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**5-7 CARLTON GARDENS
LONDON SW1**

**OPERATING & MAINTENANCE
INSTRUCTIONS
for the
MECHANICAL SERVICES**

**VOLUME 1
1.1 – Sections A-F**

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MODIFICATION INFORMATION

Modifications and authorised changes which may affect the safety, reliability, operation or maintenance of a system or any of its components are to be recorded and registered. Information on permitted plant or system modifications allowed for by manufacturers or system designers are included for each system.

All modifications and changes must be recorded as they occur.

Furthermore it is essential that a procedure is devised and incorporated to ensure that all modifications are noted in every copy of the manual, wherever it is located.

[illegible]

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Aquatanks	C.W.STORAGE TANKS
Armstrong Via Preussag	HOSEREEL BOOSTERS
Contract Components Ltd.	DUCT ACCESS DOORS
Diffussion Environmental Ltd.	FAN COIL UNITS
ACL Drayton	THERMOSTATIC RADIATOR VALVES
Estec Environmental Ltd.	CHLORINATION & WATER TREATMENT
F.E. Cole & Son Ltd.	DUCTWORK
Fire Protection Ltd.	FIRE DUCTS
Grundfos Pumps Ltd	SUMP PUMPS
Guntner UK	DRY COOLER
Hamworthy	BOILERS
Holden & Brooke Ltd	PUMPS, PRESSURISATION UNITS & COLD WATER BOOSTERS
Holmes	VALVES
Hudevad Britain	RADIATORS
IMI Rycroft Ltd	CALORIFIERS
Liff Industries	WATER CONDITIONERS
McQuay International AAF Ltd.	AIR HANDLERS & CHILLERS
Matthew & Yates	FANS
Minikin & Sons Ltd	FLEXIBLE CONNECTIONS
Noico Ltd.	INERTIA BASES
Preussag Fire Protection Ltd.	SPRINKLERS, HOSEREELS
SPC	DRY RISERS
Stepspeed Ltd.	HEATING COILS
Waterloo Air Management	THERMAL INSULATION
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AIR HANDLING UNITS (McQuay)	D.1.3.1	E.6.10(Filters) E.7.2.3.1 / E.7.3.3 E.7.5.3.1	
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A.1 GENERAL NOTES

This manual has been prepared to provide a guide to the operation and maintenance of the Building Services installed in this Development.

It details:

- a) What services and plant are installed.
- b) What the systems provide.
- c) How to operate the systems.
- d) What planned maintenance is recommended.
- e) How to deal with emergencies.
- f) How to avoid risks to Health and Safety.
- g) How to monitor the performance of the systems for the purpose of energy management.

This manual is not intended to replace the services of fully qualified Engineers.

It is recommended that any persons employed as Maintenance Engineers immediately become familiar with the installation and are available at all times to carry out regular inspections, maintenance and emergency repairs.

It is most important that this manual is read in conjunction with:

- 1) " As Fitted" Drawings.
- 2) Schematic diagrams and charts.
- 3) Specific Manufacturers Literature.

The equipment and materials supplied and installed under this contract are safe and present no risk to health, so long as the instructions that follow and those outlined in the suppliers literature contained in this manual are followed and an experienced Maintenance Engineer is engaged to effect any repairs.

Format

All O&M manuals are provided in hard copy and software format. Software versions are provided on 1.44 mB diskettes in Microsoft Word V6.0.

A.2 HEALTH AND SAFETY AT WORK

There are provisions in connection with Safety, Health and Welfare which are legal requirements; in addition there are many official recommendations. For full details of these, reference should be made to the appropriate official publications. The following paragraphs refer briefly to the more common requirements.

It is the duty of every employer:

- a) to ensure, so far as is reasonably practicable, the health, safety and welfare at work not only of all his employees but of other people who use his premises or are affected by his undertaking.
- b) to provide the information necessary for (a) above.

It is the duty of every employee while at work:

- a) to take reasonable care for the health and safety of himself and of other people who may be affected by his acts or omissions at work.
- b) to co-operate with his employer or any other person so far as is necessary for the provisions of the various Acts to be complied with.

A.2.1 Permit to Work System

A 'permit to work' system must be adopted to meet and satisfy the legal requirements of the present legislation.

A sample 'Permit to Work' is appended at the end of section E for guidance only.

The 'permit to work' system should, however, incorporate the following:-

- a) To give authority to maintenance staff to commence inspection of plant, or work on plant.
- b) To explain and outline the approach required to carry out the work in a way that no personnel or plant hazard to the working environment is created.

A.2.1 Permit to Work System (Cont'd)

- c) The system should be devised so that maintenance may be carried out safely and that starting up or running of plant presents no environmental hazard.
- d) Co-ordination of staff requirements in relation to maintenance procedures and operations to eliminate exposure of the work force to any hazard.
- e) Correct shutting down of systems must be observed and no electrical work on equipment where removal of guards or housings has taken place must be undertaken without satisfactory clearance that the plant is now safe for work to proceed.
- f) Members of the maintenance staff must only carry out work within their discipline and job description.
- g) Where it is necessary to provide staging scaffolding, towers and ladders to amine or carry out replacement of components then these must comply in all respects with the latest legislation.

All safety precautions are to be observed when using replacement products. All electric circuit diagrams, and manufacturers spares lists must be checked against the existing equipment to determine it is the correct arrangement or equipment for the specific application.

Any item used must comply with the correct British Standard specification and where tests are carried out on these, they must be in compliance with relevant British Standard Specifications or Codes of Practice.

Starting up of all plant must be acted upon in conjunction with plant manufacturer's commissioning and starting up manuals, so that the correct setting of switches, valves and their sequence of operations is correct for each individual piece of equipment.

CAUTION - Remotely Controlled Plant

Do **NOT** put hands or objects on any item of stationary rotating machinery as the equipment may start automatically and cause injury or damage.

A.2.2 Warning and Safety Notices

At all times warning and safety notices must be maintained and properly displayed and worded to give clear instructions.

Notices covering First Aid and Resuscitation from Electric Shock must be displayed in all plant-rooms.

Proper fire precautions must be observed within the plant-rooms and building.

Smoking will not be allowed in any plant-rooms or service space.

Notices must be displayed stating **"NO SMOKING"** and **"SMOKING PROHIBITED IN THIS AREA"**.

All fire fighting equipment must be clearly marked and available for use.

A.2.3 Fire Protection/Alarms

Fire fighting equipment, hose reels, sprinkler systems, must be regularly tested, maintained and kept readily available.

Fire alarm systems must be regularly checked, and kept in working order.

Care must be taken, and adequate protection provided, to prevent fire when welding or carrying out similar operations involving the application of heat. Arc welding demands protective screens. Precautions against explosions are laid down for working on tanks or containers which have held explosive or flammable substances.

All extinguishers must be periodically examined and contents renewed as required.

Each extinguisher should be numbered and a log kept of inspections and action.

A.2.4 Escape Routes

Periodic inspection of all escape routes and exits should be made to confirm that doors open freely and routes are clear of obstructions.

Should oil be spilt on bases or floors the area must be thoroughly cleaned and sanded.

A.2.5 Identification Labels

All items of plant and equipment are labelled. Refer to description of the installation (section B), description of operation (section D) plant schedules (section C) and valve schedule for functions.

A.2.6 Lighting

In all plant-rooms and service areas lighting must be maintained at a high level to enable inspections to be carried out and prevent accidents due to badly lit areas.

A.2.7 Tool & Equipment

All tools and equipment should be kept clean and in good condition. They should be regularly inspected and any which show signs of excessive wear or defects should be replaced immediately.

The following are a few notes on the use of tools and equipment:

i. Hand Tools -

- (a) Only use each tool for the purpose of which it was designed.
- (b) Never leave tools lying about. Collect them when finished and return them to their correct location.

ii. Portable Tools and Hand Lamps

Where power operated hand held tools or hand lamps are used these items together with their power supply must conform to the regulations applying to the use of this type of apparatus.

A.2.7 Tool & Equipment (Cont'd)

iii. Scaffolding and ladders -

- (a) Never tie two ladders together, always use the correct length ladder for the job.
- (b) Never have less than one metre overlap with extension ladders.
- (c) Ensure that all ladders used have non-slip feet.
- (d) Always secure the top of a ladder when there is a danger of its slipping.
- (e) Never place the bottom of a ladder more than a quarter the distance of its height away the vertical.
- (f) Always ensure that both hands are free when climbing ladders, using a tool bent to carry hand tools or a hoisting rope. Keep your body weight as close to the ladder as possible when climbing.
- (g) Ensure that the area below the ladder or scaffolding is clear of personnel. Erect warning notices if necessary.
- (h) Use only approved scaffold clamps and adapters for erecting scaffolding.
- (i) Ensure that all wheels, swivels, etc. are locked when scaffolding is in use.
- (j) Make sure all tools and equipment have been removed from removable scaffolding towers before they are moved.
- (k) Ensure that all planks are supported without any extensive overlaps at a minimum of eight feet centres.

A.2.8 Plant-rooms

A high degree of cleanliness both of rotating machinery and static equipment is of the utmost importance. Floors and machinery must be protected from spilt lubricants. Loose materials, containers and papers must not be allowed to accumulate.

A.2.9 Drains and Sumps

All drains must be cleared of silt or any refuse to ensure that these are free and unobstructed at all times. Sumps must be inspected, drained regularly and cleaned.

A.2.10 Keys

Access to all plant-rooms and equipment contained there in must be controlled and restricted to authorised personnel only.

A.2.11 Drive Guards and Housings

It is important that after maintenance has been carried out on any piece of equipment on which drive guards or housings have been removed, that these are replaced immediately the work has been completed.

Ensure that at all times, when guards and housings are removed, that the electrical supply to the unit is isolated and fuses removed.

Starting up of plant, replacing of guards and housings, any further disconnection and restoring of plant into full service is carried out by authorised personnel only.

Caution - Remotely Controlled Plant

Do **NOT** put hands or objects on any item of stationary rotating machinery as the equipment may start automatically and cause injury or damage.

A.2.12 Pollution

Anyone in control of industrial or commercial premises must render inoffensive any potentially harmful emissions into the atmosphere.

A.2.13 Protective Equipment

Where appropriate to the work, protective equipment (e.g. goggles, screens, respirators, protective clothing, safety belts) must be provided and used.

A.2.14 Dangerous Substances

Battery acid, water treatment, and all other chemicals must be stored and handled carefully. They are poisonous and can damage the skin and particularly the eyes.

Adequate ventilation must be provided. Special precautions must be taken in atmosphere where there is steam, smoke, asbestos or other unhealthy or dangerous contaminants, or in confined spaces.

Refrigerant gas should not be inhaled and must never be exposed to a naked flame.

A.2.15 First Aid

First Aid boxes or cupboards of the prescribed standard, must be provided in accessible positions, and kept clean and in good repair. The minimum quantity and quality of dressings etc. has been laid down according to the number of persons employed. Where it is required by the Regulations, a responsible and readily available person, trained in First Aid treatment, must be named, and placed in charge of the equipment during working hours.

A.2.16 Bacteria

The drain/drip trays from all cooling coils should be examined weekly for the presence of slime or algae. If detected, such slime or algae must be completely removed by vigorous scrubbing with a solution of household bleach (sodium hypochlorite). Domestic cold water storage tanks should be drained down and left empty if they are to be out of use for a long period of time.

Every six months all such tanks should be emptied, cleaned, disinfected with bleach, flushed clear of bleach and refilled with fresh mains water.

For details, see separate instructions for the particular plant item.

Full advice on Biocide treatment of Tanks and recirculatory systems should be sought from the Water Treatment Specialist.

All water in HWS and CWS systems should be kept above 65°C or below 20°C to lessen the possibility of harmful bacteria breeding in the systems: this is particularly important for storage tanks and other parts of the system (e.g. dead legs) where the water may be stagnant for considerable periods.

More detailed information on Legionnaires Disease Containment and Mandatory requirements and recommendations are given below for quick reference:

LEGIONELLA PNEUMOPHILIA CONTAINMENT MEASURES (Epidemiology)

The Legionella bacterium exists naturally as well as in man made water systems. The organism does however require the following elements in its environment for survival, namely:

- (a) A source of soluble iron.
- (b) Nitrogen based deposits (possible food source).
- (c) An optimum water temperature of around 37°C, although the bacterium can multiply in conditions of 20 to 50°C.
- (d) Anaerobic water conditions (more carbon dioxide, less oxygen).
- (e) A water pH of 8.5 / 9.5
- (f) Algae or Protozoa which can act as a host for the bacterium.

Legionella PNEUMOPHILIA is found in:

- (a) Shower heads
- (b) Pipework dead legs.
- (c) The stagnant areas of hot water calorifiers.
- (d) Cold water storage tanks (in a surviving but dormant condition).
- (e) Drains from cooling coils.
- (f) Water in ductwork.

and any area where water may stagnate under conditions which Legionella might breed.

LEGIONELLA PNEUMOPHILIA CONTAINMENT MEASURES (Cont'd)

Outbreaks of Legionnaires' Disease more usually occur in the warmer periods of the year. Legionella can occur at any time of the year if the conditions are suitable. Infections occur when people inhale fine mist/spray droplets of contaminated water (i.e. shower discharges, spray taps, cooling tower spray, etc.).

Symptoms are similar to pneumonia following an incubation period (with dry cough and higher body temperature) of between 2 to 10 days. Some patients also exhibit other symptoms such as diarrhoea, sickness and stomach upsets, and malfunction of the central nervous system.

Mild cases may recover without antibiotic therapy and in large outbreaks the mortality rate varies between 10-25% although with prompt antibiotic application the figure is much closer to 10%. In survivors, recovery is usually complete.

A milder form of the disease known as Pontiac Fever is caused in the same manner as Legionnaires' disease. Its symptoms are a milder "flu" like condition having an incubation period of between 5 hours and 3 days.

The illness normally lasts between 2 and 5 days and no deaths have so far been reported.

Current Literature Relating to Legionella

Health & Safety at Work Act
1974 (SI)

Control of Substances Hazardous to Health
1996 (SI)

Environmental Protection Act
1990 (SI)

Health & Safety Executive
ISBN 011 885 660 X (HMSO)

Guidance Note HS (G) 70
The Control of Legionellosis
(including Legionnaires' Disease)
1993.

Current Literature Relating to Legionella (Cont.)

British Standard Specification 6700:1997	Design, Installation, Testing and Maintenance of Services Supplying Water for Domestic Use within Buildings and their Curtilages.
The Chartered Institute Building Services Engineers	TM 13 Minimising the Risk of Legionnaire Disease 1991
Health & Safety Executive Guidance Note EH 48 (HMSO)	Legionnaires' Disease An Authoritative Update Jan 1987.
Water Supply Bylaws Guide 1990	
Unwin Limited Materials	Directory of Water Fittings & (updated twice a year)
British Association for Chemical Specialities ISBN 0 95 149003	Code of Practice - The Control of Legionellae by the Safe and Effective Operation of Cooling Systems 1996
DHSS ISBN 0 10102562 9 (HMSO)	Second Report of the committee of Inquiry into the Outbreak of Legionnaires' Disease in Stafford (1987)
DHSS ISBN 011 321190 2 (HMSO)	Report of the Expert Advisory Committee on Biocides-1989

LEGIONELLA PNEUMOPHILIA CONTAINMENT MEASURES (Cont'd)

Dip Slide Testing

The most convenient way to measure microbiological activity is to use "dip slides". These are plastic slides with a coating of agar - a medium on which micro-organisms will grow. The dip slide is dipped into the cooling water, then placed in a small container and allowed to incubate in a warm place for 24 to 48 hours. The incubation period and temperature should be the same each time the test is performed in relation to a particular water system. Unless this is done, it becomes difficult to interpret the results from dip slide tests performed over a period of time, as different organisms grow within different temperature ranges. Bacterium will grow to form colonies on the agar and by comparing these with a comparison chart the level of contamination of the water can be gauged. Alternative techniques are available for laboratory measurement of microbiological activity and new techniques are being developed for testing on site.

Sampling Regime

To enable the dip slides to be a significant method of monitoring, it is essential that sampling methods are repeatable.

Sampling points must accurately represent the system being sampled and should be the master sampling points used in all future monitoring programmes. Each site will establish master technique. Some useful criteria to consider whilst selecting suitable sampling points are given below:

Dip Slide Testing (Cont'd)

- (a) The times the dip slides are taken are important and should be adhered to. As a guidance; times of sampling should not coincide with automatic biotite dosing times. A time which was close to the injection time would be ideal, since the treatment would have the least effect on the system.
- (b) Sampling points would need to be located at a position which represents the most accurate status of the system.
 - i) Calorifiers should be sampled from base drain after allowing water to run for a short period. It is important that sampling points such as drains valves be kept clean and free from debris.
 - (ii) Cold water break/storage tanks should ideally be sampled from the geometric centre of the tank. In practical terms this may be difficult. It is advised that approximately 1 metre below the surface level of the tank and as close to the centre as possible will give a reasonable representation to the body of water. the drain from the tank would not be a recommended sampling point as it does not represent the body of water.

Management of Collected Dip Slides

A further consideration is the care of the collected dip slides and subsequent incubation of the sample. Dip slide manufacturers advise a constant room temperature to allow the sample to be developed. Approximately 48-72 hours is the time given to allow full development.

It is important that care is taken to store the dip slides in a suitable place during the development process.

Use of a supplementary article of equipment, such as a syringe or plastic hose, would need to be carefully managed to ensure practical cleanliness is achieved.

Domestic Water Systems and Components

Cisterns

Inspect all storage cisterns visually on a frequent basis and ensure that all covers and access manholes are correctly fitted and, in the case of access manholes that they are in the closed position. Check air vents and overflows and ensure insect/dust screens are in place.

Any cistern that is found to be open to atmosphere or to contain debris (e.g. dead birds, rodents, rust or scale deposits) should be taken out of service, emptied, cleaned and repaired. Where gross contamination is found the cistern should be chlorinated and water samples taken for bacteriological analysis prior to return to service.

The surface temperature of water contained in storage cisterns should be monitored on a frequent and regular basis and a record maintained. In the event of the temperature exceeding 20°C the cistern involved should be partially drained and re-filled to reduce the temperature. Investigate and eliminate the cause(s) of any condition which produced abnormally high temperature rises.

Domestic Hot Water Services

Water heaters should be inspected visually. If excessive rust or scale is observed then the heater should be drained, cleaned, de-scaled and reinstated. Where gross contamination is found, the heater should be pasteurised by heating the water to at least 70°C for a minimum of one hour before draining, re-filling and return to service. Alternatively superchlorination with sodium hydrochloride of the calorifier should be carried out.

Water heaters should be operated so that the water within the heater reaches a minimum of 55°C before it is distributed. Because there is a risk of scalding at hot water outlets when storing water at this temperature the attention of staff/users should be drawn to this possibility.

Infrequent Use of Water Outlets

Identify all water service outlets which may have infrequent usage and initiate a programme on a weekly basis for the operating of these fittings to ensure that "dead-leg" pipework has been drained of stagnant water, and in the case of domestic hot water that the heat trace is operational.

A.3 EMERGENCY INFORMATION

1. EMERGENCY CALL OUTS

<u>Company/Authority</u>	<u>Telephone</u>
FIRE /BURGLARY	999
POLICE	
Community Liaison	0171 321 8823
Cranes/Road Closure	0171 641 1060
London Electricity plc	0171 326 6651
Thames Water	0645 200 800
Customer Services	
Transco (Gas)	0181 371 7717
London North District	
Bittacy Hill, Mill Hill	
London NW7 1HU	

**2. *FIRMS OR STAFF TO CALL IN THE EVENT OF FAILURE OR
BREAKDOWN OF PLANT ELEMENTS:***

<u>Company</u>	<u>Telephone</u>	<u>Acknowledgement</u>
Hamworthy (Boilers)	01202 665 566	P548359
McQuay (Chillers)	0171 799 3330	
McQuay (Air Handlers)	01670 566 206	6707393
Holden & Brooke (Pumps Pressurisation Units & Cold Water Boosters)	0161 220 9660	5302 Series & 5303 Series
Diffusion (Fan Coil Units)	0181 783 0033	DFC 0000095
Waterloo (Motorised Dampers)	01622 717 861	64755
IMI Rycroft (Calorifiers)	01274 490 911	99235
Preussag (Sprinklers)	0161 428 3661	-----
Armstrong via Preussag (Hosereel Boosters)	01206 579 491	.....
Grundfos (Sump pumps)	01525 850 000	765400
Set Point (Room A/C)	01708736888	

**3. LOCATION OF FIRE FIGHTING EQUIPMENT:
SPRINKLERS, HOSE REELS AND DRY RISERS.**

3.1 AUTOMATIC SPRINKLERS

The following areas are protected by Automatic Sprinklers:

**Basement Car Park
Lower Ground to Seventh Floors**

3.2 HOSE REELS

- **The Basement Area is protected by 4 No. Automatic Swinging type fire Hose Reels.**
- **Each floor level is protected by 2 No. concealed Fire Hose Reels.**

3.3 DRY RISER

- **A twin breaching inlet is situated at ground floor level with Dry Riser installation running to all floors through the central Fire Fighting Riser.**
- **A Landing valve is provided at each floor near lift No. 4 (excluding the Ground Floor).**

4. HAZARDS PARTICULAR TO THE BUILDING.

4.0 *The following areas are identified to be of particular hazard.
The detailed precautions are listed in this section:*

- 4.0.1. *Gas installations*
- 4.0.22. *Refrigerants in the Chilled Water System*
- 4.0.3. *LTHW Systems where temperature of 80°C are to be aware of*
- 4.0.4. *Electrocution risk when dealing with electrical panels and
installations*
- 4.05. *Risks relevant to working in confined areas when dealing with
storage tanks.*
- 4.0.6. *Risks associated with dealing with rotating machinery*
- 4.0.7. *Risks associated with dealing with chemicals (COSHH)*

GENERAL OVERVIEW OF THE HAZARDS PARTICULAR TO THE BUILDING:

It is accepted that an Emergency Condition is defined as one which places at risk the safety of personnel, or creates a hazard to the Building or Plant.

The Building and the Plant have been designed and constructed in accordance with statutory regulations, local by-laws and British Standard Codes of Practice. Provided the plant is operated and maintained in accordance with the recommendations issued by the various manufacturers, the likelihood of an Emergency Condition arising is minimal.

It is strongly recommended that personnel operating or involved with running this installation make themselves aware of the location of all valve locations and isolation of electrical services and emergency "Knock off" buttons, as speed of action will minimise property damage and could save lives.

The most important single precaution against a serious hazard is, therefore, observing approved operating and maintenance procedures.

If an Emergency Condition should appear, it is most likely to be within one of the following categories :-

1. Fire or explosion caused by a gas leak.
2. Explosion in boiler combustion chamber caused by malfunction of the safety controls.
3. Flooding of an area caused by rupture of a pipe or joint.
4. Refrigerant leak.
5. Failure of water supply
6. Electric Fires

This section is in no way related to or to interfere with "Standard Procedures" that exist for the evacuation of the buildings in respect of an emergency situation such as fire, gas leaks etc., but to give an indication to the building services engineers as to general safety measures to follow.

4.1 GAS LEAKS

If a gas leak is suspected, or detected, proceed as follows:-

1. Close the manual gas shut-off valve at the boiler room. If entering the plant room seems hazardous, go to step 2.
2. Close the nearest manual shut-off valve.

The manual gas shut-off valve serving the building is located inside the gas meter room. This valve should be closed regardless whether or not the gas solenoid valve at the boiler room has closed.

3. Extinguish any ignition sources present (e.g. naked lights or fires, welding apparatus etc).
4. Shut down any adjacent electrical apparatus, but externally to the area where gas is detected.
5. Open any adjacent doors and windows to provide maximum ventilation.
6. Advise the local Gas Authority's Emergency Service.
7. Consult the local Fire Officer before restarting plant.

4.2 BOILER EXPLOSION

Rupture of the boiler shell is extremely unlikely but instances have occurred of an explosion in the combustion chamber.

The burner programmer is designed to purge the combustion chamber before the main jet. If the combustion chamber were to be filled with a gas/air mixture when the igniter began sparking, a serious explosion would occur.

Instances are recorded of burner safety controls being "adjusted" by unauthorised personnel. **ONLY QUALIFIED** personnel who have attended an approved course of instruction at the burners manufacturers works should attempt this work.

Note: All burner manufacturers offer courses of instruction for operating and maintenance personnel

4.2 **Boiler Explosion (Cont'd)**

If an explosion were to occur in the Boiler Room, proceed as follows:-

1. Shut off the main gas incoming supply valve.
2. Shut off all electrical supplies at the nearest switchgear cubicle.
3. As soon as possible (and if possible) close the main distribution heating flow and return header branch circuit isolating valves to primary and secondary circuits, to reduce flooding.
4. Close the main heating pressurisation unit system feed valve. Turn local pressurisation unit pump isolator to its OFF position.
5. Evacuate building and all adjacent areas of personnel.

Each boiler is provided with its own gas shut off valve and local panel.

Safety valves are installed basically to prevent explosions; therefore they should not be ignored. They should be regularly inspected and tested to ensure they will function when required.

Discharge pipes from safety valves must be kept clear and free of obstruction.

4.3 **FLOODING**

If a cold water pipe ruptures, or a serious leak develops, close the isolating valve nearest the leak.

1. Close down the boilers.
2. Maintain operation of the pressurisation unit (to add cold water).
3. Keep the system circulating pumps running and the cold feed supply open to the pressurisation unit to cool the system as soon as possible (there is a risk that the pumps may run dry).
4. Close the isolating valve nearest to the leak, as soon as it is accessible.

WARNING: Following such an incident, have the pressurisation unit and boiler inspected by the makers, or by the Insurers, to ensure that structural damage (caused by the thermal shock) has not occurred. It would also be advisable on completion of the repair to hydraulically re-test the particular system, once refilled, including heating coils to ensure that the entire system is sound.

4.4 **REFRIGERANT LEAKS**

In the event of refrigerant leak proceed as follows:

1. Shut down and electrically isolate the affected refrigeration plant. Refer to machine refrigerant pressure gauges to determine source of the leak.
2. Evacuate all personnel from the area local to the machine and call in specialist assistance from the manufacturers or a reputable refrigeration company.
3. The refrigerant used in the chillers is R407C and in the VRV and BMS/Security Room A/C condensing units is R22.

The refrigerant that leaks out will be in the form of vapour and therefore the source of the leak will be difficult to locate without proper leak detection equipment.

A Refrigerant Leak Detection equipment is provided by Synchronised Systems for the chillers in the basement.

The refrigerants used are virtually non-toxic. However, these vapours will break down under heat to form toxic gases.

The outstanding characteristic of these refrigerants is the small hazard to health to life and property in case of leakage. Major alarms or tendency to panic should be avoided.

When repairs are carried out it is advisable to make sure the space is well ventilated and all smoking stopped.

Refrigerant reclaim machine should be used and every care should be taken to avoid leaks and ensure the safe disposal of refrigerant to avoid damage to the ozone layer.

4.5 FAILURE OF WATER SUPPLY

1. Inform local water company immediately failure is noticed.
2. Inform local Fire Brigade and Insurance Surveyor if lack of water supply is expected to last for more than one day.
3. Endeavour to conserve water by limiting non-essential usage. Inform all staff of water failure, stressing the need to conserve available water storage.
4. Keep a careful watch on the level of water within all storage tanks. Close off the down supply system when the water level reaches a point approximately 2"-3" above the feed pipe connection.

4.6 FIRES

GENERAL

Although mechanical services have a number of automatic fire protection and detection systems incorporated in them, care should be taken to ensure they function successfully if ever called to do so in the following ways:

- (a) All fusible links on fire dampers and boilers should be regularly checked to see that they are in good condition, free from paint, etc., and are in the air stream.
- (b) Ensure that all doors to plant rooms, plant chambers, etc. are kept shut.
- (c) Ensure the access doors onto stairways are not permanently held open. They must be allowed to swing closed when not in use.
- (d) Refer to Electrical Manual to check the fire detection system related items.

Hand fire appliances should be kept in their proper locations and be regularly checked by the Fire Brigade and manufacturers.

Make sure that the right types of extinguishers are available for dealing with the likely types of fires in the areas covered by them. For any information and advice in this respect consult your Local Fire Brigade.

Follow procedures laid down by internal "House" rules.

4.6 FIRES (Con'd)

ELECTRICAL FIRES

Cleanliness of equipment, adequate ventilation, protection from water and dampness and gas or petrol fumes, correct adjustment of overload protection devices and the fitting of fuses of the correct rating are generally accepted as good practice and the most satisfactory methods of avoiding electrical fires. Another obvious precaution is to not overload an electrical circuit in the first instance.

