

Guidance Document For 1-068

G-074 Mechanical Building Services, Utility Provision and Energy Management in London Underground

Issue: A1

Issue date: April 2011

MAYOR OF LONDON



Contents

1	Introduction	3
2	Hot and Cold Water Systems	3
3	Gas, Oil and Solid Fuel Systems	7
4	Heating	8
4.1	Heating General	8
4.2	LTHW Heating and Hot Water Systems	8
4.3	Central Boilers	9
4.4	Heating Depots	10
5	Ventilation	10
5.1	Ventilation General	10
5.2	Air Handling Units	11
6	Air Cooling	12
7	Electrical Supply	14
8	Energy Management	15
9	Reliability, Availability, Maintainability and Safety	16
9.1	Maintenance	16
9.2	Labelling	16
10	Environment	17
10.1	Environmental Considerations	17
10.2	Noise	18
11	References	18
11.1	Standards	18
11.2	Technical content manager	19
11.3	Abbreviations	19
11.4	Definitions	19
11.5	Document history	20
12	Attachment 1	21

1 Introduction

- 1.1 The aim of this mechanical guidance document is to provide support to the LU mechanical category 1 standards suite and provide best practice guidance as to how it is recommended to interpret the category 1 standards and achieve compliance with the category 1 standards, as well as meeting BS and Building Regulation requirements within the LU environment.
- 1.2 The document is the Principal Electrical and Mechanical Engineer's opinion of the preferred interpretation and implementation of the LU category 1 standard 1-068.
- 1.3 This document supports 1-068. This covers hot and cold water systems, heating and cooling systems, ventilation of non-public areas, air handling systems as well as connections of water, electricity and gas supplies and energy management systems.
- 1.4 Statutory requirements are obligatory; LU has no power to allow concessions against these.
- 1.5 As with all pieces of work it is necessary to consider whether work is to be carried out on existing plant and equipment and whether the new installation is to integrate with existing systems or whether the work is to be commenced from a blank canvas. It is important to consider whether it is possible to meet current LU requirements and follow good practise, even where this has not previously been done. Of course where works are being carried out on existing equipment with existing infrastructure there is always the possibility that some undesirable situations will need to be worked around.
- 1.6 The LU load applications engineering team can provide guidance on how to complete the forms required to apply for new or alterations to utility supplies (including Water and Gas). LU category 1 standard 1-100 controls alterations to, additions to and removal of all utility supplies on LU premises.

2 Hot and Cold Water Systems

- 2.1 Water fittings should be selected from Water Regulatory Advisory Service (WRAS) approved list. Some water companies use their own lists, so it is wise to confirm the acceptability of equipment with the water companies first.
- 2.2 In order to meet LU's commitment to environmental targets, the use of recovered rain water (rain water, sometimes referred to as "grey" water) is encouraged where appropriate. Many LU premises have substantial areas of roof from which water may be drained into retention systems to permit re-use. When designing systems whole life cost, roof size, storage area, chemicals, maintenance, access arrangements, collection facilities and foreseeable usage should be considered and a cost benefit analysis is required.
- 2.3 Where grey water is utilised means are to be provided to eliminate cross contamination and all pipes should be clearly labelled to indicate service.
- 2.4 Generally grey water recycling and other such energy saving schemes will not be viable for smaller sites. They should be considered and documented for bigger sites i.e. depots and major station complexes.
- 2.5 All pipework on show in non public areas should be chrome finished copper or stainless steel. This is because bare copper would have to be painted or it will corrode.
- 2.6 Water system capacity sizing should be optimised based on demand units. Demand units and the application of these are covered in CIBSE Guide G, they are a way in which the total predicted water supply for a given location can be calculated, enabling efficient sizing of pipework and storage.



