

1975-79 FUEL SYSTEMS

General Motors Turbocharging System

1978-79 Buick V6 VEHICLE APPLICATION

BUICK

Application	VIN Code
1978	
3.8L V-6 2-Bbl. Turbo	G
3.8L V-6 4-Bbl. Turbo	3
1979	
3.8L V-6 4-Bbl. Turbo	3

DESCRIPTION

The turbocharging system is mounted on top of engine. It includes a turbine/compressor assembly, plenum chamber, wastegate, and carburetor. Turbine is spun by exhaust gas and causes compressor force air into intake manifold.

A slightly modified 4-barrel carburetor provides air and fuel to compressor assembly. Maximum manifold pressure (boost) is controlled by an exhaust bypass valve called a wastegate. This valve, sensing pressure differences through a diaphragm type actuator. It determines how much exhaust should be routed to turbine. Any excess exhaust gas is bypassed into exhaust system.

OPERATION

Air is drawn in through air cleaner and carburetor assembly. Carburetor mixes a metered amount of fuel with incoming air and passes it into compressor assembly. As engine load increases and throttle is opened, more air/fuel mixture flows into combustion chambers. As this mixture is burned, a greater volume of exhaust

gas enters exhaust system. This gas is directed into turbocharger turbine housing.

Some energy contained in exhaust gas is used to increase speed of turbine wheel. The turbine wheel is connected by a shaft to a compressor wheel. As the compressor wheel spins faster, it compresses incoming carburetor air/fuel mixture and forces a denser charge into combustion chambers producing a higher power output.

CARBURETOR & PLENUM

Carburetor is a standard 4-barrel unit with some minor modifications to throttle linkage, enrichment system and choke system. Carburetor is mounted on a plenum that leads directly to compressor intake. An electric Early Fuel Evaporation (EFE) heater is used on all Turbo engines. A ceramic heating grid is built into the carburetor spacer and minimizes fuel puddling during cold operation.

TURBINE ASSEMBLY

Turbine is mounted on top of intake manifold with compressor. It is connected to compressor by a shaft. When turbine wheel turns, compressor wheel must turn. Exhaust gas is fed into turbine through a pipe causing turbine blades to spin. The more exhaust gas piped to turbine, the faster it will spin, increasing power output.

WASTEGATE & ACTUATOR

When manifold pressure (boost) reaches a certain predetermined level, there must be some method of controlling or limiting boost past that point. The wastegate performs this function. Exhaust gas is piped into turbine continuously. Once the proper boost level is

