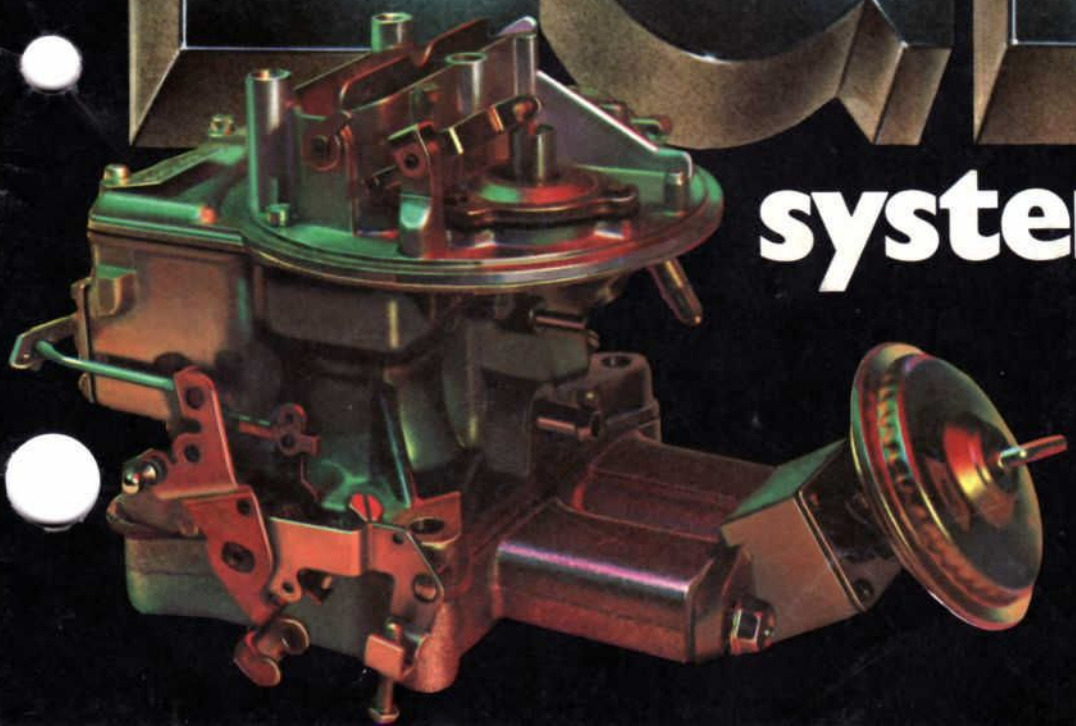
SHOP TIPS

Motorcraft

VOL. 11, NO. 6 MARCH, 1973

Servicing Ford's new E.G.R. system...



THE EGR SYSTEM...

Technical parts and service information published by the Ford Parts Division and distributed by Ford and Lincoln-Mercury Dealers to assist servicemen in Service Stations, Independent Garages and Fleets.

IN THIS ISSUE

Be sure to file this and future issues for ready reference. If you have any suggestions for articles that you would like to see included in this publication, please write to: Ford Parts Division, Merchandising Services Dept., P.O. Box 3000, Livonia, Michigan 48151.

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Motorcraft

VOL. 73 MSD 34 LITHO IN U.S.A.

CONTROLLING EXHAUST EMISSIONS

You'll hear the term "NOx" more and more as the auto industry continues its race against time to clean up the air in the U.S.A.

What is NOx? Simply this: *Oxides of nitrogen;* a by-product resulting from the burning of fuel and air when the engine is running. It is invisible to the eye, practically odorless, and is caused by peak high combustion chamber temperatures that cause the nitrogen and oxygen to unite.

NOx STANDARDS ■ The Federal Government NOx standard for all states for 1973 is 3.0 grams. This is a reduction, nationwide, of more than 50% in only one model year when compared to the equivalent of more than a 4.0 gram limit required by California in 1972.

To meet this strict standard, Ford-built engines for 1973 have added an EGR for most vehicle models . . . Exhaust Gas Recirculation system. By means of this new system, Ford is able to extract a portion of exhaust gas (about 6 to 10 percent) and direct it back to the combustion chamber by blending it with the incoming fuel/air mixture. This 6 to 10 percent of exhaust gas, the by-product of combustion, serves to "cool down" peak combustion temperatures of over 3,000 degrees F.

FORD'S EGR SYSTEM ■ Ford uses a built-in system on V-8s rather than add-on pipes to pick up a portion of the exhaust gas and to meter it back into the fuel/air mixture entering the intake manifold. On V-8 engines, the only visible portion of the EGR system is a thick spacer plate located between the carburetor base and the intake manifold. A metering valve is also connected to one end of this plate.

Both the 200 and 250 CID engines use an external stainless steel tube to direct hot exhaust gases to the EGR valve. It might be well to note here that controlling the formation of oxides of nitrogen presents different and at the same time, conflicting problems than that of limiting carbon monoxide and hydrocarbons.

The lean combustion mixtures and high temperatures that are helpful in reducing both hydrocarbon and carbon monoxide have just the opposite effect on oxides of nitrogen. In fact, the formation of oxides of nitrogen reach a *maximum* level at nearly the same air/fuel ratio that results in a *minimum* carbon monoxide and hydrocarbon emission level! Also, peak concentrations of NOx increase with engine load as combustion temperature rises. And, a richer fuel mixture reduces NOx but increases emissions of hydrocarbons. Too, leaner mixture and a retarded spark reduce NOx somewhat, but cause driveability problems.

Therefore, to balance all of these factors and to achieve the degree of NOx control required, the basic EGR system was developed. In fact, there are really TWO VERSIONS of the EGR system. A more complicated system than the one we have briefly described is needed for some engine applications for the control of EGR and to provide acceptable engine operation at high speed cruise conditions. We will refer to this more sophisticated arrangement later on as a HIGH SPEED EGR MODULATOR SUB-SYSTEM.

This issue of *Shop Tips* is designed to explain the mechanical details of both versions of the EGR system and to explain the operation, testing, and maintenance procedures.

It may be well to remember too, that any malfunction or failure of this new EGR system will have a direct bearing on the starting and operating condition of the engine. As a result, it is strongly urged that you use the chart "Diagnosis of EGR System" listed on pages 14 and 15 when necessary.

DESCRIPTION

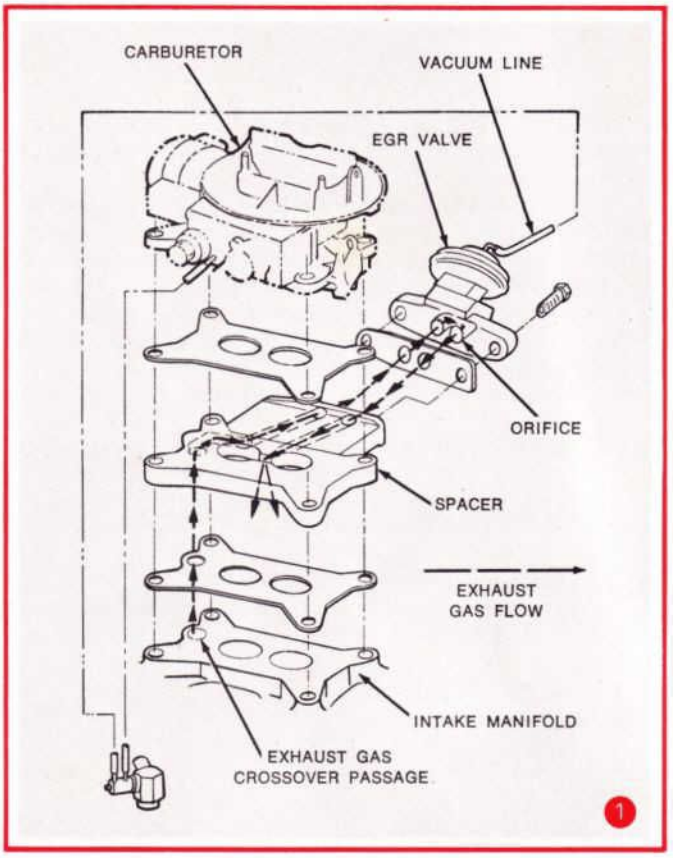
The EGR system (Exhaust Gas Recirculation) is an added emission control feature on all 1973 Ford-built cars, except the 1600 and 2000 cc engines. This system is also used on trucks rated at 6000 GVW or under (for all 50 states) when equipped with a 200, 240, 302, 360, or 390 CID engine.

Also, for California only, the EGR system is used on trucks over 6000 GVW when equipped with a 360 or 390 cubic inch engine.

