

WATER AUTHORITY – CAYMAN

GUIDELINES FOR CONSTRUCTING SEWERS

1.0 INTRODUCTION

1.1 These guidelines apply to all sewer pipelines that are to be connected to the Cayman Islands Water Authority sewerage system.

1.2 Scale drawings of the proposed sewer lines must be submitted to the Water Authority and written approval given by same prior to the commencement of construction in order to ensure that the pipes will be installed in a manner which conforms to good engineering practice and to the specifications required by the Water Authority.

1.3 The Water Authority will supervise the installation of the sewer pipelines according to an inspection schedule agreed upon at the time written approval is given.

1.4 The Water Authority is prepared to assume ownership and responsibility for all pipelines that are laid in accordance with these guidelines and reserves the right to refuse to connect its sewerage system to any pipeline that fails to meet these standards.

2.0 MATERIALS

All pipes and fittings shall be constructed with materials approved by the Water Authority in advance of construction.

2.1 Pipes

2.1.1 PVC pipes for gravity sewers shall meet the requirements of ASTM D 3034, SDR 35. These pipes shall have socket/spigot (push-fit) joints with elastomeric gaskets.

2.1.2 Minimum pipe size for gravity sewers shall be four (4) inches nominal diameter.

2.1.3 PVC pipes for pressure sewer mains shall be manufactured in accordance with the latest edition of AWWA C900 (12" nominal diameter and smaller) or C905 (14" nominal diameter and larger) with cast-iron- pipe-equivalent (CI equivalent) outside diameter dimensions. These pipes shall have socket/spigot (push-fit) joints with elastomeric gaskets. The dimension ratio (DR), the ratio of the outside pipe diameter divided by the minimum wall thickness, shall be no larger than DR18.

2.2 Fittings

2.2.1 All PVC fittings installed in pressure sewer mains shall be manufactured to the same requirements as the PVC pipe. Fittings shall be PVC injection-molded or fabricated as specified in AWWA C900/C905 standard. These fittings shall have socket/spigot (push-fit) joints with elastomeric gaskets.

2.2.2 Fabricated fittings shall be manufactured with pipe that meets or exceeds AWWA C900/C905.

2.2.3 PVC fittings shall be pressure rated to 150 psi or greater.

2.3 Valves

2.3.1 Valves which are to be installed in pressure mains shall be flanged, ductile iron valves rated to 150 psi working pressure. Flanges shall be ANSI B16.1 (Class 125). All valves (plug, check, air release etc) shall be approved by the Water Authority.

2.4 Corrosion Protection of Buried Metal Piping Specialties and Flanges

Where their use has been approved by the Water Authority, all buried metal piping specialties (flange adaptors, joint restraints, mechanical couplings, step-couplings etc.) and their flanges, fixing bolts, metal

straps etc shall be protected against the corrosive effects of groundwater by wrapping in Denso profiling mastic and/or Densyl tape, or an approved equivalent.

2.5 Pre-cast Concrete Manholes

2.5.1 Pre-cast concrete manhole rings shall be reinforced and shall comply with the requirements of ASTM C76, C655 and C44, AWWA C300 or approved equivalent.

2.5.2 All pre-cast concrete units, cover slabs and reducing slabs shall be manufactured using sulphate resisting Portland cement (Type II or Type V).

2.5.3 Pre-cast concrete manhole rings shall be provided with a PVC sheet liner to effectively protect the exposed concrete surfaces from corrosion. The liner shall be continuous and free of pinholes. The liner shall be Ameron T-Lock or approved equivalent.

2.6 Manhole Covers and Frames

2.6.1 All manhole covers and frames shall be manufactured from ductile iron or gray iron complying with the requirements of ASTM A-48 Class 35.

2.6.2 All manhole covers and frames shall be heavy duty classification for traffic bearing to meet AASHTO H-20 loadings of 16,000 lbs wheel loads.

2.6.3 Manhole frames and covers shall have a clear opening of no less than twenty four inches (24").

2.6.4 There shall be no holes or perforations in the cover. "Pick" holes shall be provided, but shall not penetrate the cover.

2.6.5 The seating surfaces between frames and covers shall be machined to ensure proper fit and prevent rocking and rattling; a rubber gasket shall be provided between frame and cover to ensure watertightness.