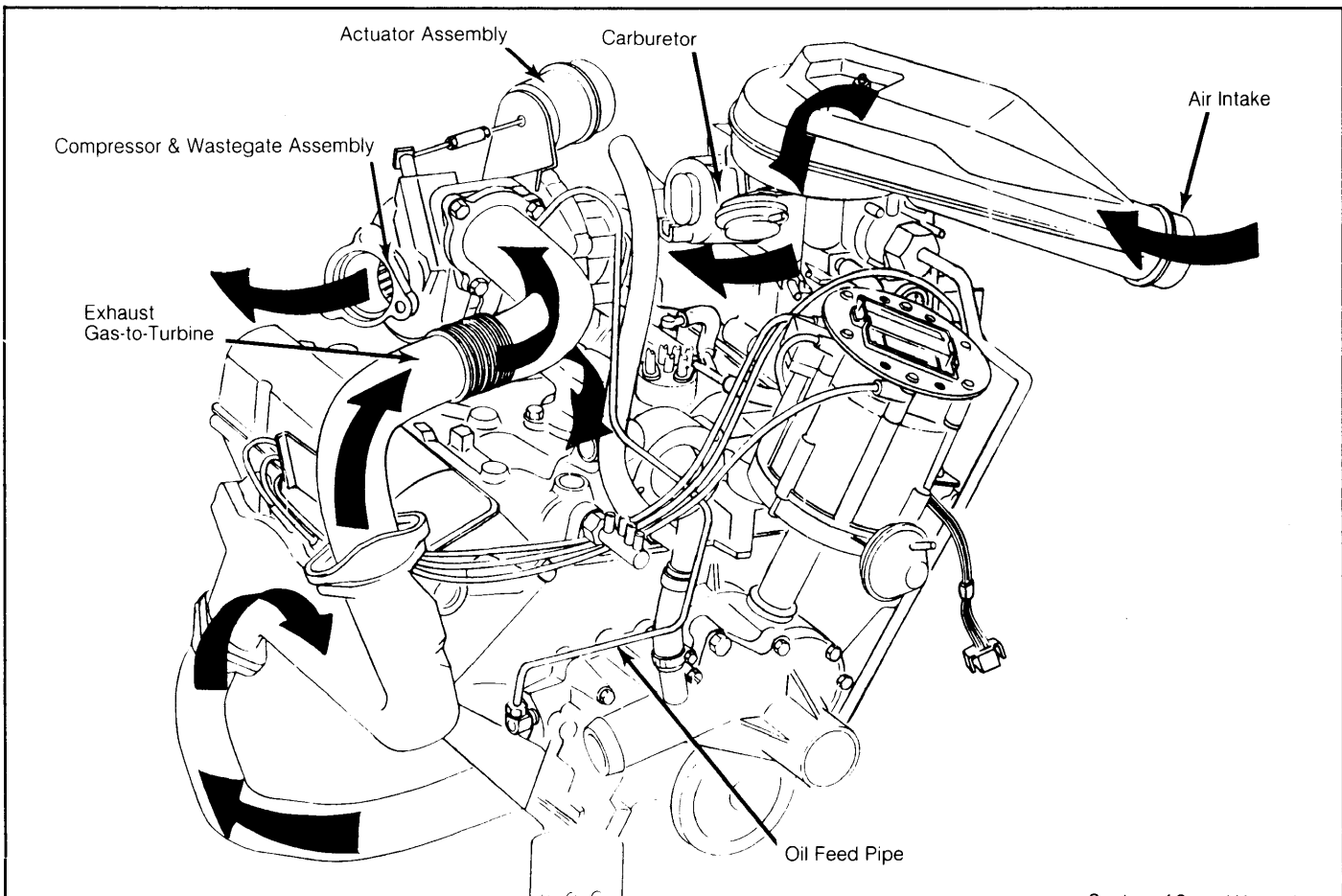


Fig. 1: Diagram Showing Airflow Pattern For Turbocharged V6 Engine

Courtesy of General Motors Corp.

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attained, the wastegate actuator bypasses enough exhaust gas into exhaust system to maintain required turbine speed.

Wastegate actuator is a pressure sensitive diaphragm type unit. It is installed to sense pressure differential across compressor. Once this differential reaches a certain level, diaphragm reacts in conjunction with an integral spring, to partially open wastegate. The wastegate is mounted to turbine assembly.

COMPRESSOR

Compressor is connected to the turbine by a shaft. As turbine wheel turns, so does compressor wheel. No exhaust gas is actually passed into compressor. Carburetor directs air/fuel mixture into compressor. The spinning compressor forces more air/fuel mixture into intake manifold than would normally be drawn in under atmospheric pressure. See Fig. 2.

POWER ENRICHMENT VACUUM REGULATOR (PEVR)

Due to change in engine vacuum caused by turbocharger operation, a vacuum regulator is used to control vacuum signals. The Power Enrichment Vacuum Regulator (PEVR) is used to direct a controlled vacuum flow to power piston enrichment port on carburetor. Vacuum input port is located in center of PEVR, output on perimeter of valve. The manifold signal port extends into intake manifold.

OIL SUPPLY

Turbocharging assembly can reach speeds of 140,000 RPM. A sufficient supply of clean engine oil is absolutely necessary to proper operation of assembly. Engine oil is fed directly to center housing rotating assembly. Any interruption or contamination of oil will result in major turbocharger damage. An oil feed pipe runs from a fitting on engine block to turbocharger.

