

# **General Mechanical Maintenance Guideline**

## **Exhibit K**

### **Scope of Work**

Reviewed By: \_\_\_\_\_

Approved By: \_\_\_\_\_

Version      1.0  
Date          04-12-06  
Author       Keith Vandebussche

## Table of Contents

- 1) Heating**
  - a) *Boilers*
    - i. *Oil Fired*
    - ii. *Gas Fired*
    - iii. *Coal Fired*
    - iv. *Modular*
  - b) *Forced Air Units*
    - i. *Oil Fired*
    - ii. *Gas Fired*
    - iii. *Electric*
  - c) *Heat Pumps*
    - i. *Continuous Loop*
    - ii. *Self Contained*
  - d) *Direct Radiant Heaters*
    - i. *Baseboard*
    - ii. *Package Units*
    - iii. *Duct Heaters*
    - iv. *Trace Heaters*
    - v. *Convactor*
  - e) *Water heaters*
- 2) Cooling**
  - a) *Chillers*
    - i. *Air Cooled*
    - ii. *Absorption*
  - b) *Cooling Towers*
  - c) *Package Units*
  - d) *Split System*
  - e) *Room AC Units*
- 3) Air Distribution**
  - a) *Air Handling Units*
  - b) *Fans*
    - i. *Ventilating*
    - ii. *Exhaust*
  - c) *Dampers*
  - d) *Filters*
  - e) *Ductwork*
  - f) *Distribution Boxes/Induction Units/Diffuser Grills*
- 4) Miscellaneous Equipment**
  - a) *Humidifier*
  - b) *Heat Exchangers*
  - c) *Tank*
    - i. *Expansion*
    - ii. *Oil Storage Tanks*
    - iii. *CW Storage Tanks*
  - d) *Pumps*
  - e) *Valves*
  - f) *Control*
    - i. *Alarms/Monitoring*
  - g) *HVAC Utility Supply*
    - i. *Oil*
    - ii. *Gas*
    - iii. *Electricity*
  - h) *Pneumatics System Flues.....*  
*Compressors/Condensors*

## Legend of Servicing Frequencies

- a) These specifications include the frequency in which certain tasks should ideally be accomplished. They are as follows:

A	Annually
M	Monthly
Q	Quarterly
SA	Semi-Annually

### 1. HEATING

#### HEATERS - SAFETY

##### Cleaning and Maintenance

Due to possible difficulties of access, cleaning and maintenance should only be done by a trained person.

When applicable, isolate unit(s) from electrical supply by removing fuses or locking main switch in OFF position.

Always refer to the manufacturer's instructions/recommendations before undertaking any cleaning or maintenance.

**1a. BOILERS**

**ROTARY CUP BURNERS (1 of 2)**

Burners of this type should be serviced every three months, certain operations requires a lesser frequency and this is noted in the frequency column. These units are specialized and should only be serviced by trained personnel. This does not apply to the filters which should be cleaned by the customer at least once per week.

1. Operating status of burner  
Check whether plant is operating or not.
2. Oil, gas, electrical and ventilating systems  
Check that all are in accordance with codes of practice.
3. Igniter  
Check.

**OIL**

1. Burner  
Ignite, if possible. Carry out safety check of flame failure device.
2. Linkages  
Check and adjust if necessary.
3. Oil metering system  
Renew seals and gaskets if necessary.
4. Main shaft on burner  
“Lift” bearings.
5. Atomizers and spray tip, if fitted  
Check.
6. Drive belts  
Check.
7. Combustion tests on both fuels  
Carry out and note any visual defects.

Q

Q

Q

Q

Q

A

A

A

A

SA

## ROTARY CUP BURNERS (2 of 2)

### GAS

A

1. Joints

Carry out leak test of all joints downstream of interlock isolator.

A

2. Main gas valve

Check operation of leak test equipment.

A

3. Gas throughout

If practical – check.

A

4. Vent pipework

Check integrity.

### ELECTRICAL

SA

1. Wiring

Check panel, junction box and terminals.

SA

2. Fuses

Check rating.

SA

3. Overload relays

Check settings.

Q

### GENERAL

Check security of mechanical parts and secure mounting of appliance.

### REPORT AND RECOMMENDATIONS

Should be signed by service engineer and kept by the client.

## **BOILERS - LTHW AND MTHW**

(Applies to boilers manufactured by casting or fabrication).

1. Check heating surfaces and fireside for corrosion, pitting, scale, blisters, bulges, soot.  
Inspect refractory.  
Clean fire inspection glass.  
Test safety/relief valve(s) after startup (Full Pressure Test).  
Clean flame safeguard scanner.  
Clean and adjust ignition electrodes.  
Check all burner linkage for excessive wear.  
Tighten all linkage set screws.  
Check gas valves against leakage (where test cocks are provided).  
Clean contacts in program timer.  
Check operation of safeguard control.  
Perform pilot turn down test.  
Check settings and test all operating and limit controls.
  
2. Review manufacturer's recommendations for boiler and burner start-up.  
Check fuel supply.  
Check auxiliary equipment operation. Inspect boiler burner and controls prior to start-up.  
Start burner, check operating controls, test safety controls and pressure relief valve.  
Review operating procedures and owner's log with boiler operator.  
Perform combustion analysis on boilers. Give report to owner.

3. Review owner's log. Log all operating conditions.  
Inspect boiler and burner and make adjustments, as required.  
Test low water cutoff and pressure relief valves.  
Blow down and test low water cutoff and feed control(s).  
Check for water, steam and fuel leaks.  
Check sequence and operation of flame safeguard control.  
Check setting and test operating and limit controls.  
Check operation of modulating motor.  
Blow down gauge cocks and try cocks to confirm glass water level.  
Lubricate motor and shaft bearings, as required.

## CONDENSING BOILERS

The essential feature of a condensing boiler is that to increase the efficiency, the flue gases are cooled below their dew point with the result that water is produced which has to be removed from the system. In addition to all the maintenance requirements listed for atmospheric gas boilers and LTHW and MTHW boilers, additional tasks need to be carried out and these are listed below.

1.     Condensate level probe (if fitted)  
       Clean and inspect.
2.     Condensate drain pipe and U-pipe  
       Clean, inspect and flush.
3.     Fan  
       Check operation and clean any deposits off blades.

A

A

A

## STEAM BOILERS - Pre-maintenance check

- |   |  |
|---|--|
| A | 1. Status<br>Check operating status.   |
| A | 2. Condition<br>Check exterior for signs of damage, leakage from valves, manholes and any loose fittings.  |
| A | 3. Safety circuits<br>Check operation.   |
| A | 4. Combustion test<br>Ensure system is on load, and carry out combustion tests.                            |
| A | 5. Thermostats, pressure sensors and gauges, and thermometers<br>Check for correct operation and settings. |
| A | 6. Shut down<br>Shut off and isolate steam, water, fuel and electrical services.                           |
| A | 7. Ventilation<br>Check that ventilation fans and louvers are functioning properly.                        |

## STEAM BOILERS - Maintenance schedule

- |   |    |   |
|---|----|---|
| A | 1. | Boiler breaching, combustion chamber, and connecting flue<br>Open, remove by brushing and/or vacuum all soot and scale. |
| A | 2. | Fire tubes<br>Open boiler enddoors and clean fire tubes by brushing or rotary scouring equipment.                       |
| A | 3. | Refractory linings<br>Check condition and report.   |
| A | 4. | Boiler breaching, doors and chamber<br>Reseal, check for air leaks seal as necessary.                                   |
| A | 5. | Flue<br>Carry out smoke test.   |
| A | 6. | Waterside<br>Remove manholes, clean out scale and residues. Replace, reseal and ensure bolts are tight.                 |
| A | 7. | Boiler<br>Refill, reconnect and bring on line.  |
| A | 8. | Instrumentation and flame monitoring<br>Check for operation and accuracy.   |
| A | 9. | Combustion test<br>Bring up to full load and carry out tests.   |

## ELECTRODE BOILERS

Note: In hard water areas, maintenance may need to be carried out more frequently. BEWARE - High water conductivity in the boiler circulated water can damage the boiler pressure vessel. Only work within the boiler manufacturer's values of conductivity.

Q

1. Status

Check and isolate by removing fuselinks.

Q

2. Electrical connections

Check all electrical connections in the cubicle and on the boiler electrodes for soundness and correct any defects.

Q

### Porcelain insulators

Q

Examine for defects and replace if necessary. Clean with non-abrasive material.

Examine all porcelain mechanical seals for water leaks.

3. Water drain unit

Check for free flow of water by operating the valve. Repair any valve gland leaks.

4. Drain pipe

Check for free flow, actuate main drain if necessary.

5. Feed solenoid (if fitted)

Clean solenoid, manifold and strainer.

6. Load Control system

Examine mechanism and lubricate.

Examine for water leaks.

7. Boiler circulated water

Test for correct conductivity at 155/170 F.

Test the hardness.

Test the pH index of the water.

8. Boiler sequence

Replace all covers and reinstate electrical supply.

Set the controls to 'start' and operate boiler in its normal mode and ensure the functions are correct.

Read the current flow in each electrode circuit. (phase).

The electrode phase current reading with the control shield fully exposed may not be high when the circulated water is cold.

## GAS BOOSTER SETS

1. Belts  
Check for wear and tension, replace as necessary.
2. Pressure Switch  
Check operation.
3. Gas Booster System  
Check operation
4. Drive Motor  
Check operation and settings of switch.  
Check tightness of electrical connections.  
Carry out in accordance with gas safety regulations.  
Check bearings and lubricate as necessary.  
Inspect guards and covers.  
Ensure that all bolts, screws, etc. are in place and tight.

**1a i. LIGHT OIL PRESSURE JET BURNER (1 of 2)**

(fan assisted, nozzle, oil/air mix, fully automatic)

Q

1. Operating status of burner  
Check whether plant operating or not.

Q

2. Oil, electrical and ventilating systems  
Check that all are in accordance with codes of practice.

Q

3. Burner  
Switch on, carry out safety check of flame failure.

Q

4. Combustion test  
Carry out and note any visual defects.  
(Optional frequency is monthly.)

Q

5. Isolation from electricity and oil supply  
Switch off, remove fuses and turn off oil supply.

Q

6. Jet arm assembly  
Remove, clean combustion head, ignition electrodes and inspect HT leads.

Q

7. Nozzle and filter  
Clean filter and inspect nozzle for wear.

Q

8. Burner  
Reassemble and set heat to manufacturer's requirements.

Q

9. Motor and fan  
Remove, clean and lubricate as required, clean fan scroll.

Q

10. Oil pump filter  
Remove and clean, inspect pump seals for signs of wear.

## LIGHT OIL PRESSURE JET BURNER (2 of 2)

11. Reassembling burner  
Inspect flexible oil line coupling, clean and renew oil line filter, clean photo cell and adjust.
12. Burner  
Switch on and check flame shape and appearance if visible.
13. Oil pressure  
Test, record oil pressure.
14. Combustion tests  
Carry out and check for smoke.
15. Flame failure device  
Test for satisfactory operation.
16. General  
Check security of mechanical parts and secure mounting of appliance.
17. Recommendation  
Provide written report which should be signed by the service engineer and kept by the client.

Q

Q

Q

Q

Q

Q

Q

## HEAVY FUEL OIL PRESSURE JET BURNERS

There are four basic fuel systems which can be subdivided into those used for distillate and those for residual oils. The use of residual oils necessitates the inclusion of equipment of pre-heating the fuel oil prior to the burner. This includes preheater coils in the storage tank, line tracing and final preheater either before or right at the burner nozzle.

1. Immersion heater/steam coils and thermostat  
Check condition and test action of thermostat.
2. Preheater tank  
Inspect for soundness. Drain water from drain valve at base tank.
3. Trace heating  
Check thermostat setting, adjust if necessary.
4. Insulation  
Examine and replace or repair as necessary.
5. Filters  
Clean and change if necessary.
6. Steam traps and drain valves (steam-heated systems)  
Check operation, repair or adjust as necessary.
7. General  
Report on condition.

A

A

A

A

A

A

A

## 1a ii. ATMOSPHERIC GAS BURNERS

These burners operate by air and gas mixed by a ventura, to provide an efficient combustion flame. This principle is used mainly for domestic and small commercial equipment.

- |    |   |
|----|---|
| A  | 1. Operational status<br>Check and note any defects.  |
| SA | 2. Gas, electrical and ventilating systems<br>Check that all are in accordance with current codes of practice.  |
| A  | 3. Burner<br>Isolate electrically, disconnect or remove fuses, turn off and isolate gas supply.   |
| A  | 4. Combustion test<br>Carry out tests.  |
| A  | 5. Thermocouple, probe pilot assembly spark electrode and main burners<br>Check and adjust, refit along with main burner.                               |
| A  | 6. Spark electrode and thermocouple probe<br>Check, adjust and refit along with main burner.  |
| A  | 7. Wiring to igniter and/or probe, gas valve and boiler thermostats<br>Check.   |
| A  | 8. Flame failure device and associated controls<br>Turn on gas, check and adjust pilot flame to envelope thermocouple, probe test flame failure device. |
| A  | 9. Electricity<br>Switch on.  |
| A  | 10. Gas<br>Check and adjust pressure to main burner.  |
| A  | 11. Combustion test<br>Carry out.   |
| A  | 12. Recommendations<br>Provide written report.  |

A

### 1a iii. COAL FIRED BOILERS

The burning of coal is a complex operation involving the storage, handling and combustion of solid material, and the handling and disposal of gaseous and solid waste. The materials are abrasive and the wear and tear on mechanical equipment is considerable. Therefore, regular maintenance is vital to ensure continuous working and a clean environment. The maintenance of each section of the coal burning operation is examined in sequence.

