

Section 3

Operating Procedures

3.01 GENERAL INFORMATION

This section deals with the pre-operational checks, start-up, normal operation and shut-down of the building service systems in general terms. It is important that the operating engineer is fully conversant with the systems, with the system routes, equipment locations, and the 'As Installed' record drawings. The design of the installed circuits and equipment ensures their automatic operation. The following points are for advice only. The order in which they are given has no particular order of priority.

Before starting-up, it is essential to make yourself aware of the system's function and the operation of the installed plant. Refer to all the available manufacturers' instructions, manufacturers' operating manuals and drawings. Carry out a general inspection to ensure that the plant and the systems are serviceable and safe to operate. The following are general instructions and should be carried out where applicable.

PLEASE NOTE NOTHING SHOULD BE HURRIED.

3.02 PREPARATION FOR START-UP

The procedures in this section are used for the initial start-up of the building services installation or restart of a particular system after a long-term shutdown for maintenance and repair. It is assumed that the automatic control system and component items are functioning correctly and the plant is selected to **OFF**.

Prepare the plant and equipment's electrical switchgear for operation. Check that the electrical supply is available to the relevant plantroom and the plant distribution fuse boards. Ensure that all fuses are correctly rated and in place. Switch all local electrical isolators and all control panel switches **OFF** and check that, where possible, all electrical switchgear contact faces and springs are in a good serviceable order. Ensure that all the control items are in place and the control settings are correct. It is essential to log and record all control points and their settings. Alert ALL personnel connected with running, maintaining or administering the systems regarding starting the systems.

Section 3/Operating Procedures

Check fuse switches and switch fuses for any signs of damage, excessive wear, loose screws or badly burned contacts. Check the operation of the mechanism and interlocks. Mechanism pivots and bearings should be lightly oiled. Wipe up any excess. Clean out any dust or dampness, particularly on or around insulation.

Check instrument, meter and relay settings and adjust as necessary all protection relays, trips and overload devices. Ensure that all protective devices, auxiliary and control equipment, (including closing contactors, anti-pump relays, timers and synchronising equipment) are in sound working order and their operation results are correct for the equipment they control. Check that fuse fixings are properly tightened on all fused equipment, e.g. fuse switches, fuse distribution boards, motor starters, control circuits. Any fuses showing obvious signs of overheating, e.g. blackened terminals, should be replaced after ascertaining and correcting the reasons for overheating.

Ensure that the installed system is complete and hydraulically tested. Ensure that the system is filled with water, that all drain points are shut, and all air pockets/valves vented.

Check that the chilled water system is ready to operate and the necessary valves are open.

Ensure that main services, water, gas and electricity are all available to plant and equipment, as required.

Inspect all ventilation ductwork to establish that the systems are complete. Check that all access doors and seals are secure. Inspect that the flexible connections are safe and complete. Ensure that all inlet and discharge louvres, grilles, and diffusers are in place and unobstructed.

Check that fan shafts, key ways, nuts and bolts are in good condition and safe, and the fan is free to run. Where possible turn the fan by hand to ensure it is free to rotate and the impeller does not foul the fan casing.

Check that belt drives are in a good, clean condition and tensioned correctly. Ensure that 'PRIME MOVERS' (motors, belts and fan drivers) are securely guarded.

CAUTION:

ATTENTION IS DRAWN TO SECTION 12(1) OF THE FACTORIES ACT 1961, WHICH STATES THAT IT IS AN OFFENCE TO RUN ANY 'PRIME MOVER' WITHOUT BEING SECURELY GUARDED.

Ensure that all the ventilation system fire dampers are open and set correctly. Make sure that all main, branch and other control dampers are either fully open/closed or adjusted to the required commissioning results. Under no circumstances alter settings of balancing dampers. Check that the ventilation damper drives are free and that the blade linkage system is lubricated with a light petroleum grease.

Section 3/Operating Procedures

HUMIDIFIERS

- Check that mains cold water is available to the humidifier break tank, the isolating valve to this tank is open, and the water level in the tank is correct.
- Check the humidifier drains are not blocked.

Ensure that the ventilation grilles, diffusers and terminal units are correctly operating. Grilles and diffusers have been adjusted by the commissioning engineers and their respective dampers must NOT be altered. Altering grilles will upset air distribution and cause unnecessary draughts.

