

Earlsfield Park, Phase 02

Drainage Specification

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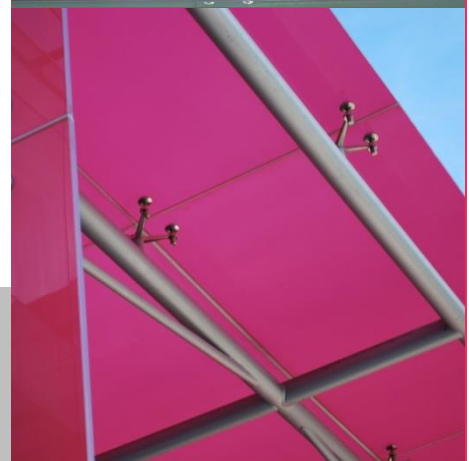
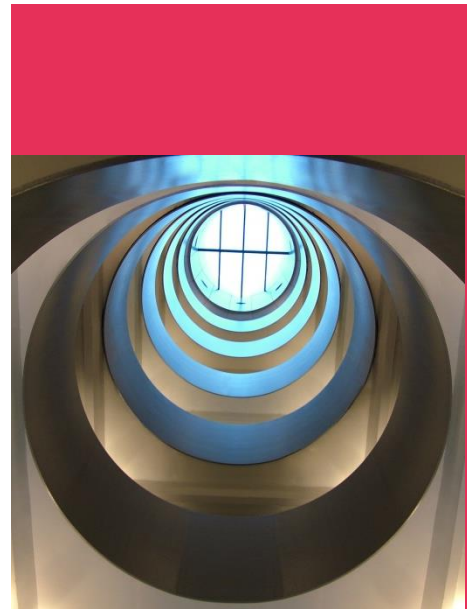
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1.0 General

This Specification shall apply to all below ground foul and surface water gravity drainage systems, unless otherwise agreed with the approving sewerage undertaker in case of working on adopted and adoptable sewers and should be read in conjunction with the provided design drawings. This Specification does not apply to any pressure pipelines and process/chemical drainage unless specified by the Engineer.

Items not covered by this Specification and items specifically to be adopted under Water Industry Act adoption agreements shall be carried out in accordance with 'Sewers for Adoption' (latest edition) by the Water Research Council (WRC) and as supplemented by any local sewerage undertaker specification and addendums.

The construction is to be undertaken strictly in accordance with the design drawings (unless these have been modified by instructions from the Engineer) and is to be to the complete satisfaction of the Engineer.

Unless specified otherwise in this Specification the materials and workmanship shall comply with all relevant British Standards and Codes of Practices and associated Curtins Specifications, the principal of which are as follows:

1. BS EN 752:2017 - Drain and sewer systems outside buildings
2. Building Regulations 2010 - Approved Document Part H – Drainage & Waste Disposal (2015 Update)
3. BS EN 12056:2000 – Gravity drainage systems inside buildings
4. BS 5911:2002 – Concrete pipes and ancillary concrete products
5. BS EN 295:2013 – Vitrified clay pipe systems for drains and sewers
6. BS EN 1401-1:2019 – Plastic piping systems for non-pressure underground drainage and sewerage. Unplasticized poly(vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system
7. BS 4660:2000 - Thermoplastics ancillary fittings of nominal sizes 110 and 160 for below ground gravity drainage and sewerage
8. BS EN 13598-1:2010 – Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE). Specifications for ancillary fittings including shallow inspection chambers
9. BS EN 1610:2015 – Construction and testing of drains and sewers
10. BS EN 124:2015 – Gully tops and manhole tops for vehicular and pedestrian areas

11. BS EN 1433:2002 – Drainage channels for vehicular and pedestrian areas. Classification, design and testing requirements, marking and evaluation of conformity
12. BS 437:2008 – Specification for cast iron drain pipes, fittings and their joints for socketed and socketless systems
13. BS EN 13101:2002 – Steps for underground man entry chambers. Requirements, marking, testing and evaluation of conformity
14. BS EN 14396:2004 – Fixed ladders for manholes
15. CIRIA Report C737 - Structural and geotechnical design of modular geocellular drainage systems

1.1 Existing drainage invert levels

It is advised that the contractor surveys all retained existing drainage prior to commencement to confirm the location and condition. Potential pre-cleansing to be undertaken in order to facilitate the survey, if required.

It is advised that drainage works are to be constructed from the outfall towards the head of run to ensure the outfall can be achieved. The Contractor shall check the location and invert levels of existing sewers at the proposed point of drainage connection and immediately advise the Engineer in writing of the levels found and any deviation in assumed position.

The local authority and utilities companies are to be notified by the Contractor prior to commencement of work on site.

All existing services to be located prior to commencement of any drainage works, and where necessary protection or diversions to be undertaken to avoid conflict with the proposed work. The contractor shall immediately advise the engineer of any services exposed which may affect the design.

1.2 Works on adopted / adoptable drainage system

The Contractor must give adequate notice to the sewerage undertaker of the proposed works on existing adopted drainage systems and of new works which are to become adopted. The Contractor shall afford the sewerage undertaker access to inspect the works as required and shall ensure that appropriate agreements are in place prior to construction as in Section 6.0 of this specification.

