

TRANSNET PIPELINES
WALTLOO DEPOT
SPILL BASIN PROJECT
PROJECT SPECIFICATION
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TRANSNET PIPELINES

WALTLOO DEPOT

SPILL BASIN PROJECT

PROJECT SPECIFICATION – MECHANICAL AND ELECTRICAL WORKS

PSL MEDIUM PRESSURE PIPELINES (SABS 1200L)

The requirements of section PSX of this document are also applicable for this section.

PSL 1 Supporting Specifications

All work involving steel pipelines and fittings shall be carried out in accordance with SABS 1200 L, ASME B31.3 (latest edition) or ASME B31.4 (latest edition) for product piping only, and this Project Specification. (See Clause 2.5 of the Special Conditions of Contract).

PSL 2 Pipelines

PSL 2.1 Notwithstanding the provisions of sub-clause 5.2.3 of SABS 1200 L jointing of pipes and specials of all diameters shall be by field welding, except where pipes are fitted to flanged valves and elsewhere as shown on the drawings or instructed by the Engineer.

PSL 2.2 The Rated Pressures of this system are as follows:

Product piping: = 1900 kPa

Fire Fighting piping: = 1600 kPa

All pipes, flanges and fittings shall be suitable for these duties.

PSL 2.3 Medium & Seals

The medium to be transported in the pipeline is as follows:

Product piping: Hydrocarbons / Fuel products

Fire Fighting Water: Sea Water

Fire Fighting Foam: Foam Concentrate

Fire Fighting Foam Pre-mix: Sea Water with 3% Foam Concentrate in solution

The seals provided shall all be suitable for the medium of product. All hydrocarbon seals shall be Nitrile or Viton. All threaded connections shall be sealed with Stag Jointing Compound.

PSL 2.4 Flanges

Flanges shall be ANSI B16.5 150lb raised face and constructed of ASTM A105 material unless otherwise stated on the drawings and shall be of the weld neck type to the correct pressure rating as specified in the Schedule of Quantities or as shown on the drawings. Plug flanges, if required, shall be as shown on the drawings.

All flanges shall be installed with bolt holes drilled off centre and symmetrically offset from the vertical centre line of the flange. Flanges shall be installed square to the axis of the pipeline.

Any item of pipework that is found to have the flanges incorrectly drilled will be rejected. Reaming of bolt holes to oversize dimensions in order to make a particular piece fit will not be permitted.

PSL 2.5 Wall Thickness of pipes and specials shall be as follows:

Product

The pipes and fittings shall be standard schedule unless otherwise stated on the drawings or bill of quantities.

Fire Fighting

The pipes and fittings shall be schedule 10s unless otherwise stated on the drawings or bill of quantities.

*PSL 2.6 Manufacture of Steel Pipes and Specials**Product Piping*

Pipe shall have bevelled ends in accordance with ANSI B16.25 by the Contractor. The rate for treatment of pipe ends shall be included in the rate for welding of pipes.

Piping shall be delivered in a clean state, together with all relevant test and quality control documentation as required by the specification.

Used steel pipe and unidentified new steel pipe shall not be used. Removal of a portion of an existing steel line and reuse of the pipe shall not be permitted.

All pipe shall be cleaned inside and outside. All pipe shall be visually inspected to determine that it is reasonably round and straight and to discover any defects that might impair its strength or tightness.

Carbon Steel

The piping shall comply with ASTM A106 Gr. B, according to availability as per Clause PSL 2.4 above. Specials, e.g. bends, tees, reducers and welding caps shall be carbon steel to ASTM A234 WPB. All piping and specials shall be seamless. Where applicable all piping is to be Denso wrapped as per manufacturer's specification or as specified in this specification.

Stainless Steel

All piping is to be 316 L stainless steel pipe to ASTM A312 seamless. Weld filler material is to be 316 L or 904 L. Where applicable all piping is to be Denso wrapped as per manufacturer's specification or as specified in this specification.

All stainless steel pipes are to be kept free of contamination by carbon steel, grinding etc.

Pipe ends are to be kept closed at all times. Should ends be left open and dust, sand, grinding, welding rods etc are found in the pipes the Engineer will instruct the Contractor, at the cost of the Contractor to broom/pig all pipes before installation, and before pressure testing.

All areas of grinding are to be cleaned with stainless steel wire brushes and pickled and passivated to prevent contamination of the stainless steel.

Where practical, full lengths of pipe are to be used with partial lengths limited to shorter tie-in spools.

Corrosion protection, welding etc are measured elsewhere unless specifically included in the schedule of quantities.

All pipes shall be colour coded as directed at direction changes or as required for ease of identification.

All pipe certificates are to be included in the data pack and are to be referenced to the pipes as installed.

Galvanic Corrosion Protection

Where dissimilar metals are being used (between the pipe, pipe brackets and pipe supports) suitable isolation means, either plastic strips, isolation kits or top hat washers shall be used to prevent galvanic corrosion.

Cathodic Protection

Electrical bosses may be required to be welded onto the pipe for cathodic protection as indicated on the drawings. Piping inside valve chambers is to be regarded as exposed piping. Cathodic protection is to be done by others.

Fittings & Specials

All steel and stainless steel pipe fittings shall be forged and not fabricated.

Changes in direction shall only be made by the use of bends or elbows. Mitres shall not be allowed.

All forged bends, tees and reducers shall conform to ANSI B 16.9. Butt welded standard caps shall conform to ASME VIII.

Elbow schedule is to match that of the pipe. Where required the elbow/pipe ID is to be ground/filed to ensure a smooth ID across the weld.

PSL 2.7 Measurement and Payment

Notwithstanding the various payment items of Clause 8.2 of SABS 1200 L, payment for fittings and straight pipes of non-standard lengths will not be measured as extra over.

The rates tendered for bolt-ups shall include for all nuts, bolts, washers and gaskets and all things necessary.

The rates tendered for pressure testing, draining and degassing shall be measured through the fittings and equipment.

Payment shall be for actual lengths installed.

PSL 2.8 Drawings

The Contractor shall be provided with a set of construction drawings which may or may not include isometrics. Should the Contractor deem it necessary for isometric drawings or further fabrication/workshop drawings to be generated, it shall be for the Contractors account.

The timing of the issuing of drawing is at the discretion of the Engineer based on the stage of the project, necessary milestones and the programme. It cannot be assumed that all drawings will be issued at the start of the project.

Piping 40NB and smaller will be site run. Drawings provided for these pipelines shall be used a routing guide rather than for dimensionally accuracy.

Only drawings marked "ISSUED FOR CONSTRUCTION" and signed by the Engineer may be used. While every effort has been made to ensure the accuracy of the drawings, and provision has been made for site shop/field welds, the Contractor is to confirm all dimensions prior to fabrication. Confirmation of the drawings must be done on site and, provided it does not hinder operations or safety, be marked out physically.

On completion of the contract the Contractor is to supply the Engineer with a set of dimensioned "as built" drawings. Hand alterations on the latest revision will be acceptable.

All dimensions and directions must be checked and marked as correct or a new dimension/direction inserted.

Before any trenching or pipe supports are done for the laying of any piping the final route for such piping shall first be confirmed with the Engineer.

PSL 3 Protection of Pipes and Specials

The requirements of section PSX of this document are also applicable for this section.

Non-destructive testing of the pipelines shall be performed prior to the painting or coating of the pipelines. A primer coat may be applied to protect the pipeline if the non-destructive testing cannot be performed in good time.

PSL 3.1 Surface Preparation

Blast Cleaning

Prior to abrasive blasting, all equipment which can be damaged by blasting, dust, grit or shot, shall be protected by wrapping, taping, or other means, to prevent damage. This equipment shall include, but not be limited to, rotating shafts, bearings, valves, machined moving parts and motors.

No final blasting shall be carried out in wet weather before painting commences.

Air used for blasting shall be dry and free of oil and other contaminants. All air pressure supply lines for blasting shall have moisture and oil trap filters.

After blast cleaning the surfaces shall be blown clean of all blasting material and dust with dry air, or by means of an industrial vacuum cleaner.

Abrasives for blast cleaning shall be clean and dry and shall be selected to provide the required surface profile for the subsequent priming materials.

The standard of blasting shall be in accordance with SIS 0559 00.

Wire Brushing

Weld spatter and slag shall be removed by grinding or chipping prior to wire brushing.

Surfaces to be wire brushed shall be degreased or solvently washed prior to wire brushing.

The wire brushed surface finish shall be in accordance with this Specification.

Wire brushed surfaces shall be blown clean using dry, oil free air.

Wire brushed surfaces shall be primed the same day and shall not be left uncoated overnight.

Paint Application

Paint shall not be applied on any surface containing grease, oil, loose rust, mill scale, corrosion products or any other deleterious material. No paint shall be applied to wet, moist, or sweating surfaces, or un-cleaned paint, previously applied.

No paint coating shall be over coated until the time as specified by the paint manufacturer has elapsed.

Coatings shall not be applied when the surrounding air temperature is below 7°C. When the surrounding air temperature is below 7°C the surfaces to be painted shall be preheated to eliminate wetness and sweating, and shall be kept completely dry prior and during paint application.

After paint application, the surface shall be protected from rain, dust or other unfavourable conditions until the paint is dry. The Employer will review damage caused by any of the above conditions and make recommendations to the Contractor for corrective actions at the Contractor's cost.

All containers shall remain closed until required for use. Mixing of paints shall be done by means of a mechanical mixer. Paint shall be agitated during application to keep pigments in suspension.

Paint shall be applied by spray, unless otherwise instructed by the paint manufacturer.

The dry film thickness of coats specified in this Specification is minimum. If the total dry film thickness or hiding is not achieved, additional coats shall be applied at no extra cost to The Employer.

All coats shall be applied in such a manner as to produce a film of uniform thickness. Attention shall be paid to crevices, weld lines, corners, edges and similar surfaces to obtain the specified thickness.

Protective coatings as detailed in this Specification shall be applied by qualified workmen only. The criteria governing good workmanship shall be surface preparation, neat appearance, free of blisters, bubbles, craters, sags, runs, lap marks and unnecessary over spray or brush marks. Other criteria are thorough mixing, straining, uniformity of film thickness, removal of dust, grease and other foreign matter, drying time between coats and protection of surfaces not to be painted.

The manufacturer's recommendations and instructions for thinning, mixing, handling and applying his products shall be considered part of this Specification. In the event of conflict between the specifications and the manufacturer's recommendations, The Employer shall determine which procedure is to be followed.

Areas where the paint coating has been damaged during transportation, erection and similar operations shall be cleaned by means of wire brush or emery paper. The surrounding paint, which is still intact, shall be roughened for a distance of 20 mm beyond the damaged area prior to spot

priming. Painting shall consist of all the coats previously applied and shall overlap the damaged area at least 20 mm.

Paint shall be applied within a maximum of four hours after blast cleaning or wire brushing.

Only inorganic zinc rich paint shall be applied by agitated pressure pot spray. For small areas painting by brush shall be done.

The primer, the intermediate and finishing coats shall be supplied by the same manufacturer unless otherwise approved by The Employer.

Thinners to be used shall be of the same manufacture as that of the paint and as specified by the manufacturer.

Areas which will be inaccessible after erection, such as back to back angles, shall receive the full specified coating prior to assembly.

Equipment or structural steel members being either primed at the workshops and delivered to site for storage, or primed on site prior to erection, shall be laid on trestles or timber sleepers which are at least 200 mm above ground level.

Workmen shall be responsible for the cleanliness of the jobsite and shall ensure that all waste material attributable to their trades are regularly removed.

Precautions as required by the Employer shall be taken to avoid fire hazards of stored on site materials. Oily or solvent soaked rags shall be kept in closed containers and in minimum quantity.

Air used for abrasive blast cleaning or for spraying shall be free from all traces of oil, water and other contaminants.

Paint containers shall be clearly labelled. The label shall show the name and type of paint, batch number, colour and any instructions for mixing and/or reducing the volume.

Colour coding and marking shall be in accordance with Section 11 of this Specification.

No primer or finish paint shall be applied on or near piping circumferential welds prior to post weld heat treatment (PWHT) or hydro test. The primer shall be held back 50 mm from either side of the weld if PWHT is required.

Shop Painting

The Contractor shall furnish the materials specified and ensure that they are applied in strict accordance with this Specification.

The Contractor shall be wholly responsible for surface preparation and primer application. The primed surface shall meet the minimum dry film thickness required by this Specification.

Surface preparation and priming on vessels, equipment and structural steel shall be performed by the Contractor in the shop unless otherwise agreed by The Employer.

All equipment requiring cold insulation operating at 15°C and lower and all un-insulated equipment shall be cleaned and primed in accordance with the schedule in this Specification.

When the piping Contractor is responsible for finish painting piping spools (mark pieces) or straight-run piping may be painted in accordance with this Specification, after completion of erection and all specified tests.

Shop finish painted mark pieces shall be "line tagged" for identification. The line tag shall consist of a galvanised metal tag, marked with the line number, mark piece number and NDE release number. Tags shall be secured to the pipe with a 15 mm wide stainless steel band.

Pipe shoes, saddles and anchors that are shop fabricated shall be primed before delivery to the jobsite. A 25 mm wide band shall be masked and left un-primed along the edges for subsequent welding to the pipe.

After attachment in the field, the shoes, saddles and anchors shall be finish painted in accordance with this Specification.

Jobsite Painting

Shop primed surfaces shall be inspected and examined for bare or marred spots. All such areas shall be thoroughly cleaned and touched up with the specified primer. The finish coating shall then be applied.

Field fabricated items shall be cleaned, primed, and finished as specified by this Specification. Cleaning, priming, and finishing over manufacturer's standard shall also be as specified in this specification for new equipment.