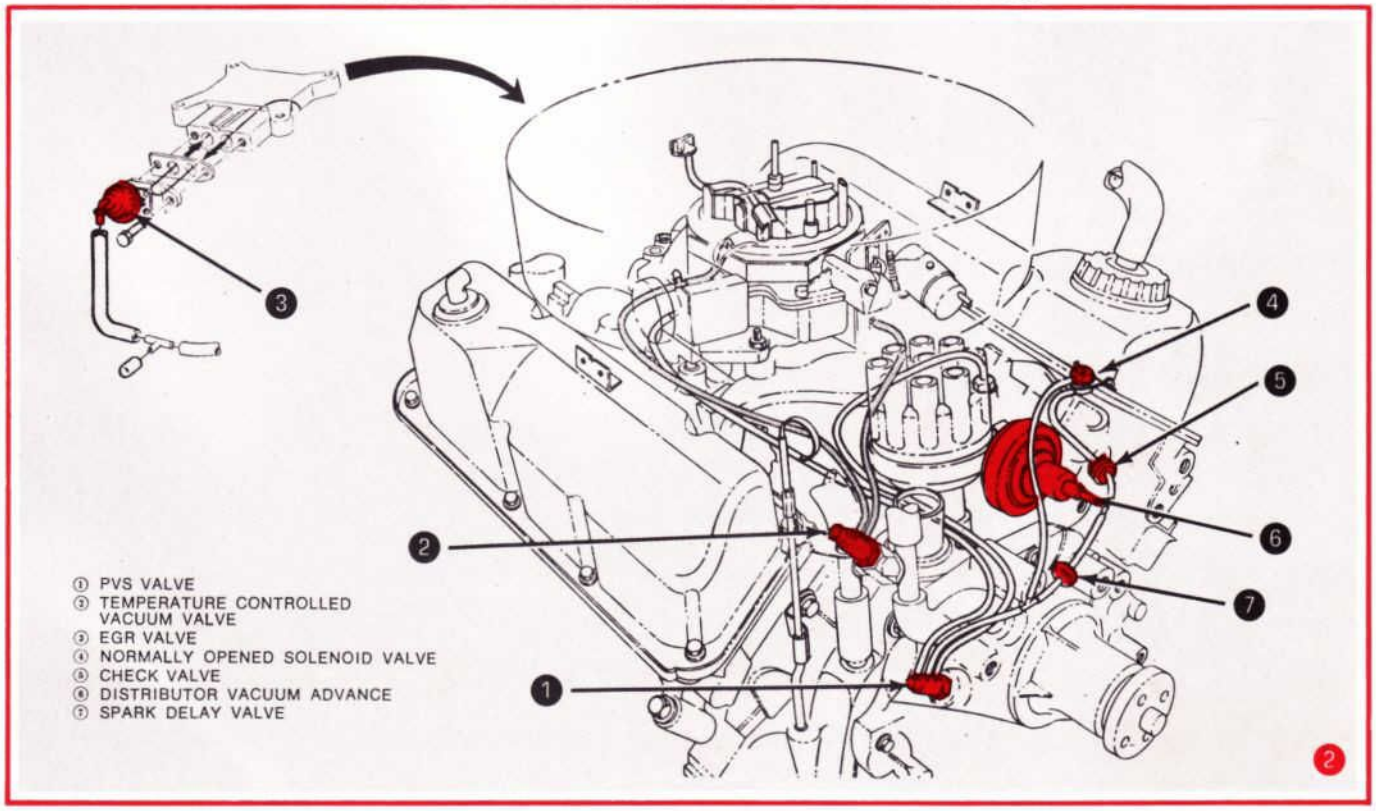
As mentioned earlier, to reduce NOx levels of 1973 Ford-built engines, exhaust gases are metered through the EGR valve (see Figure 1), to a passage in the carburetor spacer in order to dilute the fuel/air mixture going to the combustion chambers. This dilution of the fuel/air mixture lowers the temperature during combustion, thus limiting formation of nitrogen oxides (NOx).

On V-8 engines, the valve is attached at the rear of the carburetor spacer as shown in Figure 2. Exhaust gases are then taken from a drilled passage in the exhaust passage located in the exhaust crossover of the intake manifold. These exhaust gases are then routed to a metered orifice through the EGR valve to the passage in the carburetor spacer and fed into the primary bore(s).

On 6-cylinder models, the EGR system is basically the same as that used on V-8 models, except that the exhaust gas is taken directly from the exhaust manifold heat box on 240 CID engines or directly from the exhaust manifold and directed through a stainless steel tube connected to the EGR spacer on the 200 and 250 CID engines.



TYPICAL EGR SYSTEM: 351-C, 400 CID W/O AC



THE EGR SYSTEM...

CONTROL OF EGR OPERATION

There are TWO factors that control the operation of the basic EGR system . . . ENGINE COOLANT TEMPERATURE and CARBURETOR VACUUM.

When engine coolant temperature is BELOW the specified level (either 60° F., 95° F., or 125° F. depending on application), the EGR system is locked-out by a temperature controlled vacuum switch similar to the PVS switch used in 1972.

This new vacuum switch, placed in series with the EGR vacuum line, is installed in a metal "TEE" fitting at the front of 6-cylinder models and in a metal connector of the heater hose on V-8 equipped models. See Figure 2.

This temperature valve receives vacuum from a port in the carburetor body. This new port is similar to the spark port.

When the valve is closed due to lower coolant temperature NO VACUUM is applied to the EGR valve and thus NO EXHAUST GAS is fed to the air/fuel mixture.

When engine coolant temperature reaches the specified level (this will take approximately TWO minutes of engine operation) the valve opens allowing vacuum to be applied to the EGR valve. Exhaust gas is then fed to the air/fuel mixture.

The second factor concerning EGR operation involves carburetor vacuum. Generally speaking, vacuum is fed to the EGR vacuum control valve when the primary throttle plate reaches a position corresponding to a road speed of approximately 20 mph under light acceleration.

NOTE: There are three types of EGR valves; the POPPET type and the MODULATING type. See figures 3 and 4. The TAPERED-STEM valve is not illustrated.

The *Poppet type* consists of a spring-loaded diaphragm plus a valve stem and valve that operates within an enclosed valve body. See Figure 3.

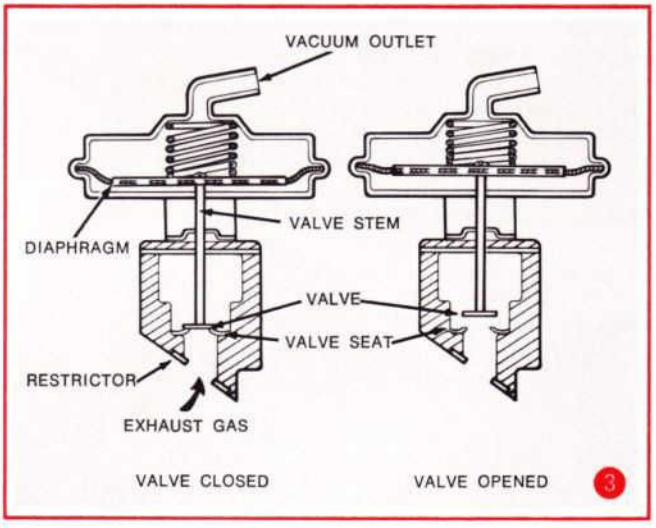
At approximately 3 inches of vacuum the valve begins to open. As the valve stem is pulled forward, it unseats the valve and allows exhaust gases to flow into the chamber in the valve.

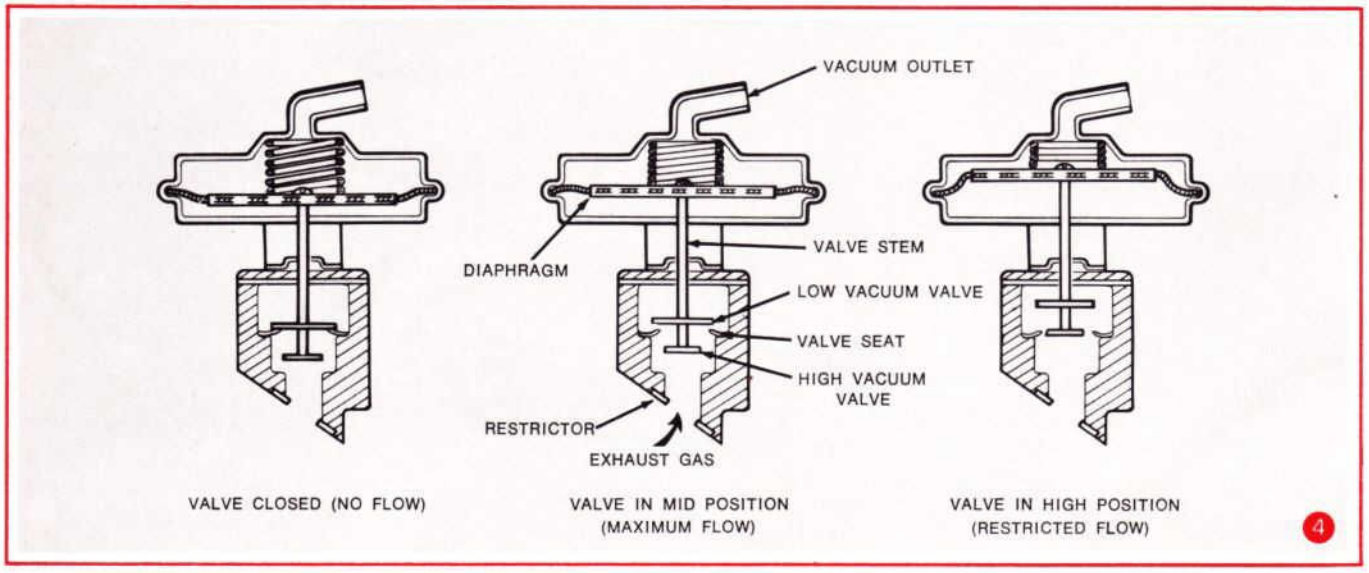
Intake manifold vacuum will then pull the gas from this chamber and into the flow of fuel/air mixture entering the combustion chambers. Once the valve has been unseated, the only means of limiting exhaust gas flow is the size of the flow restrictor placed in the inlet port of the valve body.

Restrictor size varies according to engine application. *Modulating-type* valves have an additional disc added to the valve stem below the main valve as shown in Figure 4. This modulating valve operates the same as the poppet type valve when vacuum is between approximately 3 inches of vacuum and 10½ inches of vacuum.

When vacuum reaches approximately 10½ inches of vacuum, the lower disc (high vacuum flow restrictor) approaches the shoulders of the valve seat and restricts the flow of exhaust gases. This modulation of gas flow is for the purpose of improved driveability on certain engine models. The EGR valve and the vacuum control valve CANNOT be disassembled and must be replaced if damaged!

IMPORTANT NOTE: *A* Tapered-stem *valve should never be cleaned. If plugged or the cause of a rough idle condition due to excessive leakage, it should be replaced.*





OPERATING DETAILS

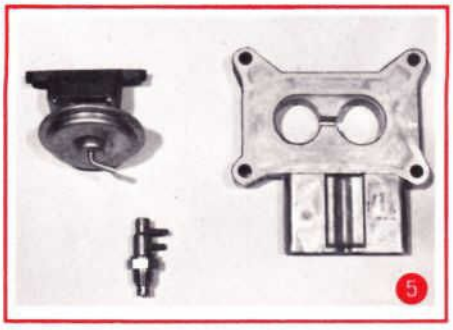
Essentially, the major units that make up the EGR system are the EGR valve . . . the temperature controlled vacuum valve (EGR PVS) . . . and a thick carburetor spacer. See Figure 5.

On V-8 engines . . . the EGR valve is attached to the rear of the carburetor spacer mounted on the intake manifold. See Figure 6.

