ANNEX 5

SCHEDULES OF PROCEDURE FOR PLANNED PREVENTIVE MAINTENANCE

The schedules presented here are meant to serve only as guidelines; modifications may be introduced to conform to manufacturers' specifications.

Each schedule should be amended to indicate to the maintenance engineer carrying out the work that each test should be checked against a checklist and all measurements should be recorded on a card. An outline record card could be included with each schedule for this purpose. The engineer should also note on the record card any item that needs to be replaced, if work is to be carried out later, and whether or not the same engineer is to carry out the work.

1. X-Ray equipment

Apparatus: General-purpose radiographic and fluoroscopic unit

Procedure	*Total time*
Every 6 months	7.0 h

1. Check controller assembly

   - Thoroughly clean interior and exterior of unit using vacuum cleaner.
   - Check mechanical integrity of control knobs, switches, etc.
   - Check mechanical integrity of connectors, relay contacts, etc.
   - Inspect physical condition of high-tension cables.
   - Check function of back-up safety timer.

2. Check high-tension transformer

   - Clean exterior units.
   - Check all connections to high-tension transformer.
   - Check oil level in transformer.
   - Inspect high-tension cable terminals; clean as necessary.
   - Inspect physical condition of high-tension cables.
   - Check main power input connections.

3. Check X-ray tube (under-table and over-table)

   - Check physical condition of tube(s); i.e., cracks in anode, oil leaks on housing, etc.
   - Inspect high-tension terminals; clean as necessary.
   - Inspect collimator alignment.
   - Check tube focal spots.
   - Check serial changer or spot film device (fluoroscopic).
   - Check resolution of image intensifier and television system.
   - Check under-table collimator or smooth operation of shutters.

4. Check over-table tube assembly (floor-to-ceiling or ceiling-mounted)

   - Check function of locking machine.
   - Check physical condition of counterweight cables and clamps.
   - Check bearing for wear; lubricate as required.

5. Check X-ray tables

   - Clean thoroughly and remove debris.
   - Clean spot film device.
   - Check bearing and bearing surfaces; lubricate as necessary.
   - Check physical condition of counterweight cables and clamps.
   - Check function of safety devices and electromagnetic locks.
   - Check condition of Bucky grid and cassette tray; check Bucky locks.

6. Check vertical Bucky stand or chest/erect X-ray stand

   - Check condition of X-ray grid.
   - Check cassette stand.
   - Check bearing and counterweight cables; lubricate and tighten as necessary

7. Check tomographic attachment

   - Clean bearing surfaces.
   - Lubricate bearing as necessary.
   - Check motor bearing.
   - Check for excessive movement.

8. Check radiator output, i.e., mA, kVp and time.

9. Check fluoroscopic output, i.e., kVp, mA.

10. Check radiographic and fluoroscopic timers and radiographic back-up timer.

11. Verify correct meter indications and appropriate audiovisual signals.

Annual total-12-16h

II. Laboratory equipment

Apparatus: Microscope

Procedure	*Total time*
Every 6 months	1.0 h

1. Check integrity of electrical grounding.

2. Check physical condition of transformer power cord and plug.

3. Clean and inspect microscope for signs of damage.

4. Clean eyepieces, condenser, objective and illuminator assembly.

5. Check adjustment of aperture diaphragm and condenser assembly.

6. Check stage assembly for smooth movement.

7. Check fine and coarse focus for smooth movement.

8. Thoroughly clean interior and exterior of unit using vacuum cleaner.

Apparatus: Colorimeter

Procedure	*Total time*
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical condition of all knobs and switches.
4. Clean interior and exterior unit.
5. Clean cleanliness of cuvette assembly.
6. Check alignment of galvanometer lamp and projector.
7. Clean lenses and optical filters.
8. Check transformer voltage.
9. Check operation of unit and adjust mechanical zero.

Annual total-2.0 h

Apparatus: Centrifuges

Procedure	*Total time*
Every 6 months	0.5-2.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, meter, cover latch, gasket, etc.
4. Inspect unit for signs of physical or electrical damage.
5. Clean commutator, check brushes; replace if necessary.
6. Check head balance.
7. Lubricate motor and bearing, if applicable.
8. Clean interior and exterior of unit.
9. Check operating unit for vibrations and excessive noise.
10. Check speed, and calibrate tachometer if necessary.
11. Check accuracy of timer.
12. Check braking system.
13. Check safety interlocks.
14. If unit is refrigerated, check temperature, clean coils and check for leaks.

