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SPECIFICATION FOR BEDDING AND SIDEFILL MATERIALS FOR BURIED PIPELINES

FOREWORD

This Water Industry Specification has been prepared by WRc plc under the direction of the Water Industry Engineering and Operations Committee. Representatives of the UK Water Industry, material suppliers and users were regularly consulted during the development of the document through the Materials and Standards Group.

This specification has been issued in conjunction with Information and Guidance Note No. 4-08-01, Issue 4, to satisfy the immediate needs of both users and suppliers of bedding and sidefill materials.

Compliance with this specification does not of itself confer immunity from legal obligations.

This specification does not purport to include all the necessary provisions of a contract. Users of this specification are responsible for its correct application. Reference to a British Standard/Water Industry Specification or any other specification applies equally to an equivalent specification.

This specification calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

It has been assumed in the drafting of this specification that the execution of its provisions is entrusted to appropriately qualified and experienced people.

Information contained in this specification is given in good faith but the Foundation for Water Research, the Water Services Association and WRc plc can accept no responsibility for actions taken by others as a result.

CONTENTS

1. INTRODUCTION

This document specifies those materials which are appropriate for use as pipe bedding and sidefill materials. For definitions and guidance on the selection of bedding and sidefill materials for buried pipelines refer to Information and Guidance Note No. 4-08-01, Issue 4.

2. BEDDING AND SIDEFILL MATERIALS

2.1 Bedding and sidefill materials shall be either processed granular or as-dug.

2.2 Processed granular material shall be granular material processed to meet the requirements of the relevant provisions of BS 882, BS 1047, BS 3797 or equivalent.

2.3 As-dug material on which the structural performance of the pipeline depends shall be excavated material which is suitable for use as bedding and sidefill without processing. It shall not be contaminated with domestic,

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building or industrial waste, shall be free from organic matter, combustible material and clay lumps larger than 75mm. For rigid pipes, the embedment materials shall have a maximum particle size and compaction fraction value (see Appendix B for details of the test) not exceeding the values given for processed materials in Table A.I. The suitability of as-dug materials for use with flexible pipes shall be assessed by reference to Table A.2 for maximum particle size and Table A.3 for other properties.

3. REFERENCES

This specification makes reference to the latest edition of the following publications (except where otherwise stated), including all addenda and revisions, which should also be consulted.

British Standards

BS 882 Specification for aggregates from natural sources for concrete.

BS 1047 Specification for air-cooled blast furnace slag aggregate for use in construction.

BS 1377 Methods of test for soils for civil engineering purposes

BS 3797 Specification for lightweight aggregates for masonry units and structural concrete.

BS 8005 Part 1: Guide to new sewerage construction.

Water Industry Specifications/ Information and Guidance Notes

IGN No. 4-08-01 Bedding and sidefill materials for buried pipelines.

IGN No. 4-11-02 Revised bedding factors for vitrified clay drains and sewers.

Other

TRANSPORT AND ROAD RESEARCH LABORATORY. Simplified tables of external loads on buried pipelines. 1986.

WRc. Report ER201E. Guide to the Water Industry for the structural design of underground non-pressure uPVC pipelines. 1986.

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APPENDIX A – TABLES OF SUITABLE BEDDING AND SIDEFILL MATERIALS

Table A.1 – Processed granular bedding materials for rigid pipes

Pipe nominal size (DN)	Nominal maximum particle size (mm) See note (c)	Class of bedding See note (d)	Maximum CF value for acceptability See note (b)	Materials specified in British Standards See note (a)
100	10	S B F	0.15 0.30 0.15	10mm nominal single-size
		N	0.30	Coarse, medium or fine sand
Over 100 to 150	15	S B F	0.15 0.30 0.15	10 or 14mm nominal single-size or 14mm to 5mm graded
		N	0.30	Coarse, medium or fine sand
Over 150 to 300	20	S B F	0.15 0.30 0.15	10, 14 or 20mm nominal single-size or 14mm to 5mm graded or 20mm to 5mm graded
		N	0.30	All-in aggregate or coarse, medium or fine sand
Over 300 to 550	20	S B F	0.15 0.30 0.15	14 or 20mm nominal single-size or 14 to 5mm graded or 20 to 5mm graded
		N	0.30	All-in aggregate or coarse, medium or fine sand
Over 550	40	S B F	0.15 0.30 0.15	14, 20 or 40mm nominal single-size crushed rock or 14mm to 5mm graded or 20mm to 5mm graded or 40mm to 5mm graded
		N	0.30	All-in aggregate or coarse, medium or fine sand

Notes:
(a) Processed granular materials to include aggregates to BS 882, air-cooled blastfurnace slag to BS 1047 and lightweight aggregates to BS 3797.
(b) Compaction Fraction value (CF), see Appendix B.
(c) The nominal maximum particle sizes apply both to processed and as-dug materials (see Section 4 of IGN No. 4-08-01).
(d) Bedding classes are defined in:-
BS 8005: Part 1
IGN No. 4-11-02
TRRL – Simplified Tables of External Loads on Buried Pipelines.
(e) The sulphate content of bedding and sidefill materials for use with cementitious pipe should not be greater than 0.3% as sulphur trioxide.