Exhaust gases, as shown in this illustration, are picked up from a drilled passage in the exhaust crossover of the intake manifold and then routed through the carburetor spacer to the EGR valve. See Figure 7.

Since exhaust gases are almost totally inert or inactive, therefore not being capable of supporting combustion, they are mixed with the air/fuel intake charge mixture in the cylinder to absorb some of the heat of combustion. This results in a lowering of combustion temperatures and thus a corresponding reduction in formation of oxides of nitrogen.

The EGR system for the 6-cylinder 200-250 CID engines is basically the same except that the exhaust gases are taken directly from the exhaust manifold through a stainless steel tube. Also, the EGR valve is mounted at the rear of the carburetor spacer on the 200 and 250 CID engines (see Figure 9), while the 240 CID 6-cylinder engine and the V-6 Capri engine have the EGR valve mounted at the front of the carburetor. See Figure 10.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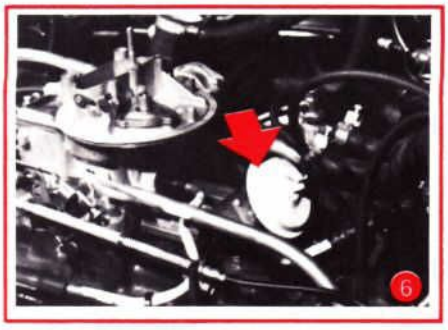
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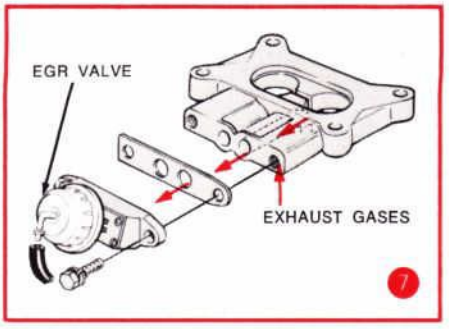

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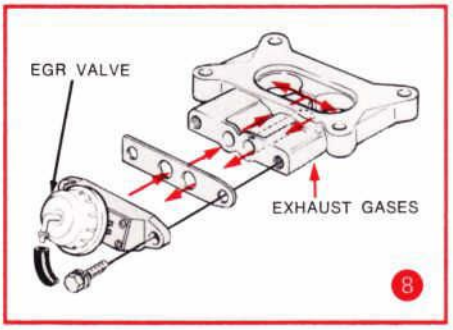

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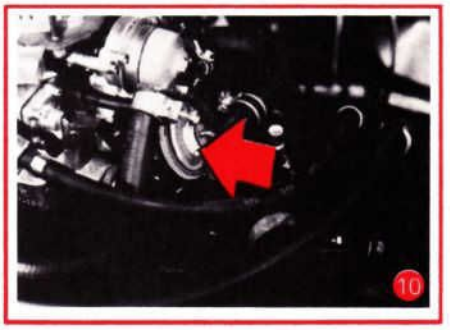
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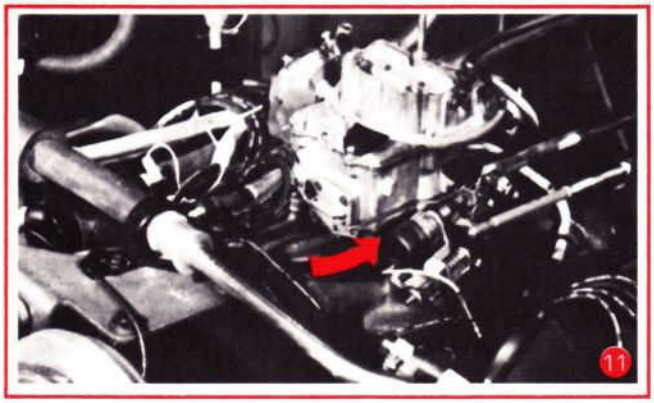
The exhaust gases are then metered through the EGR valve and returned to a separate passage in the carburetor spacer. Here the exhaust gases are directed to the primary bores where they dilute the incoming air/fuel mixture entering the combustion chambers. See Figure 8.

Vacuum from the EGR port in the primary bore of the carburetor controls the EGR valve. This port is similar to the spark port used as a vacuum source for controlling distributor advance. See Figure 11.

Generally, there are two vacuum ports . . . the EGR and SPARK (see Figure 12). The spark port is in its original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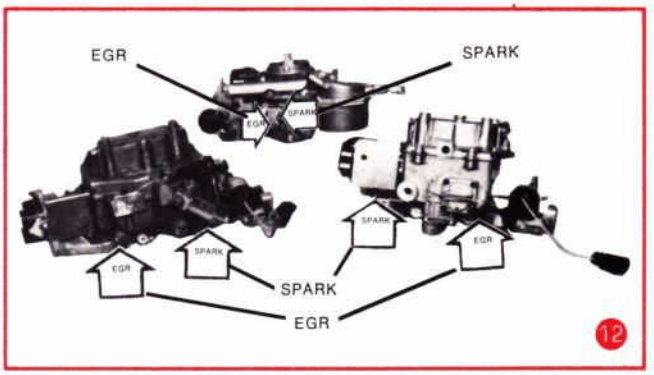

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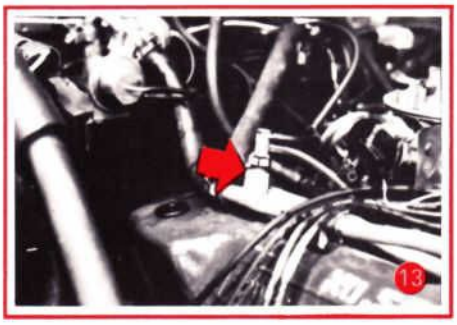
THE EGR SYSTEM...



position and has a *brass connection* while the EGR port has a zinc (silver appearing) color or is *black*.

NOTE: *Some later modifications use only the SPARK PORT for both EGR and spark vacuum.*

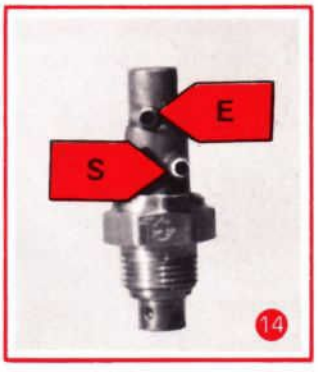
Flow of vacuum from the EGR port to the EGR valve is controlled by a temperature controlled vacuum valve (EGR PVS) placed in series with the EGR vacuum line. See Figures 2 and 13 for V-8 and 6-cylinder engines.

This valve is located in the heater hose "Tee" fitting or a fitting in the coolant bypass circuit. It senses temperature of the coolant flowing through the heater hose. No vacuum is permitted to go to the EGR valve until a specified engine coolant temperature is reached. Depending on outside (ambient) temperature, it takes about two minutes from the start-up of the engine for the coolant to reach the specified temperature.

These temperature controlled vacuum valves (EGR PVS), come in three different opening temperatures and each is designated by a color code as follows:

- Green paint on the top of the valve identifies the 60-degree F. valve.
- Black paint, the 95-degree F. valve.
- Plain, blue or no paint, the 125-degree F. valve.

Both ports on the valve are easily identified to assist in proper vacuum hose routing. The TOP PORT always connects to the EGR valve and is identified by the letter "E." The BOTTOM PORT with the letter "S" is connected to the vacuum source from the carburetor. See Figure 14.



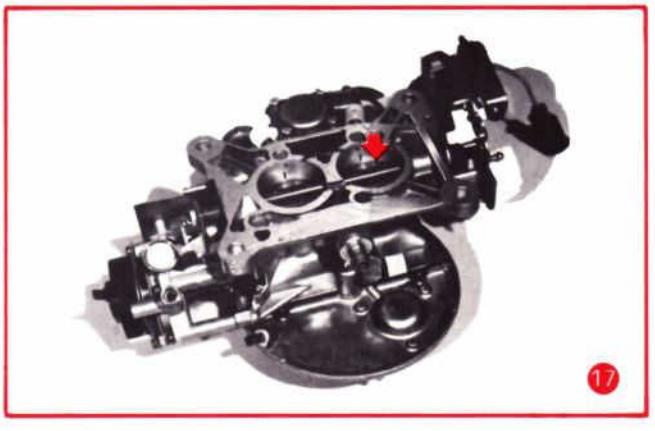
EGR VALVE OPERATIONS

Control or limitation of the exhaust gases into the EGR valve is directly dependent upon the size of the orifice in the restrictor inlet. See Figure 15.

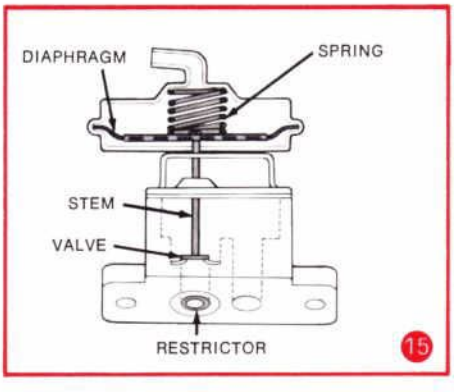
Without vacuum acting on the diaphragm, spring force holds the EGR valve closed, preventing the flow of exhaust gases from reaching the primary bores in the carburetor spacer. See Figure 16.

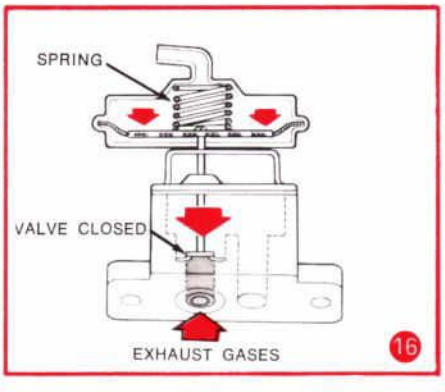
However, as the carburetor throttle plate is opened and the engine warms up to open the temperature controlled vacuum valve . . . vacuum created at the EGR port is directed to the EGR valve. Location of the EGR port in the carburetor is designed so that this occurs when the primary throttle plate corresponds to about 20 mph under light acceleration. See Figure 17.

