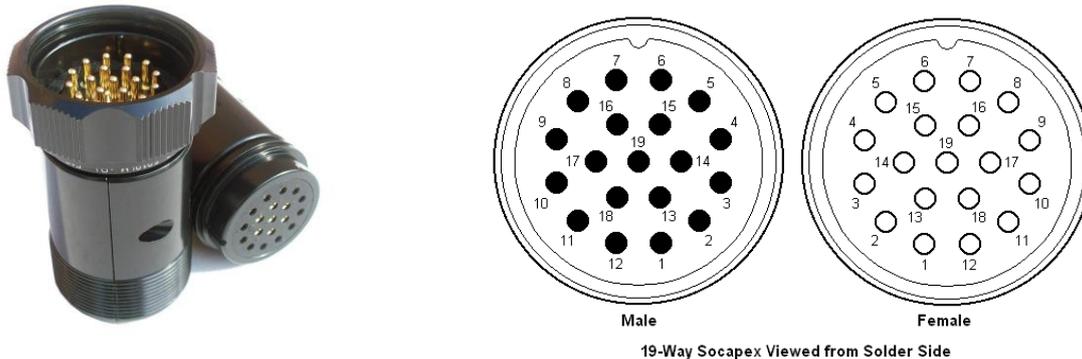


Why do Kinesys not produce hoist controllers using a single Socapex† connector for combined power and control?

The “Socapex”† 419 type circular connector is commonly used in the entertainment industry, primarily for connecting six circuits of lighting equipment to dimmers or power distribution. As such, the most frequently used pinout is now referred to (in an advisory capacity) in documents such as *BS7909:2011 - Code of practice for temporary electrical systems for entertainment and related purposes*.



Socapex cable is commonly manufactured with 18-core cable, with pins 1..18 wired straight through. Several brands of connector now incorporate features to allow the use of the centre 7 pins as CPC (**C**ircuit **P**rotective **C**onductor) or earth pins, including extended pins or sockets, and the use of a “grounding disc” which connects the centre 7 (earth) pins together, and may also connect the metal shell of the connector to the earth pins

A number of companies wish to use multicore cable for hoist power and control, to simplify cabling, for instance between the racks area and a flown truss. As Socapex cable is readily available in large quantities this would seem to be an obvious solution. If cables are incorrectly connected some damage to equipment may occur, however care must be taken to avoid a situation which could cause danger to personnel working with the equipment. The *Electricity at Work Regulations 1989* states in section (4)-1 that “*All systems shall at all times be of such construction as to prevent, so far as is reasonably practicable, danger.*”

While the chances of incorrect connection can be reduced by careful marking or positioning of cables and connectors, in the pressurised situation of a load-in, mistakes can and do occur. The harsh use conditions encountered by Socapex cabling also gives rise to the possibility of “spinners” on some brands of connector, where the insulating insert becomes rotated relative to the connector alignment keyway.

Kinesys use a connection scheme which does not eliminate the possibility of equipment damage, but does maintain the CPC or earth connection to devices at all times, irrespective of any incorrect connections. The Kinesys connection scheme also allows the use of cables with commoned earth pins (13-19).

The table overleaf details the “standard” pinout for Socapex connectors used for lighting power distribution (A), the existing Kinesys standard where one cable is used for power and one for control (B), and two of the currently available options for combined power and control (C and D) supplied by other controller manufacturers.

Consider then the scenarios which could occur when a hoist cable is inadvertently connected to a lighting dimmer or power distribution unit, or vice versa:

Pin Number	Lighting	Kinesys Standard		Combined Power & Control	
		Power	Control	Alternative 1	Alternative 2
	A	B1	B2	C	D
1	Live 1	Motor 1 L1	Motor 1 Common	Motor 1 Up	Mains L1
2	Neutral 1	Motor 1 L2	Motor 1 Down	Motor 1 Common	Mains L1
3	Live 2	Motor 1 L3	Motor 1 Up	Motor 2 Up	Mains L2
4	Neutral 2	Motor 2 L1	Motor 2 Common	Motor 2 Common	Mains L2
5	Live 3	Motor 2 L2	Motor 2 Down	Motor 3 Up	Mains L3
6	Neutral 3	Motor 2 L3	Motor 2 Up	Motor 3 Common	Mains L3
7	Live 4	Motor 3 L1	Motor 3 Common	Mains L1	Motor 1 Down
8	Neutral 4	Motor 3 L2	Motor 3 Down	Earth	Motor 1 Up
9	Live 5	Motor 3 L3	Motor 3 Up	Mains L2	Motor 2 Down
10	Neutral 5	Motor 4 L1	Motor 4 Common	Earth	Motor 2 Up
11	Live 6	Motor 4 L2	Motor 4 Down	Mains L3	
12	Neutral 6	Motor 4 L3	Motor 4 Up	Earth	
13	Earth 1	Earth 1	Earth 1	Motor 1 Down	Earth
14	Earth 2	Earth 2	Earth 2	Motor 2 Down	Earth
15	Earth 3	Earth 3	Earth 3	Motor 3 Down	Earth
16	Earth 4	Earth 4	Earth 4	Mains L1	Motor 1 Common
17	Earth 5	Earth	Earth	Mains L2	Motor 2 Common
18	Earth 6	Earth	Earth	Mains L3	Earth
19	(Earth)*	Earth	Earth		
Rack End	Male	Male	Female	Male	Male
Truss End	Female	Female	Male	Female	Female
Fan-out	Female	Female	Male	Female + Male	Female + Male