3.0 TRENCHING

3.1 Setting-out of Pipeline Route

3.1.1 Prior to the commencement of trenching operations the Contractor shall ensure that property boundaries along the route of the proposed pipeline are surveyed (by a qualified land surveyor) and flagged or otherwise clearly identified. The proposed pipeline route shall be set-out no closer than four feet (4 ft) from any property line or boundary.

3.2 Trench Depth

3.2.1 Roads along which pipelines are to be installed shall be completed to within two inches (2") of the final road elevation (to allow for final grading and a wearing surface) prior to the commencement of pipelaying operations.

3.2.2 Pipes shall be laid with a minimum of 30 inches cover from the top of the pipe to the finished ground level (see Figure 1).

3.2.3 If, arising from the Contractor's method of working, the trench is excavated below the required grade, all parts of the trench excavated below the grade shall, at the Contractor's expense, be filled in with crushed rock or gravel, maximum size 1 inch, over the full width of the trench in compacted layers not exceeding six (6) inches deep to the established grade (with due allowance for the pipe base or special bedding).

3.3 Trench Width

3.3.1 The minimum trench width is that width between the faces of the soil required to ensure the correct placing and compaction of bedding and backfill materials equally on either side of the pipe. All sheeting and supports are to be outside this width.

3.3.2 The minimum trench width for pipe sizes up to and including four (4) inch nominal diameter is twelve (12) inches.

3.3.3 For pipe sizes over four (4) inch nominal diameter the trench must be wide enough to allow six (6) inches of space on each side of the pipe. (For example when laying an eight (8) inch diameter pipe, the trench must be at least $6" + 8" + 6" = 20"$ wide.)

3.4 Trench Bottom

The trench bottom shall be at a constant grade and free from high or low spots that could cause the pipe to be supported unevenly. The bottom of the trench shall be raked smooth to remove any large stones or other unacceptable material.

3.5 Unsuitable Material at Bottom of Trench

3.5.1 When, in the opinion of the Water Authority, the existing material in the bottom of the trench is unsuitable for supporting the pipe, the contractor shall excavate below the invert of the pipe, as directed by the Water Authority.

3.5.2 Where the bottom of the trench is above the water table, the trench shall then be backfilled to specified pipe grade over its entire width with 1-inch minus crushed rock. This material shall be well graded from coarse to fine (with no more than 20 percent fines passing the No.200 sieve) and be free from organic materials. The crushed rock shall be compacted in layers not exceeding six (6) inches deep to the required grade (with allowance for the pipe base or special bedding).

3.5.3 Where the bottom of the trench is below the water table, the trench shall be backfilled over its entire width to the specified pipe grade (with allowance for the pipe base or special bedding) with clean, washed gravel (maximum size 1") free from organic materials.

4.0 PIPE BEDDING

4.1 General

4.1.1 Pipe bedding material (see 4.2 and 4.3 below) shall be placed by hand in the excavation below the invert level of the pipe and shall be tamped and rammed by hand to provide a dense well compacted bed free from soft spots throughout the length of the pipeline. Pockets shall be provided in the surface of the bedding to accommodate pipe joints and all hard spots that would prevent a uniform bearing shall be removed.

4.1.2 Gravity sewers shall be bedded as specified for Wet Conditions (see 4.3 below)

4.1.3 Stones, bricks or similar materials shall not be used below or against the pipes to locate them in position in the trench or to level the pipes. Sufficient of the infill materials shall be placed around the barrels of pipes to prevent movement.

4.1.4 After the pipes have been properly bedded, granular material shall be carefully placed into the spaces between the pipe and the sides of the trench to the level of the crown of the pipe. The bedding material shall be thoroughly packed and rammed by careful hand tamping in layers not exceeding 6" (150mm) thick before compaction.

4.2 Dry Conditions

4.2.1 All pipes laid in dry conditions shall be bedded on a minimum of 4 inches of clean, dry crusher run, marl or sand, free from stones, sticks or other unacceptable material.

4.2.2 After jointing of the pipe, additional bedding material shall be placed and firmly compacted by hand around the pipe up to half of the pipe diameter. The placing and the tamping of the material shall proceed equally on both sides of the pipe.

4.3 Wet Conditions

4.3.1 All pipes laid in wet conditions shall be bedded on a minimum of 4 inches of 3/8 inch washed gravel.

4.3.2 After jointing of the pipe, additional 3/8 inch washed gravel shall be placed by hand around the pipe up to half of the pipe diameter. The placing and the tamping of the material shall proceed equally on both sides of the pipe.