All un-insulated piping which is located outside unit battery limits (offsite), shall be painted white per the schedule. This excludes special product piping such as firewater, pitch, tar and nitrogen.

The painting of spring support housings shall be done after field installation. Attention shall be given to the following:

Galvanised surfaces shall be inspected and examined for bare or marred spots. All field welds and all abrasions caused by handling, shipping, storing, or erection, shall be thoroughly cleaned and shall be touched up with a cold galvanising compound or organic zinc rich epoxy as specified in this Specification.

PSL 3.2 Internal Protection of Piping

The Transnet Pipelines corrosion protection specification will apply to this contract and is supplied separately with the contract document.

The work shall be carried out as per the manufacturer's specifications and this document. The atmospheric conditions shall meet the manufacturer's and Transnet's requirements.

The manufacturer of the coating shall be approved by Transnet prior to the work being done.

Quality control and inspection of the coatings shall be in accordance with the Transnet Pipelines specifications mentioned above.

PSL 3.3 External Protection of New Above Ground Piping

The Transnet Pipelines corrosion protection specification will apply to this contract and is supplied separately with the contract document.

The work shall be carried out as per the manufacturer's specifications and this document. The atmospheric conditions shall meet the manufacturer's and Transnet's requirements.

The manufacturer of the coating shall be approved by Transnet prior to the work being done.

Quality control and inspection of the coatings shall be in accordance with the Transnet Pipelines specifications mentioned above.

All coats shall be different colours to clearly show coverage. The engineer or engineer's appointed inspector shall inspect the work between coats.

Pipes, specials, flanges and bolts and nuts in extremely harsh conditions (such as marine environments) shall be coated with a coating system specifically designed for such conditions. The coating system shall be supplied by a reputable manufacturer such as Jotun, Corrocoat, Akzo Nobel, Stoncor and Sigma Coatings. The coating system shall be designed to have a useful life of 15 years. The coating system shall be subject to the approval of the Engineer. The coating shall be applied by a Contractor approved by the coating manufacturer. The coating shall be applied and tested in strict accordance to the manufacturer's specifications. The test results shall be subject to acceptance of the Engineer and the coating manufacturer.

Alternative painting (including preparation) shall be as per the manufacturer's specification and subject to approval of the Engineer.

Repairs and patches to all painting and coating systems shall be done in accordance with the manufacturer's specifications and subject to the manufacturer's testing procedure.

PSL 3.4 External Protection of Existing Above Ground Piping

Certain sections of existing pipework are to be modified and re-used in the permanent works. Depending on the existing paint condition the pipes may need to be completely or partially protected as per Clause PSL 3.2 or patch repaired. The pipe shall be removed off site where blasting and protection according to the full requirements of Clause PSL 3.2 is needed. Items of pipe work and equipment to be patch repaired shall be wire brushed on site before receiving the paint coats as described in Clause PSL 3.2 item (b).

PSL 3.5 Galvanising of Pipe & Steel Surfaces

Where called for by the drawings or specifications, the mild steel pipes are to be galvanised as per SANS 32, including all necessary preparation of the piping.

Painting onto galvanised pipes shall be as follows:

- | | |
|-------------|---|
| Preparation | – Clean emulsifying agent / rinse with clean water |
| | – Chemical etch / rinse with mordant solution |
| Priming | - ZN Phosphate 2 pack epoxy (1 x 60µDFT) |
| Finish | - Acrylic modified 2 pack polyurethane (1 x 50µDFT) |

Alternatively, painting shall be as per the manufacturer's specifications (including preparation) and subject to the Engineer's approval.

PSL 3.6 Pipe Identification

The painting to equipment and pipes shall be included in the tendered rates. The colour of the pipes and identification bands shall be as per TPL's specification. Firefighting water pipes and equipment is to be painted Fire Fighting Red. Firefighting foam pipes and equipment is to be painted white.

The name of the product shall be painted on the pipeline every 12m in black paint in letters no smaller than 50mm high and 30mm wide.

PSL 4 Bolts and Nuts

Product Piping: Bolting shall conform to ANSI B16.5.

Bolts and nuts for flange connections shall be of the stud bolt type.

Carbon steel bolts shall be to ASTM A193-B7 and nuts to ASTM A194-2H, in sizes appropriate to the class flange. The length of each bolt or stud shall be such that, after the bolt has been tightened, the end of the bolt or stud projects past the nut by no less than two full threads and no more than four full threads. All bolts shall be centred so that an equal length projects past the nut on both ends of the stud bolt.

ALL STUD BOLTS, WASHERS AND NUTS SHALL BE HOT DIP GALVANISED.

All nuts are to have a 2mm washer of compatible material.

All sleeve anchors shall be ANSI 316 stainless steel. All fixings having a nominal diameter of 10mm or less shall be ANSI 316 stainless steel and this also applies to proprietary bought out items.

An approved molybdenum disulphide anti seize compound shall be used on all bolts and nuts. The cost for this shall be included by the Contractor in his rate for bolting.

The rates tendered for bolt-ups shall include for all nuts, bolts, gaskets and consumables required.

All underground flanged connections shall be protected using a petrolatum mastic formed to an even profile followed by a layer of petrolatum tape covered with a PVC outer wrap. The choice of materials and procedure is to be approved by the Engineer prior to installation.

Should galvanised hexnut bolts be specified on the drawings then the nuts, bolts and washers shall be class 10.9 as per ISO898. Galvanising should meet the requirements of SANS 120 (ISO 1461).

Should stainless steel nuts, bolts and washers be specified by the drawings, they shall be ASTM A193 B8 Class 2 bolts and ASTM A194 Grade 8 nuts and washers.

PSL 5 Bolt-Ups

For the purpose of this specification, a bolt set is deemed to consist of all the bolts, washers and nuts required for a flange.

Bolt-ups should follow the sequence recommended by the gasket manufacturer. Under no circumstances should one bolt be fully torqued prior to all other bolts being fitted and partially torqued.

The bolts should be torqued in at least 3 stages to varying percentages of the final torque value. The final torque value and the percentages per stage must be approved by the gasket manufacturer in order to achieve the necessary compression for the pressure rating. The bolt torque and gasket compression values must be submitted to the Engineer for approval prior to construction.

Bolt-ups should be done in the following sequence:

1. Fit all stud bolts and nuts
2. Hand tighten all nuts
3. Torque the bolts
4. Fitting of the tag

A tag shall be placed on all flange sets where the bolts have been tightened and correctly torqued. The tag shall include the name of the fitter who tightened the bolts, the date and time when the bolts were tightened and the signature of the fitter.

The pipeline may not be filled until all the flange sets have tags installed. Once the pipeline has been pressure tested the tags will be removed by the Contractor and the bolts coated as required by the specification.

Bolt sets in harsh environments (such as corrosive or marine environments) shall be protected by means of an approved Denso wrapping technique. The wrapping technique shall be subject to the approval of the Engineer.

PSL 6 Gaskets

Unless otherwise stated on the drawings, gaskets shall be of non-asbestos fibre complying with the requirements of BS 7531. Only approved brands, including Permanite style 229, Klinger Topgraph 2000 and Klinger Oilit may be used.

Unless otherwise stated on the drawings, all gasket material shall be 1.5mm thick flat ring to BS 3063 or ANSIB16.21 and cut so that the annular section is completely within the bolt circle i.e. ring gaskets with no bolt holes, unless otherwise specified on the drawings.

All gaskets shall be purpose made. Hand cutting and trimming of gaskets on site will not be acceptable.

Care shall be taken to ensure that all gaskets are packed properly and are not damaged by bending. For larger sizes the gasket shall be suitably supported by wooden frames during transit and while in store.

PSL 7 Welding Procedures

General

Welding procedures and welders performing work under this specification shall be qualified under the ASME Boiler and Pressure Vessel (BPV) Code, Section IX, or API 1104. The choice of either of these standards resides with the Engineer.

Field Welding should be done in alignment with ASME B31.3 and ASME Boiler and Pressure Vessel (BPV) Code, Section IX. The choice of either of these standards resides with the Engineer.

Welder re-qualification tests shall be required if there is some specific reason to question a welder's ability or if the welder is not engaged in a given process of welding for 6 months or more. All welders shall be re-qualified at least once each year.

Any re-qualification of a welder called for by the Engineer shall be for the Contractor's account.

Records of the tests that establish the qualification of a welding procedure shall be maintained as long as that procedure is in use. The operating company or Contractor shall, during the construction involved, maintain a record of all welder's qualified, showing the dates and results of tests.

Carbon steels shall be preheated and stress relieved as per the requirements of clauses 824 and 825 of ASME B31.8.

Stainless steel welding shall not be done on wet pipes or in windy conditions unless suitable wind breaks are erected to maintain the integrity of the weld shield gases. A clean and uncontaminated weld area – free of carbon (mild) steel, paint, oil, grease, crayons etc – must be maintained.

Tack weld materials shall be of the same type as the filler material. Electrodes shall comply with SABS 455.

Prior to the commencement of field welding, welding procedures shall be established and approved by the Engineer and thereafter such welding procedure shall be adhered to during subsequent construction and shall not be altered unless specifically authorised by the Engineer.

The Contractor shall provide a detailed description of all aspects of the welding technique to be employed both in jointing pipes in assemblies above trench level and in executing in-situ welds whether above or below ground level. The information required shall include a drawing of the prepared end for butt welding of flanges and pipes.

Records shall be kept by the Contractor to enable each weld to be subsequently identified with the welder concerned.

General Welding Requirements

Avoid positional welding. Avoid arc strikes on the fabrication. Use a striker pas or scrap stainless steel. Use run-on and run-off tabs. Any temporary attachment shall be of equivalent grade stainless steel and tacked in position with an electrode of equivalent grade. Such attachment shall be carefully ground off.

Maintain a short arc and adequate gas shielding. Take special care when welding in the open, or under draughty conditions. Use stainless steel wire brushes to remove slag or scale. All grinding discs and abrasives shall be iron free and used only on stainless steel.

Restore passivity/corrosion resistance of the welding area. Remove scale either mechanically or chemically – mechanically by use of dedicated abrasives/discs and chemically by pickling with nitric/hydrofluoric acid formulations. Do not use formulations of hydrochloric acid. Wash thoroughly after pickling

Passivate with nitric acid formulation if;

- weld is mechanically descaled
- application is critical or marginal
- general surface contamination of the fabrication by carbon (mild) steel has occurred.

Wash thoroughly after passivation.

Post weld heat treatment is generally not required, nor recommended.

Only TIG (tungsten inert gas)/ GTAW welding will be acceptable. MIG (metal inert gas) welds will only be acceptable upon the approval of the Engineer unless otherwise agreed in writing by the Engineer, the Employer and the Contractor.

Only pure Argon or gas mixtures of argon and helium or argon and hydrogen shall be used for TIG welding.

For MIG welding only argon + 1-2% oxygen shall be used. For non-critical corrosion resisting applications 2% carbon dioxide may be used instead of oxygen. The addition of helium may be used for automatic welding and/or welding of thick material.

Stick (SMAW) welding will not be accepted in any circumstances.

The minimum distance between longitudinal/spiral welds on two adjoining pipes is to be 50mm as measured along the circumference. All pipes to be welded are to be gas freed before welding. The maximum allowable bend angle across the welds is to be $\frac{1}{2}^\circ$. Welds are to be to ANSI B31.1

All weld slag is to be removed before the pressure test.

Generally speaking, weld procedures shall not allow for slag removal which may thin the adjacent material.

Butt Welds

Acceptable end preparations shall be as shown in Appendix I, Fig I4 of ASME B31.8

Fillet Welds

Minimum dimensions for fillet welds used in the attachment of slip-on flanges and for socket welded joint shall be as per ASME B31.8, Appendix I, Fig I6. Similar minimum dimensions for fillet welds used in branch connections are shown in ASME B31.8, Appendix I, Figs. I1 and I2.

Welding and Inspection Tests

The quality of welding shall be checked visually on a sampling basis, and defective welds shall be repaired or removed from the line at the Contractor's expense.

All welds are to be clearly numbered on the drawings and the name of the welder is to be recorded for each weld.

The quality of welding shall be checked by non-destructive inspection. Non-destructive inspection may consist of radiographic examination or magnetic particle testing. The trepanning method of non-destructive testing is prohibited.

The following minimum number of butt welds shall be selected on a random basis by the Contractor from each day's construction for examination. Each weld so selected shall be examined over its entire circumference.

- 10% of welds in Location Class 1
- 15% of welds in Location Class 2
- 40% of welds in Location Class 3
- 75% of welds in Location Class 4
- 100% of welds at major road crossings

All welds that are inspected must meet the standards of acceptability of API 1104 or be appropriately repaired and re-inspected. The results of the inspection shall be used to control the quality of welding.

All radiographic examination shall meet the requirements of API 1104.

Defective welds shall be removed or repaired. If a repair is made, it shall be in accordance with AMSE IX or API 1104. Welders performing repairs shall be qualified as set out in this specification. The cost for any removal or repair of a rejected weld shall be for the expense of the Contractor.

PSL 8 Procedure Qualification Tests

Before the Contractor commences routine field welding the procedures tests laid down in ASME Section IX shall be carried out.

The minimum number of root bead welds, the minimum number of second bead welds, and the type of clamp used (internal or external) shall be given in the description of the welding technique.

The Contractor shall maintain a record of all welders employed on the works giving particulars of each individual welder's qualification tests carried out in terms of API 1104 or ASME IX, the cost of which shall be borne by the Contractor. Nevertheless the coding of welders for this project shall be carried out by a recognised independent inspection authority approved by the Engineer and the cost of such coding shall be for the account of the Contractor.

Before a welder is employed on tack or root welds, he shall carry out a test and root weld on a pipe of the same materials and under conditions as close as possible to those experienced on the actual pipeline.

