
3. Run engine at high idle with no load.
4. The exhaust back pressure valve should be open. **(Figure 2.3–8.)** illustrates position of **tang** on bellcrank of the back pressure device when the exhaust back pressure (butterfly) valve is open. (If so equipped)

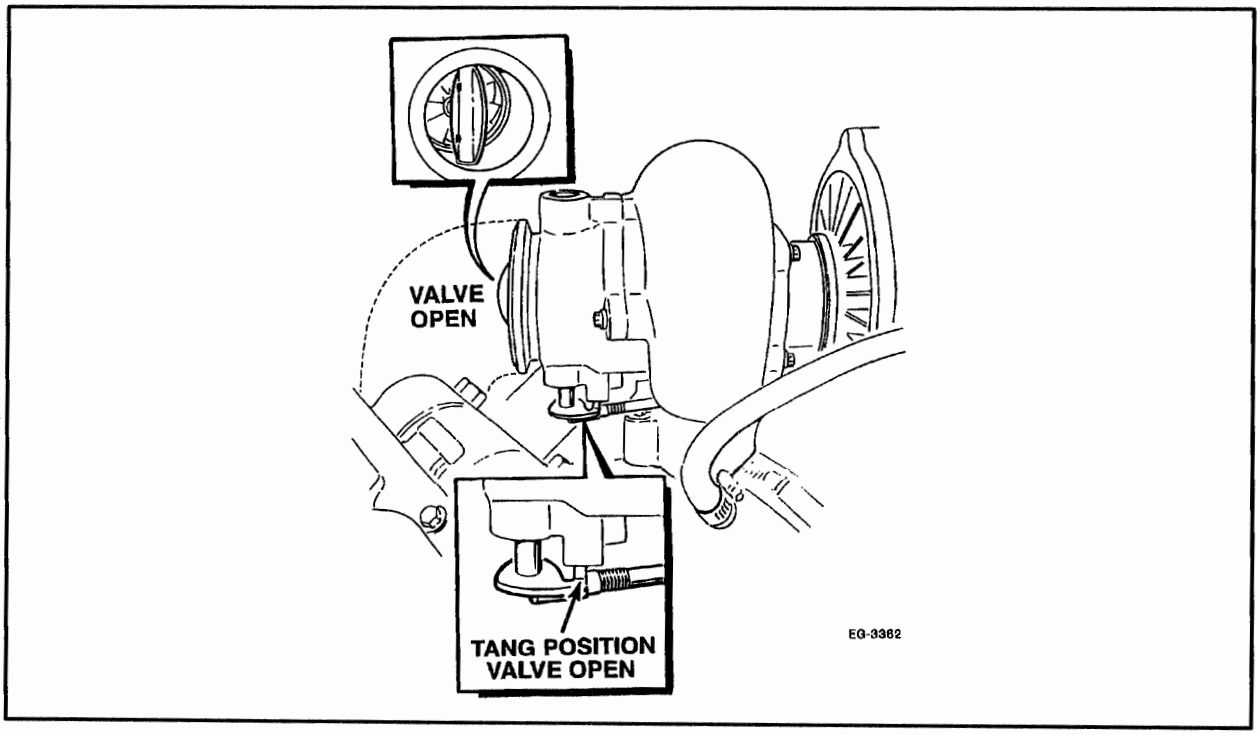

Figure 2.3–8. – Checking Position of Exhaust Back Pressure (butterfly) Valve At High Idle

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T 444E ENGINE
EXHAUST RESTRICTION (Continued)

TEST PROCEDURE

1. If the suspected exhaust restriction is not visually evident, an exhaust back pressure measurement is necessary. Install the breakout box or "T" **(Figure 2.3–9.)** in line with the EBP sensor which will allow access to the back pressure voltage signal.

NOTE: APPLY PARKING BRAKE AND INSURE THE TRANSMISSION IS IN NEUTRAL.

2. Measure exhaust back pressure (voltage) at high idle engine speed. Record voltage and compare to voltage specification on diagnostic form.

POSSIBLE CAUSES

- Closed Exhaust Back Pressure device.
- Collapsed tailpipe
- Clogged catalytic converter. (If so equipped)
- Damaged muffler.

TOOLS REQUIRED

DVOM and sensor breakout "T" (ZTSE–4347), or breakout box (ZTSE–4346).