1.3 Protection of the drainage system

The Contractor shall prevent discharges into the existing system until the new drainage system is complete and secure. In particular the Contractor should prevent overloading of pipes where final

ground levels have not been made up and temporary covers to the drainage system should also be provided to prevent ingress of debris.

The contractor shall be responsible for ensuring that pipes are adequately protected from concentrated loading by construction traffic during the construction period.

The contractor shall allow for the protection, temporary and permanent support, and temporary and permanent diversion works, as necessary to all existing services.

1.4 Use of the drainage system

The Contractor shall not be permitted to discharge foul water into the drainage system until all testing as specified in Section 8.0 has been satisfactorily completed.

The drainage system should also not be used for the wash-down of cementitious materials, and other wash-down activities should be approved by the Engineer before implementing on site.

1.5 Health and Safety

Laying drains is a hazardous operation. The Contractor must adequately plan the works to enable safe methods of work to be undertaken.

Nothing in this specification should be taken as an instruction to adopt working methods which contravene the CDM Regulations, and all contractors/sub-contractors etc are responsible for ensuring safe procedures which comply with the Regulations.

The Contractor should note that it is their responsibility to manage all risks associated with the drainage works. The residual site-specific hazards identified by the Engineer are listed on the Curtins drainage drawings and/or Designer's Hazard Register.

2.0 Materials

The materials used in the drainage works shall be in accordance with the design drawings and unless specified otherwise by the Engineer.

Generally, all sewers, unless agreed otherwise stated, shall be:

- 100mm to 300mm diameter pipework and components to be vitrified clay.
- 375mm diameter and greater pipework and components to be class 120 concrete pipes.

However, as an alternative the contractor may use an approved unplasticised polyvinyl chloride (pvcu) with approval from the engineer.

All components shall comply with the following:

Rigid Pipes and Fittings

- Perforated vitrified clay pipes for land drainage to BS 1196:1989
- Concrete pipes and ancillary products to BS 5911-1:2002+A2:2010 and BS EN 1916:2002
- Vitrified clay pipes and fittings to BS EN 295:2013 (all parts)
- Ductile iron pipes and fittings to BS EN 598:2007 & BS ISO 4179:2005

Flexible Pipes and Fittings

- Plastic pipes for land drainage to BS 4962:1989
- Plastic piping systems for non-pressure underground drainage and sewage to BS EN 1401-1:2009 & BS 4660:2000

Access Chambers

- Precast concrete manhole units to BS EN 1917:2002
- Plastic inspection chambers for drains and sewers to BS EN 13598-1:2010

Other Fittings

- Gully and manhole tops for vehicular and pedestrian areas to BS EN 124:2015
- Drainage channels for vehicular and pedestrian areas to BS EN 1433:2002
- Modular geocellular drainage systems to CIRIA Report C737

3.0 Excavations

Unless the requirements of Sewers for Adoption or those of the approving sewerage undertaker prevail for adoptable sewers, the excavations and backfill to drainage trenches shall be in accordance with the following and to the satisfaction of the Engineer.

3.1 Excavation of pits and trenches

Excavation of pits and trenches shall be taken out to the levels and dimensions shown on the design drawings or to such other levels and dimensions as may be directed otherwise by the Engineer dependent upon site conditions. Where the type of subsoil encountered at the formation differs from that indicated in the Site Investigation, the Contractor must advise the Engineer immediately. Trenches shall be excavated true to line, level, gradient and width as noted on the design drawings.

Any pockets of soft or loose material shall be removed and the voids so formed filled to formation level with the same material as the permanent work which is to rest on that formation, and appropriately compacted. Any raised ground or voids which result from over-excavation below formation level shall be refilled in the same manner.

3.2 Supports for excavations

The sides of all excavations shall be adequately supported by timbering, trench sheeting, piling or other suitable means. Where ground conditions permit, trench support should not extend below the top of the pipe bedding to avoid disturbance of the bedding materials.

All materials used for supporting excavations shall be removed as the work proceeds unless otherwise directed by the Engineer.

3.3 Water in excavations

Water shall not be allowed to accumulate in the excavations and the contractor shall allow for keeping trenches and excavations as dry as practicable and where necessary, adequate pumping from temporary sumps and de-watering should be utilised where appropriate. Care shall be taken to ensure that pumping operations do not disturb the stability of adjacent soils and structures. The point and method of discharge to be agreed with the relevant outfall authority.

If the water entering the excavation is considered to arise from unexpected groundwater not anticipated from previous site investigations, the Engineer should be notified immediately to allow the situation to be considered.

3.4 Disposal of surplus material

All surplus excavated materials shall be deposited on site in areas to be agreed or, if directed, shall be removed from the site following appropriate testing and certification, as required.

3.5 Undermining adjacent structures

The Contractor shall take due regard of existing and proposed structures during the planning and execution of trench excavations in order to prevent undermining of foundations. No excavation shall take place within the 45-degree spread below any foundation without written approval of the Engineer.