5.0 PIPELAYING

5.1 General

5.1.1 Pipes shall be stored and handled carefully and shall be protected from the effects of temperature and UV radiation in accordance with the manufacturer's recommendations.

5.1.2 Pipe laying shall not commence until the bottom of the trench and the pipe bedding have been approved.

5.1.3 Pipes shall be brought to the correct alignment and inclination, concentric with the pipes already laid.

5.2 Jointing of Pipes

5.2.1 Joints shall be made strictly in accordance with the manufacturer's instructions.

5.2.2 Before making any joints, all jointing surfaces shall be thoroughly cleaned and maintained in such condition until the joints have been completely made or assembled.

5.2.3 Notwithstanding any flexibility provided in the pipe joints, pipes must be securely positioned to prevent movement during and after making of the joint.

5.2.4 All pipes shall be accurately marked prior to laying to ensure that the gap between the end of the spigot and the shoulder of the socket when jointed shall be as recommended by the manufacturer.

6.0 MANHOLES

6.1 Manholes - General

6.1.1 Pipes in and out of manholes shall be as short as practicable but not exceeding 18". Pipes shall be connected to the manhole base either through an asbestos cement manhole adaptor monolithically cast in the base or through a Kor-N-Seal joint ("rubber boot"), or approved equivalent, secured in a carefully cored hole in the manhole base as per manufacturer's instructions (see Figures 3 and 4).

6.1.2 The depth of the main channel shall not be less than the diameter of the largest pipe. The main channel invert shall be formed in granolithic concrete trowelled smooth. Granolithic concrete shall be concrete with coarse aggregate size not exceeding 1/4".

6.1.3 Branches shall be curved in the direction of flow and shall be formed in granolithic concrete trowelled smooth.

6.1.4 Bases and benching shall be formed in 3000 psi concrete; benching shall be rendered in granolithic concrete 2" thick trowelled smooth and shall slope towards the main channel at a slope of 1 in 12.

6.1.5 Manhole covers and frames shall be fixed in the positions shown; the frames shall be solidly bedded in cement mortar so that the covers when in position are fair and even with the adjacent surfaces.

6.1.6 Manholes shall be constructed without step irons.

6.1.7 Cover slabs and bases shall be suitably reinforced, minimum cover to steel shall be 1.5", and the concrete shall be 3000 psi.

6.2 Manholes - Precast Concrete

6.2.1 Precast concrete manholes shall be constructed as shown on Figure 3 using precast concrete components set on bases formed from in situ concrete. The lowest chamber ring shall be bedded on and haunched with cement mortar and likewise the precast concrete cover slab shall be bedded on the topmost ring on cement mortar.

6.2.2 The underside of the top slab and the inside faces of each manhole ring shall be protected with a continuous PVC sheet liner. The remaining faces of the joints of the precast rings shall be sealed with an approved preformed jointing strip applied strictly in accordance with the manufacturer's instructions.

6.2.3 Lifting holes in precast units shall be cleaned and filled with cement mortar.

6.2.4 After the manhole has been successfully tested for infiltration as per Sub-Clause 11.1, the joint between the precast concrete sections shall be sealed with separate 4" joint strip as per manufacturer's specifications.

6.3 Manholes - Blockwork

6.3.1 Blockwork manholes shall be constructed as shown on Figure 4 using precast concrete blocks set on bases formed from in situ concrete.

6.3.2 After the manhole has been successfully tested for infiltration as per Sub-Clause 11.1, the underside of the top slab and the inside faces shall be protected with a continuous PVC sheet liner. The liner shall be attached to the plastered surface with mechanical fasteners of a type approved by the Water Authority.

7.0 THRUST BLOCKS

7.1 Pressure sewers shall have thrust blocks at all bends, junctions, changes of direction and at all changes in pipe diameter to prevent movement of the pipelines due to the thrust from hydraulic pressure.

7.2 Concrete thrust blocks shall be placed in such positions and sized as shown in the attached drawing (Figure 2) and the schedule below:

	90° bend	45° bend	22.5° bend	11.25° bend	Taper, Cross, Tee, End Cap
Pipe size	Dimension A	Dimension A	Dimension A	Dimension A	Dimension A
6"	15"	8"	4"	4"	12"
4"	10"	6"	3"	3"	8"
3"	10"	6"	3"	3"	8"

7.3 The concrete used for the thrust blocks shall have a minimum compressive strength of 3,000 psi after 28 days. The use of early strength cement will be required if a hydrostatic test is required within 5 days following the installation of the thrust blocks.

