SERIES 500
DRAINAGE AND SERVICE DUCTS

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NATIONAL ALTERATIONS OF THE OVERSEEING ORGANISATIONS OF SCOTLAND, WALES AND NORTHERN IRELAND

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# denotes a Clause or Sample Contract Specific Appendix which has a substitute National Clause or Sample Appendix for one or more of the Overseeing Organisations of Scotland, Wales or Northern Ireland.

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DRAINAGE AND SERVICE DUCTS

500 (02/20) Introduction

1 (02/20) This Series is part of the Specification for Highways Works. Whilst this Series is particularly relevant to the subject matter in its title it must be read in conjunction with the general requirements in Series 000 and 100 and with other Series relevant to the specification of the particular works to be undertaken.

501 (02/20) Pipes for Drainage and for Service Ducts

(02/20) General

1 (02/20) Where the term drain is used in this Series it shall be deemed to include the terms sewer and piped culvert.

The Contractor shall design the piped culverts listed in contract specific Appendix 1/10 in accordance with the requirements of Clause 106 and this Series.

2 (02/20) All drains constructed of pipes as well as piped culverts up to and including 900mm internal diameter shall comply with this Series and any additional requirements in contract specific Appendix 5/1. Drains constructed using pipes exceeding 900mm internal diameter as well as box and piped culverts shall comply with Series 2500. Unless otherwise described in contract specific Appendix 5/1 only one type of pipe shall be used within any individual drain or service duct between consecutive chambers. The Contractor shall ensure that all drainage materials are not subjected to any form of deterioration before installation into the works.

(02/20) Pipes for Drainage

3 (02/20) Pipes for drainage shall be selected from the alternatives in Table 5/1 titled Pipes for Drainage and shall comply with Clause 104 and contract specific Appendix 5/1. The Contractor shall demonstrate the pipes selected satisfy the hydraulic design of the system as described in contract specific Appendix 5/1. On completion of the whole of the drainage works, the Contractor shall provide the Overseeing Organisation with a schedule showing details of all pipe types used, including quality, joints and name of manufacturer. This will form the basis of a declaration of performance for the drainage.

(02/20) Corrugated Steel Pipes

4 (02/20) Corrugated steel pipes shall be manufactured from either:

(i) bolted segmental plate pipes complying with sub-Clause 6 of this Clause and having plate thicknesses as described in contract specific Appendix 5/1; or,

(ii) galvanized steel sheet suitable for lock seam fabrication complying with BS EN 10346 grade DX51D + Z600, or aluminium coated steel sheet complying with AASHTO specification M274-87.

Corrugated steel pipes complying with (ii) above shall be manufactured from steel of minimum thickness 1.25mm unless otherwise described in contract specific Appendix 5/1.

5 (02/20) Where described in contract specific Appendix 5/1 corrugated steel pipes shall be provided with additional protection of hot applied bitumen complying with BS EN 13808, BS EN 15322 or BS EN 14023 having a minimum peak cohesion value of 1.0 J/cm^2 by pendulum test in accordance with BS EN 13588.

6 (02/20) Bolted segmental plate pipes shall meet the following requirements:

(i) Steel for the plates shall comply with BS 1449: Part 1.1, Grade 3 or Grade 4, Condition HR;

(ii) After forming, the depth of the corrugations shall be within a tolerance of ±6% and the pitch of the corrugations within a tolerance of ±4% of the nominal dimensions. Plates shall have a minimum lip of 45mm beyond each end crest. Cut edges shall be free from notches, gouges, rust or burrs;

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(iii) Bolts and nuts for connecting plates shall comply with BS EN ISO 4014, BS EN 4017 and BS EN ISO 4032, for BS EN ISO 898-1 and BS EN 20898-2, ISO 898-2 property class 8.8, nominal size M20; or with BS 4395: Part 2, nominal size M20; or with BS EN ISO 898-1 and BS EN 20898-2, ISO 898-2 property class 10.9;

(iv) When all the plates have been assembled, the nuts shall be tightened against a domed washer. The tightening shall be repeated if necessary to achieve the torque recommended by the manufacturer; and,

(v) Steel plate shall be galvanized in compliance with Clause 1909. Plates shall be galvanized after forming the corrugations and completing all necessary cutting, punching and drilling. Units in which the zinc coating has been burned by welding or otherwise damaged in fabrication, transport or handling at site shall be made good in compliance with Clauses 1907 and 1908. Bolts and nuts shall be galvanized in compliance with Clause 1909.

TABLE 5/1: (03/20) **Pipes for Drainage**

Material	Usage	Standard	Particular Requirements
Vitrified clay	Foul drains	BS EN 295	
	Surface water drains	BS EN 295	
	Filter drains	BS EN 295	
Concrete (With Portland cement or sulfate-resisting cement when required in contract specific Appendix 5/1. Supersulfated cement shall not be used)	Foul & surface water drains	BS 5911-1 and BS EN 1916 (Ordinary reinforced or unreinforced) BS 5911-5	
	Surface water drains	BS 5911-1	
	Filter drains	BS 5911-1 (Porous with ogee or rebated joints)	
		BS 5911-1	Unperforated not exceeding 2m in length with open joints or castellated rebated joints with the total slot area between castellations being at least 1000mm² per metre length of pipe OR Perforated with circular holes not greater than 10mm nor less than 3mm in diameter
Glass reinforced plastics (GRP)	Foul & surface water drains	BS EN 14364	Class to be as specified in contract specific Appendix 5/1
Iron	Foul & surface water drains	BS 437 (Cast iron) BS EN 598 (Ductile iron)	

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TABLE 5/1: (02/20) **Pipes for Drainage (continued)**

Material	Usage	Standard	Particular Requirements
Thermoplastics solid wall pipes and fittings Unplasticised polyvinyl-chloride (PVC-U) Polypropylene (PP) Polyethylene (PE)	Foul & surface water drains	BS 4660 or BS 5481 or BS EN 1401 (PVC-U) BS EN 1852-1 (PP) BS EN 12666-1 (PE)	See the UK national forward to the relevant BS EN. The grade appropriate for use without structural calculations shall be used i.e. SN8 for PP & PE and SN4 (SDR 41) for PVC-U
	Filter drains	BS EN 13598 (BS 4660 for cleaning eyes) or BS EN 1401 (PVC-U) BS EN 1852-1 (PP) BS EN 12666-1 (PE)	Perforated with not less than 1000mm² of holes per metre length of pipe. The perforations shall not reduce the pipe stiffness by more than 5%. Circular perforations not greater than 10mm nor less than 3mm in diameter or rectangular slots not greater than 4mm nor less than 0.6mm in width
Thermoplastics structured wall pipe and fittings	Surface water drains	Clause 518	Unperforated with watertight joints and with a pipe stiffness class, creep ratio and impact resistance as described in contract specific Appendix 5/1
	Filter drains	Clause 518	Perforated with not less than 1000mm² of holes per metre length of pipe. The perforations shall not reduce the pipe ring stiffness by more than 5%. Circular perforations not greater than 10mm nor less than 3mm in diameter or rectangular slots not greater than 4mm nor less than 0.6mm in width
	Subsoil field drains	BS 4962 or Clause 518	
Corrugated steel	Surface water drains, filter drains	BS EN 10346 AASHTO Designation: M27 4-87 (2012)	

(02/20) **Pipes for Service Ducts**

7 (02/20) Pipes for service ducts, excluding those in use in highway communications installations, shall be selected from the alternatives in Table 5/2 and shall comply with the standards and particular requirements therein. Pipes for use in highway communications installations shall comply with Series 1500. Pipes for service ducts shall have a smooth internal bore without any sharp edges to the ends of pipes, shall comply with contract specific Appendix 5/2, and be of 100mm internal diameter unless otherwise described therein. Their alignment shall be tested in accordance with sub-Clause 509.9.

The use of pipes and fittings other than those included in Table 5/2 shall be permitted provided that they hold current Product Acceptance Scheme certification in accordance with sub-Clauses 104.15 and 104.16 stating that they are a suitable alternative to those listed in Table 5/2.

8 (02/20) Each duct shall be fitted with a pigmented, stranded polypropylene or equivalent rot-proof material draw rope of 5kN breaking load and having a design life of not less than 20 years, the ends of which shall be either made fast to marker blocks as shown on HCD Drawing Number I1 or secured inside chambers. The ends of a duct shall be either sealed by removable stoppers immediately it has been laid, or terminated in chambers of the type specified in contract specific Appendix 5/2.

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TABLE 5/2: (02/20) **Pipes for Ducts**

Material	Standard	Particular Requirements
Vitrified clay	BS EN 295	Plain-ended, self-aligning flexible sleeve jointed with internal ends radiused to 3mm minimum
Iron	BS EN 598 (Ductile iron)	
Glass reinforced plastics	BS EN 14364	Class to be as specified in contract specific Appendix 5/2
Thermoplastics solid wall Unplasticised polyvinyl-chloride (PVC-U) Polypropylene (PP) Polyethylene (PE)	BS 4660 and BS EN 13598 or BS 3506 (Class C) or (PVC-U) BS EN 1401, BS EN ISO 1452-1 to 5 as appropriate class PN10. BS EN 1852-1 (PP) BS EN 12666-1 (PE)	When pipes BS 3506 (Class C) are used, joints shall comply with BS EN ISO 1452-1 to 5 as appropriate
Thermoplastics single wall (Restricted to ducts buried a minimum of 600mm below the surface)	BS EN 61386-24	Ducts to BS EN 61386-24 shall be classified as normal duty, corrugated have a degree of protection against ingress of foreign objects classification rating of 3 or 4 and a degree of protection against ingress of water classification rating of 7. Resistance to bending requirements shall be as stated in contract specific Appendix 5/2.
Thermoplastics structured wall	BS EN 61386-24 and Clause 518	Ducts to BS EN 61386-24 shall be classified as normal duty, corrugated have a degree of protection against ingress of foreign objects classification rating of 3 or 4 and a degree of protection against ingress of water classification rating of 7. Resistance to bending requirements shall be as stated in contract specific Appendix 5/2

502 (02/20) Excavation for Pipes and Chambers

1 (02/20) Excavation shall comply with Clause 602 and with the following:

(i) soft spots existing below the bottom of an excavation shall be removed and the resulting voids backfilled with Type 1 unbound mixture for subbase complying with Clause 803 or pipe bedding material complying with Clause 503, both well compacted, or ST1 concrete in compliance to Clause 2602;

(ii) any additional excavation below the bottom of an excavation that is required because the Contractor has allowed the bottom to become soft or otherwise unacceptable for the construction of the pipeline or chambers shall be made good as described in sub-Clause 1(i) of this Clause; and,

(iii) any excavation greater than the net volume required for the permanent works below the level of any pipe surround shall be made good as described in (i) above.

2 (02/20) Unless otherwise described in contract specific Appendix 5/1, all pipes in or under new embankments shall be laid only when the embankment has been formed and compacted to formation level under paved areas, to finished earthworks level in other areas, or to a level which will give a minimum cover of 1.2m to the pipes, whichever is the lowest.

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503 (02/20) Bedding, Laying and Surrounding of Pipes

1 (02/20) Immediately following the excavation of the trench, the pipes shall be laid and jointed on the pipe bed. Pipes shall be laid so that each one is in contact with the bed throughout the length of its barrel. The pipes shall be laid at the level and gradients shown on the drawings and schedules. The deviation in level from that specified at any point shall not exceed 20mm and in addition the algebraic difference of the deviation in level at any two points on each pipe shall not exceed 30mm. In the case of socketed or sleeve jointed pipes the bed shall be cut away and removed at each socket or sleeve to give a clearance of at least 50mm, or 100mm for trenches in material designated as hard material, so that the socket or sleeve does not bear on the bed. Pipes shall be laid on setting blocks only where a concrete bed or cradle is used.

Pipes and fittings that show any sign of damage shall be excluded from the works. The pipes and fittings' joint surfaces and components shall be cleaned immediately before laying. Measures shall be taken to prevent soil or other material from entering pipes, and to anchor each pipe to prevent movement before the work is complete.

2 (02/20) Pipes complying with BS 4962 which are corrugated coilable perforated pipes shall, unless otherwise permitted in contract specific Appendix 5/1, be laid only by automatic single pass drain laying machines.

3 (02/20) Drainage pipe and bedding combinations shall be selected from the alternatives described in contract specific Appendix 5/1. The granular material shall consist of natural and/or recycled coarse aggregate complying with BS EN 13242 and have a declaration of performance for its intended use, the declaration of performance shall demonstrate that the aggregate meets the specification.

Where recycled coarse aggregate is used in this Clause, it shall have been tested in accordance with Clause 710 and shall not contain more than 1% 'other' materials (Class X). Pipe bedding, haunching and surrounding material shall be as shown on HCD Drawing Numbers F1 and F2, and shall comply with the following:

(i) For pipes on beds shown on HCD Drawing Numbers F1 and F2 as Types B, F, S, I, J, L, K and M the aggregate shall have:

  (a) geometrical requirements in accordance with Table 5/3;

  (b) a resistance to fragmentation in Category LA_{50} in accordance with BS EN 13242, clause 5.2 and table 9;

  (c) a water-soluble sulfate content of less than 0.2% category $SS_{0.2}$ in accordance with BS EN 13242 when tested in accordance with BS EN 1744-1, clause 10; and,

  (d) all other requirements in Category$_{NR}$.