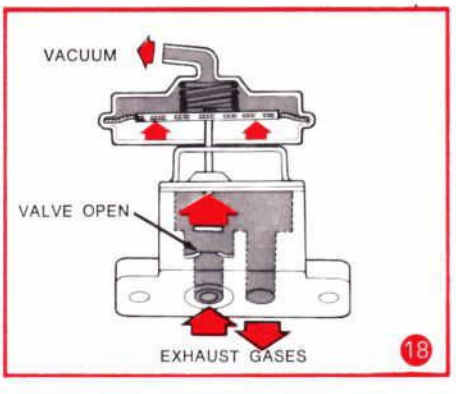
This throttle position represents approximately 3 inches of vacuum acting on the EGR valve diaphragm which is sufficient to overcome spring pressure and open the valve.



At 8 to 10 inches of vacuum, the valve is wide open. See Figure 18. Exhaust gases enter the EGR valve chamber and are drawn through the outlet and into the air/fuel mixture flowing into the combustion chambers of the engine.







EGR OPERATIONS TESTING

The first step in checking the overall operation of the EGR system is to insert a "TEE" and a vacuum gauge into the vacuum hose at the EGR valve. Then, start the engine and allow it to warm up for 3 to 4 minutes at a fast idle speed so that the engine coolant reaches above 125 degrees F. See Figure 19.

Then, quickly open the throttle plates for only a brief moment. As you do this, check the vacuum gauge reading. See Figure 20.

As engine speed increases, the vacuum gauge reading should also increase.

Here's what to do: Remove the EGR hose from the EGR port on the carburetor and attach it to the manifold vacuum source. With the engine running, the EGR valve stem should move outward again BUT THE ENGINE SHOULD IDLE ROUGHLY and engine speed should decrease drastically or possibly stall out. If this occurs, then the EGR valve is functional.

However, if you find NO CHANGE in engine speed or idle quality, this indicates that the EGR valve is restricted. Remove the EGR valve and unplug the orifice with a .060" wire or similar type of probe tool. See Figure 22. *If the EGR valve cannot be cleaned, replace it.*

Now to get back to your original test where you observed the EGR valve stem movement when vacuum reached 3 to 4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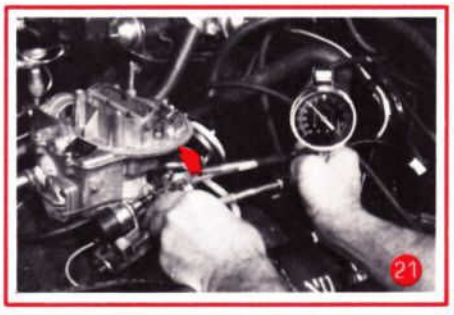
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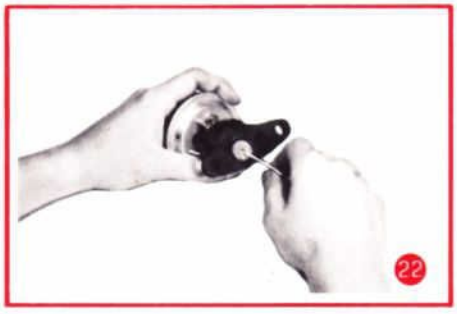
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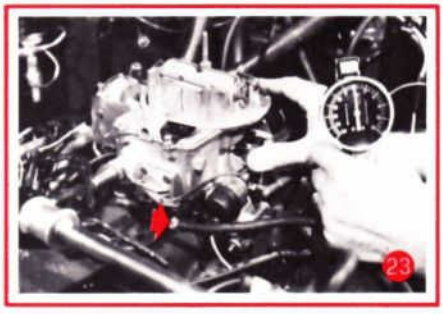
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If you find the vacuum reading DOES increase check the EGR valve stem as the throttle is opened. The valve stem should start to move outward, that is away from the carburetor, as the vacuum reading reaches 3 to 4 inches. Also, the valve should be in the wide open position at 8 to 10 inches of vacuum. See Figure 21.

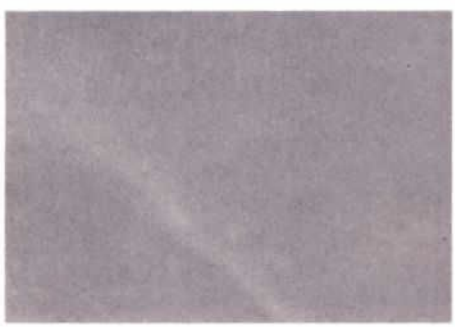
If this action DOES OCCUR, then the EGR system is functioning properly.

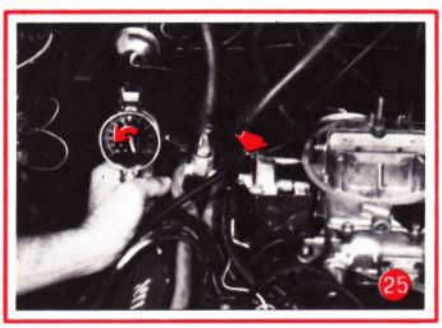
However, it is necessary to note that if the EGR valve stem does move, it is also important to make another check to be certain the valve is not restricted.

inches: If in this test the vacuum gauge showed NO VACUUM or NO INCREASE in vacuum as engine speed increased . . . other tests must be performed.

The first is to check the vacuum source at the EGR port of the carburetor.

To do this, "TEE" in the vacuum gauge at the EGR port and open the throttle quickly. See Figure 23. If there is no vacuum or no increase in vacuum as the engine speed is increased, this indicates the vacuum passage in the carburetor is plugged and must be corrected as necessary.

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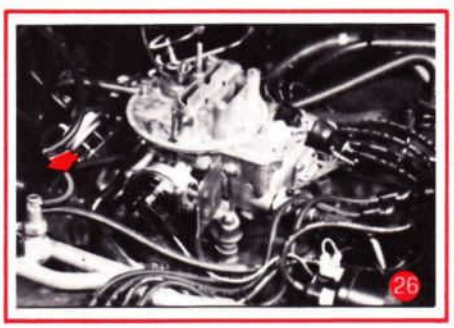
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THE EGR SYSTEM... TESTING & SERVICING *(Continued)*

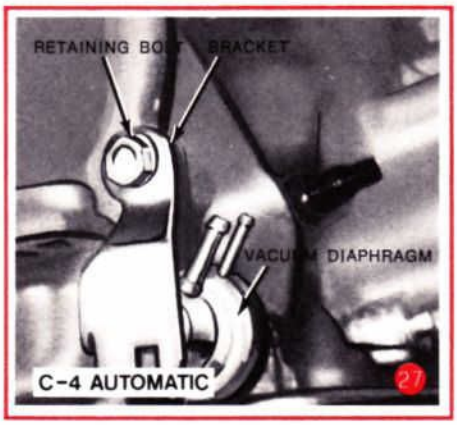
However, if vacuum at the EGR port checks out OK . . . the next step is to inspect the vacuum hose between the EGR port and the temperature controlled vacuum valve. See Figure 24. Examine the hose for correct routing . . . for leakage points . . . or a plugged, pinched or split condition. Repair as necessary.

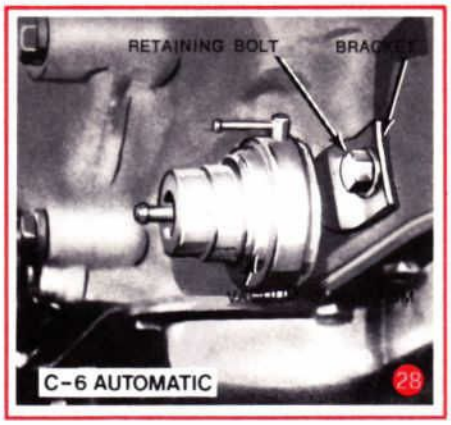
If you find the vacuum hose in good condition, the next step is to check the temperature controlled vacuum valve for proper operation.

To do this, "TEE" in a vacuum gauge at the TOP PORT of the valve (the EGR port), and once again open the throttle quickly. See Figure 25. Vacuum gauge reading should show an increase as the engine speed increases.

If it does not, the vacuum valve is not working and must be replaced.

However, if the temperature controlled vacuum valve is OK and the vacuum reading INCREASES with engine speed, check vacuum hose between vacuum valve and the EGR valve for poor connections, pinched hoses, splits or other failures. Correct conditions if found. See Figure 26.





TESTING THE DUAL-AREA DIAPHRAGM

To offset the effects of the EGR system on the engine when equipped with an automatic transmission (changes in manifold vacuum and torque characteristics), new dual-area diaphragms are used. These dual-area diaphragms permit 1973 Ford-built cars and light trucks (equipped with an automatic transmission) to function with acceptable shift spacing and shift feel.

To check dual-area diaphragms for leaks, the unit must first be removed from the rear facing of the transmission case.

On C4 and C6 automatic transmission, this is done by removing the attaching bolt and bracket. See Figures 27 and 28. Then pull the vacuum unit from the transmission since it is NOT threaded into the case.

On FMX automatic transmissions, remove the vacuum unit by using a special tool as shown in Figure 29. This unit is threaded into the case. Then, remove the control rod from the unit and reinstall the rod into the case.

Reverse the removal procedure when reinstalling any of the three types of vacuum units on the C4, C6 or FMX.

To test the dual diaphragm unit, you will need an outside vacuum source such as a distributor tester equipped with a vacuum pump.

Set the regulator on the distributor tester so that the vacuum reaches 18 inches with the end of the vacuum hose blocked off. See Figure 30.

Then connect the vacuum hose to the dual-area-diaphragm connection used for the EGR valve. See Figure 31. If the vacuum gauge still reads 18 inches . . . then the unit is OK. If it DOES NOT hold the 18 inch reading, the diaphragm is leaking and must be replaced. This test can also be performed on the vehicle but be sure the manifold vacuum connection is open to atmosphere (disconnected) during the test.

