

Technical Specification

T0002

Civil Engineering - Pump Drainage Systems

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MAYOR OF LONDON



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1 Purpose

- 1.1 The purpose of this Specification is to provide designers and tenderers /contractors with the minimum technical standards and physical requirements that Pump Drainage systems shall be designed and constructed to meet.

2 Scope

- 2.1 This Specification applies to all Pump Drainage systems designed and constructed by or for London Underground Ltd (LUL).

3 Specification

3.1 Preamble

- 3.1.1 This specification is primarily based on the mechanical and electrical content of a number of other relevant publications, including the following:
- a) Infracore BCV document entitled '*Pumps and Drainage – Standard Specification for Drainage Works*' document no. 0001 Rev D dated 09 August 2002.
 - b) Sewers for Adoption 6th Edition published by WRc plc.
 - c) The Civil Engineering Specification for the Water Industry 6th Edition published by UKWIR Ltd.
 - d) LU Category 1 Standard 1-056-A1 Civil Engineering – Pumping Systems.

All content has been comprehensively reviewed and updated as part of the drafting process for this document. Detailed input from the relevant LU technical experts has been incorporated into the document and they are listed as co-authors of the document in Clause 6.5.

- 3.1.2 This specification is as far as possible, a performance based standard. However, given that the LU environment is rather unique in certain respects, some prescription remains in the document.
- 3.1.3 This document is generic in form and not tied to any particular method of measurement.
- 3.1.4 The document contains references to the 'Client', 'Engineer' and 'Contractor'. It should be noted that in the context of this specification those terms shall be taken to have logical meaning in the broad senses of the words and shall be viewed as independent of the specific Conditions of Contract. Thus the term 'Client' shall be taken to mean Employer, Authority, Purchaser, etc; similarly 'Contractor' shall mean 'Contractor' in the traditional contractual sense if appropriate, or shall mean the relevant entity within other forms of contract such as *Alliancing* and *Joint Ventures*, etc; and the term 'Engineer' shall also be construed in a generic sense to mean Contract Administrator, Project Manager, etc. as appropriate to the contract.
- 3.1.5 There is no reference in the specification to satisfy legislation. This follows the general principle that the works are to be constructed to comply with all relevant statutes.
- 3.1.6 This specification provides broad guidance on acceptable materials and levels of workmanship. However, in common with the Civil Engineering Specification for the Water Industry (CESWI), the standard requirements of this specification must be augmented for each discrete package of work with a *contract specific appendix* (sometimes referred to as a '*Particular Specification*'). In conjunction with this specification, the contract specific appendix is referred to as *Appendix D2*; it is

prepared by the scheme designer and shall contain contract specific information and requirements. Further guidance on the preparation of the contract specific Appendix D2 is given at the end of this specification in Section 7.1 - Attachment 1.

- 3.1.7 This specification covers materials and workmanship related to mechanical and electrical engineering disciplines only. Civil engineering requirements are not covered even though civil works may be required to support the delivery of a scheme's mechanical and electrical objectives. It is intended that scheme designers prepare separate civil specifications in such circumstances. Refer to Clause 3.3.6 for further details.

3.2 General

3.2.1 Terms and Abbreviations

- 3.2.1.1 Unless specifically defined otherwise in Clauses 6.2 and 6.3, the definitions of terms used in the Specification and associated documents are those in BS 6100-1, Glossary of Building and Civil Engineering Terms.

3.2.2 British, European and International Standards

- 3.2.2.1 British, European and international standards shall be deemed to be those current 28 days prior to the date for return of tenders, or those current at the date of receipt of this specification document, whichever may be applicable.

3.2.3 Health, Safety, Environment and Quality

- 3.2.3.1 The current version of LU Category 1 Standard 1-551 Procuring and Managing Suppliers and Contractors – HS & E Requirements, shall be complied with during all construction, installation, testing and commissioning work.
- 3.2.3.2 New works and maintenance work shall comply with BS EN 752 Clause 7 Health and Safety Principles.
- 3.2.3.3 All parties involved with the delivery of works in accordance with this Specification shall comply with the relevant requirements of the Construction (Design and Management) Regulations 2007.

3.2.4 Existing and As-built Survey Drawings

- 3.2.4.1 Where required by the contract, as-built drawings shall be provided in electronic format and comply with the current version of LU Category 1 Standard 1-037 Computer Aided Design Data and the particular requirements of Appendix D2.

3.2.5 Impact on Outside Party Assets

- 3.2.5.1 Where required by the contract, the impact on Outside Party assets shall be determined in accordance with the current version of LU Category 1 Standard 1-023 Infrastructure Protection.

