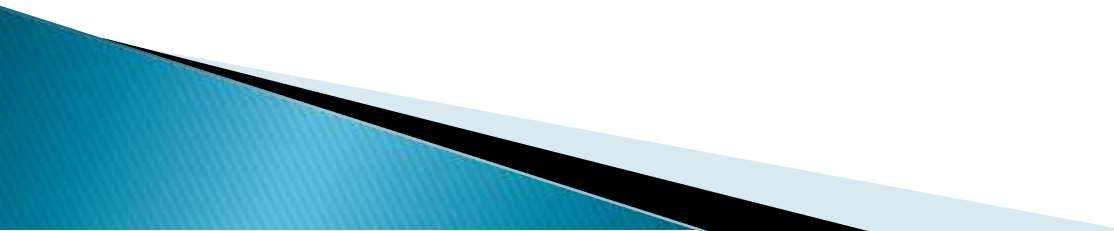


Intake and Exhaust Systems/ Turbochargers and Superchargers

Sub Code :17AT203
Program Code : 3UABVOC(AT)
Trade : Automobile

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Objectives

- ▶ Explain the operation of the air intake system
 - ▶ Describe the parts and operation of exhaust system components
 - ▶ Understand the operation of a muffler
 - ▶ Explain the differences between turbochargers and superchargers
 - ▶ Diagnose problems with turbochargers and superchargers
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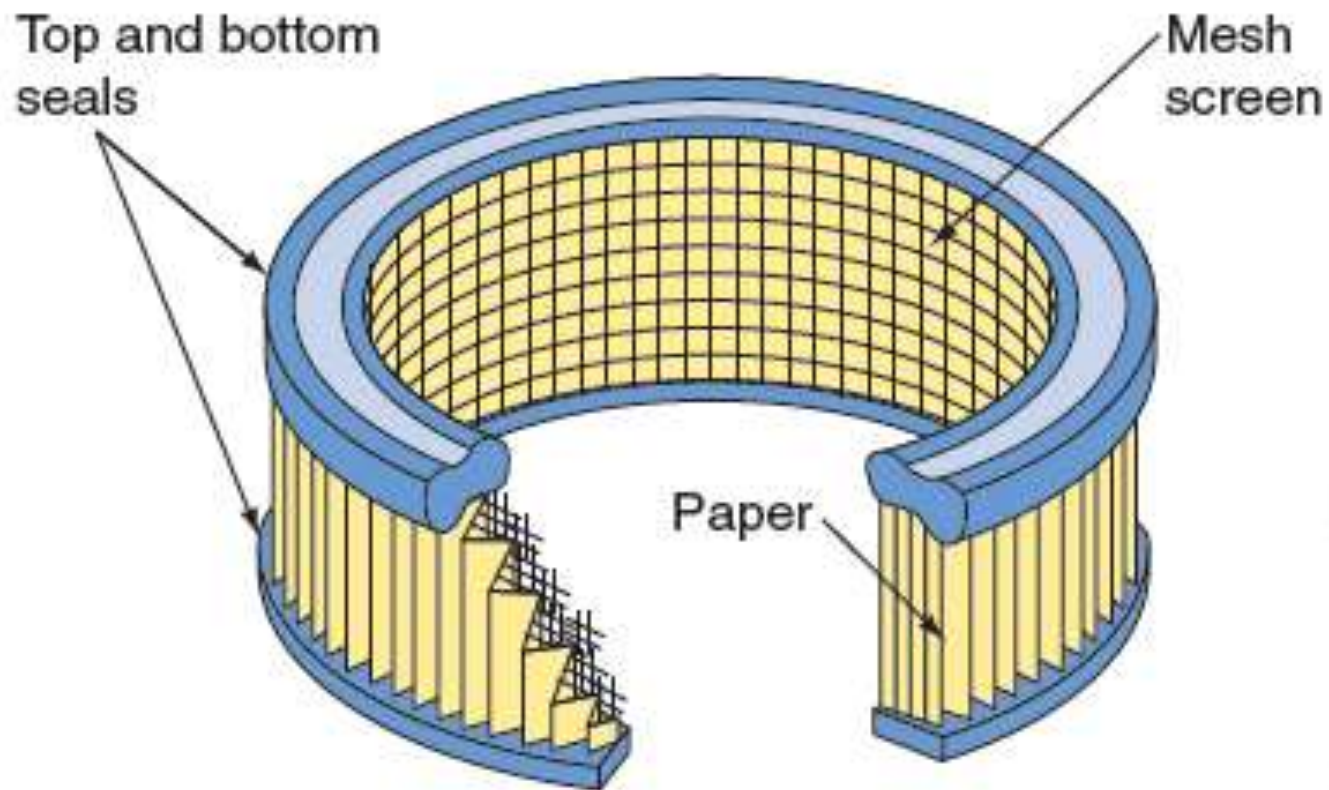
Introduction