If an electrical fire occurs, proceed as follows:-

1. Isolate the supply (or supplies) at the nearest distribution board or switchgear.
2. Use CO₂ (Carbon Dioxide) or Dry Powder hand fire extinguishers to fight the fire.

WARNING:

NEVER USE WATER BASED (E.G. WATER OR SODA ACID) EXTINGUISHERS TO FIGHT AN ELECTRICAL FIRE.

A.4 CONTRACTUAL AND LEGAL DETAILS

The followings shall be provided on practical completion:-

1. *Information on all guarantees or warranties affecting components, systems and plant items, together with expiry dates and names, addresses and telephone numbers of relevant contacts.*
2. *Insurance inspection reports.*
3. *Statutory and non statutory certificates and approval documents.*
4. *Safety and fire certificates.*
5. *Welding test certificates and documentation.*

B THE INSTALLATION

B.0.1 PURPOSE OF THE INSTALLATION

The installation is carried out to provide all the necessary Mechanical and Public Health Building Services, to maintain acceptable and safe working environment, in the Offices (Main Building) and living environment in the Residential areas; all as fully detailed below.

B.0.2 BASIS OF DESIGN

B.0.2.1 Building Loads

The building loads and capacities are calculated on occupation of the building net lettable area as follows.

WC provision floor by floor 1 person per 10 sq. metres. Proportion by sex 60% maximum of male or female.

Air conditioning internal heat gain from occupants.

Basement Ground & 1st Floors - 1 person per 7.5 sq. metres.

Second to 5th Floors - 1 person per 9.5 sq. metres.

Entrance Hall - 1 person per 18 sq. metres.

Air conditioning (chilled water cooling) gains from internal electrical loads.

Lighting 20 watts per sq. metre.

Small Power 40 watts per sq. metre.

Fresh air requirements.

12 litres per second per person to all occupied areas.

B.0.2.2 Environmental Design Conditions

External

Winter -4°C Saturated minimum
Summer 28°Cdb - 20°Cwb maximum

Internal

Offices	Summer 22°C ± 1°C	Winter 21°C ± 1.5°C
Entrances	Summer 22°C ± 1°C	Winter 21°C ± 1.5°C
Lift Motor Rm.	Summer 34°C Max.	Winter 5°C Min
Toilets	Summer Uncontrolled	Winter 20°C ± 1.5°C
Stairs	Summer Uncontrolled	Winter 18°C heating only.

The following should be noted:

Under "The Fuel & Electricity (Heating Control Amendment) Order 1980, Statutory Instrument No. 1013", it may be necessary to set the winter heating controls at 19°C (66.2°F).

The summer heat gain calculations assume the use of interior blinds on all windows except in the North face.

Office areas relative humidity is limited to 60% in summer and in winter will be a function of the outside conditions as no artificial Humidification is provided. Space and electrical supply provision have been allowed for future tenant enhancement.

Toilet rooms are provided with mechanical extract ventilation with the supply air being introduced via the office air conditioning supply air system.

The following transmittance values ('U' values) were used in the calculations.

Walls 'U' Value of 0.45w/m² °C
Roof 'U' Value of 0.45w/m² °C
Windows double glazed.

B.0.2.3 Mechanically Ventilated Areas

The following air change rates apply to the ventilated areas.

Plant room	6 air changes per hour.
Storage areas	6 air collection changes per hour.
Toilets	12 air changes per hour.
Car Parks	6 air changes per hour.

B.0.2.4 Air Filtration Standards

Office areas to European Standards EU5.

Other ventilated areas to European Standards EU4.

B.0.2.5 Internal Noise Levels

Offices not to exceed NR 37 based on open plan.

Toilets not to exceed NR 40.

Entrances not to exceed NR 40.

B.0.2.6 External Noise Levels

Noise level from plant within or on the building have been limited to NR 55 at the site boundary in agreement with the Local authority on the basis that these will operate only during the normal working day.

B.0.3

GENERAL DESCRIPTION OF SYSTEMS

The office areas are ventilated by 2 No. Air Handling Units (East & West). The toilet and Core areas are ventilated by the toilet Air Handling Unit located on the roof. All AHU's have Heat Recovery.

Final air conditioning in the office areas is provided by 4-pipe Fan Coil Units with Air Side Controls

Sundry ventilation systems are installed to provide fresh air to and extract from the service areas which include basement storage and plant areas, the car park, loading bay, toilet cores throughout the building and basement level lift motor rooms.

Some Stairs and Lobby areas are heated by Radiators, others by infiltration from the offices as shown on the drawings.

Pressurisation of Stair Cases is by supply fans SP01,02 & 03 and smoke clearance is provided by 2.5% floor area window opening operating under the dictate of the BMS with conjunction with the Fire Alarm System.

The Heating requirements of the building are met by gas fired boilers. From these units the primary hot water circuit pumps circulate LTHW water to the LTHW header A constant temperature circuit pump set feeds the heating coils of the air handling units and a heater battery on the ground floor.. A variable temperature pump set feeds the radiators and other terminal heaters.

Pressurisation unit maintains the pressure in the heating system, installed in the basement with heat rejection switch

The cooling requirements of the building are met by duplicate. water cooled water chillers installed in the basement with heat rejection units mounted on the roof of the building. From these chillers the primary chilled water circuit pumps circulate Chilled water to the CHW header.. One set of secondary pumps feeds the cooling coils associated with the air handling units and another set feeds the cooling coils of the fan coil units only.

Pressurisation unit maintains the pressure in the cooling system.

Water services in the building comprise boosted cold and drinking water storage and distribution, central domestic hot water heating, and fire fighting sprinkler and hose reel systems.

A Gravity Foul water drainage system is installed to carry all sanitary waste, over flows and condensates via drain channels and interceptors and soil & vent pipework and sump pumps to the underground sewer as shown on the schematic and layout drawings.

Rainwater is collected from roofs and floor drain channels and gullies and is gravity fed to the surface water sump pumps and run via disconnecting trap interceptor to the underground sewer as shown on the schematic and layout drawings.

Fire fighting installations protecting the building consist of sprinkler coverage on all floors, a pumped emergency hose reel system, and dry riser installation.

B.1

LTHW Plant

The Heating requirements of the building are met by 2 No. Hamworthy gas fired boilers.

The boilers are arranged in 2 rows of 4 Modular Boilers each.

From these boilers, a set of 2 duty/standby primary hot water circuit pumps (P3) circulates LTHW water to the LTHW header. One set of 2 duty/standby constant temperature circuit pumps (P7) feeds the heating coils of the air handling units and another set of 2 duty/standby constant temperature circuit pumps (P6) feeds the heating coils within the FCU's and the overdoor heaters. A set of 2 duty/standby variable temperature pumps (P9) feeds the radiators and other terminal heating units.

Another set of 2 duty/standby constant temperature circuit pumps (P8) feeds the HWS calorifier.

Holden & Brooke Pressurisation unit (PU1) maintains the pressure in the heating system.

A1 Bridge common flue connects to the individual boilers and rises 2.6 metres above roof level. The flue system is built of double wall grade 306 stainless steel with 50 mm gap insulated with rock wool. Open drain is provided at the bottom of the riser.

B.2

Chilled Water Services

The cooling requirements of the building are met by a chilled water distribution system arranged to circulate primary (CHW header) and secondary water to user points.

Refrigeration of the water is effected by two McQuay close circuit water cooled packaged water chillers (ACC1 and ACC2) installed in the basement.

The chillers have been selected such that the system capacity can be maximised by the installation of further Dry Cooler at roof level.

One set of duty/standby condensing water pumps (P1) circulates 20% Glycol condenser water between the condensers of the two chillers and 3 No. Guntner Heat Rejection units (HR1 to HR3) mounted on the roof. This pipework is trace heated on the roof.

The primary chilled water is pumped from the chillers by a set of 2 duty/standby circulating pumps (P2) arranged in duty / standby to the CHW header. These pumps are located in the basement plantroom.

One set of 2 duty stand/by pumps (P5) circulates CHW between the CHW header and the AHU's cooling coils. Another set of duty/standby pumps (P40) circulates CHW between the header and the FCU's cooling coils.

Blanked connections are provided on the main headers at basement level.

The expansion and contraction of the chilled water system is accommodated by a Holden & Brooke pressurisation unit (PU2) which incorporates, header tank, pressurisation pumps, expansion vessel and automatic controls. A separate connection from the pressurised cold water service is provided to act as a quick fill for the system.

A dosing pot is connected to the system across the primary pumps to facilitate periodic dosing of the contents of the circuits.

B.3 Heating, Ventilation and Air Conditioning (HVAC)

B.3.1 Office Air Conditioning

The office areas are air conditioned by means of 2No. McQuay's AHU's (AHU1 and AHU2), located in the basement AHU plantroom. The Air Handlers are labelled AHU No. 1 (WEST) and AHU No. 2 (EAST).

The ductwork distribution to the office areas, serving lower ground to 5th floors, is via the south west service riser (AHU No.1) and south west mechanical riser (AHU No.2).

Each AHU also incorporates an extract fan with fresh air recirculation control.

The supply air is filtered, heated or cooled as dictated by the BMS control system. The AHU's have a spare section for the future fitting of a humidifier.

The 2 hour fire rated extract duct from the lower ground floor to the 5th floor follows the same route as the supply air system via risers south west and south east. The supply air ductwork are standard galvanised complying with DW142.

Motorised smoke dampers (type WSD supplied by Waterloo) are provided at each floor level from lower ground to 5th floor both the supply and extract ducts. These dampers are accessed via the false ceilings and riser cupboards being located at each level. For smoke damper references see D&S Schematics 121/5192/SCH/A1/001 and 121/5192/A1/002.

Fire dampers are located in the standard galvanised supply ducts where passing through fire compartmentation as they leave the plantroom and enter the north west and south east mechanical riser as shown on the as installed drawings.

Return air is drawn from the false ceiling void via light fittings and returned to the AHU plantroom via the 2 hour fire rated extract ductwork.

Power to the FC Units serving the tenants areas is provided from the upper section of the tenants distribution board which houses contactors arranged such that the fans can be switched off by the fire alarm system in the event of emergency.

B.3.2 Heating of Common Areas

The common areas such as stair wells and lobbies are heated as follows:-

- Hudevad Radiators whose heat output is controlled by Drayton TRV4 Thermostatic Radiator Valves, provide heating to stair case 1 at basement level and stair case 2 at all levels and core areas levels 1 to 5.
- Ground floor core area is heated by 1 No. Heater battery located in the adjacent supply core duct.
- All other areas are heated by infiltration from the Offices.

B.3.3 General Supply & Extract Systems

Supply air to the toilets is provided by AHU 3 via the west south riser.

Other areas such as plant rooms, cold water and sprinkler tank rooms etc, get outside air make up via louvres.

The boiler and security rooms, car park and workshop have supply fans (SF01 to SF04).

Extract fans (EX01 to EX09) are provided to exhaust the vitiated air from all the above areas.

For detailed system description refer to Schedule No. 8 in Section C.

B.3.4 Staircase Pressurisation

Stairwell supply fans (SP01 to SP03) will, when commanded by the BMS, pressurise the area so that the stair lobbies serve as fire fighting lobbies.

Extract fans EXH04 & EXH05 ensure pressure relief when commanded by the BMS.

B.4 Public Health

B.4.1 Mains Cold Water

One 100 mm galvanised steel unmetered mains water service enters the site from Carlton Gardens Terrace basement level at the south side of the building. This constitutes the fire services water supply filling the sprinkler storage and hose reel systems storage tanks .

A separate 108 mm metered copper mains enters the site from Carlton Gardens Terrace basement level at the south side of the building to serve the drinking water via the break/storage tank (WT2) and a booster set (DWP2). The meter is located in the Tank Room. Metered water also feeds the cold water down service and the hot water requirements of the building via C.W. Storage tank (WT1) and a booster set (DWP1).

B.4.2 Drinking Water Supply

An automatic drinking water booster set (DWP2) installed in the basement provides a pressurised drinking water supply to the building. The set is a Holden & Brooke 2 duty and 1 Jockey pump booster unit fed from the drinking water break tank, supplied by Aquatank. The boosted main rises through the south west mechanical riser to provide drinking water services from ground to 5th floor and carries on to 6th and 7th floors where it is capped for future connections.

The drinking water passes through a Liff Conditioner (MWC2).

B.4.3 Cold Water Services

B.4.3.1 Domestic Cold Water

Domestic Cold water supplies throughout the building are provided by a Holden & Brooke packaged 3 duty and 1 Jockey pump cold water booster set (DWP1) which draws its supply from the main water storage tank (WT1), supplied by Aquatanks. The pumped main follows a similar route to the drinking water service to provide supplies to the sanitary fittings.

Liff Water Conditioners as detailed in Schedule No. 16 in Section C serve all Domestic Water Services.

B.4.3.2 Irrigation Water

Irrigation water storage tank (TW4) by Sarena, located at the 7th floor and fed from the DCWS, provides the irrigation water to the Landlord Terraces via a Stuart Turner Booster Pump Set (DWP3).

B.4.3.3 Fire Water Services

- A sprinkler water storage tank (WT3) at the basement provides water for the Automatic Sprinkler System.
- An Armstrong packaged water storage and booster set (FP1) provide the water to the Hosereel System

B.4.4 Hot Water Services

HWS supplies are generated centrally in IMI Rycroft storage calorifiers (HWT1 & HWT2) located in the basement. The outlet pipework from the calorifiers to the taps is trace heated using the Hi-Wat system and insulated to maintain water temperatures in these pipes at 60°C.

The cold feed to the calorifiers is via Liff Industries Electro Magnetic Water Conditioners (MWC1).

B.4.5 Drainage

Drainage systems within the building fall into four types, as detailed on the Schematics:-

- a) Gravity sanitary drainage for plumbing fixtures, Air Handling Units wastes etc. which can be drained by gravity to the mains sewers.
- b) Sub-sewer level sanitary drainage of plumbing fixtures, air handling units wastes, car park drainage, lift pit etc. which are below the level of the main sewer outfall. This drainage is collected in sumps at sub-basement level and pumped from these up to the main sewer. The sump pumps are supplied by Grundfos and have the following references:

FWMH 3 & 4	Foul Water
CPMH 4	Car Park
LPMH 1	Lift Well
SWMH 1 to 3	Surface Water

- c) Surface water drainage from all roofs, set back areas and canopies. This water collection system carries the rain water down through the building to discharge into the sewer via disconnecting traps and interceptor.

The drainage points in the floors of the car park pass through a petrol interceptor before entering this system.

- d) Indirect Condensate, collected from fan coil units is discharged via a glass trap connected to the Condensate stacks system located within the mechanical services risers, terminating over gullies within the basement plantroom.

B.5 Fire Protection

The building is protected throughout by an automatic sprinkler system and hose reel system which was designed to meet the requirements of BS 5306, ordinary Hazard Group II.

B.5.1 Automatic Sprinklers

The sprinkler system, provided by Preussag, is of the wet type with the car park areas pipework insulated and trace heated.

Water storage for the sprinkler system is accommodated in a storage tank, supplied by Braithwaite located in the basement sprinkler tank room.

A three pump sprinkler booster set arranged as run, standby and jockey pumps draws water from the tank and distributes water throughout the building via the core riser. Each rising main incorporates a riser alarm valve numbered SP1, SP2 and SP3 respectively. These valve sets are installed at ground floor level and include alarm valve with isolating valves for maintenance purposes and a manual bypass.

The following areas are protected by Automatic Sprinklers:

- Basement Car Park.
- Lower Ground to Fifth Floors
- 6th & 7th Floor flats

The system is fully detailed in Preussag's Manual.

B.5.2 Hose Reels

The hose reel system provides a boosted water supply to hose reels at each level and the basement area as detailed below. The booster unit (FP1), provided by Armstrong and installed by Preussag as part of the hose reel system, is a packaged unit incorporating the break tank, twin (duty/standby) booster pumps and an accumulator to maintain pressure.

- The Basement Area is protected by 4 No. Automatic Swinging type Fire Hose Reels.
- Floor levels are each protected by 2 No. Fire Hose Reels concealed above the false ceilings. A pullout hose is provided via wall mounted box.

B.5.3 Dry Risers

A dry riser installation has been provided to serve the floors within the central Core.

A fireman's twin inlet breaching valve at the North Level end of the building is provided to allow the fire brigade to augment the mains water supply and to top up the sprinkler tank during a fire.

The outlet landing valves are installed within the fire escape staircases at all levels near lift No. 4, including the roof, but excluding the ground floor.

B.6

Gas Service

The gas main enters the site from Carlton Gardens Terrace basement level at the south side of the building via the meter room. The gas mains split into two branches. One is metered and run to supply the gas fired boilers in the basement. The other supplies the 6 No. Meters feeding the flats.

A gas solenoid shut off valve of Synchronised System is provided at the south west Core at basement level. The valve shuts at the dictate of the BMS in connection with the Fire Alarm System and gas detection and on pressing the panic button at the entrance to the boiler room. Closure of the gas shut off valve for any reason raises alarm at the BMS.

B.8

Building Management System

An Open Protocol BMS system has been provided by Synchronised Systems to control and monitor the operation of the Building Services systems. The system is complete with Trend and Seachange Software as fully detailed in Synchronised Systems Manual.

The central control console is located in the BMS/Security room at Basement level.

Apart from the direct control of plant and equipment items such as general ventilation air handling units, extract fans, etc the BMS interfaces with numerous items of packaged plant such as chillers, air handling plant, chilled water pumps etc. These items have integral control panels/equipment and the BMS acts as an enabling, disabling and monitoring facility only.

C

C SCHEDULES

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SCHEDULE No. 1

SUPPLIERS / MANUFACTURERS

Supplier / Manufacturer	Plant/System Item
1. Advanced Air (UK) Ltd. 3/4 Cavendish Road, Bury St. Edmunds Suffolk IP33 3TE Tel: 01284 701 356 Fax: 01284 701 357 Maun Way, Boughton Ind Est.	FIRE, VOLUME CONTROL & NON-RETURN DAMPERS
2.. A1 Bridge Flues Nr. Newark, Nottingham NG22 9ZD Tel: 01623 860 578 Fax: 01623 835 548	Heating Boilers Flue
3. Aquatank Unit 3, Westcombe Trading Estate Station Road, Ilminster Somerset TA19 9DW Tel: 01460 556 64 Fax:01460 533 38	C.W. STORAGE TANKS
4. Armstrong Pumps Ltd. (Via Preussag) Peartree Rd.,Stanway, Colchester Essex CD3 5JX Tel: 01206 579 491 Fax: 01206 760 532	HOSEREEL BOOSTERS
5. Contract Components Ltd. 10 Woodall Road Redburn Industrial Estate, Enfield Middx. EN3 4LE Tel: 0181 805 3656 Fax:0181 805 0558	Duct Access Doors

Supplier / Manufacturer	Plant / System / Item
6. Delta T (Trace Heating) Ltd Unit 7, Alston works, Barnet Herts EN5 4EL Tel: 0181 441 9499 Fax 0181 441 4459	Trace Heating
7. Diffusion Environmental Ltd. 47 Central Avenue West Molesley Surrey KT8 2QZ Tel: 0181 783 0033 Fax::0181 783 0140	FAN COIL UNITS
8. ACL Drayton Chantry Close, West Drayton Middx UB7 7SB Tel: 01895 444 012 Fax: 01895 421 901	Thermostatic Radiator Valves
9. Estec Environmental Ltd. Old Pump House , Elmer Works Hawks Hill, Leatherhead Surrey KT22 9DA Tel: 01372 361 451 Fax:01372 361 453	CHLORINATION & WATER TREATMENT
10. Eurocoils Ltd Unit D3, Eurolink Commercial Park Boham Drive, Sittingbourne Kent ME10 3RX Tel: 01795 475 275 Fax:01795 422 210	Heater Batteries (LTHW & Electric)

Supplier / Manufacturer

Plant / System / Item

11. Fire Protection Ltd.

Millars 3, Southmill Road
Bishops Stortford
Herts. CM23 3DH
Tel: 01279 367 077
Fax:01279 466 994

Fire Resistant Ductwork

12. Grundfos Pumps Ltd

Grovebury Rd
Leighton Buzzard
Beds LU7 8TL
Tel: 01525 850 000
Fax:01525 850 011

SUMP PUMPS

13. Guntner UK

Sandhurst House
297 Yorktown Road
College Town, Sandhurst
Berks. GU47 0QA
Tel: 01276 600 817
Fax:01276 331 29

DRY COOLER

14. Hamworthy

Fleet Corner, Poole
Dorset BH17 7LA
Tel: 01202 665 566
Fax::01202 665 111

BOILERS

15. Holden & Brooke Ltd

Wenlock Way
Manchester M12 5JL
Tel: 0161 223 2223
Fax::0161 220 9660

**PUMPS, PRESSURISATION
UNITS & COLD WATER
BOOSTERS**

Supplier / Manufacturer

Plant / System / Item

16.Holmes

VALVES

Hardwick Grange, Woolstone
Warrington WA1 4Rf
Tel:01925 827 505
Fax:01925 810 589

17.Hudevad Britain

RADIATORS

130 - 132 Terrace Road
Walton - on - Thames
Surry KT12 2EA
Tel: 01932 247 835
Fax:01932 247 694

18.IMI Rycroft Ltd

CALORIFIERS

Duncombe Road
Bradford BD8 9TB
Tel: 01274 490 911
Fax:01274 498 580

19.Liff Industries

WATER CONDITIONERS

Bay Hall, Miln Road
Huddersfield
W. Yorks. HD1 5EJ
Tel: 01484 512 537
Fax:01484 513 597

20.Matthew & Yates

FANS

Peartree Road, Stanway
Colchester
Essex CO3 5LD
Tel: 01206 543 311
Fax:01206 760 497

Supplier / Manufacturer

Plant / System / Item

21.Minikin & Sons Ltd

Spa House
Hookstone Park
Harrogate HG2 7DB
Tel: 01423 889 845
Fax:01423 880 724

FLEXIBLE CONNECTIONS

22.McQuay International, AAF Ltd.

Bassington Lane, Cramlington
Northumberland NE23 8AF
Tel: 01670 566 159
Fax:01670 566 206

AIR HANDLERS

23.McQuay International, AAF Ltd.

15 Greycoat Place, Victoria
London SW1P 1SB
Tel: 0171 799 3330
Fax:0171 799 3411

CHILLERS

(To be forwarded later due to slow
response from supplier)

24.Noico Ltd.

London Road
Hook
Hampshire RG27 9EQ
Tel: 01256 766 207
Fax:01256 768 413

INERTIA BASES

25.Preussag Fire Protection Ltd.

220 Stockport Road
Cheadle Heath
Stockport SK3 0LX
Tel: 0161 428 3662
Fax 0161 428 3662

**SPRINKLERS, HOSEREELS
DRY RISERS**

(See stand alone Manual)

Supplier / Manufacturer

Plant / System / Item

26. SGD Engineerig Services Ltd.

Imex Technology Park
Longton Road, Trentham
Stoke on Trent ST4 8LJ
Tel: 01782 658 8767
Fax:01782 658 899

Glass Condensate Traps

27.Stepspeed Ltd.

Audley House
Northbridge Road, Berhamstead
Herts. HP4 1EH
Tel: 01442 876 888
Fax; 01442 876 860

THERMAL INSULATION

28.Waterloo Air Management

Quarry Wood Ind. Est.
Mills Rd., Aylesford South
Kent ME20 7NB
Tel: 01622 717861
Fax: 01622 719291

**SMOKE DAMPERS &
ATTENUATORS**

29.Woods Air Movement

Tufnell Way
Colchester CO4 5AR
Tel: 01206 544 122
Fax:01206 574 434

FANS

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Reference		B01-B04	B05-B08
Model		P105	P105
No. Of Modules		4	4
Make		Hamworthy	Hamworthy
Duty	kW	105	105
Location		Basement	Basement
Works Ref..	P5483591	563401080	563401080
Flow Temperature	(°C)	82	82
Return Temperature	(°C)	71	71
Design Flow Rate	l/s	2.28	2.28
Working Pressure	bar	6	6
Flue Connection	mm	256	256
Height from Boiler to Roof	m	40	40
Electrical Power Required	Amps	6	6
Electrical Supply	V/Ph/Hz	240/1/50	240/1/50
Minimum Inlet Gas Pressure	in Wg	7	7
Maximum Inlet Gas Pressure	in Wg	10	10
Accessories			
1. Boiler sequence controller per bank			
2. Manufacturer's four boiler header pipework is incorporated complete with insulation kits per bank.			
3. Spark ignition is included			
4. Remote alarm indication is provided			
5. High/low facility is provided to each module			
SCHEDULE OF BOILERS		SCHEDULE NO. C2	

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Reference		C1	C2
Model		PES 275	PES 275
Make		McQuay	McQuay
Duty		700	700
Location		Basement	Basement
Dimensions			
H X W X L	M	2.19x1.25x4.62	2.19x1.25x4.62
Water Temperature Flow/Return	(°C)	7 / 12	7 / 12
Water Flow Rate - Pd	l/s - kPa	33.00 - 62	33.00 - 62
Compressor Type		Stargate Screw	Stargate Screw
No. of Compressors		3	3
No. of Control Steps		8	8
Refrigerant		407C	407C
Overall Power Input	kW	198	198
Evaporator - No. Off / Passes		1 / 2	1 / 2
Electrical Supply	V/Ph/Hz	400/3/350	400/3/350
FLC / SC (Part Winding Start)	A	340 / 615	340 / 615
Condensers (20% E.G.)			
No. Off Con. / No. Off passes		2 / 2	2 / 2
Notes			
1. The above CHW flow temperature is given, based on full load. This temperature is allowed to drop to compensate for part load conditions 2. Chillers are prevented from starting simultaneously 3. Following Accessories are provided:- <ul style="list-style-type: none"> • Controller Microprocessor • Common entering and leaving chilled water sensors • Amp/volt meters • Flow switches • Evaporator victaulic connections • Suction shut off valves • Differential pressure switches • Pressure gauges • Anti-Vibration mountings 			
SCHEDULE OF CHILLERS		SCHEDULE NO. C.3	

Ref. No.		HR01 - 03
Make		Guntner
Model		GFH 091 C/2 x 4L (s)
Number off		3
Location		Roof
Heat Rejection	kW	430
Dimensions	mm	8000
Length	mm	2385
Width	mm	1550
Height	mm	1907
Ambient Air On Condition	°C	30
Flow Temperature (outlet)	°C	40
Return Temperature (inlet)	°C	43.8
Flow Rate	l/s	29.33
Pressure Drop	kPa	88
No. off Fans		8
Fan Speed	rpm	520
Power Input Per Fan	kW	1.2
Electrical Supply	V/Ph/Hz	415/3/50
Notes		
1. System is suitable for 20% glycol mix		
SCHEDULE OF DRY COOLER		SCHEDULE NO. C.3.1

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Ref. No.		P1	P2	P3
Make		Holden & Brooke	Holden & Brooke	Holden & Brooke
Model		Star bloc 150-315	Star bloc 150-250	Star bloc 80-165
Number off		2	2	2
Location		Basement	Basement	Basement
H & B Works	Ref. No.	30287	30288	30289
Operation		Run/standby	Run/standby	Run/standby
System		Condenser	CHW primary	LTHW primary
Pump type		End suction	End suction	End suction
Flow rate	kg/s	88.00	66.00	18.224/9.11
Head pressure	kPa	180	100	70
Electrical supply	V/Ph/Hz	400/3/50	400/3/50	400/3/50
Motor rating	kW	33	15	3.3/1.0

Ref. No.		P4	P5	P6
Make		Holden & Brooke	Holden & Brooke	Holden & Brooke
Model		Star bloc 100-200	Star bloc 65-125	Star bloc 65-160
Number off		2	2	2
Location		Plant room	Plant room	Plant room
H & B Works	Ref. No.	30290	30291	30292
Operation		Run/standby	Run/standby	Run/standby
System		CHW FCU	CHW AHU's	LTHW FCU
Pump Type		End Suction	End Suction	End Suction
Flow rate	kg/s	35.02	7.99	6.62
Head Pressure	kPa	80	40	75
Electrical Supply	V/Ph/Hz	400/3/50	400/3/50	400/3/50
Motor rating	kW	5.5	0.75	1.1

SCHEDULE OF PUMPS

SCHEDULE NO. C.4

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Ref. No.		P7	P8	P9
Make		Holden & Brooke	Holden & Brooke	Holden & Brooke
Model		Star bloc 65-160	Star bloc 50-125	Star bloc 50-160
Number off		2	2	2
Location		Plant room	Plant room	Plant room
H & B Works	Ref. No.	30293	30294	30295
Operation		Run/standby	Run/standby	Run/standby
System		LTHW AHU	LTHW HWS	LTHW RAD
Pump Type		End suction	Twin in line	twin in line
Flow Rate	kg/s	7.48	2.16	1.42
Head Pressure	kPa	75	40	85
Electrical Supply	V/Ph/Hz	400/3/50	400/3/50	400/3/50
Motor Rating	kW	1.1	0.4	0.55
SCHEDULE OF PUMPS		SCHEDULE NO. C.4		

