

JOHANNESBURG WATER (SOC) Ltd.
BULK WASTEWATER

PARTICULAR SPECIFICATION
VOLUME 19 : FIELD JUNCTION BOXES AND
PANELS



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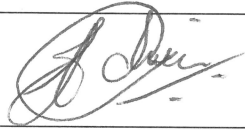


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19 **FIELD JUNCTION BOXES AND PANELS**

19.1 **Scope**

- 19.1.1 This specification covers the manufacturing, supply and installation of Field Junction Boxes, Field Equipment Panels and any other panels used for housing terminals, surge protection devices, instruments, control switchgear (such as pushbuttons, selector switches, indicating lamps, potentiometers, etc.) for process monitoring and control applications at Johannesburg Water wastewater sites.

19.2 **Abbreviations**

- 19.2.1 In this specification the following abbreviations will apply :-

BS	: British Standards
PLC	: Programmable Logic Controller
I/O	: Input/Output
MCB	: Miniature Circuit Breaker
LPZ	: Lightning Protection Zone
SPD	: Surge Protection Device

19.3 **Standards**

- 19.3.1 All design standards for cabling shall be subject to the latest amendments and editions of the following standard specifications:-

SANS 10142-1	: National Standards for the wiring of premises.
SANS 1091:2004	: National Colour Standard.
SANS 1274-2005	: Coatings applied by the powder-coating process.
BS 381C:1980	: Paint colour chart.