7.4 Thrust blocks shall always be poured against undisturbed ground. Any loose or disturbed material shall be removed immediately before the concrete is placed.

8.0 BACKFILLING (PIPE ZONE)

8.1 Granular backfill in the pipe zone (see Figure 1) shall be clean crushed rock or dry marl, reasonably well graded from coarse to fine. The maximum size shall be 1 inch. Sand may be used in lieu of 1-inch minus material. Soils having more than 20 percent of its weight passing a No.200 sieve shall not be used for backfill. Excavated material may be used if it meets the criteria of granular backfill.

8.2 The backfill shall be compacted taking care to compact the material on both sides as well as on top of the pipe to ensure that firm support is obtained to prevent any lateral movement of the pipe during the final backfill. Backfilling and compacting shall be done by hand until a layer of not less than 12 inches cover is built over the pipe. Backfill shall be placed in horizontal lifts not exceeding six (6) inches in uncompacted thickness on both sides of the pipe. Compaction shall be accomplished by thoroughly tamping and 'walking in' the material. Proper care shall be taken not to place any stones, sticks or other rubbish on or near the pipe.

9.0 MARKER TAPE

9.1 All pipelines shall be marked with magnetically detectable tape. This tape shall be at least 2" wide and shall be green in colour. It shall be marked "SEWER LINE BELOW" (or similar approved wording) continuously along its length.

9.2 The tape shall be buried approximately 12 inches above the top of the pipe and continuously along the length of the line. When the tape has to be joined, the ends shall be tied together in a tight knot.

10.0 GENERAL BACKFILLING

Upon completion of backfilling in the pipe zone (See Figure 1), the remainder of the trench can be filled and compacted using excavated material and by mechanical means if required. The excavated material shall be free of organic material and shall contain no particles in excess of 2 inches.

11.0 TESTING

11.1 Testing of Manholes

11.1.1 The Contractor shall give the Water Authority not less than twenty-four (24) hours notice of his intention to test completed manholes. A suitably qualified staff member of the Water Authority shall be present at the beginning of the test and shall be present when the infiltration flow is measured on completion of the test.

11.1.2 Manholes shall be tested for infiltration over a period of no less than 24 hours. Testing of manholes shall be carried out before application of the PVC liner.

11.1.3 All inlets into the manhole(s) shall be effectively closed and the manhole pumped dry. After the start of the test, all residual flows shall be considered to be infiltration.

11.1.4 Infiltration to manholes shall not exceed 1.25 U.S gallons per hour per manhole.

11.1.5 On successful completion of the infiltration test and the installation of PVC joint strips (where applicable), all surfaces covered with PVC sheet lining, including welds, shall be tested with an approved electrical holiday detector with the instrument set at 20,000 volts minimum.

11.2 Testing Gravity Sewers

11.2.1 The bore, linearity and jointing of all sewer pipelines shall be checked by drawing through each completed length of pipe a mandrel 30" long and 1/2" less in diameter than the nominal bore of the pipe unless an alternative method of checking is approved.

11.2.2 The Contractor shall give the Water Authority not less than twenty-four (24) hours notice of his intention to test completed sewer sections. A suitably qualified staff member of the Water Authority shall be present at the beginning of the test and shall be present on completion of the test.

11.2.3 Wherever possible, testing shall be carried out from manhole to manhole. Short branch drains connected to a main sewer between manholes shall be tested as one system with the main sewer. Long branches shall be tested separately.

11.2.4 Sewers shall be tested after backfilling has been completed.

11.2.5 Shallow sewers, i.e. pipeline sections with the deepest soffit less than 18" below water table, shall be tested in one of the following ways:

a) Water Test

A test pressure of 48" head of water above the soffit of the sewer shall be applied at the high end by means of a standpipe. A period of 1 hour shall be allowed for absorption. The loss of water over a period of 30 minutes shall be measured by adding water from a measuring vessel at regular intervals of 10 minutes and noting the quantity required to maintain the original water level in the standpipe. The average quantity of water added shall not exceed 0.2 U.S. gallons per hour per 100 lineal feet per inch of nominal bore of the sewer.

b) Air Test

The length of sewer under test shall be effectively plugged and air pumped in by suitable means e.g. a hand pump, until a pressure of 4 inches head of water is indicated in a U-tube connected to the system. The air pressure shall not fall less than 3 inches head of water during a period of 5 minutes, without further pumping, after a period for requisite stabilisation.