- 2.7 In order to demonstrate compliance with control of substances hazardous to health (COSHH), health and safety executive (HSE) approved code of practice L8 should be adopted. Legionella can exist in water; the risk comes from spreading bacteria in aerosol form (spray/fine mist). LU and its suppliers have a statutory duty to prevent risks arising from contaminated water.
- 2.8 Stop valves within 0.5m of each appliance or fitting they are designed to serve are required in order to facilitate maintenance and replacement.
- 2.9 Stop valves should have securely fixed labels to indicate which equipment they isolate. In many cases this may be obvious, but as LU assets are subject to frequent alteration it is important to have clear labelling. Regarding the provision of a valve schedule and schematic, as a minimum, a copy should be provided in the O&M manual and one on site. These are normally located in plant/boiler rooms in a metal and glass frame
- 2.10 A means of isolation in most cases can be achieved by a service-valve device. In all cases, ball type valves are preferred to gate-valves, as the latter are easily rendered inoperable by build up of lime scale.
- 2.11 The use of crimped press fitting installations is acceptable as an alternative to hot works. Push fittings are not acceptable within the LU environment.
- 2.12 Where minor works are taking place and it is not practicable to remove lead pipework then it may be possible to leave it in situ under the following conditions:
- a. The installation was installed before 1st July 1999
 - b. The Lead Pipe work is in good condition (not defective) then
 - c. If the lead part of the installation is not being modified.
- 2.13 Where alterations to pipework are being made to an existing system the materials should match the existing system or dielectric union (i.e. copper to iron) should be used. In other words where pipework of dissimilar materials such as steel and copper are to be used, such as in the connection to an existing system a connector union shall be installed to prevent cathodic reaction.
- 2.14 In every case where pipes pass through walls and floors, tubular sleeves should be fitted of the smallest standard bore through which the pipe will pass freely taking expansion into account. These sleeves are to be constructed from a material that does not cause corrosion to the pipe. The sleeve should have plain square cut ends free from burrs and be cut to accurate lengths so that both ends terminate flush with the finished surface in the case of walls or ceilings and protrude 3mm above floor finishes.
- 2.15 Off-site fabrication and testing of pipework is encouraged as a means of maximising use of available work time at LU locations, as an effective method of quality control as well as minimising hot working.
- 2.16 On stations cold water services should be fed directly from the incoming cold water main. This is because, traditionally one toilet in the ticket office was supplied from a tank so that in the event of a water supply cessation, the station could continue to remain operational for a period of time. If a tank has to be used then ideally the tank should be sized to accommodate 4 water changes in 24hours, or support the premises for 8hrs, i.e. to be correctly sized for the facility based on normal occupation. The actual requirement and tank location in each case should be confirmed with the user of the premises – i.e. the operator for a station.
- 2.17 For other locations, the requirement for water storage should be clarified with the project sponsor.
- 2.18 Cold water pipework in very exposed positions, for example on railway platforms, should be run in galvanised mild steel even where the remainder is run in copper tube. This is to afford additional mechanical protection where services may be subject to rough treatment.