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Ref. No.		PU1	PU2	PU3
Make		Holden & Brooke	Holden & Brooke	Holden & Brooke
Type		Midi Prismatic	Midi Prismatic	Midi Prismatic
H & B Works	Ref. No.	30296	30297	30298
System		LTHW	CHW	Condenser
Estimated System Volume	Litre	12000	17000	3600
Flow & Return Temperature	°C	82/71	7/12	45/40
Operating Pressure	kPa	570	100	180
Max. Pressure	bar	7	7	8
Static Head	m	43	43	55.2
No. of Pumps	kPa	2	2	2
Electrical Supply	V/Ph/Hz	415/3/50	415/3/50	415/3/50
Power Consumption	kW	0.37	0.37	0.37
	FLC	2.7	2.7	2.7
	SC	15	15	17
Expansion Vessel		500	500	300
SCHEDULE OF PRESSURISATION UNITS			SCHEDULE NO. C.5	

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Unit Reference		AHU1	AHU2	AHU3
Make		McQuay	McQuay	McQuay
Area Served		East	West	Toilet Core
Location		Basement	Basement	Roof
L x W x H		1200x2200x3300	1200x220x3300	1000x220x1350
Supply Fan				
Air Volume	m ³ /s	4.85	4.85	2.35
Estimated External Pressure	Pa	500	500	400
Motor Rating	kW	15	15	7.5
Electrical Supply	V/Ph/Hz	400/3/50	400/3/50	400/3/50
Cooling coil				
Coil Duty	kW	81	81	-
Coil On Temperature (dry/wet)	°C	28/19	28/19	-
Coil Off Temperature (dry/wet)	°C	16/14.5	16/14.5	-
Water Flow Rate	l/s	3.86	3.86	-
Water Flow/Temperature	°C	7/12	7/12	
Heater Battery				
Coil Duty	kW	87	87	42
Air temperature on/off	°C	5/20	5/20	5/20
Water Flow Rate	l/s	1.88	1.88	0.91
Water Temperature Flow/Return	°C	82/71	82/71	82/71
Heat Recuperator		Yes	Yes	Yes
SCHEDULE OF AHU'S		SCHEDULE NO. C. 6		

Unit Reference		AHU1	AHU2	AHU3
Panel Filter		EU3	EU3	EU3
Bag Filter		EU7	EU7	EU7
Frost Coil				
Coil Duty	KW	52	52	25
Air On/Off	°C	-4/5	-4/5	-4/5
Water Flow Rate	l/s	1.13	1.13	0.55
Water Temperature Flow/return	°C	82/71	82/71	82/71
Extract Fan				
Air Volume	m ³ /s	4.85	4.85	2.35 (Twin extract)
Estimated External Pressure	Pa	500	500	500
Motor Rating	kW	11	11	5.5/5.5
Electric Supply	V/Ph/H z	400/3/50	400/3/50	400/3/50
Notes				
1. Maximum Hydraulic pressure drops across the coil 23 kPa				
2. Accessories				
<ul style="list-style-type: none"> • Recuperator have face and bypass dampers • Integral Attenuators provided on all inlet and outlet connections except the supply and return ducts from/to AHU3 • Tight shut off dampers provided on air intake, extract air intake and extract air discharge 				
SCHEDULE OF AHU'S			SCHEDULE NO. C. 6	

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Ref.	Location	No off	Air Volume m ³ /s	Total Cooling (kW)	Sensible Cooling (kW)	CHW FlowRate (kg/s)	Heating Load (kW)	LTHW Flow Rate (kg/s)
FCU-01	Lower Ground	8	0.22	3.70	2.95	0.176	1.40	0.0304
FCU-02	1st,2nd,3rd&4th	40	0.20	3.36	2.69	0.160	1.10	0.0239
FCU-03	Ground	10	0.18	3.02	2.42	0.144	1.10	0.0239
FCU-04	5th	6	0.18	3.02	2.42	0.144	2.45	0.0531
FCU-05	5th	16	0.16	2.69	2.15	0.128	2.45	0.0531
FCU-06	Lower Ground	32	0.15	2.52	2.02	0.12	1.4	0.0304
FCU-07	Grd,1st,2nd,3rd &4th	132	0.15	2.52	2.02	0.12	1.1	0.0239
FCU-07	Reception	2	0.15	2.52	2.02	0.12	1.1	0.0239

Notes

1. Fan coil units are AH15 of Benson Environmental - Diffusion's Supply
2. The fan coil units operate on air side control.
3. Each fan coil unit is complete with panel filter and spigoted supply air Plenum.
4. The fan coil units are fitted with local controllers adjustment.
5. Max. Hydraulic pressure drop across the LTHW and CHW coils 25 kPa.
6. All fan coil units are mounted in the ceiling void complete with duct connections to supply grilles.
7. Chilled water temperature 7°C flow and 12°C return.
8. LPHW temperatures is 82°C flow and 71°C return.
9. The above duties are achieved at the lowest fan speed.

SCHEDULE OF FAN COIL UNITS

SCHEDULE NO. C.7

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Unit Ref.		SP01	SP02	SP03
Make		Woods	Woods	Woods
System		Stair pressurisation	Stair pressurisation	Stair pressurisation
Location		LG Fire Fighting Stair	LG Fire Fighting Stair	LG Fire Fighting Stair
Number off.		2	2	2
Fan Type		Axial	Axial	Axial
Model		112 JM	45 JM	45 JM
Run/standby		Yes	Yes	Yes
Volume Flow Rate	m ³ /s	14.57	2.53	2.26
External Static Pressure	Pa	450	450	450
Motor rating	kW	22	5.5	5.5
Electrical Supply	V/Ph/Hz	400/3/50	400/3/50	400/3/50

Unit Ref.		SF01	SF02	SF03	
Make		Woods	Woods	Woods	
System		Boiler Room	Staff	Security	
Location		Boiler Room	Car Park	Security rm.	
Number off.		2	1	1	
Fan Type		Axial	Axial	Axial	
Model		45 JM	35 JM	31 JM	
Run/Standby		Yes	Yes	No	
Max. Volume Flow Rate	m ³ /s	0.95	0.34	0.05	
External Static pressure	Pa	350	380	200	
Motor Rating	kW	1.1	0.95	0.065	
Electrical Supply	V/Ph/Hz	400/3/50	400/3/50	400/3/50	

Notes

1. Fans are fire rated to 400°C for 1 hour or meet table 6 of BS 5588 Part 4, except SF02, SF03 and SF04
2. Two speed fans are at high speed under fire conditions or high carbon monoxide detection.
3. Stairs pressure relief and supply fans are complete with pressure relief dampers to limit staircase pressure to 60 Pa.

SCHEDULE OF SUPPLY FANS

SCHEDULE NO. C.8.1

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Unit Ref.		EXH01	EXH02	EXH03
Make		Woods	Woods	Woods
System		Car Park Extract	Basement Extract	Basement Extract
Location		Car Park	West Plant	East Plant
Number off.		2	2	2
Fan Type		Axial	Axial	Axial
Model		100 JM	90 JM	90 JM
Run/Standby		Yes	Yes	Yes
Volume Flow Rate	m ³ /s	8.68	4.50	4.50
Normal Ventilation volume Flow Rate	m ³ /s	5.21	2.7	2.7
Ext Static Pressure at max. Volume	Pa	200	350	350
Motor Rating (High/Low Speed)	kW	10.0/3.0	4.8/1.1	4.8/1.1
Electrical Supply	V/Ph/Hz	400/3/50	400/3/50	400/3/50

Unit Ref.		EXH04	EXH05	EXH06
Make		Matthew Yates	Matthew Yates	Matthew Yates
System		Pressure Relief	Pressure Relief	Basement Staff Area Extract
Location		West Plant	East Plant	Car Park
Number off.		2 in series	2 in series	1
Fan Type		Axial	Axial	Axial
Model		24E	48G	12G
Run/standby		No	No	No
Volume Flow Rate	m ³ /s	5.5	1.45	0.24
Normal Ventilation volume Flow Rate	m ³ /s	-	-	-
Ext Static Pressure at max Volume	Pa	750	750	290
Motor Rating (High/Low Speed)	kW	15	30	2.2
Electrical Supply	V/Ph/Hz	400/3/50	400/3/50	400/3/50
SCHEDULE OF EXTRACT FANS		SCHEDULE NO. C.8.2		

Unit Ref.		EXH07	EXH08	EXH09
Make		Woods	Woods	Woods
System		Basement Staff Area Toilet Ext.	Security Toilet Ext	Tank and Boiler Room Ext.
Location		Car Park	Security rm.	West Plant
Number off.		1	1	2
Fan Type		Twin Axial	Twin Axial	Axial
Model		DTF 5A	DTF 4A	56 JM
Run/Standby		Yes	Yes	Yes
Volume Flow Rate	m ³ /s	0.22	0.09	1
Normal Ventilation Volume Flow Rate	m ³ /s	-	-	-
Ext Static Pressure at max Volume	Pa	340	210	150
Maximum Speed	rpm	2900	2900	2900
Motor Rating	kW	0.75	0.75	
Electrical Supply	V/Ph/Hz	400/3/50	400/3/50	400/3/50
Notes 1. Fans are fire rated to 400°C for 1 hour or meet table 6 of BS 5588 Part 4, except EXH07 and EXH08 2. All toilet extract fans are twin units, duty/standby with automatic changeover complete with non return dampers. 3. Car park exhaust fan operates at high speed for smoke extract or on high carbon monoxide detection 4. Two speed basement plant extract fans operate at high speed for smoke extract				
SCHEDULE OF EXTRACT FANS			SCHEDULE NO. C.8.2	

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Unit Ref.		R1	R2	R3	R4	R5
RADIATORS						
Make		Hudevad	Hudevad	Hudevad	Hudevad	Hudevad
No. off		10	19	4	2	1
Location		cores & Basement	cores	Basement	Plant Room	Lift Motor Room
Load	kW	0.5	0.4	1	3	1.5
Flow Rate	l/s	0.01	0.01	0.02	0.07	0.03
IN DUCT HTG. COILS						
Make						
Location		Boiler Room	Boiler Room	BMS/Security	Staff	
Duty	kW	17	5	1.5	15	
Flow Rate	l/s	.0369	-	-	0.325	
System		LTHW	Electrical	Electrical	LTHW	
Air Temperature On/Off Coil	°C	-4/11	-4/1	-4/20	-4/20	
OVER DOOR HEATERS						
Make		DH1				
No. off		2				
Duty	kW	3				
Flow Rate	l/s	0.055				
FAN CONVECTORS						
Make		FC1				
Load	kW	6				
Flow Rate	l/s	0.13				

Notes:-

Radiators are provided with thermostatic radiator valves and lockshield valves

SCHEDULE OF HEATERS

SCHEDULE NO. C.9

Ref.	Detail	Service	Make	Duty	Media
FC 1	Fan Convector	Residential 6&7 Entrance	Diffusion		Electric
HC 1	Htg Coil (in duct)	Boiler Room	Eurocoil	17 kW	LTHW
HC 2	Htg Coil (in duct)	Boiler Room	Eurocoil	5 kW	Electric
HC 3	Htg Coil (in duct)	BMS/Security	Eurocoil	1.5 kW	Electric
HC 4	Htg Coil (in duct)	Basement Staff Room	Eurocoil	15 kW	LTHW
HC 5	Htg Coil (in duct)	G.F. Reception Area	Eurocoil	1.1 kW	LTHW
	Under floor Htg	Office Reception	Multibeton	15 W/m ²	LTHW
DH 1	O/D Heater	Office Entrance	Frenger	3 kW	LTHW
DH 2	O/D Heater	Office Entrance	Frenger	3 kW	LTHW
Notes:- <ol style="list-style-type: none"> 1. All coils entering water 82°C, leaving water 71°C. 2. The fan convector operates on air side control c/w panel filter 3. The fan convector are provided with a local controller for fan and temperature adjustment 4. The hydraulic pressure drop across the LTHW coils does not exceed 5 kPa 5. Over door heaters are thermostatically controlled, provided with local temperature adjustment and on/off switch. 					
SCHEDULE OF HEATERS				SCHEDULE NO. C.9	

GENERAL	
1. Insulating	
Materials	
Reference	
	<p>A - Mineral wool rigid pipe sections</p> <p>B - Mineral wool flexible</p> <p>C - Mineral wool rigid duct insulation</p> <p>D - Mineral wool lamella</p> <p>E - Mineral wool mattress</p> <p>F - Mineral wool wire reinforcement</p> <p>G - Mineral wool wire reinforced mattress</p> <p>H - Isocyanurate form rigid</p> <p>K - Phenolic foam rigid pipe sections</p> <p>L - Calcium silicate rigid pipe sections</p> <p>M- Hydrated magnesia rigid pipe sections</p> <p>N - Flexible closed cell insulating material</p>
2 Vapour Barriers	<p>VAP 1- glass fibre reinforced aluminium foil</p> <p>VAP 2-wet applied polymeric emulsion/glass cloth</p> <p>VAP 3-polyisobutylene flexible sheet</p>
3. Cladding Finishes and Reinforcement	<p>C1- Aluminium sheet (embossed/reeded 0.6 mm)</p> <p>C2- PVC finishing sheet 0.7 mm</p> <p>C3- Roofing felt (to BS 747)</p> <p>C4- Wire mesh reinforcement (to BS 1485)</p> <p>C5- Aluminised steel sheet 0.6 mm</p>
SCHEDULE OF INSULATION	
	SCHEDULE NO. C.10

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

PIPEWORK WITHIN THE BUILDING							
CONCEALED LOCATION							
Service	Chilled Water	Heating Water	Condenser Circuit	Refrigerant Lines	Condensate Drainage	Hot & Cold Water Service	Rainwater Pipework
Size	All	All	All	All	All	All	All
Insulation Ref.	A	A	A	A	A	A	A
Vapour Barrier	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1
EXPOSED LOCATIONS							
Service	Chilled Water	Heating Water	Condenser Circuit	Refrigerant Lines	Condensate Drainage	Hot & Cold Water Service	Rainwater Pipework
Size	All	All	All	All	All	All	All
Insulation Ref.	A	A	A	A	A	A	A
Vapour Barrier	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1
Cladding Ref.	C1	C1	C1	C1	C1	C1	C1
SERVICE RISERS							
Service	Chilled Water	Heating Water	Condenser Circuit	Refrigerant Lines	Condensate Drainage	Hot & Cold Water Service	Rainwater Pipework
Size	All	All	All	All	All	All	All
Insulation Ref.	A	A	A	A	A	A	A
Vapour Barrier	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1
Cladding Ref.	C1	C1	C1	C1	C1	C1	C1
SCHEDULE OF INSULATION				SCHEDULE NO. C.10			

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

PLANTROOM LOCATIONS							
Service	Chilled Water	Heating Water	Condenser Circuit	Refrigerant Lines	Condensate Drainage	Hot & Cold Water Service	Rainwater Pipework
Size	All	All	All	All	All	All	All
Insulation Ref.	A	A	A	A	A	A	A
Vapour Barrier	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1	Vap 1
Cladding Ref.	C1	C1	C1	C1	C1	C1	C1

PIPEWORK EXTERNAL TO THE BUILDING CONCEALED LOCATIONS							
Service	Chilled Water	Heating Water	Condenser Circuit	Refrigerant Lines	Condensate Drainage	Hot & Cold Water Service	Rainwater Pipework
Size	All	All	All	All	All	All	All
Insulation Ref.	A	A	A	A	A	A*	A
Vapour Barrier	Vap 3	Vap 3	Vap 3	Vap 3	Vap 3	Vap 3	Vap 3

EXPOSED LOCATIONS							
Service	Chilled Water	Heating Water	Condenser Circuit	Refrigerant Lines	Condensate Drainage	Hot & Cold Water Service	Rainwater Pipework
Size	All	All	All	All	All	All	All
Insulation Ref.	A	A	A	A	A	A*	A
Vapour Barrier	Vap 3	Vap 3	Vap 3	Vap 3	Vap 3	Vap 3	Vap 3
Cladding Ref.	C1	C1	C1	C1	C1	C1	C1

* PIPEWORK ARE TRACE HEATED WHERE IT PASSES THROUGH UNHEATED AREAS AND EXTERNAL TO BUILDING. ALL TRACE HEATED PIPEWORK INSULATION THICKNESS IS 50 MM MINIMUM

SCHEDULE OF INSULATION

SCHEDULE NO. C.10

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

DUCTWORK WITHIN THE BUILDING				
CONCEALED LOCATIONS				
Service	Supply Air	Return Air	Re Circulation Air	Exhaust Air *
Size	All	All	All	All
Insulation Reference	C	C	C	C
Vapour Barrier	Vap 1	Vap 1	Vap 1	Vap 1
Cladding Reference	C4	C4	C4	C4

EXPOSED LOCATIONS				
Service	Supply Air	Return Air	Re Circulation Air	Exhaust Air *
Size	All	All	All	All
Insulation Ref.	C	C	C	C
Vapour Barrier	Vap 1	Vap 1	Vap 1	Vap 1
Cladding Reference	C1	C1	C1	C1

EXPOSED LOCATIONS				
Service	Supply Air	Return Air	Re Circulation Air	Exhaust Air *
Size	All	All	All	All
Insulation Ref.	C	C	C	C
Vapour Barrier	Vap 1	Vap 1	Vap 1	Vap 1
Reinforcement Reference	C4	C4	C4	C4
* ONLY EXHAUST DUCTS TO HEAT RECOVERY DEVICES				
SCHEDULE OF INSULATION			SCHEDULE NO. C.10	

PLANTROOM LOCATIONS				
Service	Supply Air	Return Air	Re Circulation Air	Exhaust Air *
Size	All	All	All	All
Insulation Reference	C	C	C	C
Vapour Barrier	Vap 1	Vap 1	Vap 1	Vap 1
Cladding Reference	C1	C1	C1	C1

DUCTWORK EXTERNAL TO BUILDING CONCEALED LOCATIONS				
Service	Supply Air	Return Air	Re Circulation Air	Exhaust Air *
Size	All	All	All	All
Insulation Ref.	C	C	C	C
Vapour Barrier	Vap 3	Vap 3	Vap 3	Vap 3
Reinforcement Reference	C4	C4	C4	C4

EXPOSED LOCATIONS				
Service	Supply Air	Return Air	Re Circulation Air	Exhaust Air *
Size	All	All	All	All
Insulation Ref.	C	C	C	C
Vapour Barrier	Vap 3	Vap 3	Vap 3	Vap 3
Cladding Reference	C1	C1	C1	C1
* ONLY EXHAUST DUCTS TO HEAT RECOVERY DEVICES				
SCHEDULE OF INSULATION		SCHEDULE NO. C.10		

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Ref. No.	Location	No. off	Duct Size	Noise Criteria Adjacent Area
AT01	West core Office Extract	7	850 x 250	38
AT02	East core Office Extract	7	450 x 250	38
AT03	East core Office Extract	7	450 x 250	38
AT04	West core Office Supply	6	450 x 300	38
AT05	West core Office Supply	6	300 x 300	38
AT06	East core Office Supply	6	450 x 300	38
AT07	East core Office Supply	6	300 x 200	38
AT08	East Ground Supply	6	850 x 250	38
AT09	West Ground Supply	1	850 x 250	38
AT10	Ground Supply Cross Talk	1	200 dia	40
AT11	Toilet Extract Cross Talk	14	200 dia	40
AT12	Staff Basement Exhaust	14	300 dia	38
AT13	Staff/Workshop Basement Supply	2	150 dia	38
AT14	Staff Basement Toilet Extract	3	250 dia	38
AT15	BMS Supply	2	100 dia	
AT16	Car Park Exhaust	1	1000 dia	
AT17	Basement Exhaust	2	800 x 600	
AT18	Pressure Relief	4	900 x 700	
AT19	Pressure Relief	1	900 x 700	
<u>Notes</u>				
Attenuators are supplied by Waterloo Air Management				
SCHEDULE OF ATTENUATORS			SCHEDULE NO. C.11	

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

D&S Ref. No.	Area Served	Fire Rating	Nominal Size mm
SD15	BASEMENT	2 Hour	300 x 300
SD16	BASEMENT	2 Hour	300 x 300
SD17	BASEMENT	2 Hour	300 x 300
SD18	CAR PARK	2 Hour	200Φ Spiral
SD19	CAR PARK	2 Hour	315Φ Spiral
SD20	BASEMENT	2 Hour	400 x 200
SD21	BASEMENT	2 Hour	300 x 200
SD22	BASEMENT	2 Hour	500 x 500
SD23	BASEMENT	2 Hour	400 x 200
SD24	BASEMENT	2 Hour	1000 x 800
SD25	LOWER GROUND	2 Hour	800 x 250
SD26	LOWER GROUND	DW 142	400 x 200
SD27	LOWER GROUND	DW 142	600 x 200
SD28	GROUND	2 Hour	800 x 250
SD29	GROUND	DW 142	800 x 250
SD30	1st FLOOR	2 HOUR	800 x 250
SD31	1st FLOOR	DW 142	400 x 200
SD32	1st FLOOR	DW 142	400 x 250
SD33	2nd FLOOR	2 HOUR	800 x 250
SD34	2nd FLOOR	DW 142	400 x 200
SD35	2nd FLOOR	DW 142	500 x 250
SD36	3rd FLOOR	2 HOUR	800 x 250
SD37	3rd FLOOR	DW 142	400 x 200
SD38	3rd FLOOR	DW 142	500 x 250
SD39	4th FLOOR	2 HOUR	800 x 250
SD40	4th FLOOR	DW 142	400 x 200
SD41	4th FLOOR	DW 142	500 x 250
SD42	5th FLOOR	2 HOUR	600 x 200
SD43	5th FLOOR	DW 142	200 x 200
SD44	5th FLOOR	DW 142	400 x 200
SD45	5th FLOOR	2 HOUR	800 x 250
SD46	LOWER GROUND	DW 142	400 x 200
SCHEDULE OF FIRE DAMPERS		SCHEDULE NO. C.12	

D&S Ref. No.	Area Served	Fire Rating	Nominal Size mm
SD47	LOWER GROUND	DW 142	400 x 200
SD48	LOWER GROUND	DW 142	400 x 250
SD49	GROUND	2 HOUR	800 x 250
SD50	GROUND	2 HOUR	800 x 250
SD51	GROUND	DW 142	800 x 250
SD52	GROUND	DW 142	800 x 250
SD53	GROUND	DW 142	800 x 250
SD54	GROUND	DW 142	800 x 250
SD55	GROUND	2 HOUR	800 x 250
SD56	1st FLOOR	DW 142	400 x 200
SD57	1st FLOOR	DW 142	400 x 200
SD58	1st FLOOR	DW 142	600 x 250
SD59	1st FLOOR	2 HOUR	800 x 250
SD60	2nd FLOOR	DW 142	400 x 200
SD61	2nd FLOOR	DW 142	400 x 200
SD62	2nd FLOOR	DW 142	500 x 250
SD63	3rd FLOOR	2 HOUR	800 x 250
SD64	3rd FLOOR	DW 142	400 x 200
SD65	3rd FLOOR	DW 142	400 x 200
SD66	3rd FLOOR	DW 142	500 x 250
SD67	4th FLOOR	2 HOUR	800 x 250
SD68	4th FLOOR	DW 142	400 x 200
SD69	4th FLOOR	DW 142	400 x 200
SD70	4th FLOOR	DW 142	500 x 250
SD71	4th FLOOR	2 HOUR	600 x 200
SD72	5th FLOOR	DW 142	200 x 150
SD73	5th FLOOR	DW 142	200 x 150
SD74	5th FLOOR	DW 142	600 x 200
Notes:			
1. Dampers are type WSD-S supplied by Waterloo Air Management			
2. End switches are provided at both ends of travel			
3. Dampers are c/w with actuators			
SCHEDULE OF SMOKE DAMPERS		SCHEDULE NO. C.12	

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Ref.		SG01	SG02	SG03	SG04	SG05	SG06
Make		Waterloo	Waterloo	Waterloo	Waterloo	Waterloo	Waterloo
Location		Office Floors FCU's	Core Lobbies Toilets	Core Lobbies Toilets	Stair 1 &2 Pressure	Stair 1 &2 Pressure	Mail Room WC Lobby
No. of Grilles	-	726	14	21	8	20	2
Air Volume	l/s	50 - 73	89	25	565/532	1820	160/190
Plenum Box	-	Yes	Yes	No	No	No	No
OBD	-	Yes	Yes	No	No	No	No
Face Size	mm	-	150 x 150	150 x 150	600 x 600	1200 x 650	350 x 350
Spigot Size	mm	200 dia	100 dia	100 dia	600 x 400	800 x 650	250 x 150
Type							

Ref.		SG07	SG08	SG09			
Make		Waterloo	Waterloo	Waterloo			
Location		Staff/Lockers Workshop Basement	BMS/Security	Entrance			
No. of Grilles	-	3	1	6			
Air Volume	l/s	80/100	50	50			
Plenum Box	-	Yes	Yes	Yes			
OBD	-	Yes	Yes	Yes			
Face Size	mm	200 x 200	150 x 150	1000 x 250			
Spigot Size	mm	150 x 150	100 dia	200 dia			
Type							

Notes

1. Integral Plenum boxes to each supply diffusers are provided as shown on the drawings
2. Grilles are polyester powder coated in a RAL finish

SCHEDULE OF SUPPLY GRILLES

SCHEDULE NO. C.13

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Ref.		EG01	EG02	EG03	EG04	EG05	EG06
Make		Waterloo	Waterloo	Waterloo	Waterloo	Waterloo	Waterloo
Location		Office FCU's	Office Toilet	Car Park	Mail Room	Lockers Staff Refuse	Entrance
No. of Grilles	-	743	64	28	1	5	2
Air Volume	l/s	37 - 43	20 - 35	310	160 - 90	80	40
Plenum Box	-	No	Yes	No	Yes	Yes	No
Face Size	mm	-	150 x 150	350 x 300	350 x 350	300 x 300	1200 x 200
Spigot Connection	mm	-	100 dia	-	250 x 150	150 x 150	-
Type							
Note Grilles are polyester powder coated in a RAL finish							
SCHEDULE OF EXTRACT GRILLES				SCHEDULE NO. C.13			

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Tank Ref.	WT1	WT2	WT3	WT4
Make	Aquatank	Aquatank	Braithwaite	Sarena Plastics Ltd
Model				SC350
Service	Domestic Water	Drinking Water	Sprinkler Storage	Irrigation Storage
Location	Basement Tank Room	Basement Tank Room	Basement Tank Room	7th Floor Plantroom
Capacity Litre	34300	2800	95000	1250
Dimensions (mm)				
Length	3500	1500	7000	1520
Width	3500	1500	4500	
Height	3000	1500	3500	910
Construction	Sectional	Sectional	Sectional	Sectional
Material	GRP	GRP	Galvanised Steel	GRP
Inlet mm	76	76	100	15
Outlet mm	108	76		28
Screened Over Flow (mm)	150	150	150	28
Warning pipe mm	28	28	28	
Vent pipe mm	100	100	100	
Drain outlet mm	65	54	65	28
Accessories				
Pump Switch	Start/Stop	Start/Stop	Start/Stop	Stop
Low Level Alarm	Yes	Yes	Yes	Yes
Mid Level Alarm	"	"	"	
High Level Alarm	"	"	"	
BMS Link	"	"	"	
Pump Panel Link	"	"	"	
Ball Valve Housing	"	"	"	
Internal Ladder	"	"	"	
Sealed Lid	Heavy Duty	Heavy Duty	Heavy Duty	Light Duty
Access Hatch	Yes	Yes	Yes	
Internal Division	"	"	"	
Contents Gauge	"	"	"	
Insulation	Factory	Factory	Site	Factory
SCHEDULE OF WATER TANKS		SCHEDULE NO. C. 14		

