Need to Know 5 – Vehicle Batteries (for cars and commercials – classic and modern)

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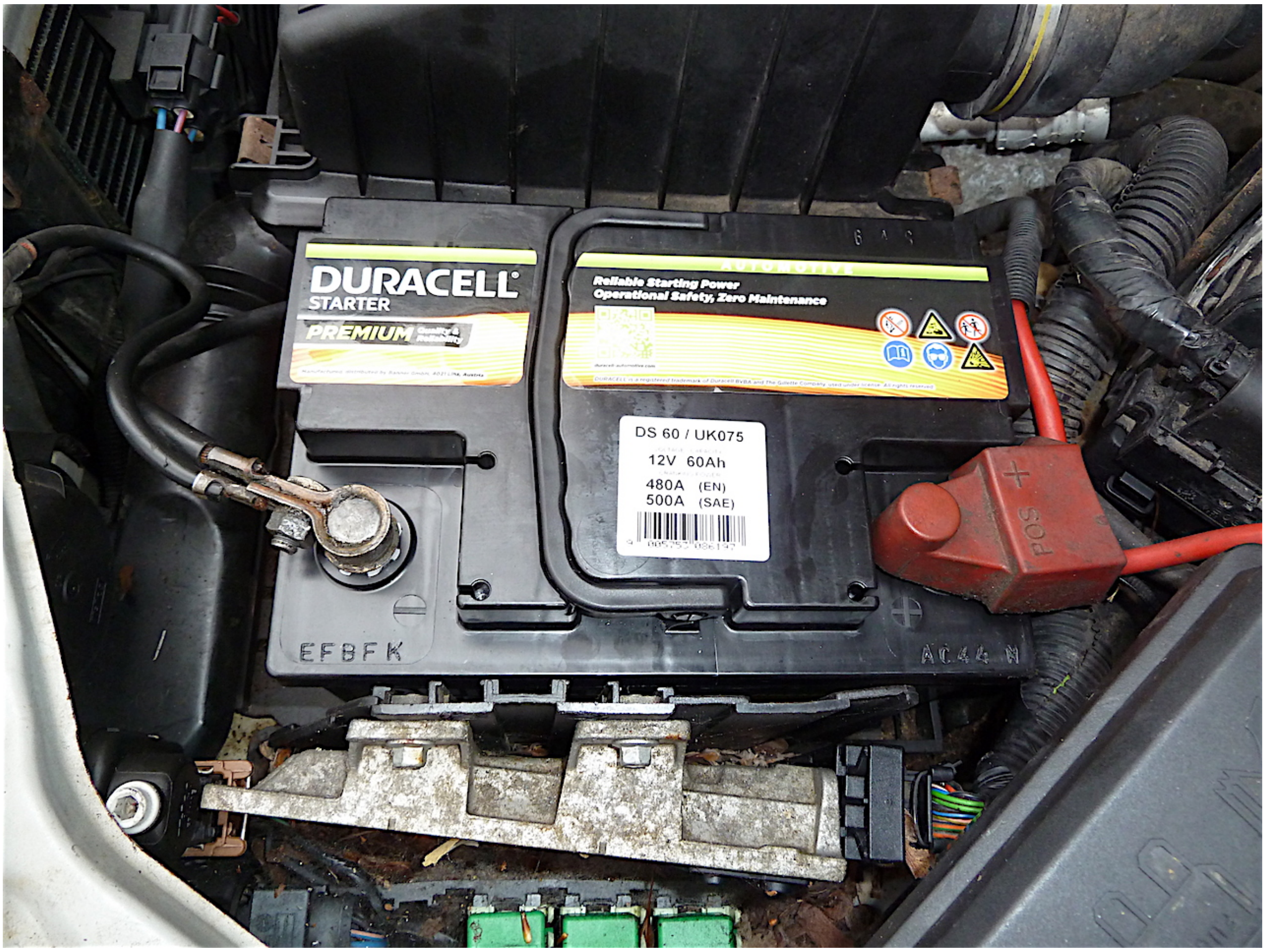


Photograph by Kim Henson.

Regardless of age and type, your vehicle relies on electrical power in order to function properly, and the battery is vital in storing/providing it.

Dave Moss explains how to look after your battery and keep you on the road.

(Photographs by Dave Moss and Kim Henson, as individually attributed).

This feature was prompted by the ten year old battery in the author's 19 year old diesel Fiesta van slowing down a bit, much as we all do on reaching old age. It's only the second battery that the van has had, and even without a test meter it was clear that it had taken a dislike to cold mornings. After a full and active life, removal to a suitably authorised last resting place – in my case the county council's nearby recycling centre – beckoned, before the end came just when a cold start was really needed most

Battery and personal safety considerations – before starting work

Car batteries are perpetually dangerous things on at least three main counts, with a couple of subsidiaries following close behind, so when working in, on or around them, always put safety foremost.

First: Keep vehicle batteries out of reach of children and pets.

Second: A principal component in car batteries is the electrolyte. It's largely sulphuric acid, which is a nasty, corrosive substance, and can easily cause burns to skin and eyes. Always ensure vehicle batteries are kept level, work in a well ventilated area, and wear gloves, eye protection and appropriate overalls.

