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1. INTRODUCTION

Eskom recognises that national codes and standards, to which plant and equipment supplied to Eskom must conform, can specify only minimum requirements, and they do not cover fully, and in some cases omit totally, requirements which are essential for the successful long-term operation and maintenance of the pipework system.

2. SUPPORTING CLAUSES

2.1 SCOPE

This specification specifies Eskom's requirements for the supply of piping and fittings, and the installation of piping systems with diameters up to 2230mm, including ancillary chambers, open trenches and in-line instrumentation sensors or connections, for conveying water, gases, petroleum products, chemicals, refrigerants, effluents and slurries under working pressures up to 2 MPa and temperatures less than 100 ºC in fossil fired thermal power stations.

The requirements of this specification are complementary to those laid down in national codes and standards, and are based on the latest available knowledge and experience necessary to design and manufacture pipework operating at medium pressures and temperatures and less than 100 ºC, which may be used safely with minimum routine maintenance, for not less than 200 000 hours under design conditions.

This specification applies to new construction, and its requirements are mandatory for this application. However, certain sections e.g. some design features and the quality control requirements for the supply and testing of pipes from the pipe manufacturer, may also be applied, for replacements or modification to existing plant and the appropriate sections will be called up in the specification for that work.

The work covered by this specification includes the supply of the material for transition pieces at contract terminal points. Machining and welding of the transition pieces at contract terminal points to valves or fittings provided by other contractors shall be carried out in the works of the suppliers of the valves or fittings. The dimension and form of the weld preparation at the pipework contractor's site weld shall be agreed between the employer and the contractors concerned.

2.1.1 Purpose

This specification specifies the design, supply, identification marking, fabrication, testing at works, transit to site, off-loading, storage at site, erection, testing, internal cleaning, lagging, cladding, corrosion protection, commissioning, painting, finishing and full documentation of low pressure pipework, between the contract terminal points, together with all necessary drains, drain piping, air release piping, valves, valve operating gear, positional indicators, supports, anchors, restraints, joints, traps, tundishes, instrument tapping points, access platforms and ladders, gratings, handrails, stairways, ladders, instruments and panels, and temporary cleaning and flushing piping.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited SOC.

Applicable to plants operated in the Republic of South Africa.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

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2.2.1 Normative

2.2.1.1 Eskom Specific Standards

[1] 240-53113333 - Eskom Plant Codification Standard

[2] 240-56241933 - Control of Plant Construction Repair and Maintenance Welding Activities Standard

[3] 240-56246601 - Personnel and Entities Performing Welding Related Special Processes on Eskom Plant

[4] 240-56247004 - Thermal Insulation Standard

[5] 240-56356376 - On-site Commissioning for Low Pressure Systems Standard

[6] 240-56364545 - Structural Design and Engineering Standard

[7] 240-89147446 - Instrument piping for fossil and hydro power stations

[8] 240-105020315 - Standard for Low Pressure Valves

[9] 240-84513751 - Material Specification and Certification Guideline

[10] 240-56247788:Weld Defects Classification and Reporting Standard

2.2.1.2 American Standards and Codes

[11] API 5L - Specification for Line Pipe

[12] ASME B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

[13] ASME B16.9, Factory made wrought steel butt-weld fittings.

[14] ASME B16.11, Forged steel fittings, socket welded and threaded.

[15] ASME B31.3 Process Piping.,

[16] ASME B.36.19, Stainless steel pipe.

[17] ASTM A 160 Standard specification for seamless carbon steel pipe for high temperature service

[18] ASTM A 193, Alloy steel and stainless steel bolting materials (high temperature service).

[19] ASTM A 194, Carbon and alloy steel nuts for bolts for high-temperatures and high-pressure services.

[20] ASTM A 312, Seamless and welded austenitic stainless steel pipes

[21] ASTM A 403, Wrought austenitic stainless steel pipe fittings.

[22] ASTM B 280, Seamless copper tubes for Air-conditioning and refrigeration field service

2.2.1.3 European Standards and Codes

[23] BS 1247 - Manhole step irons.

[24] BS 1600, Specification for dimensions of steel pipe for the petroleum industry.

[25] BS 2633, Specification for Class 1 arc welding of ferritic steel pipework for carrying fluids.

[26] BS 2971, Specification for class II arc welding of carbon steel pipework for carrying fluids.

[27] BS 3799, Steel pipe fittings, screwed and socket welded, for the petroleum industry.

[28] BS 4677, Specification for arc welding of austenitic stainless steel pipework for carrying fluids.

[29] BS 5500, Specification for unfired fusion-welded pressure vessels.

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[30] BS 6374-1 to 5, Lining of equipment with polymeric materials for the process industries

[31] BS EN 512, Fibre-cement products. Pressure pipes and joints.

[32] BS EN 545:1995 Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods

[33] BS EN 598:2007+A1:2009 Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods

[34] BS EN 969:1996 Specification for ductile iron pipes, fittings, accessories and their joints for gas pipelines. Requirements and test methods

[35] BS EN 1057 Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications

[36] BS EN 1092 Parts 1 to 4 Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories

[37] BS EN 10204 - Metallic Products- Types of inspection documents

[38] BS EN 10216-2, Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties

[39] BS EN 10217-2, Welded steel tubes for pressure purposes - Technical delivery conditions - Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties

[40] BS EN 10217-3: Welded steel tubes for pressure purposes - Technical delivery conditions - Part 3: Alloy fine grain steel tubes

[41] BS EN 10217-5, Welded steel tubes for pressure purposes - Technical delivery conditions - Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties

[42] BS EN 10224:2002 Non-alloy steel tubes and fittings for the conveyance of water and other aqueous liquids. Technical delivery conditions

[43] BS EN 10241:2000 Steel threaded pipe fittings

[44] BS EN 10311:2005 Joints for the connection of steel tubes and fittings for the conveyance of water and other aqueous liquids

[45] BS EN 12201-1 to 5 Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE

[46] BS EN 13480-1 to 6 Metallic industrial piping

[47] BS EN ISO 3452-1 Non-destructive testing. Penetrant testing. General principles

[48] BS EN ISO 17640 Non-destructive testing of welds. Ultrasonic testing. Techniques, testing levels, and assessment

2.2.1.4 German Standards and Specifications

[49] DIN 50049:1986, Materials testing certificates.

[50] DIN 8560:1982, Qualification testing of welders for welding steel.

[51] DIN 17175:1979, Seamless Tubes of Heat-resistant Steels: Technical Conditions of Delivery

[52] DIN 50049:1986, Materials testing certificates.

[53] DIN 8560:1982, Qualification testing of welders for welding steel.

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2.2.1.5 South African Standards Codes and Legislations

[54] OHS Act, Occupational Health and Safety Act (Act No. 85 of 1993).

[55] Department of labour notice number R:1591 the Pressure Equipment Regulations, 2009

[56] QM-58 Supplier Contract Quality Requirements Specification

[57] SANS M 33 A The international metric system (SI). Guide to the use of the SI in South Africa

[58] SANS 14, Malleable cast-iron pipe fittings threaded to ISO 7-1.

[59] SANS 32:1997 / EN 10240:199 Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants,

[60] SANS 62-1, Steel pipes Part 1: Pipes suitable for threading and of nominal size not exceeding 150 mm

[61] SANS 62-2 Steel pipes Part 2: Screwed pieces and pipe fittings of nominal size not exceeding 150 mm

[62] SANS 121:2011 / ISO 1461:2009, Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods

[63] SANS 285, Calcium silicate masonry units.

[64] SANS 347, Categorization and conformity assessment criteria for all pressure Equipment;

[65] SANS 460, Plain-ended solid drawn copper tubes for potable waterSANS 558, Cast iron surface boxes and manholes and inspection covers and frames

[66] SANS 676, Reinforced concrete pressure pipes.

[67] SANS 677, Concrete non-pressure pipes.

[68] SANS 719, Electric welded low carbon steel pipes for aqueous fluids (large bore)

[69] SANS 791, Unplasticized poly(vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings

[70] SANS 815 Part 1 and Part 2, Shoulder-ended and groove-ended piping systems

[71] SANS 966-1, Components of pressure pipe systems Part 1: Unplasticized poly(vinyl chloride) (PVC-U) pressure pipe systems

[72] SANS 966-2, Components of pressure pipe systems Part 2: Modified poly(vinyl chloride)(PVC-M) pressure pipe systems

[73] SANS 975, Prestressed concrete pipes.

[74] SANS 1109 / ISO 7-1, Pipe threads where pressure-tight joints are made on the threads Part 1: Dimensions, tolerances and designation

[75] SANS 1123, Pipe flanges

[76] SANS 1198, The manufacture of rubber sheeting for rubber lining

[77] SANS 1200, Standardised specification for Civil Engineering Construction (Sections A, AA, D, DA, DB, G, GA, L, and LB).

[78] SANS 1200:HA-1990, Standardized specification for civil engineering construction Section HA: Structural steelwork (sundry items)

[79] SANS 1215, Concrete masonry units.

[80] SANS 1223, Fibre Cement pressure pipes and couplings.

[81] SANS 1700 Fasteners Parts 7-3, -5 and 14—3, -4 ISO metric black bolts, screws and nuts (hexagon and square).

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[82] SANS 1748 (All Parts) Glass-fibre-reinforced thermosetting plastics (GRP) pipes

[83] SANS 2001-DP1, Construction works Part DP1: Earthworks for buried pipelines and prefabricated culverts

[84] SANS 2001-DP2, Construction works Part DP2: Medium pressure pipelines;

[85] SANS 2001-DP6, Construction works – Part DP6: Below-ground water installations.

[86] SANS 2001-DP8, Construction works, Part DP8: Pipe Jacking;

[87] SANS 4427/ISO 4427 Polyethylene pipes for water supply-Specifications.

[88] SANS 4427-1/ISO 4427-1 Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply - Part 1: General

[89] SANS 4427-2/ISO 4427-2 Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply - Part 2: Pipes

[90] SANS 4427-3/ISO 4427-3, Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply - Part 3: Fittings

[91] SANS 4633: Rubber seals - Joint rings for water supply, drainage and sewerage pipelines - Specification for materials

[92] SANS 7682 / ISO 7682, Plastics piping systems for soil and waste discharge (low and high temperature) inside buildings - Acrylonitrile-butadiene-styrene (ABS)

[93] SANS 9001 Quality Management Systems - Requirements.

[94] SANS 10102, Part 1 and 2 The selection of pipes for buried pipelines.

[95] SANS 10112, The installation of polyethylene and poly(vinyl chloride)(PVC-U and PVC-M) pipes

[96] SANS 10227, The evaluation of the technical competence of inspection authorities performing inspection in terms of the Pressure Equipment Regulations.

[97] SANS 10252-1 Water supply and drainage to buildings – Part 1: Water supply installations for buildings

[98] SANS 10252-2 Water supply and drainage to buildings – Part 2: Water supply installations for buildings Part 2: Drainage installations for buildings

2.2.1.6 Japanese Standards and Codes

[99] JIS B 2304

2.2.2 Informative

[100] 240-54690969 Compressed Air System Standard

[101] 240-54937450 Fire Protection & Life Safety Design Standard

[102] 240-56227413 Hydrogen Systems Specification

[103] 240-56239129 High Pressure Pipework Standard for Eskom Power Plants

[104] 240-56356376 On-Site Commissioning for Low Pressure Systems Procedure

[105] 240-75850027 Design Guideline for HVAC in the Eskom Coal Fired Power Stations

[106] 240-104990037 LPG gas design guideline

[107] 240-105971017 Turbine lubricating oil storage and regeneration system

[108] 240-108079354 Auxiliary and Ancillary Cooling Water Systems Design Guideline

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[109] 240-108079430 Power Plant Water Systems Design Guideline

[110] 240-109835562 Diesel fuel oil system design guideline

[111] 240-108079354 Auxiliary and Ancillary Cooling Water Systems Design Guideline

[112] 240-110414644 Nitrogen System Standard

[113] 240-101712128 Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings

[114] CSIR Human Settlement Planning and Design Volume 2

[115] SANS 10227 – Criteria for the Operation of Inspection Authorities Performing Inspections in terms of the Pressure Equipment Regulation

2.3 DEFINITIONS

Definition	Description
BS	British standard prepared by the British Standards Institution.
Code of practice	A document in the British code which gives advice and recommendations and is not mandatory
Code	A collection of compatible rules, regulations and standards prepared by a national standards authority in one country, also referred to as a code of construction.
Cold pull	The process, also known as "cold spring", is a means of simulating the effect which occurs with relaxation in service for systems operating in creep, and has the effect of reducing the forces and moments at the termination's when first put into service.
Contract terminal point	That point at which the responsibility for the supply, erection and testing of material passes from one contractor to another.
DIN	Deutsches Institut für Normung (German engineering standards)
DN	An alphanumeric designation of size for components of a pipework system, which is used for reference purposes. It comprises the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections
High energy pipework	pipes and fittings in such systems for the conveyance of steam, water, gases or other fluids whose design pressure equals or exceeds 4.0 MPa and/or whose design temperature equals or exceeds 250 °C. The term "pipework" used herein includes pipes both straight and shaped, branches, stubs, orifice carriers, attemperators, flanges, gaskets and bolting, and the pressure-bearing parts of forged or cast construction for valves or fittings, including bodies, covers and bolting.
Inspection authority	An organisation which employs inspection engineers and is accredited by the SANS in accordance with SANS 10227, has been approved by the Chief Inspector, and is appointed by Eskom to carry out the duties laid down in the code of construction, the OHS Act and its regulations.
Islanding	The situation where power being exported from a station is suddenly cut off, at, or beyond, the high voltage yard, leaving the units still running but supplying only their own house load.
K	Kelvin
KKS	Kraftwerk Kennzeichen System (power plant classification system).
Low Pressure Pipework	Working pressures up to 2 MPa and temperatures between -14 ºC and less than 100 ºCm in fossil fired thermal power stations.
MCR	The maximum continuous rating of the boiler/turbine unit.

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Definition	Description
NDE	The generic term for non-destructive examination. A number of methods are used: a) visual: examination of surfaces with the naked eye and only assisted by adequate lighting and possibly a hand-held magnifying glass; b) RT: radiography: volumetric examination by means of X-rays or gamma rays, which activate film giving a permanent record; c) UT: ultrasonic examination: volumetric examination by means of ultrasonic beams of sound reflected by defects. Results must be recorded manually; d) DP (or PT): dye penetrant examination: surface examination with the aid of coloured liquid to indicate the presence of cracks; e) MPI (or MT): magnetic particle inspection: surface examination for the presence of cracks using a strong magnetic field and iron powder, sometimes under ultra-violet light; f) XRF: X-ray fluorescence: a method of exposing an alloy steel to X-rays so that the constituent alloying elements can be detected and measured by their fluorescing
Regulations	The regulations forming part of the OHS Act.
Standard	The detailed requirements laid down by a national standards authority for the supply of materials, the design of plant or equipment, the testing of materials, plant and equipment, etc. with which compliance is mandatory.
Termination's	Are those points on equipment, including boiler headers, turbine casings, HP heaters, feed pumps, etc., which are either fixed points or whose movements are small and can be closely defined under varying temperature conditions, which form the actual ends of pipe systems, and between which the flexibility analysis is carried out.
VGB	Technische Vereinigung der Grosskraftwerksbetreiber (technical association of large power station users).
Welding abbreviations	The following abbreviations are used to distinguish different methods of welding: MMA - manual metal arc; TIG - tungsten inert gas; SAW - submerged arc welding.

2.3.1 Disclosure Classification

Public Domain: Published in any public forum without constraints (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
ABS	Acrylonitrile Butadiene Styrene
AIA	Approved Inspection Authority
ANSI	American National Standards Institute
API	American Petroleum Institute
ASTM	American Society for Testing of Materials
CAF	Compressed Asbestos Fibre
CI	Cast Iron
CID	Constant internal diameter

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Abbreviation	Description
COD	Constant outside diameter
CoE	Centre of Excellence
CS	Carbon Steel
DN	An alphanumeric designation of size for components of a pipework system, which is used for reference purposes. It comprises the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter
DVS	Deutscher Verband Fur Schweisstechnik
FC	Fibre Cement
GRP	Glass-reinforced plastic
HDPE	High density poly-ethylene
ID	Internal diameter
IRHD	International rubber hardness degrees
ITP	Inspection and Test Plan
KKS	Kraftwerk Kennzeichen System
LDPE	Low density poly-ethylene
LPG	Liquid petroleum gas
MPI	Magnetic Particle Inspection
MRS	Minimum required strength for plastic piping. The MRS is expressed as a hoop stress in megapascals
NB	Nominal bore
NCR	Non-conformance Report
NP	Nominal pressure is a pressure value assigned to a component, piping or a system for the purpose of convenient designation and indicating its belonging to a series. Nominal pressure shall be expressed as “nominal pressure of … kPa (… bar)” or “nominal pressure of MPa (… bar).”
OD	Outside diameter
OHS Act	Occupational Health and Safety Act 85 of 1993
PE	Poly-ethylene
PN	Alphanumeric designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system.
PP	Polypropylene
PS	Maximum allowable pressure, is maximum pressure for which the equipment is designed, as specified by the manufacturer
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl chloride
QA	Quality assurance
QC	Quality control
QS	Quantity surveyor
SANAS	South African National Accreditation System
SDR	Standard dimension ratio. The ratio of the nominal outside diameter of a pipe to its

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Abbreviation	Description
	nominal wall thickness for plastic piping
SEP	Sound Engineering Practice
SG Iron	Spheroidal graphite iron
SS	Stainless steel
UPVC	Unplasticised polyvinyl chloride

2.5 ROLES AND RESPONSIBILITIES

The Designer will be responsible to complete and document the design as indicated in the relevant Design Guide.

Role	Responsibility
Compiler	The document compiler is responsible for ensuring that this document is up-to-date and that this document is not a duplication of an existing documentation, regarding the document's objectives and content
Functional Responsibility	The Functional Responsible Person shall determine if the document is fit for purpose, before the document is submitted for authorisation
Authoriser	The document authoriser is a duly delegated person with the responsibility to review the document for alignment to business strategy, policy, objectives and requirements. He/she shall authorise the release and application of the document
Care Group Members	Provide input to the Standards, Guideline and associated engineering activities
Document Support group	SC chairman to ensure that the document is reviewed and approved as per SCOT requirement

The Contractor/Supplier shall conform to this pipelines specification

2.6 PROCESS FOR MONITORING

The document shall be reviewed as required via the relevant SCOT structures.

2.7 RELATED/SUPPORTING DOCUMENTS

This specification supersedes:

- GGSS 0690 Specification for medium pressure pipelines

3. REQUIREMENTS

3.1 BASIC

All the pipework supplied in one contract and complying with this specification shall be designed, manufactured, fabricated, erected and tested to comply with a single national or international code

NOTE 1 — SANS, British and American codes are acceptable to Eskom. Refer to SANS 347, Categorization and conformity assessment criteria for all pressure Equipment;[64].

The requirements of this specification are mandatory. Departures from this specification may only be made with the written approval of Eskom.

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3.2 LEGISLATION

Apart from the need to comply with a technical code of construction, all equipment supplied under this specification shall satisfy the requirements of the Occupational Health and Safety Act (Act of 1993), and its regulations including the Pressure Equipment Regulations. Any information required by the AIA shall be supplied by the Contractor on request, and at no extra cost to Eskom.