(ii) For pipes on beds shown on HCD Drawing Number F1 as Types N and T the aggregate shall comply with the geometrical requirements of either Table 5/3 or with Table 5/4, and with the fragmentation, watersoluble sulfate content and other requirements of (i) above;

(iii) For pipes on beds shown on HCD Drawing Number F1 as Types A and Z concrete shall be ST4 and ST2 respectively, in compliance to Clause 2602. Backfilling shall not be carried out until after the concrete has cured. The concrete bed or surround may extend to the sides of the trench. Class 8 material shall be used to fill any voids formed;

(iv) Except for filter drains a further surround above the bed, haunch and surround described above shall be provided to a height of 300mm above the top of the pipe consisting of Class 8 lower trench fill material as described in Table 6/1 and in compliance with Series 600;

(v) Unless otherwise described in contract specific Appendix 5/1 the materials used for the bedding, haunching and surrounding of filter drains shall comply with the appropriate bedding, haunching and surrounding materials specified in sub- Clauses 503.3.(i) to 503.3.(iv) and with the requirements for backfilling specified in sub-Clause 505.3; and,

(vi) Pipes shown on HCD Drawing Number F2 shall be laid with slots or perforations upwards where a concrete bed is used. For other beds the slots or perforations shall be orientated as described in contract specific Appendix 5/1.

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4 (02/20) Materials for bedding, haunching and surrounding pipes within 500mm, or any other distance described in contract specific Appendix 5/1, of concrete, cement bound materials, other cementitious materials or stabilised capping shall comply with the requirements stated in sub-Clause 601.16.

5 (02/20) Materials for bedding, haunching and surrounding pipes placed within 500mm, or any other distance described in contract specific Appendix 5/1, of metallic structural elements shall comply with the requirements stated in sub-Clause 601.17.

TABLE 5/3: (02/20) **BS EN 13242, Coarse Aggregate for Pipe Bedding, Haunching and Surrounding Material**

BS EN 13242, Coarse aggregate		
Category for general grading requirements	G_C80-20	
Category for tolerances at mid-size sieves	GT_{NR} (no requirements)	
Category for maximum values of fines content	Natural aggregate – $f_{1.5}$ Manufactured aggregate, recycled aggregate – f_4	
Nominal pipe diameter, mm	Aggregate size, mm	
	Graded	Single
Not exceeding 140	–	4/10
Exceeding 140 but not exceeding 400	2/14 or 4/20	4/10, 6/10 or 10/20
Exceeding 400	2/14, 4/20 or 4/40	4/10, 6/14, 10/20 or 20/40

TABLE 5/4: (02/20) **BS EN 13242, Fine and All-in Aggregated for Pipe Bedding, Haunching and Surrounding Material**

BS EN 13242, Fine and all-in aggregate		
	Fine	All-in
Category for general grading requirements	Category G_F80	Category G_A80
Category for tolerances on manufacturer's declared typical grading	GT_FNR (no requirement)	GT_ANR (no requirement)
Category for maximum values of fines content	Natural aggregate – f_3 Manufactured aggregate, recycled aggregate – f_{10}	Natural aggregate – f_3 Manufactured aggregate, recycled aggregate – f_{12}
Nominal pipe diameter, mm	Aggregate size, mm	
	Fine	All-in
Not exceeding 140	0/1, 0/2, 0/4 or 0/6	0/10
Exceeding 140 but not exceeding 400		0/10 or 0/20
Exceeding 400		0/10, 0/20 or 0/40

6 (02/20) Except where the pipeline is to be tested in compliance with Clause 509 before backfilling as specified in contract specific Appendix 5/1, the completion of the bedding, haunching and surrounding of the pipes is to be carried out immediately after jointing. The bed, haunch and surround shall be brought up equally on both sides of the pipe ensuring that it is in contact with the underside of the pipe barrel and be carefully compacted in layers not exceeding 150mm thickness ensuring full compaction next to the trench walls. Pipes shall be maintained to line and level during the bedding, haunching and surrounding operations. Where pipelines are to be tested before being covered the bedding haunching and surrounding material shall only be brought up sufficiently to support the pipeline and the joints shall be left exposed until the test is completed satisfactorily.

7 (02/20) Duct construction shall comply with the requirements of contract specific Appendix 5/2.

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504 (02/20) Jointing of Pipes

1 (02/20) Rigid joints shall mean joints made solid by caulking the sockets, or bolting together flanges integral with the pipes. Flexible joints shall mean joints made with deformable rings or gaskets held between pipe spigots and sockets, sleeves or collars.

2 (02/20) Joints in surface water drains shall be watertight complying with Table 5/1 or partly watertight complying with Table 5/1 as described in contract specific Appendix 5/1. Foul drains shall have watertight joints. Filter drains shall have joints complying with Table 5/1. Ducts need not have watertight joints unless otherwise described in contract specific Appendix 5/2.

3 (02/20) Watertight joints shall comply with Table 5/1, the manufacturer's instructions and the following:

(i) Rigid joints shall be used only where permitted in contract specific Appendix 5/1. Spigots and sockets of rigid joints jointed conventionally and the socket completely filled with mortar designation (i) complying with Clause 2404, excluding lime; a fillet of mortar being worked around the socket extending for a length of not less than 50mm from the face of the socket;

(ii) Joints in PVC-U pipes shall not be made with plastic solvent;

(iii) Flexible mechanical joints may be used with surface water pipes complying with BS EN 295;

(iv) Joints for cast iron pipes to BS 437 shall comply with BS EN 877 and have a declared performance that meets the specification requirements; and,

(v) Joints in thermoplastics structured wall pipe shall comply with Clause 518.

4 (02/20) Partly watertight joints for surface water drains shall be tested in accordance with sub-Clause 509.9 and shall be in accordance with Table 5/1. Push fit joints shall have a register to ensure that the pipe is fully pushed into the joint.

Corrugated steel pipes of lock seam fabrication, not exceeding 900mm internal diameter, shall be joined in accordance with the manufacturer's instructions. Bolted segmental plate pipe arches or circular pipes, not exceeding 900mm internal diameter, shall be joined in accordance with sub-Clause 501.6 (iv) and the manufacturer's instructions.

5 (02/20) Where a concrete bed, cradle, arch or surround is used with rigid pipes having flexible joints, joint filler board complying with Clause 1015 shall be placed in contact with the end of the socket at a pipe joint and shall extend through the full thickness of the concrete in contact with the pipe. Such joints in the concrete bed, haunch or surround shall be at intervals not exceeding 5 metres except where the spacing of joints in the pipe exceeds 5 metres when they shall be at each pipe joint.

6 (02/20) Joints in pipes for filter drains shall comply with Table 5/1 and with the following:

(i) Non-porous and unperforated concrete and clay pipes with spigot and socket, rebated or ogee joints shall be laid with unsealed joints and with a gap of 10mm between the end of the pipe and the inner end of the socket or rebate. The pipes shall be supported by a jointing material within the sockets over the lower third of the circumference so that there are no vertical steps between one pipe and another. Such pipes shall only be used with Type B filter material as described in Clause 505;

(ii) The ends of perforated or porous concrete pipes with rebated joints and perforated clayware pipes with rebated or with flexible sleeve joints shall be pushed tightly together;

(iii) Perforated or slotted thermoplastics pipes with spigots and sockets or sleeves may be dry-jointed or jointed as described in sub-Clauses 3 and 4 of this Clause; and,

(iv) Other perforated pipes shall be jointed as unperforated pipes of the same material.

7 (02/20) Joints in pipes for service ducts shall comply with BS 4660, BS EN 13598-1 and with the following:

(i) Pipes for ducts shall be jointed so that no silt, grit, grout or concrete surround is able to enter the duct. Pipes with push-fit joints shall have a register to ensure that the pipe is fully pushed into the joint.

(ii) Joints in pipes to BS 3506 shall comply with BS EN ISO 1452-1 to 5 as appropriate.

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505 (02/20) Backfilling of Trenches

1 (02/20) Backfilling shall be undertaken immediately after the required operations preceding it have been completed.

2 (02/20) Except where otherwise described in contract specific Appendix 5/1, trenches other than filter drain trenches shall be backfilled above the pipe surround material described in Clause 503, with Class 1, 2, or 3 general fill material complying with Series 600.

3 (02/20) Where detailed in contract specific Appendix 5/1 the bases of trenches formed on water soluble soils shall be sealed with a waterproof geotextile membrane. The geotextile membrane shall be in accordance with Clause 609.

4 (02/20) Each side of the waterproof geotextile membrane shall be protected by a layer of non-woven geotextile. The non-woven geotextile shall be in accordance with Clause 609.

5 (02/20) Sub-base material for the upper layer of the drain shall consist of Type 1 material to Clause 803.

6 (02/20) Geotextile membranes used between the upper and lower section of combined surface and sub-surface drains shall be in accordance with Clause 609.

7 (02/20) Use of lightweight aggregates as filter material shall be subject to the approval of the Overseeing Organisation.

8 (02/20) Filter drains shall be backfilled as described in contract specific Appendix 5/1 with Type A, Type B or Type C filter material which shall consist of natural or recycled coarse aggregate complying with BS EN 13242 and the following:

(i) for Type A and C, grading requirements for unbound mixtures in accordance with Table 5/5 and BS EN 13285;

(ii) for Type B, geometrical requirements in accordance with Table 5/5 and BS EN 13242;

(iii) a resistance to fragmentation in Category LA_{50} in accordance with BS EN 13242, clause 5.2 and table 9;

(iv) a water-soluble sulfate content of less than 0.2% Category $SS_{0.2}$ in accordance with BS EN 13242 when tested in accordance with BS EN 1744-1, clause 10;

(v) all other requirements in Category$_{NR}$

Where recycled coarse aggregate is used in accordance with this Clause, it shall have been tested in accordance with Clause 710 and shall not contain more than 1% 'other' materials (Class X).

Filter materials, shall be tested for permeability in accordance with sub-Clause 509.8 and shall comply with permeability requirements as described in contract specific Appendix 5/1.

Locations where Type A material is to be used shall be as specified in contract specific Appendix 5/1.

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TABLE 5/5: (02/20) **Grading and Geometrical Requirements for Filter Drain Material**

	Type A	Type B	Type C
Standard	BS EN 13285	BS EN 13242	BS EN 13285
Size, mm	0/20	20/40	As described in contract specific Appendix 5/1
Grading	G_E (with an additional sieve)	G_C80-20	
Oversize category	OC_{80}	–	
Category for tolerances at mid-size sieves	–	GT_{NR} (no requirement)	
Category for maximum fines	UF_3	F_{NR} (no requirement)	
Summary grading requirements			
Sieve size, mm	Percentage by mass passing		
80	–	100	As described in contract specific Appendix 5/1
63	–	98 - 100	
40	100	80 - 99	
20	80 - 99	0 - 20	
10	50 - 90	0 - 5	
4	30 - 75	–	
2	15 - 60	–	
0.500	0 - 35	–	
0.125	0 - 4	–	
0.063	0 - 3	–	
% in size fraction			
4/10	5 - 35	–	
2/4	5 - 35	–	

9 (02/20) Materials for backfilling trenches and filter drains placed within 500mm, or any other distance described in contract specific Appendix 5/1, of concrete, cement bound materials, other cementitious mixtures or stabilised capping shall comply with the requirements stated in sub-Clause 601.16.

10 (02/20) Materials for backfilling trenches and filter drains placed within 500mm, or any other distance described in contract specific Appendix 5/1, of metallic structural elements shall comply with the requirements stated in sub-Clause 601.17.

11 (02/20) Backfilling shall be deposited and compacted in compliance with Clause 612. Filter material for filter drains shall be deposited in layers not exceeding 225mm loose depth; each layer being compacted in compliance with Table 6/4 Method 3.

12 (02/20) Material shall be deposited in even layers and shall not be heaped in the trench before being spread. Spreading and compaction shall be carried out evenly without dislodging, distorting or damaging the pipe. Power rammers shall not be used within 300mm of any part of the pipe or joint.

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13 (02/20) Except in carriageways, other paved areas and locations described in contract specific Appendix 5/1, backfill of trenches shall be brought up to ground level. Where topsoil is at the surface on the line of the trench the upper section of the backfill shall be topsoil of the thickness described in contract specific Appendix 6/8, or of the same thickness and quality of topsoil as the surrounding ground where no thickness is specified. For trenches in carriageways or other paved areas the backfill shall be brought up to formation level, or sub-formation level where capping is required, unless a lower level is described in contract specific Appendix 5/1. Sheeting and other excavation supports shall be removed as the filling proceeds unless otherwise described in contract specific Appendix 6/3.

14 (02/20) The position of service ducts shall be marked when the trenches are backfilled and permanent marker blocks and location posts provided as described in contract specific Appendix 5/2.

(02/20) **Bitumen Bound Shredded Tyres**

15 (02/20) If the use of bitumen bound shredded tyres is proposed as a treatment to improve the stability of combined surface and sub-surface drains then the specification is to be submitted to the Overseeing Organisation for approval prior to use.

506 (02/20) Connecting to Existing Drains Chambers and Channels

1 (02/20) Where described in contract specific Appendix 5/1, existing drains shall be extended, connected and jointed to new drains, chambers or channels. All such connections shall be made during the construction of the new drain or other work and their positions recorded by the Contractor who shall provide to the Overseeing Organisation a copy of the record of the connections made the previous day. Where pipe connections are made to existing brick concrete or stone drains, chambers or channels, the pipes shall be well and tightly built into the concrete, brick or masonry work and be so placed as to discharge at an angle not greater than 60° to the direction of flow of the drain or channel and with the end of the pipe carefully cut to the necessary angle. Where the connections are between pipe drains, special connecting pipes shall be laid and jointed as described in contract specific Appendix 5/1.

2 (02/20) Before entering or breaking into an existing sewer or drain, the Contractor shall give notice of his intention to do so to the authority responsible for the drainage system to which the connection is to be made.

3 (02/20) Unless otherwise stated in contract specific Appendix 2/2, existing drains no longer required shall, as required by contract specific Appendix 5/1, be sealed with ST2 concrete, in compliance with Clause 2602, or removed and replaced with general fill material complying with Clause 601 and Table 6/1 and compacted in compliance with Clause 612, or grouted with a 1:10, cement: pfa mix. The grout shall use the minimum quantity of water to ensure the fluidity necessary to render it capable of being pumped to the ends of the pipe and be in accordance with the manufacturer's instructions. It shall be used within one hour of mixing but when the mix contains a retarding admixture this time may be extended in accordance with the manufacturer's instructions. The cement shall comply with BS EN 197-1 and the pulverised fuel ash (pfa) with BS 3892: Part 2, fineness to Zone B and sulfate content not exceeding 1.5%.

