

TOWBAR WIRING

This leaflet is prepared as a Club service to members. Some previous versions of it were titled 'Wiring a Vehicle For Trailer Towing'. The contents are believed correct at the time of publication. Please raise any queries with The Club's Information Department

September 2009

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1. Scope

This leaflet describes the wiring additions to a towcar to make it suitable for towing. It is based on current UK practice, and on the relevant British and international standards, including the changes resulting from the introduction of European Standards for caravans from 1 September 1998. It is not intended as a set of installation instructions for towbar wiring, and should not be used as such. Its purpose is:-

- to provide advice on the correct specification of a towbar wiring system
- to allow an already-installed system to be checked for correctness
- to diagnose common faults and problems in service

2. Introduction

Before a vehicle can be used for towing, it is necessary to fit a towbar, (probably) modify the direction indicator system and install the necessary socket(s) to power the caravan or trailer's road lights and any internal auxiliary equipment. In the past, this was commonly considered a straightforward task for a competent DIY person. In recent years, however, the increasing complexity of vehicle electrical systems has made it more and more difficult to obtain and interpret the technical information necessary to ensure that the required connections are made in a correct and safe manner.

Some vehicles could be seriously damaged by the use of an inappropriate 'off the shelf' towbar wiring kit – with some others, the additional wiring would simply not work properly without extra components. Keeping up with this topic as new and revised models of vehicle are launched is a demanding task, and is certainly one which The Club does not have the resources to do. Do check with your intended manufacturer, retailer or fitter of the system, therefore, before making a final selection. If they are unfamiliar with the characteristics of your particular vehicle, it may be best to look elsewhere. For this reason, The Club recommends professional fitting, preferably by a specialist installer.

Even if you do the work yourself, some fitting centres will check it over for you, especially if you have bought the towbar or other components from them.

Note: Choosing a towbar is discussed in the leaflet 'Choice of Towbar'.

3. Which System Do You Need?

There have been several variations in the wiring standards used for towcars and caravans over the years. Which system you need depends mainly on the age of the caravan you are planning to tow, and to some extent on where the caravan was made:-

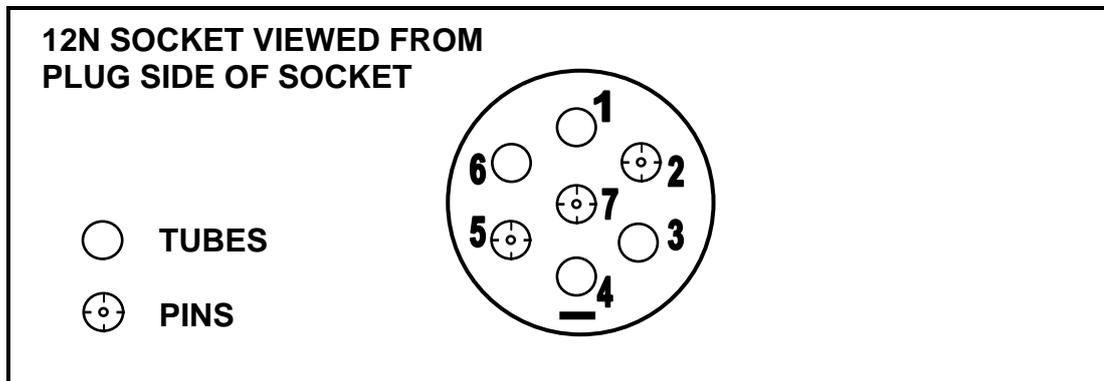
- Caravan built before 1 October 1979 – Towcar needs a single 12N seven pin socket. See Section 3.1.
- Caravan built between 1 October 1979 and 31 August 1998 - Towcar needs both 12N and 12S 7-pin sockets. See Section 3.2. Note that some caravan manufacturers adopted changes to the 12S system prior to their formal introduction from 1 September 1998. Check carefully (via the handbook or dealer) the precise specification of 1997 and pre-September 1998 models.
- Caravan built between 1 September 1998 and 1 September 2008 - Towcar needs both 12N and 12S 7-pin sockets, but with modified 12S wiring. See Section 3.3.
- Caravan built since 1 September 2008, and some Continental caravans, particularly if privately imported, or commercially imported in small numbers only - Towcar needs a single 13-pin socket. See Section 3.4. An increasing number of towcars are being fitted with 13-pin sockets as standard. Section 3.4 also describes this layout for these owners.

3.1 Pre-October 1979 Caravans

Few of these remain in their original specification now. Most caravans of this era were built with only a single black 7-pin plug ('12N' ie '12 volt, normal'), which was adequate as they tended not to have reversing lights, rear fog lights, internal auxiliary batteries that required charging, nor fridges which could run on 12V. By the end of the 70s, such features were becoming available, and in the case of rear fog lights, became compulsory for new trailers from 1 October 1979. This meant there were no longer sufficient circuits available on one 7-pin plug, and caravans made after this were therefore fitted with twin plugs (see next section). Note that a pre-October 1979 caravan fitted with twin plugs will probably have been modified from its original specification. It is prudent to check that this was done correctly before attaching it to your vehicle.

For an unmodified caravan, your vehicle needs a single 12N socket, wired as follows:-

12N Socket To Suit Pre-October 1979 Caravans



TERMINAL	COLOUR	12N SOCKET
1	Yellow	L H Indicator
2	Blue	Interior Lights etc
3	White	Return (Earth)
4	Green	R H Indicator
5	Brown	R H Tail Light
6	Red	Stop Lights
7	Black	L H Tail Light & Number Plate

Notes

The power supply to the caravan via pin 2 is usually wired as permanently live, whether the vehicle engine is running or not. This enables 12V lights and water pump to be powered from the towcar while on site, without requiring an auxiliary battery in the caravan. This means this system is inappropriate for running a 12V fridge or charging a caravan battery, for the reasons given in Sections 3.5.13 and 3.5.15 below. Also, for modern cars with integrated alarm systems, it is likely that use of this power supply in this way would trigger the alarm system unless the car was left unlocked.

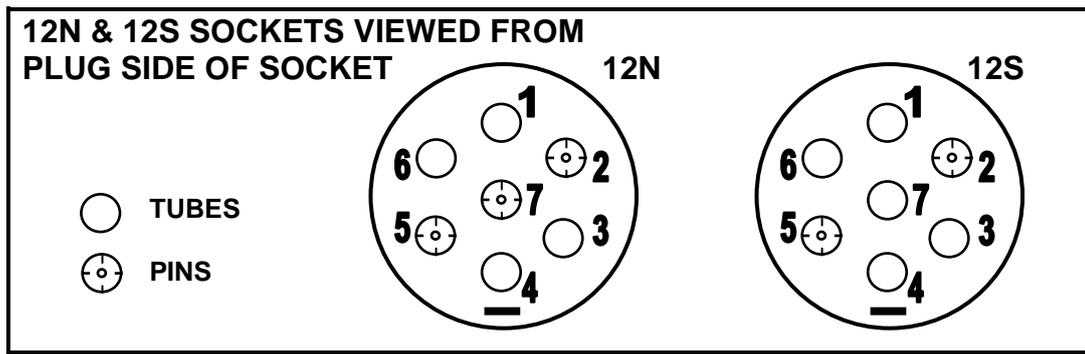
Except for the pin 2 connection, which was merely common practice, sockets wired according to this description would comply with the now-superseded British Standard BS AU 149a.

