



Power wire and the big three upgrade and why it's important.

We all know that it takes wires to make electronics work. But what is the reason there are different sizes of wires? Does it make any difference? Can the same size of wire be different internally? To sum it up, it does make a big difference on the size of the wire and what it is made of. Using the wrong wire can lead to poor quality sound reproduction, damaged electronics, and in severe cases...FIRE! You don't want that do you? We will explain the differences in power wire for the 12 volt industry.

The car's electrical system and how it operates.

Just a quick lesson on how power works in a car... Most vehicles (except hybrids) use a 12 volt battery to power the electronics while the car is not running. Yes, that includes the starter. You need a way to store energy to power the starter to get the car running. That is what batteries do, they store energy. They can be large or small and will have various storage capacities depending on what the designers of the vehicle need it to do. Let's use a bucket of water to represent a battery. Buckets come in all sizes and can hold various amounts of water for use later when you have no water source. If you put a small hole in the bucket it will begin to drain the water out. If you have no way to refill the bucket, it will eventually drain completely. This would be just like putting a small load on a battery. It will take a relatively long time to drain the battery. A battery will power a small electrical device for quite a long time. If you put a larger hole in the bucket, the water will drain out faster. This would be similar to putting a greater load on the battery like starting the vehicle. The starter requires a lot of energy to crank the engine over. The battery will provide a lot of current (amps) very quickly to the starter but will not be able to do this nearly as long before it is out of energy without recharging.

The wire in an electrical system is similar to a water pipe in your house. Small pipes provide small amounts of water and bigger pipes can provide more water assuming the same pressure in each pipe. It all depends on the amount of water you need to a particular faucet. The same is true for electricity. The more power you need to a device, the more energy you will have to provide. If your wire is not large enough for the device's requirements, two things will happen. The voltage will drop in the circuit because the small wire is restricting it. Most automotive electronics will shut down if the voltage gets too low. The wire will also begin to heat up as you require more energy. If it gets too high, you get smoke and fire...not good. So basically we are saying that if you have a very powerful amplifier, it will require larger wire than a less powerful amplifier.



There is a difference between water in a pipe and power in a wire. Water flow in a pipe will not change with length of the pipe or what material the pipe is made of. With any type of wire, it will have more resistance as it gets longer. That means that the farther you mount the equipment from the battery, the larger wire you will need to get the required amount of energy to the device. There are wire tables that will reference the amount of current needed for a device and how long the wire is. This will tell you the gauge, or size of wire required for safe operation.

Example:

Amperes	250-300	4-ga.	2-ga.	2-ga.	1/0-ga.	1/0-ga.	1/0-ga.	2/0-ga.
	200-250	4-ga.	4-ga.	2-ga.	2-ga.	1/0-ga.	1/0-ga.	1/0-ga.
	150-200	6 or 4-ga.	4-ga.	4-ga.	2-ga.	2-ga.	1/0-ga.	1/0-ga.
	125-150	8-ga.	6 or 4-ga.	4-ga.	4-ga.	2-ga.	2-ga.	2-ga.
	105-125	8-ga.	8-ga.	6 or 4-ga.	4-ga.	4-ga.	4-ga.	2-ga.
	85-105	8-ga.	8-ga.	6 or 4-ga.	4-ga.	4-ga.	4-ga.	4-ga.
	65-85	10-ga.	8-ga.	8-ga.	6 or 4-ga.	4-ga.	4-ga.	4-ga.
	50-65	10-ga.	10-ga.	8-ga.	8-ga.	6 or 4-ga.	6 or 4-ga.	4-ga.
	35-50	10-ga.	10-ga.	10-ga.	8-ga.	8-ga.	8-ga.	6 or 4-ga.
	20-35	12-ga.	10-ga.	10-ga.	10-ga.	10-ga.	8-ga.	8-ga.
	0-20	12-ga.	12-ga.	12-ga.	12-ga.	10-ga.	10-ga.	10-ga.
	0-4 ft.	4-7 ft.	7-10 ft.	10-13 ft.	13-16 ft.	16-19 ft.	19-22	
	Length in feet							

It is acceptable to use larger wire for a device than what is needed. There will be no down side to using wire that is larger than recommended. Larger wire does cost more and can sometimes be harder to bend or hide in a car's interior.