3.3 CODES AND STANDARDS

Pressurised Systems are governed by the Pressure Equipment Regulations [54]. The Pressure Equipment Regulations require all pressure equipment to be categorised and submitted to the applicable conformance assessments of SANS 347 [64]. The majority of piping in power plant fluid distribution systems are categorised as Sound Engineering Practice It is however recommended that all piping in power plant fluid distribution conform to SANS 347.The following Design Codes listed in SANS 347 [64], as health and safety standards as approved by the Department of Labour, are suitable for use with pipe distribution systems:

- SANS 10252-1 Water supply and drainage to buildings – Part 1: Water supply installations for buildings [97]
- SANS 10252-1 Water supply and drainage to buildings – Part 1: Water supply installations for buildings [98]
- SANS 10260 (All parts) Industrial gas pipelines
- SANS 1748 (All Parts) Glass-fibre-reinforced thermosetting plastics (GRP) pipes
- EN 13480 (All parts) Metallic industrial piping [46]
- ASME B31.1 Code for pressure piping – Power piping
- ASME B31.3 Code for pressure piping – Process piping [15]

One of the important criteria to be used in selecting a design code is the design code used for the/other systems within the specific power plant, as referenced above.

It is recommended that all low pressure pipelines comply with a design code even if it is not required by SANS 347 except for below ground non-metallic piping.

3.4 INSPECTION AUTHORITY

An Approved Inspection Authority shall be appointed to monitor and verify that the design, material procurement, construction, erection and testing of high pressure pipework complies with the construction code and this standard and to ensure compliance with the issuing of CoC.

SANS 10227, the evaluation of the technical competence of inspection authorities performing inspection in terms of the Pressure Equipment Regulations [93] is applicable.

Contractor's quality assurance and quality control

The contractor is entirely accountable for the quality of the Pipework that the contractor is supplying and installing for Eskom.

Also see QM-58 Supplier Contract Quality Requirements Specification [56]

3.5 DESIGN

3.5.1 General

All the pipework supplied in one contract and complying with this standard shall be designed, manufactured, fabricated, erected and tested to comply with the contractually defined latest edition of

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a single national or international code and its associated standards. Mixing of codes from different countries of origin is not acceptable.

This specification covers the installation by means of welding of certain free-issue valves and fittings, supplied under other contracts, including setting-up, preheating, welding, post weld heat treatment, grinding and non-destructive testing of the welds. It also covers for the welding in of steam and water sampling probes and condensate pots to stubs provided under this specification.

3.5.2 Criticality

For the classification of systems, refer to SANS 347 [64]

3.5.3 Features to be incorporated

Apart from mandatory compliance with the design code, the piping systems conforming to this specification shall incorporate the following features:

a) a minimum design life, for new systems, of 200 000 hours at design conditions of pressure and temperature, for piping whose design stresses are time-dependant

b) The Designer shall confirm with his final flexibility analysis that the pipework can withstand the effects of water hammer, in addition to the specified number of starts. Any restraints, dampers, etc. required to satisfy these conditions shall be included;

c) a design which minimises stress-intensified areas such as abrupt changes of thickness;

d) adequate drainage, under all conditions of operation, both steady-state and transient, by slope of the pipes and positioning and size of drains;

e) an efficient heat insulation system provided with easily-removable sections of lagging to give access to areas of the pipes, form pieces and fittings which require periodic in-service non- destructive examination; a design which facilitates the carrying out of meaningful in-service non-destructive testing during periodic overhauls of the plant;

f) an efficient heat insulation system provided with easily-removable sections of lagging to give access to areas of the pipes, form pieces and fittings which require periodic in-service non-destructive examination;

g) the ability to withstand without damage, the effects of vacuum and/or water hammer caused by the rapid closing of valves during a trip from full load of that system, and without prejudicing the specified number of cyclic transients,

h) the design, supply, erection, operation and dismantling from each section in turn, of temporary piping and valves for flushing provided in order to ensure the internal cleanliness

i) the provision and installation of the primary measuring elements for the control and instrumentation,

j) provision of all isolating valves, drain valves and the necessary actuators;

k) provision of all control valves and actuators forming part of the scope of supply for the pipework;

3.5.4 Design pressures

The minimum design pressure of feed piping between process pumps and the point of discharge shall be the highest discharge pressures at over speed conditions of the process pumps, with cold water discharging against a closed valve. The final design should take into consideration peaks revealed by water hammer analysis and vacuum analysis. Hydraulic Analysis (Simulation) is recommended to determine these boundary conditions.

Special attention must be given to pipelines that can be exposed to water hammer and/or vacuum conditions.

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3.5.5 Design temperatures

The design temperature of the system shall be for temperatures and less than 100 ºC as indicated in section 2.1

3.5.6 Fluid velocities and pressure drop

Pipe sizes shall be selected so that the following maximum permitted velocities or pressure differentials are not exceeded by design, or maximum upset conditions:

Fluid	Velocity - Guideline	Pressure Drop - Range
Feed water	5 m/sec;	5 to 50 kPa/100m
Process water	2.5 m/sec	5 to 50 kPa/100m
Drains	2.5 m/sec;	5 to 50 kPa/100m
Pump suction piping NB NPSH	1.5 m/sec	5 to 25 kPa/100m
Slurry	Minimum – Deposition value + 0.1 m/s Maximum value is Erosion Value - 0.5 m/s	5 to 50 kPa/100m
Sewage	1m/s Minimum and 2.5 max	5 to 50 kPa/100m
Oil systems	2..5 m/sec;	5 to 25 kPa/100m
Nitrogen gas	Distribution 9 m/sec;	Generally accepted practice is to allow 10% of the proposed system pressure for pipe friction loss.
Hydrogen gas	48-300 m/s	To be determined according to user requirements
LPG	Gas distribution 6-9 m/sec; Fluid 2.5 m/s	Laminar flow to be used for calculations Piping should be designed for pressure drop below 10% of operating pressure.
Fire water		
Compressed air	Distribution 9 m/sec; Inlet 5 m/s	2.5 to 50 kPa/100m Generally accepted practice is to allow 10% of the proposed system pressure for pipe friction loss.
Vacuum On basis of available pressure	Vacuum On basis of available pressure	Vacuum On basis of available pressure
Resin Transfer	0.9 to 1.8 m/s	5 to 25 kPa/100m
Chemical liquids?	Depends on viscosity	

The mass flows in the various systems will be specified after detailed requirements evolve.

The pressure drop in liquid systems pipework shall be optimised in conjunction with the velocity profiles given above to restrict line losses when passing the maximum design flow rate.

3.5.7 Stresses

3.5.7.1 Pipework shall be designed on the basis of the following:

a) primary stresses due to internal pressure, weight, etc., where applicable are within those allowed under the agreed code of construction for the specified life;

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b) secondary stresses due to restrained thermal expansion, water hammer, vacuum etc. shall be within the allowable stress range;

c) pipe system supports including hangers, anchors and restraints shall permit thermal expansion of the system without creating stresses higher than those allowed by the code, and shall control movements to prevent drainage slopes being brought below those specified;

d) piping layout, coupled with the locations of the hangers, anchors and restraints, will permit a deterioration in the mean loads and hysteresis of the hangers of up to ± 1 %0 , without exceeding the code-allowable stresses within the pipe system itself, or exceeding the permissible forces and moments imposed on pumps, compressor or other termination's;

e) stresses generated in the system, by water hammer due to rapid closing of valves or emergency stop valves, will not cause the fatigue life of the systems to be below that specified; and

f) stress intensification at changes of shape or section are kept as low as possible.

g) Occasional stresses (seismic, wind loading, etc.)

A Pipe Stress analysis should be used where a deviation from codes is experienced.

3.5.7.2 The pipework shall incorporate the following features to facilitate monitoring and in-service inspections:

a) Design of weld joints in accordance with BS EN ISO 17640 Non-destructive testing of welds. Ultrasonic testing. Techniques, testing levels, and assessment [48] to ensure ability for ultrasonic examination;

b) Easily removable sections of lagging to ensure full access to large valves, form pieces and all welds for in-service non-destructive examination;

c) Permanent access to all hangers and supports for monitoring, adjustment, and removal for testing and maintenance; and

NOTE — The above requirements are specified in greater detail in other parts of this specification.

3.5.8 Metrication

The metric equivalent of specifications, standards and codes of practice shall apply throughout this Standard.

3.5.9 Station axes

Axes of a typical six unit station are defined as follows and this concept shall be used in all drawings of pipework, and in identifying the directions of forces and moments, etc.:

— "X" axis - the centre line of the turbine shaft, the positive direction being from unit 6 towards unit 1, the zero position being at the intersection with the "Y" axis.

— "Y" axis - the boiler centre line, the positive direction being from the turbine towards the boiler, the zero position being at the intersection with the "X" axis, and

— "Z" axis - the vertical axis, the positive direction being upwards measured from the station zero level.

NOTE — Moments are positive when they act clockwise, when looking in the positive direction of an axis.

3.5.10 Pipe sizes

Pipe sizes shall be in accordance with the applicable standard, generally:

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- For Steel Pipes all diameters quoted or referred to for pipes, valves or fittings shall be DN, NB or considered as inside bore measurements unless specifically stated to be outside diameters.
- For HDPE or other plastic pipe the reference is to the nominal outside diameter.

3.5.11 Terminal points

Where the materials each side of a contract terminal point are supplied to different codes of construction, the weld preparation, welding procedures, heat treatment and testing shall be subject to approval by the inspection authority. Preparation of welding procedures and their qualification, together with the qualification of welders to such procedures and the carrying out of the work, including heat treatment and non-destructive examination, shall be carried out under the pipework contract to the satisfaction of the inspection authority.

Unless otherwise specified the following are applicable at terminal points:

- The piping is anchored on the upstream side of the terminal point;
- The connection is in accordance with the standards used on the upstream piping;
- The forces from the unsupported piping on the supported piping does not exceed the following:

3.5.12 Supporting systems and support

All low pressure pipework shall be adequately supported to allow it to expand and contract in a controlled manner, to minimise vibration and to limit stresses within the systems and at the terminations.

For galvanized piping the mass to be added due to the process should be taken in account i.e. SANS 62, 719 and 1182 add 6.5% for light pipe, 5.75 % for medium pipe and 5 % for heavy pipe.

3.5.13 Material

All materials shall comply with the code of construction and the associated material type i.e. steel, PVC, stainless etc. as indicted in the Annexes.

3.6 PIPEWORK FLEXIBILITY ANALYSIS

For purposes of flexibility analysis this specification covers the whole of each pipe system between termination's including any integral piping, stop valves or isolators provided by the contractor or free issue by Eskom. Where flexibility analysis of pipe systems is called for the contractor will be provided with final details of pipework within an agreed time period. This data shall include values for restraints and movements of plant beyond the contract terminal points, together with the permissible forces and moments at the termination points.

3.6.2 Within an agreed period following an award of the contract, details of the civil works will be provided to enable the route of the pipes to be confirmed, and hanger and anchor positions to be decided. Release of the last of the information on civil works, the pipework contractor shall inform Eskom of the locations and the magnitude of forces and moments which will be applied to concrete or steel structures. Agreement shall be reached with Eskom as to the methods of securing anchors, supports, etc. to the structure, and the maximum tolerance on the locations of hangers to keep within the designer's intentions.

3.6.3 Within an agreed period after of the award of the contract, the pipework contractor shall submit to Eskom full and final design details of the main pipework giving, inter alia, information on the following:

a) drawings showing the layout of the pipes together with erecting position drainage slope, movement of termination's, positions and types of all supports and restraints;

b) temperatures and pressures in dead-end branches, and their effect on the flexibility analysis;

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c) masses of major valves and form pieces;

d) dimensions and materials used;

e) heat insulation - materials, thickness, masses, finishes and outer surface temperatures in service;

f) weld procedures and consumables.

3.6.4 For any component of the system whose design is not fully covered by a code of construction, design details shall be submitted including a finite element analysis taking account of all stresses due to pressure, and imposed forces and moments both primary and secondary, and the maximum permissible rate of change of temperature and/or rate of differential temperature change.

3.6.5 The submission of details shall include copies of the flexibility analyses covering the following cases:

a) pump start and stop (i.e. water hammer);

b) dead-weight with working fluid;

c) any transient condition which may give rise to high stresses in the system;

d) valve closure(i.e. water hammer);

e) vacuum condition;

f) stresses due to design pressure, temperature and mass including concentrated masses of valves, etc. and lagging;

g) restrained thermal expansion; and

h) forces and moments at termination’s, anchors, supports and stress intensified areas within the system during transient conditions.

3.6.6 With the final pipework design the contractor shall provide a water hammer analysis to demonstrate that the pipework can withstand the specified number of full load trips without failure. Unless a different figure is given by the major equipment manufacturer, the closing time of the emergency stop valves shall be taken as 500 ms.

3.6.7 With the completed pipework design, the contractor shall provide details of the temporary pipework which will be supplied for cleaning and system flushing. He is also to state the maximum loads on supports, anchors and other contractors' plant when the piping is full of water for chemical cleaning or hydraulic testing, and for the conditions existing during the operation. He is also to state what additional temporary arrangements will be required for these operations.

3.6.8 With the final flexibility analysis, the contractor shall submit:

a) a list of critical components. This list shall comprise no more than 20 components which may be considered to be critical, the number of which will be reduced as a result of subsequent commissioning tests to those which may require to be monitored for the life of the plant. As-built drawings giving actual dimensions of each of the critical components shall be supplied before the commissioning of each unit;

b) the maximum deviation in hanger loads permissible before the stresses in the pipe system exceed those allowed in the code; and

c) the maximum tolerable error in the "X" and "Y" axes for the location of the hangers without affecting the operation of the support system.

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3.7 PIPEWORK COMPONENTS

3.7.1 Flange couplings, gaskets, bolts, studs and nuts

Each flanged pipe and fitting shall be supplied complete with one set of bolts and nuts and one insertion piece (gasket) of the appropriate diameter and made of a material that is suitable for the fluid conveyed, maximum test pressure and maximum temperature. All flanges shall be drilled and mounted “off-centre” unless otherwise stated.

The drilling of carbon steel and cast Iron flanges shall conform to the requirements of SANS 1123 [75], and the drilling of flanges made of stainless steel or other material shall conform to the requirements of BS EN1092 [36] or ASME B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard , as applicable appropriate to the class of pipe specified, and the flanges shall be flat face slip-on type (plate flanges) unless specified otherwise in the particular specification, except that :

a) in the case of flanges for hydrant and air valve matching tees, or flanges mating to other items of equipment using a different flange specification, the flanges supplied shall be compatible and of an approved type, and

b) in the case of Cast Iron flanges, where M27 and M33 bolts are specific in BS EN 1092, M24 and M30 bolts respectively shall be used as specified in SANS 1123, and

c) flanges that will be rubber lined shall be flat faced, and shall have the front face bore of the flange radiused 3 mm. The rubber lining shall conform to SANS 1198 [76], and the soft rubber gaskets specified therein shall be selected from table 1 of SANS 1198 so as to meet the specified duty.

Flange bolts, studs and nuts use in conjunction with stainless steel flanges shall conform to ASTM A 193 Gr. studs and nuts for other flanges shall conform to SANS 1700 [81], grade 4.6 (minimum). The lengths of bolts and studs shall be such that, after the nut has been tightened, the end of the bolt or stud shall project beyond the nut by an amount equivalent to ½ to 2 full thread pitches.

3.7.2 Backing flanges

Backing flanges for welding onto steel or plastic pipes on site shall be manufactured from the same material as is specified for the pipe, and shall be in accordance with SANS 1123 [75], ASME B16.5 or BS EN 1092 [36] as applicable. Any item of pipework that is found to have flanges that are to oversize dimensions in order to make a particular piece fit will not be permitted without Eskom’s permission in writing.

3.7.3 Flexible couplings

1. Except where special couplings are schedule, flexible couplings for plain-ended steel pipe shall be of the slip-on type with centre register complying with the relevant requirements of BS EN 10311 [44].
2. A coupling shall be able to withstand without any sign of failure a hydrostatic test pressure of twice the working pressure specified for the pipe for which the coupling is required.
3. Coupling flanges shall be capable of withstanding without any sign of damage all stresses caused by proper tightening of the bolts.
4. Rubber rings shall comply with the relevant requirements of SANS 4633 [91] and shall have a hardness of 66-75 IRHD.

3.7.4 Compensators and dismantling joints

Where compensators have been specified to cater for thermal expansion of pipelines and angular or offset misalignments, they shall be the metallic bellows type. In addition, such compensators shall be fitted with restraining bolts to cater for the pipeline stresses without over-travel or over-stressing of the

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bellows. Flexible couplings used as dismantling joints shall also be fitted with restraining bolts to limit axial movement and to prevent the joints from opening up under hydraulic pressure.

3.7.5 Spigot special

Each spigoted special shall be supplied with one sleeve coupling (or such other type of coupling as is shown in the drawings) to suit the particular pipe with which the special is to mate. The coupling shall fit the larger end of the barrel in the case of reducer.

3.7.6 Spigot and socket pipes

Spigot and socket pipes shall be provided with rubber or neoprene sealing rings for forming flexible couplings or, where so required in terms of the particular specification, caulking materials shall be provided.

3.7.7 Clamped couplings

Shouldered-end pipes and fittings and couplings shall conform to SANS 815 [70]. The use of couplings for pipe sizes and pressure ratings outside the scope of SANS 815, and grooved pipe clamped coupling systems, shall be subject to Eskom's approval.

3.7.8 Flanged sliding joint expansion pieces

Single or double expansion piece couplings may only be used with Eskom's approval, and only in conjunction with adequate anchoring arrangements or restraining bolts to prevent pull-out under conditions of axial pressures.

3.7.9 Screwed fittings

Socket unions (couplings), unions, crosses, tees, elbows, bushes, plugs, caps, nipples and reducers

Where screwed fittings in these categories are to be used to connect screwed Carbon Steel piping conforming to SANS 62 [61], they shall be malleable cast-iron fittings conforming to and applicable with SANS 14 [58] ranges. Fittings outside the scope of SANS 14, shall be either to SANS 62 if applicable, or screwed fittings to BS EN 10241 [43] (except for air or gas use on higher than 1,0 MPa and pressure systems), or screwed fittings to BS 3799 class 3000 [27], or other specifications to Eskom approval.

Note: Screwed piping is only allowed up to NB 50.

3.7.10 Bend

A pipe fitting produced by fabrication or manipulation of straight piping or segmental bends produced from standard pipe of nominal bore 200 mm or above for

3.7.11 Compression type fittings

Stainless steel pipes up to 20 mm NB, or Carbon Steel or copper pipes where so specified, shall be joined by means of compression type fittings, Class 3000. Fittings shall be four piece fittings, with back and front ferrules and body, and shall preferably be to metric dimensions. In any event a consistent metric or imperial system, and a consistent make of fittings, shall be used throughout the piping system.

3.7.12 Dismantling joints and insulating joints

Dismantling joints shall be adapted from an approved proprietary sliding joint, conforming to the requirements of 3.7.4 above, or a proprietary design subject to Eskom approval.

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Insulating joints shall be in accordance with Eskom Standard drawing 0.00/4512, or to a proprietary design subject to Eskom approval.

3.7.13 Branch (set-on or set-in):

A special in which one pipe is connected by welding to another pipe, at right angles or at an angle, as described and depicted in BS 2971 [26] or BS 4677 [28]. The terms “stubs-in”, “stub-on” and “lateral” to describe such branches will not be used in this specification.

3.7.14 Welding boss

A fitting welded to a larger pipe for connecting a smaller pipe by thread or welding, as depicted in BS 3799 [27].

3.8 VALVES

3.8.1 General

Valves shall conform to the requirements of Eskom Standard for Low Pressure Valves [8], and the international specifications stipulated therein.

3.9 STRAINERS AND FILTERS

3.9.1 Temporary line strainers

All pipelines which are designed to operate with clean fluids, and do not therefore require permanent strainers or filters, and in which are mounted items of equipment subject to damage or operation failure if impurities are present, shall be fitted with temporary line strainers during the commissioning stages to remove construction debris.

