

# Changes of Phase Colours Codes in Electrical Supplies & Impact on Temporary Power Distribution in the Entertainment Industry


## Introduction

The requirements for the colour coding of three phase and neutral conductors in electrical distribution systems are changing to harmonise the UK with the EC colour scheme, which dates back some 25 years. The effect of this is that connectors to the new colour scheme are already in circulation within the TV/Film and Video industries, even though the Amendment to BS7671:2001 (the “Wiring Regs”) is not effective until 1<sup>st</sup> April 2004.

Use of either old colour coding or new colour coding (*but not both*) will be permitted on new installations from *now* until 1 April 2006. After that date, the “new” colour coding must be used on all new installations. The introduction of changed colour codes will apply to temporary electrical installations used extensively in the Entertainment, TV/Film/Video industries at events and on locations.

Those responsible for supply, hire, planning, installation and use of temporary electrical installations and equipment, need to be made more aware of the impact of the changes and the possible safety implications to avoid potential electrical and safety hazards.

### Colour Code Changes Are As Follows

OLD	Earth (CPC)	Neutral	Line 1	Line 2	Line 3
	Green/Yellow	Black	Red	Yellow	Blue
					
NEW	Earth (CPC)	Neutral	Line 1	Line 2	Line 3
	Green/Yellow	Blue	Brown	Black	Grey
					

For the Entertainment, TV/Film/Video industries, the primary hazard arises from possible confusion of the function of Blue and Black connectors between old and new schemes.

# Changes of Phase Colours Codes in Electrical Supplies

## 1. Outline of the Colour Code Changes

The colours identifying the three phases and neutral conductors of electrical distribution systems in the UK are to change. This is harmonising with European arrangements and is dealt with in amendment No.2 : 2004 to BS 7671 : 2001 Requirements for electrical installations (IEE Wiring Regulations). Details and further information on this change are on the Institution of Electrical Engineers (IEE) website. The following are links to the information on the IEE website.

The main page on this subject <http://www.iee.org/Publish/WireRegs/CableCol.cfm>

This web page gives access to several items about the colour change including frequently asked questions and the published version of Amendment No. 2 : 2004 to BS 7671 : 2001, which for a limited period of time can be downloaded free of charge.

The changes become effective, as follows:

- Amendment No.2:2004 to BS7671:2001 came into force on 01/04/2004.
- **New installations commenced before 01/04/2006 may be in EITHER the new colour scheme or the old colour scheme, BUT NOT BOTH.\***
- **New installations commenced after 01/04/2006 MUST be in the new colour scheme.**

\*Between 1 April 2004 and 1 April 2006 it is permissible for new installations to use either the old colours or the new colours but the new installation must NOT include a mixture of old and new colours.

Temporary power distribution systems used in the entertainment industry (which are dealt with in BS 7909:1998) will be significantly affected by these changes to the UK phase and neutral colours. To maintain safety when using temporary power distribution systems in the industry, the implication of the changes will need to be understood. Additional consideration will need to be given to the installation of temporary electrical supply equipment and to the arrangements and rules which are applied by the differing organisations that are likely to be operating at any one particular venue, event or site.

The view is taken that a temporary distribution system as used in the entertainment industry at a venue or location etc. would be considered as a '*new installation*'.

The table below shows how the colour code changes will impact on temporary ac mains electrical distribution systems used in the entertainment industry. The current colour coding conventions are shown in upper half of the table; the new system for colour coding is shown in the lower half.

<b>OLD</b>	Earth (CPC)	Neutral	Line 1	Line 2	Line 3
	<b>Green/Yellow</b>	<b>Black</b>	<b>Red</b>	<b>Yellow</b>	<b>Blue</b>
<hr/>					
<b>NEW</b>	Earth (CPC)	Neutral	Line 1	Line 2	Line 3
	<b>Green/Yellow</b>	<b>Blue</b>	<b>Brown</b>	<b>Black</b>	<b>Grey</b>

Note:- The table shows only a part of the overall colour changes that will take place. Consult the IEE website as above for full information. This colour change deals with installed wiring. Installed wiring in the UK was not affected by the changes in colour of flexible cables introduced in 1975. Although the entertainment industry uses many flexible cables it continued to use the old colour identifications for the single pole connectors and cables used in temporary electrical distribution systems.

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### 2. Impact on to Temporary Electrical Installations Used in the Industry

The temporary electrical installations using the types of connectors described below are used extensively in film and television locations and at 'events' in the entertainment industry to supply electrical power, for lighting, stage, lifting, sound, vision and technical equipment and for location/venue 'facilities'. Electrical power can be sourced by various means; from 'public' or private supplies using specially provided outlet points, by making connections to installed switchgear or 'buss- bars', or by use of mobile generators. It is at the "supply" end of the temporary distribution installation where there is the greatest probability of problems arising. Once single core cables are terminated into specifically designed distribution units, further distribution takes place in conventional 'multi-core' cables, as either 3 phase or single phase supplies, using proprietary 'Ceeform' connectors, which are inherently safer by design – as shown in Photograph No.8, below. This issue does not involve multi-core cables where both their ends are permanently terminated in multi-pin connectors or equipment.

