CHAPTER 1: INTRODUCTION

The Western Cape is a region of water scarcity; the average annual rainfall is only 515 mm. Most rainfall is during winter, while the period October-March is the dry (and hot) season. For each dry season the municipality (City of Cape Town, CCT) may implement water restrictions aiming for up to 30% reduction of the consumption. Since 1997 the CCT uses an increasing block tariff (IBT) structure for water pricing. More recently it implemented the national policy of a free provision of basic services, allowing for 6 kilolitres of free water per metered household. According to this policy, the setting of tariffs must ensure both the free water as well as a financially sustainable water supply for the municipality (PDG, 2001), with a budget for the water service set by the CCT.

The delivery of services in urban areas is often more challenging in the formally settled or low-income areas where most of the poor segment of the population lives. Service delivery in such areas is usually far below the minimum requirements of the resident population. These areas lack compliance with building codes and standards.

1. **WATER DEMAND** (CSIR, 2003)

Future water demand is one of the key issues in water supply planning. The following important points regarding the demographic and economic situations determining future water demand should correspond with the contents of the Water Services Development Plan.

The demographic and service information required includes:

- The current population;
- The number of households;
- The number of residential consumer units;
- The incomes related to these consumer units;
- The number and type of non-residential consumer units;
- Current levels of water service;
- Current consumption; and
- The demand of services, in terms of willingness to pay for the services desired.

The information required to make proper projections of future requirements includes:

- Population growth;
- Economic growth;
- Growth in number of consumer units;
- Level of service provided to residential consumer units;
- Changes in income levels of residential consumer units;
- Changes in consumption per consumer unit;
- Effects of water-metering programmes; and
- Weather patterns and climate

1.1. *Estimating Residential Water Demand in South Africa (Cape Town)*

1.1.1. Background

Stand size has been used to estimate residential water demand in South Africa since at least 1979 (Garlipp 1979 cited in Jacobs, Geustyn, Loubser & Van Der Merwe, 2004, p. 2; CSIR 1983 cited in Jacobs et. el., 2004, p.2). At a later stage it was recognised that residential demand estimates should preferably be based on actual water use per town as recorded by the treasurer (City of Johannesburg 1989 cited in Jacobs et. el., 2004, p.2). Guidelines for the estimation of demand base don stand size are however still widely used and promoted (Austin 1995 cited in Jacobs et. el., 2004, p.2; CSIR 2003 cited in Jacobs et. el., 2004, p.2). A guideline based on stand size should only be used when more accurate methods are not available.

Until recent years custom analysis of the data was required, in other words it was not possible to analyse the data programmatically feasible. Treasury systems contain a wealth of information, but closed database structures often obscure knowledge on the actual water demand required for analysis. The past decade has seen software developments that enable engineers to abstract and analyse water demand from treasury database. It has subsequently become possible to abstract and analyse water information from treasury databases for selected municipalities who have employed these software tools. In this manner water demand could be modified more accurately. Results from such studies could also be used to construct guidelines for demand estimation based on stand size as a sole explanatory variable – a model with one explanatory variable, or independent variable, is termed a single coefficient model. Such guidelines can then be used in cases where more accurate methods are not affordable.

1.1.2. Guidelines for Residential Demand Estimation

The construction of three guidelines curves and corresponding envelope curves are discussed separately for three geographic regions and two stand types. When stand size is available as the sole explanatory variable these curves will provide a more accurate water demand estimate than those previously published. In each case the mathematical demand functions as well as the resulting curves are provided for practical application.

If it is assumed that Cape Town, Ekurhuleni and George represent the coastal winter rainfall region, inland summer rainfall region, and coastal annual rainfall region of the country respectively, the following guidelines for demand estimation can be constructed.

- **Coastal winter rainfall region** *(*Jacobs, et. el., 2004, p. 10*)*

Guideline curve – coastal winter rainfall region

Statistical analysis indicates that two linear equations, with separate slopes, best fit the data – instead of a single linear fit. The change in slope could be partly explained by considering the fact that no distinction could be made between townships and suburbs in the data sets of Cape Town. Cape Town, where township-type and suburb-type stands are combined in one datasets, a different slope could be expected above a stand size of approximately 800 m².

Two equations were calculated based on the least squares method for stand sizes 100 m² to 800 m² and 800 m² to 2000 m². The R^2 values of 0,981 and 0,928 respectively for the correlation between the linear equations and the data points are relatively high (a single linear fit was also constructed, but was discarded in favour of the former method, mainly due to the linear curve being less conservative for AADD estimates between stand sizes of 600 m² and 1200 m²). In order to construct a practical mathematical model over the entire stand range the intersection of the curves was calculated. The mathematical form of the guideline curve is presented in Figure 1.1 is:

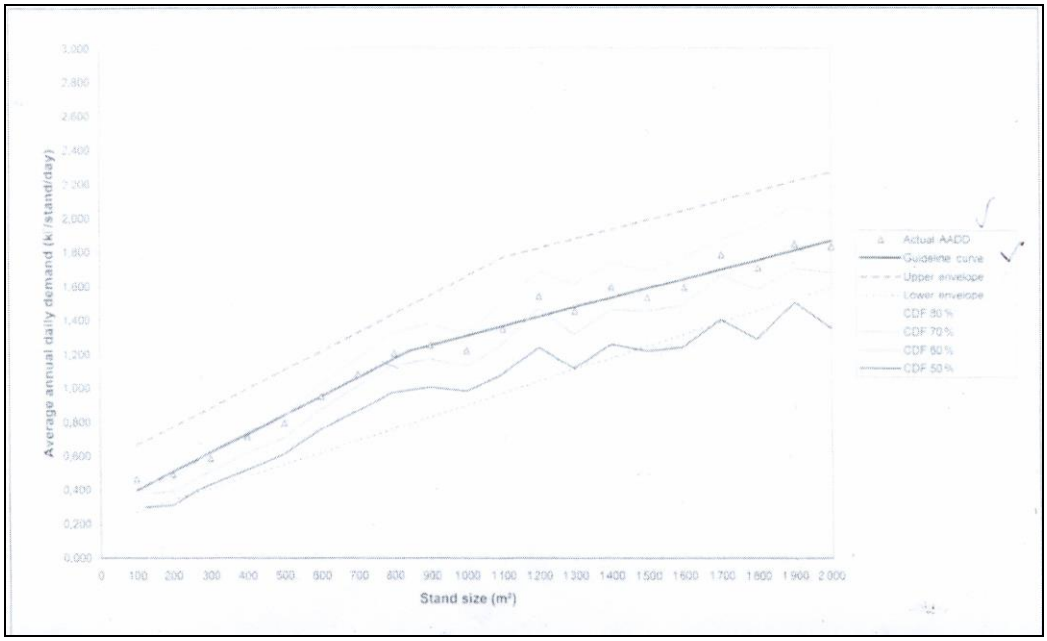


Figure 1.1: Mathematical Form of Guideline Curve

Equation 1: Least Squares Equation: Guideline Curve

Q_v = (0,00110595)*A+0,287 (50 m² ≤ A <840 m²)

(0,00056253)*A+0,745 (840 m² ≤ A < 2050 m²) ……1

When Q = average annual water demand (kl/stand/day)

A = single residential stand size (m²)

And subscript W denotes the coastal winter rainfall region

Envelope curves – coastal winter rainfall region

The upper boundary of the envelope is more critical than lower and was also split into two sections. The same two slopes as in Equation 1 were used, but the two equations were constructed to intersect the highest point of all the individual databases – that for Tygerberg at 1100 m² with an AADD of 1,767 (refer to Figure 1.2).

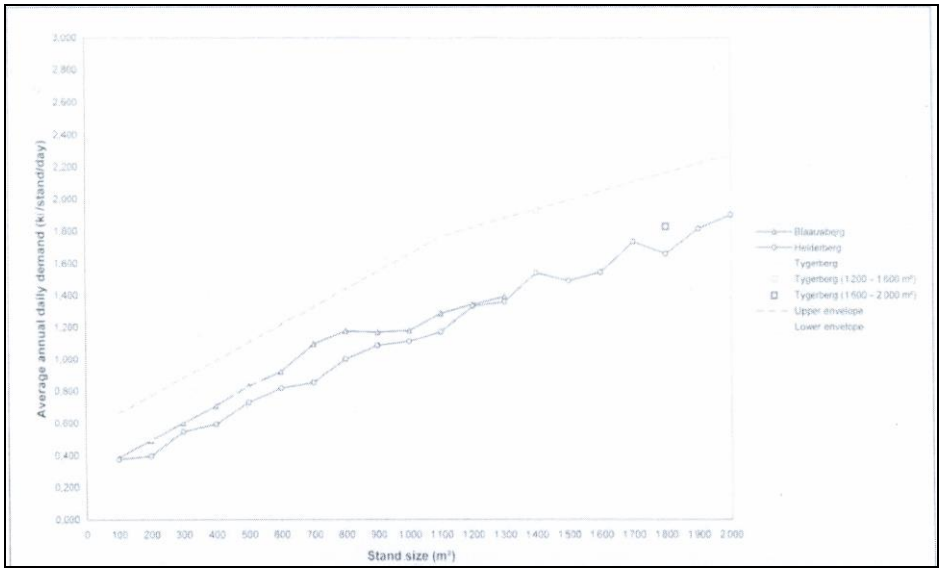


Figure 1.2: Tygerberg at 1100 m² with an AADD of 1,767

The lower envelope follows the slope of the linear trend through the combined Cape Town data, but the intersect of the linear equation was moved down by visual inspection to originate just below the lowest point. The mathematical description of the envelope curve is:

Equation 2: Envelope Curve Equation: $QHIGH_w$

$QHIGH_w$ = (0,00110595)*A+0,551 (50 m² ≤ 1100 m²)

(0,00056253)*A+0,745 (1100 m² ≤ 2050 m²) ……..2

Equation 3: Envelope Curve Equation: $QLOW_w$

$QLOW_w$ = [(0,0007000)*A+0,200 (50 m² ≤ A < 2050 m²)]……...3

Where QHIGH = Upper boundary of the envelope of average annual water demand (Kl/stand/day)

QLOW = Lower envelope of average annual water demand (kl/stand/day)

A = Single residential stand size (m²) and subscript *W* denotes the coastal winter rainfall region

CHAPTER 2: THE WATERBORNE SANITATION SYSTEM

2. SCOPE

GUIDELINES FOR THE PROVISION OF ENGINEERING SERVICES AND AMENITIES IN TOWNSHIP DEVELOPMENTS (THE RED BOOK) ARE TO BE USED AS THE DESIGN STANDARDS EXCEPT IN THE CASE OF THE FOLLOWING SPECIFIC REQUIREMENTS

CHAPTER 10 APPENDIX C: DESIGN CRITERIA FOR THE WATERBORNE SANITATION SYSTEM

2.1. Unit Design Flows

TABLE C1: Average daily flows – Page 29

To be replaced by the following table.

Table 2.1 : Average Daily Flows

Domestic:	Average dry weather flow (ADWF) 160 l/person/dwell/24 h day 5,5 persons/dwelling 880 l/dwell/24 h day
Office/Retail/Commercial	33 kl/ha (of floor area) / 24 hour day
Industrial	Maximum discharge 17,7 kl/ha site area/8 h working day

2.2. Hydraulic Design

Minimum size of main sewers – Page 29

Table 2.2: Minimum size of main sewers

Domestic/Office/Retail/Commercial	150 mm (nominal ID)
Industrial	250 mm (nominal ID)

Table C2: Minimum sewer gradients – Page 29

To be replaced by the following tables:

For 150 mm ID sewers, the following is to apply:

Table 2.3 : Minimum sewer gradients for 150 mm ID sewers

Number of dwellings	Minimum grades
Less than 10	1:90
10 – 80	1:120
81 – 110	1:150
111 – 130	1:180
More than131	1:200

For diameters greater than 150 mm, the following is to apply:

Table 2.4 : Minimum sewer gradients for diameters > 150 mm

Internal sewer diameter (mm)	Minimum gradients
200	1:260
225	1:300
250	1:340
300	1:440
375	1:600
450	1:760
525	1:940
600	1:1080
675	1:1280
750	1:1500
825	1:1770
900	1:1920
975	1:2150
1050	1:2350
1125	1:2600
1200	1:2800
1275	1:3050
1350	1:3300
1425 and greater	1:3550

For internal sewer diameter (private) refer to the Red Book Chapter 10 Table C.2.

2.3. Physical Design

Minimum depth and cover – Page 1730

To read: minimum depth **of** cover.

A. In servitudes - 900 mm

B. In road reserves - 1200 mm

Curved alignment – Page 31

Curved alignment is not permitted.

Siting – Page 32

Sewers are generally to be placed on the road carriageway centreline.

Midblock sewers are not permissible, unless demanded by the local topography.

Maximum permissible depth for midblock sewers is 2,0 metres.

When used, midblock sewers must be protected by means of registered servitudes and accessible for maintenance.

In general the width of servitudes must be twice the depth of the sewer at its deepest point.

Minimum width of servitudes is 3,0 metres.

No large trees with invasive root systems are permitted within 2,0 metres of servitudes.

2.4. Manholes

A. Location and spacing – Page 32

Maximum distance between manholes – 90 m.

Generally, no manholes are to be located on private property, but if required, they are to be placed a maximum of 1,5m from boundaries, but never on a boundary line.

B. Sizes – Page 32

As per SANS 1200.

C. Benching – Page 32

As per SANS 1200.

Dolomitic aggregate and low alkali sulphate resisting cement to SANS 471 shall be used for all benching.

D. Design - Page 32

All manholes to be constructed in accordance with SANS 1200.

Dolomitic aggregate and low alkali sulphate resisting cement to SANS 471 shall be used for all concrete, mortar and screeding.

Alternative materials for manhole covers and frames may be used, providing the cover complies with the strength test as per SANS 558 – 1973.

Polymer manhole covers and frames are commonly used

Covers must be manufactured to fit the existing Cast Iron frame.

Step irons to be or similar, approved by the Municipality.

Pre-cast chimney rings are 260/500mm in height.

PVC splits in manholes are not acceptable.

Use of HDPE anchor knob sheeting should be encouraged

E. Steep drops – Page 32

Steep drops are not permitted.

If external backdrops are required then base of backdrops must be cast monolithically with the manhole base slab. Internal backdrops may only be used in the case of new connections to existing deep trunk sewers.

2.5. Sewer Connections

A. Sizing and Siting – Page 32.

Table 2.5: Minimum size of Sewer Connections

Erf connections

TYPE	SIZE
Domestic/Retail/Office/Commercial	100 mm
Light Industrial	150 mm
Heavy Industrial	200 mm

The following is to be added:

Boundary chambers / rodding eyes are to be placed no further than 1,0m off the street and common erf boundaries.

The position of sewerage connections shall be adequately marked for future location.

Saddles for erf connections are generally not allowed.

Sewers are generally to be placed on the road carriageway centreline.

A. Depth and cover – Page 33

To read: minimum depth **of** cover.

A. In servitudes - 900 mm

B. In road reserves - 1200 mm

B. Type details – Page 33

All connection sewers to be designed in accordance with detail drawings.

2.5.1. Pipes and Joints – Page 33

The following materials may be used:

a. Vitrified clay pipes (SANS 559 Class 2)

b. Fibre Cement pipes, up to 200mm diameter, bitumen dipped, minimum-series 4, with triplex couplings (SABAS 819) (not in industrial areas).

c. Heavy duty uPVC, class 34, (SANS 791) (Not in industrial areas)

d. Structured walled uPVC SANS 1601

e. HDPE (SANS 533-3-1995)

f. Concrete pipes with sacrificial layer (SANS 677 – type SI)

g. Concrete pipes with HDPE Liner

h. Glass reinforced pipe (GRP) complying with SANS 1748.

i. Ductile Iron with epoxy coating SANS.....

CCTV inspections are to be carried out as instructed, when required, on sewer pipelines before final acceptance.

All information on new sewer lines must be provided in electronic format for GIS purposes in addition to hard copies.

All as built information must be supplied in both electronic and hard copy.

CHAPTER 3: STANDARD SPECIFICATION FOR STEEL PIPE, FITTINGS AND SPECIALS

3. SCOPE

This standard covers the manufacture and supply of straight-butt seam or spiral-butt seam electrically welded steel pipe, fittings and specials intended for the conveyance of water in accordance with SANS 719-1971 (as amended), and the following variations and additional requirements.

3.1. Definitions

For the purpose of this standard the following definitions shall apply:

- Approved: approved by the Engineer;
- Contractor: the person, firm or corporation executing the contract to supply the pipe, fittings and specials;
- Council: the Cape Metropolitan Council
- Engineer: the Executive Director : Water and Waste or his authorised representative;
- Fitting: bends, tees, collars;
- Special: any manipulated or fabricated pipe not being a fitting;

3.2. Material

The steel grade shall conform to SANS 719; Grade B or C.

3.3. General Requirements

3.3.1. Supplementary Requirements

Supplementary requirements may be given in the Schedule of Quantities which must be read in conjunction with this standard.

3.4. Dimensional Requirements of pipes

3.4.1. Length

Each pipe shall have the length stated in the Schedule of Quantities and shall not vary from the specified length by more than 50 mm. Fittings and specials shall not vary from the specified length by more than 10 mm.

3.4.2. Diameter

The pipes shall be manufactured in the nominal sizes and with the outside diameters as shown in Table 3.7.

Unless otherwise agreed, the tolerance on the outside pipe diameter for a distance of 300 mm from the end of the pipe using a diameter tape shall be as follows:

- 230 mm nominal diameter and smaller + 1,6 mm - 0,4 mm;

- Greater than 230 mm nominal diameter + 2,4 mm - 0,8 mm.

Over the remainder of the pipe the tolerances shall be as follows:

- 230 mm nominal diameter and less ± (0,01D)mm, D in mm;
  Greater than 230 mm nominal diameter ± (0,005D + 1 or ± 6)mm whichever is less; D in mm.

3.4.3. Out of Roundness

Except where more restrictive tolerances apply, the difference between the maximum and minimum values of the outside diameter of the pipe measured across any plane at right angles to the axis shall not exceed 0,5% of the relevant outside diameter shown in Table 3.7.

3.4.4. Straightness

Pipe walls shall be parallel to the axis within 5 mm for each 3 m in length.

3.4.5. Wall Thickness

The thickness shall not be less than the minimum shown in Table 3.7.

3.5. Dimensional requirements of Fittings and Specials

3.5.1. General

All fittings and specials shall have dimensions in accordance with the requirements of BS 534; 1990, except as hereinafter specified, and shall have the same outside diameters as the corresponding pipes. Except as hereinafter specified, the joints for fittings, etc. shall be of the same steel type as supplied for the pipes.

3.5.2. Bends

Bends shall be fabricated from straight lengths of pipe cut, beveled, shaped and welded.

3.5.3. Reducers

Reducers shall have a diametrical reduction of 50 mm per 300 mm of length of the tapered portion and shall have plain ends 300 mm long, unless otherwise specified in the Schedule. Where required for thrust resistance or specified in the Schedule, they shall also have an anchor ring.

3.5.4. Tees and Crosses

All branches shall be flanged unless otherwise specified in the Schedule of Quantities. For nominal pipe diameters larger than 305 mm, the distance from the centre-line of the main barrel to the mating face of the flange shall be 0,5 x (outside diameter of main barrel) + 500 mm, for branches of 500 mm nominal diameter and smaller and 0,5 x (outside diameter of main barrel) + 1 000 mm, for branches greater than 500 mm nominal diameter. All tees and crosses shall be reinforced in accordance with AWWA Manual M11, 1989.

3.5.5. Scour Tees

Scour tees shall comply with the requirements of Tees except that the branches shall be tangential to the main barrel.

3.6. Joints

3.6.1. Flanges

Flanges shall, except where otherwise stated, be in accordance with Table 3.8 for a maximum working pressure of 1,2 MPa. The jointing material shall comply with the requirements of BS 2494 (as amended).

3.6.2. Welding Collars

Where required in the Schedule, welding collars shall be supplied in accordance with Table 3.9.

3.6.3. Sleeved Joints

Where required in the Schedule, sleeved joints for internal or external field welding shall permit an angular set of 0.5º between adjacent pipes without impairing the efficiency of the joint. The sleeve shall be accurately formed in accordance with Table "3.9" so as to obtain a sliding fit. The maximum clearance over the pipe shall be 4 mm and the minimum clearance 2 mm.

