

GENERAL REQUIREMENTS FOR LOW VOLTAGE CONTROL GEAR ASSEMBLIES

SPECIFICATION

UEP-TSP-000001

RECORD OF REVISIONS

DATE:	REV.:	CHANGE DETAIL:	AUTHOR:	SIGN:	APP. BY:	SIGN:
10 May 2011	00	FIRST ISSUE	RDF		UH	

1 GENERAL

1.1 Scope

- 1.1.1 This Specification applies to low-voltage switchgear and controlgear ASSEMBLIES of which does not exceed 1 000 V a.c. at frequencies not exceeding 1 000 Hz, or 1 500 V d.c.
- 1.1.2 This Specification applies to ASSEMBLIES intended for use in the control of electric energy consuming equipment.
- 1.1.3 The object of this specification is to lay down the definitions and to state the service conditions, construction requirements, technical characteristics and tests for low-voltage switchgear and controlgear ASSEMBLIES.

1.2 Legal Requirements

- 1.2.1 All equipment and/or installations shall meet the requirements of the South African Occupational Health and Safety Act (Act No 85 of 1993). Should the plant be located outside the Republic of South Africa, such installations shall comply with the legislative requirements of the territory / country in which it will be located.

1.3 Symbols and Abbreviations

AC	Alternating Current
CT	Current Transformer
DC	Direct Current
DCS	Distributed Control System
EE	Electrical Equipment
Ex d	Flameproof
Ex n	Non-sparking
FAT	Factory Acceptance Test
Hz	Hertz
IEC	International Electrotechnical Commission
IP	Ingress Protection
kV	Kilovolt
kW	Kilowatt
LV	Low Voltage
MCB	Miniature Circuit Breaker

MCC	Motor Control Centre
mm	millimetre
NPT	Nominal Pipe Taper
OHS	Occupational Health and Safety
OMM	Operation and Maintenance Manual
PLC	Programmable Logic Controller
PVC	Poly-Vinyl-Chloride
QCP	Quality Control Plan
SCADA	Supervisory Control and Data Acquisition
SABS	South African Bureau of Standards
SANS	South African National Standards
SAT	Site Acceptance Test
SWA	Steel Wire Armoured
V	Volt

1.4 Precedence

1.4.1 The precedence of documents is as follows:

- a. The technical requirements specified in the clients RFQ or PO including terms, conditions and legal requirements;
- b. Data sheets;
- c. This Specification;
- d. Documents referenced in this Specification.

2 REFERENCE DOCUMENTS

2.1 South African National Standards (SANS)

SANS 10086	Installation and maintenance of electrical equipment used in explosive atmospheres
SANS 10108	The classification of hazardous locations and the selection of apparatus for use in such locations
SANS 10200	Neutral earthing in medium voltage industrial power systems
SANS 60529	Degrees of protection provided by enclosures (IP Code)

- SANS 808 Cable glands for use on flameproof enclosures (Ex d)
- SANS 1213 Mechanical cable glands
- SANS 60079 Electrical apparatus for explosive gas atmospheres
- SANS 10142-1 Wiring of premises Part 1: Low-voltage installations

2.2 unitemp Procedures

- UUA-QPR-000001 Document Numbering Convention

2.3 unitemp Specifications

- UEP-TSP-000000 Flanged Heater Control Panel Specifications and control Narrative
- UEP-TSP-000000 Trace Heating Control Panel Specifications and Control Narrative

2.4 Data Sheets

- UEP-TFR-000000 Flanged Heater Control Panel Data Sheet
- UEP-TFR-000000 Electrical Trace Heating Control Panel Data Sheet

3 SERVICE CONDITIONS

3.1 Normal Service Conditions

- 3.1.1 ASSEMBLIES conforming to this Specification are intended for use under the following service conditions.

3.1.2 Ambient air Conditions

- 3.1.2.1 For indoor installations where the ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C. The lower limit of the ambient air temperature is -5 °C.

- 3.1.2.2 For outdoor installations where the ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C. the lower limit of the ambient air temperature is -25°C in a temperate climate

3.1.3 Atmospheric Conditions

- 3.1.3.1 For indoor installations where the air is clean and its relative humidity does not exceed 50 % at a maximum temperature of +40 °C. Higher relative humidities may be permitted at lower temperatures, for example 90 % at +20 °C. Care should be taken of moderate condensation which may occasionally occur due to variations in temperature.
- 3.1.3.2 The relative humidity may temporarily be as high as 100 % at a maximum temperature of +25 °C.