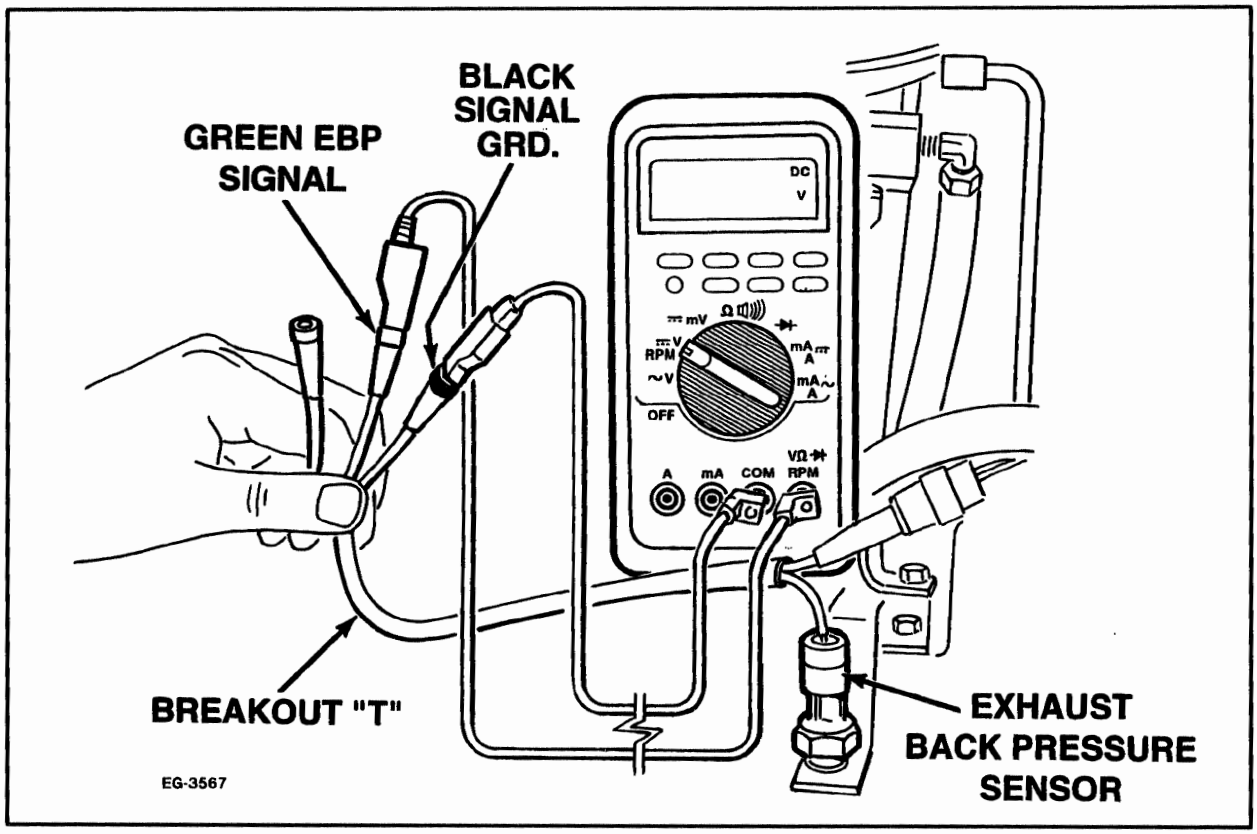

Figure 2.3–9. – Measuring Exhaust Back Pressure (Voltage)

PERFORMANCE DIAGNOSTICS

T 444E ENGINE
FUEL PRESSURE HIGH IDLE

FROM FORM EGED–130–1

8. FUEL PRESSURE HIGH IDLE

- Measure at regulator block.

Instrument	Spec.	Actual
0 – 160 PSI Gauge	30–65 PSI @ High idle	

☐ **If pressure is low, replace filter and retest.**

If pressure still low, perform test 10B.

PURPOSE

To determine if fuel pressure is sufficient to correctly operate the engine.

TEST PROCEDURE

NOTE: IF FUEL FILTER IS EQUIPPED WITH A WATER–IN–FUEL PROBE, CHECK WITH VEHICLE OPERATOR TO DETERMINE IF THE WATER– IN– FUEL LAMP HAS BEEN ILLUMINATED DURING VEHICLE OPERATION.

1. Remove 1/8" pipe plug located on the fuel regulator block. **(Figure 2.3–10.)** Install 1/8 inch (3 mm) pipe fitting in place of the pipe plug.
2. Connect a line **(Figure 2.3–10.)** from the fitting to the 0–160 PSI gauge of the Model D–200 Pressure Test Kit (ZTSE–2239). Start engine and run at low idle to check for fuel leaks in line to pressure gauge.

NOTE: BLEED AIR FROM THE FUEL LINE TO INSURE AN ACCURATE READING.

3. Measure fuel pressure at high idle and record on diagnostic form. **If pressure is not within specifications, replace fuel filter and re–check fuel pressure at high idle.**

NOTE: IT MAY TAKE A NUMBER OF CRANK CYCLES TO PURGE THE AIR OUT OF THE FUEL SYSTEM AFTER REPLACING THE FUEL FILTER.

If fuel pressure remains low after replacing the filter, perform Transfer Pump Restriction Test 10B.

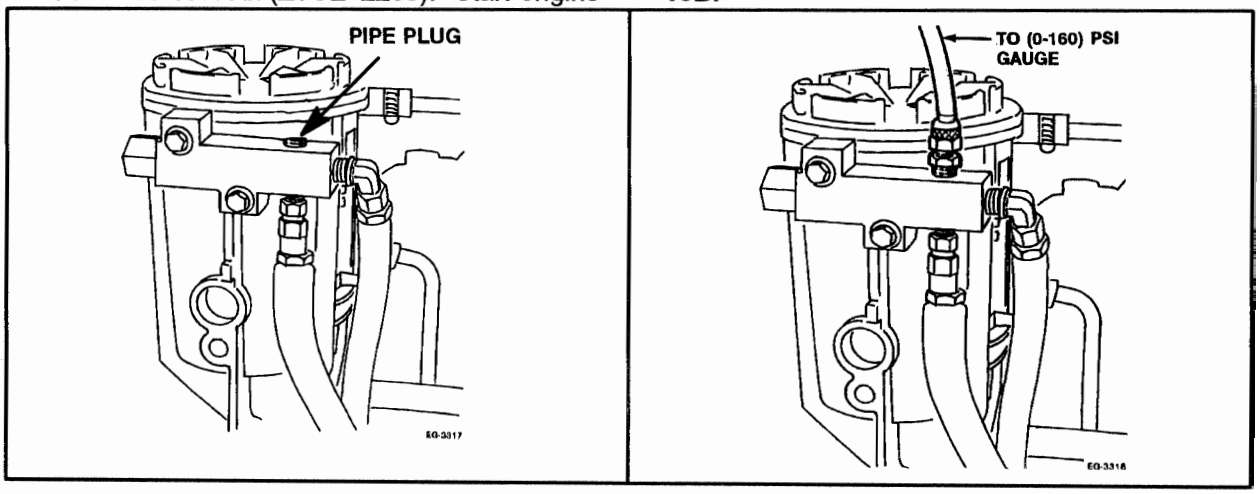

Figure 2.3–10. – Fuel Pressure Tap Location

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T 444E ENGINE
FUEL PRESSURE HIGH IDLE (Continued)

POSSIBLE CAUSES

- A fuel filter could cause high restriction and low fuel pressure because of dirt or fuel jelling in cold ambient temperatures. Replace filter and retest.
- A kinked or severely bent fuel supply line or blockage at the pickup tube could cause restriction and therefore low fuel pressure.
- A loose fuel line on the suction side of the fuel system could cause air to be ingested into the system and cause low fuel pressure.
- The fuel pump could have internal damage, e.g. ruptured diaphragm, seized plunger or leaking check valves.

TOOLS REQUIRED

Model D–200 Pressure Test Kit (ZTSE–2239) (0 to 160 PSI fuel pressure gauge), appropriate line with 1/8" NPT fitting.

PERFORMANCE DIAGNOSTICS

T 444E ENGINE
EST–ENGINE RUNNING TEST

FROM FORM EGED–130–1

9a. EST–ENGINE RUNNING TEST

- Select "Engine Running" test from the diagnostic test menu.

NOTE: Engine will run rough during this test.

Faults Found	

☐ **Refer to Electronic Diagnostic form if fault code(s) set**

PURPOSE

To verify the engine's electronic sensors and actuators are operating properly within their specified operating ranges. The Electronic Service Tool (EST) is used to signal the Electronic Control Module (ECM) to perform the "Engine Running Test". The ECM will exercise the actuators and monitor sensor feedback signals. If a sensor or actuator problem exists, the ECM will transmit fault code(s) to the EST.

TEST PROCEDURE

IMPORTANT

APPLY PARKING BRAKE AND INSURE THE TRANSMISSION IS IN NEUTRAL BEFORE RUNNING TEST.