3.2.6 Contractor Designs

- 3.2.6.1 All items to be designed by the Contractor shall be scheduled in Appendix D2 together with all applicable design standards and scopes of work.
- 3.2.6.2 If the Engineer determines that the scope of any Contractor design work is such that a Conceptual Design Statement (CDS) is required, the Contractor shall comply with that determination and make such a submission in accordance with all relevant LU standards and requirements.



- 3.2.6.3 The Contractor shall provide a fully signed-off Design Check Certificate for the category of check undertaken and appropriate for the asset designed, in accordance with the current version of LU Category 1 Standard 1-538 Assurance.

3.2.7 Setting Out

- 3.2.7.1 The Contractor shall be responsible for setting out the works, and for the correctness of the positions, levels and dimensions of the works. In setting out the Works it shall be the Contractor's responsibility to ensure that any dimensions, sizes and levels given are correct and should he wish to query any of these he shall give written notice to the Engineer before putting work in hand.

- 3.2.7.2 If at any time during the progress of the Works any error shall appear or arise in the positions, levels or dimensions of the Works, the Contractor shall at his own expense remove and amend the work to the satisfaction of the Engineer, and shall become liable for any costs associated with any delay caused to the Contract due to such error.

3.2.8 Damage to Structures

- 3.2.8.1 The contractor shall exercise due care and attention in carrying out the works and will be held fully responsible for any damage caused to the structure or building finishes by his employees. The Contractor shall obtain permission from the Engineer before any holes or chases are cut in floors, walls, steelwork, etc.

3.2.9 Protection of Plant and Equipment

- 3.2.9.1 All new and existing plant and equipment shall be protected during the execution of the work by the Contractor.

3.2.10 Safety of Moving Machinery

- 3.2.10.1 All machinery with moving or rotating parts shall be guarded for safe working by the Contractor in accordance with British Standards Institute (BSI) Published Document PD 5304 Guidance on safe use of machinery.

3.2.11 Manufacturers Test Certificates

- 3.2.11.1 Certificates of specified tests carried out at manufacturer's works for any items of plant or equipment shall be forwarded to the Engineer for his approval, prior to shipment of the plant or equipment to site.

3.2.12 Codes of Practice

- 3.2.12.1 The Contractor shall ensure that all work is installed in accordance with the standards of good practice and workmanship contained within the relevant standards (British, European and International), British Standards Codes of Practice or British Standards Published Documents. Where any requirement of the above documents conflicts with an explicit requirement of this specification then this specification shall prevail.

3.2.13 Contract Drawings and Schedules

- 3.2.13.1 A complete list of all contract drawings and schedules (site specific and standard details) shall be included in Appendix D2.

3.3 Technical

3.3.1 General

- 3.3.1.1 This part of the Specification details materials and levels of workmanship required to ensure the installation is carried out to a satisfactory standard. The items detailed in

this part of the Specification are not necessarily required within the Works, but where they are they shall comply with these standards. The contract specific Appendix D2 shall take priority over the standard clauses in this Specification where the two differ.

- 3.3.1.2 Where the term '*pump drainage assets*' is used in this section of the Specification, it shall be deemed to include pumps (*of all types*), positive and negative pressure pipelines, valves, pipe fittings, flow collection vessels, electrical installations associated with pump drainage systems and any other mechanical or electrical equipment that forms part of a pump drainage system as defined in Appendix D2 (including any *Supervisory Control and Data Acquisition* (SCADA) system present). Pump drainage system control panels are covered by separate specification documents (refer to Table 5.1).
- 3.3.1.3 Unless otherwise described in Appendix D2 only one type of pipe shall be used within any individual pipeline between consecutive installations (or chambers, etc.). The Contractor shall ensure that plastics pipes are not subject to deterioration due to sunlight during the period between manufacture and installation in the ground.
- 3.3.1.4 The Design Life of pump drainage assets shall be in accordance with Table 3.3.1.1 unless identified otherwise in Appendix D2. Evidence of compliance shall be in the form of Agrément Certificates or other verified testing and copies of such certificates and test data shall be supplied to the Engineer.