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Part Number	Application
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FL-2	General Motors
FL-9	General Motors
FL-10	General Motors
FL-20	Ford Truck
FL-22	General Motors

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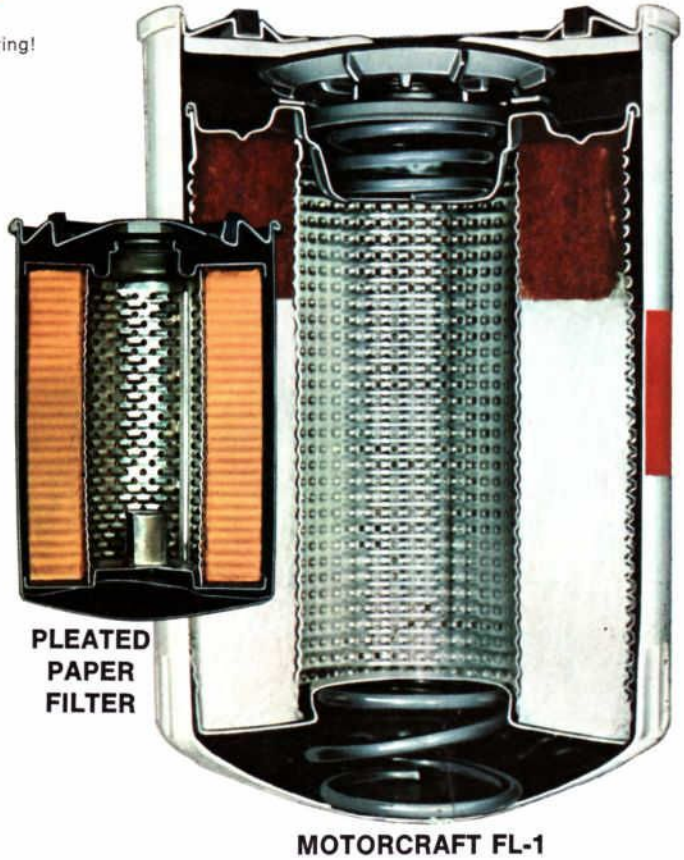
- In the second stage, soft white cotton is blended with wood-wool for superior fine-filtering and dirt removal.
- In addition to superior filtering capabilities, the water removal ability of the two-stage, dual-depth FL-1 filter traps more sludge than conventional paper filters which do not absorb water.



MOTORCRAFT FL-1

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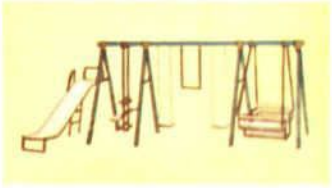

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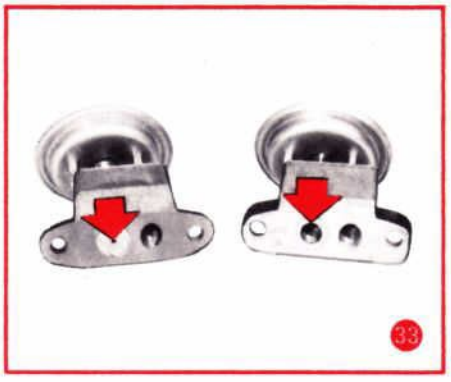
Every Remanufactured Ford Part is warranted nationally by the Remanufacturer to be free of defects in materials and workmanship for 90 days or 4000 miles from date of installation whichever occurs first. Complete OHV engine assemblies are warranted for 12 months or 12,000 miles on passenger vehicles, and 6 months or 12,000 miles on trucks, whichever occurs first. This Warranty includes parts replacement plus related labor.

Ford and Lincoln-Mercury dealers will honor this warranty anywhere in the country.

THE EGR SYSTEM... TESTING & SERVICING *(Continued)*

MAINTENANCE SERVICE


32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The functional test for the EGR system is a maintenance operation that is required EVERY 12,000 MILES or 12 MONTHS . . . whichever occurs first.

NOTE: *Page 14 of this issue of Shop Tips contains a diagnostic test.*

When you find that the EGR valve must be replaced, it will be necessary to install a new one since repairs are not recommended. Some of these valves MAY NOT look alike because of different supply sources (see Figure 21) . . . however they all perform the same function.

CAUTION: *All EGR valves are specially calibrated for specific engine applications. Therefore, be absolutely sure you install the correct one. Calibration is controlled by the size of the orifice (see Figure 33) in the restrictor at the exhaust gas inlet. These openings range in size from .083" to .312" (approximately 5/32" to 5/16").*

Installation of the EGR valve on the carburetor spacer is simple because the two attaching bolts are of different sizes. They cannot be installed incorrectly. See Figure 34.

Also, the gasket will fit in only one position. Simply match up the holes properly with the carburetor spacer.

IMPORTANT NOTE: *As mentioned earlier, the EGR functional test must be performed at 12,000 miles or 12 months. At the same time, the EGR system must be INSPECTED and CLEANED at this service interval to maintain the emission warranty. To do this, remove the EGR valve and visually check the valve orifice for any restriction or plugging. If the orifice is partially or completely plugged, use a wire or other probe of no more than .060" in diameter to clean out the restriction or deposits of combustion. See Figure 35.*

CAUTION: *Extreme care must be taken to avoid enlarging the restriction hole.*

If you find that the restriction CANNOT BE CLEANED, replace the valve assembly.

Exhaust gas passages and the cavities in the carburetor spacer must be cleaned. Encrusted and hard deposits must be loosened first, then removed with a suitable wire brush or scraper. See Figure 36.

Also, the machined holes in the carburetor spacer can be cleaned satisfactorily through the use of a suitable round wire brush as shown. See Figure 37.


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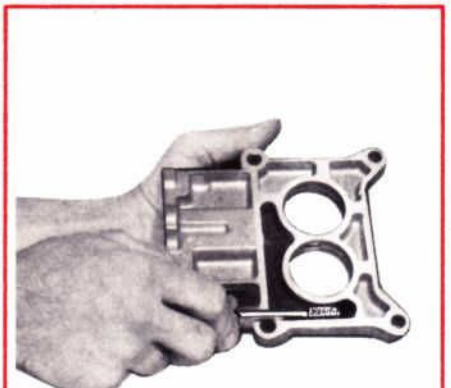
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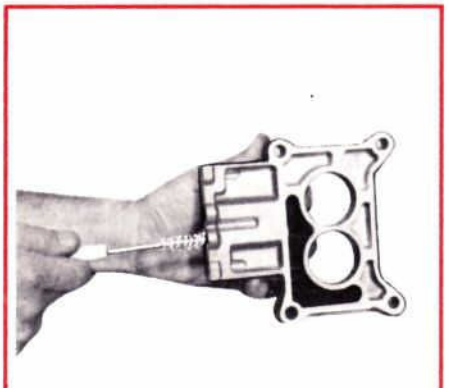
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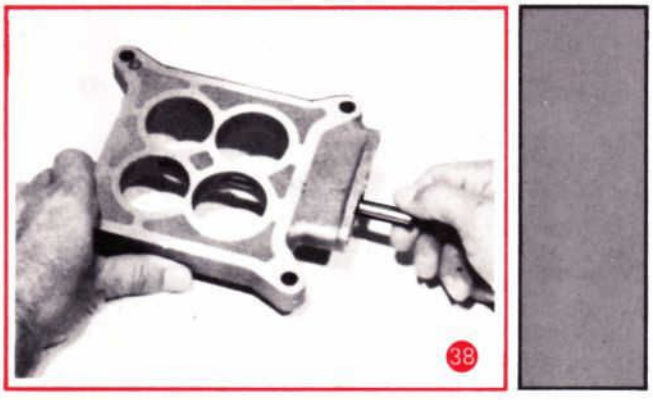
THE EGR SYSTEM...



If the maintenance is performed on a 4V carburetor application, the carburetor spacer incorporates a stainless steel tube in the center passage. This tube should be removed for cleaning purposes. See Figure 38.

CAUTION: *Before cleaning the exhaust passages in the intake manifold, the manifold riser bores must be covered or plugged with a cloth to prevent any foreign material from entering these manifold bores. See Figure 39.*

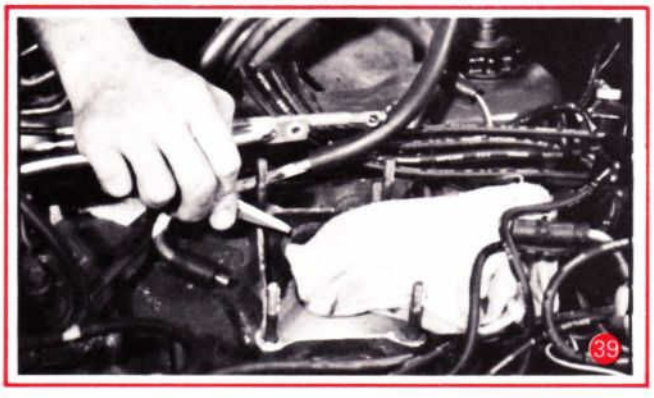
Now, clean the exhaust gas entry port in the exhaust manifold or the intake manifold. Use a round wire brush as shown. See Figure 40.

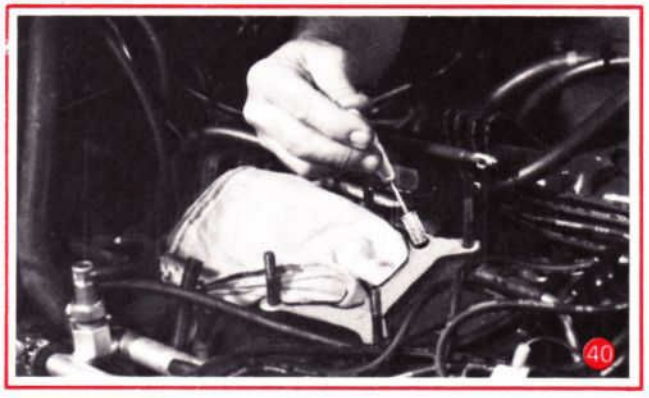
However, if necessary, clean the port by carefully passing a suitable drill size through the opening. Use HAND PRESSURE ONLY. See Figure 41.

