

THERMOSTAT TEST-THERMOSTAT REMOVED

Remove the thermostat and immerse it in boiling water. Replace the thermostat if it does not open at least 0.230" after one minute at 212° F.

If the problem being investigated is insufficient heat, the thermostat should be checked for leakage. This may be done by holding the thermostat up to the lighted background. Leakage of light all around the thermostat valve (thermostat at room temperature) indicates that the thermostat is unacceptable and should be replaced. It is possible, on some thermostats, that a **slight** leakage of light at one or two locations on the perimeter of the valve may be detected. This should be considered normal.

FAN DRIVE CLUTCH TEST

Spin the fan blade. A light resistance should be felt. If there is no resistance or very high resistance, the minimum and maximum fan speeds must be checked as follows:

Minimum Slip Fan Drive Requirement Test

1. Using a suitable marker, mark the water pump pulley hub, one of the fan blade attaching bolts and the crankshaft pulley.
2. Connect a tachometer to the engine.
3. Install a throttle adjusting tool.
4. Connect a Sun Strobe Light or equivalent. This can be a SLT-1 or SLT-2 Strobotach or a STA-1 Strobe Trigger adapter for the Sun Distributor Test Stand.

CAUTION: Do not operate the engine until the fan has been first examined for possible cracks and separation.

5. Start the engine and run it at approximately 1500 rpm until engine temperature has normalized.
6. Adjust the engine to the specified engine testing speed (Part 27-05).
7. Operate the Strobe Light at 2000 rpm and aim it at the water pump pulley. Adjust the engine speed until the light flashes and the water pump pulley mark are synchronized.
8. Aim the timing light at the fan blade attaching bolts. Adjust the Strobe Light until it is synchronized with the fan blades (fan blade appears to stand still).
9. The fan speed must not be greater than the specified minimum fan test speed at 2000 water pump rpm.

10. Turn the engine off.
11. If the fan speed was greater than the specified minimum fan test speed, check for proper parts usage.

If the correct parts are used, replace the fan drive clutch.

If the part(s) are not the correct ones, replace the part(s) and perform the test again.

12. If the Maximum Slip Fan Drive Requirement Test is going to be performed, do not remove the tachometer, Strobe Light or throttle adjusting tool.
13. If a Maximum Slip Fan Drive Requirement Test is not going to be performed, remove the tachometer, Strobe Light and Throttle adjusting tool.

Maximum Slip Fan Drive Requirement Test

1. If the Minimum Slip Fan Drive Requirement Test was not performed, follow steps 1 thru 5 under Minimum Slip Fan Drive Requirement Test.
2. Block off areas on each side of the core in the engine compartment and the front of the grille. This will raise the temperature of the air striking the clutch control unit and should cause the fan to operate at maximum speed.
3. Place the air conditioning selector to the maximum position and the blower switch to the high position.
4. Adjust the Strobe Light to 2000 rpm.

CAUTION: Do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.

5. Start the engine and adjust it until the water pump pulley is synchronized with the Strobe Light. This will be near the engine testing speed given in the specifications.
6. Turn off the air conditioning blower switch.
7. Synchronize the timing light with the marked fan to clutch attaching bolts.
8. The fan speed must meet or exceed the specified maximum slip fan test speed at 2000 water pump rpm.
9. If the fan speed was less than the specified maximum slip fan test speed, check for proper parts usage.

If the correct parts are used, replace the fan drive clutch.

If the part(s) are not the correct ones, replace the part(s) and perform the test again.

ADJUSTMENTS

DRIVE BELTS

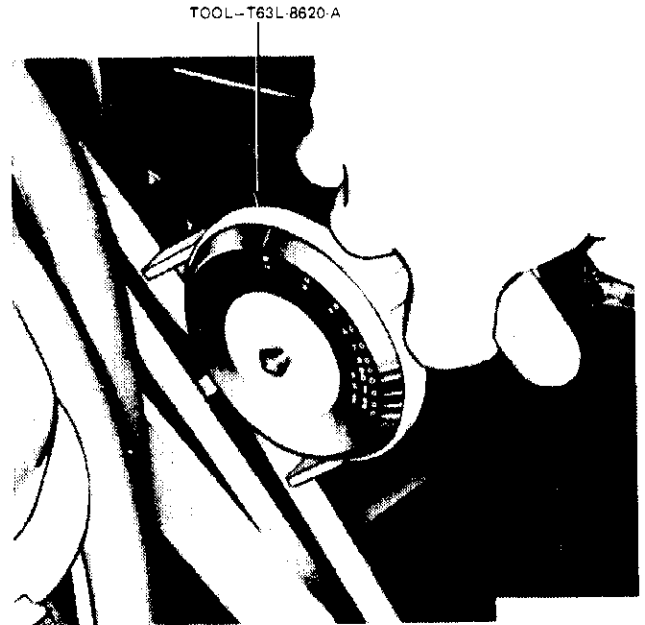
The fan drive belt(s) should be properly adjusted at all times. Loose drive belt(s) cause improper alternator, fan and water pump operation. A belt that is too tight places a severe strain on the water pump and the alternator bearings.

Properly tensioned drive belts minimize the noise and also prolong service life of the belt. Therefore, it is recommended that a belt tension gauge be used to check and adjust the belt tension. **Any belt that has operated for a minimum of 10 minutes is**

considered a used belt, and, when adjusted, it must be adjusted to the reset tension shown in the specification.

Belt Tension

1. Install the belt tension tool on the drive belt (Fig. 2) and check the tension following the instructions of the tool manufacturer.
2. If adjustment is necessary, loosen the alternator mounting and adjusting arm bolts. Move the alternator toward or away from the engine until the correct tension is obtained. Remove the gauge. Tighten the alternator adjusting arm and mounting bolts. Install the tension gauge and check the belt tension.
3. Follow similar procedures for adjusting Thermactor air pump, air conditioner compressor and power steering pump drive belts.



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FIG. 2 Checking Drive Belt Tension

REMOVAL AND INSTALLATION

FOUR AND SIX-CYLINDER ENGINE COOLING FAN

Removal

Remove the screws and washers assemblies attaching the fan to the water pump hub. Remove the fan.

Installation

Position the fan and spacer on the water pump hub. Loosen fan belt, if necessary. Install the lock washer and screws and torque the capscrews to specifications. Adjust the fan belt tension to specifications.

V-8 ENGINE COOLING FAN

On a car with an air conditioner or extra-cooling radiator, a fan drive clutch may be used (see Specifications). Cars without air conditioning or equipped with Flex-Blade Fan utilize a pulley-to-fan spacer.

Removal

1. Remove the radiator upper support and fan guard or shroud. Remove the screw and washer assemblies attaching the fan and spacer (or drive clutch) to the water pump hub. Remove the fan and spacer (or drive clutch).
2. If equipped with a fan drive clutch, remove the attaching screw and washer assemblies and separate the fan from the drive coupling.

Installation

1. Position the replacement fan on the drive clutch and install the washer and screw assemblies. Torque the capscrews evenly and alternately to specifications.
2. Position the fan and spacer (or drive clutch) on the water pump hub and install the washer and screw assemblies. Loosen the belt, if necessary. Torque the capscrews evenly and alternately to specifications. Adjust the fan belt tension to specifications. Then, check the fan drive clutch flange-to-water pump hub for proper mating. Install the radiator upper support and fan guard or shroud.

FAN DRIVE BELT

Removal

If equipped with power steering and/or air conditioning and Thermactor exhaust emission control system it will be necessary to loosen and remove the drive belts before the fan drive belt can be removed.

1. On a car with power steering (except Lincoln Continental), loosen the power steering pump at the mounting bracket and remove the drive belt.
On a car with an air conditioner, remove the compressor drive belt.
2. Loosen the alternator mounting and adjusting arm bolts. Move the alternator toward the engine. Remove the belt(s) from the alternator and crankshaft pulleys, and lift them over the fan.

Installation

1. Place the belt(s) over the fan. Insert the belt(s) in the water pump pulley, crankshaft pulley and alternator pulley grooves. Adjust the belt tension to specifications.
2. On a car with an air conditioner, install and adjust the compressor drive belt to specifications.
3. On a car with power steering (except Lincoln Continental), install the power steering pump drive belt and tighten the pump at the mounting bracket. Adjust the drive belt tension to specifications.

RADIATOR HOSE

Removal

Radiator hoses should be replaced as directed in the pertinent car Maintenance Schedule or whenever they become cracked, rotted or have a tendency to collapse.

Drain the radiator; then loosen the clamps at each end of the hose to be removed. Slide the hose off the radiator connection and the engine water outlet connection (upper hose) or the water pump connection (lower hose).

Installation

Position the clamps at least 1/8 inch from each end of the hose. Coat the connection areas with an approved water-resistant sealer and slide the hose on the connections. **Make sure the clamps are beyond the bead and placed in the center of the clamping surface of the connections. Tighten the clamps. Fill the radiator with the recommended permanent antifreeze and water mixture. Operate the engine for several minutes, then check the hoses and connections for leaks.**

THERMOSTAT (REFER TO FIGS. 3, 4 AND 5.)

On V-6 engines, the thermostat is located on the bottom of the water pump housing (Fig. 5). The thermostat housing connects to the radiator lower hose, rather than the upper, as is customary on all other engines.

Removal

1. Drain the cooling system so that the coolant level is below the thermostat.
2. Disconnect the heater return hose at the thermostat housing located on the left front lower side of engine.
3. Remove the coolant outlet housing retaining bolts. Pull the elbow away from the cylinder head or manifold (water pump on V-6) sufficiently to provide access to the thermostat. Remove the thermostat and gasket. On V-6, remove gasket, O-ring and thermostat

Installation

Check the thermostat before installing it, following the procedure under **Thermostat Test in this Part.**

1. Clean the coolant outlet housing and cylinder head, manifold or water pump gasket surfaces. Coat a new gasket with water resistant sealer. Position the gasket on the cylinder head opening. **The gasket**

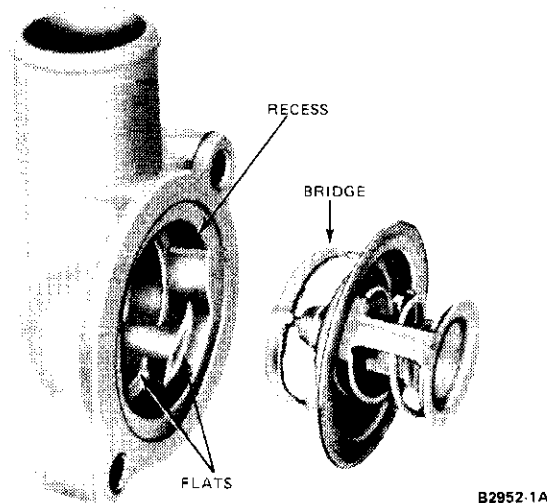


FIG. 3 Installing Thermostat—Typical I-6 Engine and V-8 Engine

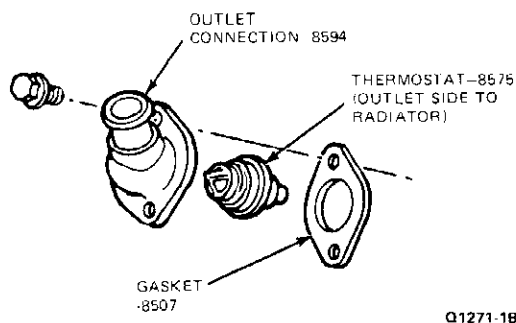


FIG. 4 I-4 Engine Thermostat and Housing—Disassembled View

must be positioned on the cylinder head or the intake manifold, before the thermostat is installed, except on 5.8L (351M CID), 6.6L (400 CID) and 7.5L (460 CID) engines, where the thermostat is installed in the block (351M and 400) or intake manifold (460) first, and then the gasket is installed. On 2.8L V-6 engines, install the gasket on the coolant elbow, install the thermostat into the recess in the water pump, and position the O-ring in the water pump over the thermostat.

To prevent incorrect installation of the thermostat, the water outlet casting on all engines except 5.8L/6.6L (351M/400 CID), 7.5L (460 CID) and 2.8L V-6 models contains a locking recess into which the thermostat is turned and locked. Install the thermostat with the bridge section (Figs. 3 and 4) in the outlet casting. Turn the thermostat clockwise to lock it in position on the flats cast into the outlet elbow.

2. Position the coolant outlet elbow against the cylinder head, intake manifold or water pump. Install and torque the retaining bolts to specifications.

3. Connect heater hose to thermostat housing.
4. Fill the cooling system with the recommended Permanent Antifreeze and water mixture. If equipped with a crossflow radiator, follow the special instructions in Part 27-03 regarding checking coolant level. Check for leaks and proper coolant level after the engine has reached normal operating temperatures.

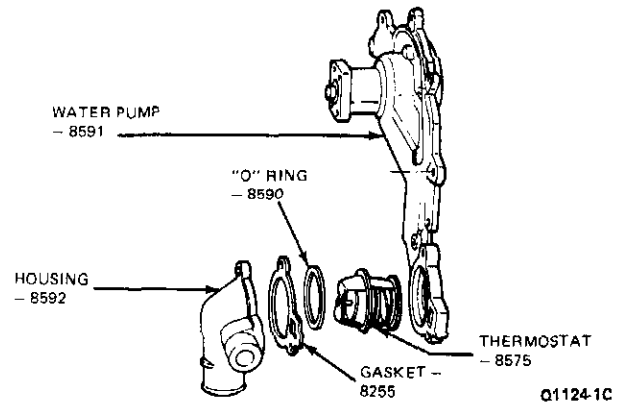


FIG. 5 V-6 Thermostat and Housing

CLEANING AND INSPECTION

CLEANING COOLING SYSTEM

To remove rust, sludge and other foreign material from the cooling system, use Rotunda Cooling System Cleanser. Removal of such material restores cooling efficiency and avoids overheating. **Always remove the thermostat prior to pressure flushing.** A pulsating or reversed direction of flushing water flow will loosen sediment more quickly than a steady flow in the normal direction of coolant flow. In severe cases where cleaning solvents will not properly clean the cooling system for efficient operation, it will be necessary to use the pressure flushing method. Various types of flushing equipment are available.

RADIATOR PRESSURE CAP

1. Inspect the areas under the vacuum valve and rubber seal for rust or dirt particles (Fig. 6).

2. Use warm tap water, raise the vacuum valve and rubber seal and thoroughly flush away loose rust or dirt particles trapped under the vacuum valve, rubber seal and on the seal surface.
3. Inspect and remove any imbedded rust or dirt particles on the sealing surfaces of the rubber seal.
4. Inspect the radiator filler neck opening for rust or dirt particles on the sealing surface at the bottom of the filler neck opening. Use a clean cloth and wipe the sealing surface to remove any rust or dirt particles.

NOTE: If paint is observed on the filler neck sealing surface, remove it using paint thinner.

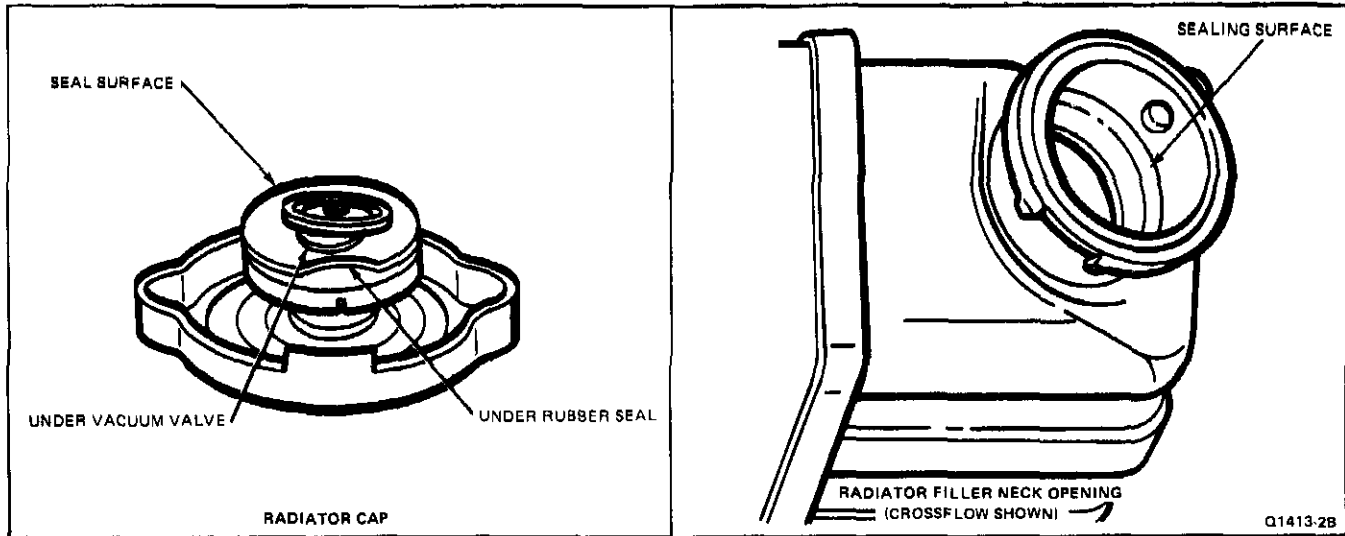


FIG. 6 Cleaning and Inspecting Radiator Cap and Filler Neck Opening

SPECIFICATIONS

COOLING SYSTEM CAPACITIES

VEHICLE	ENGINE	OPTIONS	CAPACITY (QTS.)	
			U.S.	IMP.
Pinto/Bobcat	2.3L	S/C	8.6	7.1
	2.3L	A/C	9.0	7.5
	2.8L	S/C	8.5	7.0
	2.8L	A/C	9.1	7.6
Mustang II	2.3L	S/C	8.8	7.1
	2.3L	A/C	9.1	7.6
	2.8L (M/T)	S/C	8.4	7.0
	2.8L (A/T)	S/C	8.6	7.1
	2.8L (M/T)	A/C	8.6	7.1
	2.8L (A/T)	A/C	9.1	7.6
	5.0L (302 CID)	S/C & A/C	14.6	12.1
Fairmont/Zephyr	2.3L	S/C	8.6	7.1
	2.3L	A/C	10.3	8.6
	3.3L (200 CID)	S/C, A/C	9.0	7.5
	5.0L (302 CID)	S/C	13.9	11.5
	5.0L (302 CID)	A/C	14.0	11.6
Granada/Monarch	4.1L (250 CID)	S/C, X/C	10.5	8.7
	4.1L (250 CID)	A/C	10.6	8.8
	5.0L (302 CID)	S/C	14.2	11.8
	5.0L (302 CID)	A/C	14.3	11.9
Versailles	5.0L (302 CID)	S/C	14.2	11.8
	5.0L (302 CID)	A/C	14.3	11.9
LTD II/Cougar/Ranchero	5.0L (302 CID)	S/C	14.3	11.9
	5.0L (302 CID)	A/C	14.6	12.1
	5.0L (302 CID)	Police Interceptor & Taxi	15.9	13.2
LTD II/Cougar/Thunderbird	5.8L (351W CID)	S/C	15.4	12.8
	5.8L (351W CID)	A/C	15.7	13.0
	5.8L (351M CID)	S/C, A/C, T.T.	16.5	13.7
	5.8L (351M CID)	Police Interceptor & Taxi	17.0	14.1
	6.6L (400 CID)	S/C, A/C	16.5	13.7
	6.6L (400 CID)	T.T., Police Interceptor	17.0	14.1
Ford/Mercury	5.0L (302 CID)	S/C, A/C	15.2	12.6
	5.0L (302 CID)	Police Interceptor	17.1	14.2
	5.8L (351W CID)	S/C, A/C	16.3	13.5
	5.8L (351W CID)	Police Interceptor	18.2	15.1
	5.8L (351M CID)	S/C, A/C	17.0	14.2
	6.6L (400 CID)	S/C, A/C	17.0	14.2
	6.6L (400 CID)	Police Interceptor & T.T.	17.46	14.5
	7.5L (460 CID)	S/C, A/C	18.6	15.4
Continental Mark V	6.6L (400 CID)	S/C, A/C	16.9	14.06
	7.5L (460 CID)	S/C, A/C	18.6	15.4
	7.5L (460 CID)	T.T.	18.8	15.6
Lincoln Continental	6.6L (400 CID)	A/C	16.9	14.06
	7.5L (460 CID)	A/C	18.7	15.5
	7.5L (460 CID)	T.T.	19.0	15.8

To convert to imperial measure, multiply U.S. quarts shown by .83.

7.5L (460 CID) Police Interceptor includes engine oil cooler.

Capacities shown include heater.

Service refill recommendations are 50/50 mix of water and Ford Long Life Coolant ESE-M97B18-C.

Expansion reservoirs do not use coolant in bottle except during extreme operation.

All figures shown are actual but may vary $\pm$ 15% due to system variations.

S/C — no air conditioning (standard cooling).

A/C — air conditioning.

TORQUE VALUES (ALL CARS)

NOTE: All specifications are given in ft-lbs unless otherwise noted.

Fan shroud assembly to radiator where applicable	24-48 in-lbs
Fan to pulley hub (All engines)	12-18
Radiator hose clamps	20-30 in-lbs
Transmission oil cooler tubes to radiator - all engines	9-12

SPECIAL SERVICE TOOLS (ALL CARS)

Description	Ford Tool No.
Belt Tension Gauge	T63L-8620-A

DRIVE BELT TENSIONS (lbs.)

Size	Newly Installed (1)	Used	
		Up to 10 Min.	Over 10 Min.
1/4"	50-80	40-80 (2)	40-60 (2)
Except 1/4"	120-160	90-160 (3)	75-120 (4)

(1) Read tension immediately after belt is installed, before it stretches or seats in pulley grooves.

(2) If less than 40 pounds, readjust to 40-60 pounds.

(3) If less than 90 pounds, readjust to 90-120 pounds.

(4) If less than 75 pounds, readjust to 90-120 pounds.

THERMOSTATS

Starts to Open °F	188°-195°
Fully Open	212°-215°

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RADIATOR PRESSURE CAP

Vehicle Application	Specified Cap Pressure (PSI)	Lower Limit (PSI) (Must Retain)	Upper Limit (PSI) (Must Relieve)
Mustang II/Pinto/ Bobcat, Fairmont/Zephyr w/ Std. Cooling	13	11	17
Ford/Mercury, LTD II/Cougar, Thunderbird/ Continental/Mark V, Lincoln Continental, Granada/ Monarch/Versailles Fairmont/Zephyr Exc. Std. Cooling	16	13	19

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Radiators

PART
27-03

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		DESCRIPTION (Cont'd.)	
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Crossflow Radiators	03-1	REMOVAL AND INSTALLATION	
Diagnosis	03-2	Automatic Transmission Oil Cooler	03-3
Downflow Radiators	03-1	Radiator	03-3

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DESCRIPTION

Standard and extra-cooling radiators are installed in production, but service replacement radiators are usually of the extra cooling type.

WARNING—Never remove the radiator cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine and/or personal injury.

To avoid having scalding hot coolant or steam blow out of the radiator, use extreme care when removing the cap from a hot radiator. If possible, wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn it slowly to the first stop. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, press down on the cap (still with a cloth), turn and remove it.

DOWN FLOW RADIATORS

These radiators are the tube and slit-fin-core type with the tubes arranged for vertical flow of the coolant. The radiator bottom header tank on automatic transmission cars contains a heat exchanger for cooling the transmission oil. Down flow radiators may also be equipped with a constant-full coolant return system.

CROSSFLOW RADIATORS

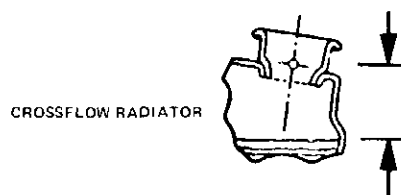
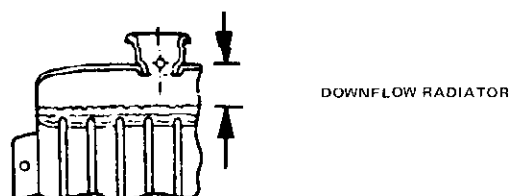
These radiators are of the tube and slit-fin-core type with the tubes arranged horizontally for crossflow of the coolant. Two header tanks, one on each side of the radiator, provide uniform distribution of the coolant to the cross-flow tubes. The header tank, or chamber, on the left side of the radiator contains a heat exchanger for cooling the transmission fluid. All crossflow radiators are equipped with a constant-full coolant return system.

FILLING COOLING SYSTEM—WITHOUT CONSTANT-FULL COOLANT RETURN

On initial fill or refilling the cooling system, the following procedures must be followed to prevent air entrapment and inadequate coolant levels.

1. Check all hose clamps for proper tightness. Be sure radiator drain cock is closed.
2. Position heater temperature selector in the maximum heat position.
3. Fill cooling system to 1-1/2 inches below the fill cap seat (Fig. 1).

CAUTION: Do not operate engine with hood open until fan has been first examined for possible cracks and separation.



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FIG. 1 Fill Level—Crossflow and Downflow Radiator

4. Leave radiator cap off and run engine until thermostat opens (hot coolant flows through radiator upper hose).
5. Stop engine and add coolant to 1-1/2 inches below fill cap seat (crossflow) or 1/4 inch below fill cap seat (downflow). Install radiator cap.

CONSTANT-FULL COOLING SYSTEM

This system is based around a 13 psi pressure cap (vehicles with downflow radiators), or a 16 psi pressure

cap (vehicle with crossflow radiators) and a plastic reservoir and hose. When the coolant in the radiator expands to the overflow point, it passes through the pressure cap and into the plastic reservoir (Fig. 2). When the coolant in the radiator cools down and therefore contracts, it pulls coolant from the reservoir through a vacuum relief valve in the pressure cap, back into the radiator.

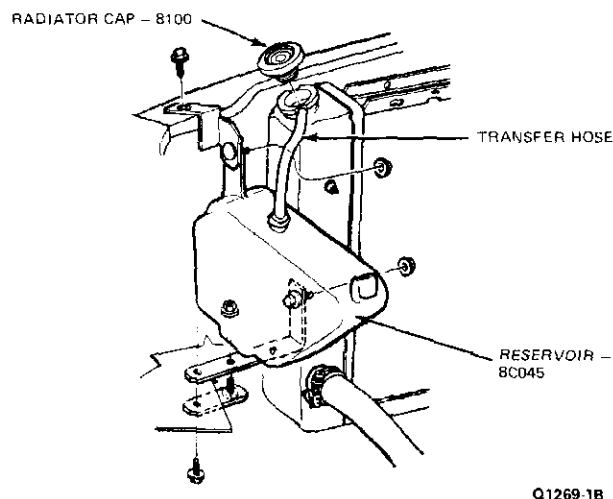


FIG. 2 Constant-Full Cooling System—Typical Ford/Mercury

The advantages of the system are the extra coolant carried in the expansion tank and the fact that any air bubbles trapped in the cooling system are vented in the plastic reservoir, rather than causing excessive aeration of the coolant.

Special Filling Instructions—Crossflow Radiators

Coolant level cannot be accurately checked while the engine is running, due to the construction of this radiator.

Filling Constant-Full Cooling System

1. Check all hose clamps for proper tightness. Be sure radiator drain cock is closed.

2. Place heater temperature selector in maximum heat position.
3. Fill radiator to 3/4" to 1-1/2 inches below the radiator cap seal (downflow radiators) or 2-1/2 to 4 inches below the radiator cap seal (crossflow radiators). See Fig. 1.

CAUTION: Do not operate engine with hood open until fan has been first examined for possible cracks and separation.

4. Run engine until thermostat opens (coolant flowing through radiator upper hose becomes hot).
5. Stop engine and add coolant to radiator as necessary to adjust level to 3/4" below the radiator cap seal (downflow radiators) or 1-1/2 inches below the radiator cap seal (crossflow radiators).

DIAGNOSIS

In the event no coolant is observed in the reservoir, or when a coolant level change does not occur, check the system as follows:

1. With the engine cold, remove the radiator pressure cap, and inspect the filler neck sealing gasket for foreign material between the gasket and cap diaphragm. Rinse cap in clean water.

The radiator pressure cap used on this system is unique; replace only with the proper cap.

2. Remove the radiator overflow-to-reservoir hose at the radiator filler neck connection and at the bottle.
3. Inspect the reservoir hose for obstruction, cracks or cuts. Replace if necessary.
4. Inspect filler neck nipple to neck flared soldered joint for possible separation. Repair if necessary.
5. Reinstall the hose with a 3/8 to 5/8 inch clearance to bottom of plastic reservoir.
6. Pressure test the system.
7. Replenish the coolant in the radiator as required.
8. Reinstall the radiator pressure cap.

