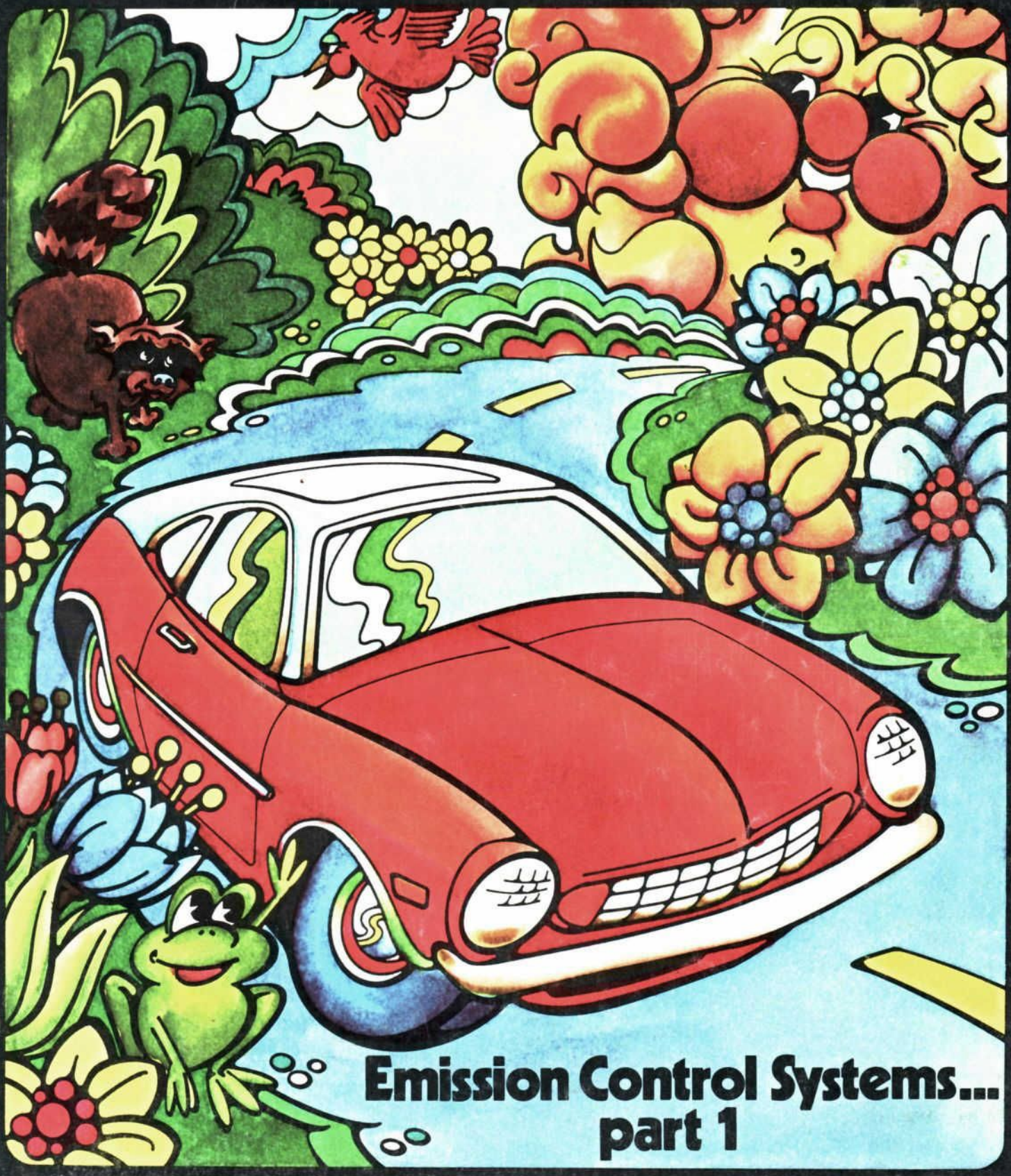
# SHOP TIPS

Motorcraft

VOL. 10, NO. 11 JULY, 1972



## Emission Control Systems... part 1

# EMISSION CONTROL SYSTEMS, Part I

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.

The information in this publication was gathered from materials released by the National Service Department of Ford Parts Division and the Ford Customer Service Division of the Ford Marketing Corporation, as well as other vehicle and parts manufacturers. The descriptions and specifications contained in this issue were in effect at the time it was approved for printing. Our policy is one of continuous improvement and we reserve the right to change specifications or design without notice and without incurring obligation.

Motorcraft Ford




VOL. 72 MSD 68 LITHO IN U.S.A.


PART ONE OF A TWO PART ARTICLE COVERING EMISSION SYSTEM OPERATION, DIAGNOSIS, AND MAINTENANCE.

## EMISSION SYSTEMS WARRANTY CALLS FOR REGULAR MAINTENANCE

By enacting the Federal Clean Air Act, Congress has recognized public demand for clean air. This has required many modifications in automotive engine design.

Purchasers of new Ford-built cars and trucks are notified in a printed booklet accompanying the vehicle that effective performance of the new emission control systems requires regular maintenance. This applies not only to the emission control system itself but also to other engine and fuel system components.

For example, regular emission system maintenance now requires replacement of spark plugs and distributor points each 12,000 miles or 12 months, whichever comes first. At 24,000 miles or 24 months, the distributor cap and rotor and the evaporative emission control canister are to be replaced.

In addition, all emission system components require inspection and testing at prescribed intervals.

To serve your customers properly, you and your men should be aware of the services which owners of affected vehicles must have performed in order to keep their emission system warranties in effect.

## THESE CAUTIONS ARE ISSUED TO YOUR CUSTOMERS

*(From "An Important Message To Owners of 1972 Ford-Built Cars, Emission Systems Warranty and Maintenance Schedules—Oct '71.")*

"Ford warrants to eligible purchasers that this vehicle: (1) has been designed, built, and equipped so as to conform at the time of sale with the emissions regulations issued under Section 202 (a) of the Federal (U.S.) Clean Air Act applicable at the time of manufacture, (2) is free of defects in material and workmanship which would cause it not to conform with those regulations within a period of 5 years or 50,000 miles, whichever occurs first, when maintained strictly according to the requirements outlined herein.

"By the express terms of the Federal law (U.S.), the required emissions system warranty applies only to vehicles which have been used and maintained according to the manufacturer's instructions."

This two-part article describes emission system operation, trouble-shooting and maintenance. Part I covers operation, diagnosis and maintenance of the IMCO System (Improved Combustion System), and TRS System (Transmission Regulated Spark System). Part II covers the Fuel Evaporative Control Systems, ESC System (Electronic Spark Control System), carburetor adjustments, emission control maintenance and application charts.

For specific details on each vehicle, consult the individual booklet furnished with the car or truck.

## INTRODUCTION/IMCO

The Improved Combustion System (IMCO) is an air pollution control, designed to reduce the internal formation of hydrocarbons, carbon monoxide and oxides of nitrogen. This system involves internal engine modifications of the induction and combustion systems. In addition, the carburetor and distributor are modified to provide lean carburetion and ignition timing retard. Together, these changes work to provide a more complete combustion of the air-fuel mixture within the combustion chamber.

IMCO depends on a variety of design modifications tailored to the requirements of each model engine, transmission and vehicle combination. These modifications affect the following:

- Inlet Air Temperature
- Carburetor
- Distributor
- Intake Manifold
- Cylinder Heads
- Combustion Chamber
- Exhaust Manifold

Since the last four items involve design modification only, this article is limited to the items which require periodic service; namely, the inlet air temperature regulator, the carburetor and the distributor.

## INLET AIR TEMPERATURE REGULATION

Engines equipped with an improved combustion emission control system incorporate a carburetor inlet air temperature regulator. This device is a part of the air cleaner and keeps the air entering the carburetor at approximately 100°F. when under-hood temperatures are less than 100°F. By keeping inlet air temperature at or above 100°F., the carburetor can be calibrated much leaner to reduce hydrocarbon emissions, improve engine warm-up and minimize carburetor icing.

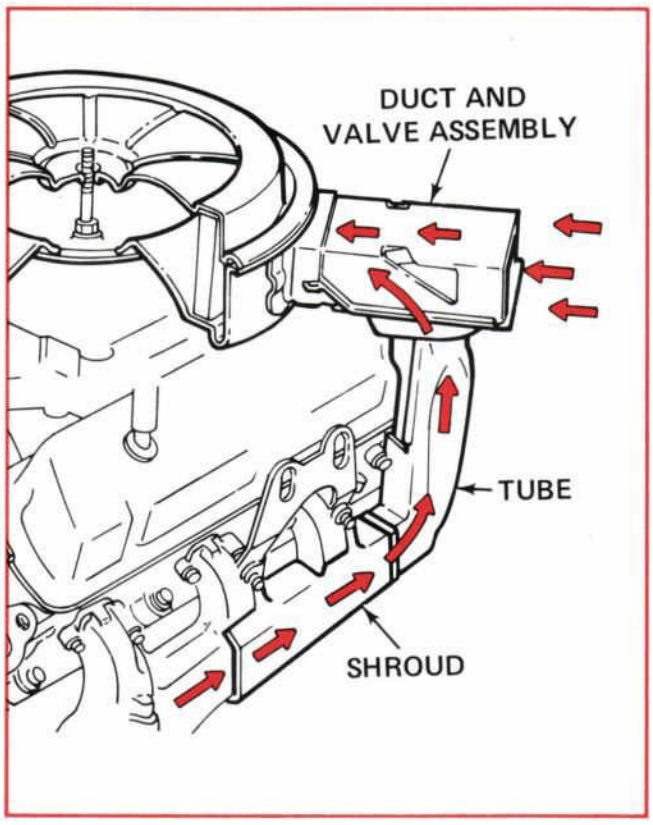



*Figure 1*

The inlet air regulator consists of a duct and valve assembly attached to the air cleaner. This assembly is connected by a tube to the exhaust manifold shroud. The valve plate is shown here in the up or "heat on" position.

During engine warm-up, when air entering the air cleaner is less than 100°F., the thermostat is in the retard position, and the valve plate is held up in the "heat on" position by a spring. This allows only air preheated by the exhaust manifold and shroud to enter the carburetor.