If icicles are present in the bore of the pipes or the weld metal projects more than 5mm the welder shall not be permitted to undertake tack or root welding. The completed test weld pieces shall be visually examined and then radio-graphed. Should the weld appear sound it shall be subjected to

approved root and face bend tests. Test pieces shall be retained by the Contractor and marked so that they can be identified with the welder carrying out the test.

PSL 8.1 Welder Qualifications

All welders shall be coded to ASME IX. Certification from a registered body shall be available for all welders utilised. Welder qualification certificates shall strictly be in accordance with the weld procedures to be used. All welder qualifications certificates shall be current. Certification which expires during the course of the contract shall be renewed at the expense of the Contractor.

PSL 9 Weather

Field welding shall not be performed when the surfaces to be welded are wet or during periods of high wind unless the operator and the work are properly protected and sheltered in an approved manner.

PSL 10 Preparation of Joint

Where scarf cutting of the pipe is required in the field the pipe ends shall be prepared by machining or machine flame cutting. Hand flame cutting shall not be permitted.

When jointing pieces by butt welding the number of tack welds applied shall be kept to a minimum to be effective in holding the pipe end securely and to maintain the required root gap prior to welding, but shall be not less than four.

The same procedure for hot cutting is applicable for welding, but where a joint is to be made with new to existing pipe, it is preferable for safety reasons to flange the joint. In the case where the flange is jointed to the existing pipe, a rubber expandable plug is inserted into the line far enough from the heat affected zone. A gas test is then done before a hot work permit is issued. In the case of the pipe being in a vertical plane, light water may be placed over the plug.

PSL 11 Cutting and Welding Work

Before any work is to be done to product pipelines they are to be disconnected from any tankage or other possible product source. Before disconnecting or cutting any pipelines, adequate electrical continuity is to be maintained to prevent sparking due to stray currents in the pipelines. A 50sq.mm (minimum) copper cable should be used for this purpose and be suitably clamped.

PSL 10.1 Cutting and Welding of Existing Pipelines

Cold Cutting (pipe cutter or hand sawing)

The line must be drained of all product after isolation from the tank and then flushed with water. As the cutting process is cold, a gas test is not required, but it is to be assumed that there will be flammable vapours present.

Hot Cutting (Oxy Acetylene torch or grinding)

The line must be drained of all product after isolation from the tank and then flushed with water.

After flushing, a 10mm diameter hole is to be drilled in the pipe adjacent to the proposed cut, with another some distance away in a low point on the line. These holes are to be used by the authorised Gas Tester, to sample the air/gas in the line.

If the line is gas-free, a hot work permit may be issued. If gas is found to be present in the pipe and cannot be cleared by repeated flushing, the Engineer may authorise the work to proceed under the following conditions:

An adequate supply of inert gas must be on hand.

A third hole is to be drilled on the other side of the proposed cut.

A quantity of inert gas is introduced into the pipe via one of the holes.

A further gas test is done after introducing the inert gas.

If a reading is not registered on the explosiometer, cutting may proceed whilst bleeding nitrogen into both holes adjacent to the cut.

If there are traces of product on the ground or concrete paving, these are to be mopped up with dry sand, prior to doing a gas test.

On ground that shows signs of heavy pollution, that cannot be flushed away, light water may be used to minimise the hazard.

Critical Tie-Ins Using the "Clay Plug" Method

Where the downtime on a particular pipeline is critical or where it is impractical to gas free a pipeline, the Engineer may order the "clay plug" method or Vetter bags to be used to perform the tie-in. The existing lines for the particular product will be drained (not gas freed) by the Contractor under the supervision of the Engineer. The Contractor shall then cold cut the existing lines on either side of the tie-in points and install slip on flanges (unless bolting to an existing flange) on the existing pipe upstream and downstream of the tie-in point using the "clay plug" method. The open ends of the cut existing lines shall be "clay plugged" thus eliminating the need for gas freeing during the tie-in period. Partially prefabricated tie-in spool pieces shall then be installed, tack welded, removed, fully welded, pressure tested and reinstalled after removal of the "clay plugs".

The Contractor shall allow in his tendered rates for the provision of sufficient cold cutting equipment and "clay plugs" to work simultaneously on all tie-in points for the line and for all extra costs involved in performing the above operations.

The use of plumbers plugs as "clay plugs" will be permitted provided that the seal between the plug and the pipe wall is air tight.

All plugs are to be vented to prevent pressure build up behind the plug. Vents are to end a minimum of 10m past all hot work and the vent pipe is to be of a non-flammable material in the vicinity of the welding.

A gas test will be required after installation of the plug before any welding commences.

Cleanliness during pipe fabrication

Every effort must be made by the Contractor to ensure internal cleanliness of product lines during fabrication.

Plastic, rubber or wood caps are to be utilised to seal the pipes to ensure cleanliness during all transport, storage and handling operations, up to placing the pipe prior to welding.

PSL 12 Inspection

Facilities shall be provided to the Engineer so that he may be able to inspect, during the process of welding, any layer of weld metal. He may require any defective welds either to be cut out and re-welded or repaired at his discretion.

The Contractor shall clean thoroughly all welds prior to inspection. The Engineer may require a number of completed joints, selected at random, to be cut for mechanical tests or to be selected for visual inspection, micro examination or examination by other means. When the Engineer orders the Contractor in writing to cut out and test joints the Contractor shall be paid for such work at day work rates.

If as a result of inspection and testing, the work of any welder is found to be unsatisfactory, the welder will not be permitted to continue welding under this Contract.

PSL 13 Radiographic Examination

The Contractor will engage the services of an approved radiographer for examination of butt welds in the pipeline. X-rays should meet the requirements of ANSI B31.3 and the Authorised Inspection Authority (AIA). The cost of this testing shall be included in the rates tendered for piping. For every weld that fails the radiographic test, the Contractor shall be debited with the cost of re-testing the repaired work. Any radiographic testing which the Contractor may consider necessary in addition to that specified shall be at his own expense. All faults revealed by the tests shall be repaired to the approval of the Engineer.

All x-ray certificates and x-rays (including x-ray viewer) are to be made available for inspection at the request of the Engineer or AIA. All x-ray reports are to be included in the data pack. All x-rayed welds are to be stamped with the welder identification and the number of the weld. All welds are to be referenced to the welder and clearly marked on the drawings to be included in the data pack.

PSL 14 Other Non-Destructive Tests

The Employer may engage the services of an approved non-destructive testing agency for examination of approximately 100% of all fillet welds in the pipeline by means of dye penetrant, magnetic particle inspection or other suitable tests. The costs involved with this testing shall be allowed for in the schedule of quantities for testing.

PSL 15 Standards of Acceptability

The workmanship shall be of the highest quality throughout. All materials and workmanship which may, in the opinion of the Engineer, be inferior to that specified for the work will be condemned. All condemned material and workmanship must be replaced or rectified, as the case may be, at no cost to the Employer, to the satisfaction of the Engineer.

The completed welds shall comply with the requirements of ASME IX. Work on which unauthorised repairs have been carried out may be rejected.

PSL 15.1 Rejected Welds

Should a weld be rejected by the AIA (Approved Inspection Authority), the contractor shall repair the weld at the contractor's expense. Additional NDT shall be performed on the welds of any welders whose welds are rejected. The additional NDT shall be performed to the satisfaction of the AIA and the Engineer, and shall be done at the Contractor's expense.

A welder will be prohibited from welding if more than three of the welder's welds are rejected.

PSL 16 Repairs to Minor Faults

Faulty welds shall be rectified in accordance with ASME IX.

All costs relative to the repair of faulty welds and joints shall be borne by the Contractor.

PSL 17 Tolerances

Tolerances for the line and level of pipelines shall be as follows:-

<u>Positions of bends</u>	:	within 150mm of the location shown on the drawings or as agreed with the Engineer,
<u>Level of pipe invert</u>	:	within 25mm of the level shown on the drawings,
<u>Location of pipe centre in plan</u>	:	within 25mm of the location shown on the drawings through the sleeves and culverts and elsewhere within 75mm of position shown on the drawings or as agreed by the Engineer.
<u>Line of the Pipe</u>	:	The line of a straight pipe shall not vary by more than 15mm from the line of a 12m vertical or horizontal line.

PSL 18 Hydraulic Testing of Pipelines

PSL 18.1 General

All the pipelines shall be tested as directed by the Engineer. Blank flanges with necessary air, water and pressure gauge connections shall be provided by the Contractor for this purpose. Before testing any pipeline all construction work on the pipeline shall be complete unless otherwise specifically directed by the Engineer.

All joints, including welds, are to be left un-wrapped and exposed for examination during the tests. Vents, drains and relief valves shall be utilised to prevent damage to the piping system due to expansion of the test fluid during the test period.

The maximum operating pressure of each piece of equipment, including bellows, shall be checked against the test pressure of the piping system in which the piece of equipment is incorporated. If the test pressure of the piping system is greater than the maximum operating pressure of the equipment, the equipment shall be blanked off and tested separately.

Water may be used for hydrostatic testing of process lines provided special precautions are taken for draining the lines.

All piping, vessels, exchangers, etc. shall be completely drained of all fluid after testing. Special precautions should be taken to ensure that all pockets where fluid may be trapped are properly drained.

All piping tested with water, in which water would be detrimental to the process operation, shall be thoroughly dried. The Engineer shall determine when the piping is dry.

The Contractor shall supply all necessary water or other fluid if so specified, labour and equipment for conducting the tests as described herein. All tests shall be carried out in the presence of the Engineer at such times and in such manner as he may direct.

PSL 18.2 Static Test

The pipeline shall be filled with water, all scours on the section being opened fully for one minute or until the water emerges clean. If after 48 hours the Engineer is satisfied that there are no major leaks, the pressure test shall be carried out.

PSL 18.3 Pressure Test

A suitable pump shall be connected to the pipeline at a mutually agreed point.

The pressure in the pipeline under test shall be raised slowly by means of the pump and measured by a pressure gauge connected to the pipeline. The full test pressure shall be maintained for at least 60 minutes, or longer if so required by the Engineer.

The test pressure shall be 1.5 times the rated pressure. The test pressure and duration shall be stated on the drawings.

The pipeline may be tested against a closed valve.

The Contractor shall be paid under the appropriate item in the Schedule of Quantities for hydraulic tests. Re-testing after repairs required by this clause shall not be paid for.

This pressure test shall also comply with the requirements of SABS 1200 L and ASME B31.4.

Records

The Contractor shall record the following information during the hydro-testing of the pipeline and hand the completed record over to The Employer after commissioning of the Works:

- a) test medium
- b) test pressure
- c) test duration
- d) test date
- e) pressure recording chart and pressure log
- f) pressure at high and low elevations
- g) elevation at point test pressure measured
- h) person(s) conducting test, Contractor, and testing sub-Contractor.
- i) Environmental factors (ambient temperatures, raining, windy etc.)
- j) Manufacturer (pipe, valves, fittings, other equipment, etc.)
- k) Pipe specifications (SMYS, diameter, wall thickness, etc.)
- l) Clear identification of what is in each test section
- m) Description of any leaks or failures and their disposition

PSL 19 Testing and Commissioning

Testing

On completion of hydraulic testing, all new pipelines shall be completely flushed out with clean water for a period of not less than five minutes and at a velocity greater than 4m/s to ensure the removal of any remaining debris to the satisfaction of the Engineer.

After flushing all pipelines are to be cleaned with a foam cleaning pig or other suitable "pull through" until proven clean to the satisfaction of the Engineer.

In addition to the above, the following tests shall be performed:

Product Pipework

After pressure testing and flushing of the pipelines, all isolating valves shall be installed and the pipework hydraulically pressurised to the rated pressure. Each valve, either new or existing used in new lines, shall then be opened and closed and visually checked for leakage.

Commissioning

Prior to commissioning, all product pipelines that have been hydro tested shall be thoroughly drained of water.

Commissioning shall be directed by the Employer but the Contractor and any specialist suppliers, (e.g. for pumps, valves, instrumentation etc) shall attend and assist the Employer as necessary.

PSL 20 Installation of Equipment

Equipment (such as valves, pumps, strainers, flow meters, regulators, etc.) shall be installed in accordance with the manufacturer's instructions.

Equipment shall be installed in such a manner as to prevent undue stresses on the connecting piping and/or equipment or fittings. All piping connections shall be stress free.

Valves in chambers shall be installed with their operating spindles vertical. The orientation of all other valves shall be agreed with the Engineer prior to installation. The Contractor shall supply all the insertions and bolts necessary for the installation of valves and shall include for these in his tendered rates.

Care is to be taken not to damage the corrosion protection, valve internal and external fittings and threads. All data sheets are to be referred to the valves as installed. Unless otherwise notified it will be assumed that the valves are delivered undamaged to the Contractor.

The Contractor is to ensure that all necessary internal components and consumables (lubrication, etc.) are installed prior to installation. Free issue equipment that are incomplete or incorrectly assembled, shall be brought to attention to the Engineer prior to installation.

Payment is to be per number installed and includes for off-loading and storage on site. All surplus free issue valves are to be returned.

Any damage after receipt will be deemed due to the Contractor's negligence and will be for his account.

PSL 21 As Built Drawings

The Contractor will be required to mark "as built" information on a set of prints to permit modification of the original drawings by the Engineer.

PSL 22 Protection of Pumps, Valves & Equipment

PSL 22.1 INTERNAL PROTECTION is not required.

PSL 22.2 External Protection

External protection of valves and strainers shall be as specified for above ground pipes in clause PSL 3, unless otherwise specified by the manufacturer and agreed to by the Engineer. Pumps and meters are to be supplied externally protected per the manufacturer's standard specifications and following installation externally protected as per PSL 3, after wire brushing & degreasing.