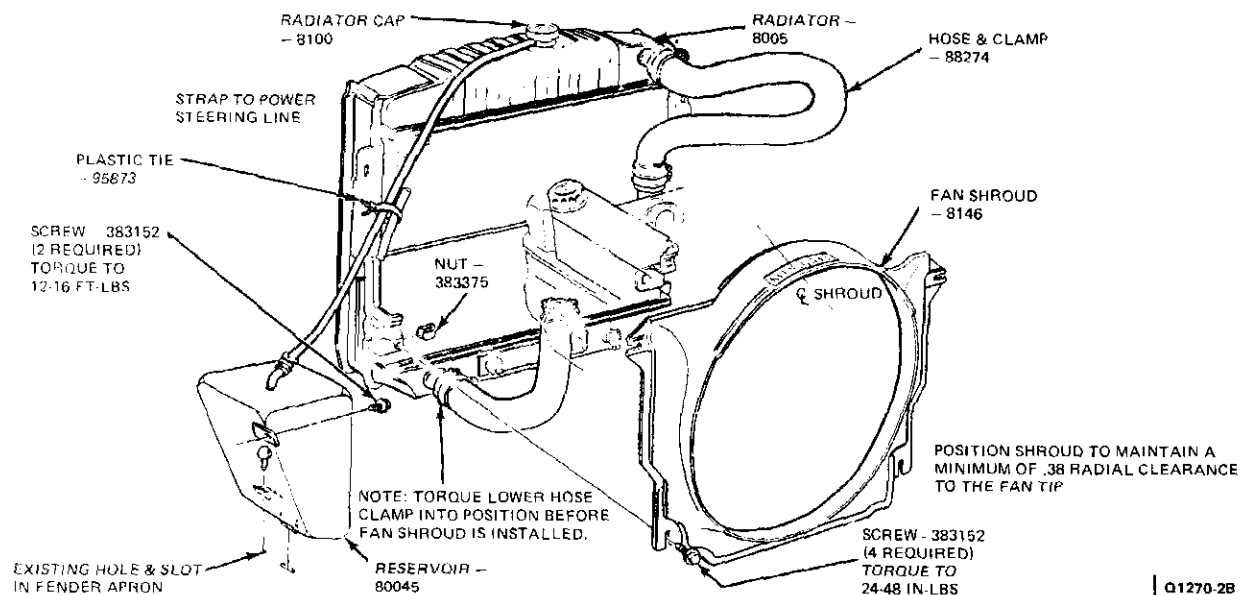


FIG. 3 Constant Full Cooling System—Mustang II W/Optional 5.0L (302 CID) V-8 Engine

REMOVAL AND INSTALLATION

RADIATOR

Removal

1. Drain the cooling system. Disconnect the radiator upper and lower hoses from the radiator.

On a vehicle with an automatic transmission, disconnect the automatic transmission fluid cooler inlet and outlet lines from the radiator.

2. Crossflow radiators
 - a. If equipped with fan shroud, remove two upper shroud attaching bolts at radiator support. Lift fan shroud sufficiently to disengage lower retaining clips and lay shroud back over fan.
 - b. Remove radiator upper support attaching bolts and remove support(s). Lift the radiator from vehicle.
3. Downflow radiators
 - a. If equipped with fan shroud, remove four attaching bolts, two at each side of radiator. Lay shroud back over fan.
 - b. Remove radiator attaching bolts, two at each side of radiator. Lift radiator from vehicle.

Installation

1. If a new radiator is to be installed, remove the drain cock from the old radiator and install it on the new radiator.
2. If a new radiator is to be installed on vehicles equipped with automatic transmission, transfer the oil cooler line connectors to the new radiator, using oil resistant sealer.
3. Position the radiator assembly into the vehicle.
 - a. On downflow radiators, install the four attaching bolts, two on each side of the radiator.
 - b. On crossflow radiator, install upper supports and secure with bolts.
4. On vehicles with automatic transmissions, connect the oil cooler lines.
5. Place fan shroud into clips on lower radiator support of crossflow radiator. Secure to upper support with two bolts. Position shroud to downflow radiator and secure with two bolts each side of radiator. Position shroud to maintain a minimum of 0.38 inch minimum radial clearance to fan blade tips.
6. Connect the radiator upper and lower hoses. Close the drain cock. Fill the cooling system.

CAUTION: Do not operate the engine with the hood open until the fan has been first examined for cracks and separation.

7. Operate the engine and check for leaks at the hose connections and the automatic transmission fluid cooler lines. Check the automatic transmission and radiator fluid level.

AUTOMATIC TRANSMISSION OIL COOLER AND RADIATOR DRAINCOCK

Replacement of the automatic transmission oil cooler or radiator draincock in the radiator lower or side tank, as given below, is usually performed by radiator specialty shops on a sub-let basis. However, the operation can be performed in a dealer service department, providing proper equipment is available.

Downflow radiators use a threaded design draincock and boss, while crossflow radiators use a draincock soldered directly to the radiator side tank.

Only manufactured or natural gas torches should be used to perform radiator repairs. Do not use acetylene.

No attempt should be made to repair a fractured radiator tank. Should a fractured tank be encountered, it must be replaced. Tank repairs usually result in repeat failures, due to the flexible nature of the tank.

Removal

1. Drain the cooling system.
2. Remove the radiator from the vehicle, following the procedure outlined previously.
3. Thoroughly clean the radiator assembly internally and externally by submerging in a tank filled with a caustic solution. Then, using clean water, flush until the caustic solution is removed from all internal and external surfaces. **NOTE: Caution should be exercised during the disassembly and assembly solder operation of radiator components. Avoid excess heat concentration which could result in burning through the radiator sheet metal or loosening an adjoining soldered area.**

On downflow radiators, apply heat to separate support tabs from lower tanks.
4. Remove the radiator tank containing the damaged or leaking oil cooler. (Tank removal is not necessary for repair of draincock).
5. Melt the puddled solder from the oil cooler inlet and outlet fittings. Remove the retaining rings from the fittings in the oil cooler.
6. Remove the oil cooler or draincock.
7. Clean the soldered surface areas and inspect and tin as necessary to assure proper solder bonding.

Installation

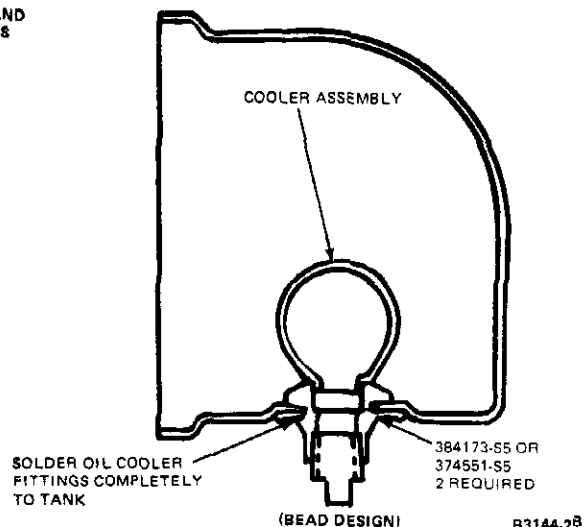
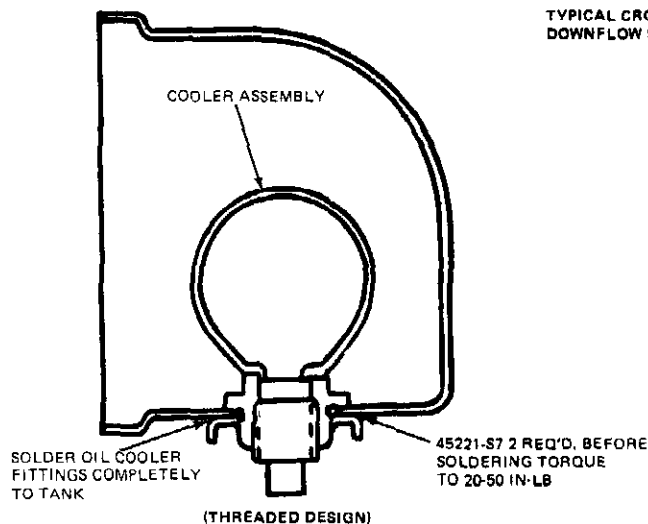
1. **Draincock** : Position the replacement draincock in the tank opening and solder using the procedures for oil cooler.

Oil Cooler : Install the replacement oil cooler assembly into the tank openings and secure cooler with new retaining rings. For threaded design, torque retainer to 20-50 in-lb; for bead design, push ring past fitting bead. Retaining ring tangs should point away from tank (Fig. 4).

2. Puddle-solder the oil cooler fittings completely to the tank.
3. Seat the tank assembly in the header well and solder securely, completely filling the well. Use 40-60 solder with either zinc chloride 30 (BAUME) or 5-B NALCO flux.
4. Resolder the supports in position on downflow radiator.
5. Flush off all excess acid, internally and externally.
6. Pressure-test the radiator assembly to 14-16 psi for leaks.

7. Paint as required.
8. Install the radiator and fan shroud to the vehicle. Install the connectors in the oil cooler inlet and outlet fittings and connect the transmission oil cooler lines.
9. Connect the hoses to the radiator inlet and outlet connections.
10. Flush the cooling system and refill with the recommended mixture of all season coolant.

NOTE: If one-piece draincock is not available, a threaded boss (-8120-) and draincock (-8115-) must be used. Solder the boss into the tank following the procedure for one-piece draincocks, then wrap the draincock threads with sealer tape and install the draincock in the boss. Tighten the draincock to 12-15 ft-lb.



B3144-28

FIG. 4 Typical Radiator Oil Cooler Installation

Fan Drive Clutch		PART 27-05	
Granada/Monarch/Ford/Mercury/Lincoln Continental/Continental Mark V/Versailles			
SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION	
Fan Drive Clutch	05-1	Fan Drive Clutch	05-2
		SPECIFICATIONS	05-3

CA4250-2B

DESCRIPTION AND OPERATION

FAN DRIVE CLUTCH

The fan clutch (Figs. 1, 2 and 3) permits use of a powerful fan without paying the penalty of power loss or noise. It is basically a temperature-controlled fluid coupling that regulates fan speed according to the temperature of the air coming through the radiator core

and flowing around the bi-metal control valve located on the forward face of the clutch.

Pulley ratios and slip-speeds are given in the Specification Section of this Part.

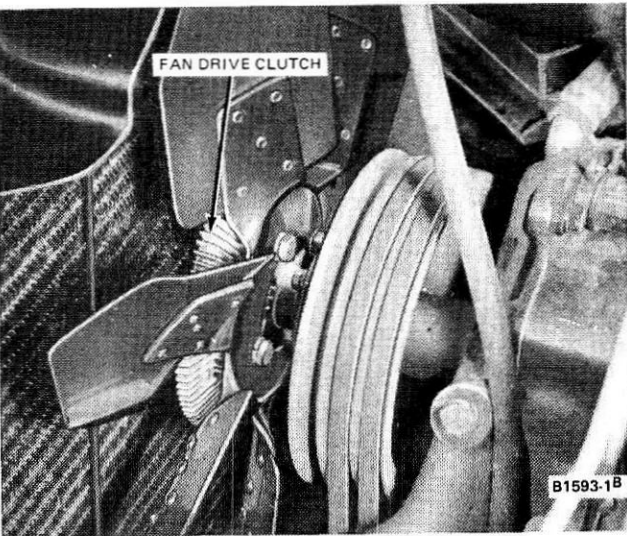


FIG. 1 Typical Fan Drive Clutch Installation

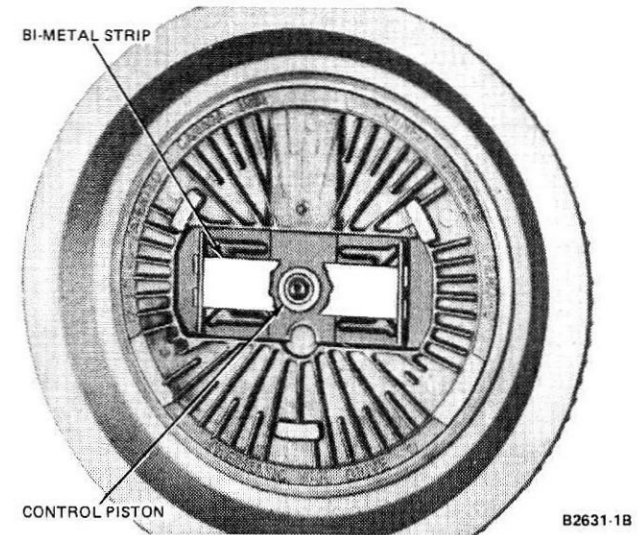


FIG. 2 Fan Drive Clutch With Flat Bi-Metal Spring

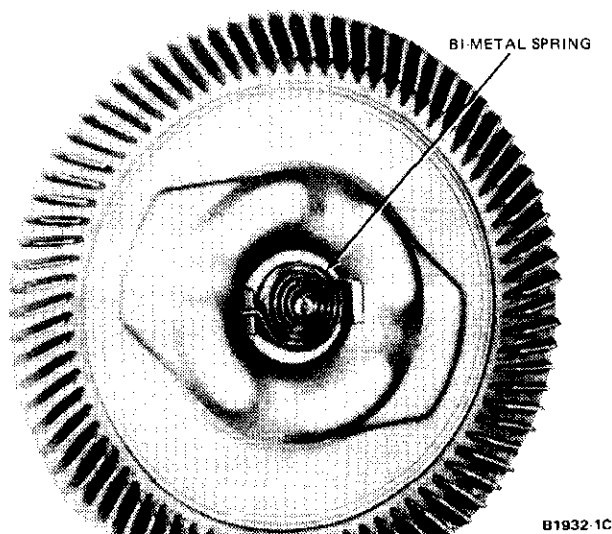


FIG. 3 Fan Drive Clutch With Coil Bi-Metal Spring

REMOVAL AND INSTALLATION

FAN DRIVE CLUTCH

Removal

1. Remove the radiator upper support and/or fan guard or shroud.
2. Loosen the fan belt. Remove the bolt and washer assemblies attaching the fan drive clutch to water pump hub (Fig. 1). Remove the fan drive clutch and fan as an assembly.
3. Remove the attaching bolt and washer assemblies and separate the fan from the drive clutch.

Installation

1. Position the fan on the drive clutch. Install the bolt and washer assemblies and torque to specifications.
2. Position the fan drive clutch and fan assembly and belt to the water pump hub (Fig. 4). Install and torque the attaching bolt and washer assemblies evenly and alternately to specifications. Then, check the fan drive clutch flange-to-water pump hub for proper mating. Adjust the fan belt tension to specifications.
3. Install radiator upper support and/or fan guard or shroud.

CAUTION: Do not operate engine with hood open until fan has been first examined for possible cracks and separation.

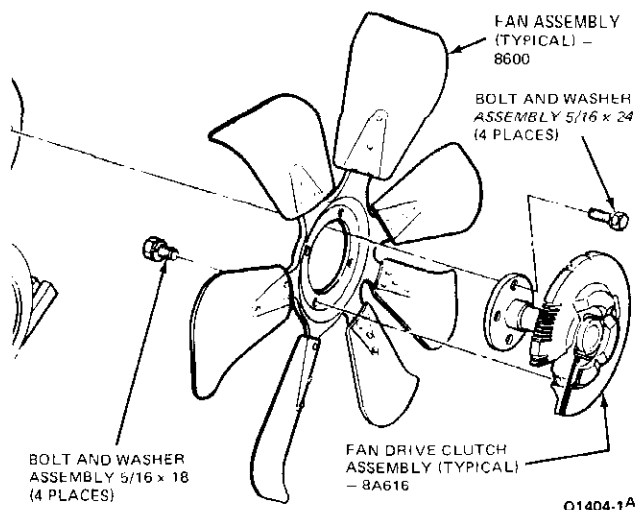


FIG. 4 Fan Drive Clutch and Fan

SPECIFICATIONS

TORQUE VALUES (ALL CARS) – FT-LB

NOTE: All specifications are given in ft.-lbs. unless otherwise noted.

Fan to Fan Clutch – All Engines

12-18

Fan Clutch to Water Pump – All Engines

12-18

FAN DRIVE CLUTCH SPECIFICATIONS

Vehicle	Engine	Cooling Option	Water Pump Pulley Ratio	Engine RPM Required to Run Water Pump 2000 RPM	Fan Test Speed @ 2000 Water Pump RPM	
					Minimum RPM	Minimum RPM
Mark V, Ford, Mercury, Lincoln Continental	7.5L (460 CID)	A/C and/or Trailer Tow Police (All)	1.25:1	1600	1400	500
Granada, Monarch, Versailles	5.0L/5.8L (302/351W CID)	A/C	1.13:1	1770	1600	500

CQ1095-2E

Flex-Blade Fan

PART
27-06

CN4037-2A

DESCRIPTION

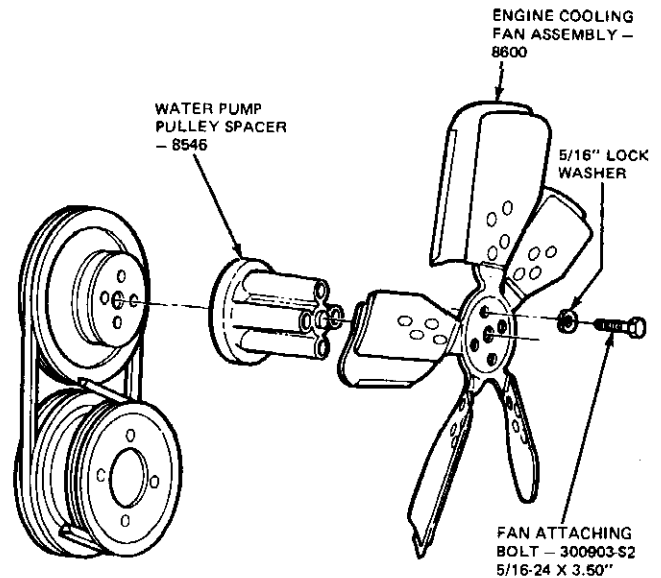
DESCRIPTION

The flex blade fan (Fig. 1) consists of a spider stamping of either 5-blade or 7-blade configuration, to which are riveted the flexible blade assemblies. Other than the riveted flexible blades, the fan is conventional in appearance and is removed and replaced in the same manner as a standard fan (Part 27-01).

OPERATION

Because the blades flex as engine rpm increases, the flex-blade fan tends to use less power and to generate less noise than does a conventional rigid cooling fan of fixed pitch. This fan adjusts itself to the engine speed without the use of complicated drive mechanisms. No test or adjustment is therefore required, beyond keeping the fan drive belt adjusted to the proper (standard) tension.

CAUTION: Do not operate engine with hood open until fan has been first examined for possible cracks or separation.



B3143-1B

FIG. 1 Flex-Blade Fan

STARTING SYSTEM

GROUP
28
(11000)

PART TITLE	PART NO.	PART TITLE	PART NO.
Positive Engagement Starter	28-02	Starting System General Service	28-01

CA4248-2B

Starting System General Service

PART
28-01

GENERAL INFORMATION

The function of the starting system is to crank the engine at a speed fast enough to permit the engine to start. Heavy cables, connectors, and switches are used in the starting system because of the large current required by the starter while it is cranking the engine. The amount of resistance in the starting circuit must be kept to an absolute minimum to provide maximum current for starter operation. A discharged or damaged battery, loose or corroded connections or partially broken cables will result in slower than normal cranking

speeds, and may even prevent the starter from cranking the engine.

In cases of starting system trouble, the owner may have discharged the battery before calling for assistance. A road service procedure is presented in Part 28-02 to aid the service technician in such cases of starting trouble. Be sure to follow diagnosis procedures in order to locate the cause of the starting difficulty. The road service is not a part of the diagnosis procedures.

Positive Engagement Starter

**PART
28-02**

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION	
Positive Engagement Starter	02-1	Granada, Monarch and Versailles	02-4
TESTING		Fairmont and Zephyr	02-4
Bench Tests	02-3	DISASSEMBLY AND ASSEMBLY	
On-Vehicle Testing	02-2	Positive Engagement Starter	02-5
Road Service	02-1	SPECIFICATIONS	02-9

CN4050-2B

DESCRIPTION AND OPERATION

POSITIVE ENGAGEMENT STARTER

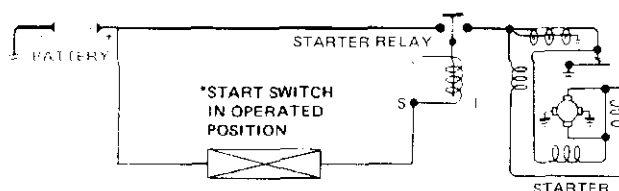
The starting system includes the starter motor with an integral positive-engagement drive, the battery, a remote control starter switch (part of the ignition switch), the neutral-start switch (automatic transmission with floor shift only), the starter relay, and heavy circuit wiring.

Turning of the ignition key to the START position actuates the starter relay, through the starter control circuit. The starter relay then connects the battery to the starter.

Vehicles equipped with a console or floor mounted shift lever have a neutral-start switch in the starter control circuit, which prevents operation of the starter if the selector lever is not in the N (neutral) or P (park) position.

Vehicles equipped with a column shift do not use a neutral-start switch. The ignition switch mechanism in the steering column is designed so that the ignition switch can be turned to the start position only when the selector lever is in NEUTRAL or PARK.

When the starter is not in use, one of the field coils is connected directly to ground through a set of contacts



J1083-1J

FIG. 1 Starting Circuit

(Fig. 1). When the starter is first connected to the battery, a large current flows through the grounded field coil, actuating a movable pole shoe. The pole shoe is attached to the starter drive plunger lever and thus the drive is forced into engagement with the flywheel ring gear.

When the movable pole shoe is fully seated, it opens the field coil grounding contacts and the starter is then in normal operation. A holding coil is used to maintain the movable pole shoe in the fully seated position during the time that the starter is turning the engine.

TESTING

ROAD SERVICE

On road service calls, connect a 12-volt booster battery to the system for cases of a starter that will not crank the engine or a starter that cranks the engine very slowly.

USE OF BATTERY JUMPER CABLES

The following instructions contain precautions that should be observed to avoid possible injury to yourself

or damage to the vehicle. Be certain that transmission is in park or neutral.

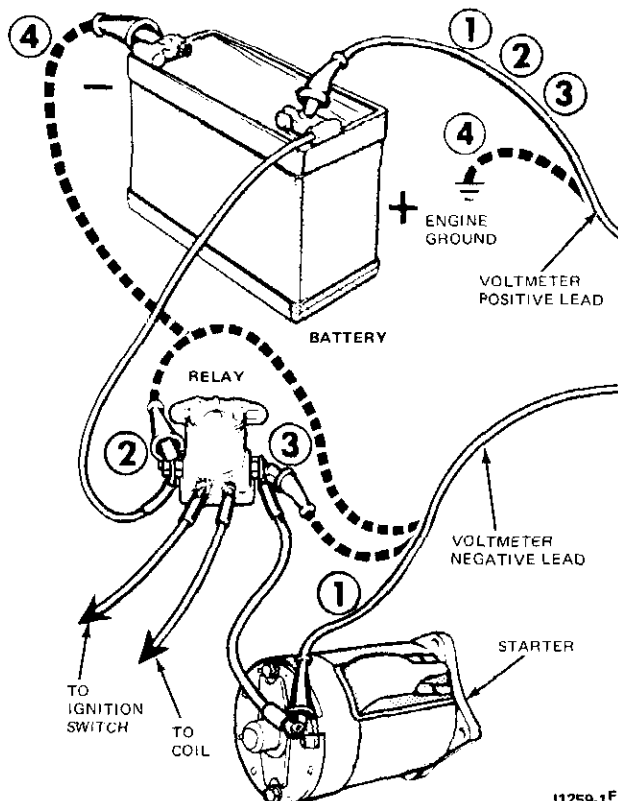
CAUTION—Use only a 12-volt jumper system. You can damage a 12-volt starting motor and ignition system beyond repair by connecting it to a 24-volt power supply (two 12-volt batteries in series, or a 24-volt motor-generator set).

WARNING—Keep batteries out of reach of children. They contain SULFURIC ACID. Avoid

contact with skin, eyes or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with skin, eyes, or clothing, **FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF 15 MINUTES.** If acid is swallowed, drink large quantities of milk or water, followed by milk of magnesia, a beaten egg or vegetable oil. **CALL A PHYSICIAN IMMEDIATELY.**

Hydrogen and oxygen gases are produced during normal battery operation. This gas mixture can explode if flames, sparks or lighted tobacco are brought near the battery. When charging or using a battery in an enclosed space, always provide ventilation and shield your eyes.

Use particular care when connecting a booster battery to prevent sparks. Before jump starting, turn the heater A/C blower "ON" and leave it on after the engine starts until after the jumper cables are removed. Turn all the lights "OFF" before jump starting and leave them off after the engine starts until after the jumper cables are removed. To jump start: (1) connect ends of one cable to positive (+) terminals of each battery, (2) connect one end of other cable to negative (-) terminal of "good" battery, (3) connect other end of cable to engine block on vehicle being started (NOT TO NEGATIVE (-) TERMINAL OF BATTERY). To prevent damage to other electrical components on vehicle being started, make certain that engine is at idle speed before disconnecting jumper cables. When disconnecting cables, remove cable from engine block before disconnecting cable from battery positive terminal.



J1259-1F

FIG. 2 Starter Cranking Circuit Test

If the starter does not turn the engine over, even with the booster battery attached, refer to the following tests.

ON-VEHICLE TESTING

Disconnect vacuum line to thermactor by-pass valve before performing any cranking tests. After tests, run engine 3 minutes before connecting vacuum line.

STARTER DRIVE TEST

1. With the transmission in park or neutral only, pull the push-on connector from the starter relay terminal "S".
2. Connect a remote control starter switch to the starter relay "S" and "BATTERY" terminals.
3. Turn the ignition switch key to the ON position and depress the remote control starter switch. As soon as the engine begins to run, turn ignition key to "OFF" position while holding the remote control switch in the START position. **The dead engine should now be cranked by the starter.**
4. Observe if the starter is cranking the dead engine and if it continues to crank the engine until the remote control switch is released. If the starter is heard to be rotating but does not crank the **dead engine, the drive assembly is slipping.**
5. Repeat the test at least three times in succession to detect intermittent operation.

STARTER CRANKING CIRCUIT TEST

Excessive resistance in the starter circuit can be determined from the results of this test. Make the test connections as shown in Fig. 2. Crank the engine with the ignition OFF. This is accomplished by disconnecting the push-on connector(s) at the starter relay and by connecting a remote-control starter switch from the battery terminal of the starter relay to the "S" terminal of the relay.

The voltage drop in the circuit will be indicated by the voltmeter (0 to 2 volt range). Maximum allowable voltage drop should be:

1. 0.5 volt with the voltmeter negative lead connected to the starter terminal and the positive lead connected to the battery positive terminal (Fig. 2, connection 1).
2. 0.1 volt with the voltmeter negative lead connected to the starter relay (starter side) and the positive lead connected to the positive terminal of the battery (Fig. 2, connection 2).
3. 0.3 volt with the voltmeter negative lead connected to the starter relay (battery side) and the positive lead connected to the positive terminal of the battery (Fig. 2, connection 3).
4. 0.3 volt with the voltmeter negative lead connected to the negative terminal of the battery and the positive lead connected to the engine ground (Fig. 2, connection 4).

STARTER LOAD TEST

Connect the test equipment as shown in Fig. 3. Be sure that no current is flowing through the ammeter and heavy-duty carbon pile rheostat portion of the circuit (rheostat at maximum counterclockwise position).

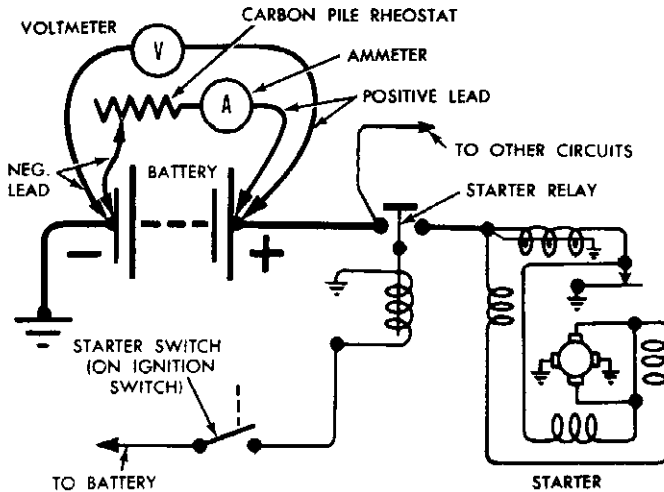


FIG. 3 Starter Load Test

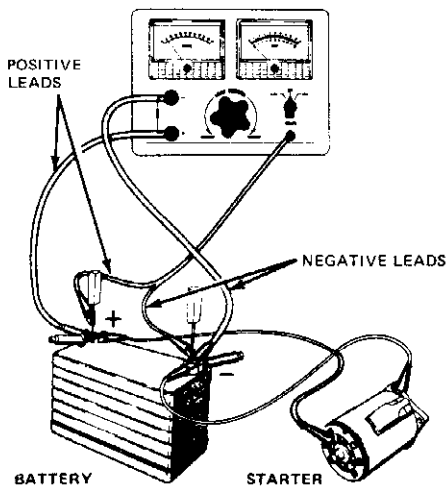


FIG. 4 Starter No-Load Test on Test Bench

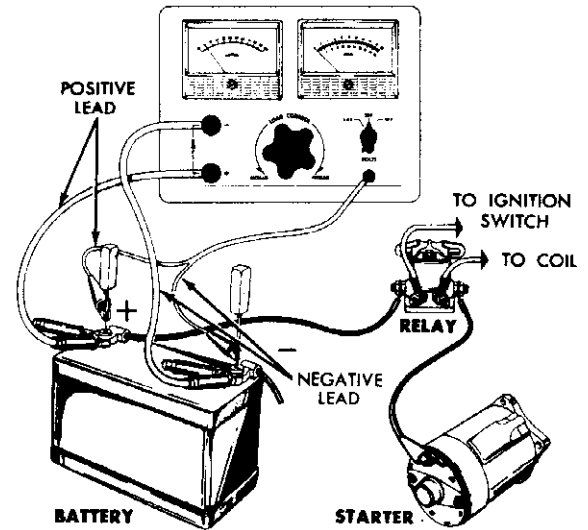
Crank the engine with the ignition OFF, and determine the exact reading on the voltmeter. This test is accomplished by disconnecting the push-on connector "S" at starter relay and by connecting a remote-control starter switch from the positive battery terminal to the "S" terminal of the starter relay.