3.6 Combined trenches

For trenches containing pipes at different levels, the whole trench width must be excavated to the depth of the lower pipe unless agreed in advance with the Engineer.

4.0 Laying and Bedding

4.1 General

Following excavation, trench bottom shall be accurately formed to levels and gradients specified on the design drawings, care being taken to ensure a uniform profile along the length of the pipe.

If rock, large stones, or other local hard spots are present, or where concrete beds or granular materials are required, the trench bottom shall be over-excavated to accommodate the granular or concrete bed as appropriate.

Pipes shall be laid true to line and to even falls with sockets facing upstream, each pipe being boned between sight rails.

All setting out references of whatever form shall be clearly marked.

4.2 Granular bedding materials

The class of pipe bedding is dependent on the site conditions and pipe setting and should be in accordance with the provided construction details on the design drawings unless specified otherwise by the Engineer.

Private, unadoptable drainage (to comply with Building Regulations)

Granular material to be used for bedding of pipes of Class S, B and F shall comply with one of the requirements set out below. The greater the proportion of fines in the material, the greater the care needed in compaction.

Compaction factor 0.3 is required for Class N & B and 0.15 for Class F. Refer to Section 12.0 for compaction factor testing procedure.

Table 4-1 Grading of granular materials for bedding Classes S, B and F

	Graded aggregate ranges (mm)	Single-sized aggregate sizes (mm)
Up to 100	10 - 5	10
150	14 - 5	14
> 150 - 600	20 - 5	20
> 600	40 - 5	40

All aggregate to be rounded unless agreed in writing by the Engineer.

Granular material to be used for bedding of pipes of Class N and T shall comply with one of the requirements set out below.

Table 4-2 Grading of granular materials for bedding Classes N and T

	Limits	Nominal Sizes (mm)
< 140	Overall Limits	10
> 140 - 400	Overall Limits	10 or 20
> 400	Overall Limits	10, 20 or 40

All aggregate to be rounded unless agreed in writing by the Engineer.

Adoptable drainage (to comply with Sewers for Adoption)

Granular beddings and pipe surround to be in accordance with Sewers for Adoption and Water Industry Specification (WIS) Guidance Note IGN 4-08-01, unless otherwise agreed with the approving sewerage undertaker.

4.3 Laying pipes on granular beds

The granular bedding material shall be placed to the pipe base level and shall extend to the full width of the trench unless otherwise shown on the drawings. A shallow depression shall be formed for the barrel of the pipe and socket holes formed at each joint position. These should be deep enough to prevent the weight of the pipe bearing on the socket or coupling and leave a minimum depth of 50mm of granular bedding material beneath the joint.

The pipes shall be laid directly on the granular bed and adjusted to the correct line and level. All temporary pipe supports shall be removed as the work proceeds and prior to completing the pipe surrounds. Side fill of either granular material or selected backfill material, depending upon the class of bedding specified, shall be placed evenly on either side of the pipe, taking care not to disturb the line and level. Bedding material shall not be compacted in the socket holes. It is sufficient that they be filled as a result of the general placing of side fill.

4.4 Laying pipes with concrete protection

Wherever possible total concrete encasement should be avoided, and protective reinforced slabs provided over granular surrounds as a primary method of protection. These shall be constructed in accordance with construction details provided by the Engineer.

Where total encasement is required, the level of trench formation shall be as specified on the design drawings but to a minimum depth of 100mm below base of pipe. The pipes shall be supported clear of the trench bottom by means of blocks or cradles of compressible material placed under the pipes immediately behind each socket. Expanded polystyrene or impregnated fibre building board are examples of suitable material that will yield under load sufficiently to permit the barrel of the pipe to rest uniformly on its bed after normal setting shrinkage of the concrete has occurred. Alternatively, rigid temporary supports such as purpose-made folding wedges may be used but these shall be removed as the concrete bed is placed.

Where flexible joints are employed the overall flexibility of the drain shall be maintained by the provision of flexible joints in the concrete. These shall be formed through the full cross section of the concrete by providing compressible materials such as expanded polystyrene or impregnated fibre building board at the face of each pipe socket or sleeve.

The concrete shall be so placed that the pipes or lateral construction joints in the concrete are not displaced and the flexibility of the joint not impaired.

5.0 Jointing of Pipes

5.1 Flexible joints

Flexible joints shall be made to conform to the pipe manufacturer's recommendations using the sealing ring supplied by the manufacturer. Where a lubricant is required it shall also be used in accordance with the manufacturer's recommendations. The jointing surface and sealing rings shall be clean and dry prior to any application of recommended lubricant.

To allow for telescopic movement, a small gap shall be left between the spigot end and adjoining socket, or between pipe ends.

Care shall be taken to avoid disturbance of the bedding when placing and jointing the pipes.

Where small diameter pipes can be jointed by hand the pipe being laid shall be pushed into the socket of the previous pipe. Where a winch or other pulling device is necessary its anchorage shall be so placed to avoid disturbance of the pipes already laid, e.g. on the remote end of the pipeline.

Pipes of 225mm nominal bore or less can be adjusted true to line after jointing, but larger pipes shall be correctly aligned before jointing as they may be difficult to move afterwards.