PSL 23 Ownership of Demolished Materials

Where items are to be demolished or dismantled and stockpiled on site, the items shall remain the property of the Employer.

Where items are to be demolished or dismantled and removed off site, the items shall become the property of the Contractor unless otherwise specified in the contract document or schedule of quantities.

All items disposed of offsite must be disposed of at a recognised waste disposal site. Safe disposal certificates must be retained and submitted to the Employer.

PSX PIPELINE REPLACEMENT REQUIREMENTS AND PROCEDURES

The requirements of section PSL of this document are also applicable for this section.

PSX 1 Decommissioning of the Pipelines

- (a) The Contractor may be required to assist TPL in the draining of product from redundant pipelines and manifold and flushing them with water.
- (b) The existing pipeline is to be removed together with all other valves and fittings as identified by the Engineer and transported to storage.
- (c) All lines are to be ventilated naturally after which TPL will conduct gas tests until the lines can be declared suitable for the issue of hot work permits.

PSX 2 Welding

Welding shall be undertaken in accordance with the provisions of PSL Medium Pressure Pipelines which is included elsewhere in this document.

- (a) Activities defined as "hot-work" can only be carried out under a valid "hot-work" permit issued on a daily basis by an authorised employee of TPL.
- (b) The Contractor is to carry out a site inspection to determine the extent of welding required on each line for permit purposes.
- (c) Only API 1107 coded welders are to be employed on this work which should conform with the requirements of ASMB 31.4 and API 2200.
- (d) Dye penetrant testing shall be carried out on seal welding and shall be witnessed by TPL, the Engineer, the Engineer's Representative or an AIA. The choice of witness shall be as per the Engineer's instruction.

PSX 3 Hydrotesting

On completion of welding, welding repairs, fitting of any relief valves & installation of new pipe sections, the pipelines are to be filled with water provided by the Employer taking care to expel all air (from high points).

Hydrostatic testing is to be carried out at a test pressure to be agreed with the Engineer and in accordance with ASME B31.4 and ANSI/ API 1110.

On completion these lines are to be drained of water to the satisfaction of the Engineer.

PSX 4 External Protection

External protection shall include surface preparation and painting / corrosion protection.

All work shall be carried out in accordance with clause PSL 3 of the Project Specification.

All repairs/ new work shall be sand blasted if the position of the pipe allows or the pipe may be removed to a location where it can be sand blasted. If neither of the prior options is available the pipe shall be wire brushed.

PSX 5 Requirements for Line Pipe and Fittings

All line pipe and fittings shall comply with the requirements of the piping design code (ASME B31.3 or ASME B31.4) and clause PSL 2 of the project specification.

PSX 6 Corrosion Protection

Corrosion protection of all new, damaged and modified pipe sections shall be carried out in accordance with clause PSL 3 of the Project Specification.

PSX 7 Handling And Construction

PSX 7.1 Plant General

All plant and machinery shall be in good condition and of a proper capacity for the work being undertaken.

A spare welding machine shall be available at all times.

The Engineer shall have the right to order immediate removal from the site of any plant which he may deem to be unsatisfactory for the proper execution of the work. The Contractor shall obtain satisfactory plant to replace that removed without delay.

PSX 7.2 Uplifting, Transporting, Handling and Rigging

The Contractor shall provide all cranes, trucks and general handling equipment for the handling, lifting and transporting of all materials.

The plant and rigging equipment used for the handling and placing of pipes shall be such that no pipe shell is over-stressed during any operation.

The Contractor shall supply, operate and maintain an adequate fleet of vehicles to be used for the safe conveyance of pipes, specials and fittings. The pipes and specials shall be handled with care at all times to avoid damage to them or to the protective coatings.

The equipment for the purpose of loading, transporting, unloading and moving and the manner in which they are handled shall be subject to the approval of the Engineer.

During transport and storage, the pipes and specials shall be supported on suitable plastic bags. All pipes and specials shall be separated so as not to bear against each other and shall be firmly secured by suitable padded lashings to prevent movement and damage in transit. The pipes and specials shall not be dropped, bumped or subjected to shock or rough handling and any pipe damaged during transport or handling may be rejected by the Engineer.

In the case of pipes and specials with bitumen coating, the coating shall not be allowed to come into contact with the ground during handling.

The use of bare cables, chains, hooks or narrow skids will not be permitted and the Contractor shall supply canvas slings and padded skids and ramps of a sufficient width to prevent damage to the protective coating. The dragging and skidding of pipes and specials in contact with the ground shall not be permitted.

Where pipes are stored for lengthy periods, resulting, in the Engineer's opinion, in the deterioration of the whitewash outer coating, the Contractor shall apply further coats as and when required by the Engineer, at his own expense.

PSX 7.3 Transportation of Line Pipe

All pipes shall be loaded in accordance with API RP5L1 or API RP5LW.

Where it is not possible to establish that pipe was transported in accordance with the appropriate recommended practice, the pipe must be hydrostatically tested for at least 2 hours to at least 1.5 times the maximum allowable operating pressure.

PSX 7.4 Stacking Of Pipes And Specials

Where a pipe yard is provided, all pipes and specials shall be neatly and methodically arranged above the ground on delivery, as directed by the Engineer. Pipes, specials and equipment may not be stored directly on the ground. Pallets or other suitable storage equipment shall be provided by the Contractor.

Caps shall be provided by the Contractor for all open ends.

They shall be segregated according to diameters and working pressures and the various stacks shall be arranged and separated in such a way that a pipe of any diameter and working pressure can be located from the stacked position without the necessity of moving other pipes.

PSX 7.5 Inspection At The Laying Site

All pipes, specials, valves and fittings shall be carefully examined by the Contractor for internal and external damage at the following stages:

- (a) on arrival at the laying site,

- (b) prior to laying,
- (c) after laying,
- (d) prior to backfilling, and
- (e) during backfilling.

All damage or defects of any kind shall be repaired by the Contractor to the satisfaction of the Engineer immediately after detection at any of the above inspections. Where, in the opinion of the Engineer, satisfactory repairs are not practicable, the damaged materials shall be replaced by the Contractor at his own cost.

PSX 7.6 Setting Out

The Contractor may use any acceptable device (subject to a work permit being issued), including one incorporating a laser beam, to control the alignment and levels of pipes.

The Contractor shall allow for a registered surveyor to mark-out any setting out points in accordance with the Engineer's drawings.

PSX 7.7 Installation Of Pipes And Specials

All pipes and specials shall be laid true to line and level as shown on the drawings or as directed by the Engineer.

Pipes and specials shall be lowered gently and carefully into the trench without jarring or bumping by crane, derrick or other approved lifting tackle and care shall be taken not to damage the pipe or its sheathing. Pipes and specials with bitumen or other soft sheathing shall be supported in stout wide canvas slings and no wooden blocks shall be used to support such pipes, either on the side or in the trench. Any supports required shall be formed with the specified bedding material.

The Contractor shall ensure that all pipe barrels are evenly supported over the whole of their length and that no weight is taken by the joints. The trench bottom shall, where necessary, be accurately trimmed by hand and each pipe shall be firmly bedded down before backfilling is commenced.

All internal surfaces of pipes and specials shall be kept clean and free of foreign matter, both during and after laying. The surface of all joints shall be thoroughly cleaned before the pipe or special is placed in its final position. No water shall be allowed to come into contact with or run through the pipe before the joint, including its protection, has been completed and at no time shall muddy, clayey or dirty water be allowed to enter the pipe.

Exposed ends of the pipe in the trench shall be tightly closed by suitable bulkheads at all times when pipe laying is not actually in progress.

For ease of inspection and testing, the pipes shall be laid with the manufacturer's class and quality identification marks visible from the top of the trench.

PSX 7.7.1 Trench Fill

All trench fill is to be sifted and granular. The fill and bedding shall have a plasticity index (PI) not exceeding 10 and shall be free of vegetation and lumps or stones exceeding 10mm diameter.

The bedding is to be a compacted 150mm layer on the bottom of the trench. The padding is to be a compacted 150mm layer on all sides of the pipe. The bedding compaction is to be 85-90% Mod AASHTO.

No back-filling is to be done until a release certificate has been issued by the Engineer.

PSX 7.8 Inspection Provisions

The Contractor shall provide suitable inspection. The inspector appointed by the Contractor shall have the authority to order the repair or removal and replacement of any component that fails to meet the requirements of this specification.

The installation inspection provisions for pipelines shall include at least the following inspections at sufficiently frequent intervals to ensure good quality of workmanship. The Contractor shall co-operate fully in this regard. It shall be the responsibility of the Contractor to inform The Employer timeously of the date and time that the inspection described below can be carried out. Any costs associated with

the repeat of any activities to allow the inspections described below to be carried out shall be at the Contractor's expense.

- Inspect the surface of the pipe for serious surface defects just prior to the coating operation.
- Inspect the surface of the pipe coating as it is lowered into the ditch to find coating lacerations that indicate they might have been damaged after being coated.
- Inspect the fitup of the joints before the weld is made.
- Visually inspect the stringer beads before subsequent beads are applied.
- Inspect the completed welds before they are covered with coating.
- Inspect the condition of the ditch bottom just before the pipe is lowered in.
- Inspect the fit of the pipe to the ditch before backfilling.
- Inspect all repairs, replacements, or changes ordered before they are covered.
- Perform such special tests and inspections as are required by the specifications, such as non-destructive testing of welds and electrical testing of the protective coating.
- Inspect backfill material prior to use and observe backfill procedure to ensure no damage occurs to the coating in the process of backfilling.

PSX 8 Installation of Valves, Flowmeters, Regulators and Fittings

Valves, flowmeters, regulators and fittings shall be installed in accordance with the manufacturer's instructions.

Valves, flowmeters, regulators and fittings shall be installed in such a manner as to prevent undue stresses on the connecting piping and/or equipment or fittings.

Valves in chambers shall be installed with their operating spindles vertical. The orientation of all other valves shall be agreed with the Engineer prior to installation. The Contractor shall supply all the insertions and bolts necessary for the installation of valves and shall include for these in his tendered rates.

Care is to be taken not to damage the corrosion protection, valve internal and external fittings and threads. All data sheets are to be referred to the valves as installed. Unless otherwise notified it will be assumed that the valves are delivered undamaged to the Contractor.

Bolt-ups and colour coding are measured elsewhere. The Contractor is to ensure that baskets are in all the strainers upon delivery.

Payment is to be per number installed and includes for off-loading and storage on site. All surplus free issue valves are to be returned.

Any damage after receipt will be deemed due to the Contractor's negligence and will be for his account.

PSX 9 Valves

PSX 9.1 Valves

PSX 9.1.1 General

All valves are to be supplied with test certificates and are to be tagged as per the data sheets. All valves are to be supplied with end caps to prevent dirt ingress and damage to the internal surfaces.

All valves shall be factory tested for seal and body leakage and opening and closing torques at the pressures specified in the Project Specification. Testing shall be done from both directions. Each valve shall have a test certificate verifying that these tests have been successfully performed. In addition, 10 percent of the valves of each diameter shall be re-tested by an independent testing agency for seal and body leakage and opening and closing torques.

The Contractor shall include in his tendered rates for all testing as specified above.

All valves shall have an aluminium or stainless steel plate securely fixed to the valve body with non-corrodible fixings giving the following information:

The manufacturer's name
The pressure rating of the valve
The direction of flow, where applicable

The body, seal, disc and spring material, where applicable
The date of manufacture
The valve serial number

The identification plate shall be attached to the valve in such a position that it may be easily observed when the valve is located in its final position.

Valves shall be actuated using one of the following : cast iron or cast steel handwheel; hand lever; 30mm square cap top; chain and sprocket; electric actuator or other special system, as described in the Project Specification.

Where chains and sprockets are used the sprocket wheel shall be fitted with a cage to keep the chain in position when in use. Where handwheels are used the direction of opening shall be clearly marked on the handwheel. Where fitted, extension spindles shall be of the same quality material as the valve spindles.

The valves shall be capable of being easily operated by one man against the maximum unbalanced pressure and the effort required to operate the valve shall not exceed a handwheel rim pull of 400 Newton. If no handwheel is fitted, the operating torque shall be that which would be generated by a rim pull of 400 N on the applicable standard handwheel.

All valves of nominal diameter 200mm and above shall be fitted with gearboxes. All gearboxes shall be easily removable from the valve body for replacement or maintenance without removing the valve or affecting the valve integrity. All gearboxes shall be of cast iron or ductile iron and shall be sufficiently waterproof to allow for permanent submersion in 20m of water and shall be able to withstand industrial and underground environments.

All quarter turn valves shall incorporate a position indicator and adjustable limit stops to prevent over opening or over closing.

The drilling of valve flanges shall be compatible with the appropriate mating flanges.

Fountain keys shall be cast iron or hot dip galvanised mild steel.

Valves for firefighting service shall be Underwriters Laboratories (UL) or Factory Mutual (FM) approved for firefighting service

PSX 9.1.2 Valves - Free Issue

Upon receipt of any free issue materials, the Contractor is to inspect it for mechanical damage and sign receipt of the materials as being defect free.

Valves are to be uplifted from the Employer's stores and installed as required by the drawings.

Any damage after receipt will be deemed due to the Contractor's negligence and will be for his account.

Care is to be taken not to damage the corrosion protection, valve internal and external fittings and threads. All data sheets are to be referred to the valves as installed. Unless otherwise notified it will be assumed that the valves are delivered undamaged to the Contractor.

Payment is to be per number installed and includes for off-loading and storage on site. All surplus free issue valves are to be returned.

PSX 9.1.3 Ball Valves

Ball valves shall have grade 316 stainless steel body and ball. The seats and stem ring seals shall be PTFE. The body is to be screwed or flanged as specified per the schedule of quantities. The pressure rating is to be ASME Class 600 minimum. The operating handle shall be 304 S/S or suitable epoxy coated steel or ductile iron.

