

## Reduced low voltage

Mark Coles examines the wiring requirements for a reduced low voltage circuit.

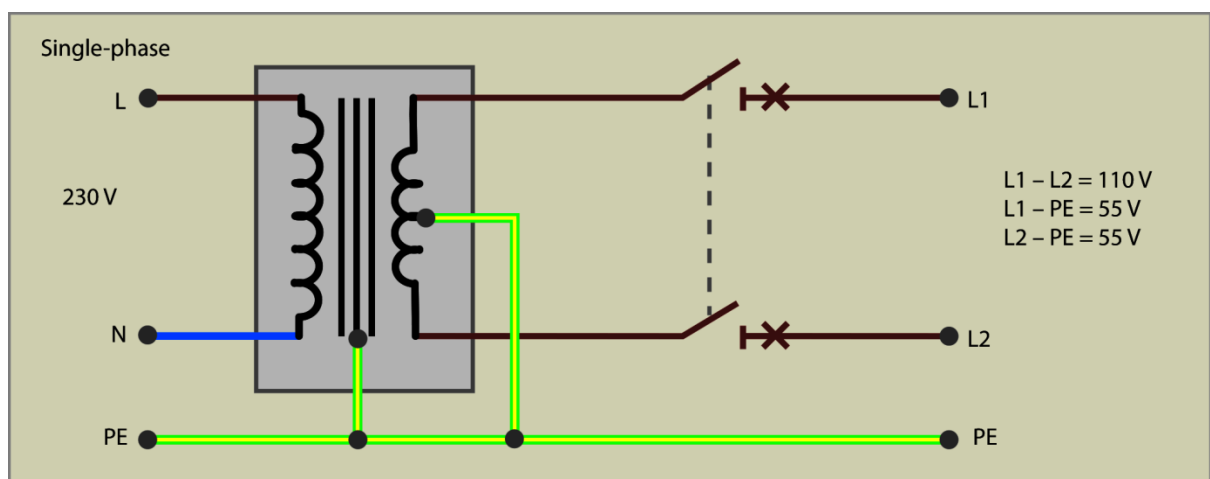


### What is reduced low voltage?

Regulation 411.8.1.2 of BS 7671:2008+A3:2015 defines the nominal voltage of a reduced low voltage system as:

*... not exceeding 110 V a.c. rms between lines, i.e. three-phase 63.5 V to earthed neutral, single-phase 55 V to earthed midpoint.*

The below figure clarifies this:



*Single-phase reduced low voltage system*

Point 'PE' is earthed midpoint. The transformer is also known as 'centre-tapped'.

## Where does a reduced low voltage system fit alongside other systems in BS 7671?

BS 7671:3008+A3:2015 generally recognises four protective measures against electric shock in Regulation 410.3.3:

- automatic disconnection of supply (Section 411);
- double or reinforced insulation (Section 412);
- electrical separation (Section 413); and
- extra-low voltage (SELV and PELV) (Section 414).

In areas of increased risk, it is common to see a reduced low voltage system in use. In a reduced low voltage system:

- basic protection is provided by basic insulation or barriers and enclosures; and
- fault protection is provided by automatic disconnection of supply with an overcurrent protective device in each line conductor.

A reduced low voltage system is recognised as a safe way of providing an electrical supply for equipment in more onerous environments or areas of increased risk. Areas include construction sites and workshops, and laboratory supplies for such items as:

- portable and hand-held tools;
- site lighting (other than fixed flood lighting); and
- portable hand-lamps (general use).

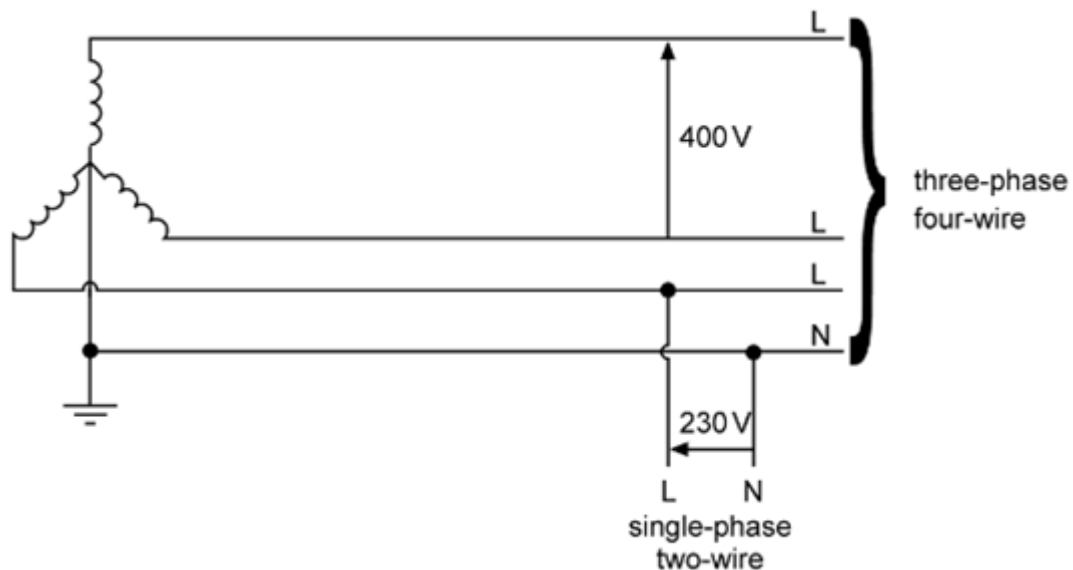
The system has its origins in the 1949 Annual Report of HM Chief Inspector of Factories, which recommended the system for use on building and construction sites and other applications involving large-scale use of portable electric tools. The system was described in the British Standard Code of Practice, CP 1017:1969, *Distribution of Electricity on Construction and Building Sites* (superseded by BS 7375:1991, now BS 7375:2010). Equipment was specified in BS 4363:1969 *Specification for Distribution Assemblies for Electricity Supplies for Construction and Building Sites* (now BS 4363:1998+A1:2013, also BS EN 61439-4:2013).