1. Start and run engine until it reaches 160° F minimum.

NOTE: ENGINE MUST BE AT LEAST 160° F TO ALLOW THE ECM TO PERFORM AN ACCURATE TEST OF THE ENGINE SENSORS AND ACTUATORS. IF ENGINE COOLANT TEMPERATURE IS BELOW SELF TEST RANGE, THE EST TOOL WILL DISPLAY AN "ECT OUT OF SELF TEST RANGE" MESSAGE.

2. Access the "Engine Running Test" from the **"DIAGNOSTIC TESTS"** menu by pressing the "↓" key, until **"ENGINE RUNNING TEST"** appears on the screen. Then press the **"ENTER"** key.

NAVISTAR MRD
DIAGNOSTIC TESTS

↑ ENGINE RUNNING TEST ↓

The ECM will then conduct the "Engine Running Test". It will command the engine to accelerate to a pre–determined engine RPM and operate the Injection Pressure Regulator (IPR) valve. If engine is equipped with the optional exhaust back pressure device, the ECM will also operate the Exhaust Back Pressure Regulator (EPR) Valve during this test.

The ECM will measure the effects of actuator movement via the sensors. At the completion of the test, the EST screen will display **"00 FAULTS"**, if no faults were detected. If EST indicates faults have been detected, press the **"ENTER"** key to display the fault codes. Record fault codes and **refer to the Electronic Diagnostic form EGED–135–1 for fault codes which were detected.**

POSSIBLE CAUSES

- Defective or inoperative sensors or actuators.
- Open or shorted wiring harness to sensors or actuators.
- Loose or corroded engine wiring harness connections at sensor or actuators.

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T 444E ENGINE
EST TOOL–INJECTOR TEST

FROM FORM EGED–130–1

9b. EST TOOL–INJECTOR TEST

(CYLINDER CONTRIBUTION)

NOTE: "Engine RUNNING Test" must be performed first, in order to gain access to the "INJECTOR TEST"

- Select "Injector Test" from "Engine Running" test menu

NOTE: Engine will run rough during this test.

Faults Found	

Refer to Electronic Diagnostic form if fault code(s) set.

PURPOSE

To verify that all power cylinders are contributing equally.

TEST PROCEDURE

NOTE: THE "ENGINE RUNNING TEST" MUST BE PERFORMED FIRST TO ACCESS THE INJECTOR TEST.

After the **"Engine Running Test"** has been completed, press the "↓" key from the **"ENGINE RUNNING TEST"** screen to access the **"INJECTOR TEST"**. Then press the **"ENTER"** key.

DIAGNOSTIC TESTS
ENGINE RUNNING TESTS

↑ INJECTOR TEST ↓

NOTE: THE ENGINE WILL RUN ROUGH DURING THE TEST.

The Electronic Service Tool (EST) will signal the Electronic Control Module (ECM) to actuate each injector in a programmed sequence and then measure power cylinder performance.

At the completion of the test, the EST screen will display **"00 FAULTS"**, if no injector faults occurred. If EST indicates faults have been detected, press the **"ENTER"** key to display the fault codes. Record fault codes and **refer to the Electronic Diagnostic form EGED–135–1 for fault codes which were detected.**

POSSIBLE CAUSES

- Broken compression rings, leaking or bent valves, bent push rods or connecting rods.
- Open or shorted engine wiring harness to injector(s).
- Defective injector solenoid(s)

TOOLS REQUIRED

PRO–LINK 9000 (ZTSE–43661)

SUPPLEMENTAL DIAGNOSTICS

Refer to Section 3.5 Electronic Control System Diagnostics.

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PERFORMANCE DIAGNOSTICS

T 444E ENGINE
FUEL PRESSURE (FULL LOAD)

FROM FORM EGED–130–1

10a. FUEL PRESSURE (FULL LOAD)

- Measure at regulator block.
- Measure at full load rated speed.

Instrument	Spec.	Actual
0 – 160 PSI Gauge	30–65 PSI @ Full load	

☐ **If pressure is low, replace fuel filter and retest.**

If pressure still low, perform Test 10B.

NOTE: FUEL PRESSURE (FULL LOAD) AND BOOST PRESSURE ARE "ROAD TESTS". THEY MAY BE PERFORMED AT THE SAME TIME.

PURPOSE

To determine if fuel pressure is sufficient to correctly operate the engine at full load operating condition.

NOTE: IF FUEL FILTER IS EQUIPPED WITH A WATER–IN–FUEL PROBE, CHECK WITH VEHICLE OPERATOR TO DETERMINE IF THE WATER– IN– FUEL LAMP HAS BEEN ILLUMINATED DURING VEHICLE OPERATION.

TEST PROCEDURE

NOTE: FUEL PRESSURE MUST BE TAKEN AT FULL LOAD. FUEL PRESSURE MAY BE SUFFICIENT AT HIGH IDLE, BUT MAY BE UNSATISFACTORY AT FULL LOAD OPERATING CONDITIONS.

1. Remove 1/8" pipe plug located on the fuel regulator block. **(Figure 2.3–11.)** Install 1/8 inch (3 mm) pipe fitting in place of the pipe plug.
2. Connect a line **(Figure 2.3–11.)** from the fitting to the 0–160 PSI gauge of the Model D–200 Pressure Test Kit (ZTSE–2239). Start engine and run at low idle to check for fuel leaks in line to pressure gauge.

NOTE: BLEED AIR FROM THE FUEL LINE TO INSURE AN ACCURATE READING.

IMPORTANT

TO MEASURE FUEL PRESSURE AT FULL LOAD, VEHICLE MUST BE DRIVEN ON THE ROAD IN THE HIGHEST GEAR (POSSIBLE) AND ACCELERATOR PEDAL DEPRESSED TO THE FLOOR (FULL DEPRESSION) OF THE CAB. IF A VEHICLE DYNAMOMETER IS AVAILABLE, OPERATE VEHICLE AT FULL RATED LOAD AND SPEED.

3. Measure fuel pressure at full load and record on diagnostic form. **If pressure is not within specifications, replace fuel filter and re–check fuel pressure.**

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T 444E ENGINE
FUEL PRESSURE (FULL LOAD) (Continued)

NOTE: IT MAY TAKE A NUMBER OF CRANK CYCLES TO PURGE THE AIR OUT OF THE FUEL SYSTEM AFTER REPLACING THE FUEL FILTER.

If fuel pressure remains low after replacing the filter, perform Transfer Pump Restriction Test 10B.

