Aim

To ensure all staff are familiar with the daily maintenance and equipment checks for the MRx defibrillator and its use for transcutaneous pacing.

Application

EMRS Team Members
SAS Air wing paramedics

Background

Daily checks are required as outlined by the manufacturer. These checks ensure all functions of the device are in working order and there is suitable amount of monitoring consumables for Air Ambulance, HEMS and Retrieval missions. The HeartStart MRx independently performs many maintenance activities, including three tests that run automatically at regularly scheduled intervals while the device is off to assess operational performance and alert you if a problem exists. Results of tests associated with critical functionality of the device are reported through the Ready for Use indicator and the Automated Test Summary report. Results are also reported through INOP statements on the display when the HeartStart MRx is turned on. The table below provides a brief explanation of the tests and lists the frequency with which each is performed. This SOP describes the operation of the MRx monitor, performing the required checks and it use for transcutaneous cardiac pacing.
<table>
<thead>
<tr>
<th>Test Name</th>
<th>Frequency</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hourly</td>
<td>Tests batteries, internal power supplies, internal memory.</td>
<td></td>
</tr>
<tr>
<td>Daily</td>
<td>Tests batteries, internal power supplies, internal memory, internal clock battery, defibrillation, pacing, ECG, SpO2, EtCO2, NBP, Invasive Pressure, Temperature, Bluetooth and printer. The defibrillation test includes low energy internal discharges. If a 3-, 5-, or 10-lead ECG cable is attached, the cable is tested as well.</td>
<td>Daily, between 11 pm and 1 am</td>
</tr>
<tr>
<td>Weekly</td>
<td>Weekly Performs the Daily Test described above, plus delivers a high energy internal discharge to further exercise the defibrillation circuitry.</td>
<td>Weekly, between 11PM Sunday and 1 AM Monday</td>
</tr>
</tbody>
</table>

Although these automated tests occur manual daily and weekly checks must be performed. These are described below.
Basic orientation

Front panel which contains operational controls and indicators.

Daily Check

- Both batteries to be full at start of shift. Checked by on screen battery indicator or by LED indicator on top of battery
- Check device for any obvious damage
- Check that monitoring devices and cables are present and in working order
- Ensure sufficient consumables are available for use
- Ensure printer has sufficient paper
- Check Ready for Use (RFU) indicator as listed below
Ready for use indicator

The results for Automated Tests are reported through the RFU indicator. Be sure to observe the RFU indicator periodically and take the appropriate action.

<table>
<thead>
<tr>
<th>RFU Status</th>
<th>Meaning</th>
<th>Required Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blinking black hourglass</td>
<td>Shock, pacing, and ECG functions are ready for use and sufficient battery power is available.</td>
<td>None</td>
</tr>
<tr>
<td>Blinking red “X” with or without a periodic chirp</td>
<td>Low battery. The device can be used but run time is limited. Chirping indicates the battery is not being charged. No chirping indicates the battery is being charged.</td>
<td>Charge the battery as soon as possible and/or replace the battery with a charged battery. Charging may be done in the HeartStart MRx by connecting to AC/ DC power, or in a Philips-approved battery support system</td>
</tr>
<tr>
<td>Solid red “X” and a periodic chirp</td>
<td>A failure has been detected that may prevent the delivery of a shock, pacing, or ECG acquisition.</td>
<td>Turn the Therapy Knob to Monitor. An inop message describing the failure is displayed. See Chapter 20, Troubleshooting, for the corrective action. If needed, run an Operational Check for further information. If the condition persists, take the device out of use and call for service.</td>
</tr>
<tr>
<td>Solid red “X” without a periodic chirp</td>
<td>No power, or device failure (cannot turn on).</td>
<td>Insert a charged battery or connect to AC/DC power. If the condition persists, take the device out of use and call for service.</td>
</tr>
</tbody>
</table>

Weekly Check (Full Operational Check)

- Turn the Therapy Knob to Monitor.
- Press the Menu Select (Tick) button.
- Using the Navigation buttons, select Other and press the Menu Select button.
- Select the Operational Check and press the Menu Select button.
- Select Run Operational Check and press the Menu select button. The message window, Leaving Normal Operating Mode, appears to let you know that you are leaving the clinical functionality and entering a test mode of the monitor.
- Press the Menu Select button to acknowledge the message.
- Full Operational Checks will commence- follow on-screen prompts.
- Ensure that RFU indicator is blinking hour glass after checks
- Be aware of warnings for annual calibrations requirements on operational check
- Sign check print out and record number of MRx tested
- Continue to Shock Test (See over)
Weekly Check Cont.