507 (02/20) Chambers

1 (02/20) Chambers shall include manholes, catchpits, inspection chambers, draw pits and walled soakaways. Chambers shall be of the type specified in contract specific Appendix 5/1, constructed in accordance with HCD Drawing Numbers F3 to F12 and F25 to F27 as appropriate to that type. Chambers for use in highway communications installations shall comply with Series 1500. All ST concrete referred to in this Clause shall comply with Clause 2602, unless otherwise described in contract specific Appendix 5/1.

2 (02/20) Foundations to chambers shall be of ST4 concrete. Channels for chambers shall be formed and finished smooth in the foundation concrete or constructed of preformed half circle channels, with sides benched in ST4 concrete, or mortar designation (i) complying with Clause 2404 excluding lime. Alternatively for inspection chambers not exceeding 1.3 metres in depth to invert, complete plastics units or other units in equivalent material surrounded by 150mm of ST4 concrete may be used.

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3 (02/20) Brickwork shall comply with Series 2400 and be built with mortar designation (i) in English bond. The joints of brickwork where exposed shall be finished as specified for unpointed joints in Clause 2412. The ends of all pipes shall be neatly built into the brickwork and finished flush with mortar designation (i). Where precast concrete adjusting units are used they shall conform to BS EN 1917 and BS 5911-3. Benching width for chambers detailed on HCD drawing numbers F25 to F27 shall be 300mm for branch connection.

4 (02/20) Precast concrete chambers shall comply with BS 5911-3 and BS EN 1917 and the particular requirements described in contract specific Appendix 5/1. Cast in situ concrete chambers shall be constructed of ST4 concrete complying with Clause 2602 and the particular requirements described in contract specific Appendix 5/1.

5 (02/20) Corrugated galvanized steel chambers shall comply with Clause 501 with in situ ST4 concrete inverts and precast concrete cover slabs complying with BS 5911-3 and BS EN 1917 and the particular requirements described in contract specific Appendix 5/1. They shall be surrounded with well graded granular material Class 6M as described in Table 6/1 compacted in accordance with Clause 612.

6 (02/20) Where the depth of invert of chambers, excluding inspection chambers, exceeds 900mm below the finished surface of the carriageway or the adjacent ground, chamber steps complying with BS EN 13101 shall be built in accordance with relevant Series F-HCD Drawings. The steps shall have a declaration of performance for their intended use within the permanent works. Threaded components shall be galvanised in compliance with Clause 1909.

7 (02/20) Excavation around chambers, except those described in sub-Clause 5 of this Clause, shall be backfilled with general fill material as described in Table 6/1 and compacted in compliance with Clause 612. Where mechanical compaction is impracticable, the excavation shall be backfilled with ST2 concrete. Where there are precast concrete access shafts to precast concrete chambers, the shafts shall be surrounded by a minimum thickness of 150mm of ST4 concrete, and the remaining excavation backfilled with general fill material as described in Table 6/1 compacted in compliance with Clause 612.

8 (02/20) Chambers for foul drains shall be tested for watertightness in accordance with Clause 509 and where required in contract specific Appendix 5/1.

9 (02/20) Chamber covers, gratings and frames shall be as described in contract specific Appendix 5/1 and shall comply with BS EN 124: 1994 and sub-Clauses 11 and 20 of this Clause. The cover shall be of suitable material, design and construction to achieve the required in-service skid resistance potential determined by the accelerated polish test method described in BS 9124. The Polished Skid Resistance Value (PSRV) shall be as stated in contract specific Appendix 5/1. The Unpolished Skid Resistance Value (USRV) is not an acceptable alternative to demonstrate in-service skid resistance.

10 (02/20) Class D 400 units and above shall incorporate a permanent non-rock feature either triangular point suspension or machined faces. Where a cover is required to be seated in a frame the design life of the seating shall match that of the frame. The seating shall not reduce the performance characteristics of the frame and cover.

11 (02/20) Bolts supplied for loosely coupling separate sections of covers and gratings shall be steel hexagon headed, complying with the requirements of BS EN ISO 4016, BS EN ISO 4018 and BS EN ISO 4034 and be galvanized in compliance with Clause 1909. They shall not be less than size M16 complete with hexagon nut and shall be provided with means to prevent undue tightening of unit sections.

12 (02/20) Unless otherwise specified in contract specific Appendix 5/1, all covers, gratings and frames shall be supplied in a fine cast (uncoated) condition. Where a coating is specified in contract specific Appendix 5/1, the coating shall only be applied when the surfaces of the casting are clean, free from rust and dry.

13 (02/20) Requirements for special duty covers for use in carriageways shall be as described in contract specific Appendix 5/1.

14 (02/20) Gratings for catchpit chambers shall have a minimum waterway area as described in contract specific Appendix 5/1.

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15 (02/20) Two sets of lifting keys shall be delivered to the Overseeing Organisation for each type of cover supplied. At least two keyways, as detailed on HCD Drawing No. F17, shall be provided in each complete cover, one in each segment for segmental covers. A recess for a prising bar shall be incorporated in manhole covers unless other means of loosening the cover from the frame are provided.

16 (02/20) Frames for chamber covers and gratings shall be set in cement mortar designation (i) complying with Clause 2404 or a quick setting mortar of equivalent strength with a declaration of performance for its intended use. The declaration of performance shall be submitted to the Overseeing Organisation.

17 (02/20) For all pipelines except those constructed with corrugated pipes the nearest joint to any chamber shall be not more than 500mm from the inner face of the wall and shall not be restricted by any concrete. Between this and the next joint, the length of the articulated pipe shall be in accordance with Table 5/6.

TABLE 5/6: (02/20) **Length of Articulated Pipe**

Nominal Pipe Diameter (mm)	Length of Pipe (mm)
450 and less	500 to 750
Greater than 450	750 to 1000

18 (02/20) Where the adjustment or replacement of existing frames and covers or gratings is required, the units shall be taken up and re-fixed or removed and replaced with new units complying with sub-Clauses 9 to 15 of this Clause, or as described in contract specific Appendix 5/1. On taking up or removal of the unit, any concrete or mortar bedding shall be broken out and the surface prepared. Where existing frames and covers or gratings are to be adjusted, the Contractor shall take up the unit and clean it so it is free from existing mortar, any debris, rust and is dry before re-use. The adjusted or replaced units shall be laid on a mortar bed complying with sub-Clause 16 of this Clause. The finished thickness of the mortar bed shall be between 10mm and 25mm. Where required in contract specific Appendix 5/1, covers and gratings shall be bedded using a quick setting high strength mortar with a declaration of performance for its intended use. The declaration of performance shall be provided to the Overseeing Organisation before use. Unless otherwise described in contract specific Appendix 5/1, adjusted or replaced frames and covers or gratings shall be set flush with the new or reinstated surface. Any additional adjustments shall be by modifying the brickwork, or adjusting units in accordance with BS EN 1917 and BS 5911- 3, in compliance with sub-Clause 507.3 or by using a frame of a suitable depth. On completion of the works, each cover shall be lifted and the frame and seating cleaned.

19 (02/20) Unless otherwise specified in contract specific Appendix 5/1, chamber covers shall have the following minimum clear opening requirements:

(i) rectangular frame 600mm, with a minimum diagonal measurement of 700mm;

(ii) circular frame minimum diameter of 700mm.

20 (02/20) Vents are not required in chamber covers unless otherwise stated in contract specific Appendix 5/1.

21 (02/20) Where stated in contract specific Appendix 5/1 the sealing of a cover within the frame is required.

22 (02/20) Access covers with a clear opening of greater than 1m shall comply with BS 9124.

23 (02/20) Where pins or circlips are used as part of the securing device these shall be of equal cross-sectional area.

24 (02/20) Chamber tops and gully tops shall be bedded upon material which has the following properties:

(i) non-shrinkable;

(ii) a minimum workable life of 15 minutes;

(iii) a compression strength that exceeds 30N/mm^2 within 3 hours of placing; and,

(iv) a tensile strength that exceeds 5N/mm^2 within three hours of placing.

25 (02/20) The bedding beneath the chamber top or gully top frame shall be free of voids.

26 (02/20) Packing materials shall not be used in the bedding of chamber tops and gully tops.

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27 (02/20) Seatings of covers within frames shall have been manufactured to ensure that, when trafficked, stability and quietness are achieved in accordance with BS EN 124: 1994.

28 (02/20) The frame bearing area shall have the following properties:

(i) the nominal bearing pressure in relation to the test load in BS EN 124:1994;

(ii) frames have an overall minimum bedding width of 50mm of metal and a maximum overall bedding width of 120mm of metal; and,

(iii) for openings with corners, the external corners of the frame are solid (unless test data are provided that demonstrate the inclusion of holes does not reduce the structural integrity of the system) and may be square, curved or chamfered but at no point shall the width be less than the minimum bedding width.

29 (02/20) The bedding flange shall have a minimum thickness of 5mm.

30 (02/20) Where vertical frame stiffening webs/gussets are provided, they shall be located adjacent to seatings.

31 (02/20) The tops of such triangular webs/ gussets shall be in accordance with BS 7903.

32 (02/20) There shall be no holes within the seating areas of the bedding flanges beneath the cover seatings.

33 (02/20) Any holes within flanges within the bedding area of the frame shall be minimal and not reduce the specified bearing area of the frame.

(02/20) **Placing of Frames and Covers**

34 (02/20) The frame of chamber tops and gully tops shall be placed on the bedding material so that all webs of the frame are fully supported by the frame supporting structure.

35 (02/20) The bedding surface shall permit a bedding thickness of between 10mm and 75mm.

36 (02/20) The webs of the frame shall not overhang the internal faces of the frame supporting structure.

37 (02/20) Any holes within the frame shall be infilled with bedding material and the flanges of the frame enveloped by a minimum thickness of 10mm of the same material.

38 (02/20) Exposed surfaces of the bedding material around the outside of the chamber or gully top frame shall be floated to fill any voids and remove loose fragments.

39 (02/20) The exposed surface of the bedding material inside the chamber shall be pointed to a smooth finish.

40 (02/20) Surround materials shall only be placed in contact with the frame once the bedding material has set.

(02/20) **Placement of Cover Surround Materials**

41 (02/20) Where a self-setting fill material is used this shall be placed no higher than 40mm below the finished surface level.

(02/20) **Securing Chamber Covers and Frames**

42 (02/20) Chamber covers and frames shall be secured to ensure that they are not dislodged by a vehicle.

(02/20) **Reinstatement Works**

(02/20) **Frame Supporting Structure**

43 (02/20) Where rebuilding involves more than one course of brickwork or precast concrete cover frame seating ring, an adjusting course shall be used to meet the specified finished surface level.

44 (02/20) Frame supporting structure reconstruction shall be engineering bricks in compliance with Clause 2400 (without holes or frogs) or adjusting units in accordance with BS EN 1917 and BS 5911-3, bedded on mortar that achieves a compressive strength exceeding 20N/mm^2 Class Md in accordance with BS EN 998 and Clause 2404 before loading.

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(02/20) **Re-bedding of Covers/Gully Gratings**

45 (02/20) Mixing and placing of proprietary bedding materials shall be in accordance with the manufacturer's instructions.

46 (02/20) Site made mortar shall be in accordance with Clause 2404.

47 (02/20) Bedding layers greater than 50mm thick shall be placed in two stages.

48 (02/20) The first layer of the mortar shall be no thicker than 40mm.

(02/20) **Reinstatement of Surrounding Flexible Carriageway**

49 (02/20) There shall be no contact between any compaction device and the frame or cover to avoid damaging the frame, cover or the bedding layer.

50 (02/20) The joint between the reinstated and existing materials shall be sealed with bituminous material in compliance with clause 903.22.

#508 (02/20) Gullies and Pipe Junctions

1 (02/20) Gullies shall be trapped, untrapped or sumpless as described in contract specific Appendix 5/1 and be in accordance with HCD Drawing Numbers F13 and F14. All ST concrete referred to in this Clause shall comply with Clause 2602 unless otherwise described in contract specific Appendix 5/1.

2 (02/20) Gullies shall be constructed so that no part of the spout or trap has a cross-sectional area less than 2/3rd that of the outlet. The depth of water seal in trapped gullies shall be not less than 50mm.

3 (02/20) Precast concrete gullies and cover slabs shall comply with BS 5911-6 and clay gullies with BS EN 295. In situ concrete gullies shall be as described in contract specific Appendix 5/1 and constructed of ST4 concrete of 150mm minimum thickness, using permanent or removable shuttering.

4 When constructing an in situ sumpless gully, the pot shall not distort under pressure.

5 Where in situ concrete gullies are formed with permanent shuttering, such shuttering shall have current product acceptance scheme certification in accordance with sub-Clauses 104.15 and 104.16.

6 (02/20) Gully gratings, kerb type gully covers and frames shall comply with BS EN 124: 1994 and the following and shall be of the classes and sizes described in contract specific Appendix 5/1.

7 (02/20) The upper surface of gully gratings shall be flat except where otherwise described in contract specific Appendix 5/1. Slots in gratings or between gratings and frames shall not be orientated parallel to the direction of traffic except where the slots are less than 150mm long or less than 20mm wide. Minimum waterway areas shall be as specified in contract specific Appendix 5/1. Unless otherwise specified in contract specific Appendix 5/1, all gratings and frames shall be supplied in a fine cast (uncoated) condition. Where a coating is specified in contract specific Appendix 5/1, the coating shall only be applied when the surfaces of the casting are clean, free from rust and dry. Frames shall be bedded on mortar complying with sub-Clause 507.21. Brickwork shall comply with sub-Clause 507.3.

