

## **FUEL SYSTEM IN AUTOMOBILE**

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# FUEL SYSTEM

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# Cooling System

- An automotive cooling system must perform several functions
  - 1. Remove excess from the engine
  - 2. Maintain a consist engine temperature
  - 3. Help a cold engine warm-up quickly
  - 4. Provide a means of warming the passenger compartment

# Cooling System

- Automotive cooling systems operate around 180-212 degree F
- Engine coolant is used to remove heat from the cylinder to the radiator where in is then dissipated.
- Engine coolant mixture should be approximately a 50/50 mixture of coolant and water.

# Cooling System

- Water soluble oil is used as a lubricant in all coolants systems components
- Coolant uses lubricant in coolant to lubricate the water pump.
- Coolant is a mixture of water and antifreeze. (Normally 50/50 mixture)
- Some people refer to coolant as antifreeze

# Cooling System

- An automotive radiator is used as a heat exchanger.
- Hot coolant from the engine is transferred to the radiator and cooler coolant is transfer to the engine by heavy duty hoses.
- There are two types of radiators
  - Cross flow and Down Flow

# Cooling System

- The cross-flow radiator is normally shorter than a down flow allowing for shorter hood lines.
- A down-flow radiator is used on larger vehicles that requires more cooling capacity.

# Cooling System

- The components that make-up the radiator is
  - 1. Radiator core: center section of the radiator
  - 2. Radiator Tank: Metal or plastic end that cover the ends of the core and provide a coolant storage areas.



# Cooling System

- The thermostat is used to regulate the flow of coolant through-out the cooling system.
- It is very important to follow manufacture instruction when installing and automotive thermostat.
- Installing a thermostat in the wrong direction can cause sever engine damage due to overheating.

# Cooling System

- To maintain proper engine temperature a thermostat is used.
- Modern engine operate at higher operating temperature. Therefore most modern thermostat open around 195 degrees F
- You should never operate a vehicle without a thermostat.

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# Cooling System

- Most cooling system use some type cooling fan there are 3 types of fans
  - A. Electric fan
  - B. Clutch type fan
  - C. Flex fan

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When checking a cooling system its important to ensure that the fan is not broken or;

- A. Engine could vibrate excessively
- B. Cause premature water pump bearing failure
- C. Overheating because not enough air will be pulled through the radiator.

# Cooling System

- A **flex fan** is mounted to the front of the engine and operates continually when ever the engine is running.
- A **Clutch fan** is also mounted to the front of the engine but will only pull air through the radiator when the engine is hot
- An **electric fan** is used on front wheel drive vehicles and will only operate when commanded by the PCM.

# Cooling System

- A water pump is used to circulate coolant throughout the cooling system.
- Water pumps consist of
  - Water pump impeller
  - Water pump shaft
  - Water pump seal
  - Water pump bearing
  - Water pump housing

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# Cooling System

- When defective water pumps should be replaced.
- Water pump seals and bearing normally fail on water pumps.

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# Cooling System

- Radiator caps are design to hold pressure on modern closed cooling system.
- The higher pressure maintained by the radiator cap will increases coolant boiling point.
- Defective radiator pressure cap should be replaced.



# Coolant Quiz

- What is the recommended coolant mixture?
  - A. 80/20
  - B. 70/30
  - C. 60/40
  - D. 50/50

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# Coolant Quiz

- What part of the cooling system serves as the heat exchanger
  - A. Heater hoses
  - B. Water pump
  - C. Fan belt
  - D. Radiator

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# Coolant Quiz

- What type lubricate is used inside the cooling system?
  - A. Water soluble oil
  - B. Non water soluble oil
  - C. Engine oil
  - D. Graphite

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# Coolant Quiz

- A radiator cap is used to:
  - A. Increase cooling system pressure
  - B. Raise cooling boiling temperature
  - C. Control expansion tank flow
  - D. All the above

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# Coolant Quiz

- Most modern thermostat open at around what temperature
  - A. 180
  - B. 185
  - C.190
  - D.195