During the making of rolling-ring joints the rings should roll evenly and, to facilitate this, the axes of the two pipes shall be aligned. With rolling-ring types of joints the pipe shall be temporarily restrained to avoid the ring rolling back and forcing the spigot of the last pipe out of its socket.

5.2 Rigid joints for flexible pipes

When rigid joints are used with flexible pipes, such as plastics and pitch fibre, the manufacturer's jointing recommendations shall always be carefully followed, and care taken to avoid entry of jointing material into the pipe. If any solvent from a plastic pipe joint is spilled in the trench the polluted bedding shall be removed immediately and disposed of appropriately, otherwise the pipe may be attacked and weakened. Clean bedding material shall then be placed.

5.3 Rigid joints for rigid pipes

Clay pipe joints shall be filled with a 1:3 mix of cement sand mortar.

Concrete pipes shall have a ring of tarred yarn inserted into the correctly centred socket and driven home by a suitable caulking tool. The yarn in its final position shall occupy not more than one quarter of the depth of the socket which shall then be completely filled with 1:2 cement mortar, well rammed in

and finished off with a neat fillet, levelled off from the outer rim of the socket to the barrel of the inserted pipe.

Cast iron joints shall be formed with approved gaskets and bolted flanges. Bolts, nuts and washers shall be protected by grease after making the joint. Cast iron pipes with open sockets shall be jointed with properly caulked lead wool.

5.4 Jointing pipes and fittings of different materials

Where it is necessary to make joints between different materials a special adapter shall be used. Most pipe manufacturers supply suitable adapters.

6.0 Connections

6.1 General

All connections should be made in accordance with the design drawings, and at a minimum of 90-degree angle to the direction of the flow in the drain or sewer to which the connection is made.

Unless otherwise agreed with the Engineer, or the approving authority, all connections should be made soffit to soffit i.e. with pipe soffits level.

Where a connection is made directly to a public sewer or to a private drain discharging to a public sewerage system a Section 106 agreement must be in place prior to commencement, and the installation carried out in accordance with the local sewerage undertaker's standard connection requirements.

Where a junction is provided for future use it shall have an effective removable seal and its position shall be accurately measured and recorded.

6.2 Connection to chamber

Where a connection is made either direct, or by a drop-pipe to an open channel, the benching shall be carefully cut away and a suitable channel branch bend inserted, preferably three-quarters section, or an in-situ entry channel formed. The incoming flow shall enter at the top of the channel in the direction of the main flow and without causing turbulence or backing up in the main or other branches. The benching shall be reinstated.

Where the connection is to a sealed system it shall be necessary to break out and replace the access fitting unless it already has a suitable spare branch.

6.3 Connection by a junction

In order to maintain a pipe continuity, only sufficient length of pipe shall be removed to enable the junction to be inserted in the pipeline. Whether socketed or sleeved joints are used they shall be appropriate to the pipeline. Ensure accurate centring and concentricity about the pipe ends and provide an effective seal. The junction shall be fixed at the appropriate angle to receive the incoming branch drain.

6.4 Saddle connections

In order to install a saddle connection into an existing pipe, the pipe shall be cut into by the cautious enlargement of a small hole or by trepanning or, where practicable, by the use of a suitable saw and purpose-made template, taking care to prevent any materials from entering the pipe. The hole shall be accurately trimmed so that the saddle fits with at least half of the width of its shoulder bearing on the pipe over the whole circumference of the shoulder. The saddle shall be of the correct size for the pipe and connection and be secured by a method appropriate for the pipe material.

If specialist proprietary adaptors are used (Fabekun etc) should be agreed in advance of a Section 106 application.

7.0 Backfill

7.1 General

Backfilling to trenches shall be carried out strictly in accordance with the Curtins Earthworks Specification and as indicated on the design drawings. Care and attention is required to the placing and compaction of backfill particularly where it forms part of a load supporting system.

7.2 Selected backfill material

Selected excavated backfill material may be used subject to approval by the Engineer. It should preferably consist of uniform soil and be readily compacted. It shall not include stones retained on a 40mm sieve, clay lumps larger than 75mm, tree roots, organic matter, other waste, or frozen soil. Cohesive soil that has been allowed to dry out on a spoil heap is not readily compactable and shall not be used.

For trench backfill material requirements above pipes laid within adoptable highways, or any other adoptable drainage, backfill specification should be to the satisfaction of the approving authority and agreed prior to construction.

7.3 Sidefill and initial backfill

The specified bed or surround shall be first laid with placement and compaction by hand tamping. As soon as possible after completion of the bed or surround, place the initial backfill with hand compaction in 100 mm thick layers to give 300 mm of compacted material above the pipe crown.

The initial backfill material shall be as specified on the drawings.

7.4 Main backfill

The main backfill shall be placed above the 300 mm of compacted initial backfill material above the pipe crown by mechanical compaction.

The main backfill material shall be as specified on the drawings.

The method of compaction of the main backfill shall comply with the Specification for the Highway Works.