COMPRESSED AIR

- Check all compressed air lines and equipment for signs of chafe and cracking, especially flexible hoses, to establish the system is sound.
- Make a thorough inspection of the air compressor ensuring that no foreign matter is present, that anti-vibration mountings where fitted, are in good condition and free to operate, and lubricating oil levels are correct.
- If the compressed air system is controlled under an automatic 'LOW-AIR' signal, it is necessary to check that it continues to operate automatically.
- Check the compressor air cooling fan air intake for obstructions. If the system is shut down for a long period, blank this off to stop the ingress of foreign matter.
- At start-up, ensure vents and drains are clear on the inter and after coolers.
- Ensure that cooling water valves to the inter and after coolers are fully open. Refer to manufacturer's operating manual if a restricted supply is necessary.
- Ensure that the bearing and cylinder lubricating systems are operating. For small compressors and diaphragm compressors, external supply of lubrication is not necessary.
- Check the completion of the manufacturer's Compressor Unit Start-up Procedures and Commissioning/Test Certificates.
- Inspect the moisture separators and filters on compressed air outlets to ensure they are clean. Remember that insufficient air pressure or air flow will reduce efficiency. Check moisture separators and air traps on the pipework distribution system.

FIRE ALARM - IN CASE OF FIRE

Once an alarm condition starts the following conditions will apply:

- ✓ All external sounders activated
- ✓ Firecheck control panel internal buzzer sounding
- ✓ ZONE and FIRE lamps lit

IMMEDIATELY INSTIGATE THE FIRE PROCEDURE RECOMMENDED FOR THESE PREMISES

When considered safe, the sounders may be silenced by an authorised person with the proper key, pressing the ALARM SILENCE switch. This will cause the SILENCED lamps to light up. All other indications will remain operative.

Following the emergency, the fire alarm system may be reset by inserting and turning the key, and pressing the reset switch. This should extinguish all indicators except the ON lamp. If BREAK GLASS CALLPOINTS or FUSIBLE HEAT DETECTORS are activated by the emergency, reinstate these before resetting the system.

Ensure distribution board charts are complete and in place and that all MCB's are correctly sized and set. Before switching ON the mains, switch OFF all fused switches and outlets so that the electrical loading can be gradual and sequential to prevent a maximum demand causing the supply to cut-out. Any circuit or supply not required must be 'locked off' safely in accordance with the manufacturers' requirements and the IEE regulations. Add a prohibition/warning notice to any 'locked off' supply advising of the reason.

Before switching on any circuit ensure the following are checked and completed.

1. Restrict access to switchrooms, plantrooms and all areas where the supply emanates from and to the areas served. Only engineering staff connected with and working with the electrical supply require access.
2. Before making any circuit LIVE equipment and outlets must be checked to ensure connections, switchgear, fuses/MCB's, isolators are all installed, serviceable and safe to operate.
3. Check that a test certificate has been recorded for the circuit. This point obviously applies to modifications carried out to any electrical circuit. The IEE Regulations require a test certificate be recorded for the whole circuit, original and modifications.
4. Switch OFF all outlets, equipment, plant, circuits, sub-circuits in readiness to reinstate or provide the electricity supply.

WARNING:

ELECTRICITY CAN KILL. IF IN DOUBT DO NOT SWITCH ON. A BAD CONNECTION, INSUFFICIENT EARTHING, FORGOTTEN CONNECTIONS CAN

Section 3/Operating Procedures

5. Switch ON the supply, and check where ammeters and voltmeters are fitted, that the supply is as it should be. If not switch OFF and investigate.
 6. When the supply is satisfactory then switch the circuits ON in a pre-determined order. Prepare a list and tick off as each circuit is energised regarding any further actions required. Allow a little time (30-60 secs min) between each circuit switching.
 7. Each outlet and piece of equipment can now be energised as required.
- WHEN ready, switch the plant and its separate components ON and select for AUTOMATIC operation. Follow the correct starting sequence unless it is fully automated.

3.03 NORMAL OPERATION

The automatic control system operation, described elsewhere, details the AUTOMATIC operation of the plant and its associated system. It is, however, necessary to check that the control system continues to operate automatically. It is also necessary to carry out the routine preventive maintenance procedures to monitor the plant's operation and to reduce the possibility of equipment failure.