### 3. Effect of the Colour Code Changes on Temporary Distribution Installations.

Making connections to individual phases, neutral and earth using single core cables and connectors is where there is the greatest possibility for mistakes as the colour code change is implemented. Black and blue colours appear in both the old and new colour schemes, but the function they identify will have changed. **The potential to confuse the function of Black and Blue conductors on site will be considerably increased. The effects are potentially dangerous, if not detected before a temporary installation is made live.**

The two areas where the dangers of confusion are likely to be most serious are in the use of:-

1. **Single pole connectors** - used with single core or mutli-core cables or as fixed connectors on equipment. and
2. **Open tails** for connection to switchgear etc., at supply points.

#### 3.1. Single Pole Connectors -

Currently three types are in use.

##### 3.1.1. "Type One" connectors:- commonly known in the industry as "BAC"

These are black connectors and the single core cables used with them have black sheaths. The cables are identified by marking with coloured tape at the time of rigging the temporary distribution. For a given current rating, these types of connectors can be interconnected no matter what their designated circuit function may be. See Photograph No 1.



Photo No.1 – Single Core Cables & 'Type 1' Connectors

N.B – Connector of a type which can be 'universally' interconnected, one with another, regardless Phase or colour.

N.B – 'Differentiation between cables & connectors, carrying Earth, Neutral and Phase Lines 1, 2 & 3, depend entirely on the correct labelling and use of colour coding conventions, made with tape.

It is suggested that the continued use of "Type One" connectors could be met by providing coloured tapes for both the old and new colour schemes. The situation when using new colours is similar to that which already exists. However, it would be essential to enforce the removal of identifying colours from cables on their return to base/supplier and to check that this had been done before the next use. This is the arrangement now in use.

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### 3.1.2. "Type Two" connectors:- commonly known in the industry as "Cam-Lok"

These are coloured green (earth), black (neutral), red, yellow [or white] and blue - phases. The single core cables used with these connectors normally have black sheaths - See Photograph No 2.

Photo No.2 – "Type Two" Colour Coded Connectors



In a temporary distribution the colour of the connector designates its circuit function. For a given current rating "Type Two" connectors can be interconnected no matter what their designated function may be – See photograph No. 3.

Photo No3 – "Type Two" Colour Coded Connectors, shown incorrectly interconnected



The application of the 'old' or use of the 'new' colour codes needs to be carefully considered for each 'new installation', because of the change of electrical function assigned to colours in each scheme. Changes of connector colour with this 'Type " connector, to meet the new colour codes, may introduce the possibility of confusion and greater chance of errors being made in making connections, especially with the old black/new black and old blue/new blue, changed functions. At the present time (October 2003), it is thought Type 2 connectors in brown and grey are not available.

### 3.1.3. "Type 3" connectors:- commonly known in the industry as "Power Lock".

These are available in individual colours to match both the old and the new colour schemes, the earth connector being green in both cases; they are also available in black for neutral and black for each phase. No matter what colour the connectors is they are all marked either E, N, L1, L2 or L3 as appropriate to their circuit function – See Photograph No.4.

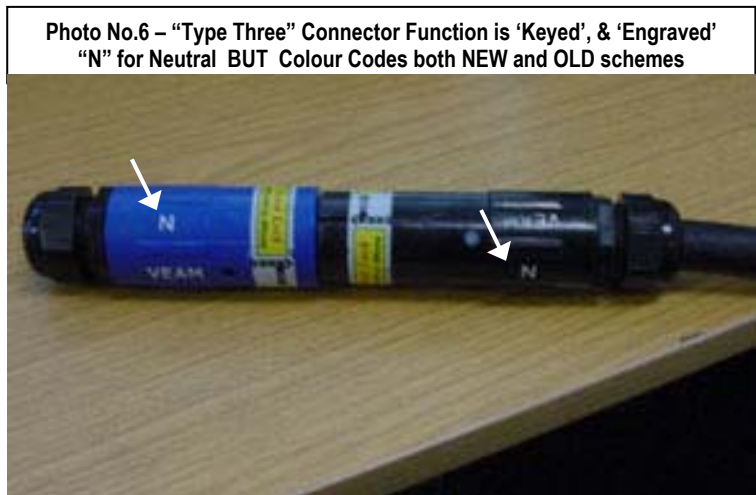
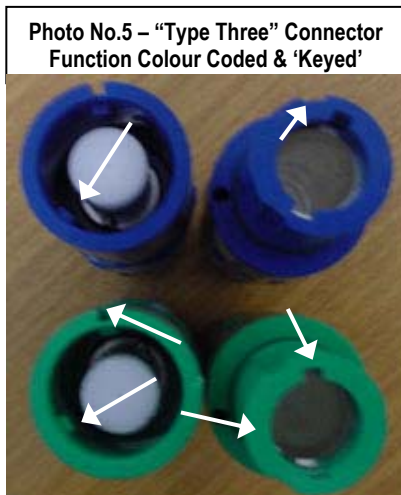
Photo No.4 – "Type Three" Colour Coded Connectors



Each connector for a given electrical function is colour coded, but is also specifically keyed for that duty; i.e. - it is not possible to couple a neutral connector with a phase connector, or to couple connectors for different phases together, no matter what colour the connectors may be. See Photographs Nos. 5 and 6, below.