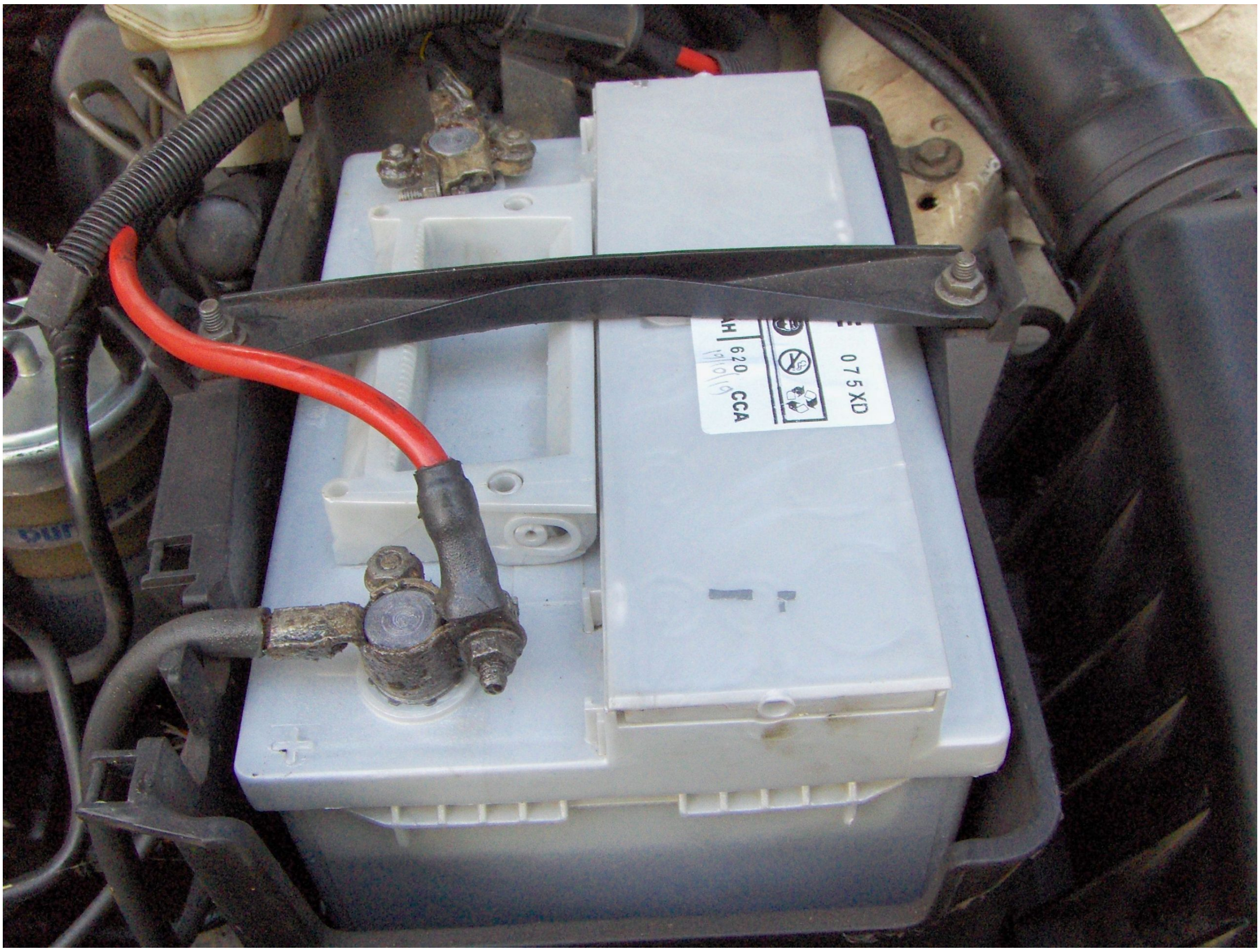
Third: Even when well past their peak performance, vehicle batteries can still deliver large amounts of electrical current into metal objects, enough to significantly raise their temperature, or even cause a fire by melting them. Whilst working on or near such batteries don't wear anything metal – watches, bracelets, medallions and so on, and use the minimum possible number of metal tools, keeping them well away from the battery terminals, except when actually in use – which should always be on just one terminal at a time. The battery shown below suffered from meltdown of the negative terminal, following a short-circuit during maintenance work by the vehicle's owner… It was lucky that the battery didn't explode and/or that the vehicle didn't go up in smoke…

Photograph by Kim Henson.

<u>Fourth</u>: Be aware there's an ever-present possibility of battery explosion, with flammable gases generated during charging – so keep naked flames well away, and avoid leaning over a battery that's being charged, or whilst connecting booster cables or a charger unit, or indeed at any time when there is a risk of sparks being generated.

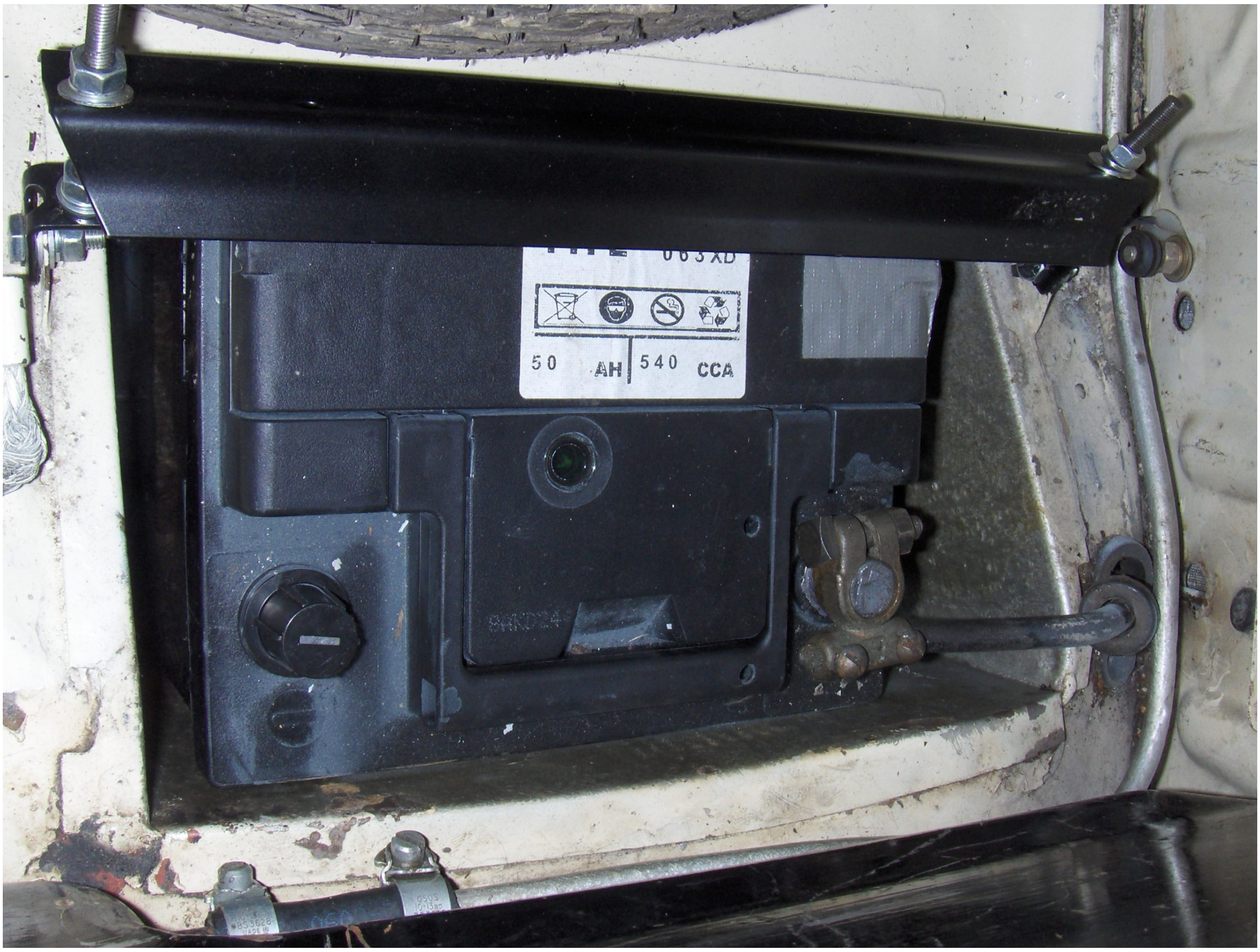
<u>Fifth:</u> Is the battery secure, and installed so that short-circuits cannot occur? Vehicle

batteries should always be firmly and robustly secured in their correct mounting place. In the vehicle shown below, the set-up incorporates a bolt-down strap across the battery centre. Insecure battery mounting can constitute an MoT failure.