#### WARNING:

Great care should be taken when entering any confined space such as a hopper, flue chamber or boiler to ensure that there is adequate ventilation and an absence of any fumes or flue gases.

1. Operational status  
Check and isolate from electricity supply. Remove fuses.
2. Bunkers  
Inspect for wear and corrosion and repair as necessary.
3. Belt conveyors  
Inspect, renew worn sections, and check and replace joints as necessary.
4. Screw conveyor  
Grease outrigger bearing on worm shaft and tube rotation guide.

A

A

A

A

## COAL FEED MECHANISMS - Under feed stokers

SA  
SA

1. Operational status  
Check and isolate from electricity supply. Remove fuses.
2. Clean-out  
Check and clean out.
3. Retort  
Check end feedscrew and refractory brickwork.
4. Ash  
Remove from plenum chamber.
5. Belts and chains  
Examine and report condition. Check pickup screw high tension bolt.
6. Smoke elimination tube  
Clean air hole and refit.
7. Overfire jet outlet  
Clean if fitted.
8. Stauffers  
Grease and lubricate.
9. Gearbox or angle stoker gear unit  
Drain oil and refill with new oil.
10. Dampers and linkages  
Check , free if necessary, and lubricate.
11. Shear pin alignment and bunker screw  
Check and adjust shear pin alignment if necessary.
12. Return to operation  
Close isolator switch. Run stoker and check sequence.

## COAL FEED MECHANISMS - Chain grate stokers

A

1. Operational status  
Check and isolate from electricity supply. Remove fuses.

A

2. Coal silo  
Empty and check internal and external coatings.

A

3. Level probes on coal surge bunkers  
Check and clean as necessary.

A

4. Drain sump  
Ensure excess water can be drained off. Check coal auger supports. Remove augers and check for wear and distortion. Reassemble and recoat coal tube.

5. Grit arrestors and internal baffles  
Check internally for signs of wear and fix as necessary.

A

6. Access doors  
Check security.

A

7. Insulation  
Check condition and security and repair or replace as required.

A

8. Stoker  
Withdraw and inspect for wear. Check condition of rear skid plate.

A

9. Stoker grate  
Renew rear side steel bars and any links showing signs of burning.

A

10. Stoker air box  
Check bottom plate and chassis for distortion.

A

11. Stoker ignition arch  
Repair or replace arch and, if necessary, firedoor lining.

A

12. Electrical  
Examine and renew switchgear contacts where necessary. Replace any worn or damaged regulator parts.

A

**1a iv. MODULAR BOILERS (1 of 2)**

General

- |   |    |   |
|---|----|---|
| Q | 1. | Clean burner exterior and module cover filter   |
| Q | 2. | Check that safety devices operate correctly:<br>Simulate flame failure and that burner goes to lockout.<br>Simulate air pressure failure-- air pressure switch should cause burner to go into lockout.  |
| Q | 3. | Check correct flame pattern on burner ribbon.   |
|   | 4. | Check for any signs of leakage around module flanges and joints: water, gas, combustion gases.  |
| Q | 5. | Clean combustion fan and venturi housing.   |
| Q | 6. | Check tightness of all cable terminations.  |
| Q | 7. | Check gas pressure at injectors (and governors for Ideal Concord Super Modular burners).  |
| Q | 8. | Check correct thermostat/sensor settings.<br>Remove boiler inspection plates from casing. Inspect modules, checking for any signs of leakage/damage. Also for any build up of debris on bottom of boiler casing, check drain is not blocked on bottom casing. |
| Q | 9. | Strip down burner assembly, clean combustion fan and venturi internally.  |
| Q | 10 | Remove and clean burner ribbon, internal and external. Ensure that no holes are blocked and check condition of ribbon.  |

## MODULAR BOILERS (2 of 2)

After 3,000 hours operation:

11. Inspect and clean flame and ignition probe, reset gap as per manufacturer's recommendations.
12. Check condition of aluminum suction/pressure pipes and that they are clear from any blockages.
13. Check operation of gas propportor, reset as per manufacturer's recommendations.
14. All boiler modules to be removed from boiler and cleaned on dry side as per manufacturer's recommendations.
15. Check wet side of module for any build-up of scale or debris. If required, clean as per manufacturer's recommendations.
16. Check condition of overheat capillary and heat sensor cable and assembly.
17. Check potentiometer settings on PCB and heat sensor.

Q

Q

Q

Q

Q

Q

Q

## FORCED DRAFT GAS BURNER (1 of 2)

(A fan assisted nozzle-mix type with fully automatic operation creating an expanding flame.)

- |    |     |   |
|----|-----|---|
| SA | 1.  | Operating status of burner<br>Check whether the plant is operating or not.                                  |
| SA | 2.  | Gas, electrical and ventilating systems<br>Check that all are in accordance with current codes of practice. |
| SA | 3.  | Burner<br>Switch on, carry out safety check on flame failure.   |
| SA | 4.  | Combustion test<br>Carry out and note any visual defects.   |
|    | 5.  | Isolation from electricity and gas supply<br>Switch off, remove fuses and turn of gas supply at main cock.  |
| SA | 6.  | Fan and motor<br>Remove, thoroughly clean, and lubricate if necessary.                                      |
| SA | 7.  | Fan scroll<br>Clean and check air passages.   |
| SA | 8.  | Automatic gas valves<br>Check gas for tightness.  |
| SA | 9.  | Removal of UV cell and head assembly<br>Clean, adjust electrode and, if required, isolation probe.          |
| SA | 10. | HT and probe leads<br>Inspect for soundness   |
| SA | 11. | Burner<br>Reassemble and fire, check air and gas settings, carry out combustion efficiency test.            |
| SA | 12. | Air pressure switch<br>Test under no air conditions   |

SA

**FORCED DRAFT GAS BURNER (2 of 2)**

- 13. Flame failure  
Test and take probe or UV cell readings.
- 14. Gas booster sets  
Check operation and safety features.
- 15. General  
Check security of mechanical parts secure mounting of appliance.
- 16. Recommendation  
Provide written report which should be signed by the service engineer and kept by the client.

SA  
SA  
SA  
SA

## GAS FIRED NATURAL AND FAN ASSISTED HEATERS

(Conventional and balanced flue)

A

1. Protection guards  
Remove internal guard.

A

2. Heater casing  
Remove and inspect for damage.

A

3. Burner  
Disconnect gas union, remove burner assembly completely.

A

4. Ignition  
Check operation of ignition assembly.

A

5. Thermocouple  
Clean with fine wire brush reassemble pilot and test.

A

6. Burner controls  
Check operation and condition of all burner controls including combustion fan if fitted.

A

7. Flueways  
Inspect flue and flueways.

A

8. Gaskets  
Renew flue gaskets, 'O' rings and joints.

A

9. Heat exchanger  
Inspect for corrosion.

A

10. Room air distribution fan assembly (if fitted)  
Inspect fan bearings, fan wheel(s) or blades and check speed.

A

11. General  
Check settings and correct operation of thermostats and time clocks.

**1b FORCED AIR UNITS (1 of 2)**

M  
M  
M  
M  
M  
M  
A  
Q  
Q  
A  
A

1. Filter

**Check manometer reading**

Renew filter media as indicated.

2. Guide vane actuators and modulating dampers

Check operation.

3. Condensate drains

**Check for condensate carryover**

Check that drains are clear.

4. Humidifier pumps, sprays and water supply to tank

Check operation.

5. Freeze Thermostat

Check operation.

6. Air vent

Air should be vented from heating and cooling coils where fitted.

7. Drive belts

Check tension, alignment, and condition.

8. Drive pulleys

Check alignment, security.

9. Damper and guide vane pivots and linkages

Lubricate lightly.

10. Motorized damper

Check to see that louvers are clear and not obstructed

Check that couplings are secure

Check that motor runs without excessive noise or vibration.

11. Heating and cooling coils

Check condition and clean

Check air and water pressure drops across coils.

12. Controls and electrical connections

Check operation and condition.

**FORCED AIR UNITS (2 of 2)**



**1b i Oil**

Q

1. Burner  
Ignite if possible. Carry out safety check of flame failure device.

Q

2. Linkages  
Check and adjust if necessary.

A

3. Oil metering system  
Renew seals and gaskets.

A

4. Main shaft on burner  
Lift bearings.

A

5. Nozzles  
Check.

A

6. Drive belts  
Check

SA

7. Combustion tests  
Carry out and note visual defects.

**1b ii GAS**

A

1. Joints  
Carry out leak test of all joints downstream of interlock isolator.

A

2. Main gas valve  
Check operation of leak test equipment.

A

3. Gas throughout  
If practical – check.

A

4. Vent pipework  
Check integrity.

**1b iii ELECTRIC**

SA

1. Wiring  
Check panel, junction box and terminals.

SA

2. Fuses  
Check rating.

SA

3. Overload relays  
Check settings.

**1c HEAT PUMPS**

**1c i. CONTINUOUS LOOP**

SA

1. Electrical supply  
Check connections.

D

2. Closed loop water  
Check system temperature and pressure.

Q

3. Filter  
Replace/clean.

Q

4. Reversing valve  
Check operation

Q

5. Compressor  
Check refrigerant.

Q

6. Condensate pan/drain  
Check for debris (clean).

**1c ii. SELF CONTAINED**

SA

1. Electrical supply  
Check connections

Q

2. Filter  
Replace/clean.

Q

3. Reversing valve  
Check operation.

Q

4. Compressor  
Check refrigerant.

Q

5. Condensate pan/drain  
Check for debris (clean).

## 1d HEATING EQUIPMENT

### 1d i. RADIANT STRIP

Maintenance of radiant heaters can be divided into two main areas: namely, the fixtures and fittings directly associated with the supply of heat and the grills and heat exchange surfaces through and over which the air passes. The efficiency of the grills and heat exchange surfaces can be affected by dust and fibers, the severity of which depends upon the location and the environment. Thus, a dusty carpeted room with perimeter skirt heating will require much more frequent cleaning of grills and heating surfaces than a VCT tile floor in a clean environment. The frequencies shown in the table below refer to a clean environment but in extreme cases it may be necessary to clean grills and heat exchangers every two weeks.

1. Panels and insulation:

Examine condition of panels and insulation.

A

2. Pipework, valves, steam traps and associated equipment:

Examine for corrosion or leaks. Where applicable, clean steam traps, strainers, non return valves and scale pockets. Examine condition of expansion joints.

A

3. Suspension:

Check condition and security of drop rods, hangers and related equipment.

A

4. General:

Leave unit in good working order.

A

## GAS RADIANT TUBE HEATERS

- |   |     |   |
|---|-----|---|
| A | 1.  | Isolation of heater from electrical and gas supply<br>Switch off, remove fuses and turn off gas supply. |
| A | 2.  | Burner<br>Disconnect gas union and remove complete burner unit.   |
| A | 3.  | Pilot burner jet<br>Remove, clean and refit.  |
| A | 4.  | Main burner jet<br>Remove, clean, inspect and refit.  |
| A | 5.  | Air filter<br>Remove, clean and refit.  |
| A | 6.  | Spark plug<br>Remove, clean and refit.  |
| A | 7.  | Pilot burner orifices<br>Inspect and clean.   |
| A | 8.  | Burner grid<br>Inspect and clean, removing all dust on back of ceramic block.                           |
| A | 9.  | Observation windows<br>Check and clean.   |
| A | 10. | Vacuum switch<br>Examine and check switching differentials for correct operation.                       |
| A | 11. | Acoustic joints<br>Check for wear.  |
| A | 12. | Condensate traps<br>Check for blockages.  |
| A | 13. | Vacuum motor pump<br>If fitted, examine mountings.  |
| A | 14. | Reflectors<br>Inspect to ensure correct fitting.  |
| A | 15. | Gas test<br>Pressure drop test back to nearest gas cock to ensure soundness.                            |
| A | 16. | General - Undertake heat test.  |

## **RADIATORS**

Maintenance of radiators can be divided into two main areas: namely, the fixtures and fittings directly associated with the supply of heat and the grills and heat exchange surfaces through and over which the air passes. The efficiency of the grills and heat exchange surfaces can be affected by fluff and fibers, the severity of which depends upon the location and the environment. Thus, a dusty carpeted room with perimeter skirt heating will require much more frequent cleaning of grills and heating surfaces than a linoleum covered floor in a clean environment. The frequencies shown in the table below refer to a clean environment but in extreme cases it may be necessary to clean grills and heat exchangers every two weeks.

## **RADIATORS**

- |   |  |
|---|--|
| A | 1. Panels and insulation<br>Examine condition of panels and insulation.  |
| A | 2. Pipework, valves, steam traps and associated equipment<br>Examine for corrosion or leaks. Where applicable, clean steam traps, strainers, non return valves and scale pockets. Examine condition of expansion joints. |
| A | 3. Suspension<br>Check condition and security of drop rods, hangers and related equipment.   |
| A | 4. General<br>Leave unit in good working order.  |

**1d ii. HEATING EQUIPMENT – Package Heaters**

Maintenance of unit heaters can be divided into two main areas: namely, the fixtures and fittings directly associated with the supply of heat and the grills and heat exchange surfaces through and over which the air passes. The efficiency of the grills and heat exchange surfaces can be affected by fluff and fibers, the severity of which depends upon the location and the environment. Thus, a dusty carpeted room with perimeter skirt heating will require much more frequent cleaning of grills and heating surfaces than a linoleum covered floor in a clean environment. The frequencies shown in the table below refer to a clean environment but in extreme cases it may be necessary to clean grills and heat exchangers every two weeks.

