

## Guidance Document

# G075 Mechanical Building Services, Asset Maintenance Management in London Underground

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**MAYOR OF LONDON**



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## 1 Purpose

- 1.1 The purpose of this 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.
- 1.2 The document is The Head of Profession, Asset Performance Directorate opinion of the preferred interpretation and implementation of the London Underground Category 1 Standard S1075 Mechanical Building Services, Asset Maintenance Management.
- 1.3 This document supports S1075 and covers Mechanical Building Services, Asset Maintenance Management in London Underground.

## 2 Scope.

- 2.1 This Guidance Document applies to the Maintenance of Mechanical Assets installed within London Underground Stations, Railway Depots and Premises.
- 2.2 “The Supplier” will be responsible for the maintenance, component replacement and fault repair including making good of the equipment installed for the following Mechanical Services Assets:-
  - a) Split Comfort Cooling Systems (DX)
  - b) VRV / VRF Cooling Systems
  - c) Chilled Water Cooling Systems
  - d) Supply / Extract Ventilation Systems
  - e) Toilet Extract Ventilation
  - f) Machine Room / Pump Room Ventilation
  - g) Miscellaneous Fans.
  - h) Tunnel Ventilation including Platform Pressure Fans
  - i) Smoke Control Ventilation Fans at Bank / Monument Station serving the DLR.
  - j) Heating Systems.
  - k) Hot Water Services.
  - l) Cold Water Services.
  - m) Mains Cold Water Services.
  - n) Gas Services and Appliances.
- 2.3 Regular inspection and maintenance will provide a measure of certainty that the plant and services shall operate safely and reliably as and when required.
- 2.4 “The Supplier” will maintain all Mechanical Assets in line with the following strategies:-
- 2.5 **Planned Preventative Maintenance (PPM)**  
“The Supplier” will provide London Underground with a full maintenance report highlighting the tasks as set out in the tables relating to each type of Mechanical Asset.
- 2.6 **Conditioned Based Maintenance**
  - a) “The Supplier” must ensure their staff are fully trained and all Test / Monitoring Equipment is maintained to enable Condition Based Maintenance to be carried out (eg Bearing Vibration, Temperature Monitoring, etc)
  - b) “The Supplier” will maintain all records electronically including a back up copy for a period of seven years.
- 2.7 **Reactive Maintenance.**  
This strategy may be used on low value maintenance of temporary or portable equipment (e.g. portable air conditioning units and temporary fans) and equipment used in low risk areas only. The strategy for Reactive Maintenance must be agreed and approved by London Underground.



- 2.8 “The Supplier” is responsible for inspecting, testing, maintaining and repairing the Assets as described in this Document such that the equipment performs in accordance with the manufacturer’s requirements relevant to each asset.
- 2.9 “The Supplier” shall list all remedial actions taken on site from either Planned Preventative Maintenance visits or any fault call out generated by the FRC on a weekly report and quantifies any new components fitted or changed including filters.
- 2.10 “The Supplier” shall update London Underground on a daily basis of progress made against outstanding faults.
- 2.11 **Corrective Maintenance.**  
Corrective Maintenance means work carried out in response to a failure of any equipment reported by the FRC.

## 3 Guidance.

### 3.1 Cooling Systems.

- 3.1.1 This section of the document describes the Cooling Equipment installed within London Underground Premises.
- 3.1.2 The Comfort Cooling or Air Conditioning Systems are primarily installed for staff comfort however the Cooling Equipment within CER`s, SER`s, IMR`s, UPS etc is installed to control the environmental conditions and hence maintain the reliability of the Communications, Signal and Electrical Equipment within.
- 3.1.3 All Plant, Plant Rooms, Condenser Rooms, Louvered Condenser Housings for both Split Comfort Cooling and Chilled Water Systems including associated Luminaries must be maintained, by “The Supplier” in a clean, tidy and safe condition at all times.
- 3.1.4 The following is a general list of major components for DX Comfort Cooling Systems, Chilled Water Systems and VRV/ VRF Systems as installed on the London Underground Network that will be maintained by “The Supplier”, although variances may occur, the principle remains.
- a) Compressors
  - b) Heat Exchangers / Water to Refrigerant
  - c) Heat Exchangers / Air to Refrigerant
  - d) Manifold / Distribution boxes
  - e) Filters (Carbon Filters / SER's)
  - f) Remote Hard Wired (Wall Fixed) Controllers
  - g) Fan and Fan motors
  - h) Humidifiers
  - i) Electrical Heaters / Coils
  - j) Condensate Pumps.
  - k) Pipe Work / Supports and Fittings (Chilled Water and Refrigerant Systems)
  - l) The Electrical Installation dedicated to the system
  - m) Controls and Control Wiring.
  - n) Control Panels
  - o) Purpose made Condenser Housing / Enclosures

### 3.2 Split Comfort Cooling Systems (DX).

- 3.2.1 Comfort Cooling Installations since September 1995 utilise the refrigerant R407C or 410A and labelled accordingly. Comfort Cooling Systems installed before this date operate using refrigerant R22.
- 3.2.2 “The Supplier” is responsible for maintaining the Mechanical Equipment including the main local isolator or control panel and interconnecting wiring.
- 3.2.3 The Condenser Units are not always located in the most suitable of locations in terms of heat dissipation and maintainability, where this is the case “The Supplier” may forward proposals to London Underground to relocate this equipment to a more suitable position.