Photograph by Dave Moss.

The new battery shown in the photograph below has been trial-fitted; i.e. placed and clamped in the intended position with only its main output cable connected – to gauge the safety of the installation. Note the second battery terminal is covered by an insulating cap to prevent accidents during the process. Though this is the manufacturer position for this vehicle’s battery, its location is low enough in its box to cause concern over the potential for short circuits between the outgoing "live" cable and the adjacent bodywork. This battery must be raised (and possibly also centred) in the box to minimise the risk.



Photograph by Dave Moss.

Problems like this can occur on classic cars with locations originally intended to accommodate physically much larger batteries than are necessary today for the required output. Extreme care must be taken that batteries are not located in such a way that the main cable connection used to supply the vehicle's electrical system could touch and short circuit to surrounding metalwork as the battery is physically clamped into position – or that such a risk might occur as a result of vibration or collision during vehicle use. Always double check terminal and clamp clearances before fully tightening battery retaining hardware.

Battery clamp securing nuts and bolts can seize through infrequent operation; it is wise periodically to coat the threads with a little copper-based anti-seize grease, to prevent future problems. The clamp bolt in the next photograph was reluctant to move, but responded to penetrating oil, and was greased on re-assembly.

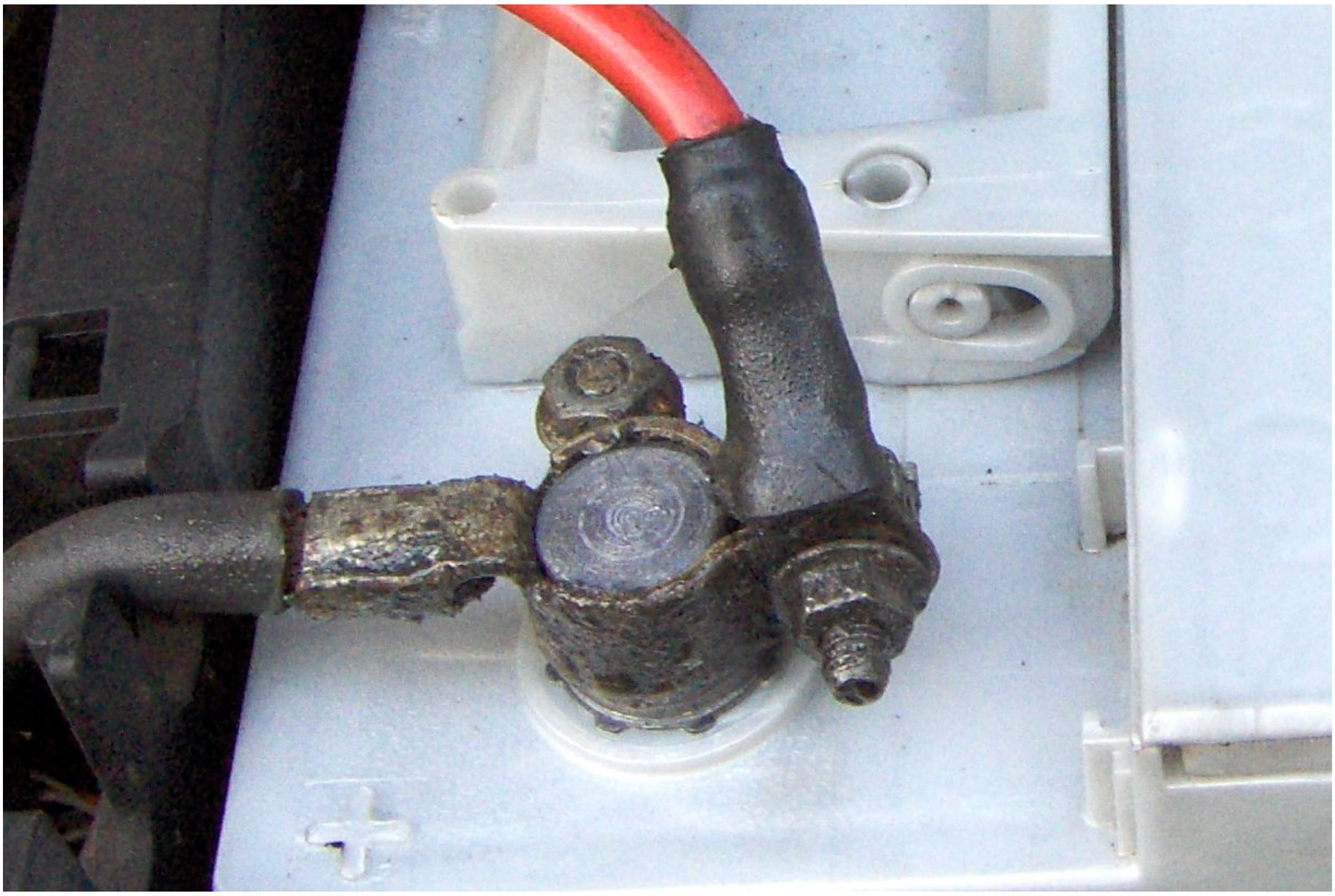
If you have time, remove, clean, de-rust and repaint the clamps/brackets as well. (Yes, that's the next job required on the clamp shown above!).

Seek out any available manufacturer advice and instructions

Though it may not always be possible with classics, with more modern vehicles it's a good idea to check any available vehicle-maker's literature, handbooks or workshop manuals before starting work on battery changing or charging. Look for any relevant instructions, safety precautions and appropriate work procedures.

Many modern vehicles are loaded with electronic gizmos which may not take kindly to unannounced interruptions or changes in their electricity supply. This can be a particular issue with security systems, immobilisers and remote central locking, but problems can spread far wider than this, so its worth doing some homework first to avoid problems later. Also remember to remove any portable equipment being powered or charged via the vehicle's cigar lighter connection – before starting work.

Important Note: If your car has a security code that needs to be keyed in before electrical functions (such as the audio system) will work, make sure that you know the code before you disconnect the battery, and/or invest in a 'memory saver' that can be connected to the vehicle's electrical system while the battery is disconnected. If in doubt, contact your vehicle's dealer before you disconnect the battery…



Photograph by Dave Moss.