Note that currently-available wiring kits will need to be modified to give this configuration, as far as the pin 2 connection is concerned.

3.2 October 1979 to 31 August 1998 Caravans

Many caravans still fall into this category. They are fitted with two 7-pin plugs (12N and 12S, 'supplementary'). The 12S plug is coloured grey or white to distinguish it from the 12N one, and the associated socket has a cover flap in grey or white. The arrangement of pins and tubes is also different to prevent accidental connection of the wrong plug to the wrong socket. The 12N system now contains all of the legally-required trailer road light circuits. The 12S system includes reversing lights (not currently a legal requirement on trailers), plus the various auxiliary power connections required by most modern caravans. Strictly speaking, you only need to have the 12N system functioning to tow a caravan legally. However, most owners use at least some of the 12S circuits, so the required towcar wiring is as follows:-

12N & 12S Sockets To Suit October 1979 to 31 August 1998 Caravans



TERMINAL	COLOUR	12N SOCKET	12S SOCKET
1	Yellow	L H Indicator	Reversing Light(s)
2	Blue	Fog Light(s)	Caravan Battery Charging (Ignition Controlled Supply)
3	White	Return (Earth)	Return (Earth)
4	Green	R H Indicator	Interior Lights Etc (Permanent Supply)
5	Brown	R H Tail Light	Sensing Device
6	Red	Stop Lights	Fridge (Ignition-Controlled Supply)
7	Black	L H Tail Light & Number Plate	Not Used

Notes

The supplies to 12S pins 2 and 6 must be installed such that they are live only when the vehicle engine is running (see Sections 3.5.13 and 3.5.15 below).

The supply to 12S pin 2 for caravan battery charging has been customary practice in the UK for many years. However, it has never been adopted into a British or other standard for towbar wiring. It is, therefore, frequently ignored by vehicle manufacturers in their wiring kits.

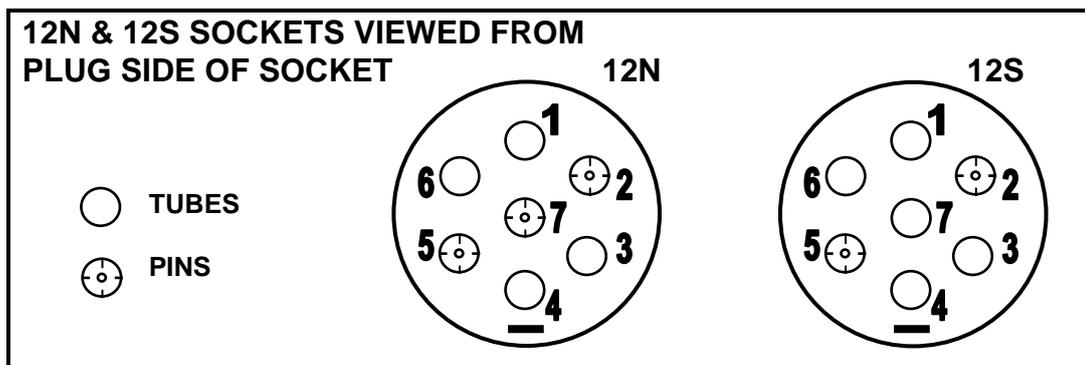
See section 3.5.16 for advice regarding 12S pin 2 if towing a Continental-built caravan.

With the exception of the 12S pin 2 connection as mentioned above, sockets wired according to these specifications will comply with British Standard BS AU 149a (12N) and BS AU 177a (12S). These standards are effectively identical to International Standards ISO 1724 (12N) and ISO 3732 (12S).

3.3 1 September 1998 to 1 September 2008 Caravans

These are built to European standards, one of which defines the 12V wiring, and results in changes to the 12S system. (The 12N system remains the same.) An extra earth acts to separate the fridge power supply from other circuits, minimising the risk of overloading the return wire when several circuits are used together. Battery charging is now officially included, but via pin 4, not pin 2, as was usual practice in the UK before, but never included in previous standards. Pin 4 also operates interior lights etc, but not at the same time as battery charging. Switching to achieve this is done within the caravan.

12N & 12S Sockets To Suit 1 September 1998 to 1 September 2008 Caravans



TERMINAL	COLOUR	12N SOCKET	12S SOCKET
1	Yellow	L H Indicator	Reversing Light(s)
2	Blue	Fog Light(s)	Sensing Device
3	White	Return (Earth)	Return (Earth) For Pin 4
4	Green	R H Indicator	Interior Lights etc or Caravan Battery Charging (Permanent Supply)
5	Brown	R H Tail Light	Not Used
6	Red	Stop Lights	Fridge (Ignition-Controlled Supply)
7	Black	L H Tail Light & Number Plate	Return (Earth) For Pin 6

Notes

The supply to 12S pin 6 should be live only when the vehicle engine is running (see Section 3.5.15 below).

12S pins 3 and 7 should not be joined together at the socket. They should be taken separately to an earth point on the vehicle structure. Failure to do may increase the likelihood of overheating of the 12S plug and socket, especially if damage to pin 7 occurs (see section 3.5.17).

12S pin 4 must be permanently live for both battery charging and interior light etc functions to operate. The fridge circuit must work correctly for switching of the pin 4 supply between these functions to occur.

At the time of writing, standards for vehicle wiring have not been updated to match the latest caravan wiring standard. The above specification complies with British Standard BS AU 149a (12N) and the effectively identical International Standard ISO 1724. BS AU 177a and ISO 3732 (12S) do not yet include the earth via pin 7, and hence this connection may be omitted by some makers and installers.

See section 3.5.16 for advice regarding 12S pin 2 if towing a Continental-built caravan.

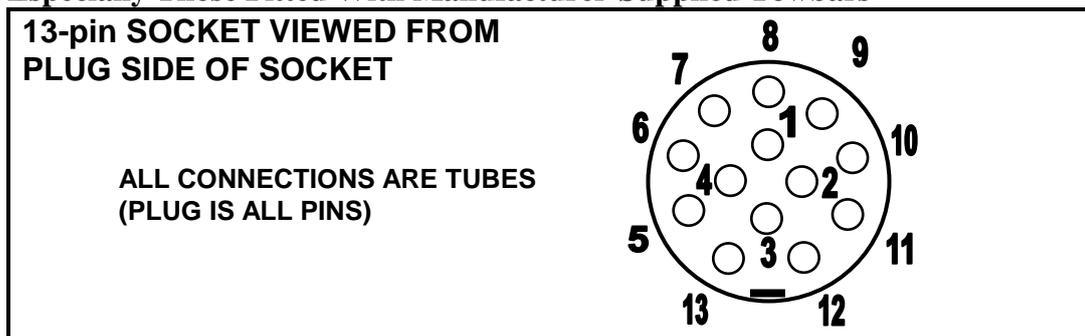
3.4 Caravans Built Since 1 September 2008 and Some Continental-Built Caravans Before and After This Date. Also Some Towcars Especially Those Fitted With Manufacturer-Supplied Towbars

A single 13-pin connector has been used for some years on the Continent, and hence is seen on some imported caravans, although most sold on the UK market have generally either been built with 7-pin plugs, or were modified to use them after importation. Low-volume models or those imported privately are most likely to have a 13-pin plug. Some owners may wish to alter such caravans to 2x7-pin system for compatibility with their car. For use without modification, the car will need a single 13-pin socket as below, or an adapter lead (see section 3.5.18).

