



**SPECIFICATION FOR EQUIPMENT CABINETS TO HOUSE
ELECTRONIC EQUIPMENT
PL 711**

REV. 010

APPROVAL

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1. INTRODUCTION

The objective of this Specification is to establish standards and codes of practice that shall be required to be adhered to by both Contractor and Client in the design, supply and installation of Equipment Cabinets to house Electronic Equipment, both indoors and outdoors, on all Transnet Pipelines Sites.

2. SCOPE

2.1 General

This document defines as a minimum, the technical requirements and general responsibilities regarding the design, supply, population, pre-staging, delivery, installation and commissioning of Equipment Marshalling Cabinets (to be installed in the Control Room and used to house electronic equipment) and Field Junction Boxes on all Transnet Pipelines sites, whether it be by the Client or Contractor, for and on behalf of Transnet Pipelines. In this regard, contractors are required to familiarise themselves with all applicable Standards and Codes of Practice listed herein, and to ensure compliance in the execution of any work in terms of this document. Failure to comply may render the contractor liable for corrections at his own cost.

These Standards and Codes of Practice should be read in conjunction with all other Specifications and drawings as issued for a particular contract. Where discrepancies occur, these must be brought to the attention of Transnet Pipelines in writing before commencement of work. In the event of any conflict between the contents of any documents forming part of a contract (as listed in the Schedule of Contract Documents) and this document, the former shall prevail.

2.2 Application to Work Activities

The Standards and Codes of Practice contained herein apply to all installations requiring Equipment Cabinets to house Electronic equipment and includes amongst others the following activities:

- Design, supply and installation of Control Room Equipment & Marshalling Cabinets
- Design, supply and installation of Instrument Field Junction Boxes
- Design of Electrical and Instrument Equipment Interfacing with Control Systems

3. REFERENCE DOCUMENTATION

3.1 The requirements of the materials, design, layout, fabrication, assembly, erection, examination, inspection and testing of equipment and facilities on site shall be in accordance with the relevant sections of codes: -

- a) ASME/ANSI.B31.3 - Chemical Plant and Petroleum Refinery Piping
- b) ASME/ANSI.B31.4 - Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia and Alcohols
- c) SABS 089:Part II-1965 - The Petroleum Industry Part II: Electrical Code
- d) SABS 0142 - Code of Practice for Wiring of Premises
- e) SABS 089 - Part II - The Handling, Storage and Distribution of Petroleum Products (Electrical Code)
- f) SABS 0198 - "The Selection, Handling and Installation of Electric Power Cables of rating not exceeding 33 KV".
- g) API 2003 - Protection against ignitions arising out of static, lightning and stray currents
- h) SABS 03 - The Protection of structures against lightning.
- i) SABS 086 - The Installation and Maintenance of Electrical Equipment used in explosive atmospheres. Refer to Section 2 for hazardous area classifications.
- j) SABS 1274 - "Coatings applied by the Powder Coating Process"
- j) DIN 41494 - Specification for Panel Mounting Racks
- k) DIN 24185 - Specification for Air Filters used in General Ventilation
- j) Government, local authorities or other statutory bodies' regulations, laws, requirements or customs which are more stringent than those specified in this project specification.

3.2 The following standard specifications are to be used for reference purposes and need to be noted by Contractors in order to signify familiarity and compliance with the requirements. It is expected of Contractors that they be familiar with the applicable clauses and that these will be adhered to in the execution of any work in terms of this specification. Contractors will be required to confirm that they are able to meet these requirements.

- a) SABS 0108 : 1995 The Classification of hazardous locations and the selection of electrical apparatus for use in such locations
- b) The Occupational Health & Safety (OHS) Act No. 85 of 1993.
- c) SABS 0314 Flameproof Enclosures for Electrical Apparatus
- d) SABS 0549 Intrinsically Safe Electrical Apparatus
- e) API Manual of Petroleum Measurement Standards Chapters 4 to 12

IP Chapter 10 and Papers 2 and 3

- f) SABS 969 Enclosures for electrical apparatus
- g) BS 5490 Classification of degrees of protection provided by enclosures
- h) BS 229 Flameproof enclosures for electrical apparatus
- i) BS 1259 Intrinsically safe electrical apparatus and circuits for use in explosive atmospheres
- j) BS 4683 Electrical apparatus for explosive atmospheres
- h) Safety Regulations for Contractors
- i) Technical Instruction No. 16 - Contractors Work Permit Procedures.
- j) VDE Standards

- 3.3 Where no specific rules, regulations, codes or requirements are contained in this specification nor covered by the above mentioned codes, the contractor shall, in consultation with Transnet Pipelines, adhere to internationally accepted modern design and engineering practices in the Petroleum Industry.

4. SPECIFICATIONS

- 4.1 The following standard specifications are to be read in conjunction with this document and require separate statements of compliance, which should be included in the tender documents.

PL727 Specification for Cable, Racking, Trenching & Earthing Reticulation Codes of Practice

PL631 Specification for Low Voltage Switchgear & Distribution Boards

Safety Regulations for Contractors

5. ABBREVIATIONS & DEFINITIONS

- 5.1 For the purpose of understanding these Standards, the following abbreviations apply.