Apparatus: Flame photometer (analog and digital)

Procedure	*Total time*
Every 6 months	1.5 h (analog) 2.0 h (digital)

1. Check integrity of electrical grounding.

2. Check physical condition of power cord and plug.

3. Check mechanical integrity of switches, control, etc.

4. Inspect air filter assembly, if applicable; examine filter cartridge and replace if necessary.

5. Check air and gas filters, if applicable; replace micron filters.

6. Clean burner assembly; replace O-ring seals.

7. Clean optical filters.

8. Clean and inspect electronic circuitry for signs of damage; check power supply voltage.

9. Check operating unit.

10. Check aspiration rate; adjust as necessary to manufacturer's specifications.

11. Check fuel and air pressures, if applicable; adjust fuel: air ratio.

12. Verify proper operation of read-out; check electronic alignment, if applicable.

13. Calibrate unit using standard.

Annual total-3-4 h

Apparatus: Haemoglobinometer

Procedure	*Total time*
Every 6 months	1.0 h

1. Check integrity of electrical grounding.

2. Check physical condition of power cord and plug.

3. Check mechanical integrity of switches, controls, etc.

4. Clean interior and exterior of unit.

5. Inspect interior for signs of damage.

6. Clean cuvette assembly thoroughly.

7. Check tubing; replace if necessary.

8. Check condition of lamp and phototube housing; clean as necessary.

9. Check lamp voltage and blank voltage; adjust if necessary.

10. Check operating unit.

11. Calibrate, using standard solutions and blood control.

Annual total-2.0 h

Apparatus: pH meter

Procedure	*Total time*
Every 6 months	0.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, connection and meter/display.
4. Clean and check interior for signs of damage.
5. Check condition of electrodes and electrode holder.
6. Calibrate meter or digital display with millivolt/pH calibrator.
7. Adjust slope as required.
8. Check batteries, as applicable, and replace as necessary.
9. Check overall operation of unit by measuring pH of known solution.

Annual total-1.0 h

Apparatus: Bilirubinometer

Procedure	*Total time*
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Thoroughly clean interior and exterior of unit.
4. Check mechanical integrity of switches, controls and knobs.
5. Check condition of reference standard and sample chambers; clean as necessary.
6. Clean slide mechanism.
7. Check condition of source lamp; replace if darkened;
8. Check operation of unit.

Annual total-2.0 h

Apparatus: Blood-cell counter

Procedure	*Total time*
Every 6 months	1.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, meter, etc.
4. Examine and thoroughly clean interior and exterior.

5. Check condition of vacuum regulator; lubricate pump if necessary.
6. Check integrity of manometer and clean; change mercury if necessary.
7. Inspect tubing; replace as necessary.
8. Check regulated power supply voltage.
9. Check operating units.
10. Check linearity and reproducibility.

Annual total-3.0 h

Apparatus: Chloridometer/Chloride analyser

Procedure	*Total time*
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls and knobs.
4. Check meter movements for sensitivity and zeroing.
5. Inspect generator electrodes; check electrode voltages
6. Examine indicator electrodes; clean with silver polish; examine insulators.
7. Inspect stirrer motor to ensure free rotation.
8. Check and replace battery, if applicable.
9. Inspect electrical and electronic components for damage.
10. Check operation and calibration of unit; recalibrate, if necessary, using manufacturer's specifications.

Every 12 months	0.5 h

1. Inspect drive belt and stirrer shaft bearing; replace belt if necessary.

Apparatus: Blood-gas analyser (analog and digital)

Procedure	*Total time*
Every 3 months	2.0 h (analog) 4.0 h (digital)

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Clean accumulations of salt from interior and exterior .
4. Inspect water baths for leaks, deteriorated tubing and cracks; clean interior water bath thoroughly.
5. Check water pump motor and lubricate; check vacuum system.
6. Check electronic component for signs of damage.

7. Check mechanical integrity of all controls, switches, connectors, etc; check condition of analog/digital display.
8. Inspect electrodes and electrode cables for signs of deterioration or cracks; clean electrodes and install new membranes.
9. Reassemble unit; check water circulation, water bath temperature control, vacuum and aspiration.
10. Check and calibrate pH, PO_2, PCO_2 electrodes.

Every 12 months	1 h

1. Replace water-bath seals, tubing, O-rings and grommets.

Annual total-9-17 h

Apparatus: Electronic balance (table-top)

Procedure	*Total time*
Every 6 months	0.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls and display.
4. Check calibration of display, using manufacturer's service and standard weight.
5. Clean exterior and ensure balance on a firm stand-
6. Check operating units.