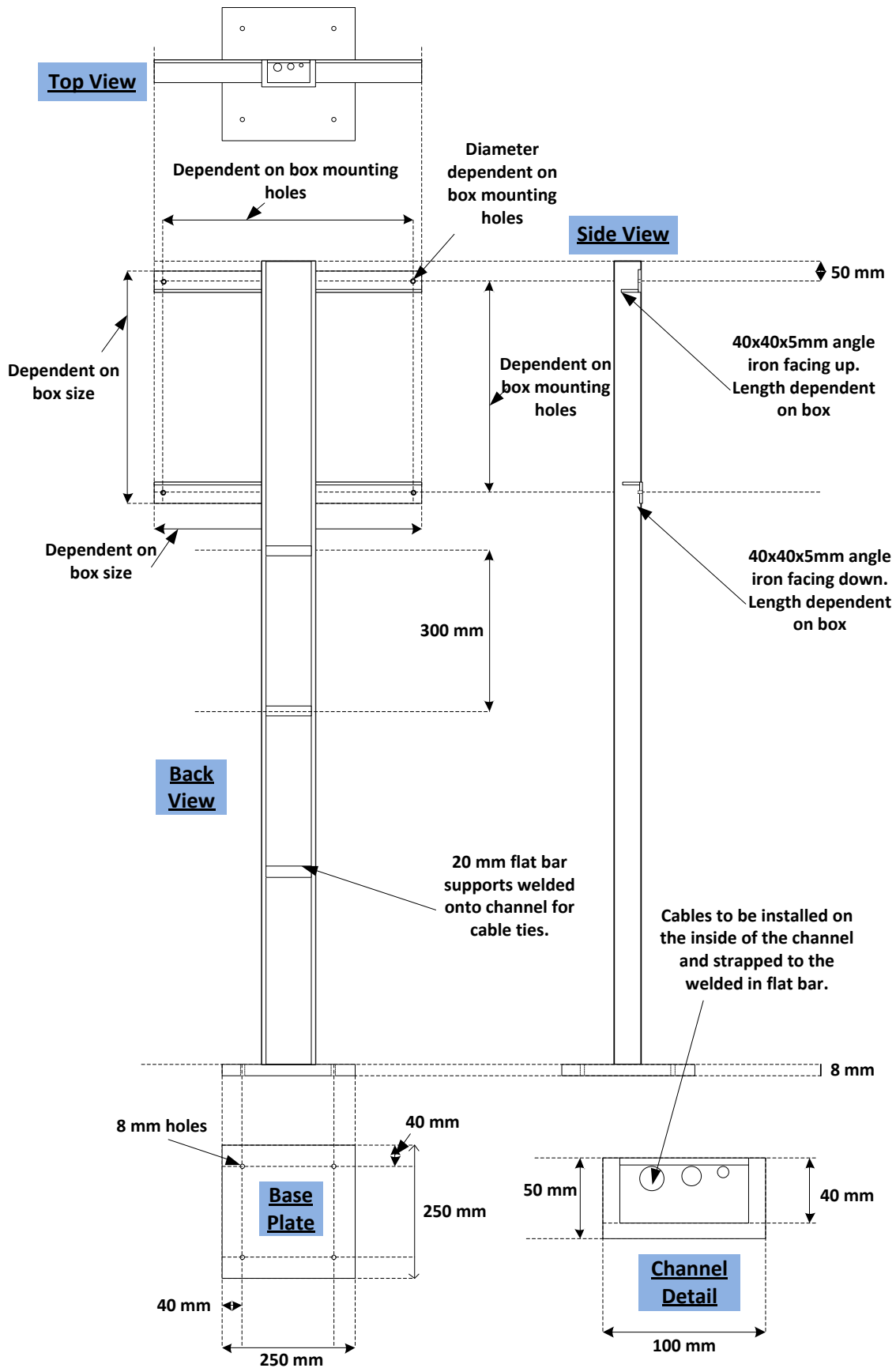
19.4 **General Requirements**

- 19.4.1 The Field Panel will typically house the following items:-

- 19.4.1.1 Terminals, fuses, MCB's, trunking, surge protection, relays, etc.
- 19.4.1.2 Pushbuttons, selector switches, potentiometers, indicating lamps, etc.
- 19.4.1.3 Power supplies, indicating instruments, etc.
- 19.4.1.4 Instruments such as transmitters.

- 19.4.2 The supply and installation shall in general comply with the relevant clauses in all specifications attached to the tender documentation.

- 19.4.3 The panels shall be free standing units with bottom cable entry (via a glanding plate) and have front door access (hinged and lockable).
- 19.4.4 For areas other than those mentioned in item 19.4.12 below, the panel should be manufactured from at least 3CR12 grade stainless steel typically not less than 1,5 mm thick. All hinges, locking devices, bolts, nuts and washers must also be at least 3CR12 stainless steel. The panel will have a door on the front which opens to the full width and height of the panel. The panel shall be free standing and the top edge of the panel shall not be more than 1,8m above floor level and it should be sized to accommodate all the associated equipment comfortably.
- 19.4.5 Once the door is open there should be no obstruction to prevent full access to every point inside the panel.
- 19.4.6 The panel shall be epoxy powder coated electric orange (Shade B26) finish. Interior chassis mounting plates will be finished in appliance white.
- 19.4.7 All IJBs should be clearly labelled with labels as specified in the Labelling Specification (Volume 25 of the Automation And Control Standards).
- 19.4.8 The panel must be vermin-proof and must have a protection rating of no less than IP 65.
- 19.4.9 Where equipment such as pushbuttons, selector switches, potentiometers, etc. are required on the panel exterior, a double door system must be used. The equipment must be mounted on a hinged door, which in turn is located inside a second hinged door fitted with a transparent panel so that all relevant equipment can be viewed without the need to open this external door. This external door with the glass panel must ensure that the IP 65 protection rating is not compromised by the fitting of equipment such as pushbuttons, switches, etc.
- 19.4.10 Where outer doors are equipped with transparent panels, such a panel must consist of a material that will not deteriorate significantly due to its exposure to the elements such as ultra-violet radiation, heat, wind, rain, etc. Glass panels will be preferred.
- 19.4.11 Where there are no existing structures against which the panel can be mounted, a sturdy stand (see the picture below), or mounting bracket must be manufactured of the same material as the panel (i.e. at least 3CR12 grade stainless steel), painted to the same specification and in the same colour as the panel. A ladder type cable rack of suitable width to accommodate all the cabling, plus at least 10% spare space must be fitted to the stand or structure to enable proper securing of the cables, if the cables cannot comfortably be run inside the channel used for the stand or if there is no stand (i.e. where brackets or wall-mounting is used). The cable racking must comply with all the requirements in the Cabling Specification (Volume 6 of the Automation And Control Standards).



- 19.4.12 Field junction boxes used inside Elutriation Terrace pump stations or in areas within 10m or less of Ferric Chloride, Sodium Hypochlorite or Chlorine shall be manufactured from Polycarbonate. All bolts, nuts, spring washers, etc. shall be 316 grade stainless steel, painted with 2K poly urethane paint, for all these applications. A sample of the panel must be approved by the engineer before manufacturing or purchasing commences. Channels or other sections used for securing of these junction boxes should be made from GRP (Glass Reinforced Polyester). Where transparent covers are used, they must be high visibility Polycarbonate with UV filtration. Since these Polycarbonate panels are used in highly corrosive atmospheres, they must contain as little metal as possible. Hinges, locking devices, etc. wherever possible, should also be Polycarbonate. All cable glands must be totally encapsulated glands (envirogland type) as shown in the example below.