ANSI	American National Standards Institute
C & I	Control and Instrumentation
IEC	International Electrotechnical Commission
ISA	Instrument Society of America
SABS	South African Bureau of Standards

- 5.2 The following Definitions are consistent with the Transnet E5 Agreement and General Conditions of Contract and apply to this specification in its entirety.

CHIEF EXECUTIVE (Transnet Pipelines) means the officer appointed as Chief Executive (Transnet Pipelines) of Transnet Limited or any person lawfully acting in that capacity.

ENGINEER means any officer in the office of the Chief Executive (Transnet Pipelines) deputed by the Chief Executive (Transnet Pipelines) to supervise and take charge of the contract.

PLANT means any machine, excluding a tool, and any vehicle, excluding a passenger vehicle, used on site for the carrying out of the Works.

EQUIPMENT means any device not forming a permanent part of the Works, used on site for the carrying out of the Works, and also any temporary building which is required for the carrying out of the Works and which is erected on site.

TOOL means any instrument, powered or otherwise, which is accepted as a hand tool by the industry concerned and which is normally used in a manual operation by an individual labourer, artisan or workman.

MATERIAL means any constructional substance or ingredient which shall form part of the permanent Works and the substances in excavations and earthworks.

DRAWINGS means the drawings referred to in any specifications, schedule of quantities and prices and any alterations of such drawings made or approved in writing by the Engineer and such other drawings as may from time to time be furnished or approved in writing by the Engineer.

SITE means the land and any other place on, under, over, in or through which the Works are to be executed or carried out and any other land or place made available by Transnet in connection with the Works.

WORKS means the works to be executed in accordance with the Contract.

6. EQUIPMENT MARSHALLING CABINETS

This specification details standards and codes of practice to be adhered to in the supply of both Equipment Marshalling Cabinets (used to house Electronic Equipment) at all Transnet Pipelines Sites.

6.1 General

- 6.1.1 Unless stated elsewhere, the Contractor shall be responsible for the design, supply, procurement, population, prestaging, upliftment, installation and commissioning of all elements associated with equipment marshalling cabinets.
- 6.1.2 Where equipment, peripherals, switchgear, or instrumentation from various suppliers or manufacturers are offered for controlling various subsystems or portions of a subsystem, it will be the responsibility of the Contractor to ensure that the various portions are fully integrated into a single coherent system.
- 6.1.3 It will be the responsibility of the Contractor to ensure that all cabinets supplied are completely suitable for the application.
- 6.1.4 Where cabinets and equipment for an installation or project are supplied by different suppliers or subcontractors, it will be the responsibility of the Contractor to ensure that all equipment cabinets for the installation match in both design and colour, to the complete satisfaction of the Engineer.
- 6.1.5 The cabinets shall be attractively styled and able to harmonise with any modern computer arrangement by virtue of colour and design.
- 6.1.6 Transnet Pipelines will prefer equipment cabinets of modular design, capable of housing different configurations of equipment.
- 6.1.7 The dimensions of the cabinets shall conform to standard specification DIN 41494.
- 6.1.8 All unpainted metallic components of the cabinet and contents shall be treated with an approved anti-corrosion process such as zinc passivated plating, zinc plating or chromium plating. This shall include all bolts, nuts, washers and screws.
- 6.1.9 The cabinets shall be treated against corrosion and painted using baked epoxy powder process to SABS 1274-1979, to achieve a textured finish. Minimum thickness of the paint shall be 60 micron.

Color standards to be adhered to are as follows:

Doors, Covers, Frames.	Beige (RAL 7032)
Mounting Plates.	Orange (RAL 2000)
Plinth.	Anthracite (RAL 7011)
Bottom Gland Plate.	Zinc Passivated Finish

- 6.1.10 On all matters on which this specification is silent, the approval of Transnet Pipelines must be obtained through the Engineer. Additional specifications will be provided as required.

