Cooling System Basics

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Components consist of:

1. Source of heat
2. Radiator
3. Water pump
4. Thermostat
5. Fan
6. Expansion tank

Rather than build separate radiators for each source of heat, the GMC radiator has provisions for a transmission cooler and an oil cooler. Both of these depend on coolant in the radiator to maintain consistent operating temperatures.

Without some means of limiting the flow of coolant to dissipate heat from these sources, they would never be able to get up to operational temperatures.

This is where the thermostat comes into play. It regulates the flow of coolant from the source of heat, to the reservoir/radiator. A properly working thermostat will open at a specific temperature and regulate flow once the source regains the design operating temperature.

GMCs originally had 195 degree thermostats installed from the factory.

Thermostats

Stant

Robert Shaw

Failed Stant type thermostat

Water Pumps


AARON
1
2
3
4
5

The size of the impeller is not critical, nor is it critical that the impeller have an anti-cavitation plate on the backside of the impeller.

Each of the pumps pictured will work well. The new water pumps have a small, stamped steel impeller and they also work well.

Radiator Caps

Make sure that whichever configuration you choose, it is rated at no more than 9 lbs. Your radiator may be rated higher than that but your unless you've replaced your heater core, it is also rated at 9lbs.

The radiator cap has a fivefold job:

1. Filler cap to access the cooling sytem,
2. Closure cap to keep coolant in the radiator,
3. Pressure cap to prevent overheating by pressurizing the system to raise the boiling temperature of coolant and allow the automobile's engine to operate at more efficient higher temperatures,
4. Pressure relief valve to safely and harmlessly vent excess pressure into the overflow jug, and
5. Vacuum relief/siphon valve to draw coolant from the overflow jug back into the radiator to prevent air from entering the system and allowing the coolant to perform its function more efficiently.

Coolant overflow reservoir, also called expansion tanks

As the coolant heats up, it expands. Once it reaches a certain pressure in the radiator, the pressure of the expanding coolant overcomes the tension spring in the cap and allows the excess coolant under pressure to overflow into the expansion tank, or recovery tank.

When the coolant temperature in the radiator drops, the volume of the coolant contracts creating a vacuum which draws coolant back into the radiator from the expansion tank thus maintaining a completely filled radiator.

The Fan

The GMC uses a steel, 7 blade fan. There are no adequate substitutes. The fan is coupled to the water pump with a thermostatically controlled clutch.

