



## CP & WIRING SPECIFICATIONS

DOCUMENT TYPE. CONTROL PANEL SPECIFICATIONS

DOCUMENT NO. AMCPS01

# CONTROL PANEL WIRING SPECIFICATIONS

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THIS DOCUMENT IS DESIGNED TO COVER ALL APPLICATIONS, NO MATTER HOW BIG OR SMALL.

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**CONTROL PANEL: AMC STANDARD SPECIFICATIONS**

**WHAT WE NEED TO KNOW**

- It is essential that the customer reads our standard specification.
- Unless directed otherwise, the control panels will be built to the following specifications, with no exceptions.
- The need to know the supply voltage from the customer is essential to plan the circuits.
- This is needed before design can commence.
- Any variation from our standard specification to be agreed with AMC and confirmed by writing.(see 1.5)

**1: APPLICATION AND SCOPE OF THE SPECIFICATION**

















- 1.1: When manufacturing a control panel, particular attention is drawn to **EN 60204-1** (electrical equipment of industrial machines).
- 1.2: All equipment used will be to **I.E.C** standard and/or **BRITISH STANDARD**.  
All components shall be ROHS compliant and will conform to IEC/EN 60947-4-1.
- 1.3: All work will be done in accordance with **IEE regulations** for electrical installations and in compliance with **EN 60204-1**.
- 1.4: A technical construction file for each control panel will be supplied by AMC, showing electrical schematics and voltage supply requirements.
- 1.5: Any special requirements or deviation from our specification shall be confirmed with AMC.
- 1.6: The construction of the control panel will be to **EN 60204-1** unless stated in the construction file.

**2: ENCLOSURES**

- 2.1: Enclosures will be sized accordingly to suit components and available space, leaving a minimum 20% spare room for additions, where possible.
- 2.2: Enclosure material may differ for each application and the environment the control cabinet will inhabit will be taken into consideration.
- 2.3: enclosure material options are ABS and GRP in **RAL 7035** colour, mild steel, powder coated to RAL 7035, or stainless steel, all with a minimum **IP65** rating,
- 2.4: There will be no provisions for customer connections, only a gland plate if the designed cabinet has provisions for one.

### IP RATINGS

THE IP (INTERNATIONAL PROTECTION) RATING GIVEN TO AN ENCLOSURE STATES THE DEGREE OF PROTECTION IT OFFERS BY MEANS OF TWO DIGITS. A SUMMARY OF THESE IS SHOWN BELOW; FOR A MORE DETAILED DEFINITION SEE IEC529:1989, BS EN 60529: 1992

FIRST DIGIT - PROTECTION AGAINST SOLID FOREIGN OBJECTS AND ACCESS TO HAZARDOUS PARTS			SECOND DIGIT - PROTECTION AGAINST INGRESS OF WATER		
THE FIRST DIGIT COVERS PROTECTION AGAINST PENETRATION BY SOLID OBJECTS, WHICH INCLUDES HANDS AND TOOLS SUCH AS SCREWDRIVERS. AT THE LOWEST OF SEVEN LEVELS, 0, NO PROTECTION IS OFFERED; EITHER OF THE EQUIPMENT ITSELF FROM DAMAGE BY INTRUSION OR OF A PERSON CONTACTING LIVE OR MOVING PARTS. AT THE HIGHEST, 6, THERE SHALL BE NO ENTRY OF DUST.			THE SECOND DIGIT COVERS THE DEGREE OF PROTECTION AGAINST THE ENTRY OF WATER, ON A PROGRESSIVE SCALE. FOR EXAMPLE, NUMBER 1 INDICATES THAT DRIPPING WATER SHALL HAVE NO HARMFUL EFFECT, AND NUMBER 8, INDICATES PROTECTION AGAINST COMPLETE, CONTINUOUS SUBMERSION IN WATER.		
IP 0		NO PROTECTION	IP 0		NO PROTECTION
IP 1		PROTECTED AGAINST SOLID OBJECTS UP TO 50MM	IP 1		PROTECTED AGAINST VERTICALLY FALLING DROPS OF WATER
IP 2		PROTECTED AGAINST SOLID OBJECTS UP TO 12MM	IP 2		PROTECTED AGAINST DIRECT SPRAYS OF WATER UP TO 15° FROM THE VERTICAL
IP 3		PROTECTED AGAINST SOLID OBJECTS OVER 2.5MM	IP 3		PROTECTED AGAINST SPRAYS OF WATER UP TO 60° FROM THE VERTICAL
IP 4		PROTECTED AGAINST SOLID OBJECTS OVER 1MM	IP 4		PROTECTED AGAINST WATER SPLASHED FROM ALL DIRECTIONS
IP 5		PROTECTED AGAINST DUST	IP 5		PROTECTED AGAINST LOW PRESSURE JETS OF WATER FROM ALL DIRECTIONS
IP 6		TOTALLY PROTECTED AGAINST DUST	IP 6		PROTECTED AGAINST STRONG JETS OF WATER
			IP 7		PROTECTED AGAINST IMMERSION
			IP 8		PROTECTED AGAINST COMPLETE, CONTINUOUS SUBMERSION IN WATER