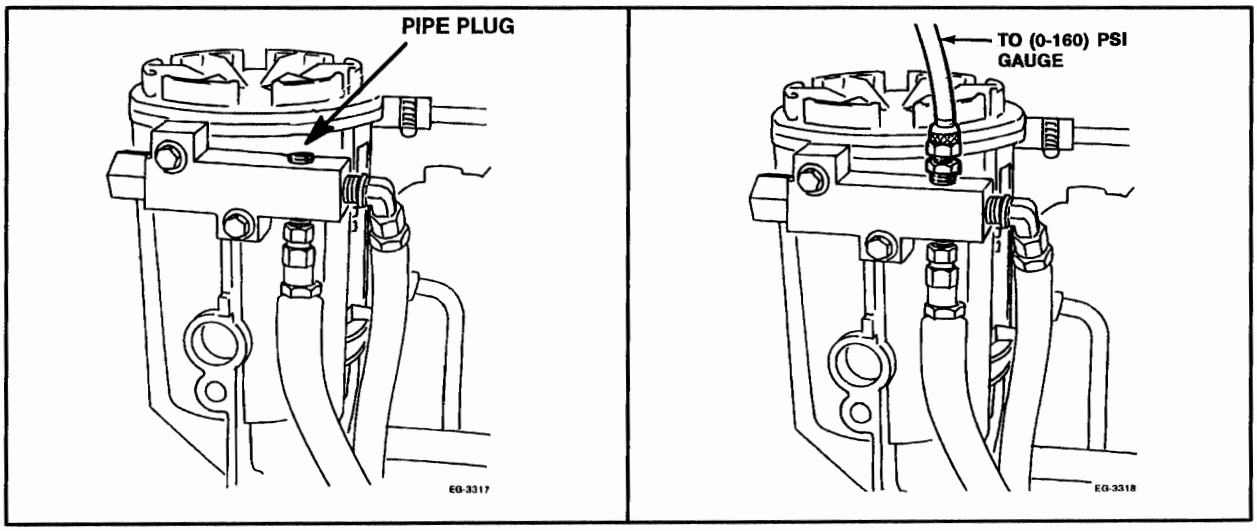

Figure 2.3–11. – Fuel Pressure Tap Location

POSSIBLE CAUSES

- A fuel filter could cause high restriction and low fuel pressure because of dirt or fuel jelling in cold ambient temperatures. Replace filter and retest.
- A kinked or severely bent fuel supply line or blockage at the pickup tube could cause restriction and therefore low fuel pressure.
- A loose fuel line on the suction side of the fuel system could cause air to be ingested into the system and cause low fuel pressure.
- The fuel pump could have internal damage, e.g. ruptured diaphragm, seized plunger or leaking check valves.

TOOLS REQUIRED

Model D–200 Pressure Test Kit (ZTSE–2239) (0 to 160 PSI fuel pressure gauge), appropriate line with 1/8" NPT fitting.

PERFORMANCE DIAGNOSTICS

T 444E ENGINE
TRANSFER PUMP RESTRICTION

FROM FORM EGED–130–1

10b. TRANSFER PUMP RESTRICTION

- Measure at fuel pump inlet
- Measure at High idle

Instrument	Spec.	Actual
0–30" Hg. Vacuum Gauge	< 6" Hg.	

☐ If restriction is high, check for blockage between pump and fuel tank.

☐ If restriction is within spec., check for sticking regulator valve or debris.

TRANSFER PUMP RESTRICTION

PURPOSE

To determine if excessive restriction to fuel flow exists from the engine fuel inlet line to the fuel tank(s).

TEST PROCEDURE

1. Connect a tee between the fuel filter inlet and fuel supply line. (**Figure 2.3–12.**) Connect a line from the tee to the 0–30" Hg. vacuum gauge of the D–200 Pressure Test Kit (ZTSE–2239).
2. Measure fuel inlet restriction at high idle and record reading on diagnostic form.
3. If restriction exceeds 6 in. Hg., locate the restriction on the suction side of the fuel system and correct.

NOTE: IF FUEL INLET RESTRICTION IS WITHIN SPECIFICATIONS, REFER TO FUEL REGULATOR VALVE REMOVAL AND INSPECTION ON PAGE 24.

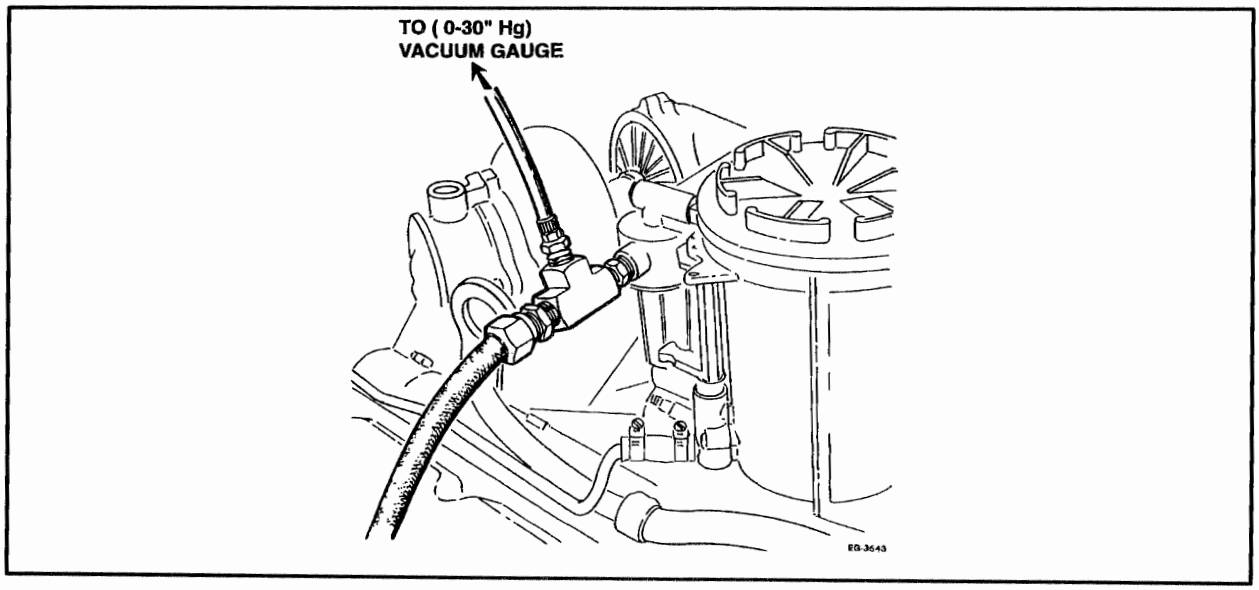

Figure 2.3–12. – Transfer Pump Restriction

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T 444E ENGINE
TRANSFER PUMP RESTRICTION (Continued)

POSSIBLE CAUSES

- A fuel filter could cause high restriction and low fuel pressure because of dirt or fuel jelling in cold ambient temperatures. Replace filter and retest.
- A kinked or severely bent fuel supply line or blockage at the pickup tube could cause restriction and therefore low fuel pressure.
- A loose fuel line on the suction side of the fuel system could cause air to be ingested into the system and cause low fuel pressure.
- The fuel pump could have internal damage, e.g. ruptured diaphragm, seized plunger or leaking check valves.