The single core cables used with these connectors normally have black sheaths.

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### 3.2 Open Tails

“Open tails” - single core cables provided to allow connection into switchgear at the point of supply, with termination lugs to enable clamping/connection – examples are shown in Photograph No.7. At the other end they are normally terminated in a multi pin connector of the ‘Ceeform’ variety or directly into an intake switch unit or distribution unit for onward supply to the temporary system – of type shown in Photograph No. 8.

**Photograph No. 7**, showing examples of ‘single core’ cables with ‘open tails’ to make the connections to a supply



**Photograph No. 8**. Showing example of Distribution Unit with ‘Ceeform’ type outlet connectors, with Type 3 inlets to old colour scheme.



At present, ‘open tails’ are normally identified by the use of old colours, but, this will change as use of the new colour coding scheme becomes more widespread. All those associated with the connection of tails to power supplies must be aware of the implications that the change from old colours to new colours will bring. They must be competent to make such connections and the tails must be marked up as set out in the documents available from the IEE website.

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### 4. Potential Failure Modes & Hazards.

Most likely are misconnections between the old colour black and new colour black causing a neutral to be connected to a circuit expecting a phase, and old colour blue to new colour blue causing a phase to be connected to a circuit expecting a neutral, and vice versa. This is effectively a phase - neutral swap for any load being supplied. Although the load is not operating as the circuit is broken by the mcb or switch, the load will remain live. It is also possible for 230V single phase equipment to have 400V applied. These are potentially dangerous circumstances. There are number of other consequences which could arise. But examples are:-

1. Incorrect rotation of motors in lifting equipment, and possible mis-operation of any positional or load sensing systems used for controlling the lifting motor, or more likely overheating and lack of operation.
2. Single phase equipment could remain live although the single pole mcb or switches have been opened or switched off.
3. Equipment could overheat and blow fuses, trip mcbs, or in worse cases, after a period catch fire, if 400V is applied instead of 230V.
4. Larger wattage lighting as used in productions could fail explosively but will be enclosed as safely as reasonably practicable within the luminaire, if 400v applied.

Any of the above could occur now using only the old colours as the circumstances enabling misconnection are already present, but they are managed successfully. However, there will be an increased potential for confusion as a consequence of the new set of colours, and it is this which industry managers and workers will need to have a greater awareness and appreciate the impact of the colour changes.

### 5. Suggested Preventative Strategies

While not a comprehensive list, below are some examples of which may considered.

Each production or event at any location/venue should adopt positive rules, so as to enforce the use of either old colours or new colours but not a mixture of both, in any temporary distribution system where single pole connectors may be used. In any production or event that may require single pole connectors to be used an agreement is reached and a decision formally taken to use only the old colours or only the new colour scheme. This would need to be considered at the planning stage, so that:-

- The event organiser or producer ensures that the decision is taken.
- A decision must be made at the time of recce or planning.
- All parties involved with the provision of equipment, its erection and operation are consulted and agree with the decision.
- The decision takes into account the extent of the job, the availability of equipment and any special requirements of the location/venue.
- The colour scheme of the supply and the colour scheme decided upon should be recorded in the risk assessment.
- The decision must be adhered to by all parties.

Further no adaptor leads or devices should be made that will allow conversion from one colour scheme to the other. Such devices will ultimately add confusion and increase risk.

The only place where a change of colour scheme will be acceptable will be at the point of connection of the temporary system to the supply. If this connection is a junction between the old and new colour schemes the arrangements for marking cables as set out in the documents available at the IEE website must be followed.

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### 6. Activities and People

User organisations of temporary electrical power distribution and hire companies and others, may wish to draw attention to these changes. Those who will or may be affected include the following:

- a. Managers of Events or Productions where temporary electrical power distribution will be used;
- b. Organisations or Companies providing equipment for use in temporary electrical power distribution systems;
- c. Organisations or Companies taking responsibility for designing, creating, managing, operating or using temporary electrical power distribution systems;
- d. Individuals or Groups of People who are involved with or take responsibility for designing, creating, managing, operating or using temporary electrical power distribution systems;

This includes those people who describe themselves as:

Producers,	Event Organisers,	Production Managers,
Location Managers,	Resource Managers,	Engineering Managers,
Lighting Directors,	Lighting Designers,	Directors of Photography,
Lighting Cameramen,	Gaffers,	Crew Chiefs or Crew Bosses,
Chief Electricians,	Best Boys,	Electricians.

This list is not exhaustive, but it aims to alert all who may need to know of these changes.

### 7. Conclusion and Further Action

As the current levels of awareness are difficult to judge, the above approach is suggested as a viable way to deal with these changes by those within that part of the entertainment industry who design, provide equipment for, set-up or operate temporary power distribution systems.

Organisations are asked to consider these implications and determine what action should be taken to raise awareness of the impact of the changes.

### 8. Point of Contact

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