Defibrillators

1. Preventive Maintenance Qualitative Tests

a. Chassis/Housing: Examine the exterior of the unit for cleanliness and general physical condition. Be sure that plastic housings are intact, that all hardware is present and tight, and that there are no signs of spilled liquids or serious abuse.

b. Mount/Fasteners: If the device is mounted on a stand or cart, examine the condition of the mount. If it attached to the wall, or rests on a shelf, check the security of the attachment.

c. Casters/Brakes: If the device moves on casters, check their condition. Look for accumulations of lint and thread around the casters, and be sure that they turn and swivel, as appropriate. Check the operation of brakes and swivel locks, if the unit is so equipped.

d. AC Plug/Receptacles: Examine the AC power plug for damage. Attempt to wiggle the blades to check that they are secure. Shake the plug and listen for rattles that could indicate loose screws. If any damage is suspected, open the plug and inspect it. Should the equipment be placed on a cart that has extra electrical receptacles for other equipment, insert AC plugs into each and verify they are firmly held. Verify that no damage is present in the cart receptacles.

e. Line Cord: Inspect the cord for signs of damage. If damaged, replace the entire cord or if the damage is near one end, cut out the defective portion. Wire a new power cord or plug on the same polarity. Check the line cords of battery chargers.

f. Strain Reliefs: Examine the strain reliefs at both ends of the line cord. Be sure that they hold the cord securely. If the line cord is detachable, we recommend that the cord be affixed to the unit so that it cannot be removed by the operator.

g. Circuit Breaker/Fuse: If the device has a switch-type circuit breaker, check that it moves freely. If the device is protected by an external fuse, check its value and type against that marked on the chassis and ensure that a spare is provided.

h. Cables: Inspect the cables of sensors, electrodes, remote control and their strain reliefs and general conditions. Carefully examine cables to detect breaks in the insulation and to ensure that they are gripped securely in the connectors at each end to prevent rotation or other strain.

i. Fittings / Connectors: Examine all fittings and electrical cable connectors for general condition. Electrical contact pins or surfaces should be straight and clean. Fittings should be tight and should not leak. If keyed connectors are used, make sure that the keying is correct.

***Defibrillators/Defibrillator Monitor*:** Verify that leads and electrodes are firmly gripped in their appropriate connectors. Look for misaligned pins, damaged receptacles and carbon deposits by disconnecting the paddles. (This is for major inspections). If the defibrillator has ECG feature, examine the cables carefully to detect breaks in the insulation and to ensure that they are gripped securely in the connectors at each end to prevent rotation or other strain. Verify that an ECG can be displayed with either paddles or ECG leads used as input. Wiggle, bend, and pull the cable to check that continuity is not affected.

j. **Electrodes/Probes:** Confirm that special paddles and electrodes are available if appropriate for the area of use. Examine all paddles and probes for physical conditions and cleanliness. Should the equipment have fluids, dried electrode gel or debris on it, inform the clinical staff. Clean paddles and electrode surfaces if needed and ensure they are completely dry before testing. Ensure that probe labels clearly identify the associated units. Improperly interchanged probes of different types or from different manufacturers may adversely affect temperature control. Confirm that any necessary transducers (if applicable) are on hand and check their physical condition.

k. **Controls/ Switches:** Before changing any controls or alarm limits, check their position any settings appear inordinate (e.g., alarm limits at the ends of their range), consider the possibility of inappropriate clinical use or of incipient device failure. Record the settings of those controls that should be returned to their original positions following the inspection. Examine all controls and switches for physical condition, secure mounting, and correct motion. Check that control knobs have not slipped on their shafts. Where a control should operate against fixed-limit stops, check for proper alignment, as well as positive stopping. Check membrane switches for membrane damage (e.g., from fingernails, pens). During the course of the inspection, be sure to check that each control and switch performs its proper function.

l. **Battery / Charger:** Inspect the physical condition of batteries and battery connectors, if readily accessible. Check operation of battery-operated power-loss alarms, if so equipped. Operate the unit on battery power for several minutes to check that the battery is charged and can hold a charge. (The inspection can be carried out on battery power to help confirm adequate battery capacity.) Check battery condition by activating the battery test function or measuring the output voltage. Check the condition of the battery charger and, to the extent possible, confirm that it does, in fact, charge the battery. Be sure that the battery is recharged or charging when the inspection is complete. Some batteries require periodic deep discharges and recharging to maintain a maximum battery capacity. If this is recommended by the manufacturer, verify that it is being performed on schedule.

m. **Indicators/Displays:** During the course of the inspection, confirm the operation of all lights, indicators, and visual displays on the unit and charger, if so equipped. Be sure that all segments of a digital display function properly.

