

WORKSHOP MANUAL

TF SERIES

GASOLINE ENGINE (C22NE, 22LE, 20LE)

SECTION

6, 6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H & 6J



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THIS MANUAL INCLUDES FOLLOWING SECTIONS

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6	Engine Diagnosis
6A	Engine Mechanical
6B	Engine Cooling
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NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section - OA under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on the latest product information available at the time of publication.

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SECTION 6

ENGINE DIAGNOSIS

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Engine Diagnosis

Hard Starting

1. Starting Motor Does Not Turn Over

Trouble Shooting Procedure

Turn on headlights and starter switch.

Condition	Possible cause	Correction
Headlights go out or dim considerably	Battery run down or under charged	Recharge or replace battery
	Terminals poorly connected	Clean battery posts and terminals and connect properly
	Starting motor coil circuit shorted	Overhaul or replace
	Starting motor defective	Overhaul or replace

2. Ignition Trouble - Starting Motor Turns Over But Engine Does Not Start

Spark Test

Disconnect a high tension cable from any spark plug. Connect the spark plug tester (use commercially available tool), crank the engine, and check if a spark is generated in the spark plug tester. Before cranking the engine, make sure that the spark plug tester is properly grounded. To avoid electrical shock, do not touch the high tension cable while the engine is running.

Condition	Possible cause	Correction
Spark jumps across gap	Spark plug defective	Clean, adjust spark gap or replace
	Ignition timing incorrect	Refer to Ignition System
	Fuel not reaching fuel injector(s) or engine	Refer to item 3 (Trouble in fuel system)
	Valve timing incorrect	Adjust
	Engine lacks compression	Refer to item 4 (Engine lacks compression)
No sparking takes place	Ignition coil disconnected or broken	Connect properly or replace
	Electronic Ignition System with module	Replace
	Poor connections in engine harness	Correct
	Engine Control Module cable disconnected or defective	Correct or replace

3. Trouble in Fuel System

Condition	Possible cause	Correction
Starting motor turns over and spark occurs but engine does not start.	Fuel tank empty	Fill
	Water in fuel system	Clean
	Fuel filter clogged	Replace filter
	Fuel pipe clogged	Clean or replace
	Fuel pump defective	Replace
	Fuel pump circuit open	Correct or replace
	Evaporative Emission Control system circuit clogged	Correct or replace
	Multiport Fuel Injection System faulty	Refer to "Electronic Fuel Injection" section

4. Engine Lacks Compression

Condition	Possible cause	Correction
Engine lacks compression	Spark plug loosely fitted or spark plug gasket defective	Tighten to specified torque or replace gasket
	Valve timing incorrect	Adjust
	Cylinder head gasket defective	Replace gasket
	Valve incorrectly seated	Lap valve
	Valve stem seized	Replace valve and valve guide
	Valve spring weakened	Replace
	Cylinder or piston rings worn	Overhaul engine
	Piston ring seized	Overhaul engine.

Engine Compression Test Procedure

1. Start and run the engine until the engine reaches normal operating temperature.
2. Turn the engine off.
3. Remove all the spark plugs.
4. Remove ignition coil fuse (15A) and disable the ignition system.
5. Remove the fuel pump relay from the relay and fuse box.
6. Engage the starter and check that the cranking speed is approximately 300 rpm.
7. Install cylinder compression gauge into spark plug hole.
8. With the throttle valve opened fully, keep the starter engaged until the compression gauge needle reaches the maximum level. Note the reading.
9. Repeat the test with each cylinder. The pressure difference between the individual cylinders should not exceed 100kPa (14.5 psi).

Rough Engine Idling or Engine Stalling

Condition	Possible cause	Correction
Trouble in fuel injection system	Idle air control valve defective	Replace
	Throttle shutting off incomplete	Correct or replace
	Throttle position sensor circuit open or shorted	Correct or replace
	Fuel injector circuits open or shorted	Correct or replace
	Fuel injectors damaged	Replace
	Fuel pump relay defective	Replace
	Manifold Absolute Pressure Sensor cable disconnected or broken	Correct or replace
	Manifold Absolute Pressure Sensor defective	Replace
	Engine Coolant Temperature Sensor cable disconnected or broken	Correct or replace
	Engine Coolant Temperature Sensor defective	Replace
	Intake Air Temperature sensor cable disconnected or broken	Correct or replace
	Intake Air Temperature sensor defective	Replace
	Knock Sensor (KS) circuits open or shorted	Correct or replace
	KS defective	Replace
	KS Module circuits open or ground	Correct or replace
	KS Module defective	Replace
	Vehicle Speed Sensor circuit open or shorted	Correct or replace
	Vehicle Speed Sensor defective	Replace
Trouble in emission control system	Engine Control Module defective	Replace
	Canister purge solenoid circuit open	Correct
	Canister purge solenoid defective	Replace
	Evaporative Emission Canister Purge control valve defective	Replace
	Trouble in ignition system	Refer to Hard Start Troubleshooting Guide
Others	Engine lacks compression	Refer to Hard Start Troubleshooting Guide
	Valve incorrectly seated	Lap valve
	Air Cleaner Filter clogged	Replace filter element
	Valve timing incorrect	Readjust
	Idle air control valve broken	Replace