Stop cranking the engine, and reduce the resistance of the carbon pile until the voltmeter indicates the same reading as that obtained while the starter cranked the engine. The ammeter will indicate the starter current draw under load.

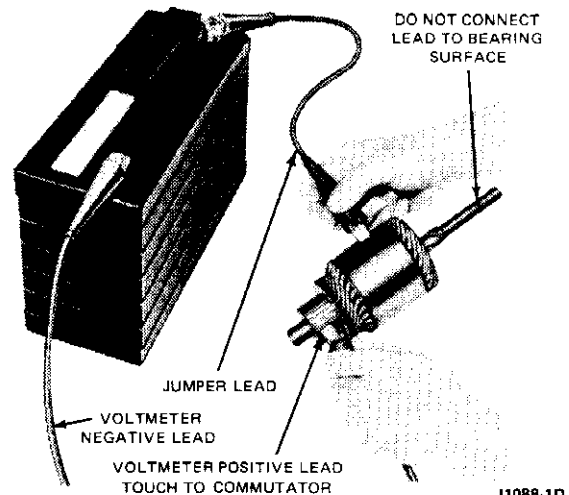
BENCH TESTS

Starter No-Load Test

The starter no-load test will uncover such faults as open or shorted windings, rubbing armature, and bent armature shaft. The starter can be tested, at no-load, on the test bench only.



J1086-2J



J1088-1D

FIG. 5 Armature Grounded Circuit Test

Make the test connections as shown in Fig. 4, with cables connected to the starter large enough to carry high current—the same as in the vehicle. The starter will run at no-load. Be sure that no current is flowing through the ammeter (rheostat at maximum counterclockwise position). Determine the exact reading on the voltmeter.

Disconnect the starter from the battery, and reduce the resistance of the rheostat until the voltmeter indicates the same reading as that obtained while the starter was running. The ammeter will indicate the starter no-load current draw.

If current exceeds specifications, check for rubbing armature, bent shaft, binding bearings, or shorts in armature, fields or brush assembly.

ARMATURE OPEN CIRCUIT TEST

An open circuit armature may sometimes be detected by examining the commutator for evidence of burning.

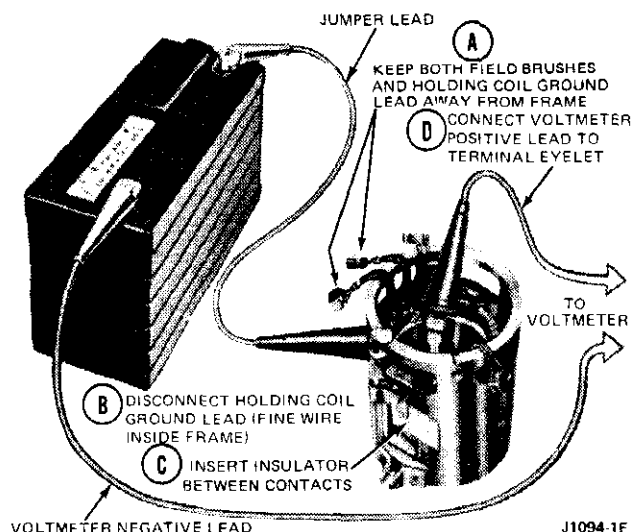


FIG. 6 Field Grounded Circuit Test

A spot burned on the commutator is caused by an arc formed every time the commutator segment, connected to the open circuit winding, passes under a brush.

ARMATURE AND FIELD GROUNDED CIRCUIT TEST

This test will determine if the winding insulation has failed, permitting a conductor to touch the frame or ARMATURE core.

To determine if the armature windings are grounded, make the connections as shown in Fig. 5. If the voltmeter INDICATES any voltage, the windings are grounded.

Grounded field windings can be detected by making the connections and following the instructions shown in Fig. 6. If the voltmeter indicates any voltage, the field windings are grounded.

REMOVAL AND INSTALLATION

GRANADA, MONARCH AND VERSAILLES WITH 5.0L (302 CID) V-8 ENGINE

Removal

1. Disconnect negative battery cable.
2. Raise the vehicle on a hoist.
3. Disconnect starter cable at the starter terminal.
4. Remove the thru bolt and nut attaching the motor mount insulator to mounting bracket.
5. Remove the two bolts attaching the insulator to block and remove the insulator from vehicle.
6. Position jack under engine and raise it.
7. Remove starter attaching bolts and remove starter.

Installation

1. Position starter to flywheel housing and install the two attaching bolts.
2. Connect starter cable to starter.
3. Position insulator to vehicle and start the two attaching bolts to cylinder block.
4. Lower engine and install thru bolt and nut attaching motor mount insulator to mounting bracket. Torque all bolts to specifications and remove jack.
5. Lower vehicle and connect negative battery cable.

FAIRMONT AND ZEPHYR WITH 2.3L I-4 AND GRANADA AND MONARCH WITH 4.1L (250 CID) I-6 ENGINE

Removal

1. Disconnect negative battery cable.
2. Disconnect starter cable from motor.
3. Raise the vehicle on hoist.
4. Remove starter attaching bolts and remove starter assembly.

Installation

1. Position starter motor to engine and install attaching bolts. Torque to specification.
2. Lower vehicle to the floor.
3. Connect starter cable to motor. Torque to specification.
4. Connect negative battery cable.

FAIRMONT AND ZEPHYR WITH 3.3L (200 CID) I-6 ENGINE

Removal

1. Disconnect negative battery cable.
2. Remove the top starter bolt.
3. Remove two nuts and remove exhaust heat shield.
4. Disconnect starter cable from motor.
5. Raise the vehicle on hoist.
6. Remove wishbone brace.
7. Remove the last two starter mounting bolts.
8. Remove the starter assembly.

Installation

1. Position starter motor to engine and hold firmly in place against mounting surface, then install (2) attaching bolts.
2. Install wishbone brace.
3. Lower vehicle to the floor.
4. Install starter cable to motor.
5. Install exhaust shield and two retaining nuts.
6. Install the top starter mounting bolt.
7. Connect battery ground cable.

FARIMONT AND ZEPHYR WITH 5.0L (302 CID) V-8 ENGINE

Starter Removal

1. Disconnect negative battery cable.
2. Raise the vehicle on hoist.
3. Remove wishbone brace.
4. Remove starter attaching bolts and remove starter assembly.
5. Disconnect starter cable from motor.

Installation

1. Connect starter cable to motor. Torque to specification.
2. Position starter motor to engine and install (2) attaching bolts.

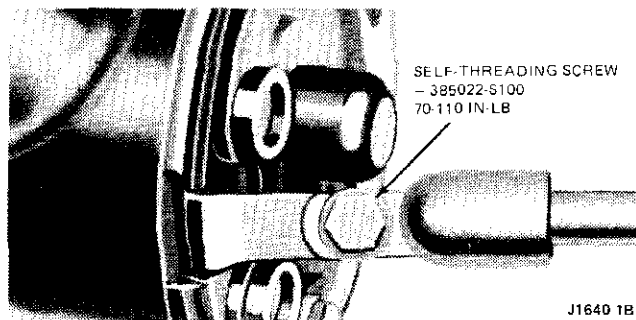


FIG. 7 Starter Cable Attachment To Starter Terminal

3. Install wishbone brace.
4. Lower vehicle to the floor.
5. Connect negative battery cable.

DISASSEMBLY AND ASSEMBLY

POSITIVE ENGAGEMENT STARTER

Use the following procedure when it becomes necessary to completely overhaul the starter. Figs. 8 and 9 illustrate a disassembled starter.

Disassembly

1. Remove the cover screw, cover, through bolts, starter drive end housing, and the starter drive plunger lever return spring.
2. Remove the pivot pin retaining the starter gear plunger lever and remove the lever and the armature.
3. Remove the stop ring retainer from the armature shaft. Remove the stop ring from the groove in the armature shaft and discard it. Remove the starter drive gear assembly.
4. Remove the brush end plate and insulator assembly.
5. Remove brushes from plastic brush holder and lift out brush holder. Note location of brush holder with respect to end terminal.
6. Remove the two screws retaining the ground brushes to frame.
7. Bend up the edges of the sleeve which is inserted in the rectangular hole in the frame and remove sleeve and retainer. Detach field coil ground wire from copper tab riveted to frame.
8. Remove the three coil retaining screws, using Tool 10044-A and an arbor press (Fig. 10). The arbor press prevents the wrench from slipping out the screw. Cut the field coil connection at the switch post lead and remove pole shoes and coils from frame.
9. Cut the positive brush leads from the field coils, as close to the field connection point as possible.

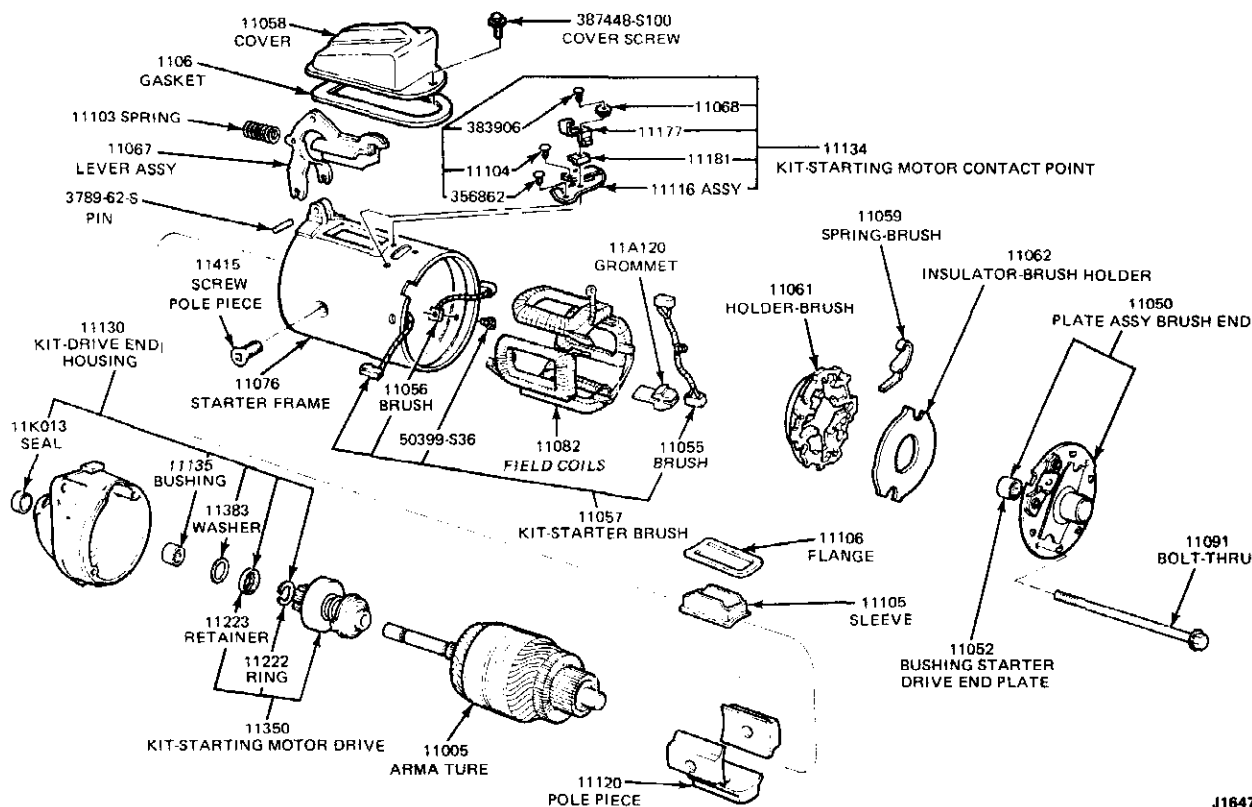
Cleaning and Inspection

1. Use a brush or air to clean the field coils, armature assembly, brush holder, brushes, drive assembly and drive end housing. Wash all other parts in solvent and dry the parts.

2. Inspect the armature windings for broken or burned insulation and unsoldered or open connections.
3. Check the armature for open circuits and grounds.
4. Check the commutator for run out (Fig. 11). Inspect the armature shaft and the two bearings for scoring and excessive wear. If the commutator is rough, or more than 0.005 inch out-of-round, turn it down to specification.
5. Check the plastic brush holder for cracks or broken mounting pads. Replace the brushes if worn to 1/4 inch in length.
6. Inspect the field coils for burned or broken insulation and continuity.
7. Check the field brush connections. A brush kit and contact kit are available. All other assemblies are to be replaced rather than repaired.
8. Examine the wear pattern on the starter drive teeth. The pinion teeth must penetrate to a depth greater than 1/2 the ring gear tooth depth (Fig. 12), to eliminate premature ring gear and starter drive failure.
9. Replace starter drives and ring gears that have milled, pitted or broken teeth or show evidence of inadequate engagement (Fig. 12).

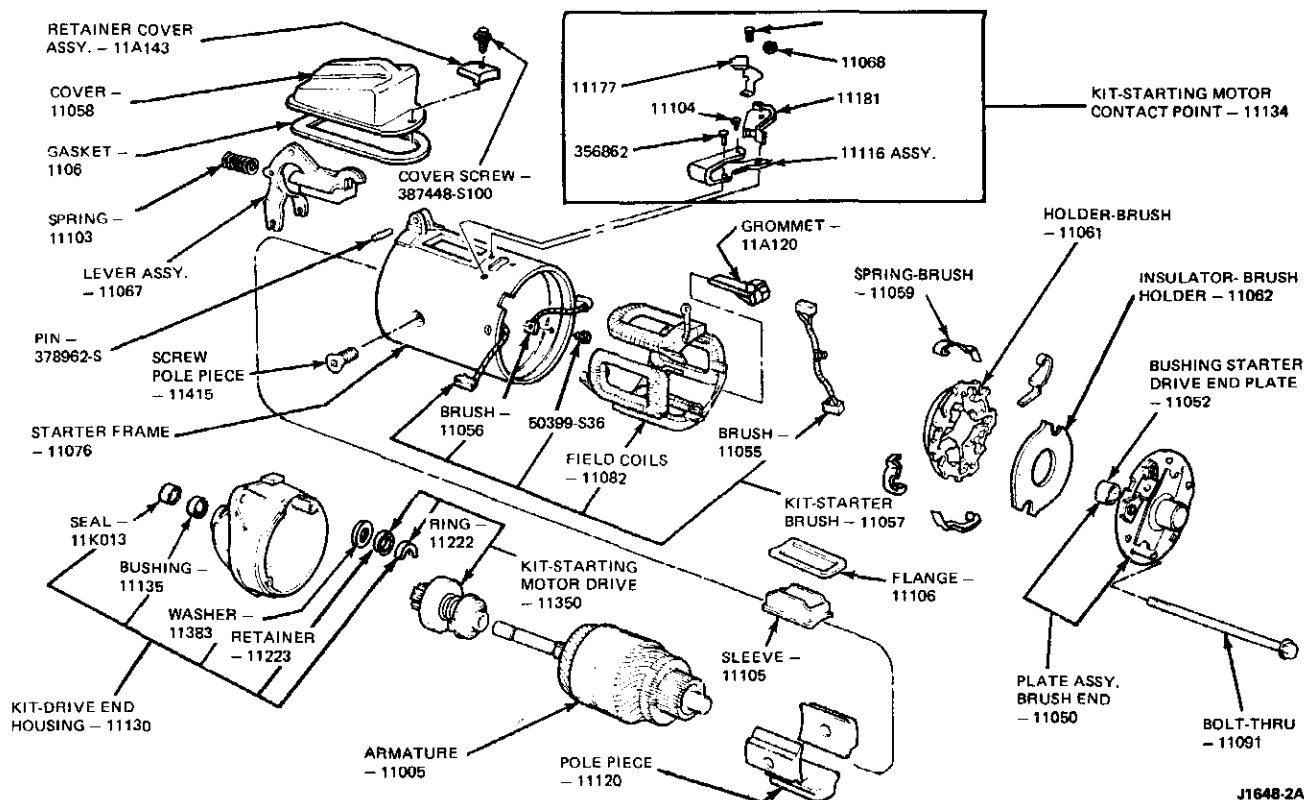
ASSEMBLY

1. Position the coils and pole pieces, then install the retaining screws (Fig. 10); as the pole shoe screws are tightened, strike the frame several sharp blows with a soft faced hammer to seat and align the pole shoes, then stake the screws.
2. Install the plunger coil sleeve and retainer and bend the tabs to retain the coils to the frame.
3. Position grammet on end terminal and align into the notch in the frame.
4. Solder field coil to starter terminal post strap. Use 300 watt iron and rosin core solder.
5. Check for continuity and grounds in assembled coils.



J1647-2A

FIG. 8 Positive Engagement Starter Disassembled—(4.0 Inch)



J1648-2A

FIG. 9 Positive Engagement Starter Disassembled—(4.5 Inch)

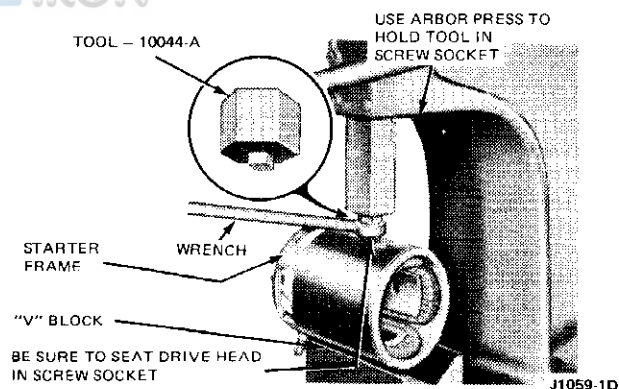


FIG. 10 Pole Shoe Screw Removal

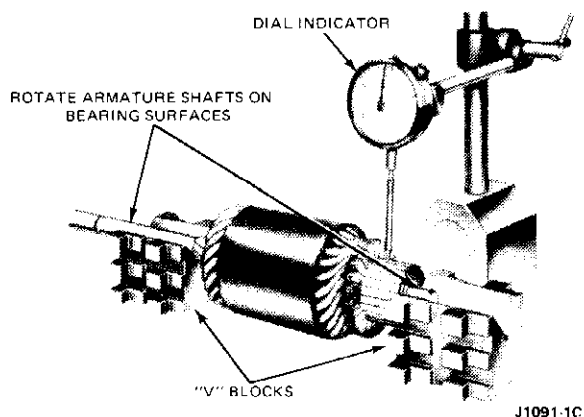


FIG. 11 Commutator Runout Check

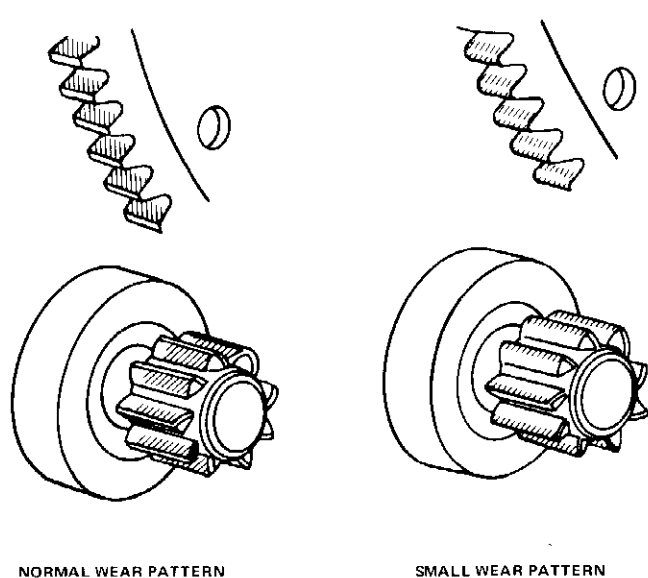
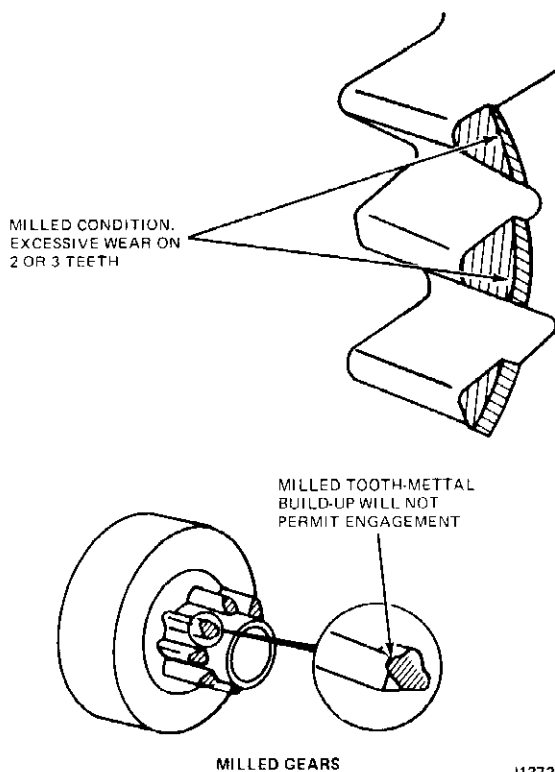


FIG. 12 Starter Pinion and Ring Gear Wear Patterns

6. Position the ground brushes to the starter frame and install the retaining screws.
7. Apply a thin coating of Lubriplate 777 or equivalent on the armature shaft splines. Install starter motor drive gear assembly to the armature shaft and install a new stop ring. Install a new stop-ring retainer.
8. Install the armature in the starter frame.
9. Position the starter drive gear plunger lever to the frame and starter drive assembly, and install the pivot pin. Apply grease into end housing bearing bore (approximately 1/4 full). Position drive end housing to frame.
10. Install brush holder and insert brushes in holder and install brush springs. Positive brush leads should be positioned in their respective slots in the brush holder to prevent potential grounding.
11. Install the brush end plate. Be certain end plate insulator is positioned properly on end plate.
12. Install the two thru bolts to the starter frame and torque to 55-75 in-lbs.
13. Install starter drive plunger lever cover and tighten retaining screw.
14. Check the starter no-load current draw per specifications.

STARTER DRIVE REPLACEMENT

1. Remove the plunger lever cover (Figs. 8 and 9).
2. Loosen the through bolts enough to allow removal of the drive end housing and the starter drive plunger lever return spring.



3. Remove the pivot pin retaining the starter drive plunger lever and remove the lever.
4. Remove the drive gear stop ring retainer and stop ring from the groove in the armature shaft and remove the drive gear assembly.
5. Apply a thin coating of Lubriplate 777 or equivalent on the armature shaft splines. Install the new drive gear assembly on the armature shaft and install a new stop ring.
6. Position the starter gear plunger lever on the starter frame and install the pivot pin. **Be sure that the plunger lever properly engages the starter drive assembly.**
7. Install a new stop-ring retainer. Partially fill the drive end housing bearing bore with grease (approximately 1/4 full). Position the starter drive plunger lever return spring and drive end housing to the starter frame, and then tighten the through bolts to specifications (55 to 75 in-lbs).
8. Position the starter drive plunger lever cover on the starter. Tighten the retaining screw.

ARMATURE REPLACEMENT

1. Remove plunger lever cover retainer screw and remove cover.
2. Remove the through bolts, the drive end housing, and the drive plunger lever return spring, brush end plate.
3. Remove the pivot pin retaining the starter gear plunger lever, and remove the lever. Remove brushes and lift out brush holder.
4. Remove the armature. If the starter drive gear assembly is being reused, remove the stop ring retainer and stop ring from the end of the armature shaft, and remove the drive.
5. Place the drive gear assembly on the new armature with a new stop ring.
6. Install the armature in the starter frame.

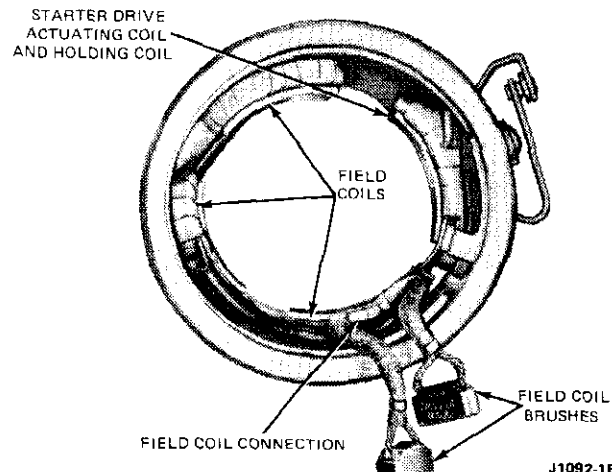


FIG. 13 Field Coil Assembly

7. Position the drive gear plunger lever to the frame and drive gear assembly and install the pivot pin.
8. Partially fill the drive end housing bearing bore with grease (approximately 1/4 full). Position the drive plunger lever return spring, the drive end housing to the starter frame. Be sure that the stop ring retainer is seated properly in the drive housing.
9. Install brush holder and insert brushes in holder and install brush springs. Positive brush leads should be positioned in their respective slots to prevent grounding.
10. Install the brush end plate (be certain end plate insulator is positioned properly on end plate).
11. Install the two thru bolts to the starter frame and torque to 55-75 in-lbs.
12. Install plunger lever cover and tighten retaining screw.
13. Check the starter no-load current draw.

SPECIFICATIONS

POSITIVE ENGAGEMENT STARTER

Positive Engagement Starter Motor						Starter Brushes			Through Bolt Torque (In-Lbs)	Mounting Bolt Torque (In-Lbs)	Cable Attaching Screw (In-Lbs)
Dia. (Inches)	Current Draw Under Normal Load (Amps)	Normal Engine Cranking Speed (rpm)	Min. Stall Torque @ 5 Volts (Ft-Lbs)	Max. Load (Amps)	No. Load (Amps)	Mfg. Length (Inches)	Wear Limit (Inches)	Spring Tension (Ounces)			
4	150-200	180-250	9.0	460	70	0.50	0.25	40	55-75	15-20	70-110
4-1/2	150-180	150-290	15.5	670	80	0.50	0.25	80	55-75	15-20	70-110

Maximum Commutator runout is 0.005 inch. Maximum starting circuit voltage drop (battery positive terminal to starter terminal) at normal engine temperature is 0.5 volt.

SPECIAL TOOLS

Ford Tool No.	Former No.	Description
TOOL 10044-A	10044-A	Generator Pole Screw Wrench

CJ1430-2D

ENGINE EMISSION CONTROL SYSTEMS

GROUP
29
(9000)

PART TITLE	PART NO.	PART TITLE	PART NO.
2.3L Feedback Carburetor Electronic		Engine Diagnosis and Service	29-02
Engine Control System	29-08	General Service	29-01
EEC System	29-06	Thermactor System	29-03
EGR System	29-07		

CA4253-2B

Emission Systems General Service

PART
29-01

All Models

SUBJECT	PAGE	SUBJECT	PAGE
GENERAL INFORMATION		GENERAL INFORMATION (Cont'd.)	
Air Cleaner Mounted Switches	01-4	Emission Related Spark Control	
Emission Related Fuel System		Components	01-2
Components	01-1	Identification	01-1
Emission Related Miscellaneous			
Components	01-4		

CA4254-2A

GENERAL INFORMATION

The Engine Emission Control Systems section of this Manual is designed to cover those adjustments and *service operations required to meet factory specifications* for passenger cars. General information for emission reduction systems and miscellaneous emission related parts will be covered in Part 29-01, while descriptions of the various components will be carried in the individual Parts. Engine Diagnosis and Service are covered in Part 29-02.