- ▶ This chapter deals with the parts, operation, and service of:
 - Intake systems
 - Exhaust systems
 - Turbochargers
 - Superchargers

Intake System Fundamentals

- ▶ Two sources of engine contaminants
 - Internal contaminants
 - Dirt entering through air intake system
- ▶ Common types of filters in use today
 - Dry paper type: made of pleated paper
 - Oil wetted polyurethane type
- ▶ Air filters are rated
 - Efficiency, flow, and capacity





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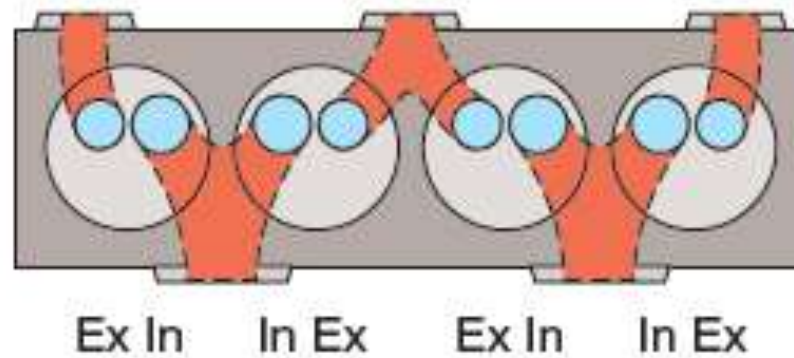
Figure 42.1 Parts of a throttle-body injection or carburetor air filter element.

Manifolds

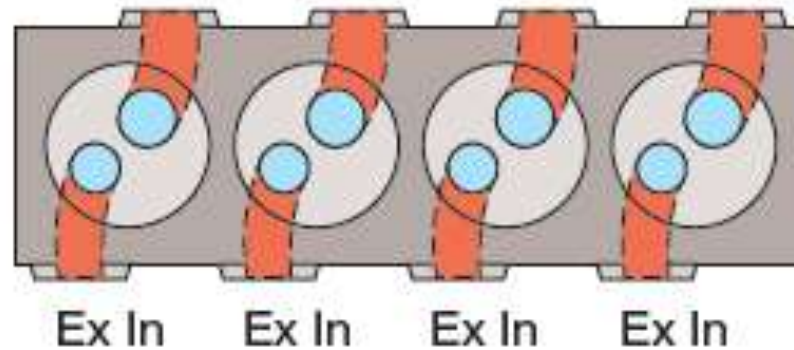
- ▶ Kinds of manifolds used in the engine's breathing system
 - Intake manifold
 - Exhaust manifold
- ▶ Designed to provide a uniform air–fuel mixture to cylinders
 - Must be the proper size and design

Intake Manifolds

- ▶ Runners
 - Passages in an intake manifold
- ▶ Port injection manifolds
 - Look different
- ▶ Plenum
 - Air space below a throttle body or carburetor
- ▶ Siamese runners
 - Feed two neighboring cylinders



(a)



(b)

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Figure 42.4 The top sketch (a) shows "siamese" valve ports that share a manifold runner. The bottom sketch (b) shows individual ports.

Intake Manifolds (cont'd.)

- ▶ Dual-plane manifold
 - Each barrel is independent
- ▶ Single-plane manifold
 - Both barrels serve all eight cylinders
- ▶ Port-injected engines
 - No intake manifold heating on



Figure 42.6 An intake manifold on a late-model fuel-injected engine.

Intake Manifolds (cont'd.)