From 1 September 2008, however, all UK-built caravans which are approved via the National Caravan Council's certification scheme (ie the overwhelming bulk of caravans sold in the UK) have also been built using the 13-pin system.

It is increasingly likely that this system will be found on the towcar, as many car makers have adopted it as standard. Some owners may prefer to change their car to 2x7-pin sockets, but manufacturers will seldom offer this as an alternative if they have opted for a standard 13-pin installation. A towbar specialist should be able to make this change if required. However, The Club's view is that the 13-pin connector is a better option, being more durable, less vulnerable to pin burn out, and more water resistant.

13-pin Socket To Suit Caravans built since 1 September 2008 and some Continental-Built Caravans before and after this date. Also Some Towcars Especially Those Fitted With Manufacturer-Supplied Towbars



TERMINAL	COLOUR	13-Pin SOCKET	TERMINAL	COLOUR	13-Pin SOCKET
1	Yellow	L H Indicator	8	Pink	Reversing Light(s)
2	Blue	Fog Light(s)	9	Orange	Interior Lights etc or Caravan Battery Charging (Permanent Supply)
3	White	Return (Earth) For Pins 1 To 8	10	Grey	Fridge (Ignition-Controlled Supply)
4	Green	R H Indicator	11	White/Black	Return (Earth) For Pin 10
5	Brown	R H Tail Light	12	White/Blue	Sensing Device
6	Red	Stop Lights	13	White/Red	Return (Earth) For Pin 9
7	Black	L H Tail Light & Number Plate			

Notes

The supply to pin 10 should be live only when the vehicle engine is running (see section 3.5.15).

Pins 3, 11 and 13 should not be joined together at the socket. They should be taken separately to an earth point on the vehicle structure.

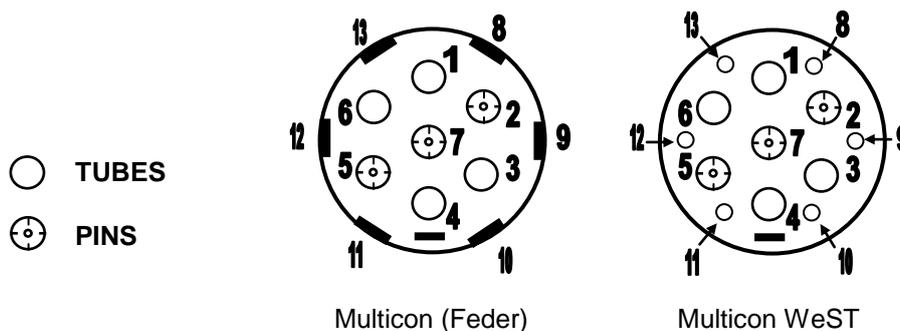
Pin 9 must be permanently live for both battery charging and interior light etc functions to operate. The fridge circuit must work correctly for switching of the pin 9 supply between these functions to occur.

This system meets International Standard ISO 11446, and may also be referred to as 'Jaeger' (the original manufacturer of connectors of this design). This single standard in effect covers the scope of both the 12N and 12S systems. There is no provision within the standard for a '12N-only' version of the 13-pin connector, but several car manufacturers have been known to implement such variants, or indeed variations with 7, 8, 10 or all 13 connections made! Such systems may still be referred to by the vehicle manufacturer as being 'ISO 11446'. It is vital when ordering a towbar with this kind of wiring to establish how fully-wired the system will actually be. Some manufacturers will not supply a fully-wired socket unless this is specifically requested (and at premium price).

See section 3.5.16 for advice regarding pin 12.

No colour convention for the wiring is defined in ISO 11446, but a convention does appear in an ISO standard for multi-core connecting cables, ISO 4141-3, and these are the colours indicated in the table above.

At least two other 13-pin systems exist, mainly in Holland, and markets closely associated with caravan manufacturers from that region. Both 'Multicon' (also known as 'Feder') and 'Multicon WeST' (or just 'WeST') give the option of compatibility with a standard 12N connector, while spacing the supplementary circuits around the edge of the connector. These systems do not conform to an international standard (although Multicon WeST meets a Dutch national standard), and patent limitations prevent them being readily produced by other manufacturers. The Club is not aware of any towcars sold in the UK market being fitted with either of these connectors. We occasionally get reports of imported caravans using them (most commonly Eriba Pucks, it seems). Owners of such caravans will either need to use an adapter lead, or have their caravan or towcar connector replaced with a compatible one. Our advice would be to replace the caravan connector with an ISO 11446 13-pin plug, if this gives compatibility with your towcar. If your towcar has two 7-pin sockets, then replacement of the single connector lead and Multicon plug with two 7-core connector leads and 12N/12S plugs is neatest.



3.5 General Design Points

3.5.1 Wire Specifications

Specially-designed multi-core cables are available, and are commonly used especially for non-vehicle manufacturer-supplied wiring kits. These are similar to the cables used for the connections at the front of the caravan. 12N cable has black outer insulation, and contains 7 wires (or 8 – see Fog Light section 3.5.9). 12S cable is grey or white, and also contains 7 wires. 13-core cable is available for use with 13-pin sockets. Each wire within these should be an appropriate cross-sectional area for its designated purpose, and where applicable should preferably be to the conventional colour codes indicated earlier.

Some vehicle manufacturers and increasingly some after-market suppliers of ‘car specific’ wiring kits (see section 3.5.19) take an alternative approach and use individual wires, held together in a loose-fitting (often ribbed tube or woven material) sheath. This allows greater choice in specifying an appropriate gauge and indeed length of wire for a given circuit, and can result in a more flexible cable assembly, which may ease fitment. It also allows the supplier to match wire colours to the vehicle manufacturer’s own standards.

CIRCUIT	CLUB RECOMMENDED MINIMUM WIRE SIZE Note 1		
	12N Note 5	12S	13-Pin Note 6
Indicators Fog Light(s) Tail Lights Stop Lights	1mm ² Typ. 14 strands, 0.3mm dia. Current capacity 8.75A		1.5mm ² Typ. 21 strands, 0.3mm dia. Current capacity 13.0A
Reversing Light(s) Note 2		1.5mm ² Typ. 21 strands, 0.3mm dia. Current capacity 13.0A	1.5mm ² Typ. 21 strands, 0.3mm dia. Current capacity 13.0A
Interior Lights etc		1.5mm ² Typ. 21 strands, 0.3mm dia. Current capacity 13.0A	2.5mm ² Typ. 36 strands, 0.3mm dia. Current capacity 21.5 A
Caravan Battery Charging Note 3		1.5mm ² Typ. 21 strands, 0.3mm dia. Current capacity 13.0A	
Fridge Note 4		1.5mm ² Typ. 21 strands, 0.3mm dia. Current capacity 13.0A	2.5mm ² Typ. 36 strands, 0.3mm dia. Current capacity 21.5 A
Sensing Device		1.5mm ² Typ. 21 strands, 0.3mm dia. Current capacity 13.0A	1.5mm ² Typ. 21 strands, 0.3mm dia. Current capacity 13.0A
Return (Earth)	2.0mm ² Typ. 28 strands, 0.3mm dia. Current capacity 17.5A	White wire (pin 3):- 2.5mm ² Typ. 36 strands, 0.3mm dia. Current capacity 21.5 A Black wire (pin 7):- 1.5mm ² Typ. 21 strands, 0.3mm dia. Current capacity 13.0A	3 wires, each:- 2.5mm ² Typ. 36 strands, 0.3mm dia. Current capacity 21.5 A

