

## Computers and Control Systems: Reading and Clearing Diagnostic Trouble Codes

### Base Ignition Timing Check

1. Turn the ignition key OFF.
2. Place the transmission in PARK (A/T) or NEUTRAL (M/T).
3. Turn OFF all electrical loads (A/C, heater, radio, lights, etc.).
4. Disconnect the SPOUT/SAW connector.
5. START the engine using the ignition switch.  
**NOTE:** If engine starts then stalls go to pinpoint test S1.
6. Using an inductive timing light, check ignition timing.
  - a. If the timing is within  $\pm 2$  degrees of specifications, continue with Computed Timing Check. See: Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Computed Timing Check
  - b. If the timing is not within  $\pm 2$  degrees of specifications, adjust ignition timing (TFI Systems) or refer to **IGNITION SYSTEMS** for possible causes of improper timing (DIS/EDIS).

### With Scan Tool

**NOTE:** Using this procedure, the technician can attempt to recreate and detect an intermittent fault.

#### KEY ON ENGINE OFF

1. Ensure the ignition switch is in the OFF position and connect a scan tool to the diagnostic connector.
2. Turn the ignition key to the ON position.
3. ACTIVATE, DEACTIVATE, and REACTIVATE the self-test (refer to scan tool manual for instructions). You are now in the wiggle test mode.
4. Tap, move, and wiggle the suspected circuits sensors and wiring. When a fault is detected, the Electronic Control Assembly (ECA) will set a code and the scan tool will signal a fault (refer to scan tool manual for signal).  
**NOTE:** If any codes are set, perform the appropriate pinpoint test. See: Diagnostic Trouble Code Tests and Associated Procedures
5. To exit the wiggle test mode, DEACTIVATE the self test and turn the key OFF.

#### KEY ON ENGINE RUNNING

**NOTE:** The Engine Running (ER) wiggle test may be entered any time the engine is running.

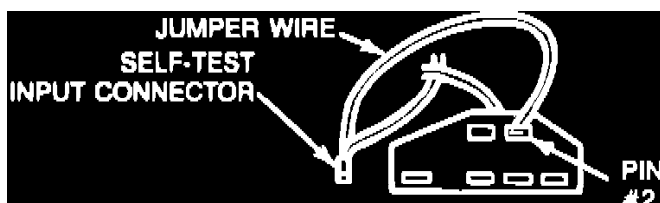
1. Ensure the ignition switch is in the OFF position and connect a scan tool to the diagnostic connector.
2. START the engine, then ACTIVATE, DEACTIVATE, and REACTIVATE the self test. You are now in the engine running wiggle test mode.  
**NOTE:** Do not turn the engine OFF.
3. Tap, move, and wiggle the suspected circuits sensors and wiring. When a fault is detected, ECA will set a code and the scan tool will signal a fault (refer to scan tool manual for signal).  
**NOTE:** If any codes are set, perform the appropriate pinpoint test. See: Diagnostic Trouble Code Tests and Associated Procedures
4. To exit the wiggle test mode, DEACTIVATE the self test and turn the key OFF.

### Without Scan Tool

**NOTE:** Using this procedure, the technician can attempt to recreate and detect an intermittent fault.

#### KEY ON ENGINE OFF

1. Ensure the ignition switch is in the OFF position.
2. Turn the ignition key to the ON position.



**Jumper Wire Installed Between Pin #2 And Self Test Input (STI)**

3. ACTIVATE, DEACTIVATE, and REACTIVATE the self-test by grounding, ungrounding, and re-grounding the STI connector. You are now in the wiggle test mode.
4. Tap, move, and wiggle the suspected circuits sensors and wiring. When a fault is detected, ECA will set a code and signal a fault by flashing the CHECK ENGINE light..
5. To exit the wiggle test mode, DEACTIVATE the self test and turn the key OFF.

#### KEY ON ENGINE RUNNING

**NOTE:** The Engine Running (ER) wiggle test may be entered any time the engine is running.

1. Ensure the ignition switch is in the OFF position.
2. START the engine, then ACTIVATE, DEACTIVATE, and REACTIVATE the self test. You are now in the engine running wiggle test mode.  
**NOTE:** Do not turn the engine OFF.
3. Tap, move, and wiggle the suspected circuits sensors and wiring. When a fault is detected, ECA will set a code and signal a fault.  
**NOTE:** If any codes are set, perform the appropriate pinpoint test. See: Diagnostic Trouble Code Tests and Associated Procedures
4. To exit the wiggle test mode, DEACTIVATE the self test and turn the key OFF.