IDENTIFICATION

Each passenger car is equipped with a decal containing emission control data that applies specifically to that vehicle and engine. This data is critical to the servicing of the emission systems (Fig. 1).

When performing services listed in Part 29-02, refer to this decal located either on the engine or, in the case of Pinto and Bobcat, on the inside front of the engine compartment hood.

EMISSION-RELATED FUEL SYSTEM COMPONENTS

ELECTRIC ASSISTED CHOKE

Some passenger cars use an electrically-assisted choke thermostatic spring heater as an aid to fast choke release and better emission characteristics during engine warm-up (Fig. 2). The heaters are temperature sensitive and operate from current supplied from the center tap of the alternator when the engine is running (Fig. 4).

The temperature sensitive electric choke assist system consists of a choke cap, thermostatic spring, a bi-metal temperature sensing disc (switch), and a ceramic positive temperature coefficient (PTC) heater. The current to operate the system is supplied from the center tap of the alternator to the temperature sensing switch.

The system is grounded through a ground strap connected to the carburetor body. At temperatures

FORD MOTOR COMPANY				DRIVE	MAINT
VEHICLE EMISSION CONTROL INFORMATION				SCHED	SCHED 8
ENGINE FAMILY 2.8 "MV" (TX160) EGR/AIR/CATALYST					
ENGINE DISPLACEMENT 2.8 (171 CID) TRANS. AUTO					
SPARK PLUG AWBF-42 GAP .032-.036					
VALVE INT. COLD P14		ALTITUDE		OVER 4000 FT	
LASH BKH COLD P16		DRIVE		UNDER 4000 FT	
TRANSMISSION GEAR		NEUTRAL		IDLE SPEED	
TIMING RPM		750		REDUCTION	
CHOKE SETTING		INDEX		100 MMES	
FAST IDLE HIGH CAM		1750			
-100 RPM/ICE DOWN				150	
CURB IDLE		A/C		750	
: 50 RPM		A/C		75	
TSP OFF		A/C		800	
: 50 RPM		A/C		75	
CATALYST					
THIS VEHICLE CONFORMS TO U.S.E.P.A. AND CALIFORNIA REGULATIONS					
APPLICABLE TO 1978 MODEL YEAR NEW MOTOR VEHICLES					
D8ZE-9C485-CA				B-000	

MAKE ALL ADJUSTMENTS WITH ENGINE AT NORMAL OPERATING TEMPERATURE A/C AND HEADLIGHTS OFF. DISCONNECT SENSOR CONNECTOR AT IGNITION MODULE BEFORE SETTING TIMING OR CURB IDLE (IF SO EQUIPPED). CONSULT SERVICE PUBLICATIONS FOR ADDITIONAL INSTRUCTIONS ON THE FOLLOWING PROCEDURES.

IGNITION TIMING ADJUST WITH HOBER DISCONNECTED AND PLUGGED AT THE DISTRIBUTOR.

CURB IDLE: ADJUST WITH ALL VACUUM HOSES CONNECTED, AIR CLEANER IN POSITION AND THROTTLE SOLENOID POSITIONER ENERGIZED (IF SO EQUIPPED).

IDLE MIXTURE: PASSBY AT THE FACTORY. DO NOT REMOVE THE LIMITER CAP(S) EXCEPT IN ACCORDANCE WITH SERVICE PUBLICATIONS.

A4056-1C

FIG. 1 Typical Emission Control Decal

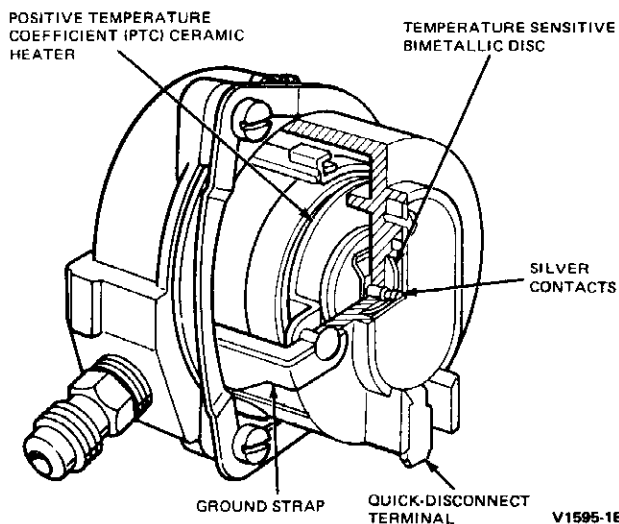


FIG. 2 Temperature Sensitive Type Electric Assisted Choke

below approximately 60 degrees F, the switch is open and no current is supplied to the ceramic heater located within the thermostatic spring. Normal thermostatic spring choking action then occurs. At temperatures above approximately 60 degrees F, the temperature sensing switch closes and current is supplied to the

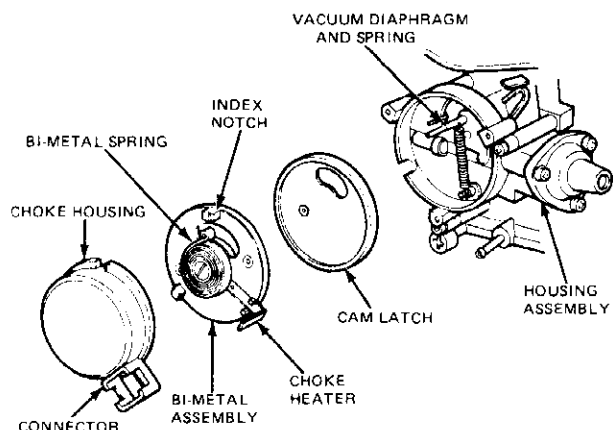


FIG. 3 Constant Operating Type Electric Assisted Choke

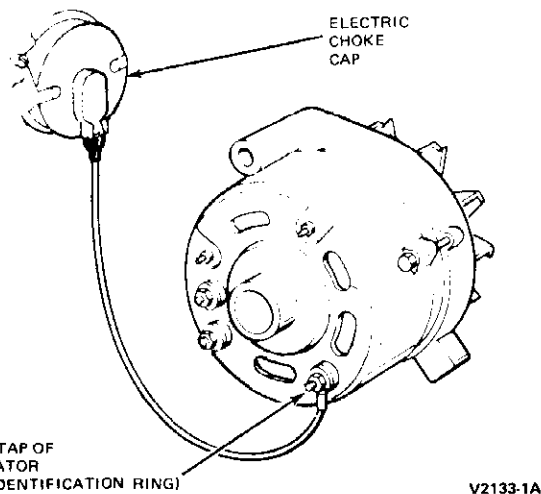


FIG. 4 Typical Electric Assisted Choke Wiring—Temperature Sensitive Type Shown

ceramic heater. As the heater warms, it causes the thermostatic spring to pull the choke plates open within 1 to 1-1/2 minutes.

The electric choke system used on the Model 5200 and 6500 carburetors is installed between the choke thermostatic spring and the choke casting and heats whenever the engine is running.

EMISSION RELATED SPARK CONTROL COMPONENTS

PORTED VACUUM SWITCHES (PVS)

These switches are used in several places in emission control and other engine systems. They consist of two-

three- or four-port coolant temperature operated vacuum switching devices. A typical three-port PVS is used in the cooling system to increase engine idle rpm when the engine overheats (Fig. 5).

When cold, the 3-port PVS provides a path through the top and center ports. When hot, only the center and bottom ports are connected. In the case of the cooling PVS, this provides carburetor spark port vacuum to the distributor vacuum advance under normal (cool) conditions and switches to engine manifold vacuum for increased idle speed when the engine is abnormally hot. As soon as the engine cools off, carburetor spark port vacuum is once again selected and the idle speed decreases as the spark is retarded again.

DISTRIBUTOR VACUUM VENT VALVE

Some engines require a distributor vacuum vent valve. The primary functions of the valve are to prevent fuel migration to the distributor and to act as a delay valve.

The distributor vacuum vent valve (Fig. 6) helps control exhaust emissions by delaying vacuum spark advance during light acceleration and by "dumping" vacuum to eliminate vacuum advance during heavy acceleration, deceleration and idle. The valve also eliminates fuel migration to the distributor diaphragm.

When spark port vacuum is applied to the vent valve diaphragm (Fig. 7), the dump valve closes, the check valve opens and the distributor diaphragm begins to evacuate through the sintered metal restrictor. At the same time, any fuel in the spark port line is evacuated. The sintered metal restrictor located in the vent valve diaphragm acts as a spark delay valve slowing spark advance.

When spark port vacuum decreases, the check valve closes and the dump valve opens the distributor vacuum line to atmosphere. Venting the distributor vacuum line to atmosphere prevents fuel migration to the distributor diaphragm and returns the distributor to zero vacuum advance.

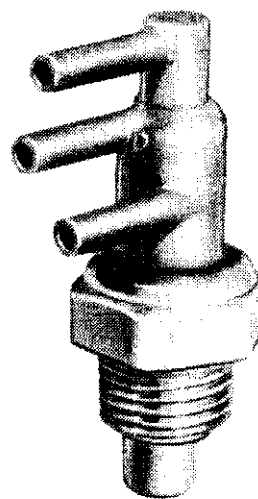
COLD START SPARK ADVANCE (CSSA)

On some engines, a Cold Start Spark Advance System (CSSA) is added to the distributor spark control system (Fig. 8).

This system momentarily traps spark port vacuum on the distributor spark advance diaphragm when the engine coolant temperature is below 125° F. The vacuum path is from the carburetor vacuum tap, through the Distributor Retard Control Valve (DRCV), through the CSSA PVS, through the cooling PVS and to the distributor.

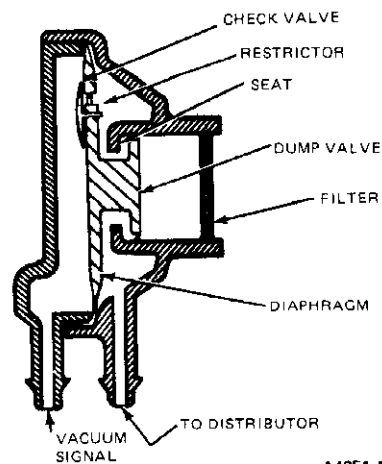
At and above the CSSA PVS temperature, the CSSA PVS is operated. Vacuum then reaches the distributor as follows: from the carburetor spark port, through the SDV, through the CSSA PVS, through the cooling PVS and to the distributor.

Above 235° F., the cooling PVS operates, directing intake manifold vacuum to the distributor. In an over-temperature situation at idle, this will increase engine rpm by providing increased vacuum. When the engine temperature decreases, spark will once more be controlled from the spark port of the carburetor.



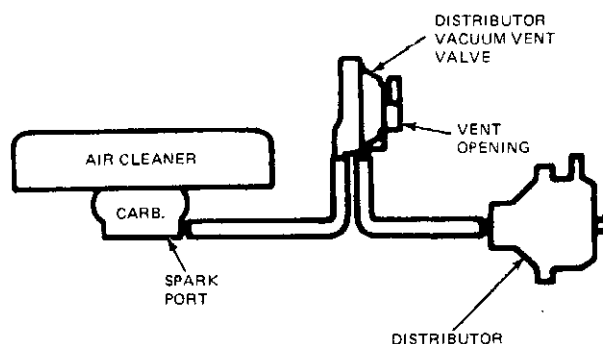
B3104-1A

FIG. 5 Cooling PVS—Typical



A4251-A

FIG. 6 Distributor Vacuum Vent Valve



A4252-1B

FIG. 7 Typical Vent Valve Installation

COLD START SPARK HOLD (CSSH)

The Cold Start Spark Hold system provides momentary spark advance hold during acceleration when the engine is cold, and is used to provide improved cold engine acceleration.

When the engine coolant is less than 53°C (128°F), the CSSH PVS is closed and the distributor vacuum signal travels through the restrictor (Fig. 9).

At cold start, high vacuum acts on the distributor diaphragm, giving maximum spark advance. During cold acceleration, the high vacuum already in the distributor diaphragm is slowly bled down through the restrictor, providing a modified vacuum advance during the initial stage of acceleration.

SPARK DELAY VALVES (SDV)

Spark delay valves are installed on many engines to permit closer control of vacuum operated emission related equipment. All SDV's have an internal sintered orifice to slow air flow in one direction, a check valve to allow free air flow in the opposite direction, and a filter. They can be installed on previous model year vehicles (Figs. 10 and 11).

EMISSION RELATED MISCELLANEOUS COMPONENTS

PCV VALVE AND CRANKCASE VENT CAP

All engines are equipped with a closed crankcase emission control system that features a filler cap ventilated to the crankcase and a vacuum-operated Positive Crankcase Ventilation (PCV) valve (Fig. 12).

When the engine is running, vapors that may escape past piston rings are pulled back into the intake manifold, causing fresh air to flow into the crankcase through the filler cap. Periodic maintenance is required to keep system operating properly.

AIR CLEANER MOUNTED SWITCHES

Cold Weather Modulator (Fig. 13)

The Cold Weather Modulator is a vacuum modulator located in the air cleaner on some modulator located in the air cleaner on some models. During engine operation in cold ambient temperatures, it prevents the air cleaner duct door from opening to non-heated intake air. When available air from the "fresh air" intake is above 55°F, the cold weather modulator does not operate.

Normally, the duct air door will be closed to outside air any time vacuum from the bimetal sensor is applied. This occurs when the outside temperature is low enough to require heated air for carburetor intake. When the vacuum is cut off, the door will open. This occurs when

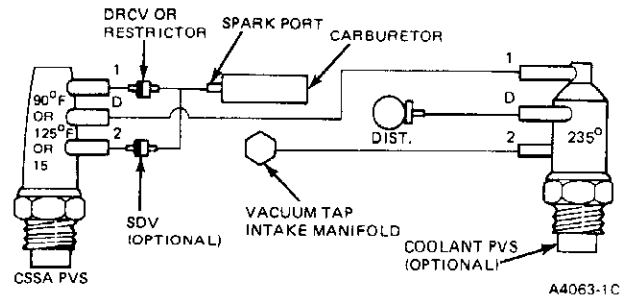


FIG. 8 Cold Start Spark Advance (CSSA) System—Typical

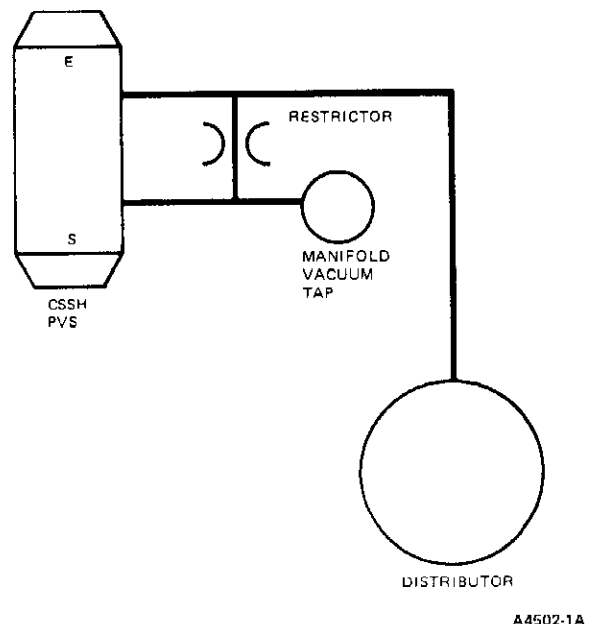
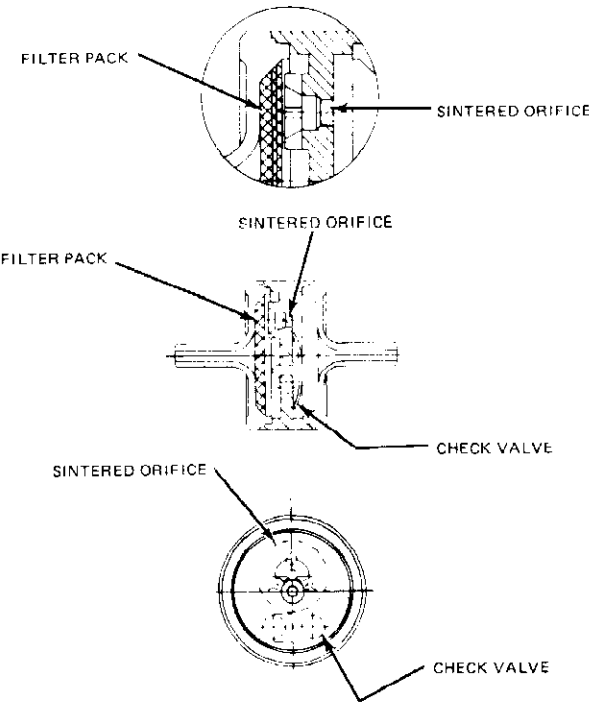


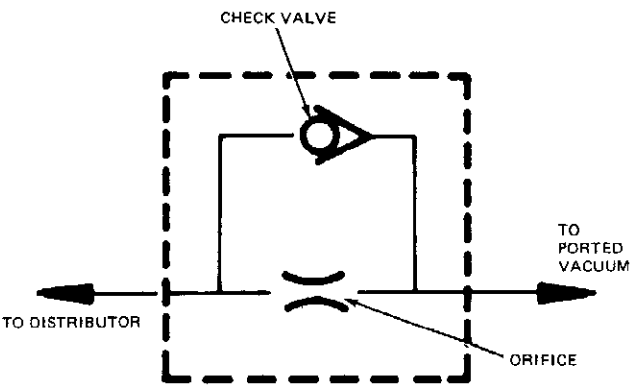
FIG. 9 Cold Start Spark Hold (CSSH) System

temperature rises high enough to operate the bi-metal sensor. It also happens during acceleration in cold conditions. When this situation is encountered, the Cold Weather Modulator, inserted in the vacuum line between the bi-metal sensor and the vacuum duct motor, will close the vacuum to the motor and hold the duct door open.



V1826-1A

FIG. 10 Spark Delay Valve (SDV)



A4101-1B

FIG. 11 Spark Delay Valve (SDV) Schematics

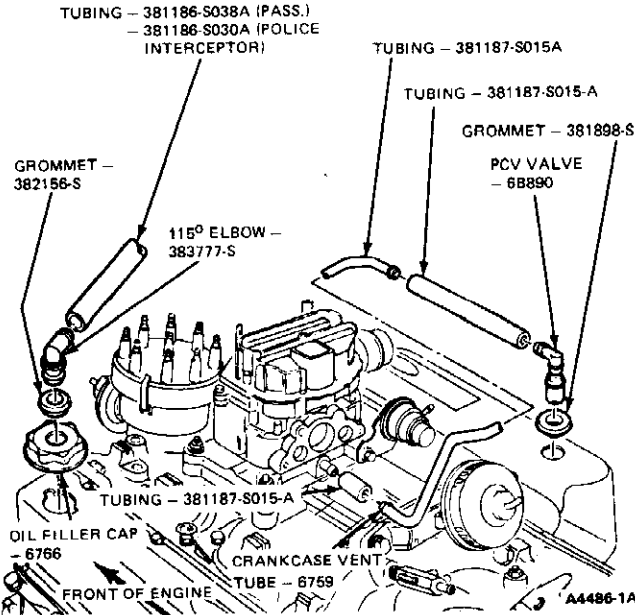
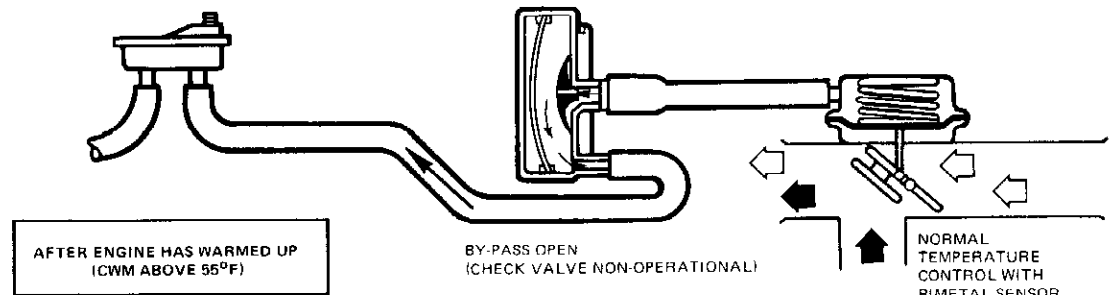
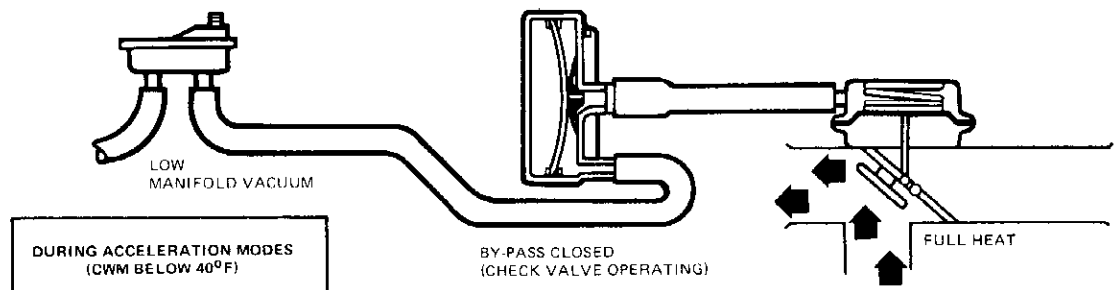
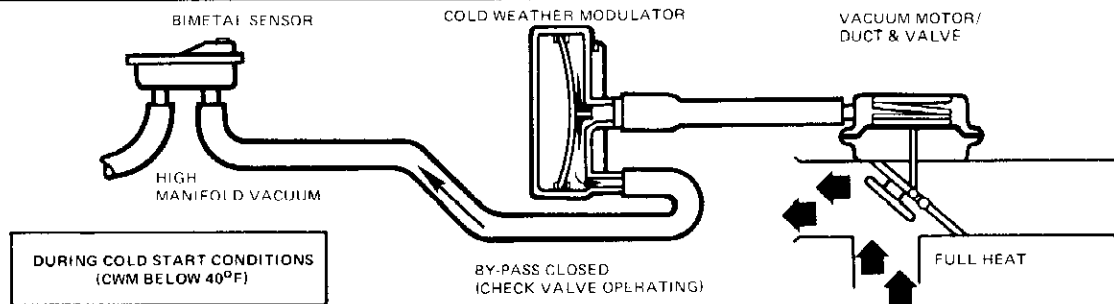
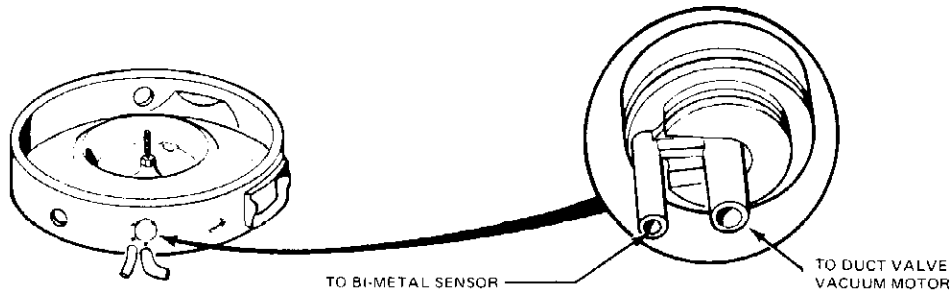


FIG. 12 Typical PCV System

PREVENTS VACUUM SIGNAL OVERRIDE AND CONTINUES TO PROVIDE HEATED AIR TO THE CARBURETOR UNTIL THE COLD WEATHER MODULATOR REACHES 55°F, AFTER WHICH THE BIMETAL SENSOR CONTROLS DUCT AND VALVE DOOR FUNCTION.



A4079-2B

FIG. 13 Cold Weather Modulator Operation

Engine Diagnosis and Service

PART
29-02

<u>SUBJECT</u>	<u>PAGE</u>
GENERAL INFORMATION	02-1
DIAGNOSIS CHARTS	
Diagnosis Chart Index	02-2

<u>SUBJECT</u>	<u>PAGE</u>
DIAGNOSIS PROCEDURES	
Procedure Index	02-62

CA4263-2A

GENERAL INFORMATION

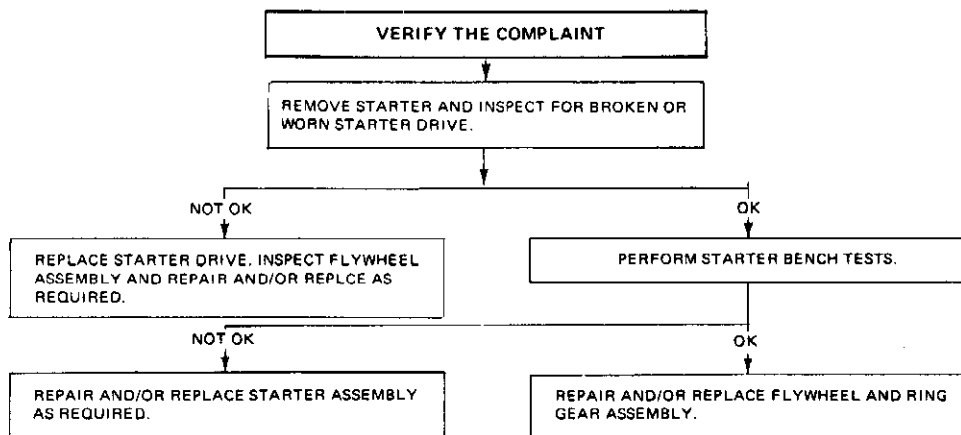
The following information comprises the Engine Diagnosis and Service procedures related to emission system related components. The diagnosis and related

service routines provided here are the only authorized service procedures for Ford Cars. Refer to Volume 5 of this Manual for Maintenance Procedures.