- 'RUN' indications show the selected plant is operating correctly.
- 'TRIP' (sometimes noted 'FAULT') indication gives visual indication of failure in the operation of the selected plant.
- 'HAND' (sometimes noted 'MANUAL') selected plant will operate without any automatic control elements and equipment.
- 'OFF'. No operating signal/selection given.
- 'AUTO' selected plant will operate under the authority of all automatic control elements and equipment.

3.04 OPERATING PROCEDURES

Operating procedures are summarised as follows:

AIR CONDITIONING SYSTEM OPERATING PROCEDURES

PREPARE SYSTEM FOR OPERATION

- See that the time switches, if fitted, are set to the required programme, and also to the correct time of day. Remember British Summer Time changes.
- Check that all air inlet and discharge louvres are free from obstruction.
- Check that filter medium is suitable for operation.
- Check damper motorised drive unit for correct operation on air inlets and air outlets to plant by checking quadrant positions on the dampers.
- Check fan belt drives are serviceable and tensioned correctly.

Section 3/Operating Procedures

- *If possible manually rotate supply fan to ensure unimpeded movement. If not override control sequences and momentarily operate the fan.*
- *Ensure that all system dampers are in their pre-set 'system- balanced' position.*
- *Check all system fire dampers are opened and that fusible links are set in place correctly.*
- *Inspect fan coil units to ensure that filters are clean and in place. Select desired fan coil unit operating speed.*
- *Check condensate drains are clear, clean and the traps are charged with water.*

TO BRING SYSTEM INTO ACTION

- *Ensure the system has been commissioned and is set to operate correctly.*
- *Start the supply fans on HAND (manual) control.*
- *Start the extract fans on HAND (manual) control.*
- *Check each supply and extract fan in turn and ensure smooth, vibration-free operation, with the absence of undue noise.*
- *When supply and extract fans have achieved normal operation, switch each to AUTO operation.*
- *When all plant operation has been established, the appropriate time switch or controller should be set-up to control the desired periods of operation.*
- *Check pressure differential across filters. This should be no more than 50Pa.*
- *Start the fan coil units individually; select the required operating speed, and check that each unit responds appropriately to satisfy the local area temperature demanded.*
- *Check, by walking through selected areas of the building, that the noise level is acceptable and the room temperatures are satisfactory.*
- *Start and operate humidifier in accordance with manufacturer's instructions.*

TO SHUT DOWN SYSTEM

- *Shut off chilled water and heating services and drain water from coils.*
- *Clean and dry out condensate trays*
- *Slacken off fan belt drives.*
- *Remove and store filter media.*
- *Drain down humidifier and follow manufacturer's instructions for shut-down procedures.*
- *Switch OFF all the appropriate fans.*

VENTILATION SYSTEMS

PREPARE SYSTEM FOR OPERATION

- See that the time switches, if fitted, are set to the required programme, and also to the correct time of day. Remember British Summer Time changes.
- Where possible, rotate the fans manually. Alternatively override automatic controls and momentarily rotate fan.
- Where more than one fan is provided in a fan unit, select the duty fan and ensure that changeover flap effectively seals off the standby fan.
- Check that kitchen extract grease filters are clean, serviceable and in place.
- Check to ensure that all the system's dampers are in their 'system-balanced' position.
- Check all system fire dampers are opened, and that fusible links are set in place correctly.
- Check fan belt drives are serviceable and tensioned correctly.

TO BRING SYSTEM INTO ACTION

- Ensure the systems have all been commissioned and are set to operate correctly.
- Start each supply and extract fan in turn and ensure smooth, vibration-free operation, with the absence of undue noise, by selecting **AUTO** on the control panel.
- Start the supply plants on **HAND** (manual) control.
- Start the extract fans on **HAND** (manual) control.
- When supply and extract fans have achieved normal operation, switch each to **AUTO** operation.
- Check, by walking through selected areas of the building, that the noise level is acceptable and the room temperatures are satisfactory.

TO SHUT DOWN SYSTEM

- To take a supply or extract fan out-of-service, switch fan to **OFF** on the isolating switch, and withdraw the circuit fuses.
- To shut down a heater or battery, shut down flow and return isolating valves, open the vent and drain cocks and drain if required.
- Slacken off fan belt drives.
- Remove and store filter media.
- Switch **OFF** all of the appropriate fans.

NOTE: Where the system is to remain in operation, switch standby fan to **DUTY**.