11.2.6 Deep sewers, i.e. pipeline sections with the shallowest soffit more than 18" below water table, shall be tested for infiltration. All inlets to the system shall be effectively closed and the residual flow shall be deemed to be infiltration. The amount of infiltration shall not exceed 0.2 US gallons per hour per 100 lineal feet per inch of nominal bore of the sewer.

11.3 Testing Pressure Sewers

11.3.1 Pressure testing shall be carried out to prove the structural soundness of the various components of the pipeline, including pipes, valves and anchorages, and to prove the watertightness of the line.

11.3.2 The Contractor may, if field conditions permit, partially backfill the trench and leave the joints open for inspection and conduct (at his own expense) an initial leak test. The actual pressure test, however, shall not be conducted until all backfilling has been completed.

11.3.3 Prior to testing (including the initial leak test if the Contractor wishes to conduct such a test), the pipeline shall be filled with clean water and all air released. Care shall be taken during the filling of the mains to provide free outlets for air to prevent surging and water-hammer.

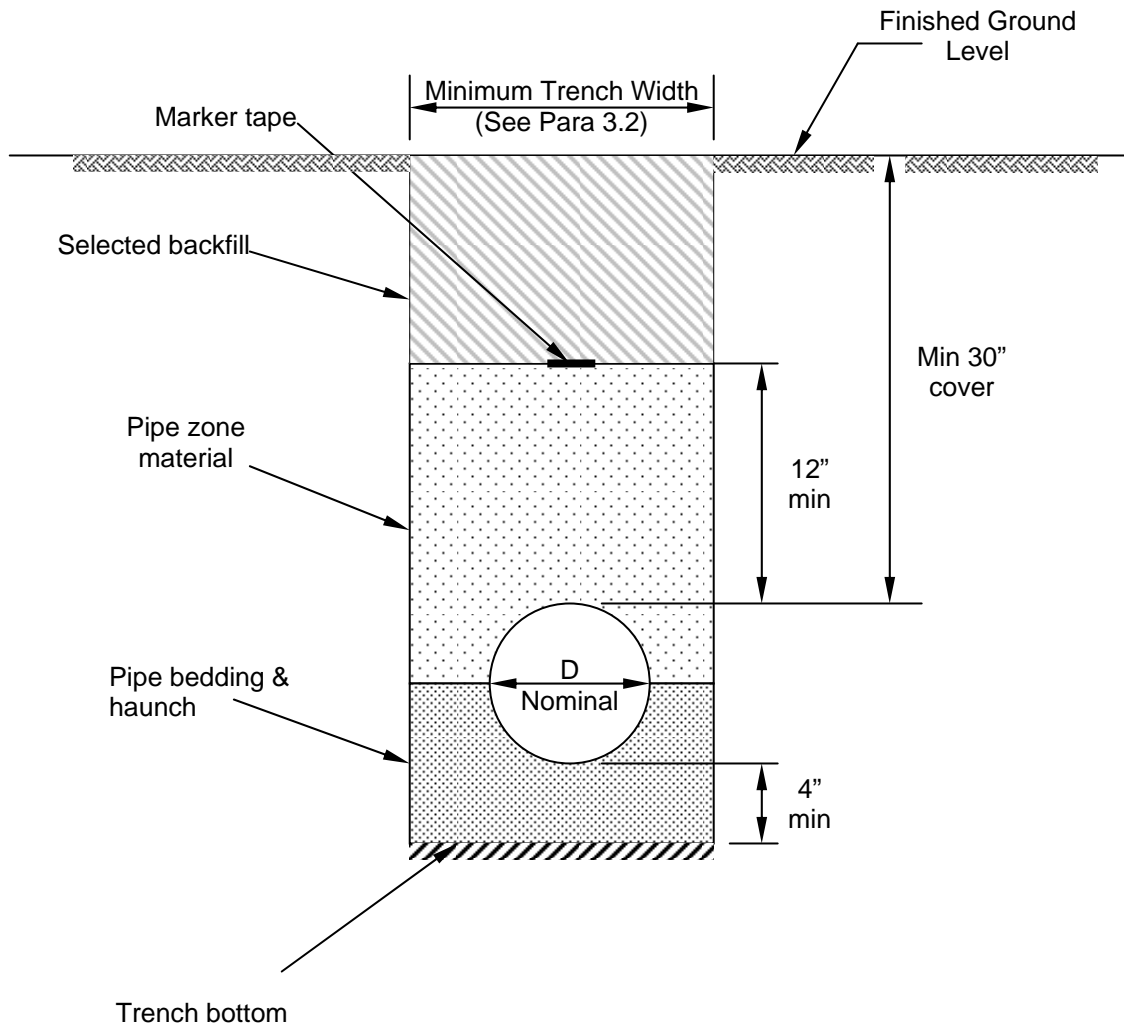
11.3.4 The Contractor shall give the Water Authority not less than twenty-four (24) hours notice of his intention to test a section of or the entire pipeline. A suitably qualified staff member of the Water Authority shall be present at the beginning of the test and shall inspect the test after it has been completed.