3.7. Fabrication of Steel Pipes

3.7.1. Pipe Ends

The pipe ends shall be square cut, plain ends with all edge burrs removed. The outside of the pipe shall be free of indentations, projections or roll marks for a distance of 250 mm from each end. Longitudinal or spiral welds on the outside of the plain end shall be ground to plate or sheet surface;

3.7.2. Pipe Ends for welding

Where required in the Schedule, the ends shall be beveled for welding as specified in SANS 719.

3.8. Testing

The cost of all specified testing as required in this specification shall be borne by the Contractor.

3.8.1. Hydrostatic Testing

- Before being cleaned, lined or sheathed, all straight pipes, fittings and specials shall be hydrostatically tested, under cover at the Contractor's factory, in a testing machine to a pressure which will stress the steel circumferentially to 85% of its yield stress. Tees shall have their flanged branches closed during this test by means of a bolted-on blanking plate of sufficient thickness to withstand the test pressure.

- The testing machine shall be of a design which will allow a steady application of the test pressure and shall be equipped with an accurate pressure gauge. Provision shall be made for attaching the Engineer's pressure gauge. Provision shall also be made for

expelling all air from any pipe, fitting or special under test during filling and before application of the pressure. Records of all hydrostatic tests shall be kept and submitted to the Engineer prior to delivery of the pipe.

- The pressure shall be steadily applied and be maintained sufficiently long for proof and inspection but in no case for less than three minutes. Each pipe, fitting and special shall withstand this test without showing any leakage, weep, sweat or other defect. Should leakage occur at any weld, such weld shall be repaired in accordance with the specification.

- If required, this test shall be carried out in the presence of the Engineer.

- All pipes, fittings and specials which have passed the hydrostatic test shall be stamped with the Contractor's test stamp. The Engineer may call for the re-testing of any pipe, fitting or special which was not tested in his presence.

- If such pipe, fitting or special passes the re-test, all costs incurred in carrying out the re-testing shall be borne by the Council.

3.8.2. Dye Penetration Testing of Fittings and Specials

- All bends, other fittings and specials whose shape precludes their being tested in terms of Clause 6.2 shall be tested by the application of an approved penetrate dye to all welds. No trace of the dye shall appear on the other side of the weld.

- Defective welds shall be repaired in accordance with the fabrication requirements.
- Fittings and specials which have passed the penetrate dye test shall be stamped with the Contractor's stamp.

- Where fittings and specials tested in terms of this Clause have been manufactured from straight pipe, such pipe, before being cut, shall be hydrostatically tested in accordance with this specification.

3.8.3. Visual inspection

All finished pipes and specials shall be visually examined and shall be free of injurious defects as defined in API 5L section 10.7.

3.9. Cement Mortar Lining and Sheathing

3.9.1. General

All pipes, fittings and specials shall be protected by means of a cement mortar lining and sheathing. These shall extend over the full effective length of each pipe, fitting or special except for those with plain or spigot ends where the sheathing shall cease 300 mm from the plain or spigot end.

3.9.2. Preparation

All pipes, fittings and specials shall be cleaned both inside and outside of all rust, loose mill scale, paint, grease, oil or other foreign matter, including solidified welding material outside of the weld proper.

Cleaning shall be carried out immediately before coating. No cleaned surface shall be left exposed to the atmosphere for a period of more than two hours before coating is carried out.

Every precaution shall be taken to prevent cleaned surfaces from becoming moist or wet. Should this occur, such surfaces shall be thoroughly dried and re-cleaned.

3.10. Cement Mortar Lining

3.10.1. Cement Mortar

The cement mortar shall be composed of Portland Cement in accordance with SANS 471 (as amended), sand in accordance with SANS 1090: 2002 (as amended) and water well mixed and of proper consistency to obtain a dense homogeneous lining that will adhere firmly to the pipe surface. The aggregate to cement ratio shall not exceed 1,5:1 and the water content shall be the minimum consistent with workability and the process used.

3.10.2. Thickness

All pipes, fittings and specials shall have a cement mortar lining which shall have a thickness in accordance with the following table:

Table 3.5: Cement Mortar Lining Thickness

NOMINAL DIAMETER OF PIPE, FITTING OR SPECIAL IN mm	THICKNESS OF LINING IN mm	TOLERANCE mm	MINIMUM BORE mm
100	5	+3 -0	85
150	5	+3 -0	135
230	6	+3 -0	205
305	7	+3 -0	285
306 to 610	10	+4 -0	
611 to 1 220	15	+5 -0	
greater than 1 220	20	+6 -0	

Pipes up to 305 mm nominal diameter shall allow a sphere (with the minimum bore diameter) to roll through under gravity and without hindrance to ensure the minimum bore for the pipe.

3.10.3. Method of Application

- The lining shall be applied to pipes and straight fittings and specials by spinning or other approved method and to fittings and specials whose shapes preclude this method by hand-plastering or other approved process. All water and laitance expelled during the lining operation shall be removed in such a manner that the surface of the lining shall be smooth, straight and true.

- At a suitable time after completion of the lining operation, as determined by experiment, the spun lining shall be given a steel trowelled or smoothing bar finish by skilled workers. A second trowelling may be necessary should the first fail to remove all laitance and produce a smooth hard surface.

- The finished lining shall be dense, firm and adhere rigidly to the surface. The lining shall be tested by lightly tapping the surface with a light hammer. Any pipe, fitting or special where there is no bond between the lining and the steel shall be rejected. Defective lining shall be repaired to the satisfaction of the Engineer.

3.10.4. Reinforcement

The lining of all fittings, specials, make-up pieces (where their length is less than their diameter) and at welded joints of nominal diameter 610 mm and greater shall be reinforced by means of a 50 mm x 50 mm x 2,5 mm diameter wire fabric. All reinforcement shall be tack-welded to the fitting or special in such a manner as to lie within the middle third of the lining.

3.10.5. Curing

3.10.5.1. General

After the initial set has taken place, the mortar lining shall be cured by water or steam as hereinafter specified.

3.10.5.2. Water Curing

- Where water curing is to be used it shall be commenced not longer than twelve hours after completion of the lining. The lining shall be continually sprayed with water by means of approved atomising sprinkler heads, placed inside the pipes, fittings and specials. They shall be so spaced and be of such capacity as to keep the entire surface of the lining continually wet for a period of not less than 96 hours.

- Where exterior sheathing is to be applied after lining, its application shall be commenced not less than 72 hours after completion of the lining and, in this case, water spraying may be interrupted for a maximum of 3 hours for any particular sheathing operation.

- When water spraying is recommenced after sheathing, precautions shall be taken so as to ensure that the sheathing is not damaged by the escaping water. Except for the sheathing operation no pipe, fitting or special shall be disturbed or moved during the curing period.

3.10.5.3. Steam Curing

- When steam curing is to be used it shall be commenced not longer than 8 hours after completion of the lining. The steam shall be introduced slowly and the total surface of the lining kept in contact with moist steam at a temperature of not less than 50°C and not more than 63°C for a period of not less than 14 hours.

- When exterior sheathing is to be applied after lining its application shall not be commenced until after completion of the steam curing.

3.10.6. Exterior Sheathing

3.10.6.1. Cement Mortar

The cement mortar shall be as specified for lining. If the mix is different to that specified, then the proposed mix shall be submitted with the Tender for approval by the Engineer. It shall not be subject to Alkali Aggregate Reaction where the aggregate expands deleteriously (>0,05%).

3.10.6.2. Thickness

All pipes, fittings and specials shall have an exterior sheathing which shall have a thickness in accordance with the following table:

Table 3.6 : Pipes, Fittings and Specials Exterior Sheathing Thickness

NOMINAL DIAMETER OF PIPE, FITTING OR SPECIAL IN mm	THICKNESS mm
Up to 610	20 +3 -0
Greater than 610	25 +6 -0

3.10.6.3. Method of Application

- The mortar shall be applied by an approved method. Fittings and specials whose shape precludes the approved method shall have the sheathing applied by hand plastering or other approved process.

- The finished sheathing shall be dense, firm and adhere rigidly to the surface. Sheathings shall be tested by lightly tapping the surface with a light hammer. Any pipe, fitting or special where there is no bond between the sheathing and the steel shall be rejected. Defective sheathing shall be repaired to the satisfaction of the Engineer.

3.10.7. Reinforcement

The exterior sheathing of all pipes, fittings and specials shall be reinforced by 5 mm diameter steel wire wrapped around the circumference. The wire shall extend over the full length of the sheathing with a maximum spacing of 40 mm. The wire shall be tack-welded to the surface at each end. All fittings and specials whose shape precludes this method of reinforcement shall have their sheathing reinforced in a similar manner to that specified in Clause 7.3.4.

3.10.8. Curing

The exterior sheathing shall be cured in a similar manner to the lining except that the minimum duration of the curing shall be 48 hours and 12 hours for water and steam respectively.

3.11. Protection against Corrosion

Hot-metal sprayed coatings shall be in accordance with SANS 2061 and shall comply with the following;

- The minimum coating thickness for both aluminium and zinc shall be 160μm. Greater thickness maybe specified in Detailed Specification.
- The thickness shall be checked on every surface plane at points not more than 300 mm apart for small articles and 500 mm for large articles. Angles shall be checked along all 4 surfaces, channels along all 6 surfaces, pipes in 4 planes. The minus tolerance on thickness in isolated areas shall also not exceed – 10% and such low areas shall not be larger than 50 mm in diameter.
- The time between surface preparation and coating shall be shortened from 4 hours to 2 hours at any application area closer than 10 km from the coast.
- Unless otherwise specified, all hot-metal coatings shall be sealed and coated immediately after hot-metal spraying. The system shall consist of a low viscosity sealant, which is applied until absorption is complete followed by suitable coating system.

The sealant systems outlined below are acceptable (where appropriate for the particular application).

System 1

Application of an epoxy zinc sealer to a dft of 60μm, (Sigmarite Sealer, or equivalent).

Application of two coats of epoxy pipe coating to a dft (per coat) of 125 μm; (Sigmarite EHB, or equivalent).

System 2

Application of micaceous oxide pigmented polyamide cured epoxy to achieve a dft of 60-80μm; (Sigmarite Sealer, or equivalent).

One coat of solvent borne modified acrylic coating to achieve a dft of 70 μm; (Sigma Topacryl coating, or equivalent).

One coat of solvent borne modified acrylic finish to a dft of 30-45 μm; (Sigma Topacryl finish, or equivalent).

3.12. Marking and Delivery

3.12.1. Marking

- All pipes, fittings and specials shall have the following information stencilled, in black painted characters not less than 40 mm in height, on the inside as close to both ends as is possible and so as to be clearly visible from outside. The paint used shall be non-toxic.
  - the serial number in order of manufacture;
  - the nominal diameter in millimetres;
  - the effective length to the nearest 5 mm;
  - the working pressure in metres head.

- All fittings and specials shall be marked in the same manner with the following additional information:
  - tees: the nominal diameter of the branch in millimeters and its effective length to the nearest 5 mm;
  - bends: the angle of deflection in degrees;
  - reducers: the nominal diameter of each end in millimetres;
  - the tender number.

- The Contractor may place his own name and/or mark or trade mark on all pipes, fittings and specials supplied by him.

3.12.2. Delivery

- Before delivery to the pipe yard, approved internal bracing shall be placed in all pipes, fittings and specials at points of suspension and support used during loading, transportation and unloading. The bracing shall be so designed as to prevent the pipes, fittings and specials from exceeding 0,5% "out-of-roundness" as measured on the diameter and shall have sufficient bearing surfaces to prevent damage to the lining or sheathing.

- All pipes, fittings and specials shall be delivered and stacked by the Contractor at the pipe yard or other site specified in the Schedule of Quantities.

- They shall be neatly and methodically arranged off the ground or as directed by the Engineer and they shall be deemed to have been delivered to the Council as soon as they have been stacked to the satisfaction of, inspected and accepted by the Engineer.

- The minimum rate of and the order of delivery shall be as stated in the Schedule of Quantities.

- Should any pipes, fittings or specials be damaged in any way, and through any cause whatsoever, during delivery and stacking, or should they suffer damage subsequently due to the faulty stacking, such damage shall be made good forthwith by the Contractor at his own expense and to the satisfaction of the Engineer. Alternatively the Engineer shall have the right to reject such pipes, fittings and specials.

Table 3.7: Pipe Details

NOMINAL SIZE mm	OUTSIDE DIAMETER mm	MINIMUM STEEL THICKNESS mm
75	88,90	4,50
100	114,30	4,50
150	165,10	4,50
230	241,30	4,50
305	323,85	4,50
380	393,70	4,50
460	469,90	4,50
535	546,10	6,00
610	622,30	6,00
685	704,85	6,00
760	781,05	6,00
840	863,60	8,00
915	933,45	8,00
1 065	1 092,20	10,00
1 220	1 244,60	10,00
1 370	1 397,00	12,00
1 525	1 613,00	12,00
1 675	1 708,15	16,00
1 830	1 860,55	16,00

Table 3.8: Flange Dimensions For a Working Pressure of 1,2 MPa (Amended August 1987)

1	2	3	4	5	6	7
NOMINAL DIAMETER OF PIPE mm	**DIAMETER OF FLANGE mm**	**DIAMETER OF BOLT CIRCLE mm**	**NUMBER OF BOLTS**	**BOLT DESIGNATION**	**DIAMETER OF BOLT HOLES mm**	**WROUGHT STEEL mm**
75	185	146,05	4	M16	18	12
100	215	177,80	4	M16	18	12
150	280	234,95	8	M16	18	12
200	337	292,10	8	M16	18	15
230	370	323,85	8	M16	18	15
305	455	406,40	12	M20	22	20
380	550	495,30	12	M24	26	22
460	640	584,20	12	M24	26	25
535	735	673,10	16	M24	26	28
610	825	755,65	16	M24	26	32
685	910	844,55	20	M24	26	35
760	995	927,10	20	M30	33	40
840	1 090	1 016,00	20	M30	33	45
915	1 175	1 092,20	24	M30	33	50
1 065	1 335	1 250,95	28	M30	33	55
1 220	1 490	1 409,70	32	M30	33	60
1 370	1 680	1 593,85	44	M45	48	75
1 525	1 855	1 758,95	52	M45	48	80
1 675	2 030	1 930,40	52	M45	48	85
1 830	2 195	2 095,50	60	M45	48	90

NOTE: The above table is based upon BS10: 1962 Table D, for sizes up to and including 1 065 mm nominal diameter, and AWWA Manual M11, for sizes greater than 1 065 mm nominal diameter.

Table 3.9: Welding Collar Details

NOMINAL SIZE mm	INTERNAL DIAMETER mm	WIDTH mm	STEEL THICKNESS mm
230	243,30	100	4,50
305	325,85	100	4,50
380	396,70	100	4,50
460	472,90	100	4,50
535	549,10	100	6,00
610	625,30	100	6,00
685	707,85	150	6,00
760	784,05	150	6,00
840	866,60	150	8,00
915	936,45	150	8,00
1 065	1 095,20	150	10,00
1 220	1 247,60	150	10,00
1 370	1 400,00	150	12,00
1 525	1 616,00	150	12,00
1 675	1 711,15	150	16,00
1 830	1 863,55	150	16,00

WELDING BEAD TO BE GROUND FLUSH ON INSIDE OF COLLAR

CHAPTER 4: STANDARD FOR FIBRE-CEMENT PIPES AND COUPLINGS, STEEL OR CAST-IRON FITTINGS AND SPECIALS

4. GENERAL

4.1. Scope

This standard covers the manufacture of fibre-cement pipes and couplings, steel or cast-iron fittings and specials intended for the conveyance of water.

4.2. Definitions

For the purpose of this standard the following definitions shall apply:

- approved: approved by the Engineer;
- contractor: the person, firm or corporation executing the contract to supply pipes, fittings and specials;
- council: the Council of the City of Cape Town;
- engineer: the City Engineer or his authorised representative;
- fittings: bends, tees, collars;
- a straight pipe of uniform outside diameter;
- special: any manipulated or fabricated pipe not being a fitting;

4.3. Supplementary Requirements

Supplementary requirements may be given in the Schedule of Quantities which must be read in conjunction with this standard.

4.4. Inspection

All work done and material furnished may be inspected by the Engineer during all phases of manufacture and testing, but such inspection shall not relieve the Contractor of his responsibility to furnish material and perform work in accordance with this standard.

4.5. Materials and Workmanship

All work done shall be done by artisans skilled in their trades. All materials furnished and all work done shall meet the requirements of this standard.

4.6. Drawings

Drawings shall be either the Engineer's drawings or the Contractor's drawings approved by the Engineer.

4.7. Description of Pipes, Fittings and Specials

4.7.1. Working Pressure

The working pressure of all pipes, couplings, fittings and specials shall be 1,2 MPa, unless otherwise specified in the Schedule of Quantities.

4.7.2. Pipes

All pipes shall be in 4 m lengths or as per manufacturer's product which generally range from 4 to 6m in the case of PVC (HDPE maybe longer) and shall comply with the requirements of SANS 1223: 1985 for COD pipes.

4.7.2.1. Dipping

- All pipes shall be bitumen dipped unless otherwise specified in the Schedule of Quantities. The bitumen coating shall form an intimate bond with the pipe and shall not peel, flake or disintegrate either when the pipes are stored in the open prior to use or when they are buried in the ground. The coating shall not contain any products obtained from the destructive distillation of coal. The Contractor shall include the cost of bitumen dipping in the prices quoted in his tender.

- If so directed by the Engineer, the Contractor shall colour the coating with an approved colouring matter for identification purposes.

4.7.3. Couplings

All fibre-cement couplings shall comply with the requirements of SANS 1223: 1985 for COD pipes and shall be bitumen dipped as in 4.7.2.1 above.

All mechanical type couplings shall comply with the Council's Standard Specification CE-WS10.

4.7.4. Fittings and Specials

4.7.4.1. Steel

Steel fittings and specials shall comply with the requirements of the relevant clauses of the Council's standard CE-WS11, except that the internal diameters and also the external diameters, within 305 mm of plain ends, shall be the same as for the asbestos cement pipes with which they are to be used. This may be achieved by thickening the lining and/or welding a steel sleeve to the outside.

4.7.4.2. Cast-Iron

Cast-iron fittings and specials shall comply with the requirements of SANS 546: 1977 and shall be cement-lined in the same manner as is required for steel fittings and specials.

No sheathing is required. The outer surfaces shall be protected by the use of approved bitumastic paint.

4.7.4.3. Flanges

Unless otherwise specified in the Schedule of Quantities, flanges for fittings and specials shall be in accordance with Table 3.8.

CHAPTER 5: STANDARD SPECIFICATION FOR GATE VALVES

5. SCOPE

This specification covers the manufacture of cast-iron, cast steel and spheroidal graphite iron gate valves from 50 mm to 300 mm nominal diameter with flanged, spigotted or socketted joints.

5.1. Working Pressures

The valves shall be suitable for working pressures of up to either 1,2 MPa or 2,5 MPa as specified in the Schedule.

5.2. Design

5.2.1. General

The valves shall comply with the requirements of SANS 664: 1989 (as amended) Class 16 Type B, for working pressures up to 1,2 MPa and with the requirements of SANS 191: 1972 (as amended) Class 25 Type B, for working pressures up to 2,5 MPa together with the following additional requirements:

- the ends of the valves shall be flanged, or spigotted, or socketted to suit uPVC pipes, as specified in the Schedule;
- the spindles shall be non-rising;
- the spindles shall be fitted with caps unless otherwise specified in the Schedule;
- the direction of closing shall be anti-clockwise;
- the dimensions of flanges shall conform to the values given in either Table 10.1 attached hereto, for working pressures up to 1,2 MPa, or Table 3.8 attached hereto, for working pressures up to 2,5 MPa and shall be drilled off centre-line;
- the design of all valves shall be such that they may be mounted in any position;
- valves for working pressures above 1,2 MPa shall be fitted with ball-bearing spindle thrust collars;

5.2.2. Wedge Gate Valves

- valves of 225 mm nominal diameter, for working pressures above 1,2 MPa, and all valves of 300 mm nominal diameter shall be fitted with a spur reduction gear having an advantage of not less than 2:1;
- the gate and spindle lugs shall be machined;
- the seat rings shall be pinned;
- the gland packing shall comply with the requirements of BS 4371 Types J, K or L (consisting of virgin Teflon or Aramid fibres), shall be strictly non-toxic and suitable for this application;
- the gland shall be secured to the stuffing box with bronze T-bolts and nuts in accordance with SANS 664: 1989 (as amended).