TOOLS REQUIRED

Model D–200 Pressure Test Kit (ZTSE–2239) (0 to 30" Hg. vacuum gauge), "T" fitting, and appropriate fuel lines.

PERFORMANCE DIAGNOSTICS

T 444E ENGINE
FUEL REGULATOR VALVE REMOVAL AND INSPECTION

FUEL REGULATOR VALVE REMOVAL AND INSPECTION.

1. Remove fuel return line from adapter fitting on fuel regulator block. **(Figure 2.3–13.)**
2. Remove the fuel line adapter fitting with "O" ring.
3. Use needle nose pliers to remove the fuel regulator spring and valve from the regulator.
4. Inspect fuel regulator valve seating surface for damage and insure spring is not broken.
5. Inspect inside of regulator block for dirt or debris that could restrict the flow of fuel past the regulator valve.

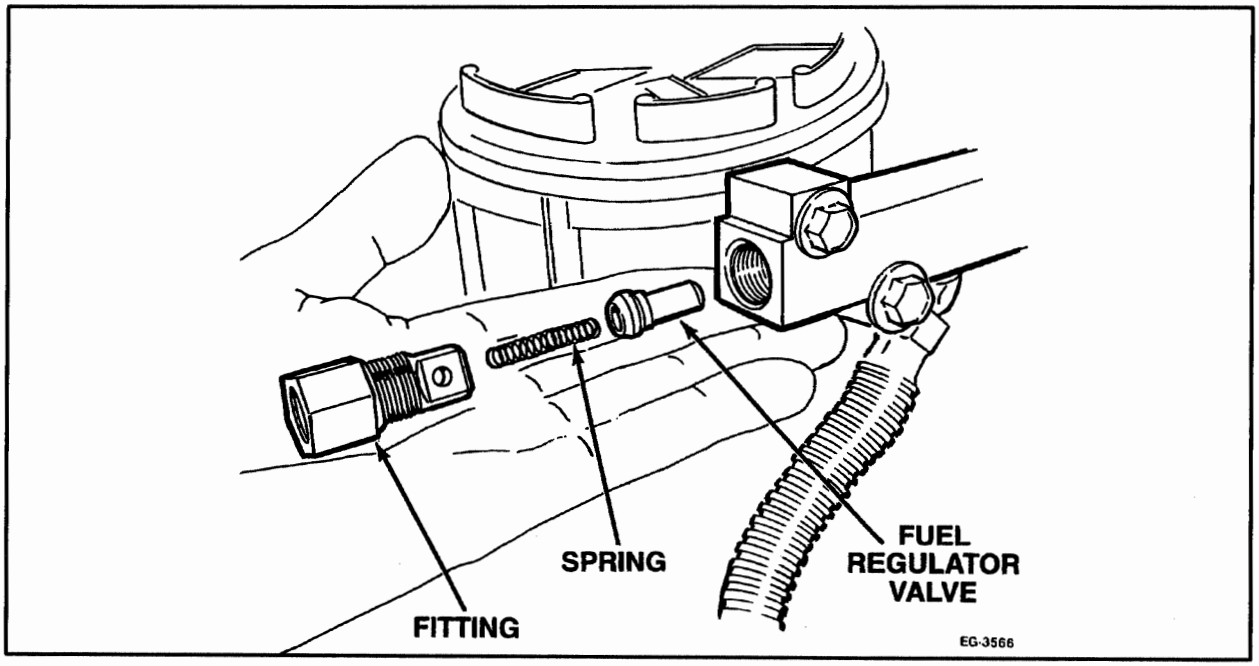

Figure 2.3–13. – Fuel Regulator Valve Removal and Inspection

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T 444E ENGINE
BOOST PRESSURE

FROM FORM EGED–130–1

11. BOOST PRESSURE

- Monitor boost pressure and engine RPM with the EST tool in data list mode, or use dash tach and 0–30 PSI gauge and "T" if EST tool is not available
- Measure pressure at full load rated speed

Spec.	Actual
PSI @ RPM	

NOTE: BOOST PRESSURE AND FUEL PRESSURE (FULL LOAD) ARE "ROAD TESTS". THEY MAY BE PERFORMED AT THE SAME TIME.

PURPOSE

To determine if the engine can develop sufficient boost to obtain specific power.

TEST PROCEDURE

NOTE: TURN ALL ACCESSORIES AND THE IGNITION OFF, BEFORE CONNECTING EST TOOL TO ATA DIAGNOSTIC CONNECTOR.

1. Connect EST to the ATA connector.
2. Turn the ignition switch to the "ON" position.
3. Access the data list and press the "↓" key until **"BOOST PSI"** is displayed on the screen.

BATT VOLTS	12.5
ENGINE RPM	0
BOOST PSI	0
BARO IN Hg.	14.4

4. Drive vehicle on road till engine reaches operating temperature. Find an open section of road and select a suitable gear. Depress the accelerator pedal (full depression) to the floor.

NOTE: DRIVING THE VEHICLE UP HILL OR FULLY LOADED WILL FACILITATE EFFORTS OF REACHING THE PROPER ENGINE LOADING AT SPECIFIED ENGINE SPEEDS.

5. Record intake manifold boost at specified engine speeds.

ALTERNATE TEST PROCEDURE

1. Install a tee into the MAP (Manifold Absolute Pressure) sensor line that comes from the intake manifold. **(Figure 2.3–14.)**

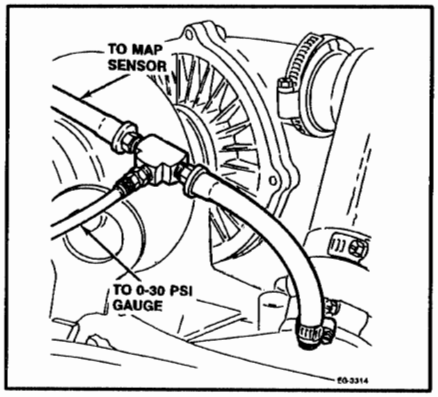

Figure 2.3–14. – Boost Pressure Tap Location

NOTE: MAP SENSOR MUST NOT BE DISCONNECTED DURING TEST.