8 (02/20) Backfilling to precast gullies shall be carried out up to sub-formation level with general fill material Class 1, as described in Table 6/1 compacted in compliance with Clause 612. Where mechanical compaction is impracticable, the backfilling shall be in ST2 concrete. The remainder of the backfilling shall be in appropriate capping and road pavement materials except that where mechanical compaction of capping or unbound mixture for subbase is impracticable ST2 concrete shall be used.

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9 (02/20) Gully connection pipes shall be either flexible or rigid not exceeding 0.7m in length with flexible joints for a distance of 2m from the gully and shall be in accordance with Clause 507 when entering chambers. Junction pipes shall be manufactured of the same type and class of material as the remainder of the pipes in the run. Junction pipes which are laid but not immediately connected, shall be fitted with temporary stoppers or seals and the position of all such junctions shall be clearly defined by means of stakes or tracing wires properly marked or labelled. Saddles may be used to form junctions only where permitted in contract specific Appendix 5/1. No internal projections greater than 5 mm will be permitted. Saddles for plastics pipes shall be installed in accordance with the manufacturer's recommendations. Saddles with clay pipes shall be jointed with mortar designation (i) complying with Clause 2404, excluding lime. Saddles and pipes shall be surrounded with ST2 concrete.

10 (02/20) Where the adjustment or replacement of existing frames and gratings is required, the units shall be taken up and re-fixed or removed and replaced with new units complying with sub-Clauses 4 and 5 of this Clause, or as described in contract specific Appendix 5/1. On taking up or removal of the unit, any concrete or mortar bedding shall be broken out and the surface prepared. Where existing frames and covers or gratings are to be adjusted, the Contractor shall take up the unit and clean it so it is free from existing mortar, any debris, rust and is dry before re-use. The adjusted or replaced units shall be laid at a level, unless otherwise described in contract specific Appendix 5/1, 6 mm below the adjoining road surface on a mortar bed complying with sub-Clause 507.16. The finished thickness of the mortar bed shall be between 10 mm and 25 mm. Where required in contract specific Appendix 5/1, covers and gratings shall be bedded using a quick setting high strength mortar which shall have a declaration of performance for its intended use, the declaration of performance shall be provided to the Overseeing Organisation before use. Any additional adjustment shall be made by modifying the brickwork in compliance with sub-Clause 507.3 or by using a frame of suitable depth. On completion of the works, each grating shall be lifted and the frame and seating cleaned.

509 (02/20) Testing and Cleaning

1 (02/20) Drains required in contract specific Appendix 5/1 to have watertight joints shall be tested as described in contract specific Appendix 1/5 in sections, e.g. between chambers, by means of the air test described in sub-Clause 2 of this Clause. If a pipeline is rejected because of a failed air test, as part of the rectification work, a water test as described in sub-Clause 3 of this Clause may be carried out as an alternative compliance test. Before testing, the ends of the pipeline to be tested, including those of short branches, shall be plugged and sealed.

2 (02/20) For the pipeline air test, air shall be pumped in by suitable means until a stable pressure of 100mm head of water is indicated in a U-tube connected to the system. The air pressure shall not fall to less than 75mm head of water during a period of 5 minutes without further pumping, after an initial period to allow stabilization. Drains with traps shall be tested to 50mm head of water and the permissible loss shall then be no more than 13mm head of water in 5 minutes without further pumping after the initial stabilising period.

3 (02/20) For the pipeline water test, the pipes shall be filled with water under a head of not less than 1.2m above the crown of the pipe at the high end and not more than 6m above the pipe at the low end. Steeply graded pipelines shall be tested in sections so that the above maximum is not exceeded. The test shall commence not less than two hours after filling the test section at which time the level of water at the vertical feed pipe shall be made up to produce the required 1.2m minimum test head. The loss of water over a 30 minute period shall be measured by adding water at regular 10 minute intervals to restore the original water level and recording the amounts so added. The drain will have passed the test if the volume of water added does not exceed one litre per hour per linear metre of drain per metre of nominal internal diameter.

4 (02/20) All pipelines less than 350mm diameter, excluding service ducts shall be checked by drawing through each completed length of pipe a spherical mandrel of a diameter 10% less than the nominal bore of the pipes being tested.

5 (02/20) During the progress of the works all existing chambers, gullies and rodding eyes shall be kept clean and free from obstruction. On completion of the whole of the works, all chambers, gullies and drains including verge/surface water drains and filter drains but excluding all fin and narrow filter drains shall be flushed from end to end with water and left free from obstructions and silt. Catchpit chambers shall be left clean and free from silt.

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Unless otherwise required in contract specific Appendix 90/1 (MCHW 5.9.3) all carrier, foul and filter drains but excluding all fin and narrow filter drains shall be surveyed by Closed Circuit Television (CCTV) in accordance with the relevant requirements of Series 9000 (MCHW 5.9, Parts 1 to 5). Further guidance is provided in sub-Clauses NG 509.4 and NG 509.5.

6 (02/20) The pipes and filter material of filter drains shall at all times be left clean and free from silt and obstruction.

7 (02/20) Where described in contract specific Appendix 1/5, samples of one or more partly watertight joints for pipelines up to and including 900mm diameter shall be tested with a head of water kept level with the crown of the pipe. The joint will not be accepted if the flow through the joint in litres per minute exceeds 20 times the square of the nominal internal diameter of the pipe in metres.

8 (02/20) Permeability tests shall be as described in contract specific Appendix 5/1.

9 (02/20) Service ducts shall be checked by drawing a wooden mandrel, as shown on HCD Drawing Number I2, through as the ducts are laid. Where a set has to be given to the line of ducts the wooden mandrel shall be replaced by an iron mandrel 250mm long but of the same diameter as the wooden version.

510 (02/20) Surface Water Channels and Drainage Channel Blocks

1 (02/20) Surface water channels and drainage channel blocks shall be constructed as described in contract specific Appendix 5/3.

2 (02/20) Surface water channels shall comply with Clause 1103.

3 (02/20) Drainage channel blocks shall comply with Clause 1101. Pre-cast concrete channel blocks shall comply with BS EN 1340. The declaration of performance shall be submitted to the Overseeing Organisation and it shall demonstrate that the channel blocks meet the specification.

511 (02/20) Land Drains

1 (02/20) Existing land drains which are permanently severed by the works shall be located and connected into a new drain, pipe or ditch all as described in contract specific Appendix 5/1. The lengths remaining within the works shall be cleaned out from the new drain trench face as necessary. Any pipe disturbed by the works shall be re-laid to ensure a free discharge into the new drain. Disused ends of intercepted land drains shall be adequately sealed with ST2 concrete in compliance with Clause 2602.

2 (02/20) Where an existing land drain is exposed and severed by temporary trench excavation, the Contractor shall mark the position of the drain and record it. The drain shall be diverted into an existing drain or watercourse. Alternatively, the normal functioning of the drain shall be continued by the construction of a pipeline or channel adequately supported across the excavation, until permanent restoration is made on the original line.

3 (02/20) The Contractor shall notify the Overseeing Organisation of any land drain which is blocked or is otherwise defective when the drain is first exposed.

4 (02/20) Severed mole drains shall be led straight into new drains; alternatively they shall where required in contract specific Appendix 5/1 be intercepted by the construction of a land drain. Where they have been disturbed mole channels shall be cleaned out and filled locally with Type A filter material or as otherwise described in contract specific Appendix 5/1.

512 (02/20) Backfilling to Pipe Bays and Verges on Bridges

1 (02/20) Unless otherwise described in contract specific Appendix 5/1, filling to pipe bays and verges on bridges shall be well graded granular material not exceeding 20mm size containing not more than 3% of material passing the 0.063mm sieve and with a uniformity coefficient of more than 5. It shall be laid and compacted in compliance with sub-Clauses 505.11 and 12. The material shall meet the sulfate requirement described in sub-Clauses 503.4, 503.5, 505.9 and 505.10.

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513 (02/20) Permeable Backing to Earth Retaining Structures

1 (02/20) Unless otherwise described in contract specific Appendix 5/1, permeable backing shall consist of one of the following materials except when the filling adjacent to the structure is selected cohesive material (Class 7A), selected conditioned pulverised-fuel ash (Class 7B) or chalk:

(i) A minimum thickness of 300mm of granular material complying with the requirements of Clause 505 for Type A or Type C material and, in addition, satisfying the following criteria:

(a) Piping ratio, defined as

$$\frac{\text{15 per cent size of the drainage material,}}{\text{85 per cent size of the backfill material}} < 5$$

(b) Permeability ratio, defined as

$$\frac{\text{15 per cent size of the drainage material,}}{\text{15 per cent size of the backfill material}} < 5$$

where the per cent size of a material is the size of particle corresponding to the given per cent ordinate of the particle size distribution graph.

(ii) Porous no-fines concrete, cast in situ 225mm thick complying with the requirements of Clause 2603.

(iii) Precast hollow concrete blocks complying with the BS EN 771-3 laid in stretcher bond with dry joints in 225mm thick walling with holes vertical. The blocks shall have a declaration of performance for their intended use which shall demonstrate that the blocks meet the specification.

2 (02/20) When the filling adjacent to the structure is selected cohesive material (Class 7A), selected conditioned pulverised-fuel ash (Class 7B) or chalk, the permeable backing shall be a minimum thickness of 300mm of 0/4 or 0/2, CP or MP, sand complying with BS EN 12620 unless otherwise described in contract specific Appendix 5/1. The sand shall have a declaration of performance for its intended use which shall demonstrate that it meets the specification.

514 (02/20) Fin Drains

(02/20) General

1 (02/20) Fin drains shall comply with this Clause and the special requirements described in contract specific Appendix 5/4.

The terms thickness, width, height and core shall have the meanings indicated on HCD Drawing Number F18 unless otherwise described in contract specific Appendix 5/4.

The term fin drain shall mean a planar geocomposite structure designed to perform the same function as a narrow filter drain.

2 (02/20) Where fin drains are designed for lateral entry of water from one side only the requirements for flow rates in sub-Clauses 4 and 5 of this Clause shall apply to the face or plane designed to admit or transmit water.

3 (02/20) The materials of which the drain is made shall be treated so that they are protected from the deleterious effects of short term exposure to ultraviolet light, and shall be resistant to degradation by acids, alkalis, common chemicals, bacteria, fungi and moulds occurring in soils and highway construction materials.

After exposure to ultraviolet light the Overseeing Organisation may require evidence that the materials still comply with the requirements of this Clause. The drain shall be protected from damage and ultraviolet light and be labelled to identify the grade and manufacturer or supplier. Where necessary, the side intended for entry of water and the direction of in-plane flow shall be identified.

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(02/20) **Geotextile**

4 (02/20) The geotextile shall:

(i) conform to BS EN 13252 and the details stated in contract specific Appendix 5/4, it shall have a declaration of performance for its intended use, the declaration of performance shall demonstrate that the geotextile meets the specification and shall be submitted to the Overseeing Organisation prior to the commencement of fin drain work;

(ii) in both machine and cross-machine directions, sustain a tensile load of not less than 5.0kN/m at break and have a minimum failure strain of 10% when determined in accordance with BS EN ISO 10319;

(iii) have a minimum static puncture resistance of 1200N when determined in accordance with BS EN ISO 12236;

(iv) have a mean hole diameter < 40mm when tested to BS EN ISO 13433;

(v) have a size distribution of pore openings such that the apparent opening size O_{90} when determined in accordance with BS EN ISO 12956 is as stated in contract specific Appendix 5/4; and,

(vi) have water permeability characteristics as stated in contract specific Appendix 5/4.

(02/20) **Composite Drain**

5 (02/20) Where a composite drain is installed in an existing drain the following steps shall be undertaken:

(i) removal of approximately 400mm depth of media from the drain;

(ii) positioning of a non-woven geotextile over the exposed media;

(iii) placement and compaction of sub-soil in compliance with Class 4 material (see Table 6/1) to form a V-channel profile;

(iv) placement of 35mm to 50mm of topsoil.

The maximum depth from the top of the topsoil to the channel invert shall be 200mm.

To ensure the grass roots get air as well as water after compaction, the subsoil shall be non cohesive and have a permeability in excess of 10^{-4}m/s as tested in accordance with HA 41.

6 (02/20) The composite drain shall:

(i) have a flow rate through each face of the drain of more than 75% of the value specified in sub-Clause 4(v) of this Clause on the side or sides where inflow occurs. This value may be found by either:

(a) direct measurement of the composite drain using a modified version of BS 6906: Part 3; or,

(b) calculation based on the flow rate obtained by the standard test in BS 6906: Part 3 and the percentage contact area of the drainage core obtained from sub-Clause 13 of this Clause or other appropriate method;

(ii) have values of long term in-plane flow rates as stated in contract specific Appendix 5/4 when determined in accordance with sub-Clauses 14 and 15 of this Clause. The values of hydraulic gradient and minimum applied stresses shall be as given in Table 5/7.

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TABLE 5/7: (02/20) **Applied Stresses (kN/m²) and Hydraulic Gradient**

HCD Drain Type	5	6	7	10
Sub-Clause 15: Normal Stress Shear Stress	 50 10	 50 10	 50 10	 100 10
Sub-Clause 16: Normal Stress	100	100	100	100
Sub-Clause 16: Hydraulic Gradient	 0.1 1.0	1.0	1.0	 0.1 1.0

(02/20) **Joints**

7 (02/20) Fin drains shall be capable of being jointed longitudinally or laterally into pipe systems or chambers for inflow and outflow purposes and be self jointing either directly or through purpose made attachment pieces for forming continuous drain lengths. All such joints shall be formed so as to prevent the ingress of soil particles or other extraneous material into the drain.

Fin drain joints transverse to the direction of flow shall have values of in-plane flow rates not less than that required by sub-Clause 5(ii) of this Clause.