Such strainers shall be of the “witch-hat” or “top-hat” configuration, mounted between flanges in advance of the removed permanently or for cleaning purposes, with the minimum of dismantling of piping. The material of construction, including integral flange, shall be stainless steel of ANSI type 304 or better if required by the duty condition, or alternatively of a suitable plastic, subject to Eskom’s approval. The person charged with the mechanical design of the pipeline shall specify the maximum allowable pressure drop across the strainer (clean and dirty) and the method for determining this pressure drop.

The aperture size and aperture percentage of pipe cross-section area, pressure drop at rated pipeline flow and pressure rating shall be advised to Eskom for approval. Positioning the strainer shall ensure that removal of the strainer does not require dismantling of adjacent piping.

3.9.2 Permanent strainers and filters

Where permanent strainers or filters are specified or are an intrinsic requirement of the system, they shall be of the duplex type, with facilities for removing and cleaning one filter/strainer element with the other element in operation. In certain circumstances where continuous operation is not required, Y-type strainers will be specified in the particular specification. The maximum allowable particle size passing through the strainer or filter shall be stipulated by the person responsible for designing the system concerned. In the case of resin traps associated with ion exchange plant, these shall be of specific design for that purpose. Positioning the strainer shall ensure that removal of the strainer element does not require dismantling of adjacent piping.

The contractor shall supply Eskom with the aperture size, aperture area as a percentage of pipe cross-section area, pressure drop at rated fluid flow, the pressure rating and construction code, for Eskom’s approval.

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3.10 PIPE SUPPORT FITTINGS

3.10.1 General

The person charged with the mechanical design of the pipework shall have an over-riding responsibility to ensure that all pipework and fittings are adequately and correctly supported so as to avoid unacceptable deflections, sagging, movement, vibration and stressing of pipes, supports, associated steelwork and foundations, and equipment to which the pipework is attached, under all design conditions, including transient conditions.

3.10.2 Support fittings

Fittings such as pipe clamps, guides, clips, over-straps shoes, hangers and anchors, and the methods of fixing these to the pipes and structures, shall conform to the applicable requirements of the code used for design

3.10.3 Attachment of pipes supports

Where pipe and ancillary equipment supports are required to be attached to structural steelwork, brickwork, concrete or blockwork supplied by others (specifically for the pipework support or supplied for other purposes), the contractor shall supply to Eskom full details of the proposed method of attachment, the imposed static and dynamic design loadings, and supporting calculations, for review by Eskom before proceeding.

Where the Contractor is required to supply structural steelwork, brickwork, concrete or blockwork for footings and/or foundation blocks, the contractor shall supply full details of methods of methods of fixing, design loadings, ground loading and supporting calculations for review by Eskom, at least 2 weeks before commencement of work on these items.

Eskom Civil specification 240-56364545 - Structural Design and Engineering Standard [6] shall be used

BS EN 13480-1 to 6 Metallic industrial piping [46], ASME B31.3 Process Piping., [15] or other approved codes shall be used to determine spacing and loads on the civil structures.

3.10.4 Anchor blocks and thrust blocks

The design of anchor blocks and thrust block shall take into consideration the maximum pipework due to dynamic and static loads, including those during hydrostatic testing, the methods of coupling the pipework, the allowable nozzle stresses at pipework termination, and the permissible ground loadings. Expansion loadings shall be based on the maximum temperature differentials which could be encountered due to extreme ambient design conditions and fluid temperatures within the pipeline.

Eskom Civil specifications 240-56364545 - Structural Design and Engineering Standard [6] shall be used.

3.11 WELDING

All welding of pressure systems are in accordance with the following standards:

- 240-56246601 – Personnel and Entities Performing Welding Related Special Processes on Eskom Plant
- 240-56241933 – Control of Plant Construction, Repair and Maintenance Welding Activities
- 240-83539994 - Eskom NDT Personnel Approval (NPA) for Quality Related Special Processes on Eskom Plant Standard
- 240-83540088 - Requirements for Non-Destructive Testing (NDT) on Eskom Plant Standard
- 240-56247788:Weld Defects Classification and Reporting Standard

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- 240-43156827: Introduction to the Welding Rulebook
- 240-83540088: Requirements for Non-Destructive Testing (NDT) on Eskom Plant Standard.

3.12 TESTING

3.12.1 General

As the work proceeds, pipelines shall be tested in convenient lengths by means of test equipment supplied by the contractor.

In case of steel pipelines butt-welded in the field, joints shall be tested immediately after being made.

Each test shall be carried out in the presence of Eskom's representative. The Contractor shall be responsible for carrying out all tests and for all expenses incurred in this connection. When carrying out the hydrostatic test the Contractor shall ensure that all valves, tees, and bends are properly secured and shored to prevent movement of pipes and fittings and, should any such movement occur, the contractor shall, at his own expense, reposition and, if necessary, repair the pipes and fittings and the securing means.

Until each section of the pipeline has been subjected to the hydrostatic test and has complied with applicable requirement for leakage rate, the pipeline will not be accepted. The hydrostatic test will be repeated until Eskom is satisfied that the section under test complies with the said requirement.

3.12.2 Initial tests on welded steel pipes

3.12.2.1 Selection of type and extent of testing

The type of testing to be carried out by the contractor (i.e. dye-penetrate, visual radiographic, ultrasonic or a combination, depending on the criticality of the piping system) and the extent of testing, including a definition of how percentages are to be interpreted, is given in the Quality Assurance section of the particular specification.

3.12.2.2 Dye-penetrate test

Where so specified for a piping installation, every weld in steel specials and, where so ordered, in pipes, shall be subjected to a dye-penetrant test carried out as specified in BS EN ISO 3452-1 Non-destructive testing. Penetrant testing. General principles[47] and (a) - (g) below:

a) The contractor shall obtain the approval of Eskom for the group of dye-penetrant and developer that he proposes to use for the test.

b) The test shall be applied to shop welding before despatch of specials or pipes to the site. As pipe laying progresses, field welds shall be subjected to the test soon after each weld is completed.

c) In order to obtain a surface that is dry, clean, and free from scale, dirt, and grease, the contractor may grind but he shall not grit blast the surface.

d) The temperature of the surface to which the developer and the penetrant are applied shall not be below 16 ºC or above 52 ºC.

e) Observations for indications shall be made not less than 15 min and not more than 60 min after the application of the penetrant.

f) Any surfaces on which non-relevant indications are observed shall be explored by visual methods and, if considered necessary by Eskom, such surfaces shall be cleaned and retested.

g) Welds that show no relevant trace of dye on the developer will be accepted.

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3.12.3 Ultrasonic testing

BS EN ISO 17640 Non-destructive testing of welds. Ultrasonic testing. Techniques, testing levels, and assessment [48].

3.12.4 Radiographic examination

Welded joints shall be examined radio-graphically as and to the extent set out in the particular specification.

3.12.5 Hydrostatic test

3.12.5.1 Test procedure and pressure

On completion of erection and cleaning each section of piping shall be hydrostatically tested.

The selected design codes shall be consulted to determine the test pressure for hydraulic and pneumatic testing. See section 3.3 for the codes and standards. The PER [55] regulation also describe test pressures expressed as 1.1 (pneumatic) or 1.25 (hydraulic) of the deign pressure.

The field test pressure shall not exceed the appropriate of the following values:

TYPE OF PIPE	SPECIFICATION NUMBER	TEST PRESSURE EXPRESSED AS A PERCENTAGE OF THE SPECIFIED HYDRAULIC TEST PRESSURE
Fibre Cement (COD) (CID)	SANS 1223 [75]	75 % of the test pressure for permeability test Table 1
Mild steel	SANS 62-1 [60]	Between 5 and 7 MPa as per formula in section 5.3
Mild steel	SANS 719 [68]	50 % (3.5 MPa max.)
Reinforced concrete	SANS 676 [66]	75 % of hydraulic pressure in Table 2
Pre-stressed concrete	SANS 975 [73])	75 % of pressure stated in the project specification.
Flanged cast iron	BS EN 545 (water) [32] BS EN 598 (sewage) [33] BS EN 969 (Gas) [34]	67 % (or works test pressure)
Black polyethylene	SANS 4427 [87]	100 %
uPVC	SANS 966 [72]	75 %

3.12.5.2 Test procedure using pressure recording

Should hydrostatic tests indicate that leakage is occurring; the contractor will determine the position and cause of the leakage and shall take remedial measures, approved by Eskom, to stop permanently such leaks. Under no circumstances will preening be permitted as a means of permanently stopping leaks. Any leakages from valves which cannot be easily stopped by the contractor by glands or seal adjustment or remaking of bolted joints shall be reported to Eskom. After leakage correction the pipeline shall be retested.

When the test pressure is reached, the valve on the test manifold isolating the pump shall be closed and sealed. The test pressure shall be held for an unbroken period of between 8 to 48 hours as agreed. A record of the hydrostatic pressure throughout the entire period of the test shall be made by an approved automatic recording pressure gauge.

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3.12.5.3 Alternative test procedure: leakage test

3.12.5.3.1 Exception

Except as where otherwise allowed, the specified test pressure is maintained for a period of at least 3 hours (or such longer period as is necessary for inspection of the pipeline) by means of a suitable pump, during which period all pipes, specials, joints, and fittings are carefully inspected for leaks. All visible leaks are made good and any pipe, special or fitting found to be defective will be removed and replaced at the expense of the Contractor and such replacement material shall, after installation, be tested at the expense of the contractor.

3.12.5.3.2 Permissible leakage rates

A test pressure is maintained for a further period of 1 hour after the completion of the test period during which time the volume of water required to be pumped into the pipeline for maintenance of the pressure shall be measured. Except for continuously welded steel pipes, the leakage volume shall not exceed the value, in litres, calculated from the applicable of the following formulae:

a) Fibre Cement and concrete pipes and concrete-lined steel pipes

0,075 × diameter of pipe in millimetres
× length of test section in kilometres
× square root of the test pressure in Mega Pascal

b) Jointed pipes in steel, cast iron, black polyethylene, and uPVC, ABS PP:

0,01 × diameter of pipe in millimetres
× length of test section in kilometres
× square root of the test pressure in Mega Pascal

3.12.6 Test on coatings and linings

Prior to installation of pipes, and after local application of coatings following site welding, all coatings shall be tested by the contractor.

3.13 GENERAL

Pipes and fittings shall be of the types specified in the schedule or in the particular specification, and unless otherwise required in terms of particular specification they and their couplings shall be capable of withstanding the applicable test pressure specified. All pipes and fittings shall be supplied complete with couplings and jointing material.

Temporary end covers to the satisfaction of Eskom shall be provided for the protection of threads, flanges and prepared ends of plain-ended pipes and fittings, and to prevent damage to internal lining and exclude foreign matter and water during transportation and during handling on site.

Pipeline materials shall be so transported, stored, and handled that pipes are not over stressed at any time, hard linings are not cracked, starred or damaged by thermal expansion, and fittings are not damaged in any way.

All thin-walled, flexible, and soft-coated pipes shall be handled with care and shall be so stored that they are not subject to concentrated pressure from stones or other objects.

Plastic pipes or pipes coated with plastic shall be stored so that they are protected from sunlight. Items made of stainless steel or 3CR12 steel shall not be allowed to come into direct contact with items made of Carbon Steel or Cast Iron.

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3.14 VALVE AND HYDRANT CHAMBERS

3.14.1 General

Valves, flow meters and other fittings shall where practicable be located above ground or in open concrete pipe trenches or in concrete pipe or cable tunnels, with due regard to access needs. Where this is not so, they shall be housed in chambers.

Scour branches shall be installed in accordance with the relevant details of drawing number 0.66/1766. Where access branches and air release valves are specified for large bore pipeline (600 NB and over), they shall conform to drawing number 0.00/4505 Rev 2. Air-release valves branches on smaller underground pipeline shall project 500 mm above ground level but shall not require a specific valve chamber.

On pipeline of nominal diameter up to and including 275 mm, unless otherwise shown on the drawings or scheduled as manholes, chambers shall be constructed around all valves, hydrants, and air valves.

The design of all valve chambers and manholes shall make provision for the removal or drainage of leakage water.

3.15 LAYING OF SURFACE PIPELINES

3.15.1 General

Included in this category are pipelines installed above ground, or in open concrete trenches, or in cable tunnels or pipe tunnels, or in concrete sleeves.

Surface pipeline shall be laid out, supported and affixed to even grades and to the levels and alignments shown on the drawings or as directed. Where packings are required under supports to achieve the grades and levels, such packings shall consist of the minimum number of packing pieces, shall fully clamped to prevent them from being dislodged.

The following specifications after determining applicability to project shall be adhered to:

SANS 1200, Standardised specification for Civil Engineering Construction (Sections A, AA, D, DA, DB, G, GA, L, and LB).

SANS 2001-DP2, Construction works Part DP2: Medium pressure pipelines; [87]

3.15.2 Clearance for surface pipes

Unless otherwise shown on the drawings, pipes shall be so positioned as to maintain the following clearances to any other fixed structure except the members to which such pipes are clamped:

PIPE NOMINAL DIAMETER (mm)	CLEARANCE (mm)
Up to 25	75
50 to 80	100
100 to 300	150
400 to 700	200
Above 700	250

The clearance between any two adjacent pipes shall be the average of the clearances applicable to the two pipes. It is a general requirement that the pipes flanges or couplings can be connected or disconnected without moving the pipes.

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Arrangement and positioning are important factors in the layout of a piping facility. Space is limited. Area and boundary limits force conservation of space. Arranging equipment throughout the unit in an orderly and sequential fashion is a necessity. Therefore, proper spacing and arrangement of pipe in the pipe rack requires special attention. A pipe rack has a defined width; therefore, working within the allotted space makes spacing crucial. Not only must pipe be arranged to take up a minimum amount of space, but also allowances should be made for any pipe that might be added in the future.

Line spacing dimensions are based on a clearance of 25 mm between the outside diameter of the largest flange and the outside diameter of the adjacent pipe. The minimum spacing between any two lines is 100 mm. If either of the lines is insulated, the thickness of the insulation must be added. When lines are placed adjacent to a building, wall, column, or other structure, a minimum clearance of 610 mm is required from the outside diameter of a flange. Pipes having orifice flanges will require a larger minimum clearance because of the valve taps and connecting instrumentation. Typically, a minimum clearance of 610 mm is used on either side of a pipe having orifice flanges.

3.15.3 Spacing of pipe supports

The spacing of pipe supports for single run piping shall conform to the design considerations specified in codes or otherwise as directed by Eskom, bearing in mind the convenience of using existing steelwork. Where more than one pipe of different diameters or construction is to be run on a common support system, the spacing of the supports shall be not greater than the spacing required for any of the pipes, with the proviso that pipes requiring support spacings larger than the minimum requirement need not impose a loading on each support structure.

Spacing shall be the minimum of relevant Standard/Code EN 13480/ASME B31.3 or the recommendation of the OEM.

3.15.4 General laying requirements

3.15.4.1 Setting of valves, specials and fittings

Unless otherwise specified or directed, gate valves shall be set as per the valve specification 240-105020315 - Standard for Low Pressure Valves [8]. All valves, special, and fittings shall correctly set, supported and placed in position as the work proceeds, and shall be properly jointed to their respective pipes.

In urban, industrial, and similar areas valves specials and fittings shall be located in the positions shown on the drawings or as otherwise directed and not merely to suit standard lengths of pipe. In open country areas they may be located to suit the pipe lengths.

After cutting a Fibre Cement pipe to suit the position of a valve, special, or fitting, the contractor shall, by means of an approved field-turning machine, turn the cut ends to suit the coupling sleeve. Filing of the ends of a Fibre Cement pipe will not be permitted.

Air release valve branches shall be mounted vertically at high points in the piping system positions shown on the drawings or directed by Eskom.

Swing-door non-return valves shall be mounted only in horizontal pipe-runs, with the swing door spindle horizontal. All other valves shall be mounted with the operation spindle vertical and the operating handle at the top, unless otherwise directed by Eskom.

3.15.4.2 Anchor and thrust block positioning

It is the responsibility of the person charged with the mechanical design of the pipeline to determine the positions where thrust blocks and anchor points are required, and the magnitude and direction of loads that will be imposed by the pipeline of the anchor and thrust blocks under extreme design

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conditions parameters. It is also the designer's responsibility to ensure that the design of the attachment of anchors or thrust blocks to the pipeline and to the fixed structure or earth is adequate.

Drawings showing the position and fixing arrangements are subject to Eskom approval prior to work proceeding, and in the case of fixings to steelwork supplied by another Contractor, to that Contractor's approval as well.

The Eskom standard 240-56364545 - Structural Design and Engineering Standard [6] shall apply.

3.15.4.3 Anchor/thrust blocks and pedestals

At positions determined by calculation, and where otherwise directed, anchor/thrust blocks shall be constructed to dimensions ordered or shown on the drawings. Anchor/thrust blocks and pedestals shall be constructed of strength 15 MPa concrete or such other strength as is scheduled or specified in the particular specification.

The concrete shall be well punned round the pipe and, if in trenches, against the undisturbed faces and bottom of the trench. Backfilling behind or under thrust faces will not be permitted. Excess excavation shall be replaced with the prescribed mix concrete given above for anchor/thrust blocks at the contractor's expense unless an item is scheduled to cover payment for overbreak. Care shall be taken to leave the joints accessible. No anchor/thrust blocks and pedestals shall be concreted until the approval of Eskom has been obtained.

3.15.4.4 Alignment and neatness

Apart from conformance tolerances specified, it is required that the piping be laid out and installed in a neat and orderly fashion, as follows:

Pipes running along common supports shall be parallel with the given tolerances, in plan view. As far as practicable, in-line instrument items, small branches and valves, nameplates and identification marks which are installed on parallel shall be mounted in a straight line in an accessible position.

Where pipelines are fixed onto vertical surfaces they shall be run parallel with those surfaces and any projections therefrom, as specified in the Isometric or General arrangement drawings, or otherwise at the direction of Eskom. Piping projecting through floors shall, unless otherwise directed, be normal to the surface.

3.16 LAYING OF BURIED PIPELINES

All piping shall be laid in accordance with:

SANS 2001-DP2, Construction works Part DP2: Medium pressure pipelines; [84]

SANS 2001-DP6, Construction works – Part DP6: Below-ground water installations.

SANS 2001-DP8, Construction works, Part DP8: Pipe Jacking; [86]

3.17 PIPES CROSSING OTHER SERVICES

3.17.1 Cable trench crossings

Where pipes cross cable trenches, care shall be taken not to install couplings over the cable trenches.

3.17.2 Cable tunnel crossings

Where buried pipeline cross cable tunnels such as to necessitate a local alteration to the pipe altitude, the installation shall be as per drawings approved by Eskom. Local highpoints or low points shall be provided with air release or scour facilities unless specifically directed otherwise in the particular specification or drawings, and pipe thrusts shall be catered for.

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3.17.3 Open trapezoidal drain crossings

Where the burying of pipelines under open drains necessitates the demolition of the drain concrete surfaces, the contractor shall reinstate the drain concrete surfaces; the contractor shall reinstate the drain concrete after compaction of the back-fill, as in the existing drain, assuring a complete bonding to the existing concrete, and the same surface finish.

3.17.4 Road crossings

Road crossings in most cases will be designed to take place in open concrete trenches bridged at the roads, the trench, bridge and road being supplied by Eskom.

In some cases concrete pipe sleeves or culverts will be provided by Eskom In the case of pipe sleeves, the pipeline shall be so supported in the sleeve that point loadings on the allowable loadings, and any flanges inside the sleeve can be dismantled without having to move the pipe. Any clamps, bolts nuts within the sleeve shall be adequately protected against corrosion.

Pipe jacking, micro tunnelling and trenchless technologies can also be investigated for an optimal solution.

3.17.5 Rail road crossings

Pipe jacking, micro tunnelling and trenchless technologies can also be investigated for an optimal solution.

3.17.6 River or marsh crossings

Wherever possible, pipe crossings of rivers shall be made on bridge at a height and of sufficient strength to cater for 75 year floods. Subsurface crossings of rivers and the laying of pipelines through marsh ground shall only be carried out after all design details have been agreed with Eskom's Civil and Building Department Manager.