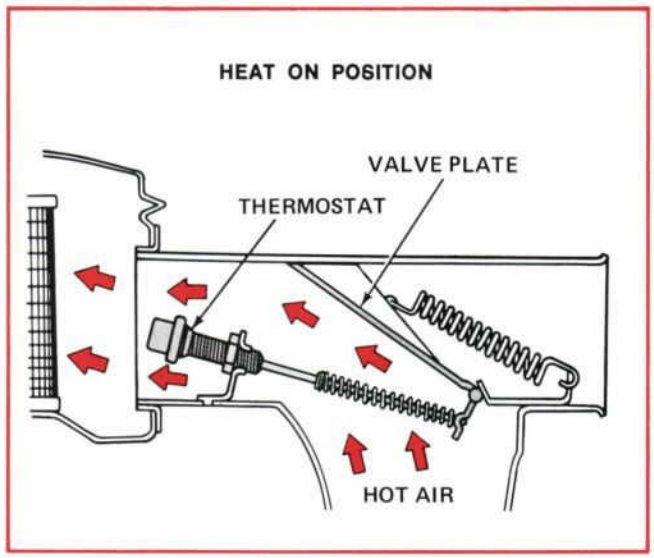



*Figure 2*

As the temperature of the air increases, the thermostat starts to expand, gradually forcing the valve plate down toward the "heat off" position. When under-hood temperatures reach 100°F., ambient air is permitted to enter the air cleaner directly.

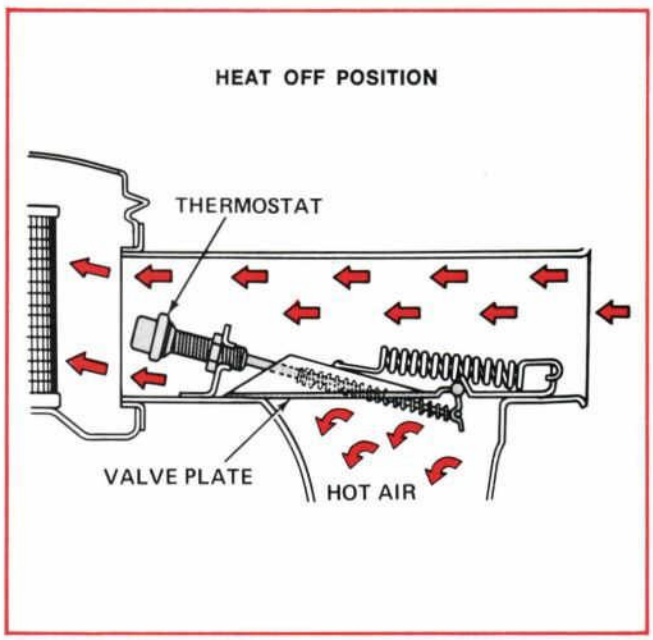



*Figure 3*

# EMISSION CONTROL SYSTEMS, Part I Continued

## THERMOSTAT OPERATED TYPE

To check the operation of the duct and valve assembly, start with a cold engine and an air cleaner temperature of less than 100°F. Check the valve plate. It should be up in the "heat on" position. If it is not, check for proper installation of the spring and free operation of the plate in the duct. If interference is present, correct by realigning plate.

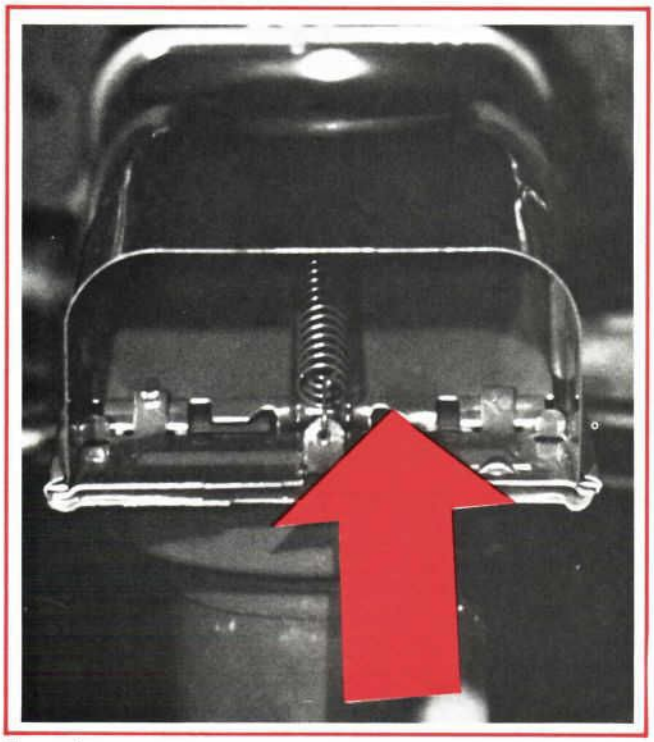


*Figure 4*

To check the operation of the thermostat, remove the duct and valve from the air cleaner. Move the valve plate by hand to make sure it does not bind in the duct. Then, immerse it in a pan of water, making sure that the thermostat capsule is covered. Raise the water temperature to 100°F., and allow a few minutes to stabilize the temperature. The valve plate should be in the "heat on" position.

Raise the water temperature to 135°F., and again allow a few minutes to stablize the temperature. The valve plate should move to the "heat off" position. If the valve plate does not operate properly under these conditions, the duct and valve assembly must be replaced.

Now start the engine. At engine idle, the plate should move to the closed or "heat on" position. Remember, the engine and the air cleaner must be about room temperature or below so the temperature sensing switch will not begin to control the valve plate.

## TEMPERATURE SENSITIVE AIR BLEED VALVE

The second type of inlet air regulator uses a vacuum-operated valve plate. The vacuum motor is controlled by a bimetallic temperature sensing switch located in the air cleaner. This unit performs the same function of inlet air temperature control.

When the temperature of the bimetallic switch is below 105°F., enough vacuum is supplied to the vacuum motor to pull the valve plate up to the "heat on" position. As the

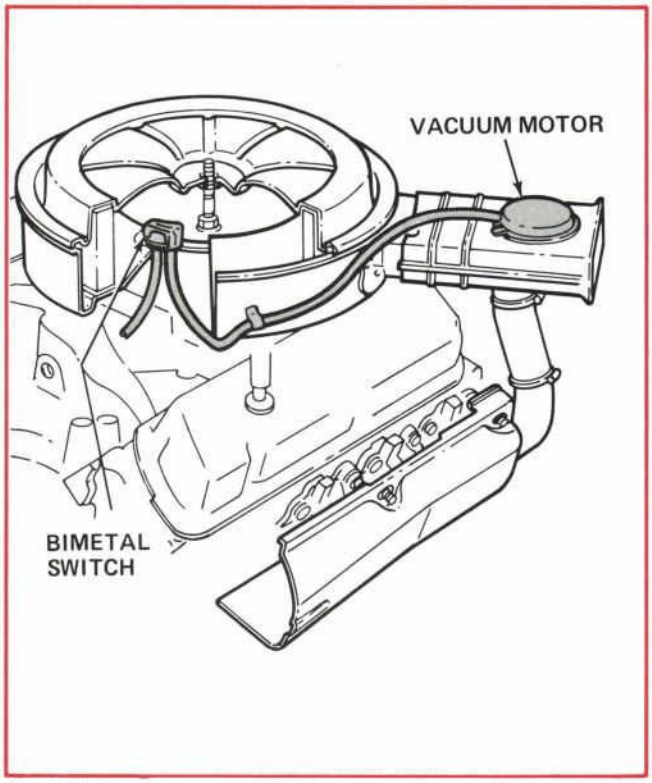



*Figure 5*

temperature of the air in the engine compartment increases, the bimetallic spring operates an air bleed in the switch, which decreases the vacuum to the vacuum motor. This allows the valve plate to move down to the "heat off" position.

During acceleration periods when outside air is cold, the low intake manifold vacuum causes the vacuum in the system to drop. The spring in the vacuum motor will override the vacuum and push the valve plate down to the "heat off" position. This permits the ambient air to pass directly to the air cleaner.

## VACUUM OPERATED TYPE

To check the vacuum-operated duct and valve assembly, begin with a cold engine that is not running. Under these conditions the valve plate in the duct assembly should be in the open or "heat off" position. If it is not, the valve plate may be binding in the duct and require realignment.

Actual operation of the bimetallic temperature sensing switch can be checked on the car. Remove the top of the air cleaner and the element. Start the engine and observe

the valve plate in the duct. It should be in the "heat on" position.

Apply hot air to the bimetallic switch with a heat gun or other hot air source. Observe the valve plate in the duct. It should be opening as the temperature of the switch increases. When the bimetallic switch reaches 105°F., the valve plate should be wide open in the "heat off" position.

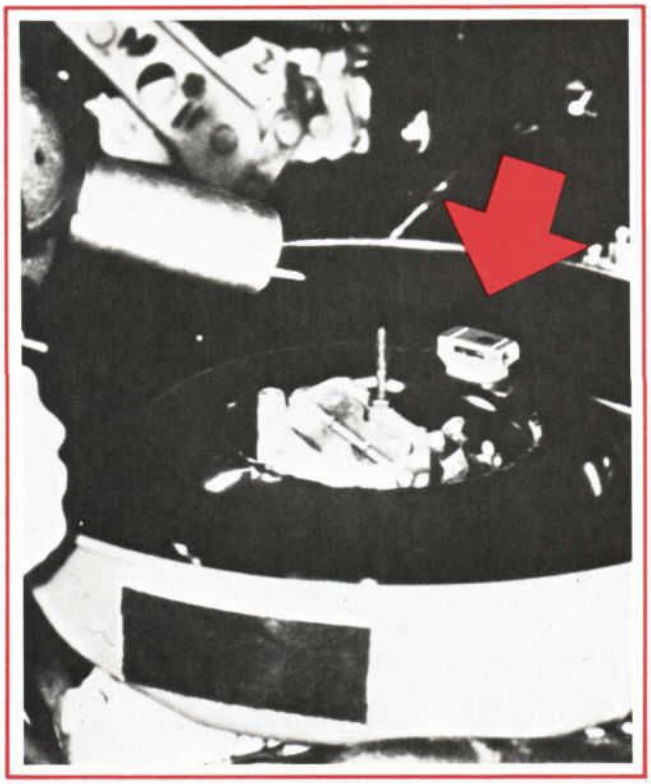


*Figure 6*

## IDLE LIMITER CAPS

An important part of exhaust emission control is the use of a leaner air-fuel mixture at idle and low speeds. In order to prevent an overly rich air-fuel mixture, all carburetors are equipped with plastic idle limiter caps. A satisfactory idle should be obtained within the range of the idle adjusting limits, providng that all other engine systems are operating within specifications.