- 2.19 Where used, tanks should be suitably sized to meet water supply regulation requirements. The aim should be to use the smallest tank practicable, taking into account an allowance for possible future system expansion. CIBSE Guide A gives further guidance as to how this is best achieved.
- 2.20 Where cisterns and cold water tanks are below a certain size and metal or other suitable compliant material tanks are not available, a concession against the materials standard will be required.
- 2.21 Cisterns, cold water tanks and pipe work are to be thoroughly cleaned and then sterilized in accordance with BS 6700 by the application of chlorine in accordance with the latest British standards, before being brought into use for domestic purposes.
- 2.22 Polyethylene medium density (blue) pipes are to be to the latest British Standard, the Class as indicated and be used for buried service pipes only in permanent works. It is acceptable for use in temporary installations providing that it is maintained and supported correctly and completely removed at end of works.
- 2.23 Where the incoming cold water main is run underground, other than in ducts, it is to be laid with a minimum cover of 750mm below finished ground level. Pipes should be bedded and covered with soft sand laid on 300mm granular bedding. Where indicated steel or copper pipe work is to be protected against external corrosion by one of the following methods:
- The pipe work to be wrapped with bituminous hessian painted with two coats of bitumen.
 - The tubes are to be coated with bitumen reinforced with glass fibre tissues applied by the manufacturer before delivery.
 - The contractor is to apply, in accordance with the manufacturer's instructions, an approved bandage protection to all joint and fittings.
- 2.24 Supplies to urinal cisterns should be fitted with automatic mechanical flow devices to economise the use of water for flushing at times of low use. To enable this, a device is to be installed between the urinal cistern and the urinal cistern stop cock. There are two acceptable methods for preventing flushing when the urinals are not being used:
- Hydraulic Impulse Device. These devices rely on a man washing his hands after using the urinal. The washbasin tap is to be taken off the same circuit as the device it should initiate a mechanical timer. A hygiene cycle attachment is to be fitted to the device to provide a janitorial flush every 12 hours if the user does not wash his hands, uses the hot tap or the urinal is not used for an extended period. Reliability is impaired with high calcium carbonate in the water. It is important to ensure the correct device is used for the head pressure available as in Table 1 below.

Model	Supply
Standard	Mains water or tank fed systems above 5m head
Low Pressure	Tank fed 3 to 5m head
High sensitivity low pressure	Tank fed 0.5 to 3m head

Table 1 – Hydraulic Impulse Device Head Pressure Values

- Electronic movement detectors – this device consists of a solenoid valve installed between the urinal cistern and the urinal cistern stop cock, a control box and a movement detector. The control box can be a separate box or integral either with the solenoid valve or detector. The device should be electrically mains operated. These devices can also control the toilet lighting and extract fan operation.
- 2.25 The material for hot water pipework may be galvanised mild steel or copper and should be selected according to the nature of the local water supply. Certain types of

commercial grade plastic pipe (i.e. polyethylene) can be used for surface installations but not for stations defined as sub-surface.

2.26 Hot water services can be provided in a number of ways:

- a) Instantaneous non storage heaters. Electrical diversity needs to be considered.
- b) Where it is shown that hot water storage is required, electric storage water units should be placed in or adjacent to the room or area being supplied.
- c) For high demand (i.e. canteens) central storage systems with return.

A site specific assessment should be made to determine the optimum solution for energy usage and maintenance must also be considered.

2.27 For new installations point of use water heaters with spouts should not be used. As the spouts get broken off and require frequent replacement.

2.28 Each stand alone commercial HWS cylinder (200l and above) should be provided with the following tapings:

- a) 1 no. electric immersion heater;
- b) 1 no. safety valve with discharge pipe (pipe to terminate 500mm from floor level);
- c) 1 no. altitude gauge;
- d) 1 no. open vent taken up over cistern;
- e) 1 no. thermometer;
- f) 1 no. valved primary flow connection;
- g) 1 no. valved primary return connection;
- h) 1 no. valved secondary flow connection;
- i) 1 no. valved secondary return connection;
- j) 1 no. drain cock on primary between return valve and indirect cylinder;
- k) 1 no. drain cock on cylinder or on cold water feed between valve and cylinder;
- l) 1 no. valved cold water feed;
- m) 1 no. tapping for control thermostat.
- n) 1 no. 250 mm dia. clean/inspection front facing access near the bottom.

2.29 Each indirect cylinder should be provided with thermostatic equipment to provide diverting control to the primary connections.