3.17.7 Concrete casing

Where Eskom requires pipes to be encased, a concrete of strength 15 MPa or such other strength as is scheduled, shall be used. No part of the concrete casing shall be closer than 150 mm to any flexible joint of a concrete-encased pipeline.

The pipe trench for a concrete-encased pipeline shall be excavated to the depth below the bottom surface of the pipe, as ordered or shown on the drawings, and to sufficient width to allow for the trench shall be trimmed true to line and grade. A light concrete screed shall be placed on the bottom of the trench, concrete saddles or pads of the requisite thickness spaced suitably, and the pipeline laid on them true to line and grade. After being jointed the pipes shall be tested in accordance with the applicable tests given in section 3.12 testing. After the pipeline has been tested, suitable formwork shall be erected and concrete carefully placed and vibrated in position underneath the pipe and up both sides.

The concrete level shall be raised equally on both sides of the pipe until encasement is complete and a cover over the surface of the pipe is provided that is not at any point less than that ordered or shown on the drawings. No earth filling over the concrete shall be commenced until at least 7 days after the concrete has been placed or until the concrete has attained strength of at least 10 MPa.

In the case of buried pipeline road crossings, the contractor shall reinstate the road surface after backfilling and compaction in conformance with the road specification.

3.17.8 Lifting and relaying of existing pipes

Where shown on the drawings and where scheduled, existing pipes and fittings that is to be removed shall be lifted and the materials recovered as far as is practicable. The pipes and couplings shall be removed from the trench and placed in the contractor's site store where they shall be cleaned, sorted,

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and listed. A copy of the list of undamaged material recovered shall be handed to Eskom's Project Manager.

To avoid damaging the pipes, the contractor shall exercise particular care in excavating Fibre Cement pipelines. Unless, in terms of the contract, other pipes are to be laid in the same trench, each trench shall be backfilled as specified in SANS 1200 DB SANS 1200, Standardised specification for Civil Engineering Construction (Sections A, AA, D, DA, DB, G, GA, L, and LB).[77].

Where recovered pipes are scheduled to be relayed, rubber rings, insertion packings, damage joints, and bolts shall be replaced, unless stipulated as otherwise by Eskom after inspection.

Before they are relayed, an acceptable number of the pipes shall be tested for compliance with the requirements of the applicable specification for resistance to hydraulic pressure.

3.17.9 Pipeline routine markers

The routes of all buried piping shall be marked with permanent concrete markers. The design of the markers shall generally be as per the relevant detail of drawing number 0.00/3407.

The wording delineating the fluid handled, as specified by Eskom (such as ''Potable water pipe'') shall be embossed on two opposite sides of the markers. The letters shall not be smaller than 20 mm.

The positioning of the markers shall be such that it is possible to follow the route of the pipeline on foot. The markers shall be erected on the centreline of the pipeline. It shall be possible for a person standing on the ground at any marker to see the next upstream and downstream markers. Markers shall be placed at all horizontal changes of direction of the pipeline.

3.17.10 Installation of mechanical equipment

The installation of mechanical equipment included in the contract, such as pumps, compressors, vessels and heat exchangers, shall be in accordance with the relevant section in the particular specification.

3.17.11 Pipe supports

Unless otherwise directed in the particular specification, the Contractor will fabricate and install all pipe supports, including all bolting, welding or clamping to the base concrete footings or structural steelwork, and shall connect the piping to the supports in the specified manner. All necessary clamps, bolts, washers, shoes and other items specified shall be supplied by the contractor. Pipe supports shall be protected from corrosion in accordance with the relevant Eskom corrosion specification.

Where the Contractor is required to install concrete foundation blocks, footings or sleepers, they shall be constructed in accordance with the relevant earthwork and concrete work specifications as supplied by Eskom for the particular project.

3.18 CLEANING OF PIPELINES

3.18.1 General pipelines

On completion of the laying and testing, each pipeline shall be cleaned of all sediment and foreign matter by flushing at a suitable velocity until the flush is clean. The flushing medium shall be clean water with the following provisos:

a) For stainless steel pipeline the flushing water shall have a chloride content not exceeding 35 mg/l.

b) For lube oil pipeline the flushing liquid shall be flushing oil similar to the lube oil for which the system is designed (as specified in the particular specification), and in addition the pipeline shall be pickled.

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c) For compressed air pipelines, water may be used if the pipeline can be drained completely, otherwise compressed air shall be used.

d) For pipelines designed to handle fluids that are incompatible with water, the flushing fluid, and hydraulic test medium, shall be as specified in the particular specification.

e) Where specified in the particular specification, chemical cleaning shall be carried out, using the chemicals and methods specified in the particular specification.

In the case of pipelines which are extensions of existing systems, and/or where a proper flush is not possible, provision shall be made for temporary line strainers which shall remain in circuit until all signs of foreign matter have disappeared, as directed by Eskom.

After flushing of pipelines, they shall promptly be drained, dried and protected from ingress of moisture until commissioned.

3.18.2 Disinfection of potable water pipelines for domestic use.

On completion of the laying and testing, each potable water pipeline shall be disinfected [84] as follows:

a) The pipeline shall be flushed out with clean water until all sediment and other foreign matter have been removed.

b) The pipeline shall then be filled with water containing 0.15g/l of calcium hypochlorite. The solution shall be allowed to flow slowly into the pipeline until it fills the whole pipeline and shall be left there for at least 24 h.

c) The pipeline shall then be thoroughly and repeatedly flushed with clean water until a sample of the wash water drawn from the pipeline complies with the requirements for potable water of Eskom, the local authority or of the appropriate authority supplying such water to the area. The wash water shall contain a residual chlorine content not exceeding 3mg/l.

3.19 TOLERANCES

3.19.1 General

No deviation will be permitted from the minimum cover of buried pipelines specified or shown on the drawings.

3.19.2 Control points

For the purposes of this clause valves set on the centre line of a buried pipeline and designated changes in gradient shall be regarded as control points shall be located with a permissible vertical deviation of ± 100 mm on the centre line, subject to simultaneous conformance with the angular deviation will be permissible laterally except where the contractor is required to lay the pipeline at a designated distance from a fence line, kerb line, or boundary bench mark, structural steelwork of installed equipment, in which case the permissible deviation shall be ± 20 mm.

Unless otherwise directed and subject to a permissible deviation (measured along the centre line) ±of 4 m, and a permissible vertical deviations, scour valves shall be located at the lowest points in pipelines and air valves at the highest points.

3.19.3 Alignment (Plan and level)

Unless otherwise directed, the permissible deviation in alignment between control points from a straight line joining the control points, when measured on the top centre of the pipeline, shall be ±1 00 mm or ± 20 % of the nominal diameter of the pipe, whichever is the larger, and the permissible deviation per pipe length shall be ± 20 mm.

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The permissible deviation from the designated level at any point on the invert of the pipeline shall be ± 50 mm or ± 10 % of the nominal diameter of the pipe, whichever is the larger.

3.19.4 Manholes, valve chambers, etc.,

Manholes, valve chambers, and the line constructed tolerances that affect access to bolts, nuts, etc., with a permissible deviation of ± 50 mm on all clearance dimensions. The clearance dimension between the outside of each nut and bolt-head and the inside face of the wall of a structure or any other fitting shall be at least the specified value.

3.20 PAINTING AND CORROSION PROTECTION

The painting or other form of corrosion protection to be applied to pipes and ancillary equipment, ,shall conform to Eskom standard 240-101712128 Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings - and the particular procedure specifications stipulated in the particular specifications.

The painting or other form of corrosion protection to be applied to pipes and ancillary equipment, including pipe supports, shall conform to Eskom standard 240-101712128 Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings - and the particular procedure specifications stipulated in the particular specification.

All buried piping shall be protected externally by a protective coating system (except piping made of an intrinsically non-corrodible material), as specified in the particular specification, with or without electrolytic corrosion protection, depending on soil conditions.

Where buried piping is specified to be protected by means of electrolytic corrosion protection, then the various pipes and fittings shall be provided with means for bonding together. Fittings shall be provided with means for bonding together electrically by means of bonding straps bolted to screwed bonding bosses welded to the ends of the sections, and where insulating joints are required; they shall to Eskom's specification.

4. AUTHORISATION

This document has been seen and accepted by:

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5. REVISIONS

Date	Rev.	Compiler	Remarks
December 2016	0.1	W. Erasmus	Pipe standard for low pressure pipes draft copy for review
February 2017	0.2	W. Erasmus	Final Draft Document for Comments Review
April 2017	1	W. Erasmus	Final Document for Authorisation and Publication

6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- Willem Erasmus

7. ACKNOWLEDGEMENTS

- A Pillay, Senior Engineer LPS
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APPENDIX A

A.1 CARBON STEEL - 12MM TO 150MM

A1.1 Steel pipes, fittings and specials

A1.1.2 Carbon Steel pipes of nominal bore up to 150 mm

Unless otherwise scheduled or specified in the particular specification, Carbon Steel pipes and fittings of nominal bore up to 150 mm shall conform to the applicable requirements of SANS 62 [61] and [61], and shall be medium class for design pressure less than or equal to 1,0 MPa, and heavy class for design pressures above 1,0 MPa and up to and including 2,5 MPa.

Pipes of nominal bore 65 mm, 80 mm, 100 mm and 150 mm shall be suitable for flanged connections and pipes 50 mm and below shall be screwed to SANS 1109 [74]. Straight pipes shall be supplied in the relevant standard length (6,1 m, 6,4 m or 6,7 m).

A1.2 Pipe fittings and specials

A1.2.1 Carbon steel

Carbon steel specials and fittings shall be fabricated or supplied with dimensions in accordance with the relevant drawings and, unless scheduled otherwise in the particular specification, in accordance with the standard specifications, grades and sizes shown in the attached annexe. Tolerances on the dimensions shall be in accordance with the relevant controlling pipe or fitting standards.

Carbon steel fittings and specials of nominal bore larger than 150 mm, and carbon steel specials containing in part piping of nominal bore under 150 mm, shall be fabricated in accordance with BS 2971[26], except that cut shut bends, in accordance with paragraph specification, all water systems, inflammable gas systems and oil systems shall be considered as “conducive to stress corrosion cracking” in terms of BS 2971, and welded branches shall conform to Figures 11 or 12, and small bore connections shall conform to figure 7. All shop welding of slip-on and other couplings and welding of specials shall be carried out by coded welders competent in terms of BS 2971.

A1.2.2 Flanges (steel pipelines)

In the jointing of steel pipes with flanges, special care shall be taken to align, grade, and level the pipes, specials, and valves to avoid straining of the flanges. All bitumen and paint shall be removed from the mating face of each flange immediately before jointing. Insertion pieces that comply with applicable requirements shall form a continuous one-piece ring between the flanges. Bolts shall be tightened up evenly in opposite pairs to ensure uniform bearing on the insertion. Care shall be taken to avoid damage to the internal surface of the pipes during assembly of the pipeline. Where loose flanges are welded onto pipelines the relevant pipe section shall be post-weld hot-dip galvanised or otherwise protected as specified in accordance with the relevant corrosion protection specification. Tack-weld final shop applied corrosion protection as specified. Welding procedure and electrodes or wire shall be in accordance with BS 2971 [26] for carbon steel or BS 4677 [28]for stainless steel pipelines.

Where it is not possible to weld from the inside of the pipe, special or fitting, the root run shall be done by argon arc.

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A1.2.3 Welding steel pipelines

Field welding of steel pipelines shall only be carried out by welders who are competent in terms of procedure approvals given in BS 2971 [26] or BS 4677 [28] as applicable.

Pipelines may only be welded in the field provided:

a) the drawings specify a field weld

b) Welding can be carried out in clean and protected conditions.

c) those pipes requiring internal corrosion protection hot dip galvanising or shop applied post-weld heat treatment, are removed to the shop (after site tack welding of the sections) for final shop welding and shop application of the post-weld protection or heat treatment procedures. The pipe trench for buried welded steel pipelines may be backfilled after, when relevant, completion of radiographic or other specified examinations.

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APPENDIX B

B1 CARBON STEEL - 200 mm TO 1400 mm

B1.1 Carbon Steel pipes of nominal bore over 150 mm

Carbon Steel pipes of nominal bore over 150 mm shall comply with the applicable requirements of SANS 719 [68] appropriate to the grade of pipe scheduled or specified in the particular technical specification listed in annex C.

a) The pipes shall be supplied with the ends prepared to suit the type of joining method specified in the particular specification, and shall be of one fixed standard length.

b) The height of the inner weld reinforcement and of upset metal on the inner surface shall not exceed 1 mm.

For pipes rated as ‘criticality level A’ as defined in 3.5.2 above, the pipes shall conform to the applicable requirements of API 5L or API 5LS, but shall otherwise conform to sub-paragraphs (a) and (b) above.

B1.2 Pipe fittings and specials

B1.2.1 Carbon steel

Carbon steel specials and fittings shall be fabricated or supplied with dimensions in accordance with the relevant drawings and, unless scheduled otherwise in the particular specification, in accordance with the standard specifications, grades and sizes shown in the attached annexe. Tolerances on the dimensions shall be in accordance with the relevant controlling pipe or fitting standards.

Carbon steel fittings and specials of nominal bore larger than 150 mm, and carbon steel specials containing in part piping of nominal bore under 150 mm, shall be fabricated in accordance with BS 2971 [26], except that cut shut bends, in accordance with paragraph specification, all water systems, inflammable gas systems and oil systems shall be considered as “conducive to stress corrosion cracking” in terms of BS 2971, and welded branches shall conform to Figures 11 or 12, and small bore connections shall conform to figure 7. All shop welding of slip-on and other couplings and welding of specials shall be carried out by coded welders competent in terms of BS 2971.

B1.2.3 Flanges (steel pipelines)

In the jointing of steel pipes with flanges, special care shall be taken to align, grade, and level the pipes, specials, and valves to avoid straining of the flanges. All bitumen and paint shall be removed from the mating face of each flange immediately before jointing. Insertion pieces that comply with the applicable requirements and form a continuous one-piece ring between the flanges shall be used. Bolts shall be tightened up evenly in opposite pairs to ensure uniform bearing on the insertion. Care shall be taken to avoid damage to the internal surface of the pipes during assembly of the pipeline.

Where loose flanges are welded onto pipelines the relevant pipe section shall be post-weld hot-dip galvanised or otherwise protected as specified in accordance with the relevant corrosion protection specification. Tack-weld final shop applied corrosion protection as specified. Welding procedure and electrodes or wire shall be in accordance with BS 2971 [26] for carbon steel or BS 4677 [28] for stainless steel pipelines.

Where it is no possible to weld from the inside of the pipe, special or fitting, the root run shall be done by argon arc.

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B1.2.4 Welding steel pipelines

Field welding of steel pipelines of diameter 600 mm or greater shall comply with the relevant requirements of BS 2971 [26] or BS 4677 [28] as applicable, and shall be carried out by welders who are competent in terms of procedure approvals given in BS 2971 or BS 4677 as applicable.

Pipelines less than 600 mm diameter may only be welded in the field provided:

a) the drawings specify a field weld

b) welding can be carried out in clean and protected conditions.

c) those pipes requiring internal corrosion protection hot dip galvanising or shop applied post-weld heat treatment, are removed to the shop (after site tack welding of the sections) for final shop welding and shop application of the post-weld protection or heat treatment procedures.

The pipe trench for buried welded steel pipelines may be backfilled after, when relevant, completion of radiographic or other specified examinations.

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APPENDIX C

C.1 C1 CARBON STEEL AND FITTINGS FOR 1,0 MPA SYSTEMS

ITEM	SIZE RANGE mm	SPEC	RATING/ WALL THK	END PREPARATION
Pipe	15 to 50 65 to 150 200 to 500 600 to 700 800 to 900 1000 to 1100 1200 to 1400	SANS 62 ERW SANS 62 ERW SANS 719/BS 2971	Medium Medium Grade B, 4.5 mm Grade B, 6.0 mm Grade B, 8,0 mm Grade B, 10,0 mm Grade B, 12,0 mm	Screwed ISO R7 Plain End
Bend 45 Bend 45 LR Bend 45 MR 3 Seg Bend 45 LR 3 Seg	15 to- 50 65 to- 150 200 to 500 600 to 700 800 to 900 1000 to 1100 1200 to 1400 200 to 500 600 to 700 800 to 900 1000 to 1100 1200 to 1400	SANS 14 Table 14 BS 1640 Or JIS B 2304 SANS 719/BS 2971 SANS 719/BS 2971	Sch 40/Std Grade B, 4,5 mm Grade B, 6,0 mm Grade B, 8,0 mm Grade B, 10,0mm Grade B, 12,0 mm Grade B, 4,5 mm Grade B, 6,0 mm Grade B, 8,0 mm Grade B, 10,0 mm Grade B, 12,0 mm	Screwed ISO R7 Butt Weld
Elbow 90 Elbow 90 LR Elbow 90 SR 3 Seg Elbow 90 MR 4 Seg Elbow 90 LR 5 Seg	15 to 50 65 to 150 200 to 500 600 to 700 800 to 900 1000 to 1100 1200 to 1400 200 to 500 600 to 700 800 to 900 1000 to 1100 1200 to 1400 200 to 500 600 to 700 800 to 900 1000 to 1100 1200 to 1400	SANS 509 Table 13 BS 1640 or JIS B 2304 SANS 719/BS 2971	Sch 40/Std Sch 40/Std Grade B, 4,5 mm Grade B, 6,0 mm Grade B, 8,0 mm Grade B, 10,0 mm Grade B, 12,0 mm Grade B, 4,5 mm Grade B, 6,0 mm Grade B, 8,0 mm Grade B, 10,0 mm Grade B, 12,0 mm Grade B, 4,5 mm Grade B, 6,0 mm Grade B, 8,0 mm Grade B, 10,0 mm Grade B, 12,0 mm	Screwed ISO R7 Butt Weld
Pulled Bend R=3D	15 to 50 65 to 150	SANS 62 ERW	Medium Medium	Screwed ISO R7 Plain End

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ITEM	SIZE RANGE mm	SPEC	RATING/ WALL THK	END PREPARATION
Equal Tee	15 to 50 65 to 150	SANS 509 Table 5 BS 1640 or JIS B 2304/JIS B 2311	Sch 40/Std	Screwed ISO R7 Butt Weld
Equal Branch	200 to 500 600 to 700 800 to 900 1000 to 1100 1200 to 1400	SANS 719/BS 2971	Grade B, 4,5 mm Grade B, 6,0 mm Grade B, 8,0 mm Grade B, 10,0 mm Grade B, 12,0 mm	Butt Weld
Reducing Tee	20 to 50 65 to 150	SANS 509 Table 9 BS 1640 or JIS B 2304	Sch 40/Std	Screwed ISO R7 Butt Weld
Reducing Branch	200 to 500 600 to 700 800 to 900 1000 to 1100 1200 to 1400	SANS 719/BS 2971	Grade B, 4,5 mm Grade B, 6,0 mm Grade B, 8,0 mm Grade B, 10,0 mm Grade B, 12,0 mm	Butt Weld
Concentric Reducer	15 to 50 65 to 150 200 to 500 600 to 700 800 to 900 1000 to 1100 1200 to 1400	SANS 509 Table 4 BS 1640 or JIS B 2304 SANS 719/BS 2971	Sch 40/Std Grade B, 4,5 mm Grade B, 6,0 mm Grade B, 8,0 mm Grade B, 10,0 mm Grade B, 12,0 mm	Screwed ISO R7 Butt Weld
Eccentric Reducer	65 to 150 200 to 500 600 to 700 800 to 900 1000 to 1100 1200 to 1400	BS 1640 or JISB 2304 SANS 719/BS 2971	Sch 40/Std Grade B, 4,5 mm Grade B, 6,0 mm Grade B, 8,0 mm Grade B, 10,0 mm Grade B, 12,0 mm	Butt Weld
Flange-Slip On Flange-Screwed Flange-Blind	50 to 1400 15 to 50 50 to 700	SANS 1123 Tab 1000/3 SANS 1123 Tab 1000/4 SANS 1123 Tab 1000/8		

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ITEM	SIZE RANGE mm	SPEC	RATING/ WALL THK	END PREPARATION
Bolt With Nut & Washer Gasket Ring - 3mm tk		SANS 135 GR 4.6 SANS 7483/ISO 7483. It is recommended that the selection of gaskets for any particular application is made in consultation with the gasket supplier		
Cap Barrel Nipple Cross Socket Union	15 to 50 15 to 50 15 to 50 15 to 50 15 to 50	SANS 509 Table 20 SANS 62 Table 9 SANS 509 Table 5 SANS 62 Table 7 SANS 509 Table 17		Screwed ISO R7
Weldolet (Reducing) Thredolet (Weldolet) Sockolet (Reducing) Bushes	15 to 50 15 to 50 15 to 50 15 to 50	ASTM A234 - WPB SANS 509 Table 16	3000 (ANSI B16.9)	Butt Weld Screwed ISO R7 Socket Weld

c) Components having the larger diameter 600 NB to 700, with t

NOTE

1 For components containing two sizes, e.g. reducers tees:

a) Reducers with the larger diameter 80 NB to 150 NB, having the smaller diameter 6 NB or less, use BS 1540 or JIS B 2340

b) Components having the larger diameter 200 NB to 500 NB, but with the smaller r diameter 100 NB to 150 NB, use 4,5 mm wall thickness and fabricate to BS 2971.

c) Components having the smaller diameter 500 NB or less, use 6,0 mm wall thickness and fabricate to BS 2971.

d) Components having the larger diameter 800 NB to 900, with the smaller diameter 700 NB or less, use 10,0 mm wall thickness and fabricate to BS 2971.

e) Components having the larger diameter 1000 to 1100, with the smaller diameter 900 NB or less, use 8,0 mm wall thickness and fabricate to BS 2971.

