How To

Keep Your Power System Cool

The Art of Temperature Management

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Wayne Hittle’s Hangar 9 100cc Beast is powered by a Xoar 27x10 propeller on a Hacker A150-8, Jeti Spin 200 speed control, and 12S 6000mAh battery. The original powerplant ran extremely hot due to severe overloads and poor airflow. Rethinking the power system corrected most of the problem, and a little airflow did the rest.

Airplane engines and power systems have needed cooling since the beginning of powered flight, and our electric-powered RC planes are no different. Electric motors generate heat through wire resistance and other types of losses. A battery’s internal resistance, while small, can generate damaging heat as the battery supplies current to the power system. Speed controls generate heat as they switch power thousands of times per second to the motor’s windings. Choosing appropriate power-system components can minimize the amount of heat generated in the system but not completely eliminate it. Cooling airflow, through properly located cowl and fuselage vents and baffles, along with good component location can help manage the heat and keep temperatures below the damage point.

Choices

The electric–power system you install in a model is the first decision you make that has an impact on how much cooling the model will need. A marginal motor, speed control, or battery that has to operate near its specified limits will generate more heat than a component that’s comfortably within its limits. Doing the math or plugging the numbers into an electric–power calculator will allow you to make a good choice. I’ve had success using speed controls that are 25 percent or so over the expected current for a given system. They’re not a lot bigger or a lot more expensive, and they tend to run cooler because they’re not stressed by the load. My 30cc Spitfire, for example, draws about 75 amps and has a 120–amp speed control installed. The propeller is an inch smaller than the motor’s maximum size, and the entire power system runs cool enough so that I didn’t need to put any vent holes in that beautiful sleek cowl.

Cool Cowl Vents

On many RC models, particularly scale models, the location of vents
This Piper Pawnee model has generous, fairly accurate scale air inlets in the cowl for good cooling.

This 30cc Spitfire has no openings in the cowl, which means very little or no airflow over the power system. In spite of that, the conservatively chosen components run well under the manufacturer’s heat limits.

The Hangar 9 Beast 60e has a well-designed cooling airflow. A curved baffle left of the spinner directs air over the motor. The right-side inlet directs air straight into the fuselage and over the speed control. Just forward of the tail, a large exit vent pulls the air out of the fuselage.

This exit vent is made by removing the covering over a cutout in the bottom plywood sheeting of a Fokker D.VII. Simple and effective, it improved the airflow through the fuselage.

COMPONENT LOCATION
Generally speaking, electric-power components are located fairly close to one another when possible. One reason for that is aircraft balance and the need to keep the heavier bits forward of the center of gravity to compensate for the weight of the airplane aft of it. Another reason is to keep wire lengths short, minimizing resistive losses and overall weight. All of that together means that, in large planes, it might be possible to mount the speed control somewhere forward of the firewall—for instance, on the underside of the motor mount. Many smaller models require the speed control to be mounted inside the fuselage in the battery compartment; in this case, you’ll need to make provisions either to get the airflow over the speed control or to mount the speed control in the path of the existing airflow.

IN-FUSELAGE AIRFLOW
Once the high-pressure air from outside the moving plane has a way into the fuselage, it needs to be directed to the hot spots. Well-placed holes in the firewall and other formers inside the model can direct air fairly effectively, resulting in a steady flow of air through the fuselage cavity. In many models, this is all you need. Castle Creations’ specifications for air scoops on the nose of the plane is predetermined. A P-40, for instance, has a fairly large opening just below the big spinner, where the radiator and oil cooler were located in the original plane. A Cessna 310 has two vents in each nacelle, one on either side of the spinner. Models of these planes would have vents in the same locations, making the speed-control mounting decision easy.

Sport models are a little different in that you can put a vent or scoop anywhere you need to. That said, the most pleasing designs tend to use the same locations and styles of vents that full-scale planes do. Chin scoops, cheek vents, and big round cowls over simulated radial engines just look right on an airplane, while they route air where it’s needed.
its aircraft speed controls’ maximum current ratings require the speed control to be “in contact with a 5mph airflow of 25°C (77°F) or cooler air.” That’s not a very fast airflow. Warmer ambient temperatures or higher temperatures in the speed control would, of course, require more air movement.

If the air needs to go to specific areas in the fuselage with higher velocity, it might help to install baffles or guides to direct the airflow more accurately. These guides can be made out of whatever material is appropriate: thin plywood, shaped balsa, flexible plastic, or foam. Many ARF models designed specifically for electric power have taken cooling airflow into consideration and come out of the box with well-designed vents, baffles, and power-component mounting areas.

**GET THE HEAT OUT**

The exit for the heated air can be just about anywhere in the rear of the fuselage or cowling that makes sense. For a model with a speed control mounted in the engine compartment, a simple cutout in the lower rear part of the cowling is all it takes. For models with the speed control inside the fuselage, cutting the covering or sheeting from the space between a couple of rear formers works pretty well.

The primary goal of the exit vent is to create a low-pressure area so that the higher-pressure air in the fuselage wants to move toward it. An easy way to do that is to make sure that the total area of the exit vent is about three times the area of the total inlet area.

**KNOW THE SCORE**

Whether before or after setting up a cooling airflow in a model, it’s handy to know what the temperatures you’re dealing with actually are. There are several ways to check temperatures: an infrared thermometer, telemetry systems for your radio, and speed-control data logging.

The most versatile of the three methods is the infrared thermometer. This is a handheld device that you simply point at the surface that you want to measure the temperature of. You can check the temperatures of any component that you need to with this device—motor, battery, speed control, wires, and plugs—so I recommend having one of these in your toolbox.

Many radio manufacturers offer telemetry systems as options for their radio systems. These transmit data from various sensors to the transmitter, and all of them have at least one temperature sensor that can be attached to any component that you need to know the temperature of. An advantage of using telemetry is that you’ll be able to see the temperatures change as a flight progresses instead of checking after the landing.

Speed-control data logging is available from several manufacturers. These speed controls keep a running log of selected data throughout a flight, and you can download the resulting file to a computer for viewing afterward. Opening the data in a graphing application provides a great way to see what’s going on.

**BOTTOM LINE**

Heat in an RC electric-power system can be fairly straightforward to manage. Choosing the components of the system conservatively can reduce the amount of heat generated in the first place, and well-placed inlets, components, baffles, and outlets can help your airplane keep its cool.