WATER INDUSTRY
INFORMATION & GUIDANCE NOTE

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SPECIFICATION FOR PRECAST GUNITE SEWER LININGS

1. APPLICATION

Vitrified day pipes and fittings are available in the nominal size range DN75 —1000 and in the following types and are broadly defined in BS 65: 1.981 as:
Normal — suitable for all drains and sewers, except where extra chemical resistance is required.
Surface Water — only suitable for surface water drainage.
Perforated — for French drains and land drains.
Extra Chemically Resistant — for drains and sewers carrying particularly aggressive effluents.
Ducts — suitable for the enclosure and protection of underground cables or other services.

2. REQUIRED PROPERTIES

(a) Adequate structural strength to withstand external loadings with or without additional bedding support.
(b) Resistance to chemical attack from effluents.
(c) Resistance to aggressive soil and ground water conditions.
(d) Impermeability.
(e) Low hydraulic resistance.
(f) Resistance to effluents carrying abrasive materials.

Normal pipes, surface water pipes, perforated pipes and ducts are available with mechanical push-fit joints to enable rapid installation and provide overall flexibility of the pipeline.

3. BRITISH STANDARD CLASSIFICATION

BS 65: 1981 states the requirements for all types of vitrified clay pipes and fittings in one document. It replaced BS 65 and 540, Parts 1 and 2, BS 539 and BS 1143. The performance requirements for flexible mechanical joints for use with Normal clay pipes and fittings are also specified.

Crushing Strength requirements are specified for each available strength class of pipe.

Bending Moment Resistance requirements are specified for normal and extra chemically resistant pipes from DN100 — 225 with nominal lengths equal to or greater than 1.1m. Within the nominal size range DN 75 — 1000 BS 65 designates "preferred" and "non-preferred" sizes. The "non-preferred" consist of some traditional UK sizes together with some metric sizes which are seldom used in the UK.

4. BRITISH STANDARD TESTS

The major tests included in BS 65: 1981 are as follows:

(a) *Dimension* (to limits and tolerances stated)
- Bore (Pipes and Fittings)
- Length (Pipes and Straight Fittings)
- Straightness (Pipes only)
- Perforations (Pipes only)
- Water Seal (Fittings)
- Curvature and radius (Fittings)
- Branch angle (Fittings)

(b) *Crushing Strength* — All types of pipe must meet crushing strength requirements stated for relevant strength class (i.e. Standard, Extra or Super Strength)

(c) *Bending Moment Resistance* — Normal and Extra Chemically Resistant pipes up to DN225 with nominal lengths equal to or greater than 1.1m in length must meet BMR strength requirements stated for relevant strength class.

(d) *Impermeability* — Normal and Extra Chemically Resistant pipes and certain specified fittings must withstand an internal pressure of 60 kPa (Pipes) and 40 kPa (Fittings) for 5 min. without leakage.

Technical enquiries to:
WRc, Frankland Road, Blagrove, Swindon, Wilts, SN5 8YF Tel: (01793) 865151 E-mail: wisign@wrcplc.co.uk

(e) *Internal Pressure Test* (Type Test when specified)
- Normal and Extra Chemically Resistant Pipes and certain specified Fittings must withstand an internal pressure of 140 kPa (Pipes) and 70 kPa (Fittings) for 5 seconds without failure.

(f) *Chemical Resistance* (Type Test)
- Specimens from Normal, Surface Water and Perforated Pipes, Ducts and Fittings, when submitted to the test described, must not experience a mass loss greater than 0-25%.

(g) *Extra Chemical Resistance* (when specified)
- Specimens from Extra Chemically Resistant Pipes and fittings when submitted to the test described must not have a water absorption greater than 4% for wall thickness up to 20 mm or 6% for greater thicknesses. When the samples are ground up and treated with concentrated hydrochloric acid, their percentage loss in mass shall not exceed 3%.

(h) *Flexible Mechanical Joint Assemblies* (Type Test)
- For use with normal pipes only. They must comply with the requirements for deflection, straight draw, and shear load. The performance of joint assemblies is tested after exposure to chemicals. Whole joint assemblies must withstand an internal pressure of 60 kPa for 5 min. without leakage.