8.0 Testing of Drains

All new drains shall be tested after laying and jointing and after sufficient surround (to mid-height) has been placed to adequately support the pipe. Air or water testing, as outlined below, should be carried out in accordance with BS EN 1610:2015.

8.1 Testing sequence

The testing of drains shall generally be carried out in two stages.

First stage of testing shall be carried out to locate and remedy any defects in soundness of construction. Such tests shall take place immediately before the work is covered up so as to facilitate replacement of any faulty pipes or pipe fittings, or to rectify any joint defects. Drains shall be tested in sections between chambers. Inspection of the pipeline will reveal any defects in the support and bedding. The method of testing shall be in accordance with Sections 8.3 or 8.4 of this specification.

Second stage of testing and inspection shall take place immediately before hand over when all relevant works have been completed. The method of testing shall be in accordance with Sections 8.3 or 8.4 of this specification.

8.2 Pre-test procedures

Before any tests are applied, attention shall be given to the safety of the operatives and other persons involved in the testing operation. It is essential that proper means of access shall be provided to the area of work, and the sides of any trench or excavation in which work is to be tested should be adequately supported and free from hazards.

Where a water test is to be applied, drain stoppers and bags shall be properly secured in position and provision made for the final removal of the stopper or bag from surface level by means of a strong cord attached to the inlet ferrule.

All obstructions, debris and superfluous matter shall be removed from sections of pipeline, inspection chambers, manholes, or other drainage features, and they shall be flushed out before testing.

Care shall be taken when a chemical cleaning agent is used to remove deposits of cement mortar from the surfaces of benching and channel inverts. Protective clothing, including gloves and eye shields, shall be provided for operatives using or handling the chemicals. On completion of the work all treated surfaces shall be thoroughly hosed down.

8.3 Air test

The air test is suitable for testing pipelines only. Air testing of manholes and inspection chambers can be dangerous for the personnel and should therefore be avoided. For manhole testing procedure refer to Section 11.0 of this specification.

The air test shall be carried out by inserting expanding drain plugs or inflatable canvas or rubber bags in the upper and lower ends of the pipeline and pumping air in under pressure. Where cement mortar joints are used, the joint shall be left for at least 24 hours before testing. Solvent welded plastic pipelines shall be allowed to stand for at least 1 hour before applying the test.

The test procedure shall be as follows:

1. Fit expanding plugs or inflatable canvas or rubber test bags into the ends of the pipeline and of all associated branches.
2. Connect a glass 'U' tube gauge (manometer) to one of the sealing plugs and a means of applying air pressure.
3. Apply pressure to achieve slightly more than 100mm water gauge for pipelines, or 50mm water gauge where gullies and/or ground floor appliances are connected.
4. Allow 5 min for stabilisation of air temperature.
5. Adjust air pressure to 100mm or 50mm water gauge as necessary and outlined above in point 3.
6. Monitor the loss of pressure over the time period specified below:

Table 8-1 Testing times for air test based on pipe size and material

Material	Testing time (min) based on pipe size (mm)						
	DN100	DN200	DN300	DN400	DN600	DN800	DN1000
Unsoaked concrete pipes	5	5	5	7	11	14	18
Soaked concrete pipes and all other materials	5	5	7	10	14	19	24

Note: DN is a numerical designation of internal pipe diameter, approximately equal to a manufacturing dimension in mm.

The drain run shall be considered satisfactory if, without further pumping, the head of water shall not fall by more than 25mm for a 100mm gauge test pressure and 12mm for a 50mm water gauge test pressure over the period of time specified above in Table 8-1.

Should the air test prove unsuccessful then a water test shall be carried out as described in Section 8.4 of this specification.

8.4 Water test

Testing shall be carried out between inspection chambers, manholes or other suitable points of access and through any accessible branch drains.

Gravity drains and sewers up to and including 300mm diameter shall be tested to an internal pressure of 1.5m head above the invert of the pipe at the high end of the line and not more than 4m head at the lower end. Larger drains and sewers should be tested such that the test pressure is equivalent or resulting from filling the test section up to the ground level of the downstream or upstream manhole, as appropriate, with a maximum pressure of 50 kPa and a minimum pressure of 10kPa measured at the invert of the pipe.

Where the test head of water is in excess of 4m at the lowest point of the pipeline under test (including the minimum test head of 1.5m), the pipeline may be tested in sections by means of appropriately placed test branches. The test branches may be extended up to the finished surface with a suitable termination and used as additional points of access.

Solvent-welded plastic pipelines shall be allowed to stand for at least 1 hour before applying the test and shall be suitably anchored to prevent flotation when the test is applied before backfilling the trench.

Where cement mortar joints are used, they shall be left for at least 24 hours before testing.

The test procedure shall be as follows:

1. Fit expanding plugs or bag stoppers, suitably secured to resist the full hydrostatic head, at the lower end of the pipe and in any branches as necessary.
2. Fit a similar plug or bag stopper into the top end of the pipeline together with a stand pipe or flexible tube leading from a container connected to the plug or bag.
3. Fill the pipeline with water making sure that there are no pockets of trapped air.
4. Fill the stand pipe or other test apparatus to a height of 1.5m above the pipe or channel invert.
5. Allow the pipeline to stand for 2 hours for absorption, topping up water as necessary to maintain the required pressure.