Fin drain joints parallel to the direction of flow and any exposed edges shall be protected from the ingress of soil by a geotextile wrapping with a minimum overlap of 150mm.

(02/20) **Pipes**

8 (02/20) For drain Type 6 pipes shall be perforated or porous and comply with sub-Clause 501.3.

For drain Type 7 pipes shall be unperforated thermoplastics pipe complying with Clause 518 slotted longitudinally along the top surface and stress relief treated (if required) in accordance with the system manufacturer's specification.

9 (02/20) Pipe joints shall comply with the requirements of the relevant British Standard for the pipe used or Clause 518.

(02/20) **Backfill and Surround Material**

10 (02/20) Pipe surround material for drain Types 6 and 7 shall comply with sub-Clause 503.3(i) or 503.3(ii) or Type A or C material complying with sub-Clause 505.3.

Where fin drains are installed in a trench backfill material shall be the original as-dug material from the trench unless otherwise specified in contract specific Appendix 5/4.

(02/20) **Dimensions**

11 (02/20) Unless otherwise described in contract specific Appendix 5/4 the dimensions of the fin drain shall be as shown on HCD Drawings F18 and F21. The pipe diameter shall be as stated in contract specific Appendix 5/4. The drain slope angle (x), as shown on Drawing F19, shall be not greater than 15% from the vertical unless otherwise stated in contract specific Appendix 5/4.

(02/20) **Installation and Handling**

12 (02/20) Installation of fin drains shall be as shown on HCD Drawing Numbers F19 to F21. Where fin drains are assembled on site the assembly area shall be clean and dry and free of wind-borne pollutants. Any material which becomes contaminated must be replaced. No geotextile or core material shall be exposed to daylight (or any source of ultraviolet radiation) for a period exceeding a cumulative total of 50 hours. Any geotextile or core material exposed to daylight (or any source of ultraviolet light) for a period exceeding a cumulative total of 50 hours shall be replaced unless it can be demonstrated that the materials of the drain still comply with the requirements of this Clause.

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Where fin drains are laid in trench, the trench bottom shall be free of irregularities and to the required levels given in contract specific Appendix 5/4. Rock and other hard protuberances shall be removed and any excess cut in the trench bottom filled and compacted back to the required grade with suitable excavated or imported material.

The drain shall be laid with the appropriate face against the side of the trench adjacent to the carriageway and in the appropriate direction. This side of the trench shall have walls sufficiently clean to enable the fin drain to come into close contact with the wall when the trench is backfilled and compacted. Compaction shall be in accordance with Clause 612. Fin drains installed as part of the works shall be protected from surface water, contamination, and accidental damage during construction.

The fin drain, pipe surround and backfill shall be installed so as to cause no damage to the fin drain. Where any damage does occur, the damaged materials shall be replaced by new material.

After the installation of the fin drain has been completed a marker tape shall be laid approximately 75mm above the fin drain in the position shown on HCD Drawing Numbers F19 and F20. The tapes shall be green self-coloured PVC or polythene plastic not less than 0.1mm thick and 150mm wide.

(02/20) **Identification**

13 (02/20) The Contractor shall obtain and make available the following information for each separate consignment of fin drain delivered to site:

(i) geotextile declaration of performance;

(ii) core name, grade/number and mass per unit area;

(iii) names and addresses of system producer core and pipe manufacturers;

(iv) manufacturing characteristics and constituents of core. This shall include composition and type of constituent filaments, threads, fibres, films, tapes and other components;

(v) consignment number and delivery date; and,

(vi) a copy of the site delivery note.

(02/20) **Test Method for the Percentage Contact Area of Drainage Core**

14 (i) (02/20) The test determines the area of one face of a drainage core which will be in contact with a geotextile filter as a percentage;

(ii) The apparatus required is as follows:

(a) loading device able to apply a compressive load of at least 2kN and having a flat steel base;

(b) flat steel loading plate 200mm x 200mm;

(c) printers ink and roller (or pad);

(d) sheet of thin compressible rubber; and,

(e) planimeter.

(iii) The test procedure shall be as follows. Cut three representative test specimens 200mm x 200mm (±2mm). Apply ink to one 200mm x 200mm face of a specimen and cover with a sheet of plain paper and a thin compressible rubber sheet. Place the prepared specimen in to the loading device and gradually apply the load of 2kN and maintain for 5 minutes. Release the load and remove the specimen and separate it from the paper. Using the planimeter find the total area of the paper which has received an imprint. Repeat for all specimens;

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(iv) The percentage contact area =

$$\frac{\text{total area of imprint}}{\text{area of test specimen}} \times 100$$

(v) The report shall include:

(a) a reference to this method;

(b) sample identification details;

(c) individual and mean percentage contact areas; and,

(d) details of any deviation from the specified test procedure.

(vi) Alternative methods of determining the percentage contact area may be employed with the prior approval of the Overseeing Organisation.

(02/20) **Test Method for Determining the Thickness of Fin Drains Under Specified Normal and Shear Stresses**

15 (i) (02/20) The test determines the thickness of the fin drain under sustained normal and shear stresses. A long term thickness (at 100,000 hours) is calculated by extrapolation and a short term equivalent normal load which produces the long term thickness is determined.

(ii) The apparatus required is as follows:

(a) a suitable compression testing machine, which shall have a vertical travel at least the nominal thickness of the specimen. It shall be capable of sustaining the necessary loads to within 1% accuracy for the duration of the test;

(b) the compression testing apparatus, which shall include a fixed base plate and parallel moveable top plate with flat steel surface with sufficient friction to permit the development of the required shear forces;

(c) a means of measuring the mean thickness of the specimen to an accuracy of 0.01mm.

As an alternative to (a) and (b), an appropriate inclined plane and kentledge system may be employed to produce the normal and shear loads.

The test procedure shall be as follows:

(iii) Cut six representative specimens of minimum size 100mm x 100mm symmetrically about the core design. Three specimens shall be tested in accordance with (v) below and three in accordance with (vi) below;

(iv) The test specimen shall be placed symmetrically on the base plate and covered by the top plate. The means of measuring thickness shall be attached and the initial thickness measured;

(v) Apply the load smoothly and as quickly as possible to the top plate. The full load (normal and shear) shall be applied in less than 20 seconds and sustained for at least 1000 hours. The applied stresses shall be those given in Table 5/7. At least four measurements of thickness shall be made during each unit of logarithmic time after the first minute. Determine the long term thickness of the specimen as the thickness of the specimen at 1000 hours reduced by 2T where T is the difference in thicknesses of the specimen thickness recorded at 100 hours and 1000 hours. Repeat the test on the two other specimens. The test specimens shall be maintained at a constant temperature of 20°C ± 2°C throughout the test period.

(vi) Apply increasing increments of normal load to the specimen. Determine the short term equivalent load which shall be the load which when applied for a period of 20±5 minutes produces a specimen thickness equal (within an accuracy of ±0.05mm) to the long term thickness of the specimen obtained at (v) above. Repeat the test on the other two specimens.

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(vii) The report shall include:

(a) a reference to this method;

(b) sample identification details;

(c) the initial thickness of the sample;

(d) the applied load;

(e) the thickness of each sample at 100 and 1000 hours and the mean of the three results;

(f) a plot of percentage reduction in thickness against logarithmic time;

(g) the mean long term thickness;

(h) the mean short term equivalent load; and,

(i) any deviations from the specified test procedure.

(02/20) **Determining In-plane Flow Under Compressive Loading**

16 (02/20) In-plane flow shall be determined in accordance with BS 6906: Part 7 except that the following conditions shall apply:

(i) the applied normal stress shall be the greater of the value given in Table 5/7 (for sub-Clause 16) or the mean short term equivalent stress as determined in sub-Clause 15 (vi) of this Clause;

(ii) the sample shall be tested such that the measured flow (or flows) is in the same direction as the principal flow (or flows) when the fin drain is in service;

(iii) the foam rubber option of the test procedure shall be used (details of the foam rubber to be used may be obtained from the Overseeing Organisation); and,

(iv) the hydraulic transmissivity shall be reported for each of the hydraulic gradients employed.

(02/20) **Test Methods**

17 (02/20) Notwithstanding the requirements of sub-Clauses 14, 15 and 16 of this Clause, variations in the test methods specified therein shall be made where deemed necessary by the British Board of Agrément (or equivalent) following consultation with the manufacturer. All such variations shall be recorded in the report.

(02/20) **Certification**

18 (02/20) Fin drains and constituent materials, other than the geotextile and aggregates, shall have current product acceptance scheme certification in accordance with sub-Clauses 104.15 and 104.16 certifying the appropriate physical properties when tested in accordance with this Clause.

515 (02/20) Narrow Filter Drains

(02/20) **General**

1 (02/20) Narrow filter drains shall comply with this Clause and the special requirements described in contract specific Appendix 5/4.

The term narrow filter drain refers to drain Types 8 or 9 indicated in the HCD Drawing Number F18. They consist of a porous or perforated pipe laid in a narrow trench surrounded by granular material where the granular material and/or the pipe is enclosed by a layer of geotextile filter. Narrow filter drains and fin drains perform the same function.

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(02/20) **Materials**

2 (02/20) The materials used in the drain shall be stored so that they are protected from the deleterious effects of short term exposure to ultraviolet light, and shall be resistant to degradation by acids, alkalis, common chemicals, bacteria, fungi and moulds occurring in soils and highway construction materials. After exposure to ultraviolet light the Overseeing Organisation may require evidence that the materials still comply with the requirements of this Clause. They shall be protected from damage and ultraviolet light and be labelled to identify the grade and manufacturer or supplier.

3 (02/20) The geotextile used in narrow filter drains shall comply with all requirements of sub-Clause 514.4 for geotextiles used in fin drains.

For drain Type 8 the geotextile surround to the pipe shall consist of a prefabricated continuous close fitting sock. Alternatively the pipe shall be firmly wrapped in a single layer of geotextile with an overlap of between 50 and 75mm and secured around the pipe in a manner so as to prevent the ingress of soil particles or other extraneous material and without affecting the permeability of the wrapped material. Splices between lengths of sock or layer shall have overlaps within these dimensions and be securely tied.

For drain Type 9 the geotextile surround to the granular material shall have a minimum overlap of 250mm including 100mm down-tuck. Splicing of lengths of geotextile shall consist of minimum 600mm overlap secured with pins or mechanical ties. Where an outlet pipe passes through the geotextile a separate piece of geotextile shall be wrapped round the outlet pipe, flared against the geotextile in the filter drain and secured. Where drain lengths are terminated at chambers, the geotextile shall be secured against the chamber walls by suitable means so as to prevent the ingress of soil particles or other extraneous material into the drain.

4 (02/20) Pipes and fittings shall comply with sub- Clauses 514.8 and 514.9. Where coilable pipes are used they shall be capable of being straightened so as to lie flat without restraint in the trench bottom before backfilling.

5 (02/20) The granular material used for trench infill shall comply with the requirements for non-plasticity, LA category and sulfate content of sub-Clause 505.8 and have a grading within the limits of Table 5/8. The material shall meet the permeability requirements described in contract specific Appendix 5/4.

TABLE 5/8: (02/20) **Narrow Filter Drain: Trench Infill Grading Requirements**

	Type 8	**Type 9**
Standard	BS EN 13242	BS EN 13242
Size, mm	1/20	10/40
Grading	G_C 80-20	G_C 85-15
Aggregate	Coarse	Coarse
Category for tolerances at mid-size sieves	as stated in contract specific Appendix 5/4	as stated in contract specific Appendix 5/4
Category for maximum fines	f_2	f_2
Additional requirements	d/8 0-3% passing by mass	d/80 0-3% passing by mass

(02/20) **Dimensions**

6 (02/20) Unless otherwise described in contract specific Appendix 5/4 the dimensions of the narrow filter drain shall be as shown on HCD Drawing No. F18. The pipe diameter shall be as stated in contract specific Appendix 5/4. The drain slope angle (x), as shown on Drawing F20, shall be not greater than 15% from the vertical unless otherwise stated in contract specific Appendix 5/4.

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(02/20) **Installation and Handling**

7 (02/20) Narrow filter drains shall be installed as shown on HCD Drawing Number F20. Before during and after installation the geotextile shall be protected from contamination, damage and exposure to ultraviolet radiation in accordance with sub-Clause 514.12.

(02/20) The excavated trench bottom shall be free of irregularities and to the required levels given in contract specific Appendix 5/4. Rock and other hard protuberances shall be removed and any excess cut in the trench bottom filled and compacted back to the required grade with suitable excavated or imported material. Drain Type 9 shall have trench walls sufficiently clean to enable the geotextile to come into close contact with the wall when the granular material is placed inside it. The deposition and compaction of infill shall be in accordance with sub-Clause 505.4 for filter drains.

(02/20) Narrow filter drains installed as part of the works shall not be used for the disposal of surface water run-off during construction. Narrow filter drains exposed to surface water ingress shall be temporarily protected.

(02/20) Marker tapes shall conform and be installed in accordance with sub-Clause 514.12.

8 (02/20) The Contractor shall obtain and make available the information required in sub-Clause 514.13 in respect of the geotextile and pipe.

516 (02/20) Combined Drainage and Kerb Systems

(02/20) **General**

1 (02/20) Combined drainage and kerb systems listed in contract specific Appendix 1/10 shall be treated as features to be designed by the Contractor. Combined drainage and kerb systems shall conform to BS EN 1433 and to the special requirements in contract specific Appendix 5/5.

2 (02/20) Combined drainage and kerb systems shall be suitable for their intended use and place of installation in the works and as stated in contract specific Appendix 5/1. The Contractor shall provide a declaration of performance for each type of combined drainage and kerb system proposed to the Overseeing Organisation prior to the commencement of drainage works. The declaration(s) of performance shall demonstrate that the system(s) meet the requirements of the specification.

3 (02/20) Design flows given in contract specific Appendix 5/5 shall be accommodated without surcharge within the main combined drainage and kerb section and beneath the underside of any inlet slot sections.