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Booster Ref.	DWP1			
Make	Holden & Brooke			
Model	RV18.5 HPB 3J			
Service	Domestic Water			
Location	Basement Tank Room			
Performance Data			Electrical Data	
Duty Flow	I/s	2.27	Supply V/Ph/Hz	415/3/50
Duty Head	kPa	588	Load Main/Jockey kW	5.5/1.5
Jockey Pump	I/s	0.72	Current A	
			FLC Main/Jockey	12.5/3.9
			SC Main/Jockey	87/32
				DOL
Lead Pump	I/s	3.63		
Lag Pump	I/s	3.63		
Standby Pump	I/s	363		
Suction Head	kPa			
Pressure Vessel				
Capacity	L	60		
Set Test Pressure	kPa			
Closed Head Valve				
Pressure	kPa	690		
Construction Data/Pumps			Control Panel Details	
Casting Material			Normal housing	1P54
Shaft Material			Start/Stop Buttons	Yes
Impeller Material		Stainless Steel	Individual Pump Run Lights	"
Suction Header (Ø)	mm	108	Individual Pump Trip	"
			Lights	"
Delivery Header (Ø)	mm	108	Supply On Lights	"
Pressure Vessel			Minimum Run Timers	"
Shell Material			Hand Auto/On/Off Switch	"
Diaphragm Material	WRC Approved		Volt Free 'Fault' Contact	"
Accessories				
Pump Isolating	Yes			
Valve	"			
Pump Strainer	"			
Test Point	"			
Pressure Gauge	"			
SCHEDULE OF BOOSTER SETS			SCHEDULE NO. C.15	

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Booster Ref.	DWP2			
Make	Holden & Brooke			
Model	RVP18.5 HPB 3J			
Service	Drinking Water			
Location	Basement Tank Room			
Performance Data			Electrical Data	
Duty Flow	I/s	4.99	Supply V/Ph/Hz	415/3/50
Duty Head	kPa	488	Load Main kW	4
Jockey Pump	I/s	Min.	Current A	
			FLC Main	7.7
			SC Main	46.2 DOL
Lead Pump	I/s	2.3		
Lag Pump	I/s	2.3		
Standby Pump	I/s	2.3		
Suction Head	kPa	685		
Pressure Vessel				
Capacity	L	24		
Set Test Pressure	kPa	1085		
Closed Head Valve				
Pressure	kPa	690		
Construction Data			Control Panel Data	
Casting Material			Normal housing	IP54
Shaft Material		Stainless Steel	Start/Stop Buttons	Yes
Impeller Material		Stainless Steel		
Suction Header (Ø)	mm	76	Individual Pump Trip	"
			Lights	
Delivery Header (Ø)	mm	76	Supply On Lights	"
Pressure Vessel			Minimum Run Timers	"
Shell Material			Hand Auto/On/Off Switch	"
Diaphragm Material	WRC		Volt Free 'Fault' Contact	"
	Approved			
Accessories				
Pump Isolating	Yes			
Valve				
Pump Strainer	"			
Test Point	"			
Pressure Gauge	"			
SCHEDULE OF BOOSTER SETS			SCHEDULE NO. C.15	

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Booster Ref.	DWP3	
Make	Stuart Turner	
Model	Boostamatic 40/60	
Service	Irrigation Water (for Flats)	
Location	7th Plantroom	
Performance Data		
Duty Flow	l/s	0.35
Duty Head	kPa	150
Suction Head	kPa	
Pressure Vessel	L	
Capacity		
Test Pressure	kPa	225
Construction Data		
Suction Header (Ø)	mm	25
Delivery Header (Ø)	mm	25
Electrical Data		
Supply V/Ph/Hz	415/3/50	
Set Load	1.1	
SCHEDULE OF BOOSTER SETS		SCHEDULE NO. C.15

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Booster Ref.	FP1			
Make	Armstrong			
Model	AMFB 8/8			
Service	Hose Reel			
Location	Basement			
Performance Data			Electrical Data	
Duty Flow	I/s	2.3	Supply V/Ph/Hz	415/3/50
Duty Head	kPa	685	Load Main/Jockey kW/.....
Jockey Pump	I/s	.....	Current A	
			FLC Main/Jockey/.....
			SC Main/Jockey/.....
Lead Pump	I/s	.....	
Lag Pump	I/s	.....	
Standby Pump	I/s	.....	
Suction Head	kPa	.....	
Pressure Vessel				
Capacity	L	.....	
Set Test Pressure				
Closed Head Valve				
Pressure	kPa	.....	
Construction Data (Pumps)			Control Panel Data	
Casting Material	MECH.	304 SS	Normal housing	1P54
Shaft Material		Stainless Steel	Start/Stop Buttons	Yes
Impeller Material		316 SS	Individual Pump Run	"
Seal Type			Lights	"
			Individual Pump Stop	
			Lights	
Suction Header (Ø)	mm	50	Individual Pump Trip	"
			Lights	
Delivery Header (Ø)	mm	50	Supply On Lights	"
Pressure Vessel			Minimum Run Timers	"
Shell Material			Hand Auto/On/Off Switch	"
Diaphragm Material	WRC Approved		Volt Free 'Fault' Contact	"
Accessories			Dimensional Data	
Pump Isolating Valve	Yes		Overall Length of Skid	1854
Pump Strainer	"		Overall Width of Skid	1244
Test Point	"		Overall Height of Skid	2400
Pressure Gauge	"			
SCHEDULE OF BOOSTER SETS			SCHEDULE NO. C.15	

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Ref.	MWC1		MWC2
Make	Liff Industries Ltd		Liff Industries Ltd
Model	R300N (Rotomag)		Powermag P300
Works Ref.	S192		S192
Service	Domestic Water		Drinking Water
Location	Basement Tank Room		Basement Tank Room
Performance Data			
Duty Flow	l/s	7.27	4.99
Duty Pressure	kPa	588	588
Max. Working Pressure	kPa	1150	1150
Max. temperature (Water)	°C	15	15
Max. Temperature (Ambient)	°C	35	35
Test Pressure	kPa	1725	1725
Inlet Ø	mm	108	76
Outlet Ø	mm	108	76
Electrical Data			
Electrical Supply	415/3/50		
Power Source	Local		
Dimensional Data			
Length	mm	330	
Diameter	mm	415	
SCHEDULE OF WATER CONDITIONERS		SCHEDULE NO. C.16	

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Ref.	HWT1 and HWT2			
Make	IMI Rycroft Ltd			
Service	Hot Water			
Works Ref.	99235			
Location	Basement Plantroom			
Performance Data			Construction Data	
Storage Capacity	Litre	150 0	Shell Material	Copper
Entering Fluid Temp.	°C	5	Shell Finish	Metal Clad
Leaving Fluid Temp.	°C	60	Tub Material	Copper mm
Max. Operating Temp.	°C	65	Shell Connection Size Ømm	75
Max. Operating Pressure	kPa	115 0	Tube Connection Type	PN16
Test Pressure	kPa	172 5	Tube Connection Size Ømm	50
			Drain Connection Size Ømm	50
Tube Side			Dimension Data	
Heater Transfer Fluid	Water		Overall Width mm	1050
Recovery Rate	kW	48	Overall Height mm	1950
Entering Fluid Temp.	°C	82		
Leaving Fluid Temp.	°C	71		
Max. Operating Temp.	°C	95		
Max. Operating Pressure	kPa	6 Bar		
Tube Side Pressure Drop	kPa	<20		
Test Pressure	kPa	10		
Accessories				
Lifting Lugs	Yes			
Safety Valve	"			
Shell Drain Cook	"			
Bursting Disk	"			
Shell Side Pressere Gauge	"			
Sockets for Control Sensors	"			
Pre Insulated	"			
Metallic Outer Casing	"			
Expansion Vessel	"			
Anti-Stratification Pump	"			
SCHEDULE OF CALORIFIERS			SCHEDULE NO. C.17	

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Ref.	FWMH3		FWMH4	
Make	Grundfos		Grundfos	
Model	AP100. 100.32 EX		APG50.09.A3	
Service	Foul Water		Foul Water	
Location	Basement		Basement	
Pump Set Type	Submersible		Submersible	
No. Off Pumps	2		2	
Pump Operation	Duty /Assist		Duty /Assist	
Duty Flow Pump	l/s	8.3		2
Duty Head Pump	m	10		10
Pump Speed	rpm	1450		2900
Construction Data				
Casting Material	Cast Iron		Cast Iron	
Shaft Material	Chromium Steel		Chromium Steel	
Impeller Material	Cast Iron		Cast Iron	
Seal Type				
Discharge Pipe Dia.	mm	100	mm	R2
Explosion Proof	Yes		Yes	
Accessories				
Normal Housing (IP52)	Yes		Yes	
Start/Stop Buttons	"		"	
Individual Pump Run Light	"		"	
Individual Pump Stop Light	"		"	
Individual Pump Trip Light	"		"	
Supply On Light	"		"	
Minimum Run Times	"		"	
Hand Auto/On/Off Switch	"		"	
Volt Free 'Fult' Contact	"		"	
Pump Isolating Valve	"		"	
Isolator	"		"	
Non Return Valves	"		"	
Electrical Data				
Supply V/Ph/Hz	415/3/50		415/3/50	
Power kW	4/3.2			
Sump Champer Size				
Sump Size	mm	1500 x 1500	mm	1500 x 1500
Sump Depth	mm	3040	mm	1680
Cover Size	mm	900 x 900	mm	900 x 900
SCHEDULE OF SUMP PUMPS		SCHEDULE NO. C.18		

Ref.	LPMW1	
Make	Grundfos	
Model	AP70.80 13.3EX	
Service	Lift Well Sump	
Location	Basement	
Pump Set Type	Submersible	
No. Off Pumps	2	
Pump Operation	Duty /Assist	
Duty Flow Pump	l/s	2
Duty Head Pump	m	12
Pump Speed	rpm	1450
Construction Data		
Casting Material	Cast Iron	
Shaft Material	Chromium Steel	
Impeller Material	Cast Iron	
Seal Type		
Discharg Pipe Dia.	mm	80
Explosion Proof	Yes	
Accessories		
Normal Housing (IP52)	Yes	
Start/Stop Buttons	"	
Individual Pump Run Light	"	
Individual Pump Stop Light	"	
Individual Pump Trip Light	"	
Supply On Light	"	
Minimum Run Times	"	
Hand Auto/On/Off Switch	"	
Volt Free 'Fult' Contact	"	
Pump Isolating Valve	"	
Isolator	"	
Non Return Valves	"	
Electrical Data		
Supply V/Ph/Hz	415/3/50	
Power kW	1.7/1.3	
Sump Champer Size		
Sump Size	mm	1500 x 1500
Sump Depth	mm	4060
Cover Size	mm	900 x 900
SCHEDULE OF SUMP PUMPS		SCHEDULE NO. C.18

Building Services Operating and Maintenance Instructions
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Ref.	SWMH 1, SWMH 2, SWMH 3	
Make	Grundfos	
Model	AP10.65 21.A3	
Service	Surface Water	
Location	Basement	
Pump Set Type	Submersible	
No. Off Pumps	3 No. Duplicate	
Pump Operation	Duty / Assist	
Duty Flow Pump	l/s	7
Duty Head Pump	m	8
Pump Speed	rpm	2800
Construction Data		
Casting Material	Cast Iron	
Shaft Material	Chromium Steel	
Impeller Material	Cast Iron	
Seal Type		
Discharg Pipe Dia.	mm	65
Explosion Proof	No	
Accessories		
Normal Housing (IP52)	Yes	
Start/Stop Buttons	"	
Individual Pump Run Light	"	
Individual Pump Stop Light	"	
Individual Pump Trip Light	"	
Supply On Light	"	
Minimum Run Times	"	
Hand Auto/On/Off Switch	"	
Volt Free 'Fult' Contact	"	
Pump Isolating Valve	"	
Isolator	"	
Non Return Valves	"	
Electrical Data		
Supply V/Ph/Hz	415/3/50	
Power kW	2.5/2.10	
Sump Champer Size		
Sump Size	mm	1800 x 1800
Sump Depth	mm	1800
Cover Size	mm	900 x 900
SCHEDULE OF SUMP PUMPS		SCHEDULE NO. C.18

Ref	CC01	
Make	Daikin	
Model		
Indoor Unit	FTY60G	
Outdoor Unit	RY60	
System	BMS/Security Room	
Total Cooling Duty	kW	5.2
Heating Duty	kW	5.8
Maximum Air Volume	m ³ /s	0.2
Filtration Efficiency		EU4
No. of Speed		3
Electrical Supply	V/Ph/Hz	240/1/50
Power Consumption	kW	2.2
Notes 1. The unit is provided by Set Point. 2. Speed control and thermostatic control are provided locally in the Security Room. 3. Volt free contact is provided with a status link to the BMS. 4. Dirty filter alarm and water leak detector are provided.		
SCHEDULE OF A/C SPLIT UNITS		SCHEDULE NO. C.19

D

D. 0 GENERAL OPERATING INSTRUCTIONS

These are general instructions applicable to the plant elements. The specific instructions follow in Clause D.2

D.0.1 GENERAL NOTES

D.0.1.1 GENERAL

1. These notes are of a general nature and present likely causes of some plant fault conditions with the actions which may succeed in correcting them. These recommendations in no way supersede the manufacturers' instructions which take precedence in all matters concerning their equipment.
2. The plants and systems have been handed over correctly tested, commissioned and proved to be working according to the designers' and makers' intentions.
3. Where the work recommended is outside the experience and training of the operating staff, specialist help should be sought from the equipment manufacturer, from the regular maintenance staff or from a specialist maintenance contractor.
4. The safety instructions and recommendations contained in this manual and in the manufacturers instructions must be strictly adhered to.
5. During remedial work on any equipment, suitable warning notices must be attached to the equipment and to its electrical controls.
6. If a motor is removed and not replaced immediately, ensure that the motor isolators are locked open, the fuses are withdrawn and the cable ends are left adequately insulated until the motor is replaced.
7. Some faults listed in the tables will be first indicated by an alarm on a local and/or a central control panel. For details of the alarms see the technical description of the plant concerned, and also that of the control or monitoring system.

8. SHUT DOWN PROCEDURES

NOTE

Before proceeding note that, except in emergency, no plant should be shut down without the relevant management authority being informed, as this will have an effect on the environmental conditions within the buildings.

To shut down individual items of plant, proceed as follows:-

- a. The selector switches on the relevant control panel should be switched to the off position.
- b. Panel isolators can be left on unless shut down is to be prolonged.
- c. If plant is switched off so that it can be worked on all isolators and stop locks should be switched "off".
- d. Before shutting down any plant (except in emergency), ensure that:
 1. The effect of this shutdown on any interlocked plant is fully understood and is acceptable. See technical description of the plant concerned.
 2. Those who are monitoring central or local alarms which may be actuated by this shutdown have been informed.
9. Ensure that standby plant, where installed, is operating correctly if a fault has occurred on the duty plant
10. Allow one motor to attain normal running speed before starting another motor controlled from the same panel.
11. Many apparent mechanical equipment failures are, in fact, failures of associated electrical equipment. Before work is started on any electrical equipment, the equipment must be disconnected from the supply by opening the isolator and withdrawing the fuses. Any work requiring technical knowledge or experience must be undertaken only by competent and authorised persons working in accordance with the correct safety procedures and with the Permit to Work system in force on the site.

8. SHUT DOWN PROCEDURES (Cont'd)

12. Remember that bearing wear and failure may be a symptom of other problems such as:
 - under or over lubrication
 - dirty lubricant
 - misaligned plant drive
 - unbalanced rotor
 - drive belts too tight
 - motor overload
 - vibration of the motor base by other plant
13. After an overload trip, blown fuse or fault within a control panel, before re-energising the panel inspect for evidence of overheating and damage to insulation, contacts and fuse carriers; renew parts, clean and repaint as necessary. Renew all phase fuses in that section of the panel where the fault has occurred, when satisfied that the plant is in sound working order. If a panel main fuse has blown, renew the main panel fuses on all phases when the fault has been rectified.
14. When lubrication is required, do not over pack grease into the bearings. Follow makers' instructions. If high pressure is needed to force in the grease, clean out the bearing housing with white spirit and refill with grease as makers' instructions. Remember that far more breakdowns are caused by over than by under lubrication.
15. All machines, particularly standby plant and motors, must be rotated at least once a week to keep the bearings in good condition and prevent seizure.

D.0.1.2 Emergency Procedure

To shut down the various systems and equipment in an emergency, carry out the following instructions and call in specialist help if required. In clause D.2 procedures particular to each plant item is detailed, when relevant.

It is good practice that personnel operating, or involved with the running of the installation make themselves aware of the location of shut off points as speed of action will minimise property destruction and save lives.

1. Appliances or sub-circuits may be shut down by closing the wheel valve fitted to the flow pipe. Do not alter the position of regulating valves, unless necessary, as this may alter the system balance.

2. To close down the entire system, switch off each component at the panel control switches or operate the "panic" stopcock (if fitted), before switching off the control panel at the main isolator.

D.1 GENERAL OPERATING INSTRUCTIONS

The followings are general operating procedures itemised per plant items. The specific Operating Procedures for the relevant plant items are laid down in Clause D.2

D.1.1 LTHW PLANT

D.1.1.1 BOILERS

a STARTING/COMMISSIONING

- Ensure that fuel lines are fully purged and that fuel is available at the burner at the correct pressure and temperature.
- If the boiler has not been run for some time, or if a fuel supply pipe has been disconnected, purge the piping via the bleed nipple up stream of the burner to ensure that a gas/air mixture is avoided.

NOTE: A gas air mixture is dangerous as it will explode if subjected to a spark.

- Ensure fuel supply valves are open.
- Check all switches, e.g. time switch, and thermostats are in the 'calling' for heat condition.
- Switch ON electrical supply
- The burner control box should now monitor the burner through its prescribed sequence to reach 'main flame on'.

b.. OPERATION

- The operation of the boilers is controlled by the BMS control panel and the boilers own control panel and control and safety thermostats to maintain the LPHW flow at the set temperature.
- A sequence-control box automatically governs the firing sequence of pre-purge, ignition, pilot or reduced start, and provides for safety lock-out in the event of flame failure or other unsafe condition. This control box contains visible indication of lock out and a manual-reset button for use in the event of flame failure.

D.1.1.1 BOILER OPERATION (Cont'd)

- The control thermostat allows adjustment of the boiler flow temperature.
- A safety-limit thermostat comes into operation should the control thermostat fail to shut the burner down. The limit stat is usually set at 5°C or more above the control thermostat's maximum setting. No automatic control may be interfered with by the boiler attendant but must be adjusted only by a qualified Service Engineer.

C. STOPPING

1) For short periods

- Switch off the Burner control switch.
- close the ball valve on the gas supply.
- Switch of the main electrical supply if all the plant is to be put out of service.

2) For long periods

- Switch off the control switch as above
- Turn the gas supply off at the gas isolation valve in the supply pipework to the boiler.
- Switch the power supply at the local isolator off.
- Shut all valves off.

d. EMERGENCY STOPPING

- Closing the gas shut off valve at the entrance to the Plant room will cause the gas supply to stop. The instruction laid down in section 1 should be followed.
- If access to the Plant room is dangerous, the main gas valve should be shut.

e. FAULT FINDING

Follow procedures detailed in the boiler and burner literature.

D.1.1.2 PUMPS

The pumps are generally controlled and monitored from the BMS control panels.

The pumps are usually in Duty/Standby configuration and the standby pump will cut automatically in upon the duty pump's failure with indication given on the relevant Control panel.

Time based rescheduling of the duty/standby set up is usually automatically carried out at the BMS.

D.1.1.3 PRESSURISATION UNITS

The expanded volume of water is stored in the main expansion vessel when the system is at operating temperature. When the system returns to ambient temperature, water is forced back into the system by means of the compressed gas cushion.

The unit will only operate if the pressure in the main vessel falls below the system fill pressure to the pump cut in pressure. The unit will then start and, provided that there is no excessive leak in the system, maintain the required pressure. Below a pre-set pressure the standby pump will also cut in. The small vessel monitors the pressure overall and raises alarms on high and low pressure.

Frequent starting and stopping of the pump is indicative of excessive leak that should be investigated and rectified.

An intermediate vessel, connected between the boilers and the PU, cushions the PU against extremely hot water temperatures.

If substantial or complete refilling of the system is required the quick fill hose unions provided should be used for refilling directly from mains. The Pressurisation Units should not be used for this purpose

D.1.2 CHW PLANT

D.1.2.1 CHILLERS

The Chilled Water plant is usually demanded to run to the dictate of the BMS Control Panel . A general chiller fault alarm is shown on this panel for all chiller alarms.

A. Chiller Start Up

For chiller start up and running the following procedure should be followed:

1. Check that chillers are available for operation
2. Drain valves should be shut.
3. System isolating valves should be open.
4. Chilled water users flow and return isolating valves should be open.
5. Check that cold water supply is available to the automatic fill/pressurisation unit and check that the unit and associated pressure vessel are prepared for operation in accordance with the manufacturer's instructions.
6. Start the fill/pressurisation unit and check that the unit operates correctly to fill and pressurise the chilled water system.
7. Check that chilled water circulating pump suction and delivery isolating valves are open, that pumps are primed and vented and that pump impellers are free to rotate.
8. Select and start the duty chilled water pump.
9. Check pump delivery pressures.
10. Bring the chiller to operation in accordance with manufacturer's instructions.

b. Emergency stop

- An Emergency Switch/button is normally provided in the front panel of the chiller controller
- To restart after Emergency Stopping follow procedure outlined in manufacturer's literature.

D.1.2.1 CHILLERS (Cont'd)

c. Shut Down

- Follow manufacturer's instructions to bring the system to Off
- The electrical supply should normally be left alive so that the crankcase heater and the evaporator heater will stay operational.

d. Fault Finding

- Follow Fault Finding Procedure laid down in manufacturer's Manuals.

When the system is started up the water contracts as it cools and the Unit will pass water from the tank via the pump to bring the pressure to the ambient temperature setting pressure. When the chiller is switched off the expanding water will pass into the expansion vessel.

D.1.2.2 PUMPS

See D.1.1.2

D.1.2.3 PRESSURISATION UNITS

1. The highest system pressure will occur when the system is at ambient temperature.
2. If the system pressure falls due to a slow leak, water in the expansion vessel will run back to the system. If the system leakage continues causing drop in pressure below the system pressure, the pump will start to restore the initial system pressure.
3. In the event of a leak exceeding the pump capacity, visual and audible alarm will be raised within the set and the BMS, and the plan will shut down.

The system should then be closed down and the leak rectified.

If substantial or complete refilling of the system is required the quick fill hose unions provided should be used for refilling directly from mains.

The Pressurisation Units should not be used for this purpose

D.1.3.1 AIR HANDLING UNITS

a. Starting and Stopping

1. Check that all inlet and outlet grilles and louvres are free from obstruction.
2. Check that all air filters are clean and serviceable.
3. Check that flow and return isolation valves are open at cooler and heater batteries.
4. Locally isolate fan motor before manually rotating fans, where possible, to check that they run freely.
5. Check that all pre-set system balance dampers are in their correct pre-set positions.
6. Check that all fire dampers are open and that operation is unobstructed.
7. Return local isolator to on and start the fan and check that it is running smoothly.
8. Check pressure drop across the filters.
9. Allow system to stabilise and check that environmental conditions are satisfactory.

D.1.3.2 FAN COIL UNITS

1. The units operate on a draw through principle, with the fan providing the supply air across the cooling coil.
2. The return air sensors, in the water side controlled units, modulate the control valves in the cooling/heating coil, and the face/by-pass dampers in the air side controlled units, to maintain the temperature set point.
4. Fan speeds can usually be adjusted to 2 - 5 speed settings.
5. Conduct the following checks after two weeks running:-

Motor full load current

Filter condition

Condensate and drains for free flow and leaks

Valve connections for leaks

Operation of controls

D.1.3.4 FIRE DAMPERS

The Fire Damper fusible links, which would shut on fusion of the links, are manually re-settable. The links will normally fuse at 72°C.

D.1.4.3 COLD WATER BOOSTER SETS

1. The initial system demand will be met by the supply in the vessel.
2. When this is exhausted the duty pump will start via its pressure switch.
3. If the demand increases the system pressure will drop and the support pump will start via its pressure switch.
4. When the demand falls the support pump will switch off and the duty pump will replenish the vessel then switch off.
5. The duty and support pumps will run for as long as the demand continues or for a minimum of four minutes under the control of a timer relay.
6. If a pump should fail turn the HAND/OFF/AUTO switch to off and the selector switch should be turned to put failed pump in the standby position.

D.1.4.4 CALORIFIERS

a. Starting

1. Adjust the calorifier thermostat to the required operating temperature.
2. Check that the thermostat is operating correctly
3. Ensure that the primary circuit is established
4. Check that the operating temperature remains constant.

b. Operation

The operation is fully automatic. The only adjustment required is to the thermostat, should the required temperature varies.

D.2 BREAKDOWN AND FAULT PROCEDURES

The following procedures are a guide to assist in tracing malfunctions that may occur within the installation. They are detailed in clause D.3 for each plant element where and if relevant.

Reference should be made to the manufacturers literature that is contained in section H.

D.2.1 ELECTRIC MOTORS : Faults and Remedial Actions

Notes:

Since motors form the cardinal part of almost every plant element (Pumps, fans, boilers etc), their relevant instructions has been detailed in length.

1. The General Notes must be read before this sheet is used.
2. In most cases a motor will fail to operate correctly because of a fault in the associated electrical supply, cabling, or control equipment such as a relay, thermostat or flow switch, rather than because of a fault in the motor itself. Some common faults of this type and some suggested remedial actions are set out in the following table but all checks of electrical equipment must be carried out only by competent and authorised persons in accordance with the correct safety procedures.
3. Where a test or work is required on the motor itself (e.g. changing a bearing) it will often be more appropriate, particularly in the case of a small motor, to replace the motor with a spare and to carry out the test or work in a workshop.

D.2.1 Motor Fault Finding Charts

	Fault indication	Possible cause	Remedial action
1.	Motor not running - switch in 'auto' position.	Interlock or automatic control operated (refer to controls drawings and schedules)	<p>i) Briefly switch to 'manual' position .</p> <p>ii) If motor runs at 'manual' check time control status of interlocked plant or conditions of temperature, etc are correctly calling for motor shut-down.</p> <p>iii) If shutdown is wrong check for fault in controls and interlocks.</p> <p>iv) If motor will not run in 'manual', see below.</p>
2.	Motor will not start at any position of switch	<p>a) Time delay operating</p> <p>b) Isolator open</p> <p>c) Thermal over-load tripped (trip indication should be illuminated; if not; replace lamp unit) .</p> <p>d) Fuse blown.</p>	<p>Nil</p> <p>Check that all isolators & stop locks are closed.</p> <p>i) Press reset button once only, but not if there are signs of severe arcing on contactor.</p> <p>ii) If overload trips again, refer to 6 below.</p> <p>i) Check all power and control circuit fuses.</p>

D.2.1 Motor Fault Finding Charts (Cont'd)

	Fault indication	Possible cause	Remedial action
2 Cont.		<p>e) Wrongly connected or faulty contactor (refer to controls drawings).</p> <p>f) Control circuit fault (refer to control drawings and schedules)</p>	<p>ii) Try to find cause of blown fuse before restarting motor.</p> <p>i) Isolate and check connections.</p> <p>ii) Inspect for dirt, grease and signs of arcing.</p> <p>iii) Clean or replace contactor. Do not oil. Remedy cause of arcing.</p> <p>i) Check control circuit voltage</p> <p>ii) If voltage correct isolate and check connections, cabling, relays, switches etc inside and outside panel. Ensure all terminals are tight.</p>
3.	Coils hum but contactor does not close when motor is switched on	<p>a) Low voltage on coil .</p> <p>b) Wrongly connected or faulty contactor.</p>	<p>Check coil voltage and remedy if low.</p> <p>Refer to 2. e) above.</p>

D.2.1 Motor Fault Finding Charts (Cont'd)

	Fault indication	Possible cause	Remedial action
4.	Motor running but 'run' lamp not illuminated.	a) Failure of bulb or indicating lamp unit. b) Control circuit fault.	Replace lamp or unit. Isolate and check control circuit against drawings.
5.	'Run' lamp illuminated but motor not running.	a) Control circuit fault. b) All-phase break between panel and motor.	Isolate and check control circuit against drawings. Locate and remedy discontinuity.
6.	Thermal overload tripped (Note: replace contactor if damaged by arcing).	a) Overload unit fault. b) Open circuit in one phase (single phasing).	i) Check overload setting is correct . ii) Isolate and check operation of unit i) Check voltage on all phases. If no or low voltage found, isolate motor, locate fault and remedy. ii) If voltage correct, isolate motor and check continuity of windings. iii) If winding faulty replace motor.

D.2.1 Motor Fault Finding Charts (Cont'd)

	Fault indication	Possible cause	Remedial action
6 cont		c) Motor rotation impeded.	iv) Isolate motor and remedy. Check and/or change bearings etc on motor or driven machinery see 7. below.
		d) Winding short-circuit or insulation fault (particularly in damp surroundings).	i) Isolate motor and check winding resistance. If any reading low replace motor. ii) Check winding insulation. If low, dry motor with electric heaters.
		e) Ambient temperatures outside design limits at motor or in control panel .	i) Check ambient temperatures. ii) Ventilate panel and/or motor. iii) Shut down motor until ambient temperature is within design limits
		f) Control circuit fault	Isolate and check control circuit against drawings.