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# Coolant Quiz

- What coolant system component circulates coolant?
  - A. Radiator
  - B. Heater hoses
  - C. Water pump
  - D. Overflow tank

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# Coolant Quiz

- What component allows for transfer of coolant from the radiator to the engine block?
  - A. Heater hoses
  - B. Radiator hoses
  - C. Radiator Cap
  - D. All the above

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# Coolant Quiz

- A broke fan blade can cause:
  - A. Excesses vibration
  - B. Overheating
  - C. Water pump failure
  - D. All the above

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# Coolant Quiz

- What are two type of cooling systems?
  - A. Water and antifreeze
  - B. Air and coolant
  - C. liquid and coolant
  - D. All the above

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# Coolant Quiz

- Automotive radiator cap should be removed when:
  - A. The engine is hot
  - B. The engine is cold
  - C. The engine is idling
  - D. There is pressure in the system

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# FUEL SYSTEM

- Automotive gasoline is manufactured from crude oil (petroleum) produces Hydrocarbons (HC)
- Hydrocarbons is really unburned gasoline.
- Carbon Monoxides (CO) is fuel that did not complete burn in the combustion chamber.
- Fuel must **atomize** (change into a vapor) before it can burn in the combustion chamber

# FUEL SYSTEM

- WHEN WORKING WITH FUEL SYSTEM: THERE IS ALWAYS A DANGER OF **FIRE.**
- NEVER SMOKE OR HAVE ANY TYPE OPEN FLAMES AROUND ANY OPEN FUEL SYSTEM

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# FUEL SYSTEM

- Earlier vehicles used carburetors.
- Carburetor were used until the mid-80
- Vehicles used carburetors until the mid Tougher emission requirement has made carburetor extinct.
- New emissions standards requires HC and CO be controlled.

# FUEL SYSTEM

- Carburetor are more complicated than fuel injection. More automotive carburetor have 5 distinct circuits.
  - 1. Idle circuit
  - 2. Enrichment circuit
  - 3. Off Idle Circuit
  - 4. High Speed circuit
  - 5. Enrichment circuit
  - 6. Choke Circuit