6.2 Construction of Cabinets

- 6.2.1 All materials used in the construction of the cabinets shall be of the best quality and of the class most suitable for the purpose for which it is required. Unless otherwise specified or approved, all materials shall be to the most recent SABS, DIN or British Standards Institution specifications where applicable, or to such published standards applicable in the country of origin. Tenderers must quote the authorised standards to which materials in the cabinet offered conform.
See Appendix 2.1
- 6.2.2 The frame of the cabinet shall be of a steel construction, the upright and horizontal members having a minimum thickness of 1,5 mm.
See Appendix 2.2
- 6.2.3 The cabinet shall be equipped with 19" vertical mounting members where required for mounting equipment. The mounting members shall be made of steel, with a minimum thickness of 2mm, and shall be pre-punched along the entire length, with a pattern of holes on universal centres of 15.88mm – 14.88mm – 12.70mm, designed to accept standard captive nuts of size M6, without interfering with the front or rear panels of equipment to be mounted. It will be preferred if the mounting members could be positioned at any pre-punched depth to suit different equipment.
- 6.2.4 The side panels of the cabinet shall be made of sheet steel having a minimum thickness of 1.2mm. The side panels must be easily removable for access to equipment. It must be possible to form a single suit of cabinets, with inter-cabinet access by removing side panels and bolting cabinets together.
See Appendix 2.3
- 6.2.5 The bottom of the cabinet must be provided with a suitable plinth 100mm high manufactured of steel, having a minimum thickness of 1.5mm, to allow for bottom cable entry. The cabinet base shall be sealed against the ingress of rodents, by means of a suitable galvanised gland plate.
See Appendix 2.4
- 6.2.6 The top of the cabinet shall consist of a steel panel of minimum thickness of 1,5 mm. The panel should make provision for adequate ventilation of the cabinet.
- 6.2.7 The rear of the cabinet shall be fitted with a full-length removable hinged door. The door shall be manufactured of steel having a minimum thickness of 1.2mm. It will be preferred if the hinges are reversible to allow for either left or right hand opening.
See Appendix 2.5
- 6.2.8 The front of the cabinet shall be fitted with a door having a steel frame fitted with a full-length single sheet of smoked, flame retardant Plexiglas (ACRO glass tinted, colour 505), when **either instruments, barrier racks, PLC I/O distribution racks** are fitted into the cabinet. Non glazed doors will be fitted to all other cabinets not containing instruments. It will be preferred if the door hinges are reversible.
- 6.2.9 The doors and panels of the cabinet shall be effectively sealed against the ingress of dust and shall carry a protection rating of IP 54 minimum.
- 6.2.10 Both front and rear doors of the cabinet shall be fitted with suitable handles and locking devices so that the doors of the cabinet may be secured. **Locking devices shall comprise of a 6mm square key, complete with insert handle, equal or similar to Sarel type 63600.** A 'key' shall be supplied with each lock.
See Appendix 2.6
- 6.2.11 Both front and rear doors shall be fitted with catches that are capable of maintaining the doors in the closed position when unlocked. Both front and rear non-glazed doors shall be fitted with suitably sized (A4 minimum) documentation pockets, where required.
See Appendix 2.7

6.3 Ventilation

- 6.3.1 Adequate ventilation must be provided for the cabinet. The temperature inside the cabinet may not rise by more than 10°C above the ambient temperature of the equipment room over the operating temperature range. Precautions must be taken to prevent localised hot spots.
- 6.3.2 Where necessary, ventilation fans or blowers may be fitted to assist with cabinet ventilation. Any fan or blower used must be designed for long life, having only sealed ball bearings, which are lubricated for the life of the bearing. The ventilation units must have a minimum life expectancy of 25 000 hours.
- 6.3.3 The air intake of the cabinet shall be fitted with a removable dust filter. The filter material must be readily available for replacement purposes and should comply at least with standard specification DIN 24185 class EU 3.
- 6.3.4 All ventilation fans, blowers used shall be powered from a 24 V DC supply.

6.4 Power Distribution

- 6.4.1 Equipment Marshalling Cabinets shall contain both 220 VAC and 24 VDC Power Distribution.
- 6.4.2 220 V AC Power shall, wherever possible be derived from a suitably rated Uninterruptible Power Supply source and routed within the cabinet/s via a suitably rated two-pole isolator/breaker. All 220 V AC circuits shall be individually protected by means of suitably rated miniature circuit breakers, on an individual equipment basis. Earth Leakage protection shall be supplied to protect amongst others, plug and light circuits, in compliance with SABS 0142.
- 6.4.3 Separate surface mounted switch-socket outlet units shall be provided for in panels where required, to supply UPS power. Switch-sockets shall be housed in 120 x 85 x 50 pressed steel boxes, and shall comprise of the dedicated UPS three pin type shuttered socket base rated for 16A at 220V AC (red in colour).
See Appendix 2.8
- 6.4.4 All cabinets shall contain 24 V DC Fluorescent lights both front and rear, rated at 8W minimum, and activated manually by integral light switch.
See Appendix 2.9
- 6.4.5 All mains power wiring and distribution shall conform to applicable South African wiring regulations (SABS 0142). All 220V AC and 24V DC circuits shall be protected by appropriately rated miniature circuit breakers, with a spare capacity of 10% installed for future use, and labelled as spare.

6.5 Mounting of Equipment

- 6.5.1 All equipment mounted in the cabinet shall be mounted only by means of the mounting members intended for this purpose.
- 6.5.2 All equipment inside cabinets shall be completely accessible without having to disturb wiring or equipment. Where it is necessary to mount cabinets near walls or where equipment is mounted back to back, swing frames may be used as a method of last resort and provided that prior permission has been obtained from the Engineer. In this regard, equipment shall be mounted on adequately rated steel telescopic slides having steel bearings. Steps must be taken to limit the extent to travel of the slides.

6.6 Rack Mount Installations

- 6.6.1 All spare rack positions as well as individual spare card positions shall be covered by means of suitable blanking plates.
- 6.6.2 All blanking plates shall be manufactured to the same tolerances, standards and dimensions as the equipment contained in the cabinet.
- 6.6.3 All blanking plates shall be retained in position by means of captive screws held in the blanking plate itself.
- 6.6.4 The front panels of any sliding chassis or removable unit shall be equipped with approved handles.
- 6.6.5 Where a blank panel is installed to cover equipment in the rack, the blank panel shall be marked with the designation of the equipment, which it covers.