5.2.3. Resilient seal valves

- The materials for construction shall be

  Body, bonnet, gate - Spheroidal graphite iron and gland to SANS 936 SG38

  Spindle - Stainless steel to BS 970 Part 4: 410S21 or 302S25

  Spindle nut - Aluminium bronze

  Corrosion protection - Internal and external sintered powder epoxy coating in accordance with SANS 1217, Type 2.
- The valve shall have a straight, unobstructed body passage and the gate shall be completely clear of the waterway in the fully open position;
- A double O-ring spindle seal with dirt cover shall be provided;
- An O-ring seal shall be provided between the body and bonnet.
- A backseal shall be provided to permit replacement of the spindle seal with the valve under pressure;
- The seal shall totally cover the gate and be firmly bonded such that it does not become torn, loose or detached and that there is no leakage past the gate during tests or normal operation;
- The valve shall be capable of withstanding a torque of 700 Nm applied to the spindle in both opening and closing directions without damage to any of the components;
- Detailed drawings as well as certification by an independent body of mechanical properties and chemical analysis of components shall be made available upon request.

Table 10.1: Flange Dimensions For a Working Pressure of 1, 2 MPa (Amended August 1987)

1	2	3	4	5	6	7	8	9
NOMINAL DIAMETER OF PIPE mm	DIAMETER OF FLANGE mm	DIAMETER OF BOLT CIRCLE mm	NUMBER OF BOLTS	BOLT DESIGNATION	DIAMETER OF BOLT HOLES mm	THICKNESS OF FLANGE		
						CAST IRON mm	WROUGHT STEEL mm	FORGED OR CAST STEEL (VALVES) mm
75	185	146,05	4	M16	18	19	12	14
100	215	177,80	4	M16	18	19	12	17
150	280	234,95	8	M16	18	21	12	17
200	337	292,10	8	M16	18	22	15	19
230	370	323,85	8	M16	18	22	15	19
305	455	406,40	12	M20	22	25	20	22
380	550	495,30	12	M24	26	25	22	25
460	640	584,20	12	M24	26	25	25	29
535	735	673,10	16	M24	26	35	28	32
610	825	755,65	16	M24	26	35	32	35
685	910	844,55	20	M24	26	35	35	38
760	995	927,10	20	M30	33	38	40	41
840	1 090	1 016,00	20	M30	33	41	45	41
915	1 175	1 092,20	24	M30	33	41	50	44
1 065	1 335	1 250,95	28	M30	33	44	55	48
1 220	1 490	1 409,70	32	M30	33	48	60	51
1 370	1 680	1 593,85	44	M45	48	51	75	
1 525	1 855	1 758,95	52	M45	48		80	
1 675	2 030	1 930,40	52	M45	48		85	
1 830	2 195	2 095,50	60	M45	48		90	

NOTE: The above table is based upon BS10: 1962 Table D, for sizes up to and including 1 065 mm nominal diameter, and AWWA Manual M11, for sizes greater than 1 065 mm nominal diameter.

Revised January 2002

CHAPTER 6: SPECIFICATION FOR WATER METER BOXES AND FITTINGS

6. SCOPE

This specification covers the requirements for metallic and non-metallic boxes and fittings suitable for the installation of water meters of 15 mm, 20 mm, 32 mm and 40 mm nominal bore either singly or in pairs. The meters are not included.

6.1. Material

The boxes shall be of metallic or non-metallic SANS approved, with a lockable but removable lid and be suitable for installation in the footway or lightly trafficked areas. They shall be protected against corrosion. The lids shall be provided with a slot to permit reading of the meter without removing the lid. The boxes shall be provided with bases.

6.2. Fittings

The fittings shall be of brass or approved plastic, shall include a stop valve on the inlet side of the meter and shall be such as to permit of the removal of the meter from the box without the need either to remove the fittings or to disturb the box. Metallic parts in contact with the water shall be manufactured from dezincification resistant brass which, when tested in accordance with ISO 6509: 1981, no individual reading shall show a penetration exceeding 250 □m, two samples being taken from each cast component (one from the thinnest and the other from the thickest part) and one sample from each other component. The inlet and outlet connections shall be threaded internally or externally to ISO 228 to suit the nominal bore of the meter to be installed. The inlet connection of a box for a pair of meters shall be one nominal size larger than the outlet connections and the necessary branch pipe shall be provided.

6.3. Packing

The boxes and fittings shall be supplied completely assembled and ready for the installation of a meter. Adaptors shall be available (but not included) to permit the installation of a 15 mm meter, in a 20 mm nominal bore box.

CHAPTER 7: SPECIFICATIONS FOR ELECTRONIC FLOW LIMITER VALVE FITTED TO METER BOX FITTED WITH WATER METER AND FITTINGS

7. Features

This unit will operate without the requirement for mains power and the volumes of water delivered shall comply with the Water Services Act.

The entire unit (Meter and valve unit) must have a metrology approval from the SABS (NCRS).

- The device/ flow limiter valve must comply with the following general operational criteria:
- The entire unit must be able to be fitted safely in an above ground meter box (surface) or ground level meter box attached to a Class C meter.
- The unit must be able to be interrogated, reprogrammed and audited in-situ via a field service terminal (laptop or hand held terminal)
- The unit must be compatible with any pulse output water meter and fitted with a security Anti-tamper seal and must also be able to function correctly in both the horizontal and vertical positions.
- The valve assembly must be highly clog resistant
- Tempering:
    - The valve must be wholly tamper resistant and the valve is to shut automatically (not immediately) if sensor removed, tampered with or if seal is removed. The valve should be able to shut off at least an hour after any of the above tampering takes place.

7.1. Valve Body

- The valve and body must be waterproof (IP68 submerged), robust, chemical and UV resistant or UV stabilized as in many cases it will be fitted underground. A plastic grade glass filled nylon reinforced to a Pn10 - Pn16 pressure rated. To be available in sizes 15mm, 22mm and 25mm size and specify any other specialised sizes not limited to the mentioned only.
- The valve must be available as a separate unit. The valve body shall have a ¾ inch internal inlet or will vary with the different sizes required and outlet threaded ports.

- Water must be delivered at full bore pressure and not on a trickle flow basis and there must be no change in pressure or flow. The preset volume of water delivered shall not vary with pressure fluctuations with a flow rate range of 25 to 700 litres per hour and a pressure rating of 0.2 bar to 10 bar.

  It must be compatible with a wide range of water meters. Meter information must be able to be recorded on device for electronic and wireless connection information update.

7.2. Meter in Box

- The meter must be assembled inside the meter box along with the unit and a ball-cock on the meter side (before the meter on Council side).
- It must be indicated the method used to connect the unit to the meter and the box.
- Each meter and unit assembly must be pressure tested.
- There must be sliding couplings for ease of installation and removal

  Meter box details:

- Meter box to have fusion welded joints
- Tamper proof locking mechanism (cover)
- Keyed in fittings to prevent meter turning when removing or working with meter
- SABS approved
- Minimum dimensions in order to accommodate the unit with a meter and a ball-cock to be:

  length of 380mm

  width at base of 225mm

  width at top of 180mm

  height of 180mm

  Type of meter attached to unit must conform to the following minimum criteria:

- Class C
- Must have a non-return valve in meter to prevent meters being turned around
- Meter to have an SABS approved pulse output (Meter must be approved to be used when utilising a pulse output, SABS approval)
- Meter to have a wet dial

- Meter to be plastic and conform to the LATEST SABS standards
- Meter must be direct drive – no magnetic interference
- Flow capabilities

7.3. After assembly test

Each unit (meter and flow limiter) to be water tested/pressure tested (certificate of compliance)

7.4. Electronic PCB Controller

- It must be IP 68 sealed for maximum durability with user-friendly Software compatible to be installed on Laptop, Palmtop or any other Field Terminal Device upon approval.
- The communication of the two devices must be a Full 2-way communications. This can be achieved via cable or wireless.

Laptop or field device must have a 6/12 month manufacture on site repair warranty on the software and all hardware related problems. Battery and other power related accessories should have a standardise warranty. Weather resistant covers to be provided by manufacture.

Car chargers to be available and issued as part of the supply (proof of such upon request)

7.5. Software and Operating features

- The software settings must be able to determine the opening time, closing time & daily limit (all daily allocation quantity limits/ settings are to be specified by client and access to the setting to be limited/ password protected and to be client specified) (by complying with the free basic water for all based on a minimum quantity of potable water of 25 litres per person per day or 200 litres per day per household in this case) and data logging of water consumption (Records meter index and event dates).
- Any change in setting must require a password by Authorised users, must be store and reflect when data logging.
- It must have a memory of at least 4/ 12megabytes to store at least 8000 recording/ hourly recordings.

- The unit must contain a full three – month transaction history of quantity of water delivered (Daily, hourly and monthly consumption profile for 90 day period). Data to be converted to PDF files for easy access, sharing and default address file storage.
- The unit must have a built in real-time clock with daily or monthly limitation Any daily unused limit maybe carried over to next day's limit until the end of the month before the next cycle starts, provided that at the end of each month if the user had not exceeded its full allocation it may not be carried over to the next month. Software must be simple to operate and user-friendly.
- Easy to use/ fully automated devices for settings can be considered as part of the proposal, approach and methodology. The programmable settings of the unit must be such that it can be configured to a minimum of 4 different types of settings/ values or as per client (The City of Cape Town Authorised person to give the instruction) (200, 350, 450, full flow or then programmable as per customer specific needs) These should be set at any given setting by authorised personnel. Other additions to each specific software package are to form part of the specifications.
- The Software must be made to be compatible with the City of Cape Town's SAP system for extraction of information and meter audit and water balance.

7.6. Training (Theory and practical on-site)

- Supplier to provide proof of available comprehensive training programme for operational as well as office staff.
- Supplier to indicate accreditation process for training.
- Supplier to provide a process chart that will indicate the monitoring of training undertaken and the criteria for accreditation.
- Supplier to provide an understanding of how the training will be offered to the city (how often, to whom and follow ups).

7.7. Tamper-proof

A built in safety mechanism for all operating system is required.

When the pulse cable has been destroyed or tampered with the device should go into a locked mode, valve closes. Software must then be able to open the valve and setup for normal mode once it has been reported.

This function should is vitally important and should form part of all reporting mechanism (e.g. AMR radio signals or downloading and data logging).

7.8. Display Function

- Unit must have a LCD display.
- Display to have various setups, e.g. Display daily limit consumption, Time - Date, Battery Life, Tampering Date, Error Code. Alarm Tampering. Leak Detection Alarm, AMR settings and more.
- The unit must have the option of an additional display (reflecting the same information as that which is displayed on the unit in the ground, e.g., water that is still available for the day as the water is being used) that can be easily installed inside the home (proof of this to be provided)
- Access/ information display to the home owner must be proposed to archive this function.

7.9. AMR feature

AMR options shall have at least, distance of 0.5km - 1km line-of-sight communication between valve and Field Terminal Device.

Able to change valve settings, download & upload information from valve remotely.

7.10. Battery

Battery life span must at least be between 4-10 years in an enclosed waterproof design (supply proof). The battery is to be a 12v DC type or similar. It must be indicated replacement process of battery. It will be preferable not to replace the entire unit

The integrated unit inclusive of the water meter must carry an SABS approval (Metrology Certification)

7.11. General

Required information from bidder pertaining to the unit

- Historic usage of this same unit within South Africa and within Local Government (proof of this is essential with reference numbers)
- SABS (NCRS) Metrological certificate for the unit as a whole and for the meter individually is essential.
- Statistics relating to supply
- Display unit for inside the house (reflecting information from the unit in ground)

- ISO Certification 9001 for the manufacturing process of the device itself
- Brief write up on company and history of company covering the following:
    a) Number of employees
    b) Factory turn over (production history proof to be supplied)
    c) After sales service and contact details for reference purposes
    d) Comprehensive Training programme related to the unit and all its functionality
    e) Facility for training and maintenance within the boundaries of The City of Cape Town

7.12. Software/ hardware

- All software must be upgradable and enabled to be used as pre-paid.
- Handheld device to be suitable for use on site (Provide sample thereof)
    - Handheld devices for downloading purposes,…are there complimentary items included, please indicate

CHAPTER 8: STANDARD FOR uPVC PIPES AND PRESSURE BENDS AND CAST-IRON FITTINGS AND SPECIALS

8. GENERAL

8.1. Scope

This standard covers the manufacture of uPVC pipes and pressure bends and cast-iron fittings and specials intended for the conveyance of water.

8.2. Definitions

For the purpose of this standard the following definitions shall apply:

- Approved: approved by the Engineer;
- Contractor: the person, firm or corporation executing the contract to supply pipes, fittings and specials;
- Council: the Council of the City of Cape Town;
- Engineer: the City Engineer or his authorised representative;
- Fitting: bends, tees, collars;
- Special: any manipulated or fabricated pipe not being a fitting.

8.3. Supplementary Requirements

Supplementary requirements may be given in the Schedule of Quantities which must be read in conjunction with this standard.

8.4. Inspection

All work done and materials furnished may be inspected by the Engineer during all phases of manufacture and testing, but such inspection shall not relieve the Contractor of his responsibility to furnish material and perform work in accordance with this standard.

8.5. Materials and Workmanship

All work shall be done by artisans skilled in their trades. All materials furnished and all work done shall meet the requirements of this standard.

8.6. Drawings

Drawings shall be either the Engineers drawings or the Contractors drawings approved by the Engineer.

8.7. Descriptions of Pipes, Fittings and SPECIALS

8.7.1. Working Pressure

The working pressure of all pipes, fittings and specials shall be 1,2 MPa, unless otherwise specified in the Schedule of Quantities.
Pipelines and Specs including home leadings should be 1:25. **See page 63**

8.8. Pipes

- The pipes shall comply with the requirements of SANS 966: 1976 Class 12 and shall be in 6 m lengths complete with integral socket and rubber ring seal.

8.9. Fittings and Specials

- Pressure bends shall comply with the requirements of SANS 966: 1976 Class 12.

- Cast-iron fittings and specials shall be cement-lined. No sheathing is required. The outer surfaces shall be protected by the use of approved bitumastic paint.

8.10. Flanges

Unless otherwise specified in the Schedule of Quantities, flanges for fittings and specials shall be in accordance with Table 10.1.

CHAPTER 9: SPECIFICATION FOR SPECIAL STOPCOCKS

9. GENERAL

The stopcocks shall comply with the requirements of SANS 226, as amended, Class 1 except where it is in conflict with this specification.

9.1. End Connections

The stopcocks shall be provided with either female or compression type end connections as specified in the Schedule.

9.2. Spindles

The stopcocks shall be supplied without crutches and the sizes across the flats of the square ends shall be in accordance with Table 11.1:

Table 11.1: Stopcock design specifications

NOMINAL SIZE mm	DIAMETER OF SPINDLE mm	SIZE ACROSS FLATS mm
15	11,10	8,71
20	12,70	8,71
25	12,70	8,71
32	14,27	8,71
40	15,88	12,70
50	17,45	12,70

CHAPTER 10: SPECIFICATION FOR DUCTILE IRON SADDLES

10.1. GENERAL

The saddles shall be manufactured in ductile iron in accordance with SANS 509 (as amended) and shall conform to the dimensions as shown on attached drawing number W4-G-004.

The saddles shall be machineable and free from blowholes, pitting, sand or any other injurious defects. The malleability of the complete fitting (bolted together) shall be tested in accordance with SANS 509 - 7.4.

- The saddles shall be suitable for use on Constant Outside Diameter Class "D" Asbestos Cement Pipe manufactured in accordance with SANS 1223 or uPVC Class 12 pipe manufactured in accordance with SANS 966 and shall be designed so as to permit tapping of the water main under pressure with a Talbot or similar tapping machine.

- The bolts and nuts shall be of electro-galvanized mild steel having an ultimate tensile strength size from 15 mm to 40 mm (½ B.S.P. to 1½" B.S.P).

- The saddle pieces shall be supplied complete with the base sealing gaskets as detailed and in accordance with SANS 564 (as amended). Where required in the Schedule, the saddles shall be drilled to any size from 15 mm to 40 mm (½ B.S.P. to 1½" B.S.P.).

CHAPTER 11: STANDARD FOR PLUMBING MATERIAL IN LOW COST HOUSING PROJECTS

11.1. General

The suitability of plumbing materials in low cost housing units has to be viewed from the perspective of pricing, its water saving capabilities, durability and the risk of it being stolen for its scrap value.

An important item, although not material related, is the location of water meters in low cost housing schemes. Often, where the meter is located on lot, accessibility for reading purposes is compromised when occupants later erect high fences, for security reasons. The best position for the meter is outside the property, in an undercover location on the footway or vertically mounted against the dwelling very effective for low coat housing.

11.2. Material

It should also be borne in mind that all materials must comply with the relevant SANS/JASWIC (Joint Acceptance Scheme for Water Installation Components) standards. This is a requirement of our Water Services by-law. However, provision has been made in the by-law for Council to use pipes, fittings and other plumbing components, which are not on the Jaswic list, should this be required in order to evaluate the suitability of new materials for specific applications.

11.3. Pipes and piping systems for underground use in the supply of potable water.

An important part in the installation of water pipes in underground locations is the condition of the soil in which the pipe is to be laid. If it is contaminated with chemical substances, this could affect the durability of the pipe. It would also determine the material of which the pipe is manufactured. Popular piping systems are:

11.3.1. Copper

Copper pipe is historically the preferred material in the Cape Town region. It is available in 3 classes, namely: class 0, class 1 and class 2. For underground use, only class is allowed, because of its thicker wall. Class 2 pipe is however, much more expensive than the other 2 classes. Copper pipe should not be laid in soil that contains ash, salt and chemicals such as ammonia and magnesite. These substances will cause ‘pitting’ of the wall of the pipe.

11.3.2. Polypropylene (polycop)

This type of 'plastic' pipe is very popular for underground use. The Water Services Hillstar depot has been using it for the installation of new water connections, ranging in size from 20mm to 50mm, since approximately 1992, and it has proven to be very reliable. The brass 'Conex' fittings could prove to be expensive, especially in the larger sizes. It should not be laid in soil that is contaminated with petrol, oil and a number of other chemicals. These chemicals permeate through the wall of the pipe, resulting in bad taste and smell in the drinking water. In such cases, the only solution is to replace the pipe with class 2 copper, since the smell and taste lingers and cannot be eliminated from the plastic pipe. This condition affects all pipes and fittings manufactured from plastic polymers, and is therefore not only restricted to polycop piping.

For this reason, in the case of plans approval for a service station, we call for copper pipe to be used in both above ground and underground applications in the forecourt area, where invariably spills of oil/petrol will take place.

It is imperative that only SANS approved, class 16 polycop pipe is used. It has been found that the lighter class 12 pipe is not so durable.

11.3.3. HDPE (high density polyethylene)

This plastic pipe has also gained popularity for underground use. The 'plasson' fittings are quite bulky. Personal experience has shown that with age, underground leaks tend to be problematic. This is found to be the case, when we have to process rebate claims for underground defects on private properties. It has also been found that moles have a special affinity for these pipes, and many an underground leak is due to a hole having been gnawed into the pipe. Chemical contamination in underground use also presents a problem.

11.3.4. Other types of 'plastic' pipes

There is a host of other 'plastic' pipes and pipe systems for potable water installation on the market. Of late, these include composite pipes, which combine layers of plastic and Aluminium to form a tube. The problems with many of these systems are that special tools are required to facilitate its installation, and that the fittings are not always readily available. Compatibility between different systems is also a problem.

11.3.5. Galvanised mild steel pipes

It should be noted that in line with our Water services by-law, galvanised mild steel pipes and fittings are not allowed to convey water supplied from the Municipality's mains.

This is because our water is only chemically stabilised for copper systems. It is also 'soft' and therefore aggressive in nature, and reacts with other metallic pipes, such as galvanised steel and Aluminium. In the case of G.I. pipes, serious encrustation forms on the inside of the pipes, thereby diminishing its bore. This eventually causes poor supply pressures and restricted flows from terminal fittings.