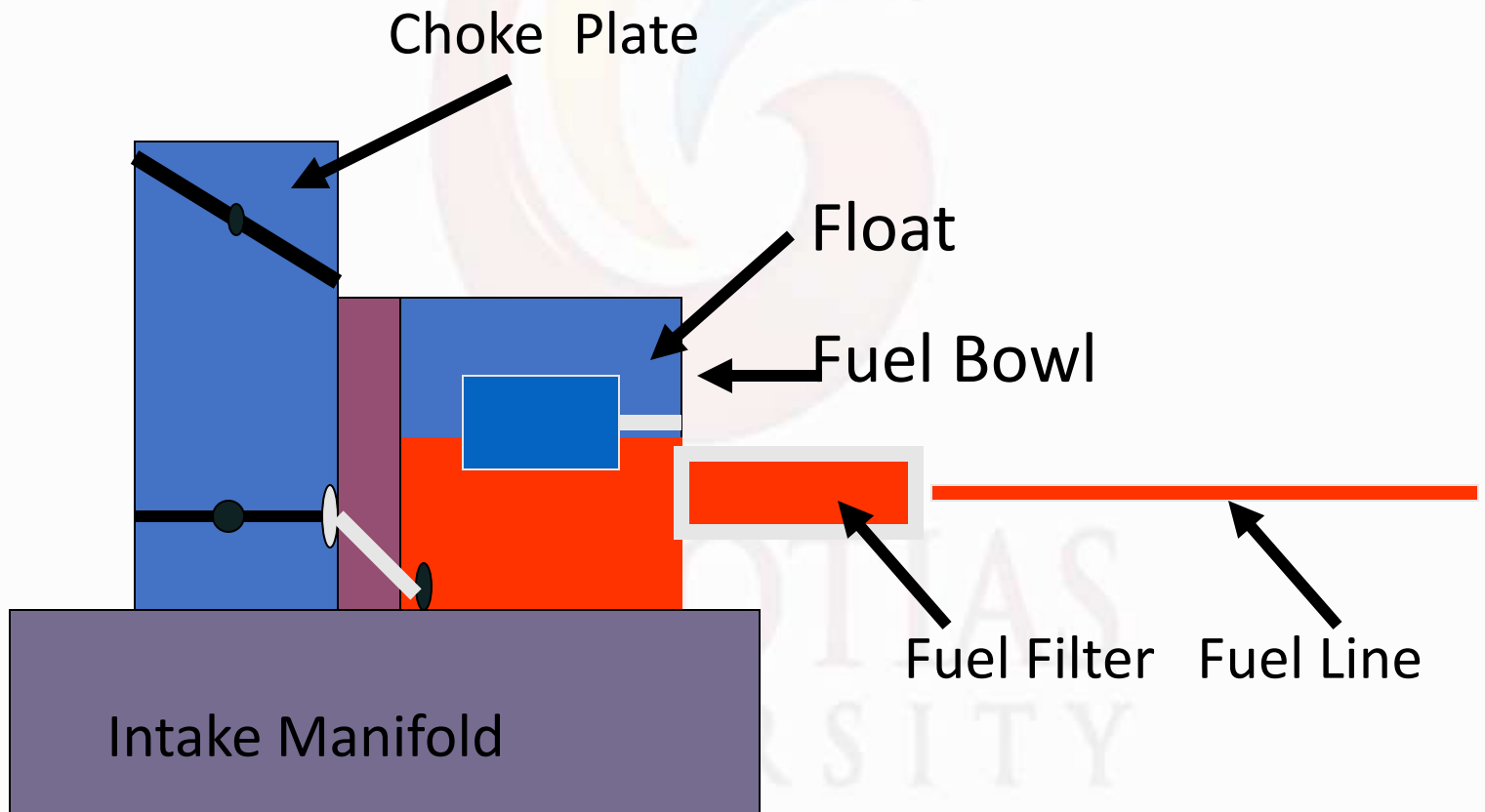
# FUEL SYSTEM

- With carburetors and **choke plate** was is used to close off the air horn so that less air and more fuel can enrich fuel mixture during cold start-up conditions.