Shock Test

- Attach test load to the end of the patient Therapy cable.
- Turn the Therapy knob to 150J.
- Press the Charge button.
- **NOTE** If it becomes necessary to disarm the defibrillator, press [Disarm].
- The strip prints if configured to do so. If the strip does not print immediately, press the Print button.
- Press the Shock button on the MRx to deliver a shock into the test load.
- Confirm on the printed strip that the energy delivered to the test load is 150J +/- 23J (127J to 173J).
- If not, take the device out of use and begin troubleshooting.
- **NOTE** Detach the test load from the patient Therapy cable after performing the Shift Check. So your device is ready for use when needed, do not leave the test load attached after performing an Operational Check.
- Sign check print out and record number of MRx tested
- Place signed print outs for both Full Operational Check and Shock Test in ‘Checklists For Filing’ folder on administrators desk

Transcutaneous Pacing

Patients in complete heart block may require temporary pacing transcutaneously prior to undergoing formal permanent pacemaker (PPM) insertion at a definitive care centre. Unless a functional transvenous pacing wire has been inserted at the referring site, the patient may require transcutaneous pacing (TCP) by EMRS during transport to definitive care.

**Advice to GP/Hospital referrer prior to team arrival:**

- Arrange for transvenous pacing if equipment & expertise available
- Support heart rate and blood pressure according to the current ALS algorithm for bradycardia
- Continuous ECG/SpO2/Heart Rate/BP monitoring
- 12 lead ECG & repeat at 30min intervals
- Consider brady-arrhythmia may be part of ACS and treat accordingly
- Look for electrolyte abnormalities and treat accordingly
- If transcutaneous pacing is available and is required, institute its use with sedation for patient comfort as required
Important points

- Position of pads – Anterior/posterior positioning of pads is optimal for pacing (below)
- Patient comfort – check for need for sedation/analgesia to achieve effective pacing
- Insertion of an arterial line ensures the effectiveness of the pacing can be closely monitored
- Triage to centre with capability of inserting a pacemaker or transvenous pacing wire

Operating pacer function on MRx

Pacing view (Shown below) appears when the Therapy Knob is set to Pacer position. The first line of the status block communicates whether pacing is active or paused. If pacing is powered by batteries, this is indicated here as well, if configured. The second line of the status block identifies the Pacer Mode (demand or fixed), pacing rate (ppm), and pacing output (mA).

Soft keys are available for setting pacing status ([Start Pacing], [Pause Pacing], [Resume Pacing]) and adjusting [Pacer Rate], [Pacer Output].
Demand Mode Pacing

To pace in demand mode:

1. Turn the Therapy Knob to the **Pacer** position. The message, **Pacing Paused**, appears in the status block and indicates that the pacing function is enabled, however, pace pulses are not being delivered.

2. Press the Lead Select button to select the best lead with an easily detectable R-wave.

**NOTE** If you are using anterior-anterior pads placement while pacing and are experiencing difficulty with Lead II, select another lead.

3. Verify that white R-wave markers appear above or on the ECG waveform. A single marker should be associated with each R-wave. If the R-wave markers do not appear or do not coincide with the R wave, select another lead.

4. Press **[Pacer Rate]** and use the Navigation and Menu Select buttons to select the desired number of pace pulses per minute.

5. If needed, adjust the initial pacer output. To do this, press **[Pacer Output]** and use the Navigation and Menu Select buttons to select the desired output. The initial output is configurable.

6. Press **[Start Pacing]**. The message, **Pacing**, appears. **WARNING** Use care when handling the multifunction electrode pads on the patient to avoid shock hazard during pacing.

7. Verify that white pacing markers appear on the ECG waveform.

8. Press **[Pacer Output]**. Then use the Navigation and Menu Select buttons to:
   a. increase the output until cardiac capture occurs. Capture is indicated by the appearance of a QRS complex after each pacing marker.
   b. decrease the output to the lowest level that still maintains capture.

9. Verify the presence of a peripheral pulse.

**NOTE** Spontaneous beats may be present which are not associated with the delivery of pace pulses. Additionally, if the patient’s heart rate is above the pacer rate, pace pulses are not delivered and, therefore, pacing markers do not appear.

To stop delivery of pace pulses, press **[Pause Pacing]**. Once paused, press **[Resume Pacing]** to resume delivery of pace pulses. You may also stop delivery of pace pulses by moving the Therapy Knob off the **Pacer** position.
NOTE Pacing will not start if there is a problem with the multifunction electrode pads connection or patient contact. Pace pulses will not be delivered if there is a problem with the ECG monitoring electrodes connections. If either situation occurs, a system message is displayed to alert you that a lead is disconnected or that the pads have a poor connection.