6.7 Cabinet Layout Design

- 6.7.1 Prior to commencement of cabinet population, design approval shall be obtained from the Engineer. Design approval shall entail as a minimum, the submission of the following documentation:
 - Equipment marshalling cabinet layout diagrams, to scale and reflecting component detail
 - Equipment marshalling cabinet wiring diagrams, detailing all internal wiring reticulation, power distribution and earthing arrangements
 - Technical specifications of all equipment to be installed within the panels
- 6.7.2 Requirements of the materials, design, layout, fabrication, assembly and erection shall, where relevant, be in accordance with Transnet Pipelines approved typical PLC Panel Layout Diagrams, which form part of this Specification.

Unless otherwise stated, general equipment cabinet design shall comply with the installation codes of practice detailed in Section 8 of this standard.

7. FIELD JUNCTION & TERMINATION BOXES

This specification details standards and codes of practice to be adhered to in the supply of Field Junction Boxes and Termination Boxes at all Transnet Pipelines Sites.

7.1 General

- 7.1.1 Contractors shall be responsible for ensuring that all Junction Boxes and Termination boxes supplied are completely suitable for the application.
- 7.1.2 On all matters on which this specification is silent, the approval of Transnet Pipelines must be obtained through the Engineer. Additional specifications will be provided as required.

7.2 Field Junction Boxes

7.2.1 Requirements of the materials, design, layout, fabrication, assembly and erection shall, where relevant, be in accordance with Transnet Pipelines approved typical Field Junction Box Layout Diagrams, which form part of this Specification.

7.2.2 All materials used in the construction of the cabinets shall be of the best quality and of the class most suitable for the purpose for which it is required. Unless otherwise specified or approved, all materials shall be to the most recent SABS, DIN or British Standards Institution specifications where applicable, or to such published standards applicable in the country of origin. Tenderers must quote the authorised standards to which materials in the cabinet offered conform.

7.2.3 Field Junction Boxes shall comply with the following specifications:

Material	: 304/316 Stainless Steel, 1.5mm thick min.
Finish	: Brushed
Access	: 6mm square key lockable
Gland Plate	: Separate, pre-punched
Rating	: IP 65
Mounting / Gland Plate:	304/316 Stainless Steel

7.2.4 Each cabinet shall make provision for a suitable insulated screen bar to be installed at the bottom of the cabinet and utilised for interconnection of cable overall screens. The bar shall be supported on robust insulating spacers and will have a minimum clearance of 20mm to the sheet steel panel.

High tensile phosphor bronze or zinc passivated (or SS304 if external to JB) plated nuts, bolts and lock washers shall be provided through the screen bar at each connection point and at least five additional holes shall be provided for future connections, each being fitted with nuts and bolts above. Connection points shall be evenly spaced along the length of the screen bar, and clearly labelled as such.

7.2.5 Unless stated elsewhere, the Contractor shall be responsible for the design, supply, procurement, population, prestaging, upliftment, installation and commissioning of all elements associated with Field Junction Boxes. In this regard, prior to commencement of cabinet population, design approval shall be obtained from the Engineer. Design approval shall entail as a minimum, the submission of the following documentation:

- Field Junction Box layout diagrams, to scale and reflecting component detail
- Field Junction Box wiring diagrams, detailing all internal wiring reticulation, power distribution and earthing arrangements where applicable
- Technical specifications of all equipment to be installed within the panels

Transnet Pipelines have standardised on the allocation of field instrumentation to Junction Boxes on the basis of individual Device Groups (i.e on a device group per junction box basis). Any deviation from this standard will need prior approval from Transnet Pipelines. (Device Group allocations have been detailed in Transnet Pipelines Specification PL101).

7.2.6 Unless otherwise stated, general Field Junction Box design shall comply with the installation codes of practice detailed in Section 8 of this standard.

7.3 Instrument Termination Boxes

7.3.1 Where Instrument Cabling is not able to be glanded and terminated directly into the Instrument itself, Termination Boxes are required to be provided. Termination Boxes shall be

mounted in an accessible position near the Instrument and shall be equipped with correctly rated terminals.

7.3.2 Instrument Termination Boxes shall comply with the following specifications:

Make : Pratley No 1
Material : Aluminium Alloy Epoxy-coated
Rating : IP68

8 INSTALLATION CODES OF PRACTICE

8.1 AC Distribution

8.1.1 All mains power wiring and distribution shall conform to current applicable South African wiring regulations (SABS 0142). All 220 VAC circuits shall be separately protected by appropriately rated miniature circuit breakers located in the front of the panel/s.

8.1.2 Mechanical protection, in the form of touch proof terminals or perspex covers with appropriate danger/warning labels, shall be installed to prevent inadvertent contact with wiring and terminals, and shall be designed in such a way as to not impede access to MCB distribution as a whole.

8.1.3 MCB's shall be clearly labelled as to their functionality (what equipment is supplied) and supply voltage by means of a laminated legend plate located on the inside door panel of the cubicle housing the respective MCB's. In addition, all MCB's shall be individually labelled alongside the breaker so as to enable rapid visual identification of MCB's. Refer to Section 8.5 for details on Label Specifications.

