1987 – 1992 GM F-Body Electric Coolant Fan Specifications and Modifications

Dual Fan Applications

Tuned Port Injection 305s & 350s with Factory A/C

General Information

General Motors engineered these cars to run HOT!! The primary coolant fan does not engage until 222° or higher (depending on year and engine) and the secondary fan until 243°! It's been shown that at these high temperatures, air and fuel burn more completely and therefore producing less hydrocarbons. However, these temperatures severely reduce engine life and kill performance. So why not just install a lower temperature thermostat and call it done? Simply because a lower temperature thermostat only allows coolant to flow through the engine sooner. In stop-and-go traffic, the engine's temperature will continue to rise unless there is sufficient airflow to the radiator. Assuming the A/C is turned off, have you noticed that on the open road, the temperature is acceptable, but when you hit city traffic, it climbs to astronomical levels?

Factory Coolant Fan Circuit Operation

The primary fan is controlled electronically through the ECM (electronic control module). The EPROM is programmed with a fan turn-on temperature of 222° (or higher, depending on application) or when the A/C head pressure exceeds 232-psig, and vehicle speed is a below 35 to 40 mph (depending on application).

The secondary fan is controlled mechanically through an in-cylinder head thermal switch only (1987) and A/C head pressure (1988 – 1992). The thermal switch engages the fan when coolant temperature reaches 243° (or similar). Also on 1988 – 1992 cars, the fan is turned on with air conditioning as described above.

Objective

Engine operating temperature must be lowered. This involves installing a lower temperature thermostat and modifying the coolant fan turn-on temperature. The true ideal system would incorporate a simple, straightforward design without disabling GM's system. I will explain this later.

So let's say that you install a 160° thermostat and a switch that engages the fan at 176° (or so). It seems like the ideal situation -- until the first cold day. Then, the engine will never reach full operating temperature because the fan is running -- when you don't want it to. The heater will only work marginally, at best. Of course, you can change your thermostat and fan switch twice per year, but do you really want to do that? How about a typical fall or spring day when it's cold in the morning and warm in the afternoon. What do you do then? Or how about on a beautiful day when suddenly, a weather front moves in, drastically dropping the temperature within hours. Is there a practical solution? First, let's examine a couple of aftermarket products.

Aftermarket Products

Here is a sampling of products that will modify the factory settings. There are others, but they essentially accomplish the same thing.

Hypertech makes a fan switch (Part No. 4026). Available through Summit Racing (800) 230-3030 for about $45.

Features:

- Replaces the factory switch.
- Fan turn-on at 176°, off at 166°.

Hypertech makes a fan switch (Part No. 4028). Available through Summit Racing (800) 230-3030 for about $45.

Features:

- Replaces factory switch.
- Fan turn-on at 200°, off at 185°.

Hayden makes a fan turn-on relay (part no. 3652). Available at Pep Boys for about $27.

Features:

- Thermal switch mounted in radiator.
- Fan turn-on at 185° and off at 170°.
- Kit designed for an add-on electric fan, but can be wired to augment factory electric fan circuitry.

Hayden makes an adjustable fan turn-on relay (Part No. 3647). Available at Pep Boys for about $40.

Features:

- Adjustable turn-on from 160° to 210°.
- Can be turned on automatically when AC is engaged.
- Can be wired to augment factory switch, not replace it.
- Can be manually turned on with a dash-mounted switch.
- Kit designed for an add-on electric fan, but can be wired to augment factory electric fan circuitry.

Recommendations

Overview

We know that heat shortens the life expectancy of engines. The temperature that GM operates their engines is acceptable for lower emissions, but a killer for performance and longevity. I found it imperative to lower the operating temperature.

Through five years of research, primarily trial and error, I believe that I have designed a system with the most versatility. I call this my “Total Fan Control” system.

For most performance enthusiasts, the approach is to lower the operating temperature by using a 160° thermostat and either running the fan constantly or using a turn-on switch at approximately 170° to 175°. This is acceptable and fully functional, except in the winter months or during emissions testing. If we follow this approach, the engine never reaches full operating temperature in the winter months and the heater works marginally at best. I suppose you could change to a 180° or higher thermostat and change the fan operation back to stock, if you're willing to do this twice per year. I do not find this solution acceptable. Also, think about the ambient temperature on a typical spring or fall day. In the morning and night, it's cold. In the afternoon, it's rather warm. On these days, it would be ideal to use the 160° thermostat and modified fan control in the afternoon and a 180° with factory fan control on those cold mornings and nights. If there were a way to run “Summer Mode” and be able to change to “Winter Mode” at the flip of a switch -- that would be ideal. This was my goal -- and I've accomplished it.