Table A.2 - Processed granular bedding and sidefill materials for flexible pipes

Pipe nominal bore (mm) See note (d)	Nominal maximum particle size (mm)	Maximum CF value for acceptability See note (b)		Materials specified in British Standards See note (a)
		Non-pressure pipe	Pressure pipe	
100	10	0.15	0.30	10mm nominal single-size
Over 100 to 150	15	0.15	0.30	10 or 14mm nominal single-size or 14mm to 5mm graded
Over 150 to 300	20	0.15	0.30	10, 14 or 20mm nominal single-size or 14mm to 5mrn graded or 20mm to 5mm graded
Over 300 to 550	20	0.15	0.30	14 or 20mm nominal single-size or 14mm to 5mm graded or 20mm to 5mm graded
Over 550	40	0.15	0.30	14, 20 or 40mm single-size or 14mm to 5mm graded or 20mm to 5mm graded or 40mm to 5mm graded

Notes:

(a) Processed granular materials to include aggregates to BS 882, air-cooled blastfurnace slag to BS 1047 and lightweight aggregates to BS 3797.

(b) Compaction Fraction value (CF), see Appendix B.

(c) For the purpose of this table, PE pipes of 630mm OD can be regarded as having nominal bores of over 550mm, irrespective of wall thickness.

(d) Nominal bore is used in preference to DN because of the different nominal size classifications for flexible pipes.

(e) For PE80 and PE100 polyethylene pipe complying with current relevant Water Industry Specifications, the maximum sidefill particle size may be increased to 10% of the pipe nominal size.

(f) For E´ values for processed granular materials reference should be made to Table A.3 where specific site tests have not been performed.

(g) For ferrous and cementitious pipeline materials, the sulphate content of bedding and sidefill materials should not be greater than 0.3% as sulphur trioxide.

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Table A.3 – Typical modulus values for processed and as-dug bedding and sidefill materials for use in flexible pipeline design

Material		Modulus of Soil Reaction E´ (MN/m^2) See note (a2)				
Description	Casagrande symbol See note (d)	Degree of compaction				
		Uncompacted See note (a1)	80% Modified Proctor	85% Modified Proctor	90% Modified Proctor	95% Modified Proctor See note (b)
Gravel single-sized	GPu	5	7	7	10	14
Gravel graded	GW	3	5	7	10	20
Sand and coarse grained soil with less than 12% fines	GP SW SP	1	3	5	7	14
Coarse grained soil with more than 12% fines	GM GC SM	*	1	3	5	10
Fine grained soil with medium to no plasticity and containing more than 25% coarse grained particles (LL<50%) See note (e)	CL, ML mixtures ML/CL and ML/MH	*	1	3	5	10
Fine grained soil with medium to no plasticity and containing less than 25% coarse grained particles (LL<50%) See note (f)	CL, ML mixtures ML/CL and ML/MH	*	*	1	3	7

Notes:

* No reliable modulus values for these materials.

(a1) For any situation where bedding and sidefill trench material must be placed and compacted within temporary trench supports, the value chosen for E´ should be that associated with uncompacted material.

(a2) Refer to ER201E for the meaning and use of modulus of soil reaction, E´.

(b) BS 1377, 'Determination of the dry density/moisture content relationship (4.5kg rammer method)', is used to determine the Modified Proctor Density.

(c) Semi-rigid pipes can be designed as either flexible or rigid.

(d) GPu - Poorly graded uniform gravel
GW - Well graded gravel
GP - Poorly graded gravel
SW - Well graded sand
SP - Poorly graded sand
GM - Very silty sand
GC - Very clayey gravel
SM - Very silty sand
CL - Clays with low plasticity
ML - Silts with low plasticity

CI - Clays with intermediate plasticity
MI - Silts with intermediate plasticity
CL-ML - Mixtures of ML and CL
CI-MI - Mixtures of MI and CI

(e) Clays and silts, with a Liquid Limit (LL) less than 50% and an appreciable fraction passing the 75μm BS test sieve, with more than 25% coarse grained particles.

(f) As note (e) with less than 25% coarse grained particles.

APPENDIX B – COMPACTION FRACTION TEST

B.1 APPARATUS

B.1.1 Open-ended cylinder

Approximately 250mm long and 150mm (+ 10mm - 5mm) internal diameter (150mm diameter pipe is suitable).

B.1.2 Metal rammer

Metal rammer with striking face approximately 40mm diameter and weighing 0.8kg to 1.3kg.

B.1.3 Rule

B.2 METHOD

Obtain a representative* sample more than sufficient to fill the cylinder (about 10kg). It is important that the moisture content of the sample should not differ from the bulk of material at the time of its use in the trench.

Place the cylinder on a firm flat surface and gently pour the sample material into it, loosely and without tamping. Strike off the top surface level with the top of the cylinder and remove all surplus spilled material. Lift the cylinder up clear of its contents and place on a fresh area of flat surface. Place about one quarter of the material back in the cylinder and tamp vigorously until no further compaction can be obtained. Repeat with the second quarter, tamping as before, and so on for the third and fourth quarters, tamping the final surface as level as possible. Tamping should not be so vigorous as to break the material being compacted.

B.3 DETERMINATION OF COMPACTION FRACTION

Measure from the top of the cylinder to the surface of the compacted material. This distance divided by the height of the cylinder gives the compaction fraction of the material under test.

* To obtain a representative sample about 50 kg of the material to be tested should be heaped into a cone shape on a clear surface after turning over the material three times. Flatten the top of the cone then divide with a spade vertically down the centre into four quarters. One pair of the opposite corners is discarded and the other pair of opposite quarters remixed into a cone shape. This procedure is repeated until the required mass of sample remains.