Notes

1. Not all installations follow these recommendations. While the Club believes these represent 'best practice', this does not mean that alternative specifications will not work adequately.
2. The larger gauge wire does not indicate a higher power demand than the other road lights, but merely results from the use of a larger standard size (1.5mm^2) wire in the 12S cable assembly.
3. The use of a larger section wire (eg 2.5mm^2) would be advantageous to give more reliable battery charging, due to a reduced voltage drop along the charging wire. Good towbar specialists will frequently use much higher gauge wiring for this circuit – perhaps using a spare 1.5mm^2 core in a multicore cable in parallel with the normal wire, to give an overall 3mm^2 . Note that by doing this, however, the cable becomes non-standard, so check carefully that doing so will not interfere with other connections in your towcar or caravan. Others will run a separate large gauge wire for this circuit, using perhaps 3mm^2 or 4mm^2 wire, or more than one relatively thin wire in combination to achieve the same effect, while retaining cable flexibility and ease of concealment behind trim.
4. The rating of the 'standard' wire is barely adequate for most fridge power supplies, and woefully inadequate for many of the larger fridge and fridge-freezers fitted in some recent caravans. Fridge manufacturers used to suggest 2.5mm^2 or 4mm^2 , depending on the distance from the battery to the fridge. When considering towbar wiring, and therefore the powering of the fridge from the towcar battery, a lengthy wire is inevitable, and hence the higher of these figures is almost invariably recommended. For current model fridges, the recommendation from the fridge manufacturers has gone up, with a minimum of 4mm^2 , and 6mm^2 for longer cable runs being advised. It has to be said that while achieving this kind of wire gauge for the internal wiring of the caravan is possible, maintaining such a specification into the towcar for the towbar wiring is very difficult. It may only be viable to aim for as large a gauge of wire as possible. Instead of running a large gauge separate wire to achieve this, it may be easier to combine the existing wire with an unused core in the 12S or 13-pin cable. Note that by doing this, however, the cable becomes non-standard, so check carefully that doing so will not interfere with other connections in your towcar or caravan. As mentioned in Note 2, using more than one relatively thin wire is a useful option to retain cable flexibility and ease of concealment.
5. Lighter gauge 12N cables are quite commonly found, the most frequent being one with 6 0.7mm^2 cores and one larger 1mm^2 core. While such cable is adequate for small trailers with a minimal number of road lights, caravans tend to be fitted with extra obligatory and optional lighting (eg front and side marker lights, high level brake lights etc) all of which adds to the electrical load. It is not unusual for a modern caravan to carry more than 100W of road lighting, all of which is connected via a single earth return circuit in the 12N cable. For this reason, the indicated cable is the minimum recommended for caravan usage.
6. Some suppliers use a 1mm^2 thin wall wire for pins 1-2 and 4-9, which should be adequate, and allows for a more compact cable bundle.

3.5.2 Connector Advice

Road light circuits are often connected to the main wiring loom of the towcar via a multiway plug and socket in the boot. Independent (ie non-vehicle manufacturer supplied) wiring kits may not use this connection, and individual connections will need to be made, as will be the case for several of the supplementary circuits.

Some wiring kits include snap-lock type connectors (eg ‘Scotchlok’), which are quick and cheap, but do not necessarily result in a secure, effective joint, especially in DIY applications. Crimp connections or plug-in connectors are better alternatives for long-term reliability. With all types of connections, though, it’s vital that care and skill are used to ensure high quality connections are achieved – failure to do this is one of the main reasons for unreliability or poor performance in towbar wiring systems.

3.5.3 Circuit Layout

Wiring between the main vehicle loom and the sockets should be hidden neatly behind trim panels, load area carpeting etc, so that it is protected. Cables should be kept to the shortest practical length to minimise voltage drop problems, but with sufficient excess to allow sockets etc to be readily removed for inspection or maintenance. Where the wiring passes through body panels, it should be protected against chaffing. Wiring external to the car should be adequately protected against the elements, and routed to avoid the vehicle exhaust.

3.5.4 Socket Positioning

Sockets should be accessible without undue difficulty, and adjacent to the tow ball. Unusual locations (eg under the bumper, or offset too far to the side) may result in the caravan cables either not reaching, or hanging too low and hitting the road. A recent trend has been for sockets to be mounted on a hinged, sprung-loaded bracket, which lifts them out of sight behind the bumper when not in use. This is particularly common with vehicle manufacturer supplied detachable towbars, since it means the towbar installation is invisible when not in use. Often only a single (12N or 13-pin) socket can be accommodated due to space restrictions, and plugging in to such hidden sockets can often be awkward – you may need to kneel in a puddle with your head under the car’s bumper to find the socket!

3.5.5 Bulb Failure Monitors

Many towcars use monitors to detect the failure of key road light bulbs. Towbar wiring should be installed so as to retain the operation of these devices. Clear fitting instructions or a skilled installer may be necessary to ensure this is the case. On many cars, a good towbar wiring installation can extend the operation of the car’s bulb failure warning system to cover the caravan as well. On a poor system, however, false bulb failure alerts may occur as the occasional presence of the caravan’s additional bulbs confusing the car’s system. The *minimum* requirement must be that the towbar wiring does not adversely affect the car’s bulb failure system.

3.5.6 Fuses

Road light circuits already have fuses, but circuits added by fitting towbar electrics should include their own. Fuses may be ‘in-line’ in cylindrical holders, or vehicle-type blade fuses. Both are acceptable, but blades tend to give a more reliable contact. It’s recommended that supplies to the fridge, battery charging and interior light etc circuits are protected by separate fuses, typically of 15A rating. There will normally be a power supply from the car battery from which these individual supplies are derived, and that typically has a 25A fuse. These figures are for illustration, and actual systems may vary. Do not vary a fuse rating without confirming such a change with the system supplier or installer.

3.5.7 Multiplexed Wiring

Most recent cars are fitted with multiplexed wiring, at least in certain areas of the vehicle. Rather than connect each component (light, motor etc) to a power supply using dedicated wiring for each circuit, such systems use a small number of wires to connect everything together, then send digital data signals around this network to ‘nodes’ near each device, which interpret the data signal as a request to, say, switch on a light. Hence, individual wires often carry only control signals, not normal power. One popular system is called CANbus, originally developed by Bosch, and this is sometimes used a generic term for this technology. Incorrect fitting of towbar wiring to such systems may cause extensive and expensive harm. Extreme caution is advised before using a general purpose wiring kit with such cars, and seeking the advice of an experienced fitter is advised. Extra components and some specialist knowledge are almost certain to be required. Check with your vehicle manufacturer or dealer if unsure if your vehicle has such wiring. In many cases, a vehicle-specific wiring kit is the best choice for such vehicles (see section 3.5.19).

