JEEP SPARK CONTROL SYSTEMS

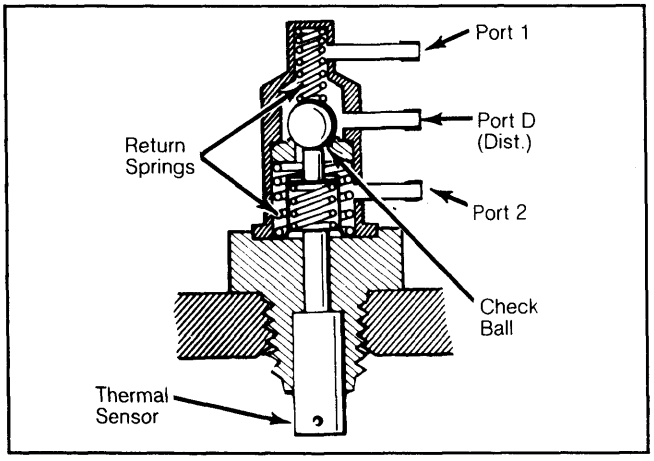
DESCRIPTION

Jeep vehicles use spark control devices to assist ignition system in controlling exhaust emissions. They are Spark Control Temperature Override (CTO) valve, Non-Linear Vacuum Regulator (NLVR) valve, Forward Delay Valve, Reverse Delay Valve, and on 4-cylinder engines, Vacuum Spark Control Delay Valve and Thermal Vacuum Spark Control valve. System application depends upon engine size, emissions category and vehicle model.

SPARK COOLANT TEMPERATURE OVERRIDE SYSTEM

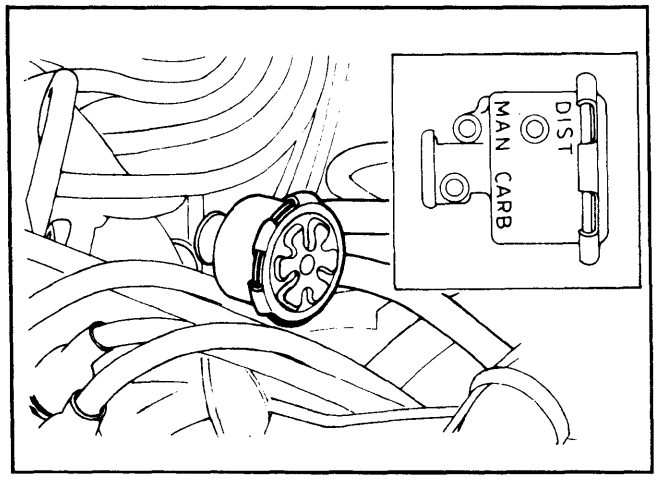
This system alternates distributor vacuum advance vacuum source between carburetor ported vacuum and manifold vacuum, depending upon coolant temperature. Two types of CTO switch are used: a single-function switch for models with standard cooling systems, and a single-function switch for heavy duty cooling systems. CTO switch is threaded into left rear of block on 6-cylinder engines, and into thermostat housing on 4-cylinder and V8 engines. On some models, this system is used in conjunction with NLVR valve.

Fig. 1: Cutaway View of Single-Function CTO Switch



CTO alternates distributor vacuum between carburetor ported vacuum and manifold vacuum.

Fig. 2: Jeep Non-Linear Vacuum Regulator Valve



NLVR valve performs different functions depending upon engine loads.

NON-LINEAR VACUUM REGULATOR VALVE

NLVR valve is used on some models. This valve supplies vacuum advance unit with a regulated combination of manifold and carburetor ported vacuum when engine load is low and switches to supply only carburetor ported vacuum as load increases.

OPERATION

SPARK COOLANT TEMPERATURE OVERRIDE SWITCH

Single-Function for Standard Cooling

When coolant temperature is below 149°F (65°C) on 6-cylinder and V8 engines, or 120°F (49°C) on 4-cylinder engines, check ball is held against inner seat by spring tension. Manifold vacuum enters through port "1" and is applied through port "D". *See Fig. 1.*

When temperature goes above specified limits, check ball is moved up in valve and manifold vacuum is applied from port "2" to port "D" on 4-cylinder engines, or carburetor ported vacuum is applied from port "2" to port "D" on 6-cylinder and V8 engines.

Single-Function for Heavy-Duty Cooling

Valve is used to prevent engine overheating at high ambient temperatures. When coolant temperature is below 220°F (104°C), carburetor ported vacuum enters port "1" and is applied through port "D". This allows full ported vacuum to distributor. Above 220°F (104°C), port "1" is blocked and manifold vacuum enters through port "2" and connectors to port "D". Manifold vacuum then controls spark advance. *See Fig. 1.*

NON-LINEAR VACUUM REGULATOR VALVE

There are 2 input ports on NLVR: intake manifold vacuum and carburetor ported vacuum. One outlet port connects to distributor vacuum unit. At curb idle, regulated vacuum is supplied to advance unit, when manifold vacuum is high and ported vacuum is very low. *See Fig. 2.*

NLVR regulates vacuum signal so it is between these 2 vacuum source levels at idle. As engine load increases and vacuum signal is above 7.5 in. Hg vacuum, regulator valve switches to ported vacuum output.

FORWARD DELAY VALVE

Some engines use this valve to improve driveability and reduce hydrocarbon emissions. The valve functions to delay effects of sudden increases in vacuum. This prevents sudden spark advance during deceleration.

REVERSE DELAY VALVE

Some engines use this valve to improve cold driveability and reduce hydrocarbon emissions. The valve is installed in vacuum line to delay effects of manifold vacuum decrease causing retarded ignition timing.