11.4. Pipes and piping systems for above ground use.

According to the Red Book pipes may have to be above ground due adverse conditions, such as rock. When considering laying pipes above ground, the following factors need to be taken into account:

- Provision should be made for expansion (the effects of thermal changes must be considered).
- Each pipe section should be properly supported. The supports should be designed to carry the load of the pipe as well as the water it conveys. Sufficient support should be included in order to prevent sagging of the pipeline. The pipe should be strapped to the support, leaving room for movement.
- Adequate thrust blocks should be designed to cater for hydraulic forces at bends.
- Adequate anchoring should be provided, especially in steep slopes, and directional and elevation changes.
- The consequences of pipe failure should be evaluated.
- Heavy equipment like valves should be supported independently.
- Adequate protection should be provided to cope with external abrasion.

11.4.1. Material used for piping system above ground

All the previously mentioned pipes, except for galvanised mild steel pipes, can be used in above ground installations.
However, in certain applications, additional conditions have to be met.

11.4.1.1. Copper

All 3 classes can be used above ground. Class 0 is an extremely hard, thin walled pipe, which should not be formed into ‘labour bends. Because of its hardness, compression fittings should also not be used. Any change of direction in the piping system, should be achieved by the use of ‘copcal’ capillary soldered fittings. A full range of tee-pieces and bends, of various angles, is provided for this purpose. Class 1 pipe has a thicker wall than class 0, and is in turn thinner walled than class 2. Both classes 1 and 2 can be formed into ‘labour’ bends, which reduces the need for a fitting, saves time during installation and gives improved flow.

Brazing (hard soldering) of copper pipes is not allowed. Although copper pipe systems are durable and very popular with plumbers, in above ground applications it is prone to theft. This can be problematic in low cost housing, where we have experienced in certain instances that the occupants of the house have in fact removed brass and copper from the plumbing system, to be sold as scrap.

In its effort to avoid this type of behavior, the maintenance section of Housing Department is investigating the use of an ‘all plastic’ threaded type of piping system. Copper systems are also more expensive than comparable plastic pipe installations. Some ‘plastic’ pipes have conditions imposed when used in hot water installations. Others are only compatible with cold water. None of the ‘plastic’ pipes in use at present is approved for use in fire and combined fire/domestic installations in above ground locations, due to its combustibility. Should a pipe rupture during a fire, it would result in severe pressure loss, rendering the fire-fighting system ineffective. For this reason only copper and black steel piping can be used in above ground locations in fire-fighting installations.

11.4.2. Taps and Stopcocks

It is noted with concern that all the less expensive chrome plated taps for kitchen sinks and wash hand basins have spouts that cannot accommodate a water saving aerator. This device is only catered for, on the more expensive models. An in-line flow controller, supplying less than 6 litres per minute installed in the supply line to the tap, should solve this problem. This would also conform to the by-law’s requirement that a basin tap should not discharge more than 6 litres per minute.

Ball valves (‘ballostops’) should be used in place of stopcocks, since they are less expensive and also have better flow characteristics.

In the case of outside garden taps, a plastic tap would be most suitable, since it doesn't represent much in terms of scrap value. 'Colour Taps' has such a product on the market, but currently it is not JASWIC approved. Council can permit it to be installed, without JASWIC approval, as per the provision of the by-law, but experience has shown that in normal use as a garden tap, it is not very durable.

Perhaps, better location of a brass garden tap, would prevent theft.

11.4.3. Water closet cisterns

There are various models of w/c cisterns on the market. One of the most suitable for low cost housing, is the 9 litre 'Shires' duranite unit. It is available for both "low level" and "high level" applications. It is extremely rugged in construction and is fitted with a dual flush siphon valve. This type of flushing mechanism does not cause water to trickle (leak) into the pan when the system is not in use. This problem is normally experienced with the type of flushing valve that employs a flapper rubber to seal off the water at the bottom of the cistern.

This leakage can be a tremendous source of wastage, since it normally carries on around the clock, until it is repaired. This type of wastage would normally go undetected in low cost housing units. Another one of this cistern's positive features is a plastic float valve with an Aluminium arm. Brass float valve arms are normally removed and sold for its scrap value. The diaphragm fitted to the siphon normally lasts for more than 5 years before a replacement is required. With this type of cistern an external overflow pipe is installed. Any overflow of water from it due to a defective float valve would be readily discernible, whilst this will not be the case with a 'flapper' rubber type valve, which has an internal overflow, as an integral part.

11.4.4. Hot water cylinders.

If there were sufficient height for its installation, a copper tank combination (gravity feed) hot water cylinder would be the best option for low cost housing.

This type of cylinder has a float valve, similar to the one installed in the w/c cistern, and therefore its maintenance is minimal. However, because it is an 'open to the atmosphere' system, heat loss is experienced. This results in slightly higher electricity bills. This 'open' system places little strain on the inner tank, and consequently this type of cylinder should last indefinitely. Where the plumbing design cannot accommodate a combination hot water cylinder, a pressurised system will have to be installed.

The 100, 200 and 400 kPa copper tank cylinders are the next best options. Some 400 and 600 kPa units have galvanised steel inner tanks, and these require a sacrificial anode to protect it against the corrosive effects of the aggressive soft water, being supplied by Council. This anode has to be inspected regularly and replaced when this becomes necessary. This operation adds to the maintenance costs of the cylinder. With the copper tank cylinders, this is not required.

The lower delivery pressure of the 100 and 200 kPa copper tank cylinders, also contributes to saving of water, since this equates to lower flow rates at terminal fittings. Both types of pressurised hot water cylinders require a pressure reducing valve, a pressure relief valve (sometimes the two are combined), a temperature and pressure safety valve and 2 vacuum breakers. This increases the installation and maintenance costs, when compared with the combination hot water cylinder.

Due to pressure variations being exerted on the inner tank of a pressurised hot water cylinder, these units normally do not last as long as a combination hot water cylinder. Galvanised tank cylinders have been known to rupture after only 2 years in service. Brazing can usually repair the copper tank cylinder, whilst a defective galvanised steel tank cylinder will have to be discarded, if the tank has ruptured.

CHAPTER 12: STANDARD SPECIFICATION FOR THE LAYING OF SMALL DIAMETER WATER MAINS (50mm to 380mm Nominal Diameter)

12.1. WATER MAINS: PIPES, SPECIALS ETC. SUPPLIED BY CONTRACTOR

12.1.1. General

The Contractor shall supply all pipes, specials, valves, hydrants, surface boxes, jointing material and all other material necessary for the construction of the water mains and pipework.

12.1.2. Jointing Material

All pipes, valves and specials shall be supplied complete with all necessary jointing material, including rubber rings, bolts, nuts, washers, couplings, packing and jointing compound, depending on the type of joint to be supplied.

The cost of supplying all jointing materials shall be deemed to be included in the price tendered for the pipes, valves and specials in the Schedule of Quantities, unless otherwise specified and scheduled.

Jointing material for flanged joints shall comply with the requirements of SANS 564, and the Tenderer shall state when tendering, the type of material offered.

Rubber joint rings shall comply with SANS 974: Part 1. Bolts and nuts for mechanical joints shall comply with SANS 136.

12.1.3. Flanges

Unless otherwise specified, all flanges shall be drilled off centre in accordance with Table 7.1 attached hereto.

12.1.4. FC and uPVC Pipes and Specials

All saddles shall comply with CE-WS4.

Fibre-cement pipes shall comply with the requirements of the Council's Standard Specification CE-WS13.

Fibre-cement bends are not permitted.

uPVC pipes, fittings and specials shall comply with CE-WS27.

12.1.5. Steel Pipes and Specials

Steel pipes and specials shall comply with the requirements of the Council's Standard Specification CE-WS11.

12.1.6. CI Pipes and Specials

Cast-iron pipes and specials shall comply with the requirements of the relevant Standard Specification, as follows:

Ductile iron pipes and fittings	BS 4772
Cast-iron flanged pipes and specials and flanged fittings	BS 2035
Cast-iron fittings for fibre-cement pressure pipes	SANS 546

All cast-iron pipes, specials and fittings shall be protected by coating externally and internally as specified in the Council's Standard Specification CE-WS11.

All specials and fittings shall be provided with joints or suitable adaptors to match the pipes offered.

12.1.7. Concrete Sleeve Pipes

All concrete sleeve pipes shall be reinforced, centrifugally spun with Ogee or other approved type ends and shall conform to the requirements of SANS 677 Class A.

12.1.8. Valves

12.1.8.1. General

All valves shall be of sound construction and of approved design and manufacture.

All valves shall be coated with an approved protective coating as specified.

All valves shall be supplied complete with the necessary adaptors to match the joints on the type of pipe offered.

All control valves of 300 mm diameter or less shall be of the sluice valve type and all control valves greater than 300 mm diameter shall be of the butterfly type.

12.1.8.2. Gate Valves

All gate valves shall comply with the requirements of the Council's Standard Specification CE-WS15.

12.1.8.3. Butterfly Valves

All butterfly valves shall comply with the Council's Standard Specification CE-WS1.

12.1.8.4. Air Valves

Air valves shall be either single ball or double ball type as specified in the Schedule and shall comply with the requirements of the Council's Standard Specification CE-WS20.

12.1.8.5. Check Valves

Check valves shall comply with the requirements of CE-WS5.

12.1.9. Fire Hydrants

Hydrants shall conform to the requirements of the Council's Standard Specification CE-WS8.

All hydrants shall be supplied with 100 mm diameter flanged steel extension pieces. The lengths of the extension pieces shall be such that the top of the hydrant outlet shall not be more than 400 mm below the top of the hydrant surface box.

The flanges shall be drilled to match the hydrant tees and hydrants, and the extension pieces shall be supplied complete with galvanised steel nuts, bolts and washers and with flange packing.

12.1.9. C.I. Surface Boxes

C.I. surface boxes for valve and hydrant chambers shall comply with the requirements of SANS 558 and shall be bitumen coated as specified therein.

Types, as detailed in SANS 558, shall be as follows: Sluice Valves: Type 3B unless otherwise specified. Air Valves: Type 5 or larger as required to suit valve. Hydrants: Type 5.

12.2. WATER MAINS: PIPELAYING

12.2.1. Handling of Pipes etc.

Proper vehicles, plant, implements, tools, machinery, slings, equipment and other facilities shall be provided and used by the Contractor, to the satisfaction of the Engineer, for the safe and efficient handling of all pipes, specials, valves and fittings. Vehicles shall be driven at a speed which will avoid damage to the material being transported.

All pipes, specials, valves and fittings shall be handled with care at all times. Under no circumstances shall pipes or accessories be dropped or dumped.

12.2.2. Laying of Pipes: General

Immediately before being laid each pipe, valve, special and fitting and all jointing material shall be thoroughly cleaned and carefully examined both inside and outside for possible damage. The onus for detecting damage shall be on the Contractor.
No water from the trench shall be allowed to enter any pipe, valve, special or fitting. The Contractor shall ensure that no dirt, stones or other foreign matter enters or is left in the pipeline.

All valves, specials and fittings shall be correctly set in position and supported as the work proceeds and shall be jointed in the same manner as specified for pipe jointing.

Pipes shall be laid and jointed singly, and shall fit concentrically bore to bore. They shall be properly and evenly bedded so that the barrel of the pipe is evenly supported throughout its length on the bottom of the trench. No weight shall be carried by the joint. Each pipe shall be firmly bedded before backfilling is commenced.

Where curves are shown on the drawings, the pipes shall be laid to such curves in smooth arcs. Pipes shall not be deflected in any direction more than the limits recommended by the manufacturer.

The pipes shall generally be laid with a cover of 1 m. To avoid other services the cover may be gradually increased or decreased to a minimum cover of 0,9 m and a maximum cover of 1,2 m. Steel units manufactured in accordance with CE-WS11 shall be used where it is necessary to cross other services at depths outside these limits.

Any variations in the cover of 0,9 m to 1,2 m shall be brought to the attention of the Engineer and shall have his written approval.

All specials shall be placed in the exact position shown on the drawings and pipes shall be cut as necessary.

12.2.3. Laying of pipe: Bedding, backfilling and compacting

The pipes shall be placed directly on an approved trench bottom after this has been hand-trimmed to ensure that the pipe will be supported throughout the length of its barrel. Joints holes shall be formed in the trench bottom for pipe sockets and couplings.

Where rock or other deleterious matter is encountered, the trench shall be excavated to a minimum depth of 50 mm below the specified depth and the over-excavation filled with sand, firmly compacted to provide a cushion for the pipe.

The pipes shall be backfilled with material free from vegetation, lumps and stones of diameter exceeding 30 mm or any other deleterious matter. No lumps or stones or any other deleterious matter shall be placed in the immediate vicinity of the pipe.

The pipe shall be backfilled with material compacted in 150 mm layers by hand tamping or other approved methods to a minimum height of 300 mm above the crown of the pipe. Care is to be taken when compacting over the pipeline. The main fill material shall be placed in 300 mm thick layers, prior to compaction and compacted to 93% of Mod. AASHTO for cohesive soils or 100% for non-cohesive soils.

12.2.4. Class Designation

All pipes shall be laid so that the letters or figures designating the class of pipe are on top and clearly visible for inspection.

12.2.5. Jointing

12.2.5.1. General

The surface of all joints shall be thoroughly cleaned before the joint is made and all joints shall be watertight and shall be tested hydraulically as hereinafter specified. Any joint which leaks or sweats shall be completely dismantled, inspected and remade to the satisfaction of the Engineer, save that where he considers that the defect is due to insufficient tightness of nuts, the Engineer may permit the defect to be rectified by additional tightening.

12.2.5.2. Fibre-Cement and uPVC Pipes

Only approved "push-home" or mechanical type couplings shall be used in accordance with the manufacturer's recommendations.

12.2.5.3. Joints for Specials, etc.

Only approved "push home" or mechanical type couplings shall be used for jointing to plain-ended specials, valves and hydrants.

12.2.5.4. Bolted Joints

All bolted joints shall be made in such a way that all nuts are tightened evenly in sequence round the circumference.

12.2.5.5. Protection of Joints

As soon as possible after each joint has been made, and before it is covered up, all joints or fittings with exposed metal shall be externally protected against corrosion in such a manner that the whole fitting has a continuous impervious external covering.

Where mechanical type couplings are used, the entire coupling shall be encased in a cement mortar consisting of 1 part Portland cement to 6 parts of fine aggregate by weight. The minimum cover to the metal shall be 25 mm and the mortar shall be poured into moulds or diapers supplied by the Contractor to the approval of the Engineer.

12.2.5.6. Installing Specials

All tees for air valves shall be installed with the flanged branches vertical. All tees for scour valves and hydrants shall be installed with the flanged branches horizontal. All other tees shall be installed with the branches set to conform to the grade of the pipe or special to which they are to be connected.

Bends shall be set to conform to the grade of the pipes or specials to which they are to be connected.

12.2.5.7. Installing Valves and Fittings

All valves shall be set with their spindles vertical unless otherwise required in the Contract Documents or ordered.

All valves and fittings shall be installed in accordance with the manufacturer's instructions.

12.2.5.8. Installing Specials

All end caps, bends and tees shall be provided with concrete thrust blocks to prevent movement of the special concerned. The concrete be Grade 15/40 in accordance with SANS 1200 GA.

All blocks shall conform to the requirements of the Council's standard drawings. Blocks shall not cover the adjacent joints.

Where possible, the thrust face of a thrust block shall be cast against solid undisturbed material in the trench walls. If the trench wall is not vertical it shall be trimmed to a vertical face.

In sandy material which will not stand, the thrust face of the thrust block shall be vertical and it shall be backfilled with selected material compacted in layers not exceeding 150 mm, prior to compaction, to 100% of Mod. AASHTO.

12.2.6. Valve Chambers

All valves shall be enclosed in chambers conforming to the requirements of the Council's standard drawings.

12.2.7. Hydraulic Testing

All pipelines shall be tested hydraulically in sections between valves or as agreed with the Engineer. The test pressure shall be 1,5 times the working pressure.

No testing shall be carried out until at least 36 hours after the last concrete thrust block has been cast if high-early-strength cement is used, or at least 7 days if standard Portland cement is used.

The pipeline shall be slowly and completely filled with water and allowed to stand for such time as may be approved by the Engineer to allow for absorption. The pressure shall then be applied by means of a force pump and shall be maintained for not less than 1 hour. While the pipeline is under hydraulic test it shall be inspected for leaks, movement or other defects. Should any defect be found, it shall be repaired or the defective item shall be replaced as ordered and at the Contractor's expense. The pipeline shall be re-tested after any repairs have been executed or replacement material installed.

The leakage rate shall be measured during the hydraulic test, and shall not exceed a rate of 6 litres per 25 mm nominal pipe diameter per kilometre of pipeline per 24 hours. Should this rate be exceeded, the Contractor shall locate and repair the leak or leaks. The Council will provide a calibrated meter for measurement of the leakage rate on request.

The apparatus used for hydraulic testing shall be subject to the approval of the Engineer, and shall be fitted with a connection for attaching the Engineer's check gauge. The Contractor shall provide the necessary force pump, pressure gauge, connections, end caps, tools, etc. required for the testing and shall carry out all tests.

Water required for hydraulic testing can be obtained from the nearest convenient Council hydrant at no charge. A metered standpipe will be provided for this purpose on request. Where no convenient hydrant exists a metered communication pipe from the Council's mains will be provided.
Where further testing is required, for whatever reason, necessitating filling the mains a second or subsequent time, the Contractor shall pay for the water supplied at the current miscellaneous tariff rate.

12.2.8. Sterilisation of Mains

The Contractor shall properly disinfect the mains to the approval of the Council before they are put into service. All dirt shall be removed by flushing prior to disinfection in the presence of a Waterworks Superintendent.

When charging the mains with water, a one piece foam plug (density 28,8 kg/m^3,) of approved manufacture, shall be passed through the pipe system to finally clean the pipes.

The sizes to be used are:

for 150 mm diameter mains:	152 mm diameter x 300 long
for 100 mm diameter mains:	102 mm diameter x 200 long

other sizes on application to the Senior Superintendent, Distribution.

The cost of these plugs and the work entailed shall be included in the rates tendered for sterilisation.

The Contractor shall consult the Engineer regarding the programme for cleaning with plugs prior to the laying of mains.

12.2.9. Alterations to Existing Mains

The connection of the water reticulation to the existing Council water mains will be undertaken departmentally.

The Contractor is required to lay all water mains within the development including the last valve and one length of pipe beyond such valve on each line which is to be connected to an existing Council water main. The Contractor shall ensure that this last length of pipe is clean and ready for connecting up to the charged mains. The end shall be temporarily covered with an adequately fixed approved plastic cap supplied by the Contractor.
The Contractor, having satisfied the Engineer that he has completed the reticulation, as specified, shall give two weeks written notice to the Council's Assistant City Engineer (Water) of when the necessary connections to the Council's mains are required.

12.2.10. Building-In

Unless otherwise authorised all pipework in concrete shall be built-in as the work proceeds.
All pipes, bends, tees, etc., which are to be built-in shall be accurately set and fixed in position and shall be steel to CE-WS11.

Before concrete is placed, the Contractor shall check to ensure that the lengths of pipes, specials, etc., and the positions in which they have been placed for concreting, are such that they will fit all subsequent work. The maximum deviation of the direction of the centre-line of the completed pipework shall not be more than 3 mm per metre nor more than a total of 12 mm from vertical or horizontal lines or other lines indicated on the drawings.

Where necessary, the Contractor may build-in the pipes, etc., after the main concrete or brickwork has been placed, in which case he shall be responsible for ensuring that the completed work is watertight. No extra payment shall be made for forming holes in concrete and brickwork or for their subsequent filling if this method of installation is adopted.

12.2.11. Pipe work in Buildings

The requirements of this specification regarding the handling, laying, jointing, testing, etc. of pipes, valves and specials in trenches shall apply *mutatis mutandis* to pipework in buildings and other structures.

The Contractor shall ensure that all pipes, valves and specials are accurately placed and secured in position that pipes are accurately laid to the lines, levels and slopes shown on the drawings and that the completed work presents a neat, accurate and workmanlike appearance.

12.3. COMMUNICATION PIPES (CONNECTIONS)

Licensed plumbers are to be employed and the whole of the work is to be executed with materials and workmanship in strict accordance with the requirements of the City of Cape Town Waterworks By-Law Number 1896, as amended.