Apparatus: Spectrophotometer (visible and ultra-violet spectra)

Procedure	*Total time*
Every 6 months	0.5 h (analog) 2.0 h (digital)

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches and knobs.
4. Clean exterior, particularly cuvette well.
5. Check integrity of photosensing device on cuvette wall.
6. Check mechanical zero of wavelength calibration, following manufacturer's instructions.
7. Check wavelength calibration using buffer solutions or, preferably, calibrating filter standard, following manufacturer's instructions.
8. Clean optical filters in front of cuvette well.
9. Check operation of unit.

Annual total-l-4 h

Apparatus: Hot-plate magnetic stirrer

Procedure	*Total time*
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches and knobs.
4. Clean exterior.
5. Check magnetic properties of stirrers.
6. Check transformer voltage.
7. Check operation of unit and speed of rotation.

Annual total-2.0 h

Apparatus: Hot-air incubator/oven

Procedure	*Total time*
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches and knobs.
4. Clean interior and exterior.
5. Check transformer voltage.
6. Check accuracy of temperature calibration of thermostat, using external thermometer.
7. Check accuracy of calibration of timer, using a stop-watch.
8. Check operation of unit and adjust as indicated in manufacturer's service manual.

Annual total-20 h

Apparatus: Water bath

Procedure	*Total time*
Every 6 months	1.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Clean and inspect for corrosion.
4. Check and clean heating element from corrosion due to hard water.

Annual total-3.0 h

Apparatus: Water distiller/softener

Procedure	*Total time*
Every 6 months	1.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls and connectors.
4. Check water circuit for leakages and calcification.
5. Check for presence of chemicals and condition of filter.

Annual total-3.0 h

III. Electro-medical equipment

Apparatus: Electrocardiograph

Procedure	*Total time*
Every 6 months	1.0 h

1. Check integrity of electrical grounding from instrument chassis.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches and controls.
4. Inspect condition of patient cables and switches.
5. Clean interior of unit using a vacuum cleaner.
6. Inspect internal components for signs of wear or damage.
7. Clean lead selector and other exposed switch contacts.
8. Check chart recorder speed.
9. Test maker stylus.
10. Check condition of writing stylus; adjust heat and pressure as necessary.
11. Test and adjust gain of amplifier according to manufacturer's specifications; check amplifier balance, frequency response and common mode rejection.
12. Check integrity of electrical grounding from each electrode in all modes.
13. Check operation of unit: run a strip of all lead configurations using a cardiac simulator.

Every 12 months	0.5 h

1. Sparingly lubricate recorder motor and gears as required.
2. Check and adjust test pulse reference voltage.

Annual total-2.5 h

Apparatus: Defibrillator/Cardioverter

Procedure	*Total time*
Every 4 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, connections, meters, etc.
4. Check physical condition of electrodes, defibrillator paddles and cables.
5. Check interior for signs of damage; clean as necessary.
6. Check operation of unit; measure energy output at all watt-second settings. Take care.
7. Check operation of synchronizer, if used.
8. Check voltage gain calibration of monitor, recorder, etc, if used.
9. Check trace on oscilloscope, if applicable.
10. Check chart recorder, stylus condition, stylus heat and pressure and recorder speed, if applicable.
11. Check electrical current leakage from each electrode, if applicable.

Every 12 months	1.0 h

1. Sparingly lubricate recorder motor and gears as required.
2. Check batteries and replace with correct spares as required.

Annual total-4.0 h

Important: Add warning about the hazards of maintaining or testing a defibrillator without having had training on the unit to appreciate the high voltage (about 5 kV) and high currents (about 50 A) that can be generated. This unit is potentially hazardous to all staff.

Apparatus: Electrosurgical unit

Procedure	*Total time*
Every 4 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, connectors, etc.
4. Check physical condition of footswitch and cable.
5. Inspect accessories for signs of deterioration or defective cables.
6. Clean and inspect interior for damage.
7. Check condition of spark gaps and vacuum tubes, if applicable.

8. Measure radio frequency output in all operating modes; refer to manufacturer's specifications.
9. Verify patient plate and footswitch for correct grounding; test function of patient ground guard circuit.
10. Check radio frequency of interference with other surgical devices, e.g., patient monitor.

Annual total-3.0 h

Apparatus: Anaesthetic machine

Procedure	*Total time*
Every 6 months	2.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check all rubber fittings (O-rings, diaphragms, gaskets, valve seals, etc) and replace if necessary with manufacturer's approved replacement parts.
4. Check for gas leakages.
5. Clean and check calibration of flow meter.

Annual total-4.0 h

Apparatus: Fetal monitor

Procedure	*Total time*
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, connectors, meters, etc.
4. Check physical condition of cables and transducers.
5. Check interior of unit for signs of damage.
6. Sparingly clean and lubricate recorder as necessary.
7. Check operation and calibration of unit in accordance with manufacturer's specifications.