ELECTRICAL SYSTEMS

PREPARE SYSTEMS FOR OPERATION

- *See that the time switches, if fitted, are set to the required programme, and also to the correct time of day. Remember British Summer Time changes.*
- *Check to 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 special (insulated) tools and safety equipment are serviceable and in their proper storage space.*

LOW VOLTAGE DISTRIBUTION

1. *Check that interlocking keys are available.*
2. *Check that main supply is available.*
3. *Check that supply incoming ACB's and bus section switches are in the OPEN position and are prepared for operation.*
4. *Check that outgoing MCB's are correctly rated and in the OFF position.*
5. *Check that the rising bus-bar system isolators are in the OPEN position.*
6. *Check that the lifts' supply isolators are in the OPEN position.*
7. *Check that plant and boiler room panels are in the OPEN position.*
8. *Check that all local distribution board isolators are in the OPEN position.*
9. *Check that all distribution panel outgoing MCB's are correctly rated and in the OFF position.*
10. *Check that all distribution board MCB's are correctly rated and in the OFF position.*
11. *Check that the rising bus-bar system tap-off units are correctly fused.*

LIGHTING AND SMALL POWER CIRCUITS

1. *Inspect luminaires for cleanliness and for any external evidence of damage or defect.*
2. *Check settings of automatically switched lighting circuit controls.*
3. *Ensure that all lighting switch covers and terminal box covers are in place.*
4. *Inspect small power outlets for external damage or defect.*
5. *Ensure that all small power terminal box covers are in place.*

TO BRING SYSTEM INTO OPERATION

- *Ensure that the low voltage main supply is available.*
- *Ensure that the low voltage distribution system is prepared.*
- *Ensure that the lighting and small power circuits are prepared.*

LOW VOLTAGE DISTRIBUTION OPERATING CHECKS

1. Close supply incoming ACB's.
2. Close outgoing MCB's. (Before closing supply isolators providing a supply to mechanical services plant or other equipment, first check with the engineer responsible for the mechanical services that it is safe to make the system 'live').
3. Close isolators to rising bus-bar systems.
4. Close isolators to services panels.
5. Close isolators to MCB distribution panels.
6. Close local isolators to MCB distribution boards.
7. Close outgoing distribution panel to MCB's as required.
8. Close outgoing distribution board MCB's as required.

LOW VOLTAGE SYSTEM OPERATING CHECKS

1. Check operation of all luminaires and local switches.
2. Check operation of small power outlets.
3. Check all time switches for correct setting and operation including override facility.
4. Check operation of all contactors.
5. Check fire alarm system power unit supply is in ON position.
6. Check fire alarm system standby battery reaches a 'healthy' charged condition.
7. Check fire alarm system in accordance with manufacturer's instructions.
8. Check emergency lighting system power unit supply is in ON position.
9. Check emergency lighting system battery reaches a 'healthy' charged condition.
10. Check operation of emergency lighting system in accordance with manufacturer's instructions.
11. Check self-contained emergency luminaires (twin lamp) for control switch in AUTO position.
12. Check operation of all self-contained emergency luminaires by switching OFF local supply.
13. Check operation of fireman's control switch.

TO SHUT DOWN SYSTEM

- When it is necessary to shut down any unit of distribution switchgear, the load should first be disconnected by switching OFF the supply at all sub-circuits.

Section 3/Operating Procedures

NOTE: All air losses are inefficient and a wasteful power loss.

NOTE: Following installation the plant was commissioned and is therefore in state of readiness for operation.



COMPRESSED AIR START-UP: Start the compressor and check for correct rotation. After start-up, check the system for leaks. This can be detected by 'EAR', 'FEEL' or a 'SOAP' test.

- Check that the receiver tank pressure relief valve is seating correctly and tight. If air escapes, shut down the plant and carry out maintenance.
- Check that all pressure-regulating valves are operating and set correctly to the various system operating pressures. (Refer to the Commissioning Results).
- Check that air drain traps are operating and drain points are clear.
- Check that air driers are functioning correctly.

The fire protection sprinkler system is designed to operate normally, under automatic control. Therefore the plant will be in operation only when fire conditions exist. Due to the nature of the plant and its purpose, it could be that the plant never has to operate for its designed purpose. However, it is essential to keep it always in full working order.

The Fire Office's Committee requires the plant to be tested at regular intervals. If not then the plant could fall into disuse and fail to start at the critical moment. The recommended test procedures are scheduled in the Routine Maintenance section.