### 3.3 Chilled Water Systems and Variable Refrigerant Volume (VRV) or Variable Refrigerant Flow (VRF) Systems

- 3.3.1 All Chillers, Pumps, Control Valves, Pipe Work and Fittings etc so as to form a complete Chilled Water or Variable Refrigerant Systems are included within this Guidance Document.
- 3.3.2 “The Supplier” is responsible for all of the equipment including the local main isolator or control panel serving the adjacent Mechanical Plant.
- 3.3.3 It should be noted that it is a requirement of the EU “F” Gas Regulations that document records are in place relating to the maintenance and servicing of equipment containing refrigerant.

### 3.4 Split Comfort Cooling Systems (DX) Maintenance Tasks.

- 3.4.1 Frequency of Tasks.

| Task No. | Asset                    | Description                                                    | Type of Maintenance. | Frequency (Weeks)                                      |
|----------|--------------------------|----------------------------------------------------------------|----------------------|--------------------------------------------------------|
| 01       | Evaporator               | Clean and Disinfect Condensate Tray.                           | Mandatory            | 4/8                                                    |
| 02       | Evaporator               | Check all Electrical Connections                               | Mandatory            | 13                                                     |
| 03       | Evaporator               | Check Electrical Heater Element (Where Installed).             | Mandatory            | 26                                                     |
| 04       | Condenser                | Check all Electrical Connections                               | Mandatory            | 13                                                     |
| 05       | System                   | Inspect & Test Electrical Installation.                        | Mandatory            | 156                                                    |
| Task No. | Asset                    | Description                                                    | Type of Maintenance. | Frequency (Weeks)                                      |
| 06       | Evaporator and Condenser | Clean Casing paying particular attention to signs of corrosion | Mandatory            | 12<br>This frequency may vary depending upon location. |



|    |                          |                                                                                                                              |           |                                                        |
|----|--------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------|--------------------------------------------------------|
| 07 | Condenser                | Check tightness and security of Flared Pipe Connections.                                                                     | Mandatory | 52                                                     |
| 08 | System                   | Test for Refrigerant Leaks using leak detector.<br>Check Sight Glass (if fitted) for signs of refrigerant loss.              | Mandatory | 52                                                     |
| 09 | Evaporator and Condenser | Check and Clean Fins with a stiff brush. If fins are damaged comb and clear restriction.                                     | Mandatory | 52<br>This frequency may vary depending upon location. |
| 10 | Condenser                | Examine the fan motor assembly for end play in the bearing.<br>Examine fan blades for signs of damage and clean as necessary | Mandatory | 52                                                     |
| 11 | Condenser                | Check that the high and low pressure switches (if fitted) are cutting out the Compressor at the commissioning settings.      | Mandatory | 52                                                     |
| 12 | Evaporator               | Remove and Clean Filter, check signs of damage, replace if necessary.                                                        | Mandatory | 4<br>This frequency may vary depending upon location.  |
| 13 | Evaporator               | If applicable check condensate pump and float switch for correct operation.                                                  | Mandatory | 52                                                     |

3.4.2. The above tasks and frequencies are mandatory, minimum which must be carried out at the stated frequencies. These may only be amended by agreement with London Underground.

### 3.5 Chilled Water Systems and Variable Refrigerant Volume (VRV) / Variable Refrigerant Flow (VRF) Systems Maintenance Tasks.

#### 3.5.1 Frequency of Tasks.

| Task No. | Asset                 | Description                                  | Type of Maintenance. | Frequency (Weeks) |
|----------|-----------------------|----------------------------------------------|----------------------|-------------------|
| 01       | Chilled Water System  | Check Make up Tank, Pumps and Insulation     | Mandatory            | 12                |
| 02       | Chilled Water Systems | Check Flow / Return Temperatures and record. | Mandatory            | 12                |
| 03       | Chilled Water System  | Clean and Inspect Strainer                   | Mandatory            | 12                |