Power circuits are shown in RED, control circuits in YELLOW and CPC / Earth circuits in GREEN

* Pin 19 is optionally connected to earth and may be used as a connection for bonding connector bodies or as a screen connection for shielded cables

Lighting power (A) connected to hoist power fanout (B1)

All CPC connections are respected so hoist fanout and hoists are correctly earthed and there is no danger to personnel. Phases and neutral will be connected to hoist 3-phase power inputs, but as these are (usually) rated for connection phase-phase, no damage to equipment should occur.

The hoist control connections (B2) use a Socapex cable run in reverse (female to racks) so incorrect connection is much less likely.

Lighting power (A) connected to hoist power & control fanout (C)

Three of the earth pins in the fanout are connected to neutral conductors in the lighting power distribution. Where lighting is equipment is connected via a non-polarised patch system phase and neutral may be reversed, resulting in the possibility of a fanout or hoist becoming live. Where hoists are connected using the standard "ceeform" connectors the pins on the yellow control connectors are connected to live circuits and could pose an electrocution hazard. Connection of power to hoist control inputs could cause significant damage to the equipment.

Lighting power (A) connected to hoist power & control fanout (D)

The majority of the CPC connections are respected so the equipment is earthed, however the pins on the yellow control connectors are connected to lighting power outlets and could pose an electric shock hazard. Connection of power to hoist control inputs could cause significant damage to the equipment.

Hoist controller (B1) connected to lighting fanout (A)

All CPC connections are respected so the lighting fanout and luminaires are correctly earthed and there is no danger to personnel. Each luminaire could be connected across two phases of the supply so significant equipment damage may occur due to the overvoltage condition. Such damage may be limited or avoided by the use of correct circuit protection such as fast acting fuses, MCBs and RCDs, or by the use of overvoltage protection components as fitted to many power supplies.

The hoist control connections (B2) use a Socapex cable run in reverse (female to racks) so incorrect connection is much less likely.

Hoist controller (C) connected to lighting fanout (A)

As 3 of the CPC conductors are connected to phases of the mains supply there is the potential for the lighting fanout and luminaires to become live, posing a significant electrocution hazard. No lighting equipment should be damaged by incorrect connection, but there is the possibility of severe damage to the hoist controller due to arcing and overheating caused by a possible phase-phase-earth short circuit if the earth connections are commoned together in the lighting fanout (as is common practice).

Hoist controller (D) connected to lighting fanout (A)

Most of the CPC conductors are connected so lighting fanouts and luminaires should be correctly earthed. As each luminaire will be connected to two conductors on the same phase, or to a control circuit, no equipment damage should occur.

Use with cables with commoned earth connections

Only connection schemes A and B are compatible with cables having a grounding disc or other arrangement whereby the earth conductors are commoned together within the cable. Connection of such cables to a hoist controller with pinout C could result in a significant shock hazard as the connector body may become live during connection.

Use with cables with rotated inserts or missing alignment keys (“Spinners”)

Connection schemes A, B and, to some extent, D will maintain a CPC connection and prevent connected systems from inadvertently becoming live. However schemes C and D in conjunction with a rotated connector could both potentially result in the pins of a hoist control connector (yellow) becoming live, causing an electric shock risk.

So what are the other options?

Several companies have implemented connection systems based on alternative connectors which are not used for any other purpose in an entertainment environment. While this reduces the availability of cables in a wide variety of lengths, it does result in a system which avoids the possibility of incorrect connection, thereby avoiding equipment damage and, most importantly, the risk of electric shock hazard to personnel using the equipment. Contact Kinesys for further information on solutions using alternative connectors.

Hoist Connector Systems

This document refers specifically to hoists connected using the red and yellow “Ceeform” type connectors commonly used in the UK and parts of Europe. The same principles can be applied to most hoists connected using dual connectors for power and control (for example the US system using “twistlock” connectors. Many of the risks of equipment becoming live due to an incorrectly connected CPC or earth connection also apply to hoists using a single connector for power and control – for example a Harting or 7-pin Socapex type connector.

Notes on Standards

This document refers to British standards for electrical equipment and the regulations governing electrical safety at work. Many other global territories have similar legislation governing the safe use of electrical equipment in the workplace.

† Socapex is a brand name of Amphenol-Socapex. Equivalent connectors are produced by a number of other manufacturers, although the terms “Socapex”, “Soca” or “Soco” are commonly used to refer to the 19-pin connector, or a cable assembly with male and female 19-pin connectors fitted.