



LAB - Cooling System Inspection



Students: 1. _____
2. _____
3. _____

Fill in each box with the appropriate information.

Be sure to have the Instructor's initials before moving on to the next step. These are there to ensure everything is SAFE and CORRECT. Each team member must be able to answer questions from your instructor to receive credit for this lab.

VEHICLE IDENTIFICATION			
Year:		Make:	
Model:		Mileage:	
VIN Number:			
BEFORE YOU BEGIN			
<p>You will need the following special tools:</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">  <p>Cooling system pressure tester</p> </div> <div style="text-align: center;">  <p>Antifreeze tester</p> </div> <div style="border: 2px solid red; padding: 10px; text-align: center;"> <p>CAUTION!</p> <p>Engine Coolant can be hot! Be very careful not to burn yourself!</p> </div> </div>			
OPERATION			
	<p>The cooling system is a vital part of your engine's survival! It is often neglected in maintenance, but it's super easy to maintain!</p> <p>LIQUID COOLANT is used in the cooling system to ABSORB HEAT from the engine components. It is usually 50% Water and 50% Ethylene Glycol. Water absorbs heat really well, but Ethylene Glycol adds three more things:</p> <ol style="list-style-type: none"> 1. Lowers the FREEZING POINT of the coolant 2. Raises the BOILING POINT of the coolant 3. Prevents CORROSION within the system 4. Kills you if you drink it. Yes. True. Don't drink it. <p>JACKETS around the cylinders in the block and around the valves and combustion chamber in the head contain the coolant. Any debris or corrosion inside these passages INSULATES the engine from transferring its heat into the coolant.</p>		

WATER PUMP circulates the coolant THROUGH the motor and TO the RADIATOR. It is driven by a belt (v-belt, serpentine-belt, or timing belt) off the motor. The pump circulates the coolant to the RADIATOR to get RID of the heat

RADIATOR is usually at the front of the vehicle where MOVING AIR can take the heat away. RUBBER HOSES bring the coolant from the motor to the radiator to opposite ends of the CORE. The core has finned tubes for coolant to travel INSIDE it, and air to travel THROUGH it to take the heat away from the tubes.

A mini radiator in the dashboard (called a HEATER CORE) provides heat to passengers – when they leak, you see steam come through the defrost vents, or puddles of coolant in the carpet.

RADIATOR FAN operates in traffic to keep air flowing through the radiator and continue taking heat away. Some fans are driven directly by the motor, some fans have a thermostatic clutch that engages the fan when it is needed, and some fans are electric. Electric Fan motors can seize, temperature switches can fail, and electrical relays can fail, preventing the fan from turning on (or shutting off).

RADIATOR CAPS provide up with a place to check and fill the coolant levels. It also acts as a PRESSURE RELIEF VALVE. Raising the operating pressure raises the BOILING POINT of the coolant

What are three things the coolant needs to do?

- 1.
- 2.
- 3.

Where does the water pump send the coolant (2 things)

- 1.
- 2.

How does the radiator get the heat out of the coolant?

STOP!

INSTRUCTOR'S INITIALS:

VISUAL INSPECTION

RADIATOR HOSES

1

Hoses should be firm, yet pliable. They need to flex to allow for engine vibration. Over time under-hood heat makes them hard and crunchy. Oil leaks onto them make them rot. Radiator hoses and heater hoses should be replaced every **FOUR YEARS**.

Visually inspect, feel, and squeeze, all the hoses.



What did you find?

WATER PUMP

2

Water pumps are replaced when they fail. They may fail by leaking (there is usually a drain hole somewhere behind the pulley so coolant can leak away from the fan and belts), or by mechanical fault (the impellor comes off internally – a lack of cooling will result, or the bearings start to fail and make noise).



Inspect the water pump by either looking or feeling around the casting looking for coolant escaping. Wiggle the pulley around to see if the bearings are allowing any play.

What did you find?

It is good practice to replace the water pump whenever replacing a timing belt, or timing chain. I mean, hey – you're in there anyway....

RADIATOR

3

My eldest kid's car had an unknown coolant leak. We found it when it started overheating on a road trip....

Radiators usually last about 10 years. They are replaced when they are failing. A replacement can cost around \$250. Sometimes your old radiator can be "re-cored" where they remove the old tanks, and attach them to a new core. This costs around \$250.



Visually inspect for any visual signs of leakage – usually a green "mold-looking" scum, especially around the tank attachment, and the hose attachments.

Visually inspect the fins for any damage or plugging. Fins can usually be cleaned out and straightened. If the fins **DISINTEGRATE** beneath your touch, the rad is garbage and needs to be replaced.

What did you find?

STOP!

INSTRUCTOR'S INITIALS:

HEAD GASKETS

4

...but it was too late. The overheating blew the head gasket, which required a FULL ENGINE REBUILD.

This was completely avoidable.

Headgaskets may fail due to corrosion or overheating. This is typically evidenced in a few ways:

- **Green scum** oozing down from cylinder head gasket location (head gasket is leaking externally)
- **Oil Inside Radiator** - looks like an oil spill, since oil floats. You must carefully remove the rad cap to see.
- **Coolant in Motor Oil** – Looks like "Creamed Coffee." Remove cap to see.
- **Champagne Bubbles** - combustion gasses getting into the cooling system – Remove cap and run the engine to see this.