3.2 Special Service Conditions

- 3.2.1 Where any of the following special service conditions exist, the applicable particular Specifications and requirements shall be complied with.
- 3.2.2 Special service conditions are, for example:
- a. Values of temperature, relative humidity and/or altitude differing from those specified 3.1.
 - b. Applications where variations in temperature and/or air pressure take place at such a speed that exceptional condensation is liable to occur inside the ASSEMBLY.
 - c. Heavy pollution of the air by dust, smoke, corrosive or radioactive particles, vapours or salt.
 - d. Exposure to strong electric or magnetic fields.
 - e. Exposure to extreme temperatures, for example radiation from sun or furnaces.
 - f. Attack by fungus or small creatures.
 - g. Installation in locations where fire or explosion hazards exist.
 - h. Exposure to heavy vibration and shocks.
 - i. Installation in such a manner that the current-carrying capacity or breaking capacity is affected, for example equipment built into machines or recessed into walls.

4 TECHNICAL REQUIREMENTS

- 4.1 Where applicable, equipment items shall carry the SANS (SABS) mark to demonstrate compliance with the directives.
- 4.2 All ASSEMBLIES wiring shall conform to the requirements for the area in which the equipment is to operate.
- 4.3 ASSEMBLIES shall be designed for a minimum operating life of 20 years.

4.4 Enclosure

- 4.4.1 ASSEMBLIES located in the open shall be of a weatherproof and dust-proof construction equal to or better than IP 55, as defined in SANS 60529.
- 4.4.2 Indoor ASSEMBLIES shall be of a construction equal to or better than IP 42.
- 4.4.3 In the case of an ASSEMBLY intended for use in locations with high humidity and temperatures varying within wide limits, suitable arrangements (ventilation and/or internal heating, drain holes, etc.) shall be made to prevent harmful condensation within the ASSEMBLY. However, the specified degree of protection shall at the same time be maintained.

- 4.4.4 Enclosures shall be of standardized design, wall or floor mounted, totally enclosed.
- 4.4.5 Wall mounted ASSEMBLIES shall have 4 fixing lugs for mounting.
- 4.4.6 Floor mounted ASSEMBLIES shall have full-length steel plinths and height not exceeding 2200 mm.
- 4.4.7 Enclosures shall be fabricated from new rust free sheet mild steel and shall have a minimum thickness of 2 mm.
- 4.4.8 The preferred finish is powder coating to a minimum thickness of 100 microns. The finish shall be smooth and glossy "orange peel" effect.
- 4.4.9 Enclosures shall be suitably reinforced to prevent warping or buckling. Folding around door openings shall be such that dust or water lodged on top of the doors will not enter into the inside of the panel on opening of the door.
- 4.4.10 Weatherproof enclosures shall have sloping roofs and guttering directing water away from doors.
- 4.4.11 Access doors shall be fitted with suitable lift off hinges and pad-lockable handles.
- 4.4.12 All nuts, bolts, screws, etc. shall be hexagonal to ISO metric commercial standards. All bolts, nuts, washers, springs, etc. shall be rustproof and chrome plated.
- 4.4.13 Self-tapping screws shall not be utilised for any purpose.
- 4.4.14 Heavy duty neoprene dust seals shall be provided for all doors and removable panels. The seal shall be glued and held in place by a continuous retaining strip.
- 4.4.15 Where threaded enclosure entries for electrical cables / instrument cables / conduits are required, it shall conform to threaded isometric, thread pitch 1.5 mm.
- 4.4.16 In cases where enclosures are threaded other than metric (e.g. NPT, etc.), purpose made thread adapters shall be provided.
- 4.4.17 Clearances between phases and between phase and earth shall be at least 8 mm.
- 4.4.18 Each enclosure shall be fitted with one M10 external earth stud with washer and bolt connected to an internal copper earth bar. All non-current carrying parts of the panel shall be effectively connected to this point. The door and gland plate shall be earthed using a flexible connection to the fixed part.
- 4.4.19 All cable entries shall be from below. Gland plates shall be galvanized steel, undrilled, removable and sufficiently sized to accommodate all cables plus a minimum of 20% spare space.
- 4.4.20 Sufficient space shall be left between the gland plate and terminals (minimum 150mm).
- 4.4.21 Depth of the enclosure to be kept to a minimum.
- 4.4.22 Working access is required for wiring, glanding of cables and terminating conduits without removing equipment.
- 4.4.23 Incomer and feeder sections must be segregated.

