The basics of 30- and 50-amp RV electrical systems installed and used in the USA

110 Volt ELECTRICS

The following article is intended to give an insight into the use of hook-ups in the USA. In the UK and Europe the maximum current provided by a hook-up will probably be 16 amps at 240 volts but very often much less. Before a motorhome, that has been imported from the USA, can be used in the UK the wiring systems MUST be modified.

Today's self-contained American recreational vehicles have two types of electrical service. Smaller units (usually with one air conditioner) have a 30-amp service, and larger units (usually with two or three air conditioners) have a 50-amp service. Any misconceptions regarding the differences between them become clear once you understand the basics of each type of service.

If you have difficulty understanding electricity, visualize it as water and the cable as a water pipe. Volts is equivalent to the pressure in the pipe driving the water, Amperes (amps) the size of the water pipe and Wattage (watts) the volume of water flowing through the pipe.

30-amp service

A 30-amp electrical service cable has three wires: usually a black wire called 'line' that provides 120 volts of alternating current (AC), a white wire called 'neutral' and a green wire called 'earth' or 'ground'. Without getting into the realms of the theory of electricity, let's just say the current is supplied by the black wire, the white wire completes the circuit loop back to the source and the green wire is a safety net to capture any stray current back to ground so that you won't get electrocuted in the event of an insulation failure.

30-amp service may be identified easily by the plug on the end of the electrical service cable. In the RV industry, it has three prongs – one rounded and two flat blade connectors.

The true measurement of electrical energy is wattage. Amperes multiplied by volts equals watts. A 30-amp service can supply 3,600 watts of electrical energy; 30 amps multiplied by 120 volts.

To determine what combination of appliances can be used with a particular service, you need to have a rough idea of how much current each appliance will consume. Major appliances such as an air conditioner, a larger microwave oven, and an electric water heater each consume 10 to 15 amps at 120 volts, or 1,200 to 1,800 watts. Thus operating two 15-amp appliances simultaneously will stretch a 30-amp service to its limit with nothing left over for illumination, battery charging, computing, or television. This is why we usually can operate only one major appliance at a time on a 30-amp service if you expect to operate any additional loads. If you must operate two major appliances, **everything else** must be turned off, and even then the main breaker might trip.

A little off the subject but worthy of mention are what some call the 'parasitic loads.' These are the smaller loads that are usually on virtually all of the time – clocks, timers, light-emitting diodes, LP-gas leak detectors, voltage monitors, and even the idle mode of the convertor, inverter, and microwave. Individually, these loads don't amount to much, but when added together, they might just be the straw that trips the breaker.

Each circuit within the RV is protected from overload by a circuit breaker of an appropriate rating for the load of that circuit. This normally calls for 15 and 20-amp breakers. The breaker for the air conditioner must be an HACR (heating/air conditioning reset) type, which is designed to tolerate the higher momentary load necessary to start the compressor. Feeding the group of individual circuit breakers is a master breaker sized for the total service. For the 30-amp service, the master breaker will be 30 amps. If the total load exceeds 30 amps, the bimetal internal conductor will warp and cause the contactors to release. To reset a breaker, push the lever to the fully 'off' position and then return it to the 'on' position.

All appliances that have met US standards will have their current consumption clearly marked. The figure may be stated on a data plate attached to the appliance, stamped on the unit, or moulded into a major piece of the equipment. So, somewhere on that iron, sweeper, or microwave, etc., this data will state its current consumption. Naturally, you could expect better performance from an appliance with a 10-amp rating than from a similar item with a 5-amp rating. Most of the time, this difference will be reflected in the price.

50-amp service

Fifty-amp service is totally different, because it involves two 120-volt lines of 50 amps each, and provides a 240-volt service. Multiply the amperage by the voltage (50 x 240) and you get 12,000 watts available – more than three times the current supplied by the 30-amp service. The two 'legs' of a 50-amp service are kept separate in the breaker box and supply 120 volts each. After the first leg is connected, the next breaker connects to the opposite leg, so the loads will be more evenly distributed.