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f) Component having the larger diameter 1200 NB 1400, with the smaller diameter 1100 NB or less, use 12,0 mm wall thickness and fabricate to BS 2971.

2 All equal branches, reducing branches or crosses where the minimum branch size is 300 NB or above shall be of gusseted construction.

3 For systems with a critically level A, all pipes and fittings shown fabricated from pipe to SANS 719 shall be to API 5 LS,

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C.2 C2 CARBON STEEL; PIPING AND FITTINGS FOR 2,5 MPA SYSTEMS

ITEM	SIZE RANGE mm	SPEC	RATING/ WALL THK	END PREPARATION
Pipe	15 to 50 65 to 150 200 to 350	SANS 62 ERW SANS 62 ERW SANS 719/BS 2971	Heavy Heavy Grade B, 6.0 mm	Screwed ISO R7 Plain End
Bend 45 Bend 45 LR Bend 45 MR 3 seg Bend 45 LR 3 Seg	15 to 50 65 to 150 200 to 350 200 to 350	BS 3799 Table 4 or BS 1740 Table 3 BS 1640 Table 4 SANS 719/BS 2971	3000 Sch 40/Std Grade B, 6,0 mm Grade B, 6,0 mm	Screwed ISO R7 Butt Weld
Elbow 90 Elbow 90 LR Elbow 90 SR 3 Seg Elbow 90 MR 4 Seg Elbow 90 LR 5 Seg	15 to 50 65 to 150 200 to 350 200 to 350 200 to 350	BS 3799 Table 4 or BS 1740 Table 3 BS 1640 Table 4 or 5 SANS 719/BS 2971	3000 Sch 40/Std Grade B, 6,0 mm Grade B, 6.0 mm Grade B, 6.0 mm	Screwed ISO R7 Butt Weld
Pulled Bend R=3D	15 to 50 65 to 150	SANS 62 ERW Table 11	Heavy Heavy	Screwed ISO R7 Plain End
Equal Tee	15 to 50 65 to 150	BS 3799 Table 4 or BS 1740 Table 2 BS 1640 Table 6	3000 Sch 40/Std	Screwed ISO R7 Butt Weld
Equal Branch	200 to 350	SANS 719/BS 2971	Grade B, 6,0 mm	Butt Weld
Reducing Tee	65 to 150	BS 1640 Table 7	Sch 40/Std	Butt Weld
Reducing Branch	200 to 350	SANS 719/BS 2971	Grade B, 6,0 mm	Butt Weld
Concentric Reducer	15 to 50 65 to 150 200 to 350	BS 3799 Table 12 BS 1640 Table 8 SANS 719/BS 2971	3000 Sch 40/Std Grade B, 6,0 mm	Screwed ISO R7 Butt Weld
Eccentric Reducer	15 to 50 65 to 150 200 to 350	BS 3799 Table 12 BS 1640 Table 8 SANS 719/BS 2971	3000 Sch 40/Std Grade B, 6,0 mm	Screwed ISO R7 Butt Weld

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ITEM	SIZE RANGE mm	SPEC	RATING/ WALL THK	END PREPARATION
Flange-Slip On Flange-Screwed Flange-Blind Flange-Slip On Flange-Blind	15 to 150 15 to 50 15 to 150 200 to 350 200 to 350	SANS 1123 Tab 2500/5 or 4000/3 SANS 1123 Tab 2500/4 or 4000/4 SANS 1123 Tab 4000/8 SANS 1123 Tab 2500/3 SANS 1123 Tab 2500/8		
Bolt With Nut & Washer Gasket Ring - 3mm tk		SANS 135 GR 4.6 SANS 7483/ISO 7483. It is recommended that the selection of gaskets for any particular application is made in consultation with the gasket supplier		
Plug Cap Cap Barrel Nipple Cross Cross Socket Socket Union Union	15 to 50 15 to 50 50 to 80 15 to 50 15 to 50 50 to 80 15 to 50 50 to 80 15 to 50 50 to 80	BS3799 T6, BS1740 T13 BS3799 T6, BS1740 T12 BS 1640 Table 9 SANS62 T9, BS1740 T16 BS3799 T4,BS1740 T2 BS3799 Table 13 SANS62 T7,BS1740 T9 BS3799 Table 14 BS3799 T14,BS1749 T11 BS3799 Table 15	3000 3000 Sch 40/Std Heavy 3000 3000 Heavy/3000 3000 3000 3000	Screwed ISO R7 Screwed ISO R7 Butt Weld Screwed ISO R7 Screwed ISO R7 Butt Weld Screwed ISO R7 Butt Weld Screwed ISO R7 Butt Weld

NOTE

1 For components containing two sizes, e.g. reducers, reducing tees:

a) If both sizes are above 200 NB, use the wall thickness specified

b) Components having the larger diameter 200 NB to 350 NB, but with the smaller diameter 80 NB to 150 NB, use 6,0 mm wall thickness and fabricate to BS 2971

c) Reducers with the larger diameter 80 NB to 150 NB, having the smaller diameter 50 NB or less, use BS EN 10253 butt weld fittings with plain pipe extensions welded on the smaller diameter end and screwed on free end.

d) All equal tees, unequal tees, stub-ins or crosses where the minimum branch size is 300 NB or above shall of gusseted construction.

2 For systems with criticality level A, all pipes and fittings shown fabricated from pipe to SANS 719 shall be to API 5L and 5LS but grade and wall thickness to be as shown.

3 BS EN 10241 may be used as an alternative to BS 3799 for liquid service at 2, 5 MPa, and for compressible gas services at

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APPENDIX D

D.1 D1 AUSTENITIC OR FERRITIC STAINLESS STEEL OR 'RUST-RESISTANT' STEEL PIPES

Stainless steel piping shall conform to ASTM A312 (ANSI B36.19 dimensions). The grade of stainless steel shall be TP 304L and the piping shall be either welded or seamless up to 150mm NB, and welded above 150 NB, or as otherwise specified in the particular specification. Pipes of 20 mm NB and below shall be joined by compression type couplings, except where flanged to mate with flanged fittings. Pipe diameter tolerances shall be suitable for such couplings, and pipes shall be annealed to a maximum hardness of Rockwell B809. Pipe wall thickness shall be as scheduled on the drawings or particular specification, and shall be not less than schedule 10S for pipe sizes up to 400 mm NB, and not less than schedule 5S for sizes above 400 NB as per ANSI B36.19 dimensions.

'Rust resistant' chrome steel of the 3CR12 type, where specified in the particular specification, shall be supplied in the nominal bore sizes and wall thickness specified in the drawings and schedules.

3CR12 piping shall be manufactured by means of an Eskom approved automatic welding process, either as spiral weld or longitudinal seam weld, and fabricated by Eskom approved fabricators using a welding specification supplied by the steel suppliers.

Pipe Fittings& Specials

D1.1 Stainless steel

Stainless steel and rust resistant chromium steel (e.g. 3CR12 steel) fittings and specials shall be fabricated or supplied with dimensions in accordance with the relevant drawings, and unless otherwise scheduled in the particular specification, in accordance with the standard specifications, grades and sizes shown in annex C1 or C2 (attached).

Tolerances on dimensions shall be in accordance with the relevant controlling pipe or fittings standards.

Stainless steel or "rust resistant" fabricated steel fittings or specials shall be fabricated in accordance with BS 4677, and all welding shall be carried out by coded welders who are competent in terms of BS 4677. All stainless steel or 3CR12 steel shall in addition meet the specification prepared by the steel supplier.

D1.2 Flanges (steel pipelines)

In the jointing of steel pipes with flanges, special care shall be taken to align, grade, and level the pipes, specials, and valves to avoid straining of the flanges. All bitumen and paint shall be removed from the mating face of each flange immediately before jointing. Insertion pieces that comply with applicable requirements and form a continuous one-piece ring between the flanges shall be used. Bolts shall be tightened up evenly in opposite pairs to ensure uniform bearing on the insertion. Care shall be taken to avoid damage to the internal surface of the pipes during assembly of the pipeline.

Where loose flanges are welded onto pipelines the relevant pipe section shall be post-weld hot-dip galvanised or otherwise protected as specified in accordance with the relevant corrosion protection specification. Tack-weld final shop applied corrosion protection as specified. Welding procedure and electrodes or wire shall be in accordance with BS 2971 for carbon steel or BS 4677 for stainless steel pipelines.

Where it is no possible to weld from the inside of the pipe, special or fitting, the root run shall be done by argon arc.

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D1.3 Welding steel pipelines

Field welding of steel pipelines of diameter 600 mm or greater shall comply with the relevant requirements of BS 2971 or BS 4677 as applicable, and shall be carried out by welders who are competent in terms of procedure approvals given in BS 2971 or BS 4677 as applicable.

Pipelines less than 600 mm diameter may only be welded in the field provided:

a) the drawings specify a field weld

b) welding can be carried out in clean and protected conditions; and

c) those pipes requiring internal corrosion protection hot dip galvanising or shop applied post-weld heat treatment, are removed to the shop (after site tack welding of the sections) for final shop welding and shop application of the post-weld protection or heat treatment procedures.

The pipe trench for buried welded steel pipelines may be backfilled after, when relevant, completion of radiographic or other specified examinations.

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APPENDIX E: STAINLESS STEEL

Stainless steel piping and fitting for 1,0 MPa systems

ITEM	SIZE RANGE mm	SPECIFICATION	RATING/ WALL THK	END PREPARATION
Pipe	32 to 400 500 to 600	ASTM A 312 Type 304L or 3CR12	10S (ANSI 36.19) 5S (ANSI 36.19)	Plain End
Bend 45	32 to 400 500 to 600	ASTM A 403 Gr WP304L/ ASTM A182-F304-L	10S (ANSI 16.9) 5S (ANSI 16.19)	Butt Weld
Elbow 90 SR Elbow 90 LR	32 to 400 500 to 600 32 to 400 500 to 600	ASTM A 403 Gr WP304L	10S (ANSI 16.9) 5S (ANSI 16.9) 10S (ANSI 16.9) 5S (ANSI 16.9)	Butt Weld
Equal Tee	32 to 400 500 to 600	ASTM A 403 Gr WP304L	10S (ANSI 16.9) 5S (ANSI 16.9)	Butt Weld
ASTM Reducing Tee	32 to 400 500 to 600	ASTM A 403 Gr WP304L	10S (ANSI 16.9) 5S (ANSI 16.9)	Butt Weld
Concentric Reducer	32 to 400 500 to 600	ASTM A 403 Gr WP304l	10S (ANSI 16.9) 5S (ANSI 16.9)	Butt Weld
Eccentric Reducer	32 to 400 500 to 600	ASTM A 403 Gr WP304L	10S (ANSI 16.9) 5S (ANSI 16.9)	Butt Weld
Flange-Slip On Flange-Blind	32 to 600 50 to 600	Mat - BS EN 10028-7	Table 10/3 Table 10/8	
Bolt With Nut & Washer Gasket Ring - 3mm tk		ASTM A193 GR 8 and ASTM A194 Gr 8 SANS 7483/ISO 7483. It is recommended that the selection of gaskets for any particular application is made in consultation with the gasket supplier.		
Cap Cross Coupling Union	32 to 50 32 to 50 32 to 50 32 to 50	BS3799 Table 14 WP304L or ASTM A403, WP 304L BS3799 Table 13 WP304L or ASTM A403, WP 304L ASTM A403 WP 304L BS3799 Table 14 WP304L BS3799 Table 15 WP304L	3000 10S (ANSI B16.9) 10S (ANSI B16.9) 3000 3000	Socket weld Butt Weld Socket weld Socket weld Butt Weld Socket weld Socket weld

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NOTE

a) Where piping in 3CR12 grade steel is specified as an alternative to type 304 stainless steel, it shall be offered as an alternative to the main offer of the type 304 SS, and the offer shall be accompanied by an assurance of its compatibility with the remainder of the system, and the fabricate on techniques available to the contractor for the material and duty.

b) All equal tees, unequal tees, stub-ins or crosses where the minimum branch size is 300 NB or above shall be of gusseted construction.

c) As an alternative to forged equal tees or reducing tees, it is permissible to use welded-on branches fabricated to BS 4677.

Stainless steel small bore piping and fittings for 1,0 MPa or 2,5 MPa systems

ITEM	SIZE RANGE mm	SPECIFICATION	RATING/ WALL THK	END PREPARATION
Pipe	10 to 25	ASTM A 312 Annealed to Max Rockwell B80	10S (ANSI B36.19)	Compression couplings
Elbow 45	10 to 25	Compression fitting type	3000	Compression couplings
Elbow 90	10 to 25	Compression fitting type	3000	Compression couplings
Equal Tee	10 to 25	Compression fitting type	3000	Compression couplings
Reducing Tee	10 to 25	Compression fitting type	3000	Compression couplings
Concentric Reducer	10 to 25	Compression fitting type	3000	Compression couplings
Cap Nipple Cross Socket/Coupling Union	10 to 25	Compression fitting type	3000	Compression couplings

NOTE

1 Use consistent system throughout, based on compression type couplings and fittings in type 304 or 316 stainless steel.

Maximum size required is equivalent to 21.3 mm by 2,0 mm wall thickness, per ANSI B36.19 dimensions 1/4 inch to 1 inch outside diameter with imperial or metric pipe threads may be offered.

2 To suit local availability, piping to ASTM A269 TP 304 to ANSI B36.19 dimension or imperial 1/4 inch to 1 inch outside diameter with imperial or metric pipe threads may be offered.

3 Compression type fittings in type 304 or 316 stainless steel, Gyrolok, Swagelok, Superlok or similar with pressure rating 3000.

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Annex E3

Stainless steel piping and fittings for resin transfer duties

ITEM	SIZE RANGE mm	SPECIFICATION	RATING/ WALL THK	END PREPARATION
Pipe	80 - 100	ASTM A 403 Gr WP304L Smooth internal surface	104mm OD * 2mm thick wall	Plain end
Bend 45	80 - 100	BS EN 10253-3 and -4	5S (ANSI 16.9)	Butt weld
Bend 90 LR	80 - 100	BS EN 10253-3 and -4	5S (ANSI 16.9)	Butt weld
Pulled Bend	80 - 100	From above quality pipe	5S (ANSI 16.9)	Plain end
Equal Tee	80 - 100	BS EN 10253-3 and-4	5S (ANSI 16.9)	Butt weld
Flange Slip On	80 - 100	Mat - BS EN 10028-7	BS EN 1092-1 Table 10	
Bolt With Nut & Washer Gasket Ring-3mm tk		ASTM A193 GR 8 and ASTM A194 Gr 8 SANS 7483/ISO 7483. It is recommended that the selection of gaskets for any particular application is made in consultation with the gasket supplier.		

Notes

a) Unless otherwise stated the inside diameter of any resin transfer pipe shall be of either 80 or 100 mm inside diameter.

Stainless steel grade ASTM 304L shall be used for pipe systems associated with handling resin slurries. The wall thickness shall be a minimum of 1.5 mm with supports designed to adequately support the system without undue deflection when filled with resin and water.

Internal surface of the pipe shall be clean and free from projections. Any weld seams shall be beaded over.

The system will be designed for ease of disassembly in the event of blockage. No lengths of low running pipework will be permitted where resin can accumulate after completion of a transfer operation.

b) Bends shall be of long radius type formed from pipe section. The radius shall be 5 times the pipe inside diameter. Bends shall be flanged at each end.

c) Flanged couplings used shall be of a design which will provide correct alignment and a smooth passage for the resin slurry.

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d) All valves for handling resin slurries will be of the full bore ball type and fitted with a suitable actuator. Internal seals shall be of PTFE and making full contact with the ball. No recess between ball, seat or body is permitted.

e) Pipe systems for carrying resin transfer motive water can be similar to that specified above or rubber lined carbon steel.

If stainless steel is selected the radius of the bends can be reduced to satisfy hydraulic calculation requirements.

f) Sight glasses will be provided at each junction for observation of the resin transfer direction. These sight glasses will be of a design suitable for the maximum hydraulic pressure capable of being supplied by the motive water supply pump or system. Cognisance will also be taken of the operating temperature range between condensate and motive water. The design of the sight glass must permit flexing of the coupled pipes without failure of the glass.

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APPENDIX F

F.1 F1 RUBBER LINED PIPING

Where rubber lined piping is scheduled on the drawings or in the particular specification, the metallic pipe to be lined shall conform to annex A or B, and the rubber lining shall performed in accordance with SANS [76] and Eskom specifications [[112]], using either the lining material given or the duty requirements specified in the particular specification.

The maximum one-piece lengths of pipes and fittings shall not exceed those given in SANS 1198 [76], and in addition pipes shall be short enough to avoid flexing damage of hard rubber linings during storage and transport.

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APPENDIX G

G1. Cast Iron pipes, fittings and specials

Cast Iron pipes and flanged fittings shall comply with the applicable requirements of BS EN 598, -/545 [33][32] and -/969 [34].

Cast Iron fittings and special fittings for use with Fibre Cement pipes shall comply with the applicable requirements

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APPENDIX H

H1 Plastic pipes

Plastic pipes and fittings shall conform to the applicable requirements of the following specifications or standards.