- 19.4.13 The GRP profile (cable rack or equipment support) shall consist of pultruded (i.e. a continuous process of pulling material, such as **glass fiber** and resin, through a shaped die for manufacturing of composite materials with constant cross-section), e-glass roving and e-glass multi-axial fabric strength mat, sandwiched between polyester synthetic veil or tissue of minimum 35 gram/ m², all of which is encased in an isophthalic vinyl-ester resin. The resin must contain UV stabiliser. It must also contain pigment to provide colour and additional environmental protection. The rack or support must be cleaned and de-greased before it is painted with a 2K automotive or industrial poly urethane paint.
- 19.4.14 IJB's shall not be installed such that they obstruct passageways or are close to the road where moving objects such as vehicles, forklifts etc. can damage the IJB.
- 19.4.15 Where cable junction boxes, terminal boxes or terminations in instruments or any other panels in the field take place it must be ensured that such a junction box, termination box, instrument, etc. is not exposed to fire hazards from burning grass or other vegetation. If such a termination point is out in the open field (e.g. where grass grows below and/or around it), a clear area of at least 2.5m radius around this termination point must be provided. This must be a permanent clearing, such as a cement or concrete surface. A mere clearing of vegetation which can grow back again will not be accepted.

19.5 Standard Features

- 19.5.1 Each panel shall have the following features as standard:-
- 19.5.1.1 No ventilation fans shall be mounted in the panel and thereby compromise the protection rating.
 - 19.5.1.2 No holes may be drilled for tapping, riveting, bolts & nuts, etc. in any section of the panel where it will compromise the protection rating of the panel. I.e. only in the first (i.e. inner) door of a 2-door panel, in the backing plate or in the glanding plate may holes be drilled. Where drilling is unavoidable, e.g. to affix labels, the holes must be sealed so that the protection rating of the

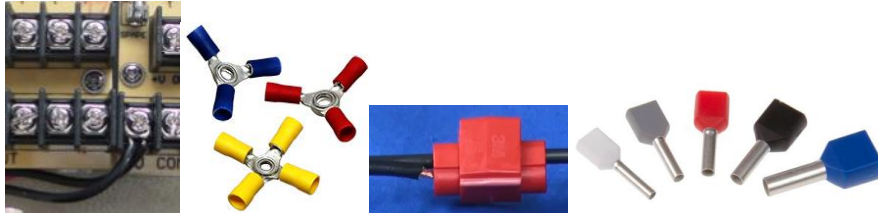
panel is not compromised.

- 19.5.1.3 Bolts with nuts shall not be used to attach equipment to any mounting plate at any point. On mounting plates only bolts in tapped holes will be acceptable. Bolts with nuts will be allowed on enclosure doors however, where the bolts and nuts are easily accessible.
- 19.5.1.4 Where bolts are used on the door or any outside panels of the enclosure, a sealing method (e.g. rubber washers) must be used to ensure that the IP protection rating of the enclosure is not compromised.
- 19.5.1.5 Wherever bolts are used, the bolts must be as short as practically possible so that there are no long protrusions that can injure people or snag clothing, wiring, other equipment, etc. If bolts are cut to the correct length, the ends of the bolts must be neatly de-burred and smoothed so that there are no sharp edges that can cause injuries and so that the nuts can be easily screwed on and off. No more than four threads of the bolt end must be visible beyond the nut. It is however preferred that the correct length of bolts are used so that shortening is not required.
- 19.5.1.6 A copper earth bar running the width of the panel at the bottom with solid electrical connection to the panel doors and to the steel of the panel at two or more places and provided with terminals for connection of equipment and screen earth wires.
- 19.5.1.7 Terminals and equipment of the same voltage must be grouped together, while terminals and equipment of different voltages must be clearly marked and separated by at least 50mm or by suitable insulated barriers to ensure that inadvertent contact or accidental terminations in the wrong place are avoided. Where such barriers are used between terminals of different voltages, these barriers must be larger than the terminals (i.e. standard terminal end barriers will not be acceptable) to ensure that there is a clear separation and to avoid accidental incorrect terminations.
- 19.5.1.8 Where the panel will be installed out in the open (i.e. not in an area where it is in the shade), the panel must be equipped with a cover which will provide shade for the panel while allowing air flow between the panel and the cover. Such panels should as far as practically possible be installed to face South and the cover should ensure that all transmitters, analysers, pushbuttons, lamps, etc. are protected from direct sunlight. It must be ensured that transmitter LED/LCD displays are **never** exposed to direct sunlight.
- 19.5.1.9 Where stopper plugs are used to seal holes that are not used, no plastic stopper plugs will be acceptable. All stopper plugs must be threaded, non-corrodible, metal plugs with rubber washers on both sides of the panel to ensure at least an IP65 seal (see examples below).