3.5.8 Indicator Circuits

A heavy-duty indicator relay may be needed to operate the additional caravan flashers without overloading the standard unit, or affecting its flashing rate. On recent cars, this may not be necessary. It’s a legal requirement that the towcar ‘shall be equipped with an operational tell-tale for front and rear indicators (including any rear indicator on the rearmost of any trailers drawn by the vehicle)’ (Road Vehicle Lighting Regulations, 1989.) This is sometimes referred to as the ‘C1’ and ‘C2’ functions (‘C1’ refers to the telltale for the car’s indicators – C2 is the extension of that function to the caravan). This tell-tale can be audible or visual. Some show the correct functioning of the indicators, perhaps via an instrument panel light or boot-mounted buzzer. Others operate by altering the standard flasher function to an alternative ‘warning’ signal if a fault is detected. This latter option is in essence an extension of the car’s built-in bulb failure monitoring system, and is increasingly the most common option especially with vehicle manufacturer-supplied wiring kits, and vehicle-specific aftermarket wiring kits. Note that this tell-tale function is sometimes neglected when the towbar wiring is fitted – this is illegal. Do check with your system supplier as to how the tell-tale functions, however, before assuming the C2 function has been ignored – some owners expecting a separate warning light or buzzer have been surprised to learn they have a function integrated into the car’s bulb failure warning system instead.

3.5.9 The Fog Light(s) Circuit

One or two rear fog lights may be fitted – at least one is a legal requirement for caravans built since 1 October 1979. Many owners find the reflection of the towcar's own rear fog light(s) off the front of the caravan a distraction, and to avoid this, it is acceptable to disconnect the towcar's fog light(s) while towing, as long as the caravan ones still function. This can be done via a mechanical switch built into a suitably-equipped 12N/13-pin socket, and operated by the insertion of the plug. This system requires the extra wire in the cable to the socket, or a separate wire alongside it. An alternative is a fog light cut-out relay, which senses power going to the caravan fog light, and automatically turns off the car's one(s). Some vehicle-specific wiring kits use the sensing device circuit (see section 3.5.16) to tell the car's control system not to switch on the car foglight's when a trailer is detected.

3.5.10 The Tail Light Circuit

Power for the illumination of the caravan number plate is also taken from this circuit, along with power for front and side marker lights, if fitted.

3.5.11 The Stop Light Circuit

High-level stop (brake) lights are not required to be fitted to caravans, but if installed will operate from this circuit along with the main stop lights.

3.5.12 The Reversing Light Circuit

This circuit is not currently a legal requirement for caravans, but all modern ones have reversing lights, and hence the use of this circuit is recommended.

3.5.13 The Caravan Auxiliary Battery Charging Supply

Most modern caravans are fitted with an auxiliary battery, which will usually be charged via a mains charger on site. If touring away from mains power, however, being able to charge the caravan battery from the towcar while towing is very useful. It's important, though, that charge is not taken from the towcar battery to top up the caravan one, or else there may be insufficient charge left to restart the engine. To avoid this, the battery charging circuit is an 'ignition-controlled' power supply from the towcar – ie charging only occurs if the car engine is running (but see further comment in the paragraph below). This is achieved either by using a relay activated by the output of the alternator of the vehicle, or by means of a voltage sensor which detects the change in voltage in the towcar circuits when the engine starts. Another reason to connect the circuit this way is to avoid the risk of the engine attempting to start from the caravan battery, if its own battery were to be flat. This could otherwise result in damage to both caravan battery and wiring throughout the outfit. The precise connections of the circuits to achieve this function vary from car to car, and hence are beyond the scope of this leaflet.

A common concern of owners is the precise point at which the ignition-controlled circuit goes live. At one time, access to an appropriate connection on the vehicle alternator made it straightforward to ensure this point was only once the engine was actually running, and not just when the ignition was turned to on. Modern engine

bay and alternator designs limit such access considerably, often making a direct connection to the alternator impractical. Some wiring kits just use a connection to an 'ignition-on only' power supply. These successfully prevent the fridge flattening the car battery while parked, but do not protect against the situation where the car battery is already flat and the engine attempts to start from the caravan one. However, The Club has no reports from members of such problems occurring in practice. Wiring kits using a voltage sensing switch (sometimes called a 'smart' relay) address this issue (if correctly set up), as their sensitivity means they can detect the difference between the nominally 12V supply from the car battery (usually ~12.5V), and the nominally 12V output of the alternator (usually ~14V). Such systems only switch the caravan battery into circuit once the alternator is outputting power – ie the engine is turning.

Some owners like to recharge their caravan battery in the boot of the car, while the caravan is left on site. To do this, an additional wire from the battery charging supply, plus an earth connection, can be run to appropriate battery terminals (not crocodile clips, which are insufficiently safe) in the boot. There are practical safety issues with this, however, which must be considered - the battery is must be safely located, which means securely held in place if there were an accident; it must not be able to fall over; and the boot must be well ventilated, or preferably, the battery should be fitted with a vent kit allowing any gases produced during charging to be safely diverted outside the car. Note- recharging batteries in both the caravan and car boot simultaneously is likely to overload the charging circuit.

3.5.14 The Interior Lights etc Circuit

This circuit is permanently live. Historically, this allowed the interior lights and water pump to be powered by the car on site, avoiding the need for a caravan battery, but at the risk of flattening the car battery. This is now done very rarely, but the facility is occasionally useful while travelling, or if the caravan battery is flat. This circuit also provides caravan battery charging on recent caravans (see above). Note that with many cars, power can only be taken with the ignition off if the car's alarm is not armed, or else it will be set off. Often, the alarm is integrated with the central locking, meaning power can only be taken from an unlocked car.

3.5.15 The Fridge Power Supply

Most caravan owners use the facility to power their caravan fridge from the towcar while travelling, thus keeping the fridge cool during the journey. Since the fridge is a relatively high-powered device the towcar battery needs to be protected against being drained by the caravan fridge if the towcar engine is not running (while parked, or on a ferry, say). This is done by connecting the fridge circuit to an 'ignition-controlled' power supply from the towcar. This may be achieved either by using a relay activated by the output of the alternator of the vehicle, or by means of a voltage sensor which detects the change in voltage in the towcar circuits when the engine starts, and which then turns a relay on. The precise connections of the circuits to achieve this function vary from vehicle to vehicle, and hence are beyond the scope of this leaflet. See also comments in section 3.5.13 regarding ignition-controlled circuits.

3.5.16 Sensing Device

The standards for 12S and 13-pin systems include provision for a ‘sensing device’ – sometimes called the ‘coding for coupled trailer’ function. Some cars may use this function by monitoring the voltage state of the relevant pin in the towbar socket – when the caravan plug is inserted, this pin becomes earthed, telling the car that a trailer is present. The car’s control system can then make changes such as turning off the car’s rear foglight(s), adjusting the shift patterns of an automatic gearbox, activating a towing-specific programme in the car’s electronic stability control system, or telling the bulb failure warning system to allow for the extra lights of the caravan. To work, not only must this function be implemented in the towcar, but also the relevant pin in the caravan plug must be connected to earth (by bridging it to one of the other pins). In principal, the connections required are as follows, but please read the notes underneath carefully:

Pre-1 September 1998 caravan	12S pin 5 to 12S pin 3	See note 1
1 September 1998 or later caravan	12S pin 2 to 12S pin 3	See note 2
13-pin caravans	pin 12 to pin 3	See note 3

Notes

- Standards suggest that older cars might look for a sensing signal on pin 5, but as far as The Club knows, this was never utilised by car makers.
- Newer cars may look for a sensing signal on pin 2. Note, though, that due to the common UK practice of using pin 2 for battery charging for many years (see section 3.2 and 3.5.13), there is a real risk of a short circuit occurring if pin 2 in the car is a 12V power supply for battery charging, and pin 2 in the caravan is connected to earth as a sensing device. For this reason, UK caravan makers tend not to earth pin 2 in the caravan plug. This wasn’t a problem when car makers were not utilising the sensing device function. With a new car, however, any sensing function may not work due to the absence of this connection in the caravan. If you believe your car may have this sensing function, and you are *positive* that your towbar wiring does not provide pin 2 as a battery charging supply, then pin 2 in the caravan may be connected up in this manner. If you have a Continental caravan, pin 2 may already be connected to earth, and you need to ensure your car doesn’t conflict with this by having battery charging available via pin 2. If it does, disconnect this circuit in either the plug or socket to avoid a short circuit.
- No conflicts should occur with 13-pin systems, and it is with 13-pin equipped cars that the likelihood of the sensing device actually working is highest.

