TECHNICAL Tips

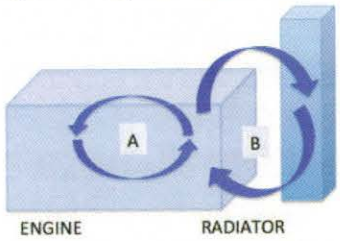
cause we all have questions

Proper Thermostats for 1935-39 Chrysler Products: Including Airflows

By John Boyd

Introduction

A good deal of attention has been devoted to overheating issues in Airflows over the years, including Tech Tips and other articles published in this newsletter. Some puzzling symptoms in a recently acquired C17 led me to investigate how the cooling system should work and why my car was running hot (190° to 205°) in normal driving.



The 1935-36 DeSoto and 1935-37 Chrysler Airflows use a common thermostat to route coolant efficiently for fast engine warm-up and effective cooling. Judging from replacement part sellers, Chrysler continued use of this thermostat in all DPCD model lines through 1939.

Engine cooling systems have two important functions. First, they help distribute heat inside the engine to prevent heat sources, like exhaust valves, from becoming too hot. Liquid cooling systems absorb heat from these sources and dissipate it to cooler areas inside the engine. Heat flow A in the figure illustrates this internal circulation of coolant. Second, the cooling system dumps collected engine heat to the atmosphere via a heat exchanger, the radiator. Heat collected in loop A is dissipated to ambient air by running the warm coolant through the radiator as indicated by loop B.

When a cold engine is first started, it may run poorly until it approaches operating temperature. The fuel delivered by the carburetor may not be fully vaporized as it passes through the cold intake manifold. To deal with this problem, carbureted engines like those in Airflows use a choke to restrict air flow. This richens the fuel-air mixture. As the engine comes up to temperature, the choke is gradually opened, and as the intake manifold warms, it fully vaporizes the fuel before it reaches the cylinders.

It is desirable to limit this warm-up time to improve drivability from a cold start. During warm-up the coolant is already cool, so there is no need to pass it through the radiator. In fact, doing so may slow the warm-up. If we can close off loop B, that will make warm-up quicker.

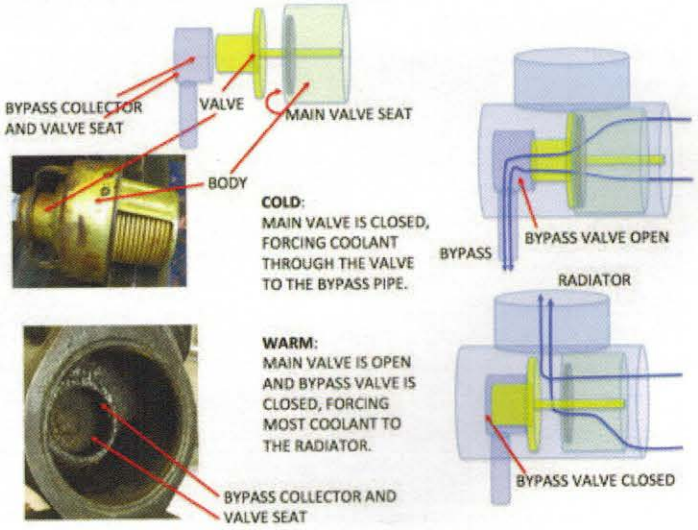
On the other hand, the temperature of exhaust valves comes up very quickly in a cold engine, and it's desirable to have loop A in full operation whenever the engine is running. If the coolant is stagnant, regions near these heat sources can become hot enough to boil it. This leaves an insulating vapor in contact with the heat sources instead of the much more effective liquid coolant, and the resulting heat retention can cause damage.

Airflow Coolant Control

The Chrysler radiator thermostat is designed to regulate the cooling system temperature. This includes bringing the engine up to operating temperature quickly, keeping it high enough for efficient engine operation (and acceptable cabin heat in cold weather) and low enough to ensure that the engine can run as designed and, importantly, that the coolant does not boil. It does this by closing off loop B for a cold engine and, when operating temperature is reached, regulating the rate of coolant flow through the radiator in loop B. The properly functioning cooling system ensures that loop A is always operating, even if loop B needs to be closed or restricted. The ideal thermostat should function as a diverter: from its position at the output of the water pump, it must ensure loop A is operating by either directing coolant through the radiator and thence back to the engine or bypassing the radiator and returning the coolant directly to the engine.

The Airflow thermostat housing has one inlet, from the water pump, and two outlets: a large one to the radiator and a smaller one back to the engine, bypassing the radiator. The second figure shows how it works.