19.6 Wiring and Terminals

- 19.6.1 All terminals shall be screw type terminals and shall be mounted on raised DIN terminal rail, secured to the chassis plate at the back of the panel.
- 19.6.2 Proprietary type wire strippers shall be used and no stranded conductor shall be terminated if one or more strands have been damaged.
- 19.6.3 Not more than one wire shall be connected to any terminal unless the terminal can accept pin lugs on either side of a screw or unless proper connecting material is used (see examples below).



Every wire shall be marked at both ends with a numbering system as specified in the Labelling Specification (Volume 25 of the Automation And Control Design Standards), or if approved by the Engineer, and all terminating wires shall also be suitably crimped to a terminal lug. Not more than one wire shall be crimped into a single lug. Bare wire terminations will not be accepted.

- 19.6.4 All wiring shall be flexible, tinned, annealed, multi-strand copper wire not less than:-
- 19.6.4.1 1,5mm² for 230V AC or 110V AC power
 - 19.6.4.2 1,0mm² for 24V DC or AC power
 - 19.6.4.3 0,5mm² for all PLC I/O wiring between modules and marshalling terminals
 - 19.6.4.4 4,0mm² for earth drain
- 19.6.5 Irrespective of the minimum wire sizes allowed in this specification, contractors must ensure that all cables and wiring are capable of carrying the full system currents, inclusive of de-rating factors as specified in SANS 10142-1:2003 as amended.
- 19.6.6 All wire terminations must be done by using suitable lugs. Where pin lugs are crimped onto the ends of wires, correctly sized pin lugs must be used, which fit into the terminals properly and such that the tightening of the terminal does not result in the loosening of the pin lug.
- 19.6.7 All panel wiring shall run in suitable sized slotted trunking for as much of their course as possible, thereafter in spiral band or similar conduit to its destination if the exposed run would exceed 100mm.
- 19.6.8 The distance between the terminals and the trunking or between equipment (such as relays, surge protection, circuit breakers, etc.) and trunking shall not be less than 50mm.
- 19.6.9 Control wiring should not run with power wiring and all cross-overs shall be at ninety degrees.
- 19.6.10 Each analogue and digital input and output to and from the PLC shall have surge protection units as specified in the Clean Power And Surge Protection Specification

(Volume 5 of the Automation And Control Standards).

19.6.11 Internal wiring shall be colour coded as follows:-

19.6.11.1	<u>230V AC Power</u>	
	Live	Brown
	Neutral	Blue
	Earth	Green and Yellow
19.6.11.2	<u>24V DC Power</u>	
	Positive	Red
	Negative	Black
19.6.11.3	<u>Digital Inputs</u>	
	230V AC	Yellow
	24V DC	Red
19.6.11.4	<u>Digital Outputs</u>	
	230V AC	Grey
	24V DC	Red
19.6.11.5	<u>Relay Outputs</u>	
	230V AC	Grey
	24V DC	Red
19.6.11.6	<u>Analogue Signals</u>	
	Positive	Orange
	Negative	Purple

19.6.12 A terminal section for AC and DC power distribution shall be included in the panel where both voltages are used for equipment power supplies. The terminal groups shall be clearly identified to indicate the various voltages.

19.6.13 All wiring must be continuous from one termination (in a terminal strip or device such as a relay, contactor, surge arrester, etc.) to the next. No spliced wiring will be accepted.

19.7 Existing Panels

19.7.1 All modifications and wiring changes to existing panels must comply with the specifications as laid down for new panels.

19.8 Factory Acceptance

19.8.1 Before delivery of the panels, a comprehensive system factory acceptance test must take place. The Engineer must be notified one week in advance of the proposed test.