**UNIT HEATERS**

- |    |  |
|----|--|
| A  | 1. Casing<br>Examine condition of casing, discharge louvres and inlet guards.  |
| SA | 2. Controls<br>Check all thermostats and other controls operate satisfactorily and are set in accordance with the specification.   |
| Q  | 3. Heat exchanger<br>Inspect and clean. Purge air from hot water units.  |
| Q  | 4. Filters<br>Quarterly or As Needed.<br>When fitted remove, examine and check for damage. Clean or replace.   |
| SA | 5. Motor/fan assembly<br>Lubricate bearings where applicable.  |
| A  | 6. Pipework, valves, steam traps and associated equipment<br>Examine for corrosion or leaks. Where applicable clean steam traps, strainers, non return valves and scale pockets. |
|    | 7. General<br>Leave unit in good working order.  |

**ENTRANCE HEATERS**

Maintenance of entrance heaters can be divided into two main areas: namely, the fixtures and fittings directly associated with the supply of heat and the grills and heat exchange surfaces through and over which the air passes. The efficiency of the grills and heat exchange surfaces can be affected by fluff and fibers, the severity of which depends upon the location and the environment. Thus, a dusty carpeted room with perimeter skirt heating will require much more frequent cleaning of grills and heating surfaces than a linoleum covered floor in a clean environment. The frequencies shown in the table below refer to a clean environment but in extreme cases it may be necessary to clean grills and heat exchangers every two weeks.

**ENTRANCE HEATERS**

- A 1. Casing  
Examine condition of casing, access panels and grilles.
- SA 2. Controls  
Check all thermostats and other controls operate satisfactorily and are set in accordance with the specification.
- Q 3. Filters  
Quarterly or As Needed.  
When fitted remove, examine and check for damage. Clean or replace.
- Q 4. Heat exchanger  
Inspect and clean. Purge air from hot water units.
- SA 5. Motor/fan assembly  
Remove from heater casing if practical. Inspect and lubricate fan bearings and resilient mounts where applicable. Clean fans and motor. Examine wiring and connectors.
- A 6. Pipework, valves, steam traps and associated equipment  
Examine for corrosion or leaks. Where applicable clean steam traps, strainers, non return valves and scale pockets.
- 7. General  
Leave unit in good working order.

### 1d iii. ELECTRIC / DUCT HEATER

Note: When cleaning, ensure that system fans are off to avoid dirt entering the system.  
Comply with lock out/tag out procedures.

A

1. Terminal box:
  - a) External surfaces
  - b) Lid retaining screws
  - c) Internal connectionsInspect for rust and clean and repaint as required.  
Check for tightness and secure if necessary.  
Check that terminal screws are tight. Check the integrity of the internal wiring.

A

2. Elements:
  - a) Within terminal box
  - b) Within casingCheck insulation resistance of each element. Check continuity.  
Clean elements (comb out if finned type).

A

3. Casing  
Inspect for rust and clean and repaint as required.

A

4. Mountings bolts  
Check for tightness and secure as necessary.

A

5. Thermostats/controls  
Check operation.

**1d iv. TRACE HEATING**

- |   |    |   |
|---|----|---|
| Q | 1. | Local disconnect<br>Check operation.                            |
| Q | 2. | Connections<br>Check all connections are clean and tight.       |
| Q | 3. | Weather proof seals<br>Check condition and remake as necessary. |
| A | 4. | Insulation<br>Check for damage and integrity.                   |
| A | 5. | Controls<br>Check functioning of controls.                      |
| A | 6. | Operation<br>Check and record the current drawn.                |

**1d v. HEATING EQUIPMENT - Fan Convectors**

Maintenance of fan convectors can be divided into two main areas: namely, the fixtures and fittings directly associated with the supply of heat and the grills and heat exchange surfaces through and over which the air passes. The efficiency of the grills and heat exchange surfaces can be affected by fluff and fibers, the severity of which depends upon the location and the environment. Thus, a dusty carpeted room with perimeter skirt heating will require much more frequent cleaning of grills and heating surfaces than a linoleum covered floor in a clean environment. The frequencies shown in the table below refer to a clean environment but in extreme cases it may be necessary to clean grills and heat exchangers every two weeks.

**FAN CONVECTORS**

- |    |   |
|----|---|
| A  | 1. Casing<br>Examine condition of casing, access panels and grilles.  |
| SA | 2. Controls<br>Check all thermostats and other controls operate satisfactorily and are set in accordance with the specification.  |
| Q  | 3. Filters<br>Quarterly or As Needed.<br>When fitted remove, examine and check for damage. Clean or replace.  |
| Q  | 4. Heat exchanger<br>Inspect and clean. Purge air from hot water units.   |
| SA | 5. Motor/fan assembly<br>Remove from heater casing if practical. Inspect and lubricate fan bearings and resilient mounts where applicable. Clean fans and motor. Examine wiring and connectors. |
| A  | 6. Pipework, valves, steam traps and associated equipment<br>Examine for corrosion or leaks. Where applicable clean steam traps, strainers, non return valves and scale pockets.                |
|    | 7. General<br>Whenever working on unit, leave in good working order.  |

## HEATING EQUIPMENT - Natural Convectors

Maintenance of natural convectors can be divided into two main areas: namely, the fixtures and fittings directly associated with the supply of heat and the grills and heat exchange surfaces through and over which the air passes. The efficiency of the grills and heat exchange surfaces can be affected by fluff and fibers, the severity of which depends upon the location and the environment. Thus, a dusty carpeted room with perimeter skirt heating will require much more frequent cleaning of grills and heating surfaces than a linoleum covered floor in a clean environment. The frequencies shown in the table below refer to a clean environment but in extreme cases it may be necessary to clean grills and heat exchangers every two weeks.

### NATURAL CONVECTORS AND PERIMETER (Skirting) HEATING

- |   |    |  |
|---|----|--|
| A | 1. | Casing<br>Examine condition of casing, access panels and grills. Where applicable, check condition of damper seal.   |
| Q | 2. | Heat exchanger<br>Inspect and clean. Purge air from hot water units. Where applicable, examine condition of expansion joints, guides and anchors.                              |
| A | 3. | Pipework, valves, steam traps and associated equipment<br>Examine for corrosion or leaks. Where applicable, clean steam traps, strainers, non return valves and scale pockets. |
| A | 4. | Controls<br>When fitted examine condition of damper seals.   |
|   | 5. | General<br>Leave unit in good working order.   |

**1e. DIRECT FIRED WATER HEATERS (1 of 2)**

Heat generation may be by electricity, light oil pressure jet burners, or forced draft by usually atmospheric gas burners. For specific maintenance instructions, check manufacturer's specifications.

**Flueways**

- A 1. Heat generation equipment  
Remove and carry out necessary maintenance.
- A 2. Fluepipe  
Remove at slip collar and clean.
- A 3. Draft diverter (where applicable)  
Remove and clean.
- A 4. Flue baffles  
Remove and clean.
- A 5. Flue tubes  
Clean with suitable brush.
- A 6. Reassembly  
Reassemble in reverse order.
- A 7. Smoke test  
Carry out smoke test on flue.

**Waterways**

- A 1. Isolation  
Turn off, isolate and remove heat generator. Where applicable, switch off electricity and remove fuses. Turn off water supply.
- A 2. Drain down heater  
Drain down using drain valve on side of heater.
- A 3. Casing cover  
Remove to gain access to inspection plate.
- A 4. Waterways  
Remove inspection plate, check for scale build up.

**DIRECT FIRED WATER HEATERS (2 of 2)**

- |   |   |
|---|---|
| A | 5. Sacrificial anodes<br>Check for condition, replace if necessary.   |
| A | 6. Gasket<br>After inspection of internal surfaces a new gasket should be fitted to inspection plate before reassembly.                       |
| A | 7. Reassemble and test<br>Fill up and test for soundness. Refit heat generator in accordance with the manufacturer's instructions. Test fire. |

## PACKAGED ELECTRIC WATER HEATERS

- |   |    |  |
|---|----|--|
| A | 1. | Operating status<br>Check; if unit is out of service, ask client for reasons.  |
| A | 2. | External case and pipework connections<br>Visual inspection for leaks and damage.  |
| A | 3. | Water temperature<br>Measure temperature, check against thermostat settings. Adjust thermostat as necessary.   |
| A | 4. | High temperature cut-out<br>Check temperature settings.  |
| A | 5. | Electrical supply<br>Isolate, remove fuse and check that rating is correct.  |
| A | 6. | Ball valve operation<br>Check, if ball valve needs re-washing, isolate water supply and repair ball valve. Check for leakage and security.                               |
| A | 7. | Presence of scale<br>Drain down unit, remove inspection covers and inspect for scale and corrosion. De-scale as appropriate or replace heating element.                  |
| A | 8. | Return to operation<br>Refit all inspection covers, refill heater and cistern. Turn on water supply to unit and check for leaks. Fit fuse and turn on electrical supply. |

**2. COOLING**

**2a. CENTRIFUGAL CHILLERS - EVAPORATORS**

**Evaporator (cooler)**

- |    |   |
|----|---|
| A  | 1. Evaporator/shell<br>Check external and internal condition, baffles and covers.   |
| A  | 2. Valves and drains<br>Check external condition, leak tightness of glands and seats. Ensure valve caps are tight and secure. Check operation.                        |
| A  | 3. Pipes and connections<br>Check external condition and leak tightness.  |
| A  | 4. Bearers, supports, holding down bolts<br>Check for security and tighten as necessary.  |
| SA | 5. Record inlet & outlet temperatures<br>Inspect for leaks.   |
| SA | 6. Record inlet & outlet pressures.<br>Check condition and clean fins.  |
| SA | 7. Approach temperatures<br>Saturated refrigeration temperature versus leaving chiller water temperature 4 to 6 degrees F are normal depending on vintage of machine. |
| 5Y | 8. Brush evaporator tubes   |

## CENTRIFUGAL CHILLERS - CONDENSERS - Water cooled

- |   |    |  |
|---|----|--|
| A | 1. | Compressor full load operation<br>Record inlet and outlet temperature on water side, pressure drop across condenser, head pressure, condensing temperature, and condenser approach temperature.      |
| A | 2. | Pump/Tower<br>Check and record pressure drop across pump. Check for leakage, bearing noise and unusual bearing temperature. Lubricate according to manufacturer's instructions. Check motor current. |
| Q | 3. | Water strainers<br>Clean.  |
| A | 4. | Condenser tubes<br>Open. Brush tubes. Inspect for alkaline deposits and/or corrosion.  |
| A | 5. | Condenser shell<br>Check for presence of non-condensable gases, purge or vent if necessary.  |
| A | 6. | Isolating valves<br>Check external condition, leak tightness of glands and seats, operational spindles and handwheels.   |

**2a i. PACKAGED CHILLERS - AIR COOLED, RECIPROCATING**

These machines come in a wide range of sizes; the larger machines can be complex both in terms of operation and maintenance requirements. In the case of compressors serving small air conditioning systems which may only run during the summer months, these may require less frequent maintenance. For the maintenance of compressors, refer to the manufacturer's maintenance instructions.

A

1. Start unit - check controls and calibrate.  
Check refrigerant and oil level.  
Check operation and refrigerant pressures.  
Make complete operating log and record readings.  
Check starter operation, voltage and current.  
Set up operating log with operator, instruct and advise troubleshooting.  
Check and tighten all electrical terminals and check contacts for wear.  
Tighten motor terminals and control panel terminals.  
Check crankcase heater.  
Check external interlocks, flow switch, pumps and fans.  
Report any uncorrected deficiencies noted.  
Pressure wash condenser coils.

A

2. Pump down and winterize units.

SA

3. Make a complete operating log and record proper operating temperatures, pressures, voltages and amperages.  
Check and adjust operating and safety controls.  
Check operation of crankcase heater.  
Check compressor oil level and add, as required.  
Check operation of control circuit.  
Check operating log with operator, discuss operation of the machine in general.  
Check water/air flow of evaporator and condenser.  
Check super heat.  
Check operation of all motors and starters.  
Report to operator any uncorrected deficiencies noted.

## PACKAGED CHILLERS - AIR COOLED - EVAPORATORS

### Shell and tube

- A 1. Tank/shell  
Check external and internal condition, baffles and covers.
- A 2. Valves and drains  
Check external condition, leak tightness of glands and seats. Ensure valve caps are tight and secure. Check operation.
- A 3. Pipes and connections  
Check external condition and leak tightness.
- A 4. Bearers, supports, holding down bolts  
Check for security and tighten as necessary.

### Coil - Direct expansion (DX)

- SA 1. Leaks  
Inspect for leaks.
- SA 2. Coil  
Check condition and clean fins.
- SA 3. Condensate tray and drain  
Check and ensure drain is clear. Flush and sterilize if necessary.
- SA 4. Condensate pump (if applicable)  
Check and ensure drain is clear. Flush and sterilize if necessary.
- SA 5. Electric heaters  
Check condition and operation.