Whenever oil and filter are changed on a turbocharged engine, oil system must be primed with oil prior to starting. This can be done

(after oil and filter are correctly installed) by disconnecting Pink wire at H.E.I. distributor. Crank engine several times (not longer than 30 seconds at a time), and observing when oil light goes out. Reconnect Pink wire and start engine.

Whenever oiling system has been contaminated in any way, change oil and filter and flush turbocharger assembly with clean oil. Any time center housing rotating assembly is replaced, oil and filter should be changed.

IGNITION SYSTEM

Turbocharged engines use a modified H.E.I. system called Electronic Spark Control (ESC). This system is used to control engine detonation by automatically retarding timing during periods when detonation occurs. The 4 major components of system are intake manifold, detonation sensor, controller and H.E.I. distributor.

The detonation sensor is mounted at rear of intake manifold. It can be recognized by large diameter (1.12") hex shape and single electrical connector. Sensor detects detonation and sends a signal to ESC controller, mounted in passenger compartment. Controller processes information from detonation sensor and sends a signal to special 5-pin HEI module. The signal delays spark timing and can retard ignition up to 22 degrees during heavy detonation. Retarding spark reduces detonation and possibility of engine damage.

NOTE: For diagnosis and testing of detonation sensor and ESC system, see GENERAL MOTORS ELECTRONIC SPARK CONTROL IN DISTRIBUTORS & IGNITION SYSTEMS section.

TESTING

NOTE: Either road test or shop test may be used to check wastegate operation. It is not necessary to perform both tests.