12.3.1. General

The communication pipes (connections), including stopcocks and meter boxes, shall be installed strictly in accordance with the relevant Waterworks standard drawings. Copper or polypropylene pipe shall be used for the connections and shall be connected to FC of uPVC pipes by means of approved full-way ball valves (or brass ferrules) screwed into saddles. The saddles shall be clamped to the pipes, and the pipes shall then be drilled and tapped for the insertion of the full-way ball valves (or ferrules). Only 25 mm and/or 40 mm □ full-way ball valves shall be used with such adaptors as may be necessary.

The minimum cover over the piping shall be 450 mm.
The saddles and full-way ball valves shall be protected against corrosion by encasement in a cement mortar consisting of 1 part Portland cement to 6 parts of fine aggregate by weight. The minimum cover to the metal shall be 25 mm and the mortar shall be poured into moulds or diapers supplied by the Contractor to the approval of the Engineer.

12.3.2. Existing Communication Pipes (Connections)

Existing communication pipe shall be disconnected from the existing mains and reconnected to the new mains, the piping being shortened or extended, as necessary. If so ordered, the whole pipe shall be replaced. In the case of HDPE fusion welding is possible.

Existing communication pipes are to be altered as required on the drawings with the minimum cessation of supply. The Contractor shall notify the Supervisory Water Inspector at least one working day in advance and provide written notice to all affected parties of their intentions to interrupt the supply of water stating times and period of discontinuity of supply.

12.3.3. Materials Supply

Unless otherwise specified or detailed in the Schedule of Quantities, the Contractor shall supply all materials, which shall all appear on the Council's List of Accepted Components.

All saddles shall conform to the Council's Standard Specification for Saddle Pieces CE-WS4.

Stopcocks shall comply with the requirements of the Council's Standard Specification CE-WS3.

The Contractor shall ensure that he has an ample supply of all the sizes and types of fittings likely to be needed, so that communication pipes can be installed with the least possible delay and interruption of supply to the consumer.

12.3.4. Sterilization

If a connection is required to be made to a main under pressure, prior arrangements shall be made with the Waterworks Superintendent and the Contractor shall ensure that the material and equipment used is properly sterilized.

A Talbot Steripress with Talcol chlorinating agent, or similar approved equipment and material, shall be used for making the connection under pressure.

12.3.5. Testing

Before backfilling is commenced all fire and combined connections shall be tested to a pressure of 2 MPa, and all other connections to a pressure of 1,5 MPa. This shall also apply to existing communication pipes which have been altered. Any leaks shall be repaired and the communication pipe shall then be re-tested. All testing shall take place in the presence of the Waterworks Superintendent.

CHAPTER 13: STANDARD SPECIFICATION FOR FIRE HYDRANTS

13.1. GENERAL

The hydrant shall consist of a 100 mm valve, 90□ bend, extension piece, adaptor and outlet assembled as shown on drawing Appendix A: W4-F-001. It shall be supplied complete with all necessary jointing material, bolts, nuts, washers, etc. The inlet flange shall be protected until required for use by means of a wooden blank flange bolted in position.

All bolts and nuts shall comply with SANS 136 (as amended) and shall be electro-galvanised.

13.1.2. Valve

The valves shall be of sound construction and of approved design and manufacture and shall comply with the requirements of the Council's Standard Specification Number CE-WS15.

13.1.3. Bend

The bend shall be manufactured in accordance with drawing number Appendix A: W4-F-003 and the Council's Standard Specification CE-WS11.

13.1.4. Extension Piece

The extension piece shall be manufactured in accordance with the Council's Standard Specification CE-WS11 and shall be of 100 mm nominal diameter and 500 mm long.

13.1.5. Reducer Adaptor

The reducer flange shall be manufactured in accordance with drawing Appendix A: W4-F-004 and shall be of mild steel.

13.1.6. Outlet

The outlet shall be manufactured in accordance with drawing Appendix: W4-F-005 and shall be of gun-metal.

13.1.7. Jointing Material

Jointing material shall comply with the requirements of SANS 564 (as amended) and the tenderer shall state the type of material offered.
The bolts should be wrapped in dense tape and greased.

CHAPTER 14: DESIGN CRITERIA FOR SIZING THE COMPONENTS OF THE SYSTEM

14.1. WATER DEMAND

The water demand figures adopted for design purposes should be based on a projected value, say 20 years hence. The figures given in the guidelines allow for rising standards of living, and are the actual figures anticipated for the year 2000 based on 2 per cent per annum compounded growth. The water demand figures given apply to townships with flush sanitation.

The water demand figures are given in Appendix F1: Table SW5.1. Figures for special residential erven of area larger than 2 000 m^2 are not given as these large erven occur rarely in new townships. Figures adopted by the designer for such erven should be based on local conditions. Where upper and lower limits are given, it is envisaged that the upper limit would generally apply to the high income level township, and the lower limit to the lower income level township. Designers should note that in adopted water demand figures for a specific, cognizance must be taken of local factors such as income level, climate and water charges when interpolating between the upper and lower limits provided in these guidelines.

14.1.1. Hydraulic formulae

For the purpose of calculating friction losses in pipelines any of the recognized hydraulic formulae may be used. Friction loss calculations must take into account the long-term conditions of the internal surface of the pipes, and the possible increase in friction loss due to the quality of the water conveyed. Friction coefficients adopted and the motivation for their choice should accompany the design. Allowance should also be made for losses in specials, fittings and laying imperfections by increasing calculated friction loss by a nominal 7 ½ per cent.

14.1.2. Peak factors

To obtain the residual head in the reticulation at any point it is necessary to balance the network using instantaneous peak flows. The various types of development should first be converted to equivalent erven (ee) according to the design annual average daily demand accepting as a basis for design that one ee has an annual average daily demand of 1 000 l. Using the ee thus obtained, the peak factor pertaining at any point in the network should be obtained from Appendix F: Table SW5.1. The annual average daily demand multiplied by the peak factor gives the instantaneous peak flow.

14.1.3. Fire-fighting requirements

The provision of water for fire-fighting should comply with the requirements as described in SANS 090-1972: Code of Practise for Community Protection Against Fire, but with the deviations from the code as provided in Appendix F: Tables SW5.2 to this document.

14.1.4. Residual pressures

The reticulation should be designed such that the residual pressure in the reticulation main at any point is within the limits given in Table 12.1. The residual pressures applicable during fire flow conditions are given in the paragraph above.

Table 12.1: Reticulation Main Limit

Types of development	Minimum head (under instantaneous peak demand) (m)	Maximum head (under zero flow conditions) (m)
Dwelling houses for higher income level	24	90
Dwelling houses for middle income level	24	90
Dwelling houses for lower income level	12	90
All development other than dwelling houses for all income levels	24	90

Plus the height difference between the main and the highest ground level at any point on the erf not exceeding 50 m from the boundary adjacent to the main.

14.1.5. Erf connection

The communication pipes for erf connections for dwelling houses (Residential zone 1) should be sized according to Table 13.1 and Table 13.2.

Table 13.1: Communication Pipes Across Road

Income level	**Minimum actual internal diameter (mm)**	
	Serving two erven	Serving one erf
Higher	38 branching to 2 x 19	24 reducing to 19 at the erf
Middle	38 branching to 2 x 19	24 reducing to 19 at the erf
Lower	24 branching to 2 x 19	19

Table 14.2: Communication Pipes on Near-Side of Road

Income level	**Minimum actual internal diameter (mm)**	
	Serving two erven	Serving one erf
Higher	24 branching to 2 x 19	19
Middle	24 branching to 2 x 19	19
Lower	19 branching to 2 x 19	19

The communication pipe may be reduced to 13 mm minimum actual interval diameter, provided the minimum head in the reticulation main at the take-off point for the erf connection under instantaneous peak demand is not less than 30 m. For development other than dwelling units metered individually, the communication pipe should be sized according to the specific demand.

CHAPTER 15: KOSOVO VACUUM SEWER SYSTEM

15.1. SYSTEM DESCRIPTION

Unlike conventional gravity systems which depend solely on gravity flows, vacuum sewer systems make use of a combination of gravity and differential air pressure as the driving force that propels sewage through the sewer network. Vacuum sewer systems consist of three key components, collective chambers, vacuum sewers and the vacuum station.

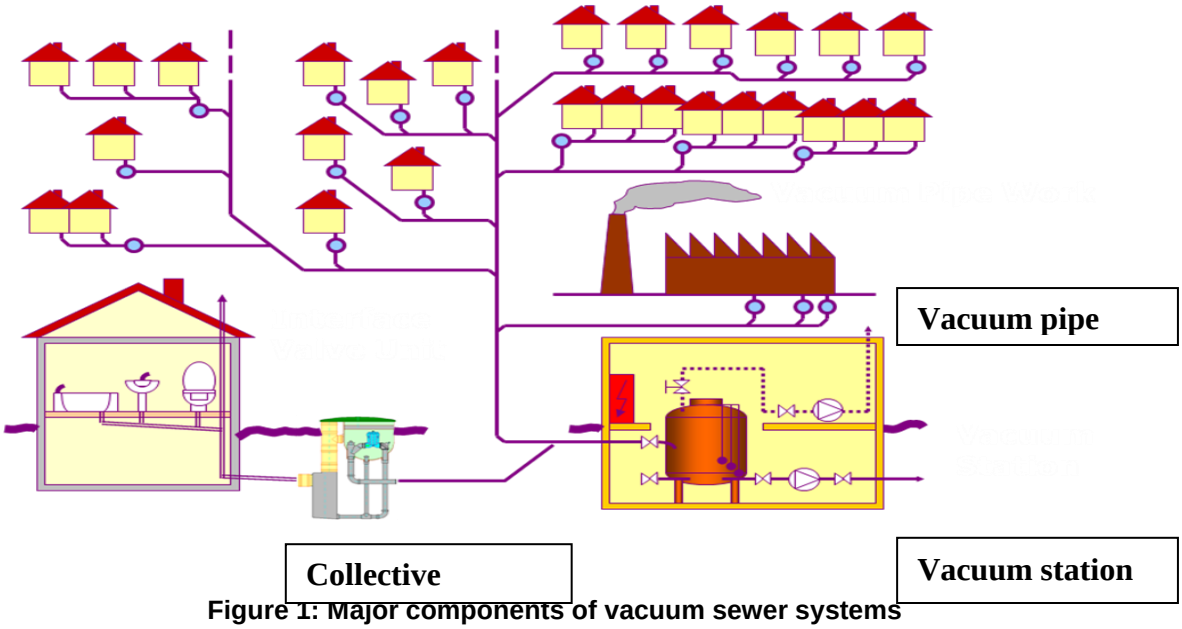


Figure 1: Major components of vacuum sewer systems

As constructed in Kosovo, toilets cubicles at each sanitation block are drained through 160mm diameter uPVC pipes to an adjacent vacuum valve pit containing the collection chamber, sensor unit and an interface valve. Once a predetermined volume of sewage has accumulated in the collection chamber the pneumatically activated sensor unit prompts the opening of the interface valve which links the collection chamber to the vacuum sewer network. When the interface valve opens, the sewage, followed by a short burst of air, is sucked into the vacuum sewers. Each input of energy, occurring as the each interface valve along the network opens, further propels the sewage along the vacuum sewer network, consisting of 90 to 160mm diameter pipes, until it reaches the vacuum station where it accumulates in vacuum vessels.

The vacuum station houses the vacuum pumps which generate and maintain the negative pressure in the vacuum vessels and throughout the vacuum sewer network. The sewage that accumulates in the vacuum vessels is evacuated by sewage pumps and is conveyed to a sewer outfall where it joins an existing gravity sewer.

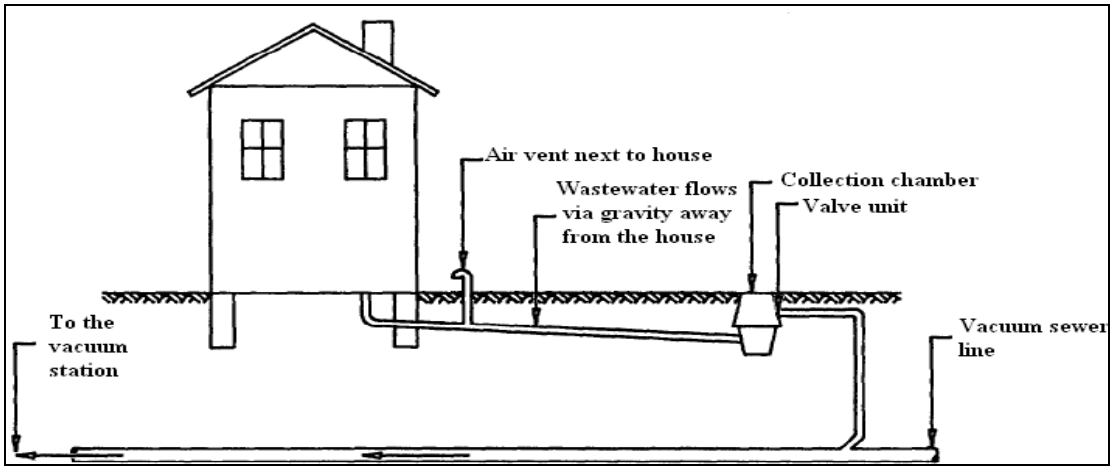


Figure 2: Typical vacuum sewer system service connection setup.

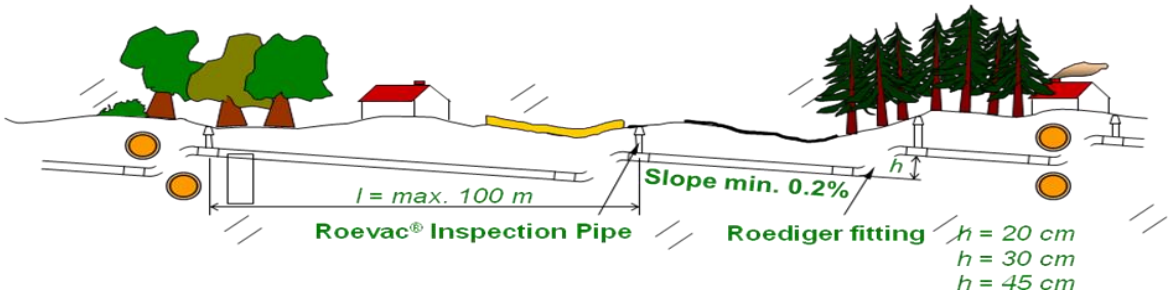


Figure 3: The Saw Tooth method used for the vacuum sewer lines.

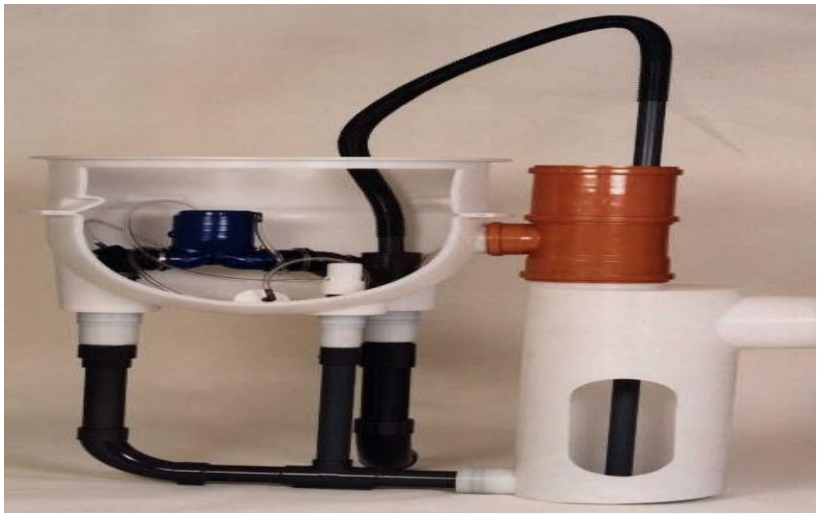


Figure 4: Collective chamber

15.1.1. Advantages

Vacuum sewerage has the advantage of enabling the use of conventional flush toilets without the need for deep trenches, large diameter sewers, numerous access manholes and the need to always travel in straight lines, as is customary with waterborne sewerage. The use of reduced diameter pipelines and shallow trenches in Kosovo reduced the disruption caused retrofitting a sewer network in the informal settlement by minimizing the number of shacks that had to be moved to allow for construction. Due to the flat gradients, sandy soils and high water-tables in the area, the installation of a conventional gravity sewer system would have used 160 mm diameter pipes installed at depths of up to 7m and incorporating three lift stations. As a result of the high transport velocities within the vacuum sewers, the risk of sewer blockages is reduced. Major leaks in the system are also immediately evident, as suction is lost in the system, making vacuum sewerage particularly useful in environmentally sensitive area.

Figure 5: The blocks of toilets used in Kosovo

15.1.2. Constraints

A disadvantage of vacuum sewerage is that the system's operation can be disrupted by a disruption in the power supply to the vacuum pump station and carelessness when using the toilets by flushing down foreign objects (e.g. Cutlery, stones, sticks, etc.) resulting in the vacuum pumps not being able to generate the negative pressure required for the system to operate. In addition to this the malfunctioning of an interface valve or sensor unit would result in the toilet units draining to the specific collection chamber being rendered unusable. Any air leaks, originating from either the interface valves or the vacuum sewer lines, will result a loss of pressure thus causing the vacuum pumps to run for extended periods of time

Figure 6: A clogged up collective chamber that will normally be sucked clean with a honey sucker in an event like this

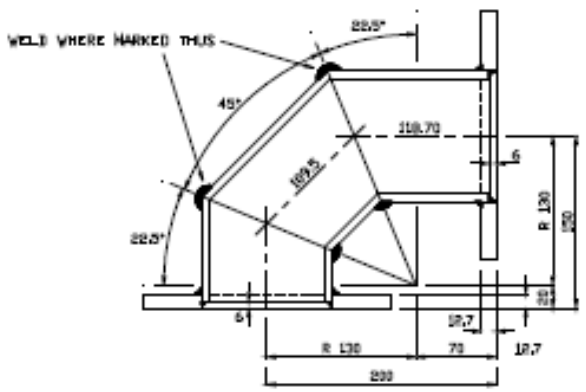
Figure 7: A clogged toilet.

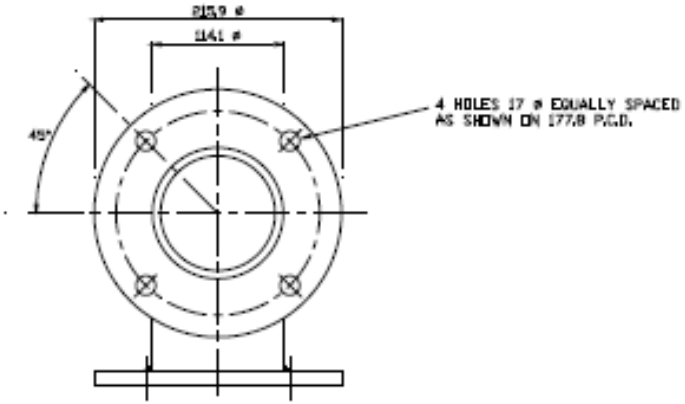
REFERENCES

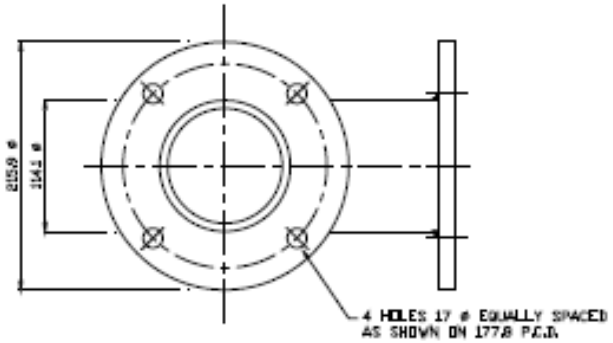
CSIR. 2003. Guidelines for human settlement planning and design: The red book

Jacobs, H.E., Geustyn, L.C., Loubser B.F. and van der Merwe B., 2004. Estimating Residential Water Demand in Southern Africa. *Journal of the South African Institute of Civil Engineers*, 46(4), pp.2-13.