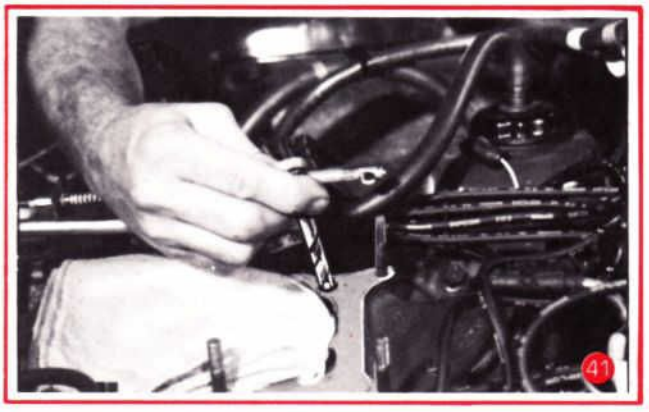
Both the 429 and the 460 engines require a ½" drill to open up the passage while all other engines require a 7/16" drill bit.

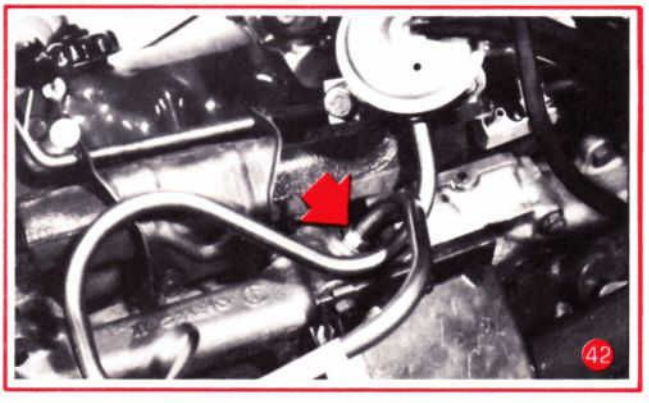
On the 200 and 250 CID 6-cylinder engines, the external tube must be removed and cleaned with a suitable brush or a locally made tool plus the use of compressed air. See Figure 42.

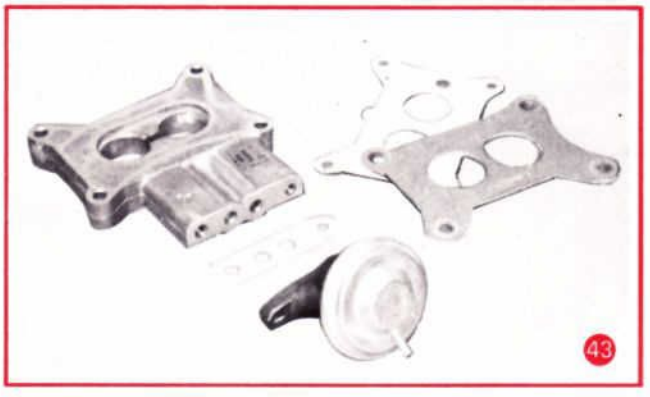
Always use new gaskets when reinstalling the EGR units on the engine. These include a gasket between the carburetor and carburetor spacer . . . the intake manifold and the carburetor spacer . . . and the EGR valve and the spacer. See Figure 43.



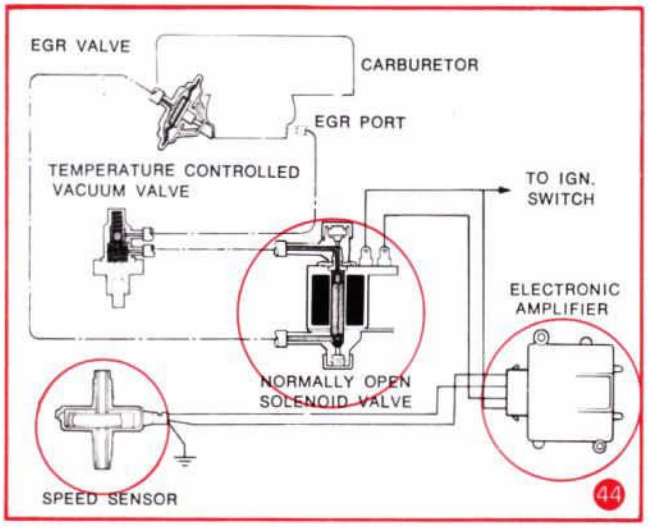


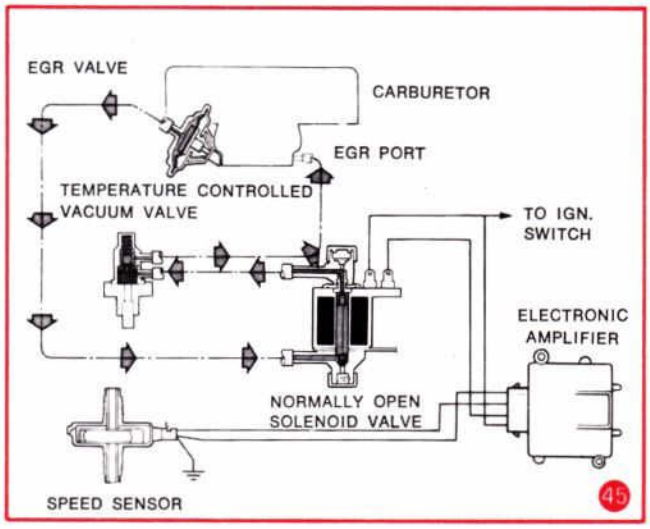






HIGH-SPEED EGR MODULATOR SUB-SYSTEM





Certain Ford-built V-8 engine applications incorporate a high-speed EGR modulator sub-system to improve vehicle driveability ABOVE 64 miles per hour.

Presently this more complicated system is used on the 351-C . . . the 400 . . . the 429 . . . and the 460 CID engines.

This system cuts off (modulates) the exhaust gas recirculation flow by stopping the vacuum flow from the EGR port to the EGR valve at speeds ABOVE 64 mph. Make-up of this system includes a *speed sensor* . . . an *electronic module* . . . and a *2-way vacuum solenoid valve*. See Figure 44.

DESCRIPTION AND OPERATION

Units of this system are similar to the components of the ESC system (Electronic Spark Control) and operate basically the same. Capri for 1973 uses the ESC system exclusively when equipped with a 2600cc engine (V-6) and an automatic transmission. Getting back to the EGR system, note that the vacuum solenoid valve is installed in the EGR vacuum line and is normally OPEN (not energized), to allow vacuum flow from the EGR port to the EGR valve. See Figure 45. In other words, the EGR system function remains operational when the valve is NOT energized.

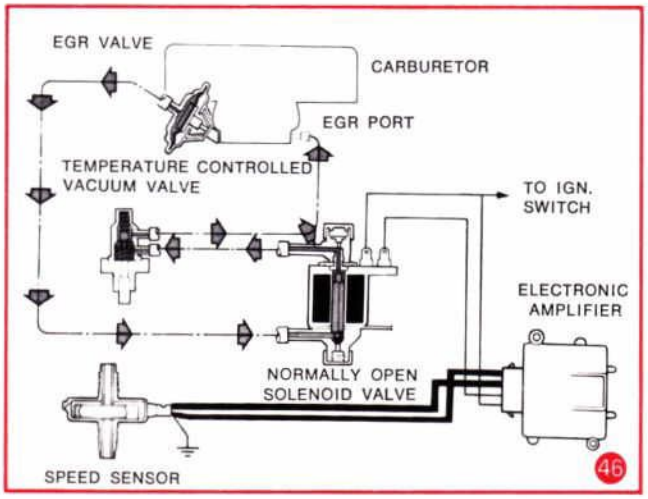
A speed sensor, driven by the speedometer cable, puts out an electric voltage that is in direct proportion to vehicle road speed.

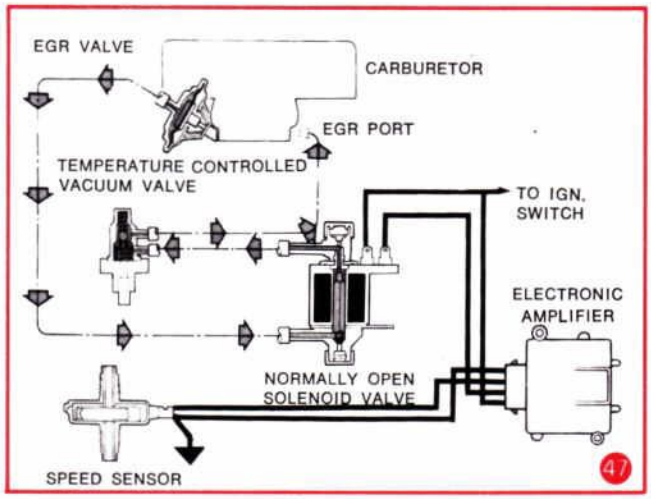
This Alternating Current signal tells the amplifier when to energize the vacuum solenoid valve. See Figure 46.

In turn, the electronic module takes this signal from the speed sensor and amplifies it to provide an output signal to the vacuum solenoid valve.

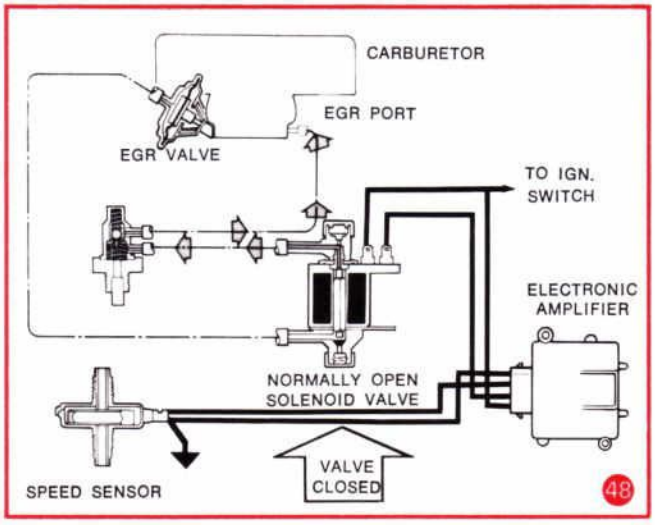
When the vehicle speed exceeds the trigger speed of the amplifier (approximately 64 mph), the hot circuit to the ignition switch is completed. See Figure 47.

At this point the normally "open" vacuum solenoid valve is energized and the plunger is moved upwards to shut off the EGR port vacuum at the top (inlet) port of the valve.