Ball valves of 50mm nominal diameter and above are to be dimensioned to ASME B16.10.

The pressure rating is to be 1600kPa. They may be either full or reduced bore, shall have raised face flanged ends to ASME B16.5 Class 150, shall have a PTFE seal, a type 316 stainless steel ball and a cast steel or ductile iron body to ASTM A216 Gr WCB. All valves shall be provided with an indicator

(raised text for: "open" & "closed") to show the position. External protection is to be as factory standard coating for the applicable environment. Valves of nominal diameter 150mm and below shall be lever operated with ratchet to lock position. Valves of nominal diameter 200mm and above shall be gearbox operated.

PSX 9.1.4 Check Valves

Unless otherwise specified, all check valves shall be of the swing check type, regular sizes and shall conform to ASME B16.10 and shall be double-flanged (unless otherwise stated) and suitable for a working pressure of 1600kPa. Large sizes, 200mm and up should be double door type and should also be fitted with a lifting lug. Bodies to be of cast iron (ASTM A126 Class B) and doors are to be stainless steel (ASTM A351 Grade CF8M or Grade CF8). Springs and pins are to be stainless steel AISI 316. Body is to incorporate a soft seal in EPDM material. External protection is to be as factory standard coating. Direction arrows are also to be indicated using cast / raised symbols, where applicable.

PSX 9.1.5 Butterfly Valves

The body of the butterfly valve shall be manufactured from cast ductile iron (ASTM A395). The valve shall be of wafer type but with lug type body and shall comply with API 609, ISO 5752, ISO 5211 and ISO 598. It shall have a working pressure of 1600kPa and shall withstand a test pressure of 1,5 times the working pressure. The valve internals shall be lined with EPDM material. Materials of construction must be suitable for the liquids as described below.

Material of construction of the disc of the valve shall be:

- stainless steel (type 18/8) for fresh water service and

If stub shaft construction is offered, each stub shall be inserted into the valve disc hubs for at least 1,25 x shaft diameters. The two shall be connected by splines or similar; pins will not be accepted.

Valves of nominal diameter 150mm and below shall be lever operated with ratchet to lock position. Valves of nominal diameter 200mm and above shall be gearbox operated. The valves may be used for isolating purposes with their installation being similar to a terminal position and the maximum allowable pressure differential across the valves with the disc in the closed position shall be the same 1,1 times the working pressure. For valves 200mm nominal diameter and above, the valve shaft is to be orientated so as to operate with the shaft in the horizontal position.

The drive gearing shall not be an integral part of the main valve's body but shall be a separate unit bolted to the body for easy removal. If compound gearing is necessary, a torque limiting device shall be provided at the input handwheel. All handwheels shall be fitted with suitably sized shear pins that will fail before damage can be done to the drive gearing or the valve. The design of the drive gearing shall be such that the dynamic torque acting on a partially closed disc shall not cause the gearing to become motorised resulting in the uncontrolled closing of the disc.

Positive limit stops shall be provided to prevent over-opening and over-closing of the valves.

The valves shall be capable of being easily operated by one man against the maximum unbalanced pressure and the effort required to operate the valve shall not exceed a handwheel rim pull of 400 Newtons.

The number of turns to open geared valves shall not be less than the nominal diameter of the valve expressed in centimetres, i.e. a size 700mm valve requires not less than 70 turns to open.

All valves shall be provided with an indicator (raised text for: "open" & "closed") to show the position of the disc. Where butterfly valves are double flanged, they shall have their flange diameters and thicknesses, bolts and holes drilled off centre, in accordance with the appropriate mating flanges used. External protection is to be as factory standard coating.

Each valve shall have a plate securely fixed to the body on which the following information shall be stamped:

- the manufacturer's name & model
- the size of the valve
- the class of the valve
- an arrow indicating the direction of the flow (if applicable).

Testing shall be in accordance with ISO 598 and a test certificate shall be provided by the manufacturer for each valve.

PSX 10 Thrust Blocks

Thrust blocks are not required unless otherwise indicated on the drawings.

PSX 11 U-Bolts

U-bolts are required at some supports. All U-bolts are to be non grip and are to electrically insulate the u-bolt from the pipe support sleeves around U-bolts will not be accepted. All U-bolts are to be M12 stainless steel 316, unless otherwise specified on the drawings.

Where the U-bolts are a dissimilar material to the pipe, an insulating strip is to be placed around the pipe to prevent galvanic corrosion. Where the u-bolts are to be bolted to a pipe support of dissimilar material then the u-bolts are to be isolated by means of nylon top-hat washers. The nylon is to be specified to prevent embrittlement and degradation due to the environmental conditions.

A 6mm thick Teflon pad is to be placed between the pipe and structural steel supports, the u-bolts are to locate and fix the Teflon pads. See standard drawing for Teflon pad and fixing.

PSX 12 Anchors

Anchors are not required unless otherwise indicated on the drawings.

PSX 13 Brackets/Supports

All brackets are to be hot dip galvanised to SABS 763 unless otherwise noted on the drawings. All damaged galvanising is to be repaired with cold galvanised as recommended by the paint supplier (minimum 2 coats). All bracket details are to be submitted to the Engineer for approval a minimum of 1 week before they are due to be manufactured.

PSX 14 Scaffolding

Scaffolding is to comply with both the OHS Act and the depot standards. Safe for use tags clearly showing the inspection and expiry date are required on all scaffold towers/access points.

PSX 15 Viking Johnson Flange Adapters and Stepped Couplings

Where Viking Johnson flange adapters are scheduled, they shall be installed in conjunction with a system of restraining rods and flanges or lugs as shown on the drawings to prevent longitudinal separation of the pipeline. All adapters and their restraining rods etc shall be hot dip galvanised with screw threads undercut prior to galvanising. Where the adapters are buried, the whole unit shall further be protected as specified for flanges. Where adapters are exposed to view either in manhole chambers, buildings etc, the paint system specified shall generally be applied but modified for coating on top of galvanised surfaces.

All Viking Johnson flange adapters shall be supplied by the CONTRACTOR unless specified otherwise.

All elastomer seals shall be Nitrile rubber.

PSX 16 Strainers/Filters

Strainers shall be installed in the positions shown on the drawings. Unless otherwise scheduled, strainers shall be of the basket pattern with a Carbon Steel body and flanged ends.

The Employer will decide if the strainers are to be free issued to the Contractor, or if the Contractor will supply the strainers.

PSX 17 Cradles and Clamps

All steel for the manufacture of cradles and clamps and shoes shall be grade S355JR steel. All welds are to be 6 mm continuous fillet welds. All cradles and clamps and shoes shall be sandblasted and painted as per the specification or drawings.

All U-Bolts shall be 316 stainless steel.

Minimum thickness of all brackets is 6 mm. 6 mm TEFLON strips are to be placed under all pipes between the pipe and support (width to match support width).

PSX 18 Testing

PSX.18.1 Protective Coatings And Linings

The Contractor shall provide all necessary labour and equipment for conducting the tests as described below. All tests are to be carried out in the presence of the Engineer at such time and in such manner as he may direct.

All coatings and linings provided by the Contractor shall be tested in accordance with Appendix B of BS 534 using a high voltage holiday detector.

PSX 18.2 Hydraulic Testing Of Pipeline

PSX 18.2.1 General

The whole of the pipeline shall be tested as directed by the Engineer. Blank flanges with necessary air, water and pressure gauge connections shall be provided by the Contractor for this purpose. Before testing any pipeline all construction work on the pipeline shall be complete unless otherwise specifically directed by the Engineer.

All joints, including welds, are to be left un-insulated and exposed for examination during the tests. Vents, drains and relief valves shall be utilised to prevent damage to the piping system due to expansion of the test fluid during the test period. Any test on process piping shall include a preliminary pneumatic check at no more than 200 kPa gauge.

The maximum operating pressure of each piece of equipment, including instruments, shall be checked against the test pressure of the piping system in which the piece of equipment is incorporated. If the test pressure of the piping system is greater than the maximum operating pressure of the equipment, the equipment shall be blanked off and tested separately. All expansion joint/bellows in process lines shall be removed prior to testing.

All piping which is pneumatically tested, such as process piping, instrument air, plant air and other low pressure piping, is tested at a pressure of 110 per cent of the maximum operating pressure. Any leaks found during the tests shall be repaired and re-tested to the satisfaction of the Engineer.

Water may be used for hydrostatic testing of process lines provided special precautions are taken for draining and drying the lines.

Other testing fluids may be used provided they are approved by the Engineer before testing is started.

All piping, vessels, exchangers, etc. shall be completely drained of all fluid after testing. Special precautions should be taken to ensure that all pockets where fluid may be trapped are properly drained.

All piping tested with water, in which water would be detrimental to the process operation, shall be thoroughly dried. The Engineer shall determine when the piping is dry.

The Contractor shall supply all necessary water or other fluid if so specified, labour and equipment for conducting the tests as described herein. All tests shall be carried out in the presence of the Engineer at such times and in such manner as he may direct.

PSX 18.2.2 Static Test

The pipeline shall be filled with water, all scours on the section being opened fully for one minute or until the water emerges clean. If after 48 hours the Engineer is satisfied that there are no major leaks, the pressure test shall be carried out.

PSX 18.2.3 Pressure Test

A suitable pump shall be connected to the pipeline at a mutually agreed point.

The pressure in the pipeline under test shall be raised slowly by means of the pump and measured by a pressure gauge connected to the pipeline. The full test pressure shall be maintained for at least 60 minutes, or longer if so required by the Engineer.

The test pressure shall be 1.5 times the maximum operating pressure.

No section of a pipeline shall be tested against a closed valve.

The Contractor shall be paid under the appropriate item in the Schedule of Quantities for hydraulic tests. Re-testing after repairs required by this clause shall not be paid for.

PSX 18.2.4 Records

The Contractor shall record the following information during the hydro-testing of the pipeline and hand the completed record over to The Employer after commissioning of the Works:

- test medium
- test pressure
- test duration
- test date
- pressure recording chart and pressure log
- pressure at high and low elevations
- elevation at point test pressure measured
- person(s) conducting test, Contractor, and testing sub-Contractor.
- Environmental factors (ambient temperatures, raining, windy etc.)
- Manufacturer (pipe, valves, fittings, other equipment, etc.)
- Pipe specifications (SMYS, diameter, wall thickness, etc.)
- Clear identification of what is in each test section
- Description of any leaks or failures and their disposition

PSX 19 Quality Control

PSX 19.1 Data Book

The Contractor shall build and maintain a quality data book which shall as a minimum have the following sections;

- Final Acceptance and Hand-over forms
- Quality Control Plans
- Drawings
- General Arrangement Drawings
- Weld Maps indicated on Isometric Drawings
- Material identification Maps shown on Isometric Drawings
- Pressure Test Layouts
- Welding register
- Radiographic and Surveillance Reports
- Material Certificates
- Pressure Test Certificates
- Corrosion Protection Inspection Certificates
- Welding Procedures and Welders Coding Certificates

In general the data book should be indexed in the following order:

1. Certificate of Manufacture. (Release and handover certificates can be included here as sub indices).
2. Quality control plans
3. Welding:
 - a. Welders WPQ
 - b. WPS
 - c. PQR
 - d. Welding consumable certificates
4. NDT

- a. NDT procedures
 - b. NDT technicians qualifications
 - c. NDT reports
 - d. NDT map
5. Materials
 - a. Material certificates
 - b. Material allocation map
6. Corrosion Protection
 - a. Material certificates
 - b. Application procedures
 - c. Application datasheets
 - d. Test certificates
7. Equipment
 - a. Certificates
8. Design
 - a. Construction drawings
 - b. Marked up drawings
 - c. Design review

PSX 19.2 Quality Procedures

A detailed quality plan is to be submitted, before any work may commence, for approval of hold, witness, and inspection, points. The quality plan shall be tailored to comply with the EMPLOYERs specific requirements. A sample of the proposed plan is to accompany the tender.

The quality Control Plans shall as a minimum have the following activities;

- Documentation
- Drawing Approval
- Material Identification
- Material ID Map
- Welding Procedure Approval
- Welders Certificate Approval
- Approve QCP
- Weld Map Approval
- Dimension Check
- NDE
- Radiography
- M. P. I.
- Pressure Test
- Corrosion Protection
- Wrapping
- Final Inspection

The Tenderer shall state in his tender the name of the painting sub-Contractor that he proposes to use to carry out any corrosion protection work under this contract.

The Contractor shall transfer the material trace number onto all pieces of the pipeline.

The Contractor shall ensure that all his sub-Contractors have obtained a copy of this specification.

The Contractor shall accept full responsibility for the quality of his work and of materials used, irrespective of any quality surveillance that may be carried out by the Engineer or his representative.

The Engineer may, at his discretion, require a Quality Audit of the Contractor or any of the sub-Contractors to ensure that he has the capabilities, resources and quality control facilities to carry out the work to ensure compliance with this specification.

The Contractor shall have available the latest issue of each of the manufacturer's data sheets for the materials to be used, all Specifications and Codes of Practice relevant to the work to be carried out, including a copy of this specification, all of which shall be available to the Contractor's Quality Control Manager.

The Contractor shall:

- 1) supply a Quality Plan and Quality Program at the time of tendering, both of which are subject to acceptance by the Engineer.
- 2) maintain Quality Control records in accordance with the Quality Plan during execution of the contract. Such records shall be available to the Engineer or his Representative at each Quality Surveillance visit.
- 3) mark or securely label each component with a unique identification tag, and
- 4) carry out such tests as are required to ensure compliance with the specification.

The cost of Quality Control shall be inclusive in the Contractor's tender price.