The intention of a reduced low voltage supply is that should a person come into contact with a line conductor, the maximum voltage they would be exposed to is 55 V.

55 V can still be dangerous if tools and equipment are not used correctly and maintained, but no deaths have ever been recorded where a person has been exposed to a 55 V electric shock.

## Conductors

Note that a single-phase reduced low voltage supply does not have a neutral conductor. Consider a 230 V AC single-phase supply where one pole of the supply is earthed; this is usually at the transformer on a TN or TT system. The below figure shows the conventional UK supply system.



## UK supply system

This connection creates a conductor we reference as neutral. On a reduced low voltage system there is no neutral; the centre point of the transformer's secondary winding is earthed, so, each leg of the circuit emerging from the transformer is at equal potential to each other with respect to earth.

## Conductor identification

Regulation 514.3.1 states that conductors shall be identified by colour or by an alphanumeric method. Further, Table 51 of BS 7671:2008+A3:2015, *Identification of conductors*, sets out the standard method; extract here:

**TABLE 51 – Identification of conductors**

Function	Alphanumeric	Colour
Protective conductors		Green-and-yellow
<b>a.c. power circuit</b>		
Line of single-phase circuit	L	Brown
Neutral of single- or three-phase circuit	N	Blue
Line 1 of three-phase a.c. circuit	L1	Brown
Line 2 of three-phase a.c. circuit	L2	Black
Line 3 of three-phase a.c. circuit	L3	Grey

Where colour is used to identify the conductor, the line conductor of a single-phase circuit is identified with brown; neutral is identified with blue. However, there is no neutral conductor in a single-phase reduced low voltage 55-0-55 V system; therefore, no neutral means no blue conductor. As both live conductors of the circuit are at exactly the same potential with respect to earth, i.e. 55 V AC, they would, therefore, need to be the same colour. Remember, these conductors are not of different phases, there is no angular displacement between them, they are two poles of the same phase; therefore brown is used for each conductor.

## Is there a concern about polarity?

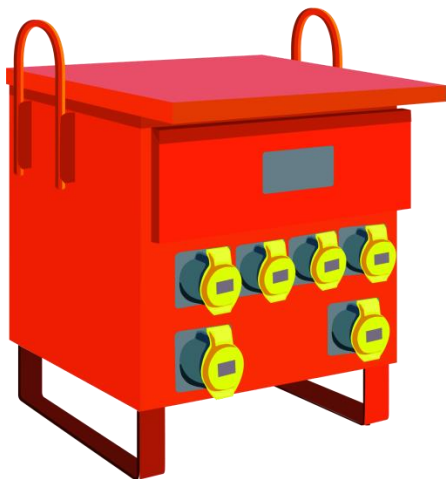
As each conductor is from a circuit of alternating current, and each conductor is at the same potential with respect to earth, there is no discernible advantage in maintaining polarity.

## Identification at the socket-outlet

The very slight fly in the ointment here is the identification of terminations at 110 V socket-outlets for use in AC systems. BS 4363:1998+A1:2013 states in clause 11 *Terminal markings and identification of connections* that:

*... the neutral conductor terminal shall be identified N.*

In a 55-0-55 V reduced low voltage system there is no neutral conductor, but bear in mind that not every 110 V system is center-tapped. Equipment can be used/operated at 110 V to earth where transformers are not centre-tapped but have one pole earthed to create a neutral conductor. Consequently, manufacturers mark terminals as 'L' and 'N' to allow for systems that require polarity to be maintained.



*Typical 110 V (55-0-55) power assembly*

## Summary

Reduced low voltage systems are used extensively in construction sites, workshops and for supplies to laboratory equipment. Socket-outlets on a single-phase reduced low voltage circuit will have three conductors; the protective conductor will be identified by green-and-yellow markings whilst the two current-carrying conductors, also known as live conductors, will both be coloured brown where colour is used as the identifying medium. There is no requirement to maintain polarity between the live conductors.

## Further reading

- BS 7671:2008+A3:2015 *Requirements for Electrical Installations*. IET Wiring Regulations 17th Edition 411.8 Reduced low voltage systems
- IET *Commentary on IEE Wiring Regulations 17<sup>th</sup> Edition* Chapter 4, clause 4.4.10.1
- IET *Guidance Note 7 Special Locations* Chapter 4 *Construction and demolition site installations*
- BS 4363:1998+A1:2013 *Distribution assemblies for reduced low voltage electricity supplies for construction and building sites*