4 (02/20) Where applicable, the width and depth of combined drainage and kerb system units shall not exceed the dimensions given in contract specific Appendix 5/5.

5 (02/20) When used adjacent to pervious surfacing materials, units shall incorporate side entry inlets to permit drainage of water held within the pervious surfacing. Inlets shall comply with the requirements of contract specific Appendix 5/5 and shall have the capacity to drain pervious surfacing.

(02/20) **Classification**

6 (02/20) Combined drainage and kerb systems, excluding in situ system, shall be classified as follows according to their intended use and shall be as stated in contract specific Appendix 5/5:

(i) C 250:

(ii) D 400; and

(iii) where, exceptionally, combined kerb and drainage units have to be located in areas subjected to large numbers of high speed heavy goods vehicles, Class E600 combined kerb and drainage units shall be considered.

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(02/20) **Water Tightness**

7 (02/20) Joints between units comprising the system and between the channel and units, shall be designed to avoid leakage of surface water. Joints between bridge deck waterproofing and component parts passing through the waterproofing shall be watertight. Sealants shall be compatible with the waterproofing system.

(02/20) **Installation and Handling**

8 (02/20) Combined drainage and kerb systems shall be laid and jointed in accordance with the manufacturer's instructions.

9 (02/20) Adjacent carriageway, footway, verge or central reserve to bedding, backing, surrounding or jointing of combined drainage and kerb units shall be in accordance with the manufacturer's instructions.

10 (02/20) Junctions, connecting pipes and other fittings comprising the combined drainage and kerb system shall comply with sub-Clause 501.3 and shall be as described in contract specific Appendix 5/5. The combined drainage and kerb system shall incorporate measures to enable rodding of the outfall pipework and adequate access for jetting by water jetting equipment into the system.

(02/20) **Cleaning**

11 (02/20) Combined drainage and kerb systems shall be cleaned out by appropriate means and shall be left clean and free from all obstruction. The completed combined drainage and kerb systems shall be surveyed in accordance with the relevant requirements in contract specific Appendix 5/5.

517 (02/20) Linear Drainage Channel Systems

(02/20) **General**

1 (02/20) The linear drainage channel systems listed in contract specific Appendix 1/10 shall be treated as features to be designed by the Contractor and shall conform with requirements stated in contract specific Appendices 1/10 and 5/6. In situ linear drainage channel systems shall conform, where applicable, to sub-Clauses 517.2 to 517.17. Prefabricated, or manufactured, linear drainage channel systems shall conform to BS EN 1433.

2 (02/20) Linear drainage channel systems shall be suitable for their intended use and place of installation in the works. The Contractor shall provide evidence of such suitability for the purpose to the Overseeing Organisation. For prefabricated or manufactured linear drainage systems this shall be the declaration of performance. The declaration of performance shall demonstrate that the linear drainage system meets the requirements of the specification.

3 (02/20) Design flows given in contract specific Appendix 5/6 shall be accommodated without surcharge within the main channel section and beneath the underside of any inlet slot sections.

4 (02/20) Where applicable, the width and depth of linear drainage channel system units shall not exceed the dimensions given in contract specific Appendix 5/6.

5 (02/20) Dimensions of inlet slots shall comply with the following criteria:

(i) for prefabricated linear drainage channel systems they shall conform to BS EN 1433; and,

(ii) for in situ linear drainage channel systems they shall conform to BS EN 1433.

6 (02/20) When used adjacent to porous asphalt surfacing materials, units shall also incorporate side entry inlets to permit drainage of water held within the porous asphalt. Inlets shall comply with the requirements of contract specific Appendix 5/6 and shall have the capacity to drain porous asphalt.

(02/20) **Weathering Resistance**

7 (02/20) Marking relating to the grade of weathering resistance for drainage channels made of concrete shall be as stated in contract specific Appendix 5/6.

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(02/20) **Classification**

8 (02/20) Linear drainage channel systems shall be classified as follows according to their intended use and shall be as stated in contract specific Appendix 5/6:

(i) C 250;

(ii) D 400; and

(iii) where, exceptionally, linear drainage channel systems have to be located in areas subjected to large numbers of high speed heavy goods vehicles, Class E600 combined kerb and drainage units shall be considered.

(02/20) **Water Tightness**

9 (02/20) Joints between units comprising the system and between adjacent construction and the system shall be designed to avoid leakage of surface water. Where applicable, joints between bridge deck waterproofing and component parts passing through the waterproofing shall be watertight. Sealants shall also be compatible with the waterproofing system.

10 (02/20) Junctions, connecting pipes and other fittings comprising the linear drainage channel system shall comply with sub-Clause 501.3 and shall be as described in contract specific Appendix 5/6. The linear drainage channel system shall incorporate measures to enable rodding of the outfall pipework and adequate access for jetting by water jetting equipment into the system.

(02/20) **Cleaning**

11 (02/20) The linear drainage channel systems shall be cleaned out by appropriate means and shall be left clean and free from all obstruction on completion of the works. The completed linear drainage channel systems shall be surveyed in accordance with requirements stated in contract specific Appendix 5/6.

(02/20) **In Situ Systems**

12 (02/20) In situ systems shall comply with the requirements of sub-Clauses 1103.1, 1103.3 and 1103.4. They shall also comply with the requirements of sub-Clause 1103.2 except that the concrete shall be considered as plain concrete within the terms of this sub-Clause, irrespective of the inclusion of reinforcement.

13 (02/20) In situ systems shall be slip formed except for sections at gullies which shall be hand formed. Full depth joints shall be constructed at the interface at each side of gullies with a 25mm thick filler board complying with Clause 1015 and sealed in accordance with Clauses 1016 and 1017.

14 (02/20) The central void may be formed by an inflated tube which is then removed, or by an in situ suitable pipe or similar former fit for the purpose. At gully positions the inner former shall be pre-sleeved with a suitable pipe or similar former fit for the purpose which shall be of sufficient length to overlap the two joints on either side of the gully.

15 (02/20) The central void shall be checked in accordance with sub-Clause 509.4. Verification of slot widths shall be determined by suitable templates.

16 (02/20) Reinforcement shall comply with Series 1700. Cover to reinforcement shall be not less than 75mm.

17 (02/20) Trial lengths and testing of in situ channels shall be undertaken in accordance with contract specific Appendix 1/5 and clauses 6 and 8.6 of BS 5931 and the relevant paragraphs of clause 9 of BS EN 1433 respectively.

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518 (02/20) Thermoplastics Structured Wall Pipes and Fittings

(02/20) General

1 (02/20) Thermoplastics structured wall pipe shall comply with this Clause and the special requirements described in contract specific Appendix 5/1. The term structured wall pipe shall mean all types of smooth bore pipe except solid wall homogeneous pipe. Typical forms of construction classified as structured wall pipes include: single wall externally structured smooth bore, twin wall, foamed core and spirally wound.

The term fitting shall mean a product used in conjunction with the pipe to form the system but excluding gullies manhole chambers, inspection chambers and access chambers.

(02/20) Materials

2 (02/20) The materials from which the pipe and fittings are made, shall be treated so that they are protected from the deleterious effects of short term exposure to ultraviolet light, and shall be resistant to degradation by acids, alkalis, common chemicals, bacteria, fungi and moulds occurring in soil, highway construction materials and highway drainage systems. In addition, the materials from which the pipe and fittings are made, shall not incorporate any additives in quantities sufficient to cause microbiological degradation or to impair the conformity to the chemical, physical and mechanical properties or impact resistance requirements given in sub-Clause 5 of this Clause. The specification of the raw material shall be agreed between the certification body, as defined in sub-Clause 15 of this Clause, and the manufacturer and may incorporate re-processable and/or recyclable material. The agreed specification shall incorporate tolerances for each of the relevant characteristics defined in the appropriate clause of BS EN 13476. The Contractor shall submit to the Overseeing Organisation, prior to commencement of the works, completed information sheets in accordance with contract specific Appendix 5/7.

(02/20) Dimensions

3 (02/20) Systems for carrier drainage shall be between 150mm and 900mm nominal internal diameter. Pipes for narrow filter drains shall be 110mm or 150mm nominal internal diameter. Pipes for service ducts shall have nominal internal diameters of between 50mm and 150mm. Pipes for sub-soil drainage shall incorporate slots or holes with a minimum cross sectional area of 1000mm^2 per metre run of pipe.

The bore of the pipe and fittings shall be in accordance with the standard tolerances for nominal bores given in BS EN 476.

(02/20) Appearance

4 (02/20) The system shall have a smooth bore and be free from any burs, flash or other inconsistencies that could have a detrimental effect on the performance of the system. Pipes and fittings for drainage shall be externally coloured either terracotta or black. The colour of ducting pipes shall be in accordance with National Joint Utilities Group publication "Guidelines on the Positioning and Colour Coding of Utilities' Apparatus". Any variation in the colour shall be described in contract specific Appendix 5/2.

(02/20) Structured Wall Pipe

5 (02/20) The structured wall pipe shall have the properties defined in Table 5/9.

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TABLE 5/9: (02/20) **Requirements for Structured Wall Pipe**

Property	Relevant Standard	Requirement
General	BS EN ISO 2897-1, BS EN ISO 2897-2 and BS ISO 11922-1	Dimensions to be specified
Ring stiffness	BS EN ISO 9969	6 kN/m² minimum. Lower stiffness values are permitted if design calculations to BS EN 1295-1 (UK national annex), based on site specific installation conditions, indicate satisfactory performance.)
Creep Ratio	BS EN ISO 9967	PVC-U – maximum 2.5 PP and PE – maximum 4.0
High volume low pressure jetting	WRc Jetting Test Method	Minimum acceptable failure pressure 137 bar.
Longitudinal bending	sub-Clause 518.11	Pipes with nominal diameters ≤ 350 mm to have a difference in dimensions when measured in the vertical axis of less than 5% of the pipe length and no local permanent deformation occurs during the test.
Impact resistance at 0ºC	BS EN 1411 with d25 striker of 1 kg	Preliminary test – test 10 pieces as described in BS EN 1411, dropping the striker from a height of 1m. If any test pieces fail, subject the pipe to the full test given in clause 7.3 of BS EN 1411 starting the striker from a drop height of 400 mm. The mean minus 1.64 times the standard deviation must exceed 1m.
Impact resistance at 23ºC	BS EN 1411 with striker as above	Value to be derived from the same batch of pipe as used in the impact resistance test at 0°C. The H50 (mean) value - 10% to be used as the minimum value for quality control testing. Alternatively the 0°C test can be used as a QC test if the manufacturer chooses.
Rodding resistance	sub-Clause 518.12	Pipes with nominal diameters ≤ 350 mm to have an average failure energy >3 joules
Static friction coefficient (ducts)	TS 12-24	Pass
Creep at elevated temperature(ducts)	BS EN ISO 9967	Test to be carried out at 45ºC, creep ratio to be less than 2 times the values to BS EN ISO 9967.
Resistance to point loads (ducts)	sub-Clause 518.13	No perforation at 10% rod travel
Tensile strength of a seam	BS EN 1979	BS EN 13476

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(02/20) **Fittings**

6 (02/20) The fittings for use with structured wall pipe shall have the properties defined in Table 5/10.

TABLE 5/10: (02/20) **Requirements for Fittings**

Property	Relevant Standard	Requirement
General	BS EN ISO 2897-1, BS EN ISO 2897-2 and BS EN ISO 11922-1	Dimensions to be specified
Ring stiffness (excluding couplers)	ISO 13967	6kN/m² minimum
Rodding resistance	sub-Clause 518.12	Fittings with nominal diameters ≤ 350 mm to have an average failure energy >3 joules
Strength and flexibility of fabricated fittings	BS EN 12256	BS EN 12256
Impact resistance (drop test)	Drop Test to BS EN 12061: 1999	Fall height 1000mm at a temperature of 0ºC. Product less than ND 300 shall show 'no damage'. Others may fail but must be identified as 'handle with care'
Watertightness of fabricated fittings	BS EN 1053	0.5 bar for 1 minute

(02/20) **Pipe and Fittings**

7 (02/20) The pipe and fittings shall have the properties defined in Table 5/11.

TABLE 5/11: (02/20) **Requirements of the Systems**

Property	Relevant Standard	Requirement
Leaktightness of joints – diameter distortion (watertight joints)	BS EN 1277 Method 4 Condition B Temperature (23 ± 2)°C	Use default values from BS EN 1277
Leaktightness of joints – angular deflection (watertight joints)	BS EN 1277 Method 4 Condition C Temperature (23 ± 2)°C	Use default values from BS EN 1277
Leakage rate from partially-watertight joints	sub-Clause 509.7	Less than 20 times the square of the ID of the pipe in metres shall flow through the joint in litres per minute
Resistance to wheel loads	BS EN 1437 adapted to suit HA loading conditions	Less than 5% deformation when loaded to 100 kN (for unequal branches only)

(02/20) **Bedding, Backfill and Surround Material**

8 (02/20) All systems shall be installed in accordance with the pipe and bedding combinations given in CD 533 (DMRB 4.2.5). Other combinations shall be supported by calculations in accordance with BS EN 1295-1 UK National Annex. Bedding, backfill and surround materials are classified in Clause 503 and Clause 505.

(02/20) **Installation and Handling**

9 (02/20) The bedding, surround and backfill shall be installed so as to cause no damage to the pipes and fittings. Installation of the pipe and fittings, particularly, procedures for preparation and execution of jointing operations, shall be in accordance with the manufacturer's instructions.

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(02/20) **Identification**

10 (02/20) The Contractor shall maintain records with the following information for each separate consignment of structured wall pipe or fittings delivered to Site:

(i) system name, ring stiffness grade/number and size;

(ii) name and address of the system manufacturer;

(iii) consignment number and delivery date; and,

(iv) a copy of the site delivery note.