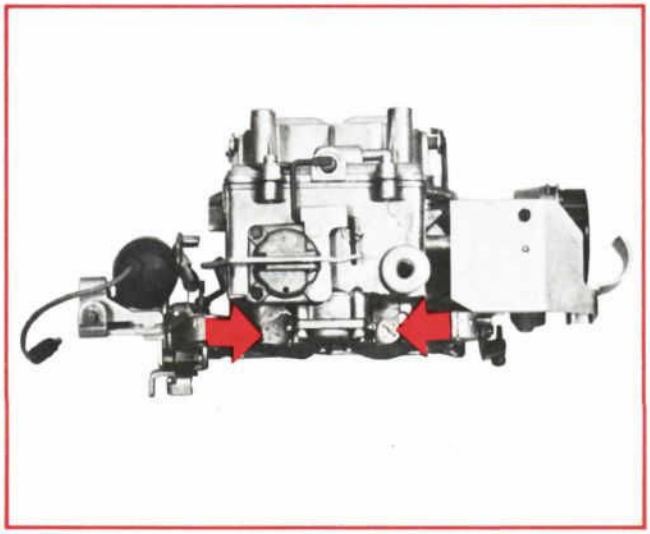


*Figure 7*

## IDLE SPEED THROTTLE SOLENOID

On some engine designs, the lean idle mixture, in conjunction with slightly higher idle speeds, might result in the engine "dieseling." To prevent this, an electric solenoid throttle positioner is installed on the carburetor. This allows for higher idle speeds when the solenoid is energized by the ignition circuit. When the ignition is turned off, the solenoid retracts, allowing the throttle plate to close fully against the throttle stop screw.

When checking the operation of the throttle positioner, remember that the solenoid does not have enough power to open the throttle. Turn the ignition switch to the run position and depress the accelerator to the one-quarter throttle position. This allows the plunger to move out.

Now, as the accelerator is released and the engine is started the solenoid plunger holds the throttle lever open to the proper curb idle setting.

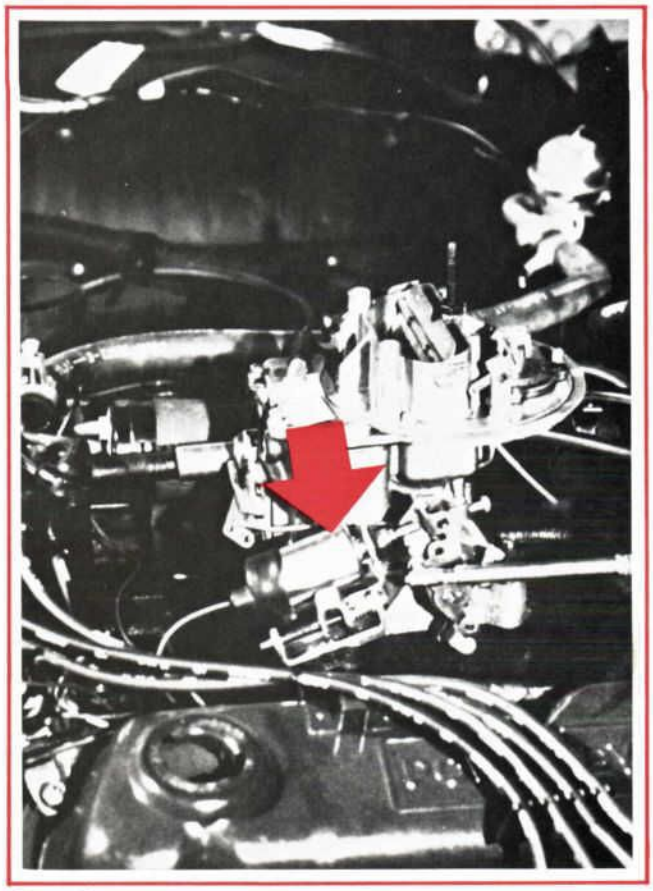


*Figure 8*

## CHOKE PULLDOWN SYSTEM (STAGED)

Some 2-V and 4-V carburetors have a two-stage choke pulldown system to improve emission control. The system has a temperature sensing and timing device built into the control unit. (See Figure 9, page 6.)

The unit is mounted on the carburetor base, mechanically connected to the choke linkage, and has a vacuum connection to the carburetor manifold vacuum. The vacuum is controlled by a bimetallic valve. When this sensing device is below approximately 60°F., the valve is closed and the system does not operate. When it is above approximately 60°F., the valve is open, and the system will go into operation the moment the engine is started.

# EMISSION CONTROL SYSTEMS, Part I Continued

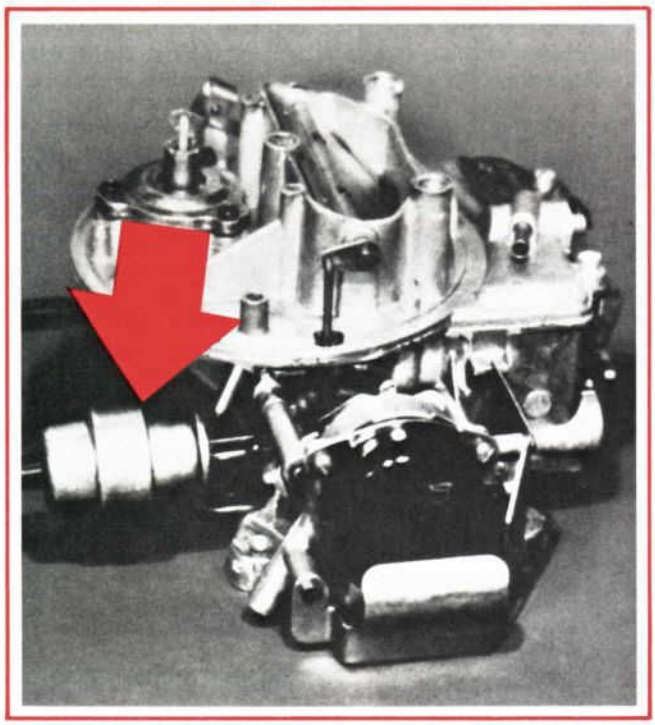


*Figure 9*

Let's take a look at the construction and operation of the control unit to help us with diagnosis. The vacuum end of the unit contains the bimetallic temperature sensing valve. Then comes the timing device, which consists of a vacuum diaphragm and a linkage diaphragm, separated by an orificed spacer and spring. The space between the two diaphragms is filled with a fluid. A link, which is attached to the linkage diaphragm, connects the control unit to the choke linkage.

With the temperature of the control unit below approximately 60°F., the vacuum is shut off by the temperature valve and the spring keeps the linkage diaphragm and link extended. This allows the choke to remain closed, or open normally as the engine warms up.

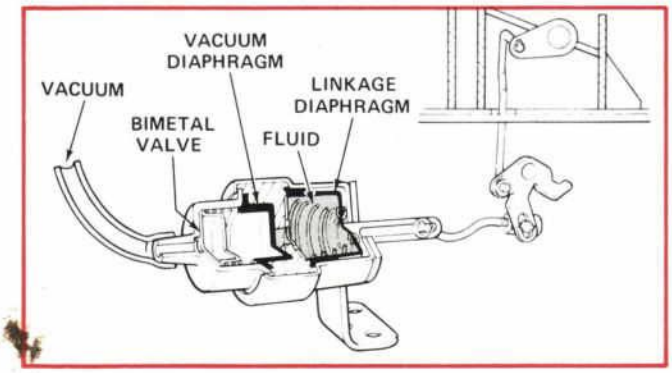



*Figure 10*

Now, with the temperature of the control unit above 60°F., the temperature valve is open. The moment the engine is started, vacuum is supplied to the vacuum diaphragm, creating a low pressure area. Atmospheric pressure, acting on the linkage diaphragm, overcomes the spring and forces the fluid out of the forward chamber, through the orifice in the spacer, and into the rear chamber.

This transferring of the fluid from the forward chamber into the rear chamber is the timing device. The timing is checked from the moment the engine starts to the time the link reaches the end of its stroke and the choke is pulled open.

The timing can also be checked off the car. Use an external vacuum supply, such as a distributor tester, and set the vacuum at 13 inches. Connect the vacuum hose to the vacuum port and note the number of seconds it takes the link to travel to the end of its stroke.

The timing will vary on different applications. 2-V carburetor applications will have two different control units. The first letter stamped on the unit will indicate the timing. 4-V carburetors will have three control units. The timing, itself, will be stamped on these units.

## DECEL VALVE

The decel valve is a control used on the four-cylinder engines to provide additional air-fuel mixture to the intake manifold during deceleration. The purpose of the valve is to maintain the proper mixture to aid in emission control.