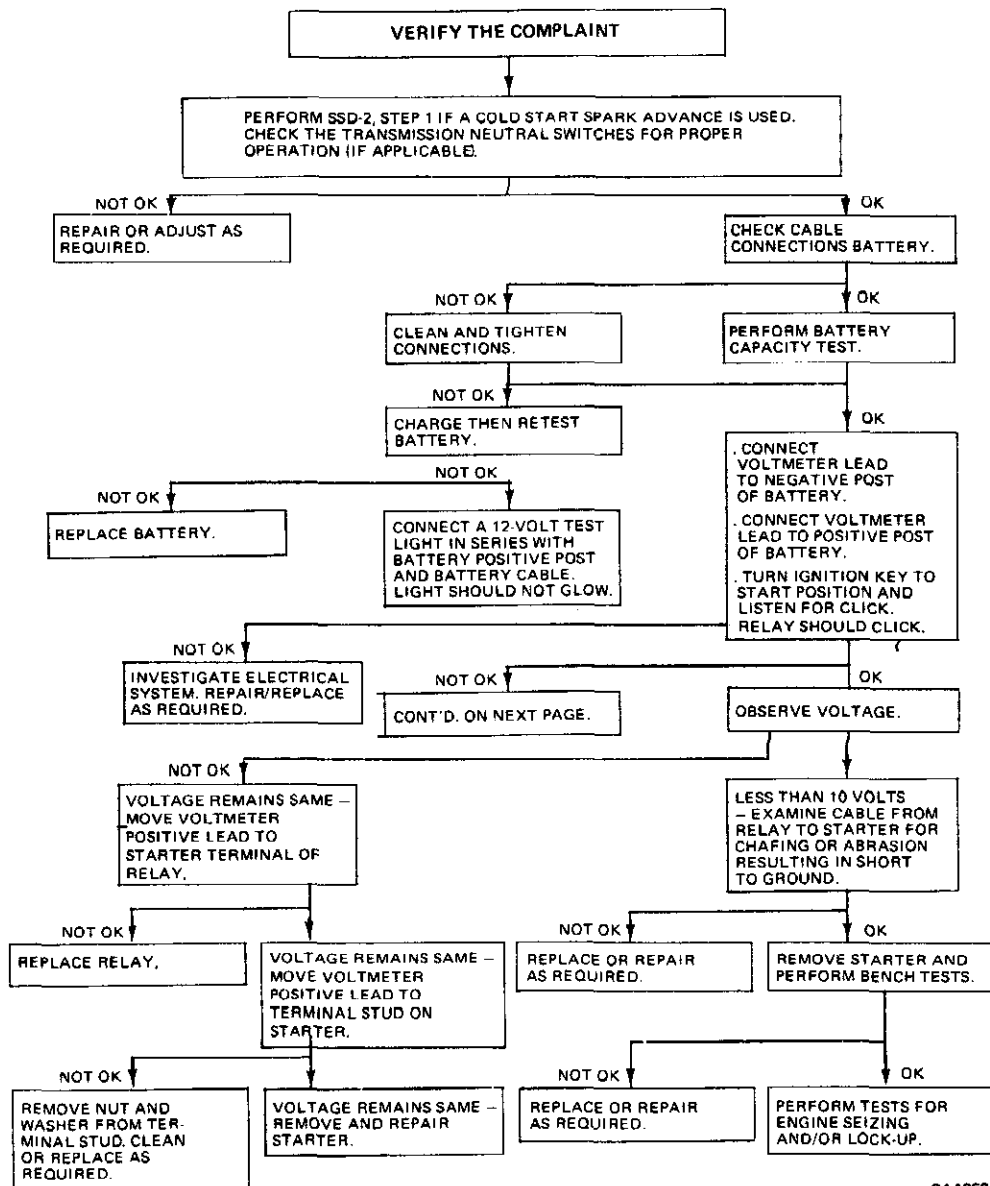
DIAGNOSIS CHARTS

ENGINE DIAGNOSTIC CHARTS	
COMPLAINT	PAGE
Routine 101 – Engine will not crank – starter spins	02-3
Routine 102 – Engine Will Not Crank	02-4
Routine 103 – Engine Cranks Slowly	02-6
Routine 104 – Engine Cranks Normally – Will Not Start	02-7
Routine 105 – Engine Cranks Normally – Starts Hard When Cold	02-9
Routine 106 – Engine Cranks Normally – Starts Hard When Hot	02-11
Routine 107 – Engine Idles Rough – Misses	02-13
Routine 108 – Engine Idle Speed Varies	02-16
Routine 109 – Engine Misses at High Speed	02-18
Routine 110 – Engine Misses at Low Speed	02-20
Routine 111 – Engine Stalls at Idle – Engine Cold	02-22
Routine 112 – Engine Stalls at Idle – Engine Hot	02-25
Routine 113 – Engine Stalls During Deceleration Or On Quick Stop	02-27
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Routine 117 – Exhaust System Backfire	02-36
Routine 118 – Engine Surges	02-37
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Routine 121 – Engine Diesels – Continues To Run After Shut Off	02-44
Routine 122 – Engine Noise	02-46
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Routine 123 – Engine Vibration	02-51
Routine 124 – Engine Fails To Reach Normal Operating Temperature	02-52
Routine 125 – Loss of Coolant Or Engine Overheating	02-53
Routine 126 – Smoke From Vehicle Exhaust System	02-55
DIAGNOSTIC CHART REFERENCE ONE	02-57
DIAGNOSTIC CHART REFERENCE TWO	02-58

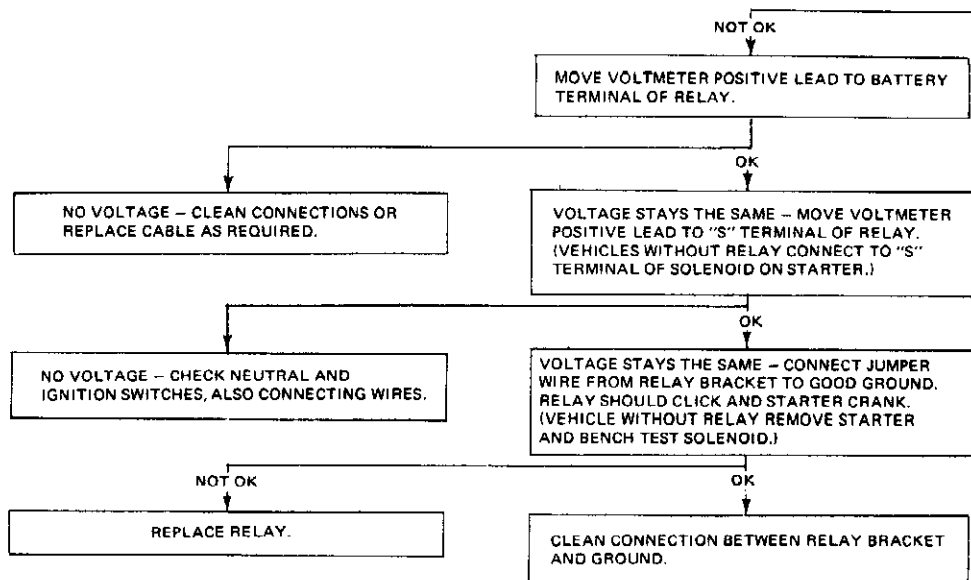
ROUTINE NO. 101
ENGINE WILL NOT CRANK – STARTER SPINS



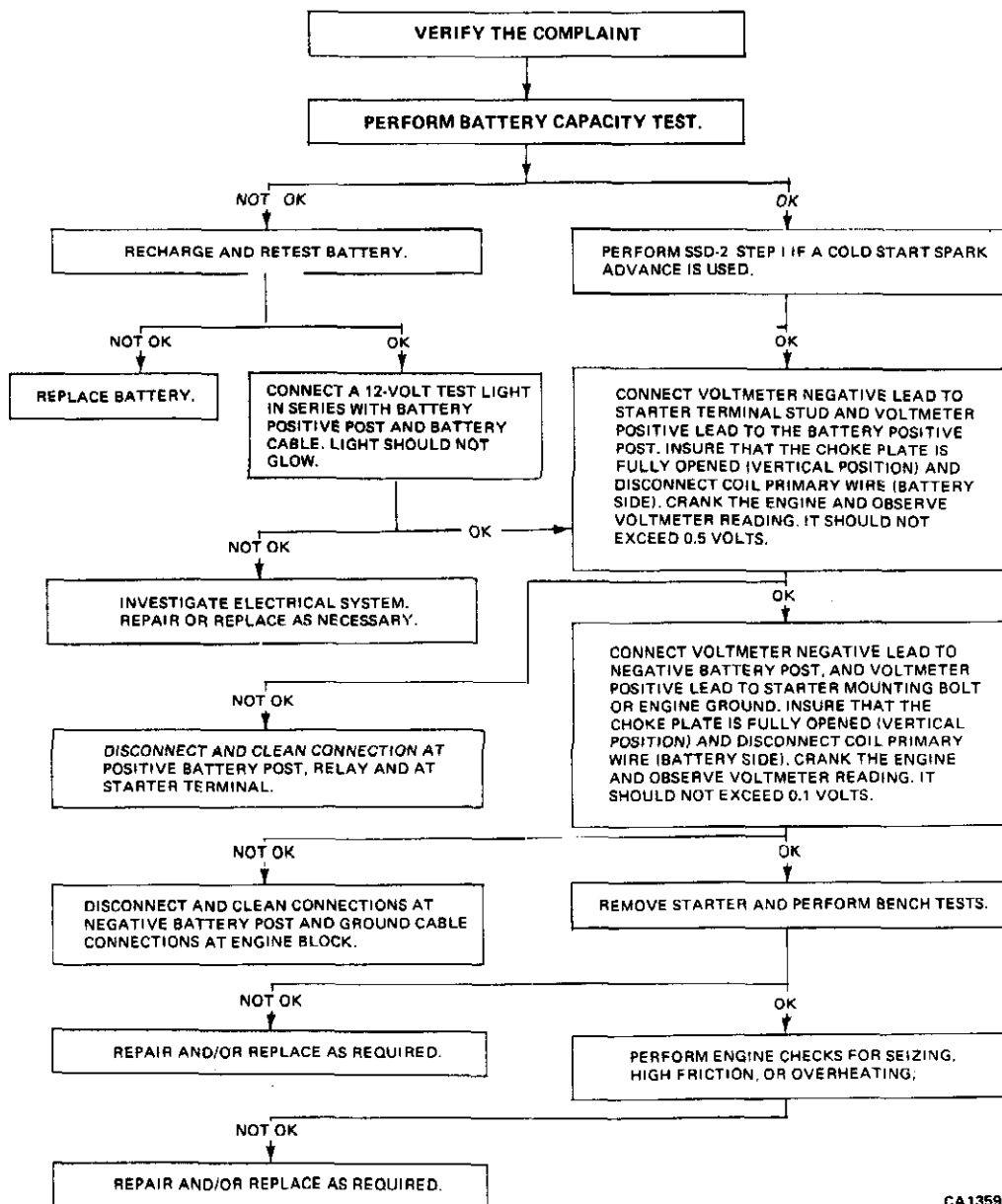
ROUTINE NO. 102 ENGINE WILL NOT CRANK



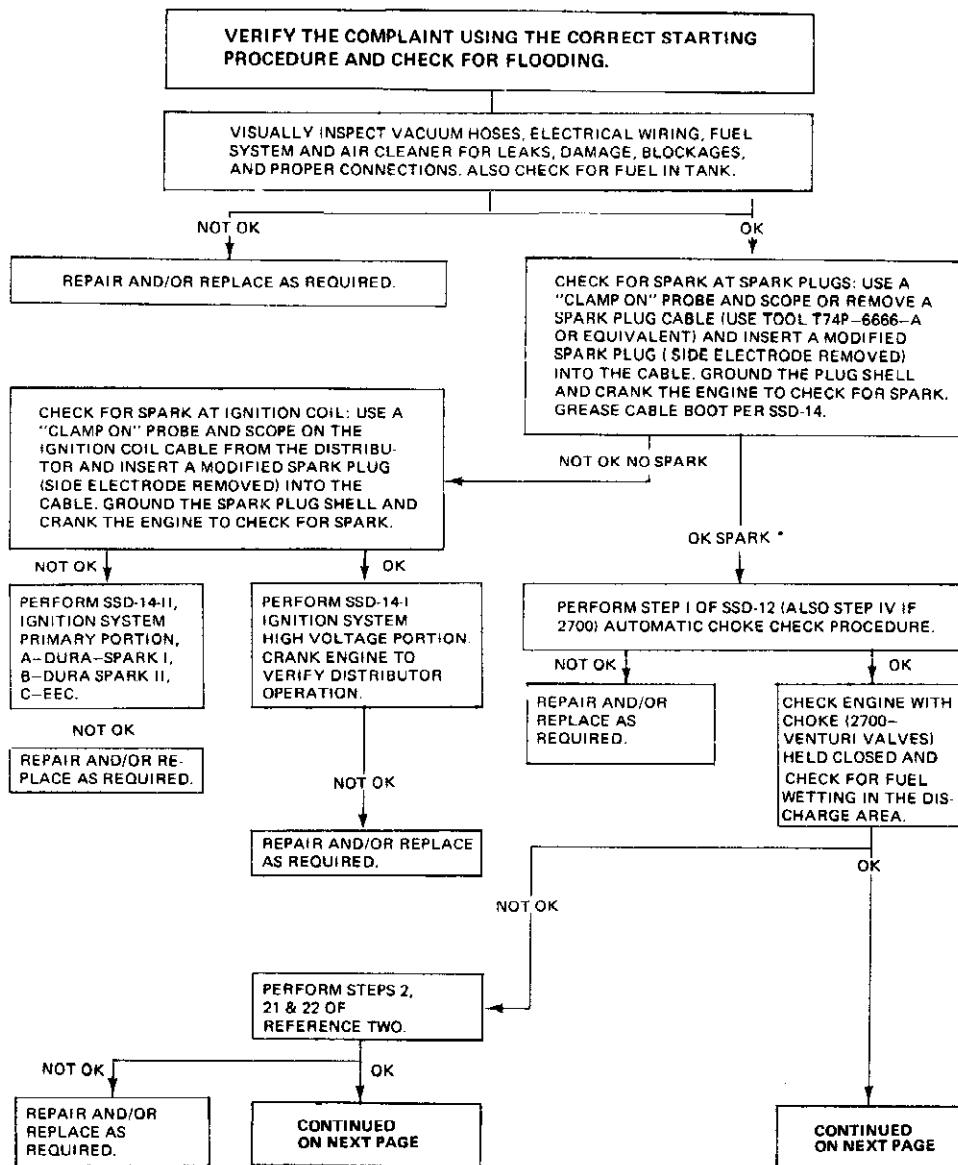
ROUTINE NO. 102
ENGINE WILL NOT CRANK – CONTINUED



ROUTINE NO. 103
ENGINE CRANKS SLOWLY



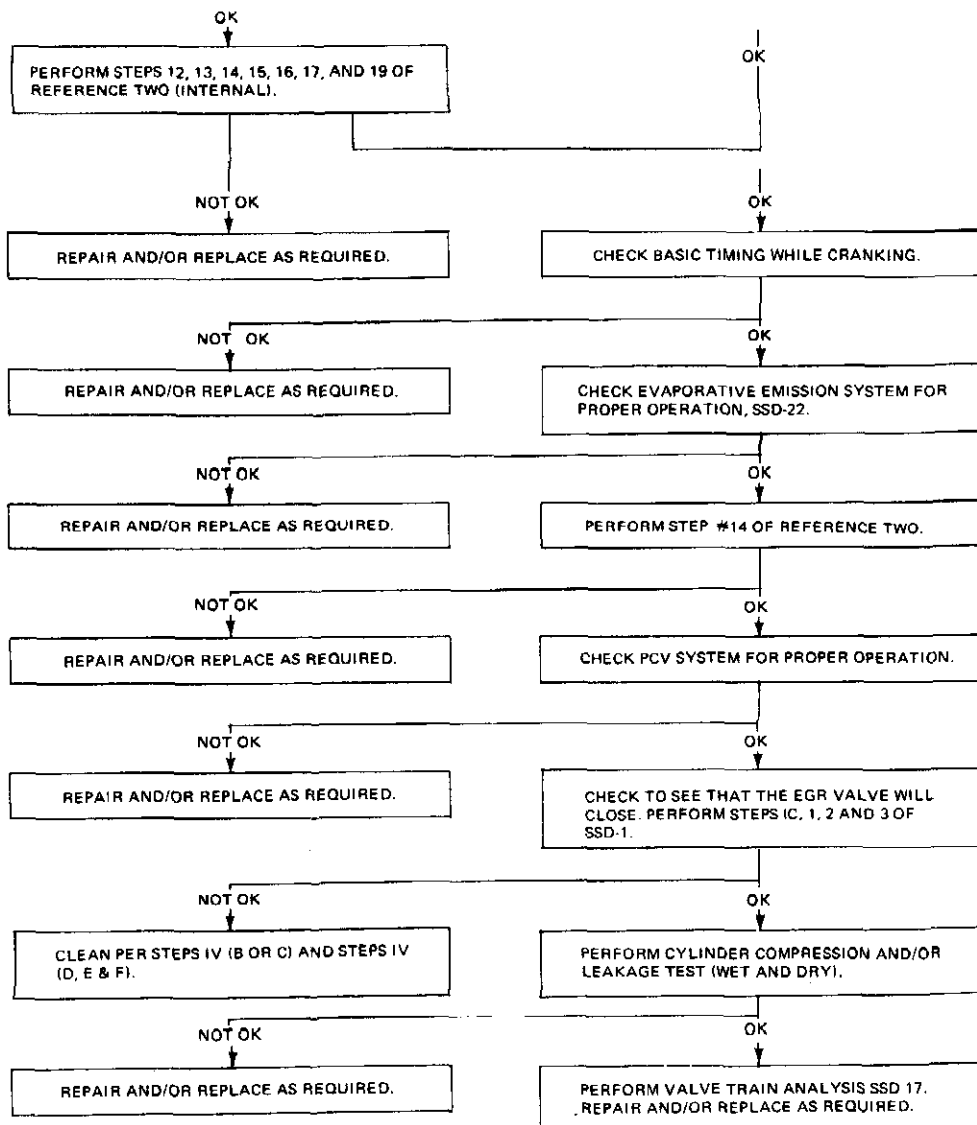
ROUTINE NO. 104
ENGINE CRANKS NORMALLY — WILL NOT START



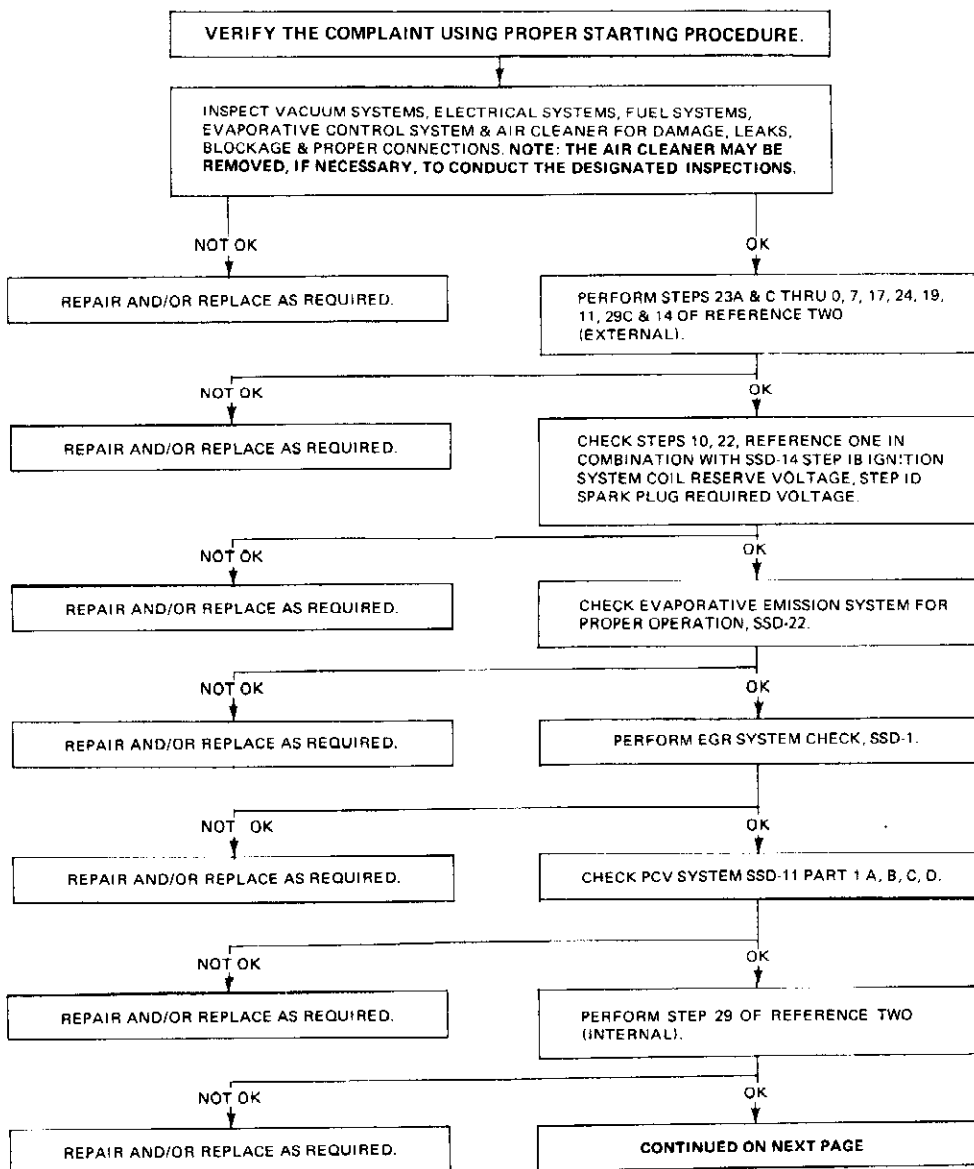
IF ENGINE ATTEMPTS TO START DURING CRANK, BUT DIES WHEN IGNITION SWITCH IS RETURNED TO THE "ON" POSITION, PERFORM SSD-14-II A FOR DURA SPARK I, B-DURA SPARK II, E-EEC.

CA1360-2C¹

ROUTINE NO. 104
ENGINE CRANKS NORMALLY – WILL NOT START – CONTINUED

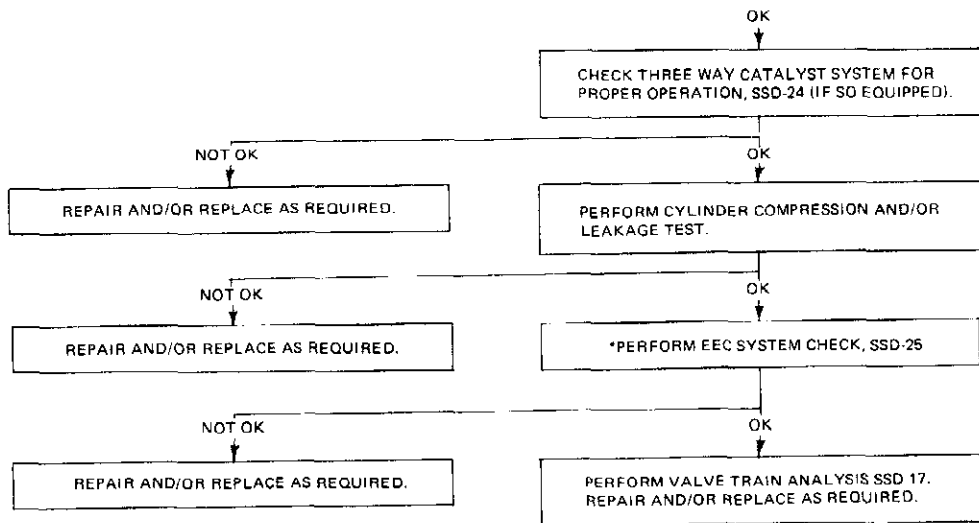


ROUTINE NO. 105
ENGINE CRANKS NORMALLY — STARTS HARD WHEN COLD



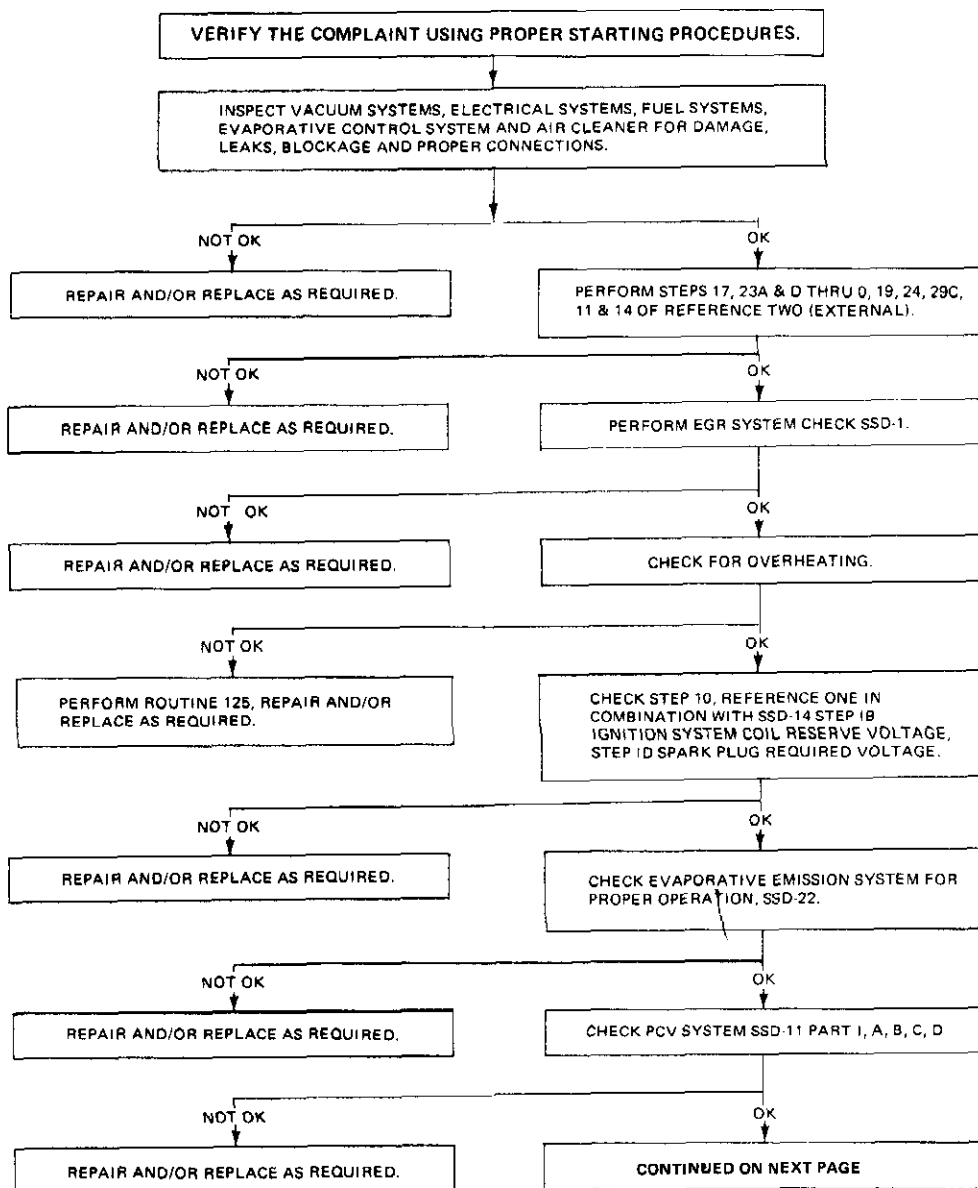
ROUTINE NO. 105

ENGINE CRANKS NORMALLY -- STARTS HARD WHEN COLD -- CONTINUED



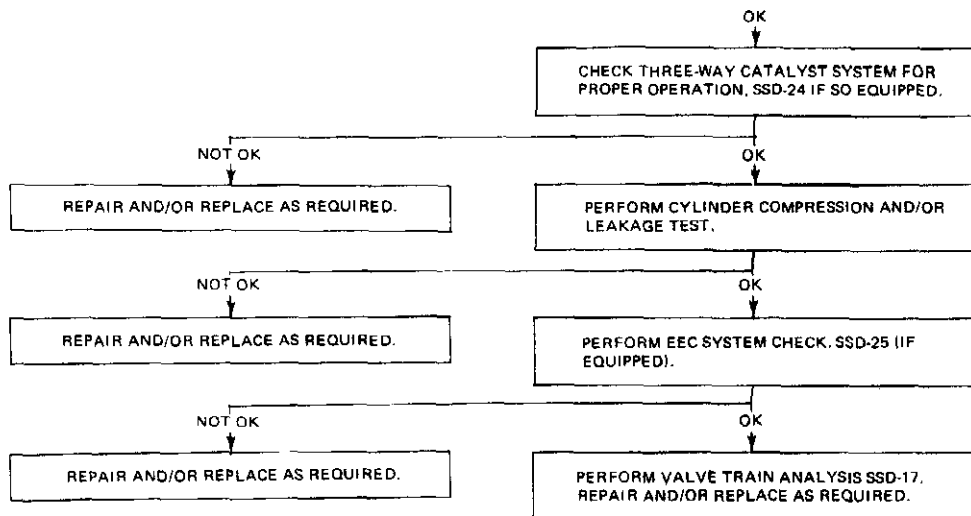
*IF EQUIPPED WITH AN EEC SYSTEM.