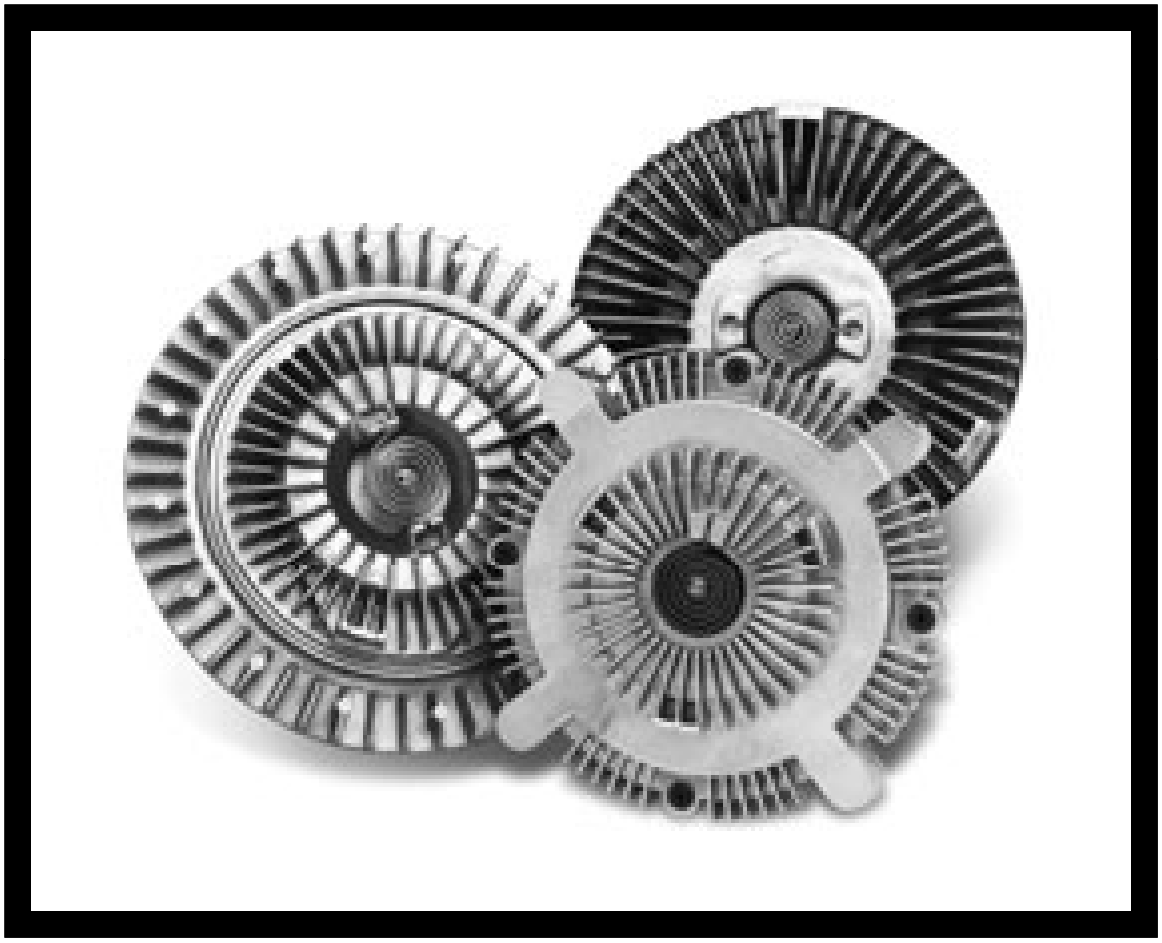
It is not necessary for the fan to operate at 100% of the engine rpm at all times. If it did, the engine would most likely never reach proper operating temperature and the parasitic loss on power would significantly lower MPG.

Enter the fan clutch

Important note regarding checking your coolant

After initial fill up, and the radiator is full and the cap is installed, all level checking should be done at the expansion tank. As the cooling system goes through it's heating and cooling cycles, coolant needed to replace air trapped in the block will be drawn from the expansion tank. This is where you add coolant. Removing the radiator cap will result in loss of system balance and it will take another heating/cooling cycle to reestablish this balance.

Which one is right?



The heavy duty AC Delco part number that cross references to the OEM fan clutch is:

P/N 15-4644 for the 455 engine
And the 403 engine

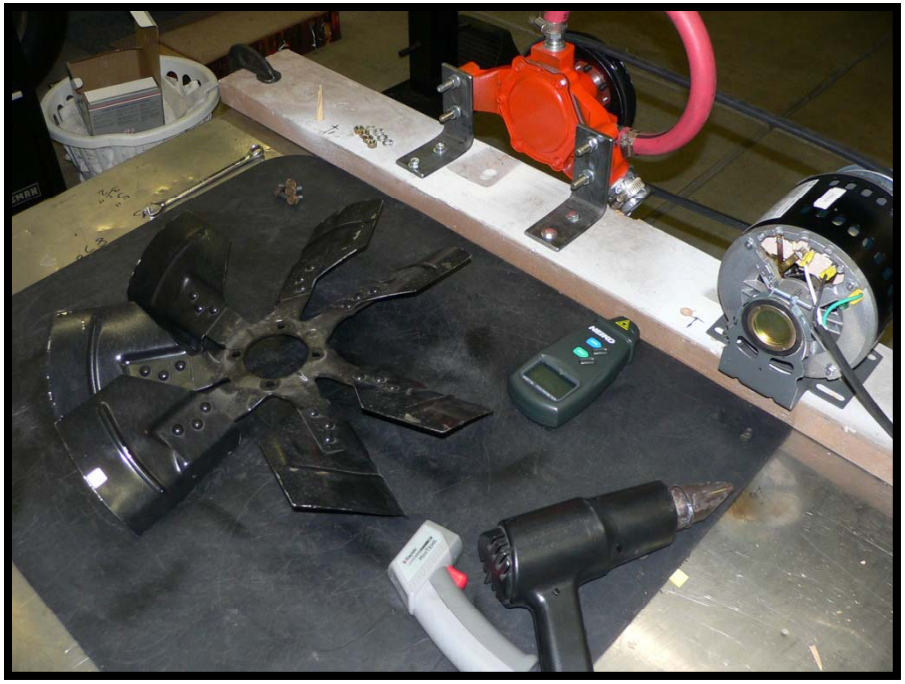
The light duty AC Delco part number that cross references to the OEM fan clutch is:

P/N 15-4223 for the 455 and
the 403 engine

Aftermarket companies also make replacements. Hayden, Murray, NAPA, Torque-Flo etc.
Many of these are made by the same company and are marketed under different brands. Also, AC Delco outsources some of it's fan clutches and Hayden is one of the sources. Torque-Flo (Autozone) fan clutches are made by Hayden and the HD 2797 Torque-Flo is made in China.

As my testing shows, there are major differences between different models and also differences between the same models with different manufactures.

First, the test setup!



Testing was done using a photo tachometer to test fan speed with the fan clutch completely disengaged, and fully engaged.

In order to ensure each fan clutch was completely disengaged, each one was run for 10 minutes with no heat applied to the bi-metallic control springs. Upon initial installation on the test fixture, all clutch fans were fully engaged from storage .

Dynamic testing consisted of using a photo tachometer to record the speed of the fan blade and the motor driven pulley with the fan clutch fully disengaged. I then heated the bi-metallic control spring to fully engage the fan clutch and again recorded the results.

Fan Clutch Test Results

All testing was done using a 1hp electric motor driving a water pump with a 7 blade, 3" pitch 5.5“ fan.

AC Delco 15-4644 #1

Disengaged		Engaged	
Engine rpm	Fan rpm	Engine rpm	Fan rpm
1,292	1,000	1,268	1.238

