

WATER SUPPLIES DEPARTMENT
STANDARD SPECIFICATION E-11-03
ELECTRICAL & INSTRUMENTATION PANELS AND CUBICLES

1. **GENERAL**

Panels/Cubicles manufactured or assembled in individual units to a standard/custom design shall comply with this Specification. Unless otherwise specified in the Particular Specification, wall-mounted cubicles shall be mass manufactured and floor-standing panels shall be custom-built.

This Specification takes precedence of WSD Standard Specification E-00-01 where there are discrepancies between these two Standard Specifications.

2. **EQUIPMENT & COMPONENTS**

2.1 **General**

Provision shall be made for the checking of components and insulation materials prior to the fixing of covers or access plates. Components mounted on hinged covers shall have a minimum clearance of 25 mm from equipment mounted inside the cubicle. Components and insulation sheets shall not be mounted on side plates and bolted access plates.

2.2 **Power Components**

Transformer windings shall be epoxy-resin encapsulated or vacuum impregnated with waterproof varnish.

Wire-wound resistors shall be on ceramic formers and embedded in fire-proof and dust-proof materials, e.g. vitreous enamel.

2.3 **Indicating Lamps**

Indicating lamps for switchgear panels shall be of individually flush-mounted units with brass or die-cast bevelled aluminium bodies. LED indicating lamps complying with IEC 60947-1 and IEC 60947-5-1 shall be used. They shall have a protection rating of IP54 for indoor or IP65 for outdoor / chemical process area to IEC 60529.

‘Running’/‘On’ indicating lamp shall be located on the right hand side of the ‘Off’ indicating lamp when arranged in a row.

2.4 Push-buttons

Push-buttons shall comply with IEC 60947-5-1 with brass or die-cast bevelled aluminium bodies. For circuit-breakers and motor starters in switchgear panels, push-buttons shall be of individually flush-mounted units in circular of nominal diameter 32 mm. For valve control in control panels and motor control, rating up to 40 kW, Push-buttons in individual local starter cubicle shall be in circular of nominal diameter 22 mm. They shall have a protection rating of IP54 for indoor or IP65 for outdoor / chemical process area to IEC 60529.

Suitable shrouds or guards shall be fitted to each push-button to prevent inadvertent operation. Units shall be water-tight to IEC 60529 IP 55 at the front.

Emergency stop push-buttons shall be of twist-knob released type with red mushroom head and shall have shrouds or guards to prevent inadvertent operation.

The contacts of push-buttons shall be rated for 1 million mechanical operations. The rated thermal current of contacts shall be not less than 15A at 220V 50 Hz a.c.

‘Start’ push-button shall be located on the right hand side of ‘Stop’ push-button when arranged in a row.

2.5 Instruments

Panel mounted equipment/instruments shall be housed in enclosures rated IP54 for indoor or IP65 for outdoor / chemical process area to IEC 60529.

Ammeters and voltmeters shall have 240° scale and have performance and marking in full compliance with IEC 60051 of Class Index 1.5.

2.6 Control Selector Switches

Control selector switches shall be of rotary, independently manual operated action with double break air-break contacts complying with the following requirements :-

Rated insulation voltage : 600V 50 Hz a.c. or 300V d.c.

Rated thermal current of contacts : Not less than 15A at 220V 50 Hz a.c.

Endurance : 1 million mechanical operations and 0.1 million on-load electrical operational cycles

Switches shall be turned clockwise for ‘On’ or ‘Close’ position and anticlockwise for ‘Off’ or ‘Trip’ position. Switches for pump duty and control mode selection shall be fitted with integral locks within the spindle of the handle. Handles shall

be black in colour. Switches shall have a flush square bezel unit and anodized aluminium escutcheon plate suitable for panel front mounting.

Selectors shall have break-before-make contacts except for ammeter or recorder selector application. Ammeter switches shall have three phases and neutral current selections and voltmeter selector switches shall have all phases and line voltage selections.

2.7 Relays and Timers

2.7.1 General

Control relays shall be used for control of power supplies rated 80A and above, motors rated 40 kW and above, station control and tripping. Auxiliary relays may be used for control of power supplies up to 80A and motors below 40 kW, alarm and indication. Control relays shall be secured on sockets by vibration proof quick-fastening clips.