6. After 2 hours, measure the loss of water from the pipeline by noting the quantity of water needed to maintain the test head in the apparatus over a period of 30 min.

The test will be considered satisfactory if the rate of water loss does not exceed 1 litre/hour per metre diameter per linear metre run of pipe. For various pipe diameters this rate of loss over a 30 min period may be expressed as follows:

1. 100mm nominal bore pipe 0.05 litres per metre run;
2. 150mm nominal bore pipe 0.08 litres per metre run;
3. 225mm nominal bore pipe 0.12 litres per metre run;
4. 300mm nominal bore pipe 0.15 litres per metre run;

Note: The figures are equivalent to a loss of 1 l/h per metre diameter of pipe per metre run of pipeline.

Leaking or other defects which may be revealed during the test shall be made good and the test repeated until the pipe run proves satisfactory.

8.5 CCTV inspection

All pipes of the drainage system are to be CCTV inspected immediately prior to handover.

Immediately before CCTV inspection, lift all manhole covers, inspection chamber covers, and access point covers and remove all debris. Thoroughly flush the entire drainage system with water to remove all silt and check for blockages. Rod or jet pipelines between access points to remove any debris and obstructions, which have not been removed by flushing. Securely replace all covers after cleaning.

CCTV equipment shall be of a type to satisfactorily record the condition of the drainage system using self-levelling cameras and adequate illumination.

Immediately prior to camera entry all pipes must be flushed with water to enable backfalls in the system to be identified.

No flows should be permitted into the system during inspection.

The Engineer must be afforded access to inspect the CCTV inspection from a suitable monitor during the site inspection. If site attendance is not possible the Engineer shall be given sufficient time to inspect CCTV footage before handover of the works.

The Contractor shall provide a file transfer (or alternative such as USB stick or DVD) containing all of the video files obtained during the CCTV inspection. A plan should accompany the findings and clearly

reference each pipe and chamber. A written report shall accompany the findings from the investigation and should identify any defects and recommendations.

Any defects identified as part of the CCTV investigation shall be rectified by the Contractor. Subsequently, a CCTV survey should be undertaken to prove that the defect has been rectified.

8.6 Laser line profile and level testing

Where the specific pipe material dictates that laser line, profile and level testing is required for drainage systems adoptable under Water Act adoption agreements. The testing shall be carried out strictly in accordance with the relevant sewerage undertaker's requirements.

8.7 Connectivity

Dye testing shall be undertaken by the Contractor to prove that no inter-connectivity between the foul and the surface water system is present.

9.0 Tolerances

All pipes must be laid such that the position of the internal face of any pipe is within +/- 20 mm of the specified drawing line and level, providing that no pipe shall have a reverse gradient, and that no ponding occurs within any length of pipe. Any pipe outside the above tolerance must be re-laid correctly.

Any pipe which does not meet the above tolerances must be re-laid to achieve the specified tolerances.

10.0 Access

Manholes, inspection chambers and other access points shall be constructed in accordance with the design drawings and as a minimum should be located at any of the following:

- change of alignment, gradient, pipe size or material
- the head of all drains and sewers

10.1 Brick manholes

Brick manholes shall be constructed in engineering brick Class B English bond, using 1:3 Portland Cement mortar, on a base of Grade GEN3/C20 concrete in accordance with Sewers for Adoption. Each brick shall be well flushed and jointed up before mortar for the next course is spread. A sulphate-resisting cement shall be used where there is a danger of sulphate attack and where indicated on the drawings.

The ends of pipes shall be built into manholes with watertight joints. A single brick-on-edge arch shall be formed over all pipes.

Where the depth of the manhole exceeds 1m double-width, galvanised step iron rungs, to BS EN 13101:2002 shall be built into each third course, commencing at not more than at 675mm below the manhole cover.

Main channel inverts shall, wherever possible, be purpose-made, half-round channels of the same material as the outgoing pipes from the manholes. Where channels are formed in-situ, they shall be formed to the required profile in high concrete strength Grade C25/ST2 and shall be rendered in 1:2 cement mortar trowelled smooth.

Side branches shall, where practicable, be brought into the main channel by the use of half section or three-quarter section channels. Where the connecting angle (with the main channel) is greater than 45°, a three-quarter section branch should be used.

The channels shall be bedded in 1:1 cement mortar and connected to the main channel so that the discharge from the branch drain is in the direction of flow in the main channel. The benching shall rise vertically from the edge of the channel pipe to a height of not less than that of the soffit of the outgoing sewer and shall be sloped upwards from that point to meet the wall of the manhole at a gradient of between 1 in 10 and 1 in 30. It shall be floated to a smooth hard surface.

All branches shall be connected with the pipe soffits level to that of the main drain.

Where specified on the design drawings, sulphate resisting cement shall be used for the benching and rendering.

Cover slabs, when required, shall be reinforced concrete with rebates where required for the cover frames. Concrete grade and design sulphate class noted on contract documents.