D.2.1 Motor Fault Finding Charts (Cont'd)

	Fault indication	Possible cause	Remedial action
7.	Motor rotation impeded (overload trip or excessive current reading on one or more phases).	a) Physical obstruction to rotation .	i) Inspect motor and remove any internal or external obstructions. ii) Isolate motor, disconnect drive and try to rotate by hand. iii) If rotor fouling stator, replace bearing. See b) below. iv) If bearing seized or failed, refer to b) below. v) If motor when unloaded runs correctly refer to c) below.
		b) Bearing worn, failed or seized.	i) Isolate motor and refer to maker's instructions. ii) Repair or replace shaft if damaged.

D.2.1 Motor Fault Finding Charts (Cont'd)

	Fault indication	Possible cause	Remedial action
7 cont		c) Excessive driven load.	iii) Fit new bearing. iv) Remedy cause of bearing failure. ii) If direct drive, check coupling; realign or replace as necessary. i) Check drive belts re-tension or replace as necessary. Check pulley alignment. iii) Examine driven plant for excessive friction, bearing fault unbalanced rotor or physical obstruction. iv) If tripping persists, reduce driven load or substitute more powerful motor.
8.	Excessive motor hum.	a) Motor rotation impeded. b) Uneven air gap (bearing wear). c) Wrongly connected or faulty contactor.	i) Check current on all phases. ii) If high reading, refer to 7) above. Refer to 7 b) above. Refer to 2 e) above.

D.2.1 Motor Fault Finding Charts (Cont'd)

	Fault indication	Possible cause	Remedial action
8 cont		d) Winding fault. e) Unbalanced rotor	Refer to 6 b) and 6 d) above. Isolate and replace motor, or re-balance rotor, preferably dynamically.
9.	Unusual internal noise	a) Foreign matter in air gap. b) Bearing worn or failed. c) Loose cooling fan blade. d) Drive misaligned. e) Lubricant contaminated. f) Bearing slack in housing. g) Bearing moving on shaft. h) Bearing brinelled.	Isolate motor and remove foreign matter. Refer to 7 b) above. Replace fan impeller. Isolate motor and realign drive. Isolate motor, wash out bearing and housing in white spirit; refill with lubricant as makers' instructions. Isolate motor and fit new end shield. Isolate motor, tighten bearing on shaft or fit bearing with tighter bore. Isolate motor replace bearing and ensure shaft is rotated each week.

D.2.1 Motor Fault Finding Charts (Cont'd)

	Fault indication	Possible cause	Remedial action
10.	Excessive vibration	a) Drive misaligned b) Holding-down bolts loose. c) AV mounting failed or bridged. d) Vibration in drive. e) Unbalanced rotor (particularly following motor repair). f) Bearing worn or failed.	Isolate motor and re-align drive. Tighten bolts. Replace mounting or remove bridge. i) Disconnect drive. ii) Remedy fault in driven plant and reconnect drive. Isolate motor and rebalance rotor, dynamically if possible. Refer to 7 b) above.
11.	Motor overheating	a) Motor overload. b) Insufficient ventilation. c) Ambient temperature outside design limits.	i) Check motor ammeter, if fitted. ii) Refer to 7 above if high amps. i) Clean motor and check no external obstruction to ventilation. ii) Increase ventilation. i) Increase ventilation or ventilate with cooler air.

D.2.1 Motor Fault Finding Charts (Cont'd)

	Fault indication	Possible cause	Remedial action
11 cont		<p>d) Rotor fouling stator.</p> <p>e) Winding fault.</p>	<p>ii) Shut down motor until ambient temperature is within design limits.</p> <p>Isolate motor and replace bearing. Remedy cause of bearing wear.</p> <p>Refer to 6 b) and 6 d) above.</p>
12.	Bearing overheating.	<p>a) Insufficient lubrication.</p> <p>b) Bearing over-lubricated or lubricant contaminated.</p> <p>c) Drive misaligned.</p> <p>d) Bearing worn or failed.</p> <p>e) Drive belts too tight.</p>	<p>i) Lubricate as maker's instructions .</p> <p>ii) If grease is solidified (i.e. high pressure required to lubricate), isolate motor; clean out bearing and housing with white spirit and repack with grease as maker's instructions.</p> <p>Isolate motor; clean out bearing and housing with white spirit and refill with lubricant as maker's instructions.</p> <p>Isolate motor and re-align drive.</p> <p>Refer to 7 b) above.</p> <p>Isolate motor and adjust belt tension.</p>

D.2.1 Motor Fault Finding Charts (Cont'd)

	Fault indication	Possible cause	Remedial action
12 cont		f) Motor over-load.	i) Check motor ammeter if fitted. ii) Refer to 7) above if high amps.
13.	Random intermittent changes in motor speed or other evidence of inadequate performance.	a) Variations in supply voltage or frequency. b) Motor over-load. c) Faulty winding.	i) Consult supply authority on voltage and frequency variations and/or monitor actual variations. ii) Obtain manufacturer's advice on effect of variations on motor. iii) Fit different motor as advised by manufacturer. i) Refer to 7 above. ii) Refer to 6 b) and 6 d) above.
14.	Motor (3 phase) revolves in wrong direction.	Power connections incorrect.	Reverse the connection polarity of the motor.

D.2.2

Air Handling Units General Fault Finding

Note: Some of the faults listed below may be repeated under motors or fans.

	Symptom	Possible Causes	Possible Remedies
1	No Air or insufficient air	<p>a) Fan running</p> <p>b) Grille/Diffuser damper closed</p> <p>c) Volume control dampers closed</p> <p>d) Fire dampers closed</p> <p>e) Control/mixing dampers incorrectly set</p> <p>f) Pressure drop across filter (s) in excess of the maximum</p> <p>g) System restriction due to blockage</p>	<p>Check impeller shaft for rotation Switch fan on, refer to detailed controls information</p> <p>Open damper, check reason for closing</p> <p>Check settings and reset as necessary</p> <p>Remove inspection doors and check damper. Reset as necessary</p> <p>Check setting and operation of damper actuators. Reset as necessary.</p> <p>Replace filters</p> <p>Where possible make a visual inspection with particular attention to:</p> <p style="padding-left: 40px;">Bends Coils Dampers</p> <p>At direction and duct size changes; listen for unusual air noises. Where visual check is not possible, take pressure readings at regular intervals along the suspect ductwork. Sudden increase in pressure difference should indicate location of restriction.</p>

D.2.3

Fans General fault Finding (Cont'd)

	Symptom	Possible Causes	Possible Remedies
4	Excessive vibration	Fan out of balance	Disconnect belt drive and turn Impeller by hand to see if it comes to rest in one position all the time and check condition of vanes. Consult manufacturer on balancing and repairing impeller.
		Anti-vibration mounting worn or broken	Inspect and renew as necessary
		Worn impeller shaft bearings	Check float on shaft both axially and radially. Renew as necessary
		Bent impeller shaft	Check with gauge. Renew as necessary
		Loose holding down bolts	Check with gauge. Renew as necessary
		Motor out of balance	Remove motor and check. Send motor to manufacturer for re-balancing.
5	Excessive noise	Worn bearings (motor or fan)	Check float and end play. Renew as necessary
		Impeller impinging	Disconnect drive belts or other coupling and rotate impeller by hand. Repair as necessary
		Misaligned and/or incorrectly tensioned drive belts.	Check alignment and tension of belts. Adjust as necessary.

D.2.4 Heating Coils General fault Finding Chart

	Symptom	Possible Causes	Possible Remedies
1	Underheating	<p>One or more valve covering coil incorrectly set</p> <p>Automatic control valve malfunctioning</p> <p>Air leak in coil</p> <p>Incorrect control settings</p> <p>Water temperature too low</p> <p>The duty of the pump too low</p>	<p>Check valve settings and pressure drop through coil. Reset as necessary.</p> <p>Check positioning and functioning of actuator</p> <p>Test air vent. Vent coil</p> <p>Check set points at sensors, stats, controllers etc. Reset as necessary, refer to detailed controls information.</p> <p>Check flow and return temperatures</p> <p>Check pump duty</p>
2	Overheating	<p>One or more valve covering coil incorrectly set</p> <p>Automatic control valve malfunctioning</p> <p>Incorrect controls settings</p> <p>Water temperature too high</p> <p>The duty of the pump too high</p>	<p>Check valve settings and pressure drop through coil. Reset as necessary</p> <p>Check positioning and functioning of actuator</p> <p>Check set points at sensors, stats, controllers etc. Reset as necessary, refer to detailed controls information.</p> <p>Check flow and return water temperatures</p> <p>Check pump duty</p>

D.2.5 Cooling Coils General Fault Finding Chart

	Symptom	Possible Causes	Possible Remedies
1	Undercooling	<p>One or more valve covering coil incorrectly set</p> <p>Automatic control valve malfunctioning</p> <p>Air leak in coil</p> <p>Incorrect control settings</p> <p>Water temperature too high</p> <p>The duty of the pump too low</p>	<p>Check valve settings and pressure drop through coil. Reset as necessary.</p> <p>Check positioning and functioning of actuator</p> <p>Test air vent. Vent coil</p> <p>Check set points at sensors, stats, controllers etc. Reset as necessary, refer to detailed controls information.</p> <p>Check flow and return temperatures</p> <p>Check pump duty</p>
2	Overcooling	<p>One or more valve covering coil incorrectly set</p> <p>Automatic control valve malfunctioning</p> <p>Incorrect controls settings</p> <p>Water temperature too high</p> <p>The duty of the pump too high</p>	<p>Check valve settings and pressure drop through coil. Reset as necessary</p> <p>Check positioning and functioning of actuator</p> <p>Check set points at sensors, stats, controllers etc. Reset as necessary, refer to detailed controls information.</p> <p>Check flow and return water temperatures</p> <p>Check pump duty</p>

D.3 NORMAL OPERATION

D.3.0 GENERAL

Under normal operation the building services are controlled and monitoring by remote Building Management System which is fully detailed in the Controls Manual.

The function of the control systems are:-

1. To control plant operating times.
2. To maintain environmental conditions within the buildings.
3. To communicate with the fire systems, details of the fire alarm interface are to be found in the Controls Manual.
4. To monitor environmental conditions and optimise energy utilisation.
5. To indicate equipment failure.
6. To sequence use of run and standby heating/cooling equipment.

SPECIFIC OPERATING INSTRUCTIONS

The Clauses that follow are the particular operating instructions for the plant elements itemised as follows:-

NOTE:

All Manufacturer literature referred to in this section can be found in Volume 1.3 Section H as per the index in the section.

D.3.1.1 BOILERS

a. STARTING/COMMISSIONING

- Follow Hamworthy's instructions for initial starting and/or starting the boilers after a prolonged shut-down
- Ensure that fuel lines are fully purged and that fuel is available at the burner at the correct pressure and temperature.
- If the boiler has not been run for some time, or if a fuel supply pipe has been disconnected, purge the piping via the bleed nipple up stream of the burner to ensure that a gas/air mixture is avoided.

NOTE:

A gas air mixture is dangerous as it will explode if subjected to a spark.

- Ensure fuel supply valves are open.
- Check that all switches, e.g. time switches and thermostats are in the 'Calling for Heat' condition.

Follow Hamworthy's prescribed procedure for initial lighting of the boiler.

b. OPERATION

- The operation of the boilers is controlled by the BMS control panel and the boilers own control and safety thermostats to maintain the LTHW flow at the set temperature.
- Local control should only be used if the BMS system is inoperative or malfunctioning.
- A sequence-control box (mounted on the fascia) automatically governs the firing sequence of pre-purge, ignition, pilot or reduced start, and provides for safety lock-out in the event of flame failure or other unsafe condition. This control box has a visible indication of lock out and a manual-reset button for use in the event of flame failure.

D.2.2

Air Handling Units General Fault Finding (Cont'd)

	Symptom	Possible Causes	Possible Remedies
1 cont		h) Excessive air leakage J) Fan not working or running at reduced speed	Check for badly fitted access doors, inspection covers etc. Check air tightness of all flexible ductwork connections to equipment. Check airseals on all ductwork joints. Remake seals as necessary. See relevant fan clauses.
2	Excessive air Supply air temperature too high	a) Filter media not in air stream b) Air volume too low	Check and replace media as necessary Check air volumes
3	Supply air temperature too low	Air volume too high	Check air volumes
4	Excessive noise	Grille air velocities too high Excessive noise from fan	Check velocities. Clean grilles. Re-balance grilles and system See clauses on fan
5		Blockage in ductwork	Remove blockage

D.2.2

Air Handling Units General Fault Finding (Cont'd)

	Symptom	Possible Causes	Possible Remedies
6	Smutting	Excessively dirty filtering Excessively dirty incoming fresh air Build-up of dirt on internal surfaces of ductwork	Check filter media is correctly installed. Check filter media is correctly installed Inspect ductwork and clean as necessary
7	Obnoxious odours	Impregnated incoming fresh air Insufficient air Dirt on heating coils	Check external area adjacent to fresh air inlet and eliminate source of odour Check air volumes Inspect coils and clean as necessary.

D.2.3 Fans General Fault Finding Chart

	Symptom	Possible Causes	Possible Remedies
1	Will not run	Controls not calling for operation Interlocked plant (where applicable) not operating Electrically isolated Motor fault	Refer to detailed controls information Refer to detailed controls information Check: Panel isolator Local isolator switches See relevant clauses on motors
2	Duty low	Fan running backwards Drive belts slipping (where applicable) Restriction at inlet or outlet System resistance excessively high	Check direction of impeller rotation. Swap any two phases serving the motor to reverse direction (3 phase motors) Check speed of fan and motor. Re-adjust belt tension Remove restriction Check damper settings. Check for blockages in ductwork. Re-balance system.
3	Duty high	System resistance excessively high	Check damper settings. All access covers are closed. Major air leaks . filter media in air stream.

b. **Boiler Operation (Cont,d)**

- A control thermostat allowing adjustment of the boiler flow temperature is fitted behind the instrument panel fascia to discourage unauthorised adjustment after it has been set by the commissioning engineer.
- A safety-limit thermostat comes into operation should the control thermostat fail to shut the burner down. The limit stat is generally set at 100C, with the setting minimum 15C above the control thermostat's setting. No automatic control may be interfered with by the boiler attendant but must be adjusted only by a qualified Service Engineer.

The operation of the boiler and the burner is fully detailed in Hamworthy's Manual.

c. **FAULT FINDING**

Follow Fault Finding Procedures are outlined in Hamworthy's Manual.

d. **STOPPING**

- Turn Control Thermostat to minimum
- Switch of the main electrical supply if all the plant is to be put out of service.
- Switch Boilers off at the control panel.

e. **BOILER EMERGENCY STOPPING**

- Pressing the Emergency knock-off button at the entrance to the boiler room will cause the gas solenoid valve to close. The instructions laid down in section 1 should be followed.
- Shut the main gas valve if access to the boiler room is dangerous.
- Activation of the thermal links mounted above the boiler will also cause the gas solenoid valve to close.
- Closure of the gas solenoid valve will raise the alarm at the BMS

Note: On shut down due to fire signal follow procedure laid down in section A (4.2 Boiler Explosion). Recommission plant after the "All clear" as detailed above

D.3.2.1 CHILLERS

The chillers have Micro-Tech Controller containing control keypad and monitoring as detailed in AAF McQuay's literature.

Commissioning and setting up of the operating parameters are fully described in AAF McQuay's literature.

For monitoring the operation and alarm situations follow AAF McQuay's instructions for interrogating the panel.

The Chilled Water plant is demanded to run to the dictate of the BMS Control Panel. A general chiller fault alarm is shown on this panel for all chiller alarms.

The chiller manual lists the faults that resets automatically once the fault is cleared and those requiring manual reset. The manual reset switch, will, however, reinstate the system only after the fault has been cleared.

3 No. Dry Coolers having 6 fans each cool the condenser water as detailed in the Schedules. Cycling the coolers and the fans keep the head pressure to limits specified by McQuay. The fans have thermo-couple protection against excessive temperatures which resets automatically.

a. Chiller Start Up

1. For chiller start up and running the procedure laid down in Clause D.1 above should be followed in full compliance with AAF McQuay's instruction as laid down in the chiller literature
2. Switch the chiller unit to run by pressing the RUN/STOP. Bring to operation in accordance with manufacturer's instructions.

Note: Control and monitoring facilities available at the chillers control panel though briefly described above are detailed in McQuay's Manual. The operator should familiarise himself with the functions prior to use.

D.3.2.1 **Chillers (Cont'd)**

b. **Chiller Emergency Stop**

- Red Emergency Switch Q11 is provided in the front panel of the controller
- To restart after Emergency Stopping follow procedure outlined in AAF McQuay's literature.

c. **Shut Down**

- Follow AAF McQuay's instructions to bring the system to Off
- The electrical supply is to be left alive so that the crankcase heater and the evaporator heater will stay operational.

d. **Fault Finding**

- Follow Fault Finding Procedure laid down in AAF McQuay's Manuals.

D.3.1.2 **LTHW PUMPS**

D.3.2.2 **CHW PUMPS**

Refer to Holden & Brooke's literature for detailed Operational and Fault Finding Instructions.

D.3.1.3 **LTHW PRESSURISATION UNITS**

D.3.2.3 **CHW PRESSURISATION UNITS**

Refer to Holden & Brooke's literature for detailed Operational and fault Finding Instructions.

D.3.3.1 **AIR HANDLING UNITS**

Refer to AAF McQuay's literature for detailed Operational and fault Finding Instructions.

D.3.3.2 FAN COIL UNITS

1. The units operate on a draw through principle, with the fan providing the supply air across the cooling coil.
2. The return air sensors modulate the control valves in the cooling coil to maintain the temperature set point.
4. Fan speeds can be adjusted to 2 - speed settings.
5. Follow Diffusion's instructions for initial starting of the unit and for fault finding.
6. Conduct the following checks after two weeks running:-
 - Motor full load current
 - Filter condition
 - Condensate and drains for free flow and leaks
 - Valve connections for leaks
 - Operation of controls

B.3.3 RADIATORS

The operation of the Radiators is controlled by their own TRV's.

The TRV's can be set to control over temperatures from 10 to 27°C approximately which are denoted by numbers on the setting scale of the regulator from 1 to 5 and 'MAX'. The valve leaves the factory set on No. 4.

At least an hour should be allowed for the result of any change in the setting to take effect.

Further details are to be found in Drayton's literature.

D.3.4.2/3.1 COLD WATER BOOSTER SETS (DOMESTIC & DRINKING)

The initial system demand will be met by the supply in the vessel..

When this is exhausted the duty pump will start via its pressure switch.

If the demand increases the system pressure will drop and the support pump will start via its pressure switch.

When the demand falls the support pump will switch off and the duty pump will replenish the vessel then switch off.

The duty and support pumps will run for as long as the demand continues or for a minimum of four minutes under the control of a timer relay.

If a pump should fail turn the HAND/OFF/AUTO switch to off and the selector switch should be turned to put failed pump in the standby position.

Full Operational and Fault Finding details of the sets are provided in H&B's literature.

Drinking Water Conditioner

The Rotomag Water Conditioner once commissioned to Liff Industries instructions will automatically descale water.

Refer to Liff Industries literature for Fault Finding instructions.

D.3.4.3.2 Irrigation Water Booster

Operation is similar to drinking and cold water boosters. For in depth details see Stuart Turner's literature.

D.3.4.4 HOT WATER SERVICE

Follow IMI Rycroft instructions for commissioning.

a. Starting

1. Adjust the calorifier thermostat to the required operating temperature.
2. Check that the thermostat is operating correctly
3. Ensure that the primary circuit is established
4. Check that the operating temperature remains constant.

b. Operation

The operation is fully automatic. The only adjustment required is to the thermostat, should the required temperature varies.

D.3.4.4 Hot Water Service (Cont'd)

Water Conditioner

The Powermag Water Conditioner once commissioned to Liff Industries instructions will automatically descale water.

D.3.4.5 SEWAGE PUMPS

The sets, once commissioned to Grundfos instructions, will operate automatically to the dictate of the start/stop level switches. The high level switch will raise the alarm if the preset level is exceeded.

A built in temperature sensor will open at 135 °C.

See fault finding chart in Grundfos literature for trouble shooting.

D.3.5.2 HOSEREELS

The operation of the Hosereel Pump Set is similar to that of the C.W. Booster detailed in clause D.3.4.3. The only difference is that on operation of any of the Hosereels, the pressure drop will suddenly decrease and put the pumps immediately in operation.

CAUTION

Never attempt to fight a fire that seems uncontrollable. Whenever in doubt sound the alarm at the nearest break glass unit and evacuate the area.

1. Sound the alarm at the nearest break glass unit.
2. Pull approximately 2m of hose from the reel, this will automatically operate the valve inside the reel and in a matter of seconds full water pressure is at the nozzle under the operator's control.
3. With the nozzle directed at the fire adjust the water to jet or spray as required, unwinding the hose to the required length.
4. Water flow causes pressure drop that will be detected by the system pressure sensors and set the booster set duty/standby pumps in their operation sequence which is similar to the cold water system as detailed in Armstrong's literature.
5. After use, rewind the hose back onto the reel; when approximately 2m has been rewind the valve will automatically close and the flow of water will cease. Ensure that the control nozzle is open to release any surplus water.

D.3.5.2 Hosereels (C0nt'd)

6. It is recommended that after use the nozzle is left in the open position to eliminate the risk of the hose being left under pressure and in order to ensure that the automatic valve is fully closed and not passing water.

D.3.5.3 Dry Riser

The dry risers are provided for the exclusive use of the Fire Brigade.

E

E MAINTENANCE OF THE INSTALLATION

E.1 INTRODUCTION

Only a regular and organised scheme of maintenance work, planned to cover all details of the installation, within given maintenance periods, can ensure continued satisfactory operation with a minimum liability to interruptions to supply due to equipment faults. A maintenance scheme is also a requirement under the Electricity at Work Regulations.

Careful attention must be given to securing the safety of personnel and equipment while maintenance or repair work is in progress. A code of safety rules based on a system of 'permits to work' similar to that which is detailed in British Standard Code of Practice CP 1008 (1958) Section 12 is recommended.

A planned maintenance scheme should include a system of logging wherein records are kept of inspection maintenance and repair on all items of plant and equipment.

Switch Rooms should be kept clean and the practice of using Switch Room space for storage must not be permitted.

Where maintenance work is in progress a DANGER notice must always be attached to any 'live' apparatus calling attention to the danger of approach. A CAUTION notice must always be attached to plant or its associated control equipment, warning of possible damage to equipment which may be occasioned by interference.

Before any work is commenced on any item of equipment, the supply and ancillary circuits must be isolated and locked off if possible.

All safety precautions and general recommended procedures relating to the maintenance of switchgear are contained in the BS CP 5405 (1976) and this should be read in conjunction with the instructions for routine periodic maintenance given in the following pages.

E.2

SAFETY PROCEDURES

The following is a guide to the procedures to be generally adopted to ensure the safety of personnel and to protect plant and equipment from damage.

Access to Switch Rooms and electrical distribution equipment must be limited to authorised personnel who are members of the engineering staff.

Before making a circuit 'live', the equipment or outlets served must be checked to ensure that plant, equipment and switchgear are serviceable and safe to operate.

Where switchgear, distribution boards or any other item of plant or equipment is out of service, unserviceable or unsafe, the item in question must be electrically isolated, all fuse switches and MCB's switched off and a suitable warning notice fixed in place.

Maintenance work should be effected under the control of a 'permit to work' system designed to ensure that all necessary safety precautions are put into effect before work is allowed to commence. A 'permit to work' should be issued by an authorised engineer only after all safety requirements have been met. No maintenance work should commence until the 'permit to work' has been issued.

Check and ensure that Switchrooms, Equipment Rooms and Plant Areas are clean and free from obstruction.

Check to ensure that all equipment access panels and doors are closed and secured.

Ensure that all tools and safety equipment are serviceable and in their proper storage space.

Check that fire extinguishing systems are serviceable.

E.3

PERMIT TO WORK

Before commencing work on any item of plant or equipment, it is suggested that authorisation be obtained. This authorisation should be in the form of a 'permit to work' ensuring that the equipment in question is isolated from the system and that supply ancillary circuits are isolated and locked off. Danger and caution notices must be displayed and must be firmly attached to supply and control switchgear.

A permit to work is a written authorisation to carry out work on or about electrical apparatus, signed for or on behalf of the person on whom the occupier's responsibility for safety rests. It should, as a minimum, set out clearly and concisely the apparatus on which the work is to be done, the extent of the work and the precautions which are to be taken or have been taken to ensure that the apparatus designated is safe to work on.

Permits to work should only be issued by a person specially authorised in wiring by the occupier to do so.

The permits should be numbered serially for reference and should be in duplicate. One copy should be retained by the issuer and one copy handed to and signed as an acknowledgement of its terms by the person carrying out or in charge of the work; he should retain it until the work is completed or stopped.

When the work is completed or stopped, the appropriate section of the permit should be signed by the person to whom it was issued and the permit returned to the issuer for cancellation. In those cases where the permit is returned prior to the completion of the work, a note to that effect should appear on the permit and work should not be recommenced until a fresh permit is issued.

The apparatus designated in the permit or permits as 'dead' **must not again be made 'live'** until every permit covering that apparatus has been cleared by the person to whom it was issued and returned to and cancelled by the issuer.

When a person authorised to issue permits to work intends to do work on the apparatus himself, he should complete a permit to work form to ensure that he is taking the same precautions as he would when authorising work by others.

SAMPLE OF PERMIT TO WORK

A sample of Permit to Work is given below for quick reference.

NOTES

Part 1 should be completed by the person authorising the work before issuing to the person for any building/maintenance operations. Where the person authorising the work is responsible for the building/maintenance operation etc., he should issue this to himself as a check on procedure.

Part 2 should be completed by the person responsible for the building/maintenance operations after their completion.

Part 3 both the original and the duplicate should be signed by the person actually in charge of the work on the equipment. The original should be retained by the person actually in charge of the work until the work is stopped or completed. The duplicate should be retained by the person authorising the work.

Part 4 should be signed by the person actually in charge of the work when the work has been stopped or completed, and then handed back to the person who authorised the work.

Part 5 should be signed by the person responsible for signing part 2, or in his unavoidable absence, by a person of equivalent status.

Building Services Operating and Maintenance Instructions
5-7 Carlton Gardens, London SW1

Example of Permit to Work -- Mechanical Services

Permit to Work on Mechanical Equipment

Part 1 Authorisation for Work.

A. This permit is issued for the following work-----

By-----To-----

being an authorised person in charge of building/maintenance operations.

B. Switching and Isolating. The plant to be electrically isolated by the following operation-----

C. Cooling/heating coils. The LPHW/Chilled Water/Steam/MTHW to be isolated if applicable at the following points-----

D. Danger Notices are to be posted at:- -----

E. Caution Notices are to be posted at:- -----

Time-----Date-----Signed-----

-----Rank-----

Part 2 declaration

I hereby declare that the operations detailed in parts 1. B. C. & D have been completed and the equipment detailed in Part 1.A. is safe to work on. It will not be put back into operation until the Clearance certificate in Part 4 is completed.

ALL OTHER EQUIPMENT IS DANGEROUS

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Time-----Date-----Signed-----
-----Rank-----

Part 3 Receipt

I hereby declare that I accept responsibility for doing the work on the equipment detailed in Part 1.A. of this permit and that no attempt will be made by me or by men under my control to work on any other plant or equipment.

Time-----Date-----Signed-----
-----Rank-----

Part 4 Clearance of Work

This to certify that the work detailed in Part 1.A. above has been (stopped/completed)* men gear and tools have been withdrawn.

Time-----Date-----Signed-----
-----Rank-----

(delete the word that does not apply)

Part 5 Cancellation

I hereby declare this Permit to Work cancelled, and the services are reinstated at point indicated in Part C. The equipment is now ready to go back into service.

Time-----Date-----Signed-----
-----Rank-----

E.4 RECOMMENDATIONS FOR MONITORING

E.4.1 General

It is recommended that a log is kept, preferably written in a book used exclusively for this purpose. Details should be regularly recorded about the performance of the system; this practice not only provides a stimulus to look after the plant properly with consequently lower running, maintenance and replacement costs, but the information recorded can prove invaluable in evaluation of system performance and fault-finding, particularly when outside specialist assistance is required.

Where it is practicable to obtain the following data it is suggested that it should be kept, but experience of the particular plant may dictate that different or additional information should be recorded.