Pump Drainage asset	Design life
Pump control panels	25 years
Electrical cables	25 years
Pumps and valves	15 years
Pipes and fittings made from metallic materials:	
Galvanised mild steel	40 years
Stainless steel	60 years
Copper and copper alloys	60 years
Ductile cast iron (<i>spheroidal graphite iron</i>)	60 years
Grey cast iron	100 years
Pipes and fittings made from hydrocarbon-based materials e.g. High Performance Polyethylene (HPPE); and CIPP lining systems.	40 years

Table 3.3.1.1 – Design Life of Pump Drainage Assets

- 3.3.1.5 All materials supplied under the contract shall comply with the relevant requirements of the current version of LU Category 1 Standard 1-050 Civil Engineering – Common Requirements.
- 3.3.1.6 LU maintains a Products Register (<http://www.lu-apr.co.uk>); only products appearing on that register may be incorporated into the works. Should a supplier or contractor wish to use a product not on the register then special approval (from the LU *Professional Head (Pumps and Drainage)*) will need to be sought *and granted* before it can be incorporated into the works.
- 3.3.1.7 Any non-compliant or damaged materials (including workmanship defects) incorporated into the works shall not be accepted and shall be replaced or rectified at the Contractor's cost.
- 3.3.1.8 Before any work is covered up or made otherwise inaccessible, the Contractor shall obtain the Engineer's approval to that part of the installation.
- 3.3.1.9 The Contractor shall ensure, that where the Contract makes him responsible for deciding the positions of assets, that such assets are easily accessible by maintenance staff and adequate working space is allowed for maintenance and replacement in the future.



3.3.1.10 Thermal insulation for pipes, tanks and other vessels shall comply with the requirements of BS 5422 and any contract specific requirements in Appendix D2.

3.3.2 Pumpsets

3.3.2.1 General

3.3.2.1.1 The pumpsets shall be compatible with LU's stock of spare units/parts held by the Pumps Maintenance Team. Therefore, the Pumps Maintenance Team shall be consulted on pumpset selection.

3.3.2.1.2 The pumpsets shall comply with all relevant Statutory Legislation and Regulation and the latest editions of all relevant British and harmonised European Standards.

3.3.2.1.3 The pumpsets shall also comply with the requirements of:

- a) This Specification.
- b) Any other standards or particular Specifications issued by LU (including Appendix D2).

3.3.2.1.4 Where this Specification imposes additional requirements to a British or harmonised European Standard, the requirements of this Specification shall prevail.

3.3.2.1.5 Where there is conflict between the documentation referenced in sub-Clauses 3.3.2.1.3 a) and 3.3.2.1.3 b), the requirements of the documentation referenced in sub-Clause 3.3.2.1.3 b) shall prevail.

3.3.2.1.6 All pumpsets shall meet the requirements of the current version of LU Category 1 Standard 1-085 Fire Safety Performance of Materials, in respect of flammability, smoke emission and toxic fume emission.

3.3.2.2 Pumps for Clean Water

3.3.2.2.1 This Clause relates to pumpsets intended to lift clean water. Clean water is defined as water that is sufficiently free of contamination such that it could be safely and legally discharged to Controlled Waters or Public Surface Water Sewer. Thus, it will typically be groundwater (including groundwater infiltration into structures (also called *seepage* flow)) and/or rainwater that is uncontaminated by proscribed substances but may contain inert solid organic and mineral debris in suspension.

3.3.2.2.2 Pumpsets for *new* clean water pumping station installations

3.3.2.2.2.1 Pumpsets for any one pumping station installation shall be identical, except in exceptional circumstances for sites where large flow variance may be expected. Any proposal for non-identical pumpsets at a site, shall only be proposed in the context of a design approved by the LU *Professional Head (Pumps and Drainage)* in accordance with LU Category 1 Standard 1-538 Assurance.

3.3.2.2.2.2 Pumpsets shall be of the single stage, centrifugal, submersible type, suitable for pumping untreated effluent containing fibrous material (*rags, paper, etc.*), solid organic debris and grit.

3.3.2.2.2.3 Pumpsets shall be capable of continuous operation with the motor housing uncovered.

3.3.2.2.2.4 Pumpsets shall be reliable, efficient and capable of operating between the manufacturer's recommended service intervals without attention or inspection.

3.3.2.2.2.5 In addition to any motor protection systems required for hazardous area certification, pumpsets rated at 15kW and above shall be equipped with protection sensors built into the pumpsets for:

- a) Preventing overheating of the insulation;
- b) Detecting seal failure.

3.3.2.2.2.6 Pumpset motors shall be suitable for a 400 V, 3-phase, 3-wire, earthed neutral, 50 Hz supply. Tolerances on the supply shall be +10/-6% on voltage and +/-1% on frequency.

3.3.2.2.2.7 Pumpset motors shall be capable of handling a maximum of (i.e., up to) 15 starts per hour.

3.3.2.2.3 *Like-for-like replacement pumpsets for existing clean water pumping station installations*

3.3.2.2.3.1 In all pertinent respects replacement pumpsets shall match the technical specification of the existing pumpset being replaced. This means that the physical arrangement of the pumping station and all relevant existing *pump drainage assets* shall not require modification to accommodate the replacement pumpset. The hydraulic performance of the existing pumping station shall not be detrimentally affected by the replacement pumpset.