3.5.17 Earths & Pin 7 Burn-Out

Each circuit is completed via a ‘return’ or ‘earth’ connection. Unlike most towcars, the chassis or body of the caravan is not used to provide the earth path – instead discrete wires are used. Since several circuits often share the same earth wire, these wires need to be able to handle quite high currents when several devices are operating simultaneously. As the number and power of devices in caravans has increased over the years, the relevant standards have added extra earth connections to ensure that these wires are not overloaded. To allow this to work effectively, it is essential that these wires are not connected together, either in the caravan, or within the towcar, until they are attached to an earthing point on the body of the car. Joining earth wires in the 12S socket, say, can result in local sections of the circuit (particularly the 12S plug and socket) overheating and failing.

On a 1 September 1998 or later caravan with 2x7-pin wiring, 12S pin 7 becomes an earth for the fridge power supply. This was an unfortunate decision, since this is a

particularly high power circuit, yet the design of the 12S plug makes it especially vulnerable to damage, which can lead to overheating problems. If you look carefully at a 12S plug, you'll notice two things about pin 7. Firstly, like the other pins, it has a split end, to provide a bit of spring to improve the fit of the pin into its tube. Second, it's slightly longer than the other pins, so that it acts as a locating device as you line the plug up with the socket. If you do not slide the plug in exactly parallel to the socket, however, these features can lead to the pin being squashed or bent. The deformed pin does not make as good a connection to its tube, and a poor contact leads to high resistance and lots of heat when a large current flows through it. The surrounding plastic area of both the plug and the socket can then melt. It is vital to keep this pin and its tube in the 12S socket in good condition (ie clean and undistorted) to minimise the risk of this happening. It has been suggested that using an alternative pin for the fridge earth - ie pin 5, which is unused – or using pin 5 in addition to pin 7 would improve this situation. While this is almost certainly true, it would make such an installation non-standard, and hence is not recommended by The Club.

3.5.18 Adapters and Extensions

Most commonly needed is an adapter lead which connects to a towcar's single 13-pin socket and the caravan's two 7-pin plugs. Such leads are sometimes included when the towcar is bought, or may be an 'extra' available through the vehicle dealer, often at a significant price. Alternative leads are obtainable from larger accessory shops, or from component specialists. The use of an adapter lead can make the caravan connections too long, and there is a risk of them dragging on the ground while travelling. Make sure that any such adapter lead includes all of the required wires for your caravan – leads which do not include all the 12S circuits are not unknown. The cable used in adapter leads should be comparable to that used in the rest of the circuitry. Again, it is not unknown for light gauge wires to be used in cheaper adapter leads, thus creating a 'bottleneck' in the supply – the resultant voltage drop can adversely affect the effectiveness of the battery charging and fridge power supplies.



An alternative (avoiding the excess cable length issue) is a simple plug which converts a 13-pin socket to a 12N 7-pin socket. These are also useful if towing something other than a caravan, which doesn't require 12S circuits. A similar plug converts a 12N 7-pin socket to a 13-pin socket, although clearly only the road light circuits are included. While not commonly available through caravan accessory shops in the UK at present, this latter plug is often found as an accessory for Continental-made cycle carriers, which use a 13-pin plug-equipped lighting board.



Also available is a lead to connect a towcar's two 7-pin sockets to the 13-pin plug of a Continental or recent UK caravan.

3.5.19 Car-Specific Wiring Kits

For a long time, vehicle manufacturers have supplied dedicated wiring kits for each of their models. These tend to include a bespoke wiring harness, with wires of the correct length for the dimensions of the car, and perhaps in colours to match the vehicle's own wiring scheme. Most if not all of the connections to the car's wiring loom tend to be made using multiway plug-in connectors, making installation fast, easy and generally foolproof. Any additional electronics required to communicate with, say, the car's bulb failure warning system are included with the kit as a 'trailer module'.

The increasing complexity of car electrics has encouraged the aftermarket suppliers of towbar wiring kits to start taking the same approach now, and such kits are well worth considering, either for DIY use or fitment by your towbar installer. They may cost a little more, but they should give great peace of mind that the kit supplied is really going to work properly with your car.



The kit shown to the left illustrates how different these may be to a 'universal' one. Note the pre-assembled wiring harness, complete with connector plugs designed to fit straight into sockets included in the car's wiring loom, with all the wires of appropriate length. Also, the correct-specification up-rated flasher relays and all the necessary fixings, grommets and electronic 'black boxes' necessary to properly integrate the new components into the vehicle.

It would seem logical to assume that a vehicle-specific wiring kit would be 'fully wired', including all the relevant circuits specified by the relevant standards. Usually this is the case, but occasionally (normally with vehicle manufacturer-supplied kits rather than aftermarket ones), the 'standard' kit may only cover road light circuits, or at least perhaps not all the auxiliary circuits. Once again, it is important to be 100% sure of what you have ordered.

Some specialist towbar fitters may prefer not to use vehicle-specific wiring kits. This is fine, subject to them ensuring that they instead achieve a 'vehicle-specific installation', through the correct specification and fitment of discrete components. The key thing is that the towing electrics fitted are suitable for and compatible with the towcar, and do not interfere with any (especially safety-related) systems on the car. A good towbar fitting specialist should be able to achieve this, while a non-specialist fitter or DIY installer is probably better off using a dedicated kit, especially for any reasonably modern car.

4. DIY vs Professional Fitting

As stated earlier, DIY fitting of towbars and wiring is much less common than it once was. The Club recommends that if you have a modern car, you really should think hard before tackling this task yourself. If you do choose this route, however, check the following points first:-

- Use only good quality, new parts – they should not let you down while on holiday. Consider the value of your car and caravan, and whether it is worth compromising on the quality of the vital connection between the two.
- Make sure you know the specification of your towcar before you start – eg does it have bulb failure monitors, multiplexed wiring etc? Do you need a Type Approved towbar?
- Take advice from your supplier regarding unusual features of your vehicle – they should have such details, or if not, can you trust them to sell you the correct kit?
- Seriously consider buying a ‘vehicle-specific wiring kit’, unless you are 100% sure that you fully understand the wiring and electrical systems fitted to your car.
- Most vehicle dealers offer only a full ‘supply and fit’ service, and few know much detail about towbar wiring anyway. By all means ask for advice, but do not expect detailed help. They should confirm if multiplexed wiring is used or not, however.
- Try to see a copy of the fitting instructions before you buy. This is not always possible, but can give a useful indication of how easy or difficult a job will be. Sometimes tasks which you might expect to be straightforward can actually be extremely difficult – removing the rear bumper on some vehicles, for instance. Some manufacturers include fitting instructions on their websites.
- Check everything as you fit it, and check it all again before you first power up and hitch to the caravan. Remember that any damage resulting from any fitting errors will be your responsibility, and your vehicle warranty etc will not cover it.

If you have the wiring fitted for you, there is a choice between using a vehicle dealer or an independent specialist.