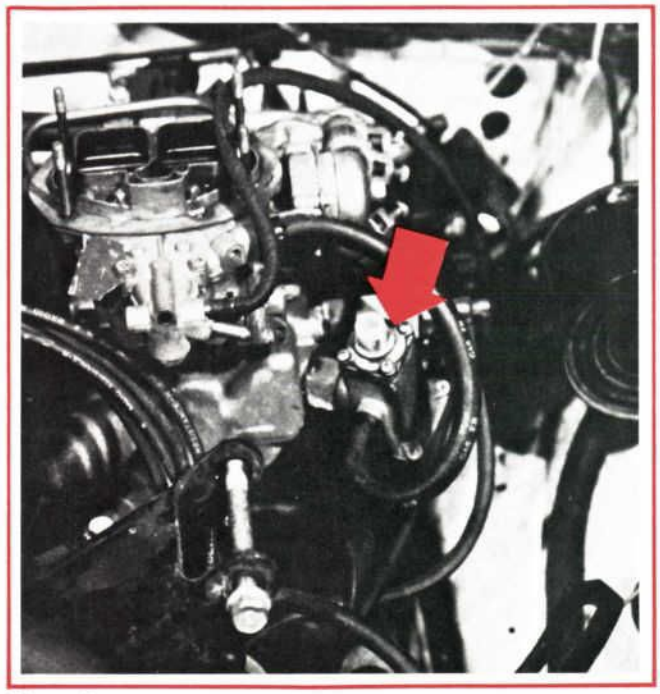


*Figure 11*

One side of the decel valve is connected to the carburetor bowl vent area. The other side of the decel valve is connected to the intake manifold vacuum.

During periods of deceleration, manifold vacuum is high and the diaphragm is raised. As the diaphragm is raised, the decel valve is unseated. This allows an air-fuel mixture flow from the carburetor line to the intake manifold, providing a more complete combustion, and thus lower emissions.

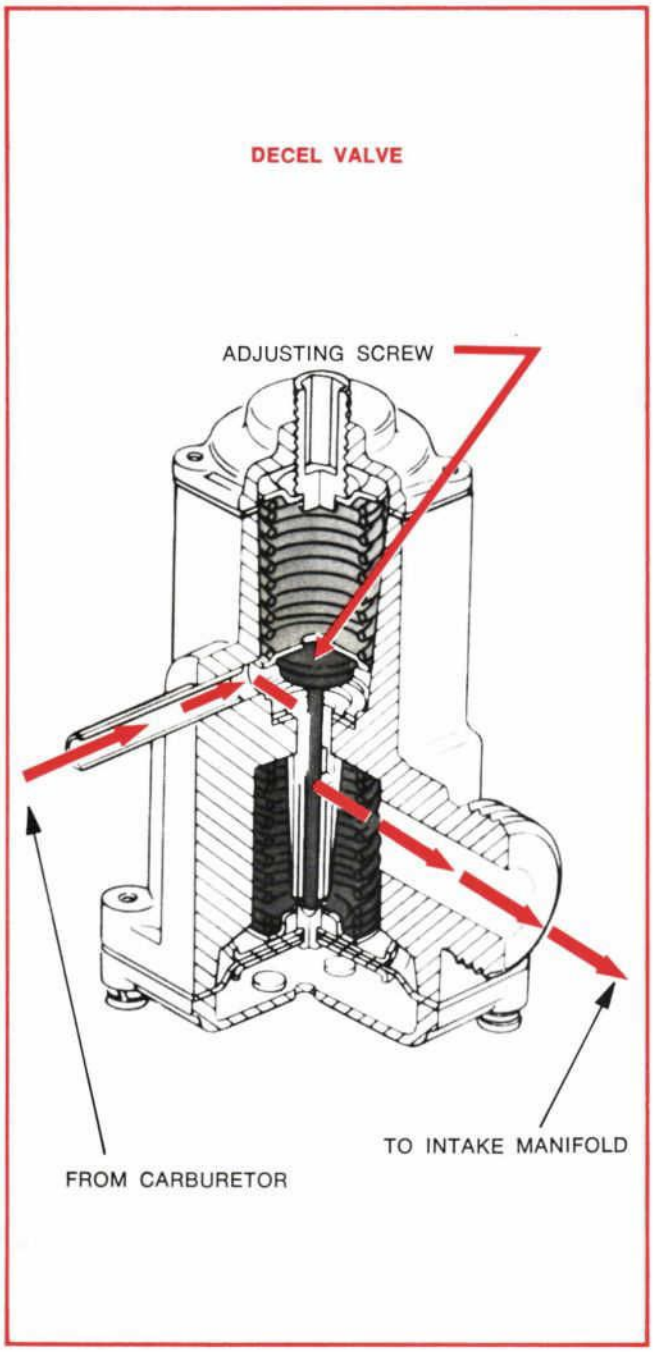



*Figure 12*

A lower and an upper spring are compressed as the diaphragm is raised. The balance between these springs and the intake manifold determines how long the valve remains open.

An adjusting screw is provided at the top of the decel valve to regulate the upper spring pressure and, therefore, the length of time the valve stays open.

## DECEL VALVE TEST

Check for vacuum leakage at the small hole in the bottom of the decel valve. Leakage here would indicate the diaphragm is leaking and the diaphragm must be replaced.

To test the valve, use a T-fitting to install a vacuum gauge into the line from the decel valve to the carburetor.

A tachometer is also required.

**NOTE:** It is impossible to properly test and adjust the decel valve without a tachometer and a vacuum gauge. It is also important to have the vehicle at operating temperature during the testing and to have the idle speed and ignition timing set to specifications with the decel valve hose disconnected. A vacuum reading at idle indicates a stuck valve that must be replaced. To check valve operation increase engine speed to 3000 rpm.

Close the throttle. Watch the time . . . the vacuum gauge reading should drop to zero in two seconds for all engines.

If the decel valve is outside the limits, it will require adjustment. Remove the cap for access to the adjusting screw. Turning the adjusting screw in reduces the time the valve is open. If the valve closes below the spec setting, emission levels will be high. If the valve stays open more than the specs call for, excessive engine speed will be experienced. A valve setting on the low side is more desirable for vehicles with manual transmissions to allow a smoother shift.

## DUAL DIAPHRAGM VACUUM ADVANCE MECHANISM

The IMCO System requires additional ignition timing control at low engine speeds and during deceleration. This additional control is provided by a dual-diaphragm vacuum advance mechanism.

*Figure 13*

The unit consists of two independently operating diaphragms. The advance diaphragm is connected to a lever that controls the movable breaker plate in the distributor. The retard diaphragm is connected to a plate that is used as a stop for the advance diaphragm lever, but is not connected to the lever.

Let's say that the initial timing has been set at 6° B.T.D.C. The retard diaphragm plate and the diaphragm lever would

# EMISSION CONTROL SYSTEMS, Part I Continued

be in this position. Both vacuum lines must be removed and plugged.

Now, if we connect intake manifold vacuum to the retard diaphragm, the plate is moved toward the distributor. This allows the diaphragm lever to move the breaker plate and retard the timing.

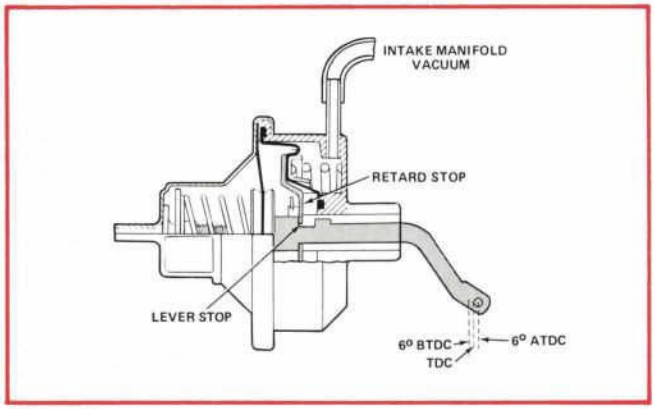



*Figure 14*

To check for proper retard during idle or deceleration, first set the initial timing to specification, then install the intake manifold vacuum hose to the retard side of the dual diaphragm. The timing at the crankshaft damper should retard from 8° to 14° depending on the specifications.

## DISTRIBUTOR VACUUM CONTROL VALVE

The distributor vacuum control valve is installed in the coolant outlet elbow to sense engine coolant temperature. The purpose of the valve is to prevent overheating during periods of prolonged idling, due to the additional heat released by the improved combustion process. Overheating is prevented by advancing the ignition timing, which, in turn, increases engine speed and cooling efficiency.

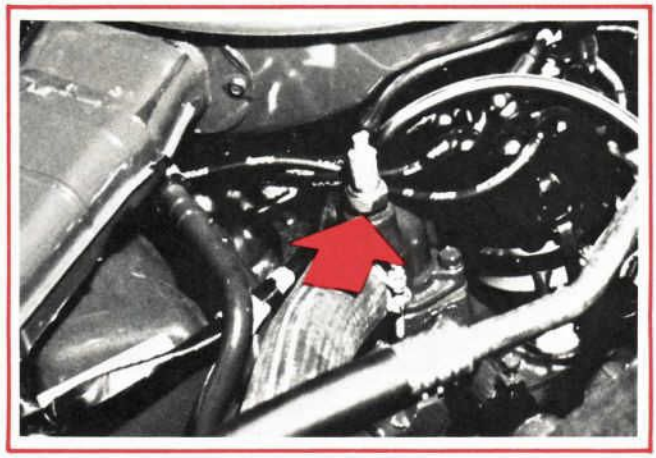


*Figure 15*

The distributor vacuum control valve is shown here in the normal engine operating temperature position. Notice that the two upper ports are connected. This allows carburetor vacuum to be applied to the distributor vacuum advance diaphragm. The manifold vacuum is blocked by the ball valve.

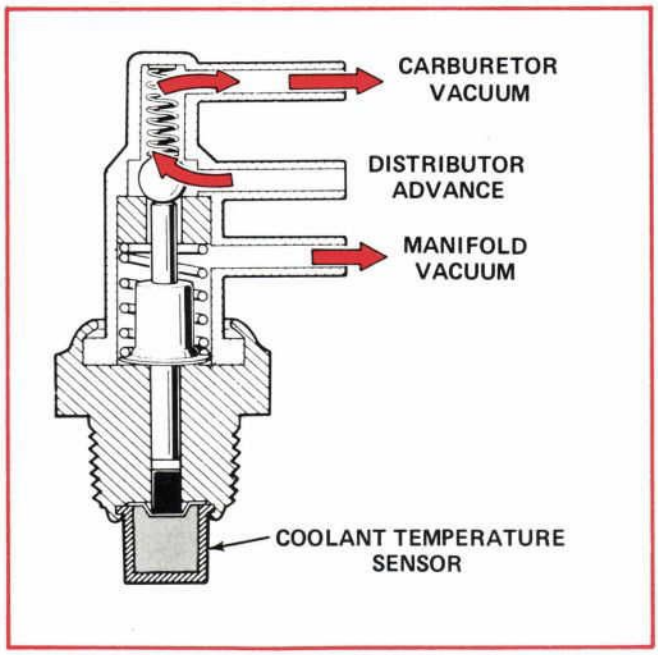



*Figure 16*

If the engine temperature increases to the point where the red overheat indicator light comes on (approximately 225°), the ball valve moves up and closes off the carburetor vacuum port. The two lower ports are now connected and the higher manifold vacuum is applied to the distributor vacuum advance diaphragm. This advances the ignition timing, which increases engine speed and reduces engine temperature.