In all cases it is vital during installation/replacement to ensure that the new battery's polarity matches that of the vehicle wiring. In the photograph below, the positive terminal clamp has a red cable connected to it – but cable colours should never solely be relied upon as being indicative of correct battery polarity. Always check and mark the individual cables with their polarity as they are removed from the old battery. On re-installation, always double-check the battery case polarity marking and that you have located the correct matching cable – before connecting to the battery.Note too that 'jump starting' any vehicle – and especially a modern one – needs to be carried out with extreme caution. ALWAYS follow the instructions provided in the manufacturer's handbook, or seek advice from your dealer. Engine management systems and ECUs don't take kindly to electrical 'spikes', and at the very least attempting to jump start a car which has a discharged battery needs to be undertaken with care. While on this subject, when connecting jump leads, always attach them to purpose-designed jump start connection points (where available), or to the ends furthest from the battery of the main battery cables (rather than to the battery terminals; a spark in this vicinity could cause an explosion…)..

Overall, if you're in any doubt, before getting involved with vehicle battery replacement or recharging, or jump starting, the advice must be to seek suitably qualified recommendations from a dealer for the marque or a specialist in the auto electrical field.

Avoid a state of decay…

If an otherwise healthy vehicle battery becomes completely or partially discharged as a result of a dynamo or alternator (or related equipment) malfunction or failure, or through something being left accidentally switched on, try and avoid leaving it in that state for any length of time. The same applies where a vehicle is being stored for months on end, and run only occasionally, perhaps without any road use. If it has no inbuilt systems such as an alarm, clock, or radio memories which remain permanently powered with the ignition switched off, a fully charged battery can usually be stored without a recharge for up to maybe 3 months, after which a 12 hour top-up trickle charge should keep it healthy enough for another similar period.

It's worth noting here that experience has shown that vehicle batteries do seem to like regular – though not necessarily daily – use, on the type of charge/discharge cycle for which they are intended. Thus it's worth trying to avoid storing them completely unused for many months at a time. Another tip here, for vehicles laid up out of use for long periods, is – bearing in mind the issues raised earlier – to disconnect at least one battery terminal. This helps prevent any possible slow "leakage" discharge which might occur, particularly with older vehicles and damp storage conditions – and it's also a useful safety measure, guarding against the possibility of accidental fire. Opinions differ on which terminal should be disconnected: This writer favours disconnecting the terminal connected directly to the vehicle chassis, but if struck by an agony of indecision, there's absolutely no harm in removing both.

Partially or fully discharged batteries do not take kindly to lengthy periods of inactivity. Storage for 3 months in this state will certainly not help to promote a long and happy working life, and may well send a battery into a decline from which full recovery could prove impossible. For vehicles which are not in regular use, but where the battery remains connected to preserve integrity of systems which are active with the ignition off, top-up recharging will be vital at quite frequent intervals – not exceeding three weeks to a month at most.

Note too that in many cases problems that appear to be due to a failing battery can in fact be attributed to dodgy cables and connectors. To start with, ensure that all cables and connections are clean and secure.

Photograph by Kim Henson.

Battery terminals can suffer from corrosion, which greatly reduces available power for the starter motor and all electrical systems on the vehicle. Sometimes the corrosion is hidden. If in any doubt, WEARING PROTECTIVE GLOVES AND GOGGLES separate the connection, clean up the components and re-assemble, applying petroleum jelly or a silicone protectant, to guard against future corrosion.

What makes a car battery deliver electricity?

Vehicle batteries produce electricity as a result of a reversible chemical reaction, which takes place in cells containing negative plates made of lead, and positive plates of lead dioxide. If an electrical load is connected between positive and negative terminals of these cells, the materials react with the sulphuric acid in which they are immersed to produce an electrical voltage, which drives a current through the connected load. Depending on its state of charge, the characteristic delivered voltage is in the approximate range of 1.7 to 2.1 volts for one lead acid cell in good condition.

When this voltage falls to around 1.75 through time spent delivering this current, the cell is said to be fully discharged. Lead acid batteries are robust and durable things, and during hard use it is possible to measure much lower cell voltages than this in such batteries – without long term damage – as long as they are in healthy condition, and recharging is undertaken without too much delay. Recharging can be initiated at any time during a discharge cycle, reversing the chemical process, by applying a controlled voltage in the region of 2.25 volts per cell from a suitable external source – until it is again recharged back to a terminal voltage around 2.1 volts.

Of course voltages this low aren't much use for a car electrical system, so six identical cells (three in a 6 volt battery) are connected in series within the battery casing, to achieve an acceptable working range centred around 6 or 12 volts – and actually not less than about 6.33 or 12.66 volts for a fully charged battery. This is the basic operational theory for typical modern lead acid battery types, as used in most classics and modern conventional petrol and diesel-engined cars and light commercials.

Not all batteries are equal – or the same inside…

Nowadays quite a range of chemical combinations other than lead/acid are in use, in batteries delivering electricity for a myriad of applications. Other rechargeable battery types range from established nickel cadmium and nickel-metal hydride types to the more controversial lithium-ion. Each type has its own unique characteristic voltage, and varying charge/ discharge requirements. If you have a car battery charger, never attempt to use it to recharge anything other than the lead-acid type of battery intended for vehicle use. It could be dangerous.

Electric (EV) and Hybrid (HEV or PHEV) vehicles are different – and potentially dangerous!

From a battery power and electrical system points of view these vehicles are very different from their modern petrol and diesel-engined relations. They may contain both lead acid and other battery types – each for very specific applications on the vehicle. Electric vehicles will have on-board mains power connections available, and some hybrids can also be recharged by plugging into the mains. Both EVs and HEVs may also have multiple internal power rails running at different voltages, with 48 volts increasingly found in vehicles capable of running on battery power alone.

However, much higher voltages can also be present in these vehicles, so a warning here about a very genuine risk of serious electric shock. If you own or run an electric or hybrid vehicle which suffers electrical problems, do consult the handbook for information, and take any specific recommended actions – but beyond that the advice has to be: Don't attempt battery charging, and don't interfere with on-board electrical systems in any way. If there's a problem – seek expert, qualified help – as soon as possible.

Irritating characteristics and vicious circles

Nothing in life is perfect, and car batteries suffer from a particular characteristic – shared by all battery types – which at some time or other most vehicle owners will probably find irritating. The performance of batteries in general varies with temperature, as do their charging and discharging possibilities. The downhill slide in capability as temperatures fall is certainly noticeable with conventional car batteries – though rather less so in modern vehicles with efficient alternators, high tech ignition and fuelling systems and sophisticated battery charging control – than it was 50, 60 or 70 years ago.

Temperature principally affects the output of a car battery because as the electrolyte's temperature reduces, the density of the acid it contains increases, and the required chemical reaction slows down.

Why does car battery performance go downhill with age?