All the SANS Standards published as indicated in the SABS Technical Committee (SABS TC 138/SC 02

Polyethylene (PE) pipes and fittings for water supply

SANS 370, Steel mesh reinforced polyethylene (PE) pipes for water supply

SANS 371, Steel mesh reinforced polyethylene (PE) pipe fittings for water supply

SANS 674, Steel-reinforced spirally wound PE drainage and sewer pipes

SANS 4427/ISO 4427, Polyethylene pipes for water supply-specifications.[86] and SANS 10130 for installation

SANS 4427-1 / ISO 4427-1, Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply - Part 1: General

SANS 4427-2 / ISO 4427-2, Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply - Part 2: Pipes

SANS 4427-3 / ISO 4427-3, Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply - Part 3: Fittings

SANS 4427-5 / ISO 4427-5, Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply - Part 5: Fitness for purpose of the system

SANS 4633/ISO 4633, Rubber seals – Joint rings for water supply, drainage and sewerage pipelines – Specification for materials

SANS 8770, Plastics piping systems for soil and waste discharge (low and high temperature) inside buildings - Polyethylene (PE)

SANS 8772, Plastics piping systems for non-pressure underground drainage and sewerage - Polyethylene (PE)

SANS 10252-2, Water supply and drainage for buildings – Part 2: Drainage installations for buildings.

BS EN 12201-1 to 7, Plastics piping systems for water supply, and for drainage and sewerage under pressure - Polyethylene (PE) - Part 1 to 7

Polyethylene (PE) pipes for the supply of gaseous fuels

SANS 4435, Plastics piping systems for non-pressure underground drainage and sewerage - Unplasticized poly(vinyl chloride) (PVC-U)

SANS 4437 / ISO 4437, Buried polyethylene (PE) pipes for the supply of gaseous fuels - Metric series – Specifications

SANS 4437-1:2014 / ISO 4437- Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) Part 1: General

SANS 4437-2:2014 / ISO 4437-2,

SANS 4437-3:2014 / ISO 4437-3

SANS 8085-2:2010 / ISO 8085-2

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SANS 8085-3, Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels - Metric series - Specifications Part 3: Electrofusion fittings

SANS 12176-1 to 4 / ISO 12176-1 to 4, Plastics pipes and fittings - Equipment for fusion jointing polyethylene systems Part 1: Butt fusion, Part 2: Electrofusion, Part 3: Operator's badge, Part 4: Traceability coding

SANS 14531-1 / ISO 14531-1 Plastics pipes and fittings - Cross-linked polyethylene (CP-X) pipe systems for the conveyance of gaseous fuels - Metric series -Specifications Part 1: Pipes,

SANS 14531-2:2010 / ISO 14531-2, Plastics pipes and fittings - Cross-linked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels - Metric series -Specifications, Part 2: Fittings for heat-fusion jointing,

SANS 14531-3:2010 / ISO 14531-3, Plastics pipes and fittings - Cross-linked polyethylene (CP-X) pipe systems for the conveyance of gaseous fuels - Metric series -Specifications Part 3: Fittings for mechanical jointing (including PE-X/metal transitions)

SANS 14531-4:2010 / ISO 14531-4, Plastics pipes and fittings - Cross-linked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels - Metric series -Specifications Part 4: System design and installation guidelines

SANS 15494:2005 / ISO 15494:2003 (2010-11-26), Plastics piping systems for industrial applications - Polybutene (PB), polyethylene (PE) and polypropylene (PP) - Specifications for components and the system - Metric series

SANS 21307:2011 / ISO 21307, Plastics pipes and fittings - Butt fusion jointing procedures for polyethylene (PE) pipes and fittings used in the construction of gas and water distribution systems

SANS 52842:2007 / EN 12842, Ductile iron fittings for PVC-U or PE piping systems - Requirements and test methods

Polybutylene (PB)

Used inside buildings and not used in this specification.

Polypropylene (PP)

SANS 161-1:1995 / ISO 1873, Plastics - Polypropylene (PP) moulding and extrusion materials Part 1: Designation system and basis for specifications

SANS 161-2:1997 / ISO 1873-2, Plastics - Polypropylene (PP) moulding and extrusion materials Part 2: Preparation of test specimens and determination of properties

SANS 721, Polypropylene (PP) pipes and pipe fittings for soil, waste and vent applications for above-ground use

SANS 8773, Plastics piping systems for non-pressure underground drainage and sewerage - Polypropylene (PP)

SANS 15874-1:2004 Plastics piping systems for hot and cold water installations - Polypropylene (PP) Part 1: General

SANS 15874-2:2004, Plastics piping systems for hot and cold water installations - Polypropylene (PP) Part 2: Pipes

SANS 15874-3:2004, Plastics piping systems for hot and cold water installations - Polypropylene (PP) Part 3: Fittings

SANS 15874-5:2004, Plastics piping systems for hot and cold water installations - Polypropylene (PP) Part 5: Fitness for purpose of the system

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SANS 15874-7:2011 / ISO/TS 15874-7, Plastics piping systems for hot and cold water installations - Polypropylene (PP) Part 7: Guidance for the assessment of conformity

SANS 21138-1 to 3 / ISO 21138-1 to 3, Plastics piping systems for non-pressure underground drainage and sewerage - Structured-wall piping systems of unplasticized poly(vinyl chloride) PVC-U), polypropylene (PP) and polyethylene (PE) Part 1: Material specifications and perfor-mance criteria for pipes, fittings and system, Part 2: Pipes and fittings with smooth external surface, Type A, Part 3: Pipes and fittings with non-smooth external surface, Type B

Acrylonitrile-butadiene-styrene ABS

SANS 7682, Plastics piping systems for soil and waste discharge (low and high temperature) inside buildings - Acrylonitrile-butadiene-styrene (ABS)

Unplasticized poly(vinal chloride) (PVC-U)

SANS 791, Unplasticized poly(vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings

SANS 966-1, Components of pressure pipe systems Part 1: Unplasticized poly(vinyl chloride) (PVC-U) pressure pipe systems (for pressurised cold water systems)or uPVC pipes and fittings shall be fitted with spigot and socket rubber ring joints.

Modified poly (vinyl chloride)(PVC-M)

SANS 966-2, Components of pressure pipe systems Part 2: Modified (polyvinyl chloride)(PVC-M) pressure pipe systems

Other Standards

The standards or specifications to be used for other types of plastic piping or plastic lined steel piping or GRP piping are subject to Eskom approval

H1.2 Jointing methods

H1.2.1 Detachable couplings

Each pipe end shall be thoroughly cleaned by brushing and wiping immediately before the joint is closed. All rubber rings and seals shall be carefully inspected after being placed in position and before the joint is closed, to ensure that they have not suffered any cuts, tears, or other damage, and are not in any other way defective. Only the lubricant recommended by the manufacturer shall be used for pipes. Polyurethane joints for uPVC pipes shall be lubricated with soft soap or similar material approved by the manufacture. Grease derived from petroleum products shall not be used in uPVC pipe joints. A uPVC pipeline shall be jointed in accordance with the manufacturer's instructions. In particular, joints in such pipelines with Cast Iron detachable couplings shall have a gap, after laying and jointing, of approximately 10 mm between the ends of the pipes and central to the collar, for expansion when the pipes are filled and have absorbed moisture

SANS 1671-1, Welding of thermoplastics - Machines and equipment Part 1: Heated-tool welding

SANS 1671-2, Welding of thermoplastics: Machines and equipment Part 2: Electrofusion welding

SANS 1671-3, Welding of thermoplastics - Machines and equipment Part 3: Hot-gas welding

SANS 1671-4 Welding of thermoplastics - Machines and equipment Part 4: Hot-gas extrusion welding

SANS 1671-6, Welding of thermoplastics - Machines and equipment Part 6: Ultrasonic welding, staking and insertion

SANS 10268-1, Welding of thermoplastics - Welding processes Part 1: Heated-tool welding

SANS 10268-2, Welding of thermoplastics - Welding processes Part 2: Electrofusion welding

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SANS 10268-3, Welding of thermoplastics - Welding processes Part 3: Hot-gas welding

H1.3 Installation

SANS 1200 DB, Standardized specification for civil engineering construction Section DB: Earthworks (pipe trenches)

SANS 1200 L, Standardized specification for civil engineering construction Section L: Medium-pressure pipe lines

SANS 1200 LB, Standardized specification for civil engineering construction Section LB: Bedding (pipes)

SANS 1200 LG, Standardized specification for civil engineering construction Section LG: Pipe jacking

SANS 2001-DP1, Construction works Part DP1: Earthworks for buried pipelines and prefabricated culverts

SANS 11296-1, 3 and 4, Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks Part 1: General, Part 3: Lining with close-fit, pipes, Part 4: Lining with cured-in-place pipes.

Note: For installation of piping above or below ground the Manufacturers instruction shall be complied with. Eskom to approve any exceptions from these instructions.

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APPENDIX I

PE Pipe and fittings

ITEM	SIZE RANGE mm	SPEC	RATING/ WALL THK	END PREPARATION
Pipe	16 to 453	SANS 4427	Class 6	Plain End
Elbow 45 SR Elbow 45 SR Elbow 45 MR Bend 45 SR 2 Seg Bend 45 MR 3 Seg Bend 45 LR 3 Seg	16 to 51 16 to 89 61 to 256 61 to 453 61 to 453 61 to 453		Class 6	Comp Coupling Socket Weld Butt Weld
Elbow 90 SR Elbow 90 SR Elbow 90 MR Bend 90 SR 3 Seg Bend 90 MR 4 Seg Bend 90 LR 5 Seg	16 to 51 16 to 89 61 to 256 61 to 453 61 to 453 61 to 453	SANS 4427	Class 6	Comp Coupling Socket Weld Butt Weld
Equal Tee Equal Tee Equal Tee Fabricated	16 to 51 16 to 89 61 to 453	SANS 4427	Class 6	Comp Coupling Socket Weld Butt Weld
Stub Stub	16 to 89 61 to 89	SANS 4427	Class 6	Socket Weld Butt Weld
Concentric Reducer	16 to 51 16 to 89 61 to 453	SANS 4427	Class 6	Comp Coupling Socket Weld Butt Weld
Eccentric Reducer	61 to 453	SANS 4427	Class 6	Butt Weld
Flange-slip On Flange-Blind Shoulder Clamp	61 to 453 61 to 453 61 to 228	SANS 1123 Tab 1000/3 SANS 1123 Tab 1000/8 SANS 815		
Bolt With Nut & Washer Gasket Ring Type CAF 3mm		SANS 1700 GR 4.6		
Cap Barrel Nipple Adapter Male/Female Union Union	16 to 51 16 to 51 16 to 51 16 to 51 16 to 89	SANS 4427 SANS 4427 SANS 4427 SANS 4427 SANS 4427	Class 6 Class 6 Class 6 Class 6 Class 6	Screwed ISO R7 Screwed ISO R7 Screwed ISO R7 Comp Coupling Socket Weld

NOTES

a) A system of stub flanges and backing rings for joining pipes and fittings. Friction type couplings are not acceptable.

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b) The system design shall take thermal expansion of the material into consideration to prevent “snaking” and deflection of the pipe run when under elevated temperatures.

c) Particular attention must be paid to support of the piping. The material manufacturers recommendations must be strictly followed.

d) Before any site or shop welding of components is started the contractor must submit to Eskom proof with relative certificates that proposed welders have been trained in accordance with requirements of DVS 2207 and DVS 2212.

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APPENDIX J

K1 Copper pipes

Refrigerant field service tubing shall be seamless cold drawn copper tubing to ASTM B280-88, or tubing to a similar recognized and Eskom approved standard for refrigeration duty. For small lines up to 12.7 mm OD soft copper tubing with flared fittings shall be used. Where sweated fittings are used, joints shall be properly cleaned and carefully made using an approved silver solder.

For non-refrigerant general purpose duties, copper tubing to BS 2871 shall be used. Copper tubing specifically for domestic plumbing duties shall be to SANS 460. Fittings in both cases shall be of the compression coupling type conforming to 4.5.

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APPENDIX K

L1 Fibre Concrete pipes and specials

Fibre Cement pipes shall comply with the requirements of SANS 1223 [80], and shall be of the pressure class and type Constant outside Diameter or Constant inside Diameter type stated in the particular specification.

Fiber Cement pipes shall be bitumen-dipped if so required in terms of the particular specification. Specials for use with a Fiber Cement pipeline, whether of Fiber Cement, Cast Iron or Steel, shall be rated at not less than pressure rating of the pipeline.

L1.1 Jointing materials

Fibre Cement pipes shall be jointed to each other by means of AC 3-ring sleeve-type couplings complying with the relevant requirements of BS EN 512 [31]. Unless otherwise scheduled or shown on the drawings, Fibre Cement pipes shall be jointed to valves with standard Cast Iron short collar detachable couplings

L1.1.1 Detachable couplings

Each Fiber Cement pipe end shall be thoroughly cleaned by brushing and wiping immediately before the joint is closed. All rubber rings and seals shall be carefully inspected after being placed in position and before the joint is closed, to ensure that they have not suffered any cuts, tears, or other damage, and are not in any other way defective. Only the lubricant recommended by the manufacturer shall be used for pipes. In particular, joints in such pipelines with Cast Iron detachable couplings shall have a gap, after laying and jointing, of approximately 10 mm between the ends of the pipes and central to the collar, for expansion when the pipes are filled and have absorbed moisture

L1.1.2 Concrete spigot and socket pipelines

Where rubber joint sealing gaskets are used in flexible joints of a concrete spigot and socket pipeline, the gaskets shall be installed free from loops and twists and shall evenly compressed around the joint perimeter. The gaskets shall be placed in their designed position and the contractor shall use feeler gauges inserted into the socket to check the positioning of the gasket after completion of each joint.

Subject to the provision of a gap between pipe ends as recommended by the pipe manufacturer, pipes shall be pushed fully home at joints. Particular attention shall be paid to obtaining a smooth continuous bore throughout the pipeline without steps between adjacent pipes.

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APPENDIX L

M1 Concrete pressure pipes

Unless otherwise scheduled, concrete pressure pipes shall comply with the requirements of SANS 676 [66] appropriate to the pressure class stated in the schedule and shall have spigot and socket ends with rubber ring joints or other approved flexible joints.

M1.1 Prestressed concrete pipes

Prestressed concrete pipes shall comply with the requirements of SANS 975 [73] and the nominal internal diameter, the nominal effective length, the hydraulic test pressure, and the proof load shall be as stated in the particular specification. The contractor shall supply the information detailed in accordance with SANS 975 when so requested by Eskom.

Metal couplings of all types and the means used for distributing coupling stresses to the concrete shall be capable of withstanding all stresses caused by proper tightening of the bolts without any sign of cracking or other damage.

M1.2 Construction of chambers

After all items have been tested in accordance with the relevant tests and found acceptable excavations shall be backfilled to the level of the top of the pipe with material selected and compacted as specified in SANS 1200 LB [77].

From this level brickwork or concrete work or precast units, as approved, for each chamber as detailed on the drawings shall be constructed to a height such that the top of the valve, or hydrant surface box is at the level of the sidewalk or street, or at a height 50 mm above ground level in the case of unsurfaced areas. The upper dimensions of the structure shall be such as to fit the base of the box. The surface box shall be grouted to the top of the structure and then the excavation shall be backfill well compacted to the level of the top of the box, which shall be held firmly in position by the fill.

M1.3 Manholes

M1.3.1 General

Each valve of diameter 300 mm and more fitted in a buried pipeline shall be housed in a manhole constructed in accordance with the details shown on the applicable drawings, or as otherwise specified in the particular specification.

M1.3.2 Precast manholes

Precast manholes shall be constructed in accordance with the applicable details shown on the drawings.

M1.3.3 Brickwork in chambers and manholes

Each chamber and manhole shall be built to the details shown on a particular drawing or as shown on the applicable type drawing. The walls shall be constructed in an approved bond comprising header and stretcher courses with the fair face on the inside. No false headers shall be built in and only whole bricks shall be used except where closures are required to form bond. Clay bricks shall be well soaked

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in water immediately before being laid and the course of clay bricks last laid shall be well wetted before fresh bricks are upon it. Concrete bricks shall not be wetted. All walls shall be carried up regularly so that no part of the walling is more than 1,3 m higher than any adjoining wall.

Joints shall be flushed up solid at every course throughout the whole width of each course, which shall be laid on a solid bed of mortar of thickness not exceeding 10 mm, and, when applicable, the joints shall be raked out as the work proceeds to form a key for plaster.

Mortar for brickwork and plaster work shall be composed of one part of cement to three parts of sand. Sand shall be clean pit sand free from clay and other impurities and, if so directed, shall be properly screened and washed.

If required, step irons for a manhole shall be built into the straight sections of the wall at 300 mm intervals staggered right and left in vertical rows. Cast Iron fittings shall be bitumen painted. Each Cast Iron cover and frame shall be grouted solidly onto the shaft. Concrete surrounds of each manhole shall be finished off to suit surrounding surfaces.

M1.3.4 Concrete spigot and socket pipelines

Where rubber joint sealing gaskets are used in flexible joints of a concrete spigot and socket pipeline, the gaskets shall be installed free from loops and twists and shall evenly compressed around the joint perimeter. The gaskets shall be placed in their designed position and the contractor shall use feeler gauges inserted into the socket to check the positioning of the gasket after completion of each joint.

Subject to the provision of a gap between pipe ends as recommended by the pipe manufacturer, pipes shall be pushed fully home at joints. Particular attention shall be paid to obtaining a smooth continuous bore throughout the pipeline without steps between adjacent pipes

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APPENDIX M

N1 Manholes and surface boxes

N1.1 Bricks

Bricks shall be either non-facing extra (NFX) 14 MPa nominal compressive strength, burin clay, or engineering bricks that comply with the applicable requirements of SANS 227, or class S14 calcium silicate bricks that comply with the applicable requirements of SANS 285, or concrete masonry solid face units of 14 MPa nominal compressive strength complying with SANS 1215.

The contractor shall submit to Eskom samples of the bricks that he intends using for the construction of works (see sub clause 4.1 of SANS 1200 A SANS 1200 AA, as applicable). The samples of bricks that are approved will be retained by Eskom.

N1.2 Precast rings

Precast rings may be of spun concrete, Fiber Cement, glass reinforced polyester, or PVC, except particular materials are required in terms of the schedule or the particular specification. Precast concrete rings shall comply with the applicable requirements of SANS 1294. Sectional spun concrete rings shall comply with the requirements for pipes of SC type, Class as specified in the particular specification, of SANS 677. Jointing between rings shall be of the interlocking self-centering type suitable for sealing.

N1.3 Concrete

Except as required in 3.17.7 concrete shall comply with the requirements of SANS 1200 G or SANS GA, as applicable, or the particular specification for concrete works.

N1.4 Concrete casing

Where Eskom requires pipes to be encased, a concrete of strength 15 MPa, or such other strength as is scheduled, shall be used. No part of the concrete casing shall be closer than 150 mm to any flexible joint of a concrete-encased pipeline.

The pipe trench for a concrete-encased pipeline shall be excavated to the depth below the bottom surface of the pipe, as ordered or shown on the drawings, and to sufficient width to allow for the trench shall be trimmed true to line and grade. A light concrete screed shall be placed on the bottom of the trench, concrete saddles or pads of the requisite thickness spaced suitably, and the pipeline laid on them true to line and grade. After being jointed the pipes shall be tested in accordance with the applicable tests given in during testing. After the pipeline has been tested, suitable formwork shall be erected and concrete carefully placed and vibrated in position underneath the pipe and up both sides. The concrete level shall be raised equally on both sides of the pipe until encasement is complete and a cover over the surface of the pipe is provided that is not at any point less than that ordered or shown on the drawings. No earth filling over the concrete shall be commended until at least 7 days after the concrete has been placed or until the concrete has attained strength of at least 10 MPa.

In the case of buried pipeline road crossings, the contractor shall reinstate the road surface after backfilling and compaction in conformance with the road specification.

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N1.5 Step irons and access ladders

Step irons shall be of malleable cast iron complying with the applicable requirements of BS 1247 [23] and of length suitable for fixing in brick, in-situ concrete, or precast concrete, as applicable, and shall be galvanized in accordance with SANS 121.

Where the particular specification calls for access ladders because of manhole depth, those shall be in accordance with Eskom standard drawing 0.00/2901.