There are two different vacuum line hookups used at the valve. In the first method, the carburetor vacuum is connected to the top port, the advance side of the distributor diaphragm is connected to the middle port, and the intake manifold vacuum is connected to the bottom port.

In the second method, the intake manifold vacuum is connected to the top port, the retard side of the distributor diaphragm is connected to the middle port, and a filter is installed on the bottom port to keep the valve clean and open to the atmosphere.

Application of the distributor vacuum control valve and the dual-diaphragm vacuum advance mechanism will vary from vehicle to vehicle. The control valve is used with a single or dual-diaphragm distributor. The point to remember is that carburetor vacuum is routed directly to the advance diaphragm during normal engine operating temperatures.

# Attention, MUSIC LOVERS...

# SIPCON

## TAILORED IGNITION SETS

*LOWER THE COST OF LISTENING...*


Now SIPCON Tailored Ignition Sets are a greater value than ever! Packed in each SIPCON Set is a special offer coupon that can provide you with a money-saving opportunity when you purchase records or cassettes. Use the coupon to order "The Record Gallery Certificate Book". Each book contains 27 discount certificates worth substantial discounts—40% off Manufacturer's Suggested List Prices on name brand stereo record albums and 25% off on cassette cartridges and tapes. Use these money-saving discount certificates to make your listening pleasure even more enjoyable!

*USE THESE MONEY-SAVING DISCOUNT CERTIFICATES YOURSELF OR GIVE THEM TO YOUR CUSTOMERS TO PROMOTE ADDITIONAL SALES!*

## ASK AT OUR PARTS COUNTER

**ABOUT THE SIPCON COUPON OFFER!**

# Autolite and Motorcraft 'Go-Together'

## so does this great new Bar-B-Q Set!

**YOURS WITH A QUALIFYING ORDER OF ANY COMBINATION OF AUTOLITE SPARK PLUGS AND MOTORCRAFT TUNE-UP KITS AND MOTORCRAFT OIL FILTERS!**

A great, new all-purpose Bar-B-Q Set—from Ford Parts Division! When you buy the parts for full-service jobs during the Summer months, you get this stainless steel and cherry wood set that's heavy enough for a lifetime of carefree use.

The 'Go-Together' set of these versatile cooking tools includes a combination fork/can opener and spatula/bottle opener. These two pieces also mesh together to form tongs. The third piece is a cutting knife/jar opener/bone saw. All three have cherry wood grained handles that are firmly riveted in place.

This superb and timely premium has a retail value of $19.95! It's yours at a low, low price with a qualifying order during the Bar-B-Q months of June and July.

**Light Your Fire and Get All These 'G**

# Get Set for Hot-Selling 'Go-Together' Parts Sales Now!


## Motorcraft Tune-Up Kits...

For 80% of the cars on the road today. It includes all the parts (spark plugs, point set, condenser) for a professional tune-up job—in a handy, easy-to-use sealed can. A new addition: Five kits for Volkswagens! You also get a ½ Pacemaker Prize Point Certificate in every kit.

## Autolite Spark Plugs...

For full range coverage of the always growing replacement market. Quality engineered and designed to deliver peak performance and top mileage in all cars, trucks, recreational and industrial applications.

## Motorcraft Oil Filters...

The performance-proven brand designed for all cars. Easy to specify and use for quick replacement. A sure profit-maker for you. The fast-moving FL-1 is the replacement oil filter for most Ford and Chrysler vehicles.

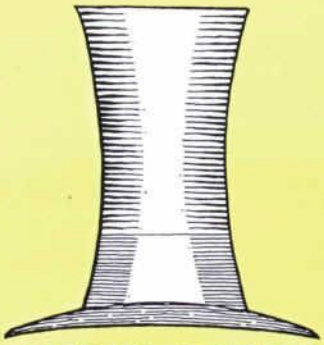
# o-Togethers' At Our Parts Counter Today!

# DWELL POINTS

notes and quotes for the service world

## FIX TIP

When you're faced with the tough job of installing a new bypass hose for the cooling system on Ford engines with a front mounted distributor, you may think it is necessary to remove the water pump to get the job done. Here's a quick and sure way to do it without pulling the pump. Cut a 2¼-inch long section of ½-inch I.D. heater hose. Bend it end for end in a vise and wire it snug to hold it doubled. Place this bent hose on the bypass tubes then apply hand pressure on the folded section. As you're doing this, cut the wire and the hose will almost jump into place.



## FACT OR FICTION

Here we have "Abe Lincoln's" old hat. The question is this: How much taller is the crown of the hat than the width of the brim? Answer on this page.

## Motor Milestones

Spindletop . . . one of the nation's most spectacular and historic oil wells . . . came gushing from the Texas ground near Beaumont in 1901. This event tipped the source of automotive power away from steam and electricity, and made the gasoline-powered engine the front runner in the quest for self-propelled vehicles. The new source of oil helped establish the first direct-service gasoline stations and also triggered the opening of at least 190,000 gasoline service stations across the country.

## THINGS YOU NEVER THOUGHT ABOUT

***. . . and could easily forget***

The strength of the adhesive on the antennae of a barnacle is stronger than any known adhesive . . . but it exists in such small quantities that scientists can't collect enough of the substance to test and reproduce it commercially.

## OLD FRIENDS

The Ford Motor Company and the remanufacturing industry have been friends for a long time. In fact, Henry Ford established the first automotive remanufacturing program back in 1932.

Ford engines were remanufactured at the Rouge Plant in Dearborn, Michigan (just outside of Detroit) and Ford became the first vehicle for which a less expensive but totally acceptable replacement engine was made available.

## NO PART-TIME JOB!

Water pumps for the cooling system of cars and trucks work every minute of engine operating time And generally, they rotate faster than engine rpm In doing so, they must prevent leakage of coolant . . . must run quietly . . . rotate without vibration . . . and operate at peak efficiency. All this during cold or high engine temperatures.

Ford Authorized Remanufactured water pumps meet that challenge! They are dependable because seals, bearings and gaskets are 100% new. Older model cast iron impellers are now replaced with ceramic impeller seats to provide better seating and longer life. Recommend and install Ford Authorized Remanufactured water pumps. That is . . . when you want to be known as a *professional* in the service trade.

Remanufactured Ford Engines · Parts

## TAILOR EACH ENGINE JOB

Ford Authorized Remanufacturers have completely remanufactured ROCKER ARM ASSEMBLIES . . . CRANKSHAFT ASSEMBLIES . . . SHORT BLOCKS and of course COMPLETE ENGINES ■ Install only what you need ■ Each assembly is fully remanufactured to strict Ford Motor Company standards ■ Each assembly is warranted nationally. Read the warranty at the bottom of this page. It backs up the QUALITY built into our products. Quality you can count on.

### We Stand Behind This All The Way!

*NATIONAL WARRANTY*

Every Remanufactured Ford Part is warranted nationally by the Remanufacturer to be free of defects in materials and workmanship for 90 days or 4,000 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.

## MECHANIC'S WORLD

"There's one thing I'd like to know, Mr. Forfran, just how long have you been making these Do-It-Yourself repairs?"

*The truth of the matter is that the crown is exactly as high as the brim is wide.*

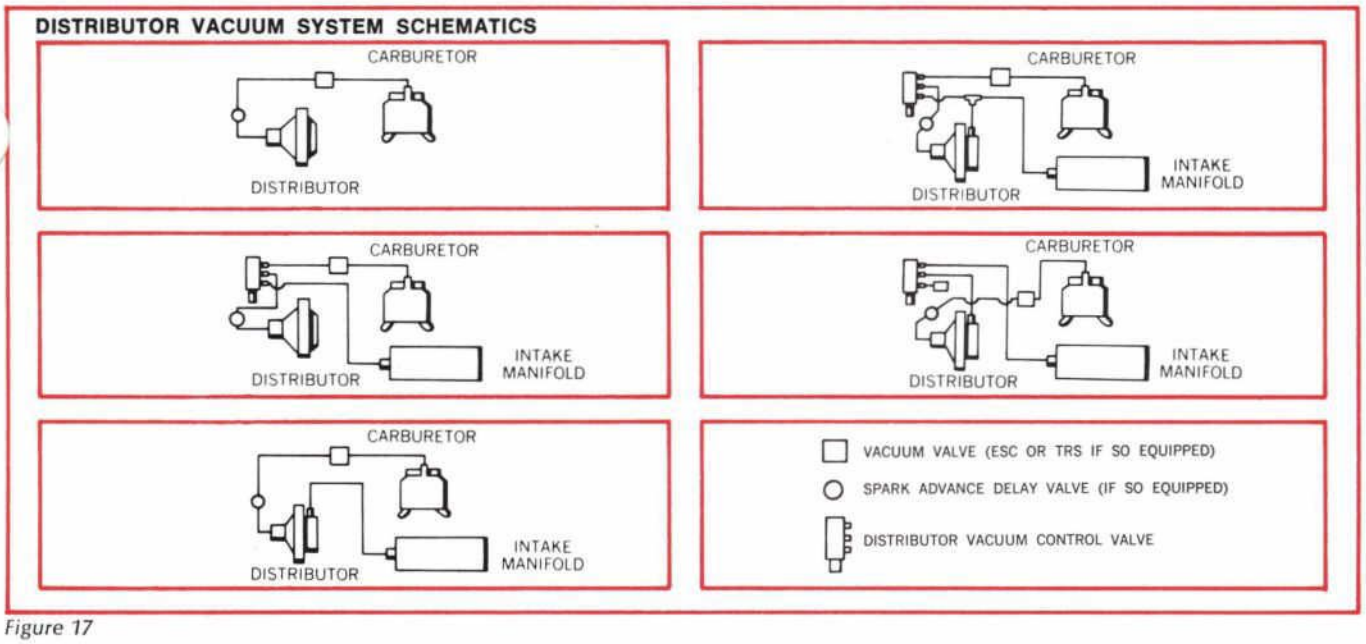



*Figure 17*

The dual-diaphragm vacuum advance mechanism is also used by itself or with the distributor vacuum control valve. Basic schematics for the various hook-ups are shown.