3.3.2.2.4 *Non like-for-like replacement pumpsets for existing clean water pumping station installations*

3.3.2.2.4.1 Replacement pumpsets shall only be proposed in the context of a design approved by the LU *Professional Head (Pumps and Drainage)* in accordance with LU Category 1 Standard 1-538 Assurance.

3.3.2.2.5 *Replacement pumpsets for existing GGG clean water suction/pumping station installations*

3.3.2.2.5.1 Replacement pumpsets for existing GGG clean water suction/pumping station installations shall comply with the requirements of sub-Clause 3.3.2.3.3.

3.3.2.3 *Pumps for Grey Water*

3.3.2.3.1 This Clause relates to pumpsets intended to lift grey water. Grey water is defined as wastewater that is generated from domestic activities such as laundry, cleaning, dishwashing and bathing but *not* human waste. Within LU underground stations, grey water is often combined with groundwater infiltration flows (*also called seepage flow*) for conveyance to outfall together. The combined flow designation remains 'grey water'.

3.3.2.3.2 *Pumpsets for new grey water pumping station installations*

3.3.2.3.2.1 Pumpsets for new grey water pumping station installations shall comply with sub-Clause 3.3.2.2.2 or with the requirements of sub-Clause 3.3.2.3.2.2.

3.3.2.3.2.2 Pumpsets for new grey water pumping station installations shall only be proposed in the context of a design approved by the LU *Professional Head (Pumps and Drainage)* in accordance with LU Category 1 Standard 1-538 Assurance.

3.3.2.3.3 *Replacement pumpsets for existing GGG (this is a clean water only pump that has now been required to pump grey water as defined in sub-Clause 3.3.2.3.1) grey water suction/pumping station installations*

3.3.2.3.3.1 Existing GGG suction/pumping station installations shall typically be replaced with small centrifugal submersible pumps in any outlying collection sumps, which would lift flows through the existing suction pipework to a new flow retention structure/tank (*space permitting*) vented to atmosphere, from where a larger non-submersible self-priming centrifugal pump would lift flows to ground level for discharge to an appropriate receiving drain. If available space precludes installation of a new flow retention structure/tank, then the existing suction pipework (*being re-used as delivery pipelines from the small centrifugal submersible pumps*) would be manifolded together and connected directly to the suction side of the larger non-submersible self-priming

pump. A power supply frequency inverter (*capable of providing power with a frequency in the range 40 Hz to 60 Hz*) may be used in conjunction with the larger non-submersible self-priming pump to assist in the 'tuning' of the pumped drainage system.

3.3.2.3.3.2 Small submersible pumps referred to in sub-Clause 3.3.2.3.3.1 shall comply with the following:

- a) be of the single stage, centrifugal type;
- b) be capable of delivering a flow rate of at least 2.5 l/sec against a total head of at least 8m;
- c) have a minimum solids handling capability of 6mm solid spheres and fibrous materials, e.g. mop head strands;
- d) be suitable for a 400 V, 3-phase, 3-wire, earthed neutral, 50 Hz supply;
- e) be rated IP68 in accordance with BS EN 60529;
- f) have a discharge bore of 2 inch (50mm) minimum diameter;
- g) have a sludge handling capability appropriate for the conditions of installation, (*the Pumps Maintenance Team must be consulted for guidance on specific site conditions to ensure compliance with this sub-Clause*);

NOTE: LU Pumps Maintenance Team hold spare parts for the following pumpsets which comply with sub-Clause 3.3.2.3.3.2. Pumpset No. 1 represents the preferred LU solution for typical sites. Pumpsets No. 2 represents the preferred LU solution for sites where a significant sludge handling capability is required.

1. Tsurumi KTV2-8 Heavy Duty Site Drainage Pump, or equivalent replacement model if the manufacturer supersedes the mentioned pump.

2. Tsurumi KTV2-50 (*or in some special instances KTV2-80*) Submersible Sand/Agitator Pump, or equivalent replacement model if the manufacturer supersedes the mentioned pump.