Vehicle dealers do not fit towbars and wiring everyday, so they may be relatively inexperienced at it. Make sure they understand what you expect from the wiring system (use the specifications from Sections 3.1 to 3.4, if need be). Generally, few problems result from the 12N system (or the 12N ‘half’ of a 13-pin system). Frequent problems arise with the 12S circuits, however, with circuits either missing entirely, or not being correct (eg permanently live when it should be ignition-controlled). You may not get much choice of system at a dealer either – 13-pin electrics and a swan-neck style towbar do not suit all caravanners! The advantage of a dealer-fitted system is the work should be properly guaranteed, and your vehicle warranty will not be affected. Dealer prices are surprisingly variable, and not *always* extortionately expensive – it’s certainly worth getting a quote from them. If buying a new car (or indeed a high value secondhand one), it is always worth trying to make the cost of the towbar and electrics part of the negotiation process, of course.

In contrast, for most independent towbar fitters this is the major part of their business. They *should*, therefore, be both experienced and knowledgeable. This is generally the case, but there have been enough reports of ‘cowboy’ fitters to advise a degree of caution. Look for well-established companies, and question them on their knowledge of your particular vehicle. Bear in mind that damage to the vehicle through the fitting of non-manufacturer approved towbar wiring may not be covered by the vehicle warranty, so make sure the fitter’s work is fully guaranteed.

For peace of mind, a nationwide scheme has been set up by the National Trailer and Towing Association, the trade body for towbar fitters, trailer manufacturers and retailers. To join the ‘Quality Secured’ Scheme, a fitting outlet must pass an assessment for competence, and will provide a thorough guarantee of work carried out.



The NTTA provides the only specialist towbar fitting and towbar electrics training in the UK, and additionally have excellent technical back-up advice available to their members for ‘awkward’ vehicles. Hence, their accredited fitters should provide some of the best installation services available. The scheme comprises around 60 outlets), but the number of accredited outlets should increase steadily over time. The NTTA website www.ntta.co.uk includes a Buyers’ Guide section which includes contact details for QS and other towbar fitting members. If a Quality Secured outlet is not located near you, then look for one with at least NTTA membership – this tends to be a good indication of their professionalism, and means they will have access to the Association’s technical back-up.

5. Checking A New Installation

If you have installed the wiring yourself, you will hopefully have carried out checks as you go, but a final functional check will still be needed, of course. If the system has been installed for you, then an installation check may also be prudent:-

5.1 Installation Check

- Are all the components (sockets etc) securely fitted, and located in a sensible place, such that you can readily insert and remove the caravan plug(s)?
- Is the wiring neat, and not vulnerable to damage, especially in the luggage compartment?
- Can you identify where all the key components (eg fuses, relays) are fitted, in case of future problems?
- Have sufficient fuses of appropriate ratings been fitted?
- Do the connections between the towbar wiring and the main vehicle wiring loom look adequate and secure?
- Has the point where the towbar wiring from the sockets enters the towcar been protected with a rubber grommet or seal to protect the cables from abrasion, and to prevent water penetration into the towcar?
- Is the point where the cable enters the back of the socket fitted with a rubber seal, to help keep water out of the socket wiring?
- Have any trim panels which were removed during the installation been correctly and securely refitted, using all of their fixings?
- Have you been given documentation (eg fitting instructions, specification sheet, warranty details etc) which gives details of the components which have been fitted? These may be very useful during fault checking or if components need to be replaced in the future. Keep such details with the towcar's handbook.

5.2 Functional Check

5.2.1 Road Lights

- Do all of the towcar's lights still work without the caravan attached?
- Attach a test device, multimeter, trailer lighting board or ideally the caravan. Note that in some situations, attaching anything other than a caravan may not result in the correct load being applied to the electrical system, and hence may not show up all faults. In the vast majority of cases, however, a test device or trailer board is adequate and often more convenient.
- Check each road light circuit in turn. Make sure that the towcar's lights remain operational in addition to the caravan's.
- Check road lights in combination – eg head/tail lights, fog light and indicators together, and make sure that the circuits are not interfering with each other.

5.2.2 Supplementary Functions

- These are best checked either by connection to the caravan, or with a multimeter.
- With a multimeter, check that there is voltage at the battery charging, fridge and interior lights connections on the socket while the engine is running, but that battery charging and fridge supplies turn off when the engine is stopped. Note

that simply checking for the presence of power at the socket is a fairly rudimentary check (it does not confirm the correct function of the circuits under a realistic load), but it does at least prove that the necessary circuits have been connected up.

- If using the caravan, disconnect power from the caravan battery, then attach the caravan plug to the towcar. Make sure the caravan is not connected to a mains supply as well. Check for operation of the interior lights when the engine is not running. This proves that the permanent live feed is working, since the only available source of power for the lights is the car battery. Switch the fridge to 12V operation, and check it works only when the engine is running. If you can not readily tell that the fridge is working (perhaps because it is a model without an 'On' light), and you have a post-1 September 1998 caravan, leave the interior lights on, and then start the car engine. The interior lights should go out, indicating that power has been diverted (to battery charging). Given that it is the fridge power supply which controls this switching action, this should indicate that power is being supplied to the fridge. Check that power is present at the disconnected connectors for the caravan battery (not at the battery terminals themselves) only when the engine is running. This will prove that power is being supplied for battery charging.
- Note that with some installations (those utilising a voltage sensing switch instead of an electromechanical relay for the control of the charging and fridge circuits), there may be a short delay after the car engine is switched off before the ignition-controlled circuits switch off. This is not usually a problem, unless the delay is excessive, in which case the sensitivity of the switch may need adjusting.
- These checks do not prove that the installation is perfect, but they should pick up most of the common installation-related problems which tend to occur, and are simple enough for an owner with basic DIY skills and equipment to carry out. Professional fitters should be using more sophisticated test equipment to verify their installations to a higher level of confidence.

6. Fault Finding

6.1 Road Light Circuits

	Battery Connected & Functional?	12N Or 13-pin Plug Inserted Correctly?	12S Plug Inserted Correctly?	Check Connections On Plug & Socket	Check Wiring Connections To Caravan Lights	Check Connections Between Socket Cable & Main Wiring Loom	Check Bulbs	Check Vehicle Fuses	Check Indicator Relay	Check For Moisture Or Corrosion In Plug, Socket Or Caravan Lights	Check Exposed Cables For Damage
No Road Lights Work	✓	✓		✓	✓	✓		✓			✓
Caravan Indicators Do Not Flash		✓		✓	✓	✓		✓	✓		✓
Only One Indicator Flashes		✓		✓	✓	✓	✓	✓		✓	✓
Indicators Flash Dimly, Or At Wrong Rate		✓		✓	✓	✓	✓			✓	✓
Wrong Indicator Flashes				✓	✓	✓			✓		✓
Other Lights Do Not Work		✓	✓	✓	✓	✓	✓	✓		✓	✓
Indicator Tell-Tale Does Not Mark				✓		✓	✓		✓		✓
Indicator Tell-Tale Works w/o Caravan				✓		✓			✓		✓
Fuses Blow				✓	✓	✓				✓	✓