8.2 DC Distribution

8.2.1 All DC wiring and distribution shall conform to current applicable South African wiring regulations (SABS 0142). All 24 VDC circuits shall be separately protected by appropriately rated miniature circuit breakers located in the front of the panel/s, and shall include for the following functions:

- Supply to 24 VDC powered equipment
- Supply to Field Device groups

8.2.2 MCB's shall be clearly labelled as to their functionality (what equipment is supplied) and supply voltage by means of a laminated legend plate located on the inside door panel of the cubicle housing the respective MCB's. In addition, all MCB's shall be individually labelled alongside the breaker so as to enable rapid visual identification of MCB's. Refer to Section 8.5 for details on Label Specifications.

8.3 Equipment

8.3.1 All equipment shall be mounted in the front of the equipment marshalling cabinets, and shall be mounted to ensure easy access to functionality and wiring.

8.3.2 All equipment shall be 24 V DC powered, where possible, unless the Engineer has granted prior permission.

- 8.3.3 The following components have been standardized on by Transnet Pipelines, and require to be adhered to by the contractor. Contractors wishing to offer alternate makes may do so with prior written permission from the Engineer.
See Appendix 1 for component and part numbers.

8.4 Cable Marshalling

- 8.4.1 Unless stated otherwise, all cabling, inclusive of power, control, data and instrument shall be bottom entry. Cable entry shall be via pre-punched gland plates, and shall be glanded within the cabinet to which the associated cable is terminated. Glanding of cables in cabinets different to that in which the cable is terminated shall not be permitted. Spare cable entries shall be plugged using appropriately sized **and rated** blanking plugs. The use of “push-out” blanking inserts to plug cable entries shall not be permitted.
- 8.4.2 Cable identification shall be as follows:
1. Where Cable Tags are fixed to the cable within the cabinets:

Grafoplast Trasp Series 130 Gull-wing transparent PVC sleeves (30mm in length), with printed text black on white background, fastened onto the cable via means of Stainless Steel cable ties. Text height to be 3mm minimum.
 2. Where Cable Tags are fixed to the cable outside the cabinets:

Grafoplast Targa Metal TGT System (Carrier Rail length: 58mm for 7 characters, 82mm for 11 characters, 106mm for 15 characters) 316 Stainless Steel Markers, with punched text 6 mm height minimum, fastened onto the cable via means of Stainless Steel cable ties.
- 8.4.3 Transnet Pipelines have standardised on the allocation of field instrumentation signals to Junction Boxes on the basis of individual Device Groups (i.e. on a device group per junction box basis). **In addition and where possible, discrete and analogue signals are also to be clearly separated and identified within these Junction Boxes. In the case of Junction Boxes with dual terminal rails, discrete signals will be terminated on the LHS terminal rail, and analogue signals on the RHS terminal rail. Where PLC and Metering signals are terminated into the same Field Junction Box, PLC signals will be terminated on the LHS terminal rail, and Metering signals on the RHS terminal rail.**
- 8.4.4 **Note that whilst field junction boxes may incorporate both analog and discrete signals, IS and non-IS signals may not be marshalled within the same junction box or within the same multi-core cable.**
- 8.4.5 Termination of individual cable cores in the termination strips will be such that all Control System related cabling will be terminated to the **RHS** of termination strips, whilst all field instrumentation/equipment cabling will be connected to the **LHS** of termination strips. In the case of Field Junction Boxes with dual terminal strips, multi-core cabling will be glanded in the centre of the gland plate and terminated into terminal rails provided, running from the centre PVC Trunking outwards. Individual Instrument cables will then be terminated into the terminal rails provided, running from the outermost PVC Trunking inwards.
- 8.4.6 Field Termination rails within the Control System Marshalling Enclosures shall be allocated on the basis of a one-one match with field cabling i.e. will match the allocations made within the respective Filed Junction Boxes. PLC Termination rails within the Control System Marshalling Enclosures shall be divided into units on the basis of PLC I/O Modules, thus ensuring grouping of Control and Feedback signals on the basis of I/O marshalling.
- 8.4.7 Sizing of PVC Trunking and related conductors shall comply with SABS 0142 of 1981 code of Practice Reg. 5.4.1 (f). In addition to the above requirements an additional 25% Spare capacity shall be allowed. The manufacturer shall ensure that all trunking is adequately sized. All cabling

shall be neatly arranged and loomed within the trunking, using proprietary plastic cable straps available for this purpose. Spiral lacing shall be used for flexible or semi-flexible looms.

Allowance shall be made during PLC Cabinet Layout design to ensure that a minimum distance of 50mm is maintained between terminals and PVC Trunking, in order to ensure that conductor core idents are visible at all times.

The manufacturer shall also ensure that a space of not less than 50mm shall be maintained between trunking and any component or object.

Transnet Pipelines has standardised on PVC slotted trunking for use in cable and wiring marshalling (Non IS circuits – grey in colour, IS circuits – blue in colour).

8.4.8 All PVC Cable Trunking carrying IS Rated circuits shall be coloured blue (both Field J/B and Equipment Cabinets). It is preferred that trunking manufactured for this purpose be used, however, painted trunking will be acceptable if it meets the following conditions.

- Method of painting must prevent cracking or peeling of the paint and all trunking used in the panel must be painted as a batch to prevent colour mismatch.