11.3.5 All pipes shall be tested to a minimum of 100 psi and shall maintain this pressure for a minimum period of 24 hours. The specific testing procedure shall be approved by the Water Authority prior to beginning an official test.

12.0 CLEANING PIPELINES

Immediately before being handed over to the Water Authority, every sewer pipeline shall be thoroughly cleaned and shall be flushed with clean water while being rodded from manhole to manhole with a rubber tipped plunger the same size as the bore of the pipe. Manholes shall be washed down, emptied and left to dry.

FIGURE 1



TYPICAL PIPE TRENCH DETAILS

(Not to Scale)

FIGURE 2

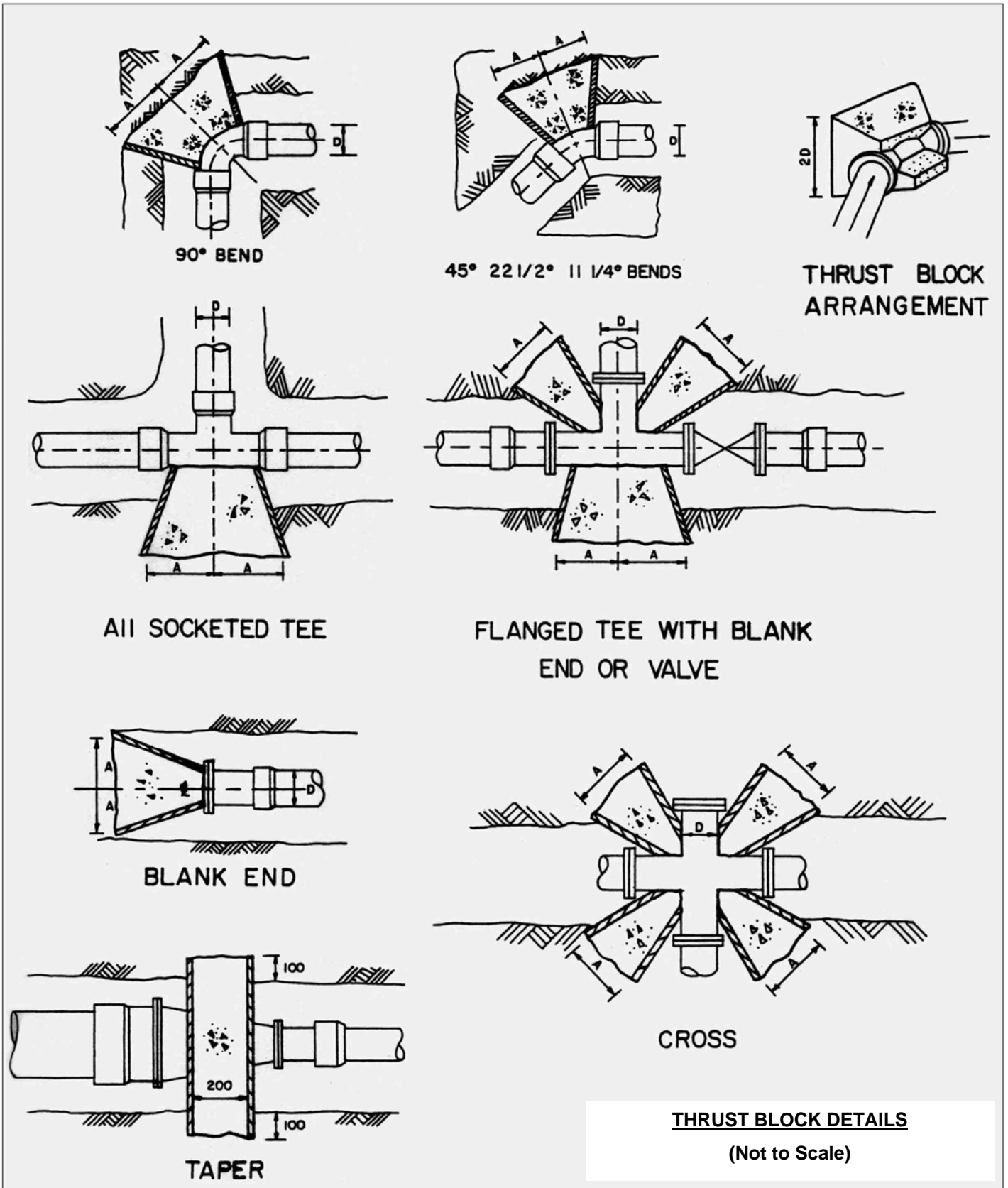
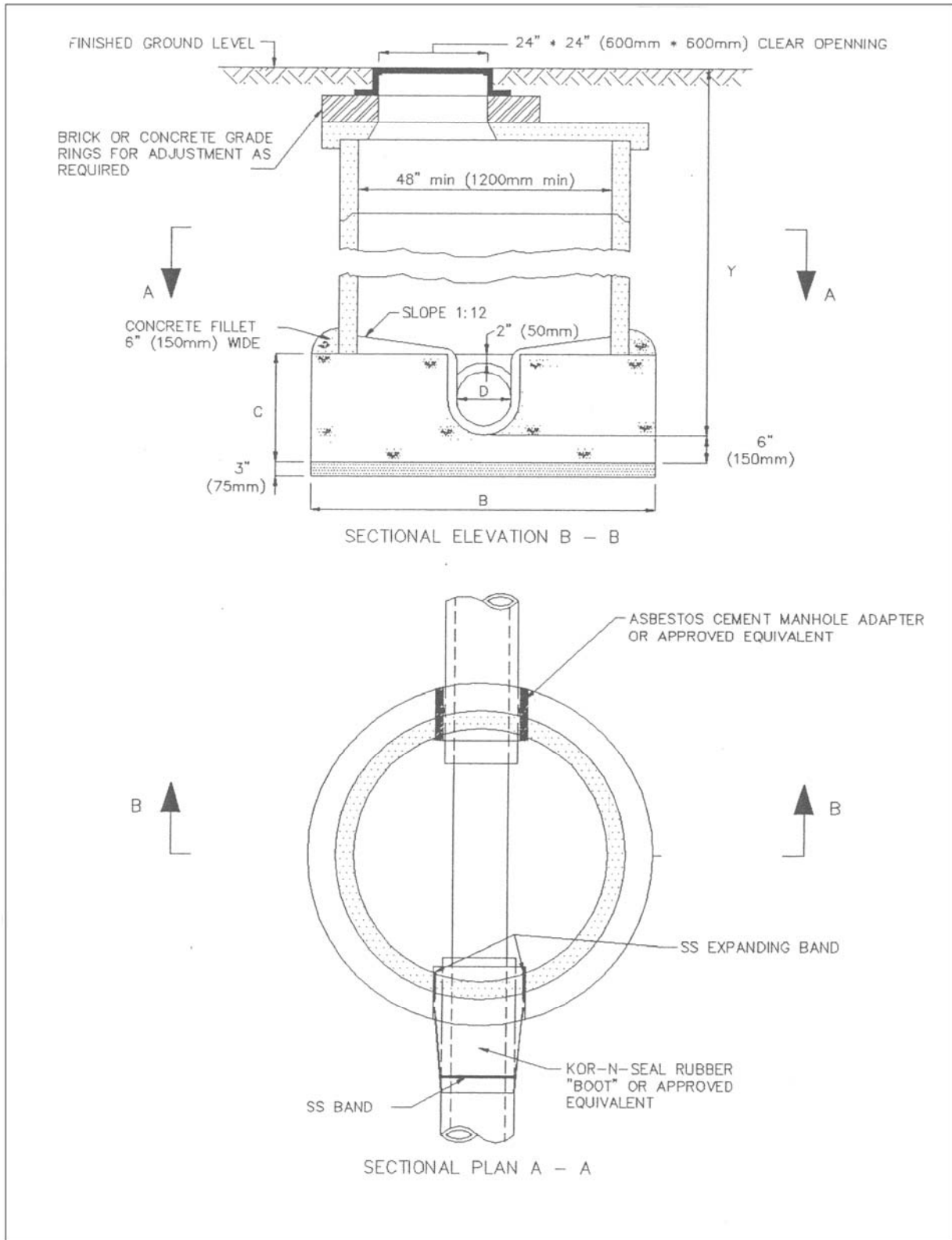