- ▶ Some high-performance late-model engines use three, four, or five valves per cylinder
 - Greater flow area for a given valve lift is possible
- ▶ Intake manifolds are designed for low-speed or high-speed use
 - Engines with four valves per cylinder and variable valve timing are more capable of breathing
 - Speed of air movement is important to effective engine breathing

Exhaust System Fundamentals

- ▶ Exhaust system functions
 - Carries burned exhaust gases away from the passenger compartment
 - Quiets the engine
 - Most new cars have one or more catalytic converters
- ▶ Excessive backpressure
 - Reduces performance and fuel economy
- ▶ Exhaust system flow
 - Not severely affected by bends in the pipe

Exhaust Manifolds

- ▶ Mounted to cylinder head's exhaust ports
 - Typically made of cast iron or steel
- ▶ Exhaust temperature
 - Related to the amount of load on the engine
- ▶ Headers
 - Aftermarket manifolds made of tube steel
 - Sometimes require modification to install

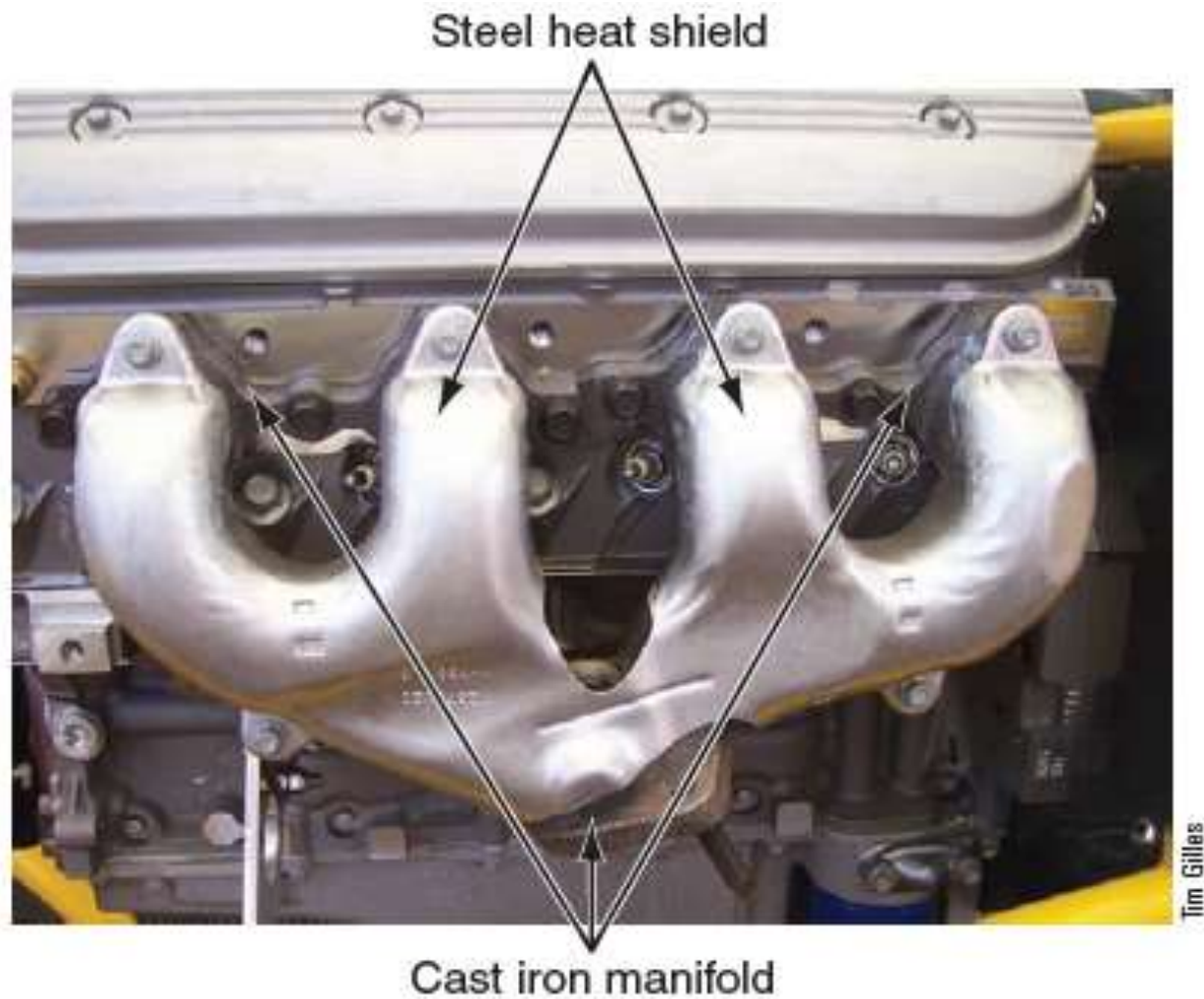


Figure 42.12 An exhaust manifold.