## Cylinder Balance Test

The purpose of the cylinder balance test is to aid the technician in finding a weak cylinder. The test is entered by depressing and releasing the throttle within two minutes after the engine RUNNING self test codes have been outputted.

Once the test is entered, the idle speed control duty is fixed and the engine is allowed to stabilize. The engine speed is measured and stored for comparison with the other readings received later in the testing. Then the fuel is shut OFF to the last cylinder in the engine. After the engine speed stabilizes, the rpm is measured and stored. The injector is turned ON and the process is repeated for each cylinder. At this point, the maximum rpm drop is selected from the table of drops for each cylinder. This maximum drop is now multiplied by a calibrated percentage. The resulting number (rpm) is now used as the minimum rpm that each cylinder must have dropped to pass the test. (Example: 150 rpm x 65% = 98 rpm).

If all cylinders drop at least this amount, then a code 90 is output indicating a pass. No further testing is necessary. If a cylinder did not drop at least this amount, then the cylinder number will be output. (Example: 30 is output for cylinder #3). This indicates that cylinder 3 is weak or non-contributing.

The test can now be repeated a second time if the throttle is depressed and released within two minutes of the last code output. This time the maximum rpm drop that occurs is multiplied by a lower percentage. This number is now used as the minimum rpm drop for each cylinder. (Example: 150 rpm x 43% = 65 rpm).

If all of the rpm drops are greater than 65 rpm, then a code 90 is output. If cylinder number 3 had failed the first level and passed the second, then cylinder 3 is considered to be weak. If cylinder 3 fails again, the code 30 will be output again.

This test can be repeated a third time by depressing and releasing the throttle within two minutes of the last code output. This time the maximum rpm drop that results is multiplied by a still lower percentage. This number is now used as the minimum rpm drop for each cylinder to pass this test. (Example: 150 rpm x 20% = 30 rpm).

If all of the rpm drops are greater than 30 rpm, then a code 90 is output. If cylinder number 3 had failed the previous two levels, but passed the third, then it is considered to be a very weak cylinder. If cylinder 3 again fails the test, then a code 30 is again output. In this case, cylinder 3 is considered a non-contributing cylinder.

The cylinder balance test may be repeated as many times as desired by depressing and releasing the throttle within two minutes of the last code output. All further testing will be done using the third percentage level.

## Output State Diagnostic Test Mode

1. Enter the self test procedure.
2. After the codes are outputted, briefly depress the throttle to the wide open throttle. The Electronic Control Assembly (ECA) ENERGIZES the actuators.
3. Briefly depress the throttle to the wide open throttle. The Electronic Control Assembly (ECA) DE-ENERGIZES the actuators.

## With Scan Tool

**NOTE:** Correct results of the quick tests are dependent on the proper operation of related non-EEC-IV components.

It may be necessary to disconnect or disassemble harness connector assemblies to do some of the inspections. Pin locations should be noted prior to disassembly.

1. Turn OFF the ignition, place the transmission in PARK (A/T) or NEUTRAL (M/T), and place blocks around a wheel.
2. Inspect the air cleaner and inlet ducting.
3. Check all engine vacuum hoses for damage, leaks, cracks, blockage, proper routing, etc.
4. Check EEC-IV system wiring harness for proper connections, bent or broken pins, corrosion, loose wires, proper routing, etc.
5. Check the Electronic Control Assembly (ECA), sensors, and actuators for physical damage.
6. Check the engine coolant for proper level.
7. Check the transmission fluid level and quality.
8. Make all necessary repairs prior to continuing with test preparation.
9. Turn off all electrical loads (radios, lights, A/C-heater blower fans, etc.).
10. Turn the ignition switch OFF.
11. Connect the scan tool to the diagnostic connector.
12. Connect a timing light to the engine.
13. Continue with quick test. See: Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Key On Engine Off (KOEO) Self Test

## With Malfunction Indicator Light or Analog Voltmeter

**NOTE:** Correct results of the quick tests are dependent on the proper operation of related non-EEC-IV components.

It may be necessary to disconnect or disassemble harness connector assemblies to do some of the inspections. Pin locations should be noted prior to disassembly.