3.3.2.3.3.3 Larger non-submersible pumps referred to in sub-Clause 3.3.2.3.3.1 shall comply with the following:

- a) be of the self-priming, centrifugal type;
- b) be capable of delivering a flow rate of at least 4.0 l/sec against a total head of at least 32m for a power frequency of 50 Hz and a maximum motor speed of 2900 rpm;
- c) have a minimum solids handling capability of 10mm solid spheres and fibrous materials, e.g. mop head strands;
- d) be suitable for a 400 V, 3-phase, 3-wire, earthed neutral, 50 Hz supply;
- e) be capable of normal operation when supplied by power with a frequency in the range 40 Hz to 60 Hz;
- f) have a discharge bore of 1^{1/2} inch (38mm) minimum diameter;
- g) have a sludge handling capability appropriate for the conditions of installation, (*the Pumps Maintenance Team must be consulted for guidance on specific site conditions to ensure compliance with this sub-Clause*).

NOTE: LU Pumps Maintenance Team hold spare parts for the following pumpsets which comply with sub-Clause 3.3.2.3.3.3. The decision as to which pumpset may be appropriate for a given site is a design decision made (*primarily*) on the basis of the required flow rate and total head.

1. Varisco J 1-180 G Electrically Driven Self-priming Centrifugal Pump, or equivalent replacement model if the manufacturer supersedes the mentioned pump.

2. Varisco J 2-180 G Electrically Driven Self-priming Centrifugal Pump, or equivalent replacement model if the manufacturer supersedes the mentioned pump.

3.3.2.4 Pumps for Foul Water

3.3.2.4.1 This Clause relates to pumpsets intended to lift foul water. Foul water is defined as wastewater containing human waste and/or proscribed substances (*usually the result of industrial processes*). Within LU underground stations, foul water may or may not be combined with grey water and/or clean water for conveyance to outfall together. The combined flow designation remains 'foul water'.

3.3.2.4.2 Pumpsets for new foul water pumping station installations

3.3.2.4.2.1 Pumpsets for new foul water pumping station installations shall comply with sub-Clause 3.3.2.2.2 or with the requirements of sub-Clause 3.3.2.4.2.2.

3.3.2.4.2.2 Pumpsets for new foul water pumping station installations shall only be proposed in the context of a design approved by the LU *Professional Head (Pumps and Drainage)* in accordance with LU Category 1 Standard 1-538 Assurance.

3.3.2.4.3 Replacement pumpsets for existing foul water pumping station installations

3.3.2.4.3.1 Existing foul water pumping station installations shall typically be replaced with a self-contained package pumping station unit. A typical unit will have an enclosed tank (*wet well*) with two dry mounted, high-efficiency, centrifugal pumps and the arrangement will employ the principle of solids-diversion, such that solid waste matter does not get directly pumped. Instead, the liquid part of the effluent only is directly pumped and the velocity of flow is used to mobilise and move the solid fraction of the effluent along the delivery pipeline (*pumping main*) without it ever coming into direct contact with the pump impeller.

3.3.2.4.3.2 Package pumping stations compliant with sub-Clause 3.3.2.4.3.1 shall only be proposed in the context of a design approved by the LU *Professional Head (Pumps and Drainage)* in accordance with LU Category 1 Standard 1-538 Assurance.

NOTE: LU Pumps Maintenance Team hold spare parts for the following family of package pumping stations which comply with sub-Clause 3.3.2.4.3.1. They represent the preferred LU solution for typical sites. The choice of which unit to propose for any given site is a design decision subject to approval in accordance with sub-Clause 3.3.2.4.3.2.

1. Strate AWALIFT Dry Well Sewage Pumping Stations

3.3.2.5 Micro Package Pumping Stations

3.3.2.5.1 Micro Package Pumping Stations (MPPS) are defined as self-contained grey or foul water pumping systems serving a small number of sanitary fittings (*WC, wash hand basin, sink, shower, urinal, etc.*) and following the pattern of employing a small GRP, thermoplastic or metallic tank (*wet well*) with a storage capacity generally not exceeding 250 litres, containing one or two centrifugal submersible pumps with integral level control and audible and/or visual alarm system. Such MPPS's will generally be positioned as close as possible to the sanitary fittings draining to them, e.g. under a sink. Such systems are packaged as single units by manufacturers.

3.3.2.5.2 Micro Package Pumping Stations may or may not employ macerator type pumps. However, *domestic* macerator package pumping station systems (e.g. *Saniflo™ units specifically designed by their manufacturer for domestic rather than business/industrial use*) are not permitted to be used anywhere on LU premises.

3.3.2.5.3 Micro Package Pumping Stations compliant with sub-Clause 3.3.2.5 shall only be proposed in the context of a design approved by the LU *Professional Head (Pumps and Drainage)* in accordance with LU Category 1 Standard 1-538 Assurance.

NOTE: Micro Package Pumping Stations are available from several different manufacturers and most products employ thermoplastic tanks. Where MPPS's are to be installed in