**2a ii. ABSORPTION CHILLERS - Single stage, low pressure steam**

1. Lithium bromide analysis  
Pull sample. Send out for analysis.
2. Low temperature cut out  
Check per manufacturer's instructions.
3. Octyl alcohol  
Add per manufacturer's instructions.
4. Valve diaphraThe Owners  
Replace per manufacturer's instructions.
5. Site glass  
Replace per manufacturer's instructions.
6. Vacuum tubes in electronic control center  
Replace per manufacturer's instructions.
7. Brush tubes in condenser and absorber section  
Per manufacturer's instructions.
8. Tests  
Perform running vacuum test or leak rate test per manufacturer's instructions.
9. Capacity control valve  
Lubricate linkage with cup grease.  
Check setting per manufacturer's instructions.
10. Evaporator  
Check evaporator water charge.
11. Bypass valve  
Check setting.
12. Torque valves, gaskets, joints, and diaphraThe Owner valves  
Check setting.
13. Hermetic pump  
Inspect for worn parts. Replace per manufacturer's instructions.
14. Vertical purge  
Check operation per manufacturer's instructions.

**2b. COOLING TOWERS**

- |    |     |  |
|----|-----|--|
| A  | 1.  | Auto-air eliminators<br>Check for operation  |
| M  | 2.  | Ball valves<br>Check for operation   |
| Q  | 3.  | Belt drives<br>Check for wear and tension, replace if necessary  |
| A  | 4.  | Direct drives<br>Check operation   |
| A  | 5.  | Motors<br>Check operation  |
| Q  | 6.  | Strainers<br>Check for clogging  |
| SA | 7.  | Fan blades<br>Check for looseness  |
| A  | 8.  | Amprobe motor<br>Check for proper electrical draw  |
| A  | 9.  | Starter<br>Check for operation   |
| A  | 10. | Float valve<br>Check for operation   |
| Q  | 11. | Water box nozzles (Marley)<br>Check for leaks. Clean float chamber and needle valve assembly.<br>Ensure valve opens/closes.<br>Check condition and alignment. Correct tensioning if necessary.<br>Check shaft alignment.<br>Grease, remove purge plug as per manufacturer's instructions.<br>Remove, clean and replace.<br>Check and clean. Inspect for tightness.<br>Record amperage.<br>Check contactor points are clean. Tighten all electrical connections.<br>Make sure valve closes off without leakage; no chatter.<br>Clean out nozzle with screwdriver. |

## Y TYPE STRAINERS

Y type strainers are found in cooling towers.

SA

1. Strainer cage/basket  
Remove bottom flange. Remove basket. Clean. Replace basket.

SA

2. Blow down strainer  
Open blow off valve. Use 5 gallon pail to catch water.

**2c. PACKAGED CHILLER UNITS - CONDENSER - AIR COOLED**

- |    |     |  |
|----|-----|--|
| M  | 1.  | Operating pressure<br>Check pressure and pressure switches using gauges.   |
| SA | 2.  | Solenoid valves<br>Ensure that they do not bypass.   |
| M  | 3.  | Head pressure control (fan speed)<br>Check operation.  |
| SA | 4.  | Motor mountings<br>Check for security and tightness.   |
| SA | 5.  | Condenser coil<br>Inspect and clean.<br>Test for refrigerant leak.   |
| SA | 6.  | Casing<br>Clean and secure.  |
| SA | 7.  | Sediment<br>Remove; if substantial build-up has occurred, investigate cause.   |
| Q  | 8.  | Alignment and wear of belt drives (where applicable)<br>Check pulley alignment and belt wear.                          |
| SA | 9.  | Head pressure control damper<br>Lubricate control damper bearings.   |
| SA | 10. | Electrical connections<br>Check and tighten as necessary. Check condition of flexible conduits, wiring and insulation. |
| SA | 11. | Pipework<br>Inspect connections, pipes and supports for damage, loose or missing fittings. Repair as necessary.        |

## PACKAGED CHILLER UNITS - WATER COOLED

These machines come in a wide range of sizes; the larger machines can be complex both in terms of operation and maintenance requirements. In the case of compressors serving small air conditioning systems which may only run during the summer months, these may require less frequent maintenance. For the maintenance of rotary compressors, refer to the manufacturer's maintenance instructions.

- |    |     |  |
|----|-----|--|
| SA | 1.  | Full load condition (discuss with client)<br>Check and record suction and discharge pressure, oil pressure.          |
| SA | 2.  | Start and run currents<br>Check and compare with manufacturer's recommended figures.                                 |
| SA | 3.  | Operating status<br>Check whether plant is in use. If a meter is fitted, record hours run.                           |
| SA | 4.  | Leaks<br>Check for oil and refrigerant leaks. Any leak of refrigerant should be dealt with immediately.              |
| SA | 5.  | Oil in crankcase<br>Check level and condition.   |
| SA | 6.  | Crankcase heater<br>Check operation.   |
| SA | 7.  | Compressor drive<br>Check condition and alignment.   |
| SA | 8.  | Compressor and bearing temperatures<br>Observe and include crankcase, seal housing and cylinder surface temperature. |
| SA | 9.  | Safety cut-outs<br>Test and ensure correct operation.  |
| A  | 10. | Refrigerant charge<br>Check quantity and moisture content at liquid level sight glass.                               |
| SA | 11. | Noise and vibration<br>Check for any abnormalities.  |
| A  | 12. | Electric motor<br>Lubricate according to manufacturer's instructions. Check full load current.                       |

**SINGLE ZONE ROOFTOP UNITS - AIR-COOLED, RECIPROCATING**  
(natural gas heating/electric cooling, 3 ton to 20 ton)

SA

1. Start unit - check controls and calibrate.  
Check refrigerant and oil level.  
Check operation and refrigerant pressures.  
Check starter operation, voltage and current.  
Check and tighten all electrical terminals and check contacts for wear.  
Tighten motor terminals and control panel terminals.  
Check crankcase heater.  
Report any uncorrected deficiencies noted.  
\*Pressure wash condenser coils.

SA

2. Check and adjust operating and safety controls.  
Check operation of crankcase heater.  
Check compressor oil level and add, as required.  
Check operation of control circuit.  
Check air flow of evaporator and condenser.  
Check super heat at compressor inlet.  
    Check operation of all motors and starters.  
    Check for refrigerant leaks.  
Change filters, GSH recommends quarterly.

SA

3. Vacuum out burner assembly.  
Check burner operation (adjust).  
    Inspect flame failure controls. Clean & inspect ignition assembly. Inspect heat exchanger.  
    Check gas valve operation.

**2d. SPLIT SYSTEM AIR CONDITIONING UNITS (1 of 2)**

This text relates primarily to units with either integral or remote air cooled condensers working with direct expansion coolers for refrigeration or air conditioning applications. The frequency of servicing or cleaning will depend upon the working environment and the amount of usage.

- SA 1. Compressor  
Check for undue noise or vibration and high or low cylinder head discharge pressure.
- SA 2. Compressor suction/side  
Check for symptoms of liquid slugging or high superheat.
- SA 3. Oil separator float valve (if fitted)  
Check condition and compressor crankcase oil level.
- SA 4. Refrigerant
  - a) Charge
  - b) LeaksCheck level in receiver and/or liquid line sight glass.  
Test accessible parts of system.  
Install gauge manifold.
- SA 5. Condenser and evaporator fins  
Check for damage and/or dust accumulation. Clean as necessary.
- SA 6. Fans and motors  
Check bearings and lubricate as necessary. Inspect and check on fan guard covers and inspection plates.
- SA 7. Evaporator and drains, drip tray and pump  
Check and clean. Check condensate drain is clear and clean.
- SA 8. Compressor capacity control and unloaded start valves  
Check for correct operation. Check motor current against nameplate data.
- SA 9. Refrigerant pipework  
Check for vibration and rectify any loose or inadequate support / fixing.

**SPLIT SYSTEM AIR CONDITIONING UNITS (2 of 2)**

- |    |     |  |
|----|-----|--|
| SA | 10. | Insulation<br>Check condition. Repair and reseal as necessary.   |
| SA | 11. | General cleanliness<br>Clean surfaces of compressors and components of condensing unit.  |
| SA | 12. | Electrical<br>Check for damage to flexible conduits. Tighten all terminal connections. Isolate local control panel and inspect for signs of overheating. Check integrity of electrical insulation. |
| SA | 13. | System operation<br>Confirm that it is in accordance with design parameters.   |

**2e. ROOM AIR CONDITIONERS**

(Unitary reverse cycle heat pump terminal units with electric heating and reversing valve)

NOTE: If unit is ceiling mounted, cover office equipment immediately below any area of work.

- SA 1. Status  
Isolate electrically.
- SA 2. Heating/cooling coil  
Remove air entry filter, inspect coil for dirt and clean as required.
- A 3. Fan and motor bearings  
Lightly oil.
- SA 4. Condensate drain pan and pump  
Check pan and drain are clear.
- SA 5. Air filter  
Wash, dry and refit, Replace if necessary  
(Disposable filters Replace)
- SA 6. Water loop connections  
Check for leaks.
- SA 7. Refrigeration circuit  
Check for leaks.
- SA 8. Electrical wiring and terminals  
Check integrity.
- SA 9. Return to service  
Place on cooling cycle, isolate from water loop, and check high pressure safety device stops refrigeration compressor.
- SA 10. Controls  
Return to standard settings.
- SA 11. External cleaning  
Clean unit externally.

**3a. AIR HANDLING UNITS (1 of 2)**

- |   |     |  |
|---|-----|--|
| M | 1.  | Filter<br>Check manometer reading<br>Renew filter media as indicated.  |
| M | 2.  | Guide vane actuators and modulating dampers<br>Check operation.  |
| M | 3.  | Condensate drains<br>Check for condensate carryover<br>Check that drains are clear.  |
| M | 4.  | Humidifier pumps, sprays and water supply to tank<br>Check operation.  |
|   | 5.  | Freeze Thermostat<br>Check operation.  |
| M | 6.  | Air vent<br>Air should be vented from heating and cooling coils where fitted.  |
| M | 7.  | Drive belts<br>Check tension, alignment, and condition.  |
| A | 8.  | Drive pulleys<br>Check alignment, security.  |
| Q | 9.  | Damper and guide vane pivots and linkages<br>Lubricate lightly.  |
| Q | 10. | Motorized damper<br>Check to see that louvers are clear and not obstructed.<br>Check that couplings are secure.<br>Check that motor runs without excessive noise or vibration. |
| A | 11. | Heating and cooling coils<br>Check condition and clean.<br>Check air and water pressure drops across coils.  |
| A | 12. | Controls and electrical connections<br>Check operation and condition.  |

## **AIR HANDLING UNITS (2 of 2)**

Q 13. Valves  
Check full range of operation and reset at the original setting.

A 14. Motors  
Check motor brushes and replace if necessary.  
Check, clean and test windings.  
Check tightness of terminals.  
Check full load current.  
Check bearing wear.  
Replace lubricant in motor bearings.

Q 15. Anti-vibration mountings and ductwork flexible connections  
Check condition for excessive dryness or cracking.

## **Q AIR HANDLING UNITS, BELT DRIVES**

1. Belt drives  
Check for condition and alignment.  
Check sheaves for wear. Replace if needed.  
Correct tensioning if necessary.

## DRIVE ELEMENTS - MOTORS

NOTE: Before carrying out any work on electrical equipment, check status and isolate in accordance with Health and Safety legislation requirements.

- |   |    |  |
|---|----|--|
| Q | 1. | Mountings<br>Check condition.  |
| Q | 2. | Motor casing<br>Check ventilating louvres are clear.   |
| Q | 3. | Bearings<br>Lubricate where external nipples or lubricators are fitted.                        |
| A | 4. | Brushes<br>Check condition and replace if necessary.   |
| A | 5. | Windings<br>Clean and test.  |
| A | 6. | Terminals and connections<br>Check and ensure that they are secure.                            |
| A | 7. | Rating<br>Check motor running current.   |
| A | 8. | Variable speed drives and other solid state controls<br>Refer to manufacturer's specification. |

**3b FANS**

**3b i. MAKE-UP AIR UNITS**

M

1. Filter  
Replace, wash if metallic.

M

2. Belts  
Check alignment and condition.

Q

3. Gas, electrical, ventilating systems  
Check that all are in accordance with current codes and practice.

Q

4. Gas leak check  
Soap and water solution.

Q

5. Fan bearings, cock valves  
Lubricate.

Q

6. Flame safety controls  
Perform control test for fire eye M Series control with type 57AV7 tester.

Q

7. Spark plug  
Check ignition visually. Replace if burned.

Q

8. Flame rod  
Check with DC voltmeter.

## AXIAL / FORCED DRAFT / INDUCED DRAFT FANS

Fixed and/or variable pitch.