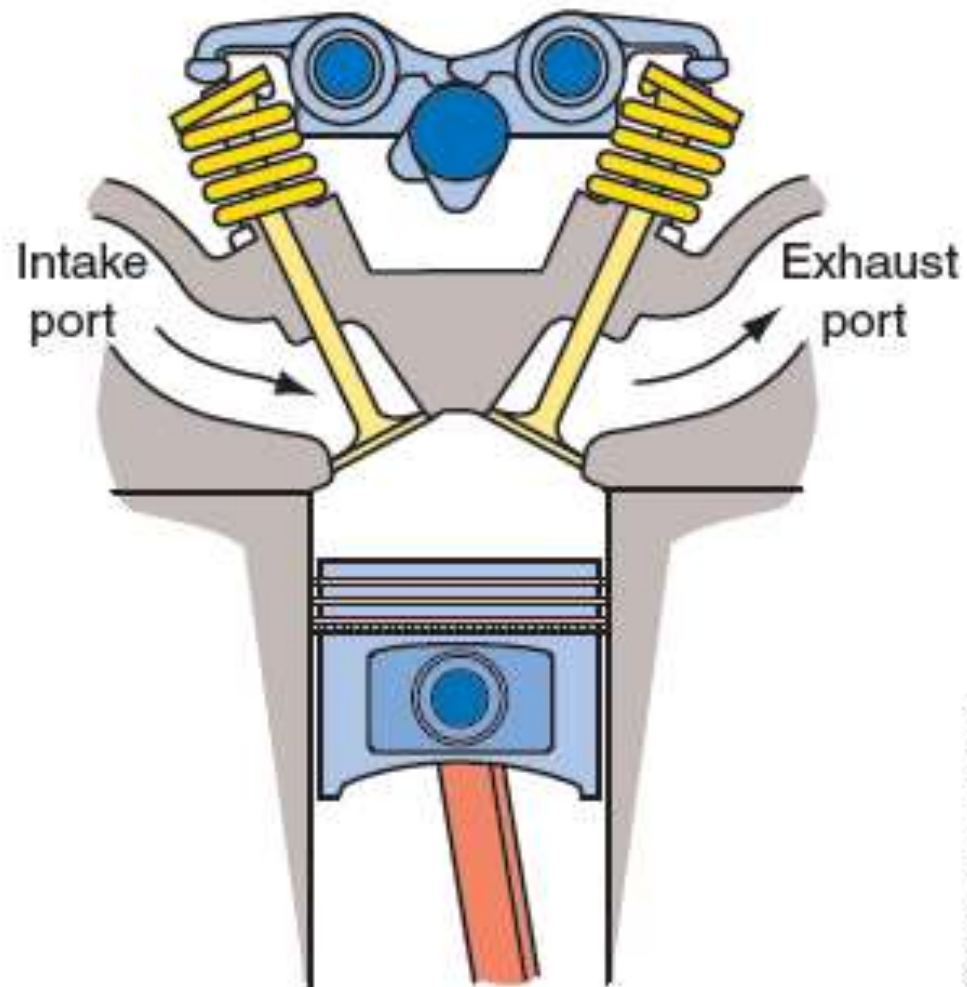
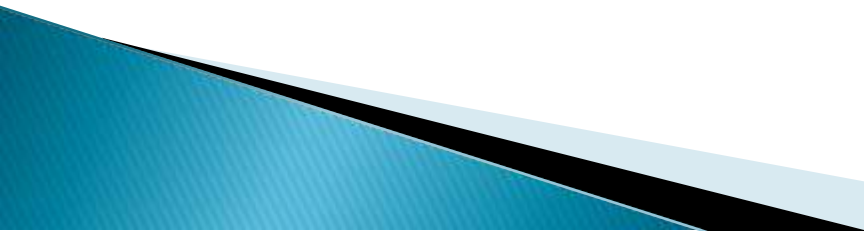


Figure 42.13 A cross-flow head.

Exhaust Pipes

- ▶ Usually three steel exhaust pipes
 - Header, exhaust, and intermediate pipe
 - ▶ Muffler
 - Tubes and chambers smooth vibrations of air
 - ▶ Resonator
 - Second muffler in line with primary muffler
 - ▶ Catalytic converters
 - Contain catalysts to reduce engine emissions
 - ▶ Muffler hangers
 - Support the muffler and pipes
- 

Exhaust System Service

- ▶ Exhaust systems rust because of acids and moisture
 - Exhaust gaskets suffer a good deal of abuse
 - Header pipes collapse resulting in a restriction
- ▶ Tools used for exhaust work
 - Chain-type pipe and roller-type exhaust cutters
 - Pipe expander
 - Deep sockets
 - Chisel cutter
 - Oxyacetylene torch



Tim Gilles

Figure 42.23 This collapsed laminated exhaust pipe caused breathing problems.