Rough Engine Running

Condition	Possible cause	Correction
Engine misfires regularly	Ignition coil layer shorted	Replace
	Spark plugs fouling	Clean or install hotter type plug
	Spark plug(s) insulator nose leaking	Replace
	Fuel injector(s) defective	Replace
	Engine control module faulty	Replace
Engine knocks regularly	Spark plugs running too hot	Install colder type spark plugs
	Powertrain control module faulty	Replace
Engine lacks power	Spark plugs fouled	Clean
	Fuel injectors defective	Replace
	Manifold Absolute Pressure (MAP) Sensor or Manifold Absolute Pressure Sensor circuit defective	Correct or replace
	Engine Coolant Temperature Sensor or Engine Coolant Temperature Sensor circuit defective	Correct or replace
	Engine Control Module faulty	Replace
	Intake Air Temperature Sensor or Intake Air Temperature Sensor circuit defective	Correct or replace
	Throttle Position Sensor or Throttle Position Sensor circuit defective	Correct or replace
	Knock Sensor or Knock Sensor circuits defective	Correct or replace
	Knock Sensor Module or Knock Sensor Module circuits defective	Correct or replace

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Hesitation

Condition	Possible cause	Correction
Hesitation on acceleration	Throttle Position Sensor adjustment incorrect	Replace throttle valve assembly
	Throttle Position Sensor circuit open or shorted	Correct or replace
	Excessive play in accelerator linkage	Adjust or replace
	Manifold Absolute Pressure (MAP) Sensor circuit open or shorted	Correct or replace
	MAP Sensor defective	Replace
	Intake Air Temperature (IAT) Sensor circuit open or shorted	Correct or replace
	Knock Sensor (KS) Circuit open or shorted	Correct or replace
	KS defective	Replace
	KS Module circuits open or shorted	Correct or replace
	KS Module defective	Replace
	IAT Sensor defective	Replace
Hesitation at high speeds (Fuel pressure too low)	Fuel tank strainer clogged	Clean or replace
	Fuel pipe clogged	Clean or replace
	Fuel filter clogged	Replace
	Defective fuel pump system	Check and replace
	Fuel Pressure Control Valve leaking	Replace
Hesitation at high speeds (Fuel injector not working normally)	Power supply or ground circuit for Multiport Fuel Injection System shorted or open	Check and correct or replace
	Cable of Multiport Fuel Injection System disconnected or defective	Correct or replace
Hesitation at high speeds	Engine Control Module defective	Replace
	Throttle Position Sensor circuit open or shorted	Correct or replace
	Throttle Position Sensor defective	Replace
	Engine Coolant Temperature Sensor circuit open or shorted	Correct or replace
	Engine Coolant Temperature Sensor defective	Replace
	MAP Sensor cable open or shorted	Correct or replace
	MAP Sensor defective	Replace
	IAT Sensor circuit open or shorted	Correct or replace
	IAT Sensor defective	Replace
	KS Circuit open or shorted	Correct or replace
	KS defective	Replace
	KS Module circuit open or shorted	Correct or replace
	KS Module defective	Replace
	Throttle valve not wide opened	Check and correct or replace
	Air Cleaner Filter clogged	Replace filter element
Power supply voltage too low	Check and correct or replace	