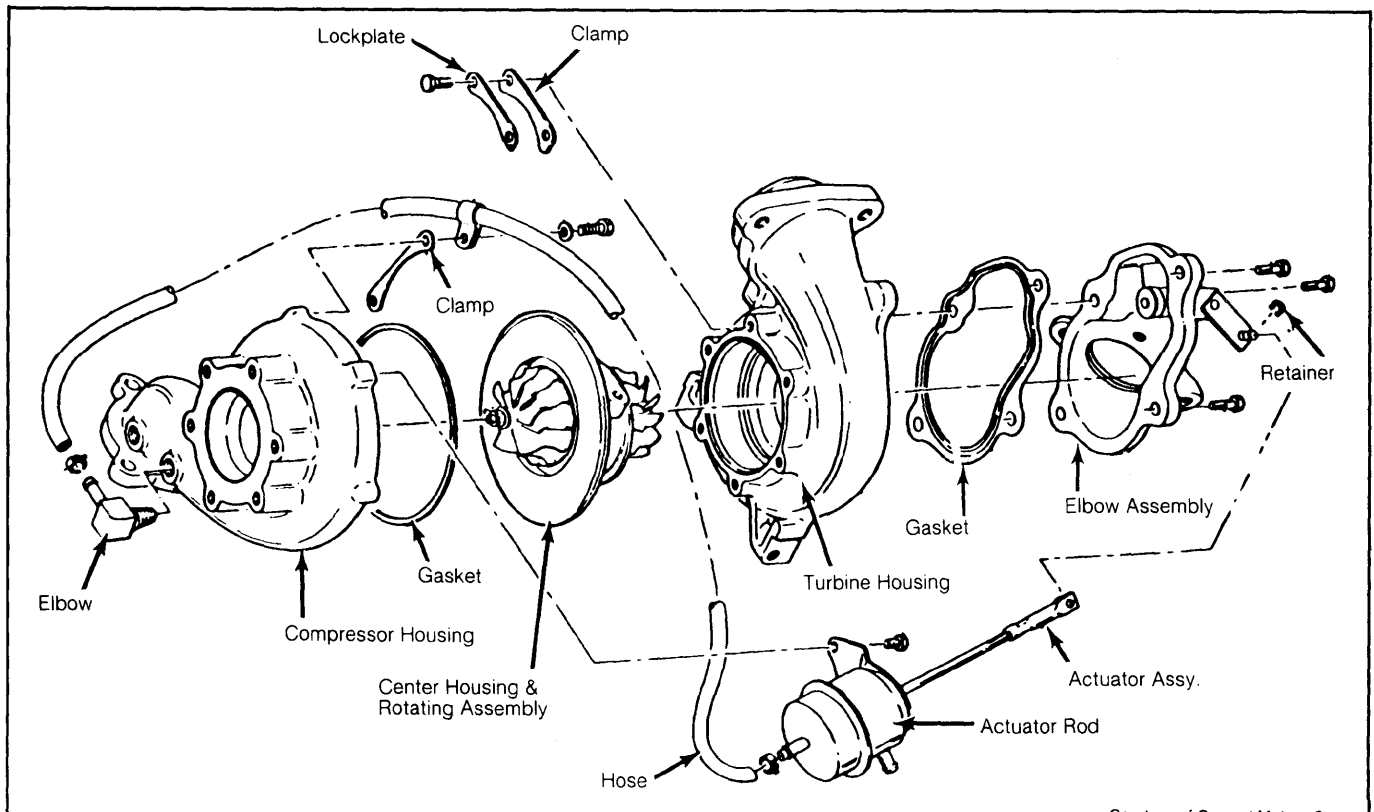


Fig. 2: Exploded View of General Motors V6 Turbocharging System

Courtesy of General Motors Corp.

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WASTEGATE/BOOST PRESSURE

- 1) Inspect wastegate and actuator assembly for linkage damage. Check condition of hose from compressor housing to actuator, then remove hose.
- 2) Connect a hand operated vacuum/pressure pump in series with compound vacuum/pressure gauge, and install in place of plenum-to-actuator hose.
- 3) With 3 in. Hg vacuum applied to actuator, rod should move .015" (.38 mm). Replace actuator if not operating properly. Check new unit and crimp threads on rod to maintain proper calibration. Remove test equipment. Reconnect plenum-to-actuator hose.

BOOST PRESSURE ROAD TEST

- 1) Install compound vacuum/pressure gauge between compressor and boost gauge or vacuum switches. Use tubing to place gauge in passenger compartment.

CAUTION: Be sure that gauge and tubing are in good condition to prevent leakage of air/fuel mixture into vehicle while testing.

- 2) Perform a wide open throttle acceleration test from 0-50 MPH. Boost pressure should reach 8-9 psi (.56-.63 kg/cm²). If not, replace actuator and retest.

POWER ENRICHMENT VACUUM REGULATOR (PEVR)

- 1) Inspect valve and hoses for wear or damage. Replace as needed. Tee one hose from Manometer (J-23951) between Yellow striped hose and input port. Connect other manometer hose to output port of PEVR.
- 2) Start engine and run at idle speed. There should be no more than 14" H₂O difference. If there is, replace PEVR.
- 3) If PEVR passes this test but is still suspected to be faulty, remove PEVR from manifold and plug manifold opening. Connect input and output hoses back to PEVR. Tee Compound Gauge (J-28474) into output hose from PEVR.
- 4) Start and run engine at idle speed. Compound gauge reading should be 7-9 in. Hg vacuum. Apply 3 psi (.21 kg/cm²) to manifold signal port of the PEVR. Output vacuum reading should be 1.4-2.6 in. Hg.
- 5) Apply a minimum of 5 psi (.35 kg/cm²) to manifold signal port. There should be no vacuum output. If PEVR does not pass both of these tests, replace with new unit.

REMOVAL & INSTALLATION

Before beginning any unit repair procedures on a turbocharging system, several general cautions should be considered.