ROUTINE NO. 106
ENGINE CRANKS NORMALLY —STARTS HARD WHEN HOT

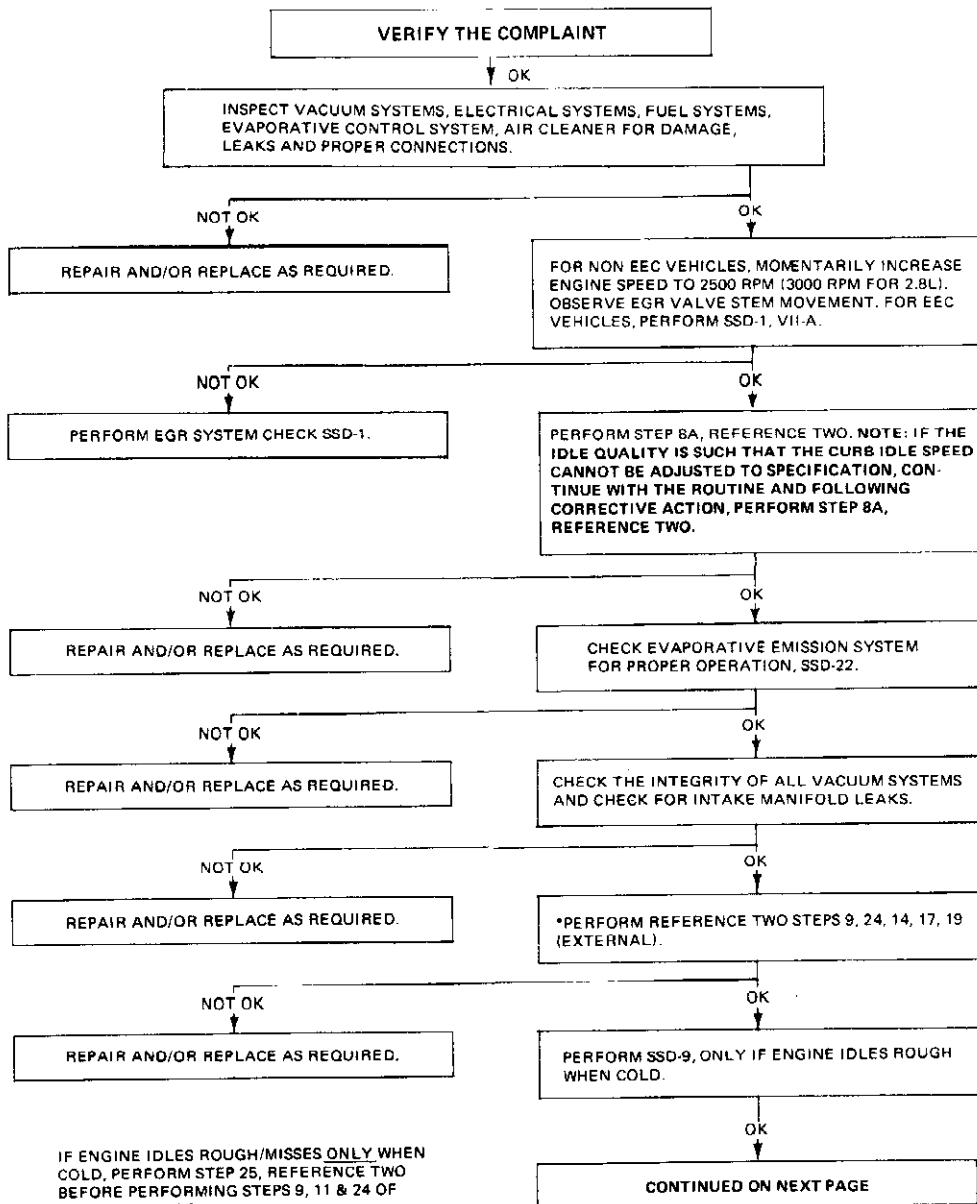


ROUTINE NO. 106

ENGINE CRANKS NORMALLY – STARTS HARD WHEN HOT – CONTINUED

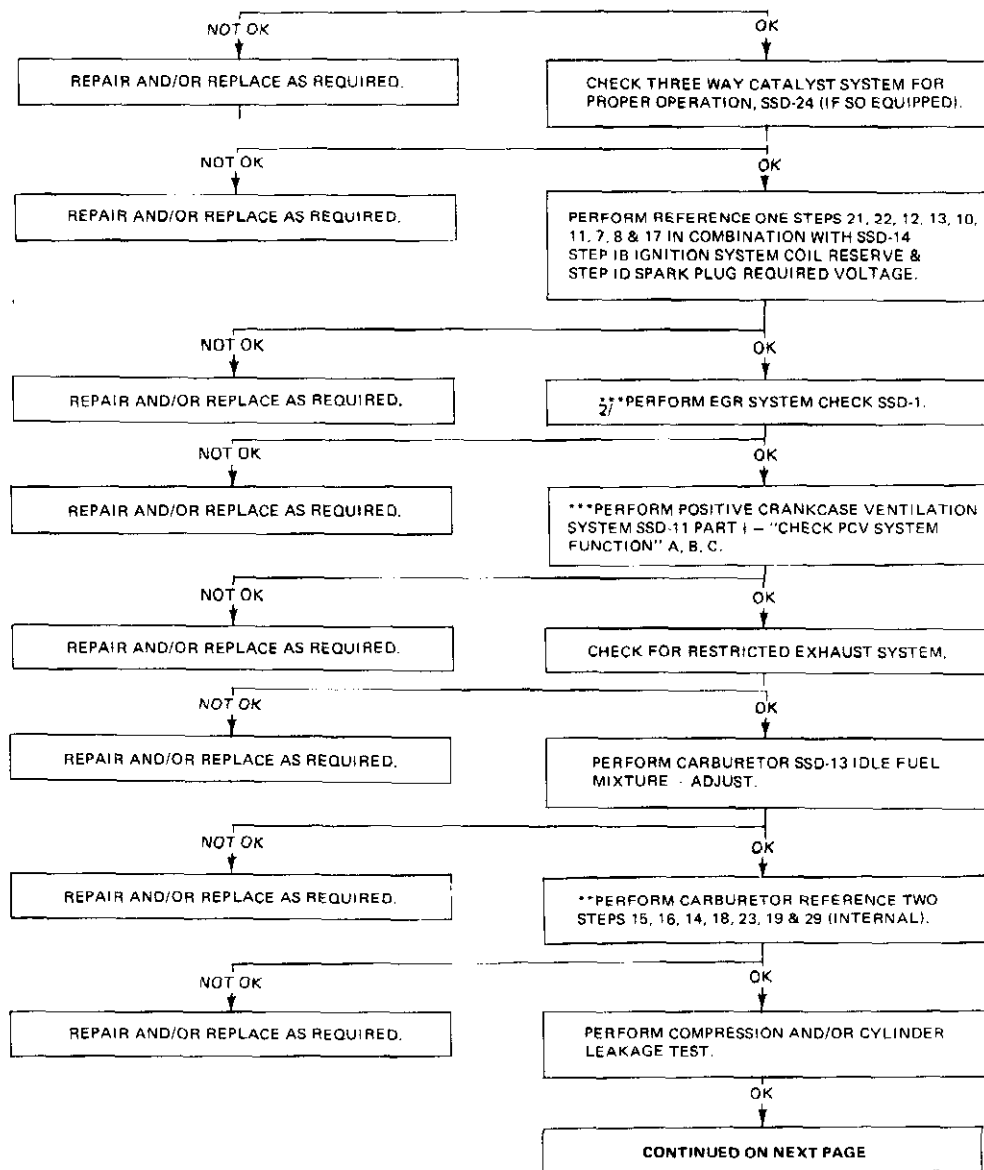


ROUTINE NO. 107
ENGINE IDLES ROUGH/MISSES (WARM OR COLD ENGINE)

CA1363-2D¹

ROUTINE NO. 107

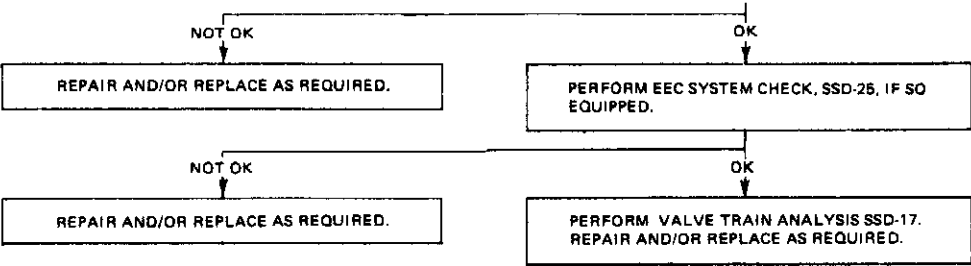
ENGINE IDLES ROUGH/MISSES – CONTINUED (WARM OR COLD ENGINE)

CA1363-2D²

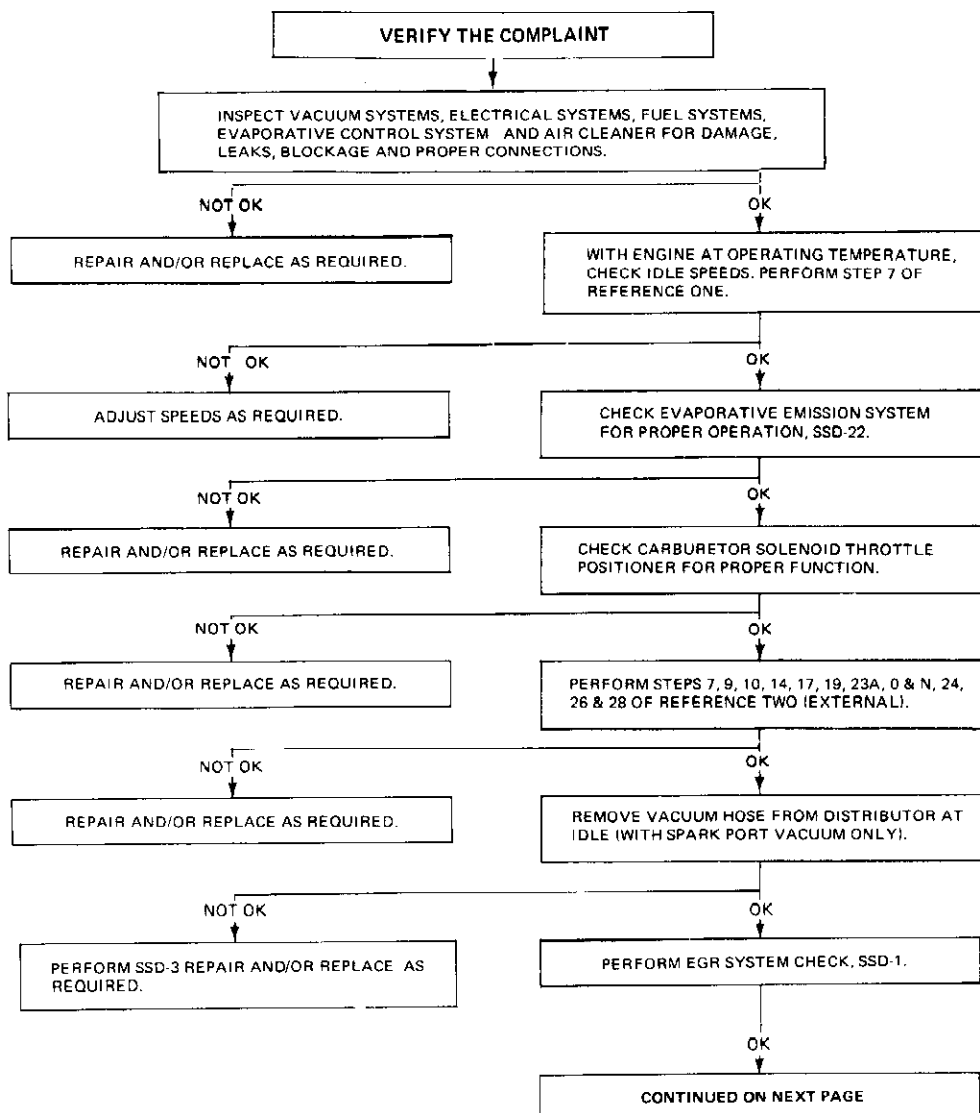
**PERFORM STEP 23, REFERENCE TWO, OF THIS STEP ONLY IF IT WAS NOT PERFORMED EARLIER IN THE ROUTINE
 ***IF ENGINE IDLES ROUGH ONLY WHEN COLD, PERFORM THIS STEP AFTER PERFORMING CARBURETOR
 REFERENCE TWO STEPS 15, 16, 18, 23, 19 & 29.

2/ OMIT THIS STEP (SSD-) IF IT HAD BEEN PERFORMED EARLIER IN THIS ROUTINE.

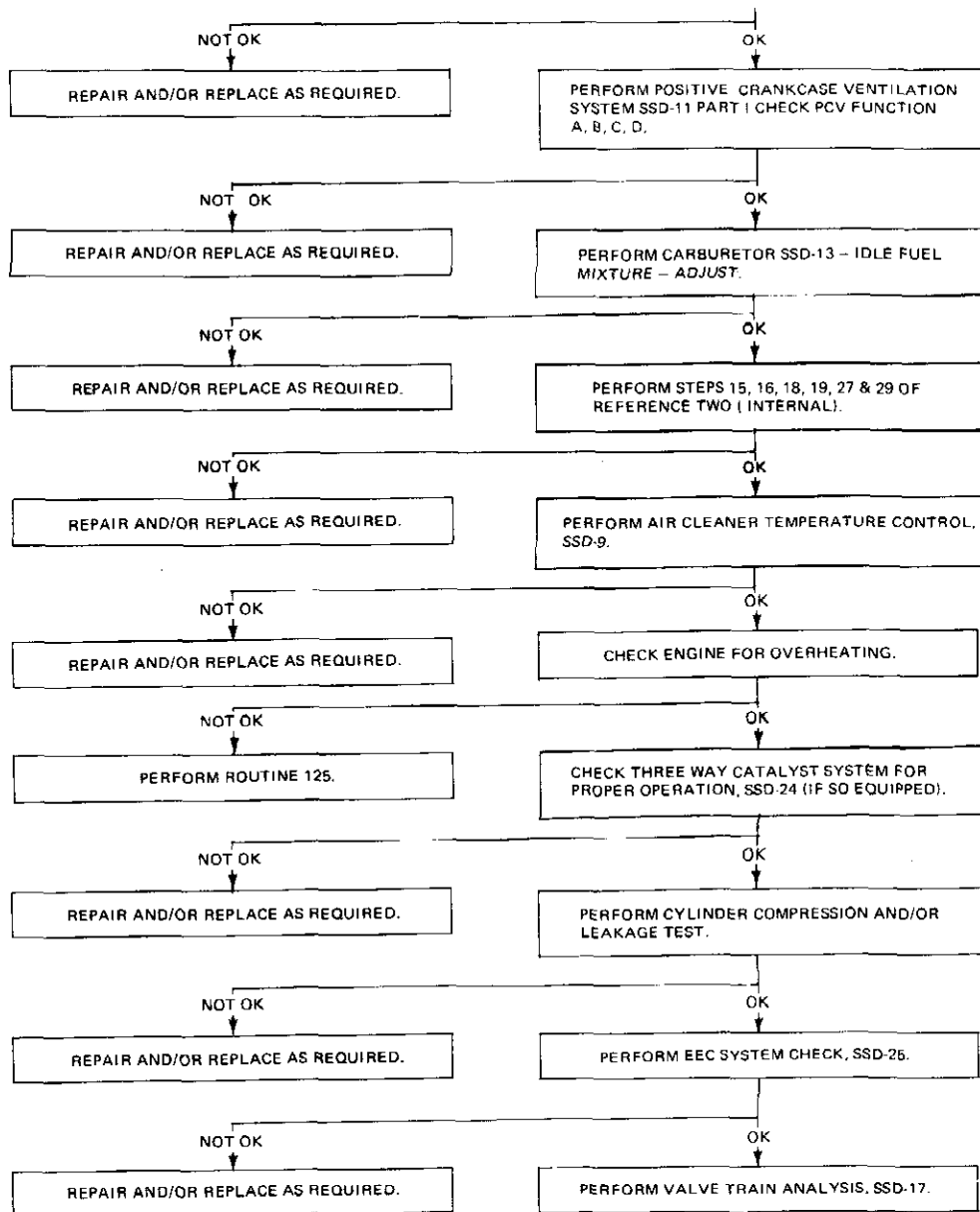
ROUTINE NO. 107
ENGINE IDLES ROUGH/MISSES – CONTINUED (WARM OR COLD ENGINE)



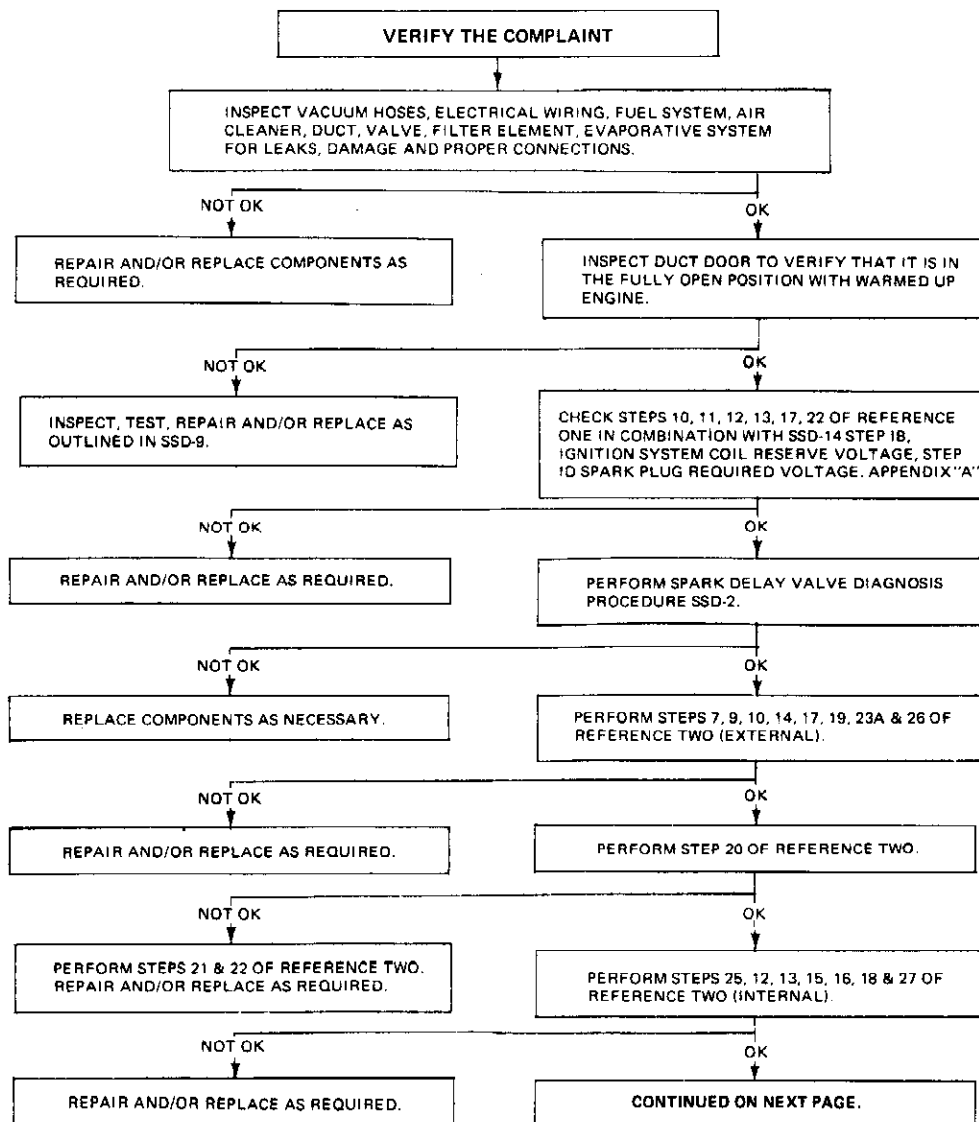
ROUTINE NO. 108 ENGINE IDLE SPEED VARIES



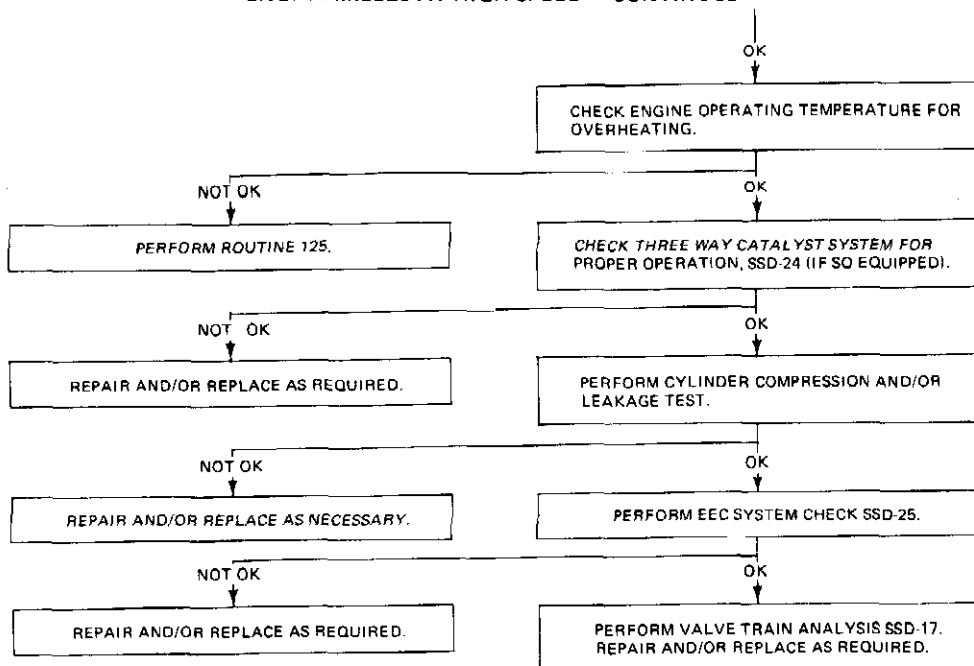
ROUTINE NO. 108
ENGINE IDLE SPEED VARIES – CONTINUED

CA1364-2D²

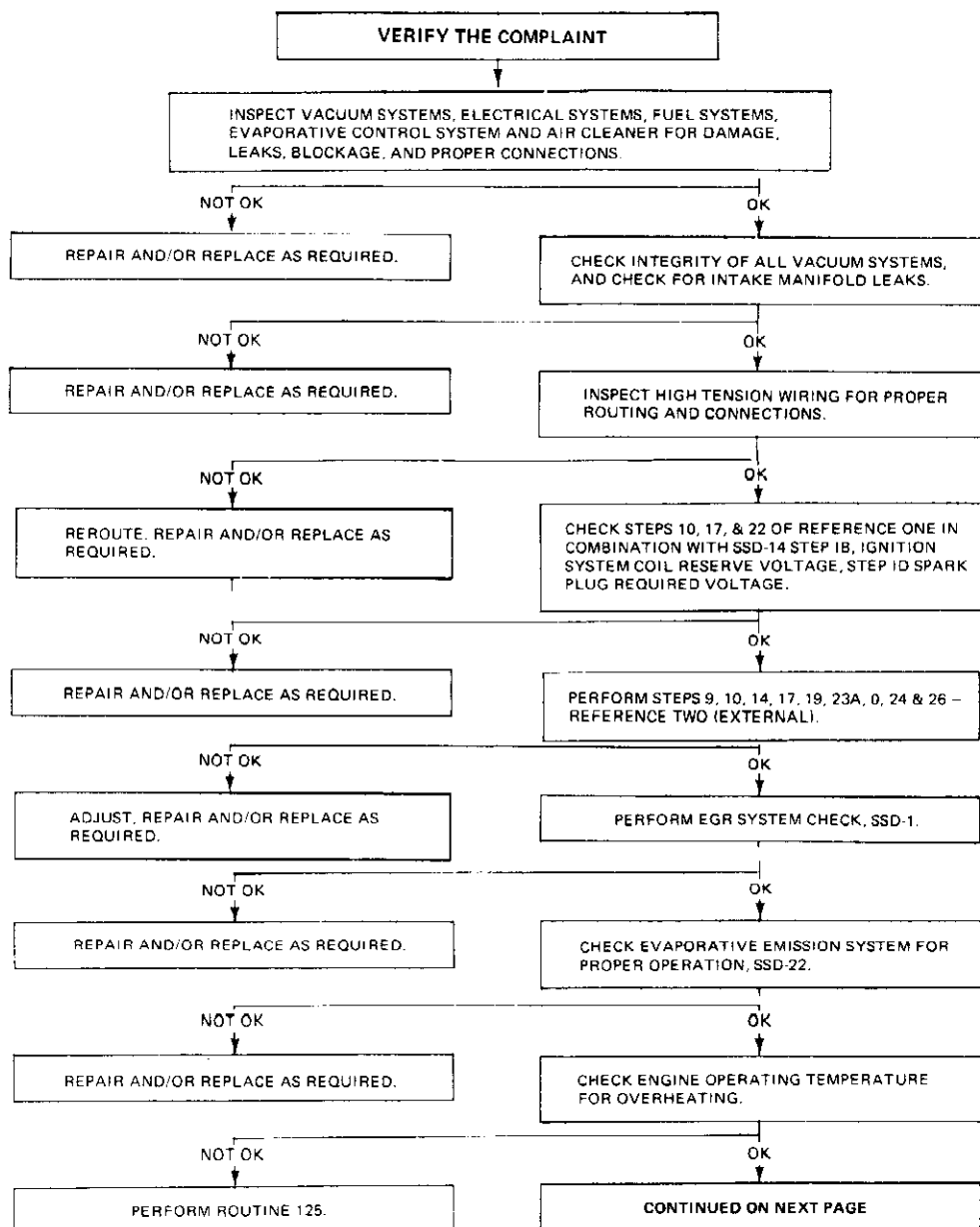
ROUTINE NO. 109 ENGINE MISSES AT HIGH SPEED



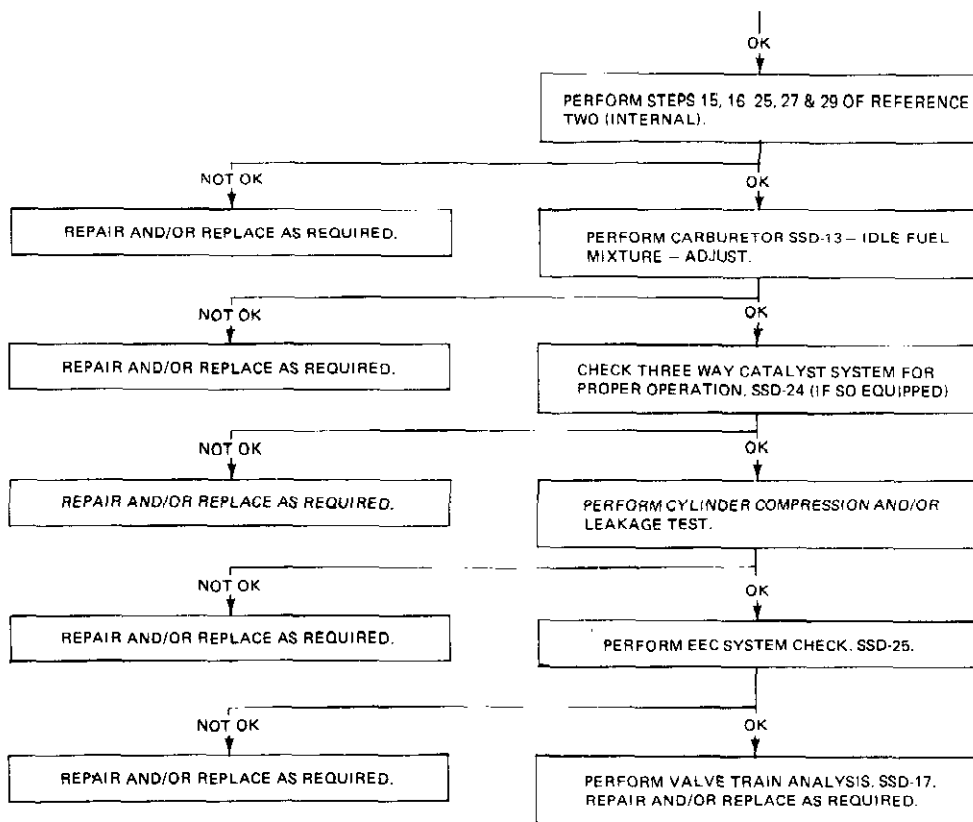
ROUTINE NO. 109
ENGINE MISSES AT HIGH SPEED – CONTINUED



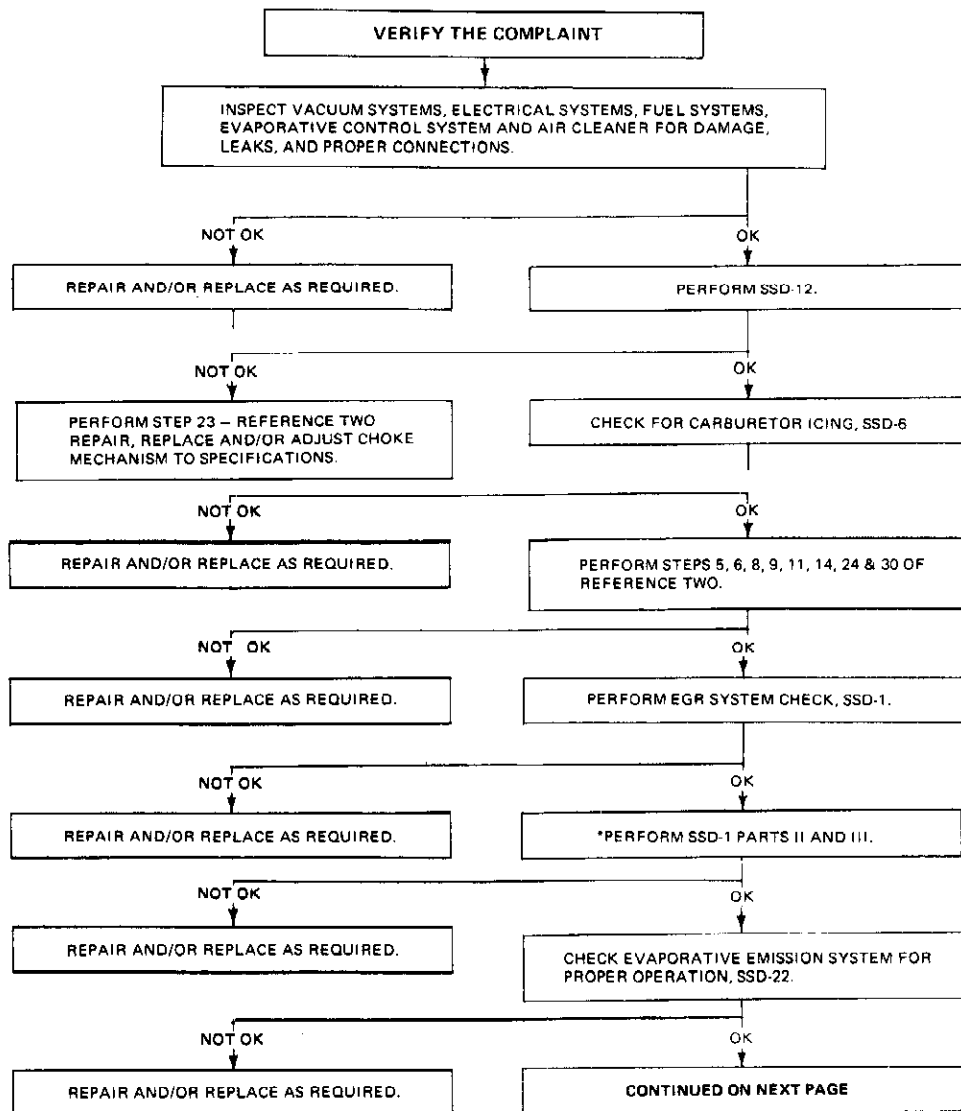
ROUTINE NO. 110 ENGINE MISSES AT LOW SPEEDS