N1.6 Manhole covers and frames

N1.6.1 Unless otherwise required in terms of the particular specification, covers and frames for manholes shall comply with the requirements of SANS 558 [65] for Type 2B in the case of manholes in roads and other areas subjects to road traffic roads, and Type 4 in the case of manholes areas not subject to such loads.

N 1.6.2 Covers and frames for manholes shall be supplied in matching sets. The cover and frame of each set shall each bear a serial number (applied by means of an oil paint) to enable the sets to be identified. The contractor shall ensure that, when installed, the covers and frames still comply with the requirements of SANS 558 for freedom from warp and evenness of seating.

N1 7 Surface boxes

Surface boxes may be of Cast Iron or, provided that they conform to the relevant shapes and internal dimensions given in SANS 558, of materials that comply with the applicable requirements of SANS 558 for type 3A in the case of surfaces boxes for gate and scour valves, and for type 5 in the case of surface boxes for hydrants and air valves. All Cast Iron surface boxes shall have been hot dipped in an acceptable bituminous compound before dispatch from the manufacturer's works.

N2 Contractor's equipment

N2.1 Handling and rigging

The plant and rigging equipment used by the contractor for the handling and placing of pipes shall be such that no pipe shell or pipe fitting is over-stressed or damaged, and no coating or paint is damaged during any operation covered by the specification.

N2.2 Setting out

The contractor may use any effective device, including one incorporating a laser beam, to control the alignment and laying of the pipeline so as to meet the specified tolerances.

N2.3 Testing

The contractor shall provide all the equipment, materials, tools, and fittings required for the performance of the tests.

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N2.4 Construction

N2.4.1 Laying of pipes

N2.4 1.1 Damage

Each pipe and each fitting shall be thoroughly cleaned and carefully examined for damage and defects immediately before laying. Should any damaged or defective pipe or fitting be laid, it shall be removed and replaced at the contractor's expense and to the satisfaction of Eskom.

N2.4.1.2 Keeping buried pipelines clean

Every reasonable precaution shall be taken to prevent the entry of foreign matter and water into the pipe system. At the close of each day's work or at any time when work is suspended for a significant period, the last laid section of each of pipe shall be plugged, capped, or otherwise tightly closed until laying is recommenced.

During laying and jointing of pipes and until the pipeline system has/have passed the required backfilled, all trenches shall be kept in a state which, in the opinion of Eskom, is reasonably dry.

N2.4.1.2 Keeping surface pipelines clean

The provisions for keeping surface pipelines clean shall be the same as for buried pipelines above, except that with Eskom's approval, the requirement for plugging, capping or otherwise tightly closing the last laid section at the end of a day's work will not apply.

N2.5 Laying of buried pipelines

N2.5.1 General

A pipeline shall be laid and bedded (see SANS 1200 LB) to even grades and to the levels and alignments shown on the drawings or as directed. It shall be laid centrally in the trench in such a manner that the side allowance conforms to the applicable value specified in clause 8 of SANS 1200 DB. 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, in the case of large pipes, the position of lifting eyes renders this impracticable.

Control of laying and bedding shall be by means of boning rods and sight rails or an acceptable laser beam device. Sight rails shall be painted black and white and shall be fixed securely and accurately.

N2.5.2 Depths and cover

Unless otherwise shown on the drawings, the nominal cover measured from the overt of the pipe shall be 1 000 mm, the minimum cover shall be 600 mm, and the maximum cover shall 1 500 mm.

Pipes shall be laid to even grades with the specified cover. Where so required, the cover may be increased gradually by deflection at pipe joints, but the deflection shall not be greater (and should generally be less) than the deflection recommended by the manufacturer of the pipe (e.g. the deflection shall not exceed 1,5º per joint in the case of Fiber Cement pipes). No deflection is permissible at flanged joints. After laying, the trench shall be backfilled and compacted in layers of not more than 150 mm (after compaction) to a density directed in the civil specification selected for the project.

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N2.5.3 Clearances to other pipes crossing

The minimum clearance between the outside of pipeline being laid and the outside of any other pipe that it crosses shall be 150 mm for pipes up to 500 mm NB, and 200 mm for pipes above 5 00 mm NB.

Where this requirement conflicts with the requirements for cover over the pipeline the contractor shall ask Eskom for written instructions and shall carry out the work in accordance with those instructions.

N2.5.4 Side clearances for pipes in a trench

The side clearance for single pipes in a trench shall be not less than those given in the following table:

PIPE NOMINAL DIAMETER (mm)	SIDE CLEARANCE (mm)
Up to 200	200
200 to 700	300
800 to 1 000	400
1 100 to 2 000	500
Above 2 000	600

If more than one pipe is laid in a trench, the side clearance between any two adjacent pipes shall be the average of the side clearances applicable to each pipe. The base width of the pipe trench and the center-line spacing of the pipes shall be calculated using the above clearances and the pipe nominal diameters.

In the case of a pipe which is to be laid in a trench parallel to an already buried pipe in the same servitude the trench for the pipe shall be so located that 45º slopes from the nearest bottom corners of the two trenches shall not intersect below ground level.

N2.5.5 Concrete spigot and socket pipelines

Where rubber joint sealing gaskets are used in flexible joints of a concrete spigot and socket pipeline, the gaskets shall be installed free from loops and twists and shall evenly compressed around the joint perimeter. The gaskets shall be placed in their designed position and the contractor shall use feeler gauges inserted into the socket to check the positioning of the gasket after completion of each joint.

Subject to the provision of a gap between pipe ends as recommended by the pipe manufacturer, pipes shall be pushed fully home at joints. Particular attention shall be paid to obtaining a smooth continuous bore throughout the pipeline without steps between adjacent pipes.

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APPENDIX N: ESSENTIAL DATA ASSOCIATED WITH SANS 2001

The following sections describe the essential information required when SANS 2001 are applicable. It also contains considerations specific to Low pressure pipelines in Eskom.

N.1 ESSENTIAL DATA ASSOCIATED WITH SANS 2001-DP1

Essential data	Clause number	Consideration
A lot is	3.13	State what a lot is (for example, each trench crossing a road), or omit if not required.
Selected granular material shall be material that has ……..	4.1.1	Omit if default values are suitable and requirements are not shown in the construction drawings.
Selected fill material shall be …….	4.1.2	Omit if default values are suitable and requirements are not shown in the construction drawings.
Concrete shall be grade …… or higher	4.1.4	Omit if default values are suitable and requirements are not shown in the construction drawings.
Backfill in the following areas shall comply with the requirements of 4.1.5.2: …….....	4.1.5.1	Omit if backfill in areas subjected to loads from road traffic only is required to comply with the requirements of 4.1.5.2.
The requirements for the sub-base and base are	4.1.6.1	State requirements for sub-base and base if not specified elsewhere in the scope of work.
Pilot trenches are required as the following services are likely to cross the trench:	4.2.1.2	Omit if not a requirement.
The base width of the trench shall not be less than ..... m.	4.2.2.3.2	Omit if default values are suitable.
The base width of the trench shall not exceed the minimum by more than …..%.	4.2.2.4	Omit if default value is suitable.
The bedding for pipes shall be a class A/B/C/D bedding for rigid pipes/bedding for flexible pipes.....	4.2.3.1.1	Omit if shown in the drawings or specified elsewhere in the scope of work.
The concrete encasement of pipes is required.	4.2.3.8	Identify portions of pipes where concrete encasement is required.
A compacted selected fill blanket shall be placed on either side of prefabricated culverts to a height of not less than …..	4.2.4.3	Insert height as necessary, or omit where default provisions are suitable.
Soft excavation shall be disposed of at ……	4.2.5.3	Omit if unsuitable or surplus soft excavation material may be disposed of along the trench servitude.
Hard excavation shall be disposed of at ….	4.2.5.4	Omit if hard material may be disposed of along the trench servitude.
The requirements of 4.2.6.2 shall apply to ….	4.2.6.2	Omit if 4.2.6.2 shall apply only to areas in addition to those carrying loads from road traffic.
The materials used to make good any settlement defects shall comprise ….	4.2.8.2	Specify material or omit where the default provisions are suitable.
Immediate reinstatement of the bitumen surface is required.	4.2.8.4.3	Omit if immediate reinstatement of the bitumen surface is not required.
The thickness of asphalt is	4.2.8.5.1	Omit if specified elsewhere in the scope of work or in the construction drawings.
The primer and tack coat shall be ……	4.2.8.5.3.1	Omit if requirement for a suitable primer and tack coat is suitable.

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Essential data	Clause number	Consideration
The thickness of the compacted asphalt carpet shall be .....……	4.2.8.5.3.2	Omit if specified elsewhere in the scope of work or in the construction drawings
Testing by means of a dcp is not permitted.	5.1.3	Omit if dpc testing is permitted.
The permissible deviations from OMC and density in the construction of the pipe bedding are .....……	5.2.2.1	Omit if default values are suitable.
The permissible deviations from OMC and density in the construction of the backfill are ….....…	5.2.2.2	Omit if default values are suitable.

N.2 ESSENTIAL DATA ASSOCIATED WITH SANS 2001-DP2

Essential data	Clause number	Consideration
The following types of pipes and associated fittings may be used: …..	4.1.1.1	State the type of pipes and fittings that shall be used and if alternatives are permitted. If particular types of pipes are specified, they should be shown in the drawings. Where they are not shown in the drawings, the permitted types of pipes should be specified, e.g. reinforced concrete pipes. The specifier should confirm with manufacturers that the pipes of the required diameter are available.
The silicon content of pipes that comply with the requirements of SANS 62-1 shall not exceed 0,040 %.	4.1.2.1.1	Omit if default silicon content is suitable.
A certificate that certifies compliance with the requirements of SANS 62-1 and SANS 62-2, as relevant, is required for each consignment of pipes and fittings.	4.1.2.1.3	Omit if not a requirement.
Steel pipes shall a) be a grade A/B/C pipe; b) have a random average length of … m/an exact length of … m; c) have a nominal wall thickness of … mm; d) have plane ends/ends prepared for field welding; e) be such that the height of the inner weld reinforcement does not exceed 1 mm; f) be hot dipped galvanized in accordance with the requirements of SANS 32/ SANS 121/ powder coated internally and externally in accordance with the requirements of SANS 1217/ lined and coated with bitumen coal tar.	4.1.2.2.1	State requirements and preferences for pipes (see SANS 719).
A steel maker's certificate covering all steel used in the manufacture of the pipes is required.	4.1.2.2.2	Omit if not a requirement
Welders shall be assessed as being competent in terms of ……	4.1.2.2.4	Omit if default competence test is suitable; or state what competence test is required.
Fabricated flanged steel pipework shall a) have flanges that comply with the requirements of ……; b) be attached to medium/heavy duty class pipes that comply with SANS 62-1 and SANS 62-2;	4.1.2.3	State requirements for a) flanges, if other than in accordance with SANS 1123, b) class of pipe, where pipes shall comply with the requirements of SANS 62, and c) alternative pipe, weld joint preparation and

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Essential data	Clause number	Consideration
c) be attached to pipes that comply with the requirements of ……; d) have weld joints prepared and configured in accordance with the requirements of ……; e) be welded in accordance with the requirements of …..; f) be of random length/be …. m in length; g) be hot-dip galvanized/coated or lined (or both); h) have the flowing additional markings:…..		configuration or weld specifications, if any. State preferences for lengths, finish and additional markings (see SANS 1476).
Ductile iron pipes shall comply with the requirements of SANS 50598 and shall be supplied a) with flexible/flanged joints; b) in ….. m lengths; c) with an external coating comprising …; d) with an internal coating comprising ….. The coatings for fittings and accessories shall comprise:…..	4.1.3	State the requirements if necessary for a) the joint type, b) length (see SANS 50598), and c) alternative internal/external coatings if not specified in the drawings. Pipes manufactured in accordance with the requirements of SANS 50598 should be used in mains that convey surface water, domestic waste water and certain types of industrial effluents where the pressure does not exceed 6 bar.
Ductile iron pipes shall comply with the requirements of SANS 50545 for a class K9/ class K10/class 40/PN 10/PN 16/PN 25 pipe and shall be supplied a) with flanged / flexible joints; b) in lengths of …..m; c) with an external coating comprising ……; d) with an internal coating comprising …... The coatings for the joint areas shall comprise:……. The coatings for fittings and accessories shall comprise …..	4.1.3	State the requirements, if necessary, for the joint type, class, length (see SANS 50545) and alternative internal/external coatings if not specified in the drawings. Pipes manufactured in accordance with the requirements of SANS 50545 should be used in mains that convey potable water.
Ductile iron pipes shall comply with the requirements of SANS 1835 for a class K9/ class K10/PN 10/PN 16/PN 25 pipe and shall be supplied a) in lengths of …..m; b) with an external coating comprising ….; c) with an internal coating comprising …..; d) with a finishing layer of mean thickness…. Integrally/separately cast samples shall be made. Test method A/B shall be used.	4.1.3	State the specific requirements, as necessary (see SANS 1835).
Reinforced concrete pipes shall a) be provided with spigot and sockets with rolling rubber rings/spigot and sockets with sliding rubber rings/in-the-wall with	4.1.4.1	State requirements if not specified in the drawings (see SANS 676).

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Essential data	Clause number	Consideration
rolling rubber rings/in-the-wall with sliding rubber rings/ogee/butt joints; b) be provided with an effective length of……m; c) have a non-standard cover of ……mm; d) have a pressure class of T2, T4, T6, T8, or T10; e) have a D-load designation of 25D/50D/ 75D/100D; f) have a low content of material insoluble in hydrochloric acid; g) be made using dolomite aggregate/ sulfate-resisting cement; h) have a …. mm sacrificial layer.		
Prestressed concrete pipes shall a) have a length of …….m; b) withstand a hydraulic pressure of ….. bar; c) support a proof load of ….. kN/m.	4.1.4.2.1	State requirements if not specified in the drawings (see SANS 975).
FC pipes shall a) be class A/B/C/D/E/F/6/12/18/24/30/36 pipes; b) be COD/CID pipes (see SANS 1223); c) be supplied in 4 m/ 5 m lengths. The following optional tests shall apply: a) straightness of pipe; b) crushing strength of fittings; c) flexural strength of pipes. FC pipes shall be bitumen dipped in accordance with the requirements of SANS 1223.	4.1.5	State class, type, and preferences for length and joint type, if any, if not specified in the drawings, and state which optional tests are applicable (see SANS 1223). State if pipes shall be bitumen dipped (see SANS 1223).
GRP pipes shall a) have a nominal pressure (PN) class of 2/5/6/8/10/12,5/16/20/25/32/40; b) have a pipe-stiffness (SN) class of 630/1 250/2 500/5 000; c) be evaluated and certified for conveying potable water; d) be supplied in 3 m/6 m/9 m/12 m/18 m lengths. The following optional tests shall apply: a) determination of beam strength; b) additional 48 h test for hydraulic leaks. Unrestrained joints shall comprise a coupling or bell-and-spigot gasket joint/ mechanical coupling with an elastomeric seal. Restrained joints shall comprise a coupling or bell-and-spigot gasket joint/butt joint with laminated overlay/a bell-and-spigot joint with laminated overlay/a bell-and-spigot joint that is adhesive-bonded/a flanged joint, integral or loose ring. The tolerance on the planarity of the flange faces in flanged joints shall be ….. The elastomeric gaskets shall comply with ASTM F 477/SANS 4633.	4.1.6	State nominal pressure class, pipe stiffness class, and other preferences and requirements, if not specified in the drawings (see SANS 1748-1).

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Essential data	**Clause number**	**Consideration**
The additional marking shall be …..		
PE pipes shall a) Have a designation of PE 100/PE 80/PE 63/PE 40; b) have a standard dimension ratio of 6/7,4/9/11/13,6/17/21/26/33/41; c) be supplied in lengths of …..m. PE pipes shall be joined by butt fusion/electrofusion fittings/mechanical joint compression fittings/ push-fit fittings/heated-tool socket weld. Mechanical joint compression fittings shall a) be type 1/type 2; b) be class 1/class 2.	4.1.7.1	State designation of material, standard dimension ratio, pipe lengths and type of jointing, if not specified in the drawings (see SANS 4427-1, SANS 4427-2, SANS 4427-3 or SANS 4427-5). State preferences for jointing systems, if required. SANS 14236 provides for the manufacture of mechanical joint compression fittings to join pipes of an outside that does not exceed 160 mm.
Steel-mesh-reinforced PE pipes shall a) have a PN 10/ PN 16/PN 20/PN 25 nominal pressure rating; b) be supplied in 6 m/8 m/10 m/12 m lengths; c) be joined by means of a flanged connection/ electrofusion connection.	4.1.7.2	State nominal pressure rating and preferences for length and joint type, if any, if not specified in the drawings (see SANS 370).
PP pipes shall be a) type PP-H/PP-B/PP-R; b) class A/B1/B2/C; c) pipe series 5/3,2/2,5; d) colour:…….. e) supplied in straight/coiled lengths of ...m. PP pipes shall be jointed by butt fusion/mechanical joint compression fittings/heated-tool socket weld.	4.1.8	State type of pipe, class, pipe series, colour, pipe lengths and type of jointing, if not specified in the drawings (see SANS 15874-2).
PVC-U pipes shall: a) have a pressure class of 4/6/9/12/16/20/25; b) have a length of …. m; c) have plain ends/one end plain and the other an integral pipe-end socket. PVC-U fittings shall have a pressure class of 4/6/9/12/16/20/25.	4.1.9.2	State pressure class, effective length if other than 6 m, and type of end if not specified in the drawings (see SANS 966-1).
PVC-M pipes shall comply with the requirements of SANS 966-2/SANS 1283.	4.1.9.3	State which standard shall apply to PVC-M pipes.
PVC-M pipes that comply with SANS 966-2 shall a) be ……. in colour; b) have a pressure class of 6/9/12/16/20/25; c) have a length of …. m; d) have plain ends/one end plain and the other an integral pipe-end socket. PVC-M fittings shall be …….. in colour and have a pressure class of 6/9/12/16/20/25.	4.1.9.3	State colour if other than blue, pressure class, effective length if other than 6 m, and type of end, if not specified in the drawings (see SANS 966-2).
PVC-M pipes that comply with SANS 1283 shall a) have a pressure class of 4/6/9/12/16/ 20/25; b) have an effective length of ….. PVC-M fittings shall be plain end couplings/flanged couplings.	4.1.9.3	State pressure class and effective length if other than 6,1 m, and any specific requirements for fittings, if not specified in the drawings (see SANS 1283). State choice of couplings, if relevant.

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Essential data	Clause number	Consideration
PVC-O pipes shall have a) an overall service (design) coefficient of 1,4/1,6; b) a pressure class of 6/9/12/1/20/25.	4.1.9.4	State requirements for overall service (design) coefficient and pressure class, if not shown in the drawings (see SANS 16422).
Metallic compression-type pipe couplings shall a) have a working pressure rating of 1 000 kPa/1 600 kPa/2 500 kPa; b) have a corrosion-resistant coating; c) be designed for the situation where one side of the pipe is not restrained against longitudinal movement.	4.1.10	State requirements for compression-type fittings (see SANS 1808-2).
Valves shall comply with the requirements of SANS 1808-13/ SANS 1808-18/ SANS 1808-31/ SANS 1808-32/ SANS 191/ the relevant part of SANS 664.	4.1.13	State which standards for valves apply. (Confirm that valves are available in the required sizes.)
Diaphragm valves shall: a) be semi-weir/weir/straight-through pattern flanged/screwed body end valve; b) have a nominal pressure of PN 6/PN 10/PN 16; c) have flange dimensions that comply with SANS 1123/EN 1759-3/EN 1092-3/have undrilled flanges; d) have a sealed bonnet/not have a sealed bonnet; e) have hand wheels fitted/be actuator-operated by means of an actuator which allows the maximum differential pressure across the valve and the power supply of …..; f) have anticlockwise closure; g) be supplied with an indicator; h) have the following materials: 1) body: …… 2) body lining: ….. 3) diaphragm: ……. 4) bonnet: …… i) be supplied with a test certificate; j) have the body lining marked; k) be painted; l) have the body ends sealed.	4.1.13.2	State requirements for diaphragm valves (see SANS 1808-13).
PVC-U gate valves shall a) have a design pressure rating of 1 000 kPa/1600 kPa; b) be a stem of the rising/non-rising spindle type; c) have a stem cap that complies with the following: ……..; d) be supplied with a flange thickness of …mm; e) be supplied with a socket with a thickness of …. mm; f) be supplied with an end-threaded connection.	4.1.13.3	State requirements for PVC-U valves (see SANS 1808-18). PVC-U valves shall not be used in waterworks.
Float valves (equilibrium type) shall a) have a working pressure rating of1 000 kPa/1600 kPa/2 500 kPa; b) have an inlet size of ….; c) have a flanged/threaded inlet connection; d) have a flanged/threaded/plain outlet	4.1.13.4	State requirements for float valves (see SANS 1808-32).