EMERGENCY LIGHTING - SAMPLE TEST REPORT CARD

LUMINAIRE LOCATION:

TEST NO:

MODULE NO:

FUNCTIONAL DURATION: 3 MINS.

| ROUTINE TEST RECORD | | | | | |
|---------------------|------------------------|-------------------------|------------------------|-------------------------|------------------------|
| TEST (MONTHLY) | FIRST YEAR SIGNED/DATE | SECOND YEAR SIGNED/DATE | THIRD YEAR SIGNED/DATE | FOURTH YEAR SIGNED/DATE | FIFTH YEAR SIGNED/DATE |
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SAMPLE

3.05 SHUT-DOWNS

If the shut-down is for a period longer than 4 weeks then implement a regular plant inspection. This should include visual inspection of pumps, plants and valves. All pumps will require running for a short period say 2-3 minutes every 4 weeks to prevent brinelling. Obviously pumps must not be run dry, that is without water.

Where plant and associated equipment is taken out-of-service for any length of time, steps need to be taken to prevent damage due to internal corrosion.

In the case of heating and chilled water systems, leave filled with water containing oxygen scavengers or corrosion inhibitors and a biocide, and maintain at a high *ph* level. Precautions may be needed to prevent frost damage. Plant should only be drained down if it can be maintained in a completely dry condition internally. Otherwise rapid localised attacks will occur, resulting in premature failure.

TO SHUTDOWN THE COLD WATER DOWN SERVICE: The cold water down service is from the main cold water storage tanks. The mains supply to these tanks needs to be shut-off at the isolating valve. Drain the water system if work is to be carried out on the pipework. If work is required on the tanks then isolate the outlet after draining the tank. If maintenance is not being carried out but there is a possibility of freezing conditions then drain down the systems and tanks.

When refilling either hot or cold water service pipework, after it has been modified, added to or maintained, it is best to sterilize the whole system to eliminate possible traces of bacteria. Contact your local Water Authority who will advise the best method and type of sterilization recommended. It is essential that no-one uses the hot or cold water services until the clearance is given by whoever is carrying out the sterilisation service.

TO SHUT DOWN THE FIRE FIGHTING SERVICES

SPRINKLER INSTALLATION

This must be in service at all times. If the pump set is out of action due to maintenance/repair the work must not be held-over pending spares, overtime etc.

PREPARATION FOR ELECTRICAL SHUT-DOWN: Use the suggestions below when shutting down the plant for a period of time.

- Switch the control panel selection switches to **OFF** and electrically isolate the equipment.
- Remove the circuit fuses to prevent the accidental starting of the equipment. Place notices regarding the removed fuses and isolated circuits.
- Take the opportunity to carry out any remedial works on the system, remove rust, prime and paint, repair hinges and catches and replace defective anti-vibration mounts. Also carry out necessary protective measures (such as greasing all bright surfaces and putting greased paper between contact faces) to ensure electrical switchgear remains in operative condition.

NOTE: Refer to Section 8 for details of 'Water Supply Failure'.

NOTE: Refer to Section 8 for details of 'Electrical Supply Failure'.

AD

CAUTION:

TAKE ALL PRECAUTIONS AGAINST ELECTRIC SHOCK BY SWITCHING OFF BETWEEN ALL TESTS AND ENSURING LOOSE WIRES ARE NOT IN CONTACT WITH ANY METALWORK OR IN DANGEROUS POSITIONS.

ELECTRICAL SHUT-DOWN: Do not disturb any existing settings unless it is necessary to do so and unless the method of resetting is known. When shutting down any item of equipment for maintenance or inspection ensure the electrical supply is located and locked off. Post a suitable advice of shutting-down. Inspect all equipment, whether detailed in this manual or not, at regular intervals. Keep equipment clean and ventilation opening clear of debris and dust. All protective guards and covers must always be in good repair and in the proper protecting location.

MOTOR STARTERS: Inspect starters monthly 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 reduced in thickness or pitted, renew the contacts. During routine daily or weekly plant inspections, give careful attention to noting any electrical discharge noise which could be indicative of loose or poorly mating components.