**Fixed Mode Pacing**

To pace in fixed mode:

1. Turn the Therapy Knob to the **Pacer** position. The message, **Pacing Paused**, appears and indicates that the pacing function is enabled, however, pace pulses are not being delivered.

2. Change the pacer mode to fixed mode, using the menu selections shown below

### Changing Pacer Modes

<table>
<thead>
<tr>
<th>Main Menu</th>
<th>Pacer Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pacer Mode</strong></td>
<td><strong>Demand</strong></td>
</tr>
<tr>
<td>Start Data Transmit</td>
<td><strong>Fixed</strong></td>
</tr>
<tr>
<td>Volume</td>
<td></td>
</tr>
<tr>
<td>Displayed Wave</td>
<td></td>
</tr>
<tr>
<td>Printed Waves</td>
<td></td>
</tr>
<tr>
<td>Measurements/Alarms</td>
<td></td>
</tr>
<tr>
<td>Patient Info</td>
<td></td>
</tr>
<tr>
<td>Trends</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>High Contrast On</td>
<td></td>
</tr>
<tr>
<td>Exit</td>
<td></td>
</tr>
</tbody>
</table>

3. Use the Lead Select button to select the desired lead for viewing.
   **NOTE** If you want to see the ECG waveform and related parameters while pacing, you must have electrodes on the patient with pads. Using pads only will give you an incorrect heart rate and inappropriate alarms.

4. Press **[Pacer Rate]** and use the Navigation and Menu Select buttons to select the desired number of paced pulses per minute.

5. If needed, adjust the initial pacer output. To do this, press **[Pacer Output]** and use the Navigation and Menu Select buttons to select the desired output.
6 Press [Start Pacing]. The message, Pacing, appears.

7 Verify that white pacing markers appear on the ECG waveform (if ECG electrodes are in place).

8 Press [Pacer Output]. Then use the Navigation and Menu Select buttons to:
   a. increase the output until cardiac capture occurs. Capture is indicated by the appearance of a QRS complex after each pace pulse marker.
   b. decrease the output to the lowest level that still maintains capture.

9 Verify the presence of a peripheral pulse.

10 To pause or stop pacing:
   – Press [Pause Pacing].
   – A prompt message will ask you to confirm your action.

<table>
<thead>
<tr>
<th>Pause Pacing?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
</tr>
</tbody>
</table>

   – Confirm your action. Use the Navigation buttons to highlight Yes and press the Menu Select button.
   OR
   - Move the Therapy Knob off the Pacer position.

General pacing notes

- While pacing, if the pacer output drops below the selected setting (sometimes caused by poor pads contact as a result of gas bubbles underneath the pads) by 20 percent or 10 mA (whichever is greater), a Pacer Output Low yellow alarm is displayed on the top line of the Pacer Status block. The alarm remains on the display until pacing is stopped, the condition clears or the therapy knob is moved off the Pacer position.

- Heart rate displays and alarms function during pacing, but they can be unreliable. Observe the patient closely while pacing. Do not rely on the indicated heart rate or heart rate alarms as a measure of the patient’s perfusion status.

- Use demand mode pacing whenever possible. Use fixed mode pacing when motion artifact i.e. during helicopter transfer or other ECG noise makes R-wave detection unreliable or when monitoring electrodes are not available.

- The HeartStart MRx requires a 3-lead ECG cable and monitoring electrodes as the source of the ECG during demand pacing. Pace pulses are delivered through the multifunction electrode pads. However, the pads cannot be used to monitor the ECG and deliver pace pulses simultaneously.
Full user guide and further teaching material is located in the Equipment Folder on the Shared Drive or available at the following web address.


**Instructions to copy patient data from MRX monitor onto the internal data card following a mission**

- Switch machine on
- Select ‘MENU’
- Scroll to and select ‘OTHER’
- Scroll to and select ‘DATA MANAGEMENT’
- Select ‘ACKNOWLEDGE’
- Using the cursor keys underneath the screen, scroll down to your mission data (using date/time to guide you)
- Select ‘MENU’
- Scroll to and select ‘COPY’
- Select ‘ALL EVENT DATA’

You should then see a box appear in the middle of the screen saying ‘COPYING PATIENT DATA’.
Please note, this may take some time depending on the amount of data being transferred. Once this box disappears, the machine has finished copying all selected data onto the internal card. Either exit data management (will navigate you back to the monitoring screen) or simply turn the machine off.