E.E.7 Daily

The following readings to be taken at 0800, 1200 and 1600:

1. Flow temperature of each water circuit.
2. Return temperature of each water circuit.
3. Air temperature in key rooms in each building.
4. Where mechanical ventilation is provided, a note that room conditions are satisfactory.
5. Outside temperature.
6. Temperature of pumps.
7. Pressure of altitude gauge readings.
8. Ammeter readings of electrically-driven plant e.g. pumps, fans.

E.4.3 Weekly

9. Record weekly fuel consumption.
10. If water treatment is provided check and record the water condition in the system in accordance with the instructions given elsewhere.

E.4.4 Non-routine items

11. Time switch settings, with date and details of any changes.
12. Dates and amounts of fuel deliveries, if appropriate.
13. Record any breakdown or malfunction of the plant; action taken and the results.
14. Record dates and details of maintenance carried out by own staff and by outside specialists.
15. Record dates and details of spares or replacement plant brought and installed.
16. Record dates of changeover to standby equipment e.g. pumps.
17. Record dates of summer/winter changeover, or shut down of plant and equipment e.g. valves, fresh and return air dampers etc.

CAUTION

When monitoring indicates a fault, its cause must be identified before taking action other than the essential safety precautions. A number of causes could produce a similar effect and the haphazard alteration of valve, thermostat, or damper settings may upset the system and create other faults. If the cause cannot be readily diagnosed, it is better to obtain expert advice.

E.5

SYSTEM TESTING

It is a requirement of the IEE Regulations that the electrical installation is tested on a regular basis at a minimum interval as indicated in the Completion Certificate issued for this installation. It is recommended that the installation is tested on an annual basis by an approved electrical contractor or when modification or alterations are made to the installation.

The following tests are required:

Verification of Polarity

Check that all fuses and single pole control devices are connected in the live conductor only, that centre contact Bayonet and Edison type screw lampholders in circuits having an earthed neutral conductor have their outer or screwed contact connected to that conductor and that wiring has been correctly connected to socket outlets.

Earth Continuity Test

A test of the earth continuity conductor should be made. On conduit/trunking installations providing an inductor is incorporated and subject to the earth loop impedance test, a total resistance of 0.5 ohms should not be exceeded or where the earth continuity conductor is composed entirely of copper, copper alloy or aluminium, a value of resistance should not exceed 1 ohm, measured by a hand DC instrument.

Tests of Effectiveness of Earthing

Where earth leakage protection relies on the operation of fuses or excess current circuit breakers, the installation should be tested for the effectiveness of the Earthing of each socket outlet and switch spur outlet at each final connection of equipment by means of an earth loop impedance test.

Test of Ring Circuit Continuity

The ring circuits should be tested to verify the continuity of all conductors including the earth continuity conductor in each circuit.

Insulation Resistance Tests

The insulation resistance must be tested by the application of a DC voltage of not less than twice the working voltage, with the provision that the testing voltage should not exceed 400 volts for a medium voltage circuit. A constant voltage test set of adequate capacity should be used in order to avoid changeable readings being obtained due to capacity effects. The test results may largely depend on the dryness of the building and atmospheric conditions.

Insulation Resistance Tests (Cont'd)

To test the insulation resistance to earth, all fuse links should be in position and intact, switches should be closed and, except where earthed concentric wiring is installed, all poles or phases of the wiring should be electrically connected together. The installation is then connected to the 'line' terminal of the test set, with the 'earth' terminal of the set connected to the earth continuity conductor or to some point in good connection with the installation earth.

For these tests, large installations may be divided into groups of outlets earth containing not less than 50 outlets. However, the insulation resistance of the whole installation shall be not less than 1 Megaohm. The term 'outlet' includes every point and every switch except that a socket outlet, appliance or lighting fitting incorporating a switch is regarded as one outlet.

If the insulation resistance of the installation or a section of an installation is below 1 Megaohm, the defective section should be overhauled until the required figure is obtained. Heating and power appliances should not be connected when the installation is tested but should have an insulation resistance of not less than the value given in the appropriate British Standard Specification or, if no standard exists, should have an insulation resistance of at least 0.5 Megaohm.

Where practicable, a test should also be made between all the conductors connected to one pole of the installation and all the conductors on the other pole. To do this, all the switches should be closed, all the fuse links in position and intact and the test set applied between the poles. Wherever practicable, so that all parts of the wiring may be tested, all lamps shall be removed and all current using apparatus shall be disconnected. Where the removal of lamps and/or disconnection of current using apparatus is impracticable, the local switches controlling such lamps and/or apparatus shall be open. This test is not applicable to earthed concentric wiring systems.

E.6 GENERAL MAINTENANCE NOTES

E.6.1. BEARINGS

E.6.1.0 All types bearings

- a) "Re-lubrication" refers to the changing of lubricants whereas "replenishment" means the addition of fresh lubricant to the charge in use
- b) Rolling bearings of plant which remain stationary for prolonged periods can suffer damage due to static indentation caused by locally transmitted vibrations. This can be minimised by regular weekly rotation of the shaft to a new position.
- c) Cleanliness and correct lubrication is the key to long bearing life.
- d) When removing or replacing rolling bearings always use the correct procedure and tools. Always ensure that all parts likely to damage the oil seals (threads etc) are tapped up. Never subject a bearing to hammer blows.
- e) Before commencing any work which brings skin into contact with bearing oil/grease, use a barrier cream or suitable gloves to prevent the onset of dermatitis.
- f) Always carefully monitor the temperature of new or re-lubricated bearings for 2 or 3 hours. To ensure maximum life it is advisable to re-lubricate a new bearing after two days operation (particularly ball roller bearings).

E.6.1.1 Grease lubricated bearings

- a) Grease are semi-solid lubricants composed of a stabilised mixture of oil and a "thickener", generally a metallic soap. This holds the lubricant where it is required whilst preventing the ingress of foreign matters into the bearings. For general purposes a good quality lithium soap grease such as Shell Alvania R should be used. Where excessive temperatures or moisture is likely to be encountered, obtain recommendations from the manufacturer or seek advice from a lubricant manufacturer on the type and quality of grease to be used.
- b) Do not overfill roller type bearings. Enough space should be left in the housing to allow for the grease displaced by churning from the bearing track. Overfilling can lead to bearing damage due to "breakdown" of the grease through overheating.
- c) When packing roller bearings with grease ensure that the bearing is clean and dry, as grease will not adhere properly to surfaces wet with oil or coated with anti-corrosion compounds.

E.6.1.1 Grease lubricated bearings (Cont'd)

- d) A lubricated or replenished roller bearing will initially run hot for an hour or so due to churning of the grease whilst it redistributes itself between the bearing and the housing.
- e) Before replenishing grease bearings (where a replenishment facility is provided) it is essential to ensure that a relief opening is provided in the form of a vent hole, relief plug or relief valve to prevent pressurisation of the bearing or escape of grease through the oil seals. Wherever possible replenishment should be carried out while the drive is in motion. Relief f) Use only a low pressure type grease gun with the correct connector.

E.6.1.2 Adding Grease to Motor Bearings

This describes a general procedure to adopt when adding grease to electric drive motor bearings

1. This procedure is based upon the recommendations of Brook Motors Ltd. although it should be pertinent to other manufacturers.
2. If in any doubt, consult the relevant manufacturers instructions on motor data plate.
3. This procedure is relevant for motors fitted with grease nipples and relief plug.

Step 1. Isolate motor to be greased.

Note: Whilst the motor may be lubricated while running, re-greasing at standstill will minimise leakage along shaft seals.

Step 2. Wipe clean the pressure gun fittings and the regions around the motor grease fittings.

Step 3. Remove the relief plug and free the relief hole of any hardened grease.

Step 4. Add grease until new grease is expelled through the relief hole.

Step 5. Run the motor for about 10 mins. with the relief plug removed, to expel excess grease.

Step 6. Clean and replace the relief plug. Check that the lubricator cap or plug is firmly attached.

E.6.1.3 Oil lubricated bearings

- a) Manufacturers recommendations should always be followed regarding the type and quality of oils to be used.
- b) Oil levels must be strictly maintained. Underfilling will result in insufficient lubrication while overfilling will cause excessive churning and agitating.
- c) A pointer to deterioration of oil is a darkening of colour and a distinct rancid smell.
- d) Replenishment of oil should be carried out when the plant is stationary.

E.6.1.4 Adding oil to Motor Bearings

This describes the procedure to adopt when adding oil to electric drive motor bearings.

This procedure is based on the recommendations of Brook/Crompton Parkinson Ltd. although it could be pertinent to other manufacturers. If in any doubt, consult motor data plate, or refer to manufacturer.

- Step 1. Shut down motor.
- Step 2. Remove filter and level plugs.
- Step 3. Add oil until overflow occurs from level plug. Take precautions to avoid overflow to surrounding area.
- Step 4. Refit plugs.

E.6.2 BELT DRIVES

Belts should be stored in a dry room. Avoid contact with hot water surfaces and direct sunlight. Hang belts loosely in coils. Do not tie tightly with thin string.

Never use belt dressing on Vee belts.

Always use the full number of correct size of belts in multi-belt drives.

Never run old and new belts together in one drive, always renew all belts at the same time in multi-belt drives.

Never force belts on pulley, as this may damage the outer casing and/or inside cords. When replacing belts, move the motor (or prime mover) towards the driven unit, so that each belt can easily be placed by hand in its respective groove.

New belts for multi-belt drive must be matched sets.

E.6.2 Belt Drives (Cont'd)

Never run at too high tension as this causes undue wear on the bearings of the machine.

Never run belts too slack as this causes slip, loss of speed of the driven unit and excessive belt wear.

Accurate lining up of pulleys is essential, otherwise undue wear takes place on the belt flanks.

The shafts of the pulleys must be parallel. To ensure this, the adjusting screw at the feet of the motor should be at diagonal opposite corners for easy positive control of the motor when tensioning the drive.

Vee belts manufacturers provide explicit but rather complex instructions for correct belt tensioning. In simple terms, the belt should be tensioned just enough to prevent slip. Grip the Vee belt between thumb and forefinger at the mid point between pulleys. If a twist of the belt through 90 degrees is just possible, the tension is correct. This should result in slight bow in the slack side of the belt when running under load.

Inspect new belts after two days running and adjust tension if necessary.

Replacing and Adjusting Drive Belts

This procedure describes the changing and adjusting of the drive belts.

For adjustment and tension checking of belts follow steps 1 to 4 and 9 to 16 only.

The method of checking the belt tension given below is based on belts as manufactured by J.H. Fenner & Co. Ltd. For other makes of belt consult manufacturer's literature

This procedure may be used generally for the replacing and adjusting of pump and fan drive belts.

Step 1. Shut down air system in which fan is serving.

Check that appropriate panel indication lights are extinguished.

Step 2. Select "off" position with local isolator lock stop buttons.

Check that operation of panel switch has no effect.

As a further safeguard the fuses within the appropriate control panel covering the fan to be worked on should be removed.

Step 3. Where necessary - remove access panel on supply plant fan section.

E.6.2 Replacing Belt Drives (Cont'd)

Check each of the existing belts for the following :

- a) Small cracks on side and base of belt.
- b) Swelling of belt.
- c) Softening of belt.
- d) Excessive or uneven wear.

If any of the belts show one or more of the above, replace all the belts with a matched set by following step 5 onwards after ascertaining cause by consulting the appropriate fault tracing chart. If all of the belts are in good condition, then check tension and adjust as necessary by following step 10 onward.

Step 4. Slacken off motor/slide rail clamping bolts.

Step 5. Slacken off motor/slide rail adjusting screw on fan Side of motor as far as possible.

Step 6. Slide motor as far as possible towards the fan. The driving belts will slacken.

Step 7. Remove all the existing driving belts by easing them off the pulleys.

Check that pulley grooves in both driving and driven pulleys are clean, undamaged, unscored and free of grease and oil.

Step 8. Install the new belts onto the pulleys by first placing each in its correct groove on the larger pulley, and then easing it onto its correct groove on the smaller pulley, starting with the belt on the inside pulley groove. Do not force the belts over the pulley with crowbar, screwdrivers, wedges or any other implement.

- a) Check that belts are the correct size, type and section for the particular fan set.
- b) Check that each belt is properly seated in the grooves of both pulleys the correct way up.
- c) Check that belts have not been externally damaged when installed (especially if forced over outside pulley grooves).

Step 9. Move motor away from fan until belts tension by tightening an motor/slide rail adjusting screw on side of motor.

Step 10. Measure distance between centres of fan and motor shafts (span length).

Step 11. Measure the force required, when applied at right angles to one belt only at the centre of the span, to deflect belt 16 mm for every metre of its span length (5/8" per 3 feet) and compare this with the belt manufacturers tabulated value.

E.6.2

Replacing Belt Drives (Cont'd)

If the measured force falls within the values given by the manufacturers, the belt tension should be satisfactory. If the force is higher than the upper limit, the belt is over tensioned. If the force is below the lower limit, the belt is under tensioned. With new belts it is advisable to have the tension nearer the higher value to allow for stretch during the initial running-in period.

NOTE: Check that the fan and motor pulleys are parallel and aligned with each other. On multi-belt installations differing tensions in the belts would indicate the pulleys are not parallel, providing the belts are of the same age and in good condition. Use a straight edge across both pulley faces to check they are in line and parallel. Use motor/slide rail adjusting screws as necessary, always rechecking tensions after any adjustment has been made.

- Step 12. When belts are correctly tensioned and pulleys correctly aligned, tighten motor/slide rail clamping bolts.

Recheck belt tensions and pulley alignment after tightening the clamping bolt.

- Step 13. Switch on local isolator of fan, replacing any fuses removed under Step 2.

- Step 14. Start the fan on which the belts have been changed switch on the control panel.

Check that the driving belts of the fan are running correctly in their slack side, but without any undue vibration, lashing or noise.

- Step 15. Replace fan section access cover.

- Step 16. Start the remaining fan (s) serving the shut down air system (when applicable).

- Step 17. After the fan has been running for 3 to 4 days with new belts fitted recheck the tensions of the belts and re-adjust as necessary by repeating steps 1 to 4 and 9 to 16 above. This step will allow any slack resulting from stretching of the new belts to be taken up.

E.6.3

ELECTRIC MOTORS

Regular maintenance must be carried out and the following programme takes precedence over other instructions unless it conflicts with those of the maker.

All electric motors should be kept clean and dry.

There are two main classes of bearings used in electric motors: sleeve and ball/roller bearings.

Some electric motors have self-lubricating sleeve bearings, or packed-for-life ball bearings, both of these contain sufficient lubricant for the practical life of the bearings.

Refer to Manufacturers' literature for recommended re-lubrication intervals.

WARNING

Before carrying out maintenance work switch off the electric supply. This must be done from the starter. The isolator, which can be integral with the starter, or separate and local to the motor, should then be switched off. (This is a safety device provided for isolation purposes only and it must NEVER be used as a means of stopping or starting the motor).

On all types of bearings, temperatures should be checked regularly to ensure that any tendency towards overheating is observed and remedial action is taken in order to prevent damage to motor. Manufacturers' instructions relating to checking for bearing wear and permissible running temperatures should be carefully noted. Where Vee-belt drives are employed, careful attention to the recommendations contained in Belt Drives is necessary.

Ball and roller race bearings are generally packed with grease and sealed to prevent the ingress of dust and moisture. Unless the manufacturer specifically recommends otherwise, lubricant should not be added to the bearings. Where the manufacturer does recommend the addition of lubricant after a given period of operation, care should be taken to follow the manufacturers' instructions. Grease should only be added to the bearings with the motor at standstill and using a Low PRESSURE GREASE GUN. Where a relief plug is fitted, this should be removed before adding lubricant and refitted on completion of the task.

During the period set aside for the inspection/overhaul of the plant served by the motor (allowing for the motor having been in operation for the manufacturers recommended number of running hours), bearings, excluding sealed for life' bearings, should be dismantled, cleaned, inspected and re-packed with the correct grade of lubricant as recommended by the manufacturer.

E.6.3 Electric Motors (Cont'd)

All bearings, including 'sealed for life' bearings, should be carefully examined for serviceability and renewed where there is noticeable degree of wear. Motor casing should be kept clean and motor installations regularly inspected to ensure that ventilation is unobstructed. Any build-up of dust within the motors having ventilated enclosures should be removed occasionally by means of a portable, fan powered blower (do not use compressed air line unless pressure is below 10 lb in²).

Motor windings should be regularly tested for insulation resistance.

E.6.4 CONTROL AND CONTROL PANELS

Automatic controls should receive regular maintenance and thorough checks.

The work should be carried out by a suitably qualified technician with the necessary specialist knowledge and instrumentation.

Control panels should be kept clean and indicating and alarm lamps checked daily. control switches should be regularly checked for damage or malfunction. Defective switches and lamps should be renewed at the time of inspection.

Doors and access panels should be checked regularly to ensure that they seat correctly.

Instrument readings should be regularly checked and compared to ensure that indicated and recorded values are correct.

Motor starters should be inspected at regular intervals to ensure that contactors are making and breaking correctly and that there is no evidence of 'pitting' or 'build-up' on the contacts which would seriously affect the 'follow-through movement.

Where contacts or contact facings are noticeably reduced in thickness, the contacts should be renewed.

During routine daily or weekly plant inspections, careful attention should be given to noting any electrical discharge noise which could be indicative of loose or poorly mating connections.

E.6.5 PUMPS

Regular maintenance must be carried out and the following programme takes precedence over other instructions unless it conflicts with those of the maker.

Pumps generally have ball/roller, sleeve or oil ring sleeve bearings. They are driven by electric motor through close or direct couplings, or Vee belts.

Pump shafts are normally fitted with stuffing box glands, but may have mechanical seals.

Never run any pump unless it is primed. Never run any pump without the suction valve open.

Failure to adequately maintain pumps may result in inconvenience because the system will not function without the pump and premature replacement would be costly.

1. Stuffing Boxes

Tighten up the glands so that the leak is at the rate of one drop of water every 2-10 seconds. If re-packing is necessary remove the old packing completely. Clean thoroughly the stuffing box and shaft seal. Do not over-tighten. (Adjust as required during running).

2. Mechanical Seals

No adjustment is possible. If leaking, carefully renew the seal materials in accordance with the maker's instructions.

E.6.6 TANKS

Storage and feed and expansion tanks should be regularly inspected for cleanliness and for signs of damage, corrosion or leaks. A careful check should be maintained on liquid levels.

E.6.7 PIPEWORK

Pipework supports should be regularly inspected to ensure that pipe hangers and brackets are firmly mounted and undamaged.

Pipework and valve mounting flanges should be regularly inspected for signs of leakage.

E.6.8 INSULATION

Any insulation removed from pipework or ancillary equipment should be replaced, repainted where necessary, ensuring that identification markings are restored.

Insulation should be inspected regularly for damage. Check for signs of staining which may be evidence of system leakage.

E.6.9 STRAINERS

System strainers should be cleaned and inspected at regular intervals..

Damaged strainer elements and worn seals should be renewed at the time of inspection.

E.6.10 AIR FILTERS

Differential pressures across air filters should be checked regularly, with the provided manometer and replaced as necessary. Permissible pressure drops across filters are listed in the relevant AHU's schedules.

E.6.11 PLUMBING SYSTEMS

1. General

Discharge pipe systems should be kept in a clean and sound condition in order to maintain maximum efficiency and the following points should be noted:-

- (i) Vertical ventilating pipes of cast iron or steel are liable to accumulate rust at bends and offsets.
- (ii) When access covers, caps and cleaning eyes are removed, damaged packing, ring seals, washers and missing fixing should be renewed before replacement.
- (iii) Care should be taken in the use of chemical de-scaling agents, which are often of a corrosive nature and materials employed in the pipe system should be clearly identified before treatment, to ensure that the internal surfaces are not subject to damage by chemical attack.
- (v) Caution is necessary when using methods of clearing obstructions which involve the use of air or water at high pressures.
- (vi) Hand operated rods for removing blockages in discharge pipes should be capable of passing through the system without damaging the internal surfaces of pipes and fittings.
- (vii) When renewing paint work, care should be taken to preserve any distinguishing colours, which have been used for identification purposes. Reference should be made to BS. 1710.

2. Cleaning and De-scaling

The following notes describe the normal types of blockages or deposits found in plumbing/drainage systems and the methods used for their removal.

3. Deposits due to misuse of the discharge system

Complete or partial blockages due to large objects or compacted masses, such as toilet paper and sanitary towels, can usually be loosened by rodding. All such material should be removed from the system at the nearest access point.

4. Lime Scale

The worst condition will be found in the stacks and pipes from urinals where precipitation of lime, generated by the reaction of urine in contact with hard water, accelerates the process of scale formation.

In these situations conditions can be further aggravated by the residue from abrasive cleaning powders, used in cleaning of sanitary appliances. This may combine with the lime precipitate causing a complete blockage of the pipe.

Recurring scale formation of this type are best dealt with by a periodic de-scaling of the system using suitable inhibited acid based cleaners.

The discharge stacks and pipes should be inspected periodically and the rate of scale formation noted. The required frequency of treatment and the strength of acid required to soften the scale can then be established and included on a planned maintenance schedule. It should not be necessary to repeat the treatment more than three to four times a year.

Where lime scale incrustation in a urinal discharge pipe is very heavy to the point of almost total blockage, the obstruction can sometimes be removed by the application of an acid drip method (see below for precautions in use of chemicals).

5. Accumulation of grease and soap residues

Obstructions in discharge pipes and traps caused by accumulations of grease and soap residues can often be partially removed by use of a plunger, but a more effective treatment is by flushing the system with a strong solution of Soda Crystals dissolved in hot water.

The process is easy to carry out and once the frequency of the treatment has been established it can be applied as a routine periodic service.

Blockages of this type are mostly found in long discharge pipes from sinks or wash basins, especially in soft water areas and where the rate of flow in the pipe falls below that required to sustain a self cleansing velocity. Where mirrors are fixed above basins, hair combing washed into the waste pipes will combine with the grease and soap residues and considerably increase the risk of blockage.

E.6.11 Plumbing Systems (Cont'd)

6. Cleaning and De-scaling Techniques

The following notes describe the principal methods used for cleaning etc. using mechanical means.

Plunger

This provides a simple means of clearing a slight blockage in a sink or basin branch pipe and trap or even WC.

Rods

This is the traditional method of clearing blockages. A number of devices are available for the end of the rod, e.g. scrapers, plungers and brushes. These are suitable for cleaning pipes of 75 mm size and larger, where only moderate flexibility is required to introduce the rods into the pipework. Mechanically rotated versions are also available.

Kinetic Ram

The Kinetic ram gun can be usefully employed for the removal of obstructions in branch pipes provided its function and limitations are properly understood. The function of the gun is based on the principle that the impact of compressed air against a column of water behind a blockage will create a shock wave which is transmitted to the obstruction to dislodge and remove it. A stubborn blockage can, however, produce a "blow back" of the gun and injure the operator or damage pipework/appliances not designed to withstand the pressure applied. Where there are open branches on the system, waste matter may be forced out of the openings and damage wall/ceiling decorations.

The use of this type of gun in plumbing installation should generally be restricted to the removal of blockages consisting of compacted soft material e.g. grease, soap residue and saturated paper.

Coring and Scraping

Coring of the pipe can be considered in pipes of 10 mm size and above, when the pipe bore is severely restricted or even completely blocked with hard lime scale or similar material. However the pipe material should first be ascertained to ensure that damage will not result. The process involves the use of a purpose made rotating steel cutter on a flexible drive which can be pushed into the pipe to cut through the obstructions. Peripheral accumulations of grease and other gelatinous formations in pipes of these sizes can generally be removed satisfactorily by the periodic use of profile scrapers attached to ropes and pulled through the pipe.

E.6.11 Plumbing Systems (Cont'd)

Chemical Dosing

Work involved in the removal of scale and grease from sanitary appliances and plumbing drainage installations requires understanding of the problem and skill in the handling and application of chemicals and tools. Extreme care should be taken to ensure that all necessary precautions are taken to minimise the risk of personal injury. Protective clothing e.g. gloves and eye shields should be provided for the operatives. On completion of the work all exposed surfaces of sanitary appliances should be thoroughly washed, using a detergent cleanser to remove any acid or other chemical which might otherwise come into contact with a person using the appliance. Adjoining finishes and decorations may need protecting while the work is in progress.

Attention to safety precautions is vital if injury to the operator or damage to the pipework/appliances is to be avoided.

E.6.12 BOILERS

Boilers, boiler rooms and ancillary equipment should be inspected at regular intervals.

Abnormal operating conditions should be reported and rectified. Servicing (overhaul) should be conducted to Manufacturers instructions.

Check for gas leaks and test the operation of motorised gas valves at the entry to plant rooms.

E.6.13 CHILLERS

Before carrying out any maintenance activity, equipment must not be working and be completely isolated with fuses removed from electrical control gear.

For recharging with refrigerant, a refrigerant recovery unit should always be used to manufacturers instructions.

The maintenance instructions are given in this section as an essential of the maintenance of the equipment. However, the service of a qualified service technician are required to perform the periodic maintenance procedures as part of a regular maintenance contract.

Maintenance procedures should be carried out at the Scheduled intervals. This will prolong the life of the unit and reduce the possibility of costly equipment failure.

An "operator log" should be used to record the weekly "operating condition history" of the machine. The operating log for the unit can a valuable diagnostic tool for service personnel also, by noticing trends in the operating conditions can often foresee and prevent problems situations before they become serious. It may be required for inspection in the event of warranty claim.

E.6.14

HEAT EXCHANGERS/ CALORIFIERS

The equipment must not be working and also be fully isolated before carrying out any maintenance activity.

In the interest of safety, when using a de-scaling agent, the manufacturers instructions should be observed as regarding ventilation of work area, use of protective clothing, gloves, eye shields, and breathing masks and the procedure of disposing of de-scaling residue and excess de-scaling agents.

Personnel should not enter a confined space unless accompanied by another who shall remain on the outside to call for or render assistance in an emergency.

E.6.15

RADIATORS AND CONVECTORS

The terminal heating units should be inspected at regular intervals for leaks, cleanliness and normal operation.

Venting should be carried out at least once a year if no automatic air vent is provided.

Final control elements, including TRV's should be checked for proper regulating action.

Servicing (overhaul) should be conducted to manufacturers instruction.

E.7 MAINTENANCE SCHEDULES

E.7.1 DAILY INSPECTION

E.7.1.0 General

Conduct Routine Inspection of all plant areas checking for :-

- * Signs of abnormal conditions (noise, heat etc).
- * Impeded access to items of plant
- * Normal operational parameters of gauges and electrical measuring instruments

and rectify where required.

E.7.1.1 LPHW Plant

- * Check Pressure and temperature gauges for correct working parameters.
- * Check motors and pumps for excessive noise, vibration or heating.
- * Check for gas leakage from boiler valve train connection, gas cock and fittings.
- * Check visible pipework connections and fittings for possible leaks; rectify as necessary.
- * Check for any gas leak throughout the system; use a soapy water solution on any suspect joint to detect leaks.

E.7.1.2 Chilled Water Plant

E.7.1.2.1 Chillers

- * Check that chiller working parameters are within the limits specified by AAF Mcquay:

Fluid outlet temperature

Evaporator pressure drop

Power consumption

E.7.1.3 HVAC

- * Check for correct ambient conditions and ventilation.

E.7.1.4 Public Health

- * Check for leaks and overflows in water supplies and the sanitary system.
- * Ascertain that Hot Water is readily available to all users.

E.7.1.5 Fire Protection

E.7.1.5.1 Sprinklers

Follow Preussag's instructions in the stand alone Sprinklers Manual to conduct the daily routine checks stipulated by BS 5306 part 2

E.7.2 Weekly Inspections

E.7.2.1 LPHW Plant

E.7.2.1.1 Boilers

- * Check seals for leakage.
- * Check and note flue gas temperatures; rapid rise indicates need to clean tubes.
- * Check burners operation and ignition sequence (including gas test, start up, modulation and shut down.)
- * Check that air dampers at the burners are clean and unobstructed.
- * Visually check flame conditions - flame should be even and bright without sparks or impingement on combustion chamber walls.

E.7.2.1.3 Pressurisation Units

- * Check that pumps are cutting in/out at the correct pressures.
- * Check overall for leaks and rectify.

E.7.2.2 CH/W Plant

E.7.2.2.1 Chiller

- * Ensure that chiller casing and grilles and the area around are clean. Remove all debris.
- * COMPRESSOR OIL COLOUR : new oil is clear and retains its new appearance for a reasonable length of operating time. If it turns lighter brown or in some cases darker, this is an indication of contamination, basically due to moisture and/or foreign material, and should be changed.
- * CIRCUIT TIGHTNESS : check the refrigerant circuit for leaks and repair immediately.
- * Check that fluid in the sight glass is free from bubbles.

