



# Top tools for electrical repairs

With the improved capacity of lithium-ion batteries, cordless soldering irons are now a reality. Soldering electrical connections is by far the most reliable connection method, and this month we look at a range of soldering options, as well as what tools to put in your electrical repair kit. By **Josh Giumelli**

**T**he increasing complexity of farm machinery means that more often than not, it is an electrical fault which brings things to a grinding halt rather than a mechanical issue.

While most of us don't have the ability to diagnose complex issues or interpret error codes, there is much that can be done with a good basic set of electrical tools and a keen eye for a severed wire

or dry connection. Many mechanically minded farmers would make sure their toolboxes are well-stocked with every conceivable spanner or socket set but may not pay a lot of attention to their electrical repair tools which are just as important.

In last month's *Workshop*, we looked at some of the handy supplies needs to connect and repair wiring. This month we

look at a range of essential repair tools for electrical work, as well as the range of soldering options for both in the workshop and out in the paddock. Next month we will discuss common electrical plugs used in agriculture and how to install them.

As with all of these electrical workshop articles, the methods outlined are for low voltage vehicle electrical systems. Never attempt work on 240V systems.



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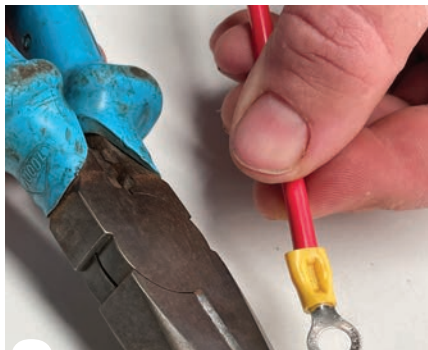
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1

The cornerstone of any electrical toolkit is a pair of quality linesman's pliers. While they resemble standard pliers, there are a few key differences. The cutting jaws are of a 'knife and anvil' design, where one edge is blunt and the other sharp, which helps when stripping wire to avoid cutting through both the insulation and wire underneath. The gripping jaws are a crosshatch pattern which helps for gripping and twisting wire.



2

You can also use the crimping jaws in between the handles to compress crimp connectors, although it won't do as good a job as a dedicated set of crimping pliers. While it is irrelevant for 12V work, the handles are insulated to 1000V. This 216mm Channellock brand costs around \$65.



3

While on the subject of pliers, any electrical toolkit will benefit from a set of needle nose and side cutter pliers. Needle nose pliers are ideal for any fiddly, delicate work, and for any the side cutters are a little easier to use for cutting cable.



4

A quality set of ratchet crimping pliers is a must (right) and is sized for the correct amount of pressure for red, blue and yellow crimp connectors. Avoid cheap crimping pliers (left) as they do a second-rate job. The wire stripping section in between the handles actually works better than the crimping jaws.



5

With use, the ratchet crimping pliers may require adjustment to increase the jaw pressure and make sure the jaws close fully when crimping. Remove the small screw pictured and advance the graduated adjusting wheel a notch or two as needed.



6

A set of electrician's screwdrivers is essential in any electrical kit. While the 1000V insulated shank is designed more for commercial electrical work, it can prevent accidental shorting when working on 12 and 24V electrical systems. While any appropriate sized screwdrivers can be used, dedicated electrical screwdrivers tend to have tips sized to common electrical terminal screws. A set of watchmaker's screwdrivers is also handy.