2. Temporarily install the D–200 Pressure Test Kit (ZTSE–2239) in the cab of the vehicle. Connect a line to the 0 to 30 PSI gauge and route it to the "T" so it is not crimped or in contact with a hot engine surface.

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PERFORMANCE DIAGNOSTICS

T 444E ENGINE
BOOST PRESSURE (Continued)

3. Drive vehicle on road until engine reaches operating temperature. Find an open section of road and select a suitable gear. Depress the accelerator pedal (full depression) to the floor.

NOTE: DRIVING THE VEHICLE UP HILL OR FULLY LOADED WILL FACILITATE EFFORTS OF REACHING THE PROPER ENGINE LOADING AT SPECIFIED ENGINE SPEEDS.

5. Record intake manifold boost at specified engine speeds.

NOTE: IF BOOST PRESSURE IS WITHIN SPECIFICATIONS, THE ENGINE IS FUNCTIONING PROPERLY. THERE MAY BE CHASSIS OR APPLICATION CONCERNS.

POSSIBLE CAUSES:

- Restricted intake or exhaust.
- Low fuel pressure.
- Low injection control pressure.
- Control system faults
- Defective injectors.
- Defective turbocharger
- Base engine failure

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T 444E ENGINE
CRANKCASE PRESSURE

FROM FORM EGED–130–1

12. CRANKCASE PRESSURE

- Measure at road draft tube with orifice restrictor tool (ZTSE–4146)
- Measure at High idle no load RPM.

Instrument	Spec.	Actual
0 to 60" H_20 Magnehelic	< 6" H_20	

PURPOSE

To measure power cylinder condition.

TEST PROCEDURE

1. Park vehicle on level ground.
2. Insure breather tube is free of dirt.
3. Insure engine oil level is not above the full mark and the dipstick is securely in place.
4. Connect a line from the restrictor tool **(Figure 2.3– 15)** to a water manometer or to the pressure side of the magnehelic gauge on the D–200 Pressure Test Kit (ZTSE–2239). **NOTE: Install a quick connect plug in the vacuum port of the gauge to vent it to atmosphere.** (Make sure that the magnehelic gauge has been zeroed)
5. Run engine to attain normal engine operating temperature before measuring crankcase pressure.
6. Perform engine crankcase pressure test with engine at high idle (no load) RPM. Allow the gauge reading to stabilize before taking the pressure reading.
7. Record crankcase pressure on diagnostic form.

IMPORTANT

DO NOT PLUG THE BREATHER TUBE DURING THE CRANKCASE PRESSURE TEST AS RESTRICTING THE TUBE CAN CAUSE CRANKSHAFT AND TURBOCHARGER SEALS TO LEAK.

POSSIBLE CAUSES:

- Dirt entering air induction system. (Check system for leaks.)
- Broken or worn compression rings
- Leaking or bent valves
- Turbocharger boost pressure entering crankcase.
- Air from air compressor leaking into crankcase.

TOOLS REQUIRED

Orifice restriction tool (ZTSE–4146) and water manometer or D–200 Pressure Test Kit (ZTSE–2239)

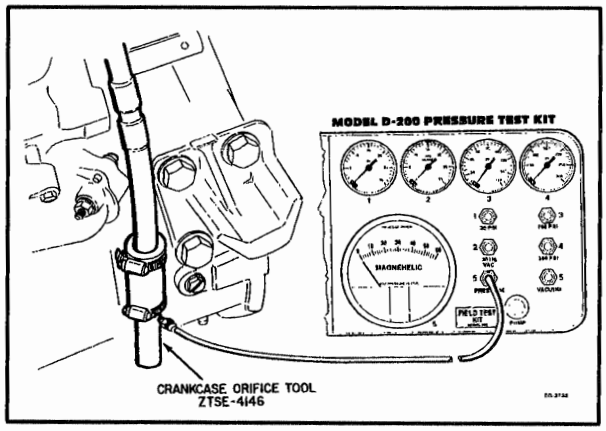

Figure 2.3–15. – Crankcase Pressure Test

PERFORMANCE DIAGNOSTICS

T 444E ENGINE
WASTEGATE ACTUATOR TEST

FROM FORM EGED–130–1

13. WASTEGATE ACTUATOR TEST

- Apply regulated air to actuator
- Inspect for leakage
- Inspect actuator for movement

Instrument	Spec.	Actual
0 to 60 PSI Gauge	17–19 PSI	

PURPOSE

To determine operation of actuator in conjunction with turbocharger operation.

TEST PROCEDURE

1. Remove actuator boost line from turbo compressor housing and connect an air regulator with a 0–60 PSI gauge to the actuator boost line. **Figure 2.3–16.**

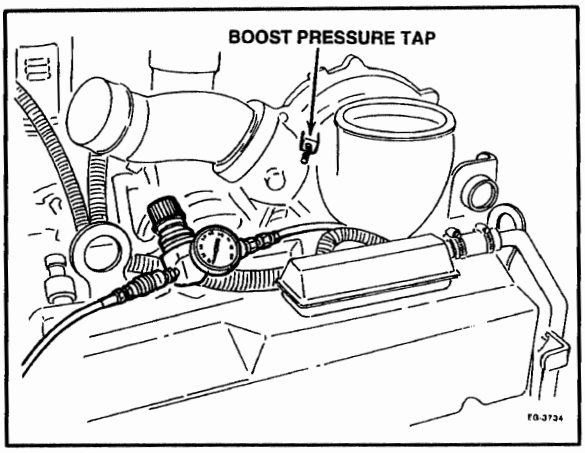

Figure 2.3–16. – Boost Pressure Tap Location and Air Regulator Connection

2. Mark actuator (link) shaft with paint pen. **Figure 2.3–17.**

3. Spray leak detector **Figure 2.3– 18.** around the actuator housing and slowly apply air pressure to the actuator. **Actuator (shaft) movement (indicated by position of paint mark)** should begin to occur between 17–19 psi.