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Essential data	Clause number	Consideration
connection; e) have an iron/bronze/stainless steel valve trim; f) be issued with a flow/head loss curve or table.		
Automatic control valves shall a) have a working pressure rating of 1 000 kPa/1 600 kPa/2 500 kPa; b) be coated with a ……/uncoated; c) have an iron/bronze/stainless steel valve trim.	4.1.13.5	State requirements for automatic valves (see SANS 1808-31).
Cast steel gate valves shall a) be class 100/40/25; b) have a rising/non-rising spindle; c) be fitted/not fitted with handwheels; d) have bronze/stainless steel spindles; e) have flange bolt holes in accordance with….. The design of the guides shall be such that the valves may be installed in any position.	4.1.13.6	State requirements for cast steel gate valves (see SANS 191).
Cast iron gate valves shall a) be flanged/ double-spigotted/ double-socketed; b) be class 10/16/25; c) have an inside screw/outside screw; d) have a resilient seal/wedge gate; e) have a stainless steel/copper alloy trim; f) be designed for operation by means of a valve cap/hand wheel/……; g) be clockwise/anticlockwise closing; h) have an O-ring or other pressure-actuated stem seal/a back seating surface in the bonnet; i) have flanges that comply with SANS 1123/ANSI/ASME B 16.1; j) have raised flanges; k) have blank flanges; l) have a position indicator attached to the valve; m) be supplied with a test certificate for each lot; n) have body ends sealed; o) have a metal identification plate.	4.1.13.7	State requirements for cast iron gate valves (see the relevant part of SANS 664).
Inline strainers shall a) have a working pressure rating of 1 000 kPa/1 200 kPa/1 600 kPa/2 500 kPa; b) have a filter element of a suitable plastics material; c) have an aperture area of 30 mm^2/90 mm^2; d) have a head loss across the filter element of ….. and a maximum flow rate of …..	4.1.14	State requirements for inline strainers (see SANS 1808-58).
Mechanical backflow-prevention devices shall a) be a type 1/2/3 device; b) have a working pressure rating of 1 000 kPa/ 1600 kPa.	4.1.15	State requirements for mechanical backflow-prevention devices (see SANS 1808-15).
Underground hydrant valves shall open anti-clockwise. The inlet of underground hydrant valve outlet connections shall be furnished with a fixed/valve. The outlet of underground hydrant valve outlet	4.1.16	State direction of opening if default direction (anticlockwise) is not required.

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Essential data	**Clause number**	**Consideration**
connections shall be of the bayonet/v-thread/round-thread type.		
Portable standpipes shall have an inlet of the bayonet/screw type. The inlets of portable standpipes of the bayonet type shall have mating surfaces. Screw-type portable standpipes shall have a 2 tpi/5 tpi Witworth thread. A portable standpipe outlet connection shall comprise one/two instantaneous connections.	4.1.16	State requirements if default provisions are not suitable.
Above-ground hydrant valves shall open anti-clockwise. Above-ground hydrant valves shall have a) a flanged / threaded valve inlet; b) an upwards oblique/downwards oblique/right angle/straight-through pattern valve outlet; c) an outlet furnished with an instantaneous connection integrally cast with the body/ instantaneous coupling or connection screwed onto the body; d) a gland with packing/O-rings; e) an operating device of the tamperproof key type that has an open/shielded sheath/fixed wheel type/……; f) an outlet coupling and outlet adaptor comprising….. Blank caps shall be furnished for each outlet.	4.1.16	State direction of opening if default direction (anticlockwise) is not required. State requirements if a 65 mm instantaneous outlet connection is not suitable (see SANS 1182).
Masonry units shall have the following attributes:……	4.1.17.1	Omit if default attributes are suitable, or state what the attributes should be.
Precast cylinders shall be of ….	4.1.17.2	If precast cylinders shall be of a specific material, specify material.
Concrete shall be grade…….	4.1.17.3	Omit if default grade is suitable, or state what the grade should be.
Manhole covers and frames shall ……	4.1.17.5 4.1.17.6	Omit if default requirements are suitable, or state what the requirements should be.
Surface boxes, valve chambers and covers and frames shall be ……..colour-pigmented	4.1.17.6 4.1.17.7	State colour pigment (see SANS 1882).
Surface boxes shall be cast iron/polymer concrete.	4.1.17.7	Omit if alternatives are permitted or if requirements are established in the construction drawings.
Polymer concrete valve chambers and fire hydrant boxes shall be heavy duty/medium duty class. The following additional marking information is required:……..	4.1.17.7	State duty class if default duty class is not suitable. State requirements for special lettering or other markings.
The additional corrosion protection measures are the following:…….	4.1.18.1	State additional protection measures, as necessary.
External protection against electrolytic corrosion is required.	4.1.18.2	Omit if not a requirement.
The plastic wrappings shall	4.1.18.2	State the type of wrapping, the material (for types A, C and D only), the nominal width, the nominal

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Essential data	**Clause number**	**Consideration**
a) be a type A/B/C/D wrapping; b) be a PVC/PE material; c) have a nominal width of 50 mm/100 mm/ 160 mm/ 225 mm/ 250 mm/ 300 mm/ 400 mm/ 450 mm; d) have a thickness of …. mm; e) have a resistance to cathodic disbanding of; ….; The quality of the primer shall be …..		thickness (for type D only), the resistance to cathodic disbanding, and the quality of the primer (see SANS 1117).
Bolts and nuts shall be protected with…..	4.1.18.4	State requirements for the corrosion protection of bolts if the default provisions are not suitable.
The depth of excavation of trenches shall not exceed…	4.3.4.1	If the depth of trench excavation is required to exceed 1,50 m and this is not evident from the drawings, indicate a revised maximum depth.
The depth of cover shall not be less than …..	4.3.4.2	State minimum depth of cover if not shown in the drawings. (If no cover is specified, the minimum depth shall be that indicated in SANS 2001-DP1, i.e. 300 mm for rigid pipes and 200 mm for flexible pipes).
Pipes may be hot-bent on site.	4.3.5	Omit if not permitted.
Welders shall be tested and certified in accordance with the requirements of SANS 10269 and shall be in possession of a valid test certificate.	4.4.3.1.4 4.4.3.2.5 4.4.3.3.2	Omit where not a requirement.
Screw threads shall not be cut on PE pipes.	4.4.3.5.1	Omit if screw cut threads are permitted in terms of the default provisions or state which types of PE pipes may be threaded.
The concrete used in anchor or thrust blocks shall be grade ……	4.8.2	Omit if default grade of 15 is suitable, or specify grade.
Masonry manholes shall be plastered.	4.10.3	Omit if shown in the drawings or not required.
The sample of recovered pipes to be pressure-tested shall be…	4.11.5	State if the sample of recovered pipes to be pressure-tested shall be more than 20 %.
The repair of the corrosion protection of pipes, specials and joints shall be as follows:….	4.13	Omit if repairs are permitted in accordance with 4.12, or state that repairs shall not be permitted or provide specifications for repairs.
Radiographic examination of welded joints shall be carried out to the following extent…	5.3.2.2	Indicate the extent to which radiographic examination of welded joints shall be carried out, bearing in mind that, in terms of 5.3.2.1 such joints shall not be subjected to dye-penetrant testing.
The test pressure for field testing shall be…	5.3.3.1.2	Indicate the test pressure for field testing if it shall be other than specified.
Testing of PE/PP pipe assemblies is required. The specific requirements are…..	5.3.4	Omit if not a requirement or specify test requirements.
The following additional adhesion tests shall be carried out on pipelines…	5.3.5.5	Indicate if additional tests are required on pipelines.

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N.3 ESSENTIAL DATA ASSOCIATED WITH SANS 2001-DP6

Essential data	**Clause number**	**Consideration**
The following types of pipes and associated fittings may be used: …..	4.1.1.1 4.1.1.2	State the type of pipes and fittings that shall be used and if alternatives are permitted. If particular types of pipes are specified, they should be specified in the construction drawings. Where they are not shown in the drawings, the permitted types of pipes should be stated The specifier should confirm with manufacturers that the pipes of the required diameter are available.
The silicon content of pipes that comply with the requirements of SANS 62-1 shall not exceed 0,040 %.	4.1.3.1	Omit if default silicon content is suitable.
A certificate certifying compliance with the requirements of SANS 62-1 and SANS 62-2, as relevant, is required for each consignment of pipes and fittings.	4.1.3.3	Omit if not a requirement.
Fabricated flanged steel pipework shall: ……	4.1.3.4	State requirements for flanges if default requirements are not suitable (see SANS 1476).
FC pipes shall …… FC pipes shall be bitumen dipped in accordance with the requirements of SANS 1223	4.1.4	State requirements if default requirements are not suitable (see SANS 1223). State if pipes shall be bitumen dipped (see SANS 1223).
GRP pipes shall ……..	4.1.5	State requirements if default requirements are not suitable (see SANS 1748-1).
PE pipes shall…… PE pipes may be joined by butt-fusion/ electrofusion fittings/push-fit fittings/heated tool socket weld/ mechanical jointing systems.	4.1.6.1	State requirements if default requirements are not suitable (see SANS 4427-2). State alternative means of jointing, if relevant.
Steel-mesh-reinforced PE pipes shall …… Steel-mesh-reinforced PE pipes shall only be joined by means of a flanged connection/electrofusion connection.	4.1.6.2	State requirements if default requirements are not suitable (see SANS 370). State which of the two methods is permitted.
PP pipes shall comply with the requirements of SANS 15974-2, with the following properties ….. PP pipes shall be jointed by butt-fusion/heated-tool socket weld/mechanical fittings	4.1.7	State requirements if default requirements are not suitable (See SANS 15874-2). State alternative means of jointing, if relevant.
PVC-U pipes and fittings shall …… Pipes shall not be joined by means of solvent-weld joints	4.1.8.2	State requirements if default requirements are not suitable (see SANS 966-1). Omit if solvent weld joints are permitted.
PVC-M pipes shall comply with the requirements of SANS 966-2 or SANS 1283.	4.1.8.3	State which standard applies to PVC-M pipes. Omit if there are no preferences.
PVC-M pipes that comply with SANS 966-2 shall……	4.1.8.3	State requirements if default requirements are not suitable (see SANS 966-2).
PVC-M pipes that comply with SANS 1283 shall……	4.1.8.3	State requirements if default requirements are not suitable (see SANS 1283).
PVC-O pipes shall……..	4.1.8.4	State requirements if default requirements are not suitable (see SANS 16422).

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Essential data	**Clause number**	**Consideration**
Copper pipes shall……..	4.1.9	State requirements if default requirements are not suitable (see SANS 460).
Metallic compression-type valve pipe couplings shall be……..	4.1.10	State requirements if default requirements are not suitable (see SANS 1808-2).
Diaphragm valves shall……..	4.1.13.2	State requirements if default requirements are not suitable (see SANS 1808-13).
Float valves (equilibrium type) shall……..	4.1.13.3	State requirements if default requirements are not suitable (see SANS 1808-32).
Automatic control valves shall……..	4.1.13.4	State requirements if default requirements are not suitable (see SANS 1808-31).
Cast steel gate valves shall……..	4.1.13.5	State requirements if default requirements are not suitable (see SANS 191).
Cast iron gate valves shall……..	4.1.13.6	State requirements if default requirements are not suitable (see relevant part of SANS 664).
Copper alloy gate valves shall……..	4.1.13.7	State requirements if default requirements are not suitable (see SANS 776).
Inline strainers shall a) Have a working pressure rating of 1 000 kPa/1 200 kPa/1 600 kPa /2500 kPa b) Have a filter element of a suitable plastics material; c) Have an aperture area of $30mm^2/90mm^2$; d) Have a head loss across the filter element of …… and a maximum flow rate of ……	4.1.14	State requirements for inline strainers (see SANS 1808-58).
Mechanical back-flow prevention devices shall a) Be a type 1/2/3 device; b) Have a working pressure rating of 1 000 kPa/1 600 kPa	4.1.15	State requirements for mechanical backflow-prevention devices (see SANS 1808-15).
Underground hydrant valves shall open anticlockwise. The inlet of the outlet connection of underground hydrant valves shall be furnished with a fixed …/valve. The outlet connection of underground hydrant valves shall be of the bayonet/v-thread/round-thread type.	4.1.16	State direction of opening if default direction (anticlockwise) is not required (see SANS 1128-1).
Portable standpipes shall have an inlet of the bayonet/screw type. The inlets of portable standpipes of the bayonet type shall have mating surfaces ….. Screw-type portable standpipes shall have a 2 tpi / 5 tpi Witworth thread. The portable standpipe outlet connection shall comprise one/two instantaneous connections.	4.1.16	State requirements if default requirements are not suitable.
Above ground hydrant valves shall open anticlockwise.	4.1.16	State direction of opening if default direction (anticlockwise) is not required.

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Essential data	**Clause number**	**Consideration**
Above-ground hydrant valves shall have i) a flanged/threaded valve inlet; j) upwards oblique/downwards oblique /right angle/straight-through pattern valve outlet; k) an outlet furnished with an instantaneous connection integrally cast with the body/instantaneous coupling or connection screwed onto the body; l) a gland with packing/"O" rings; m) an operating device of the tamperproof key type that has an open/shielded sheath/fixed-wheel type; n) an outlet coupling and outlet adaptor comprising….. Blank caps shall be furnished for each outlet.		State requirements if a 65 mm instantaneous outlet connection is not suitable (see SANS 1128-1).
Masonry units shall have the following attributes……..	4.1.17.1	Omit if default attributes are suitable or state what the attributes should be.
Precast cylinders shall be of…..	4.1.17.2	If precast cylinders shall be of a specific material, indicate this.
Concrete shall be grade…..	4.1.17.3	Omit if default grade is suitable or state what the grade should be.
Manhole covers and frames shall ……	4.1.17.5 4.1.17.6	Omit if default requirements are suitable or state what the requirements should be.
Surface boxes and covers and frames shall be …… colour-pigmented.	4.1.17.6 4.1.17.7	State colour pigment (see SANS 1882).
Surface boxes shall be cast iron/polymer concrete.	4.1.17.7	Omit if alternatives are permitted or requirements are established in the construction drawings.
Polymer concrete valve chambers and fire hydrant boxes shall be heavy duty/ medium duty class. The additional marking information required is ……..	4.1.17.7	State duty class if default duty class is not suitable. State requirements for special lettering or other markings.
Meters shall …….	4.1.18.2	Specify requirements for meters.
Markings and marker posts shall ….	4.1.19	State requirements for markings and marker posts.
Pipes shall have a minimum top cover of …..mm.	4.3.6	State minimum cover if default value is not suitable.
Pipes and fittings shall have the following diameters: ……	4.4.1	Omit if shown in the construction drawings or specify diameters.
Pipes may be hot-bent on site.	4.4.8	Omit if not permitted.
Welders shall be tested and certified in accordance with the requirements of SANS 10269 and be in possession of a valid test certificate.	4.5.3.1.4 4.5.3.2.5 4.5.3.3.2	Omit where not a requirement.
Screw threads shall not be cut on PE pipes.	4.5.3.5.1	Omit if screw-cut threads are permitted in terms of the default provision or state which types of PE pipes may be threaded.

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Essential data	Clause number	Consideration
The concrete used in the casing of pipes shall be grade ……..	4.6.1	Omit if default grade of 15 is suitable or state grade.
The concrete used in anchor or thrust blocks shall be grade……..	4.6.3	Omit if default grade of 15 is suitable or state grade.
Valve and hydrant chambers shall be constructed in accordance with ….	4.7	Omit if default requirement is suitable or specify requirements.
Plug-in type ferrules shall be used for service connections in FC pipes.	4.8.2.2.1	Omit if direct tapping of saddles is permitted.
The recording of service connection data is required. The recording of …… is also required.	4.8.2.7	Omit if not a requirement. State additional requirements e.g. co-ordinates
The recording of meter installation data is required. The ……shall also be recorded.	4.9.5	Omit if not a requirement.
The water installation shall be tested and in accordance with the requirements of SANS 2001-DP2.	5.3.2	Omit if the default test provisions are suitable.
Testing of PE or PP pipe assemblies is required. The specific requirements are…..	5.4	Omit if not a requirement or specify test requirements.

N.4 ESSENTIAL DATA ASSOCIATED WITH THIS PART OF SANS 2001-DP8

Essential data	Clause number	Consideration
Pipes shall …….	4.1.1	State requirements for pipes if not in accordance with the requirements of SANS 677.
Concrete pipes shall a) be of the SI/SC type; b) have a diameter of …..; c) be provided with in-the-wall joints with rolling rubber rings/ in-the-wall joints with sliding rubber ring; d) be provided with an effective length of ……m; e) have a non-standard cover of ……mm; f) have a D-load designation of 25D/50D/ 75D/ 100D; g) have a low content of material insoluble in hydrochloric acid; h) be made using dolomite aggregate; i) have a …. mm sacrificial layer.	4.1.1	State requirements if not shown in the construction drawings, as required (see SANS 677). State requirements for joints if not butt-jointed or in-the-wall jointed.
The grout strength shall be ……	4.1.3 4.2.9.1	State requirements for grout strength if not specified elsewhere in the scope of work.
The jacking pits and reception pits shall…..	4.2.8.1	State requirements for backfilling or protection of jacking pits and reception pits if not specified in the construction drawings.
Surplus excavated materials shall be	4.2.8.2	If not specified elsewhere in the scope of work, state

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Essential data	**Clause number**	**Consideration**
disposed of by …….		where excavated materials shall be disposed of.
All the holes in the pipeline shall be sealed with a suitable epoxy sealant or sand-cement mortar.	4.2.9.2	Specify which sealant shall be used.
The tolerances of the jacked pipe shall be……..	5.1	State requirements and tolerances for gradients, if default requirements are not suitable, e.g. where grade is of primary importance, ensure the following: a) The horizontal deviation from the designated line shall not exceed 150 mm. b) At the end, where the jacking forces are applied, the invert of the last pipe shall not differ from the design level by more than 10 mm. c) Provided that the tolerance at the free end of the jacked section shall be plus or minus only in the case of downhill or uphill jacking, respectively (in order to avoid a backfall in connecting manholes or junction boxes), on completion of the jacked section, the invert of the lead pipe shall not differ from the design level by more than the tolerance *d* given in (d) below. d) The level of any joint shall not differ more than the tolerance *d,* given by the following formula, from a straight line between two joints immediately before and immediately after the joint that is being checked for tolerance: $$d = 5 + \frac{L^{1/2} \times D^{1/2} \times S^{1/2}}{10}$$ where d is the tolerance, in millimetres; L is the length between measuring points, in millimetres; D is the normal pipe diameter in millimetres; S is the slope of the pipeline, fall to length.
Variations		
1 Replace … with the following: 2 The provisions of … do not apply.		State variations, as applicable.
Additional clauses		
1 …… 2 ……		State additional clauses, if any.

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