With 12,000 watts, you can operate four major appliances with plenty of power left over for other things (presuming all four major loads are not on the same leg).

The service cable for a 50-amp system normally will have a black, a red, a white, and a green wire. The plug will have four prongs – one rounded and three flat blade connectors. The black and the red wires are designated line-1 and line-2. Each line provides 50 amps at 120 volts. The white wire is the common, and the green wire is the ground.

Electrical Service Post

At the electrical service post will be a matching socket for the four prong, 50-amp plug. This outlet will be protected from overload by two 50-amp breakers. Depending on local code or the electrician's preference, the breakers usually will be paired to trip together by banding the two reset levers together. Not all breakers are paired in this manner however, and in this case it may be possible to trip only one leg of the 50-amp service. This would cause an interruption of service to only half of the circuits on your distribution panel. This unusual scenario may cause some anxious moments. One would be inclined to think the root of the problem lies within the RV but it is actually just a tripped breaker at the service post.

A variety of adapters in the USA make it possible to adapt the plug on the end of the RV service cable to a non-matching outlet. If you plug a 30-amp connector with an adapter into a 15-amp outlet, you now have a 15-amp service. If you overload the circuit, the overload protector (the breaker or fuse) on the service post will interrupt the service. So, keep in mind that when using adapters, the lower-amp service will prevail. If a 50-amp service is adapted to a 30-amp plug, 240 volts is no longer available. If you have an all-electric coach with a 240-volt cooker or dryer, those appliances won't work in this arrangement.

Polarity testing in the USA

With or without an adapter, always test the outlet for proper polarity. Purchase a polarity tester and a 30-to-15-amp reducer adapter. This will enable you to plug the adapter into the 30-amp outlet and to plug the 15-amp tester into the adapter. If reverse polarity exists, don't plug in any

appliances, as this would allow the incoming power to flow into the common connector, thereby creating a dangerous condition. In damp weather, your body could become a conductor from the door handle to the earth (ground), and possibly cause electrocution. Immediately report the condition to the park operator, and ask for another pitch. A 50-amp service can be checked using a voltmeter.

A 'cheater' is an electrical adapter that accepts the 50-amp service cable plug. A cheater has two more connectors, so service may be obtained from two receptacles feeding into the 50 amp cable. The two plugs may each be 30 amps, or consist of one 30-amp and one 15-amp. Caution: when using a cheater, always test the receptacles for reverse polarity! If you plug into a reverse-polarity outlet with one of those two plugs, the 'live' common will feed back to the common connector of the other plug, creating a potentially dangerous situation.

Earth leakage protection. US Code dictates that outlets within 6 feet of sinks, lavatories, tubs, showers, **and all exterior outlets** must be connected to a ground fault interrupter (GFI), also called a ground fault circuit interrupter (GFCI). This device measures current flow; if some current is lost to ground – such as through your body – it will trip the circuit. The GFI should be checked occasionally by using the test button. When you press this button, the reset button pops out and the electrical service is interrupted. Push the reset button to continue service. A single GFI may control more than one outlet and so when tripped all outlets will lose service. Any exterior outlet should have GFI protection; if your GFI is tripping for no apparent reason, turn off the service and inspect the outlet for moisture, the most common cause of such failure. Any questionable GFI should be replaced without hesitation. If you use extension electrical cables, they must be of a suitable wire size for the load or a voltage drop will occur. A smaller wire will start heating up it is overloaded. When voltage decreases, amperage rises as the load tries to remain at a constant wattage. For example, say you are running a 15-amp air conditioner that consumes 1,800 watts at 120 volts. If the voltage goes down to 90, the amperage will rise to 20 amps, because the appliance consumes 1,800 watts (1,800 divided by 90 equals 20).