E.7.2.2.3 Pressurisation Units

- * Check that pumps are cutting in/out at the correct pressures.
- * Check overall for leaks and rectify.

E.7.2.3.1 Air Handlers

- * Check conditions of flexible joints.
- * Check for signs of air, water or steam leaks.
- * Check security of all panels, fittings and connections.
- * The control panels will indicate when filters are to be changed. Check, however, that pressure drops are within limits specified by manufacturer. Wipe clean the Filter Housing Framework.

E.7.2.3.4 Ventilation

- * Inspect overall and clean inlet and outlet louvers/grilles if required.
 - * Check bearings of the Extract Fans to Manufacturers Instructions.
- Sealed for life bearings should be replaced when suspect.

E.7.2.4.2 HWS

Check that Temperature of water delivered at point of use does not fall below 55°C.

E.7.2.5 Fire Protection

E.7.2.5.1 Sprinklers

Follow Preussag's instructions in the Stand Alone Sprinklers Manual to conduct the weekly checks and reviews stipulated by BS 5306 part 2

E.7.2.5.2 Hosereels

- * Run the complete system through both automatic and manual start sequences
- * Check for blown indicator fuses on the controller
- * Listen for any unusual noise developing
- * Note that the suction gauge reading is normal
- * Note that the discharge gauge reading is normal

Follow instructions in Armstrong's Manual for investigating and rectification of any irregularity.

E.7.2.8

Controls

- * Check that rubber mats are placed in front of panels.
- * Check that instrument covers are in place.
- * Check starters for excessive electrical noise.

E.7.3 Monthly Maintenance

E.7.3.1 LPHW Plant

Listen to bearings using a stethoscope or screw driver. Healthy bearings emit low humming noise. Shrill noise indicates dry bearings while a rumbling irregular noise indicates damaged bearings.

The bearings are sealed-for-life and should be replaced if found unsatisfactory.

E.7.3.2 CH/W Plant

Listen to bearings using a stethoscope or screw driver. Healthy bearings emit low humming noise. Shrill noise indicates dry bearings while a rumbling irregular noise indicates damaged bearings.

All bearings, including the chiller, are sealed-for-life and should be replaced if found unsatisfactory.

E.7.3.3 HVAC

- * Check filters to Colt's instruction. Clean or renew as required.

Panel Filters: By reference to operating pressure drop and by visual inspection.

Bag Filters: By reference to operating pressure drop and by visual inspection.

- * Listen to bearings using a stethoscope or a screwdriver. Healthy bearing emits low humming noise. Shrill noise indicates dry bearing while a rumbling irregular noise indicates damaged bearings.

The sealed for life bearings should be replaced if found unsatisfactory.

E.7.4 Three Monthly Maintenance

E.7.4.1 LPHW Plant

Water Treatment

- Use Test Kit to determine pH level and TDS of the Nitrates. Follow Water Treatment specialist's instructions for rectification if required
- Take Dip Slide for examination by a qualified laboratory and act according to their recommendations.

E.7.4.2 CHW Plant

E.7.4.2.1 Chillers

- Check filter drier to McQuay's instruction and replace if required
- Clean the Dry Coolers externally and remove debris from fan
- Check fan belt tension to Guntner's instructions. Replace if required.

Water Treatment

- Use Test Kit to determine pH level and TDS of the Nitrates. Follow Water Treatment specialist's instructions for rectification if required
- Take Dip Slide for examination by a qualified laboratory and act according to their recommendations.

E.7.4.3 HVAC

Ductwork

Dampers

Check dampers for smooth movement and clear blades.

Grilles/Diffusers

Vacuum all supply and extract diffusers and grilles. Dirt that can't be removed by vacuuming should be washed out with mild detergent.

Fan Coil Units

- Check Fans to Diffusion's instructions
- Check Heating/Cooling Coils to Diffusion's instructions
- Check Filters and clean as required. Damaged filters should be replaced.

E.7.4.4 Public Health

- * Check that the C.W. booster sets are functioning as required.
- * Ensure that Cold and Hot Water taps shut off without leakage from seating of glands.
- * Ensure that all stopcocks can be operated and shut off as required.
- * Ensure that basin wastes, floor gullies and overflows are clear from obstruction.
- * Ensure that WC flush tanks are functioning correctly and not overflowing.
- * Check that shower sprays are clear and mixing apparatus and taps are functioning correctly.
- * Clean and disinfect shower and mixing tap heads.

- * **Sump Pumps:** Conduct the service stipulated in Grundfos literature.

E.7.4.5.1 Sprinklers

Review of Hazard

Follow Preussag's instructions in the Sprinkler's stand alone Manual to carry out the quarterly routine checks and reviews stipulated by BS 5306 part 2.

The effect of any change of structure, occupancy, heating, lighting or equipment of the building on hazard classification or installation design should be considered.

E.7.4.5.2 Hosereels

1. Examine and operate the nozzle stopcock or jet spray control and the hose guide to insure they operate freely
2. Close nozzle stopcock or control and fully unwind the hose. Thoroughly examine for signs of perishing, mechanical damage and mildew attack. Thoroughly examine for leaks including couplings and connections between hose and nozzle.
3. Carry out flow test to ensure that at least 24 litres/min is discharged. If it is not possible to check every hose reel, the highest reel on each rising main should be tested.
4. Also a note and report should be made if there is evidence of use for unauthorised purposes.
5. Check that the booster set has operated as required.
6. After testing, drain hose and rewind every drum wiping the hose with clean rag.
7. Check general condition of pipework and supports including insulation.

E.7.5 Six Monthly Maintenance

E.7.5.1 LPHW Plant

E.7.5.1.1 Boilers

- * Conduct combustion tests on all boilers and log results for future comparison.
- * Inspect Electro-thermal links connections for tightness.

E.7.5.1.2 Pumps/motors

Check electric supply cables for damage and electrical connections for tightness.

E.7.5.1.3 Pressurisation Unit

- * Check the gas fill pressure in the small membrane vessel to manufacturers instructions. Check vessel for signs of corrosion and rectify if required.
- * Check the gas charge at the main expansion vessel and recharge if required to manufacturers instructions. Check vessel for signs of corrosion and rectify if required.
- * Check the electrical installation thoroughly.
- * Check operation of high/low pressure switches.

Pipework

- * Inspect pipe lagging and cladding for signs of damage; repair as necessary.
- * Check that isolating valves operate freely by operating valve to the fully open and closed positions, lubricating if required. Ensure valves are left in the original /correct operating position.
- * Inspect all nuts bolts and stubs for corrosion; clean and/or replace as necessary. Nuts, bolts, stubs as well as valve bodies are to be covered with anti-corrosive paint.

E.7.5.1 Pipework (Cont'd)

Strainers

- * Isolate, de-pressurise if applicable and drain unit.
- * Remove strainer basket and clean using non-shedding material. Replace if deterioration is detected.
- * Reassemble unit, using new gasket or "O" ring as required and return to service.

E.7.5.2 CHW Plant

E.7.5.2.1 Check setting and proper operation of control devices to AAF McQuay's instructions.

E.7.5.2.2 Pumps/motors

Check electric supply cables for damage and electrical connections for tightness.

E.7.5.2.3 Pressurisation Unit

- * Check the gas fill pressure in the small membrane vessel to manufacturers instructions. Check vessel for signs of corrosion and rectify if required.
- * Check the gas charge at the main expansion vessel and recharge if required to manufacturers instructions. Check vessel for signs of corrosion and rectify if required.
- * Check the electrical installation thoroughly.
- * Check operation of high/low pressure switches.

Pipework

- * Inspect pipe lagging and cladding for signs of damage; repair as necessary.
- * Check that isolating valves operate freely by operating valve to the fully open and closed positions, lubricating if required. Ensure valves are left in the original /correct operating position.
- * Inspect all nuts bolts and stubs for corrosion; clean and/or replace as necessary. Nuts, bolts, stubs as well as valve bodies are to be covered with anti-corrosive paint.

Strainers

- * Isolate, de-pressurise if applicable and drain unit.
- * Remove strainer basket and clean using non-shedding material. Replace if deterioration is detected.
- * Reassemble unit, using new gasket or "O" ring as required and return to service

E.7.5.3 HVAC

E.7.5.3.1 Air Handlers

1. Check and rectify Vee belt tension to AAF McQuay's instructions.
2. Check and align pulleys to AAF McQuay 's instructions.
3. Rotate drive by hand - ensure fan impeller runs true and does not foul casing.
4. Ensure there is no play in fan or motor bearings.

NOTES: Bearings are sealed for life and should be replaced when faulty to AAF McQuay"s instructions.

5. Ensure that all fixing bolts and screws are secure.
6. Inspect AV mounts and replace if deterioration observed.
7. Check for excessive temperature rise of motors.
8. Isolate motor from supply and check security of electrical connections.
9. Check that motor's vents are clear and unobstructed.
- 10 Check earth continuity of all wiring.

Fire Dampers

- * Inspect all fire dampers and check that fusible links are serviceable and shutter movement is unimpeded.
- * Lightly lubricate the shutter guide channels.
- * Ensure that access panels are unobstructed and properly replaced(airtight).

NOTE : The frequency of inspection and possible "Test Operation" may be subject to specific local regulations. The Area Fire Officer should be consulted.

E.7.5.3 HVAC Cont'd

Radiators

Remove all dirt either by vacuuming or using soft brush. Hard dirt deposits can be removed using warm soapy water.

Fans

- * Vacuum clean all fans; where dirt and deposits can't be removed, disassemble and clean with agreed detergent to manufacturers instructions.
- * Observe the manufacturers servicing instructions.

E.7.5.4.2/3 **C.W. Booster Sets (Domestic, Drinking & Irrigation Water)**

Follow Holden & Brooke and Stuart Turner's instructions (as relevant) to conduct the following:-

1. Witness the control and monitoring pressure switches functioning as per the settings.
2. Check pipework for leaks and rectify.
3. Check mechanical seals for leaks and replace if required
4. Pump bearings are self lubricated and should be replaced if suspected of malfunctioning.
5. Motor bearings are sealed for life and should be replaced if suspected of malfunction.

Water Conditioner

Follow Liff Industries instructions to conduct the 6 monthly service.

E.7.5.4.4 HWS Calorifiers

Conduct detailed examination of the Calorifiers to IMI Rycroft's instructions. If the internals are clean with no signs of corrosion or scale, the service can be carried out on a yearly basis.

If deposits of scale or corrosive products are witnessed on the heater, a full service should be carried out to IMI Rycroft's instructions.

Pipework

- * Inspect pipe lagging and cladding for signs of damage; repair as necessary.
- * Check that isolating valves operate freely by operating valve to the fully open and closed positions, lubricating if required. Ensure valves are left in the original /correct operating position.
- * Inspect all nuts bolts and stubs for corrosion; clean and/or replace as necessary. Nuts, bolts, stubs as well as valve bodies are to be covered with anti-corrosive paint.

Drainage Systems

- Inspect all floor and roof gullies and vent pipe tops and remove all debris.
- Ensure air handlers drain pipes are draining properly by flushing with hose pipe.
- In all areas where excessive sludge is found, the area is to be properly cleaned and disinfected.
- Remove and clean hand basin and sink traps.
- Check that all pipework is securely supported.

E.7.5.5.1 Fire Protection/Sprinklers

Follow Preussag's instructions in the Sprinkler's stand alone Manual to carry out the Half Yearly check and inspections stipulated in BS 5306 part 2

E.7.5.5.2 Hosereels

- Inspect general condition of Hosereels:
 - a. Fixings, connections, isolating valves cabinets, cabinet doors, handles and locks
 - b. Hose operating valves
 - c. Labels and notices
 - d. Painting
- Follow Armstrong's instructions to conduct the following:-
 - 1. Witness the control and monitoring pressure switches functioning as per the settings.
 - 2. Check pipework for leaks and rectify.
 - 3. Check mechanical seals for leaks and replace if required
 - 4. Motor bearings are sealed for life and should be replaced if suspected of malfunctioning.
 - 5. Isolate the 3 phase supply to the starter and check for loose connections particularly on the contactors.
 - 6. Lubricate door hinges and handles.

E.7.5.5.3 Dry Riser

1. Check general condition of dry riser inlet boxes including doors, glazing, locks and hinges, painting and labelling.
2. Check general condition of dry riser inlet valve:
 - a. Valve, connections, couplings, blanking plugs and chains.
 - b. Exercise inlet valve and drain valve, ensuring that any water contained in the riser is drained.
3. Check general condition of riser pipework as far as practicable including:
 - a. Painting/Galvanising.
 - b. Pipe joints, brackets and supports.
 - c. Visually check air relief valve on top of riser.
4. Check general condition of outlet landing valves:
 - a. Valves, spindles, glands, washers, connections, couplings, blanking plugs and chains.
 - b. Exercise landing valve and replace padlocks and straps.
 - c. Where outlet boxes are provided check doors, glazing, locks and hinges, painting and labelling.

E.7.5.8 Control

1. Study control system diagrammatic drawings and installation to ensure a knowledge of functions. Where low voltage control signals are used, check transformer output voltage.
2. Check units for loose covers, broken seals, etc., which may indicate unauthorised re-setting.
3. Note all existing unit settings e.g. set point, band width etc. and compare with commissioning or design data. Investigate any discrepancies found.
4. By manipulating settings ensure that controls respond correctly. Reset to original points at conclusion of test.
5. Check all items electrically interlocked e.g. slave relays etc. operate in the correct sequence.
6. Check electrical terminations for security and wiring for damage.
7. Check all indicator lamps/LED's in units. Change where defective.
8. Check operation of any safety cut-out fitted.

E.7.5.8 Control (Cont'd)

9. Check earth wiring connections to controls.
- 10 Refit covers to instruments and clean exterior.

Sensors

11. Check all sensors for correct location.
12. Check that output signal corresponds with temperature/ pressure etc., being sensed.
13. Check function of all controlled units e.g. motorised valves, damper actuators, step controllers etc. Check that feed-back signal from position gives correct and stable operation
14. If controlled unit is part of a sequence chain ensure full travel is achieved before end switches operate.
15. Check spindle and flanges of valves for leaks. Correct as necessary.
16. Ensure all loose or missing notices warning of live connections are fixed. Replace as appropriate.
17. Restore electrical power when service is completed.
18. Note defects for inclusion in report.

E.7.6 Yearly Maintenance

E.7.6.1 Heating Plant

E.7.6.1 Boilers

- * Service Boiler and Burners to Hamworthy's instructions.
- * Ensure that all ventilation grilles, ducts, flue systems and chimneys are kept clean and free from blockage.
- * Service all auxiliary equipment in accordance with the manufacturers instructions.
- * Test operation of Gas Shut-Off Valve.
- * Conduct insulation test on wiring.
- * Check the condition and operation of the safety valve.

Pipework

Isolating valves:

- * Check operation of valves to smoothly open and close.
- * Check stuffing glands and flanged joints for leakage and corrosion
- * Remove any corrosion from valve spindle and take up gland, adding valve packing where necessary. Lightly lubricate gland nuts and valve spindle.
- * Inspect all nuts, for erosion, clean and/or replace as necessary. Same as well as valve bodies and flanges are to be covered with anti-corrosive paint.
- * Replace lagging and cladding. Renew lagging and/or cladding if damaged.

Trace Heating

- * Service the system to Delta 'T' instruction.
- * Witness operation by raising the thermostat set point and watch the system coming on with an ammeter. Return thermostat set point to initial setting

E.7.6.2 CH/W Plant

- * Measure insulation resistance of all electrical components.
- * Examine the condenser conditions and rectify as required, to relevant manufacturers instruction.

Pipework

- * Check operation of valves to smoothly open and close.
- * Check stuffing glands and flanged joints for leakage and corrosion
- * Remove any corrosion from valve spindle and take up gland, adding valve packing where necessary. Lightly lubricate gland nuts and valve spindle.
- * Inspect all nuts, for erosion, clean and/or replace as necessary. Same as well as valve bodies and flanges are to be covered with anti-corrosive paint.
- * Replace lagging and cladding.

Trace Heating

- * Service the system to Delta 'T' instructions.
- * Witness operation by raising the thermostat set point and watch the system coming on with an ammeter. Return thermostat set point to initial setting

E.7.6.3 HVAC

E.7.6.3.1 Air Handlers

- * Clean fan impellers
- * Check upstream face (air inlet side) of the fin tube coils of the heating and cooling batteries to AAF McQuay's instructions. Clean, if required from downstream side (air outlet side) with compressed air.
- * Check for general painting and repaint if required.
- * Examine all sealing strips and renew if required.
- * Ensure that all fixings are tight enough.
- * Test insulation resistance of electric wiring and motor windings.

E.7.6.3 HVAC (Cont'd)

E.7.6.3.3 Fan Coil Units

- * Check insulation resistance of the wiring and electrical components to Diffusion's instructions
- * Check and clean externally and internally to Diffusion's instructions

Radiators

Clean overall and vent radiators

Fans

- * Clean fans overall
- * Test electrical insulation of wiring and motor windings.

E.7.6.4.3 C.W. Booster Sets

Follow Holden Brooke and Stuart Turner's instructions (as relevant) to conduct the following:-

- * Check the pressure at the Hydraulic Accumulator and rectify if required.
- * Examine the control panel overall for electrical soundness and functional performance for control and monitoring elements.

E.7.6.4.4 HWS

Calorifiers

Follow IMI Rycroft's instructions to carry out the following:-

1. Check correct operation of relief valves.
2. Check sacrificial anode. Substantially dissolved anodes should be replaced.
3. Check correct operation of the control thermostats.

Pipework

Isolating valves:

- * Check operation of valves to smoothly open and close.
- * Check stuffing glands and flanged joints for leakage and corrosion
- * Remove any corrosion from valve spindle and take up gland, adding valve packing where necessary. Lightly lubricate gland nuts and valve spindle.
- * Inspect all nuts, for erosion, clean and/or replace as necessary. Same as well as valve bodies and flanges are to be covered with anti-corrosive paint.
- * Replace lagging and cladding. Renew lagging and/or cladding if damaged.

Trace Heating

- * Service the system to Delta 'T' instructions.
- * Witness operation by raising the thermostat set point and watch the system coming on with an ammeter. Return thermostat set point to initial setting.

E.7.6.4.5 Sump Pumps

Observe Grundfos instructions to conduct the following service:

Replace oil (at 3000 operating hours or yearly whichever is earlier).The recommended oil is Shell Ordina 15.

Check impeller for wear. Replace defective parts.

Check shaft for noisy or heavy operation . Replace defective bearings.

NOTE: A general overhaul is usually required in case of defective bearings or poor motor functioning. This should be carried out by authorised Grundfos workshop.

E.7.6.5.1 Sprinklers

Follow Preussag's instructions in the Sprinkler's stand-alone Manual to carry out the yearly routine checks and inspections stipulated in BS 5306 part 2.

E.7.6.5.2 Hosereels

Follow Armstrong's instructions to conduct the following:-

- * Check the pressure at the Buffer Vessel and rectify if required.
- * Examine the control panel overall for electrical soundness and functional performance for control and monitoring elements.

E.7.6.5.3 Dry Risers

- * Check that air-valve is functioning properly.
- * Carry out a wet test using the topmost landing valve.
- * Record static and running pressures and inspect system for leaks.
- * Where and when it is impossible to carry out the test, note and report.
- * Carry out Hydraulic test. Allow static pressure test of 10 Bar to continue for 15 minutes, whilst checking for water leaks.

E.7.6.8 Control

1. With plant running, check Ammeter reading for all motors. Compare with commissioning data and note any divergence.
2. Make interior of panel safe by operating master isolator.
3. Examine all terminals for tightness. Check for any signs of overheating.
4. Examine all interconnecting wiring for signs of damage or overheated.
5. Examine contactors for freedom of operation. Clean contacts as required. Lubricate where required.
6. Check that plug-in devices, e.g. relays, timers, etc. are secure in their places.
7. Check that settings of overloads are compatible with motors being protected.
8. Check that fuse ratings are compatible with equipment or wiring being protected. Check that fuses are secure in their carriers and that carriers are secure in their holders.
9. When a control circuit transformer is used, check that output voltage is correct.
10. Check running times for all timers e.g. Star/Delta control etc.
11. Check setting of all time clocks.
12. Check all flexible wiring, e.g. between control cabinet and door, for fraying or other damage.
13. Ensure all indicator lights are operating. Renew where necessary.
14. Check security of all switches and isolators.
15. Clean panel internally and externally.
16. Close up panel and restore master isolator.
17. Report defects that require further in-depth attention.

E.7.7 Three Yearly Maintenance

E.7.7.5.1 Sprinklers

Follow Preussag's Sprinklers stand - alone Manual's instructions to carryout the 3 yearly checks and inspections stipulated in BS 5306 part 2.

E.7.8 15 Yearly Maintenance

E.7.8.5.1 Sprinklers

Follow Preussag's Sprinklers stand - alone Manual's instructions to carry out the 15 yearly checks and inspections stipulated in BS 5306 part 2.

1. The following shall be checked and recorded:
 - (a) All water and air pressure gauge readings on installations, trunk mains and pressure tanks, and
 - (b) All water level in elevated private reservoirs, rivers, canals, lakes, water storage tanks (including pump priming water tanks) and pressure tanks.
2. Water motor alarm test. Each water motor alarm shall be sounded for not less than 30 s.

COMMENTARY AND RECOMMENDATIONS

This verifies that the alarm will not ring intermittently. The test may also automatically test any fire brigade connection

3. Automatic pump starting test. Tests on automatic pumps shall include instructions to:
 - (a) Check the fuel and engine lubricating oil levels in diesel engines;
 - (b) Reduce water pressure on the starting device, thus simulating the condition of automatic starting,
 - (c) When the pump starts record the starting (cut-in) pressure, and check that this is correct.
 - (d) On diesel pumps, check the oil pressure where gauges are fitted, and the flow of cooling water through open circuit cooling systems.
4. Fire brigade and remote central station alarm connection. The equipment for automatic transmission of alarm signals from a sprinkler installation to a fire brigade or remote manned centre shall be checked for:
 - (a) Continuity of the connection
 - (b) Continuity of the connection between the alarm switch and the control unit.

If the circuits are continuously monitored.

E.7.8 15 Yearly Maintenance (Cont'd)

E.7.8.5.1 Sprinklers (Cont'd)

COMMENTARY AND RECOMMENDATIONS

The testing procedure should be agreed with the Fire Authority to avoid false calls. The fire service may carry out the test and may be prepared to give an undertaking to do so.

5. Trace heating and localised heating systems.

Heating systems to prevent freezing in the sprinkler system shall be checked for correct function.

E.8 MAINTENANCE PROGRAMME (E.7 Clauses)

Clause	System/Plant/Item	D	W	M	3M	6M	Y	3Y	15 Y
E7.1.0	General	X							
E7.1.1	LTHW	X							
E7.1.2	CHW	X							
E7.1.3	HVAC	X							
E7.1.4	Public Health	X							
E7.1.5.1	Sprinklers	X							
E7.2.1.1	Boilers		X						
E7.2.1.3	LPHW PU		X						
E7.2.2.1	Chillers		X						
E7.2.2.3	CHW PU		X						
E7.2.3.1	AHU's		X						
E7.2.3.4	Fans		X						
E7.2.4.2	HWS		X						
E7.2.5.1	Sprinklers		X						
E7.2.5.2	Hose reels		X						
E7.2.8	Controls		X						
E7.3.1	LPHW			X					
E7.3.2	CHW			X					
E7.3.3	HVAC			X					
E7.4.1	LTHW Water Treatment				X				
E7.4.2	CHW Water Treatment				X				
E7.4.3	HVAC				X				
E7.4.4	Public Health				X				
E7.4.5.1	Sprinklers				X				
E7.4.5.2	Hose reels				X				

E.8 MAINTENANCE PROGRAMME (E.7 Clauses) Cont'd

Clause	System/Plant/Item	D	W	M	3M	6M	Y	3Y	15 Y
E7.5.1.1	Boilers					X			
E7.5.1.2	LTHW Pumps					X			
E7.5.1.3	LPHW PU					X			
E7.5.1.4	LPHW Pipework					X			
E7.5.2.1	Chillers					X			
E7.5.2.2	CHW Pumps					X			
E7.5.2.3	CHW PU					X			
E7.5.2.4	CHW Pipework					X			
E7.5.3.1	AHU's					X			
E7.5.3.4	Dampers					X			
E7.5.4.3	CW Booster					X			
E7.5.4.4	Calorifier					X			
E7.5.4.5	Drainage					X			
E7.5.5.1	Sprinklers					X			
E7.5.5.2	Hose reels					X			
E7.5.5.3	Dry Risers					X			
E7.5.5.8	Controls								
E7.6.1	LPHW Plant						X		
	LPHW Pipework						X		
	Trace Heating						X		
E7.6.2	CHW Plant						X		
	CHW Pipework						X		
	Trace Heating						X		
E7.6.3.1	AHU's						X		
E7.6.3.3	FCU's						X		
E7.6.3.4	Fans						X		
E7.6.4.3	CW Booster						X		
E7.6.4.4	Calorifier						X		
	HWS Pipework						X		
	Trace Heating						X		
E7.6.4.5	Sump Pumps							X	

E.8 MAINTENANCE PROGRAMME (E.7 Clauses) Cont'd

[illegible]

E.9. SPARES LIST

<u>Supplier / Manufacturer</u>	<u>Plant/System Item</u>	<u>Spares</u>
Armstrong Via Preussag	HOSEREEL BOOSTERS	TBA
Diffusion Environmental Ltd.	FAN COIL UNITS	See Appended List
Grundfos Pumps Ltd	SUMP PUMPS	See Appended List
Guntner	DRY COOLERS	See Appended List
Hamworthy	BOILERS	See List in Hamworthy's Manual
Holden & Brooke Ltd	PUMPS, PRES. UNITS & C. W. BOOSTERS	See Appended List
IMI Rycroft Ltd	CALORIFIERS	See Appended List
Liff Industries	WATER CONDITIONERS	Control Panel & Pump for RN300
McQuay International (AAF) Ltd.	AIR HANDLERS	
	Filters	See GA Drawings
	Belts Supply Fan 3 No. SPZ940 (per AHU)	
	Extract Fans 2 No. SPZ900 (per AHU)	

E.10 TOOLS LIST

See Appended quotation from KEM EDWARDS Ltd.

E.8.1 ELECTRIC MOTORS

E.8.1.1 General

- a) Regular maintenance must be carried out, and the following programme takes precedence over other instructions unless it conflicts with those of the maker.
- b) All electric motors should be kept clean and dry.
- c) Some electric motors have self lubricated sleeve bearings or packed-for-life ball bearings, both of these contain sufficient lubricant for the economic life of the bearings. Alternatively they may require attention only at intervals of say 5 years.
- d) **WARNING:** Before carrying out maintenance work switch off the electric supply. This must be done from the starter. The isolator, which can be integral with the starter if local to the motor or separate and local to the motor, should then be switched off. This is a safety device provided for isolation purposes only, and it must never be used as a means of stopping or starting the motor, except in the event of an emergency.

E.8.1.2 Every Month

- 1. Unless the motor is fitted with self lubricated or packed-for-life bearings, check and if necessary lubricate all motor bearings in accordance with maker's instructions, taking care to prevent the entry of grit or dirt. Avoid over lubrication.
- 2. Check for leaks and remove all surplus lubricant spreading from the bearings. Replace seals if necessary.
- 3. All standby motors should be inspected, and spun a few turns by hand or electrically.

E.8.1.3 Every 3 Months

- 1. Blow out all motors except totally enclosed types with compressed air or hand bellows to remove dust and dirt.
- 2. Ensure that all flexible conduit connections are sound and all terminal nuts secure.

3. Inspect motors in damp situation or with difficult access; carry out insulation checks on both motor and wiring.
4. Check the operation of centrifugally operated switches (where fitted) of resistance and capacitor start motors; check contacts for undue wear.
5. Check for signs of overheating of, and leakage from, electrolytic capacitors (where fitted) to capacitor start motors.
6. Examine starter for cleanliness. Clean contacts using an approved lubricant. Abrasive materials must not be used to clean the contacts of contactors. Check the clean operation of the switching actions. Make sure the indicator lights and interlocks function properly. Check the timer settings (refer to separate instructions).

E.8.1.4

Every 8,000 Hours Running Time (12 Months)

1. On grease lubricated ball/roller bearing motors (except bearings packed for life), remove all old grease, wash out the bearings, housings, seals etc. with a suitable detergent.
2. Check bearings for wear; if necessary fit replacements.
3. Repack the bearings as in 1. above. First the bearing itself should be fully packed, then the housing should be one third filled with grease.