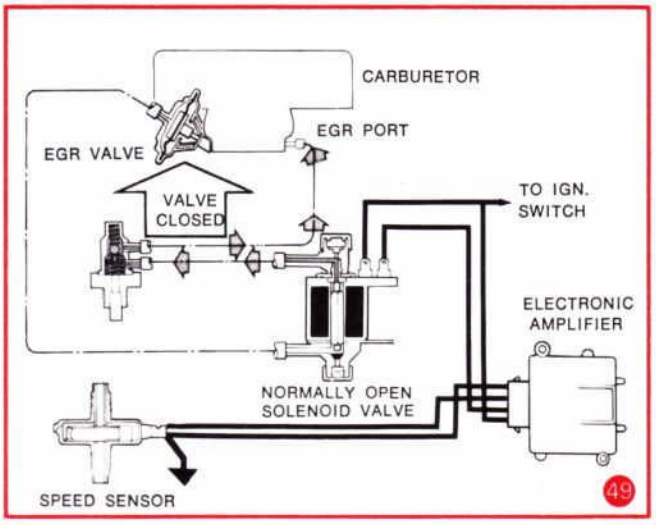


THE EGR SYSTEM...



Vacuum supply to the EGR valve is now cut off entirely. See Figure 48.

At the same time . . . the vent at the bottom of the vacuum valve is opened to bleed vacuum from the EGR valve and hose. Spring force closes the EGR valve and now the EGR system is NOT FUNCTIONAL until the vacuum solenoid valve is de-energized at speeds BELOW approximately 64 mph. See Figure 49.



NOTE: *A continuous internal vacuum bleed is provided by the vent at the top of the valve . . . regardless of whether the valve is in a CLOSED or OPEN position. This vent purges the vacuum supply hose from the carburetor of any gasoline vapors that may be present.*

TESTING THE HIGH SPEED EGR MODULATOR SUB-SYSTEM

To make this test, first disconnect the vacuum hose from the EGR valve. Now, install a "TEE" fitting and a vacuum gauge with a long hose into the vacuum line. See Figure 50.

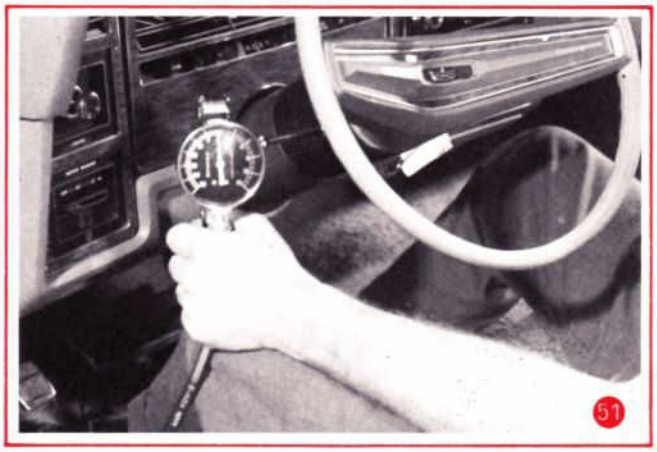
Next, raise both front and rear wheels off the ground at least 12 inches and position the vacuum gauge so that it can be seen from the driver's seat.

NOTE: *All four wheels off the ground is for your own personal safety and the safety of your co-workers.*

Start the engine and allow it to warm up by running the engine at a fast idle speed for about 3 to 4 minutes. This warm-up is necessary to be certain the temperature controlled vacuum valve is OPEN for the operational test. With the engine at curb idle speed, the vacuum gauge should indicate a ZERO vacuum reading. See Figure 51.

Now, engage the transmission in THIRD gear on a MANUAL transmission or in DRIVE position on an AUTOMATIC. Observe the speedometer and vacuum gauge. Begin to increase engine speed and as you do, the vacuum gauge should also increase. See Figure 52.

Continue to increase engine speed until the speedometer shows about 67 mph. At this speed, the vacuum gauge should drop to a ZERO reading. See Figure 51.



If this occurs, the EGR High-Speed Modulator sub-system is working properly.

POWER TESTING THE HOT CIRCUIT

To make this test, use a test light (self-powered) to check for current to-and-from the vacuum solenoid valve. If the test light does not light, continue testing back to the power source.

If you find power to-and-from the vacuum solenoid valve, move the test light to the electronic amplifier connector. Remove the connector from the amplifier and test for power to the connector. If you find the test light does not light at this point, then repair the wiring from the vacuum solenoid valve. See Figure 53.

SPEED SENSOR TEST

You can test the speed sensor by making a continuity test with an ohmmeter between the leads. The resistance should be from 40 to 60 ohms.

Check to be certain the speed sensor connector is tight. It has a GROUND INTERLOCK LOOP between the connectors . . . which will UNGROUND the circuit when the connector is open.

The other test point in the ground circuit is at the amplifier connector. Test there for continuity to ground.

VACUUM VALVE ELECTRICAL TEST

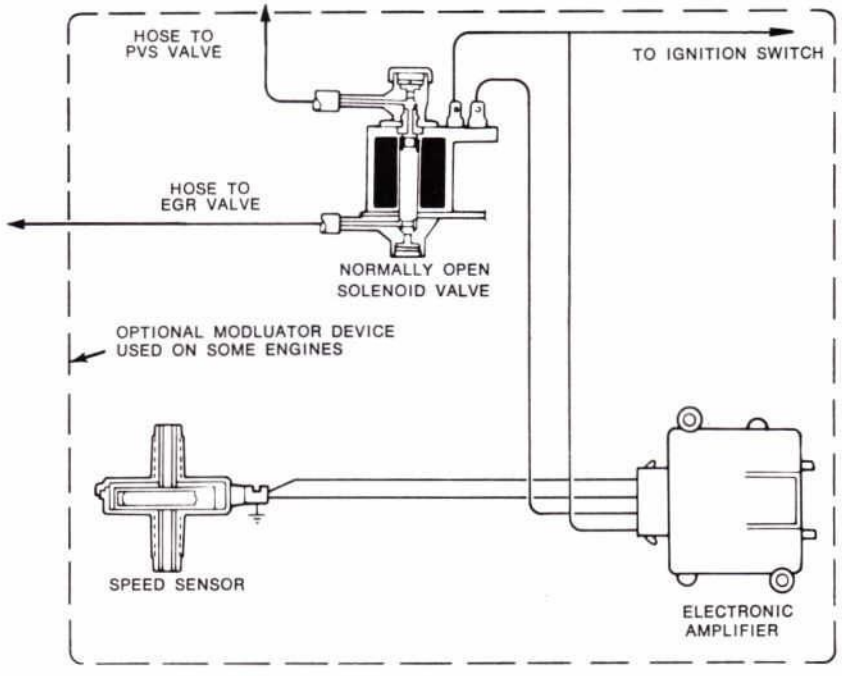
To make this test, first disconnect the electrical leads from the valve to isolate it from the electronic amplifier.

CAUTION: *Never connect any test jumper . . . test light or a "hot screwdriver" . . . to the valve EXCEPT when it is isolated from the amplifier. To do so can severely damage the electronic amplifier.*

Apply power to the isolated valve by connecting jumper wires from its terminals to the battery and to a ground. Then operate the engine in NEUTRAL at about 1500 rpm. The valve should CLOSE when power is applied. If there is a vacuum reading . . . replace the valve.

If the gauge shows NO VACUUM with the valve coil energized, the valve is OK. The only unit left in this check-out is the amplifier.

NOTE: *There is no way to test the amplifier and any attempt to do so would damage it. Therefore, replace the amplifier if there is trouble after checking out all other units of the system.*