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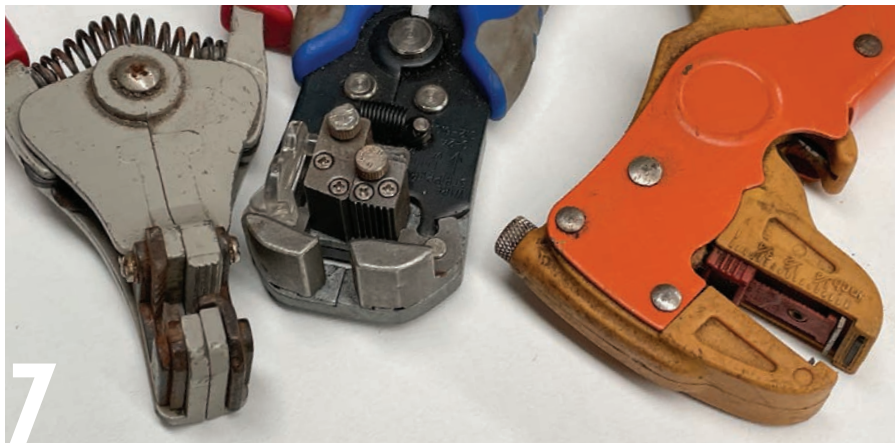
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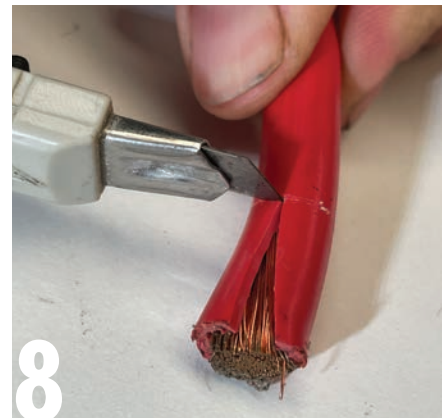
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7

There are plenty of different style wire strippers available, and selection is largely based on user preference. While stripping pliers are not essential, they save time when stripping multiple wires. Select a pair with adjustable pressure and strip length.



8

Keep a sharp knife or box cutter in your kit. Apart from being useful when peeling insulation off larger cables it will come in handy for all sorts of jobs.



9

A pair of cable tie or flush-cutting pliers is a pretty handy tool to throw in. Cable ties are commonly used when securing electrical cables, but standard side cutters or other pliers will leave a sharp nib protruding when trimming the tie which can cause injury. The cable tie pliers leave the trimmed tail flush as shown on the left.



10

A decent multimeter is crucial for any fault chasing, and you don't have to spend a heap to get something appropriate. Select an auto-ranging unit with a ruggedised case if possible. The auto-ranging function saves time and makes the unit simpler to operate. In general the most used functions will be voltage measurement and continuity, and a unit with an audible beep for continuity will be easier to use in the field. See *From the Workshop, Farming Ahead* No. 237, October 2011 for more information in using a multimeter.



11

If multimeters aren't your thing, a test lamp will help with some fault-finding tasks. They are also quick and easy to use as one lead can be clipped on to a terminal (or earthed vehicle chassis) and the probe quickly touched onto a terminal, or even carefully used to pierce the insulation of a cable to contact the wire underneath. The unit pictured handles voltages from 6 to 36V and costs around \$20.



12

While there are plenty of different testers which can be included in your electrical toolkit, we found this Narva fuse tester and remover particularly handy. It has a set of adjustable pins which can be used to check the continuity of different size blade fuses.



13

While you can easily check continuity with a multimeter, the fuse tester can be simply pressed against the back side of a blade fuse while it is in place (left). If you need to remove the fuse, the jaws on the other end make it easier to grip (right).





# Soldering solutions

**A**s outlined in last month's *Workshop* article, soldering really is the best way to reliably join electrical connections. It forms a very low-resistance electrical connection, and if done properly, moisture cannot get in between contact surfaces causing corrosion and increased resistance to current flow.

Soldered joints are also strong

mechanically, and resist pulling apart, or failure through vibration which is common on farm machinery. But a poorly soldered joint can fail just as easily as a crimp connector or simple twisted join.

The key is to get enough heat into the wires so that the solder melts on contact with the wire and not just the tip of the soldering iron. Use a small tip for small wires and a large tip for large wires to

promote heat transfer. And keep things clean as solder does not adhere well to dirty or oily surfaces.

While we have covered soldering in depth in the past, we haven't examined the different soldering tools available. A 240V soldering station may work well in the workshop, but what are the options if you are out in the paddock? We examine a range of options below.



1

Most of us will have a couple of low-cost basic 240V soldering irons in the workshop. They will carry a current rating such as 25, 40 or 50W which is a direct measure of the amount of heat it can output. Larger capacity soldering irons will usually have a larger tip, or will be provided with an interchangeable chisel tip or point tip. Most will only have a fixed output so a larger unit may cause problems with smaller wires such as melting the insulation.



2

A better option for the workshop is a soldering station with adjustable output. The tip temperature can be tailored for the size of the job or the melting point of the solder used. This unit has a maximum output of 48W and cost about \$110, although you can spend several hundred dollars for higher output soldering stations with more advanced features and digital displays.