2.30 All vertical cylinders should have de-stratification pipe work loop connections.

2.31 All cylinders should be supported on cradles to facilitate inspection of the underside.

2.32 Water services pipework should be supported in accordance with Tables 2 and 3.

Support for Steel Pipework	Horizontal run	Horizontal run	Interval for vertical runs, bare or lagged
	Bare	Lagged	
mm	m	m	m
15	1.8	1.8	2.0
20	2.4	2.4	3.0
25	2.4	2.4	3.0
32	2.7	2.4	3.0
40	3.0	2.4	3.6
50	3.0	2.4	3.6
65	3.7	3.0	3.6
80	3.7	3.0	4.5
100	4.0	3.0	4.5
125	4.5	3.7	5.5
150	5.5	4.5	5.5
200	8.5	6.0	8.5
250	9.0	6.5	9.0
300	10.0	7.0	10.0

Table 2: Support for Steel Pipework

Support for Copper Pipework	Horizontal run	Horizontal run	Interval for vertical runs, bare or lagged
	Bare	Lagged	
mm	m	m	m
15	1.2	1.2	1.8
22	1.2	1.2	1.8
28	1.8	1.5	2.4
35	2.4	1.8	3.0
42	2.4	1.8	3.0
54	2.7	1.8	3.0
67	3.0	2.4	3.6
76	3.0	2.4	3.6
108	3.0	2.4	3.6
133	3.0	2.4	3.6
159	3.6	3.0	4.2

Table 3: Support for Copper Pipework

3 Gas, Oil and Solid Fuel Systems

- 3.1 Gas and oil boilers and heaters should be fitted with fuel cut-off flame failure devices. Boilers and any associated firing equipment are to be fully automatic in normal operation and use.
- 3.2 Gas burners are to be atmospheric or forced air type complete with flame failure devices, electric ignition and fully automatic in its working functions. Boilers should be complete with a delay or purge period after gas shut off following flame failure. Installations using forced air gas burners should be compatible with the boiler and comply with standards for automatic gas burners, published by the gas supplier.
- 3.3 The use of gas boosters should be avoided where possible due to the maintenance requirements. Where they have been proven necessary and justified with a whole life costing assessment and agreement of the gas supplier has been reached. Gas pressure boosters should be duplicated with isolating valves for ease of maintenance and should have easily replaced gas seals.
- 3.4 Gas boilers below 70kW should be installed in accordance with BS6798:2009, BS5546:2010 and BS5540-2:2009. All boilers above 70kW should be installed in accordance with BS6644.
- 3.5 Design and installation of new gas appliances and pipe work, should take account of existing gas appliances on the system and their required minimum gas pressures and flow rates, for which a documented survey is to be provided at the early stages of the design contract, giving gas input flow/pressure rates and existing pipe sizes. Any problem areas should be highlighted and referred to the LU project engineer.
- 3.6 Where pipe work is to be buried in the ground, the mechanical services contractor is to mark out the position of the trenches to be excavated and indicate where concrete is required for pipe supports. A gas main should normally be laid with a minimum depth of cover of 750 mm in a road or verge and 600 mm in a footpath. A gas service pipe should normally be laid with a minimum depth of cover of 375 mm in private ground and 450 mm in footpaths and highways. Where a common excavation is made for gas pipes and electric cables, a minimum clearance of 300mm is to be maintained between the two services. Pipes are to be bedded and covered with soft sand and laid on a 300mm granular bedding.
- 3.7 Gas, oil and solid fuel is seen as not being compatible with the environment or fire safety devices and therefore should not be considered for sub-surface stations unless

the plant can be located remotely from the station at an above ground location and outside of the sub-surface station fire compliance footprint.

4 Heating

4.1 Heating General

- 4.1.1 A simplified building energy model (SBEM) calculation is to be submitted to LU project engineer. The calculations are to clearly show the outcome of the calculations and have a signed declaration by the contractor to show compliance.
- 4.1.2 When selecting fuel consuming equipment consideration should also be given to the size of plant, local availability of fuels, cost, pollutant effect and ease of control.
- 4.1.3 Heating systems should meet the recommendations given in CIBSE Guide B1. Electric heating equipment should be installed to meet the requirements of LU standard 1-069.
- 4.1.4 The heating source is to be concluded from the efficiency of plant, maintenance complexity, life time cost and compliance with whole building energy efficiencies in respect to the Building Regulations. Solid fuel and oil systems should not, where possible, be the preferred form of heating source for the fact that these have to be delivered to site by vehicle and have a greater need of maintenance regime.
- 4.1.5 Strainers are to be fitted to protect heat exchangers, automatic control valves and other sensitive areas and are to be of the single or double type.