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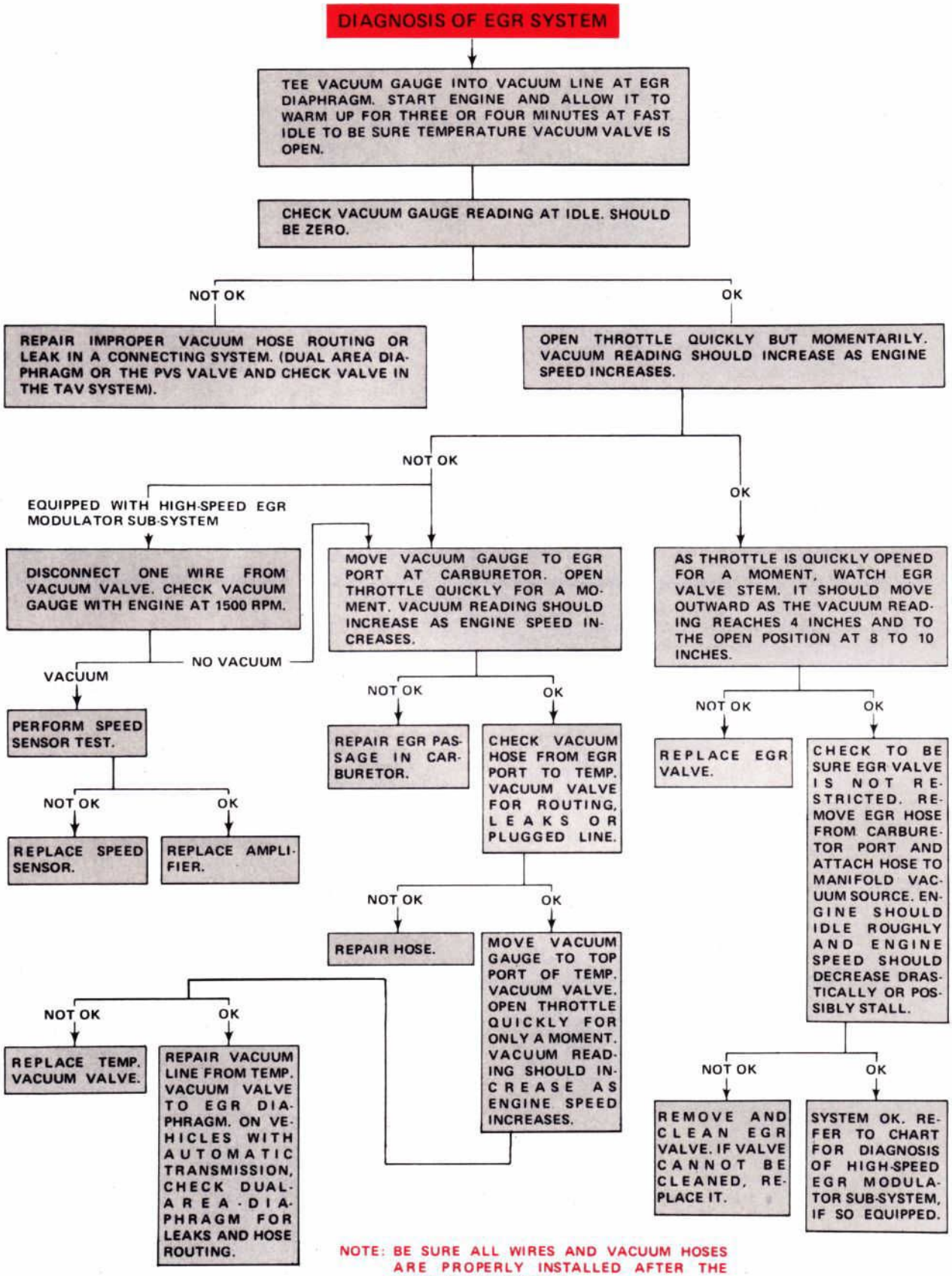
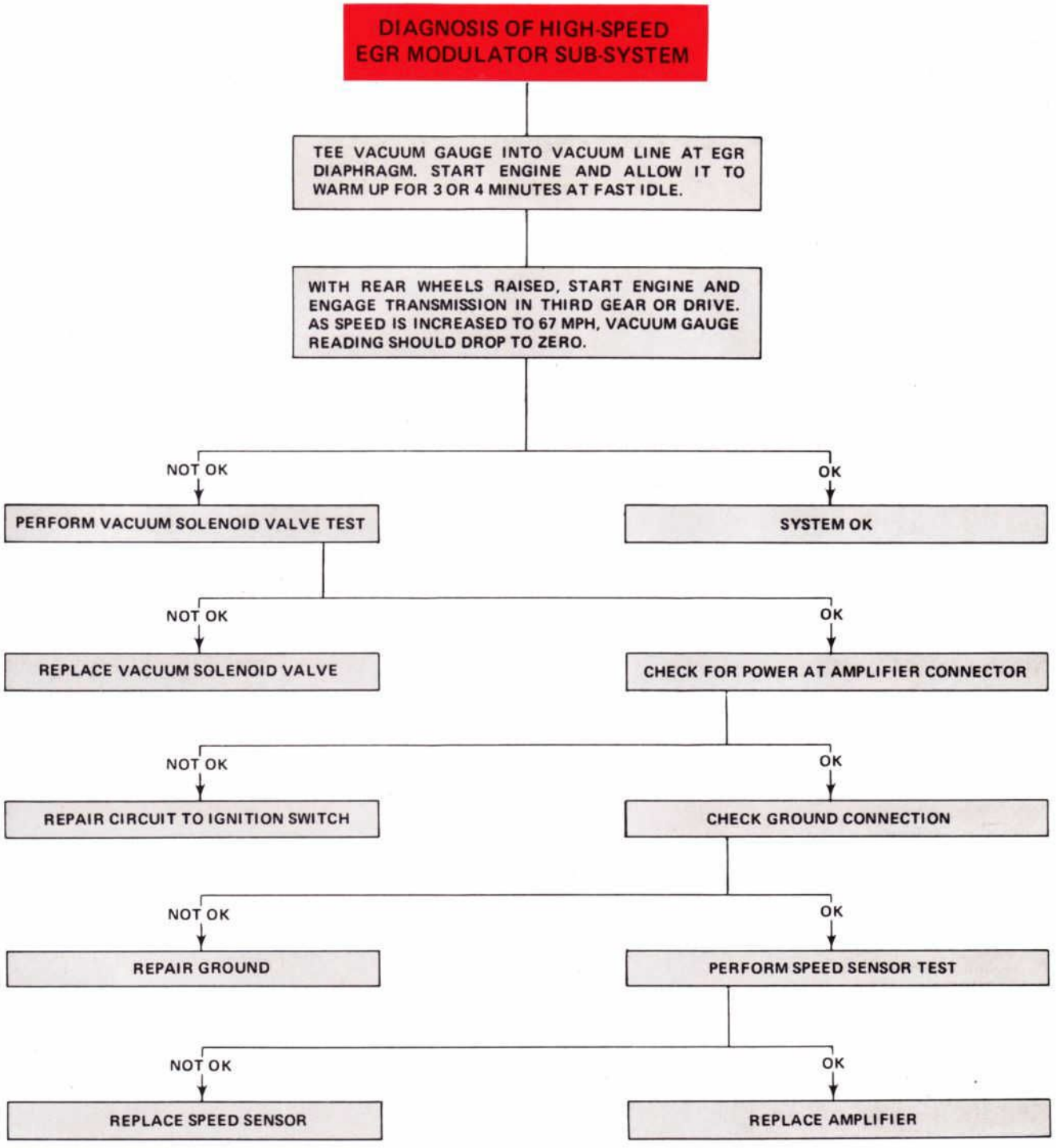


NOTE: BE SURE ALL WIRES AND VACUUM HOSES ARE PROPERLY INSTALLED AFTER THE TESTS ARE COMPLETED.


DIAGNOSIS OF HIGH-SPEED EGR MODULATOR SUB-SYSTEM
TEE VACUUM GAUGE INTO VACUUM LINE AT EGR DIAPHRAGM. START ENGINE AND ALLOW IT TO WARM UP FOR 3 OR 4 MINUTES AT FAST IDLE.
WITH REAR WHEELS RAISED, START ENGINE AND ENGAGE TRANSMISSION IN THIRD GEAR OR DRIVE. AS SPEED IS INCREASED TO 67 MPH, VACUUM GAUGE READING SHOULD DROP TO ZERO.
NOT OK
OK
PERFORM VACUUM SOLENOID VALVE TEST
SYSTEM OK
NOT OK
OK
REPLACE VACUUM SOLENOID VALVE
CHECK FOR POWER AT AMPLIFIER CONNECTOR
NOT OK
OK
REPAIR CIRCUIT TO IGNITION SWITCH
CHECK GROUND CONNECTION
NOT OK
OK
REPAIR GROUND
PERFORM SPEED SENSOR TEST
NOT OK
OK
REPLACE SPEED SENSOR
REPLACE AMPLIFIER

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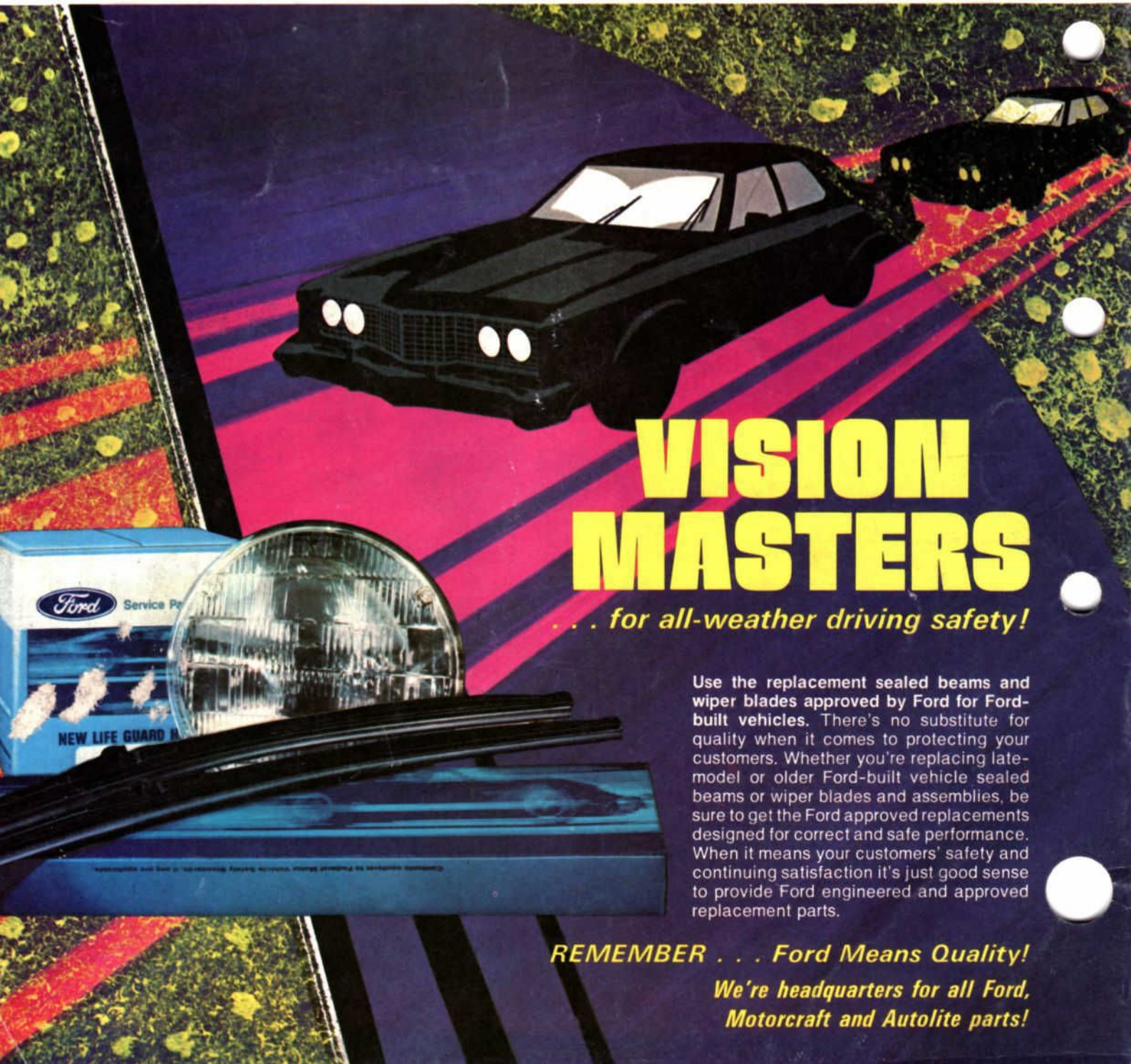

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