- Clean area around turbocharger with non-caustic solution before disassembly.
- Use extreme care during removal to avoid damaging turbine blades. Any damage may result in turbocharger failure when engine is started.
- Scribe reference marks on turbine and compressor housing before disassembly to ensure correct reassembly.
- If any joints are found to be coated with sealer, clean thoroughly and recoat with sealant during assembly.

WASTEGATE/ACTUATOR ASSEMBLY

Removal & Installation – Disconnect hoses from actuator. Remove wastegate-to-actuator rod clip. Remove 2 bolts and actuator. To install, reverse removal procedure.

ELBOW ASSEMBLY & CENTER ASSEMBLY

Removal & Installation – 1) Disconnect turbocharger exhaust outlet pipe from elbow assembly. Raise vehicle. Disconnect outlet pipe from catalytic converter. Lower vehicle. Disconnect inlet pipe from right exhaust manifold and turbine housing.

- 2) Remove 2 bolts securing turbine housing to intake manifold bracket. Disconnect turbocharger oil feed pipe from center housing. Remove oil drain hose from pipe.
- 3) Remove clip securing wastegate linkage to actuator rod. Remove 6 bolts holding backplate to compressor housing and 6 bolts holding turbine housing to center assembly. To install, reverse removal procedure.

TURBOCHARGER & ACTUATOR ASSEMBLY

Removal & Installation – 1) Disconnect exhaust inlet and outlet pipes at turbocharger. Disconnect oil feed line from center housing, then remove linkage from carburetor.

- 2) Disconnect linkage bracket from plenum and remove 2 bolts securing plenum to side bracket. Disconnect fuel line and all necessary hoses. Drain cooling system and disconnect hoses from front and rear of plenum.
- 3) Remove power brake vacuum line, then disconnect plenum front bracket from intake manifold. Remove 2 bolts securing housing to manifold. Disconnect EGR manifold from intake manifold and plenum. Remove air injection by-pass hose from pipe.
- 4) Remove 3 bolts attaching compressor housing to intake manifold. Remove turbocharger and actuator, still attached to carburetor and plenum. Remove 6 bolts and turbocharger assembly. Remove oil drain from center housing. To install, reverse removal procedure.

INTERNAL INSPECTION

TURBOCHARGER

- 1) Remove exhaust outlet pipe from elbow assembly on turbocharger. Using a mirror, observe movement of wastegate while operating actuator linkage manually. If wastegate fails to open or close, replace elbow assembly.
- 2) Remove turbocharger assembly from engine. Do not separate center housing rotating assembly from turbine housing. Inspect for loose backplate-to-center housing rotating assembly bolts. Tighten if needed.
- 3) Gently spin compressor wheel. Replace if binding. Remove oil drain from center housing. Check housing for sludging in oil drain area. If slightly dirty, clean. If heavily sludged or caked, replace center housing rotating assembly.
- 4) Inspect compressor wheel for signs of oil leakage. If present, replace Center Housing Rotating Assembly (CHRA). Inspect compressor wheel for damage or caking. Replace as necessary.

NOTE: If CHRA is being replaced, lubricate with clean engine oil.

- 5) Inspect compressor housing (on engine) and turbine housing for gouges, nicks or distortion. Replace either housing if damaged.
- 6) If CHRA is not being replaced, remove turbine housing from CHRA and check bearing clearances as described in the following procedures. If clearances are correct, install oil drain and turbocharger assembly.

NOTE: Before connecting exhaust pipe to turbocharger assembly, gently spin turbine wheel to be sure it is not binding or scraping housing.

BEARING CLEARANCES

Journal Bearing Radial Clearance – 1) Attach dial indicator with 2" long, 1" offset extension rod contacting shaft of turbine. Insert shaft through oil outlet port. See Fig. 3.

- 2) Apply finger pressure to both turbine and compressor wheels to move shaft AWAY from dial indicator plunger. Set indicator to zero.
- 3) Move shaft TOWARD dial indicator, rotating slightly to ensure it moves as far as possible. Record maximum reading. Move shaft away from indicator and check to be sure indicator moves to zero.
- 4) Repeat procedure to ensure clearance has been measured accurately. If not within .003-.006", replace center housing rotating assembly (CHRA) and inspect turbine and compressor housings.