NOTE  
IN THE EVENT OF ADDITIONAL HOLES BEING DRILLED/PIERCED OR KNOCKOUTS REMOVED, SUITABLE MEASURES SHOULD BE TAKEN TO RESTORE THE PRODUCTS TO THE ORIGINAL RATINGS.  
IEC 529, BS EN 60529 DOES NOT APPLY TO PROTECTION AGAINST THE RISK OF EXPLOSION OR CONDITIONS SUCH AS HUMIDITY, CORROSIVE GASES, FUNGI OR VERMIN. IN CERTAIN CASES EQUIPMENT DESIGNED TO BE MOUNTED IN AN ENCLOSURE WILL CONTRIBUTE TOWARDS THE STATED IP RATING (EG PUSH BUTTONS MOUNTED IN AN ENCLOSURE). DIFFERENT PARTS OF ENCLOSURES CAN HAVE DIFFERENT DEGREES OF PROTECTION AND STILL CONFORM TO THE STANDARD (EG ENCLOSURES WITH PRE-DRILLED CONDUIT ENTRY).

### 3: SUMMARY OF BUILD

- 3.1: Terminal rails will carry 20% minimum spare terminals (where possible); fitted with blank markers to allow the terminals to be labelled should they ever be used.
- 3.1A: Terminals of cables of different voltage will be segregated/separated by means of an end stop, minimum.
- 3.1B: Fuse terminals will be clearly labelled and be of 20X5mm in size, cartridge type.
- 3.2: There will be minimum testing requirements on any control panel. (See section 6)
- 3.3: All wiring will be numbered which will correspond to the electrical schematics. (See 3B.5)
- 3.3A: All spare I/O will be wired to terminals.

- 3.5: All control gear IE: circuit breakers, contactors and relay overloads Etc, will be sized accordingly to suit motor ratings and control gear ratings.
- 3.6: We have no standard control voltage; however certain regulations call for certain requirements. We would always use low voltage for controls and this can be either 24VAC or 24VDC.
- 3.7: A Pilz safety relay (dual channel) will be used in all applications as standard where deemed necessary. If deemed unnecessary, sometimes a latching relay will be used instead.
- 3.8: A local emergency stop pushbutton will be fitted on every control panel, where deemed appropriate, with the facility to add at least 1 remote emergency stop pushbutton.
- 3.9: Standard trunking used is a narrow slot trunking which conforms to **DIN EN 50085** to the colour of **RAL 7030**.
- 3.10: Every panel will have a main isolator, cutting power to all internal circuits.
- 3.10A: The door will be interlocked through a main isolator (where applicable/necessary) and sized accordingly, to prevent unauthorised entry. It will be possible to override this.
- 3.11: All devices will be fixed using screws where applicable, and tapped holes.
- 3.11A: Din rail will be used for smaller components; larger components will be nut and bolted.
- 3.11B I.S.O Metric screws will be used throughout.
- 3.12: Anti condensation heaters (if fitted) will have an appropriate warning label in close proximity.
- 3.13: All removable plates will be fitted with a gasket.
- 3.14: Internal guarding will be **IP2X** minimum, i.e.: no live parts should be able to be touched with the bare hand. If it can be touched then the guarding will be deemed as insufficient.
- 3.15: Any panel lighting (if fitted) to be operated by a door switch unless specified.
- 3.16: All safety switches shall be to **BS EN 60204** and **BS 5304**.