|                 |                    |                                                                                                                              |                             |                                                        |
|-----------------|--------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------|
| 04              | VRV / VRF Systems  | Check BC Controller / Box for integrity of pipe work                                                                         | Mandatory                   | 52                                                     |
| 05              | VRV / VRF Systems  | Check tightness and security of Flared Pipe Connections.                                                                     | Mandatory                   | 52                                                     |
| 06              | VRV / VRF Systems  | Test for Refrigerant Leaks using leak detector.<br>Check Sight Glass (if fitted) for signs of refrigerant loss.              | Mandatory                   | 12                                                     |
| 07              | VRV / VRF Systems  | Check that the high and low pressure switches (if fitted) are cutting out the Compressor at the commissioning settings.      | Mandatory                   | 52                                                     |
| 08              | VRV / VRF Systems. | Remove and Clean Filter, check signs of damage, replace if necessary.                                                        | Mandatory                   | 4<br>This frequency may vary depending upon location.  |
| 09              | VRV / VRF Systems  | If applicable check condensate pump and float switch for correct operation.                                                  | Mandatory                   | 52                                                     |
| 10              | All Systems        | Inspect and Test Electrical Installation.                                                                                    | Mandatory                   | 52                                                     |
| 11              | All Systems        | Clean Casing paying particular attention to signs of corrosion                                                               | Mandatory                   | 12                                                     |
| 12              | All Systems        | Pipe Work insulation, check condition and repair as necessary.                                                               | Mandatory                   | 52                                                     |
| 13              | All Systems        | Check and Clean Fins with a stiff brush. If fins are damaged comb and clear restriction.                                     | Mandatory                   | 52<br>This frequency may vary depending upon location. |
| <b>Task No.</b> | <b>Asset</b>       | <b>Description</b>                                                                                                           | <b>Type of Maintenance.</b> | <b>Frequency (Weeks)</b>                               |
| 14              | All Systems        | Examine the fan motor assembly for end play in the bearing.<br>Examine fan blades for signs of damage and clean as necessary | Mandatory                   | 52                                                     |

3.5.2 The above tasks and frequencies are mandatory, minimum which must be carried out at the stated frequencies. These may only be amended by agreement with London Underground.



## 3.6 Energy Efficiency Air Conditioning Certificate and Inspections

3.6.1 The purpose of the Energy Efficiency Inspection is to ensure the Air Conditioning (Comfort Cooling) System installed within London Underground Stations comply with The Energy Performance of Buildings (Certificates and Inspections) (England & Wales) Regulations 2007 SI 2007/991 amended by SI 2007/1669, SI 2007/3302 and SI 2006/647

### 3.6.2 Why Air Conditioning (Comfort Cooling) System Inspections are required.

3.6.3 Having the Air Conditioning (Comfort Cooling) System inspected by an Energy Assessor will improve efficiency and reduce the electricity consumption operating costs and carbon emissions from the system. Energy inspections will highlight improvements to the operation of the existing systems or opportunities to replace older, less energy efficient systems or oversized systems with new energy efficient systems.

3.6.4 As the replacement of refrigerant is restricted in older systems (as established under other legislation), there is an additional incentive to improve or replace older systems with more modern energy efficient units.

3.6.5 Inspection, maintenance and cleaning programmes maintain the ability of the system to provide healthy and comfortable environments for building occupants, limiting the escape of refrigerant gases and ensuring the safety of equipment. The practices and procedures needed to achieve these aims should be applied more frequently than the assessment for energy efficiency described here. It is outside the scope of this document to describe such procedures in detail. Any equipment that is not identified from the asset list, or has a maintenance label must be added and included to the report.

### 3.6.6 When Air Conditioning (Comfort Cooling) Inspections are required.

3.6.7 All Air Conditioning (Comfort Cooling) Systems with an effective rate output of more than 12kw per site, not system, must be regularly inspected by an Energy Assessor. These inspections must be carried out after the first year of services, then every five years thereafter.

### 3.6.8 Air Conditioning (Comfort Cooling) System Inspections.

3.6.9 The inspection will examine the refrigeration and air movement equipment that are part of the Air Conditioning (Comfort Cooling) Systems, and their controls. The energy assessor is also required to estimate whether the system is suitably sized for the cooling loads in the treated spaces, and to provide advice on ways in which the performance of the system might be improved. Closing doors or removing temperature and speed control from the user as an example. The energy assessor may need to be accompanied by the responsible person's delegate or maintenance contractor at times.

3.6.10 Some additional access is likely to be needed, for example to the inside of AHU's or ducts. This must be provided and supervised by the responsible persons delegate or maintenance contractor with due regard to the safety of the energy assessor and to building occupants. This would require the systems to be turned off to allow safe access, so arrangement may need to be made for this outside working hours to avoid disruption to business. Similarly, the Energy Assessor may need to access a sample of components, such as fan coil units, which may be hidden above suspended ceiling. Again, access should be provided by the responsible person's delegate.