1. Inspect the air cleaner and inlet ducting.
2. Check all engine vacuum hoses for damage, leaks, cracks, blockage, proper routing, etc.
3. Check EEC-IV system wiring harness for proper connections, bent or broken pins, corrosion, loose wires, proper routing, etc.
4. Check the Electronic Control Assembly (ECA), sensors, and actuators for physical damage.
5. Check the engine coolant for proper level.
6. Check the transmission fluid level and quality.
7. Make all necessary repairs prior to continuing with test preparation.
8. Turn off all electrical loads (radios, lights, A/C-heater blower fans, etc.).
9. Turn the ignition switch OFF.
10. Connect a timing light to the engine.
11. Continue with quick test. See: Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Key On Engine Off (KOEO) Self Test

## With Scan Tool

**NOTE:** It may be necessary to service non-EEC-IV faults before running the quick test.

Continuous codes recorded in this step will be used for diagnosis in **CONTINUOUS MEMORY CODES** after a pass code is received in both Key On Engine Off (KOEO) and Engine Running (ER) self-tests.

Deviation from this procedure may cause false codes to be output.

1. START engine and bring to normal operating temperature.  
**NOTE:** If engine will not start or stalls after starting, proceed with the Key On Engine Off (KOEO) self test.
2. Turn the key OFF, then wait ten seconds.
3. ACTIVATE the self test (refer to scan tool manual for instructions).
4. Turn the ignition key to the ON position.
5. Record all codes received.
6. Turn the ignition key OFF and DEACTIVATE the self test.
7. If a pass code (11 or 111) is received for hard codes (11/111-10-any code), proceed with substep a.  
If any hard codes are received, refer to the appropriate service code chart for diagnostic path. See: Diagnostic Trouble Code Tests and Associated Procedures  
If no codes are received, go to pinpoint test QA, step QA1.  
After completing the proper pinpoint test(s), return to this test and perform the KOEO test again.
  - a. IF THE CHECK ENGINE LIGHT IS ON:  
Refer to the appropriate continuous memory code chart before addressing any other symptoms. See: Diagnostic Trouble Code Tests and Associated Procedures
  - b. IF ENGINE RUNS OR IDLES ROUGH:  
Continue with substep c for DIS or EDIS vehicles, or go to pinpoint test S, step S2 for a TFI equipped vehicle.
  - c. IF CONTINUOUS MEMORY FAULT CODES 45, 46, 48, 215, 216, 217, 232, OR 238 WERE RECEIVED DURING KOEO SELF TEST:  
Go to IGNITION SYSTEMS for diagnostics.  
IF THESE CODES WERE NOT RECEIVED:  
Go to pinpoint test S, step S2.
  - d. IF NONE OF THE ABOVE SITUATIONS ARE PRESENT:  
Perform computed timing check. See: Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Computed Timing Check

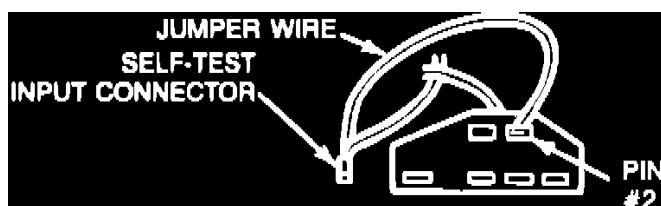
## With Malfunction Indicator Light (MIL)

**NOTE:** It may be necessary to service non-EEC-IV faults before running the quick test.

Continuous codes recorded in this step will be used for diagnosis in **CONTINUOUS MEMORY CODES** after a pass code is received in both Key On Engine Off (KOEO) and Engine Running (ER) self-tests.

Deviation from this procedure may cause false codes to be output.

1. START engine and bring to normal operating temperature.  
**NOTE:** If engine will not start or stalls after starting, proceed with the Key On Engine Off (KOEO) self test.
2. Turn the key OFF, then wait ten seconds.