6.2 Supplementary Circuits

	Check Battery Condition & Terminals Are Secure	Check Alternator Output	12S Or 13-pin Plug Inserted OK?	Check Connections In Plug & Socket	Check Connections Between Socket Cable & Main Wiring Loom	Check Fuses	Faulty Relay	Adjust Sensitivity Of Relay	Main Power Feed From Battery Too Thin	Fuse In Main Power Feed Cable From Battery Too Small	Check Earth Wires Are Not Joined Together	Check Exposed Cable For Damage	Normal, But Move Unit Away From Heat Sensitive Surfaces	Correct Function – Too Heavy Drain On Vehicle System
Ignition Controlled Supply Does Not Work	✓	✓	✓	✓	✓	✓	✓	✓				✓		✓
Ignition Controlled Supply Works All The Time, Even When Engine Is Off				✓	✓		✓	✓						
Ignition Controlled Supply Cycles On & Off	✓			✓	✓			✓		✓				
Ignition Controlled Supply Does Not Turn Off Promptly When Engine Stops							✓	✓						
Ignition Controlled Supply Turns Off When Other Accessories In	✓			✓	✓				✓					✓
Relay Feels Hot													✓	
Permanent Supply Does Not Work	✓		✓	✓	✓	✓						✓		
12S Plug & Socket Feels Hot			✓	✓							✓			

7. Miscellaneous Matters

7.1 42V Electrical Systems

At the last major revision of this Information leaflet, indications were that the replacement of current vehicle electrics by much higher voltage systems was an imminent event. It has become clear that the motor industry was overly optimistic in terms of both the need for such a change in the short term, and the ease with which new systems could be developed. It now appears that with the exception of a few hybrid electric-powered vehicles, perhaps, we will not be seeing high-voltage cars for a few more years yet.

However, the motor industry still seems to believe that the days of 12V systems in vehicles are numbered. Eventually, they plan to treble the nominal voltage at which vehicle systems operate. Currently, vehicle alternators produce around 14V, and vehicle batteries are around 12V. In due course, the battery voltage will be increased to 36V, while the alternator output rises to 42V. The reasons for this are twofold. Firstly, the power requirements within a typical vehicle have increased by 50% over the last 20 years, and the existing system cannot be stretched much further. Secondly, by raising the voltage, it is easier to introduce higher powered sub-systems, such as electric power steering and electric air conditioning. By taking direct loads off the engine, it is believed that such sub-systems will enable fuel economy to be increased significantly.

Clearly, this will impact on the towbar electrics, and The Club is monitoring this situation closely to ensure that caravanners' interests are protected. At the time of writing, however, it is unclear how the industry will modify many of the more fundamental vehicle electrical sub-systems, and hence there is no indication yet what will be adopted for towbar wiring. In the short to medium term, though, it is likely that caravans will remain as they are at present, with higher voltage vehicles needing the addition of a step down unit to deliver 12V to the caravan.

7.2 Glossary of Terms

Some of the terminology used in this leaflet may benefit from further explanation:-

Cable	The term cable has been used to describe a conductor which is made up of a number of separately insulated wires (eg the lead to the 12S socket).
Circuit	A path for electricity from a power supply (eg a battery) via a wire to a load, and back to the power supply via an return wire.
Load	A device powered by electricity.
Loom	The network of wires and cables throughout the body of the towcar.
Monitor	A device which measures an effect and generates a signal as a result of this – eg it might indicate whether a light is on or not.
Pin	The male half of the circuit connection in the car to caravan plug and socket. Note that sockets are usually described as being '7-pin' or '13-pin' even if the socket half of the connector actually contains a mixture of pins and tubes, or even just tubes!

Relay	A switch which is triggered by a signal (perhaps from a monitor) which results in a circuit being turned on or off (eg the fridge power supply).
Return	The wire which completes the electrical circuit from the load back to the power supply. Also commonly know as an 'earth'. Within most towcars, return connections are made via the metal of the vehicle body or chassis, thus reducing the number of separate wires needed to run the entire length of the vehicle.
Sensor	See Monitor.
Short	A direct (and usually inadvertent) linkage between a power supply and a return (earth) connection, without there being a load in between. The absence of a load means there is negligible resistance to the flow of electricity, usually resulting in a very high current flow, and an associated risk of overheating, if the circuit is not protected by a suitable fuse.
Tube	The female half of the circuit connection in the car to caravan plug and socket.
Wire	In this leaflet, the term wire has been used to describe a single insulated conductor (eg the cable to the 12S socket is made up of 7 separates wires).

8. Useful Contacts

Several of these sources are trade-only suppliers – ie they do not tend to deal directly with individual car owners. Their details are included here firstly because you may come across references to their products through retailers, and secondly because most of them provide informative websites with details of their products, and often quite a lot of background information as well.

National Trailer & Towing Association Plestowes Barn Hareway Lane Barford Warwickshire CV35 8DD	www.ntta.co.uk Tel 01926 335445 (limited hours – answerphone at other times)	Trade association Website includes Buyers' Guide for towbar fitters and product suppliers etc. Run 'Quality Secured' scheme for accredited towbar fitters
Witter Towbars Drome Road Deeside Industrial Park Deeside Flintshire CH5 2NY	www.witter-towbars.co.uk Tel 01244 284500	Towbar manufacturer, distributor and retailer Standard and vehicle-specific wiring kits. Dealer list for retail supply and fit on website. Website includes sample 'I-Fit' instructions which show in illustrated steps how a wiring kit is fitted
Brink U.K. Ltd (Thule) Unit 7, Centrovell Ind. Estate Caldwell Road Nuneaton Warwickshire CV11 4NG	www.brink.eu Tel 02476 352353	Towbar manufacturer and distributor Standard and vehicle-specific wiring kits. Dealer list for retail supply and fit on website.
PCT Automotive Holbrook Industrial Estate Holbrook Sheffield S20 3GH	www.pct.eu.com Tel 0845 1231111	Towbar manufacturer, distributor and retailer Standard and vehicle-specific wiring kits. Adapter leads and plugs. Mobile fitting service
Maypole Limited 162 Clapgate Lane Woodgate Business Park Birmingham B32 3DE	www.maypole.ltd.uk Tel 0121 4233011	Electrics manufacturer and distributor Standard and vehicle-specific wiring kits. Plugs, sockets, adapter leads, cable etc. Retailed via local stockists –contact company for details.

<p>Right Connections UK Limited 7 Churchill Buildings Queen Street Wellington Telford TF1 1SN</p>	<p>www.rightconnections.co.uk Tel 01952 249333</p>	<p>Electrics manufacturer and distributor Standard and vehicle-specific wiring kits. Plugs, sockets, adapter leads etc. Limited direct retail supply</p>
<p>Ryder Towing Equipment Ltd Alvanley House Alvanley Industrial Estate Stockport Road East Bredbury Stockport Cheshire SK6 2DJ</p>	<p>www.rydertowing.co.uk Tel 0161 4301120</p>	<p>Electrics manufacturer, distributor and trade supplier Website contains a wealth of background information and advice, plus downloadable trade catalogue</p>
<p>Towsure Products Limited 151-183 Holme Lane Hillsborough Sheffield S6 4JR</p>	<p>www.towsure.com Tel 0870 6090070</p>	<p>Retailer Standard and vehicle-specific wiring kits. Plugs, sockets, adapter leads, cable etc. Retailed via website, telephone sales or superstores</p>
<p>LeisureShopDirect Ltd Mullacott Industrial Estate Ilfracombe EX34 8PS</p>	<p>www.leisureshopdirect.com Tel 0845 4300325</p>	<p>Retailer Plugs, sockets, adapter leads etc. Retailed via website, or telephone sales</p>