Engine Lacks Power

Condition	Possible cause	Correction
Trouble in fuel system	Fuel Pressure Control Valve not working normally	Replace
	Fuel injector clogged	Clean or replace
	Fuel pipe clogged	Clean
	Fuel filter clogged or fouled	Replace
	Fuel pump drive circuit not working normally	Correct or replace
	Fuel tank not sufficiently breathing due to clogged Evaporative Emission Control System circuit	Clean or replace
	Water in fuel system	Clean
	Inferior quality fuel in fuel system	Use fuel of specified octane rating
	Engine Control Module supplied poor voltage	Correct circuit
	Throttle Position Sensor cable disconnected or broken	Correct or replace
	Throttle Position Sensor defective	Replace
	Manifold Absolute Pressure Sensor not working normally	Replace
	Intake Air Temperature sensor not working normally	Replace
	Engine Coolant Temperature Sensor circuit open or shorted	Correct or replace
	Engine Coolant Temperature Sensor defective	Replace
Engine Control Module defective	Replace	
Trouble in intake or exhaust system	Air Cleaner Filter clogged	Replace filter element
	Air duct kicked or flattened	Correct or replace
Ignition failure	-	Refer to Hard Start Troubleshooting Guide
	Heat range of spark plug inadequate	Install spark plugs of adequate heat range
	Electronic Ignition System with module	Replace

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Condition	Possible cause	Correction
Engine overheating	Level of Engine Coolant too low	Replenish
	Thermo switch or fan motor defective	Replace
	Thermostat defective	Replace
	Engine Coolant pump defective	Correct or replace
	Radiator clogged	Clean or replace
	Radiator filter cap defective	Replace
	Level of oil in engine crankcase too low or wrong oil in engine	Change or replenish
	Resistance in exhaust system increased	Clean exhaust system or replace defective parts
	Throttle Position Sensor adjustment incorrect	Adjust Wide Open Throttle switch setting
	Throttle Position Sensor circuit open or shorted	Correct or replace
	Cylinder head gasket damaged	Replace
	Cooling Fan clutch defective	Replace
	Fan belt slipping	Adjust tension of V-belt or replace V-belt
Engine overcooling	Thermostat defective	Replace (Use a thermostat set to open at 92°C (197.6°F))
Engine lacks compression	-	Refer to Hard Start
Others	Tire inflation pressure abnormal	Adjust to recommend pressures
	Brake drag	Adjust
	Clutch slipping	Adjust or replace
	Level of oil in engine crankcase too high	Correct level of engine oil

Engine Noisy

Abnormal engine noise often consists of various noises originating in rotating parts, sliding parts and other moving parts of the engine. It is, therefore, advisable to locate the source of noise systematically.

Condition	Possible cause	Correction
Noise from crank journals or from crank bearings (Faulty crank journals and crank bearings usually make dull noise that becomes more evident when accelerating)	Oil clearance increased due to worn crank journals or crank bearings	Replace crank bearings and crankshaft or regrind crankshaft and install the over size bearing
	Crankshaft out of round	Replace crank bearings and crankshaft or regrind crankshaft and install the over size bearing
	Crank bearing seized	Replace crank bearings and crankshaft or regrind crankshaft and install the over size bearing

Abnormal Noise Due to Hydraulic Lash Adjuster

Should abnormal noise due to the hydraulic lash adjuster trouble be heard immediately after the engine is started, inspect as follows:

Condition	Possible cause	Correction
Abnormal noise is heard	Air contaminated	Bleed
HLA is spongy	Check ball valve broken	Repair
	Safety valve in cylinder head broken	Replace
Valve clearance is not zero	HLA inside stick	Replace HLA assembly

Troubleshooting Procedure

Short out each spark plug in sequence using insulated spark plug wire removers. Locate cylinder with defective bearing by listening for abnormal noise that stops when spark plug is shorted out.

Condition	Possible cause	Correction
Noise from connecting rods or from connecting rod bearings (Faulty connecting rods or connecting rod bearings usually make an abnormal noise slightly higher than the crank bearing noise, which becomes more evident when engine is accelerated)	Bearing or crankshaft pin worn	Replace connecting rod bearings and crankshaft or regrind crankshaft and install the under size bearing
	Crankpin out of round	Replace connecting rod bearings and crankshaft or regrind crankshaft and install the under size bearing
	Connecting rod bent	Correct or replace
	Connecting rod bearing seized	Replace connecting rod bearings and crankshaft or regrind crankshaft and install the under size bearing

Troubleshooting Procedure

Abnormal noise stops when the spark plug on the cylinder with defective parts is shorted out.

Condition	Possible cause	Correction
Piston and cylinder (Faulty piston or cylinder usually makes a combined mechanical thumping noise which increases when engine is suddenly accelerated but diminishes gradually as the engine warms up)	Piston clearance increased due to cylinder wear	Replace piston and cylinder body
	Piston seized	Replace piston and cylinder body
	Piston ring broken	Replace piston and cylinder body
	Piston defective	Replace pistons and others

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Troubleshooting Procedure

Short out each spark plug and listen for change in engine noise.

