EXPANSION TANKS, COOLANT RECOVERY SYSTEMS AND HOW THE COOLING SYSTEM WORKS

by Dave DuBois

The title of this article may be a bit misleading, after all, we all know how the cooling system is supposed to work – The heat generated by the engine is transferred to the coolant being circulated in the coolant jacket of the engine, the coolant is circulated through the radiator and the air flowing through the radiator transfers the heat from the coolant to the circulating air, which reduces the temperature of the coolant so it can start the cycle all over again – simple and straight forward, but…!

Judging from the various questions that are repeated over and over again at meetings, on the Bulletin Boards and Forums – Should I install an expansion tank? Should I install a coolant recovery system? Should I install an overflow tank? How come, when I fill the radiator up with coolant and drive the car, I always loose coolant onto the ground? Is my radiator cap defective because it allows coolant to be pushed out of the radiator? etc., etc., etc. In this article I will attempt to answer these questions with more than, “It’s normal to loose coolant or you should install a…”

Expansion Tanks and Lost Coolant

First of all, let’s talk about expansion tanks. All cooling systems have an expansion tank already installed – its other name is the header tank. Some cars come with an external expansion tank mounted on the inner fender or some other place remote from the radiator. On some cars with a remote expansion tank there is a pressure cap on the header tank and on the external expansion tank and on some cars (those that came with a remote expansion tank installed by the factory) there is just a solid cap on the header tank (or perhaps no filler neck at all) and the pressure cap is on the remote expansion tank. The latter is the correct configuration. If a car is fitted with an external expansion tank, then there has to be a hose capable of withstanding the maximum pressure in the cooling system, leading from the header tank of the radiator to the external expansion tank. The expansion tank can be metal or plastic, but must be tough enough to withstand the pressure established by the pressure cap on the filler neck. It must also be able to hold up to hot coolant without softening.

The purpose of the expansion tank is to provide space for the coolant to expand when it gets hot. If the cooling system is filled clear up to the top of the filler neck on the internal or external expansion tank, when the coolant gets hot and expands (take notes here, this is one of the answers), it will push past the pressure cap and force its way out the overflow tube onto the ground. This leaves less coolant in the system and when it cools down and contracts, there is (horrors!) an air space above the coolant in the system where there was coolant before and the diligent owner will immediately get his/her supply of premixed coolant and replace what was lost. But – guess what, the next time the car is driven, the above cycle is just repeated. How do we prevent this coolant loss – get a pressure cap with a higher pressure rating? The simple and correct answer is do nothing. Don’t replace the coolant that has been pushed out, just watch it. After a couple of times driving the car, the expansion tank will have sufficient room above the cold coolant to accommodate the expansion of the coolant when it gets hot and the coolant loss will stop. Just monitor the coolant level and make sure that when it is cold, there is sufficient coolant in the header tank to cover the top of the radiator tubes or, in the case of the cars with an external expansion tank, just make sure that the tank is a quarter to a third full of coolant at all times when the entire cooling system is cold. What’s that you say? You can’t see the top of the tubes in your radiator? Some radiators are what are called cross flow. Their tubes run horizontally rather than vertically in the radiator and are not visible through the filler neck.

Further, some cars have an offset filler neck, like on the MGAs and early MGBs, the filler neck comes out of the header tank horizontally for a couple of inches then turns up vertically the last bit before the portion where the pressure cap is fitted on. This presents a conundrum. How do we know how much to fill the header tank on these cars. Another problem (at least it is for me), how low can we let the coolant level get in the radiator of the TC or TD, where the temperature sensor (if one is installed) is part way up the header tank. Obviously the sensor will be above the coolant level if we allow the coolant to fall to the point where it is just above the tops of the radiator tubes. There is also the problem of the owner (like me) who is too lazy to continually check the level of the coolant by having to remove the filler cap. Stay tuned, the answer to this will come further on in this article.