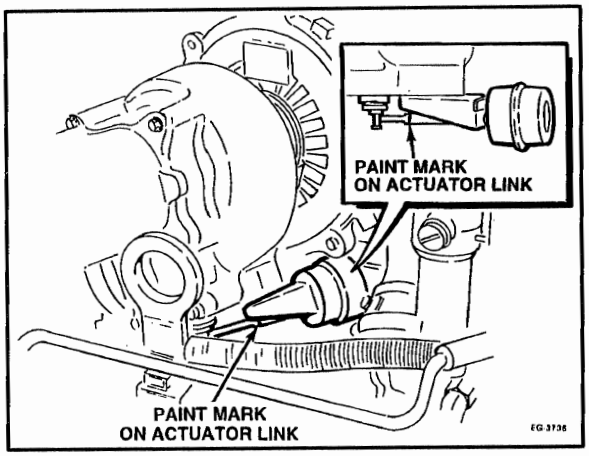

Figure 2.3–17. – Paint Mark Location on Actuator LInk

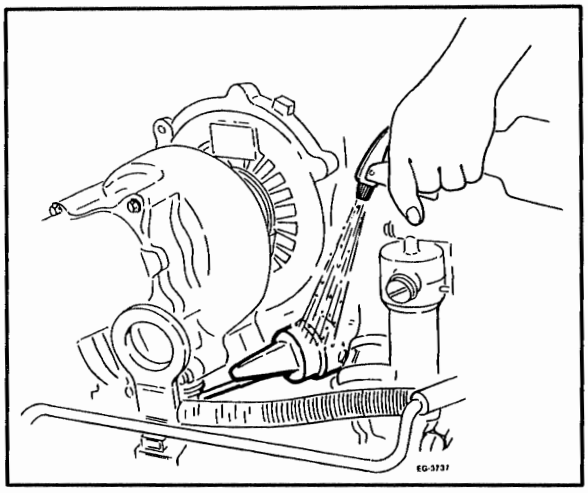

Figure 2.3–18. – Checking Actuator for Leaks

If a significant amount of actuator shaft movement occurs and no air leaks are detected at actuator housing, actuator is OK. If little or no shaft movement occurs or air leaks are present at the actuator housing, the turbocharger must be removed from

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T 444E ENGINE
WASTEGATE ACTUATOR TEST(Continued)

engine. Refer to engine service manual for further wastegate diagnosis.

POSSIBLE CAUSES

- Sticky flapper valve
- Ruptured actuator diaphragm
- Leaky canister
- Leaky hose to actuator

TOOLS REQUIRED

Air pressure regulator, 0–60 psi gauge and paint marker. (Alternative: Dial indicator)

PERFORMANCE DIAGNOSTICS

T 444E ENGINE
INJECTION CONTROL PRESSURE TEST (OIL AERATION–POOR IDLE QUALITY)

FROM FORM EGED–130–1

14. INJECTION CONTROL PRESSURE (Oil Aeration–Poor idle quality)

NOTE: TEST SHOULD BE PERFORMED AFTER ENGINE HAS BEEN RUN UNDER LOAD.

- Hold engine speed at high idle for 60 seconds.
- Monitor ICP pressure with EST data list or
- Measure at breakout box pins 27+ & 46– or Breakout "Tee" green and black –

Instrument	Spec.	Actual
EST	PSI	
DVOM (27+ , 46–)	Volts @ High Idle	

☐ **If ICP signal increases above 1040 PSI or 1.6 volts, change oil and retest.**

PURPOSE

To determine if engine lube oil is being aerated and causing poor idle quality.

TEST PROCEDURE

IMPORTANT

IF ENGINE OIL IS AERATING, IT MAY CAUSE THE ENGINE TO IDLE ERRATICALLY. TO DETERMINE IF OIL IS BEING AERATED, PERFORM THIS TEST AFTER ENGINE HAS BEEN RUN UNDER A LOAD.

NOTE: TURN ALL ACCESSORIES AND THE IGNITION OFF, BEFORE CONNECTING EST TOOL TO ATA DIAGNOSTIC CONNECTOR.

1. Connect the Electronic Service Tool (EST) to the American Trucking Association (ATA) data link connector. **(Figure 2.3–19.)**

2. Start the engine and bring it to operating temperature.

NOTE: APPLY PARKING BRAKE AND INSURE THE TRANSMISSION IS IN NEUTRAL.

3. Press the "↓" key on the EST until **"INJ CNTL PSI"** appears on the screen.

BATT VOLTS	12.5
ENGINE RPM	0
INJ CNTL PSI	0
FUEL GAL/HR	0.3

4. Operate engine at high idle and monitor (ICP) Injection Control Pressure for 60 seconds on the EST.

Normal ICP pressure is 1000–1040 PSI. If ICP pressure does not stabilize below 1100 PSI and continues to rise while high idle speed is maintained, engine lube oil may be aerated. If this condition occurs, change oil and filter, then repeat ICP test.

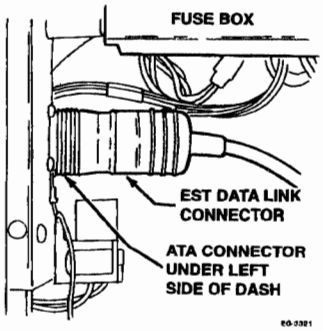

Figure 2.3–19. – ATA Connector Location

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T 444E ENGINE
INJECTION CONTROL PRESSURE (OIL AERATION–POOR IDLE QUALITY) (Continued)

ALTERNATE METHOD OF MEASURING INJECTION CONTROL PRESSURE USING (BREAKOUT "TEE")

1. Remove engine harness connector at ICP sensor.
2. Connect the breakout "TEE" to the removed engine harness connector and the ICP sensor.
3. Connect DVOM leads (+Green, –Black) to the breakout "TEE" as shown in **(Figure 2.3–20.)**
4. Start the engine and bring it to operating temperature.
5. Operate engine at high idle and monitor (ICP) voltage for 60 seconds. Normal ICP voltage is between 1.2 to 1.6 volts. If the ICP signal voltage continues to rise as high idle speed is maintained, the engine lube oil may be aerated. Change oil and filter, then repeat ICP test at high idle.

TOOLS REQUIRED
DVOM and breakout sensor "T", (ZTSE–4347)