### **3A: LABELLING AND IDENTIFICATION**

- 3A.1: All information plates, door labels and name plates will be written in English as standard and will be black engraving on white traffolyte.
3. A.2: Any informative labels will be in yellow, all warning labels will be red.
3. A.3: All internal back plate marking, where fitted will be engraved gravoply.
3. A.4: All component markers where fitted, will be printed stickers.
- 3A.5: The voltages within the panel will be clearly identified with a label within the control panel, and the supply voltage must be clearly marked on the door near the isolator in the form of a danger label.
- 3A.6: A general hazard sign will be suitably fixed to all electrical control cabinets at access points. The hazard sign shall be to **BS 5499** and **BS 5378**.
- 3A.7: A free issue AMC sign to be fitted suitably externally on each control panel.

### **3B: INTERNAL CABLING AND CABLE MARKING**

- 3B.1: The wiring of the control panel will be tri-rated cable (T.R.S – TRI RATED SINGLES) or **BS6231** cable.  
This meets the requirements of **UL** and **CSA**, as well as **BS6231**, making it suitable for use in North America and all across Europe.  
With a maximum operating temperature of 105<sup>o</sup>C it is made from class 5 copper stipulated by **BS EN 60228:2005** and an outer sheathing of heat resistant polyvinyl chloride (PVC).  
Incorporating this, power cables (PHASE) will be harmonised as to **BS EN 50525** and **EN 60445** and **EN 60446** and **IEC 60227-1**.

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CONDUCTOR COLOR CODING		
Conductors	International Conductor Color Coding	North American Conductor Color Coding
	Coding used for North American, International, and Universal Cable	Alternative Coding Used for North American Cable
<b>3 Conductors</b>		
Ground	Green/Yellow	Green
Neutral	Blue	White
Line	Brown	Black
<b>4 Conductors</b>		
Ground	Green/Yellow	Green
Line	Brown	Black
Line	Black	Red
Line/Neutral	Gray*	White
<b>5 Conductors</b>		
Ground	Green/Yellow	Green
Neutral	Blue	White
Line	Brown	Black
Line	Black	Orange
Line	Gray	Red
International conductor color coding per EN 60445 Section 6 and IEC 60227-1 Section 4.1.2 North American conductor color coding per UL 62 and CSA C22.2 No.49		
* International conductor color coding for 4 conductor flexible cable is specified by the standards as ground (green/yellow) line (brown), line (black), and line (gray). North American 4 conductor flexible cord is specified by the standards and codes as ground (green), line (black), line (red), and neutral (white). This difference is due to the multiple main configurations where North American flexible cords can be utilized.		

3B.2: The minimum size for power cables will be 1.5mm, and sized accordingly to current rating of the components.

3B.3: Where possible, the control panel's internal wiring will be to EN60204-1 IEC60204-1 cable colours. **AMC001.**

**TABLE AMC01.**

BLACK	A.C AND D.C POWER CIRCUITS.
RED	A.C. CONTROL CIRCUITS
BLUE	D.C. CONTROL CIRCUITS
ORANGE	INTERLOCK CONTROL CIRCUITS SUPPLIED FROM AN EXTERNAL POWER SOURCE
LIGHT BLUE	NEUTRAL
GREEN-AND-YELLOW	PROTECTIVE CONDUCTOR

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3B.4: If we cannot apply EN60204-1 IEC60204-1 cable colours, we will apply our in house standard cable specification.

Please refer to the table below. **AMC002.**

**TABLE AMC02.**

<b>VOLTAGE</b>	<b>COLOUR</b>	<b>MINIMUM CABLE SIZE</b>
400-460VAC	BROWN/BLACK/GREY	1.5MM
AC NEUTRAL ALL VOLTAGES	BLUE	1.5MM
240VAC	LINE VOLTAGE COLOUR	1.00MM
110VAC	YELLOW	1.00MM
24VAC	WHITE	0.5MM
24-48VDC	VIOLET	0.5MM
10-12VDC	RED	0.5MM
ANALOGUE (4-20MA/1-5V)	PINK	0.5MM
VOLT FREE (DRY CUSTOMER)	ORANGE	0.5MM
LIVE SIDE OF ISOLATOR	DARK BLUE	1.5MM
INTRINSICALLY SAFE CIRCUITS	LIGHT BLUE	1.00MM
INTERNAL SCREENS	GREEN	1.00MM
EARTHING/BONDING	GREEN WITH YELLOW TRACE	1.00MM

3B.4: The minimum size for control cables to be 0.5mm.

