SECTION 5

Catalyst and Exhaust Systems

Contents

Catalyst and Exhaust Systems

DESCRIPTION

Catalytic Converter System

The engine exhaust consists mainly of Nitrogen (N_2), however, it also contains Carbon Monoxide (CO), Carbon Dioxide (CO_2), Water Vapor (H_2O), Oxygen (O_2), Nitrogen Oxides (NOx), and Hydrogen (H_2) as well as various, unburned Hydrocarbons (HC). Three of these exhaust components — CO, NOx, and HC — are major air pollutants, so their emission to the atmosphere has to be controlled.

The catalytic converter, mounted in the engine exhaust stream, plays a major role in the emission control system. The converter works as a gas reactor, and its catalytic function is to speed up the heat producing chemical reaction between the exhaust gas components in order to reduce the air pollutants in the engine exhaust. The catalyst material, contained inside the converter, is made of a ceramic substrate that is coated with a high surface area alumina and impregnated with catalytically active, precious metals (Fig. 1).

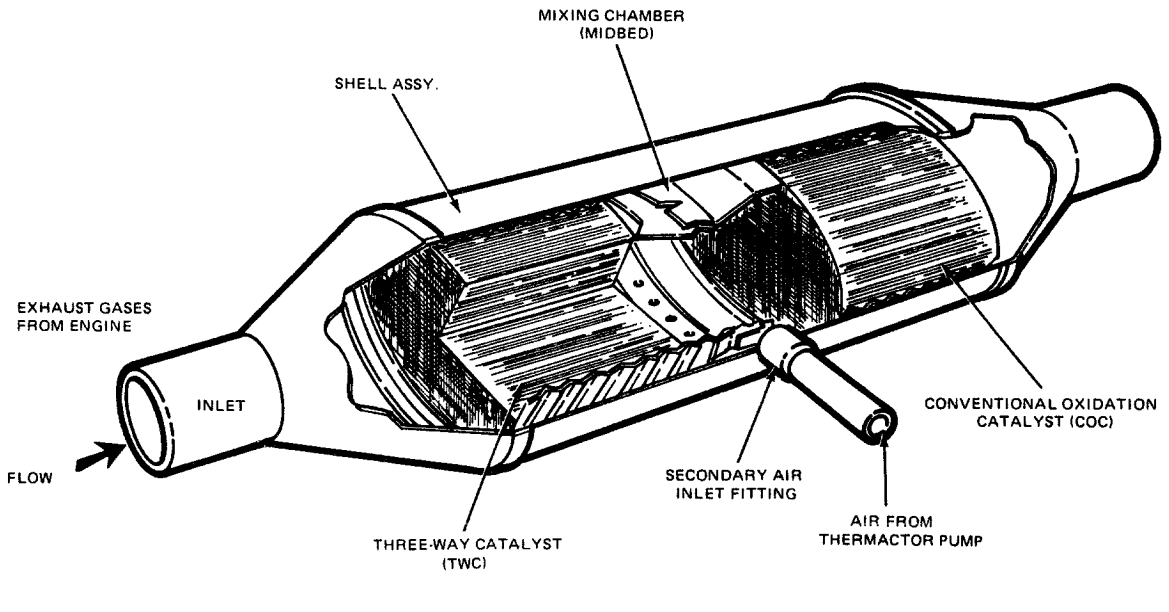

Figure 1 Dual Catalytic Converter

It is the surface of the catalyst material that plays a major role in the heat producing chemical reaction. There are basically three types of catalysts:

1. The conventional oxidation catalyst (COC), containing Platinum (Pt) and Palladium (Pd), is effective for catalyzing the oxidation reactions of HC and CO.
2. The three-way catalyst (TWC), containing Platinum (Pt) and Rhodium (RH) or Palladium (Pd) and Rhodium (RH), is not only effective for catalyzing the oxidation reactions of HC and CO, but it also catalyzes the reduction of NOx.

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3. The Light Off Catalyst (LOC) is a single bed converter. It is arranged in series with the main catalytic converter assembly of COC and/or TWC as the aft member(s). This converter is designed to perform the very specialized function of exhaust emission control during engine warm-up when the main converter(s) is not yet at the temperature required for maximum efficiency. The LOC is designed to operate effectively in the high temperature environmental conditions that exist near the manifold flange. The LOC was designed with a minimum heat sink effect and, therefore, provides minimum delay in warm-up of the main catalytic converter(s).