Turbochargers and Superchargers

- ▶ Supercharger is an air pump
 - Designed to increase density of air in the cylinder
- ▶ Superchargers and turbochargers
 - Draw-through
 - Blow-through

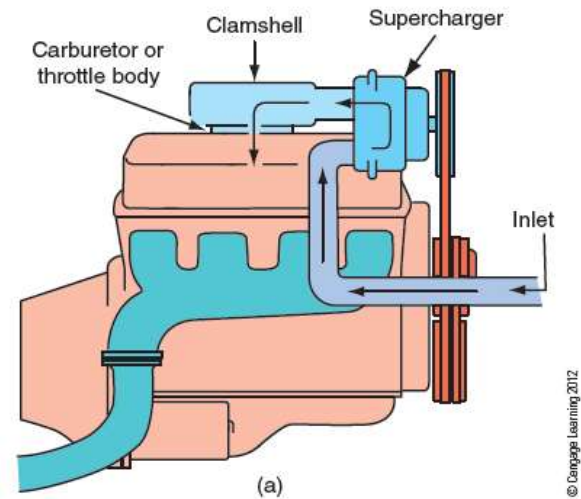


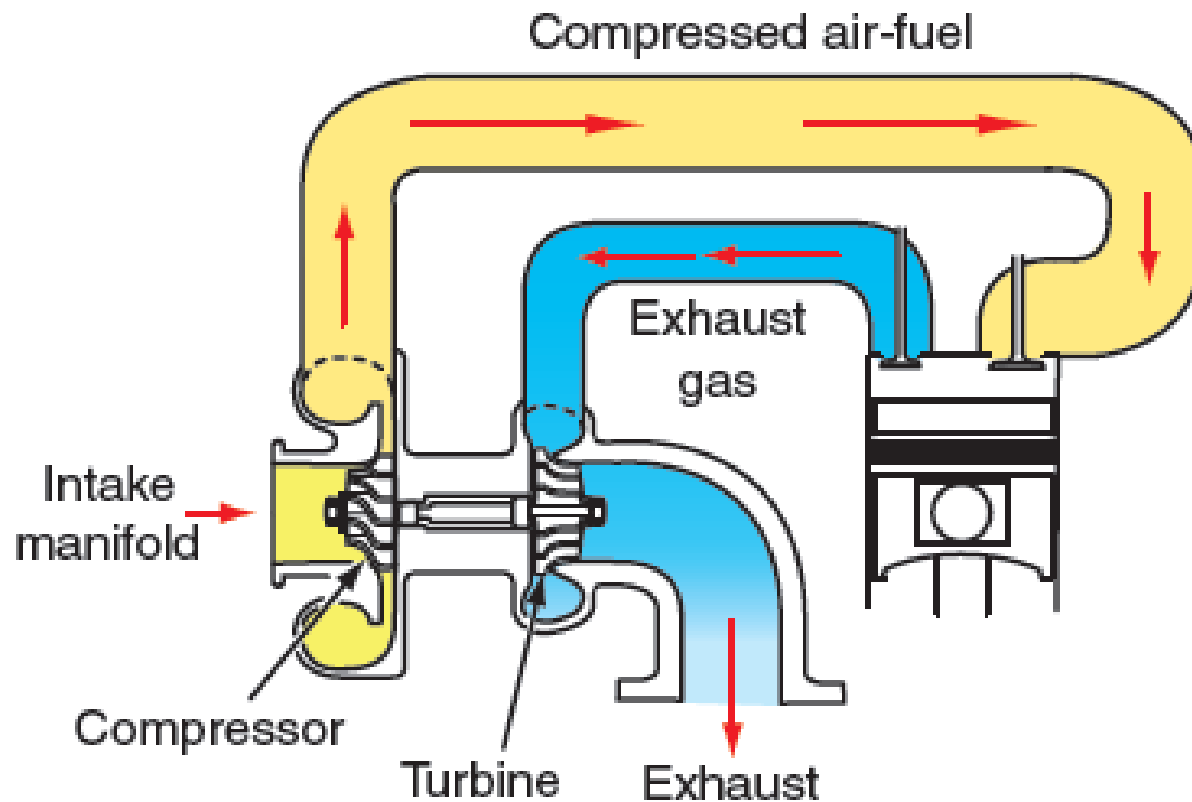
Figure 42.28 (a) A blow-through supercharger. (b) An aftermarket centrifugal belt-driven supercharger that is a fuel-injected blow-through design.