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# FUEL QUIZ



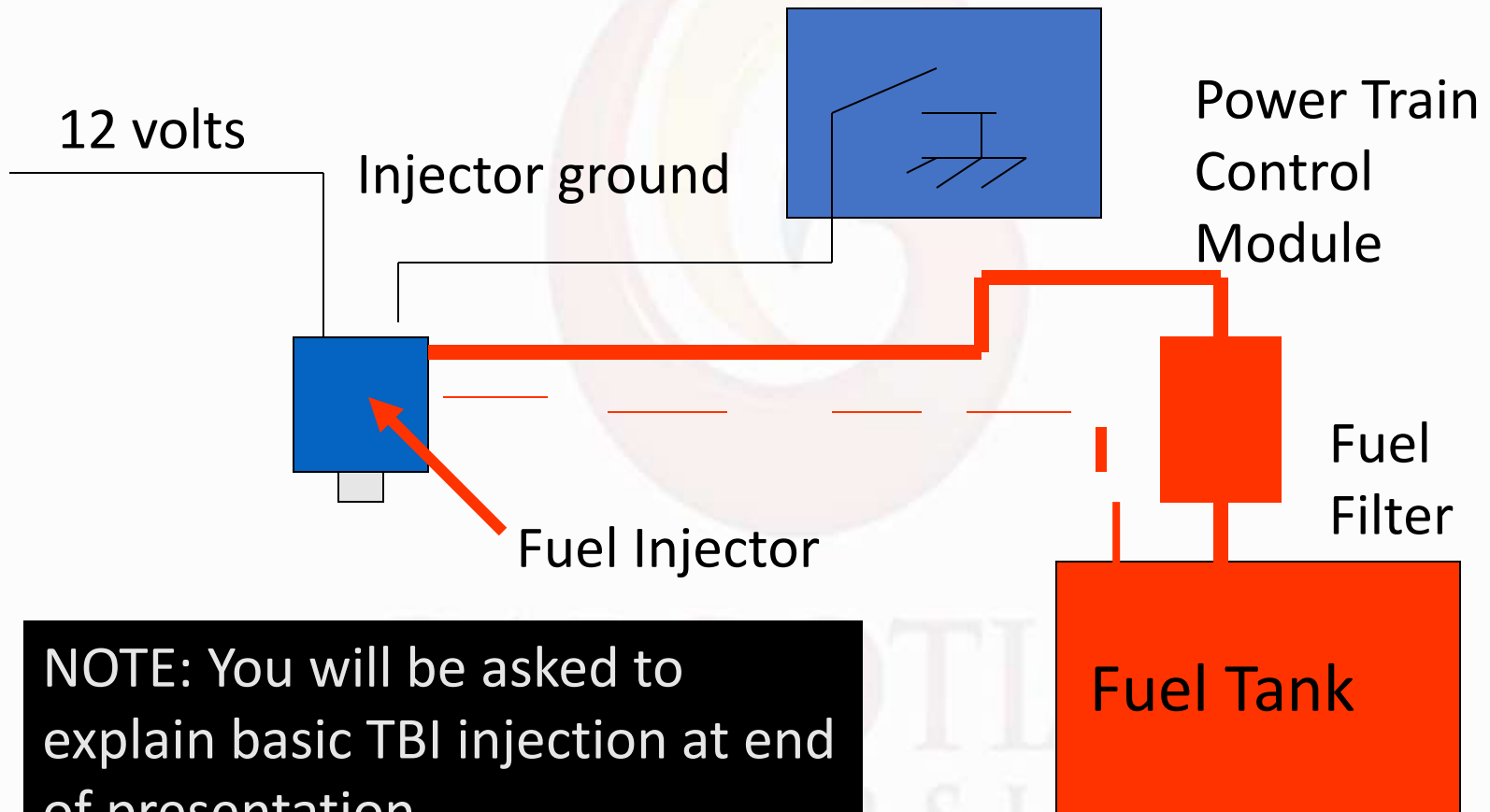


# FUEL SYSTEM

- Late model vehicle have all started using fuel injection as a means of delivering fuel to combustion chamber.
- Fuel injection offers some major advantage over carburetion.
  - A. Better fuel economy
  - B. No need for Manifold heat
  - C. Higher torque at lower speeds.

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# FUEL



**NOTE: You will be asked to explain basic TBI injection at end of presentation**

# FUEL SYSTEM

- **Better fuel economy.** With the addition of electronic engine controls fuel injection can be injected into the combustion at the instance the intake valve is opened.
- With carburetion and some early fuel injection system fuel was injected into the intake manifold. Fuel then had to travel to the intake combustion chamber.

# FUEL SYSTEM

- For proper combustion the correct amount of air and fuel must mix before entering the combustion chamber.
- The ideal air fuel mixture is 14.7-1

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# FUEL SYSTEM

- When ever fuel is added to air the fuel mixture will become richer
- When air is added fuel mixture will become leaner
- Colder engine requires a richer fuel mixture than hot engines.

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# FUEL SYSTEM

- When the ideal fuel mixture of 14.7-1 is reached the vehicle combustion should be ideal and render the most power with least amount of exhaust emissions.
- **Stoichiometric** is the term used to describe the ideal fuel mixture.
- All late model fuel injected engine are electronically controlled

# FUEL SYSTEM

- With the addition of fuel injection several sensor had to be added to the engine to ensure proper fuel mixture.
- Some of the more importance sensor are
  - A. Mass air flow sensor/MAP
  - B. Oxygen sensor
  - C. Throttle position sensor
  - D. Coolant sensor

# FUEL SYSTEM

- The sensor system is responsible for monitoring:
  - A. Intake air temperature
  - B. Engine load
  - C. Engine temperature
  - D. RPM

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# FUEL SYSTEM

- **Oxygen sensor:** Is mounted in the exhaust system senses the amount of oxygen in the exhaust gasses.
- All Feedback carburetors and fuel injection system use an oxygen sensor to determine the amount of unburned fuel in the exhaust system.