10.2 Precast concrete manholes

Precast concrete manholes shall be supplied with precast inverts shaped to accommodate incoming drains or cast in-situ inverts of high-strength concrete (Grade C25/ST2). Joints shall be made in a mortar mix having a 1:3 cement sand ratio. Alternatively, plastomeric or elastomeric seal conforming to BS EN 1917:2002 and BS 5911-3.

Where required for sewers adoptable under the Water Industry Act adoption agreements, bases are to be formed as shown on the drawings using channel pipes and monolithic benching on precast GEN3/C20 concrete bases in accordance with Sewers for Adoption (including local sewerage undertaker's variations and addendums).

The precast concrete manholes shall be provided with a surround of concrete Grade GEN3/C20 of minimum thickness 150mm, unless agreed otherwise with the approving authority.

Any joints in concrete surrounds shall be staggered with the manhole construction joints.

Where specified on the drawings sulphate resisting cement shall be used for precast concrete manholes, their benching, rendering and surrounds.

Step iron rungs to comply with BS EN 13101:2002 and ladders to comply with BS EN 14396:2004 shall be provided as detailed on the drawings.

10.3 Catchpits

Brick catchpits shall be constructed in common brickwork 225mm or 115mm thick as indicated on the drawings and laid in 1:3 Portland Cement mortar on a base of GEN3/C20 concrete.

Concrete catchpits shall be constructed in precast rings to BS 5911-3: 2010 and BS EN 1917: 2002 as indicated on the drawings generally in accordance with a standard precast ring manhole with a sumped section replacing the usual channelled invert.

Plastic catchpit chambers shall be formed using proprietary units with the bases formed of GEN3/C20 concrete or granular material as indicated on the design drawings.

Where plastic chambers are to be constructed below the water table the base and surround should be formed using GEN3/C20 concrete.

The silt trap section of the catchpit shall be formed and sized as shown on the design drawings.

10.4 Inspection chambers

Inspection chambers shall be constructed as indicated on the design drawings.

The access cover shall be fitted with a 350mm diameter restrictor to prevent man access where the depth of chamber exceeds 1.2 metres in private drainage systems, and 1m in adoptable systems, unless agreed otherwise with the sewerage undertaker.

Where plastic chambers are to be located in vehicular areas, the top of the chamber shaft shall be concrete surrounded and fitted with a vehicle loading cover in accordance with the design drawings.

Where plastic chambers are to be constructed below the water table the base and surround should be formed using GEN3/C20 concrete.

10.5 Rodding eyes

Rodding eyes shall be constructed as indicated on the design drawings.

Where rodding eyes are located in vehicular areas, the top of the pipe riser shaft shall be concrete surrounded and fitted with the correct vehicle loading cover in accordance with the design drawings.

10.6 Access Fittings

All access fittings, stacks, rwp's and gullies to be roddable. all to have low level rodding access plates unless an alternative means of access is agreed. access point to be above any ground floor connected appliance spill level.

Large access fitting required above ground where greater than 12m up to 22m to a junction. Small access fitting required up to 12m to a junction.

10.7 Gullies and Channels

All gully and channel drain outlets and termination points to be trapped and roddable. Internal gullies and channel drains are to be specified by others.

10.8 Covers and gratings

Covers and gratings shall be to the dimensions and gradings as shown on the design drawings.

All internal manhole covers shall have mechanically jointed corners and be double sealed air tight units to prevent the egress of odours, as shown on the drawings and as detailed by the Architect - recessed to suit their specification of floor finishes, where necessary.

11.0 Testing of Chambers

11.1 Test head

All new chambers shall be water tested in accordance with BS EN 1610:2015.

Chambers less than 1.5m in depth to invert shall be filled with clean water to the underside of the cover and frame located at ground or surface level. Where the depth to the channel invert is 1.5m or greater, the test head shall not be less than 1.5m. Testing of petrol interceptors, suction wells and similar underground chambers shall be carried out to manufacturer's specification.

Where the chamber is located below the groundwater level, the test head shall no less than the highest expected seasonal groundwater level, or test heads specified above, whichever is greater.

11.2 Test procedure

Tests shall not be carried out until the structures have reached sufficient strength to sustain the pressure from testing.

Open channel manholes, inspection chambers and other surface water containing structures shall, whenever possible, be tested independently of any drain or sewer.

The external faces of a structure shall not normally be backfilled, or concrete surrounded before the chamber is filled with water to the specified test level. Adequate stability shall be ensured during the period of the test and subsequent concrete placement and backfilling.

For the tests, a bag stopper shall be fitted in the outlet of the inspection chamber or manhole and expanding plugs or bag stoppers in all other connections.

The inspection chamber, manhole, etc shall be filled with clean water to the required test level and allowed to stand for a minimum of 2 hours for absorption, topping up the level as necessary.

The criterion for acceptance shall be that the water level remains constant for 30 minutes. Where water can be observed issuing from the outside face of the structure at an identifiable point or points, such leakage shall be made good and the test repeated.

12.0 Compaction Factor Test for Bedding & Surround Material

12.1 Apparatus

Where testing the bedding and surround material, the following apparatus shall be used:

1. Open-ended cylinder, 250mm long and 150mm internal diameter (150mm plastic pipe is suitable).
2. Metal rammer with striking face of 40mm diameter and mass of 0.8kg to 1.3kg.
3. Rule.