## SPARK DELAY VALVE

Another unit used to control the ignition timing to obtain proper emission control is the spark delay valve. It is installed in the distributor vacuum line to the distributor advance diaphragm. The purpose of the valve is to delay the spark advance during acceleration and still permit immediate retard on deceleration.

The length of the spark delay will vary with engine application. Several different valves are used and can be identified by a color code. The spark delay valve cannot be checked or repaired, and must be replaced every twelve thousand miles or twelve months, whichever comes first. The replacement valve must be the same color as the original.

One precaution on installing the spark delay valve. It is a one-way valve and the system will not operate properly if the valve is installed backwards. The black side of the valve must always be toward the carburetor.

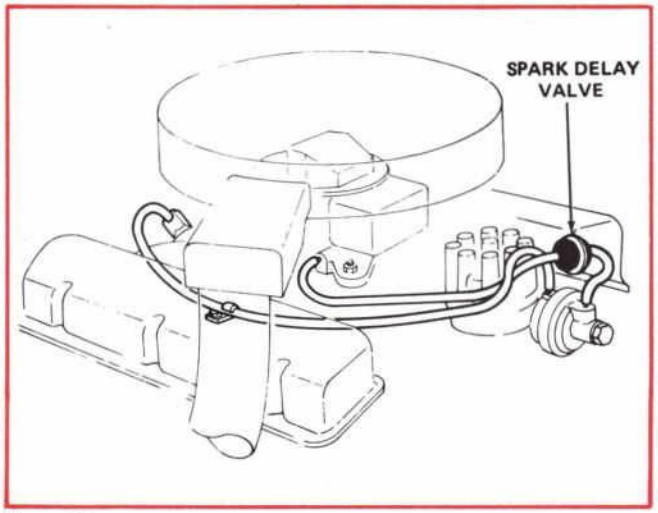



*Figure 18*

## TRS SYSTEM (TRANSMISSION REGULATED SPARK SYSTEM)

The TRS System is used on certain transmission engine applications for both cars and light trucks . . . to help meet the exhaust emission standards set by government regulations.

The function of the TRS System is to control vacuum to the primary vacuum advance diaphragm of the distributor; retarding the spark for more complete combustion of the fuel, when the vehicle is in a lower gear . . . and the outside air temperature is approximately 65 degrees Fahrenheit or higher.

You will find that a complete checkout of this system is a required part of each 12,000-mile or 12-month emission maintenance service interval; so you will want to understand its operation and test procedures for diagnostic purposes.

There are three principal components to the TRS System: a solenoid vacuum control valve, a temperature switch, and a transmission switch . . . in addition to the electrical circuit and vacuum lines from the carburetor to the distributor.

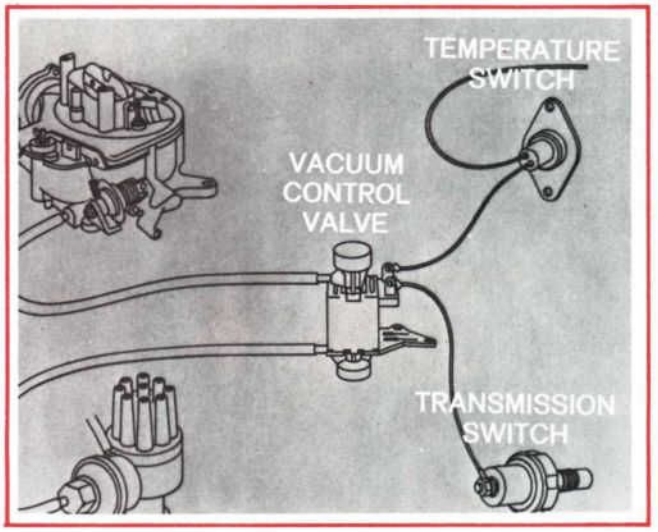



*Figure 19*

# EMISSION CONTROL SYSTEMS, Part I Continued

The spark control device in the TRS System is the solenoid vacuum control valve (distributor modulator valve) which is connected in the vacuum line from the carburetor to the primary vacuum advance diaphragm on the distributor.

The solenoid vacuum valve is a normally open valve. In the open position, it permits the vacuum advance to function normally; not retarding the spark.

When in the open position, an internal bleed on top of the valve housing purges the vacuum line of any vapor or liquids in the system, which might damage the valve plunger.

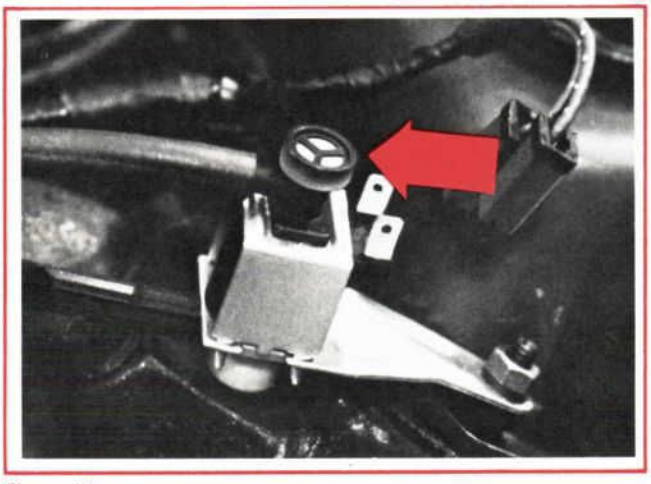


*Figure 20*

To close the solenoid vacuum valve, an electric current must be applied to its two blade contacts; energizing a coil built into the valve assembly.

When the valve is closed by closing its electric circuit, advance vacuum from the carburetor is blocked.

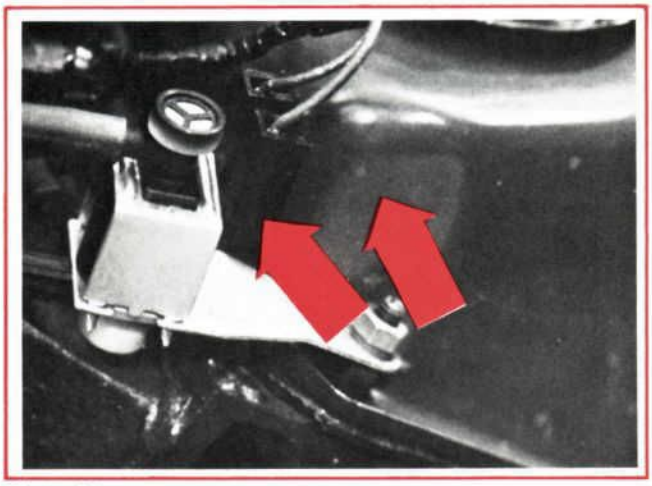


*Figure 21*

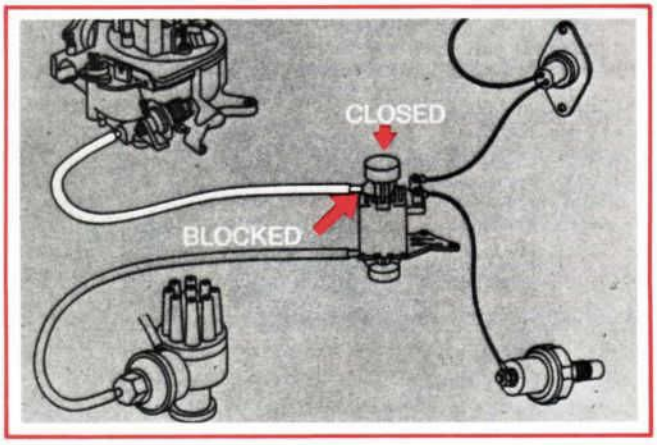



*Figure 22*

At the same time, vacuum at the distributor advance diaphragm is bled off through a vent at the bottom of the valve housing.

With no vacuum present at the advance diaphragm, the spark is retarded so that the fuel burns more completely, due to hotter combustion chamber and exhaust manifold temperatures. And that's all there is to the vacuum portion of the TRS System.

Now, let's look at the electric circuit to the vacuum valve, which determines the conditions in which the spark is to be retarded.

The circuit is powered from the ignition switch, through the fuse block, and through a temperature switch located in the outside of the right or left "A" pillar.

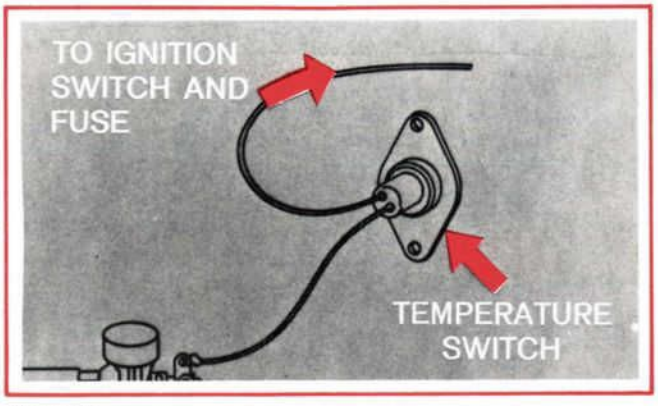



*Figure 23*

## TEMPERATURE SWITCH

The temperature switch contains a bimetal element which senses the ambient or outside air temperature.

In the "A" pillar location, the switch is isolated from passenger or engine compartment heat.