(02/20) **Test Method for Longitudinal Bending**

11 (i) (02/20) The test specimen shall be a six metre length of pipe or the maximum length available from the manufacturer (if less than six metres);

(ii) The apparatus shall include:

(a) two level support blocks at least 250mm wide and of sufficient height to allow the pipe to sag over its length without touching the ground; and,

(b) a means of measuring the vertical distance between the pipe at the centre of the span and a fixed point of reference to an accuracy of ±0.5mm.

(iii) The test procedure shall be as follows:

(a) condition the specimen for at least 1 hour at 23°C ± 2°C;

(b) set the supports at a distance apart equal to the length of pipe minus 500mm;

(c) place the pipe symmetrically on the supports;

(d) measure the distance between the top of the supports and the fixed point of reference, in the vertical axis through the centre line of the pipe;

(e) after a period of two minutes measure the distance between the underside of the pipe at mid span and the fixed point of reference; and,

(f) record the difference in readings as a percentage of pipe length.

(02/20) **Test Method for Rodding Resistance (Internal Puncture)**

12 (i) (02/20) The test specimens shall be:

(a) twenty specimens cut from the structured wall pipe, each specimen to be 242mm to 246mm in length and a quarter section of the circumference; or,

(b) twenty specimens cut from a number of identical fittings.

(ii) The apparatus shall include:

(a) a standard drop weight pipe testing apparatus capable of dropping a tup from a height of 1m;

(b) a 300g tup which can be varied in 30g multiples with a striker consisting a steel rod 18mm in diameter with a 9mm hemispherical end; and,

(c) a 250mm x 250mm box containing dry Leighton Buzzard sand (Garside quarry) such that there is at least 100mm of sand beneath the test specimen when bedded down.

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(iii) Procedure shall be as follows:

(a) mark the intended point on the inside of the pipe on the intersection of the centre lines. With profiled pipes the point of impact shall be at the point nearest the intersection that mid way between the ribs or in the middle of a hollow corrugation;

(b) alternatively mark the intended point of impact on the section of fitting;

(c) condition the test specimens in air at a temperature of 4°C ± 2°C for a period of at least one hour before the test;

(d) locate the box under the drop tube of the impact apparatus;

(e) embed the specimen into the sand using a vibrator with the inner surface exposed and facing upwards;

(f) locate the specimen such that the marked point of impact is under the centre line of the tup;

(g) drop the tup from a height of 1m on to the inner surface of the specimen within 10 seconds of removing the specimen from the conditioning environment;

(h) examine the specimen for damage. Damage is defined as a puncture or crack of the inner layer. Ductile bending or "whitening" is not considered to be damage;

(i) if the specimen exhibits no damage the next test shall be conducted with a tup of 30g greater mass. If the specimen does exhibit damage the next test shall be conducted using a tup of 30g smaller mass; and,

(j) after having completed the 20 strikes calculate the average of the energies where a pass (no damage) was recorded and the average of the energies where a failure (damage) was recorded, then calculate the average of the two averages.

(iv) The test report shall include:

(a) identification of the samples;

(b) the overall average; and,

(c) whether or not the specimens were damaged.

(02/20) **Test Method for Resistance to Sharp Objects**

13 (i) (02/20) Test specimens shall be three samples of duct each 300mm long.

(ii) The apparatus shall include:

(a) a compression testing machine;

(b) a 4.7mm diameter steel rod with an hemispherical end;

(c) and a 120° steel vee block at least 300mm long.

(iii) The test method shall be as follows:

(a) condition the test specimens for at least 1 hour at 23°C ± 2°C;

(b) insert the steel rod in the jaws of the moveable platen of the compression testing machine so that the hemispherical end protrudes at least 15% of the nominal pipe diameter;

(c) position the specimen in the vee block and place directly below the steel rod, for twin-walled pipe the specimen shall be positioned firstly so that the rod strikes on the corrugation or rib, and secondly in the valley (where possible);

(d) set the machine to lower at a rate of 5mm/min; and,

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(e) allow the rod to travel into the pipe a distance equal to 10% of the nominal internal diameter of the pipe (T_{10} mm) or until the pipe wall is perforated. When the outer skin of a twin wall pipe is perforated before 10% is attained, the rod travel up to the point of failure shall be recorded (T_f mm) and the rod allowed to travel to the inner wall. The rod travel shall be continued to a total of 10% (ie T_{10} - T_f) or until complete penetration occurs.

(iv) For each test specimen: pipe size, reference, maximum load and rod travel shall be recorded.

14 (02/20) Notwithstanding the requirements of sub-Clauses 11, 12 and 13 of this Clause, variations in the test methods specified therein shall be made where deemed necessary by the British Board of Agrément (or equivalent) following consultation with the manufacturer and in agreement with the Overseeing Organisation. All such variations shall be recorded in the report.

(02/20) **Certification**

15 (02/20) Pipes and fittings shall have current product acceptance scheme certification in accordance with sub-Clauses 104.15 and 104.16 certifying the appropriate physical properties when tested in accordance with this Clause.

519 (02/20) Concrete Bagwork

1 (02/20) ST4 concrete in compliance with Clause 2602 shall be used throughout. The concrete filling to the bags shall have a low workability with a slump of 25mm.

2 (02/20) The bags shall be hessian sand bags complying with BS 1214. The size of the bags shall be such that when filled, the dimensions shall be 450mm x 300mm x 150mm. The bags shall be placed in position and shaped to the profile shown on the drawings by striking with a flat timber board until all faces are flat and all edges square.

3 (02/20) The finished exposed faces of the bagwork shall not be punctured or torn and no tucked ends shall be visible.

4 (02/20) Each concrete bag is to be spiked to the one below and the bottom row spiked to the foundation with 10mm x 200mm mild steel dowel bars. Where the concrete bags have a concrete backing, alternate rows of bags shall be spiked to the backing concrete with 10mm x 200mm mild steel dowel bars at 45 degrees to the horizontal with one dowel per bag in the row.

5 (02/20) Where bagwork forms a headwall, headwall foundations are to be cast against the excavated face and any overdig filled with ST4 concrete.

6 (02/20) Formed concrete surfaces shall be to Class F1 finish and unformed surfaces to Class U1 finish in accordance with Clause 1708.

7 (02/20) Where bagwork is provided to protect watercourses, before placing the bags, the banks shall be cut into horizontal steps to provide a suitable foundation and shall be covered in geotextile to the requirements of Clause 609. The bottom course of bags shall be at least 450mm below the stream bed and all succeeding courses shall be horizontal and all vertical joints shall be staggered in alternate courses. Headers shall be placed at every third bag in alternate courses.

8 (02/20) The bagwork shall be thoroughly soaked with water upon completion of the construction to saturate the hessian bags.

520 (02/20) The Cleaning of Existing Drainage Systems

1 (02/20) Where stated in contract specific Appendix 5/1, the Contractor shall clean existing drainage systems in accordance with this Clause.

2 (02/20) The Contractor shall take measures when clearing blocked drains to ensure that adjacent water courses or groundwater via soakaways, will not be contaminated. Contamination includes mud or soil being washed or flushed into streams as well as other more obvious contaminants including diesel fuel, oil and chemicals.

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3 (02/20) Initial attempts to clear blocked drains prior to jetting, shall be undertaken by hand rodding and any debris and silt removed by the operation shall be removed off site. The Contractor shall report any localised blockages that cannot be cleared by rodding to the Overseeing Organisation.

4 (02/20) Where jetting is required in contract specific Appendix 5/1 the procedures stated in Clause 521 shall be followed.

(02/20) **Cleaning of Gullies, Catchpits, Soakaways and Oil Separators**

5 (02/20) At each chamber all mud and vegetation in the vicinity of the chamber likely to impede the flow of water shall be removed. After lifting the cover or grating the chamber shall be cleansed of all water, detritus, debris and silt, refilled with clean water to the outlet level, and all covers and gratings replaced and evenly bedded.

6 (02/20) Cleaning of chambers shall be by mechanical means. The vehicle used to clean existing chambers shall be equipped with a 125mm dia gulley arm with boom jets, an exhauster with a minimum output of 5.95cum/min and minimum 5455 litres capacity. Sediment, detritus and liquor from the chamber shall not be permitted to discharge into the outlet. This may be achieved either by plugging the outlet during cleaning, or by simultaneous jetting and abstraction of liquor from the chamber using a tanker fitted with low pressure high volume water jets around the boom.

7 (02/20) Gullies and chambers not cleaned for whatever reason, blocked connections and broken or cracked covers, gratings or frames shall be marked to aid subsequent identification.

8 (02/20) Oil separators shall be refilled with uncontaminated water following the cleaning operation.

9 (02/20) The Contractor shall dispose of all surplus water, debris and arisings from the works off site at a licensed tip.

(02/20) **Cleaning or Testing of Piped Drainage Systems and Subway Drainage Channels**

10 (02/20) Routine cleaning or testing of piped drainage systems and subway drainage channels shall be carried out by rodding or low pressure high volume jetting in accordance with Clause 521.

11 (02/20) The location of any obstruction that cannot be removed by flushing shall be marked on the ground using a wooden peg or other semi-permanent means and reported to the Overseeing Organisation using the Routine Maintenance Manual System (RMMS) referencing system in Part 3, Chapter 3.7.

12 (02/20) All covers which have been removed for cleaning operations shall be replaced and evenly bedded.

13 (02/20) The Contractor shall report any damage and defects to the drainage system or components to the Overseeing Organisation each day, or immediately if considered a safety hazard.

(02/20) **Cleaning Kerb or Channel Offlet Pipes**

14 (02/20) Where necessary all vegetation and debris shall be removed from around metal kerb weirs and the cover lifted for cleaning.

15 (02/20) Offlets shall be cleaned such that all silt and loose obstructions are removed from the pipe. This shall be achieved by rodding or by using lorry-mounted drain clearance equipment comprising combination pressure jetting with high air flow suction equipment. The vehicle shall also be equipped with a hydraulically powered grid lifter.

16 (02/20) The Contractor shall ensure that each end of the offlet is free from vegetation or other obstructions including any material expelled from the pipe. Where the invert of the outlet is below the invert of the ditch, the bottom of the ditch shall be excavated until the invert of the pipe is exposed and the ditch invert regraded to facilitate flow from the outlet.

17 (02/20) The location of any obstruction that cannot be removed shall be marked on the ground using a wooden peg or other semi-permanent means and reported to the Overseeing Organisation.

18 (02/20) All covers lifted for cleaning operations shall be replaced and evenly bedded.

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(02/20) **Cleaning of Bridge Drainage Systems**

19 (02/20) Cleaning of bridge bearing shelves, subway sumps, grit chambers and other bridge drainage systems shall be carried out by one of the following methods:

(i) vacuum/air suction having the ability to remove materials from depths of up to 9.0m with a suction facility capable of displacing 55m³/min of air at 95% vacuum;

(ii) low pressure high volume jetting in accordance with Clause 521; and,

(iii) sweeping.

20 (02/20) All adjacent surfaces of the structure shall be protected to prevent staining by arisings from the cleaning operation. All arisings shall be taken off site.

21 (02/20) The Contractor shall report to the Overseeing Organisation any damage or defects to the bridge drainage system.

521 (02/20) Low Pressure High Volume Jetting of Drainage Systems

1 (02/20) Where stated in contract specific Appendix 5/1, the Contractor shall clean existing drainage systems in accordance with this Clause.

2 (02/20) The drainage systems to be cleaned shall be as detailed in the contract specific Appendix 5/1.

3 (02/20) The pipe material of the drainage systems to be cleaned shall be identified in contract specific Appendix 5/1. Where the material is unknown and cannot be verified by either visual inspection, without recourse to man-entry, or from drainage records, or damage to the pipeline is the suspected cause of a blockage, cleaning shall proceed on the basis of use of the lowest pump pressure stated in Table 5/12.

4 (02/20) Where the cleaning forms part of the pre-cleansing works for the CCTV survey of drainage systems, the works shall be detailed in contract specific Appendix 90/1 (see Model Contract Documents for CCTV Survey of Highway Drainage, (MCHW 5.9.3)).

(02/20) **Jetting of Piped Drainage Systems**

5 (02/20) Cleaning shall take place from downstream of the blockage in an upstream direction. The pipe shall be plugged below the jetting point to prevent contaminants flowing to the watercourse. The cleaning shall take place from a chamber, although it may be necessary to make a temporary excavation into the pipeline in some circumstances.

6 (02/20) Should the Contractor find that it is not possible to jet in an upstream direction, then the pipe shall be plugged below the blockage and the jetter then used to "back jet" to a suction hose.

TABLE 5/12: (02/20) **Maximum Recommended Pump Pressures**

Material	Maximum pump pressure (bar/psi)
Unknown/structurally damaged	80/1200
Brick/masonry	100/1500
Plastics – Structural Wall	127/1900
Plastics – Solid Wall	127/1900
Concrete	340/5000
Clay	340/5000

7 (02/20) The Contractor shall select a jethead that is appropriate for delivering the maximum jetting pressure for the pipe material and also the minimum volume of water for the appropriate pipe diameter stated in Table 5/13.

8 (02/20) The jet head shall be of a configuration such that the number and direction of jets are adequate to be directed to the sides and soffit of the pipeline to prevent debris passing over the top of the jetting head.

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TABLE 5/13: (02/20) **Minimum Jetting Flow Rates**

Pipe Diameter	Minimum jetting flows
<230 mm	156 l/m
450 mm	270 l/m
900 mm	300 l/m
1600 mm	342 l/m

9 (02/20) The Contractor shall provide suitable jetting equipment that shall include the provision of the following:

(i) operation at a maximum rate of 850 l/min at 150 bar/2250 psi;

(ii) liquid ring vacuum pump operating with air flows of 4000m^3 per hour, with a working vacuum of not less than 90%;

(iii) a minimum of 20m of 100mm diameter suction hose for cleaning pipes up to 300mm diameter and 150mm diameter suction hose for cleaning pipes of diameter greater than 300mm;

(iv) minimum of 150m of 25mm or 38mm diameter jetting hose and a capability of jetting up to 200m;

(v) automatic and continuous water recycling; and,

(vi) silt, sand and rubble to be de-watered prior to discharge at licensed tip.