Condition	Possible cause	Correction
Piston pin noise (Piston makes noise each time it goes up and down)	Piston pin or piston pin hole worn	Replace piston, piston pin and connecting rod assy

Troubleshooting Procedure

The slapping sound stops when spark plug on bad cylinder is shorted out.

Condition	Possible cause	Correction
Timing belt noise	Timing belt tension is incorrect	Replace pusher or adjust the tension pulley or replace timing belt
	Tensioner bearing defective	Replace
	Timing belt defective	Replace
	Timing wheels defective	Replace
	Timing belt comes in contact with timing cover	Replace timing belt and timing cover
Valve noise	Valve and valve guide seized	Replace valve and valve guide
	Valve spring broken	Replace
	Valve seat off-positioned	Correct
Crankshaft noise	Crankshaft end play excessive (noise occurs when clutch is engaged)	Replace thrust bearing
Engine knocking	Preignition due to use of spark plugs of inadequate heat range	Install Spark Plugs of adequate heat range
	Fuel too low in octane rating	Replace fuel
	Wide Open Throttle enrichment system failure	Refer to Section 6E
	Selection of transmission gear incorrect	Caution operator or incorrect gear selection
	Engine overheating	Refer to "Engine Lacks Power"
Others	Water pump defective	Replace
	V-belt slipping	Adjust tension of V-belt or replace V-belt

Abnormal Combustion

Condition	Possible cause	Correction
Trouble in fuel injection system	Fuel pressure control valve defective	Replace
	Fuel filter clogged	Replace
	Fuel pump clogged	Clean or replace
	Fuel tank or fuel pipe clogged	Clean or replace
	Fuel injector clogged	Clean or replace
	Fuel pump relay defective	Replace
	Power supply cable for fuel pump loosely connected or defective	Reconnect, correct or replace
	Manifold Absolute Pressure Sensor circuit open or shorted	Correct or replace
	Manifold Absolute Pressure Sensor defective	Replace
	Engine Coolant Temperature (ECT) Sensor circuit open or shorted	Correct or replace
	ECT Sensor defective	Replace
	Throttle Position Sensor adjustment incorrect	Reconnect
	Throttle Position Sensor defective	Replace
	Throttle Position Sensor connector loosely connected	Reconnect
	Vehicle Speed Sensor cable loosely connected or defective	Correct or replace
	Vehicle Speed Sensor loosely fixed	Fix tightly
Vehicle Speed Sensor in wrong contact or defective	Replace	
Engine Control Module cable loosely connected or defective	Correct or replace	
Trouble in emission control system	Heated Oxygen Sensor circuit open (If applicable)	Correct or replace
	Heated Oxygen Sensor defective (If applicable)	Replace
	Signal vacuum hose loosely fitted or defective	Correct or replace
	ECT Sensor circuit open or shorted	Correct or replace
	ECT Sensor defective	Replace
	Evaporative Emission Control system (If applicable)	Refer to Section 6E
Trouble in ignition system	-	Refer to "Engine Lacks Power"
Trouble in cylinder head parts	Carbon deposits in combustion chamber	Remove carbon
	Carbon deposit on valve, valve seat and valve guide	Remove carbon

Engine Oil Consumption Excessive

Condition	Possible cause	Correction
Oil leaking	Oil pan drain plug loose	Retighten or replace gasket
	Oil pan setting bolts loosened	Retighten
	Oil pan gasket broken	Replace gasket
	Front cover retaining bolts loose or gasket broken	Retighten or replace gasket
	Head cover retaining bolts loose or gasket broken	Retighten or replace gasket
	Oil filter adapter cracked	Replace
	Oil filter attaching bolt loose or rubber gasket broken	Retighten or replace oil filter
	Crankshaft front or rear oil seal defective	Replace oil seal
	Oil pressure unit loose or broken	Retighten or replace
	Blow-by gas hose broken	Replace hose
	Engine/Transmission coupling area	Replace oil seal
Oil leaking into combustion chambers due to poor seal in valve system	Valve stem oil seal defective	Replace
	Valve stem or valve guide worn	Replace valve and valve guide
Oil leaking into combustion chambers due to poor seal in cylinder parts	Cylinders and pistons worn excessively	Rebore cylinder and replace pistons and others
	Piston ring gaps incorrectly positioned	Correct
	Piston rings set with wrong side up	Correct
	Piston rings sticking	Rebore cylinder and replace pistons and others
	Piston ring and ring groove worn	Replace pistons and others
	Return ports in oil rings clogged	Clean piston and replace rings
Crank case ventilation, Positive Crankcase Ventilation System malfunctioning	Positive Crankcase Ventilation Hose clogged	Clean
Others	Improper oil viscosity	Use oil of recommended S.A.E. viscosity
	Continuous high speed driving and or severe usage such as trailer towing	Continuous high speed operation and or severe usage will normally cause increased oil consumption