The decline that sets in when vehicle batteries age, or are left in a low state of charge for long periods, mostly comes about through a process called sulphation. This is essentially the formation of sulphur deposits on the lead plates inside the battery, and is pretty minimal when a battery is idling its time away fully charged. With use and as a battery ages, however, a proportion of sulphation becomes irreversible, gradually increasing the battery internal electrical resistance, and reducing the current deliverable into any loads placed on the battery by the car.

Easily the biggest such load is the starter motor, and the reduced current available to it is likely to be the driver's first warning of battery trouble ahead – because, through no fault of its own, it cannot turn the engine over as quickly as it once did. This problem is compounded by the effects described earlier of lower temperatures affecting any battery's ability to meet the demands made on it. These are the key reasons why battery problems always seem to strike in winter.

Sulphation also limits the general ability of a battery to accept a full recharge, though some high power chargers can effect a partial improvement, usually effective for only a limited time. If you have a battery that seems to have entered this downward spiral of decline, either through age, or by remaining undercharged for too long, the only real cure is to bite the bullet and replace it. Before writing it off, however, it’s worth checking that slow engine turnover and reluctant recharging aren’t the result of faults elsewhere in the vehicle’s electrical system. It may also be worth having a suspect battery tested, at a specialist auto-electrical depot.

Brighter lights – good news or bad news..?

Where a battery is in decline, its sometimes possible to see the vehicle headlights brighten noticeably and stabilise as engine speed moves away from idle. More than an occasional sign of this on alternator-equipped vehicles is unlikely to be good news, and may be advance warning that a battery or other electrical issue is lurking not too far around the corner. This is because car alternators are very efficient suppliers of electricity, even at low engine speeds, and – in tandem with out-of-sight manufacturing improvements in batteries themselves – when integrated with modern electronic regulators are capable of keeping a battery in daily use apparently working normally to the very end of its natural life. This powerful combination can lead to batteries simply stopping working one day – often with little advance warning of imminent failure ahead.

Alternator efficiency combined with accurate control of charging voltage and current under virtually all conditions have together also been instrumental in significantly extending vehicle battery life. Today, consistent charging rates, closely aligned with the needs and capabilities of lead acid batteries, far exceed the performance achievable from a typical dynamo/generator of times gone by linked to even the best mechanical control box. In the 1950’s and 60’s, car batteries might typically have survived three or four years in average use: Today it’s not uncommon for them to work efficiently for eight or ten years – and sometimes even longer. Though nothing lasts for ever, and all batteries gradually deteriorate with use, the technical advances of recent years now prompt a once absolutely unheard of question: Which will last longer, the car… or it’s battery?

All this said, the brightening of headlights is of course a well known phenomena on classic vehicles, where dynamo-type generators were a universal fitment. Here, it's a useful sign that the regulator box cut-out is doing its job, and usually nothing to be alarmed about, though if the variation becomes very noticeable – or changes continuously with engine speed when driving along – a few minutes with a test-meter, plus a visual check of relevant main electrical cable connections for cleanliness and tightness, could be time well spent. Control boxes do go wrong – and today it's possible to obtain modestly priced test equipment to easily check and adjust the internal control box functions as required. Various look-alike boxes hiding modern solid-state control electronics inside are also available if you wish to improve reliability and voltage/current control accuracy by an order of magnitude.

The perils of overcharging

As we've seen, car batteries that are not in regular use need their charge level maintained at intervals – but there's also a need to avoid overcharging. This is more about the charging voltage being supplied than the time intervals involved, though too frequent trickle charging with a mains-powered charger unit lacking automatic switch off / charge control at the appropriate voltage level for the battery type should be avoided if possible.

Overcharging amounts to battery abuse, and can cause it to heat up, resulting in "gassing", and evaporation of electrolyte. This can damage the internal structure, and reduce the battery's ability to deliver current. If things gets this far, as before there's only one real cure: Replacement. It's worth bearing in mind that overcharging is a possibility which can result from a faulty regulator on the vehicle electrical system, or built into an alternator – while the alternator itself works normally – meaning such a problem may not be immediately apparent to the driver. Tell-tale signs include brighter than usual or flickering lighting – and sometimes repeated bulb-blowing around the vehicle.

These things certainly happen, but arguably, overcharging is more likely to occur through connection of a charger delivering an output voltage beyond the correct range for the battery type involved. Lead acid batteries commonly used in cars demand charging voltages within certain limits, which are either disconnected/switched off or reach an unchanging “float” level at the point of maximum charge.

Regulators fitted in tandem with modern alternators normally fulfil all battery demands seamlessly, continuously and automatically, their efficiency having incidentally led to the disappearance of once-common dashboard-mounted ammeters and voltmeters. Most consumer-level external vehicle battery chargers available today can also cope with a car battery’s preferences and requirements automatically. However, older chargers tend to be much less sophisticated, with the charging voltage simply rising with reducing load reduces as the battery charges up. This may or may not matter, depending on the charger’s design, but if you are using a unit of this type, two tips would be to (1) monitor its delivery carefully with a voltmeter during charging, and (2) don’t leave it connected to a battery approaching full charge for hours on end. Finally, be wary of using so called “fast chargers” on a frequent basis – especially those that work only when plugged into a mains supply…

The voltages (and other information) that you need to know.

Photograph by Dave Moss.

Modern batteries come complete with a label that tells you a great deal about the battery type and available power, etc. Indeed, this one label says all you really need to know about the bettery. In the case of the battery label in the photograph below, '075' refers to a common reference number series used by battery suppliers. The correct battery for a modern vehicle can in most cases be identified by simply knowing its make, model and year or possibly just its registration number – which can all be cross referenced to this 3-digit number series across most battery manufacturers. Also visible here are various safety warnings, the CCA rating, and the battery capacity at the standard 20 hr rate.

A 12 volt car battery is made up of six cells, though nowadays most are of a sealed type. This means it's unusual to be able to access – or even see – the individual cells either to top them up with distilled water (which once upon a time was a routine requirement) or measure each cell's voltage. If you have a battery in which individual cells are visible and linked together, with each having a removable cap for "topping up", cell voltages can be measured separately to check overall battery health. Alternatively the state of charge can be determined by using an hydrometer to measure the specific gravity of the liquid in each cell – that is its density, compared to the density of pure (distilled) water. As a battery discharges the electrolyte's specific gravity reduces, and this change can be seen on a calibrated hydrometer, though it's important to note that such readings will also vary somewhat with temperature.

If using a hydrometer, care must be taken to avoid electrolyte spillages, or its contact with skin or clothing. After completing each cell test, ensure that the cap is adequately tightened down.

Battery replacement will be necessary if any faulty cells are found by either of these methods, since repairs are not possible.

Fully charged battery voltages (approx), and Hydrometer readings

Across the + and – terminals	across 1 cell	specific gravity	at temp
12.65 to 12.99 v	2.10 to 2.17 v	1.284	16C/61F .