8.4.9 Individual Cable Screens shall be terminated onto screen bars running the full length of the cabinet alongside the respective terminal rails, and from there to the Instrument Earth rail provided in the bottom of the cabinet/s. Overall screens shall be terminated directly onto the Electrical Earth rail provided in the bottom of the cabinet/s.

8.4.10 All Cable Screens (both individual and overall) shall be isolated from inadvertent contact using suitably sized yellow/green coloured sleeving. (Except IS individual screen – shall be sleeved blue.)

8.4.11 Each conductor/core of a cable shall be fitted with an insulated double crimp lug of the correct size. Pin lugs shall be used for pressure type terminals, with ring and spade lugs used for post type terminals. LeGrand bootlace ferrules shall be utilised for all instrument cabling terminated into pressure type terminals.

Proprietary type wire strippers and crimping tools must always be used.

8.4.12 Each conductor shall be identified by a Core Identification number, which shall include the number of the terminal into which the core is to be terminated and shall include terminations into termination boxes, field junction boxes, marshalling cabinets and instruments themselves. Plastic sleeving shall be correctly sized to ensure a snug fit on the conductor. **Grafoplast printed identification system shall be utilised for all instrument and control cabling (black lettering on white background). Sleeve length of 30mm has been standardised on.**

For details of Transnet Pipelines Core Ident Numbering Standards refer to Transnet Pipelines Specification PL727 Rev 6 Section 8.6.

8.4.13 All terminals shall be numbered on both sides consecutively in accordance with design documentation. All terminal rails shall be identified by means of a terminal rail label situated at the top of the termination rail. End stops and end plates shall be used to prevent inadvertent contact with conducting surfaces. Refer to Section 8.5 for details on Label Specifications.

8.4.14 All Cable ends shall be protected by heat shrink to provide protection and prevent moisture ingress.

8.4.15 IS and Non IS Signals are to be run in separate cables.

8.4.16 All spare cores shall be terminated and identified as “spare”.

8.4.14 Digital Output Marshalling

All Digital Outputs shall be galvanically isolated from the field and thus interposing relays are to be supplied and installed. In this regard, these interposing relays shall be driven via open collector PLC digital outputs, with field power being sourced from the field equipment itself. Field power shall only ever consist of either + 110V DC, + 50V DC or + 24V DC respectively. Compliance with the following minimum specifications are required:

Input Voltage	24V DC
Max Output Voltage	250V
Rated Output Current	5A
Min Switching Frequency	30 Hz
MTBF	5 x 10 ⁶ operations

Where field voltages exceed + 24V DC, cabinet terminals shall be labelled as high voltage.

8.4.15 Digital Input Marshalling

All Digital Inputs shall consist of voltage free contacts fed from the common 24V DC Field Power Supply located in the Control Room. These feeders shall be protected by suitably rated Circuit Breakers on an individual Device Group basis.

Conversion from intermediate voltages (eg. 50 VDC, 110 VDC) may require the installation of interposing relays in order to convert from intermediate voltages.

8.4.16 Analogue Input Marshalling

All loop powered Analogue Inputs shall be powered directly from the respective PLC Analogue Input Modules themselves whilst all self powered Analogue Inputs shall be powered directly from suitably rated MCB's located in Equipment Marshalling Cabinet.

8.4.17 IS Barrier Protection

Contractors are to note that most discrete and analogue signals associated with Field and Pump Set Instrumentation are terminated in Hazardous Areas and consequently IS Protection shall need to be provided.

8.4.18 Surge Protection

Transnet Pipelines Pump Stations are situated in areas of high risk in terms of lightning strikes and thus adequate Surge Protection shall be required to be provided by the Contractor. Contractors are to note that responsibility for the provision of adequate surge protection lies with the Contractor and that Transnet Pipelines will not regard damage to equipment resulting from a lightning strike or power surge as unavoidable, except in instances of a "direct strike". Rectification of all resultant damage shall be undertaken at the Contractor's cost.

8.5 Earthing Requirements

8.5.1 Earthing and bonding conductors shall be sized and installed in compliance with regulations detailed in the current SABS 0142 Standard Regulations for the Wiring of Premises and in SABS 03 as applicable. Conductors shall comprise of multi stranded, PVC insulated cable, of gauge not less than 6mm², cross sectional area.

8.5.2 All cabinet doors shall be earthed to the panel earth using a braided copper conductor of not less than 6mm², cross-sectional area.

- 8.5.3 Each Equipment Cabinet (excluding Field Junction Boxes) shall make provision for a suitable 'electrical earth' to be installed at the bottom of the cabinet and comprising of a solid 50 x 5mm min copper bar running the entire length of the cabinet in the front. The bar shall be bolted to the base framework with a minimum clearance of 40mm from the sheet steel gland plate.

The following equipment shall be earthed directly to the electrical earth bar, via adequately sized PVC insulated copper cabling (green/yellow):

- Electrical equipment housings/backplanes. (Where earth terminals have been provided, the earth wiring cross section shall be the maximum compatible with the size of the terminals provided. Where earth studs have been provided, the earth wiring cross section shall be in compliance with manufacturer's recommendations. Where not specified, earth cable cross sectional areas shall not be less than 6mm²).
- Cable overall screens.
- Cabinet chassis.