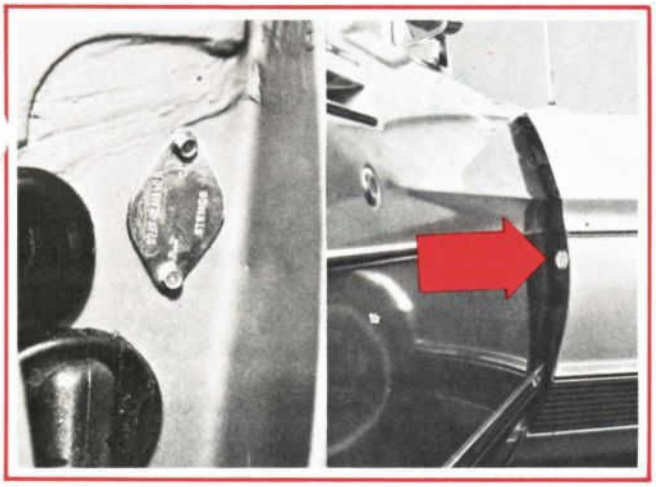


*Figure 24*

The function of the temperature switch is to close the electrical circuit to the vacuum valve coil at temperatures of approximaely 65 degrees Fahrenheit or higher; and to open the circuit at approximately 49 degrees or less. Thus, the spark can be retarded only with warm outside air available.

It is also possible for the switch contacts to be either opened or closed within the range of 49 to 65 degrees. Do not condemn the switch as a bad one if it falls within this opened or closed variance.

## TRANSMISSION SWITCH AND GROUND

The ground circuit for the solenoid vacuum control valve is the brown wire with yellow dots. It leads to the transmis-

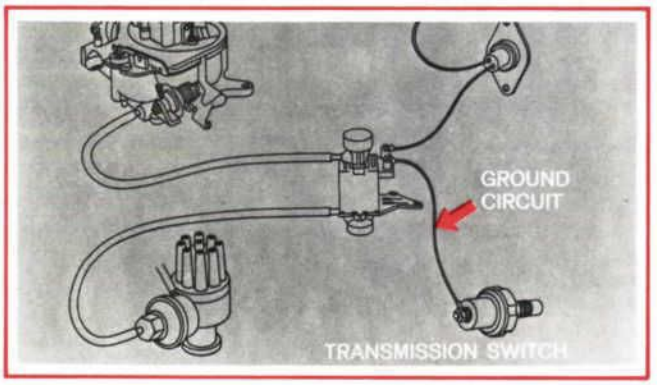



*Figure 25*

sion switch, which is screwed into a threaded opening in the transmission case.

The transmission switch is normally closed, so that it grounds the circuit to the transmission case in the lower gears: first and second.

When the transmission is shifted to a high gear (third or fourth), the transmission switch opens the circuit, and the vacuum valve coil is de-energized to open the vacuum and allow normal spark advance.

On manual transmissions, the switch is mechanically operated. It opens when the shift rail enters the top gear positions: third gear for 3-speed transmissions, or third and fourth for 4-speed transmissions.

The automatic transmission switch operates hydraulically. Oil pressure from the Reverse-and-High clutch circuit opens the switch in High gear. It also opens in Reverse, which will come in handy for testing the system.

Therefore, to complete the electrical circuit and close the vacuum control valve, the outside air temperature must be approximately 65 degrees Fahrenheit or higher, and the transmission must be in one of the lower gears.

If either of these conditions is not present, the vacuum valve opens and the spark advances normally from the carburetor venturi vacuum.

To summarize the operation of the Transmission Regulated Spark System: its function is to control vacuum to the primary spark advance connection of the distributor through the solenoid vacuum control valve.

The vacuum valve is normally open to allow a normal spark advance. It remains open until its electrical circuit is completed by closing both the temperature switch and the transmission switch.

When the temperature switch is closed at 65 degrees and the transmission switch is closed in one of the lower gears, the vacuum valve is closed to retard the spark.

## DIAGNOSIS AND TESTING

Now, let's turn our attention to the operational tests for the TRS System. The operational test for the system is required as part of each 12,000-mile or 12-month maintenance service interval.

In operational testing, you will simulate the actual operating conditions on the car, using a 12-volt test light and vacuum gauge to be sure the desired operation actually is occurring.

The first operational test is for the entire TRS System, then there are individual test procedures for the temperature switch, the transmission switch, and the vacuum valve.


*Figure 26*

## SYSTEM OPERATIONAL TEST

To prepare for the system test, install a T-fitting and a vacuum gauge with a long hose into the line at the primary vacuum port on the distributor. Position the vacuum gauge so you can see it from the driver's seat.

Be sure the room or air temperature is 65 degrees or higher, so that the temperature switch will be closed.

# EMISSION CONTROL SYSTEMS, Part I continued

With a manual shift, start the engine in Neutral and check the vacuum gauge. There should not be any vacuum reading.

Then, with the clutch disengaged, increase the RPM to about 1500. This is sufficient to produce vacuum at the carburetor spark port. However, the gauge should still read zero, since the vacuum valve is still closed.

Holding the clutch disengaged and with approximately 1500 RPM, shift into a High gear . . . third or fourth. Now, two things should happen. The transmission switch should open the TRS electrical circuit.

At the same time, the vacuum gauge needle should move upscale to at least six inches of vacuum. The vacuum valve opens when its electrical coil is de-energized. When these conditions check out during the operational test, the system is functioning properly.

To make the system operational test with an automatic transmission, start the engine in Park or Neutral. Observe that the vacuum gauge reads zero.

The automatic, of course, can't be shifted to High gear manually. But, remember that, with an automatic transmission, the switch also opens in Reverse.

So, with the engine operating at idle, apply the foot brake firmly and shift to Reverse to actuate the transmission switch.

However, there may or may not be a vacuum reading at this low RPM. If there's not, carefully increase RPM to 1500.

If the system is operational, the transmission switch will open the circuit to de-energize the vacuum valve . . . so that vacuum can get to the distributor. (Do not maintain 1500 RPM longer than one minute.)

If there is still no vacuum, pull either one of the leads from the vacuum valve to de-energize the circuit. Then, with the transmission in Neutral, increase the engine speed to 1500 RPM.

Now . . . there should be a reading of at least six inches on the vacuum gauge.

If you have a vacuum reading now, this means that the vacuum valve is open and spark advance vacuum is available. And that's all there is to the operational test on automatics.

In the event there is no vacuum indicated during the operational test, further individual tests will have to be performed to isolate the malfunction as a vacuum problem or an electrical problem.

First, check the vacuum hoses to the distributor for proper routing and restrictions. If required, make the necessary repairs to correct the condition.

Next, test for the availability of vacuum from the carburetor. Bypass the vacuum valve by pulling the hoses from the vacuum valve and connecting them with a nipple. Once again, operate the engine at 1500 RPM and recheck the vacuum gauge.

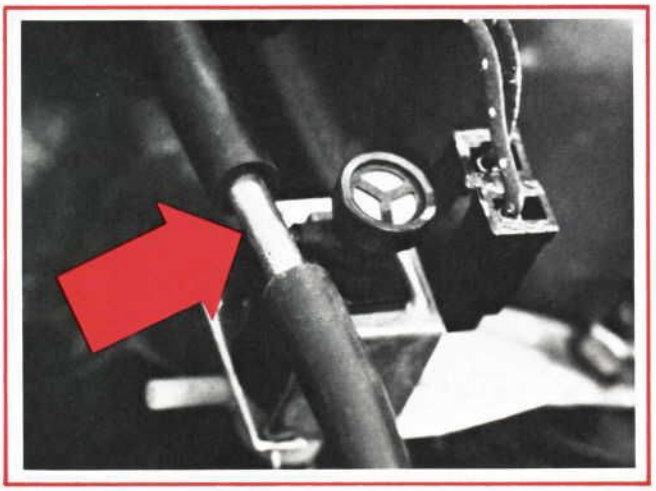


*Figure 27*

If there's still no vacuum, check out the vacuum system back to the carburetor to correct the problem. But, if there is vacuum, then the vacuum valve itself is probably not functioning properly.

Replace the vacuum valve and repeat the operational test to verify that the malfunction has been corrected.

## ELECTRICAL SYSTEM CHECK

Okay . . . now we'll run through the individual tests that would pinpoint these problems that may be encountered in the electrical circuit of the TRS System.

## TRANSMISSION SWITCH TEST

To test the transmission switch, pull the ground circuit lead, the brown wire with yellow dots, from the vacuum switch.

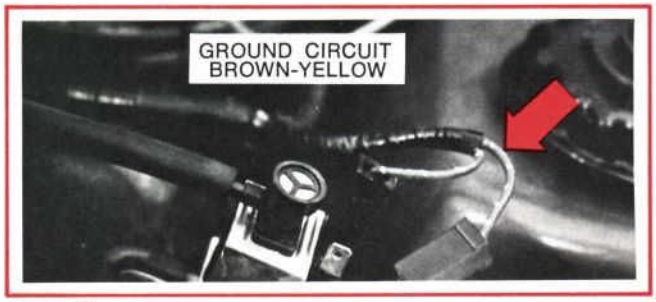



*Figure 28*

Connect a test light between the wire terminal and any terminal that is hot from the battery. The light should go off and on as the transmission switch opens and closes.

With a manual transmission, move the gearshift through all the positions. The light should stay on, except in High gear: third or fourth.

If the vehicle is equipped with an automatic, start the engine and hold the foot brake firmly applied, as you shift through all the selector positions and watch the test light.

Observe on the automatic that the light goes off in Reverse; indicating that the Reverse and High clutch pressure has opened the transmission valve.

Should the test light stay on in all gearshift positions, it means that the circuit is shorted to ground; probably through a malfunctioning transmission switch.

If the light doesn't glow at all, the circuit is open; which again may or may not be a malfunctioning transmission switch.

In any case where the ground circuit does not test okay, use a self-powered test light to isolate the problem in the circuit. Refer to the diagnosis chart on Page 15.