APPENDIX A: FIRE HYDRANTS







1. MATERIAL : MILD STEEL & 100 NOM. DIA STEEL PIPE
2. FOR ASSEMBLY DRAWING SEE W4-F-002
3. THE BEND SHALL BE LINED INTERNALLY WITH CEMENT MORTAR AND EXTERNALLY WITH A COATING PROTECTED BY A SEAL COAT ALL IN ACCORDANCE WITH CE-WS 11

THIS DRAWING SUPERSEDES W4-2720

CITY OF CAPE TOWN
SERVICES AND INFRASTRUCTURE
B.V. MASENGANA
executive director: services & infrastructure

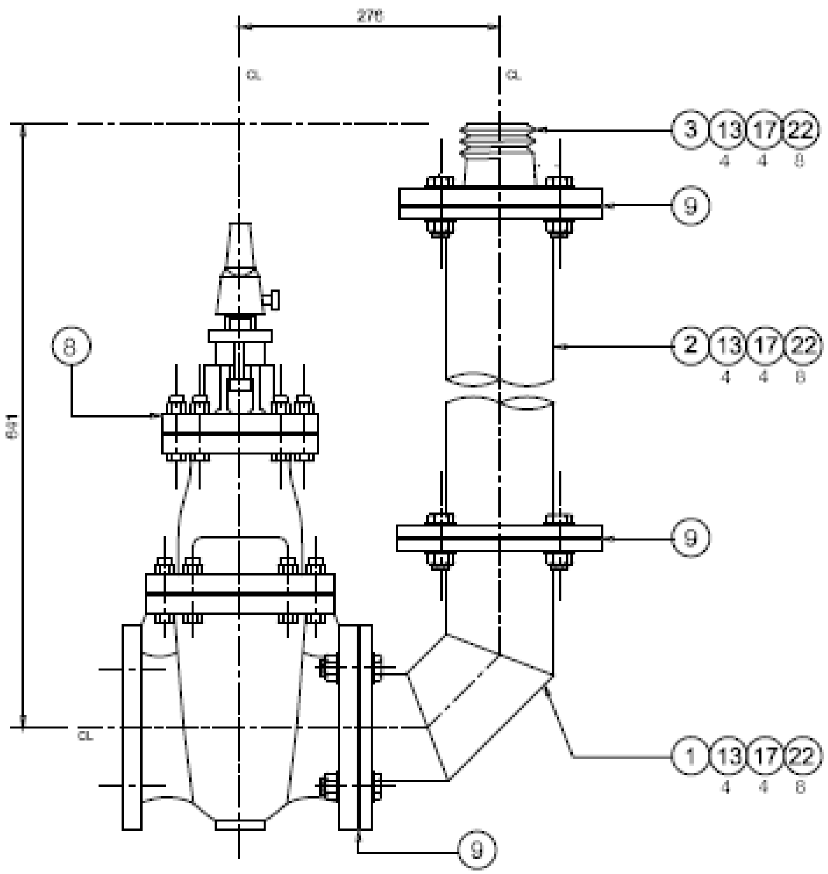
manager : water

STANDARD DRAWING

FIRE HYDRANT 90° STEEL BEND

REVISIONS

scale	drawing no.
1 : 5	W4-F-003
	revision suffix
date 92/12/08	drawn M.V. / designed / checked



ITEM	DESCRIPTION	DRAWING/ PART NO.	QTY.	REMARKS
1.	100mm Ø 90° STEEL BEND	W4-F-003	1	
2.	100mm Ø x 800mm DOUBLE FLANGED PIPE		1	
3.	65mm Ø STEEL NOZZLE	W4-F-007	1	
4.				
5.				
6.				
7.				
8.	100mm D.F. SLUICE VALVE		1	
9.	RUBBER INSERTION		AS REQUIRED	
10.				
11.				
12.				
13.	HEXAGONAL BOLT M16 x 60		12	
14.				
15.				
16.				
17.	HEXAGONAL NUTS M16		12	
18.				
19.				
20.				
21.				
22.	FLAT WASHERS (BRIGHT) 16		24	
23.	FLAT WASHERS (BRIGHT) 14		3	
24.				
25.				

THIS DRAWING SUPERSEDES W1-2010

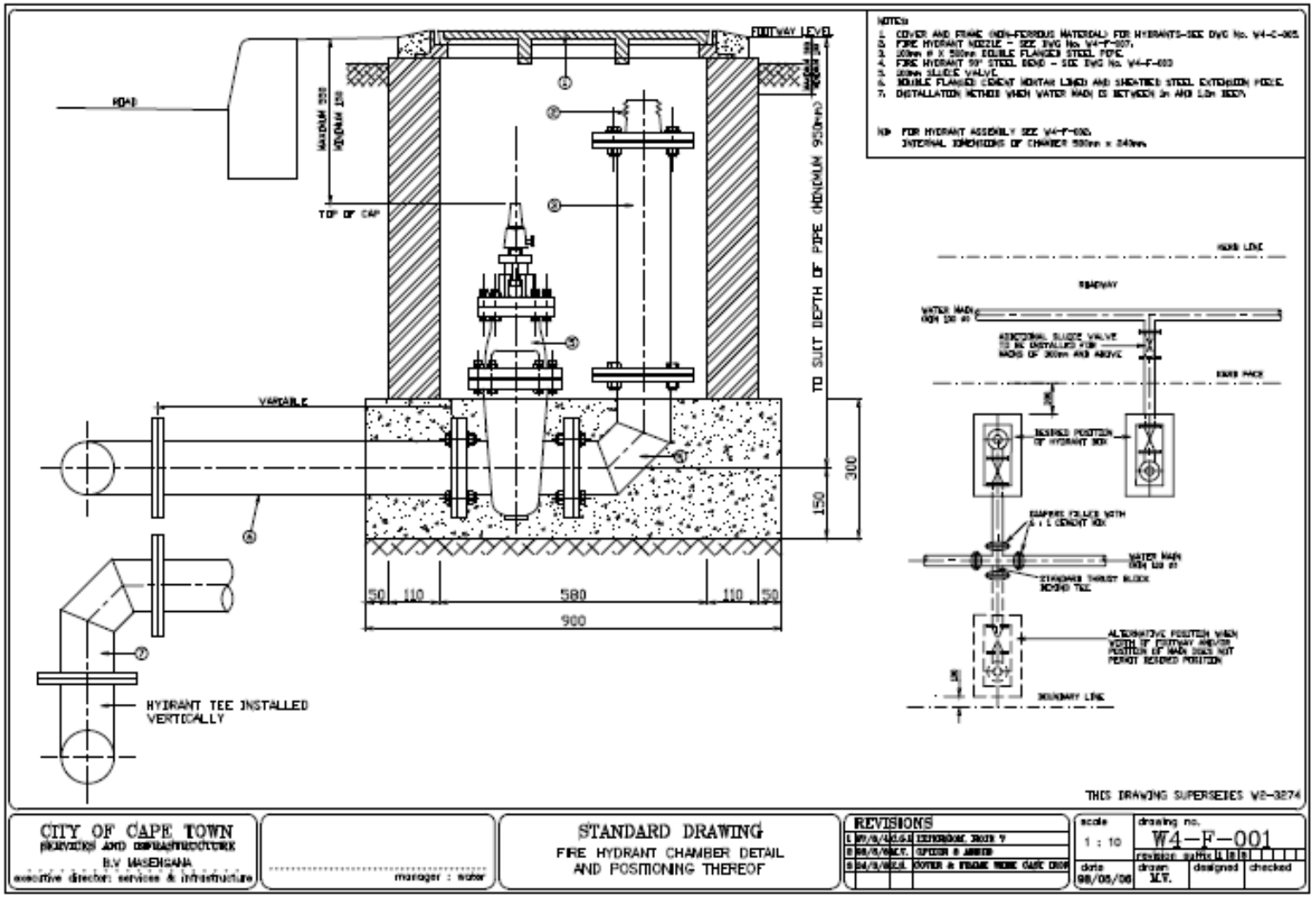
CITY OF CAPE TOWN
SERVICES AND INFRASTRUCTURE
B.V MASENGANA
executive director: services & infrastructure

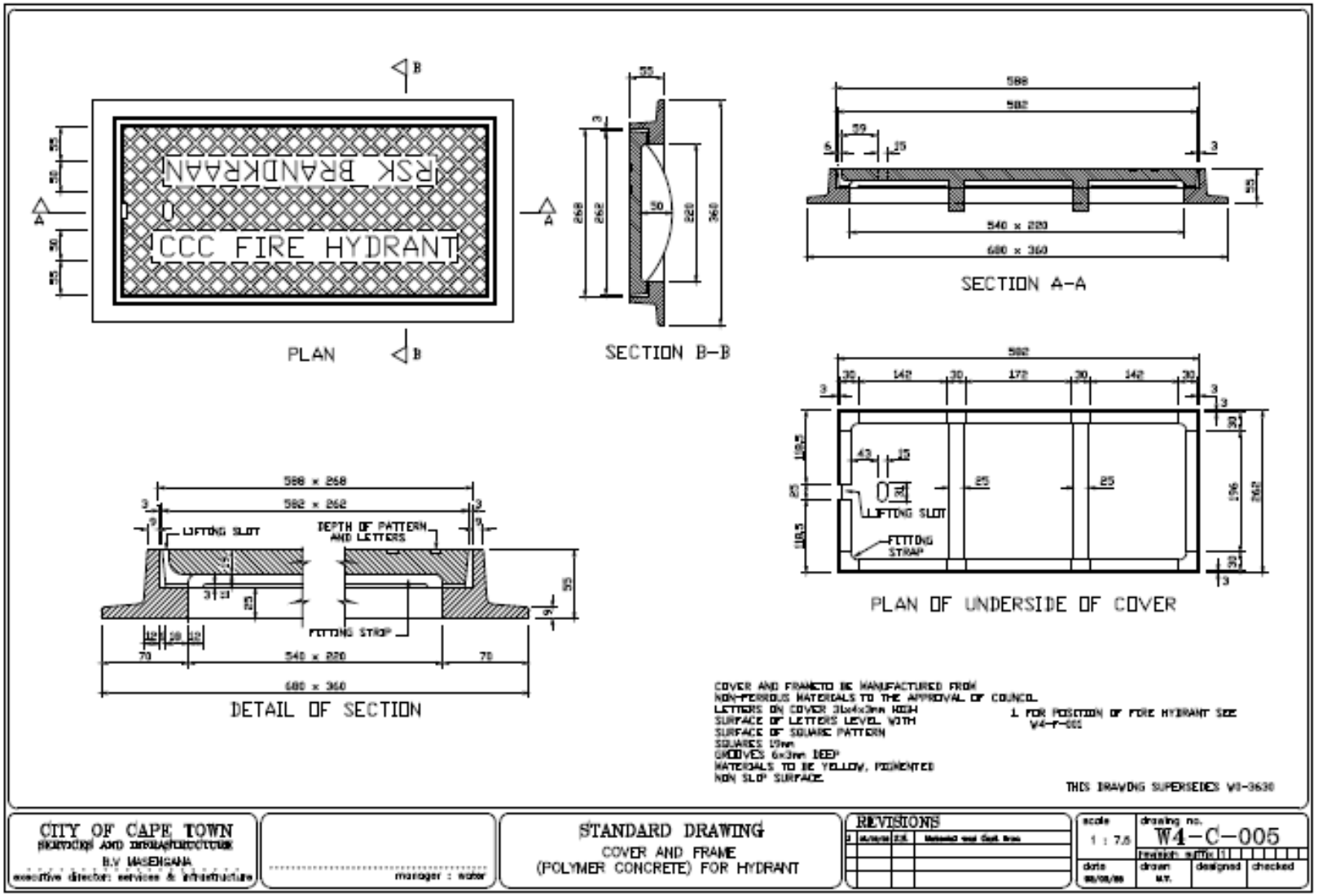
manager : water

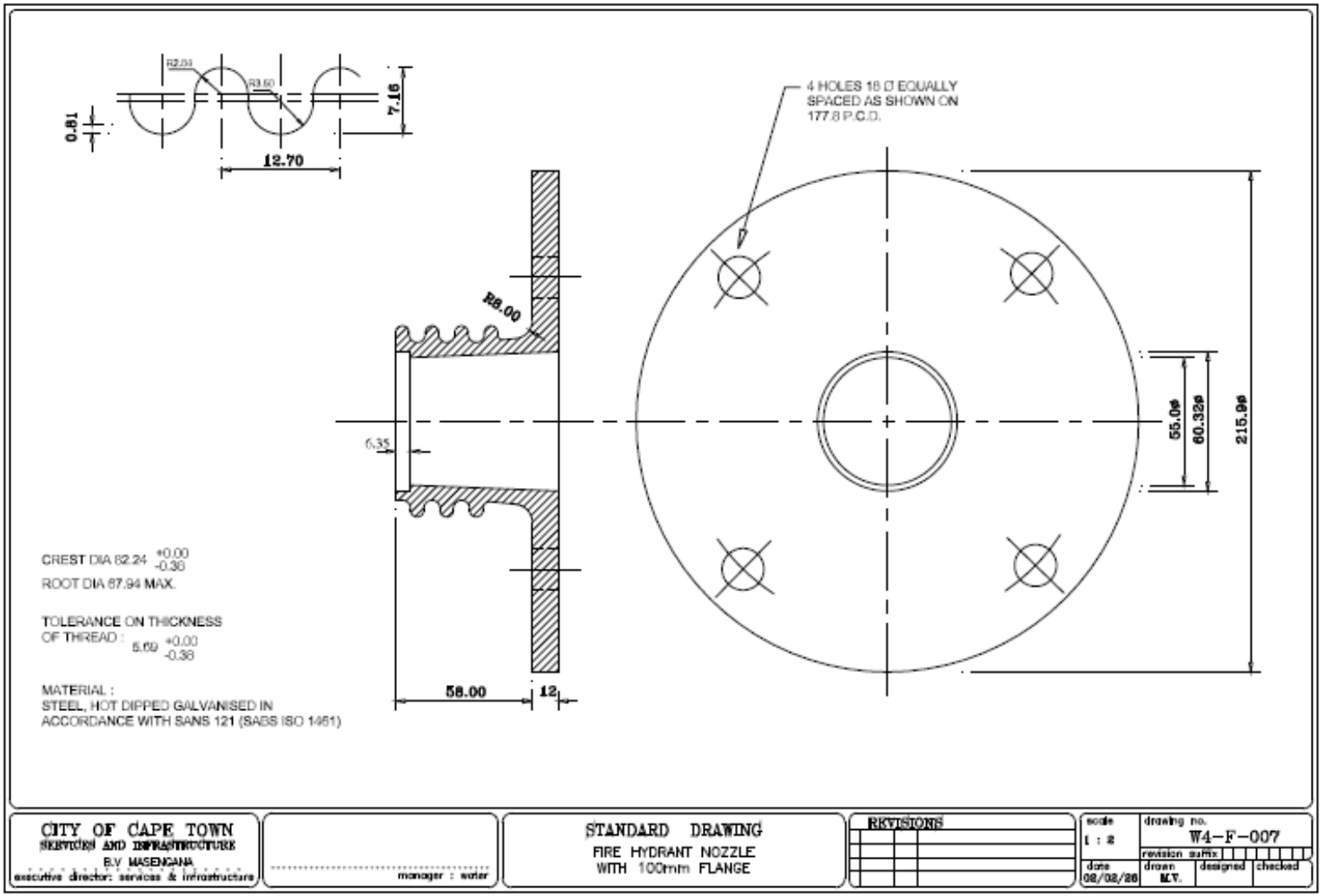
STANDARD DRAWING
FIRE HYDRANT ASSEMBLY DETAIL

REVISIONS

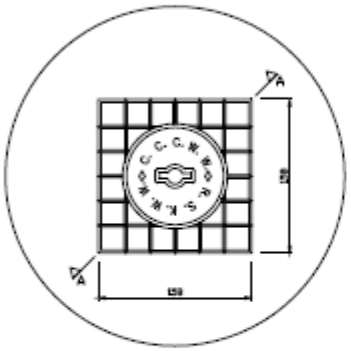
scale 1 : 5
drawing no. W4–F–002
revision suffix
date 08/01/13
drawn P.C.R.
designed
checked


NOTES:
1. COVER AND FRAME (NON-FERROUS MATERIAL) FOR HYDRANTS-SEE DWG No. W4-C-005
2. FIRE HYDRANT NOZZLE - SEE DWG No. W4-F-007.
3. 300mm ø X 500mm DOUBLE FLANGED STEEL PIPE.
4. FIRE HYDRANT 90° STEEL BEND - SEE DWG No. W4-F-003
5. 300mm SLUICE VALVE.
6. DOUBLE FLANGED CEMENT MORTAR LINED AND SHEATHED STEEL EXTENSION PIECE.
7. INSTALLATION METHOD WHEN WATER MAIN IS BETWEEN 3m AND 10m DEEP.
NB FOR HYDRANT ASSEMBLY SEE W4-F-002.
INTERNAL DIMENSIONS OF CHAMBER 580mm x 840mm
ROAD
TOP OF CAP
FOOTWAY LEVEL
TO SUIT DEPTH OF PIPE (MINIMUM 950mm)
VARIABLE
300
150
50
110
580
110
50
900
HYDRANT TEE INSTALLED VERTICALLY
THIS DRAWING SUPERSEDES W2-3274
CITY OF CAPE TOWN
B.V. WASENGANA
executive director: services & infrastructure
manager : water
STANDARD DRAWING
FIRE HYDRANT CHAMBER DETAIL
AND POSITIONING THEREOF
REVISIONS
scale
1 : 10
drawing no.
W4-F-001
date
98/05/06
drawn
M.V.
designed
checked

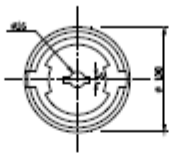

RSK BRANDKRAAN
CCC FIRE HYDRANT
PLAN
SECTION B–B
SECTION A–A
PLAN OF UNDERSIDE OF COVER
LIFTING SLOT
FITTING STRAP
DEPTH OF PATTERN AND LETTERS
DETAIL OF SECTION
COVER AND FRAME TO BE MANUFACTURED FROM NON-FERROUS MATERIALS TO THE APPROVAL OF COUNCIL.
LETTERS ON COVER 31x4x3mm HIGH
SURFACE OF LETTERS LEVEL WITH SURFACE OF SQUARE PATTERN
SQUARES 19mm
GROOVES 6x3mm DEEP
MATERIALS TO BE YELLOW, PIGMENTED NON SLIP SURFACE.
1. FOR POSITION OF FIRE HYDRANT SEE W4-F-001
THIS DRAWING SUPERSEDES W8-3630
CITY OF CAPE TOWN
B.V. WASENSAWA
executive director: services & infrastructure
manager : water
STANDARD DRAWING
COVER AND FRAME
(POLYMER CONCRETE) FOR HYDRANT
REVISIONS
scale 1 : 7,5
drawing no. W4-C-005
revision suffix
date
drawn
designed
checked


R2.03
R3.60
7.16
0.81
12.70
4 HOLES 18 Ø EQUALLY SPACED AS SHOWN ON 177.8 P.C.D.
R8.00
6.35
58.00
12
55.0ø
60.32ø
215.9ø
CREST DIA 62.24 +0.00 -0.38
ROOT DIA 57.94 MAX.
TOLERANCE ON THICKNESS OF THREAD : 5.59 +0.00 -0.38
MATERIAL :
STEEL, HOT DIPPED GALVANISED IN ACCORDANCE WITH SANS 121 (SABS ISO 1461)
CITY OF CAPE TOWN
SERVICES AND INFRASTRUCTURE
B.V. MASENGANA
executive director: services & infrastructure
manager : water
STANDARD DRAWING
FIRE HYDRANT NOZZLE
WITH 100mm FLANGE
REVISIONS
scale 1 : 2
drawing no. W4-F-007
revision suffix
date 08/02/26
drawn M.V.
designed
checked

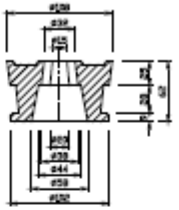
APPENDIX B: SLUICE GATE VALVES



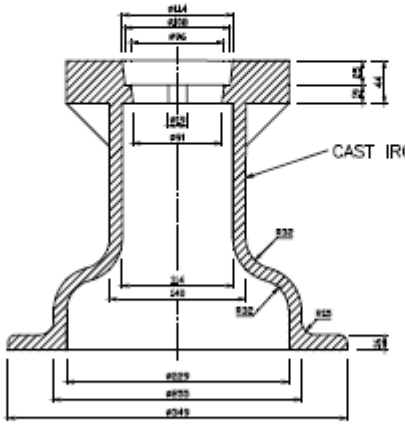
PLAN



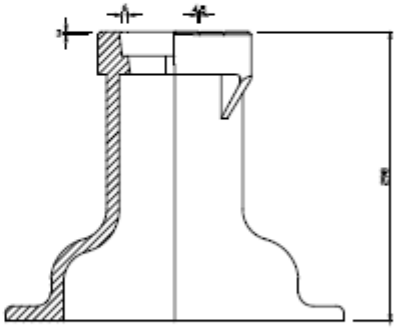
VIEW OF UNDER SIDE OF CAP
(NON-FERROUS MATERIAL)