19.8.2 The test shall comprise of at least, but not be limited to:

19.8.2.1 Checking the panel manufacturing and assembly for compliance with this specification.

19.8.2.2 Layout, numbering and labelling of equipment.

19.8.2.3 Wiring – sizes, numbering, colours, termination, etc.

19.8.2.4 Wiring as per drawings, I/O schedules, etc. (i.e. loop checks).

19.9 Over-Voltage/Lightning Protection

19.9.1 The function of the over-voltage/lightning protection units is to prevent damage from occurring to the electrical and electronic devices due to destructive voltages, by resistive coupling, capacitive coupling or inductive coupling, arising from extraneous events such as lightning discharges, switching surges etc. All lightning and surge protection must be in accordance with the requirements in the Clean Power And Surge Protection specification (Volume 5 of the Automation And Control Design Standards).

19.9.2 The SPD's on all incoming power supplies to the panel shall be in accordance with the LPZ in which the panel is and must comply with the requirements of SANS 10142-1:2003 Annex L. Even if the LPZ dictates that class III surge protection is required, at least class II surge protection must be installed.

19.9.3 All analogue and digital input and output circuits shall be in accordance with the LPZ in which the panel is and must comply with the requirements of SANS 10142-1:2003 Annex L. and even if the LPZ dictates that class III surge protection is required, at least class II surge protection must be installed. for protection of these circuits.

19.10 Spares

19.10.1 The tenderer will be required to provide at least 10% spare fuses and other consumable items which may be required during commissioning. In addition to commissioning spares, a recommended spare list for three years maintenance, should be submitted. This item must be completed so that spares may be ordered as part of the capital contract. Tenderers ignoring this condition may be disqualified.

19.11 Painting (Powder Coating Method)

19.11.1 General

Switchboards and panels shall be epoxy powder coated in accordance with Type 1 coatings to SANS 1274-2005.

Unless specified otherwise, a high gloss finish in the following colour shall be provided:

Colour - Light Orange, Colour No. B26, Munsell Ref. 2,5 YR C/14 to SANS 1091 : 2004 and Colour No. 381C-557 to BS 381C : 1980.

Paintwork must be guaranteed against blistering, peeling, cracking and general deterioration which can lead to rusting, corrosion, etc. for a period of no less than three years. If the tenderer cannot comply with this requirement, it must be clearly stated as such in the tender.

19.11.2 Specifications

The following specifications in accordance with SANS 1274-2005 shall be provided:-

<u>Property</u>	<u>Requirement</u>	<u>Test Method</u>
Thickness, minimum	50 micron	6.7
Marking Resistance (400g)	No marking	6.20
Impact Resistance, J, minimum	6,78	6.10
Water Resistance, h, minimum	720	6.13

Humidity resistance, h, minimum	1000	6.14
Resistance to salt fog, h, minimum	1000	6.16

19.11.3 **Surface Preparation**

Surface preparation of sheet steel components shall be carried out by means of the multi-bath zinc phosphate/chromate passivation treatment.

All fabricated sheet steel components are to be degreased and de-rusted ready for treatment.

A steel surface is considered ready for treatment when all dirt, grease, rust, mill scale, moisture or other contaminants have been removed in an alkaline degreaser to give a dry, clean, bright, metallic surface.

Steel plate less than 4mm thick - black steel sheet shall be pickled to white metal condition while pre-pickled, bright, cold rolled sheet steel shall be solvent cleaned.

These surfaces shall be treated within eight hours in all cases while still uncontaminated and rust-free.

The prepared steel surface shall be treated by means of immersion in a heated zinc phosphate solution bath, rinsing and thereafter chromate passivated by means of immersion in the final treatment bath.

19.11.4 **Powder Coating**

A thermosetting powder consisting of epoxy/polyester resin shall be applied by means of an electrostatic spray gun to give a uniform coating thickness of 50 to 60 micron. Less than 50 micron will not be acceptable.

The powder coating shall be baked at a metal temperature of 185°C so as to melt the powders to form a continuous film over the metal substrate.

19.12 **Drawings And Diagrams**

19.12.1 The tenderer must submit layout drawings, showing the panel size, cable entry, location of equipment, details of equipment (such as trunking size, circuit breakers, fuses, terminals, etc.), panel colour, material of construction (e.g. 2mm 3CR12 SS), etc. for approval by the Engineer before any manufacturing commences.

19.12.2 The drawings must be accompanied with data lists of the proposed equipment. These data sheets must show the type, supplier, make, model, size, etc. of equipment where applicable. For example:

Terminals	- Phoenix SK12, 4mm, white.
MCB's	- Merlin Gerin, 5A, 10kA, single-pole.
Etc.	