Use common sense when handling electrical cables in wet weather. Make it a habit to trip the breakers at the service post prior to plugging in, and then reset the breakers afterward. It's safer and prevents arcing within the socket during connection – wet or dry.

Gaining an understanding of the basics of 30-amp and 50-amp electrical service will help you to operate your motorhome's appliances efficiently and safely.

The above article is intended to give you a guide to the electrical hook-ups that are installed in American RVs, as intended for use in the USA. If you import a motorhome into the UK the wiring and hook-ups will have to be modified to match current UK and European standards.

DO NOT JUST PLUG IT IN, GET ADVICE FROM A QUALIFIED ELECTRICIAN FIRST.

240 Volt Hook-Ups in the UK and Europe

240 Volt ELECTRICS

Provided that the electrical installation in your American RV has been adapted to 240 volts at 50 Hz then you will be able to take advantage of the electrical hook-ups provided on many of the sites in the UK and Europe.

More and more sites are now equipped with Mains Hook-ups and with a little thought and care before connecting up you can have the advantages of Mains Electricity. The current provided by hook-ups varies widely and is normally in the range of 5-16 Amps. Older and poorly installed site installations can suffer from reduced voltage, but fortunately this is slowly becoming less common.

Pitch Circuit Breaker

Many sites have a Circuit Breaker for each pitch, so you should be aware of the maximum current provided by the site supply. Often these Circuit Breakers are mounted inside the hook-up box and to reset them necessitates opening the box which should only be done by a qualified electrician. The newer site installations, however, have the Circuit Breaker mounted externally so that it can be reset more easily by the user.

Calculating Amps

American RVs are notorious for tripping hook-up circuit breakers and so it is well worth estimating the amount of current (Amps) you might require before you connect up.

So lets get back to the basics of the calculation just for a moment. The true measurement of electrical energy is wattage. Amperes multiplied by volts equals watts. A 5-amp hook-up can supply 1,200 watts (5x240) of electrical energy and a 16-amp 3,840 watts (16x240).

To determine what combination of appliances can be used with the hook-up, we need to have a rough idea of how much current each appliance will consume. Major appliances such as microwave ovens and electric kettles can consume between 1,000 and 3,000 watts each, depending on size. The battery charger/converter can also consume 1000-2000 watts again depending on size. Using any of these appliances either singly or together will quite clearly trip a 5-amp hook-up and even a 16-amp will not be able to run a large wattage electric kettle as well as other appliances.

5-amp hook-up is suitable for running a Refrigerator, Lights, Television etc. whereas, a 16-amp supply would be capable of running a Fan Heater, a Microwave Oven or Electric Kettle etc. A simple 'rule of thumb' is to allow 4 amps per 1,000 watts of power, so a 2,000 watt Electric Kettle would draw about 8 amps.

Polarity testing

It is extremely important to ensure that the hook-up supply and your hook-up cable are connected correctly so that the Polarity at electrical outlets in the RV is correct. Polarity testers are readily available at electrical suppliers and caravan accessory shops. They consist of a moulded unit with 3 neons on the front and a 13-amp plug on the back. All you have to do is to plug it into a 13-amp socket and provided the neons light up as indicated then all should be well. If you find a fault then check the site hook-up and also the wiring of your hook-up cable.

Get expert advice if the fault persists.

Hook-up Cable

The minimum requirements for a hook-up cable are that it should be suitable for 20 amps minimum current capacity and have the correct connectors on both ends (16A blue) and should be a maximum of 25 metres in length. Longer cables can be used but these will cause quite severe voltage drops. Hook-up cables must never be left coiled whilst in use as any heat produced in the cable will probably destroy the insulation of the cable permanently. Domestic type extension leads are not suitable for hook-up cables. Hook-up cables and connectors should be kept dry at all times. Whilst in use keep connectors off the ground and protect them from the elements. Store the cables in a dry locker.

Important Note

REMEMBER - Plug into the site Hook-up LAST when connecting up and un-plug FIRST when disconnecting. Do not handle LIVE cables and connectors.