Solid state timers shall be of plug-in type with accuracy of 5% or better. Timer contacts shall not be used for direct switching of circuit breakers and contactors above 80A with d.c. operating coils.

2.7.2 Contact Rating

Contacts for relays and timers shall be rated at 1 million mechanical operations and 0.1 million on-load electrical operational cycles. Contacts for control relays shall be of double break type.

The rated thermal current of the contacts for control relays shall be not less than 15A at 220V 50 Hz a.c. Contact rating for auxiliary relays and timers shall be not less than 30% of that of control relays.

2.8 Mass Assembled Motor Starters

2.8.1 General

This section only applies to individual wall-mounted starters for electrical motors up to 16 kW e.g. plant room/pumphall ventilation fans, bearing cooling pump etc.

Cast iron and plastic enclosures shall not be used.

2.8.2 Starter Short-circuit Capacity

The starter, including the enclosure, shall be designed to comply with the following requirements:-

- (a) Short-circuit capacity of AC3 or AC4 utilization category to IEC 60947-4-1.

- (b) Contactor and overload element shall comply with type '2' coordination to IEC 60947-4-1.

Contactors shall be rated for the line currents even if star/delta starting is employed. Contactors for all reversible drives shall be rated at AC4.

2.9 Custom-built Motor Starters

Starters with an enclosure, contactor or other components that differ from the standard mass production version shall be considered as custom-built starters whereby the following requirements shall be complied with :-

- (a) Panels/Cubicles for starter assembly shall be of 2 mm thick zinc coated sheet steel, rated IP 55 to IEC 60529.
- (b) Contactors shall be of standard rating 16A, 40A, 80A or 160A, AC3 or AC4 duty as specified. The contactor current shall correspond with the line current regardless of the contactor connection.
- (c) Main fuses shall comply with IEC 60269 or BS 88 Part 2.
- (d) The short-circuit capacity of the contactor shall comply with IEC 60947-4-1 utilization category, AC3 or AC4 as applicable.
- (e) Contactor and overload element shall comply with type '2' coordination to IEC 60947-4-1.

3. WALL-MOUNTED AND FLOOR-STANDING PANELS AND CUBICLES

3.1 General

Wall-mounted or floor-standing panels/cubicles shall be provided for switchgear panels or control panels. Unless otherwise specified in the Particular Specification, floor-standing panels shall be provided if the size of the enclosure exceeds 1000 mm in height or 800 mm in width.

3.2 Wall-mounted Steel Cubicle

3.2.1 Enclosure

For outdoors, chemical storage areas/chemical plant areas and salt water applications, enclosure shall be of stainless steel of 1.5 mm thick. Degree of protection of the enclosure shall be IP 65 to IEC 60529.

For indoors in clean environment, enclosure shall be of sheet steel of 2 mm thick. Degree of protection of the enclosure shall be IP 54 to IEC 60529.

3.2.2 Construction

The enclosure shall be fitted with two gland plates of 3 mm nominal thickness complete with fixing lugs. The cover and gland plates shall be fitted with neoprene gaskets. Padlocking facility shall be provided. Panels for outdoor installations shall be fitted with a canopy.

The cover shall be fixed with stainless steel hinge and fixing screws. An internal earthing stud shall be provided.

3.3 Wall-mounted Die-cast Aluminium Cubicle

3.3.1 Application

Die-cast aluminium cubicle can be used as a junction box in electrical building services installation in chemical plant areas.

3.3.2 Enclosure

The enclosure shall be of 5 mm thick die-cast aluminium alloy AL-Sil2 or approved equivalent suitable for an operating temperature up to 120°C maximum.

3.3.3 Construction

The enclosure shall have a neoprene gasket seal. Fixing holes for the lid shall be outside the sealed area with captive fixing screws. An earth connection shall be provided.

3.4 Custom-built Floor-standing Panels and Cubicles

3.4.1 Enclosure

Floor-mounted panels shall be free standing with a skirt of 100 mm minimum. In addition, panels shall be fitted with a canopy for outdoor applications.

For floor-standing panels, an access door with chromium-plated hinges and handles shall be provided. Integral locks shall be fitted and flushed with the door handles. For floor-standing cubicles, cover shall be secured by quick-release fasteners. Rubber or neoprene sealing gaskets shall be fitted on the channels on the edges of panel/cubicle doors and cover plates for effective dust sealing. Plain surface with adhesive gasket shall not be acceptable.