- |    |    |   |
|----|----|---|
| Q  | 1. | Impeller<br>Clean and ensure no build up of dirt.   |
|    | 2. | Motor bearings<br>("Sealed for life" bearings should not be serviced)<br>Lubricate with recommended lubricant at intervals noted on fan nameplate.        |
| Q  | 3. | Belt drive (if fitted)<br>Check tension and adjust if necessary. Replace if condition warrants it.  |
| SA | 4. | Flexible conduit connections and wiring<br>Check for soundness and ensure terminal connections are secure.<br>Check integrity of electrical installation. |
| SA | 5. | Belt guards (where fitted)<br>Check these are free from dirt build up. If necessary, clean.   |
| SA | 6. | Impeller, variable pitch mechanism<br>Check that there is no excessive movement at the wing root.   |
| A  | 7. | Adjustable pitch actuation<br>Check correct operation.  |
| SA | 8. | Back flow damper (where fitted)<br>Check operation.   |

**3b ii. EXHAUST FANS - Including fire/smoke exhaust units, water-cooled and kitchen exhaust.**

- Q 1. Controls  
Check correct action.
- Q 2. Motorized control dampers  
Check operation.
- Q 3. Electrical connections  
Check all flexible connections and electrical insulation.
- Q 4. Fan and motor  
("Sealed for life" bearings should not be serviced)  
Lubricate according to manufacturer's instructions.
- Q 5. Fan impeller and scroll  
Check condition.
- Q 6. Motor casing and louvres  
Check condition and clean.
- Q 7. Anti vibration mountings (where fitted)  
Check mountings, belts and fixings for security.
- Q 8. Back flow damper (where fitted)  
Check operation.

## VENTILATING/TOILET EXHAUST FANS - General

The instructions in the table below refer to all air handling fans including exhaust, make-up, re-circulation and small air handlers.

Before working on any moving machinery, switch 'off' and ensure that the equipment is isolated electrically in accordance with Lock and Tag Out, OSHA Section 269D - 1910.

- |    |    |  |
|----|----|--|
| SA | 1. | Bearings ("sealed for life" bearings should not be serviced)<br>Inspect and lubricate as necessary.                        |
| SA | 2. | Housing<br>Clean and inspect for looseness and corrosion.  |
| SA | 2. | Drives and belts<br>Inspect, check condition and alignment of drive and shaft. Adjust or replace if condition warrants it. |
| SA | 4. | Fan wheels<br>Check and clean. Inspect for tightness.  |
| SA | 5. | Sheaves and bearing collar<br>Check tightness.   |
| SA | 6. | Mountings bolts<br>Check and tighten as necessary.   |
| SA | 7. | Anti-vibration mountings<br>Check effectiveness.   |
| SA | 8. | Backdraft damper<br>Check operation.   |

## SMOKE REMOVAL FANS

NOTE: This type of fan, axial with the motor outside of the airstream, is normally used for fume extracts. e.g. kitchen fire and smoke extraction and for fume removal, particularly where corrosive.

- |    |     |  |
|----|-----|--|
| Q  | 1.  | Unit<br>Check operation.   |
| Q  | 2.  | Fan impeller<br>Check condition and clean.   |
| Q  | 3.  | Lubrication<br>("Sealed for life" bearings should not be serviced)<br>Check and lubricate if necessary acing to the manufacturers instructions.      |
| Q  | 4.  | Standby motor (where provided)<br>Check and rotate a few turns by hand or electrically.  |
| Q  | 5.  | Flexible conduit connections and wiring<br>Check for soundness and ensure terminal connections are secure. Check integrity of electrical insulation. |
| SA | 6.  | Belt drive (if fitted)<br>Check wear, alignment and tension.   |
| SA | 7.  | Automatic shutters (usually fitted roof units).<br>Clean and check operation.  |
| A  | 8.  | Anti-vibration mountings<br>Check condition.   |
| A  | 9.  | Ductwork including fixings and insulation (where fitted)<br>Inspect external condition and report.   |
| A  | 10. | Motor<br>Check full load current and log.  |
| A  | 11. | Bearings<br>Check for wear. Remove oil/grease and clean.   |
| A  | 12. | Micro switches on automatic shutters<br>Check operations. Reset if necessary.  |

### 3c. DUCTING - BALANCING DAMPERS AND FIRE/SMOKE DAMPERS

#### Caution:

All balancing dampers are set up during commissioning and should not normally be subject to further adjustment unless modifications are made to the ductwork distribution system. If it is essential to move the damper for maintenance purposes, extreme care should be taken to ensure that the damper is returned to the position as set when commissioned. In the event of a ductwork modification, the system should then be recommissioned.

- SA 1. Balancing dampers  
Check position and ease of movement and security of locking devices.
- SA 2. Fire and smoke dampers  
Check action and proper operation. Inspect all dampers, apply a few drops of oil to the mechanism. Replace fusible links if required.
- SA 3. Linkages on motorized dampers  
Check for wear and lubricate if appropriate.
- SA 4. Controls  
Check condition and operation.
- SA 5. Electrical  
Check for damage to flexible conduits. Tighten all terminal connections. Isolate control panel and inspect for signs of overheating. Check integrity of electrical insulation.

### 3d. AIR HANDLING FILTERS

NOTE: In normal use, air filters do not present a health and safety hazard. However, used air filters do contain quantities of dust which, unless precautions are taken, may expose maintenance personnel to a "nuisance dust" hazard, as defined by the "Dust Hazards" section of OSHA Regulations 1000A - 1910. As a precaution, personnel should wear a dust/mask respirator, safety glasses, loose protective clothing and gloves when changing any air filter. Used filters should be sealed into plastic bags for disposal.

1. Filter elements
2. Seals and/or fasteners

Remove and replace according to manufacturer's recommendations. Ensure that any spillage or dust is vacuumed away. Some filters may have to be cleaned more frequently, depending upon site conditions and operating hours.

Do not attempt to wash or clean out and reuse.

Ensure that any damaged seals or fasteners are replaced.

#### **FILTERS (COMMON PROCEDURES)**

- Q 1. Air flow  
Stop any air flow to filter.
- Q 2. Removal  
On removal be sure that trapped dust remains in the filter medium.
- Q 3. Filter housing  
Thoroughly clean, including surrounding ductwork and floor.
- Q 4. Housing  
Inspect for damage and/or corrosion.

#### **REUSABLE (CLEANABLE) FILTERS**

- Q 1. Filter elements  
Clean and replace as per manufacturer's recommendations.  
Filters may require more frequent cleaning where the air is heavily with dust of fumes.
- Q 2. Kitchen exhaust grease filters  
Remove and clean as per manufacturer's recommendations. Frequency of

cleaning can vary from daily to weekly intervals. Generally, the use of a commercial dishwasher is possible/

Failure to change/clean filters when loaded with grease may result in the carryover of grease into the duct, leading to a greater risk of fire.

When cleaning, care should be taken to avoid damage to the filters either mechanically or by the use of aggressive solvents. Usually hot soapy water or an approved cleaning liquid is adequate.

**ABSORPTION TYPE**

- SA 1. Damage and corrosion  
Check and report if found.

**ROLLOMATIC FILTER TYPE**

- SA 1. Damage  
Check and report if found.
- SA 2. Differential pressure  
Measure.
- SA 3. Operation  
Check for correct operation.

**GREASE FILTERS**

- M 1. Condition  
Check and clean.

High efficiency – HEPA. The maintenance activities for these depend on the individual installation and operating conditions. Reference should be made to the design/operating manuals for the building.

## ELECTROSTATIC FILTERS

- |   |    |  |
|---|----|--|
| M | 1. | <p>Electrical</p> <ul style="list-style-type: none"><li>a) Powerpack<br/>Check for correct operation.</li><li>b) Rectifiers<br/>Check operation and follow manufacturer's instructions.</li><li>c) Isolation<br/>Isolate electrically in accordance with OSHA Lock &amp; Tag Out Section 269D - 1910.</li><li>d) Ionizing wires<br/>Check condition and, if broken, replace immediately.</li></ul> |
| M | 2. | <p>Mechanical</p> <ul style="list-style-type: none"><li>a) Cells<br/>Wash according to manufacturer's instructions.</li></ul>  |

**3e. DUCTWORK SYSTEM - GENERAL**

NOTE: Special requirements are necessary in the food and process industries and clean room applications.

- A 1. Access doors  
Inspect for any loose panels and secure.
- A 2. Flexible connections  
Check for condition, leaks and secure fittings.
- A 3. Insulation  
Inspect for any damage or deterioration.
- A 4. Anti-vibration mounts  
Inspect for permanent set (in springs).
- A 5. Internal cleanliness  
Check internal condition through sampling points (test points) where fitted.

**3f. FAN COIL TERMINAL UNITS**

- |    |    |  |
|----|----|--|
| SA | 1. | Status<br>Switch off and isolate.  |
| Q  | 2. | Coil block<br>Vent air from cooling and heating coils.<br>Remove air entry filter, inspect coil block for dirt and clean as necessary. |
| SA | 3. | Condensate drain connection<br>Check connection is clear.  |
| SA | 4. | Permanent filters<br>Clean and refit, ensuring proper location.  |
| SA | 5. | Disposable type filters<br>Replace ensuring proper location.   |
| SA | 6. | Test unit<br>Restore power supply and run unit. Check air flow is normal at correct speed setting.                                     |
| SA | 7. | Casing<br>Clean.   |
| A  | 8. | Ductwork flexible couplings (if fitted)<br>Check condition.  |
| SA | 9. | Grills and diffusers<br>Clean using vacuum or alternatively remove and clean.  |

## TERMINAL INDUCTION UNITS

- |    |    |   |
|----|----|---|
| SA | 1. | Secondary air filter<br>Clean washable filter and retain for reuse.   |
| SA | 2. | Coil block (where fitted)<br>Inspect for dirt and/or obstructions, cleaning where necessary. Check also for water leaks and rectify as necessary. |
| SA | 3. | Primary air nozzles<br>Check condition, cleaning if necessary by brushing. Push scratch awl in each nozzle.                                       |
| SA | 4. | Nozzle air pressure<br>Check with manometer.  |
| SA | 5. | Damper and/or pneumatic valves<br>Check correct functioning and rectify any defects.  |
| SA | 6. | Chilled water/LPHW control valves<br>Check functioning.   |
| SA | 7. | Control thermostats<br>Check operation.   |
| SA | 8. | Isolation valves<br>Check for leaks and rectify as necessary.   |
| SA | 9. | Unit<br><b>Clean internally and externally. Refit secondary air inlet filter.<br/>Replace any casing which was removed.</b>                       |

## VAV UNITS - Pneumatic-powered

- |   |    |   |
|---|----|---|
| A | 1. | Access to units<br>Remove access panels or ceiling tiles as appropriate.  |
| A | 2. | Control system<br>(For information only)<br>a) Pneumatic or<br>b) Electrical<br>Disconnect pneumatic control pipe and check unit motors to alternative setting.<br>Disconnect electrical control and check that unit motors to alternative setting.<br>Reconnect. |
| A | 3. | Air leaks<br>Check and if found rectify.  |
| A | 4. | Insulation<br>Check condition and make good as necessary.   |
| A | 5. | Actuator<br>If visible, check for dirt, lightly oil mechanism as required.  |
| A | 6. | Unit thermostat<br>Operate and check VAV unit moves in relation to change in setting.<br>Restore to original setting.   |
| A | 7. | Filter<br>Clean or replace as necessary.  |
| A | 8. | Diffusers<br>Clean, taking care not to stain ceiling.   |

**VAV UNITS - Fan-powered**

- SA 1. Fan motor  
Grease or oil bearings.
- SA 2. Dampers  
Check operation and lubricate linkages if necessary.
- SA 3. LPHW and CW coils  
Check operation and clean.
- SA 4. Controls  
Check operation.

**VAV UNITS - Self-powered**

- SA 1. Thermostat  
Check operation.
- A 2. Unit filter  
Check condition and change if necessary.
- Q 3. Main filter  
Check condition.

**3g. DIFFUSERS AND GRILLS**

SA
A
A

1. Grills
  - a) External  
Examine, check mountings and clean.
  - b) Internal  
Examine, check fitting and clean.
  
2. Diffusers  
Examine, check fitting and clean.

**4. MISCELLANEOUS EQUIPMENT**

**4a. HUMIDIFIERS - Compressed air type**

NOTE: This schedule should be read in conjunction with those on air compressors.

- Q 1. Status  
Isolate electrically and hydraulically.
- Q 2. Nozzles  
Clean dust and debris from outside of nozzles.
- Q 3. 'Y' strainer  
Inspect and replace strainer screen.
- A 4. Water pressure regulator  
Check condition and carry out maintenance in accordance with the manufacturer's instructions.

## ELECTRODE BOILER HUMIDIFIER

NOTE: In hard water areas maintenance may be required more frequently. If output is decreased due to heavy scaling renewal of the cylinder, refer to client.

BEWARE - High water conductivity in the boiler circulated water can damage the boiler drums. Only work within the boiler manufacturer's values of conductivity.

- Q 1. Status  
Check and isolate both water and electricity supplies.
- Q 2. Steam drum  
Check all electrical connections on the cylinder for soundness and correct any defects.
3. Drum exchange  
As per manufacturer's instruction:  
Hard water areas 3/4 months.  
Soft water areas 12 months.
- Q 4. Water drain pump  
Check for free flow of water by operating the pump. Repair any gland leaks. Check manual drain switch actuation.
- A 5. Drain pipe  
Check for free flow, actuate drain if necessary.
- A 6. Feed valve  
Clean strainer.
- A 7. Unit testing after drum exchange  
Set the controls to start and operate humidifier in its normal mode and ensure the functions are correct and humidistat is functioning.
- A 8. Fully automatic modulating type humidifier  
Check output modulation.