SECTION THRU CAP



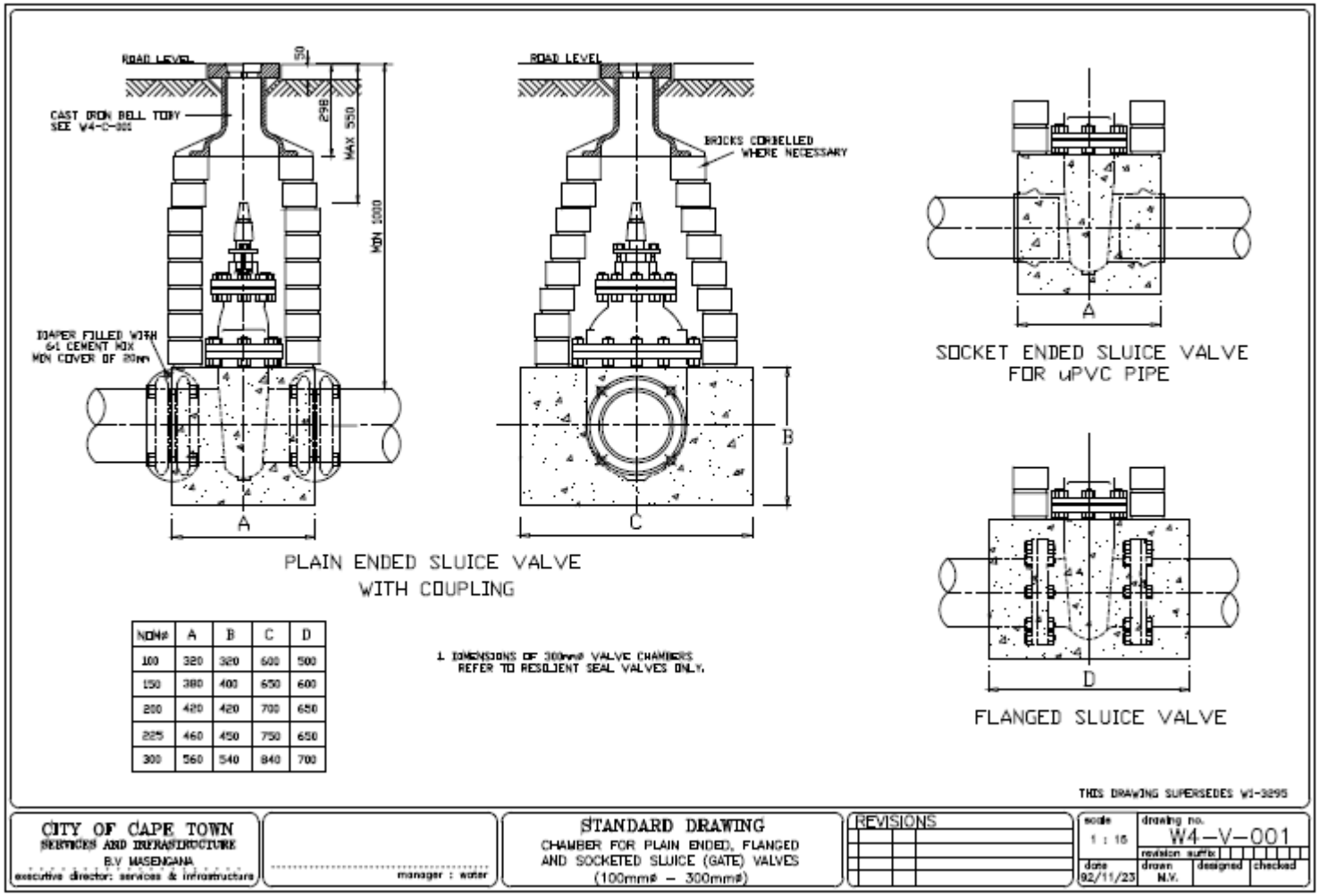
SECTION A-A



HALF-SECTION FRONT VIEW

THIS DRAWING SUPERSEDES WS-3046

CITY OF CAPE TOWN SERVICES AND INFRASTRUCTURE B.V. WASEMSANA executive director: services & infrastructure	..... manager : water	STANDARD DRAWING COVER AND CAP FOR SLUICE (GATE) VALVES	REVISIONS 1 [illegible] Cap new Cast Iron
scale 1 : 5 date 98/11/26	drawing no. W4-C-001 revision suffix drawn d.g.s. / designed / checked		



NOM#	A	B	C	D
100	320	320	600	500
150	380	400	650	600
200	420	420	700	650
225	460	450	750	650
300	560	540	840	700

1. DIMENSIONS OF 300mm# VALVE CHAMBERS REFER TO RESILIENT SEAL VALVES ONLY.

THIS DRAWING SUPERSEDES W1-3295

CITY OF CAPE TOWN
SERVICES AND INFRASTRUCTURE
B.V MASENGANA
executive director: services & infrastructure

manager : water

STANDARD DRAWING
CHAMBER FOR PLAIN ENDED, FLANGED AND SOCKETED SLUICE (GATE) VALVES
(100mm# – 300mm#)

REVISIONS

scale 1 : 15
drawing no. W4-V-001
revision suffix
date 92/11/23
drawn M.V.
designed
checked

APPENDIX C: CHECK VALVES

CITY ENGINEER'S
DEPARTMENT
CAPE TOWN

WATERWORKS BRANCH
CE-WS5: 1993

STANDARD SPECIFICATION FOR CHECK VALVES

1. GENERAL

The check valves shall conform to SABS 1551-1: 1992 for general waterworks practice and shall be double flanged or double-door wafer check valves.

2. WORKING PRESSURE

The valves shall be suitable for a working pressure of up to 1,2 MPa.

3. MATERIALS

Double-door wafer check valves shall have a stainless steel spring to aid closure and the doors shall be of bronze, stainless steel or other approved material.

4. FLANGES

Flanges shall be sized and drilled off centre in accordance with BS10: 1962 Table D.

5. LEAKAGE TEST

The leakage shall be less than that specified in SABS 1551-1: 4.3.4(e).

6. CASTING DEFECTS

Castings shall be inspected for acceptability in accordance with SABS 1551-1: 4.3.5.1 (d).

7. FINISH

The valves shall be coated in either sintered epoxy, a solvent-free epoxy or other approved finish suitable for long-lasting waterworks practice.

APPENDIX D: AIR RELEASE VALVES

CITY ENGINEER'S
DEPARTMENT
CAPE TOWN

WATERWORKS BRANCH
CE-WS20: 1993

STANDARD SPECIFICATION FOR AIR RELEASE VALVES

1. SCOPE

This specification covers the requirements for single and double orifice air release valves of nominal diameters 20 mm to 150 mm inclusive.

2. DESIGN

2.1 Cast-Iron Single and Double Orifice Type

The body of the single orifice valve shall be of cast-iron housing a rubber covered ball seating on a replaceable bronze outlet nipple. The valve shall be fitted with a bronze isolating cock, the inlet of which shall be of the nominal diameter ISO-R7 male thread specified in the Schedule.

The double orifice valve shall incorporate both a small and a large orifice. The body shall be of cast-iron housing two balls, one rubber covered and seating on a replaceable bronze outlet nipple and the other vulcanite covered and seating on a replaceable rubber seal at the outlet. A cast-iron shield plate shall be provided to prevent the entry of dirt when the large orifice is open. The valve shall also incorporate a screw-down type isolating valve which shall have a bronze spindle fitted with a standard spindle cap, gunmetal spindle nut, stopper and seat and a neoprene washer. The inlet shall be flanged according to the dimensions given in Table D below and, shall be drilled off centre-line.

2.2 Kinetic Type

The valves shall be perform slam-free under all working conditions. Certified performance tests which indicate discharge performance and slam-free operation for the specified working conditions shall be submitted.

Single orifice models of 20 to 50 mm shall be fitted with a bronze or similar approved isolating valve, the inlet of which shall be of the nominal diameter ISO-R7 male thread specified in the schedule.

Single and double orifice models above 50 mm shall be supplied with a hand-wheel operated isolating valve in accordance with CE-WS15. The valve shall be flanged according to the dimensions given in Table 1 below and shall be drilled off centre-line.

TABLE 1: Flange details for working pressures up to 1,2 MPa.

NOMINAL DIAMETER mm	DIAMETER OF FLANGE mm	DIAMETER OF BOLT CIRCLE mm	NUMBER OF BOLTS mm	BOLT DESIG-NATION mm	THICKNESS OF FLANGE mm
80	185	146,05	4	M16	19
100	215	177,80	4	M16	19
150	280	234,95	8	M16	21

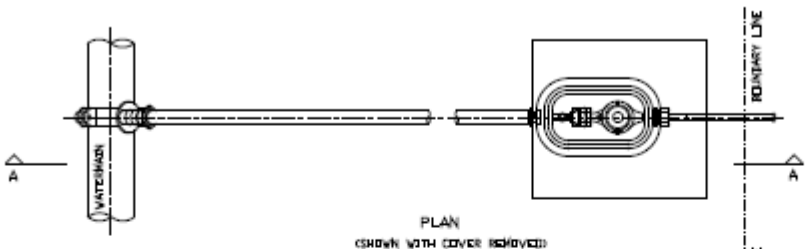
3. WORKING AND TEST PRESSURES

Unless otherwise specified in the Schedule, the valves shall be suitable for a working pressure up to 1,2 MPa and shall be tested to not less than twice the working pressure.

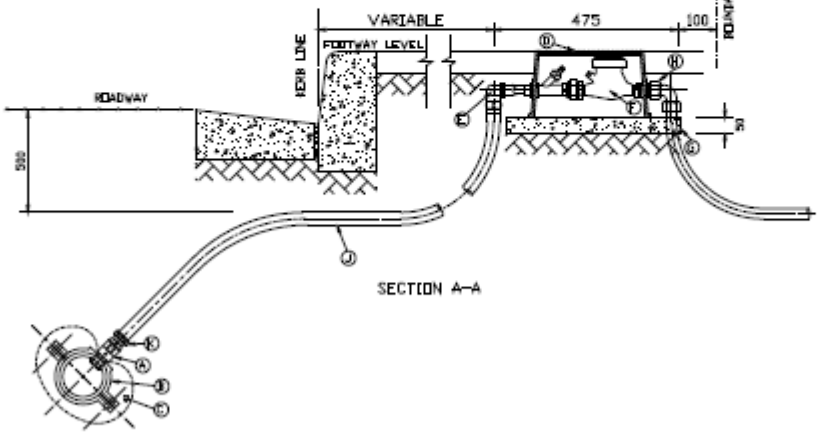
4. MARKING AND PACKING

Each valve shall be indelibly marked, in a position which will be easily visible after installation, showing the nominal diameter in mm and the working pressure in kPa. Prior to despatch the inlet thread or the mating face of the inlet flange shall be protected by a plastic cap or wooden blank flange as the case may be.

APPENDIX E: METER CONNECTION



PLAN
(SHOWN WITH COVER REMOVED)



SECTION A–A

NOTES

Ⓐ BRASS BALL VALVE 20mm ø
MALE IRON INLET
FEMALE IRON OUTLET

NB IN TOWNSHIP DEVELOPMENTS USE MALE IRON TO COPPER COUPLER ONLY (NO VALVE)

Ⓑ SADDLE CLAMP (SEE W4-G-004)

Ⓒ DIAPER FILLED WITH 6:1 MORTAR MIX AND A MINIMUM COVER OF 20mm

Ⓓ SINGLE NON-FERROUS METERBOX WITH COVER
(TYPE AS REQUIRED BY COUNCIL)

Ⓔ MALE IRON TO COPPER ELBOW (CONEX)

Ⓕ WATER METER

Ⓖ 450mm x 450mm PRECAST CONCRETE SLAB

Ⓗ FEMALE IRON TO COPPER ELBOW (CONEX)

Ⓙ COPPER / POLYPROP 20mm ø

Ⓚ MALE IRON TO COPPER COUPLER

POLYPROPYLENE PIPES TO COMPLY WITH SABS 1129/1998 CLASS 16, OUTSIDE DIAMETER TO COMPLY WITH SABS 460/1985 NOMINAL DIAMETERS

WHERE THIS WORK IS UNDERTAKEN BY ANYONE BESIDES THE COUNCIL, THE WATER METER SHALL BE INSTALLED BY THE COUNCIL AT THE APPLICABLE TARIFF RATE

THIS DRAWING SUPERSEDES W3-4124

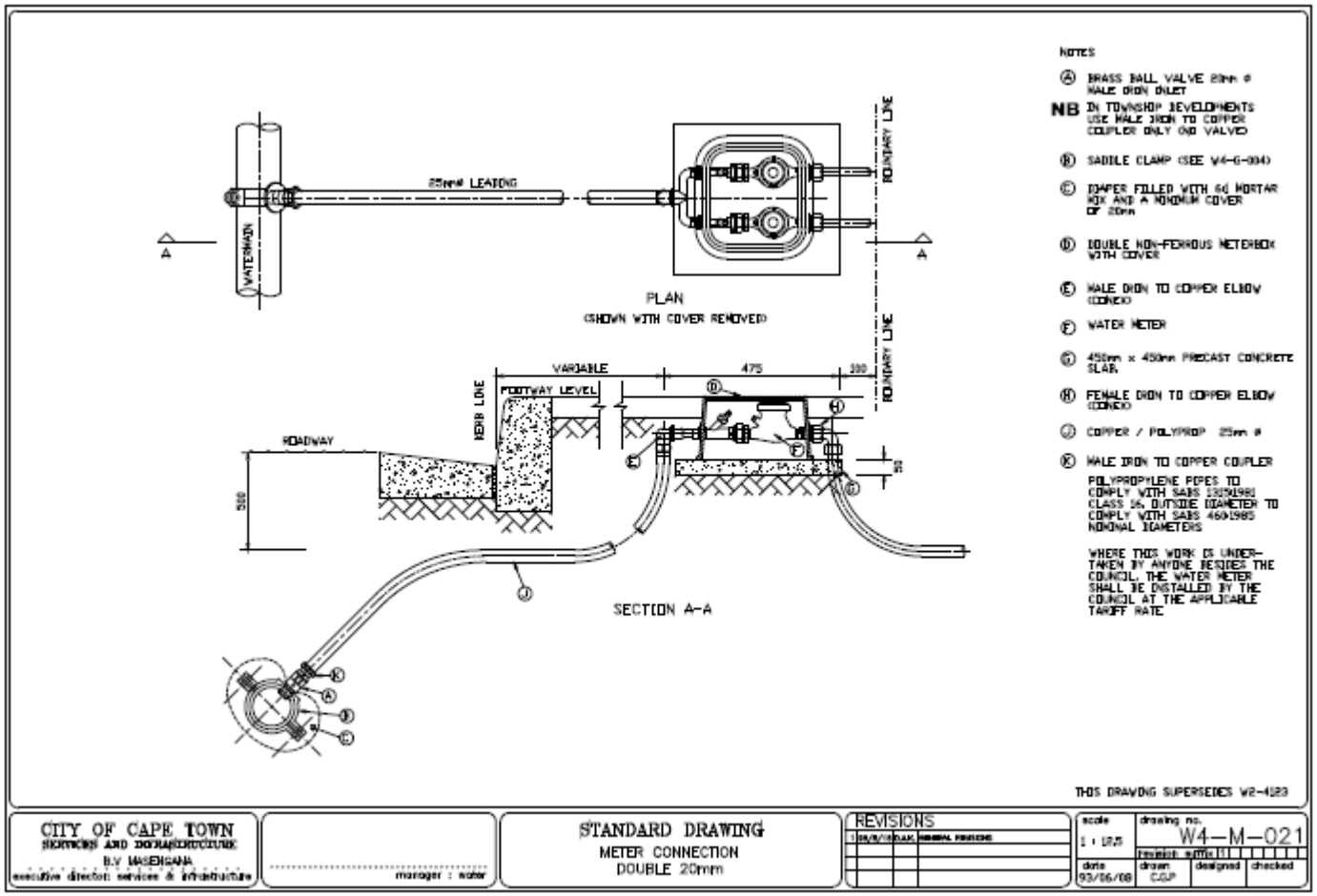
CITY OF CAPE TOWN
SERVICES AND INFRASTRUCTURE
B.V. WAGENAAR
executive director: services & infrastructure

manager : water

STANDARD DRAWING
METER CONNECTION SINGLE
20mm

REVISIONS			
1	05/11/12	S.A.K.	GENERAL REVISION
2	09/05/13	S.S.	GENERAL REVISION

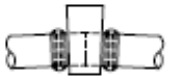
scale	drawing no.
1 : 12.5	W4–M–020
	revision suffix: 1 | 2
date: 05/08/13	drawn: G.G.F. | designed | checked


25mm# LEADING
WATERMAIN
BOUNDARY LINE
BOUNDARY LINE
A
A
PLAN
(SHOWN WITH COVER REMOVED)
VARIABLE
475
100
FOOTWAY LEVEL
KERB LINE
ROADWAY
500
50
SECTION A-A
NOTES
Ⓐ BRASS BALL VALVE 20mm ø MALE IRON INLET
NB IN TOWNSHIP DEVELOPMENTS USE MALE IRON TO COPPER COUPLER ONLY ONE VALVE
Ⓑ SADDLE CLAMP (SEE W4-G-004)
Ⓒ DIAPER FILLED WITH 4d MORTAR MIX AND A MINIMUM COVER OF 20mm
Ⓓ DOUBLE NON-FERROUS METERBOX WITH COVER
Ⓔ MALE IRON TO COPPER ELBOW (CONEX)
Ⓕ WATER METER
Ⓖ 450mm x 450mm PRECAST CONCRETE SLAB
Ⓗ FEMALE IRON TO COPPER ELBOW (CONEX)
Ⓙ COPPER / POLYPROP 25mm ø
Ⓚ MALE IRON TO COPPER COUPLER
POLYPROPYLENE PIPES TO COMPLY WITH SABS 1329/1981 CLASS 16, OUTSIDE DIAMETER TO COMPLY WITH SABS 460/1980 NOMINAL DIAMETERS
WHERE THIS WORK IS UNDERTAKEN BY ANYONE BESIDES THE COUNCIL, THE WATER METER SHALL BE INSTALLED BY THE COUNCIL AT THE APPLICABLE TARIFF RATE
THIS DRAWING SUPERSEDES W2-423
CITY OF CAPE TOWN
SERVICES AND INFRASTRUCTURE
B.V. MASEMGANA
executive director: services & infrastructure
manager : water
STANDARD DRAWING
METER CONNECTION
DOUBLE 20mm
REVISIONS
scale
1 : 10,5
drawing no.
W4-M-021
revision suffix
date
93/06/08
drawn
CJP
designed
checked

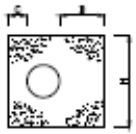
APPENDIX F: THRUST BLOCK

DIMENSIONS FOR HORIZONTAL THRUST BLOCKS (mm)