- 8.5.4 Each Equipment Cabinet (excluding Field Junction Boxes) shall make provision for a suitable "instrument earth" to be installed at the bottom of the cabinet and comprising of a solid copper bar (50mm x 5mm) running the entire length of the cabinet in the front. The bar shall be supported on robust insulated spacers, with a minimum clearance of 40mm to the sheet steel panel, and clearly labelled. The instrument or clean earth shall be insulated from the panel at all times.

The following equipment shall be earthed directly to the instrument earth bar, via adequately sized PVC insulated copper cabling (blue):

- 24 V DC Power supply common rail.
- Barrier/Isolator earth (Earth cable cross sectional area 70 mm² min).
- Cable individual screens

- 8.5.5 Earth bar specifications shall comply with the following:

- 50mm x 5mm x full length of Panel.
- Yellow/Green (Electrical) and Blue (Instrument) at regular intervals, so that identification from each panel section is possible.

Sufficient number of holes to be provided on bus sections for all outgoing circuits & 20% spare for double cables. High tensile phosphor bronze or passivated plated nuts, bolts and lock washers shall be provided through the earth bar at each earthing position, with at least 25% additional holes being provided for future connections, all fitted with nuts and bolts.

- 8.5.6 All panel cubicles to be bonded to each other and to the Main earth bar.

- 8.5.7 All metal housings shall be earthed.

8.6 Cabinet and Equipment Labelling

8.6.1 Internal Labels:

All components shall be labelled with their complete "-" Component Identification designation, in accordance with the Transnet Pipelines Label Designation Standard attached to this Specification (Ref: 711-001_PLCLabelSpec). The labels shall be readable/visible after the wiring has been done. Where possible, labels are to be attached on the panel next to the device, but where this is not practical, then, and only then, may the label be placed directly onto the device.

Labels shall comprise of the Traffolyte engraved type, and fixed to the board by means of stainless steel screws or epoxy glue. Finish shall comprise of black letters against a white background, except in the case of cautionary labels where letters shall appear white on a red background.

All lettering shall be in upper-case letters except where standard abbreviations of units are used, e.g. kWh, kVA, etc.

8.6.2 Internal Labels: Terminal Rails

All Terminal Rails shall be labelled with their complete "-" Component Identification designation, in accordance with the Transnet Pipelines Label Designation Standard attached to this Specification. (Ref: 711-001_PLCLLabelSpec).

Note that two types of Terminal Rail Labels have been defined as follows:

Field Marshalling – label identifies the Cable ID terminated into the terminals

PLC I/O Marshalling – label identifies the PLC ID:Rack No:Slot No of the associated I/O Card

Labels are to be attached to Terminal Rail Label Holders located at the top of the terminal rail.

8.6.3 Internal Labels: Equipment

Each device shall be labelled with its complete Functional Identification designation, in accordance with the Transnet Pipelines Label Designation Standard attached to this Specification. (Ref: 711-001_PLCLLabelSpec). The labels shall be readable/visible after the wiring has been done. Where possible, labels are to be attached on the panel above the device.

MCB's shall be clearly labelled as to their functionality (what equipment is supplied) and supply voltage by means of a laminated legend plate located on the inside door panel of the cubicle housing the respective MCB's. In addition, all MCB's shall be individually labelled with the respective MCB No's on the front top of the breaker so as to enable rapid visual identification.

8.6.4 External Labels:

Labels shall comprise of the Traffolyte engraved type, and fixed to the board by means of stainless steel screws. Finish shall comprise of black letters against a white background, except in the case of cautionary labels where letters shall appear white on a red background.

All lettering shall be in upper-case letters except where standard abbreviations of units are used, e.g. kWh, kVA, etc.

8.6.5 External Labels: Panel/Cubicle

All Panel doors shall be labelled with their complete "+" Location Identification designation, in accordance with the Transnet Pipelines Label Designation Standard attached to this Specification. (Ref: 711-001_PLCLLabelSpec). Labels are to be attached on the panel door top centre where possible.

8.7 Panel Wiring Colour Coding Standards

8.7.1 The following panel wiring standards have been standardised on by Transnet Pipelines and are required to be adhered to when installing internal panel wiring:

	<u>Core Size</u>	<u>Insulation rating</u>	<u>Insulation Color</u>
Signal I/O			
PLC Digital	0.5 mm ²	300 V	Grey (+) Grey (-)
PLC Analogue	0.5 mm ²	300 V	Violet (+) White (-) Twisted pair
Power Distribution			
220 V AC Supply	1.0 mm ²	300 V	Brown (L) Blue (N)
24 V DC Supply	1.0 mm ²	300 V	Red (+) Black (-)
Earthing Distribution			
Electrical Earth	SABS 083	1000 V	Green/Yellow
Instrument Earth	SABS 083	1000 V	Blue
Pre-manufactured E.T. Looms			Blue, Numbered

9. FACTORY ACCEPTANCE TEST PROCEDURES

9.1 Unless otherwise specified, work and acceptance tests shall be conducted on all equipment at the place of manufacture. Contractors shall be responsible for the compilation of an Acceptance Test Schedule to be used for acceptance testing of the system. The test schedule shall be comprehensive and must cover all aspects of the system to be tested and will be subject to the approval of Transnet Pipelines, prior to commencement of Pre-acceptance Testing.