10 (02/20) The Contractor shall ensure that no damage occurs to the manhole chamber or pipeline during insertion of the jetting equipment.

11 (02/20) The jetting head shall be propelled through or over the blockage and then the hose pulled backwards enabling the force of the jet to break up the blockage material. The minimum force necessary to penetrate the blockage shall be used but the pump pressures should not exceed those stated in Table 5/12.

12 (02/20) The hose shall be rewound at a rate of between 100mm and 200mm per second.

13 (02/20) There is a possibility that damage may occur to certain pipe materials should the jetting head remain stationary thus the Contractor must ensure that the jetting head never remains stationary for more than 60 seconds.

14 (02/20) Where the presence of perforated pipes and porous concrete pipes in piped highway drainage systems is discovered during the course of the works, the Overseeing Organisation shall be notified immediately and the cleaning operation suspended for that section of the works.

(02/20) **Cleaning of Linear Drainage Systems**

15 (02/20) Where possible the Contractor shall clear blockages in linear drainage channels and combined kerb drainage units by rodding.

16 (02/20) Where silt removal is necessitated, the use of pressure jetting will result in the loss of pressure through the grating, slot or drainage holes together with the escape of silt and debris, unless the apertures can be temporarily covered. The application of pressure shall be regulated such that there is only sufficient to drive the jetting head across the silt to access remote from the point of entry.

17 (02/20) If necessary the jetting head shall be changed for one that can deliver the highest volume of water at low pressure. The water pressure shall be sufficient to agitate the silt.

18 (02/20) The nozzle shall be drawn back to the point of entry at a rate of between 100mm and 200mm per second.

(02/20) **Silt Removal**

19 (02/20) Suitable measures such as stanks or stoppers shall be positioned downstream of the drainage system to be cleaned to minimise the risk of sediment causing contamination of watercourses or soakaways.

20 (02/20) Wherever practical the Contractor shall use equipment to carry debris over a greater depth than one atmosphere and with a capability to suck liquid.

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21 (02/20) All arisings from the cleaning process shall be disposed of in an environmentally sensitive manner in accordance with current legislation.

(02/20) **Health and Safety**

22 (02/20) The use of high pressure water can result in serious internal injuries that may not be apparent at the skin surface.

23 (02/20) The Contractor shall ensure that all hoses are free from damage and that the equipment is in full working order.

24 (02/20) Where overhead electric cables are present, there is a potential danger from accidental strike by a jet of water.

522 (02/20) Vortex Separators

1 (02/20) Vortex separators shall be installed in accordance with the manufacturer's requirements and requirements stated in contract specific Appendix 1/10.

2 (02/20) The formation level of the vortex separator shall be blinded with ST1 concrete in accordance with Series 2600.

3 (02/20) The thickness of the concrete blinding shall be in accordance with the manufacturer's requirements and requirements stated in contract specific Appendix 1/10.

4 (02/20) Vortex separators shall have no moving parts.

5 (02/20) Internal components of the vortex separator shall be constructed from stainless steel and/or polyethylene.

523 (02/20) Grassed Surface Water Channels

1 (02/20) For grassed surface water drainage channels a Type 5 or 6 fin drain in accordance with Clause 514 incorporating a double cuspated central impermeable core shall be installed at the edge of the pavement construction and in accordance with contract specific Appendix 5/3.

2 (02/20) The double cuspated central core shall be made from polyethylene or polypropylene and in accordance with Clause 514.

3 (02/20) The grassed surface water channel construction shall comprise of graded subsoil, a layer of topsoil and sub-surface drainage.

4 (02/20) Prior to placing subsoil, the formation shall be ripped to a depth exceeding 150mm to provide a key between the existing ground and subsoil layer.

5 (02/20) The subsoil shall be non cohesive.

6 (02/20) The subsoil shall be free from stones larger than 50mm.

7 (02/20) Where an impermeable membrane is required, the subsoil shall be free from flints.

8 (02/20) Subsoil shall be placed in layers, not exceeding 100mm thick and compacted in accordance with Table 6/4 using a vibrating plate compactor Ref No. 4 Method 1 or Ref No. 2 Method 3.

9 (02/20) The subsoil shall be shaped to the required channel cross sectional and longitudinal profiles stated in the contract specific Appendix 5/3.

10 (02/20) Where stated in the contract specific Appendix 5/3, biodegradable geosynthetic reinforcement shall be placed between the subsoil and topsoil layers to provide support until the grass becomes established.

11 (02/20) Fixings used to hold a geosynthetic in place shall not pierce the impermeable liner.

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12 (02/20) The surface material shall be topsoil class 5B in accordance with BS 3882 in contract specific Appendix 6/8 and the following:

(i) the topsoil texture shall be a sandy loam or loamy sand;

(ii) the topsoil shall have a pH greater than 5.5;

(iii) the topsoil depth shall be between 35mm and 50mm once compacted.

13 (02/20) Topsoil shall be compacted in accordance with Table 6/4 using a vibrating plate compactor Ref No. 4 Method 1 or Ref No. 2 Method 3 but the number of passes shall be reduced to two.

14 (02/20) A grassed surface water channel shall be seeded or lined with turf in accordance with this Clause.

15 (02/20) The steps for seedbed or turfbed preparation shall be:

(i) application of seedbed fertiliser at a ratio of 10:15:10 for $N:P_2O_5:K_2O$ at 30 g/m^2; and,

(ii) final raking or harrowing before seeding, hydroseeding or turfing in accordance with contract specific Appendix 5/3.

16 (02/20) Where turf is used, it shall be placed immediately after compaction of the topsoil to minimise the risk of soil fines being washed away by surface runoff.

17 (02/20) Where turf is used, an allowance shall be made for its thickness when defining the finished level of the topsoil.

524 (02/20) Combined Surface Water Channel and Pipe (Concrete)

1 (02/20) Combined channel and pipe sections shall be constructed in accordance with Clause 1103 and contract specific Appendix 11/1.

2 (02/20) Combined surface water channel and pipe sections shall be in accordance with contract specific Appendix 5/3.

3 (02/20) The maximum pipe size for unreinforced mass concrete combined channel and pipe sections with a loading class of C250 and D400 shall be 300mm (D_{max}), with a minimum vertical cover (U_{min}) of D/2, and a minimum horizontal cover (Hc_{min}) of D/2.

4 (02/20) The maximum pipe size for light mesh reinforced concrete combined channel and pipe sections with a loading class of D400, shall be 400mm (D_{max}), with a minimum vertical cover (U_{min}) of D/2, and a minimum horizontal cover (Hc_{min}) of D/2.

5 (02/20) Light mesh reinforcement is a welded mesh made of steel bars compliant with BS 4483 and contract specific Appendix 5/3.

6 (02/20) Light mesh reinforcement shall be placed horizontally in the base of the combined channel and pipe block such that the bars run parallel and perpendicular to the line of the pipe.

7 (02/20) For light mesh reinforced concrete combined channel and pipe sections the minimum area of steel perpendicular to the longitudinal centre-line of the pipe shall be in accordance with contract specific Appendix 5/3.

8 (02/20) The maximum pipe size for heavier mesh reinforced concrete combined channel and pipe sections with a loading class of D400, shall be 500mm (D_{max}), with minimum vertical cover (U_{min}) of D/2, and a minimum horizontal cover (Hc_{min}) of D/2.

9 (02/20) Heavier mesh reinforcement is a welded mesh made of steel bars compliant with BS 4483 and contract specific Appendix 5/3.

10 (02/20) Heavier mesh reinforcement shall be placed horizontally in the base of the combined channel and pipe block such that the bars run parallel and perpendicular to the line of the pipe.

11 (02/20) For heavier mesh reinforced concrete combined channel and pipe sections the minimum area of steel perpendicular to the longitudinal centre-line of the pipe shall be in accordance with contract specific Appendix 5/3.

12 (02/20) For mesh reinforced concrete combined channel and pipe sections the ends of the bars shall be left flat.

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525 (02/20) Reservoir Pavements

1 (02/20) If the use of reservoir pavements is proposed then the specification shall be submitted to the Overseeing Organisation for approval prior to construction.

526 (02/20) Maintenance Plans for Soakaways

1 (02/20) The commissioning phase for soakaways shall be as described in contract specific Appendix 5/8.

2 (02/20) The routine inspections required to determine the rate of accumulation of sediment in soakaways and pre-discharge treatment devices shall be as described in contract specific Appendix 5/8.

3 (02/20) Based on the routine inspections and minimum monitoring requirements contained in contract specific Appendix 5/8, an asset specific inspection and maintenance plan shall be created for each soakaway. The 'initial management plan' shall be the starting point for the asset specific inspection and maintenance plan.

4 (02/20) The asset specific inspection and maintenance plan shall specify the frequency for future:

(i) removal of debris from the floor of chamber and sediment traps (minimum annual frequency);

(ii) checking observation wells/inspection tubes for clogging;

(iii) checking that the soakaway is emptying;

(iv) inspecting the area around the soakaway for ground settlement or sediment loss;

(v) removal and washing of exposed stones on the trench surface; and,

(vi) trimming any roots that may be causing blockages.

5 (02/20) The inspection and maintenance plan(s) shall be submitted to the Overseeing Organisation to the timetable stated in contract specific Appendix 5/8.

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NATIONAL ALTERATIONS OF THE OVERSEEING ORGANISATION OF NORTHERN IRELAND

508NI (02/20) Gullies and Pipe Junctions

1 (02/20) Gullies shall be trapped, untrapped or sumpless as described in contract specific Appendix 5/1 and be in accordance with HCD Drawing Numbers F13 and F14. All ST concrete referred to in this Clause shall comply with Clause 2602 unless otherwise described in contract specific Appendix 5/1.

2 (02/20) Gullies shall be constructed so that no part of the spout or trap has a cross-sectional area less than 2/3rd that of the outlet. The depth of water seal in trapped gullies shall be not less than 50mm.

3 (02/20) Precast concrete gullies and cover slabs shall comply with BS 5911-6 and clay gullies with BS EN 295. In situ concrete gullies shall be as described in contract specific Appendix 5/1 and constructed of ST4 concrete of 150mm minimum thickness, using permanent or removable shuttering. Where in situ concrete gullies are formed with permanent shuttering, such shuttering shall have current product acceptance scheme certification in accordance with sub-Clauses 104.15 and 104.16. Precast rectangular section gullies shall be as described in contract specific Appendix 5/1.

4 (02/20) Gully gratings, kerb type gully covers and frames shall comply with BS EN 124: 1994 and the following and shall be of the classes and sizes described in contract specific Appendix 5/1.

5 (02/20) The upper surface of gully gratings shall be flat except where otherwise described in contract specific Appendix 5/1. Slots in gratings or between gratings and frames shall not be orientated parallel to the direction of traffic except where the slots are less than 150mm long or less than 20mm wide. Minimum waterway areas shall be as specified in contract specific Appendix 5/1. Unless otherwise specified in contract specific Appendix 5/1, all gratings and frames shall be supplied in a fine cast (uncoated) condition. Where a coating is specified in contract specific Appendix 5/1, the coating shall only be applied when the surfaces of the casting are clean, free from rust and dry. Gully gratings shall be laid parallel to and 6 mm below the finished road surface. Hinged gratings shall be orientated to close in the direction of traffic flow. Frames shall be bedded on mortar complying with sub-Clause 507.16. Brickwork shall comply with sub-Clause 507.3.

6 (02/20) Backfilling to precast gullies shall be carried out up to sub-formation level with general fill material Class 1, as described in Table 6/1 compacted in compliance with Clause 612. Where mechanical compaction is impracticable, the backfilling shall be in ST2 concrete. The remainder of backfilling around gully shall be strength class C8/10 or ST2 concrete.

7 (02/20) Gully connection pipes shall be either flexible or rigid not exceeding 0.7m in length with flexible joints for a distance of 2m from the gully and shall be in accordance with Clause 507 when entering chambers. Junction pipes shall be manufactured of the same type and class of material as the remainder of the pipes in the run. Junction pipes which are laid but not immediately connected, shall be fitted with temporary stoppers or seals and the position of all such junctions shall be clearly defined by means of stakes or tracing wires properly marked or labelled. Saddles may be used to form junctions only where permitted in contract specific Appendix 5/1. No internal projections greater than 5mm will be permitted. Saddles for plastics pipes shall be installed in accordance with the manufacturer's recommendations. Saddles with clay pipes shall be jointed with mortar designation (i) complying with Clause 2404, excluding lime. Saddles and pipes shall be surrounded with ST2 concrete.

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8 (02/20) Where the adjustment or replacement of existing frames and gratings is required, the units shall be taken up and re-fixed or removed and replaced with new units complying with sub-Clauses 4 and 5 of this Clause, or as described in contract specific Appendix 5/1. On taking up or removal of the unit, any concrete or mortar bedding shall be broken out and the surface prepared. Where existing frames and covers or gratings are to be adjusted, the Contractor shall take up the unit and clean it so it is free from existing mortar, any debris, rust and is dry before re-use. The adjusted or replaced units shall be laid at a level, unless otherwise described in contract specific Appendix 5/1, 6mm below the adjoining road surface on a mortar bed complying with sub-Clause 507.16. The finished thickness of the mortar bed shall be between 10mm and 25mm. Where required in contract specific Appendix 5/1, covers and gratings shall be bedded using a quick setting high strength mortar which shall have a declaration of performance for its intended use, the declaration of performance shall be provided to the Overseeing Organisation before use. Any additional adjustment shall be made by modifying the brickwork in compliance with sub-Clause 507.3 or by using a frame of suitable depth. On completion of the works, each grating shall be lifted and the frame and seating cleaned.

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