12.2 Test procedure

The test procedure shall be as follows:

1. Obtain a representative sample more than sufficient to fill the cylinder (about 10kg) by heaping about 50kg of the proposed material onto a clean surface and dividing it with a spade down the middle into two equal sections.
2. Divide one of these and repeat this procedure until the required mass of sample is left. In the sieving, clumps of material that break up under light finger pressure may be helped through the sieve, but considerable force must not be used to squeeze over-size clumps through the mesh. It is important to ensure that the moisture content of the sample does not differ significantly from that of the main body of material at the same time of its use in the trench.
3. Place the cylinder on a firm flat surface and gently pour the sample material into it, loosely and without tamping. Strike off the top surface level with the top of the cylinder and remove all surplus spilled material.
4. Lift the cylinder clear of its contents and place on a fresh area of flat surface. Place about one quarter of the material back in the cylinder and tamp vigorously until no further compaction can be obtained. Repeat with the second quarter, tamping as before, as so on for the third and fourth quarters, tamping the final surface as level as possible.
5. Measure down from the top of the cylinder to the surface of the compacted material. This distance, in millimetres, divided by the height of the cylinder (250mm) is referred to as the compaction factor.

12.3 Suitability of compaction factor for use

Suitability of the compaction factor for use is as follows:

Table 12-1 Suitability of compaction factors

<u>Compaction Factor</u>	<u>Suitability for Use</u>
0.15 or less	Material suitable for all granular bedding classes.
Between 0.15 and 0.3	Material suitable for bedding Classes N and B, but requires extra care in compaction. Not suitable if the pipe is subject to waterlogged conditions after laying.
Over 0.3	Material unsuitable.

13.0 Land Drains

13.1 Pipe materials

The type of land drain shall be in accordance with the design drawings.

13.2 Filter and bedding material

Unless otherwise specified, the filter material surrounding the pipe shall consist of hard, clean, crushed rock, crushed slag or gravel having a grading within the limits shown in the table below. The aggregate crushing value of the material as determined by the tests in BS EN 933-1:2012 shall not exceed 30%. The material passing the 10mm sieve shall be non-plastic when tested in accordance with BS 1377-1:2016 and BS EN ISO 17892-12:2018.

Filter materials shall be to DoT Filter Drain Material Type B (CI 505)

Table 13-1 Filter material grading

<u>BS Sieve Size</u>	<u>Range of Grading Percentage by Weight Passing</u>
63 mm	100
37.5 mm	85 - 100
20 mm	0 - 20
10 mm	0 - 5

13.3 Joints

Where pipes with unsealed joints are specified, a gap of 10mm shall be left between the end of the pipe and the inner end of the socket. The pipe shall be supported with tarred rope yarn or other suitable flexible jointing material within the socket over at least the lower third of the circumference so that there are no vertical steps between one pipe and another.

Where perforated or porous pipes are specified, the joints shall be prepared as recommended by the pipe manufacturer. Perforated pipes shall be laid with the perforations facing downwards for groundwater management and facing upwards for conventional drainage systems.

14.0 Disused Drainage

Drains or sewers less than 1.5m deep which are in open ground should as far as practicable be removed. Where impractical or deeper than 1.5m, pipes should be sealed at both ends and at any point of connection/junction, and grout filled. Where a pipe connects to a public sewer or the sewers to be abandoned were previously classified as a public sewer, the advice of the relevant sewerage undertaker should be sought.

14.1 Grouting procedure

Reference should be made to The Building Regulations Part H Appendix H1-B for pipes to be grouted.

Pipes to be grouted shall be filled with a grout consisting of one of the following:

- Class G3 grout to consist of 1:10 cement to sand ratio - mixed with the minimum amount of water to ensure fluidity.
- Class G4 grout to consist of 1:10 cement to PFA ratio - mixed with the minimum amount of water to ensure fluidity.

The grout shall be introduced at the higher end of the length of sewer being filled. Grouting operations shall proceed such that no length of sewer shall be filled until all upstream communicating lengths have been completed.

The seals at the lower end of each run of sewer shall be fitted with a flexible breather pipe, fixed at the soffit of the sewer and turned vertically upwards to a height of 600mm above the soffit level of the higher end of the relevant sewer length.

The head of the existing redundant sewer section shall be suitably sealed and a 150mm flexible injection pipe constructed through the seal at the soffit of the sewer. This shall be turned vertically and extended upwards to a minimum height of 1m above the soffit level.

On completion of grouting operations, the injection pipe shall be sealed with a plug of concrete at least 150mm deep and having 150mm bearing outside the injection pipe.

The shafts of manholes on abandoned sewers shall be broken down to a level of 1 metre below finished ground level and the remaining void filled with GEN0 concrete, unless agreed otherwise.

15.0 As-built Records

The Contractor must provide an as-built survey of the new drainage system or provide marked up copies of the Engineer's drawings indicating any changes to invert levels, pipes, manholes etc. prior to Practical Completion.

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