ANGLE	5.125°					11.25°					22.5°					45°					90°				
NOMINAL Ø	A	B	C	D	H	A	B	C	D	H	A	B	C	D	H	A	B	C	D	H	A	B	C	D	H
1830	1600	500	200	1300	2000	2000	1900	200	1200	3100	3600	2900	200	500	3400	6000	2900	200	1100	4000					
1675	1900	500	200	1300	2000	2900	1400	200	1250	2700	3500	2300	200	450	3000	6000	2800	200	1000	3400					
1525	1300	500	200	1100	2000	2000	1000	200	900	2400	3400	2000	200	450	2500	6000	2400	200	700	2800					
1370	1300	500	200	1100	1900	2500	800	200	1000	2200	2900	1600	200	400	2400	5400	2500	200	500	2500					
1220	1300	500	200	1100	1700	2450	600	200	2050	1900	2900	1400	200	1000	1900	5400	2000	200	400	2000					
1065	1150	500	200	1000	1500	2300	500	200	900	1600	2300	1200	200	300	1800	4300	1200	200	200	1900					
925	900	500	250	750	1400	1800	500	150	700	1500	2000	1000	250	300	1500	4000	1500	250	500	1500					
840	900	500	250	750	1300	1800	500	150	700	1400	1850	1000	250	200	1400	3600	1400	250	200	1400					
760	900	500	250	750	1200	1800	500	150	700	1200	1500	1000	250	400	1400	3000	1200	250	600	1400					
685	750	500	250	650	1200	850	500	150	600	1200	1300	800	250	300	1200	2600	1000	250	200	1300					
620	750	450	250	650	1100	850	400	150	600	1100	1200	800	250	450	1200	2300	1000	250	500	1200					
535	650	400	250	500	1000	700	400	150	500	1000	1100	700	250	300	1000	1900	800	250	450	1100					
463	650	400	250	500	900	700	400	150	500	900	900	600	250	400	900	1700	700	250	400	900					
388	600	400	250	500	800	670	400	150	500	800	800	500	250	400	800	1300	600	250	300	800					
305	500	400	250	400	700	600	400	150	400	700	500	300	250	250	700	950	500	250	100	700	1900	600	200	400	700
230	350	400	250	250	600	400	400	150	250	600	500	300	250	200	600	650	300	250	100	600	1200	400	300	300	600
150	300	300	250	250	400	300	300	150	250	400	300	300	250	100	400	300	300	250	100	400	800	400	100	100	400
100	300	300	250	250	400	300	300	150	250	400	300	300	250	100	400	300	300	250	100	400	500	300	100	100	400



DETAIL SHOWING DIAPERS



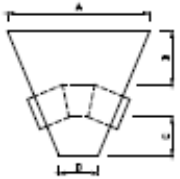
TYPICAL SECTION

PLAN 5.125°

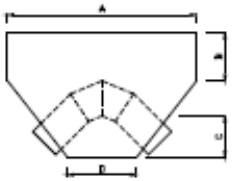
PLAN 11.25°

PLAN 22.5°

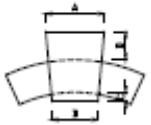
STEEL SEGMENTED BENDS



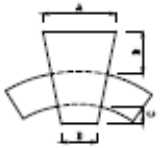
PLAN 45°



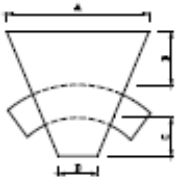
PLAN 90°



PLAN 11.25°

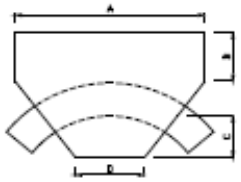


PLAN 22.5°



PLAN 45°

TYPICAL uPVC AND CAST IRON BENDS



PLAN 90°

THIS DRAWING SUPERSEDES W2-3315
W2-4214
W2-4215

CITY OF CAPE TOWN
(WATER AND SANITATION)
B.V. MSENGANA
executive director services & infrastructure

manager : water

STANDARD DRAWING
THRUST BLOCK SCHEDULE
FOR BENDS

REVISIONS

scale	N.T.S.	drawing no.	W4-G-005
		revision suffix	
date	92/12/08	drawn M.V.	designed / checked

SIZE OF TEE	A	B	C	D	E	90% FACE AREA (m^2)
100 X 100	360	250	200	280	280	0.10
150 X 100	360	250	200	280	280	0.10
225 X 100	360	250	200	280	280	0.10
300 X 100	500	250	200	300	300	0.10
375 X 100	575	250	200	300	300	0.10
450 X 100	650	250	200	300	300	0.10
150 X 150	300	250	200	770	300	0.23
225 X 150	450	250	200	550	450	0.23
300 X 150	500	250	200	460	460	0.23
375 X 150	660	250	200	400	400	0.23
450 X 150	660	250	200	400	400	0.23
225 X 225	450	350	200	1160	500	0.52
300 X 225	600	250	200	870	600	0.52
375 X 225	750	250	200	690	500	0.52
450 X 225	900	250	200	650	650	0.52
300 X 300	600	450	200	1530	600	0.92
375 X 300	750	400	200	1230	500	0.92
450 X 300	750	250	200	1230	750	0.92
375 X 375	750	750	200	1920	500	1.44
450 X 375	900	450	200	1600	750	1.44
450 X 450	1000	650	200	2000	750	2.08

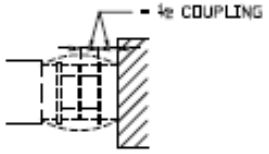
NOTES

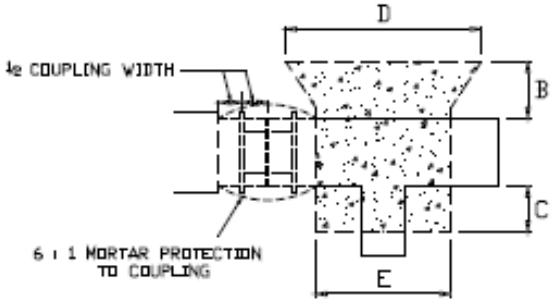
HEAD = 120m
ASSUMED b_p = 100 kN/m^2 (SAND)

VALUE FOR B GIVEN AS ABSOLUTE MINIMUM.

THRUST BLOCK TO BE CAST AGAINST UNDISTURBED EARTH.

THE BLOCK IS TO BE KEPT CLEAR OF THE COUPLING BY ½ THE WIDTH OF THE COUPLING ie:





THIS DRAWING SUPERSEDES W2-3535

CITY OF CAPE TOWN
SERVICES AND INFRASTRUCTURE
B.V. WAGENAAR
executive director: services & infrastructure

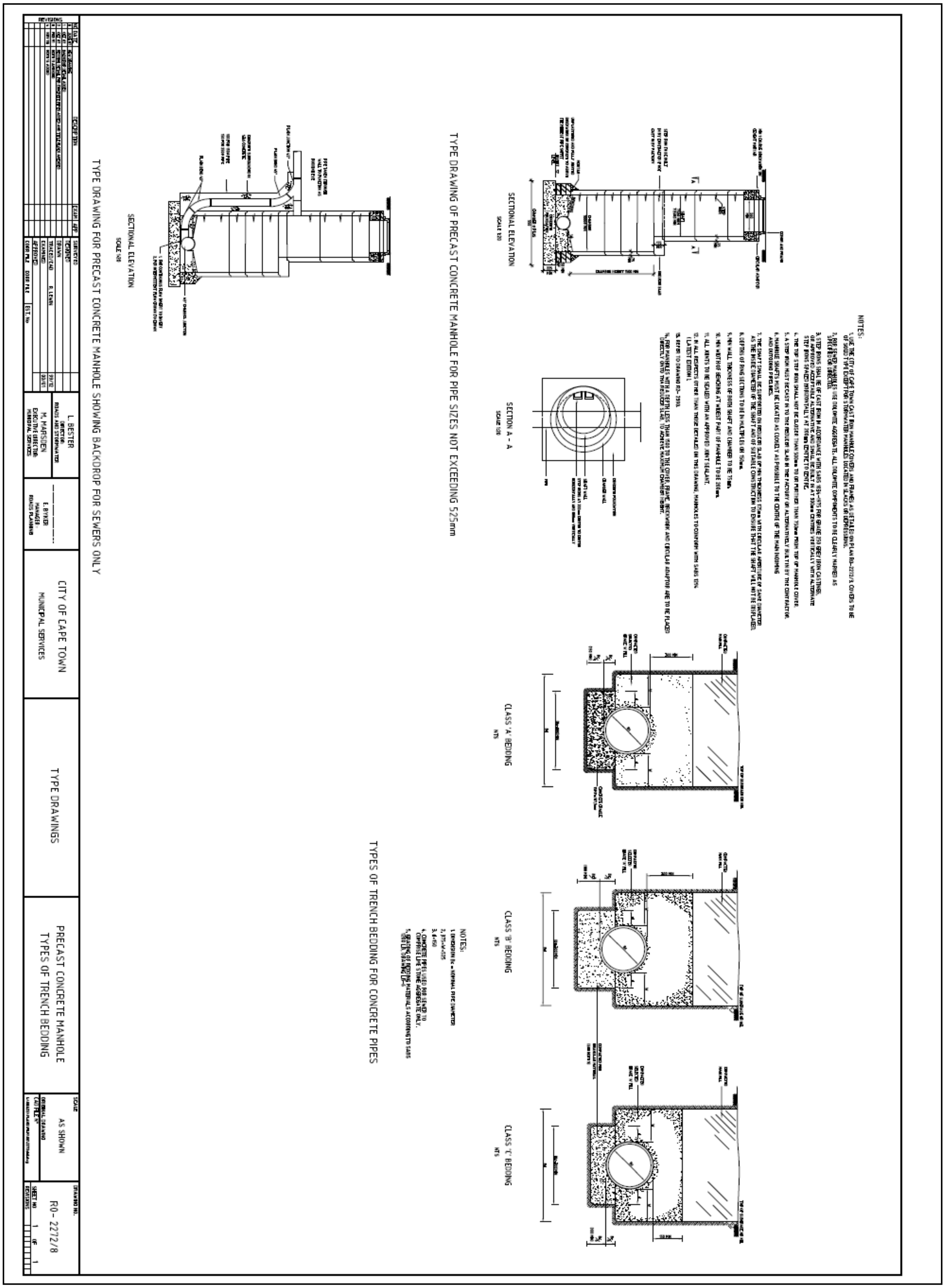
..... manager : water

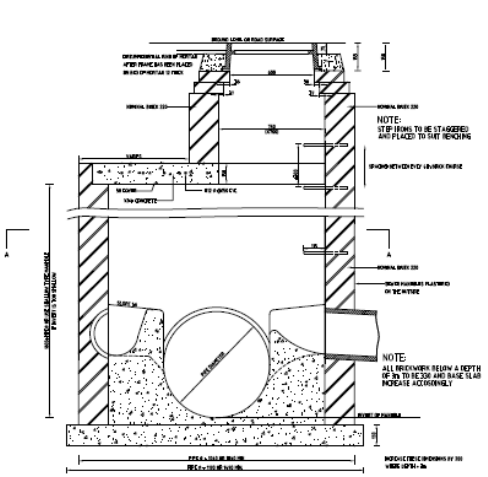
STANDARD DRAWING
THRUST BLOCK SCHEDULE FOR TEE'S

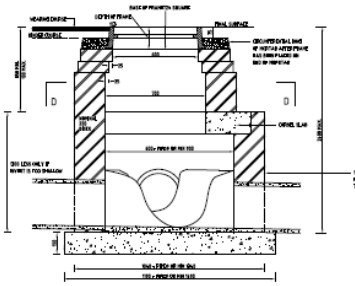
REVISIONS

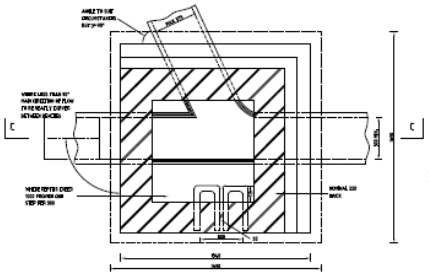
scale N.T.S.
drawing no. W4-G-006
revision suffix
date 92/12/08
drawn M.V.
designed
checked

APPENDIX G: MANHOLE

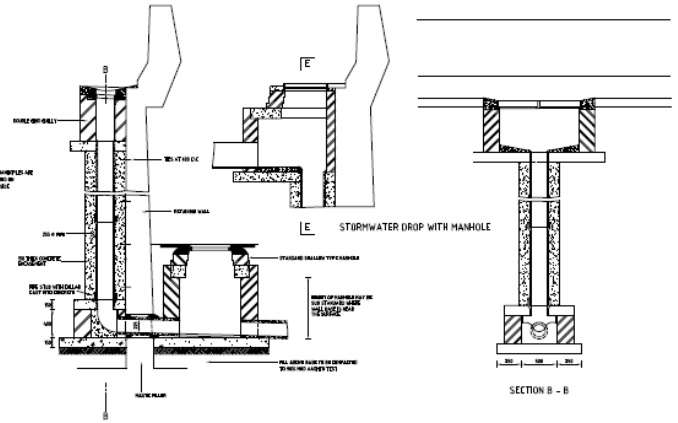

TYPE DRAWING FOR PRECAST CONCRETE MANHOLE SHOWING BACKDROP FOR SEWERS ONLY
SECTIONAL ELEVATION
TYPE DRAWING OF PRECAST CONCRETE MANHOLE FOR PIPE SIZES NOT EXCEEDING 525mm
SECTIONAL ELEVATION
SECTION A - A
NOTES:
CLASS 'A' BEDDING
CLASS 'B' BEDDING
CLASS 'C' BEDDING
TYPES OF TRENCH BEDDING FOR CONCRETE PIPES
L. BESTER
M. MARSDEN
CITY OF CAPE TOWN
MUNICIPAL SERVICES
TYPE DRAWINGS
PRECAST CONCRETE MANHOLE
TYPES OF TRENCH BEDDING
AS SHOWN
RO- 2272/8







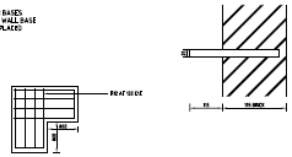
TYPE SHALLOW MANHOLE

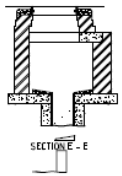


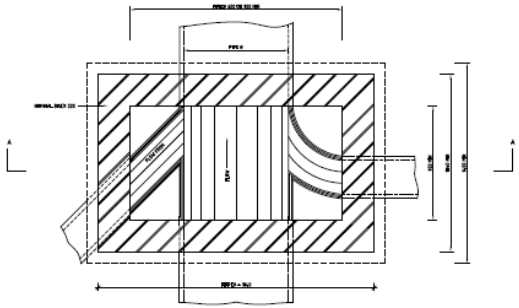
STORMWATER DROP AT RETAINING WALLS

SCALE 1:20

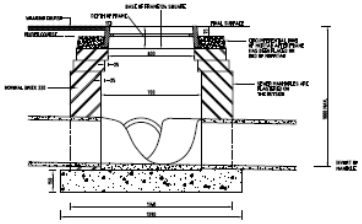
NOTE:
WHERE MANHOLE AND CHAMBER BASES ARE CAST DIRECTLY ON TOP OF WALL BASE THE MASTIC PILLAR IS TO BE REPLACED BY CONCRETE.



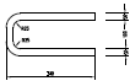




SECTIONAL PLAN
TYPE DEEP MANHOLE
SCALE 1:10

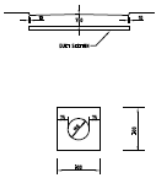


TYPE SHALLOW MANHOLE LESS THAN 1,0m
SCALE 1:10



PLAN

DETAILS OF CAST IRON STEP
SCALE 1:5



PARKS AND FORESTS- DUCT SECTION
SCALE 1:10

NOTE:
1. MANHOLES TO BE CONSTRUCTED ON SEWERS SHALL BE PLASTERED EXTERNALLY AND DOLOMITIC AGGREGATE SHALL BE USED IN ALL CONCRETE.
2. BRICKWORK FOR MANHOLES AND DRAINAGE STRUCTURES BRICKS- ENGINEERING GRADE IN ACCORDANCE WITH S.A.B.S. 227 (1986) NOMINAL COMPRESSIVE STRENGTH 21MPa. MORTAR: CLASS 1 IN ACCORDANCE WITH S.A.B.S. 0164.

NO	DATE	DESCRIPTION	CHAN	APP
1	JUNE 01	CONCRETE UPDATE		

SURVEYED
DESIGNED
DRAWN
TRACED/CAD R. LEVEN
EXAMINED
APPROVED
CORR FILE CORR FILE EST. No

L. BESTER
DIRECTOR: ROADS AND STORMWATER

M. MARSDEN
EXECUTIVE DIRECTOR: MUNICIPAL SERVICES

E. BYKER
MANAGER: ROADS PLANNING

CITY OF CAPE TOWN
MUNICIPAL SERVICES

TYPE DRAWINGS

DEEP MANHOLE
SHALLOW MANHOLE
STORMWATER DROP

SCALE: AS SHOWN
GENERAL DRAWING
COPYRIGHT RESERVED

DRAWING NO.: R0- 2272/2
SHEET NO 1 OF 1
REVISIONS

APPENDIX H: DESIGN SPECS

Table BMS5.2: Operating min/max velocities and design spare capacities

Flow Velocities		
Minimum (m/s)	Maximum (m/s)	Absolute Maximum (m/s)
Gravity mains		
0.60	2.50	4.00
Rising mains		
0.60	1.50	2.50
Spare Capacities		
Flow Condition	Minimum (%)	Absolute Minimum (%)
Gravity mains		
IPDWF	30	25
IPWWF	0	-5

Table BMS5.1: Minimum gradients for ±0,65 m/s full flow velocity

Pipe Diameter			Class	Material	Minimum gradient 1 in … (Manning n = 0,012)
Nominal (mm)	Outside (mm)	Inside (mm)			
110	110	104	34	uPVC	120
160	160	151	34	uPVC	200
200	200	188	34	uPVC	250
250	250	235	34	uPVC	350
300	368	272	75D	Concrete	450
375	445	343	75D	Concrete	600
450	533	416	75D	Concrete	800
525	616	534	50D	Concrete	1 100
600	699	611	50D	Concrete	1 400
675	787	685	50D	Concrete	1 500
750	870	762	50D	Concrete	1 800
825	946	830	50D	Concrete	2 000
900	1 041	913	50D	Concrete	2 300
1 050	1 194	1 066	25D	Concrete	2 800
1 200	1 365	1 219	25D	Concrete	3 400
1 350	1 524	1 372	25D	Concrete	3 900
1 500	1 689	1 523	25D	Concrete	4 500
1 650	1 878	1 700	25D	Concrete	5 200
1 800	2 019	1 803	25D	Concrete	5 700

Table DW5.3:Design and evaluation criteria - Reservoirs and bulk supply

RESERVOIRS	Guideline	Comment
Emergency volume	33h to 42h x AADD	
Balancing volume	6h to 15h x AADD	Depends on feeder cap & type of demand
Total volume	48h x AADD	Find optimum
Feeder system capacity	PWF to PDF x AADD	Depends on res. cap & type of demand
WATER TOWERS	**Guideline**	**Comment**
Total volume	2h to 6h x AADD	To prevent many short pump cycles
Feeder system capacity	1,1 x PHF x AADD	No drawdown during pump cycle

Table SW5.1: Design and evaluation criteria - Peak factors for water demand

Predominant land use	AADD (kℓ/d)	PWF	PDF	PHF
Low cost housing	<1000	1.50	1.90	3.60
	1000 - 5000	1.40	1.80	3.40
	5000 - 10000	1.35	1.70	3.30
	10000 - 15000	1.30	1.50	3.20
	15000 - 20000	1.25	1.40	3.10
	>20000	1.25	1.40	3.00
Residential	<1000	1.80	2.20	4.60
	1000 - 5000	1.65	2.00	4.00
	5000 - 10000	1.50	1.80	3.60
	10000 - 15000	1.40	1.60	3.50
	15000 - 20000	1.35	1.50	3.30
	>20000	1.30	1.50	3.00
Business/Commercial/Industrial	<5000	1.45	1.70	3.30
	5000 - 10000	1.30	1.60	3.15
	>10000	1.25	1.50	3.00

Table SW5.2:Design and evaluation criteria - Flow and pressure

Flow Condition			Min./Max. Pressure (m)	Absolute Min./Max. Pressure (m)
Peak hour demand - min.			20 to 24	16 to 20
Static (no demand) - max.			90	120
Fire flow (@ peak hour demand)			See below	
Area where fire occurs	**Total fire flow (ℓ/s)**	**Flow at hydrant (ℓ/s)**	**Min. pressure at fire (m)**	**Min. pressure rest of system (m)**
Industrial/business:				
- High risk	100 to 200	25	10 to 15	10
- Moderate risk	50 to 100	25	10 to 15	10
Residential:				
- High rise flats	50 to 100	25	10 to 15	10
- Cluster housing > 30 units/ha	50	25	7 to 10	5
- Cluster housing < 30 units/ha	25	25	7	5
- Low density single residential	15	15	5	5
- Medium density single residential	9	9	3	5
- High density single residential	6	6	3	5

APPENDIX I: INFORMAL SETTLEMENTS SANITATTION