3.6.11 Building owners and managers should not expect the Air Conditioning (Comfort Cooling) inspections to identify hazards or unsafe aspects of the installation, operation or maintenance of systems that should be identified and addressed by other

arrangements, nor should they expect the energy assessor to fix any problem identified as part of the inspection.

### **3.6.12 Expectations and Deliverables of the Report.**

3.6.13 The purpose of the inspection and report is to provide London Underground with basic information regarding the efficiency of the Air Conditioning (Comfort Cooling) Systems that they control, together with advice on how the energy efficiency or effectiveness of these systems might be improved.

3.6.14 Acting on the advice in the inspection report, rectifying faults or making appropriate improvements, where this is attractive and cost effective, will result in immediate improvements to the effectiveness of Air Conditioning (Comfort Cooling) System which in turn could reduce the system operating costs.

3.6.15 In many cases it will be clear that the building and systems are already well understood, documented and commissioned, with records available showing that the equipment has been regularly maintained to a good standard. In such cases an energy inspection could be reduced in extent and the inspection report brief, with the main content advising on opportunities for load reduction or on alternative solutions not previously considered, however, in other cases the energy assessor may find it necessary to suggest relatively basic maintenance, such as cleaning or repairs of equipment whose efficiency has evidently suffered through neglect.

3.6.16 Cleaning operations or adjustments to controls do not form part of the inspection procedure, even where they might be carried out simply and with significant immediate effect in improving efficiency. The inspection is not intended, or expected, to involve any physical work of this nature as this could change the level of professional risk to the energy assessor. Authority to carry out such work would need to be given as part of a separate arrangement by the London Underground Building Services Maintenance Manager provided the Energy Assessor has the necessary competence to do this work, however the London Underground Building Services delivery manager or their representative may be able to carry out some alterations themselves as the energy inspection is carried out, provided they agree with the assessor's observations.

3.6.17 Most reports are likely to contain advice with a combination of simple low or no cost measures and measures where some investment may be required either to apply the measures, or to investigate the potential to apply measures in more detail the London Underground Building Services Maintenance manager should be provided with, or informed, how to obtain, access to advice on the ongoing management of the systems particularly that contained in existing free publications such as the Carbon Trust's Good Practice Guides.

### **3.6.18 What the Report will contain.**

3.6.19 The inspection report will include an assessment of the efficiency of the Air Conditioning (Comfort Cooling) System, its size and its size compared to the cooling requirements of the building. It will also contain appropriate advice on possible improvements to the system.

3.6.20 The following information will be included:-

- a. The address of the Station, Depot and London Underground premises in which the Air Conditioning (Comfort Cooling) System is installed.
- b. Asset Number and Details eg Manufacturer, Unit Rating, etc.
- c. Location of Evaporators, Fan Coil Units and Condensers or Chilliers.
- d. Where is the system fed from Electrically.
- e. The Name of the Energy Assessor.



- f. The Name and Address of the Energy Assessors Employer, or the name under which the Assessor Trades including his address.
- g. The date when the inspection was carried out.
- h. The Name of the approved accreditation scheme that he or she is a member of.

3.6.21 Note! : - London Underground Station BRS Codes and SID Room Coding System will be used to identify the Asset Location.

3.6.22 The final report will be in the format that can be downloaded into London Underground Live Link Document Management System.

### **3.6.23 Conducting the Inspection.**

3.6.24 An energy inspection of an Air Conditioning (Comfort Cooling) System must be carried out by an accredited energy assessor who is a current member of an approved accreditation scheme. The appropriate methodology is as described in CIBSE TM44 or equivalent

3.6.25 The energy assessor will provide a written report of the inspection to "The Supplier" who in turn will pass onto London Underground as soon as practicable after the inspection or a maximum of 4 working weeks

### **3.6.26 Energy Assessor`s Accreditation.**

3.6.27 Government approved accreditation schemes control the quality of Air Conditioning (Comfort Cooling) Systems by ensuring assessors are competent and posses the appropriate skills to conduct energy assessments.

## **3.7 Ventilation Systems including Tunnel, Station and Plant (Supply, Extract, Toilet Extract and Machine Room).**

3.7.1 This section of the Document describes the Ventilation Equipment installed within London Underground Premises.

3.7.2 The following is a general description of the Ventilation System and components installed on the Underground Network that will be maintained by "The Supplier" although variances may exists.

- a) Fans including Centrifugal, Twin Toilet, Bifurcated, Mixed Flow, Axial and Propeller
- b) Electric Motors
- c) Belt
- d) Filters (Disposable) – Panel and / or Bag type
- e) Filters (Washable)
- f) Carbon Filters
- g) Heater Battery (Electrical Type)
- h) Humidifiers.
- i) Attenuators
- j) Thermostats
- k) Insect / Bird Screens
- l) Guards
- m) Control Panels
- n) Ductwork
- o) Access Doors
- p) Flexible Connections
- q) Insulation of Ductwork