Fully discharged battery voltages (approx) and Hydrometer readings

Across the + and – terminals	across 1 cell	specific gravity	at temp
10.4 to 10.6 v	1.73 to 1.77 v	1.114	16C/61F

Note: These voltages are approximate and only a guide. They may also vary if the battery remains connected to the vehicle electrical system during measurement.

Typical maximum voltage across the battery terminals, minimum electrical load

(Expected figures at approx 16C/61F with battery in a fully charged condition . Readings may be affected by regulator compensation for higher or lower ambient temperatures.)

Alternator, engine running above 1200 rpm engine revs.

13.75 volts to 14.1 volts

Dynamo, with correctly adjusted regulator set up, engine running above 1400 rpm engine revs.

13.5 volts to 14.0 volts

Note: Voltages are approximate and should be taken as a guide . Readings outside these limits may not necessarily indicate fault conditions.

A classic car digression… the alleged dynamo, regulator and battery conspiracy…

Owners of dynamo-equipped classic cars using their vehicle all year round, especially if a 6 volt electrical system is employed, might have noticed that starting at zero degrees Celsius or – gulp – even lower, can become nail-bitingly touch and go. Though this effect can be well hidden where an alternator is fitted, the simple fact is that – in common with other battery types – in winter a vehicle battery just cannot deliver the same considerable output it magically conjures up on a mild summer day. A "will it, won't it" circle of decline tends to follow: The starter motor turns the engine over more slowly than usual – and because the battery is struggling, the voltage it can simultaneously offer the ignition system is also lower than usual, reducing the high tension voltage delivered to the spark plugs.

On dynamo-equipped cars, it was an eternal winter possibility that a battery otherwise apparently in good condition would give up the ghost before a start was achieved. Cunning ways to offset low ignition voltages for cold starting were found, mostly involving relays, resistors and ignition coils designed for optimum output below 12 volts. Decades later the jury remains out on whether "solutions" of this type were simply expedient bodges… but they certainly helped in difficult cold starting conditions.

For many mass market vehicles of the classic period however, the root cause of these types of problems often lay in low average battery charge levels in winter – usually traceable back to modest dynamo output. The Lucas C39 C40/1 C45 and RA series dynamos and associated control boxes found on countless post-war British cars and light commercials were some of just a handful of practical charging solutions available in their day, and did what their designers intended very well – but, despite some control box ingenuity, and the success of so called "compensated voltage control" regulation, these systems were never really efficient enough to answer the full range of multi-faceted electrical demands made on them. They didn't do battery life any favours either. Taking the C40/1 series dynamo as an example – it was a great compromise in weight, size, efficiency – and cost to car makers – but it was also absolutely flat out at 13.6 volts and 22 amps.

Trade data published in their heyday indicates the Lucas design target for many years was to achieve maximum generator output when the vehicle to which it was fitted exceeded about 20 mph in top gear. This translated into a regulator "cutting in" speed between 950 and 1,200 revs, with the dynamo typically geared to run around 1¼ times engine speed, giving theoretical maximum machine revs of 8,400 rpm. But the basic maths reveal that on a wet, cold, and dark night, a 50's/60's car electrical system might consume around 15-16 amps – without any luxuries like a radio or fog lights. In most cases that didn't leave a lot for charging the battery, especially while stuck in freezing temperatures in fog-bound stop-start traffic jams – when dynamo cutting in speed was only fleetingly reached, mostly in bursts of seconds – and mostly in the lower gears.

Once the engine was running and warmed up these set-ups would usually get you home, but – unless the vehicle had a regular medium to high speed run over a reasonable mileage, or an overnight trickle charge, whether the battery would start the engine the next morning at

–5°C – or even 0°C – was another matter entirely.

Lucas's winter battery performance philosophy was that a successful cold start required a car engine to be turning over at around 100 rpm, with battery voltage holding at 8.5 volts or above whilst it was doing so. The maths showed the required starter motor torque potentially involved discharge rates between 250 and 350 amps – depending on compression ratio, number of cylinders, cubic capacity, and oil viscosity – amongst other things. Being good at sums and knowing the limits of its dynamo and regulator ranges, Lucas knew full well that routinely achieving such meaty mid-winter performance would more often than not prove to be a challenge, because the vehicle's battery would not only be at a low temperature, but it was also unlikely to be fully charged – for reasons outlined earlier. Thus the post-war motor industry was, ahem, encouraged, to over-specify batteries, so they would be capable of delivering both the required cranking speed and maintained terminal voltage at a temperature of only 20°F (-6.7°C) – from a starting point of only 70% of the chosen battery's fully charged capacity.

This conundrum is the foundation on which the modern day requirement for battery specifications to include a "Cold Crank Rating" is built. The battery CCR or CCA figure, developed from the learning curve described above, emerged after the arrival of alternators – but it is a very helpful aid. Using this rating, a battery can readily be selected to reliably provide appropriate cold start performance – but without it being unnecessarily over-specified (and therefore more expensive than it needs to be) for the task in hand. There are more details on this rating in the "Abbreviations and key battery parameters" section.

A driver's graduation to a car with an alternator fitted – if it was a British model, probably a Lucas 11AC unit – invariably came with a big sigh of relief, as they banished almost all cold starting worries. Though of course vehicle electrical demands today are noticeably higher, it's rare indeed nowadays to find an alternator which delivers less than double the example C40 dynamo's maximum output – and usually also a rather higher voltage – all at lower engine revs. Indeed many alternators today come close to three times that output; even in the depths of winter, batteries just never had it so good…

Important abbreviations and key battery parameters:

AGM BATTERY
A battery which contains no liquid electrolyte. Instead it is absorbed in a mat type of material made from glass fibre, contained within each of the battery's cells. Hence the name – an "Absorbed Glass Mat battery."

AMP-HOUR (also seen written as AH or Ah)

In a car battery context, today this is usually quoted at a "20hr rate". This is a key parameter, which you'll usually see prominently labelled on the battery itself. Strictly it's a number of "Ampere Hours", being a figure which indicates a battery's ability to deliver electricity over time – essentially showing its storage capacity. The higher the number, the more storage capacity a battery has, so long as comparisons are all made at the "standard" 20hr rate.

The relevant figure is found by multiplying the amount of current in Amps which a battery is capable of delivering, by the number of hours for which that current can be delivered. The standardised 20 hour reference to fully discharged is achieved by a 12 volt battery when 10.5 volts is measured across the output terminals.

As an example, a typical modern mid-range vehicle might have a requirement for a battery rated at 60Ah. This translates as one with sufficient capacity to deliver 3 Amps for 20 Hours.

A whole range of design, material, and manufacturing considerations contribute to a battery's ability to deliver the output capacity specification as rated in amp hours. The higher this figure, the more expensive the battery is likely to be – and the longer it will be able to continue delivering useable electricity.