The catalytic converter assembly consists of a structured shell containing a monolithic substrate — a ceramic, honeycomb construction. In order to maintain the converter's feed gas (exhaust) oxygen content at a high level to obtain the maximum oxidation for producing the heated chemical reaction, the oxidation catalyst requires the use of a secondary air source, and this is provided by the pulse air or thermactor air injection systems.

The catalytic converter system is protected by several devices that block out the secondary air supply from the thermactor air injection system when the engine is laboring under any abnormal hot or cold operating situation.

Depending on the engine calibration, these block-out devices are functional under one or more of the following conditions:

- Cold engine operation with rich choke mixture.
- Abnormally high engine coolant temperatures above 107 °C (225 °F), which may result from a condition such as an extended, hot idle on a hot day.
- Wide open throttle.
- Engine deceleration.
- Extended idle operation.

A complete description of the design and operation of these block-out devices can be found in Thermactor Systems, Section 10.

Exhaust Heat Control Valve

Exhaust Heat Control Valve Bimetal Type

The valve is normally in the closed position — engine cold and not running to divert exhaust gases to the intake manifold riser pad. When the engine is started, the heat from the exhaust gases actuates the bimetal spring which opens the valve. As operating temperatures are reached, the valve will remain open. The valve, when cold, will also open at high engine speeds, due to the action of the exhaust gas on the unbalanced valve plate.

A. Inspect valve assembly for any abnormal condition. Service or replace as necessary.

B. Lubricate the valve with C0AZ-19A501-A or C4AZ-19A501-A graphite lube or equivalent.

C. Check valve and thermostatic spring operation by manually rotating the valve shaft. Valve must be free and return to the closed position when cold (Rotunda Choke Tester Model 090-00001 or equivalent may be used if necessary to cool bimetal).

Vacuum Operated Heat Control Valve

Refer to Components, Section 3 for description and operation.

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Restricted Exhaust System Diagnosis — Lack of Power or Induction Backfire

A restricted or blocked exhaust system usually results in loss or lack of power or popping through the carburetor. Verify that the condition is not caused by ignition or timing problems, then proceed with diagnosis per the following procedure.

TEST STEP		RESULT ▶	ACTION TO TAKE
B0	VISUAL INSPECTION		
• Visually inspect the exhaust system. • Is the exhaust system visually OK?		Yes ▶	GO to **B1**.
		No ▶	REPLACE any collapsed exhaust components. GO to **B1**.
B1	VACUUM TEST		
• Attach vacuum gauge to intake manifold vacuum source. • Hook up tachometer. • Start engine and gradually increase speed to 2000 RPM with transmission in Neutral. • Is the manifold vacuum above 16 inches of mercury?		Yes ▶	No restriction in exhaust system. REFER to Section 2, Diagnostic Routine 209, Lack of Power.
		No ▶	GO to **B2**.
B2	VACUUM TEST — EXHAUST DISCONNECTED		
• Turn engine OFF. • Disconnect exhaust system at exhaust manifold(s). • Repeat vacuum test. Is the manifold vacuum above 16 inches of mercury?		Yes ▶	GO to **B3**.
		No ▶	GO to **B4**.
B3	VACUUM TEST — CATALYTIC CONVERTER(S) ON/ MUFFLER(S) OFF		
• Turn engine OFF. • Reconnect exhaust system at exhaust manifold(s). • Disconnect muffler(s). • Repeat vacuum test. Is the manifold vacuum above 16 inches of mercury?		Yes ▶	REPLACE muffler(s).
		No ▶	REPLACE catalytic converter and inspect muffler to be sure converter debris has not entered muffler.
B4	EXHAUST MANIFOLD RESTRICTED		
• Remove the exhaust manifold(s). Inspect the ports for casting flash by dropping a length of chain into each port. **Do not use a wire or light to check ports. The restriction may be large enough for them to pass through but small enough to cause excessive back pressure at high engine RPM.** • Is a restriction present?		Yes ▶	REMOVE casting flash. If flash cannot be removed, REPLACE exhaust manifold(s).
		No ▶	REFER to Section 2, Diagnostic Routine 209, Lack of Power.

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