ROUTINE NO. 110
ENGINE MISSES AT LOW SPEEDS – CONTINUED



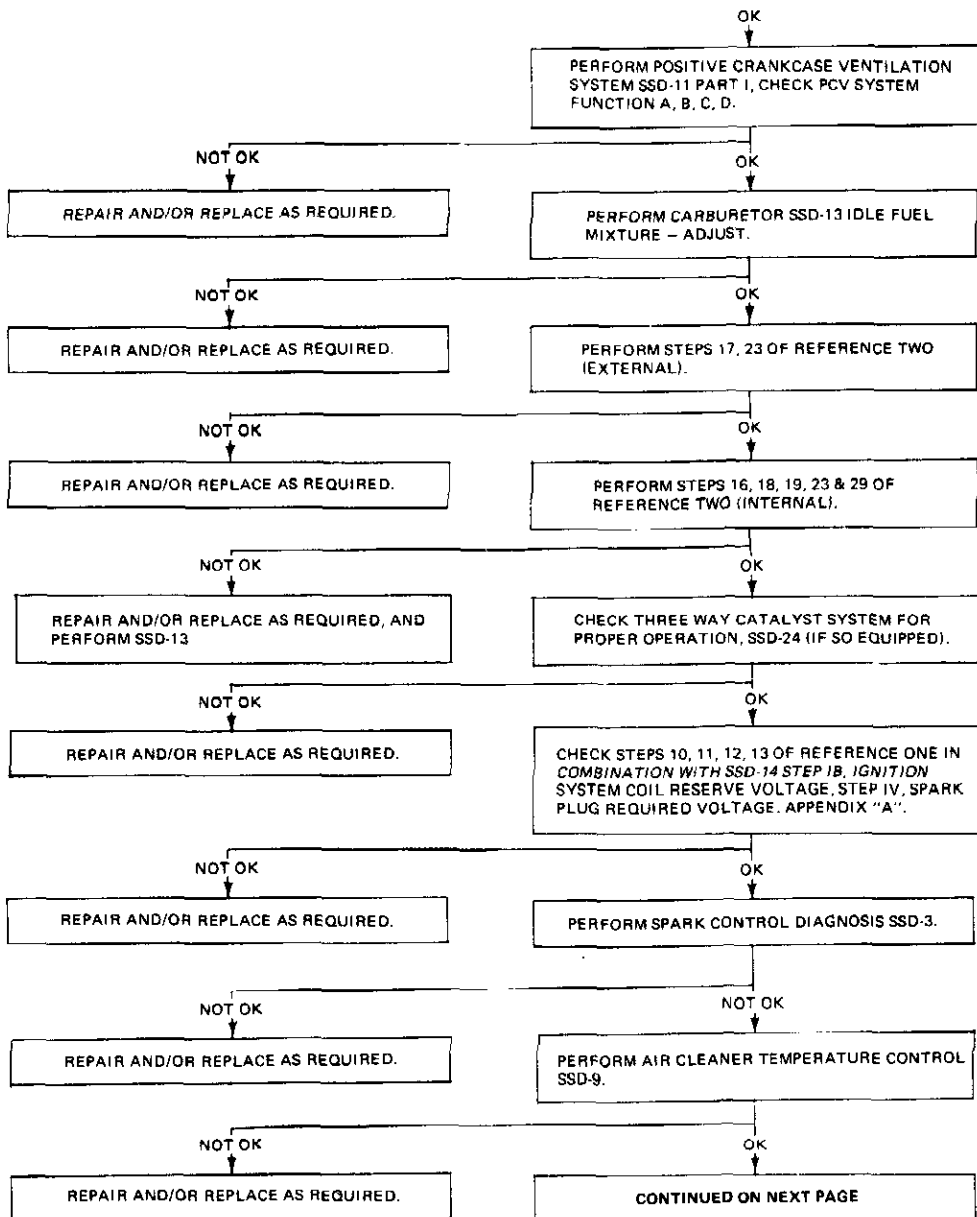
ROUTINE NO. 111
ENGINE STALLS AT IDLE – ENGINE COLD



*NOT REQUIRED FOR VEHICLES EQUIPPED WITH EEC.

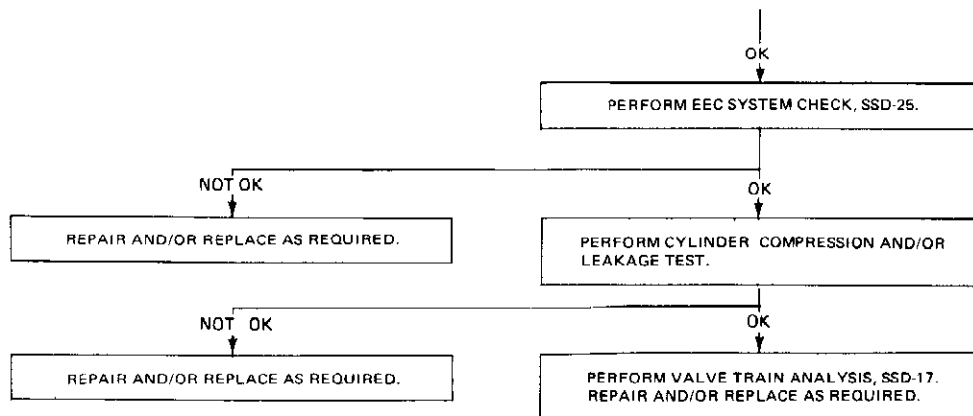
CA1367-2D¹

ROUTINE NO. 111
ENGINE STALLS AT IDLE – ENGINE COLD – CONTINUED

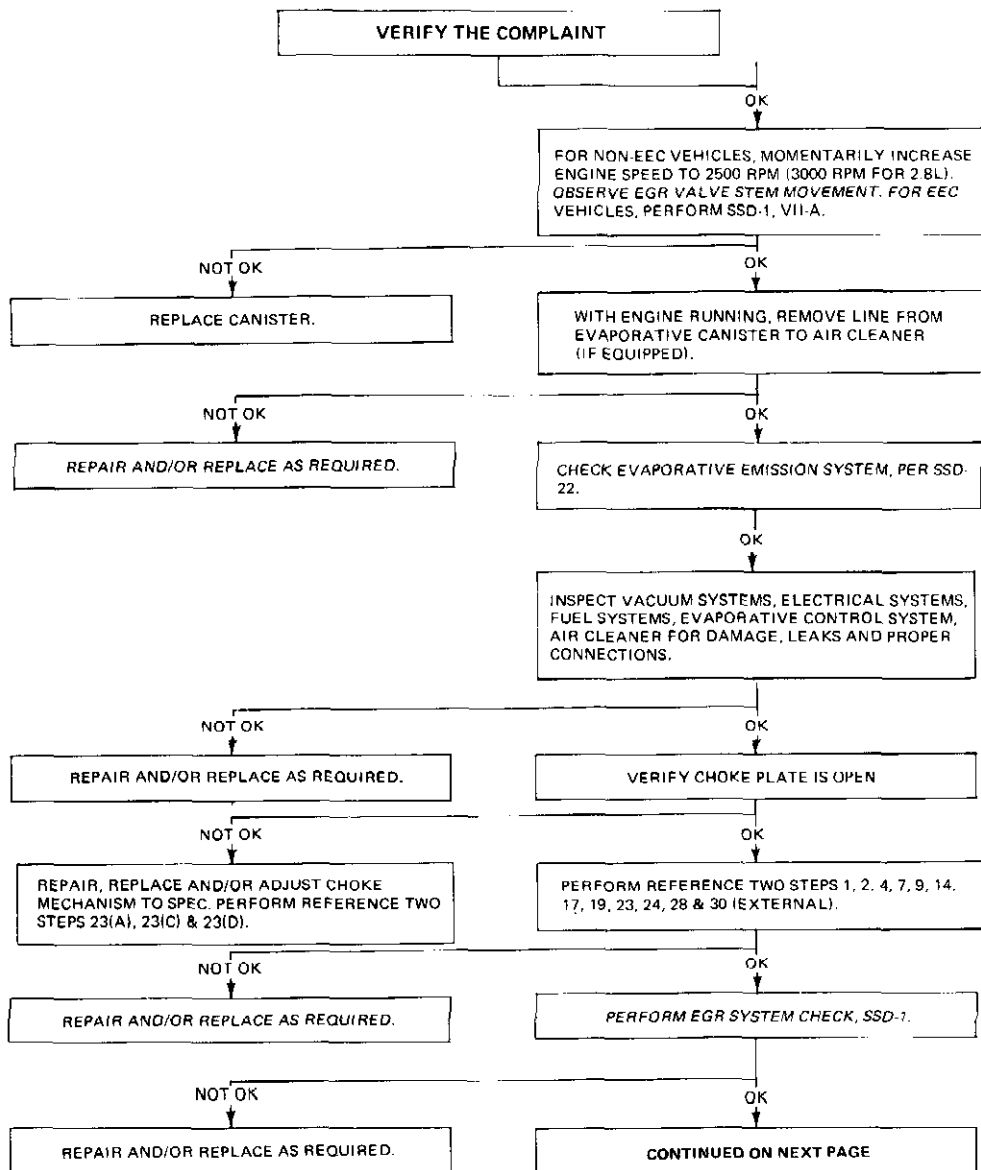
CA1367-2C²

ROUTINE NO. 111

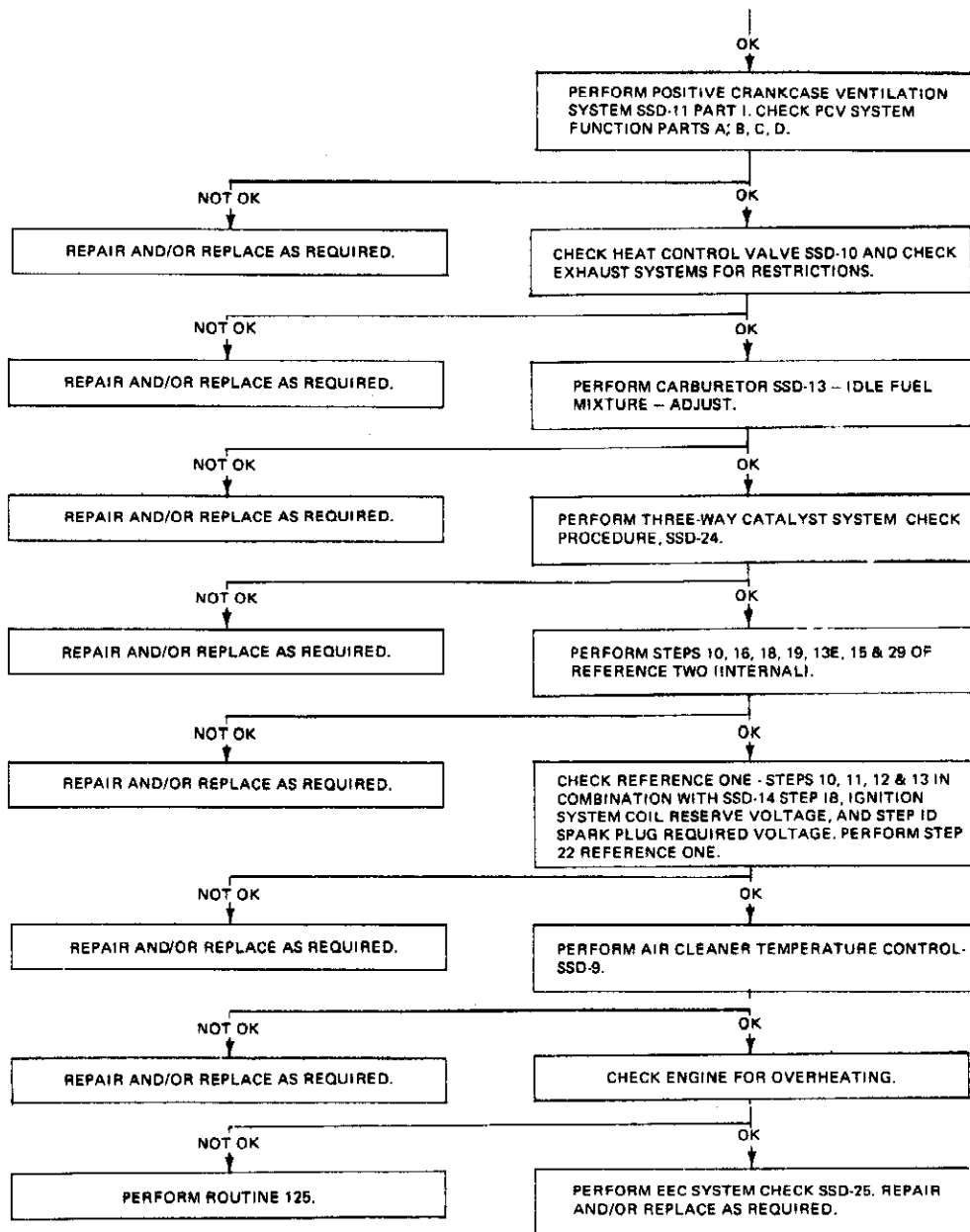
ENGINE STALLS AT IDLE – ENGINE COLD – CONTINUED



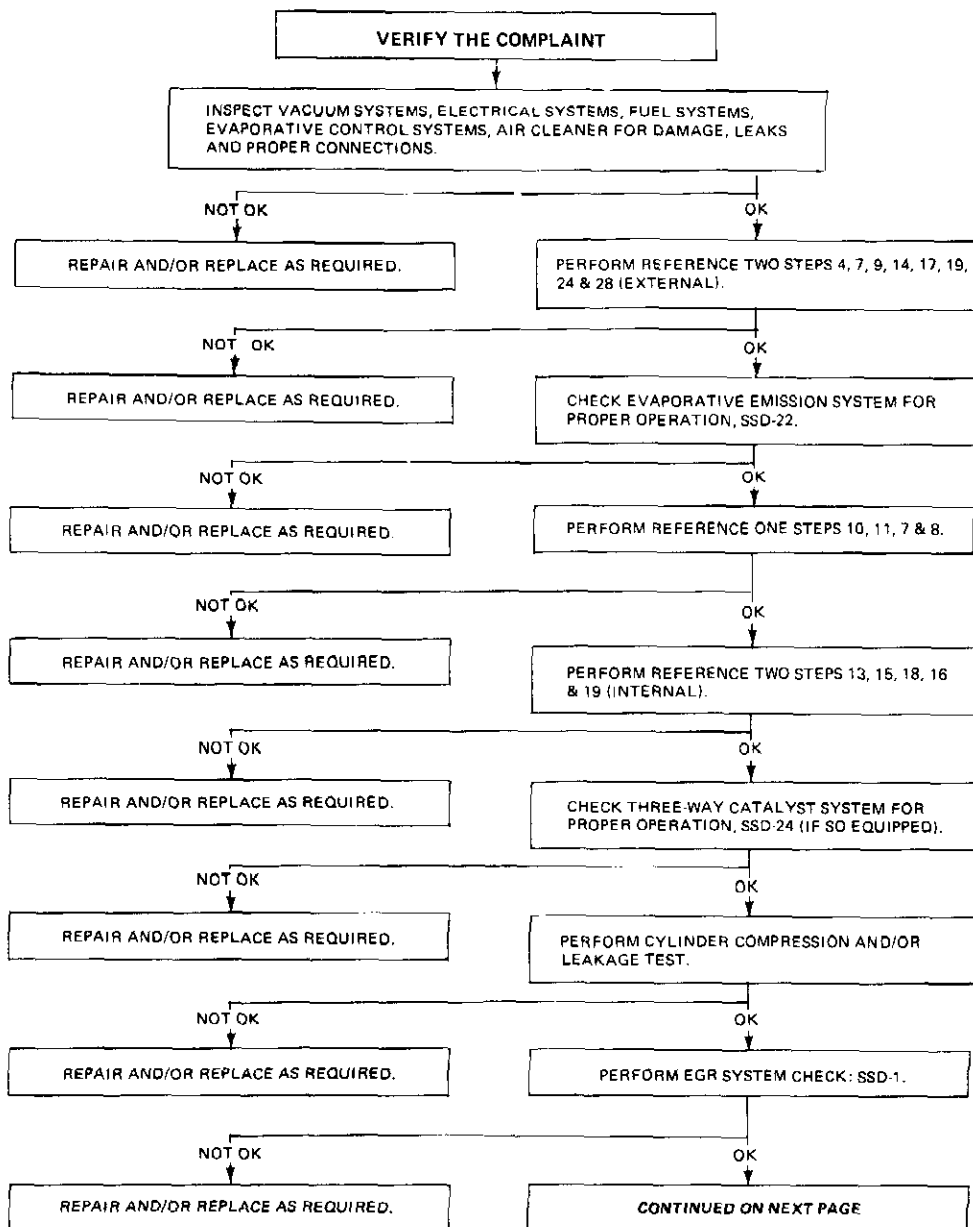
ROUTINE NO. 112
ENGINE STALLS AT IDLE - ENGINE HOT