COLD CRANK RATING (CCR, often simply CCA – "cold crank amps")

These are simple abbreviations for what is an easily understood concept. But, a note of caution here – there are various different ways of defining the performance involved, which have evolved into several different standards used around the world. All aim to provide a practical indication of one of the most important battery parameters, so which standard the battery is specified against shouldn't matter too much if you're choosing it for a known vehicle but have no specific battery requirement information available. In general, look for the highest CCA rating amongst batteries that are of the right physical size and terminal type/layout – which also fulfil all other known technical requirements/demands – particularly a correct or slightly higher Amp-hours figure. If a faulty battery is being removed, it may be labelled with relevant information, or its specification might be available in its manufacturer's catalogue

CCR/CCA STANDARDS

The standard that is arguably the most widely used in Britain to define this important battery parameter is the American Society of Automobile Engineers (SAE) Jun 1994 Standard, J537. This defines a battery's performance at –17.8°C – that's zero degrees Fahrenheit. The SAE CCA figure indicates the number of Amps a particular battery can deliver at this temperature for 30 seconds, while maintaining at least 7.2 volts across the battery output terminals – that's 1.2 volts per cell.

In addition to the SAE standard, there are at least three European-based CCR test standards which might be seen marked on replacement batteries. These are the nowadays rare German DIN standard, the more complex International Electro Technical Commission (IEC) standard 60095-1, released in 2006, and the newest, two-part European standard EN50342, which was introduced in 2011.

There is also a less stringent 1999 Japanese test standard – JIS D5301, which is rarely seen in Britain.

Whichever standard a car battery meets, fulfilling the Cold Crank test routine is a very demanding check on battery performance, and another all-important key battery specification. If you want to be sure of getting a start on the coldest of winter mornings, when choosing a new battery, ensure first that it meets all other general specification requirements, then look for one that combines or most closely matches all these requirements with the highest possible Cold Crank Rating.

This and the Amp-hour rating are the two basic electrical requirements in order to begin specifying the correct replacement battery for most modern cars. However, cars today are a lot more complicated than they used to be – incorporating new electrical demands associated with things like engine stop-start facilities in traffic for instance. Thus more information is usually needed in order to locate the exact replacement required for a recent vehicle.

If however you're looking for a classic car battery, the physical measurements, terminal positioning, amp-hour rate and Cold Crank amps figures may well be enough. The CCR figures came along after most classics were built, so in this case after checking measurements and terminal positioning, look for a battery offering a suitably close Amp-Hour rating first, and then select something within the budget with a medium to high CCR, which should aid cold starting.

END VENTING

Vehicle batteries are now frequently found with an end venting arrangement, replacing the common earlier system which allowed venting through cell caps or individual vent plugs. These gassing outlets come in various styles, and can be arranged under the latest EU standards to specifically allow remote venting of a battery where this is required. Batteries are sometimes delivered with vents plugged or taped over to prevent transit spillage – if fitted such protection must be removed before a battery enters service.

In the photograph below, the cell structure (though not individual cell connections) is visible on this ten-year old battery – though the actual caps which would once have allowed cell top up with distilled water are sealed here, and not removable, since topping up is not required. Note the red "end vent" provided.


Yuasa Batteries Sales Label
Voltage

Photograph by Dave Moss.

FLOAT CHARGE/TRICKLE CHARGE

The voltage at which charging of a lead acid battery should “top out.” It’s a voltage level slightly above the fully recharged voltage displayed by a battery in good condition, which is usually in the range of 12.65 to 13.25 volts immediately after charging, but will fall slightly afterwards. Modern battery chargers should find and sit at a suitable “float” level within this range without difficulty. It provides a minimal charge rate effectively equal to the internal losses of a battery – just enough to keep the battery in a fully charged state.

HYDROMETER

Rarely seen in these days of sealed lead acid batteries which have no easy access to their individual cells, a hydrometer is a calibrated device used to determine a battery’s charge status by measuring the specific gravity of the electrolyte it contains, which is its density compared to the density of pure distilled water. The concentration of the electrolyte, which is a mix of sulphuric acid and distilled water, reduces as the battery discharges. Hydrometer readings vary slightly with temperature.

MAINTENANCE FREE BATTERY

Most modern batteries don’t need topping up with distilled water at intervals – hence the tag “maintenance free”. With non-sealed batteries, electrolyte loss can occur through constant recharging, and these require periodic checking and replenishment with distilled water. See also “Hydrometer.”

RESERVE CAPACITY

This is a figure dating from a time before alternators were universally fitted to vehicle electrical systems. It was intended as a guide to how long a battery in good condition might be expected to continue powering key vehicle electrical systems in the event of complete charging system failure. (Or a broken fanbelt, quite a common occurrence in times gone by…). Though perhaps less relevant today, it could only ever be a guide, since much depends on electrical system load, and the state of battery charge at the point of system failure. It’s specified as the time in minutes that a fully charged new battery, operating at 80° F / 25°C, can be expected to deliver 25 amps – before the terminal voltage falls to the fully discharged level of 10.5 volts.

SMART CHARGE ALTERNATOR CHARGING SYSTEMS

A ‘Smart Charge’ alternator charging system varies the level of battery charging according to battery voltage levels and the operating temperature of the engine, delivering a higher rate of charging at lower temperatures. Note that these systems are not perfect nor infallible; in case of difficulties/poor charging rates, consult you car dealer or a competent mechanic.

It is important NEVER to jump-start a car with a ‘Smart Charge’ set-up, if the car’s battery is discharged. The reason for this is because the system may supply up to about 18 volts, potentially causing major damage to electrical components/modules on the vehicle. In any event whenever jump-starting any vehicle, always use the special jump-start posts, where provided, rather than connecting directly to the battery.

It is also important to note that modern vehicles with ‘Smart Charge’ systems require a special ‘Enhanced Flooded’ type battery; normal lead-acid varieties are NOT suitable and their use should not be attempted; they are not designed for this job. If in any doubt consult your car dealer and/or battery supplier. Using the wrong type of battery may result in system damage…

VRLA

This is an abbreviation for “Valve Regulated Lead Acid”, a phrase commonly seen in relation to maintenance free batteries. It indicates that a safety valve is fitted to the battery, allowing release of excess internal pressure while maintaining sufficient pressure to allow recombination of internally generated hydrogen and oxygen back into water.

A Note on vehicle electrical system and battery voltage testing equipment.

Test meters adequate for occasional and non-professional checks on vehicle electrical systems are readily available from a range of suppliers at quite modest prices One example of a suitable light duty test meter for this work is the Duratool D03145, available to order online as part no IN07523 from www.cpc.co.uk for £10.73 plus VAT.