CONTROL PANELS: Keep control panels clean and test indicating and alarm lamps daily. Regularly check control switches for damage or malfunction. Renew defective switches and lamps at the time of inspection or as soon as possible following inspection. Check doors and access panels regularly to ensure that they seat correctly. Check instrument readings regularly and compare to ensure that indicated and recorded values are correct.

ELECTRIC MOTORS: Electric motors are essentially reliable machines and require little maintenance. In fact, they tend to suffer from over-attention more than lack of attention. The following hints, however, should prove of service.

Avoid wherever possible:

- Damp and falling moisture.
- Dirt, especially fluff, which may cause blocked ventilation.

Motors situated in dusty positions should be dismantled occasionally by an experienced maintenance man and the windings blown free of dust. A coat of insulating varnish on the windings is helpful.

SWITCHGEAR

CIRCUIT BREAKERS: Before doing any inspection or maintenance remove the circuit-breaker from its enclosure and padlock the shutters. When a circuit-breaker breaks a load frequently, examine it at shorter than normal intervals to ensure the coil and the contacts are in good condition and the insulator surfaces are clean. In addition, make a similar examination when a circuit-breaker has operated under short-circuit conditions.

Before putting into service a circuit-breaker which has been out-of-service for a considerable time, clean it thoroughly on the outside, especially the high voltage insulators, isolating contacts and secondary isolating contacts, and inspect it as circumstances allow. Test the insulating oil in the tank.

When a circuit-breaker has not been operated for some time isolate and operate it manually or electrically several times, to ensure that it is in good working order.

OPERATING MECHANISMS

WARNING:

DO NOT TOUCH THE OPERATING MECHANISM UNLESS THE CIRCUIT-BREAKER IS WITHDRAWN FROM THE ENCLOSURE AND OFF.

Ensure that all fixings, circlips and split pins are safe. Clean the mechanism with a dry, non-fluffy cloth and lubricate. Keep a spare set of three complete fixed-contact assemblies, turbulators and moving-contacts available to facilitate maintenance.

Operate a circuit-breaker slowly for contact inspection: Put the lever of the locating-bolt mechanism in the isolating mechanism FREE position. Fit the maintenance handle, moving it downwards towards the ON position and up to the OFF position as required. Because the closing mechanism is in a TRIP FREE CONDITION it will not latch-in and the operator must always keep control of the maintenance handle.

CONTACTS: Maintenance consists of carefully dressing the arcing tips. Do this without dismantling the assembly, using a small file, taking care to preserve the contact-profile and making sure that the finish is as smooth as possible. When excessive dressing is involved replace the contact assembly.

ROTARY AUXILIARY SWITCHES: If the contacts are excessively burnt, discard them and fit new ones, using the following procedure:

- a. Note the relative positions of the driving-link and rotating contacts and disconnect the driving link.
- b. Tag all terminals with their respective lead reference numbers and remove the leads.
- c. Remove the two fixing screws which pass through the switch base and remove the switch from the circuit-breaker.

VOLTAGE TRANSFORMERS: Isolate the voltage transformers and clean the exposed cast-resin insulation with a clean, dry, non-fluffy cloth. Check or renew the high voltage fuses. Unscrew the primary isolating contacts and remove the fuses. Check and renew the fuses as required, replace the fuses and refit the primary isolating contacts. Ensure the contacts are clean and securely fitted.

INSTRUMENTS AND RELAYS: Clean the faces of instruments and relays and see that all connections are tight.

INDICATING LAMPS: Test each indicating lamp by applying the normal operating voltage to the indicating lamp circuit.

FUSES: Make a continuity test of voltage-transformer secondary fuses, time-limit fuses in current-transformer secondary circuits and all other fuses, such as those in lighting, indication, and protection circuits.

WINTER FREEZE-UP PRECAUTIONS

In severe winter conditions damage is caused to equipment, plant and services where water is concerned. It is advisable that an inspection is carried out listing items likely to require special treatment such as hydrants, idle water tanks/boilers and sprinkler valve sets.

IMPORTANT

**TO PREVENT FREEZING CONSIDER ADDING ANTIFREEZE
(ETHYLENE GLYCOL).**

**MAKE SURE THIS IS NOT ON SYSTEMS LIKELY TO BE USED FOR
DOMESTIC HOT OR COLD WATER.**

Flush out with anti-freeze and blow through using an air line if available.

For totally exposed fans make sure the lubricants are suitable for low temperature applications. Check all control piping for signs of cracks. Also check electrical wiring conduit.