ROUTINE NO. 112
ENGINE STALLS AT IDLE – ENGINE HOT – CONTINUED

CA1368-2D²

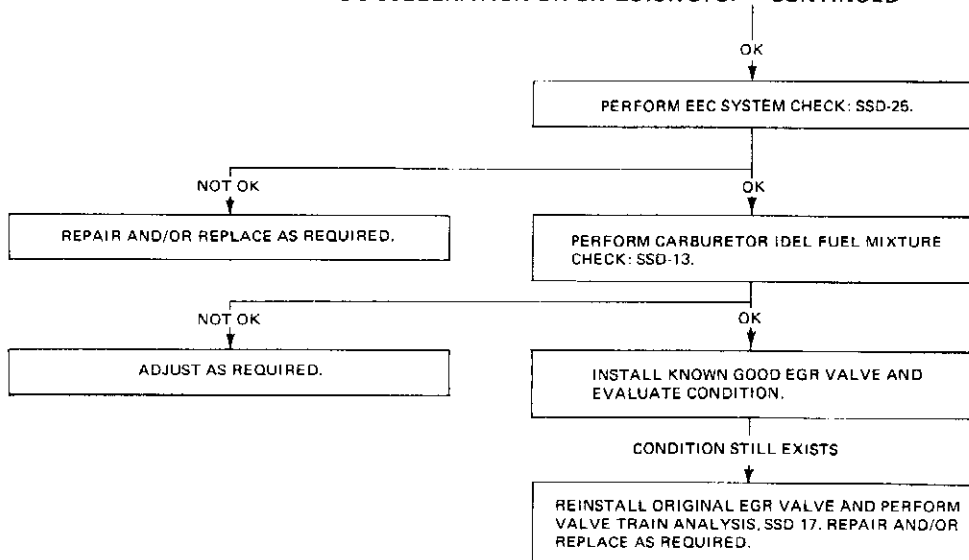
ROUTINE NO. 113
ENGINE STALLS DURING DECELERATION OR ON QUICK STOP



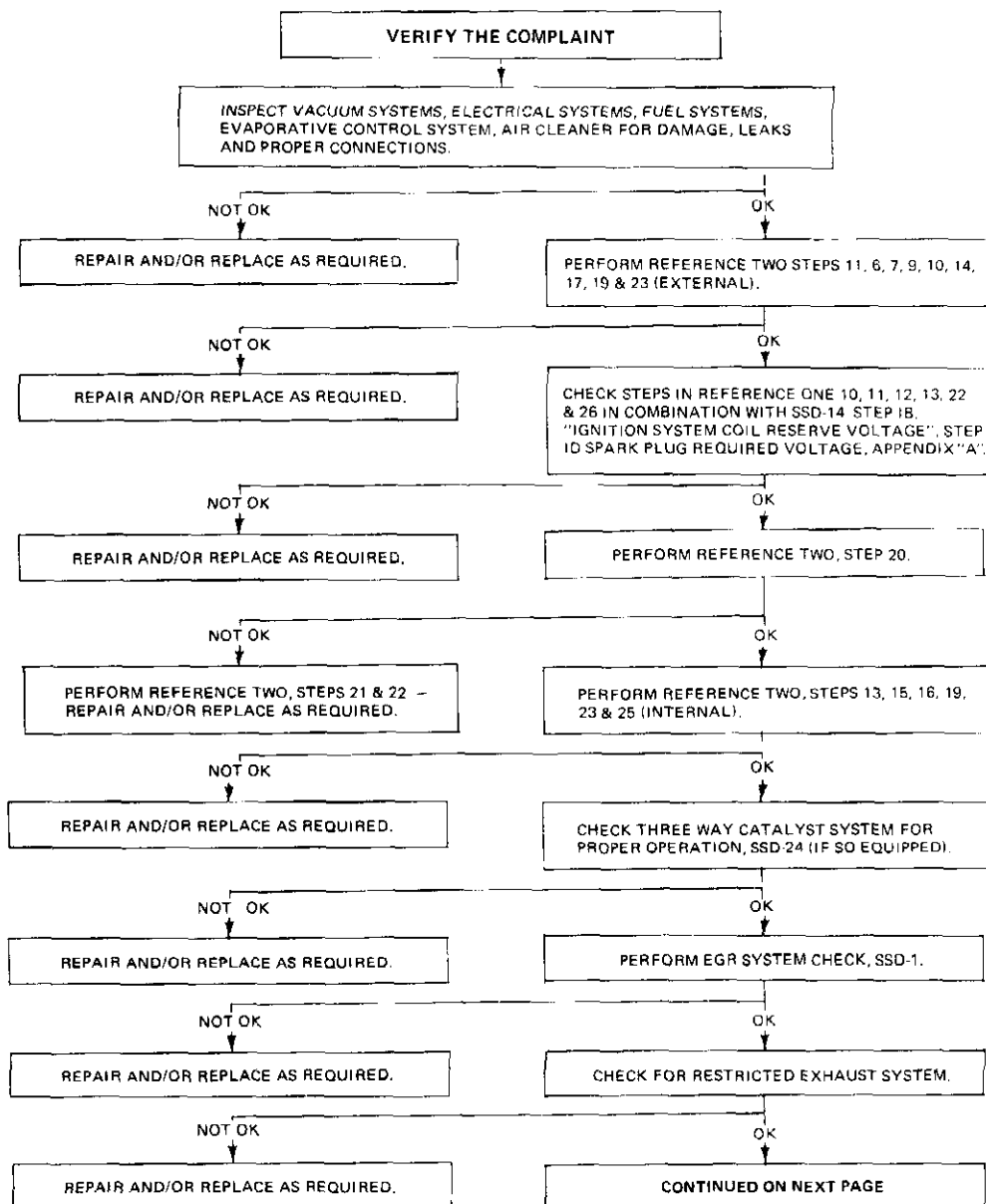
CA1369-2D

ROUTINE NO. 113

ENGINE STALLS DURING DECELERATION OR ON QUICK STOP – CONTINUED



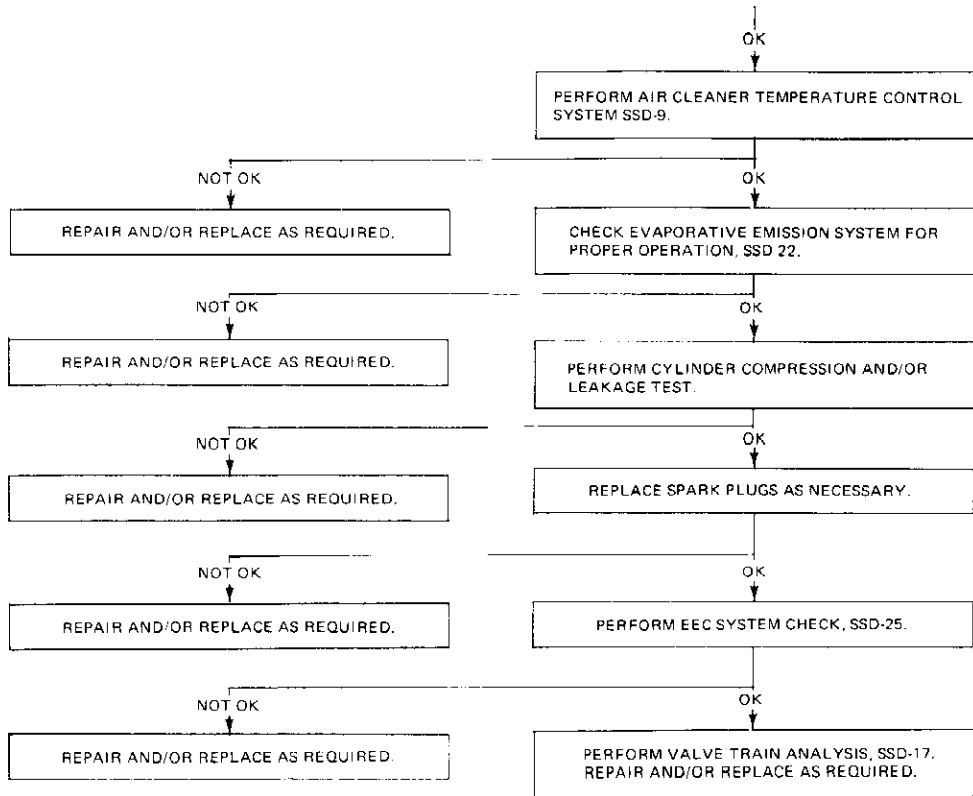
ROUTINE NO. 114
ENGINE HESITATES/STALLS DURING ACCELERATION



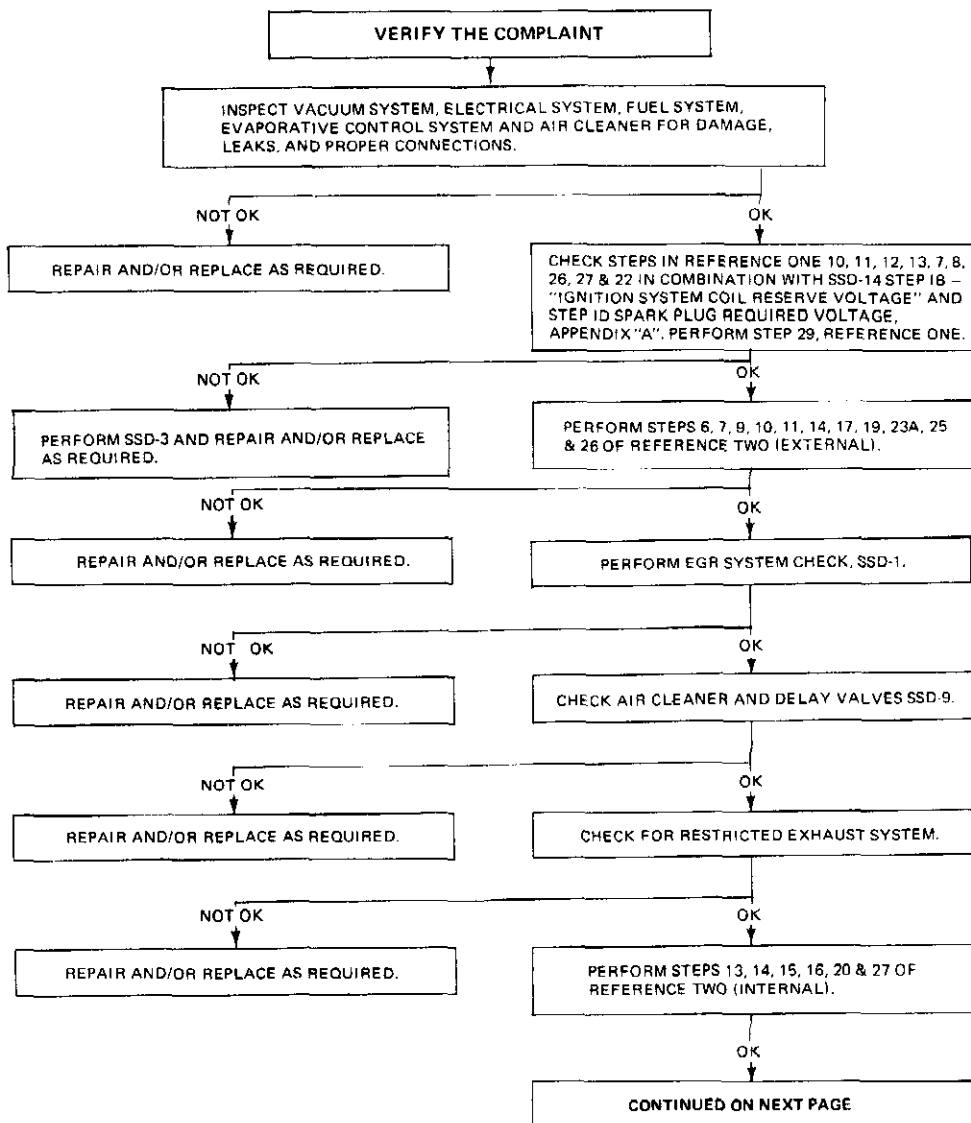
CA1370-2C1

ROUTINE NO. 114

ENGINE HESITATES/STALLS DURING ACCELERATION – CONTINUED

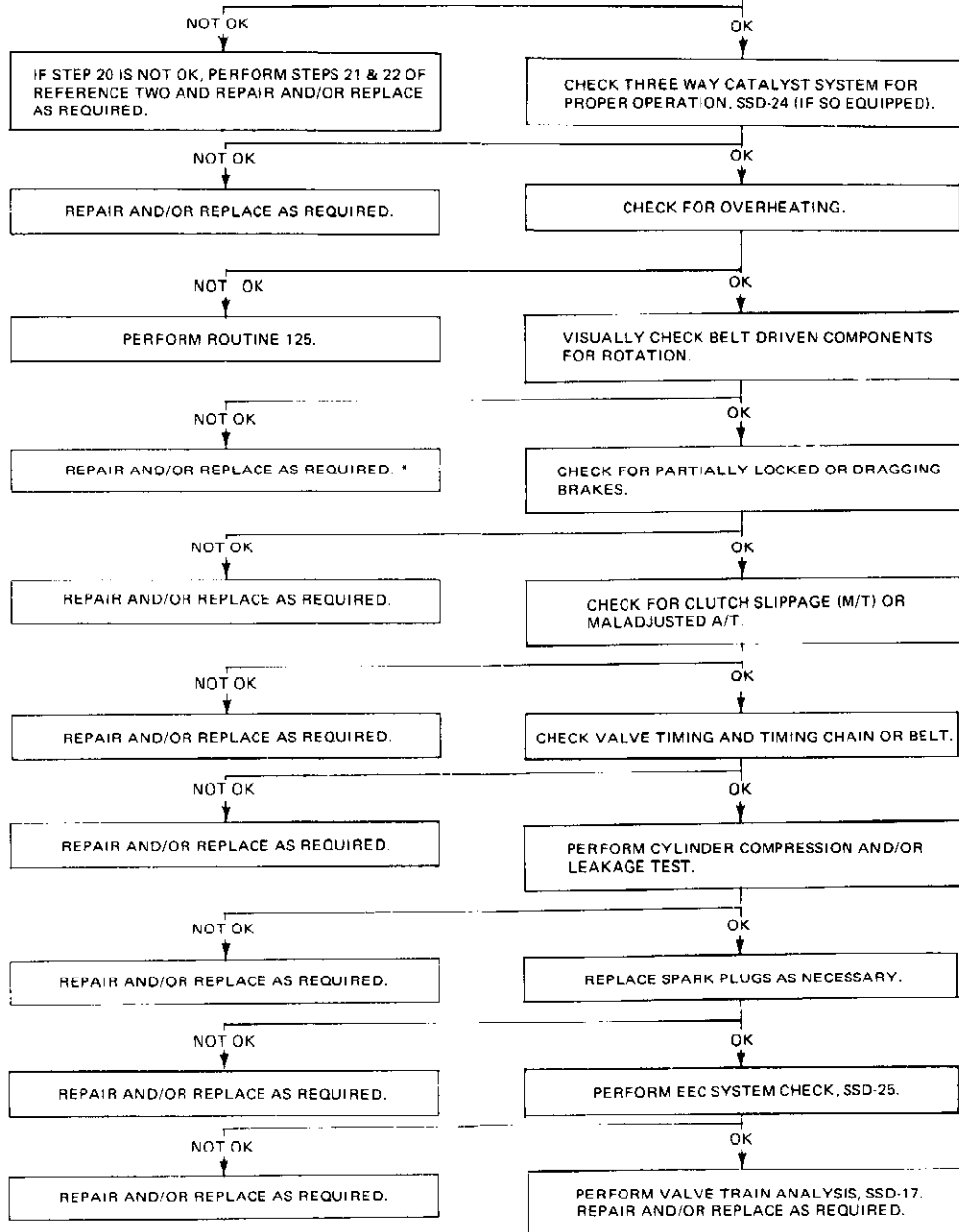


ROUTINE NO. 115
ENGINE HAS POOR ACCELERATION



ROUTINE NO. 115

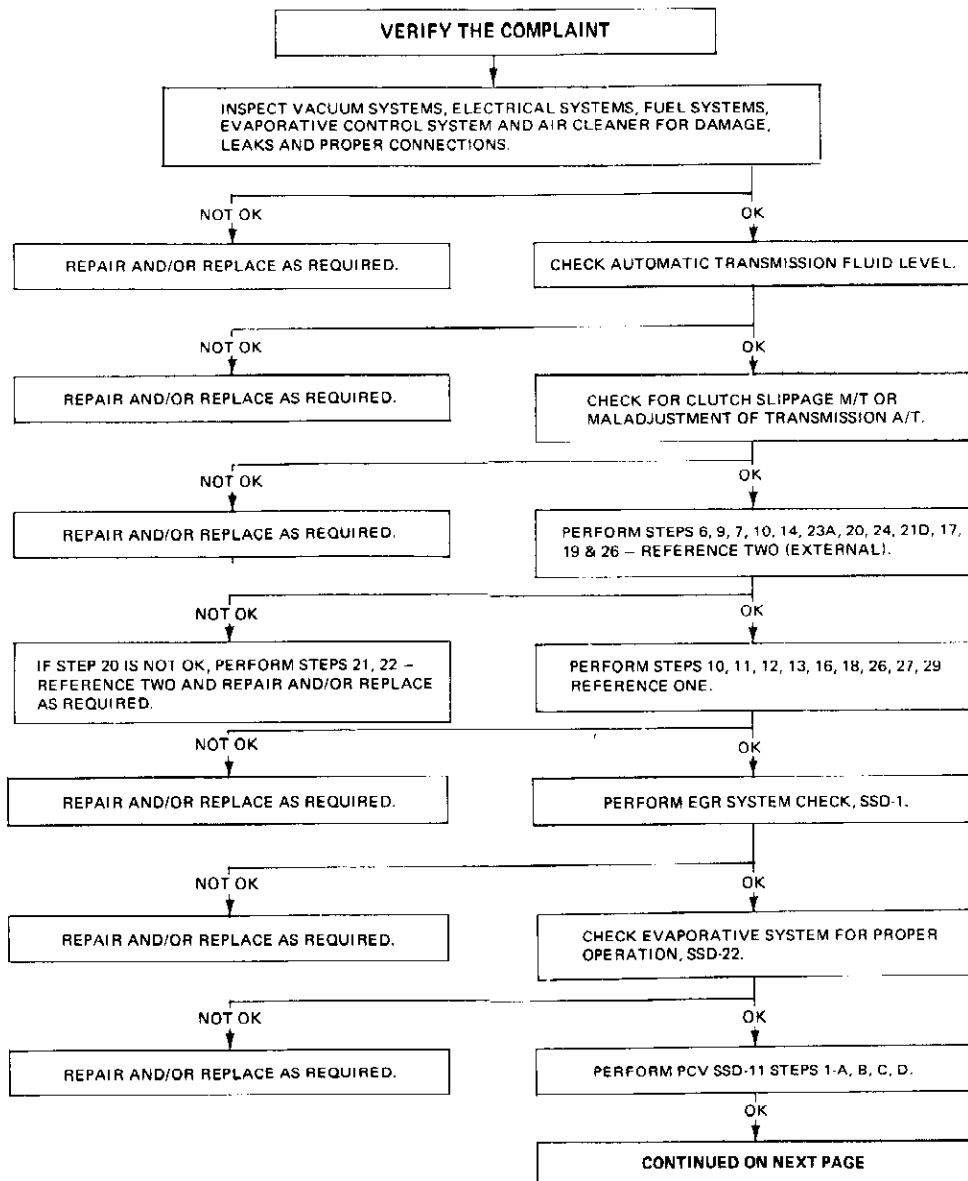
ENGINE HAS POOR ACCELERATION – CONTINUED



*IF THERMACTOR PUMP BELT

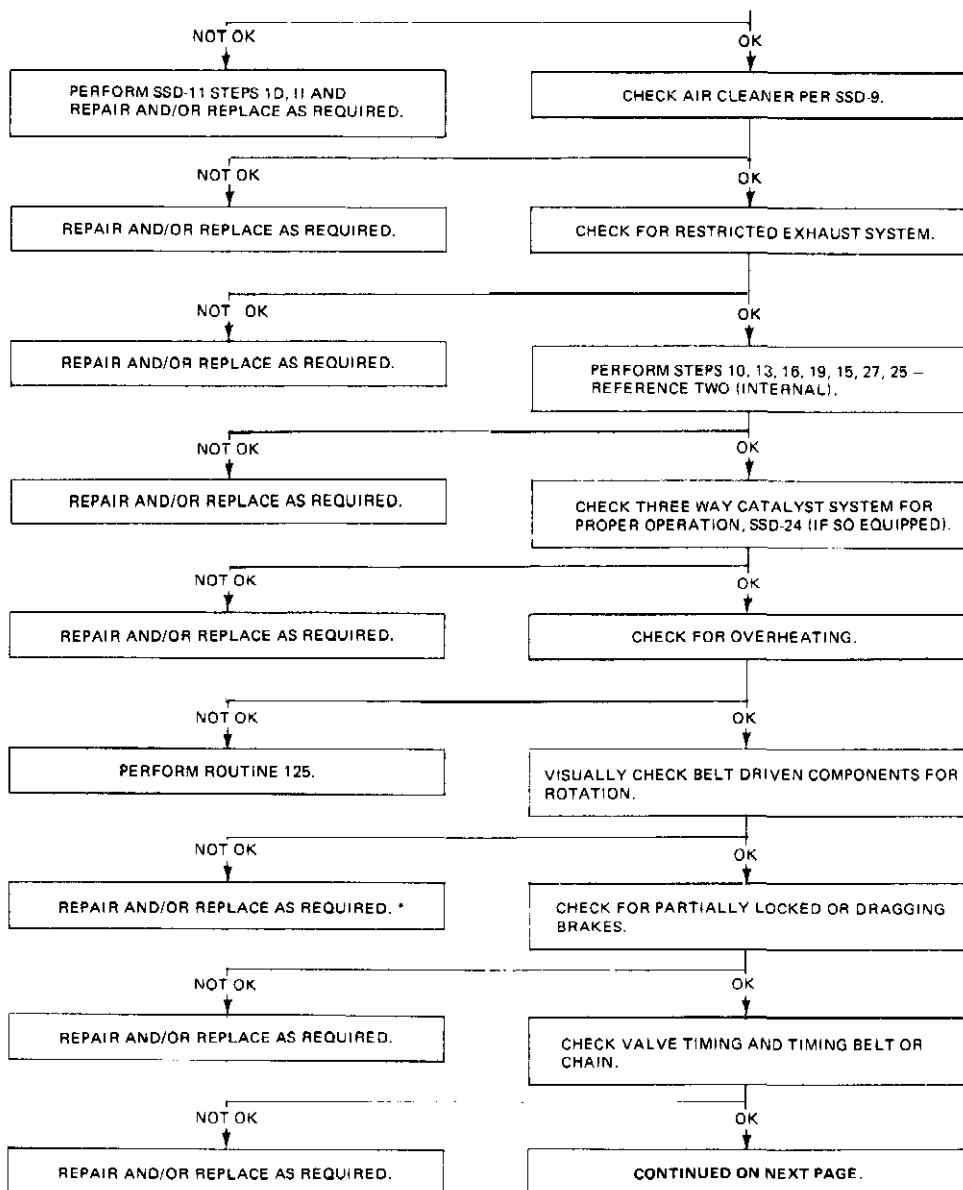
CA1371-2C²

ROUTINE NO. 116
ENGINE HAS LESS THAN NORMAL POWER

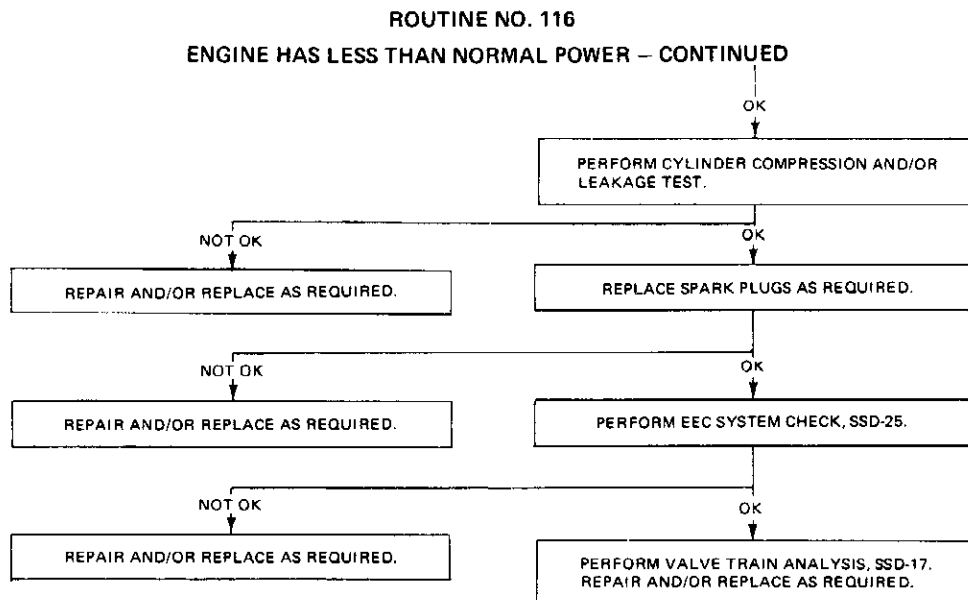


ROUTINE NO. 116

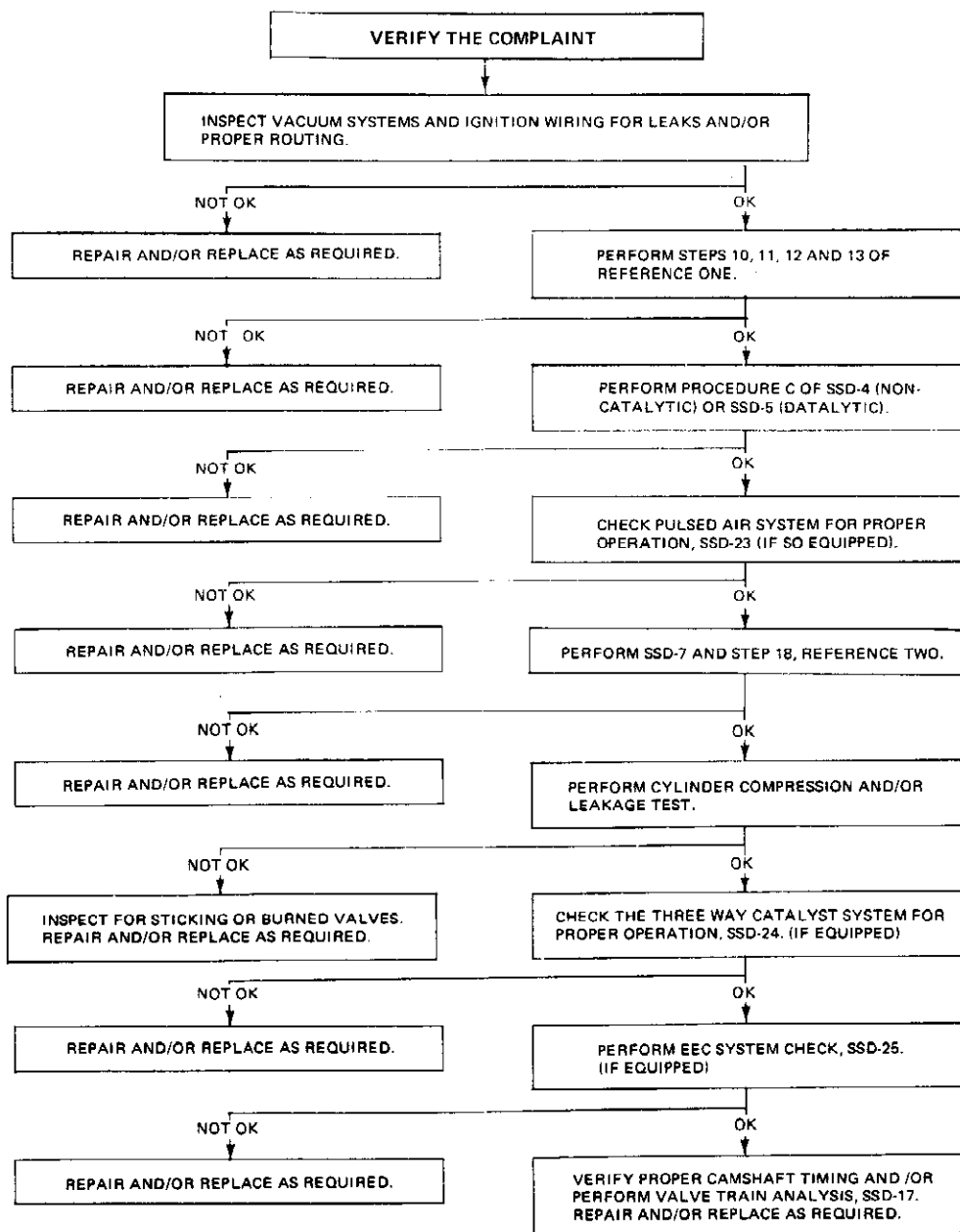
ENGINE HAS LESS THAN NORMAL POWER – CONTINUED



*IF THERMACTOR PUMP BELT.



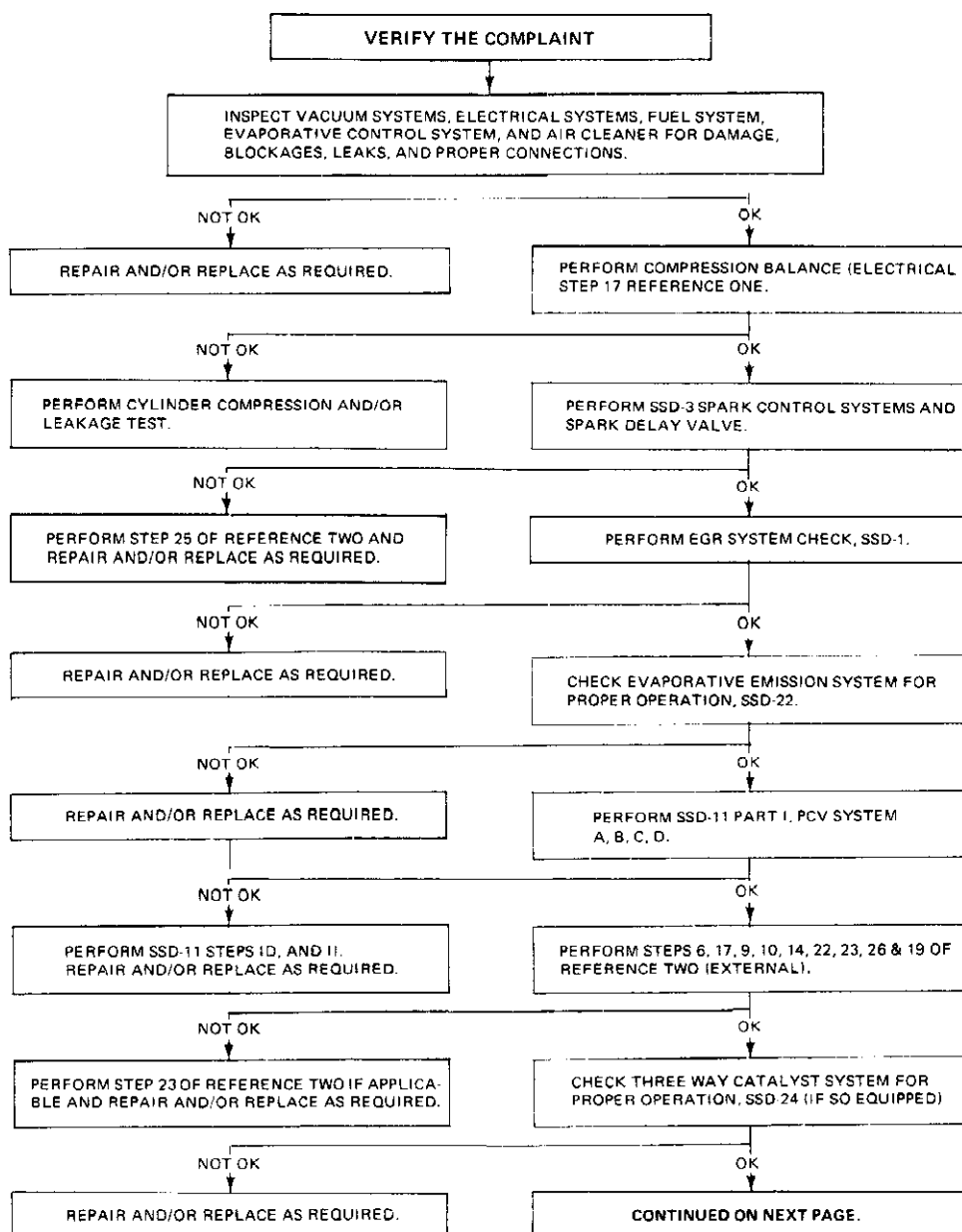
ROUTINE NO. 117 EXHAUST SYSTEM BACKFIRE



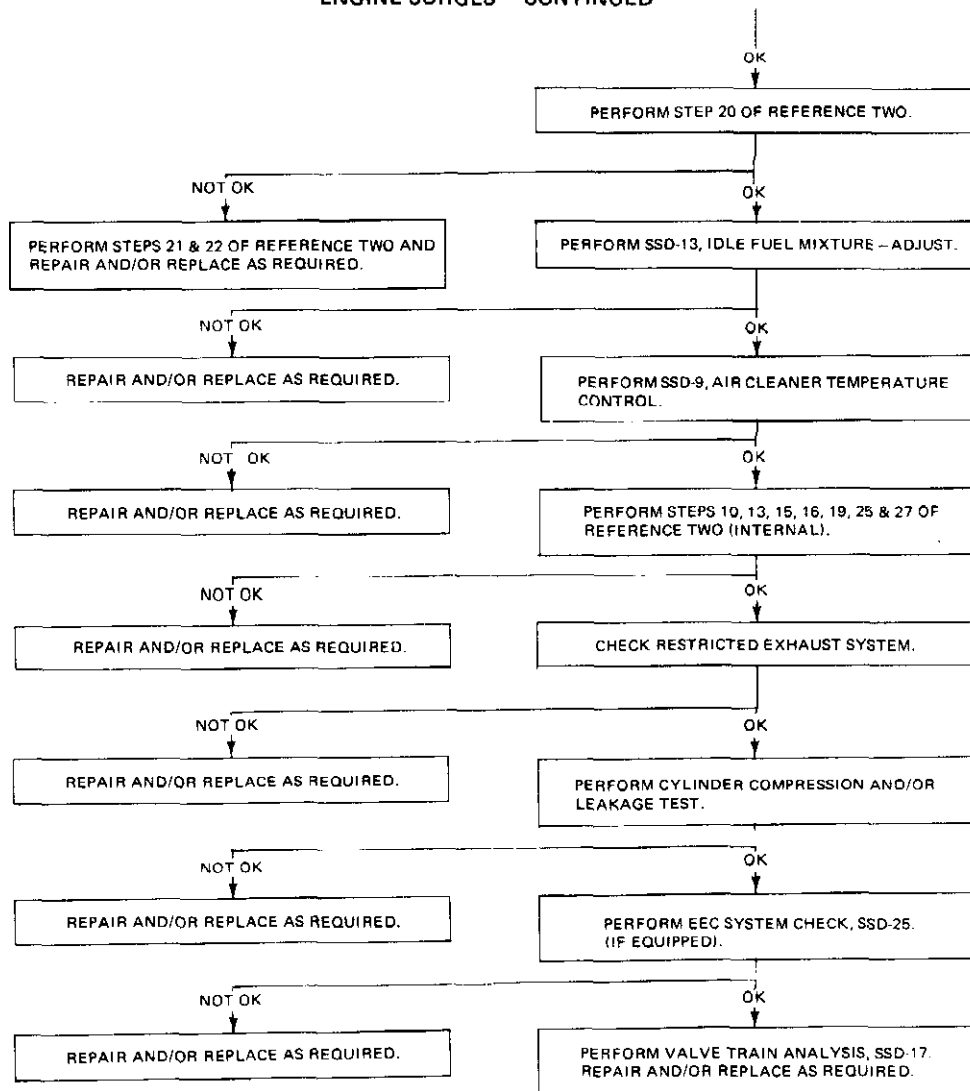
CA1373-2C

ROUTINE NO. 118

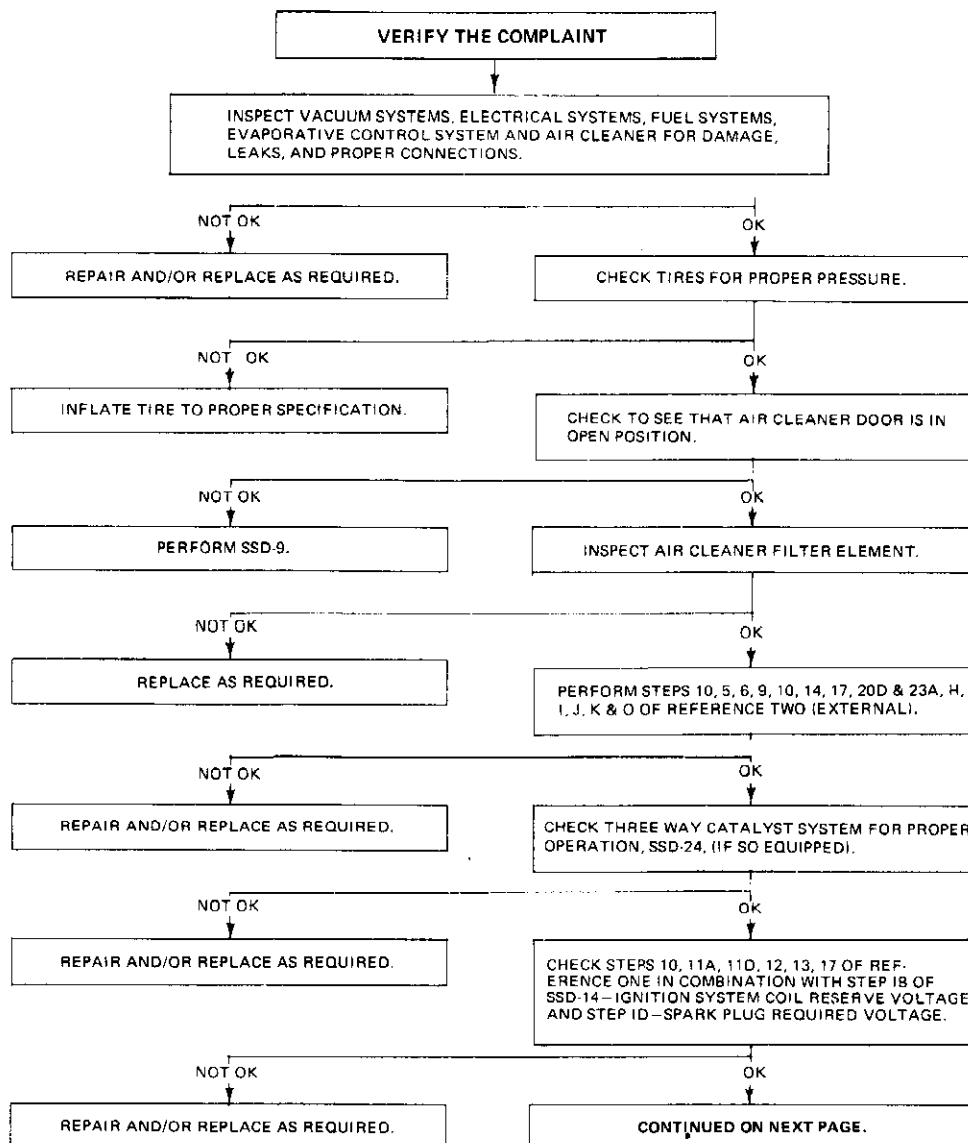
ENGINE SURGES



ROUTINE NO. 118
ENGINE SURGES – CONTINUED

CA1374-2C²

ROUTINE NO. 119
EXCESSIVE FUEL CONSUMPTION



ROUTINE NO. 119

EXCESSIVE FUEL CONSUMPTION – CONTINUED