Kim’s extra notes/tips/information:

1. Many modern cars with engine management systems require specific types of battery, and in some cases the new battery needs to be ‘programmed’ to the vehicle, often requiring the use of diagnostic equipment. Make quite sure that the battery you buy is definitely correct for your vehicle, or the new battery may fail and damage may be caused to the vehicle’s electronic systems… In all cases, if in doubt consult your vehicle dealership or battery specialist.

2. Sometimes, especially for classic car applications, a higher rated battery may be available within a casing with the same external dimensions as the original battery. This can be very useful! It is also worth considering paying a few extra pounds for a heavy duty battery with a longer warranty than usual. Your battery supplier will be able to advise regarding these aspects.

3. Safety Tip – on older vehicles only; DON’T attempt on examples built later than about1980: When connecting/testing a battery, before clamping any leads to the battery, keep your face and hands well clear of the battery top, and, to start with, momentarily ‘touch’ the lead’s connector to the battery terminal, rather than clamping it in place straight away. This way, if there should be a short-circuit at least you have a better chance of quickly pulling the lead

away and avoiding ‘meltdown’ or a fire, rather than if it is clamped in place! In all cases you need to avoid sparks at all cost (there’s a risk of explosion) – and any actions that might ‘spike’ the management system/ECU (Electronic Control Unit).

Photograph by Kim Henson.

4. Jump packs are available to help start a car with a discharged battery, and can be especially helpful if you are on your own with a car that won’t start, some way from a mains charger etc. However, as with any form of jump starting, great care needs to be exercised and all recommendations by the vehicle maker need to be observed (please also see main text). As with most things in life, the better quality/higher powered jump packs tend to cost a bit

more (the one illustrated costs around £100 but provides high levels of cranking power). ALWAYS use special jump-starting posts, where provided, rather than directly connecting to the battery itself.

Photograph by Kim Henson.

5. When removing or re-fitting a battery, and when disconnecting/connecting the cables, use as short a spanner as possible, to minimise the chance of contact between a live connection and the car's bodywork (earth or ground). Wearing rubber gloves will help to protect your hands too. Releasing the earth connection FIRST will help to avoid live connector to earth short-circuits too.

Photograph by Kim Henson.

6. On completion of any battery-related work, always re-fit insulator covers to the battery connections, and in cases where the battery has its own full cover (as in the Vauxhall shown below), re-fit and clip in place the cover too.

Photograph by Kim Henson.

7. A trickle-charger is invaluable to keep a little-used battery on top form. This one incorporates a handy 'start' feature as well, enabling a vehicle to be started while connected to the charger. When buying, go for the best quality you can afford…


KENLOWE
BATTERY VOLTS
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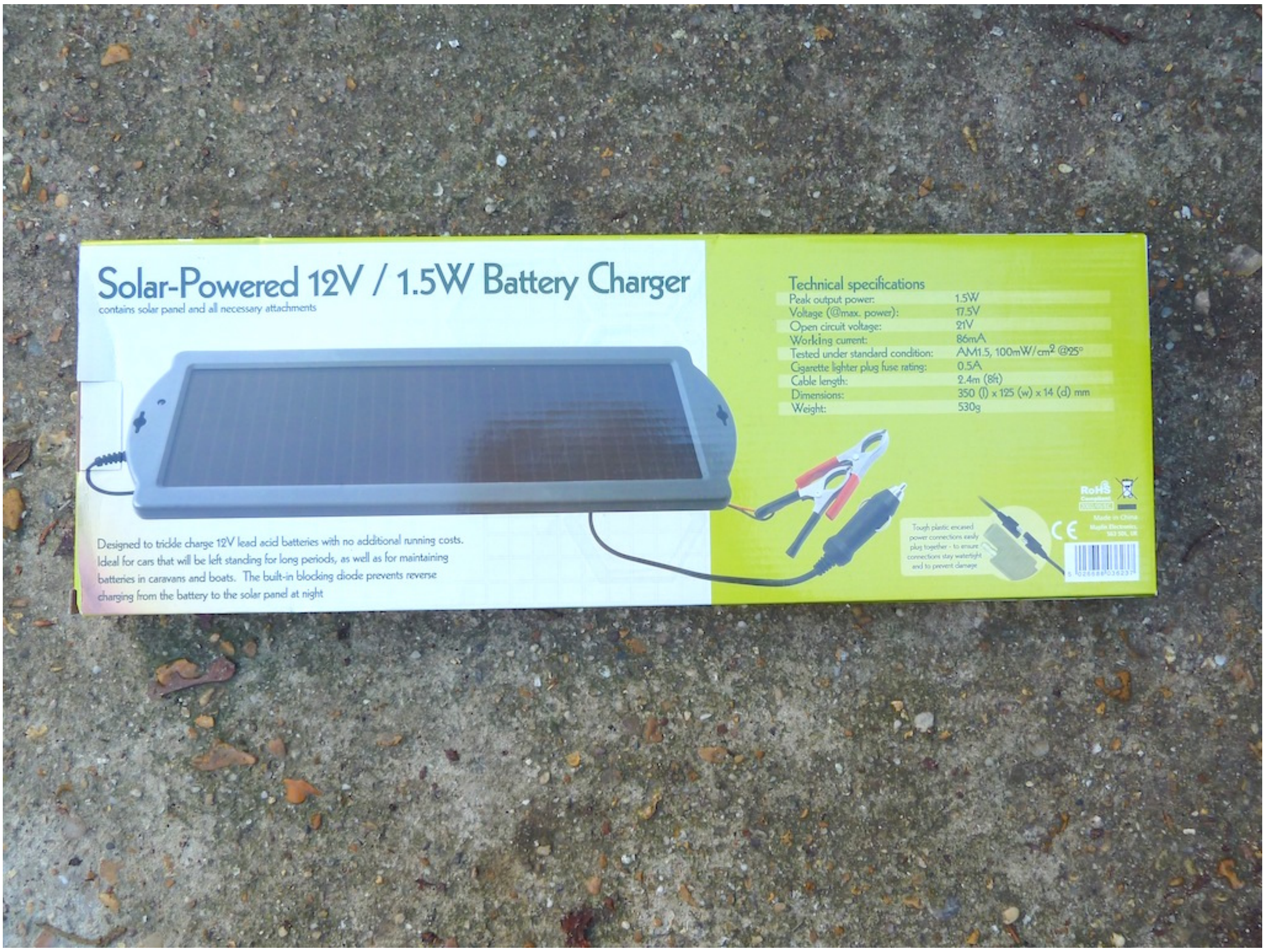
Photograph by Kim Henson.

8. If you have to store a vehicle at a remote location, and/or where there is no electricity supply, the use of a solar panel type battery charger can help to keep the battery charge topped up. These are widely available and inexpensive.



Photograph by Kim Henson.

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