Fan Performance Worksheet

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This worksheet will help you quickly diagnose poor electric fan performance in 6 easy steps!

STEP 1 - Alternator Drive Ratio

Alternators work best when they are driven at 3 times the speed of the crankshaft. This represents a 3:1 drive ratio. *This is a must for street driven vehicles!* Record this below via the following formula.

Drive Ratio = Crank Pulley Diameter / Alternator Pulley Diameter Drive Ratio = _____ :1

If the drive ratio measures less than 3:1, you need to alter the pulleys to attain the correct drive ratio before proceeding. *Drive ratios less than 3:1 will greatly affect alternator output at idle!*

STEP 2 - Voltage at Idle

Note that you will need a quality DMM (Digital Multi-Meter) to obtain the measurements in the following steps. Alligator adapters and piercing probes will certainly make the job easier, but are not absolutely necessary.

Bring the vehicle to operating temperature. Ensure that all electric fans, the heater or A/C, and the headlights are ON. Measure Voltage at the battery terminals at idle (800 RPM). Record this below. If you measure less than 13.4 Volts, the alternator, its wiring, or both is not large enough. *This must be addressed before continuing!*

Voltage Measured at Battery Terminals		A

STEP 3 - Voltage Drop Measurements

Voltage drop is power that is wasted as heat. All circuits have voltage drop, even the very best ones. The more that voltage drop can be minimized, the better a given circuit will perform. Before beginning:

- Note that all measurements are to be taken at idle and with the engine at operating temperature
- All other accessories (headlights, A/C, etc.) should be turned OFF
- Note that it is best to record measurements to two decimal places if your DMM offers the resolution

Connect DMM probes exactly as outlined in each step!

Black Probe	Red Probe	Measurements		
Case of Alternator	Output Stud of Alternator			B
		Fan 1	**Fan 2**	
Fan Ground Lead (fan side at plug)	Fan Power Lead (fan side at plug)			C

Total Voltage Drop to Fan 1 = (B - C) / B (_____ - _____) / _____ = _____ OR _____ %

Total Voltage Drop to Fan 2 = (B - C) / B (_____ - _____) / _____ = _____ OR _____ %

Example: B = 13.8V, C = 12.9V (13.8V - 12.9V) / 13.8V = .065 OR 6.5 %

If you measure more than 3% for either fan, proceed. Otherwise, your cooling problem lies elsewhere.

Note that all measurements at Fan Relay(s) are the LARGE wires (the switch) and not the small ones (the coil)!

Black Probe	Red Probe	Measurements		
		Fan 1	**Fan 2**	
Fan Relay Fuse Holder (feed side)	Output Stud of Alternator			D
Fan Relay Fuse Holder (relay side)	Fan Relay Fuse Holder (feed side)			E
Fan Relay Input (feed side)	Fan Relay Fuse Holder (relay side)			F
Fan Relay Output (at relay)	Fan Relay Input (at relay)			G
Fan Power Lead (feed side at plug)	Fan Relay Output (at relay)			H
Fan Power Lead (fan side at plug)	Fan Power Lead (feed side at plug)			I
Fan Ground Lead (feed side at plug)	Fan Ground Lead (fan side at plug)			J
Case of Alternator	Fan Ground Lead (feed side at plug)			K

STEP 4 - Voltage Drop Calculations

The following chart will allow you to narrow down your search for defective components, undersized wire, poor terminations, etc. Do the math in the Formula column and write your answers in the column to the right.

Description	Formula		%age		
Voltage Drop between Alternator and Battery (Total)	A / B				
Note: The above should be a very low %age, even in vehicles with centrally or rear-located batteries!					
		Fan 1	**%age**	**Fan 2**	**%age**
Voltage Drop between Alternator and Fan Relay Fuse Holder	D / B				
Voltage Drop across Fan Relay Fuse Holder	E / B				
Voltage Drop between Fan Relay Fuse Holder and Fan Relay	F / B				
Voltage Drop across Fan Relay	G / B				
Voltage Drop between Fan Relay and Fan Plug	H / B				
Voltage Drop across Fan Plug - Positive	I / B				
Voltage Drop across Fan Plug - Negative	J / B				
Voltage Drop between Fan Plug and Case of Alternator	K / B				

STEP 5 - Repairs

Focus your efforts on improving the areas with the highest percentages first. This may involve:

- Repairing poor terminations (quality terminals and proper crimping and soldering techniques are a must!)
- Replacing wire that is undersized for the task with *full AWG spec pure copper wire* (see Chart A)
- Replacing undersized charge lead and/or battery cables with *full AWG spec pure copper cable* (see Chart B)
- Replacing low quality or worn out components, connectors, wire, or cables with high quality replacements
- Improving the return path of your charging system and accessories (ask us about our Ground Kits!)

Chart A - Electric Fan Wiring Size Recommendations

Note that the following applies to the wiring from the source of power to the fan relay fuse holder(s), from the fan relay(s) to the fan connector(s), and from the fan connector(s) to ground! Recommendations are given per fan.

Fan Current	Minimum Size		Fan Current	Minimum Size
Up to 20A	12 AWG		30A - 40A	10 AWG
20A - 30A	10 AWG		40A - 75A	8 AWG

Chart B - Alternator Cable Size Recommendations

Note that vehicles with rear-located batteries with charge leads that run the length of vehicle will require larger cables than outlined in this chart! Also note that vehicles with functioning Ammeters require special consideration!

Max Output	Charge Lead	Alt Ground Lead	Battery Ground Upgrade
Up to 40A	10 AWG	n/a	n/a
40A - 75A	8 AWG	n/a	n/a
75A - 120A	6 AWG	6 AWG - case of alt to frame	6 AWG - Battery (-) to frame
120A - 170A	4 AWG	4 AWG - case of alt to frame	4 AWG - Battery (-) to frame
170A - 225A	2 AWG	2 AWG - case of alt to frame	4 AWG - Battery (-) to frame
225A - 300A	1/0 AWG	1/0 AWG - case of alt to frame	1/0 AWG - Battery (-) to frame
> 300A	2/0 AWG	2/0 AWG - case of alt to frame	2/0 AWG - Battery (-) to frame

STEP 6 - Re-take the following measurements to analyze the results of your efforts

Black Probe	Red Probe	Measurements		
Case of Alternator	Output Stud of Alternator			B
		Fan 1	**Fan 2**	
Fan Ground Lead (fan side at plug)	Fan Power Lead (fan side at plug)			C

Total Voltage Drop to Fan 1 = (B - C) / B (_____ - _____) / _____ = _____ OR _____ %

Total Voltage Drop to Fan 2 = (B - C) / B (_____ - _____) / _____ = _____ OR _____ %