In analyzing all the products on the market, I came to the conclusion that none of them would meet all my criteria. It would take a combination of products and a little ingenuity on my part. In analyzing the factory coolant fan wiring diagrams, I decided that I would not disable GM's wiring scheme in any way for two reasons:

1) For those who live in states with a yearly emissions check, wouldn't it be nice to revert back to the factory settings at the flip of a switch?

2) By supplementing the factory system, there are actually two systems working independently of each other, the factory system and the Total Fan Control system. If the Total Fan Control system were to fail (in ten years, it never has failed me), the factory settings, which have not been disabled, will engage the fan(s).

The information I share with you is a culmination of my research. I think you will agree that this is the best and most versatile system available today.

Thermostat

Of the numerous experts on tuned port injection engines, Greg Carroll of Carroll Supercharging Company and Myron Cottrell of TPI Specialties are the forerunners. Greg Carroll states that 160° is too cold for these engines. He suggests a 170° thermostat. Myron Cottrell says, “We have found that 170° is a better temperature for all-around driving. The computer in your car is designed to provide a correct fuel mixture at whatever temperature the motor is controlled. The 170° thermostat provides the best compromise between power, economy and wear.” I have found that with a 170° thermostat, I do not need to change between a 160° for summer and a 180° for winter, but that I can use it year-round.

Recommendations (Continued)

Thermostat (Continued)

I used to use the 160°/180° thermostats in combination with my coolant fan system and a stock EPROM for about ten years with no problems. I did grow tired of having to change it twice per year, though. I knew of the 170° thermostat, but to the best of my knowledge, TPI Specialties was the only source. For $10, it was not worth it. A little know fact is that GM does produce this thermostat. It retails for about $6 and have been using it ever since. Order AC Delco #10220957.

With the 170°, the heater functions very well on those cold mornings, It never really worked effectively with the 160° thermostat (luke warm at best). And as for those hot days, think of this; with a 160° thermostat, what do you think your normal operating temperature is with the A/C off? I'm willing to bet that it's not between 160° and 170°. It's probably around 170° to 185°. Even with a 160° thermostat and both fans running, the engine will only cool to around 170° to 185°. Therefore in the summer, it's irrelevant whether the thermostat is a 160° or a 170°.

Before installing the thermostat, modify it by drilling four 0.150-inch diameter holes around the perimeter of the thermostat. The holes allow a constant restricted flow of coolant through the engine, which prevents hot pockets from forming.

Fan System

Now that I've decided to use the 170° thermostat, which fan switch should I use?

Primary Coolant Fan

The primary fan is controlled exclusively by the ECM. The only method to lower the fan turn-on temperature is to burn a new EPROM or add a circuit that grounds the fan relay. This can be accomplished with the Hayden 3652 or 3647 kits or by adding a manual turn-on switch. These are the only alternatives. All these alternatives retain complete factory designed functions. My design, in essence, only adds to the factory circuitry.

Now, let's examine both Hayden switches. The Hayden 3652 thermal switch turns the fan on at 185°. This temperature is fixed and non-adjustable. The Hayden adjustable unit can be adjusted to turn on the fan from 140° to 260°. Both these kits are made to be used with an aftermarket add-on electric fan, not factory electric fans. However, I have modified the wiring so that both switches can be used in conjunction with the factory fans!

The choice is simple. I recommend either the Hayden 3652 thermal switch (185° on) or the Hayden 3647 adjustable switch, simply because of the versatility both afford. My suggestion is given later.

Secondary Coolant Fan

The Hypertech 4026 and 4028 switches replace the stock in-cylinder head switch. Once this switch is installed, you're stuck with its fan turn-on temperature. If you decide on the 4026, your fan will turn on at 176° (200° with the 4028). Although the 4026 is a nice switch for summer operation, it is too cool for winter months. Conversely, the 4028 is nice for winter, but probably too hot for summer. Now, if we could find a way to "switch" between these two or be able to revert back to factory specs with the flip of a switch, I'd say this is the optimal solution. Unfortunately, this is impossible with Hypertech's switches.