Pressure Cap

Now that you know more than you ever really wanted to know about expansion tanks, let's turn to the pressure cap. Not all of our cars have these modern day wonders. The TC and TD use a non pressurized cooling system and don't use a pressure cap. All the rest of the MGs do use a pressure cap. Let's take a look at what a pressure cap is, how it functions and why they are a good thing to use. I'll take the last issue first, why a pressure cap is a good thing to use. We all know that water at atmospheric pressure boils at 212°F at sea level. Go up into the mountains several thousand feet high and the same water will boil at some lower temperature (approximately 4.5°F lower for each 1000' in altitude). Put the water in a radiator with a pressure cap on it and the water will boil at some higher temperature (3°F for every pound per square inch the pressure is raised), set by the pressure of the cap, whether the car is at sea level or up in the mountains, regardless of the altitude. That means that in the TF, with a 4 PSI pressure cap, just by installing that cap, we can raise the boiling point of plain water up to 224° F. Add a 50% solution of antifreeze and the boiling point will go up to 238°F. As you all know, an engine is not over heating as long as the coolant is not boiling while the car is moving so you can see where the addition of a 4 PSI pressure cap to the radiator will greatly increase the temperature an engine will operate without over heating. Stick a 16 PSI cap on the radiator filler neck, as some of the every late MGBs use and fill the radiator with a 50% solution of anti freeze and the operating temperature is increased to 274°F. How does this little item costing less than $10 work its magic and what else does it do for us. For that look at Figures 1 and 2. In Figure 1 it can be seen that there are three important parts to the pressure cap – the primary or pressure seal, the secondary or non pressure seal and the vacuum release check valve. The primary or pressure seal is pushed against the primary seal surface in the filler neck (Figure 2) by a spring that is behind it and determines at what pressure the seal will lift off of the sealing surface. The secondary, or non pressure seal, rests lightly against the upper, secondary seal surface of the filler neck