## HUMIDIFIER - Direct steam injection type (1 of 2)

Note: When in operation, there is intermittent live steam injected from manifold within.  
**DO NOT ATTEMPT TO SERVICE WITHOUT ISOLATING STEAM AND ELECTRICITY SUPPLIES.**

- |   |     |  |
|---|-----|--|
| Q | 1.  | Status<br>Isolate electrically.  |
| Q | 2.  | Removal of deposits<br>Clean and flush out.  |
| Q | 3.  | Ball valve<br>Check operation.<br>Clean and renew washer.  |
| Q | 4.  | Water level<br>Check level in gauge glass corresponds with indicator plate.  |
| Q | 5.  | Humidistat<br>Check operation, clean if necessary.   |
| Q | 6.  | Misting sprays<br>Observe spray pattern, clean if necessary.   |
| Q | 7.  | Control and indicator lights<br>Check for correct functioning.   |
| Q | 8.  | Steam traps<br>Check operation and clean.  |
| Q | 9.  | Steam pressure<br>Check.   |
| Q | 10. | Strainer (where fitted)<br>Clean strainer on steam supply.   |
| A | 11. | Water supply<br>Turn off at ball valve and empty via drain cock.   |
| A | 12. | Steam manifold<br>Remove outer casing lid baffles. Remove any scale either physically or by using suitable chemical descaling agent. |

**A HUMIDIFIER - Direct steam injection type (2 of 2)**

13. Feed water line

**A** Check that it is clear.

14. Re-assembly

**A** Ensure all joint faces are clean and re-assemble using new gaskets.

15. Re-commission

Put back into service and check operation.

**SA HUMIDIFIERS - Ultra sonic**

1. Status

**SA** Isolate electrically and hydraulically.

2. Water tank

**SA** Clean out and refill.

3. Ultra sonic diaphragm

**A** Clean carefully with soft non-scratch cloth.

4. Ultra sonic generator

**M** Check operational efficiency as per manufacturer's instructions. Replace if necessary.

5. Sediment removal

Remove as necessary from top of reservoir.

## HUMIDIFIER - Resistance heater type

In hard water areas more frequent maintenance may be required.

- |    |    |   |
|----|----|---|
| A  | 1. | Status<br>Isolate electrically and hydraulically.                                     |
| A  | 2. | Water boiling chamber<br>Drain.   |
| A  | 3. | Resistance heater element<br>Inspect and descale as necessary.                        |
| A  | 4. | Scale collecting bag (where fitted)<br>Change as necessary.                           |
| A  | 5. | Float valve, or solenoid valve on make-up line<br>Check operation.                    |
| SA | 6. | Control indicator lights (where part of humidifier)<br>Check for correct functioning. |
| Q  | 7. | Built-in step controller (where fitted)<br>Check for correct operation.               |
| *  | 8. | Operation<br>Restore services and put unit back on line.                              |

**4b. HEAT EXCHANGERS - HEATED BY LTHW OR MTHW**

Low temperature hot water systems (LTHW or LPHW) are heating systems operating up to 140 bar (gauge) and 200(F and indirect systems complementary to them.

- |    |    |  |
|----|----|--|
| A  | 1. | Operation and safety controls<br>Check, note, and report any visible defects.  |
| A  | 2. | Safety valves<br>Check operation of safety valves.   |
| A  | 3. | Sensors<br>Thermostats, pressure sensors, altitude gauges and thermometers<br>Check for correct operation and settings.                              |
| A  | 4. | Auto controls and primary side<br>Shut down primary heat source.   |
| A  | 5. | Drain valve / drain cock on secondary side<br>Draw off a small quantity of water to remove any sediment.   |
| 2Y | 6. | Heating surface and internal surfaces of shell<br>Drain down secondary side, remove manholes, inspect for scale formation and corrosion, and report. |
| 2Y | 7. | Bursting discs (where fitted)<br>Check condition.  |
|    | 8. | Put back into operation<br>Refit all manholes, refill secondary side. Put primary side into operation.   |

## HEAT EXCHANGERS - HEATED BY STEAM

- |    |     |  |
|----|-----|--|
| A  | 1.  | Check operations, in particular safety controls<br>Note and report any visible defects.  |
| A  | 2.  | Safety valves<br>Check for corrosion and manually operate.   |
| A  | 3.  | Thermostats, pressure sensors, altitude gauges and thermometers<br>Check for correct operation and settings.   |
| A  | 4.  | Auto controls and primary side<br>Shut down primary heat source.   |
| A  | 5.  | Drain valve/drain cock on secondary side<br>Draw off a small quantity of water to remove any sediment.   |
| 2Y | 6.  | Heating surface and internal surfaces of shell<br>Drain down secondary side, remove manholes and inspect for scale formation and corrosion and report. |
| 2Y | 7.  | Bursting discs (where fitted)<br>Check condition.  |
| A  | 8.  | Gaskets<br>Check gaskets on steam chest for leakage, replace as necessary.   |
| 2Y | 9.  | Vacuum breaker (where fitted)<br>Check operation and service as appropriate.   |
| A  | 10. | Steam trap<br>Clean and overhaul steam trap.   |
| A  | 11. | Strainer on primary pipework<br>Remove strainer, clean and refit.  |
| A  | 12. | Return to operation<br>After completion of maintenance, refit all manholes, refill secondary side and put primary side into operation.                 |
| A  | 13. | Check insulation for damage<br>Repair or renew as necessary.   |

## HEAT EXCHANGERS - COILS

NOTE: When cleaning, ensure that system fans are off to avoid dirt entering into the system.

### WATER TO AIR

- A 1. Drain pans  
Inspect for corrosion and clear obstructions (if any) in condensate drain piping on cooling side.
- A 2. Coils
  - a) External surface air side
  - b) Water sideClean coils and comb out fins.  
Flush out coils to remove sediment.
- A 3. Coil casing  
Inspect for rust and clean and repaint as required.
- A 4. Coil mounting bolts  
Check for tightness and secure if necessary.

### STEAM TO AIR

- A 1. Coils
  - a) External surface air side
  - b) Water sideClean coils and comb out fins.  
Flush out coils to remove sediment.
- A 2. Coil casing  
Inspect for rust and clean and repaint as required.
- A 3. Coil mounting bolts  
Check for tightness and secure if necessary.
- A 4. Gas burners and associated equipment  
Service.

**4c TANKS**

**4c i. EXPANSION TANKS**

A 1. Condition  
Examine for damage or corrosion.

A 2. Diaphragm  
Check condition and pressure.

**DHWS Heat Exchanger**

Q 1. Diaphragm expansion tank(s)  
Check.  
A Inspect.

Q 2. Non-return valve (cold water service (CWS) to heat exchanger)  
Check.

**4c ii OIL STORAGE TANKS**

SA 1. Isolation valves

SA 2. Fire valves

SA 3. Tank

SA 4. Gauges

Check operation. Examine for leaks.

Check for deterioration. Carry out a visual inspection and report findings to outer condition of tank.

Check operation and report any defects.

#### 4c ii. CW STORAGE TANKS

NOTE: Storage tanks operate at atmospheric pressure whereas tanks are sealed vessels operating at pressures above atmospheric.

- |    |     |   |
|----|-----|---|
| Q  | 1.  | Float-operated ball valve<br>Check operation, water level and shut off. Replace washer if necessary.<br>Check float for leakage and security. |
| SA | 2.  | Level control switches (if fitted)<br>Check for scale deposits, clean as necessary and check operation.                                       |
| SA | 3.  | Cistern or tank body<br>Check for leaks and any structural weaknesses.  |
| SA | 4.  | Valves<br>Check valve stems are free to turn.   |
| SA | 5.  | Air vents and overflow screens<br>Check for blockage and condition.   |
| SA | 6.  | Insulation<br>Check condition, replace if necessary.  |
| A  | 7.  | Manhole lid and access covers<br>Check condition of seals.  |
| A  | 8.  | Cistern or tanks<br>Inspect and report cleanliness and condition.   |
| A  | 9.  | Tanking<br>Ensure drains are clear, check condition.  |
| A  | 10. | Associated pipework<br>Check condition and rectify any faults.  |
| A  | 11. | Generally<br>Check that all items of equipment comply with:<br>a) legislation,<br>b) bylaws, and<br>c) codes of practice.                     |

## COLD WATER TANKS - Including breaktanks

- |    |     |   |
|----|-----|---|
| Q  | 1.  | Ball-valve<br>Check operation and tight shut off. Replace washer if necessary.                        |
| SA | 2.  | Control switches<br>Check for scale deposits, clean as necessary and check operation.                 |
| SA | 3.  | Tank body<br>Check for leaks and any structural weakness.   |
| SA | 4.  | Valves<br>Check valve stems are free to turn.   |
| SA | 5.  | Insulation<br>Check condition, replace if necessary.  |
| A  | 6.  | Tank<br>Drain, clean, check condition and repaint where required.                                     |
| A  | 7.  | Immersion heater<br>If fitted check for scale, de-scale if required and check electrical connections. |
| A  | 8.  | Associated pipework<br>Check condition and rectify faults.  |
| SA | 9.  | Associated valves<br>Check operation of valves on system.   |
| A  | 10. | Overflow pipe<br>Check for blockage.  |

#### 4d. PUMPS

Checks on pumps should only be carried out by trained personnel. LPHW pumps should be checked frequently (typically weekly) for excessive noise or vibration, excessive seal leakage, that the pressure differential is as required and that the casing is free from air. It may be appropriate to change over duty and standby pumps at the same time. Belt drives should be checked and adjusted as necessary (typically once per month), and anti-vibration mountings and flexible pipe couplings checked. Grease lubricated bearings intended for replenishments should be greased as recommended (typically every six months), taking care not to overfill.

General for all pumps

- Q 1. Noise, vibration and overheating  
Check, rectify if possible and report.
- Q 2. Lubrication  
Lubricate pump and motor bearings.
- Q 3. Drives, pulleys, anti-vibration mounts and drive couplings  
Check and adjust where necessary.
- Q 4. Glands  
Inspect and adjust if necessary. Repack if required.
- A 5. Electrical connections  
Check.
- A 6. Motor vent slots  
Clear.
- A 7. Suction line strainers  
Clean.
- A 8. Pressure switches and level controls  
Check settings and test functionally.
- A 9. Drive guards  
Check and rectify security.

## PRESSURIZATION PUMPS

- |   |     |   |
|---|-----|---|
| Q | 1.  | Pump base and connections<br>Ensure pump base is level and pipework not strained.   |
| Q | 2.  | Strainer elements<br>Clean.   |
| Q | 3.  | Pump and motor alignment<br>Check and adjust if necessary.  |
| Q | 4.  | Motors and bearings<br>Oil or grease where external nipples or lubricators are fitted.  |
| Q | 5.  | Drain holes, pipes and tank<br>Clean and ensure that all blockages are cleared.   |
| Q | 6.  | Guards and shields<br>Check for security and safety.  |
| Q | 7.  | Control and safety switches<br>Inspect and check.   |
| Q | 8.  | Control, pressure relief and reducing valves, air vents, purgers and constant flow regulators                                   |
| Q | 9.  | Test for correct operation and rectify any faults.  |
| Q | 10. | Diaphragm expansion tanks<br>Inspect. Should be 20 PSI air pressure above bladder.  |
| Q | 11. | Test run pressure booster sets, pressurizing units, and filling pump<br>Carry out adjustments to ensure satisfactory operation. |

## WATER PUMPING PRESSURE BOOSTING SETS

- |   |     |   |
|---|-----|---|
| Q | 1.  | Pump base and connections<br>Ensure pump base is level and pipework not strained.   |
| Q | 2.  | Strainer elements<br>Clean.   |
| Q | 3.  | Pump and motor alignment<br>Check and adjust if necessary.  |
| Q | 4.  | Motors and bearings<br>Oil or grease where external nipples or lubricators are fitted.  |
| Q | 5.  | Drain holes, pipes and tank<br>Clean and ensure that all blockages are cleared.   |
| Q | 6.  | Guards and shields<br>Check for security and safety.  |
| Q | 7.  | Control and safety switches<br>Inspect and check.   |
| Q | 8.  | Control, pressure relief and reducing valves and constant flow regulators<br>Test for correct operation and rectify any faults. |
| Q | 9.  | Hydraulic accumulator (if fitted)<br>Inspect and check gas cushion pressure and adjust as necessary.                            |
| Q | 10. | Test pressure booster sets<br>Run and carry out adjustments to ensure satisfactory operation.                                   |
| Q | 11. | Building management system controls<br>Simulate every function to ensure satisfactory operation.                                |

**4e. VALVES (1 of 4)**

**GATE VALVES**

- Q 1. Operational status  
Check, rotate handwheel sufficiently to indicate that wedge is not seized in closed position or jammed in open position. If normally open, close valve and reopen.
- Q 2. Gland leakage  
Check; within the first week slightly tighten gland nuts. If after a period leakage still occurs, replace gland.
- A 3. Overall condition  
Inspect for external deterioration due to leaks at end flanges or aggressive environment.

**GLOBE VALVES**

- Q 1. Operational status  
Check by rotating handwheel sufficiently to ensure freedom of movement.
- Q 2. Gland leakage  
Check; within the first week slightly tighten gland nuts. If after a period leakage still occurs, replace gland.
- A 3. Overall condition  
Inspect for external deterioration due to leaks at end flanges or aggressive environment.

**LUBRICATED PLUG VALVES**

- Q 1. Operational status  
Check by partially rotating plug to ensure freedom of movement.
- Q 2. Stem leakage  
  
If evidence of leakage, inject correct compound while simultaneously rotating plug
- A 3. Overall condition  
Inspect for external deterioration due to leaks at end flanges or aggressive environment.