Recommendations (Continued)

Fan System (Continued)

Suggestion on Selecting the 3647 or 3652

If you desire your primary fan to turn on at 185° and your secondary to turn on at a higher temperature, use the 3652 kit for the primary fan and the 3647 kit for the secondary. If you want your primary fan to turn on at a temperature lower than 185, reverse the kits. Your personal preference will dictate which is right for your application.

Note

Both Hayden products can be wired for fully automatic operation – no toggle switches to worry about. But if you desire flexibility and the ability to have multiple fan turn-on temperatures, please read about the options as I describe below.

Fan System Options

Please keep in mind that these are options. They are not required. Without the options, the fans are regulated completely and no driver interaction is necessary. However, if you like having control, consider these some or all of these.

#1 – Switch to arm the Hayden fan turn-on.

I call this switch "Auto 1" for the primary fan and "Auto 2" for the secondary. With these switches off, stock fan turn-on temps are operational. Turning them on arms the "Total Fan Control" circuitry, thereby turning both fans on at your settings. This switch is required if both your and factory turn-on temperatures are needed.

#2 – Switch to manually turn on the fan.

I call this switch "Fan 1" for the primary fan and "Fan 2" for the secondary. These circuits are used as a "manual override" to turn the fans on at your command.

#3 – "Fan On" Indicator LED.

Not only is this information important, especially in the summer, but it is an excellent diagnostic tool. You can actually tell when your fans are on!

Recommendations (Continued)

Fan System Summary

Modes of Operation

I have addressed these problems stated in the Objective section -- and have solved it. It takes one aftermarket product installed with a modified wiring scheme. What I have designed is a system that will run the engine as cool as possible in the summer, and at the flip of a switch, warm enough in the winter to maintain sufficient engine coolant temperature (and a properly functioning heater). Also, how about that dreaded time each year, emissions check? That's when we wish our cars would magically return to the stock temperature. My system is so versatile that this can also be accomplished at the flip of another switch. All this without having to change the thermostat or a in-head fan turn-on switch.

Oh, Those Hot Summer Nights.
When the ambient temperature is high, turn on "Auto". This will engage the fan at any desired temperature setting.

Brrrrrr!!! Those Icy Cold Days.
When the ambient temperature is low, turn off "Auto". In the winter, I have found that the fan never turns on when in factory configuration – it just doesn't get warm enough.

Wanna run???
At any time, the fan can be manually turned on by switching on "Fan".

Yes, Mr. EPA, my car IS stock!!
At any time, the fan turn-on temperature can be returned to factory specifications by leaving both switches off.

Recommendations (Continued)

Throttle Body Coolant Bypass

The throttle body on tuned port injection engines contains a passageway for coolant to flow through to aid in heating the intake charge. By heating the air, the engine warms up quicker. However, the coolant flows through the throttle body 100 percent of the time, not just when the engine is cold. For performance considerations, this design is far from optimal. In fact, the ideal situation is to introduce the coolest air into the engine as possible.

The factory uses a 3/4 inch heater hose to route coolant from the intake manifold base to the throttle body. Then the coolant flows from the throttle body to the heater control valve. If a bypass hose is used to route coolant directly from the manifold base to the heater control valve, the coolant passage through the throttle body is bypassed. This results in a cooler intake charge by not heating the air as it passes through the throttle body.

Although making this modification does not directly yield lower coolant temperatures, it does allow cooler air to enter your engine. This, in turn, allows your engine to run more efficiently. As proof, tests were conducted on a '96 LT1. In the baseline study, the coolant temperature was 178°, intake air was 80°, and the throttle body surface temperature was 102°. After bypassing, the coolant temperature was held at 180°, the intake air at 80°. After bypassing, the throttle body surface temperature dropped to 82°, or 20° cooler. This test resulted in a 6.3 horsepower and 7.1 ft/lb. torque increase. Not bad for replacing 14" or so of heater hose!!!

If you would like wiring instructions for your specific application, please e-mail the following information:

Year, Make and Model, Engine Size, TPI, TBI or Carbureted, Single or Dual Fans, and which options (if any) most interested in, to

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