Charging the battery:

The alternator is the primary source of power in the vehicle. Without the alternator, you will soon have no sound at all. It is the alternator's job to charge the battery after the vehicle is started and to power all the electronics in the vehicle while it is running. They will vary in output depending on the manufacturer and how much power is required for each specific vehicle. The automotive manufacturers design the alternator to meet the needs of the specific vehicle. Basically, they will not install larger alternators than they feel necessary to run the electronics that come in the car from the factory. If you add high power electronics, the stock alternator and its wiring may not be enough to power everything adequately so an upgrade is necessary.



Power wire types:

Typically, you will want to use oxygen free copper wire for automotive electronics. It has the best conductivity vs cost and is the most popular in the industry. This wire may have a silver oxide coating to help eliminate long-term corroding.

There is another type of wire that is gaining market share in car audio. This is called copper clad aluminum wire commonly called CCA wire. It is cheaper and lighter than pure copper wire. It is aluminum wire that sometimes has a copper coating to make it appear it is made of copper. Aluminum has approximately ½ the current capability as copper. This is because it has almost double the resistance per foot that the same size copper wire. With CCA wire, you will have to use larger wire to get the same capacity as copper. This will sometimes negate the savings because you will have to buy thicker wire than the recommended copper wire. With more resistance in aluminum wiring, you will get more heat buildup in the wire and you will have more voltage drop at the amplifier causing loss of power or more current consumption. The extra buildup of heat is dangerous. It can melt the coating on the wire, melt carpet, and in extremely rare cases it may catch on fire. To sum it up, there is no substitute for oxygen free copper wire for automotive electronics.

In either case, you should also be aware that having smaller strands within the wire will carry more current and be much easier to bend and install in the car audio environment.

Example:

CHARACTERISTICS	COPPER	ALUMINUM
Tensile strength (lb/in ²)	50,000	32,000
Tensile strength for same conductivity (lb)	50,000	50,000
Weight for same conductivity (lb)	100	54
Cross section for same conductivity	100	156
Specific resistance (ohms-cir/mil ft)(20°C ref)	10.6	18.52
Coefficient of expansion (per deg. C x 10 ⁻⁶)	16.6	23



The big three upgrade:

It is suggested that if you install a car audio system of 1000 watts or greater you will need to upgrade the stock wiring in the charging system. This is one of the most overlooked necessities of car audio. As discussed above, the stock wiring is only adequate for the electronics the vehicle came with from the factory. Any extra demand will require upgrading the wire and possibly the alternator as well. We are just going to address the wire upgrades here.

There are three key areas that can be improved to make sure you get the maximum from your stock alternator. More wire is better for getting more power so it is not necessary to remove the factory wires, just add to them. It should also be noted that bigger wire is always better. Your wire upgrade should be a minimum of 4 gauge but 2 gauge or 1/0 is always better.

1. Start by upgrading the charging wire that comes from the back of the alternator going to the battery. It sometimes feeds the fuse block or distribution block in the vehicle. This will be the largest wire coming from the back of the alternator. It is usually 8, 6, or sometimes in larger charging systems can be 4 gauge. Make sure this wire is protected so it will not rub and short to ground. It will also be a good idea to protect it with a fuse.
2. The next wire that needs to be upgraded is the ground wire from the battery to the body of the vehicle. The ground wires are especially important. Electricity flows from more negative to more positive. This means that the power is actually entering the ground wire in automotive electronics. All you will need to do is to add large wire from the battery negative post to the body of the vehicle. Most electronics in the vehicle are grounded to the chassis of the vehicle. This will ensure they get to maximum voltage and current to operate properly.
3. The last wire that will need improvement is the ground wire from the battery to the engine block. The alternator is grounded to the engine block by its mounting points so the engine block itself becomes an electrical ground distribution block. You can even add a wire from the chassis of the car to the engine block. This will do the same thing as from the battery ground to the engine block if you have upgraded the battery ground to the chassis of the vehicle. More is always better when it comes to charging system wiring.

Upgrading these three main wires will ensure that you will get the maximum performance your alternator is able to deliver. They all make up the charging circuit and will require upgrading when you put more demand on the charging system with aftermarket electronic accessories.



Example:

In this example, all the wire is blue 1/0. The color does not matter as long as it is easily identifiable as to which is + and -. You will also see an optional fuse holder on the charging wire. This is to protect the wire in case it is shorted between the battery and alternator. The fuse should be rated higher than the maximum output of the alternator and be placed as close to the battery as possible. It is always a good idea to fuse a power wire that has a possibility to short to ground.



The wire on the left is the ground from the chassis to the engine block. The center wire is the charging wire and the wire on the far right is the ground from the battery to the chassis of the vehicle. The black jacketed wire coming off the left post (+) is the power wire that runs back the audio system.