4.5 Busbars, Copper-work and Wiring

- 4.5.1 The busbars, copperwork and connections shall comply with SANS 60439-1 and shall be marked indicating phases.
- 4.5.2 Busbars shall be supported by suitable insulators.
- 4.5.3 All bolted copper joints shall be silver plated. Only high tensile bolts and nuts may be employed (with a minimum tensile strength of 8.8). The use of spring washers is not acceptable.
- 4.5.4 The insulation applied to conductors or used for barriers shall not be hygroscopic, nor subject to cracking or deterioration due to stresses met with during handling and transport, or due to short circuit conditions and ageing.
- 4.5.5 Applied insulation shall be in intimate contact. Epoxy powder or heat shrink insulation shall be used wherever possible.
- 4.5.6 When using floor standing panels consisting of multiple vertical sections, a continuous external and readily visible copper main earth bar shall run along the whole length of the switchgear with suitable cross sectional area. All components which are earthed within an individual panel shall be effectively earthed within the panel to the main earth bar of that panel.
- 4.5.7 All sections of the main circuit cable box, in particular the gland plate, shall be effectively earthed, except where the cable box is integral with the panel.
- 4.5.8 All access doors are to be effectively and permanently earthed to the main panel enclosure of the switchgear, by means of a suitable braided copper earth strap, crimped with lugs and bolted at each end to the door and enclosure.
- 4.5.9 The installation of all low voltage equipment and wiring shall conform to the requirements of SANS 10142-1.
- 4.5.10 Small control wiring shall be of flexible stranded annealed un-tinned copper construction and shall comply with the table 4.1 below. Conductors shall comply with SANS 1411, Part 1, Table 4 (Class 5).

CT WIRING:	
Phases	2,5mm ² Phase-coloured insulation
Common Return	2,5mm ² Black insulation
Shorting Links	2,5mm ² Yellow insulation
VT WIRING:	
Phases	1,5mm ² Phase-coloured insulation
MISCELLANEOUS CONTROL WIRING:	
	1,5mm ² Black insulation
EARTH WIRING:	
	Green/Yellow insulation, sized to suit application.

Table 4-1

- 4.5.11 All internal wiring shall be neatly run in PVC trunking with clip-on removable covers. All door wiring shall be run in plastic spiral wrap.
- 4.5.12 Control wiring SHALL NOT be housed in the same compartment as the main circuit, the only exception being the CT secondary wiring, which must take the shortest possible route to the point of termination. Where led through a high voltage compartment this wiring shall be run in steel conduit which is solidly earthed.
- 4.5.13 Components and terminals shall be arranged logically.
- 4.5.14 The incoming and outgoing terminals shall be suitably sized for the external cables.
- 4.5.15 All wiring, connections, instruments and other equipment shall be mounted inside the board.
- 4.5.16 All internal wiring / busbars shall be rated for the maximum current in the respective circuit.
- 4.5.17 All Wires shall be marked with interlocking ferrules.
- 4.5.18 All insulation used on electrical conductors, connections and wiring shall be silicone insulated or of approved equivalent type.
- 4.5.19 All copper work shall be marked as Red, Yellow or Blue for the different phases and Green / Yellow for earth with non-removable sleeves or paint, designed not to discolor or peel away from the copper. The colour-coded indications shall be clearly visible on all exposed copper in every panel.

4.6 Terminal Blocks

- 4.6.1 Terminal blocks shall be supplied and clearly marked for all wiring. Each internal interconnecting wire shall be identified by a label at each end. Wire numbers shall match the interconnection drawing. All terminals shall be of a type approved by unitemp.
- 4.6.2 Terminal blocks shall include at least 20% spare terminals.
- 4.6.3 Terminals shall be supplied for site-connected external cabling as indicated on the detail design drawings.
- 4.6.4 Terminal arrangements shall facilitate easy access for terminating and testing
- 4.6.5 All wiring to the terminal strips shall be such that the signal flow through the terminals shall be from the top to the bottom for horizontally mounted terminal strips and from the left to right for vertically mounted terminal strips.
- 4.6.6 The following standard terminal strip numbers shall be allocated inside switchboards:
 - XDC: DC supply
 - XAC: AC supply
 - X1: AC heater supply
 - X2: Bus wiring
 - X3: CT wiring
 - X4: VT wiring
 - X5: General wiring
 - X6: Switching device auxiliary signals

- X7: Field wiring
- X8: DCS wiring
- A maximum of 2 wires per terminal connection point shall be allowed.
- All internal signal wiring and control wiring shall be 1.5 mm² with grey wire for DC wiring and black wire for AC wiring.