THERMAL VACUUM SPARK CONTROL VALVE

This valve is used on California 4-cylinder engines and is located in air cleaner. It passes manifold

JEEP SPARK CONTROL SYSTEMS (Cont.)

vacuum to port "1" of CTO valve and distributor vacuum advance mechanism only when air cleaner intake is below 63°F (17°C). At temperatures above 63°F (17°C), manifold vacuum is prevented from reaching CTO valve until coolant temperature reaches spark CTO valve switching point. *See Fig. 1.*

VACUUM SPARK CONTROL DELAY VALVE

This valve is used on 4-cylinder engines to improve driveability when engine is cold. It is located in vacuum advance circuit. When vacuum is greater at port "4" than at port "1", air must flow through orifice to equalize pressure. This creates a momentary delay that prevents a sudden decrease in spark advance. When vacuum is greater at port "1" than at port "4", air flows freely through check valve and pressure is instantly equalized. *See Fig. 3.*

MAINTENANCE

Periodic maintenance is not normally required; should any switch or valve fail to function properly it should be replaced.

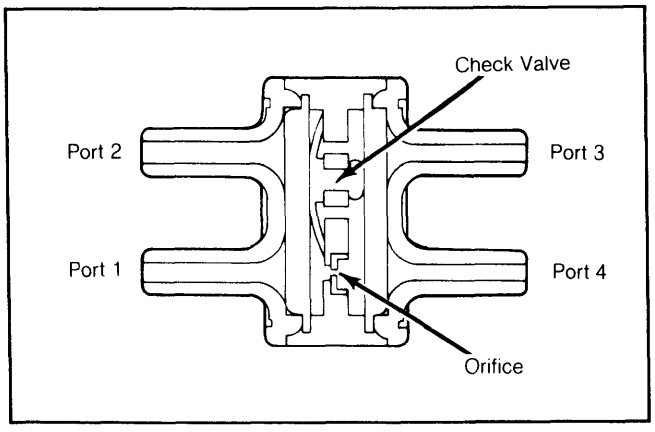
TESTING

SPARK COOLANT TEMPERATURE OVERRIDE SWITCH

Single-Function For Standard Cooling (6-Cylinder & V8 Engine)

Connect a vacuum gauge to center port "D" of CTO switch. When coolant is below 165°F (74°C), manifold vacuum should register. Above 165°F (74°C), carburetor ported vacuum should register. If valve does not meet these requirements, it must be replaced. *See Fig. 1.*

Fig. 3: Jeep Vacuum Spark Control Delay Valve (4-Cylinder Engines)



When testing disconnect vacuum hose from port "4"

Single-Function for Standard Cooling (4-Cylinder)

Disconnect vacuum hose from port "4" of delay valve and cap. Manifold vacuum should not register until coolant temperature reaches 120°F (49°C). If valve fails these tests it must be replaced. *See Fig. 3.*

NOTE: Ported vacuum is not available with throttle closed. Ported vacuum is available at part throttle (equivalent of 1000 RPM).

Single-Function for Heavy-Duty Cooling

Connect a vacuum gauge to center port "D" of CTO switch. When coolant is below 220°F (104°C), carburetor ported vacuum should register. Above 220°F (104°C), manifold vacuum should be indicated.

NON-LINEAR VACUUM REGULATOR VALVE

Connect vacuum gauge to distributor port "DIST" on NLVR. With engine at idle speed, a vacuum reading of 7 in. Hg vacuum should be shown. As throttle is opened and engine speed increases, ported vacuum level should be indicated. If not, replace NLVR. *See Fig. 2.*

FORWARD DELAY VALVE

1) Connect an external vacuum source to port on Black (or Red) side of delay valve. Connect 1 end of a 2' (.61 m) section of rubber hose to vacuum gauge and other end to port on colored side of valve.

2) With elapsed time device in view and a constant 10 in. Hg vacuum applied, note time required for gauge pointer to move from 0 in. Hg. to 8 in. Hg.

3) If valve fails to meet time limits, replace valve. If valve meets specifications, install so that Black (or Red) side is toward vacuum source.

FORWARD DELAY VALVE TIME LIMITS [1]

Valve Color	Min. Time	Max Time
Black/Purple	0.3	0.7
Black/Gray	0.6	1.6
Black/Brown	1.0	3.0
Red/Blue	1.9	5.7
Black/White	2.7	9.3
Black/Yellow	4.5	13.2
Black/Green	14.0	47.2

[1] — Time in seconds.

REVERSE DELAY VALVE

1) Connect external vacuum source to port on colored (non-White) side of delay valve. Connect 1 end of a 2' (.61 m) rubber hose to vacuum gauge and other end to port on White side of valve.

2) With elapsed time device in view and a constant 10 in. Hg. vacuum applied, note time required for gauge pointer to move from 0 in. Hg. to 8 in. Hg.

3) If valve fails to meet time limits, replace valve. If valve meets specifications, install with non-White side toward vacuum source.

Reverse Delay Valve Time Limits [1]

Valve Color	Min. Time	Max. Time
White/Purple	0.3	0.7
White/Gray	0.6	1.6
White/Gold	0.8	2.3
White/Brown	1.0	3.0
White/Yellow	4.5	13.2
White/Red	14.0	47.2

[1] — Time in seconds.

JEEP SPARK CONTROL SYSTEMS (Cont.)

VACUUM SPARK CONTROL DELAY VALVE

1) Connect a tee fitting at ports "1" and "4". Connect vacuum gauge to each fitting. Start engine. Vacuum should be equal at both ports. *See Fig. 3.*

2) When throttle is suddenly depressed, vacuum at port "1" will instantly decrease and vacuum at port "4" should be maintained momentarily. If valve fails these tests, replace valve.

Fig. 4: Jeep (California) 4-Cylinder Spark Control System