Every 12 months	1.0 h

1. Check amplifier gain, frequency response and common mode rejection.

Annual total-3.0 h

Apparatus: Cardiac monitor

Procedure	*Total time*
Every 6 months	1.0 h

1. Check integrity of electrical grounding and current leakage

2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, knobs, connectors and cables.
4. Clean interior with damp cloth.
5. Check voltage gain calibration for all lead positions.
6. Test rate meter and rate meter alarm functions, if applicable.
7. Clean and inspect electrodes, straps and patient cables.
8. Check trace on oscilloscope.

Every 12 months	1.0 h

1. Test input circuitry.
2. Replace reference cell if necessary.
3. Check battery, if applicable.

Annual total-3.0 h

Apparatus: Respirator

Procedure	*Total time*
Every 6 months	2.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches and knobs.
4. Inspect high-pressure hose assembly for wear and leaks.
5. Check high-pressure inlet filter and associated O-rings; clean all parts.
6. Check control pressure regulator; replace if necessary.
7. Inspect operation of all gauges; calibrate if necessary.
8. Check operation of cycling mechanism and related controls; comply with manufacturer's test procedures.
9. Inspect and clean all tube and manifold assemblies.
10. Clean and check nebulizer assembly; replace O-ring if necessary.
11. Complete final check of system as recommended by manufacturer.

Annual total-4.0 h

Apparatus: Short-wave/Micro-wave diathermy

Procedure	*Total time*
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.

3. Check condition of radio frequency cables and applicators for cracks, overheating or deterioration; replace if required.
4. Check mechanical condition of all accessories, front-panel controls, switches and output.
5. Clean and inspect interior for signs of damage; vacuum if necessary.
6. Clean ventilation screen and oil blower motor sparingly.
7. Check operation and functioning; refer to manufacturer's specifications for tuning.
8. Check for corona and arcing at high-power setting.
9. Check timer and safety shut-off.
10. Check power output with radio frequency wattmeter; compare readings with previous measurements.

Annual total-2.0 h

Apparatus: Infant incubator

Procedure	*Total time*
Every 6 months	1.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord, connectors and plugs.
3. Check mechanical integrity of switches and controls.
4. Inspect condition of oxygen and air inputs.
5. Check water-level gauge and inspect distilled-water compartment.
6. Clean or replace water and air filters.
7. Check temperature indicator and thermometers according to manufacturer's specifications.
8. Check temperature cut-off alarm.
9. Check power failure alarm.
10. Check operation of unit; warm to temperature setting on temperature control and check with external thermometer.
11. Check canopy for breakage; clean interior and exterior of unit.

Annual total-3.0 h

Apparatus: Dental chair unit

Procedure	*Total time*
Every 6 months	1.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord, connectors and plugs.
3. Check mechanical integrity of switches and controls.

4. Check for leakages in water circuit; replace rubber rings and other consumable materials according to manufacturer's recommendations.
5. Check all water pipes for calcification; check integrity of filters; clean or replace as necessary.
6. Check for leakages in air circuit; replace elements accordingly.
7. Check movement of chair, tray, light and other parts.
8. Check for correct movement of all hand-pieces.
9. Check X-ray unit for correct exposure by exposing dummy dental film.
10. Check operation of unit.

Annual total-3.0 h

Apparatus: Suction pump

Procedure	*Total time*
Every 6 months	0.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord, connectors and plugs.
3. Check mechanical integrity of switches and controls.
4. Check two-way air valve.
5. Check for damage to bottles and clean.
6. Check air circuit for leakage and absorption.
7. Check operation of unit.

Annual total-1.0 h

Apparatus: Operating table and lamps

Procedure	*Total time*
Every 6 months	1.0 h

1. Check mechanical movement of moving parts and oil accordingly.
2. Check hydraulic up-down movement of table.
3. Check hydraulic circuit for leaks and replace rubber parts according to need and manufacturer's specifications.
4. Check stand-by theatre-light battery for switch-over operation; correct water level of cells, battery acidity and voltage.
5. Check mechanical integrity and operation of footswitches, if used.
6. Check operation of lights and table.

Every 6 months	1.0 h

1. Check battery water level, voltage and acidity.

Annual total-4.0 h

Apparatus: Intensive care monitoring system

Procedure	*Total time*
Every 6 months	2.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord, connectors and plugs.
3. Check mechanical integrity of switches, connectors, cables and controls.
4. Check signal connection between central panel and monitors by giving known signals and monitoring centrally.
5. Clean exterior of unit with damp cloth.
6. For bedside monitors, follow procedure given under "Cardiac monitor."

Annual total-4.0 h for system connected to 4-bed unit