4.7 Protection Relays

- 4.7.1 General type designations of the required instruments are given in the Switchgear Data Sheet, but the specific types must be selected such that each individual trip function (e.g. over current, earth fault, etc.) shall be 'flagged' or clearly indicated and shall only be resettable at the Switchgear panel.
- 4.7.2 Unless stated to the contrary (see Switchgear Data Sheet) all feeder circuits shall be protected by means of a four element relay as a minimum.

4.8 General Meters

- 4.8.1 Ammeters, voltmeters, power factor meters, hour meters, watt meters and frequency meters shall be flush mounted 96mm x 96mm metric type and shall have 90° deflection where applicable.
- 4.8.2 Ammeters shall have a maximum indicating pointer (15 minute time lag).
- 4.8.3 All meters shall incorporate glass faces; polycarbonate or other static inducing materials applied for this purpose are not acceptable.
- 4.8.4 Where multi-ratio CT's are specified, loose meter scales shall be provided for the unused ratios.
- 4.8.5 Where ammeters are wired to protection class current transformers they shall incorporate saturating CTs.

4.9 Auxiliary Relays

- 4.9.1 Auxiliary control relays shall be plug in type, complete with self-retaining feature to prevent loosening of the relay in the associated socket.

4.10 Drawings

- 4.10.1 The text of all drawings shall be in the English language and all descriptive and essential numerical units shall be expressed in SI units.
- 4.10.2 All drawings shall be prepared by means of an industry approved computer aided drafting system.
- 4.10.3 For all new works, drawing numbering shall be in accordance unitemp's document numbering convention as laid down in procedure UUA-QPR-000001.

4.10.4 IEC symbols and ANSI device numbers shall be used on all single-line diagrams, wiring diagrams, schematic and control diagrams.

4.11 Equipment Marking

Components, control, power wiring, terminations, process interface elements and the like, shall be clearly marked for easy identification in accordance with the drawings and instructions issued with the engineering package covering the design of the assembly.

4.11.1 Externally visible, permanent nameplates shall be provided to identify each protective relay, meter, instrument, selector switch, indicating light etc. Permanent equipment and terminal blocks within the compartments shall be labeled. Protective relays shall be designated as to use and the phase to which they are connected. The back side of door mounted relays shall be marked with a label bearing the appropriate ANSI device function number(s) to enable easy identification.

4.12 Electrical Equipment Colour Scheme

4.12.1 All doors, exposed metal work, outer panels and removable parts shall be powder coated according to SANS 1274. All metal parts not powder coated shall be galvanised or nickel-cadmium plated.

4.12.2 All electrical equipment shall be painted in accordance with the following table based on the equipment nominal voltage rating : British Standards Institute (BSI 381C Specification for Colours for Identification)

EQUIPMENT	COLOUR	PAINT REFERENCE NUMBER TO BS318C AND RAL STANDARDS
525 VAC	Iron Grey	RAL – 7011
400 VAC	Light Orange	RAL – 2011
230 VAC	Mid Brunswick Green	RAL – 6005
220 VDC	Mahogany Brown	RAL – 8016
115 VAC	Traffic Orange	RAL – 2009
115 VDC	Signal Brown	RAL – 8002
32 VAC	Signal Yellow	RAL – 1003
Equipment Supplied by Emergency Power source	Traffic red	RAL – 3020

5 INSPECTION AND TESTING

5.1 All electrical equipment shall be inspected. The inspection shall consist of a physical check for completeness and conformance to specifications, and operational tests as required. Shipment shall not be permitted unless the equipment is complete.

- 5.2 All equipment and material shall be inspected immediately after receipt for shipping damage.
- 5.3 On completion of the installation of all equipment and materials on site, and prior to commissioning, all electrical equipment and systems shall be checked out and tested in strict accordance with the detailed quality control procedures established for the project.
- 5.4 Relevant testing and inspections shall be stated on the QCP
- 5.5 The tests in general shall as a minimum include the following:
- Insulation resistance;
 - High potential test;
 - Operational tests;
 - Complete functional test including all sequence and interlock circuits.

6 DRAWING AND DOCUMENTATION REQUIREMENTS

- 6.1 Typical drawings are not acceptable unless they are revised to show only the equipment furnished. Reproducible drawings and documents shall be as a minimum supplied as follows:
- Control Panel Data Sheet;
 - General arrangement;
 - Wiring diagrams and terminal strip wiring diagrams;
 - Panel layout drawings;
 - Auxiliary wiring diagrams;
 - Foundation / mounting requirements;
 - Installation details;
 - Operating Manual;
 - SPIR List;
 - Alarm and trip setting schedules.
- 6.2 Reference shall be made to the Project Document Submission Index for any additional documentation requirements.