Doors with components exceeding 1 kg in weight mounted thereon shall be 3 mm thick. Access plates shall have no components fitted. All swing door openings shall be limited to 120°.

Separate mounting plates of minimum thickness 3 mm shall be used for individual group of components for ease of removal and access to components. The group of components shall be so arranged that the removal of a group does not require the removal of another group to facilitate maintenance.

Undrilled cable gland plates of 3 mm minimum thickness shall be provided for bottom entry of cables. The gland plate shall be fixed by bolts or studs and nuts such that they can easily be removed for drilling. For cubicles less than 150 x 300 mm, knockouts for 20 mm conduit can be acceptable in lieu of cable gland plates.

Front and rear access doors shall be provided for floor-standing motor starters and control panels. Rear doors shall be double-leaf fitted with lockable handles and lift-off hinges. Front access doors shall be swing panel of 3 mm thick, hinged at the left hand side. No components shall be mounted on rear access doors or access plates (front or rear).

For each panel and cubicle where condensation is likely to be present, an anti-condensation panel heater complete with a humidity sensor and 16A double-pole isolating switch shall be fitted.

3.4.2 Construction

Panels/Cubicles shall be fabricated from zinc coated sheet steel with minimum zinc coating thickness 0.063 mm. The plate shall be of 2 mm minimum thickness suitably braced to form a rigid structure. For outdoor application, 2 mm thick minimum stainless steel shall be used.

External bolts and nuts shall be chromium-plated. Moreover, exterior corners and edges shall be rounded to give a smooth overall appearance.

3.4.3 Steelwork Finish

Untreated steelwork shall be thoroughly cleaned by chemical pickling and an approved anti-rusting priming coat shall be applied. Treated steelwork shall be suitably cleaned and degreased. Surfaces after treated shall then have not less than two stoved undercoats and two stoved finish coats of paint. Undercoats shall be epoxy based and easily distinguishable in shade or colour from the priming and finishing coats. The two final coats shall have a total minimum dry film thickness of 0.075 mm with each coat separately stoved in an air-circulating oven.

The final paint coating shall be semi-matt shade 18B21 to BS 4800 (light grey) or equivalent. Panel interior shall be of white anti-condensation paint.

Where a number of floor-standing panel sections are assembled to form a complete unit, the manufacturer shall ensure that a finish of uniform texture and an exact colour match is achieved.

If an alternative finishing processes is to be used details with type test certificates on paint finish to BS 3900 or equivalent shall be provided for verification of equivalence to the process specified above.

3.5 Mass Manufactured Floor-standing Panels and Cubicles

3.5.1 General

Mass manufactured floor-standing panels/cubicles can be provided only where specified in the Particular Specification.

3.5.2 Enclosure

For outdoors, chemical storage areas/chemical plant areas and salt water applications, stainless steel of 1.5 mm thick enclosure shall be used. Degree of protection of the enclosure shall be IP 65 to IEC 60529.

For indoors in clean environment, sheet steel of 2 mm thick enclosure shall be used. Degree of protection of the enclosure shall be IP 54 to IEC 60529.

3.5.3 Construction

Mounting plates shall be of sheet steel with minimum thickness 3 mm.

Doors shall open to 120° nominal free from obstruction. Sealing gaskets and earth strap shall be fitted on the door. Sealing gaskets shall be of easily replaceable type.

Vertical pre-drilled rails shall be provided on both sides of the panel and door interior for added strength and attachment of horizontal mounting rails and cable channels, unless the door is of 3 mm thick sheet steel.

Panels shall be primed by electrophoresis dip coating or of zinc coated sheets for the first rate protection against corrosion, and suitably cleaned and degreased prior to coating of electro powder epoxy base paint finish.

Panels shall be fitted with sturdy edge bolts, 100 mm skirt at the base and an integral lock flush with the panel. In addition, panels shall be fitted with a canopy for outdoor applications.

4. SMALL WIRING

4.1 Wiring - General

Supply cables for 1-phase / 3-phase equipment shall be colour coded to conform to the latest colour coding requirements as specified in the Code of Practice for the Electricity (Wiring) Regulation of EMSD. Small wiring in switchgear and control panels shall be marked and colour coded. Small wiring for a.c. shall be black and that for d.c. be grey. Earthing connections shall be green/yellow.