4.2 LTHW Heating and Hot Water Systems

- 4.2.1 LTHW heating and HWS circulating pumps should be installed with a valve on the inlet, a strainer and then a valve together with a non-return valve on the outlet connections.
- 4.2.2 Each floor mounted circulating set is to be properly levelled, bolted down and grouted in, on a brick or concrete base of 600mm minimum height. Anti-vibration mountings and flexible connections will be provided as indicated and the complete unit is to be efficiently balanced to eliminate noise and vibration.
- 4.2.3 Altitude gauges are to be connected to the main on each side of the circulator. Where duplicate pumps are provided the gauges should be connected to the common suction and delivery mains. Wherever possible the gauges will be wall mounted at the same horizontal level and provided with flanged backs and air venting facilities.
- 4.2.4 The positions and heights above floor of all radiators and convectors are to be as follows.
 - a) A minimum clearance of 75mm is to be provided between the floor and the underside of any pipe serving a radiator.
 - b) The minimum clearance between the floor and the underside of a radiator should be 200mm.
 - c) Radiators are to be kept 40mm clear of walls when supporting brackets and stays are built-in, otherwise the clearance is to be in accordance with the manufacturer's standard bracket details.
- 4.2.5 All LTHW radiators are to be fitted with and controlled by thermostatic radiator valves, constant temperature system only. Note: Pipe work on the end of a run should be looped between flow and return.

The return loop should be on the end radiator on the index run, not in the boiler housing so that if all the thermostatic radiator valves closed, the pumps would not pump against a closed circuit. All radiators must be fitted with a lock-shield valve on

the return. Prior to the thermostatic radiator valve there should be a ball-o-fix valve installed in case the thermostatic valve opens with the radiator removed for maintenance as not all thermostatic valves are locked shut.

4.3 Central Boilers

- 4.3.1 Central boilers are to be installed in a separate boiler plant room designated for that plant only. The boilers should be controlled by a purpose built control panel which includes the following.
- a) LED run and failure lights for all plant items i.e. pumps, boilers, pressurisation units, Flue fans etc.
 - b) LED light test button
 - c) Run hours meters
 - d) On/off/auto switches
 - e) Main isolator with LED indication light
 - f) External building management system interface
- 4.3.2 The contractor is responsible for ensuring that the boiler manufacturer has approved the firing equipment offered to match the boilers they are intended to fire where these are of a separate make, in order to ensure completely satisfactory service. Evidence of approved compatibility is to be given to LU.
- 4.3.3 Equipment for boilers used for water systems should include the following for each boiler:
- a) Safety and relief valves are to be suitable for the operating conditions of the systems and as required by the BS for the boilers, calorifiers or pressure vessels to which they are connected. They are to be of the totally enclosed spring loaded type with padlock.
 - b) Discharge and waste pipes are to terminate at visible and safe positions (normally 450mm above drain for testing purposes) and connections to drains are to be provided.
 - c) Open vent pipe on low temperature systems when these are open to atmosphere;
 - d) Dial type altitude or pressure gauge;
 - e) Emptying cock/s or drain valve/s with removable keys;
 - f) A nameplate giving: maker's name, series and type, serial number, rated output, design pressure, date of manufacture.
 - g) A plate bearing a distinct and easily visible number where two or more boilers are provided.
- The positions of these are to be in accordance with the manufacturer's standard arrangement
- 4.3.4 Where two or more boilers are open to atmosphere the open vent pipe from each may be connected to a common pipe through a three way cock which is open either to the vent pipe or the free outlet at all times.
- 4.3.5 Where brick or concrete boiler/plant bases are to be provided by the main contractor, the mechanical services contractor is responsible for providing all dimensions and details to enable the bases to be set out correctly for plant location and maintenance spacing.