The Engineer may, at his discretion, employ an independent technically qualified organisation to carry out quality surveillance of the work on his behalf. In the event of dispute, the Engineer's decision shall be final.

The Contractor shall advise the Engineer timeously, in writing, when and where the following processes will be carried out;

- 1) Completion of fettling or dressing prior to leaving the fabricator's works
- 2) Blast cleaning and application of the first or primer coat
- 3) After completion of all coats to be applied at the Contractor's works
- 4) At the commencement of repairs or overcoats of existing equipment to be carried out on site.

Failure of the Contractor to advise the Engineer of his program may result in rejection of the work. The cost of any such rejection shall be borne by the Contractor.

For the purpose of carrying out quality surveillance, the Engineer or his representative shall be granted access to any part of the Contractor's premises relevant to the work being carried out, at any reasonable time. The Contractor shall provide, at his own cost, any equipment or labour necessary to gain access to surfaces which are coated, to be coated or are in the process of being coated.

The cost of Quality Surveillance will be borne by The Contractor.

Quality Control Reports shall be updated regularly and a copy of all relevant reports shall accompany all payment certificates. No payments will be authorised by the Engineer unless a copy of an approval report has been received by him. The Engineer may withhold payment until a final report has been issued, giving approval to the components after installation on site and repair of damage to coating.

Proper and adequate quality control records shall be maintained by the Contractor for all stages of the work. These records shall be available for inspection by the Engineer or his representative at the time of Quality Surveillance. Incomplete, inaccurate or inadequate records shall be regarded as non-compliance with the specification, and the cost of surveillance will be back charged to the Contractor.

No variation from specification, or change of sub-Contractor or materials to be used from those stated in the tender documents, will be permitted without written approval of the Engineer. Products equivalent to those specified may be submitted for approval. Adequate information shall be supplied by the Contractor to Engineer in order to assess the claim of equivalence from the Contractor.

PSX 20 Drawings

The Contractor shall be provided with a set of construction. The timing of the issuing of drawing is at the discretion of the Engineer based on the stage of the project, necessary milestones and the programme. It cannot be assumed that all drawings will be issued at the start of the project.

Piping 40NB and smaller will be site run. Drawings provided for these pipelines should be used as a routing guide rather than for dimensionally accuracy.

Only drawings marked "ISSUED FOR CONSTRUCTION" and signed by the Engineer may be used. While every effort has been made to ensure the accuracy of the drawings, and provision has been made for site, shop and field welds, the Contractor is to confirm all dimensions prior to fabrication. Confirmation of the drawings must be done on site and, provided it does not hinder operations or safety, be marked out physically.

On completion of the contract the Contractor is to supply the Engineer with a set of dimensioned "as built" drawings, hand alterations on the latest revision will be acceptable.

All dimensions must be checked and marked as correct or a new direction inserted.

Before any trenching is done for the laying of any piping the final route for such piping shall first be confirmed with the Engineer.

PSX 21 Commissioning Facilities

PSX21.1 General

Written procedures shall be established for commissioning. Procedures shall consider the characteristics of the fluid to be transported, the need to isolate the pipeline from other connected facilities, and the transfer of the constructed pipeline to those responsible for its operation.

Commissioning procedures, devices, and fluids shall be selected to ensure that nothing is introduced into the pipeline system that will be incompatible with the fluid to be transported, or with the materials in the pipeline components.

The Employer shall be consulted to determine the commissioning procedures.

PSX21.2 Cleaning and Drying Procedures

Consideration shall be given to the need for cleaning and drying the pipe and its components beyond that required for removal of the test medium.

PSX 21.3 Functional Testing of Equipment and Systems

As a part of commissioning, all pipeline and compressor station monitor and control equipment and systems shall be fully function-tested, especially including safety systems such as pressure and flow-monitoring systems, and emergency pipeline shut-down systems. Consideration should also be given to performing a final test of pipeline valves before the fluid is introduced to ensure that each valve is operating correctly.

PSX 21.4 Start-up Procedures and Introduction of Transported Fluid

Written start-up procedures from the Employer shall be obtained and followed before introducing the transported gas into the system and shall require the following;

- the system be mechanically complete and operational
- all functional tests be performed and accepted
- all necessary safety systems be operational
- operating procedures be available
- a communications system be established
- transfer of the completed pipeline system to those responsible for its operation.

PSX 21.5 Documents and Records

The following commissioning records shall be maintained as permanent records;

- cleaning and drying procedures
- cleaning and drying results
- function testing records of pipeline monitoring
- control equipment systems
- completed pre-start checklist

PSX 22 Measurement And Payment

Measurement and payment shall be in accordance with the provisions of SABS 1200 L unless otherwise provided in the Schedule of Quantities or in the Project Specification.

Payment will be for meters as installed and not as supplied or billed.

PSY HDPE PIPE**PSY 1 Introduction**

This section covers the requirements for the supply and installation of HDPE pipe and fittings as per the Schedule of Quantities (SOQ).

PSY 2 Definitions

ASME –	American Society of Mechanical Engineers
ASTM –	American Society for Testing & Materials and its successor ASTM International
API –	American Petroleum Institute
HDPE -	High Density Polyethylene
Purchaser –	Employer
SABS -	South African Bureau of Standards (subsequently renamed SANS)
SANS –	South African National Standards
SOQ –	Schedule of Quantities
Supplier -	The successful tenderer

PSY 3 Reference Standards

Although not bound in nor issued with this document, the following standardised specifications shall form part of the contract document:

ASME IX -	Boiler and Pressure Vessel Code Section IX
ASME B16.5 -	Pipe Flanges and Flange Fittings
ASME B46.1 -	Surface Texture, Surface Roughness, Waviness and Lay
ASTM D3350 -	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
ASTM D3261 -	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
API 5L -	Specification for Line Pipe
SANS 32 -	Internal and/or external protective coatings for steel tubes — Specification for hot dip galvanized coatings applied in automatic plants
SANS 121 -	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
SABS 763 -	Hot dip (galvanized) zinc coatings
SANS 1700 -	Fasteners
SANS 2001-DP2 -	Medium pressure pipelines
SANS 4065 -	Thermoplastic Pipes – Universal Wall Thickness Table
SANS 4427 -	Polyethylene (PE) pipes for water supply
SANS 10102 -	Selection of pipes for buried pipelines
SANS 10112 -	The Installation of Polyethylene Pipes
SANS 10684 -	Fasteners - Hot dip galvanized coatings
SANS 14713 -	Protection against corrosion of iron and steel in structures - Zinc and aluminium coatings

PSY 4 General

The term HDPE shall be taken to refer to High Density Polyethylene pipes and fittings as covered by SANS 4427 and SANS 4427 Parts 1, 2, 3 & 5.

The fluid medium to be conveyed by the pipe and fittings include all of the following:

- 1) Potable water
- 2) Potable water mixed with a foam concentrate solution, up to a maximum of 6% solution

All HDPE pipe and fittings shall have a nominal pressure rating of PN16 at ambient temperatures.

The HDPE pipe and fittings shall be suitable for ambient temperature conditions. Ambient temperature is defined as the range of 0°C to 40°C. Ambient temperatures shall apply to the temperature of the environment and the fluid medium.

The majority of the HDPE pipe and fittings shall be installed below grade in soil / bedding. Sections of the HDPE pipe and fittings may be exposed to the elements in valves chambers.

PSY 4.1 Pipe

HDPE material shall have a minimum material designation code of PE100 as per SANS 4427 or PE 4710 as per ASTM D 3350. The material shall meet the requirements of ASTM D 3350.

For the purpose of this contract, the supply of all HDPE pipes and fittings shall be for the Suppliers account. All HDPE pipes shall be as specified in this document or on the drawings and in diameters as listed in the Schedule of Quantities (SOQ) or on the drawings.

PSY 4.2 Fittings

Fittings shall be made of either PE4710 with a minimum Cell Classification as specified in ASTM D3350 or PE100 as per SANS 4427. Butt welded fitting shall meet the requirements of ASTM D3261. Moulded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the drawings.

In general, butt welded fittings are supplied in a limited range of SDR's. If the same SDR as the pipe is not available, then a smaller SDR (i.e. thicker wall) may be used providing it is approved within the hydraulic design. If fittings with a smaller SDR are used, then the inside needs to be chamfered to match the inside diameter of the pipe. Chamfering shall be the account of the Supplier.

PSY 4.3 Elbows

Only long radius seamless bends or sweep bends shall be supplied. Bends shall have a nominal bend radius of at least 3 and shall be plain ended, unless otherwise specified on the drawings or in the SOQ. The minimum tubular length of fitting shall be as per table B.2 of SANS 4427-3.

PSY 4.4 Flanges

Flanged joints shall only be used where the HDPE pipe is connected to steel piping. The flanged joints are to consist of a HDPE stub end with an ASME B16.5 150lb backing flange.

Where the steel piping is galvanised then the flange shall be ASTM A105N, hot dipped galvanised to SANS 32 / SABS 763.

Where HDPE stub ends connect to stainless steel piping, an ASTM A182 F304L stainless steel flange shall be used.

PSY 4.5 Tee's

Tee pieces shall be butt weld moulded tee's only.

Fabricated tee pieces shall not be used.

PSY 5 Pipe & fitting identification

The pipe shall be marked in accordance with the standards to which it is manufactured.

The pipe shall be “black” as per SANS 4427.

PSY 6 Material Certificates

All pipe and fittings shall be supplied with material certificates. All material batches supplied shall be tested by the manufacturer at an accredited laboratory. The certificates shall all be signed by the responsible quality control manager and stamped with the manufacturer's stamp. The certificates shall be provided in hard copy and scanned into PDF format.

The material certificates shall be in accordance with EN10204 type 3.1.

Material from India, China and other Asian countries shall have material certificates in accordance with EN10204 type 3.2.

Non-standard or custom made forgings shall have material certificates in accordance with EN10204 type 3.2

For all EN10204 material certificates, the Supplier shall assume the responsibilities defined as the “Manufacturer” and “Intermediary”.

All pipes and fittings shall be marked in accordance with the “Marking” sections of SANS 4427.

Should the Purchaser stipulate it, a third party inspection by an independent company of the Purchaser's choosing shall witness the material test/s and countersign the material certificate/s. The Supplier shall make allowance for the cost of the third party inspection in such cases.

The Purchaser reserves the right to conduct further material testing of the pipe and fittings supplied at an accredited, local laboratory. Should the pipe or fittings fail the Supplier's material tests then the Supplier shall remove and replace all material of that heat batch at the Supplier's cost.

PSY 7 Dimensional Certificates

All pipe and fittings shall be supplied with a certificate confirming that the pipe and fittings meet the dimensional requirements of the applicable code. The certificates shall be provided in hard copy and scanned into PDF format.

Should the Purchaser stipulate it, a third party inspection by an independent company of the Purchaser's choosing shall witness the dimensional test/s and countersign the dimensional certificate/s. The Supplier shall make allowance for the cost of the third party inspection in such cases.

The Purchaser reserves the right to conduct further dimensional testing of the pipe and fittings supplied at an accredited, local laboratory. Should the pipe or fittings fail the Supplier's dimensional tests then the Supplier shall remove and replace all material of that heat batch at the Supplier's cost.

PSY 8 Delivery

Transportation shall comply with SANS 10112. The pipe and fittings shall be loaded and transported on suitable transport. All items shall be secured on the transport vehicle to avoid damage to the pipe and fittings. Pipes and fittings shall not be allowed to rest directly against each other.

Pipes shall be supplied with plastic end caps on both ends. Pipes may only be coiled at temperatures below 30°C. The internal diameter of the coil shall be at least 24 times the outside diameter of the pipe or 600mm, whichever is greater.

During transportation the pipe and fittings shall not be exposed to temperatures in excess of 30°C or to direct sunlight.

Fittings shall be supplied in sealed wooden containers with plastic linings. A plastic lining shall be wrapped around each individual item. Flange faces and mating surfaces shall be protected during transport and handling.

All pipes and specials shall be separated so as not to bear against each other and shall be firmly secured by suitable padded lashings to prevent movement and damage in transit. The pipes and specials shall not be dropped, bumped or subjected to shock or rough handling and any pipe damaged during transport or handling may be rejected by the Engineer.

The Supplier shall make allowance for and shall comply with all the Purchaser's Health Safety Security and Environmental (HSSE) requirements at the delivery point.

The Supplier shall allow for off-loading is so stipulated in the SOQ.

PSy 9 Storage

The Supplier shall allow for the storage of the pipe and fittings at the Supplier's premises for a period of up to 6 months in their offer.

Storage of the pipe and fittings shall be:

- 1) Undercover.
- 2) On dunnage, made of inert material, at least 150mm above ground level.
- 3) All openings shall be sealed.

During storage the pipe and fittings shall not be exposed to temperatures in excess of 30°C or to direct sunlight.

The pipe and fittings shall be stored in an area away from regular vehicle movements and contamination by incompatible materials.

Stacking of the pipes shall comply with SANS 10112.

PSY 10 HDPE Welding

Only suitably qualified personnel may weld HDPE pipe.

Particular care shall be taken to ensure the accurate temperature, time and pressure for the joints to ensure full fusion while avoiding carbonising the pipe ends in contact with the heater plate.

All welds shall be cleaned as recommended by the supplier to eliminate all oxidation and foreign material.

Test certificates are to be supplied with all machinery used for HDPE joints to ensure efficient operation.

Each weld is to be clearly numbered on the pipe and the drawings, and the time, pressure, temperature and current draw is to be recorded and referenced to the weld and welder.

All pipes and fittings shall be jointed using fully butt welded fusion joints and installed to satisfy the minimum requirements of SANS 10112.

PSY 10.1 HDPE Welding Procedures

All pipework 50 OD and above is to be joined by butt fusion welding as detailed below:

- Set up the equipment.
- If necessary, erect a welding tent to protect against wind and dust.