Replacing head gaskets is a major repair. If the engine has been overheated, it will never really be the same again without a full rebuild. Try not to ever let your engine overheat – take good care of the system!!

What did you find?

OVERFLOW TANK

5

The overflow tank is usually connected by a hose to just under the radiator cap. You should always keep this filled up to the proper fill line. If it is empty – **MAKE SURE** the radiator is not low as well – top the rad up completely, then fill the overflow tank to the correct level.



Check for leaks in the container, and cracks in the hose.

What did you find?

FROST PLUGS

6

Frost plugs are more correctly called "core plugs" – their only purpose is in the original casting of the engine block – it holds the pattern that creates the water jacket around the cylinders.



Over time, they may begin to rust and create leaks. If unchecked, you may lose coolant and ruin your motor.

Many of these are really hard to see, and even harder to replace! (You might need to remove the engine to get at them!!).

Most iron blocks have core plugs, most aluminum blocks do not. See if you can find and inspect all of yours.

What did you find?

It is always a good idea to run Antifreeze in your engine, even if you live in California. Antifreeze also prevents rust, lubricates the water pump, and increases the boiling point!

BELTS

7

V-belts and Serpentine belts should be replaced every FOUR YEARS. Over time, they become hard, cracked, and eventually desintigrate. Twist the belt in your fingers, and look at the inside (the grooved, or pulley side). A few cracks are reasonably normal, but it's often best to replace it when the cracks become excessive.



What did you find?

STOP!

INSTRUCTOR'S INITIALS:

TESTING

We are now going to perform a few tests on the cooling system:

1. COOLANT STRENGTH – If the coolant is too weak, it might freeze in winter
2. INTERNAL CORROSION – If the radiator tubes are corroded, they are preventing the coolant from getting to the radiator
3. CAP PRESSURE – if the cap does not hold pressure, the system run hot enough
4. SHOW this sentence to your instructor for a free extra mark showing that you are actually reading this.
5. SYSTEM LEAKS – If the system is leaking, it cannot hold pressure, and will lose coolant, and eventually destroy the engine

RADIATOR AND CAP

8

Engine should be at OPERATING TEMPERATURE, but OFF

Cover the radiator cap with a rag (to protect yourself from potential burns), and SLOWLY release the rad cap. Some may leak out, that's fine (clean it up ASAP). A geyser is not fine.



Coolant should be flush with the top of the filler neck with an overflow tank (1" below, if not)

Good antifreeze coolant should be a light yellow-ish/green colour. Over time it tends to get dull coloured or murky.

What did you find?

Using a light, see if you can see the inside tubes of the radiator. Over time, they start to get corroded and begin to plug up. This is made worse if the rad was filled with tap water (ALWAYS USE DISTILLED WATER – THERE ARE NO MINERALS IN IT!)



What did you find?

Insert the Antifreeze tester into the radiator, keep it upright (there is a level in it), and draw coolant up exactly to the fill line. A large pointer should float indicating the freezing temperature of the coolant. We want to see about -35°



What did you find?

Engine coolant should be replaced every two years. There is "long life" coolant which can be replaced every five years. GM's DEXCOOL cannot be mixed with other coolants – it turns to jello, which doesn't cool very well.

STOP!

INSTRUCTOR'S INITIALS:

PRESSURE TESTING

9

Radiator caps are rated by their pressure. It may be in pounds per square inch (psi), or in Barometers (Bar).

Eg:

13 lbs 14psi 1.1 1.1bar

1 bar is 14.7psi (atmospheric pressure on earth).



What pressure is the cap rated at?

If you know your friend doesn't read instructions, YOU need to take control at this point and SAVE THE ENGINE

PAY ATTENTION NOW!

***DO NOT BE THE NEXT KID TO
DAMAGE SOMETHING BY OVER PRESSURE!!***

Attach the pressure tester to the radiator filler next, and pressurize the system to **NO MORE THAN** the rad cap rating. We want to FIND leaks, NOT CREATE THEM!!!

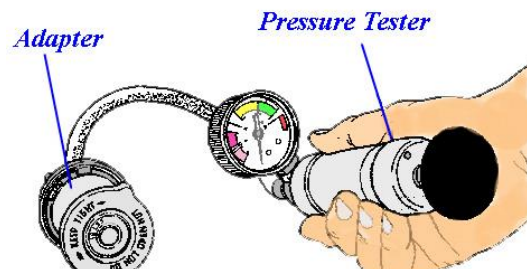
The system should hold pressure. If the pressure starts to drop, you have a leak – find it!



What did you find?

Next, use the rad cap adapter and pressure test the rad cap. It should release at its rated pressure.

Most caps I have tested do not pass. Radiator caps are usually \$15 or so.



What did you find?

STOP!

INSTRUCTOR'S INITIALS:

SKILL TESTING QUESTIONS

10

Assume that the cooling system is not working adequately. What would cause the following situations?

1. Overheating while sitting in traffic?
2. Overheating only while pulling a long hill? (assume it's fine everywhere else)
3. Never heating up at all?

STOP!

INSTRUCTOR'S INITIALS:

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