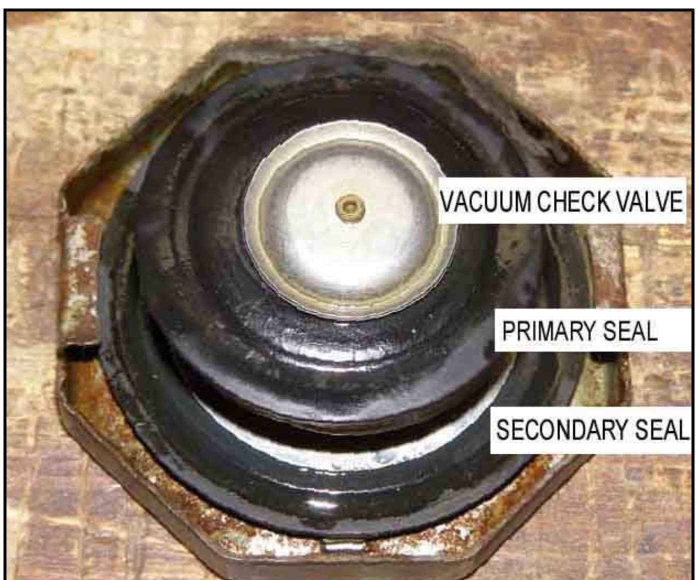

FIGURE 1

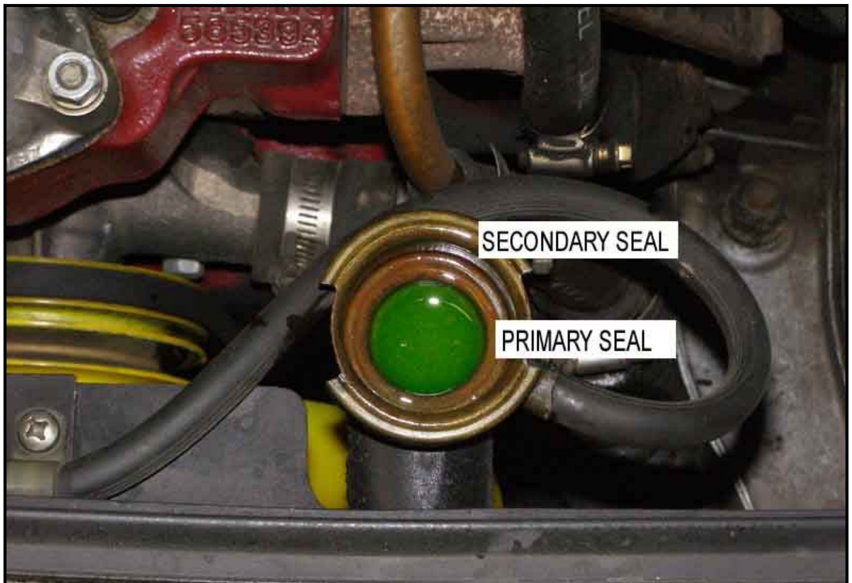

FIGURE 2

(Figure 2) and routes the hot coolant out the overflow tube and onto the ground, preventing it from pushing past the cap and into the engine compartment (or worse onto your hand if you are loosening the cap). If you recall, when the pressure cap is put on, the first quarter turn is relatively easy (pressing the secondary seal against its surface) and the second quarter turn is harder to turn as it is pressing the primary seal against the spring tension against the primary sealing surface. The final piece in this pressure cap puzzle is the vacuum release check valve. This check valve covers a small passage to the area between the primary and secondary seals and is held in place against the primary seal on the cap by a light tension spring. When the cooling system is pressurized, the system pressure keeps this disk pressed very hard against the primary seal. When the coolant cools off and the pressure drops to the point where a vacuum develops in the cooling system the check valve opens to allow ambient pressure to enter the system rather than allowing the system to develop a rather large vacuum that would, if large enough, collapse the upper or lower radiator hoses (this used to be a common thing to happen back in the days before the check valves were installed on the pressure caps). This little check valve is the key to the coolant recovery system, which is the next element I am going to cover.

Coolant Recovery System

First of all, a coolant recovery system is not an overflow tank. An overflow tank is nothing more than a catch basin that keeps the expanded coolant that is pushed out of the header tank from going on the ground and harming the environment and prevents Fluffy or Fido from lapping it up and being poisoned by it – an overflow tank serves no other purpose. On the other hand, a coolant recovery system captures the hot coolant that is expelled from the cooling system, holding it until the cooling system cools off and the coolant contracts, at which point that expelled coolant is drawn back into the cooling system and insures that the tops of the radiator tubes are always fully covered with coolant. The way this works is that the hot, expanded coolant pushes past the primary seal of the pressure cap (as we talked about in the previous paragraph). The secondary seal routs the expelled coolant out the over flow tube that is now attached to the bottom of a catch tank (the overflow tube is either attached to a tube at the bottom of the tank, or routed through the top of the tank and pushed clear to the bottom, where it will be submerged in the coolant at all times). The top of the tank is vented to the atmosphere. Now, when the engine is shut off (and you have gone into the house where you can't see the magic that is happening), the coolant cools off, contracting and developing a vacuum in the system and our little vacuum release check valve opens up to relieve the vacuum.

Only instead of pulling air into the system to relieve the vacuum, it sucks the coolant being held in the recovery tank back into the radiator header tank ensuring that the coolant level is covering the tops of the radiator tubes. In fact this system will keep the header tank full to the bottom of the pressure cap at all times, exactly the same as an external expansion tank will, but without the necessity of a tank and plumbing that will withstand the maximum cooling system pressure. As with the external expansion tank, the material of the recovery tank needs to be such that it will withstand hot coolant and the recovery tank should be one quarter to one third full of coolant when the entire cooling system is cold. Coolant recovery systems are still available from auto parts stores, but you can also make up your own using materials at hand. Figures 3 and 4 show the coolant recovery systems that I made for our MGB and our TD. The one for the MGB (Figure 3) is commercial (that I modified to fit the car) and the one for the TD (Figure 4) I made myself out of 2" PVC pipe. For best operation, the recovery tank should be mounted at approximately the same height as the header tank on the radiator .

FIGURE 3

Obviously, the TD, having a non pressurized cooling system, doesn’t have a pressure cap. The system still works as long as the tank it at about the same height as the header tank on the radiator. On a non pressurized system, the alternating expanding and contracting of the coolant as it heats up and cools down, just pushes the coolant into the tank and pulls it back without the need for the check valve.

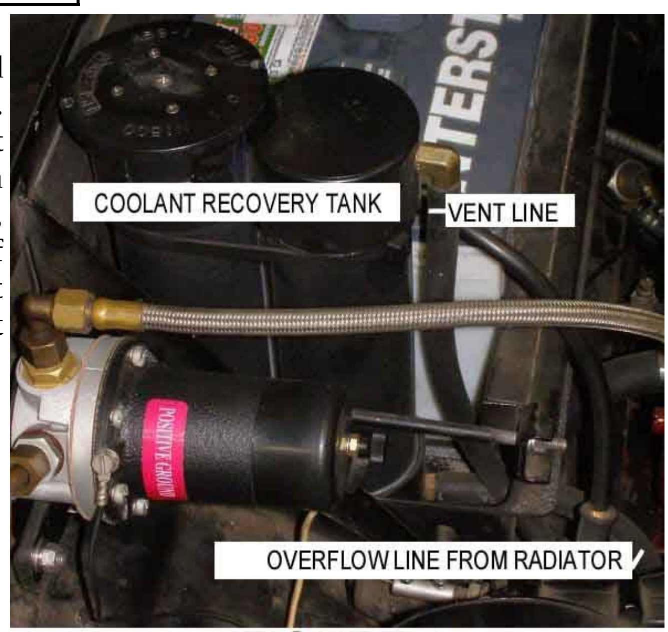

FIGURE 4

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