- Mount the facing plane (trimmer).
- Align the parts to be welded (with the aid of roller mountings or other supports).
- Clamp the pipes or pipe, and fitting and seal the pipe ends.
- Plane the joint faces.
- Remove the plane.
- Remove shavings – do not touch pipe ends by hand.
- Check parallelity of joint faces by bringing them together (maximum gap 0.5 mm).
- Check pipe alignment (maximum $0.1S = 10\%$ of wall thickness).
- Clean the heating area of the heating plate with non-fluff paper and methylated spirit.
- Check the welding temperature (210 ± 10 °C). With $S > 12$ mm, aim at lower temperature range.
- Insert the heating plate.
- Press the pipe faces against the heating plate until a bead is formed all round the pipe circumference in accordance with the table of guide values.
- Reduce the pressure setting for heating up (soak period).
- After sufficient heating up release the joint faces from the heating plate.
- Remove the heating plate and immediately join the parts to be welded. Do not exceed the maximum changeover time specified in the table of guide values.
- Steadily increase the jointing pressure or force from 0 to the final value; follow the jointing time specified in the Table of Guide Values after final value (0.15 MPa).
- Allow the weld to cool with the jointing pressure maintained; follow the Table of Guide Values here. K must be greater than 0 at all points.
- When the cooling time has elapsed, the welded joint can be removed from the clamps.

All welds are to be clearly numbered on the drawings and all pressure temperature and time values are to be recorded for each weld as well as the name of the welder.

All pipework 50 OD and below is to be joined by socket fusion welding and all fittings shall be magnum compression fittings which shall be installed as per the manufacturers recommendations.

PSY 10.2 HDPE Weld Testing

Tensile testing, a destructive method for testing a butt welded joint shall be undertaken in accordance with ISO 13953:2001, Polyethylene (PE) Pipes and Fittings - Determination of the tensile strength and failure mode of test pieces from a butt-fused joint.

Three percent (3%) of all welds are to be destructively tested by means of tensile testing. The test welds are to be welded under the same conditions as the field welding. The test spool is to be a minimum of 1m long or as required by the testing authority.

All test spools are to be numbered and dated and contain the welder's name. Before fabrication commences for the day, a test weld is to be done on each pipe size before any field welding may commence.

For every field weld failure, two or more welds are to be cut out of the installed pipe and tested at The Suppliers cost. If the two welds fail the inspection, each and every weld done by the respective welder will be tested. These costs to test and repair shall be for The Suppliers account. The repair of the pipe shall also be for The Suppliers account.

PSY 11 Hydraulic Testing Of Pipeline

PSY 11. 1 General

The whole of the pipeline shall be tested as directed by the Engineer. Blank flanges with necessary air, water and pressure gauge connections shall be provided by The Supplier for this purpose. Before testing any pipeline all construction work on the pipeline shall be complete unless otherwise specifically directed by the Engineer.

All joints, including welds, are to be left un-insulated and exposed for examination during the tests. Vents, drains and relief valves shall be utilised to prevent damage to the piping system due to expansion of the test fluid during the test period. Any test on process piping shall include a preliminary pneumatic check at no more than 200 kPa gauge.

The maximum operating pressure of each piece of equipment, including instruments, shall be checked against the test pressure of the piping system in which the piece of equipment is incorporated. If the test pressure of the piping system is greater than the maximum operating pressure of the equipment, the equipment shall be blanked off and tested separately. All expansion joint/bellows in process lines shall be removed prior to testing.

All piping which is pneumatically tested, such as process piping, instrument air, plant air and other low pressure piping, is tested at a pressure of 110 per cent of the maximum operating pressure. Any leaks found during the tests shall be repaired and re-tested to the satisfaction of the Engineer.

Water may be used for hydrostatic testing of process lines provided special precautions are taken for draining and drying the lines.

Other testing fluids may be used provided they are approved by the Engineer before testing is started.

All piping, vessels, exchangers, etc. shall be completely drained of all fluid after testing. Special precautions should be taken to ensure that all pockets where fluid may be trapped are properly drained.

All piping tested with water, in which water would be detrimental to the process operation, shall be thoroughly dried. The Engineer shall determine when the piping is dry.

The Contractor shall supply all necessary water or other fluid if so specified, labour and equipment for conducting the tests as described herein. All tests shall be carried out in the presence of the Engineer at such times and in such manner as he may direct.

PSY 11.2 Static Test

The pipeline shall be filled with water, all scours on the section being opened fully for one minute or until the water emerges clean. If after 48 hours the Engineer is satisfied that there are no major leaks, the pressure test shall be carried out.

PSY 11.3 Pressure Test

A suitable pump shall be connected to the pipeline at a mutually agreed point.

The pressure in the pipeline under test shall be raised slowly by means of the pump and measured by a pressure gauge connected to the pipeline. The full test pressure shall be maintained for at least 60 minutes, or longer if so required by the Engineer.

The test pressure shall be 1.5 times the maximum operating pressure.

No section of a pipeline shall be tested against a closed valve.

The Supplier shall be paid under the appropriate item in the Schedule of Quantities for hydraulic tests. Re-testing after repairs required by this clause shall not be paid for.

PSY 11.4 Records

The Supplier shall record the following information during the hydro-testing of the pipeline and hand the completed record over to The Employer after commissioning of the Works:

- test medium
- test pressure
- test duration
- test date
- pressure recording chart and pressure log
- pressure at high and low elevations
- elevation at point test pressure measured
- person(s) conducting test, supplier, and testing sub-contractor.
- Environmental factors (ambient temperatures, raining, windy etc.)
- Manufacturer (pipe, valves, fittings, other equipment, etc.)
- Pipe specifications (SMYS, diameter, wall thickness, etc.)
- Clear identification of what is in each test section
- Description of any leaks or failures and their disposition

PSES SPECIFIC ELECTRICAL SPECIFICATION**PSES 1 Motor starter**

The pump motor starter shall have Type 2 co-ordinated protection with Schneider or Siemens switchgear. The motor starter must have an Isolator on the door to switch the main breaker off before enabling the door to open. The pump supply voltage shall be 380/400VAC 3 phase and the motor starter controls shall be 220/230VAC single phase. The motor starter configuration shall be direct online for pumps smaller than 15kW and star delta for pumps 15kW and above. The motor starters can be started and stopped manually at the starter or at the RCU and automatically from a PLC. The motor starter controls components must include; control circuit breaker, 24VDC E-Stop relay (wired fail safe – stops motor starter if not energized), current transformer (if required), start / stop button, on / running / tripped indication lights, relays with voltage free contacts for PLC feedback signals, run-hour meter and a start delta timer (if required). All wires / cables entering the motor starter shall be terminated on terminals and not connected directly to the components.

PSES 2 Cables

Cables to be sized for 5% maximum running volt drop and 20% maximum starting volt drop. If the conductor size is 2.5mm² the power and control cable can be combined, else separate power and control cables has to be installed. The cables shall be SWA and ECC cables are not acceptable. Each pump shall be connected to the existing site earthing.

PSES 3 Field Equipment

Each pump must have a RCU and stand installed next to the pump. The RCU must be Ceag Exde 29-4-37 and a RCU JB (if required) must be Ceag 744.

PSEG GENERAL ELECTRICAL SPECIFICATION**PSEG 1 QUALITY SPECIFICATIONS, STANDARDS AND CODES OF PRACTICE**

Unless otherwise specified the entire installation shall comply with the Standard Quality Specifications and with the current editions of the relevant Standards and Codes, Government and Supply Authority By-Laws and provisions.

No claims for extras in respect of failure by the Contractor to comply with any of the above regulations will be considered.

Where conflict exists between any of the above regulations and the specifications, the said conflict must be referred to the Engineer in writing for his ruling

The latest editions and amendments of the following standards and codes of practice shall be applicable:

Occupational Health and Safety Act No. 6 of 1983.

The South African Bureau of Standards, specifications and codes of practice.

I.E.C. standard specifications and codes of practice where S.A.B.S. and B.S.I. equivalents have not been published.

SABS 0142 Code of Practice for the Wiring of Premises.

SABS 089-2 The Petroleum Industry: Part 2: Electrical installations in the distribution and marketing sector.

SABS 086-3 The installation, inspection and maintenance of equipment used in an explosive atmosphere.

SABS 0108 Classification of hazardous locations and the selection of apparatus for use in such locations

SABS IEC 60079 Electrical apparatus for explosive gas atmosphere.

Part 0: General Requirements:

Part 7: Increased Safety 'e'

Part 11: Intrinsic safety 'i'

SABS 0123 The control of undesirable static electricity

SABS 808 Cable glands for use on Exd enclosures.

SABS 97/1507/168 Cables

SABS 064 Paint surface preparation

British Standard specifications and codes of practice where the S.A.B.S. equivalents have not been published

PSEG 2 QUALITY ASSURANCE

Preference will be given to contractors who are ISO 9001 registered. Otherwise, the contractors shall be required to submit at time of tender their quality assurance, procedure and documentation. As a minimum requirement, the following quality assurance provisions shall apply.

Quality assurance summary sheet detailing:-

- Procurement details and procedure
- Material delivery, checking and acceptance to site
- Installation procedure
- Interim and final detail test documentation

PSEG 3 ENVIRONMENTAL CONDITIONS

The Installation contractor (IC) shall co-operate and work in conjunction with the Engineer, Shell All equipment and materials shall be suitable for the tropical climatic and environmental conditions as found in corrosive petro-chemical industry.

Metal work exposed to, weather, sea/salt water or vapour and shall be of stainless steel or protected against corrosion to the approval of the Engineer.

Full details of the type of steel selected shall be provided for approval complete with the steel manufacturer's certification and recommendations regarding installation and usage.

Contact between dissimilar metals shall be avoided. As a minimum the following electrode potentials shall not be exceeded.

- for connections exposed to the weather, salt water vapour or salt water : 0,25 V
- for connections of interior parts exposed to condensation but not contaminated by salt : 0,50 V

PSEG 4 INSPECTIONS AND TESTING

Prior to the delivery of all equipment to site, the Contractor shall arrange for the Engineer (with five days notice) to witness the Factory Tests which are required to determine that the equipment complies with the specification and installation requirements.

All costs for this, including transport/air fares etc. shall be borne by the Contractor and included in the tender price provisions for works testing etc.

The Engineer/Employer shall be given minimum 1 week notice for the opportunity to attend and witness all site tests.

The Contractor shall submit a testing programme for the works which will be included as part of his installation programme.

The various sections of the standard specification indicate the routine tests required. These are to be regarded as a minimum requirement. Additional requirements are given in the Particular Specification sections.

All test results are to be recorded by the Contractor and submitted in an agreed typed format to the Engineer for approval.

Except where otherwise provided in the contract documents, the Contractor shall provide:

1. A test schedule for each section of the works or item of equipment plant to be tested, giving the times, date and place of the test, detailing the test procedure, the type and number of tests to be carried out and the type, make and serial numbers of all test instruments that will be used. Functional and simulation tests of all equipment control, interlocking circuits shall be conducted to the satisfaction of the Engineer.
2. All labour, materials, test equipment/accessories and properly calibrated instruments necessary for carrying out the tests.
3. The requirements of S.A.B.S. 0142 must be compiled with in addition to the tests specified herein.
 - Insulation resistance is to be measured by means of an acceptable hand cranked "Megger" type instrument. The test voltage to be used is 500 volt.
 - The earth loop impedance and continuity tests are to be measured using an acceptable hand cranked null balance "Megger" type instrument or Megger providing minimum 0.1 ohm resolution.

The Contractor shall prior to the first delivery acceptance test, carry out the preliminary tests necessary to satisfy himself that the plant, materials and equipment comply with the provisions of the contract and are in a suitable state to satisfy the requirements of the specification. The Contractor is required to record these preliminary test results (in a manner to be agreed with the Engineer) and to submit one typed copy to the Engineer in advance of the acceptance tests.

Should the Contractor fail to undertake the acceptance tests within a reasonable period of time. The Employer may arrange to have the tests performed by others. All tests so made shall be at the risk and expense of the Contractor.

Upon satisfactory completion of the final inspections and acceptance tests, the First Delivery Certificate (hand-over) shall only be issued accepting the plant and equipment on behalf of the Employer for beneficial use once the approved specified manuals and as-built drawings have been supplied. Until the issue of First Delivery Certificate, the whole of the contract works shall remain the responsibility of the Contractor.

In the event of the plant or installation not passing the tests, the Employer shall be at liberty to deduct from the contract price any reasonable expenses incurred with the abortive cost in repeating the tests.

PSEG 5 RECORD DRAWINGS, OPERATION/MAINTENANCE MANUALS

Prior to First Delivery Inspection and Handover, the Contractor shall provide three copies of indexed loose leaf manuals containing complete operating and maintenance instructions for all mechanical and electrical systems, specified under this contract.

The Contractor shall also provide a complete set of transparent record drawings cross-referenced to the Operating and Maintenance Manuals where necessary and in sufficient detail to enable the employer to carry out proper maintenance and to facilitate subsequent alterations and additions to the system.

The Operating Manual shall comprise of:-

1. The record drawings, schedules and manuals pertaining to the relevant final approved and installed installation and shop drawings as specified elsewhere in the document.
2. The 'Users' operating instructions and guidelines for the most efficient use and control of the installation including the maintenance and fault finding manuals. These shall be explicit, shall cross-reference to the drawings, schematics and control logic diagrams, and shall provide full maintenance details, requirements, methods and schedules for each and every type of device employed.

3. Furthermore, the manual shall contain spare parts lists and numbers, for all equipment.

Record drawings shall be maintained on a current basis as work progresses. Site inspections shall include a review of the record drawings for the area or equipment inspected.