3



A benefit of using a soldering station is that it will usually have a cleaning sponge attached (just moisten before use) as well as a holder for the soldering pencil. The pencil is lightweight compared to a basic 240V soldering iron shown previously, and has a much finer, flexible cord, all of which makes it easier to use when soldering for a longer time period.



4

There are several butane soldering torches on the market which are ideal for use out in the paddock. This Kincrome unit comes in a rugged steel case and features a range of accessories such as alternate tips and a small cleaning sponge. It costs about \$89. The head of the unit can be set to a convenient angle, or the tool can also be sat on its base on the bench, freeing up both hands. It uses piezo ignition to ignite the gas flame, which is adjustable in intensity to tailor the heat output.



5

The soldering torch is simply filled from a butane can by pressing against the base with the unit held upside down. A refill can cost about \$10 and will provide several refills.



6

Select an appropriately sized tip and tin (coat) with solder. A wet tip will aid the conduction of heat into the joint. Apply the solder to the wire and not the soldering iron tip. If the wire is sufficiently hot the solder should melt quickly on contact.





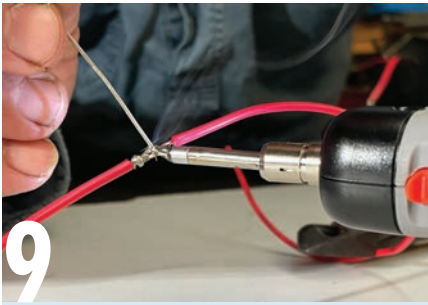
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A benefit of the gas-powered soldering iron is that it can also be used as a heat source for heat shrink insulation. Simply remove the soldering tip while the unit is cool (left). This kit is supplied with a slip-on heat shield which can be used to protect other wires in close proximity from damage (right).



8

There are also battery-powered and rechargeable soldering irons available, but all are not equal in performance. This low-cost Tradeflame unit operates off four AA batteries and costs about \$25. While small, it reaches a useable temperature of 350 degrees in about 36 seconds, and a maximum temperature of 480 degrees in three minutes. It has a selectable output of 8W or 11W, and a claimed run time of 45 minutes on low.



9

With good quality batteries, the soldering iron surprisingly performs quite well, and is perfectly suitable for soldering smaller automotive wires or even repairing kid's toys. Having no power cord, it is quite convenient to use. Tradeflame also makes a similar unit which is rechargeable via USB connection, and costs \$90.



10

The ultimate cordless soldering iron is the Milwaukee 12V unit, which costs about \$169 for the skin (without battery). If you have any other Milwaukee 12V cordless gear, it would be a great addition, otherwise it will cost around \$300 in a kit with a charger and a single 2Ah battery. The unit has an impressive output of 90W and reaches operating temperature in 18 seconds, with a maximum temperature of 400 degrees Celsius.



11

Like the Kincrome gas soldering iron, the head pivots for ease of use. The soldering iron is great to use with more than adequate heat output, and we had no difficulty soldering lug-ends onto thick automotive cabling. A green LED illuminates when the soldering iron is at operating temperature, and when switched off a red LED will remain on while the unit is hot. A progress bar of red LEDs indicates battery life. It is supplied with interchangeable point and chisel tips. Run time is rated at 45 minutes with a 2Ah battery (as pictured).



12

You may already have all the equipment on hand for soldering away from the workshop. A perfectly workable setup is the use a 12V to 240V inverter, and a low-cost soldering iron as shown. An extension cord can be used if you need to solder away from the power source. It may not be as fast as the Milwaukee cordless soldering iron but it will get the job done.



### SELECTING SOLDER

All solder is not created equal. Solder for electrical joints falls into two categories – lead-based and lead-free. Lead-based solder is an alloy of tin and lead in the ratio of 63/37 or 60/40. The best lead solder for electrical work is 63/37 as it is a little easier to use with a lower melting point. Lead-free solder has been developed due to the health complications associated with lead, in particular when used for food containers and copper water pipes. Lead-free solder is an alloy of tin, and copper, and sometimes silver. It is more expensive than lead solder and has a higher melting point making it potentially harder to use. Most electrical solder has a small tube of flux up the centre of the wire, and is sold as 'Rosin-core' solder. If you buy solder without a flux core, you will probably need an additional flux when soldering. Select the diameter of the solder to suit the job; fine solder for small work and thicker solder for large cables.





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