**Jumper Wire Installed Between Pin #2 And Self Test Input (STI)**

3. ACTIVATE the self test by grounding the STI connector.
4. Turn the ignition key to the ON position.
5. Record all codes received.
6. Turn the ignition key OFF and DEACTIVATE the self test.
7. If a pass code (11 or 111) is received for hard codes (11/111-10-any code), proceed with substep a. If any hard codes are received, refer to the appropriate service code chart for diagnostic path. See: Diagnostic Trouble Code Tests and Associated Procedures

If no codes are received, go to pinpoint test QA, step QA1.

After completing the proper pinpoint test(s), return to this test and perform the KOEO test again.

- a. IF THE CHECK ENGINE LIGHT IS ON:  
Refer to the appropriate continuous memory code chart before addressing any other symptoms. See: Diagnostic Trouble Code Tests and Associated Procedures
- b. IF ENGINE RUNS OR IDLES ROUGH:  
Continue with substep c for DIS or EDIS vehicles, or go to pinpoint test S, step S2 for a TFI equipped vehicle.
- c. IF CONTINUOUS MEMORY FAULT CODES 45, 46, 48, 215, 216, 217, 232, OR 238 WERE RECEIVED DURING KOEO SELF TEST:  
Go to IGNITION SYSTEMS for diagnostics.  
IF THESE CODES WERE NOT RECEIVED:  
Go to pinpoint test S, step S2.
- d. IF NONE OF THE ABOVE SITUATIONS ARE PRESENT:  
Perform computed timing check. See: Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Computed Timing Check

## With Scan Tool

1. Ensure self test is DEACTIVATED, then START and run the engine at 2,000 rpm for two minutes.
2. Turn the engine OFF and wait for ten seconds.
3. ACTIVATE the self test (refer to scan tool manual).
4. Start the engine.
5. After the engine ID code, depress and release the brake pedal, then turn the steering wheel 1/2 turn and release it. If the vehicle is equipped with an E4OD transmission cycle the Overdrive Cancel Switch (OCS).
6. If the dynamic response "goose" code appears, briefly go to wide open throttle.
7. Record all codes displayed.  
**NOTE:** Engine running service code 98/998 indicates vehicle is in Failure Mode Effects Management (FMEM) and DID NOT PASS the Key ON Engine OFF (KOEO) on demand/continuous memory self test. Engine running self test cannot be performed while in FMEM. Rerun KOEO self test and correct all fault codes.
8. Turn OFF the engine and DEACTIVATE the self test.
9. If a pass code (11) was received in the ER test, go to substep a. If any other codes are received, refer to the proper service code chart for the diagnostic path. See: Diagnostic Trouble Code Tests and Associated Procedures

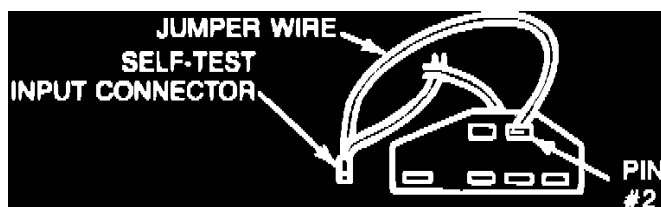
If no codes are received go to pinpoint test step QA1. See: Pinpoint Tests/QA - No Codes/Codes Not Listed

After completing the proper pinpoint test(s), return to this test and perform the ER test again.

- a. If there are continuous memory codes from KEY ON ENGINE OFF self test, proceed to SERVICE CODE CHARTS for the appropriate diagnostic path. See: Diagnostic Trouble Code Tests and Associated Procedures  
Once the repair procedures are complete, clear the continuous memory codes. See: Clearing Diagnostic Trouble Codes  
Rerun quick test.
- b. If there are no continuous memory codes present and there are no driveability symptoms present, EEC-IV testing is complete.
- c. If there are no continuous memory codes present and there are driveability symptoms present, perform the proper diagnosis by symptom non-computer related chart.

## With Check Engine Light

1. Ensure self test is DEACTIVATED, then START and run the engine at 2,000 rpm for two minutes.  
**NOTE:** IF the engine starts but stalls, or stalls during self test, refer to pinpoint test step S1.
2. Turn the engine OFF and wait for ten seconds.
3. ACTIVATE the self test by grounding the STI connector.