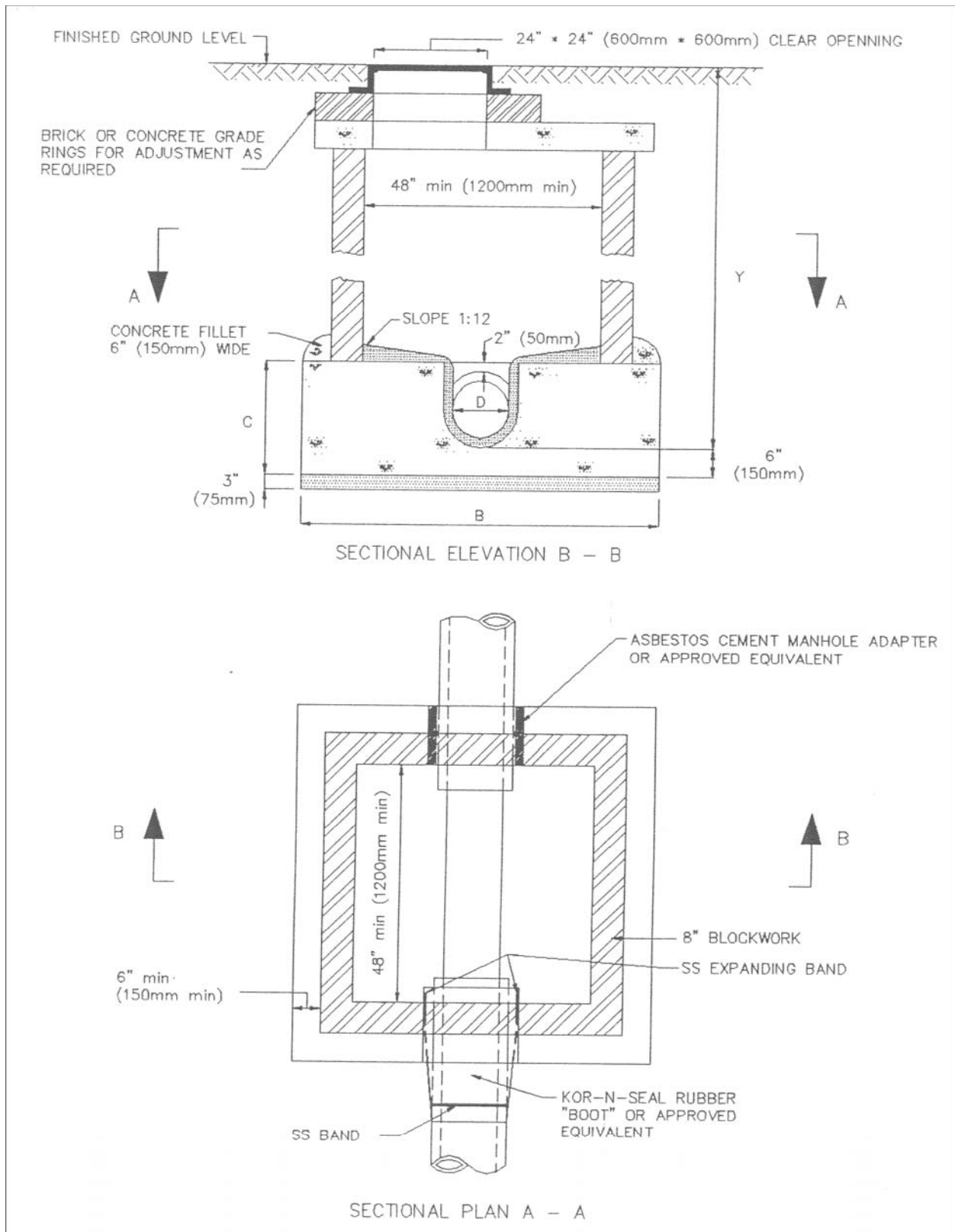
FIGURE 3



**PRECAST CONCRETE CIRCULAR
MANHOLE**

(Not to Scale)

FIGURE 4



BLOCKWORK MANHOLE

(Not to Scale)