## VALVES (2 of 4)

### BUTTERFLY VALVES

- Q 1. Operational status  
Check by partially rotating disc to ensure freedom of movement.
- Q 2. Stem leakage  
Check for freedom from dirt particles. Tighten gland if adjustable type, if not replace proprietary seals (e.g. O rings).
- A 3. Overall condition  
Check for deterioration externally or aggressive environment.

### FLOAT OPERATED VALVES

- Q 1. Operational status  
Check for drips from valve indicating leaking seat.
- A 2. Overall condition  
Check.

### PARALLEL SLIDE VALVES

- Q 1. Operational status  
Valve normally closed, rotate handwheel to ensure freedom of movement.
- Q 2. Gland leakage  
Check, within first week slightly tighten gland nuts. If after a period leakage still occurs replace gland.
- A 3. Body leakage  
Check for body/cover joint leakage and tighten nuts to stop.
- A 4. Overall condition  
Inspect for external deterioration due to leaks at end flanges or aggressive environment.

### SAFETY VALVES

- Q 1. Operational status  
Check by raising lever to discharge steam or air. Release gagging lever to reset.  
Check for dirt or damage.
- A 2. Bursting Discs (if fitted)  
Check condition, report.

## VALVES (3 of 4)

### STEAM PRESSURE REDUCING VALVES

- |    |    |  |
|----|----|--|
| SA | 1. | Main valve seat and valve head<br>Isolate and reduce pressure to zero. Remove screen and clean. Clean gasket faces and renew gasket. |
| SA | 2. | Pilot valve chamber assembly<br>Isolate and reduce air pressure to zero. Check dimensions of plunger gap and adjust if necessary.    |
| SA | 3. | Pilot and main diaphragm<br>Thoroughly clean upper and lower diaphragm chambers, ensure contact faces are clean, and reassemble.     |

### PRESSURE CONTROL VALVES

- |    |    |   |
|----|----|---|
| SA | 1. | Strainers preceding valves<br>Clean strainer screens.                             |
| A  | 2. | Control Valve<br>Overhaul using standard maintenance repair kit.                  |
| A  | 3. | Main valve and seat assembly<br>Examine seat for damage, wear and scale build-up. |

### DIAPHRAGM VALVES

- |   |    |  |
|---|----|--|
| A | 1. | Valve<br>Isolate and check condition. Dismantle and clean body, threads, spring and diaphragm. |
| A | 2. | Diaphragm<br>Change if condition suspect.  |
| A | 3. | Re-assemble<br>Tighten bolts diagonally. Do not overclose the diaphragm.                       |

## VALVES (4 of 4)

### BOILER VALVES

- |    |    |  |
|----|----|--|
| A  | 1. | Main stop valve<br>Lap seats, inspect for corrosion, reset valve at correct set pressure and carry out accumulation test.  |
| A  | 2. | Main stop valve<br>Lap seat, repack gland and lubricate spindle, checking for ease of operation.   |
| *  | 3. | Water level controls<br>* Daily or Weekly<br>Blowdown and check operation.<br>Lower boiler water level and check operation.<br>Clean out chambers of any deposits. |
| SA | 4. | Sequencing valve<br>Clean and lap seats, check for ease of operation.  |
| SA | 5. | Water level gauge<br>Refit sight glass, repack cock plugs and check for ease of operation.   |

## AUTOMATIC AIR ELIMINATORS VALVES

A 1. Valve

A 2. Float

Check for leaks.

Clean float chamber and needle valve assembly.

#### 4f. CONTROLS

##### OPTIMIZERS

- |   |    |   |
|---|----|---|
| A | 1. | Outside air temperature sensor<br>Check outside sensor for calibration and display accuracy.  |
| A | 2. | Inside air temperature sensor<br>Check inside sensor for calibration and display accuracy.  |
| A | 3. | Program setting<br>Check program setting is correct.  |
| A | 4. | Optimum stop/start operation<br>Check operation by simulation.  |
| A | 5. | Battery<br>Check condition.   |
| A | 6. | Output devices<br>Check that output devices respond to command signals.   |
| A | 7. | Energy savings<br>Communicate with system operator if there is any other opportunities to save energy with the present sequence of operation. |

## **OUTDOOR RESET CONTROLLER**

- |    |    |  |
|----|----|--|
| SA | 1. | Flow temperature sensor<br>Check.  |
| SA | 2. | Outside air temperature sensor<br>Check.   |
| SA | 3. | Settings<br>Check that settings are correct.   |
| SA | 4. | Output signal<br>Check output signal and output device operation.                                  |
| SA | 5. | Controllers<br>Check and calibrate for correct relationship between outside and flow temperatures. |
| SA | 6. | System operation<br>Check system under control for proper operation.                               |

## HEAT EXCHANGER CONTROLS

Certain common maintenance procedures should be carried out for all controls. These are:

All control items, e.g. thermostats and the like, that have been switching contacts - ensure that contacts make and break easily and that there is no arcing or pitting. Inspect thermostat phial and capillaries for mechanical damage. Inspect thermostat pockets for corrosion and leakage. Ensure immersion thermostats are secure in their pockets (and that the sensor is in contact with the end of the pocket). Inspect motorized valves for leakage and damage to linkage.

- A 1. Control thermostat  
Check operation and confirm set point.
- A 2. High limit thermostat (if fitted)  
Check operation and confirm set point.
- A 3. Temperature sensor controller; motorized valve  
Check operation and confirm set point(s).
- A 4. Power fail return; motorized valve  
Check operation.
- A 5. Direct acting control valve  
Check operation and confirm set point.
- A 6. Direct acting control valve high limit  
Check operation and confirm set point.
- A 7. Temperature sensor  
Controller  
Motorized valve

### **Power fail return motor**

Check performance.

## HEATING SYSTEMS CONTROLS

Certain common maintenance procedures should be carried out for all controls. These are:

All control items, e.g. thermostats and the like, that have switching contacts –ensure that contacts make and break easily and that there is no arcing or pitting.

Inspect thermostat phial and capillaries for mechanical damage.

Inspect thermostat pockets for corrosion and leakage.

Ensure immersion thermostats are secure in their pockets (and that the sensor is in contact with the end of the pocket).

- A 1. Room thermostat  
Check operation. Confirm the set point.
- A 2. Zone motorized valve  
Check operation.
- A 3. Temperature sensor  
Motorized valve  
Check operation. Confirm set points.
- A 4. Temperature sensor  
Controller  
Motorized valve  
Check performance.

7. 4f i ALARMS

**BOILERS - FIRE AND SAFETY CIRCUITS (1 of 2)**

Is the plant safe? It should be noted that fire prevention and fire alarms are not included in the scope of this document. Any steam plant over 15 psi needs a City of Chicago licensed engineer to operate it. It is essential that the operation of all indicator lights should be checked regularly and that any malfunctions should be corrected as soon as possible.

- 1. Oil
  - A Manual fire valve
  - A Check valve and associated couplings for positive oil shut off.
  - A Quick release mechanism
  - A Actuate and check that any dead weight or solenoid valves operate correctly.
  - A Valve and quick release system
  - A Reset.
- 2. Gas
  - A Manually operated valves
  - A Check to establish positive shut off gas is achieved.
  - A Pressure switches on gas boosters
  - A Check for operation and sensitivity.
  - A Gas detection unit
  - A Test sensitivity.
  - A Manual quick release mechanism
  - A Actuate and recheck operation of the dead weight valve or solenoid.
  - A Valves and quick release mechanism
  - A Reset.
- 3. Solid fuel
  - A Fusible links, inter-connecting tension wire and pulleys
  - A Inspect.
- 4. Pressure switches
  - A Check operation.
- 3. Foam inlets
  - A Ensure foam inlet pipes are free from blockage.

**BOILERS - FIRE AND SAFETY CIRCUITS (2 of 2)**

- |    |    |   |
|----|----|---|
| SA | 6. | Smoke/heat detection<br>Check operation.  |
| SA | 7. | General<br>Check all fuel supply valves for free operation.   |
| A  | 8. | Combustion air source into plant room<br>Check that original provision has been left clear of any obstruction dirt. |

## PNEUMATIC ACTUATORS

Pneumatic actuators do not have an electrical supply but function by air pressure alone. Therefore should there be any loss in pressure, the performance of the actuator (and thus the whole system) will be impaired making it inefficient.

- |    |    |  |           |
|----|----|--|-----------|
| A  | 1. | Pressure/leakage/seizure<br>Check operation between actuator and controller. Test diaphragm for leakage (pump up gauge).                           | The Owner |
| A  | 2. | Pipe connections<br>Check condition of glands and seals, Check pipework for deterioration.   |           |
| A  | 3. | Air quality<br>Check that any filters are clear of water and oil (filter may not be local to the actuator).  |           |
| A  | 4. | Manual operation (if fitted)<br>Check to ensure actuator achieves stroke limits. Check for minimum/maximum setting.                                |           |
| A  | 5. | Linkage assembly<br>i.e., nuts, bolts, spring, valve stem or damper assembly<br>Check<br>a) Wear<br>b) Security, and<br>c) Corrosion.              |           |
| A  | 6. | Lubrication and cleaning<br>As recommended.  |           |
| SA | 7. | Actuator function<br>Check calibration-controller output to actuator position.<br>Note: More than one actuator may be fed from the control supply. |           |
| A  | 8. | Auxiliary control units<br>e.g. positioners, electrical feedback units, end switches<br>Check operation.   |           |

## MOTOR DRIVEN ACTUATORS

- |    |    |  |
|----|----|--|
| A  | 1. | Electricity supply<br>Check supply voltage and that polarities are correct.  |
| A  | 2. | Control signal<br>Check for presence and that polarity is correct.   |
| A  | 3. | Auxiliary control functions<br>i.e., on/off switches, frost protection, position indicators, feedback potentiometers<br>Check operation. |
| A  | 4. | Manual operation (if fitted)<br>Check to prove actuator will mechanically open/close valve or damper to its working limits.              |
| A  | 5. | Actuators position on power failure<br>Check for correct position for application when power fails.                                      |
| SA | 6. | Reaction to safety signal<br>i.e., fire, smoke<br>Check that the actuator assumes correct position (if applicable).                      |
| A  | 7. | Reaction to control signal<br>Check for correct response to signal.  |
| A  | 8. | Running time (if applicable)<br>Check.   |

**4g HVAC SUPPLY/DISTRIBUTION**

**4g i. OIL**

- Q 1. Burner  
Fire, if possible. Carry out safety check of flame failure device.
- Q 2. Linkages  
Check and adjust if necessary.
- Q 3. Oil metering system  
Renew seals and gaskets if necessary.
- Q 4. Main shaft on burner  
"Lift" bearings.
- Q 5. Atomizers and spray tip, if fitted  
Check.

**4g ii GAS**

- |   |  |
|---|--|
| A | 1. Joints<br>Carry out leak test of all joints downstream of interlock isolator. |
| A | 2. Main gas valve<br>Check operation of leak test equipment.                     |
| A | 3. Gas throughput<br>If practical - check.                                       |
| A | 4. Vent pipework<br>Check integrity.   |

**4g iii ELECTRICAL**

SA 1. Wiring  
Check panel, junction box and terminals.

SA 2. Fuses  
Check rating.

SA 3. Overload relays  
Check settings.

Q **GENERAL**

Check security of mechanical parts and secure mounting of appliance.

**REPORT AND RECOMMENDATIONS**

Should be signed by service engineer and kept by the client.

#### 4h. PNEUMATICS SYSTEM/AIR COMPRESSORS (1 of 4)

It should be noted that to ensure dry, clean, and oil free air there are a number of daily and weekly tasks which the plant operator must carry out as part of his or her duties. These include daily condensate drainage, pressure drop checks across filters, oil contamination check and audible leaks.

- |   |    |  |
|---|----|--|
| A | 1. | Capacity test<br>Pump up receiver from zero atmospheric pressure to working pressure and note time taken.  |
| A | 2. | General condition<br>Check the following:<br>a) Condition of guards,<br>b) Interstage cooler drains,<br>c) Bearers and holding down bolts,<br>d) Hand operated valves, and<br>e) Moisture traps. |
| A | 3. | Status<br>Switch off and isolate electricity.  |
| A | 4. | Oil<br>Note level and change using recommended lubricating oil.  |
| A | 4. | Belt and drive<br>Check tension and condition of belts and drives.   |
| A | 6. | Condensate removal<br>Check condensate drainage system and clean as necessary.   |
| A | 7. | Pressure relief valve<br>Operate and check valve for condition, operation, setting and leak tightens. Adjust if necessary.   |
| A | 8. | Air filter<br>Clean.   |
| A | 9. | Electrical connections<br>Check and tighten all connections. Check condition of wiring and insulation.   |

## **AIR COMPRESSORS (2 of 4)**

- A 10. Gauges  
Check operation.
- A 11. Pipes and connections  
Check external condition and leak tightness. Tighten connections as necessary.
- A 12. Controls  
Check operation of pressure switches and auto change over solenoids.
- A 13. Offloaders, mechanical and electrical  
Check operation.
- A 14. Main air intake air quality  
Check air source for possible contamination and dangerous gases.

## **COMPRESSED AIR DRYERS**

- 1. Refrigeration type
- Q 2. Pipe connections  
Check for leak tightness. Remedy as necessary.
- A 3. Electrical wiring and conduits  
Check condition of contacts. Clean or replace.
- A 4. Discharge air dewpoint  
Measure and record.
- Q 5. Condensate trap bowl  
Drain, clean with soapy water and replace.
- Q 6. Evaporator fins  
Clean and straighten.