Drawings/Legends/Schedules/Diagrams intended for framing and wall mounting, are to be of the fade-free black ink on a transparency or photographic type.

Manuals and log books are to be hard covered, at least A4 in size with faint line ruling and be provided with transparent plastic over-covers and reinforcing ring binders for each page. Pages of Operating and Maintenance Manuals are to be housed in clear plastic covers with reinforced bindings to ensure long life.

All manuals/log books must lie flat when open.

PSEG 6 HAZARDOUS AREA INSTALLATION WORK

All electrical apparatus and equipment including other integral attachment components e.g. glands, couplings etc. shall be supplied with a certificate from approved testing authority that is acceptable to S.A.B.S. certifying the apparatus construction codes and standards for its safe use in the hazardous location. These certificates are to be labelled and indexed to form part of the as-built manuals and drawings.

Particular attention is to be given when ordering the equipment to specifying the required installation details regarding the number and sizes of cable entries, number of terminals and service amperage etc. to ensure certification compliance of the apparatus construction safety codes/standards in particular pertaining to junction and cable boxes.

Only experienced competent artisans are permitted to install certified electrical equipment. Particular care shall be given to installing EXe cable glands and the proper fitting of the inner O-ring seals. In this regard, the contractor's technical and quality supervision of the proper installation of the EX certified equipment shall be by a licensed Master Electrician on a daily basis.

PSEG 7 CABLES

PSEG 7.1 General

Cables shall be manufactured in accordance with SABS 150 where applicable, and shall be constructed as follows :

- | | | | |
|------|---|---|---|
| i. | Unarmoured cables | : | PVC-insulated/PVC-sheathed. |
| ii. | Armoured cables
extruded PVC outer sheath. | : | PVC-insulated/XLPE/armoured/black |
| iii. | Single Core cable | : | PVC-insulated/unsheathed. |
| iv. | Screened un/or armoured
sheathed (armour)/PVC sheathe | : | PVC-insulated/braided or mylar screen/PVC |
| v. | RG Co-Axial Cables
Sheathed | : | TFE-insulated/braided screen/PVC |
| vi. | Instrument Cables
as manufactured by Aberdare Telecom
Network | : | US Dekabon cable specification and BS5308 |
| vii. | Optical Fibre | : | As specified |

2. All cable insulation shall be 600/1 000 V Grade apart from instrument cables. Instrument cable shall be 300 Volt grade, XLPE insulation manufactured by Aberdare.

3. Where armouring is specified it shall consist of one layer of galvanized steel wire (in the case of multi-core cables).

4. Power and Control Cable Insulation Test

Use a 500 Volt A.C./D.C. Megger for 600/1 000 V cables and a 2 500 volt DC Megger for 6kV/11 kV cables to measure the following cable parameters:-

- | | | |
|----|--------------------------------|-------------------------|
| a. | Phase – phase | - greater than 200 Mohm |
| b. | Phase – neutral | - greater than 200 Mohm |
| c. | Phase – earth and/or armouring | - greater than 200 Mohm |
| d. | Neutral to earth | - greater than 200 Mohm |

In addition, continuity check on every conductor. All measurements to be recorded on the Cable Test Certificates.

5. Instrument Cable XLPE Insulation Test

Use a 500 Volt D.C. Megger or 333 Volts A.C. Megger to measure the cable insulation resistance and continuity parameters:-

- | | |
|----|---|
| a. | Each pair: conductor to conductor greater than 500 Mohm. |
| b. | For each pair: conductor to screen greater than 250 Mohm. |
| c. | Individual screen to overall screen greater than 1 Mohm. |
| d. | Overall screen to armour/protective sheath greater than 200 Mohm. |
| e. | Continuity of all conductors, screen and armouring (Dekabon or SWA) |

All values to be recorded on Cable Test Report

Details of the test method used are to accompany the cable test certificate.

6. The Contractor shall verify all cable lengths by site measurement. The lengths given in the cable schedules are based on drawing measurements and must therefore be considered as approximate.

7. Cable shall be manufactured and supplied in one length as specified, unless these lengths exceed standard drum length.

8. No joints in cable runs will be allowed, except where specifically approved. Where joints are approved, proper jointing kits, approved by the Engineer, shall be used. Where written permission is given for a cable joint, the contractor shall provide in writing, an unconditional two year guarantee for each joint, prior to the joint being made. A minimum of one meter of slack should be provided at each end of the cable at each joint.

All joints shall be made either by means of compound filled boxes, according to best established practice by competent cable jointers using first-class materials, or by means of approved epoxy resin pressure-type jointing kits. Epoxy resin joints must be made entirely according with manufacturer's instructions, and entirely with the materials stipulated in such instructions.

9. The cables are to be clearly marked with cable numbers at each end immediately adjacent to the cable gland. The cable markers shall be non-corrodable, ultra-violet protected type marker indicating the cable reference number.

10. The Contractor shall compile a fully comprehensive cable schedule indicating the technical and installed details e.g. cable No, From - To, Core Size, No of Cores, Type, Rating, Length, etc. for the various type of installed cables.

PSEG 8 CABLE RACKING

Cable racking shall be 'O Line heavy-duty type. The reference to Cable Tray shall generally apply to all forms of racking viz. cable ladder etc.

1. Cable trays shall not obstruct traffic nor interfere with accessibility or removal of process equipment, e.g. pumps, motors etc.

2. Trays shall be erected when there are three or more cables running in parallel.

3. Conduit shall be used on walls and structures for a single cable. Fabricated angle iron cable supports (refer standard drawing No 079) shall be used for two cables. On concrete surface flooring, only angle iron cable supports or vertical racking on pedestal mounted angle iron shall be used.
4. When specified, the racking shall be painted electric orange colour to B26 SABS 1091.
5. Cable racking in this contract shall include all necessary proprietary fixing materials, deviations, bends, angles, tees, reducers and other components required, to make the cable trays complete and ready for the laying of cables.
6. Cable trays/ladders shall be galvanised to SABS 763 and the heavy-duty type, minimum 2 mm thick or as otherwise specified.
7. Cable tray supports shall be spaced adequately to avoid sagging between supports, and shall consist when applicable of two steel hanger rods of minimum thickness of 9 mm, on both sides of the tray, with O-line channel cross-member to support the tray, maximum allowable sag to be 10 mm. Where necessary, to achieve this SAG, the cable tray shall be reinforced along its length, with angle iron or similar stiffening members.
8. Cable tray suspended from slabs, or cantilevered off walls shall be installed at a distance of not less than 300 mm from soffit of slab to bottom of tray. The cable tray crossing a beam, shall be spaced with a minimum clearance of 200 mm between the soffit of beam to bottom of tray. Where there is any doubt about height restrictions, or other considerations effecting the position of cable tray, this matter must be referred to the Engineer.
9. Cable racking shall be continuously conductive by cross bonding across all joints, splices or open type transitions by 6 mm² PVC earth wire straps.

PSEG 9 CABLE GLANDS

Preferred cable glands shall be "Pratley" unless otherwise agreed complete with earth tag as required.

Non corrosion type sealed glands shall have tight fitting long type hydro-carbon (HC) shrouds made from non-deteriorating synthetic material or neoprene resistant to oil and sunlight. The shrouds shall tightly fit around the glands and cable.

Glands shall be provided as required with ISO threads, imperial / Pg adaptors, reducers, nipples etc. and shall be suitably sized for the specified cable dimensions.

In hazardous classified areas, Zone 1 and 2 certified glands shall be installed by competent installers who are fully conversant with the selection and use of flameproof or increased safety certified apparatus in hazardous areas classifications.

PSEG 10 INSTALLATION OF CABLING, WIRING AND FIELD DEVICES

1. Work to be carried out by the Contractor includes, laying, fixing, glanding and terminating of specified cables unless otherwise stated.
2. All trenches and trays shall be completely finished before starting the installation of cables. Cables shall be installed in one consecutive and uninterrupted operation. When interruption is unavoidable, trenches are to be made "Safe" with the use of barrier guards, danger tape etc.
3. All cables rising from underground shall be protected by a kick pipe to a suitable height. Kick pipes shall be galvanized conduits or thick walled black PVC pipes.
4. When cables are laid in soft soil, they shall have sufficient slack (especially at riser points) to prevent stress.
5. All cables used for power or signals, shall be screened type Aberdare manufactured control or instrument cable with minimum 0,5 mm² conductor size.

6. Special attention shall be paid to the interconnection of cable screens in such a way that the screening is earthed only at the intended location, and that multiple earthing does not occur.
7. Cables carrying intrinsically safe (IS) circuit shall be dedicated. IS cables shall be easily identifiable from other cables (preferably by a blue covered outer sheath or the cable ends are to be "flashed" i.e. with blue heat shrink sleeve).
IS cables shall at all times be separated by at least 75 mm from other instrument cables and similarly instrument signal cables be separated min 75 mm from power low cables.
8. Special signal cables such as coaxial cables for pH electrodes shall be installed in accordance with the manufacturer's instructions.
9. All cabling shall be arranged for maximum accessibility and shall allow for instrument removal without disturbing other operating instruments, or disfiguring wiring or tubing and shall not obstruct vision, partially or otherwise, to any field-mounted instrument.
10. Cables shall be strapped at maximum 400 mm intervals. Such strapping shall be by means of devices which shall not damage the cable over a period of time and be immune to ultra-light.
11. Cable entries into field-mounted enclosures shall be side or bottom entry only. Top entry will not be acceptable.
12. All cable cores/wires shall be numbered at the connection point with a slip on interlocking type ferrule/marker carry the "Address Wiring Code", as specified elsewhere - refer Control panels.
13. Terminations of cable cores and wires shall be made by using spade- type crimp-on lugs or pin connectors and shall be crimped with controlled pressure-crimping tools of the correct size for the lug used.
14. Only Weidmuller or Phoenix terminals shall be used. Pinching-type terminals shall not be used e.g. chocolate blocks etc.
15. When wiring of different potentials be on the same terminal rail, these shall be clearly spaced apart or be separated by terminal barrier partition.
16. Junction boxes; shall be steel or GRP construction Junction boxes shall be fitted with a label indicating junction box number, service, power isolating circuit number and termination drawing numbers fixed to cover.

Boxes for indoor use shall be minimum IP51 and for outdoor IP65.

Cable entries into field-mounted junction box, shall only be bottom entry.

17. Labels; shall be the laminated plastic traffolyte type and fixed by means of screwed nuts in accordance to the standard drawing No 083

All circuits shall be labeled with their equipment Tag number / service description and service function.

All equipment components e.g. circuit breakers, relays, contactors, terminals etc shall be labeled according to drawing symbol identity codes.

PSEG 11 EARTHING SYSTEM

1. Circuit protective earth conductor earth loop impedance and the entire installation non-current carrying metal equipment shall be cross bonded and earthed to comply with SABS 0142 e.g. water pipes, roofs, down pipes, structures etc. and SABS 086-1 and 089-2.
2. Prior to earth electrode installation, soil resistivity and earth resistivity tests are to be undertaken, in the presence of the Engineer, to determine the number and type of earth grid system required to obtain an adequate earth resistance value to the mass of the earth. These tests must be done before any earth works take place; such as cut and filling.

3. The tests shall be carried out by contractor's earthing specialist with the use of a null balance megger in accordance with BS Code of Practice 1013. The test results shall be submitted to the Engineer in a typed and graphical format with earthing recommendations for approval.
4. The resistance of earth electrode/grid system to the mass of earth shall not exceed :
 - a. Electrical earth system : 0.5 ohms
 - b. Hazardous area lightning protection system : 7.0 ohms
 - c. Lightning protection system : 20.0 ohms *

* Or may be assessed in term of SANS0313

The maximum limits are subject to the results of the prior soil resistivity tests and the depth of electrode or type of earthing system to be used, and may have to be revised to suit the particular situation. The Engineer shall produce an earth electrode final drawing showing exactly where and how this is to be installed.

5. All earth electrodes are to be provided with easily accessible test link/disconnection point 400 mm above ground or from within the inspection earth well (EW), refer standard drawing No 020.
6. The earth electrodes shall be 1.8 metre x 15 mm copper/steel earth rod electrodes complete with proprietary accessories, e.g. couplings, hammer caps etc.
7. The main earth conductor departing from the main earth bar shall be a continuous unbroken ring earth wire. The branch tee-off earth wire from the ring shall be connected to the ring by means of a hydraulically crimped 70/70 mm² or 70/25 mm² (as specified) open type 'Ceetap' ferrule, refer standard drawing No 085. The earth terminal connection shall be made with the correct sized 'Metmak' type lugs and crimped with the relevant Metmak crimping tool or other approved.
8. All earth wires elevating from the ground or exposed to vandalism shall be installed in a galvanised conduit pipe (minimum wall thickness 1.6 mm.) The length of conduits above ground are to be minimum 1.5 and 3 metres respectively.
9. On completion of the installation, the Contractor's Earthing Specialist shall undertake the final earth tests to measure the resistance to mass of earth of each earth electrode/well as well as the combined earth grid system before and after connection to the earth system. The loop impedance of the earth ring conductor shall be measured and recorded.
10. Under no circumstances shall earth electrodes/wells be watered/or treated with chemicals, salt prior to tests being conducted.
11. All earth electrodes/wells are to be labelled and the test results recorded for compliance.
12. In the event of the earth test resistance values being too high, the contractor shall with the Engineer's confirmation, install additional earth rods/conductors and re-test the installation.

The installed electrodes/wells and main earth conductor shall in this instance be subject to re-measurement and priced at the Bill of Quantities rates. All other items will remain fixed as per the Bill of Quantities.
13. Down conductors for lightning protection shall be made as short and direct as possible. No right angle bends in down conductors are permitted. Where doubt/problem exists consult the Engineer.