Jumper Wire Installed Between Pin #2 And Self Test Input (STI)

4. Start the engine.
5. After the engine ID code, depress and release the brake pedal, then turn the steering wheel 1/2 turn and release it. If the vehicle is equipped with an E4OD transmission cycle the Overdrive Cancel Switch (OCS).
6. When the dynamic response "goose" code appears, briefly go to wide open throttle.
7. Record all codes displayed.  
**NOTE:** Engine running service code 98/998 indicates vehicle is in Failure Mode Effects Management (FMEM) and DID NOT PASS the Key ON Engine OFF (KOEO) on demand/continuous memory self test. Engine running self test cannot be performed while in FMEM. Rerun KOEO self test and correct all fault codes.
8. Turn OFF the engine and DEACTIVATE the self test.
9. If a pass code (11) was received in the ER test, go to substep a. If any other codes are received, refer to the proper service code chart for the diagnostic path. See: Diagnostic Trouble Code Tests and Associated Procedures

If no codes are received go to pinpoint test step QA1.

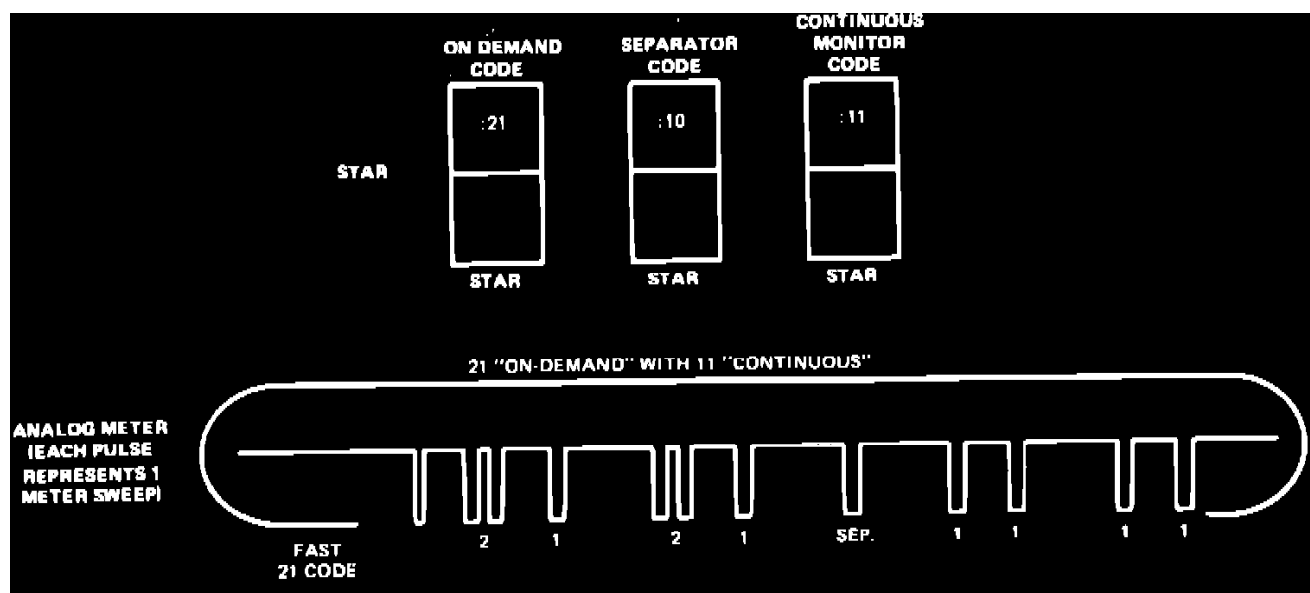
After completing the proper pinpoint test(s), return to this test and perform the ER test again.

- a. If there are continuous memory codes from KEY ON ENGINE OFF self test, proceed to SERVICE CODE CHARTS for the appropriate diagnostic path. See: Diagnostic Trouble Code Tests and Associated Procedures  
Once the repair procedures are complete, clear the continuous memory codes. See: Clearing Diagnostic Trouble Codes  
Rerun quick test.
- b. If there are no continuous memory codes present and there are no driveability symptoms present, EEC-IV testing is complete.
- c. If there are no continuous memory codes present and there are driveability symptoms present, perform the proper diagnosis by symptom non-computer related chart.