Fuel Consumption Excessive

Condition	Possible cause	Correction
Trouble in fuel system	Mixture too rich or too lean due to trouble in fuel injection system	Refer to "Abnormal Combustion"
	Fuel cut function does not act	Refer to "Abnormal Combustion"
Trouble in ignition system	Misfiring or abnormal combustion due to trouble in ignition system	Refer to Hard Start or Abnormal Combustion Troubleshooting Guide
Others	Engine idle speed too high	Reset Idle Air Control Valve
	Returning of accelerator control sluggish	Correct
	Fuel system leakage	Correct or replace
	Clutch slipping	Correct
	Brake drag	Correct
	Selection of transmission gear incorrect	Caution operator of incorrect gear selection

Oil Problems

Condition	Possible cause	Correction
Oil pressure too low	Wrong oil in use	Replace with correct engine oil
	Relief valve sticking	Replace
	Oil pump not operating properly	Correct or replace
	Oil pump strainer clogged	Clean or replace strainer
	Oil pump worn	Replace
	Oil pressure gauge defective	Correct or replace
	Crankshaft bearing or connecting rod bearing worn	Replace
Oil contamination	Wrong oil in use	Replace with new engine oil
	Oil filter clogged	Replace oil filter
	Cylinder head gasket damage	Replace gasket
	Burned gases leaking	Replace piston and piston rings or rebore cylinders
Oil not reaching valve system	Oil passage in cylinder head or cylinder body clogged	Clean or correct

Engine Oil Pressure Check

1. Check for dirt, gasoline or water in the engine oil.
 - a. Check the viscosity of the oil.
 - b. Change the oil if the viscosity is outside the specified standard.
 - c. Refer to the "Maintenance and Lubrication" section of this manual.
2. Check the engine oil level.
 The level should fall somewhere between the "ADD" and the "FULL" marks on the oil level dipstick.
 If the oil level does not reach the "ADD" mark on the oil level dipstick, engine oil must be added.
3. Remove the oil pressure unit.
4. Install an oil pressure gauge.
5. Start the engine and allow the engine to reach normal operating temperature (About 80°C).
6. Measure the oil pressure.
**Oil pressure should be:
 150 kPa(21.8 psi) at idle speed.**
7. Stop the engine.
8. Remove the oil pressure gauge
9. Install the oil pressure unit.
10. Start the engine and check for leaks.

6-14 ENGINE DIAGNOSIS (C22NE, 22LE, 20LE)

Malfunction Indicator Lamp

The instrument panel "CHECK ENGINE" Malfunction Indicator lamp (MIL) illuminates by self diagnostic system when the system checks the starting of engine, or senses malfunctions.

Condition	Possible cause	Correction
"CHECK ENGINE" MIL does not illuminate at the starting of engine	Bulb defective	Replace
	MIL circuit open	Correct or replace
	Command signal circuit to operate self diagnostic system shorted	Correct or replace
	Engine Control Module (ECM) cable loosely connected, disconnected or defective	Correct or replace
	ECM defective	Replace
"CHECK ENGINE" MIL illuminates, and stays on	Deterioration heated oxygen sensor of internal element	Replace
	Heated oxygen sensor connector terminal improper contact (If applicable)	Reconnect properly
	Heated oxygen sensor lead wire shorted (If applicable)	Correct
	Heated oxygen sensor circuit open (If applicable)	Correct or replace
	Deterioration engine coolant temperature sensor of internal element	Replace
	Engine coolant temperature sensor connector terminal improper contact	Reconnect properly
	Engine coolant temperature sensor lead wire shorted	Correct
	Engine coolant temperature sensor circuit open	Correct or replace
	Throttle position sensor open or shorted circuits	Correct or replace
	Deterioration of crankshaft position sensor	Replace
	Crankshaft position sensor circuit open or shorted	Correct or replace
	Vehicle speed sensor circuit open	Correct or replace
	Manifold absolute pressure sensor circuit open or shorted	Correct or replace
	Intake air temperature sensor circuit open or shorted	Correct or replace
	Fuel injector circuit open or shorted	Correct or replace
	ECM driver transistor defective	Replace EPROM or ECM
	Malfunctioning of ECM RAM (Random Access Memory) or Malfunctioning of ECM PROM (Programmed Read Only Memory)	Replace EPROM or ECM

SECTION 6A

ENGINE MECHANICAL

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