E.8.1.5

ANNUAL PROGRAMME

[illegible]

E.9.2 PACKAGED AIR HANDLING UNITS

E.9.2.1 General

- a) These instructions apply to the fan section of packaged air handling units. For maintenance instructions of other components e.g. dampers, filters, heating and cooling coils, humidifiers etc. included in the package, refer to makers' or separate instructions.
- b) Regular maintenance must be carried out and the following programme takes precedence over other instructions unless it conflicts with those of the makers.

**PLEASE REFER TO MANUFACTURER'S
MAINTENANCE INSTRUCTIONS, SECTION H.**

- c) Failure to adequately maintain fans or other equipment may result in inconvenience, discomfort, or even danger to the user; also perhaps loss of production and premature and costly replacement.
- d) **WARNING:** Before carrying out maintenance work switch off the electric supply.

E.9.2.2 Every Week

- 1. Check that the ammeter, if fitted, reads the correct value for the fan duty.
- 2. Check the condition and tension of belt drives.
- 3. Check grease lubricated plummer block bearings to ensure that there is no overheating or unusual noise.

E.9.2.3 Every Month

- 1. Examine the fan impeller for balance, damage, dirt or wear and take action as necessary.
- 2. Check that the anti-vibration mountings are securely bolted, free to move and functioning properly.

3. Inspect the belt drive for condition, pulley alignment and belt tension. Make sure pulleys are secure on their shafts. Refer to separate instructions.
4. Examine the flexible connections for airtightness and repair or replace as necessary.

E.9.2.4

Every 6 Months

1. Check that motor and fan mountings are secure and that assembly bolts between sections are tight.
2. If fan and/or motor have grease lubricated bearings these should be checked. Where external lubricators are provided, grease of an approved grade may be added sparingly by grease gun. Avoid over lubrication by temporarily removing surplus grease release plug if fitted.
3. Check the thermal and acoustic linings are in good condition and securely fixed. Repair or refix if necessary. Check that all access covers, removable panels etc., are securely closed and that their fixings are in good condition.
4. Clean the entire fan section including the impeller and make sure dirt and dust have been removed before restarting the fan.

E.9.2.5

Every Year

1. Inspect starter and controls wiring. Make sure the connections are tight. Check earth continuity and insulation resistance (by qualified electrician). Examine starter contacts and replace if burned or pitted.
2. Slacken off drive, remove and examine belts, paying particular attention to uneven wear on individual belts which could indicate misalignment or possible wear in bearings.
3. Remove all grease from fan bearings, thoroughly clean, check for wear by rocking and rotating shaft in bearings, fit replacements as necessary and relubricate. For electric motor maintenance refer to maker's or separate instructions.
4. Inspect for missing bolts, nuts, screws etc. and replace. Examine all metal surfaces, flanges etc. for damage or deterioration; clean and coat with protective paint as necessary.

[illegible]

E.9

SPARE PARTS LIST

Each Contractor is to provide a comprehensive list of recommended spare parts as per specification, to include model, part numbers and prices.

E.10 TOOLS LIST

<u>Item</u>	<u>Qty</u>	<u>Price</u>
<u>A Tools & Instruments</u>		
Boiler Test Kit (Brigon)	1	
Air Flow Meter	1	
Manometer	1	
Temperature & RH meter	1	
Hydrometer	1	
Micronta Digital Multimeter	1	
Megger Evershed & Vignoles Ltd. (JC No. 0277/460/B77/500V)	1	
Pr. Stillsons 18" Record	1	
Adjustable Wrench 15" Bahco 0674-375	1	
Superrcraft Pop Riviter	1	
Mole Grips	1	
Interlube Grease Gun (Push on Nozzle Nipple type)	1	
Wolf Hand Electric Drill (Model 2310 W475 - Ser.No.728A)	1	
Eclipse 20T Hacksaw	1	
Spear and Jackson Wood Saw, The Professional	1	
25mm Wood Chisel Marple S	1	
19mm Wood Chisel Marple	1	
13mm Wood Chisel Marple	1	
6mm Wood Chisel Marple	1	
Tap Wrench Presto No. 101 1/8" - 1/2"	1	
JoJo MK20 250V-13A, Extension Lead	1	
Briticent Gripper Hand Lamp 240V 100w	1	
Oil Can wesco 3320	1	
Set of Presto Drills 1/16" - 1/2" x 1/32	1	
Set Presto Drills 1-13mm x 0.5mm	1	
Chloride Torch	1	
Half round files 10	2	
Flat Files 10"	4	
Round Files 10"	2	
Eclipse Cold Chisel 3/4"	1	

E.10 TOOLS LIST (Cont'd)

<u>Item</u>	<u>Qty</u>	<u>Price</u>
Eclipse Cold Chisel 1"	1	
Eclipse Cold Chisel ½"	1	
Taymar Butane Gas Blow Lamp	1	
Masonry Drills:		
No.8	3	
No.10	3	
No.12	3	
No.14	3	
Jack and Handle	1	

BENSON ENVIRONMENTAL LTD
SPARE PARTS LIST

13/10/98

Product **HIGHLINE AH 12**
Medium **HW/CW**
Stock Code **FC-000980/1**
Project **5-7 CARLTON GDN**

COMPONENT PARTS:			
Stock Code	Qty	Description	Unit Price (£)
COIL-0155	1	COOLING COIL SIZE 12	116
COIL-5434	1	HEATING COIL SIZE 12	33
MOTR-0011	1	90W MOTOR C/W CAPACITOR LOT-54541-888	77
FANS-0052	2	FAN ASSY	27
ELEC-5380	1	TRANSFORMER (STEP) 24V RBM 5278	22
ELEC-0504	1	STAEFA ACTUATOR A1L150	73
ELEC-1087	3	ACTUATOR FIX KIT	23

ALL PRICES EXCLUDE CARRAGE AND VAT BUT MAY BE SUBJECT TO PRICE INCREASE IN THE FUTURE.

SHOULD YOU REQUIRE MORE INFORMATION OR A QUOTATION ABOUT SPARE PARTS OR SERVICE/MAINTENANCE OF ANY OF OUR PRODUCTS, PLEASE CONTACT OUR SPARES & SERVICE DEPARTMENT AS BELOW OR FAX DIRECTLY ON 0181-979-2465.

A MEMBER OF BENSON GROUP PLC

BENSON ENVIRONMENTAL LIMITED
47 CENTRAL AVENUE
WEST MOLESEY
SURREY KT8 2QZ

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96001381-AP70.80.19.3EX COMPONENT PRICE LIST

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GRUNDFOS 

96001363

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[illegible]

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SPARE PARTS FOR GUNTNER DIM WOWER

MODEL: GFH-

Qty

- ① FAN Assembly 090.FC. L. £ 890.- Each. 1
- ② Gunther GST electronic step control £490.. Each 1
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RECOMMENDED SPARES LIST

DRAKE & SCULL ENGG LTD

SALES ORDER NO :S30299

REQUEST DATE :13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

FINAL ASSEMBLY PUMP NUMBER : HPB3+1/3RVL18+1RVL4

DESCRIPTION	PART NUMBER	QUANTITY	PRICE
S30299			
1x Seal KIT 18-S	RPV	1	150.00
1x " " 4-8.	RPV	1	150.00

S30300

1x Seal KIT 18-S	RPV	1	150.00
1x " " 2-7.	RPV.	1	150.00

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A

HOLDEN AND BROOKE
WENLOCK WAY
GORTON
MANCHESTER M12 5JL

RECOMMENDED SPARES LIST

DRAKE & SCULL ENGG LTD

SALES ORDER NO :S30287

REQUEST DATE :13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

FINAL ASSEMBLY PUMP NUMBER : B150315N200

DESCRIPTION	PART NUMBER	QUANTITY	PRICE
JOINT 394 O/D X 380 I/D X1.6TH	K2011/70	1	8.15
SEAL 60DIA (LT) FOR WATER PH7	K2008/14	1	249.00

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A

HOLDEN AND BROOKE
WENLOCK WAY
GORTON
MANCHESTER M12 5JL

RECOMMENDED SPARES LIST

DRAKE & SCULL ENGG LTD

SALES ORDER NO :S30288

REQUEST DATE :13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

FINAL ASSEMBLY PUMP NUMBER : B150250N160

DESCRIPTION	PART NUMBER	QUANTITY	PRICE
JOINT 294DIA X 274I/D X 3 THK	K2011/41	1	3.80
SEAL 2100 50MM DIN24960	K2008/210	1	120.00

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A

HOLDEN AND BROOKE
WENLOCK WAY
GORTON
MANCHESTER M12 5JL

RECOMMENDED SPARES LIST

DRAKE & SCULL ENGG LTD

SALES ORDER NO :S30289

REQUEST DATE :13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

FINAL ASSEMBLY PUMP NUMBER : B080165N100/112

DESCRIPTION	PART NUMBER	QUANTITY	PRICE
JOINT 199DIA X 183I/D X 3THK	K2011/39	1	2.35
SEAL 2100 40MM DIN24960	K2008/209	1	81.00

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A

HOLDEN AND BROOKE
WENLOCK WAY
GORTON
MANCHESTER M12 5JL

RECOMMENDED SPARES LIST

DRAKE & SCULL ENGG LTD

SALES ORDER NO :S30290

REQUEST DATE :13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

FINAL ASSEMBLY PUMP NUMBER : B100200N132

DESCRIPTION	PART NUMBER	QUANTITY	PRICE
JOINT 231DIA X 216I/D X 3THK	K2011/40	1	3.20
SEAL 2100 40MM DIN24960	K2008/209	1	81.00

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A

HOLDEN AND BROOKE
WENLOCK WAY
GORTON
MANCHESTER M12 5JL

RECOMMENDED SPARES LIST

DRAKE & SCULL ENGG LTD

SALES ORDER NO :S30291

REQUEST DATE :13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

FINAL ASSEMBLY PUMP NUMBER : B065125N80

DESCRIPTION	PART NUMBER	QUANTITY	PRICE
JOINT 165DIA X152I/D X 3.2THK	K2011/38	1	2.35
SEAL 2100 30MM DIN24960	K2008/208	1	39.00

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A



HOLDEN and BROOKE

L I M I T E D

MANCHESTER M12 5JL

RECOMMENDED SPARES LIST
Wenlock Way, Manchester, M12 5JL, England

DRAKE & SCULL ENGINE LTD Telephone 0161 223 2223 Fax 0161 220 9660
SALES ORDER NO : S30292
REQUEST DATE : 13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

FINAL ASSEMBLY PUMP NUMBER : B065160N90

DESCRIPTION	PART NUMBER	QUANTITY	PRICE
JOINT 199DIA X 183I/D X 3THK	K2011/39	1	2.35
SEAL 2100 30MM DIN24960	K2008/208	1	39.00
ADAPTOR NO.1 SEAL MK 1	K2086/1	1	8.60
O RING 44.5ID X 3DIA SECT	K1003/78	1	0.80

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A



Manufacturers of Quality Pumps & Packaged Sets

REGISTERED IN ENGLAND NO. 2479694 REGISTERED OFFICE MANCHESTER M12 5JL



HOLDEN AND BROOKE
WENLOCK WAY
GORTON
MANCHESTER M12 5JL

RECOMMENDED SPARES LIST

DRAKE & SCULL ENGG LTD

SALES ORDER NO :S30293

REQUEST DATE :13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

FINAL ASSEMBLY PUMP NUMBER : B065160N90

DESCRIPTION	PART NUMBER	QUANTITY	PRICE
JOINT 199DIA X 183I/D X 3THK	K2011/39	1	2.35
SEAL 2100 30MM DIN24960	K2008/208	1	39.00
ADAPTOR NO.1 SEAL MK 1	K2086/1	1	8.60
O RING 44.5ID X 3DIA SECT	K1003/78	1	0.80

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A

HOLDEN AND BROOKE
WENLOCK WAY
GORTON
MANCHESTER M12 5JL

RECOMMENDED SPARES LIST

DRAKE & SCULL ENGG LTD

SALES ORDER NO :S30294

REQUEST DATE :13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

FINAL ASSEMBLY PUMP NUMBER : TL50-80

DESCRIPTION	PART NUMBER	QUANTITY	PRICE
SEAL 25DIA (LT)	K2008/127	2	38.50
O RING L50/65 (1345-30) BS4518	K2123/16	2	1.10
TOLERANCE RING HV 19 X 10 REV1	K2216/3	2	1.00
BOLT M6 X 40 CAP SKT HD SS	K3133/06040	2	0.00

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A

HOLDEN AND BROOKE
WENLOCK WAY
GORTON
MANCHESTER M12 5JL

RECOMMENDED SPARES LIST

DRAKE & SCULL ENGG LTD

SALES ORDER NO :S30295

REQUEST DATE :13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

FINAL ASSEMBLY PUMP NUMBER : T050160N80

DESCRIPTION	PART NUMBER	QUANTITY	PRICE
JOINT 199DIA X 183I/D X 3THK	K2011/39	2	2.35
SEAL 2100 30MM DIN24960	K2008/208	1	39.00
ADAPTOR NO.1 SEAL MK 1	K2086/1	1	8.60
O RING 44.5ID X 3DIA SECT	K1003/78	1	0.80

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A

HOLDEN AND BROOKE
WENLOCK WAY
GORTON
MANCHESTER M12 5JL

RECOMMENDED SPARES LIST

DRAKE & SCULL ENGG LTD

SALES ORDER NO :S30296

REQUEST DATE :13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

FINAL ASSEMBLY PUMP NUMBER : YMIDI54

DESCRIPTION	PART NUMBER	QUANTITY	PRICE
MICROPROCESSOR CONTROLLER	K2112/52	1	305.30
230V TRANSFORMER c/w 320mm LG.	K2112/53	1	54.50
TRANSDUCER - PRESSURE 0-10 BAR	K2176/2	1	116.60

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A

HOLDEN AND BROOKE
WENLOCK WAY
GORTON
MANCHESTER M12 5JL

RECOMMENDED SPARES LIST

DRAKE & SCULL ENGG LTD

SALES ORDER NO :S30297

REQUEST DATE :13/10/98

REDCLIFFE HSE (USE OR/NO 129/M
10, WHITEHOUSE STREET.
BRISTOL
BS3 4AU

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TRANSDUCER - PRESSURE 0-10 BAR	K2176/2	1	116.60

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TF749 ISSUE A

HOLDEN AND BROOKE
WENLOCK WAY
GORTON
MANCHESTER M12 5JL

RECOMMENDED SPARES LIST

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TRANSDUCER - PRESSURE 0-10 BAR	K2176/2	1	116.60

If at any time you wish to order any of the above, please tick the parts you require and send to the above address.

TF749 ISSUE A

Fax Message



Rycroft

Heating the world's water

Message No :
Company : Drake & Scull
Attention of : Joseph
From : Sales
Date : 08 October 1998
Ref : A.S.1010, W/O-99235/1.
Sheet No : 1/1
Project : 5/7 Carlton Gardens.

Rycroft Ltd.
Duncombe Road, Bradford
England BD8 9TB
Tel: 01274 490911
Int: +44 1274 490911
Fax: 01274 482565
Int: +44 1274 482565

Regarding our conversation earlier, please find to follow recommended spares for the calorifiers you have :

Yearly Inspection :

1 x Manhole Gasket, Type 455mm BRMH,
Price £24

1 x Battery Gasket Set, Type 255mm.
Price £23

Minimum Order Charge £60

Best Regards,
Adam Shackleton.
Sales Office.

QUOTATION

VAT Reg. No. GB 211 7424 03



KEM EDWARDS LTD.

CABLE MANAGEMENT · FIXINGS & FASTENINGS · HAND & POWER TOOLS
 EDSON HOUSE · 143 HERSHAM ROAD · WALTON-ON-THAMES · SURREY · KT12 1RR
 Telephone: WALTON-ON-THAMES (01932) 227700 (5 Lines) Fax: (01932) 244095

DOCUMENT Q 995269
NUMBER

TO: JOSEPH.

DRAKE & SCULL ENGINEERING LTD
 DRAKE & SCULL HOUSE
 THURSTON ROAD
 GREAT BARTON BURY ST. EDMUNDS
 SUFFOLK IP31 2PJ



DELIVER TO:

DRAKE & SCULL ENGINEERING LTD
 DRAKE & SCULL HOUSE
 THURSTON ROAD
 GREAT BARTON BURY ST. EDMUNDS
 SUFFOLK IP31 2PJ

3 PAGES

ALL QUERIES RELATING TO THIS INVOICE MUST BE
 RECEIVED BY US IN WRITING WITHIN SEVEN DAYS

ACCOUNT		INSTRUCTIONS	SALES REF.	PICKED BY	CHECKED BY	YOUR ORDER REF.			DELIVERY REF.		DATE	
DRA017						Q 995269					24.09	
PRODUCT CODE	PRODUCT DESCRIPTION		YOUR ORDER	DELIVERY	OUR ORDER	QUANTITY SENT	QUANTITY ORDERED	QUANTITY TO FOLLOW	PRICE	UNIT	DISCOUNT	NET AMOUNT
REC30018	RECORD 18" PIPE WRENCH			24.09.98		1			32.67	EACH		32.67
66	BAH8074 15" ADJUSTABLE			24.09.98		1			34.00	EACH		34.00
19782	DRAPER 2 WAY RIVETER			24.09.98		1			18.50	EACH	30.00	12.90
35368	7" SELF GRIP PLIERS(=36368)			24.09.98		1			6.28	EACH	30.00	4.40
57734	LEVER GREASE GUN			24.09.98		1			20.24	EACH	30.00	14.10
GSB16RE-1	BOSCH IMPACT DRILL 110V			24.09.98		1			130.00	EACH	40.00	28.00
31131	12" HACKSAW FRAME			24.09.98		1			11.88	EACH	30.00	8.88
11399	22" HARDPOINT SAW			24.09.98		1			12.68	EACH	30.00	8.68
MAR4441	1 MARPLES CHISEL			24.09.98		1			12.07	EACH	25.00	9.57
MAR44434	3/4 MARPLES CHISEL			24.09.98		1			11.01	EACH	25.00	8.51
MAR44412	1/2 MARPLES CHISEL			24.09.98		1			9.87	EACH	25.00	7.37
MAR44414	1/4 MARPLES CHISEL			24.09.98		1			9.35	EACH	25.00	7.35
36305	TAP WRENCH 1.6-13MM PACKED			24.09.98		1			6.38	EACH	30.00	4.00
35134	25M 240V EXTENSION LEAD			24.09.98		1			38.36	EACH	30.00	26.36
27640	INSPECTION LAMP			24.09.98		1			21.98	EACH	30.00	11.98
21718	300ML OIL CAN			24.09.98		1			5.24	EACH	30.00	3.00
(Cont'd).....												

(Cont'd)....

VAT CODE	GOODS VALUE	RATE	VAT AMOUNT	Certificate of Conformity
				It is hereby certified that the whole of the supplies detailed hereon have been inspected, tested and conform in all respects to the contract or order.
				Signed _____ Date _____
				Position _____
				For and on behalf of KEM EDWARDS LTD

TERMS: NET 30 DAYS

NOTE: The Contract for the sale of these goods incorporates our terms and conditions of sale, a copy of which is available on application.
 Certificate of conformity only valid if signed by a duly authorised person.

FOR

QUOTATION

VAT Reg. No. GB 211 7424 03



KEM EDWARDS LTD.

CABLE MANAGEMENT · FIXINGS & FASTENINGS · HAND & POWER TOOLS

EDSON HOUSE · 143 HERSHAM ROAD · WALTON-ON-THAMES · SURREY · KT12 1RR

Telephone: WALTON-ON-THAMES (01932) 227700 (5 Lines)

Fax: (01932) 244095

DOCUMENT Q 995269
NUMBER

TO:

DRAKE & SCULL ENGINEERING LTD
DRAKE & SCULL HOUSE
THURSTON ROAD
GREAT BARTON BURY ST. EDMUNDS
SUFFOLK IP31 2PJ



DELIVER TO:

DRAKE & SCULL ENGINEERING LTD
DRAKE & SCULL HOUSE
THURSTON ROAD
GREAT BARTON BURY ST. EDMUNDS
SUFFOLK IP31 2PJ

ALL QUERIES RELATING TO THIS INVOICE MUST BE
RECEIVED BY US IN WRITING WITHIN SEVEN DAYS

ACCOUNT	INSTRUCTIONS	SALES REF.	PICKED BY	CHECKED BY	YOUR ORDER REF.			DELIVERY REF.		DATE	
DRA017					Q 995269					24.09.9	
PRODUCT CODE	PRODUCT DESCRIPTION	YOUR ORDER	DELIVERY	OUR ORDER	QUANTITY SENT	QUANTITY ORDERED	QUANTITY TO FOLLOW	PRICE	UNIT	DISCOUNT	NET AMOUNT
	....(Cont'd)										
HSET	GX 19 PCE HSS DRILL SET		24.09.98		1			26.68	EACH	50.00	13.34
66	46052 IMPERIAL HSS SET		25.09.98		1			69.98	EACH	30.00	48.99
WT	WATERPROOF LANTERN TORCH		25.09.98		1			13.00	EACH	30.00	9.10
4R25	4R25 H.D. 6 VOLT BATTERY		25.09.98		1			181.00	EACH	30.00	1.27
10HRF	10" SECOND CUT HALF-ROUND FILE		25.09.98		2			6.48	EACH	30.00	9.07
10FF	10" SECOND CUT FLAT FILE 12086		25.09.98		4			4.56	EACH	30.00	12.77
10RF	10" SECOND CUT ROUND FILE 12141		25.09.98		2			3.96	EACH	30.00	5.54
F2	FILE HANDLE NO.2 (33528)		25.09.98		8			0.68	EACH	30.00	3.81
12042	8" COLD CHISEL		25.09.98		1			3.56	EACH	30.00	2.49
52023	8"X1" COLD CHISEL		25.09.98		1			5.40	EACH	30.00	3.78
12040	6" COLD CHISEL		25.09.98		1			2.10	EACH	30.00	1.47
3.5501	ROTTENBURGER EUROSET TORCH		25.09.98		1			21.20	EACH	10.00	19.08
KS5XSTD	STRAIGHT SHANK MASONRY BIT		25.09.98		3			0.78	EACH	50.00	1.17
KS5.5XSTD	STRAIGHT SHANK MASONRY BIT		25.09.98		3			0.80	EACH	50.00	1.20
KS6XSTD	STRAIGHT SHANK MASONRY BIT		25.09.98		3			0.68	EACH	50.00	1.02
	(Cont'd)....										

VAT CODE GOODS VALUE RATE VAT AMOUNT

Certificate of Conformity

It is hereby certified that the whole of the supplies detailed hereon have been inspected, tested and conform in all respects to the contract or order.

Signed _____

Position _____

Date _____

For and on behalf of KEM EDWARDS LTD

NOTE: The Contract for the sale of these goods incorporates our terms and conditions of sale, a copy of which is available on application.

TERMS: NET 30 DAYS

FORM 1

QUOTATION

VAT Reg. No. GB 211 7424 03



KEM EDWARDS LTD.

CABLE MANAGEMENT · FIXINGS & FASTENINGS · HAND & POWER TOOLS

EDSON HOUSE · 143 HERSHAM ROAD · WALTON-ON-THAMES · SURREY · KT12 1RR

Telephone: WALTON-ON-THAMES (01932) 227700 (5 Lines)

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DOCUMENT Q 995269
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TO:

DRAKE & SCULL ENGINEERING LTD
DRAKE & SCULL HOUSE
THURSTON ROAD
GREAT BARTON BURY ST. EDMUNDS
SUFFOLK IP31 2PJ



DELIVER TO:

DRAKE & SCULL ENGINEERING LTD
DRAKE & SCULL HOUSE
THURSTON ROAD
GREAT BARTON BURY ST. EDMUNDS
SUFFOLK IP31 2PJ

ALL QUERIES RELATING TO THIS INVOICE MUST BE
RECEIVED BY US IN WRITING WITHIN SEVEN DAYS

ACCOUNT	INSTRUCTIONS	SALES REF.	PICKED BY	CHECKED BY	YOUR ORDER REF.			DELIVERY REF.		DATE		
DRA017					Q 995269					24.09.98		
PRODUCT CODE	PRODUCT DESCRIPTION	YOUR ORDER	DELIVERY	OUR ORDER	QUANTITY SENT	QUANTITY ORDERED	QUANTITY TO FOLLOW	PRICE	UNIT	DISCOUNT	NET AMOUNT	VAT
	....(Cont'd)											
KS6.5XSTD	DUAL PURPOSE BIT		25.09.98		3			0.90	EACH	50.00	1.35	
37173	2T JACK		25.09.98		1			65.00	EACH	30.00	45.50	

VAT CODE	GOODS VALUE	RATE	VAT AMOUNT	Certificate of Conformity	TOTAL
				It is hereby certified that the whole of the supplies detailed hereon have been inspected, tested and conform in all respects to the contract or order.	456.44
				Signed _____	
				Position _____ Date _____	
				For and on behalf of KEM EDWARDS LTD	

NOTE. The Contract for the sale of these goods incorporates our terms and conditions of sale, a copy of which is available on application.

TERMS: NET 30 DAYS

F

F SYSTEM RECORDS

F.1 EXPECTED SERVICE LIFE

Expected service life of all major plant elements are as follows, assuming that they are properly maintained to manufacturers instructions:-

<u>Plant Element</u>	<u>Estimated Life Expectancy</u>
Dampers	10 Years
Storage Tanks	25 Years
Hosereel Pump	20 Years
Fan Coil Units	15 Years
Dry Coolers	20 Years
Boilers	20 Years
LTHW & CHW Pumps	15 Years
Pressurisation Units	15 Years
CW Boosters	15 Years
Water Conditioners	10 Years
Air Handling Units	15 Years
Chillers	20 Years

F.2 CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH C.O.S.H.H. REGULATIONS 1996

The Control Of Substances Hazardous To Health Regulations 1996, applies to all substances that are capable of causing adverse health effect and includes chemicals, biological agents, carcinogens, dust, allergens etc. Five categories of hazardous substances are specifically defined as follows:

- a) Substances classified as harmful, irritant, toxic, very toxic or corrosive under the Chemicals, (Hazard Information and Packaging For Supply) Regulations 1994.
- b) Substances that have a maximum exposure limit listed in the COSHH Regulations or an occupational exposure standard assigned to them by the HSE;
- c) Biological agents capable of causing any ill-health effect, in any micro-organism, human endo-parasite etc, that may cause infection, allergy, toxicity or any other human health hazard;
- d) Substantial quantities of dust;
- e) Non-specified substances that may create a comparable health risk.

The Regulations do not apply to hazards associated with the physical properties of substances, e.g. flammability, explosivity, temperature or pressure where the risk is to safety rather than health. Lead, asbestos and ionising radiation are covered by specific legislation.

COSHH requires employers to:

- a) Asses the risks posed by exposure to hazardous substances in the workplace;
- b) Prevent, or at least adequately control these risks;
- c) Provide, maintain, test and examine suitable control measures and ensure that they are used;
- d) Monitor workplace exposure against the prescribed exposure limits, where appropriate;
- e) Provide health surveillance, where appropriate.
- f) Provide relevant information, instruction and training to employees.

F 2 DISPOSING OF ITEMS

It is required that a qualified specialist disposes of items which are hazardous to health.

Generally, to safely dispose of relevant plant items, the Manufacturers literature and COSHH Data Sheets should be consulted for instructions. Few items are given below for guidance only.

A. ROCKWOOL INSULATION

Old insulation, when replaced, should be placed in impermeable heavy duty polythene bags for usual disposal.

Refer to Manufacturers/Suppliers COSHH Data Sheets.

B. AIR FILTERS

When changing air filters, used filters could liberate dust at substantial concentration as covered by C.O.S.H.H. Regulations 1996.

It is recommended that persons engaged in filter maintenance operations should wear protective clothing and face masks/respirators to prevent inhalation.

Used filters should be placed in plastic bags to prevent inhalation, and disposed of to the Local Authority's requirements.

For further information see the supplier COSHH Data Sheets.

C. BOILER SEALS/INSULATION Etc.

For handling health hazards see Hamwothy's literature, and seek their advice if in doubt.

D. REFRIGERANT

Best to recover and recycle using a Recovery Unit

If disposal is necessary, destruction should be in an approved facility which is equipped to absorb and neutralise acid gases and other toxic processing products. For further instruction and/or transitional storage vessel and dispatch to their works. contact ICI.

For additional in-depth information see ICI Klea COSHH Data Sheets.

E. CHILLER LUBRICATING OIL

The product is suitable for burning in an enclosed, controlled burner for fuel or by supervised incineration. Contact Mcquay for details.

See SUNISO COSHH Data Sheets.

DIRECTORY OF SPECIALISTS AND DISPOSAL SERVICES

**REFER TO WESTMINSTER CITY COUNCIL (Telephone No. 0171 641 6000)
FOR LIST OF SPECIALISTS**