Turbochargers

- ▶ Small radial fan pump driven by the energy of the exhaust flow
 - Helps a smaller engine provide more power
- ▶ Components and characteristics
 - Centrifugal pump
 - Diffuser and volute
 - Size must match compressor
 - Boost pressure: amount of air density provided
 - Turbo lag: time required to bring the turbo up to a functioning speed

Turbochargers (cont'd.)

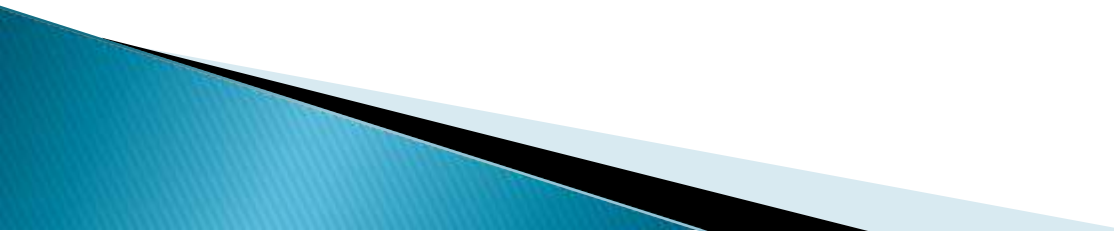
- ▶ Supercharged systems
 - Use different ways to prevent excess pressure from accumulating
- ▶ Wastegate
 - Prevents overpowering
 - Internal and external
 - Amount of boost can be changed
 - Spring or boost controllers
- ▶ Valves
 - Blow-off and compressor by-pass



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Figure 42.30 A turbocharger uses the energy of exhaust gas to force more air-fuel mixture into the cylinder to increase engine power.

Turbochargers (cont'd.)

- ▶ Variable geometry turbochargers
 - Vary turbocharger geometry
 - ▶ Aftercooler/intercooler
 - Cooled by either air or water
 - ▶ Turbocharger thrust/boost differential
 - Occurs when pressure is higher in either the turbine or the compressor
 - ▶ Turbocharger parts
 - Bearings, turbine shaft, compressor, turbine wheels, and housings
- 

Turbochargers (cont'd.)

- ▶ Turbocharger bearings
 - Turbo thrust bearing
 - Turbo ball bearings
- ▶ Compressor wheel design
 - Most compressor wheels are cast aluminum
- ▶ Turbine wheel and shaft
 - Most expensive part of the turbo
- ▶ Bearing housing
 - Seals gas and controls oil

Turbochargers (cont'd.)

- Turbocharger oil control
 - Turbochargers deflect oil, rather than using seals for oil control
- Temperature and pressure gauges
 - Located in intake manifold
- Turbocharger lubrication
 - Critical
- Turbocharger care
 - Heat: potentially damaging



Turbochargers (cont'd.)

- ▶ Turbocharger balance
 - Turbos spin in excess of 100,000 rpm and are balanced to run in excess of 150,000 rpm
- ▶ Turbocharger replacement
 - Not usually attempted in repair shops
- ▶ Turbocharger troubleshooting
 - Common failures: blockages, leaks, and foreign object damage

Turbochargers (cont'd.)

- ▶ Diagnosing damage to a turbo
 - Turbine damage
 - Broken piston rings, valves, or pistons
 - Compressor damage
 - Results from objects entering the intake
- ▶ Thrust bearing failure
 - Not common

Belt-Driven Superchargers/ Blowers

- ▶ Supercharger is an air pump
 - Commonly called blowers
 - Engine can easily produce 50% more power
 - Spin at 10,000 to 15,000 rpm
- ▶ Positive displacement pump
 - Delivers the same amount of air with each revolution regardless of the speed
- ▶ Roots-type blower
 - Most popular positive displacement supercharger

Belt-Driven Superchargers / Blowers (cont'd.)

- ▶ Blower lubrication
 - Not as big of a problem
- ▶ Pressure relief valves
 - Different designs and purposes
- ▶ Blower problems
 - Dependable
 - Can be damaged if they ingest dirt
 - Vacuum leaks