## Computed Timing Check

1. Disconnect the SPOUT/SAW connector.
  2. Start the engine and allow to idle.
  3. While observing ignition timing with a timing light, install the SPOUT/SAW connector.
    - a. If the ignition timing changed when the SPOUT/SAW connector was installed continue with engine running self test. See: Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Key ON Engine Running (KOER) Self-Test
    - b. If the ignition timing did not change when the SPOUT/SAW connector was installed continue with engine running test and look for code 213/18. See: Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Key ON Engine Running (KOER) Self-Test
- If the code is present, ignore any other codes and refer to the appropriate code chart for code 213/18.  
If the code is not present, continue with the engine running test as directed in the test.

## Service Code Output Format



Self-Test Code Output Format. Key ON/Engine OFF

The Electronic Engine Control (EEC-IV) system communicates service through the self test codes. These codes are two or three digit numbers representing the results of the self test.

The service codes are transmitted on the Self Test Output (STO) wire located on the vehicle self test connector. The codes are in the form of timed pulses, and are read by the technician on a scan tool, the Overdrive Cancel Indicator Light (OCIL), or the CHECK ENGINE light.

**NOTE:** Two digit codes are shown in the images. Three digit codes are similar.

## Fast Codes Description

Fast codes are given prior to regular service codes. These codes contain the identical information as the regular service codes but are transmitted at 100 times the normal rate. These codes are used at the factory and should be ignored in the field.

## Continuous Memory Diagnostic Test Codes Description

The continuous codes are issued as a result of information stored (memory codes) during continuous monitor testing, while the vehicle was in normal operation. These codes are displayed only during the Key On Engine Off (**KOEO**) testing after the separator code.

## Dynamic Response (Goose) Code Description

The dynamic response (goose) code is displayed during the Engine Running (**ER**) test only. It is displayed as single pulse (10 on a scanner) and is displayed after the engine ID code. When the "goose" code is displayed, the operator should briefly go to wide open throttle.

## Engine ID Code Description

Engine identification codes are issued at the beginning of the engine running test. The engine identification code is equal to the number of engine cylinders when the number is multiplied by two and the zero dropped. These codes are used to verify that the proper processor is installed and that the self-test has been entered.

## Hard Codes (On Demand) Description

The hard (on-demand) codes are displayed in both the Key On Engine Off (**KOEO**) and Engine Running (**ER**) self tests. If a hard code is displayed it means that there is a fault present in the system at the time the test was run. In the KOEO self test, the hard codes are displayed first. The hard codes are the codes up to, but not including the separator code (10). In the ER self test the hard codes are the last codes displayed and will follow the "goose" code.

## Separator Pulse Description

A single 1/2 second separator pulse is issued 6-9 seconds after the last functional test code (Key ON/Engine OFF only). Then 6-9 seconds after the single 1/2 second separator pulse, the continuous codes will be issued.

## With Scan Tool

**NOTE:** DO NOT disconnect the battery to clear continuous memory codes. This will erase the Keep Alive Memory (**KAM**) information and may cause driveability symptoms.

Perform the Key On Engine Off (**KOEO**) self test. When the codes begin to be displayed, DEACTIVATE the self test by disconnecting the ground wire from the STI connector. The continuous memory codes are now erased from the computers memory.

## Without Scan Tool

**NOTE:** DO NOT disconnect the battery to clear continuous memory codes. This will erase the Keep Alive Memory (**KAM**) information and may cause driveability symptoms.

Perform the Key On Engine Off (**KOEO**) self test. When the codes begin to be displayed, DEACTIVATE the self test by disconnecting the ground wire from the STI connector. The continuous memory codes are now erased from the computers memory.

## Clearing Keep Alive Memory (KAM) and Relearn Procedure

The Electronic Control Assembly (**ECA**) stores information about vehicle operating conditions and uses this information to compensate for component tolerances. When an emission related component is replaced, Keep Alive Memory (**KAM**) should be cleared to erase the information stored by the processor from the original component.

To clear the KAM, disconnect the battery negative terminal for five minutes or more. Drive the the vehicle for at least ten miles to allow the ECA to relearn the values for optimum performance.

**NOTE:** During the ten mile relearn drive, the vehicle may exhibit some driveability symptoms. These should be eliminated when the KAM has relearned the operating values.