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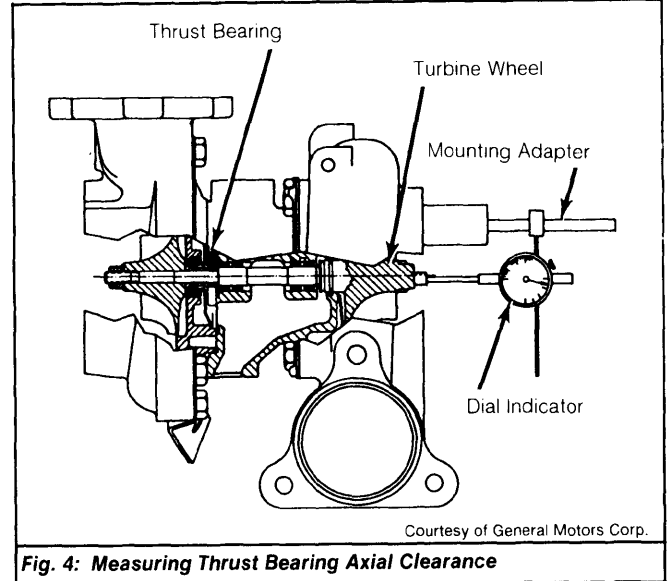
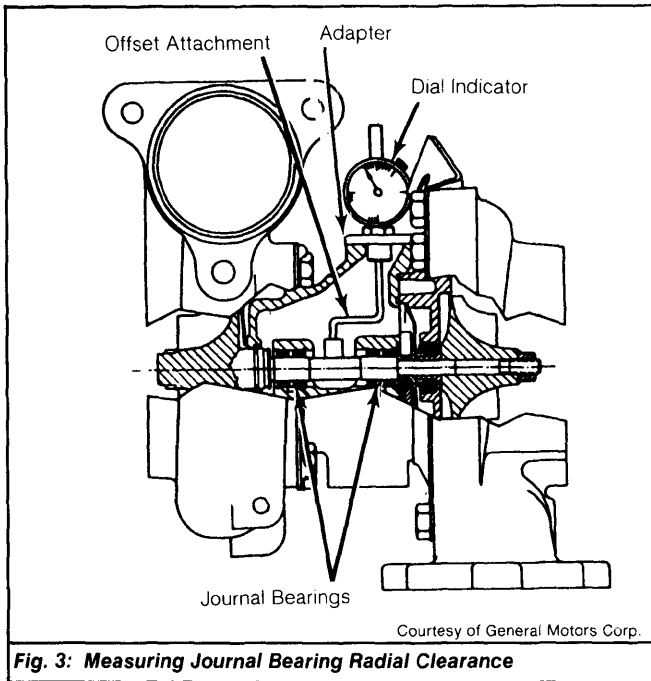


Fig. 4: Measuring Thrust Bearing Axial Clearance

3) Repeat procedure after rotating turbine several times. If clearance is not within .001-.003", replace CHRA and inspect housings.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Carburetor-to-Plenum	21 (28)
CHRA-to-Housings	15 (20)
Compressor-to-Intake Manifold	35 (48)
Compressor-to-Plenum	21 (28)
Detonation Sensor	14 (19)
EGR Manifold-to-Intake Manifold	15 (20)
Exhaust Pipe Fittings	15 (20)

CAUTION: If turbocharger is operated with improper radial bearing clearance, severe damage may occur to housing.

- Thrust Bearing Axial Clearance** - 1) Mount dial indicator on turbine end of housing so tip rests on end of turbine wheel. See Fig. 4.
- 2) Manually apply pressure to turbine shaft and move it toward and away from indicator plunger. Record maximum travel indicated.