The successful Tenderer will be responsible for providing all test equipment and facilities required for the period of the acceptance tests such as the Engineer may deem necessary, and to produce a report of the tests concerned.

Transnet Pipelines reserves the right to add or delete any item or test from the test result of hardware failure, re-scheduling of the test will be at the discretion of the Engineer. Transnet Pipelines reserves the right to repeat or incorporate any additional test into the test schedule.

9.2 The following tests shall be required to be performed as part of a Factory Acceptance Test Procedure:

- A physical check of all equipment shall be made against drawings and shall include a check for tightness of connections, **correct core indenting** etc.
- A terminal to terminal routing check of all panel wiring shall be made against drawings **and the drawings red-lined accordingly**
- Trip element ratings of all supply and distribution breakers shall be made
- Earth leakage tripping shall be made on all circuits
- Effectiveness of earthing system shall be checked
- Powering up of panel shall be conducted and equipment run for a period of three hours. During this time a check for abnormal operating conditions shall be made e.g. Temperature and current.
- **Simulation of all discrete and analog signals from the respective field terminals into the respective PLC I/O modules**

9.3 The following Panel Inspection Hold Points have been defined by Transnet Pipelines and will require to be complied with:

- Prior to commencement of wiring
- Prior to Functional Testing

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APPENDIX 1

Material listing and suppliers.

	ITEM	SUPPLIER	PART No.	ALTERNATE	PART No.
1	Panel Lights	RS Components	230-6574		
2	Panel Filters	Weidmuller	PFA3000		
3	Panel Fans	Weidmuller	PF3000 24vDC		
4	20Amp Power supply	Siemens	6EP1336-1SH01		
5	10Amp Power supply	Siemens	6EP1334-1SL11		
6	5Amp Power supply	Siemens	6EP1333-1SL11		
7	Power supply Rail	Siemens			
8	Overvolt Protection	Weidmuller	118706		
9	Change over Relays	Siemens	3TH 3022-OB		
10	Circuit Breakers	Siemens	5SX2---/7		
11	Neutral Rail	Weidmuller	034890		
12	Neutral Supports	Weidmuller	106120		
13	Neutral 4mm Yokes	Weidmuller	047538		
14	Neutral 16mm Yokes	Weidmuller	050288		
15	0 Volt Rail	Weidmuller	034890		
16	0 Volt Supports	Weidmuller	106120		
17	0 Volt Yokes	Weidmuller	047531		
18	Rhomberg Relays	Rhomberg	ST110/30VDC-DP		
19	Relay Bases	Rhomberg	S3-B		
20	16Amp S/O Dedicated	Voltex	CT6896/6546/103		
21	Terminals 2.5mm	Weidmuller	102378		
22	Terminals plc disconnect	Weidmuller	101110		
23	Terminals Valve disconnect	Weidmuller	068746		
24	Terminals I/S Circuits	Weidmuller	102158	Weidmuller	059008
25	Terminal Bridge 2.5mm	Weidmuller	157906		
26	Terminal Bridge Valves	Weidmuller	157906		
27	Terminal Bridge I/S	Weidmuller	105446		
28	Terminal Bridge I/S	Weidmuller	157900		
29	Screen Rail	Weidmuller	028020		
30	Screen Rail Support	Weidmuller	029986		
31	Instrument Busbars	Gold Circle	20 x 5		
32	PE Busbars	Gold Circle	20 x 5		
33	Instrument Busbar Supports	Allbro	GL-5		
34	Panel Enclosures	Ellen Electrical	Series 6000		
35	Valve Relays	Siemens	3TX7002-1AB00		
36	Transorbs	Comunica	1.5KE68CA		
37	Trunking	Schneider	75 mm Depth		
38	Label Holders	Weidmuller	163193		
39	Label Holder covers	Weidmuller	163194		
40	Wire Pin Lugs	Legrand	Starfix Range		
41	Wire Markers	Grafoplast		Legrand	Memocab range
42	Panel Light Terminal Block	Weidmuller	019782		
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APPENDIX 2

2.1

Cabinet Supplier: Elen Enclosures
Type: Sarel (Spacial 6000)
Product Certifications: IEC 529, BV, DNV, UL, CSA.

2.2

Sarel spacial 6000
Uprights: part No. 60020
Top/Bottom frame and roof: part No. 67068

2.3

Sarel spacial 6000
Side covers: part No. 61048
Side-by-side fixing kit: part No. 64620

2.4

Sarel spacial 6000
Plinth: part No. 69068
1 piece Gland plate: part No. 63098

2.5

Sarel spacial 6000
Plain door: part No. 67226

2.6

Sarel spacial 6000
Door handle: part No. 63600
6mm Square lock: part No. 63650

2.7

Sarel spacial 6000
Document pocket: part No.64086

2.8

Voltex
Dedicated 16A socket outlet: part No. CT6896 / CT6546/103

2.9

RS Components
Panel light: part No. 230-6574

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