## TEMPERATURE SWITCH AND CIRCUIT TEST

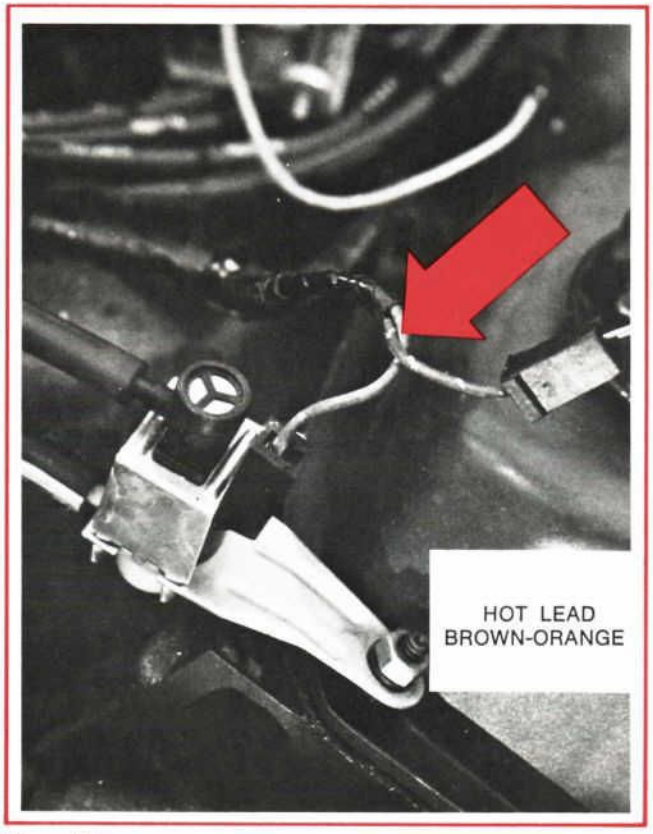



*Figure 29*

To test the temperature switch, install a test light between the vacuum valve hot lead (the brown wire with orange hash marks) and a good ground.

The light should glow with the ignition switch on, indicating that the temperature switch is warm and closed.

If the temperature switch is cold, warm it with the palm of the hand. Use a warm sponge if the switch can't be reached by hand.

Then, cool the switch with ice or an aerosol spray, such as starting fluid. Now, it should show an open circuit when cold . . . 49 degrees or below.

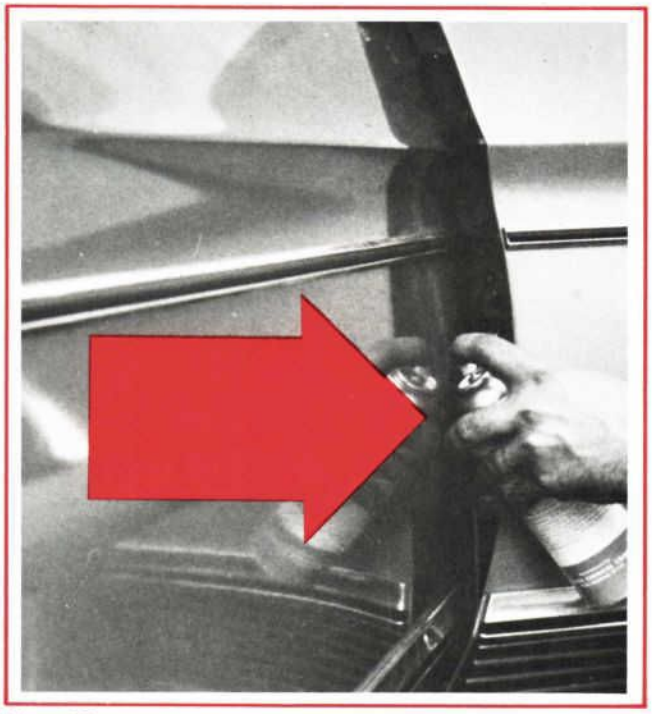


*Figure 30*

The test light must go out when the temperature switch is cooled. Otherwise, the switch is malfunctioning.

Similarly, if the light doesn't glow when the switch is warm, the circuit is open somewhere; possibly in the switch itself.

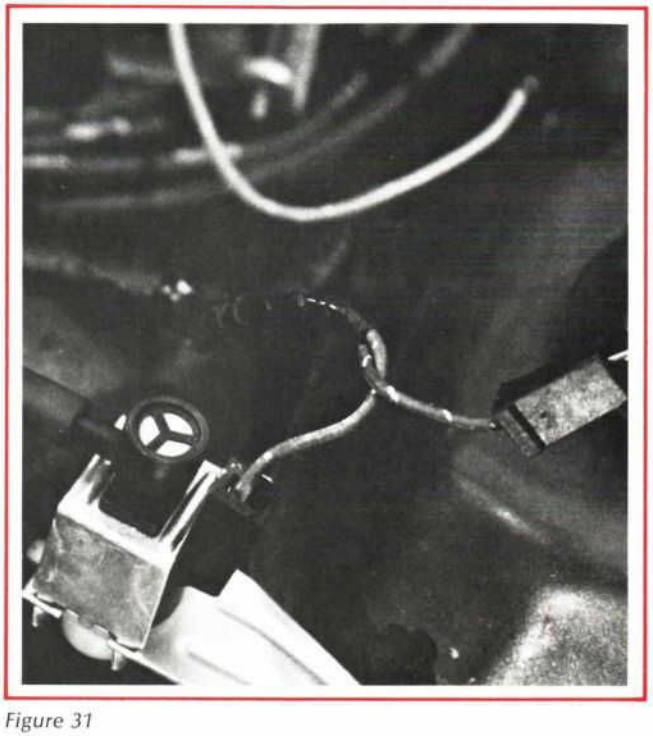


*Figure 31*

## TEMPERATURE SWITCH CONTINUITY TEST

To test the temperature switch in isolation from the hot circuit, perform a simple continuity check. First, warm the switch by hand or with a warm sponge. It should show continuity when 65 degrees Fahrenheit or above.

# EMISSION CONTROL SYSTEMS, Part I continued


*Figure 32*

Then, cool the switch in ice or with an aerosol spray. It should show an open circuit when cold . . . 49 degrees or below.

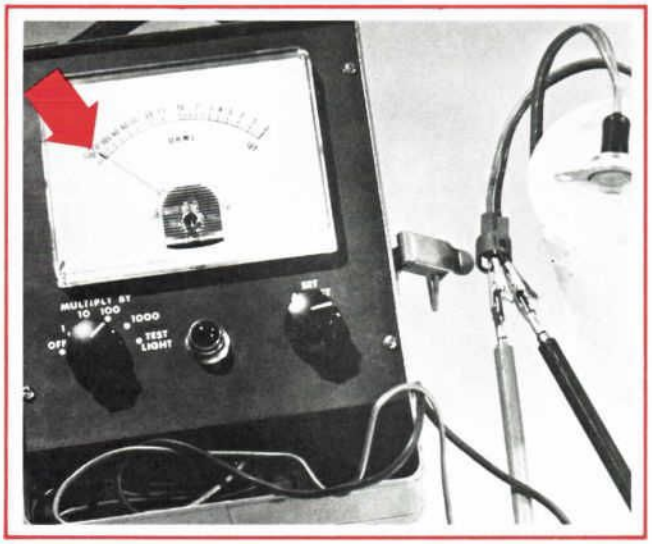



*Figure 33*

## OPEN CIRCUIT TEST

If the switch alone tests okay, but the circuit tested open, look for the trouble in the hot circuit with a test lamp, checking for broken wires or faulty connectors. This will help you pinpoint the problem before starting to take things apart.

## VACUUM VALVE ELECTRICAL TEST

As a final check, the vacuum valve can be tested for electrical problems, using jumper wires and a vacuum gauge.

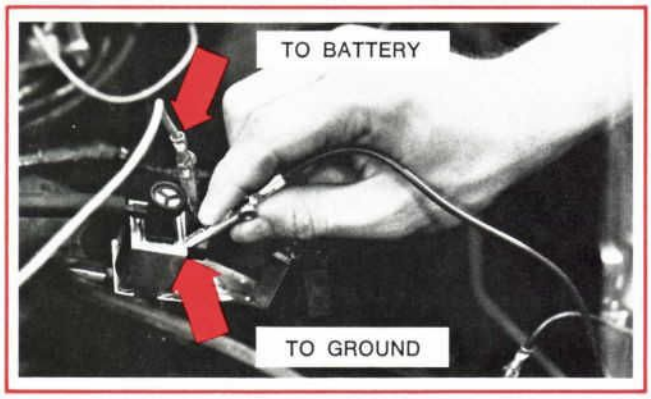



*Figure 34*

To begin, disconnect the electrical leads from the valve.

Apply power to the valve by connecting jumper wires from its terminals to the battery and to ground.

Operate the engine in Neutral at about 1500 RPM. If the valve is functioning properly, it will close when power is applied. The valve must be replaced if there is a vacuum reading at this time.

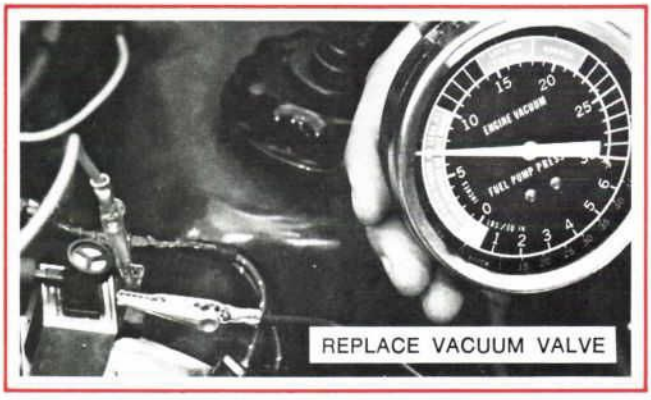



*Figure 35*

## SPECIAL NOTE

*In the case of a malfunction in the vacuum valve, temperature switch or transmission switch, do not attempt a repair. All three components are replaced as assemblies.*

**The Transmission Regulated Spark system for emission control is simple in operation, and simple to test and service, when you understand how it works.**

**Use this article to refresh your memory of the system and to help you test and service the system. When you are servicing emission control systems, you are both complying with government regulations and ensuring customer satisfaction.**

**Save this copy and combine it with next month's issue which will cover Part II–Electronic Spark Control System, Carburetor Adjustment, Fuel Evaporative Control Systems, Emission Control Maintenance and Application Charts.**

# VEHICLE EMISSION CONTROL