***Defibrillator Monitor*:** During the course of the inspection, confirm the operation of all lights, indicators, meters, and visual displays on the unit and charger. Be sure that all segments of a digital display function. Observe a simulated EGG signal on the display, and verify compliance with the following criteria:

- The baseline should *stay* in focus across the display.
- The baseline should be horizontal and should not be noticeably sloped or bowed.
- The pulses from an EGG simulator should be regularly spaced (uneven spacing indicates a sweep nonlinearity).
- All portions of a simulated EGG waveform should be clear and visible, including the P-wave and QRS.
- When the vertical position of the baseline is varied by adjusting the vertical position control, the baseline should move throughout most of the vertical height of the display. There should be no distortion in the baseline as it is moved up or down on the screen. In monitors that incorporate a self-centering baseline and therefore lack a position control, the baseline should be correctly positioned.
- Ambient light should not affect the visibility of the trace. (If monitors are located so that ambient light reflects from the face of the display.

- Burn spots should not be visible on cathode-ray tube.
- Sixty hertz or other interference should not be superimposed on the baseline with the ECG simulator attached. Baseline interference may be apparent as a thick baseline at high gain settings, but should be invisible through the lower two-thirds of the gain control range

n. User Calibration/Self-Test: Verify operation of these features, if applicable.

o. Alarms: Operate the device in a way that activates all the alarms. Check that any associated interlocks function. Check action of disconnected-probe alarm, if unit so equipped. If the device has an alarm-silence feature, check the reset method.

p. Audible Signals: Operate the device to activate any audible signals. Confirm appropriate volume, as well as the operation of a volume control, if so equipped. If audible alarms have been silenced or the volume set too low, alert clinical staff to the importance of keeping alarms at the appropriate level.

q. Labeling: Check that all necessary labels, conversion charts, and instruction cards are present and legible.

r. Accessories: Verify that defibrillator gel, disposable defibrillator pads, or disposable defibrillator electrodes are stored with the unit and that they are within their expiration dates. Verify that the gel being used is defibrillator and not any other type of gel.

s. Other Qualitative Tests:

Defibrillator: Verify that the unit releases stored energy when the defibrillator is turned off. If the unit has a front panel button for this purpose, verify its working correctly.

***Defibrillator/Monitor*:** If the unit has a recorder, confirm that it operates smoothly, that the paper feeds evenly and does not move to the sides and that the trace is of good quality. Perform step 1.19 on the direct writer. If the unit has synchronization mode available, verify the unit will not discharge energy when no signal is present and that it will when a simulated ECG signal is used.

2. Preventive Maintenance Electrical Safety Test

a. Grounding Resistance: Using an ohmmeter, electrical safety analyzer, or multimeter with good resolution of fractional ohms, measure and record the resistance between the grounding pin of the power cord and exposed (unpainted and not anodized) metal on the chassis. We recommend a maximum of 0.5 Ohms.

b. Leakage Current: Measure chassis leakage current to ground with the grounding conductor of plug-connected equipment temporarily opened. Operate the device in all normal modes, including on, standby, and off, and record the maxi- mum leakage current. Chassis leakage current to ground should not exceed 300µA.

3. Preventive Maintenance Quantitative Tests

a. Energy after 60 seconds: When energy storage capacitors deteriorate or stop working, there can be charge leakage after the charging circuit has deenergized. The available energy may decrease if it is not used right after it has been fully charged. In order to check the capacitors, charge the defibrillator in its maximum setting (usually 360 Joules), and then wait one minute before discharge. The energy discharged must 85% of the expected energy output if discharged immediately. Repeat three times.

Set (J)	Delivered (J)
Max	
Max	
Max	

b. Output Energy: Measure the output of the defibrillator at its minimum, intermediate and maximum settings. At each level of energy, record the control settings, the expected and delivered energy after discharging the defibrillator. At its maximum setting verify that the unit delivers a reading within ±5% of the maximum set.

Set (J)	Delivered (J)
Min	
Intermediate	
Max	

c. Charge Time and Maximum Energy: It is important to verify that defibrillator batteries can perform ten successive discharges at different energy levels. The batteries should be fully charged and ten discharges, each in increasing energy ranges, should be performed. On the tenth discharge, record the time it takes to charge and how much energy was delivered. The maximum time to charge up to maximum energy should not be above 15 seconds. The energy output should remain within 4 Joules. Should the time for the defibrillator take to charge exceeds 15 seconds or the unit terminates the charge early, batteries must be replaced.

Set (J)	Delivered (J)	Charge Time
10		
20		
30		
50		
100		
200		
300		
360		
Synchronized		

Capacitor Test @ 60 sec. at Max energy:_____

Defibrillator Monitor

a. Synchronized Test: Using a simulated ECG with rates of 60 and 120 pulses per minute, verify that the heart rate indicator displays a rate within 5% or 5bpm, whichever is greater.

4. Preventive Maintenance

a. *Clean* the exterior and interior

b. *Lubricate and clean* fan assembly if required

c. *Calibrate* if needed

d. *Replace* filter and battery if needed based on Scheduled Parts Replacement Policies.

e. Replace battery if charge time and maximum energy test fails or if battery's life is 2 years or older. It is also recommended that a record of battery replacements be kept, so that technicians can have an idea of when the equipment may need a new battery, so it can replaced promptly.