Shown below is a photo of a thermostat for the 35-37 Airflows, Chrysler part number 640708 or (for cars with cabin hot water heaters) 645494. (The latter holds the coolant to a higher minimum temperature to ensure adequate cabin heat during cold weather.) At the right of the thermostat is a bellows device that expands



(horizontally in this view) as it is warmed by the coolant. In the center is the main body, and on the left side is a sliding valve assembly operated by the bellows.

At the lower left is a photo of the inside of the thermostat housing. In the center of the casting is a cavity that connects to the bypass outlet of the housing. The larger portion of the housing connects to the main (radiator) outlet. The thermostat valve, sketched at the top of the figure, has a hollow tube about an inch in diameter attached to an annulus – a disk with an inch-wide hole in the center. These two parts are brazed to an operating rod attached to the bellows (not shown in this sketch). The valve assembly can slide left and right under control of the bellows. The valve body has a second annulus as an end cap – this forms the main valve seat for the thermostat.

When the engine is cold, the bellows is at its minimum length, and the valve assembly annulus is held firmly against the main valve seat. Any water entering the housing is directed through the tube in the valve to the bypass collector. Almost none goes through the radiator in this case. As the coolant warms, the bellows expands and the valve assembly moves to the left. This does two things: it opens the main coolant valve as the valve annulus lifts away from the main valve seat and, when the valve is fully open, its tube bottoms out in the bypass collector, effectively closing off the bypass outlet. In this case, all the coolant flows out the main housing outlet to the radiator. The thermostat therefore closes off loop B until the coolant is warm enough to open it. When it's at operating temperature, it sends more or less of the warm coolant through the radiator as conditions dictate, automatically. Should the radiator flow (loop B) be limited by the thermostat, internal circulation (loop A) continues uninterrupted, protecting internal engine parts from overheating in all cases.

Implications: What can go wrong?

1. *Wrong thermostat installed.* Most parts stores don't carry the correct thermostat for Airflows or other 35-39 Chrysler products. Consequently many of our cars have a modern, incorrect, thermostat installed. If an incorrect thermostat of the right diameter and a suitable temperature range is fitted, loop B should function approximately correctly. But incorrect thermostats are almost certain to not shut off the bypass; it remains open. Some of the warm coolant is returned to the engine without going through the radiator, and the total radiator flow is consequently reduced. This can result in an engine running too hot: the engine is generating more heat than the weakened radiator flow can dissipate. On my C17, for example, the temp gauge showed high engine temperature, while a thermometer stuck in the radiator neck read 20-30° lower. The gauge was correct – my engine was running too hot.
2. *No thermostat installed.* In hot weather, the absence of a thermostat could go unnoticed. Without a thermostat, loop B runs wide open all the time. This can lead to engine inefficiency, including rough running and poor fuel economy, inadequate cabin heat, and in some cases, engine overheating. As with the incorrect thermostat, the bypass is never shut off, and some warm coolant goes back to the engine without being cooled by the radiator.
3. *Incorrect thermostat stuck open.* This is just like case 2, no thermostat installed.
4. *Correct thermostat but stuck open.* In the open position, the correct thermostat sends almost the entire water pump output through the bypass and little or none through the radiator. Serious overheating is almost certain; loop B is unavailable.
5. *Any thermostat stuck shut.* Loop B is not operating; coolant heated in the engine is not cooled at all. Serious overheating and engine damage are very likely.

Fixes

In every case, the best solution is to get the correct thermostat, clean up the housing to ensure the thermostat valve can open and close as is intended, then reinstall. If the correct thermostat cannot be found, some have recommended limiting flow through the bypass hose. This will ensure that most of the coolant from a warm engine will flow through the radiator (loop B will function). The advantages of the Chrysler-designed, dual-loop cooling system will be lost.[1]

As has previously been published in this newsletter, you can limit bypass flow on Airflows by fabricating and installing a plug. Drill a quarter-inch hole in the center of each of two quarters. Drill an eighth-inch hole in each near the edge to let air and a small amount of coolant pass. Run a 1-inch, quarter-inch machine screw through one of them and screw on a nut. Now put the other quarter on the bolt with a lock washer and another nut and tighten. Put this plug in the short bypass hose on the thermostat housing. The plug will ensure radiator flow is high by limiting the rate of bypass flow.

So what?

There are many other issues that can cause Airflow engines to run hot: imperfect water pump, crud in the engine cooling passages and radiator, stuck manifold heat risers, worn-out radiators, leaks, and more. But in some cases, installing the correct thermostat might be all it takes. The day I wrote this, in April 2017, there were three for sale on eBay. I bought one of them.

[1] Some engines (for example, the small-block Chevy) were never equipped with a radiator bypass. Coolant in such engines is stagnant until it is warmed sufficiently to open the thermostat. Interestingly, Ford small-blocks and Ford FE engines all have bypasses, as does the big-block Chevy family.