3B.5: Cable marking will comply with **IEC 60757**. Please refer to the table below **AMC003.**

**TABLE AMC003**

<b>NUMBER</b>	<b>COLOUR</b>
1	BROWN
2	RED
3	ORANGE
4	YELLOW
5	GREEN
6	BLUE
7	VIOLET
8	GREY
9	WHITE
0	BLACK

3B.6: Numbers will read away from the device.

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- 3B.7: Cable numbering will be as the schematic, and will not be duplicated.  
 3B.8: Insulated bootlace ferrules will be used on all cables including mains.  
 3B.8A: Ring lugs are acceptable on earth bonding.  
 3B.9: No more than 2 wires into any side of a terminal, and the appropriate double insulated bootlace ferrule will be used.  
 3B.10: Please refer to the colour chart below.  
 Either standard is acceptable.

Cord End Ferrules						
French Type			German Type			
Part No.	Colour	Conductor Size (mm <sup>2</sup> )	Barrel Length (mm)	Colour		Part No.
CEF025F	Violet	0.25	6	Light Blue		CEF025G
CEF034F	Pink	0.34	8	Turquoise		CEF034G
CEF508F	White	0.5	8	Orange		CEF508G
CEF7508F	Blue	0.75	8	White		CEF7508G
CEF108F	Red	1.0	8	Yellow		CEF108G
CEF1508F	Black	1.5	8	Red		CEF1508G
CEF2508F	Grey	2.5	8	Blue		CEF2508G
CEF409F	Orange	4	9	Grey		CEF409G
CEF612F	Green	6	12	Black		CEF612G
CEF1012F	Brown	10	12	Ivory		CEF1012G
CEF1412F	Ivory	14	12	Green		CEF1412G
CEF25014F	Black	25	16	Brown		CEF25014G
CEF35014F	Red	35	16	Beige		CEF35014G

### **3C: PUSHBUTTONS AND INDICATION LAMPS**

We have used **EN 60204-1:1997** as a guideline to determine the colours of indication lamps and pushbuttons. Please refer to the table below **AMC004** for colour identification.

**TABLE AMC004**

COLOUR	LAMP	PUSHBUTTON
<b>RED</b>	DANGER/TRIPPED/STOPPED CONDITION	STOP/E-STOP/DISABLE
<b>AMBER</b>	WARNING/MONITOR/ABNORMAL CONDITION	OVERRIDE
<b>GREEN</b>	RUNNING	START/RUN/ENABLE
<b>WHITE</b>	POWER SOURCE/HEALTHY	
<b>BLUE</b>	RESET	RESET/
<b>BLACK</b>		CAUSE OPERATION MOMENTARY/JOE/INCH/CRAWL

### **3D: TRUNKING AND CABLE MANAGEMENT.**

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3D.1: Standard trunking used is narrow slot which conforms to **DIN EN 50085** to the colour of **RAL 7030**.

3D.2: All cables will be contained in slotted trunking where possible conforming to **DIN EN 50085**.

3D.3: Wiring from doors etc, will be in a flexible conduit/sleeving as to protect the cables from wear and tear through opening and closing of the enclosure door.

3D.4: All cables will be neat and tidy.

3D.5: Terminals will be of screw type.

#### **4: EARTHING**

4.1: Either earth terminals or earth bar to be fitted (depending on space) in all control cabinets.

4.2: All components with an earth connection will be individually earthed to an individual earth terminal, or point on the earth bar.

4.3: Earth straps will be fitted between the main cabinet and all removable plates/side panels etc, including the back plate.

4.4: A P.E label will be used to identify where the main incoming earth is to be connected as required by **EN 60204-1**, whether this be a terminal or an earth stud.

4.4A: Minimum size for an earth stud will be 8mm and to be of brass material.

#### **5: TESTING**

See supporting documents **AMCPS03 & AMCPS04**.

The test procedure will be as follows.

6.1: Screw tightness: - all terminations to be tested for tightness prior to applying voltage.

6.2: Point to point test: - continuity tests for all analogue cabling.

6.3: Voltage test: - voltage applied to the circuitry.

6.4: Function tests: - voltage applied to all coils ensuring that they energise and operate correctly.

6.5: Testing the whole panel circuitry ensuring it operates as per schematic drawings.

6.6: Signed documentation/certification showing the above has been carried out will be supplied.

- All delivery notes etc for free issue items will be supplied.
- Full set of schematics will be provided.
- I/O list will be provided.

\*\* Acceptance will be subject to AMC approval







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