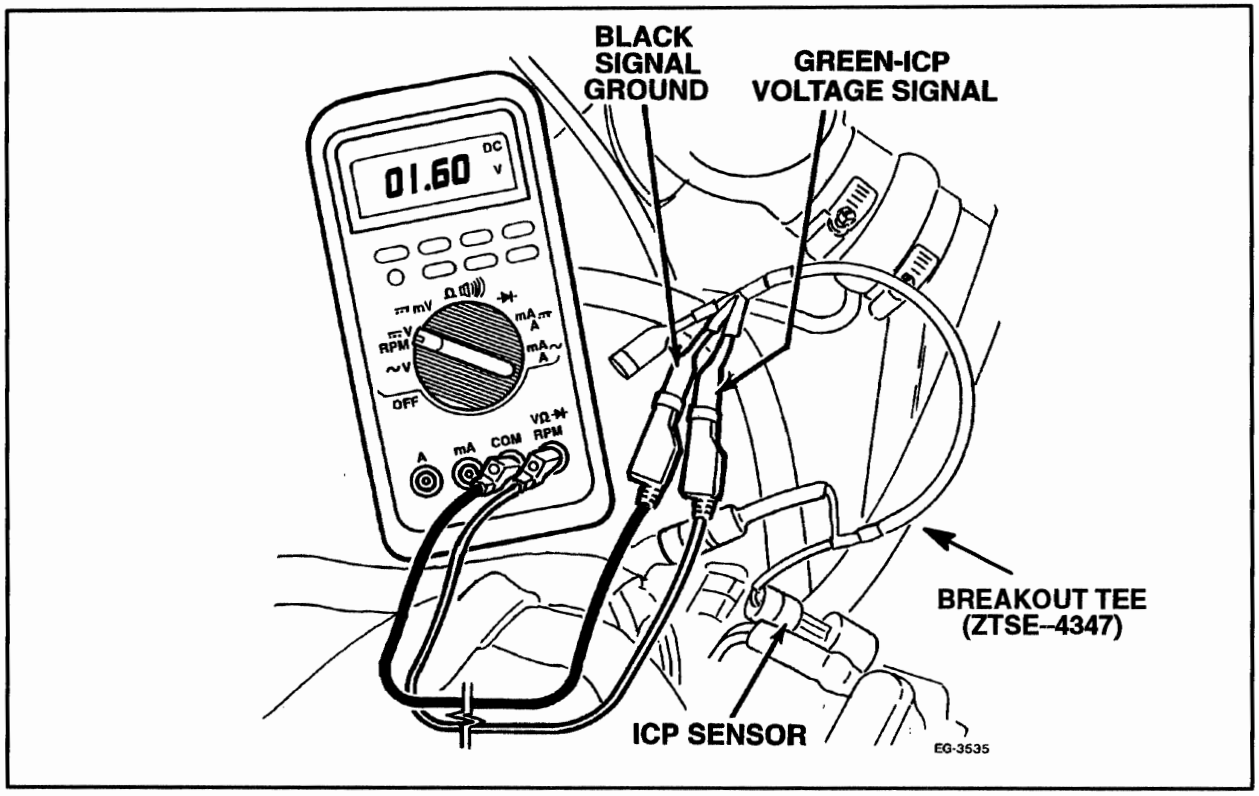

Figure 2.3–20. – Measuring Injection Control Pressure Using "Breakout Tee"

PERFORMANCE DIAGNOSTICS

T 444E ENGINE
INJECTION CONTROL PRESSURE (OIL AERATION–POOR IDLE QUALITY) (Continued)

ALTERNATE METHOD OF MEASURING INJECTION CONTROL PRESSURE USING BREAKOUT BOX

1. Connect breakout box at ECM. **(Figure 2.3–21.)**
2. Connect DVOM to breakout box terminal #s (+27, –46).
3. Start the engine and bring it to operating temperature.
4. Operate engine at high idle and monitor (ICP) voltage for 60 seconds. Normal ICP voltage is between 1.2 to 1.6 volts. If the ICP signal voltage continues to rise as high idle speed is maintained, the engine lube oil may be aerated. Change oil and filter, then repeat ICP test at high idle.

TOOLS REQUIRED

DVOM and breakout box (ZTSE–4346).

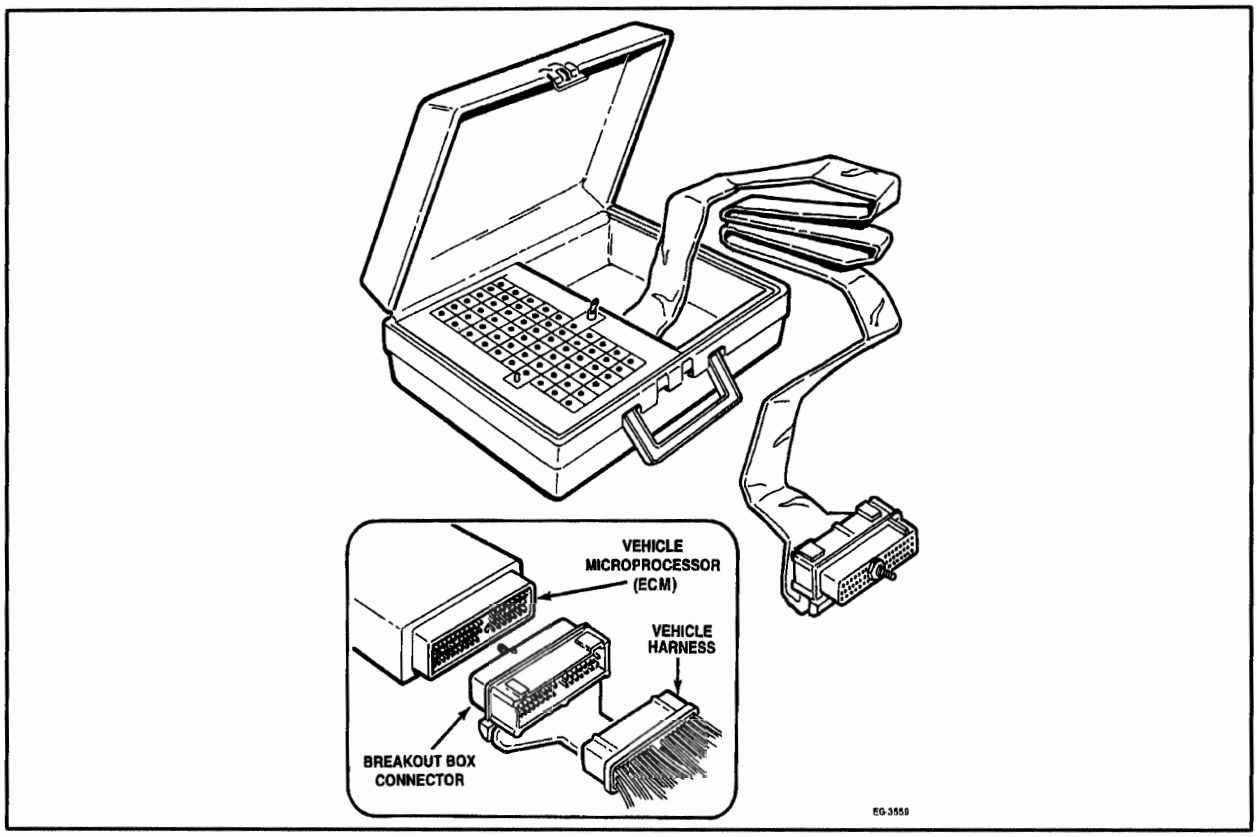

Figure 2.3–21. – Breakout Box (ZTSE–4346)

POSSIBLE CAUSES:

- Extended oil drain intervals. The anti–foam additives in the oil may be depleted from severe use or extended oil drain intervals.
- Wrong oil type or grade of oil.

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