# FUEL SYSTEM

- NOTE: Later model vehicle use 2 Oxygen sensor minimum to determine fuel mixture and catalytic converter efficiency.
- NOTE: We will be covering engine controls in more detail later.

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# FUEL SYSTEM

- A Mass Air Flow Sensor (MAF) or Manifold Absolute Pressure (MAP) sensor is used to determine:
  - A. Engine load
  - B. Air temperature (MAF)
  - C. Help determine ignition timing

# FUEL SYSTEM

- Engine temperature is very important in determining proper fuel mixture. For that reason an Engine Coolant Temperature (ECT) sensor is mounted in the intake manifold.
- The ECT sends a analog signal to the PCM that is in direct proportion to the engine temperature.

# FUEL SYSTEM

- A **throttle position sensor** (TPS) is used by the PCM to determine the angle of the throttle.
- The more the throttle is open the more air entering the engine. More air means more fuel.

# FUEL SYSTEM

- There are 3 typical types of fuel injection systems.
  - 1. Throttle Body (TBI)
  - 2. Port fuel injection system
  - 3. Sequential Fuel injection system

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# FUEL SYSTEM

- A throttle body fuel injection system uses either one or 2 injector mounted in a throttle body that looks similar to a carburetor.
- Port fuel injection and sequential fuel injection system uses a fuel injector mounted at each cylinder
- All type fuel system uses a filter inline capture dirt and contaminants before entering the engine.

# FUEL QUIZ

- **1.** What is the most flammable chemical in an automotive shop?
  - A. Engine oil
  - B. Coolant
  - C. Brake fluid
  - D. Gasoline

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# FUEL QUIZ

- **2.** Technician A says reducing air flow into an engine will increase fuel mixture. Technician B says increasing fuel mixture while maintaining air flow will decrease fuel mixture. Who is correct?
  - A. Technician A only
  - B. Technician B only
  - C. Both A and B
  - D. Neither A nor B

# FUEL QUIZ

- 3.** Technician A says all crude oil has hydrocarbons. Technician B says an oxygen sensor is used to determine engine load. Who is correct?
- A. Technician A only      C. Both A and B  
B. Technician B only      D. Neither A nor B

# FUEL QUIZ

- **4.** Technician A says the ideal air fuel ratio is 14.9-1 Technician B says A rich fuel mixture produces and excess in hydrocarbons. Who is correct?
  - A. Technician A only
  - B. Technician B only
  - C. Both A and B
  - D. Neither A nor B

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# FUEL QUIZ

- **5.** Technician A says a cold engine requires a richer fuel mixture than a warm engine. Technician B says a warm engine requires a leaner fuel mixture than a cold engine. Who is correct?
  - A. Technician A only      B. Technician B only
  - C. Both A and B          D. Neither A nor B

# FUEL QUIZ

- **6.** What sensor determines engine load?
  - A. Oxygen sensor
  - B. Mass air flow sensor
  - C. Throttle position sensor
  - D. engine coolant sensor

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# FUEL QUIZ

- **7.** What component is installed into the fuel line to catch dirt and other contaminants?
  - A. Fuel tank
  - B. Fuel pump
  - C. Fuel net
  - D. Fuel filter

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# FUEL QUIZ

- **8.** Throttle body and port fuel injection system are controlled:
  - A. Mechanically
  - B. By the Body control module
  - C. By the Power train control module
  - D. All the above

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# FUEL QUIZ

- **9.** Technician A says fuel injection is more efficiency than carburetors. Technician B says fuel injection uses n electric fuel pump to supply fuel to the engine. Who is correct?
  - **A. Technician A only**
  - B. Technician B only
  - C. Technician A and B
  - D. Neither A nor B



# FUEL QUIZ

- **10.** In 100 words explain the operation of a basic TBI fuel injection system.

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**Thank you**

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