(i) *Sampling* — The rates for sampling to satisfy performance requirements and acceptance/ rejection levels for each batch of pipes, fittings, and joints are defined and are principally in accordance with the statistical sampling methods described in BS 6000, 6001 and 6002. Special procedures are defined for isolated batches.

(j) *Kitemark — All* the manufacturers of vitrified clay pipes and fittings in the U.K. are licensed under the BSI Certification and Assessment Department Kitemark Scheme to provide independent assurance of the quality of vitrified clay pipes, fittings and flexible joints manufactured or supplied.

5. MANUFACTURING METHODS

Before being used in pipe manufacture, samples of clays are categorized, tested and blended. The blended clay is then crushed and ground to fine particle size prior to mixing with water so that the mixture becomes just sufficiently plastic to be extruded. Prior to extrusion, air trapped in the clay is removed by shredding the clay in a vacuum chamber. This achieves a uniform body, free from voids. Socketed pipes are formed either horizontally or vertically by high pressure extrusion, the sockets being formed first, followed by the required length of barrel. Plain end pipes are usually extruded as a continuous column of clay which is subsequently cut into the required lengths. Fittings are made either by automatic extrusion, pressure moulding, hand moulding, or by sticking extruded shapes together before or after firing.

The natural water content of the clay together with the water added to aid formation of the pipes and fittings is removed by chamber, roller, or tunnel drying.

Firing is carried out either in continuous kilns, tunnel or roller, or in intermittent type kilns at a temperature in excess of 1000℃ to ensure that on cooling, a hi gh density, strong, impermeable clay body is produced.

During drying and firing, the pipes undergo approximately 10% contraction from their extruded size.

Modern production methods ensure that vitrification takes place throughout the wall thickness thereby rendering glazing unnecessary.

6. JOINTING METHODS

Three types of flexible mechanical joints are available for normal pipes and fittings:

(a) *Sleeve Joints* — for plain end pipes in the range DN100 — 225. These consist of polypropylene sleeves each having two elastomeric sealing rings to give the watertight seal between the pipes and sleeves.

(b) *'O' ring or Seal Joints* — for socketed pipes in the range DN100 — 500. Each of these consists of an elastomeric sealing ring compressed between factory cast polyester fairings on socket and spigot. The sealing ring is located in a groove in the polyester fairing which is cast onto the outside of the spigot end of the pipe and the joint may usually be completed by hand after applying a lubricant to the fairings.

(c) *GRP 'O' ring or Seal Joints* — for plain end pipes in the range DN600 — 1000 a GRP socket is formed at the factory by the helical winding of polyester bonded glass fibre filaments. An elastomeric sealing ring is located in a groove in the polyester fairing cast at the factory around the spigot end of the pipe and

the watertight seal is obtained by compression of the elastomeric ring between the spigot fairing and the filament-wounded socket.

Note: Traditional Cement Mortar joints are sometimes used as an alternative to the above. The flexible mechanical joints used for ducts and perforated pipes are principally for exclusion of silt, location and ease of laying and consist of plastic sleeves fixed to one end of the pipes or fittings.

7. RECENT DEVELOPMENTS

It has been shown that by effecting improvements in raw materials control, introducing an additional heat treatment stage before extrusion, and utilising roller kilns so that each pipe experiences an identical drying and firing regime, pipes can be consistently produced which exceed BS65: 1981 requirements in several aspects.

Dimensional tolerances are made significantly tighter in respect of limits of bore, variation in pipe length and maximum deviation from straightness. Crushing strength, Bending Moment Resistance and flexibility of joints are also substantially improved.

A system based on 100 mm pipes manufactured using the techniques described above is commercially available.

Various improvements have recently been made in the production of fittings including better firing with 'Top-Hat' kiln principal. Higher quality fittings of greater dimensional accuracy are now available.

8. SUMMARY AND CONCLUSIONS

The Clay Pipe Industry in the U.K. has carried out and is continuing extensive programmes of Research at the British Ceramic Research Association, Stoke-on-Trent and the Water Research Centre, Swindon. The availability of indigenous raw materials and the lowest total energy requirements for the production process compared with other materials ensure a sound future for the industry.

Technical assistance with design and construction problems is available from:

Clay Pipe Development Association Ltd., Dray ton House, 30 Gordon Street, London WC1H0AN. Telephone: 01-388 0025