4.2 Wiring Method

Wiring for relays, timers, auxiliary switches, selectors and push-buttons shall be neat with a minimum spacing of 30 mm between terminals and wiring channels. Outgoing and incoming contacts shall be wired to a terminal board on the fixed portion of the panel.

Wiring shall be adequately protected from mechanical damage by the use of cabling channels, rubber grommets through holes etc. Wires shall be neatly clipped and run at horizontal and vertical directions only. Where more than 10 wires are in the same route, cabling channel shall be used.

A general arrangement diagram shall be provided. The diagram shall show to scale the location of each component relative to others and the wiring route.

4.3 Termination

Pre-insulated compression terminals shall be preferred for small wiring of stranded and flexible conductors of up to 6 mm², otherwise insulated sleeves shall be fitted at the ends of wires. Terminals shall be manufactured from high conductivity tin-plated copper. Insulated sleeves shall be of nylon or 0.8 mm thick PVC colour coded as follows :-

<u>Conductor Size</u>		<u>Colour of Sleeve</u>
0.5 - 1 mm ² flexible)	Red
0.5 - 1.5 mm ² stranded)	
1.5 mm ² flexible)	Blue
2.5 mm ² stranded)	
4 - 6 mm ² stranded)	Yellow

4.4 Terminal Blocks

Except for electronic equipment and instruments, the rated thermal current of terminal blocks for wiring shall be not less than 30A. Terminals for motors and valve actuators shall be at least 2 sizes larger than the rated output current to cater for larger cables required due to voltage drop considerations. Each terminal shall bear a permanent identification number or letter.

Stud type terminal blocks of M6 or OBA size can be provided for relays, complete with removable PCP or PVC shrouds. PVC taping is acceptable as an alternative. Studs shall be of such length that lock nuts shall not be more than 10 mm from the end.

Spacing between adjacent rows of terminal blocks shall be not less than 150 mm to permit convenient access to wires.

4.5 Wire Termination Method

Number interlocking ferrules of white or yellow PVC with black characters shall be fitted to terminations corresponding to circuit diagrams and wiring diagrams. The numbers shall be read from the wire ends, except for vertical runs, where the numbering shall be correct-side-up.

Where external control cables are to be terminated on the equipment supplied, terminal blocks shall be provided in the equipment.

Different wires of the same wire number shall be terminated at different but adjacent terminals and shorted by tinned or nickel-plated copper links at the terminal block. Internal wiring cable cores shall be terminated at the upper, inner or right side of the terminal block. Where inter-panel wiring passes through panel side sheets, access holes shall be fitted with rubber or plastic grommets.

Wiring for known future equipment/connections shall be provided, and all such wires shall be terminated on terminal blocks.

10% spare terminals shall be provided.

5. ACCESSORIES

5.1 Locks

Chromium-plated brass cylinder locks with engraved labels and three sets of keys shall be provided for panels & cubicles.

5.2 Labels

For components such as push-buttons, control relays and component assemblies, individual labels shall be provided. Where several identical components are installed within the same panel, the description of labels shall distinguish between them. Labels shall not be blocked by equipment or wiring. Panel front labels shall be located above the corresponding components.

Wording of labels shall be concise and unambiguous and shall be approved by the purchaser before manufacture.

Each label shall be permanently secured to the panel surface by chromium-plated raised head screws, closely indicate the item functions to which it refers. Small labels inside an enclosure may be pasted with araldite.

The size of characters shall be as detailed below :-

<u>Type Designation</u>	<u>Height of Character</u>
Panel Nameplate - above 1.6 m high	15 mm
- below 1.6 m high	10 mm
Cubicle Nameplate	6 mm
Circuit Legend	4.5 mm
Control equipment & alarm annunciator legends	3 mm

For known future equipment blank labels shall be provided.

5.3 Rainhood and Sunshade Provision

For outdoors, the rainhood and sunshade provision for the control panels and cubicles should be provided as specified in the Particular Specification, if necessary.

6. MANUFACTURER'S WORKS TESTS

Where several panels are supplied to form a complete unit these shall be fully assembled in manufacturer's works with all panels rigidly bolted together for witnessed inspection and testing prior to despatch.

Routine tests as required by the relevant IEC Standards and additional tests as detailed in the specification shall be carried out in the course of and/or on completion of manufacturing of equipment, and a detailed test report shall be submitted together with the delivery of the equipment.

- End of this Specification -