AC Delco 15-4644 #2

1,289	1,030	1,259	1,227

AC Delco 15-4949

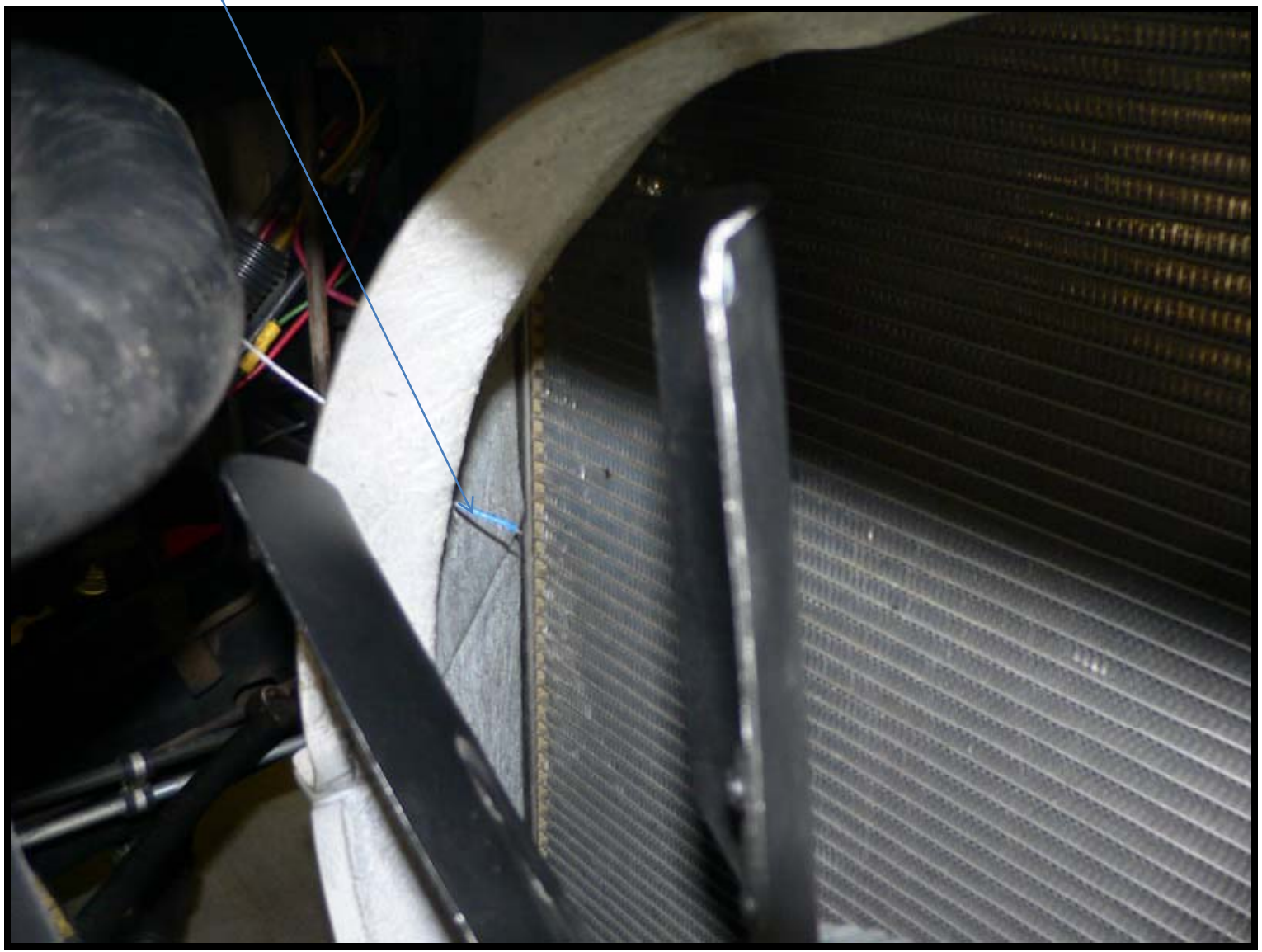
1,320	357	1,255	1,226

Hayden 9727

1,317	650	1,252	1,227

As you can see from the numbers, the key element in performance is the percentage of rpm that the fan spins in relation to engine rpm. In the case of the ones I tested, the AC Delco models clearly rotate at a much higher percentage of engine rpm while disengaged than do the aftermarket fan clutches.

Temp probe




080
DIGITAL MULTIMETER
HOLD
LIGHT
ON/OFF

With a 195 Robert Shaw balanced flow thermostat installed, aluminum radiator, Curtis full fan shroud, ambient air temps in the low 80's, I took the GMC for a test drive (with the AC on) to determine at what air temps (inside the shroud) the fan clutch would engage, and ultimately, disengage.

Fan engages

Coolant temp: 215 deg Shroud air temp: 198 deg

Disengages

Coolant temp: 200 deg Shroud air temp: 176

The 15-4644 clutch fan responds quickly to the rise in shroud air temps when the thermostat fully opens. Typically, the coolant temp plunges when the fan engages but it takes a few miles at 65 mph for the clutch fan housing to cool enough for the clutch to fully disengage.

In addition to bench testing, I tested all the listed fan clutches in my GMC motorhome. All testing was done with ambient temperatures in the 80 – 85 deg range, some stop and go, and sustained speeds of 65 mph.

In summary, if you live in a relatively cool climate, you may want to run the Hayden 9727 HD unit. It spins at a very low percentage of engine rpm when disengaged. When engaged, it spins at the same percentage of engine rpm as the heavy duty AC Delco units. This reduced parasitic drag could result in a little more MPG.
In the hot SW, the HD AC Delco units are the only way to go.

If you have an aluminum radiator installed, the most efficient thermostat is the 190 deg Robert Shaw balanced flow unit. Mr Gasket performance thermostats are not recommended as they tend to open sooner, and close later resulting in constant fan clutch cycling. The aluminum radiator, coupled with the AC Delco HD 4644 fan clutch, the RS balanced flow thermostat is the best combination I tested. This combination resulted in very stable coolant temperatures and minimum clutch fan cycling.