## **WATER COOLED AFTER COOLERS**

- A 1. Pipe connections  
Check for leaks.

## **AIR COMPRESSORS (3 of 4)**

### **WATER ABSORPTION TYPE**

- Q 1. Drying medium  
Remove from container, check condition and treat as necessary.
- Q 2. Cleaning  
Where applicable, dismantle and clean with dry oxygen free nitrogen.  
Examine, test, refit or renew items listed under notes.
- Q 3. Discharge air quality  
Check and record.  
a) Air dewpoint,  
b) Air temperature.
- Q 4. Re-activation drying time  
Time change-over period.
5. Cartridge  
Change complete container.

### **COMPRESSED AIR DISTRIBUTION NETWORK**

- Q 1. Filter and pressure reducing station  
a) Check particle filters and change as required.  
b) Check oil filter and change as required.  
c) Check pressure reducing valve settings.  
d) Check low pressure safety valve.
- Q 2. Moisture drain  
Check operation.
- A 3. Valves  
Check external condition operation, leak tightness of glands and seats, spindles and handwheels.
- A 4. Safety and reducing valves  
Examine external condition check operation, settings and leak tightness.

## AIR COMPRESSORS (4 of 4)

- |   |    |  |
|---|----|--|
| A | 5. | Drains and trap<br>Check external condition, operation and leak tightness.   |
| A | 6. | Filters and strainers<br>Check external condition, operation and leak tightness.                                   |
| A | 7. | Gauges<br>Check operation, condition, leak tightness.  |
| A | 8. | Pipes and connections<br>Check external condition and leak tightness. Ensure correct "signwriting" (color coding). |
| A | 9. | Pipe insulation<br>Check condition of insulation on drain legs, etc. and replace if defective.                     |

## PNEUMATIC RELAYS

ELECTRIC TO PNEUMATIC, PNEUMATIC TO ELECTRIC AND PNEUMATIC TO PNEUMATIC.

- |    |    |   |
|----|----|---|
| SA | 1. | Input signal(s)<br>Check.   |
| SA | 2. | Output signal(s)<br>Check.  |
| SA | 3. | Operation<br>Check for correct relationship between input and output signals. |

M

**4i. FLUES**

- A 1. Drain plugs at the base of the flue  
Remove, allow any accumulated condensate to drain away and replace.
- A 2. Supports  
Inspect security of supports and condition of paintwork. Treat any signs of rust or corrosion.
- A 3. Flue terminals  
Check flue terminals at roof level.
- A 4. Boiler flue and vertical chimneys  
Clean thoroughly with custom made flue brushes and tools.
- A 5. Balanced flue terminals  
Check for obstruction, corrosion, and if fan assisted, check safety circuit.
- A 6. Induced draught  
Check for obstruction and condition of bearings.
- A 7. Fan dilution units
- A 8. Modular boiler flue systems
- A 9. Condensing boilers  
Check for obstruction and corrosion. If fan assisted check safety circuit.
- A 10. Stabilizers (explosion doors)  
Check condition and ensure movement is free.
- 11. Structural stability  
Check condition and if free standing, examine condition of guy ropes.

**4j. REFRIGERATION COMPRESSORS - Centrifugal - R11 or R-123  
Refrigerant (1 of 2)**

NOTE: More frequent maintenance checks should be carried out by the plant operators and local maintenance personnel.

- Q 1. Operation  
**Check running conditions, oil pressure, purge unit operation, oil level and oil return system. Look for signs of leakage.**
- Q 2. Refrigerant charge  
Check level and carry out leak test.
- Q 3. Holding down bolts  
Check compressor and motor holding down bolts and tighten if necessary.
- Q 4. Purge unit  
Check frequency of discharges.
- Q 5. Controls  
Check oil pressure differential and chilled water temperature and flow rate.
- Q 6. Purge unit filter driers (if fitted)  
Change in accordance with manufacturer's instructions.
- A 7. Compressor oil  
Take sample for analysis.
- SA 8. Oil filter  
Change both filter and oil drier return system.
- A 9. Purge unit valves, valves and associated equipment  
Clean and inspect.
- A 10. Float assembly  
Remove and flush shell with degreaser.  
Clean the orifices.
- A 11. Oil return filter drier  
Change.
- A 12. Foul gas supply filter  
Change.

**REFRIGERATION COMPRESSORS - Centrifugal - R11 or R-123**  
**Refrigerant (2 of 2)**

- |   |     |   |
|---|-----|---|
| A | 13. | Oil return filter drier<br>Change the filter/drier, check that eductor tee is undamaged, clean.<br>Clean dirt leg.  |
| A | 14. | Main oil filter<br>Change.  |
| A | 15. | Electrical and safety controls<br>Check that they are working satisfactorily.   |
| A | 16. | Condenser and evaporator<br>Check water pressure drops.   |
| A | 17. | Cooling tower<br>Check settings of cooling tower fans controls.   |
| A | 18. | Motors<br>Hermetic/Open Type<br>Open Type<br>Carry out electrical insulation tests with megaohm meter.<br>Check motor/fan is clean and efficient. Check motor and compressor alignment. |

## CONDENSER – WATER COOLED

- |   |    |  |
|---|----|--|
| A | 1. | Compressor full load operation<br>Record inlet and outlet temperature on water side, pressure drop across condenser, head pressure and condensing temperature.                                 |
| A | 2. | Pump<br>Check and record pressure drop across pump. Check for leakage, bearing noise and unusual bearing temperature. Lubricate according to manufacturer's instructions. Check motor current. |
| A | 3. | Water strainers<br>Clean.  |
| A | 4. | Condenser tubes<br>Open. Brush tubes. Inspect for alkaline deposits and/or corrosion.  |
| A | 5. | Condenser shell<br>Check for presence of non-condensable gases, purge or vent if necessary.  |
| A | 6. | Isolating valves<br>Check external condition, leak tightness of glands and seats, operational spindles and handwheels.   |

## CONDENSER – AIR COOLED

- Q 1. Operating pressure  
Check pressure and pressure switches using gauges.
- Q 2. Solenoid valves  
Ensure that they do not bypass.
- Q 3. Head pressure control (fan speed)  
Check operation.
- A 4. Motor mountings  
Check for security and tightness.
- Q 5. Condenser coil  
Inspect and clean.  
Test for refrigerant leak.
- Q 6. Casing  
Clean and secure.
- Q 7. Sediment  
Remove; if substantial build-up has occurred, investigate cause.
- Q 8. Alignment and wear of belt drives where applicable  
Check pulley alignment and belt wear.
- SA 9. Head pressure control damper  
Lubricate control damper bearings.
- A 10. Electrical connections  
Check and tighten as necessary. Check condition of flexible conduits, wiring and insulation.
- A 11. Pipework  
Inspect connections, pipes and supports for damage, loose or missing fittings. Repair as necessary.

## 4k. WATER TREATMENT

### CHEMICAL ANALYTICAL SERVICES - Testing of Closed Systems

The following systems are covered:

- (a) Heating systems
  - (i) LTHW / LPHW
  - (ii) MPHw
  - (iii) HPHW
- (b) Chilled Water System
  - (i) Glycol Systems
  - (ii) Non-Glycol systems
- (c) Constant temperature closed circuits, e.g., Versatemps
- (d) Condenser Water Closed systems

**Method Statement**

- (1) Sample drawn from system, in the case of heating systems a sample cooler should be utilized if installed.
- (2) Sample analyzed using the following parameters:

T.D.S., pH, p ALK, m ALK, Total and Dissolved iron, Inhibitor, Glycol

Depending on the system, the inhibitor will be specified for that system, and will have been added with regard to the system metallurgy and operating conditions (e.g., temperature).

Details of types of inhibitors are included in the Chemical Products Section, including both user instructions and OSHA Safety Data Sheets.

- (3) The chemical analysis is compared to the specified limits set for each system and any anomalies noted.
- (4) If analysis shows any anomalies, then the required action is either taken directly or written instruction issued to responsible person for any remedial work to be done.
- (5) If system has bypass feeder fitted (dose pot) or dose pump and tank fitted to system, then operative will dose additional inhibitor into system if analysis shows low levels.
- (6) If no simple method of dosing system is available, written instruction will be sent to site responsible person for dosing to be performed in some other manner.

**CHEMICAL ANALYTICAL SERVICES - Method Statement For Non-Acidic Clean And Flushing Of Closed Systems**

- 1. With circulating pumps running, allow system water to drain while make-up flushes clean water into system. Drain at farthest point from make-up. Ensure all

drain cocks flushed out.

2. Add treatment to system via dose pot to give concentration of 1000ppm of product in system.
3. Allow system to circulate for a minimum of 24 - 48 hours.
4. Begin flushing treatment and debris from system while keeping circulating pump running.
5. Continue flushing, including flushing all drain points to remove settled sediment until all suspended solids have been removed and the dissolved iron level in the circulating water is the same as the incoming mains.
6. Redose system with scale/corrosion inhibitor

**CHEMICAL ANALYTICAL SERVICES - Routine Monitoring Of Cooling Towers/  
Evaporative Condensers (1 of 16)**

All work to be in compliance with EPA and local authorities.

- (1) Full survey of system to have been carried out prior to setting up of cooling tower log book. (Appendix I)
- (2) Record all system data in log book. (Appendix I)
- (3) Prepare water treatment program. (Appendix II)
- (4) If site requires weekly tests or if site is manned, then weekly checks are carried out and recorded in site log book. (Appendix III - XI)
- (5) At monthly site service visits, the following will be carried out:
  - i. Analytical tests as per water treatment program.
  - ii. Dipslides taken from cooling tower.
  - iii. Check of weekly records.
  - iv. Chemical usage checked and recorded.
  - v. Water usage checked and recorded.
  - vi. Written report left on site with all changes detailed.
  - vii. Results logged. (Appendix XII)
- (6) Sample shall be taken at every six months and should be submitted for specific analysis for Legionella Pneumophilla by an independent laboratory. Such results to be certified and logged.
- (7) Biannually, cooling tower will be cleaned and disinfected as designated the preceding Specification for Carrying Out Risk Assessment on Building Water Systems. Such work shall be suitably certified and logged in the site log book. (Appendix XIII)

## **Work Schedules and Log Sheets**

- Appendix I Cooling Tower System Data
- Appendix II Cooling Tower Water Treatment Program
- Appendix III Cooling Tower Weekly Tests
- Appendix IV Chemical Stock / Usage
- Appendix V Operation of Bleed
- Appendix VI Water Meter Readings / Water Usage
- Appendix VII pH Levels
- Appendix VIII TDS / Conductivity Levels
- Appendix IX Bromine Levels
- Appendix X Softener Hardness
- Appendix XI Dipslides
- Appendix XII Cooling Tower Monthly Checks
- Appendix XIII Cooling Tower Routine Chlorinations

### **Appendix I**

Site:

System Data:

Make and Model of Tower:

System Volume:

Re-circulation Rate:

Temperature Drop:

Evaporation Rate:

Bleed Rate:

Operation - hrs/day:

- days/year:

Make-up Water Quality:

Water Treatment Chemicals in Use

Inhibitor:

Biocide 1:

Biocide 2:

Bleed Control System

Pre-treatment Plant Type

### **Appendix II**

Site:

#### **WATER TREATMENT PROGRAM**

Control Parameters

1. Total / Ca Hardness :
2. Alkalinity (M) :

- 3. Chloride :
- 4. TDS/Conductivity :
- 5. pH :
- 6. Inhibitor Levels :
- 7. Concentrate Ratio :
- 8. Total Bromine :
- 9. Microbiological Activity :

All or some of the above may be used.

See following chart concerning product application.

Product Application  
 Product  
 Initial Dose  
 Maintenance Dose  
 Dosing Equipment

Dosing equipment settings may change frequently. See Analytical Service Reports for current settings.

**Appendix III**

**COOLING TOWER WEEKLY TESTS**

**Work Schedule**

- 1. Check chemical stock, recording levels and weekly usage.
- 2. Check operation of bleed and record.
- 3. Record water meter readings. Calculate and record water usage.
- 4. Test and record pH levels in tower(s).
- 5. Test and record TDS/conductivity level in tower(s).
- 6. Test and record bromine level in tower(s).
- 7. Test and record softener hardness (if applicable).
- 8. Take a dipslide from each tower. Record results after incubating for the required time.

**Appendix IV**

Site:

**1. CHEMICAL STOCK / USAGE**

System Reference :  
 Chemical Reference : 1=  
 2=  
 3=  
 4=

Date

Chem. Stock  
Chem. Usage  
Obs. / Action  
Signature

#### Appendix V

Site:  
2. OPERATION OF BLEED  
System Reference:  
Date  
S or NS  
Action  
Signature

#### **Appendix VI**

Site:  
3. WATER METER READINGS / WATER USAGE  
System Reference:  
Date  
Water Meter Reading  
Water Usage  
Signature

#### **Appendix VII**

Site:  
4. pH LEVELS  
System Reference:  
Parameters:  
Date  
pH  
S or NS  
Action  
Signature

#### **Appendix VIII**

Site:  
5. TDS / CONDUCTIVITY LEVELS  
System Reference:  
Parameters:  
Date  
TDS/Cond.

S or NS  
Action  
Signature

### **Appendix IX**

Site:  
6. BROMINE LEVELS  
System Reference:  
Parameters:  
Date  
Bromine Level  
S or NS  
Action  
Signature

### **Appendix X**

Site:  
7. SOFTENER HARDNESS  
System Reference:  
Parameters: