Short-wave diathermy machine

- principles of operation
  - function
  - use
  - scientific principles
- construction
  - components
  - system diagram
  - inputs/outputs
- troubleshooting
  - identifying common faults
  - replacing components
  - rectifying faults

18.4.5 Maintain a short-wave diathermy machine
Unit C18.4 Maintaining Physiotherapy Equipment
Module 279 19 C Medical Instrumentation II

©
dr. Chris R. Mol, BME, NORTEC, 2015
Diathermy (general)

Diathermy literally means "heating through." Diathermy is the controlled production of "deep heating" beneath the skin in:
- subcutaneous tissues (‘under the skin’)
- deep muscles
- joints

for therapeutic / revalidation purposes.

The application of moderate heat by diathermy increases blood flow and speeds up metabolism and the rate of ion diffusion across cellular membranes.

The fibrous tissues in tendons, joint capsules, and scars are more easily stretched when subjected to heat, thus facilitating the relief of stiffness of joints and promoting relaxation of the muscles and decrease of muscle spasms.

The three main forms of diathermy employed by physical therapists are:
- ultrasound
- short wave
- microwave
Techniques for Diathermy

1. **ultrasonic diathermy**
   = therapeutic ultrasound; see previous lectures

2. **Short wave diathermy** is performed with the use of high-frequency (1–100 MHz) electromagnetic currents.
   It is the same technique as used during surgery in an electro-surgical machine, but the heat is spread out over a larger area with a much lower energy density.

3. **microwave diathermy**
   microwaves are electromagnetic waves with a frequency in the 915 MHz or 2.45 GHz bands. Microwaves have a lower penetration depth and are used for more superficial tissues.

Roughly, all 3 different diathermy techniques are used for the same therapeutic purpose.

A diathermy device increases tissue temperature by up to 8°C at a depth of 5 centimetres in less than 20 minutes. Hyperthermia is safe if the temperature is kept under 45 °C

When diathermy equipment is utilized, the power output is maintained below the pain threshold of the patient.
Electromagnetic Radiation Spectrum
Short wave diathermy

Short wave diathermy is performed with the use of high-frequency electromagnetic currents, usually at 27.12 MHz.

Short wave diathermy machines use two condenser plates that are placed on either side of the body part to be treated. Alternatively, these devices use induction coils that are pliable and can be molded to fit the part of the body under treatment.

The degree of heat and the depth of penetration depend in part on the properties of the tissues that the waves encounter.
Treatment Procedure

1. Prepare the patient:
1. Examine **thermal and pain sensitivity** of the patient
2. Ensure removal of any metal objects (rings, etc.)
3. Remove all bandages and clothes from the treatment area
4. Ensure dryness of skin
5. Ask to patient to report immediately any abnormal sensation felt during the treatment

2. Prepare the machine:
1. Ensure correct connection of cables.
2. Ensure that cables & applicators are not placed on metal surfaces.
3. Ensure appropriate alignment of the electrodes for maximum energy transfer.
4. Ensure that cables are not close to untreated tissues.
5. All metal objects are kept at least 3meters away.

3. Once the unit is activated:
1. Remain at least 1m from the cables.
2. Ensure that the patient maintains correct position.
3. Do not leave the patient alone during treatment.
4. Ensure the patient does not touch the machine.
5. Ensure that no other person is in the vicinity of the machine.

*Two electrodes are positioned near the target area*
Treatment Procedure

Diathermy uses either continuous or pulsed currents with a pulse rate of 10-400 Hz.

With pulsed currents, the patient receives a lower dose if compared with continuous Diathermy applied during the same time. The tissues will receive lower thermal load.

Typically up to 100 Watt average power; 200 Watt peak power.

Treatment time is 1-30 minutes.
Control Panels

Intensity is a combination of pulse width and pulse frequency...

Tuning can be either manual or automatic.
Components

Flexible metal plate → malleable electrodes

Rigid metal discs → disc electrode (more commonly used method.)
System Diagram Shortwave diathermy unit

The tuner is used to adapt the frequency of the generator to the electrodes resonance frequency.
Construction

Auto-Therm 390, Controls and Receptacles Located on the Back of the Unit
System Diagram

Enraf Nonius Curapulse 670
6.1 Cleaning and disinfecting

Turn off the unit and unplug it from the main power supply before cleaning or disinfecting it. Clean and disinfect the unit and its accessories (except for the felt spacers) with commercially available surface disinfectants.

To prevent damage to the surface materials of the Auto-Therm 390, use only surface disinfectants based on agents like aldehydes, alcohol or ammonium compounds that are suitable for wipe and spray disinfection. Use them according to their instructions for use and duration of action.

To prevent possible material damage, avoid the use of products based on halogen-splitting compounds, strong organic acids and oxygen-splitting compounds, solvents, benzene and similar agents.

ATTENTION:

Do not allow any liquids to penetrate the unit or its accessories while cleaning and disinfecting. Dry all sockets and connectors that have become wet before any further use!
6.2 Protecting Other Electronic Devices from the Output of the Auto-Therm 390

The Auto-Therm 390 generates high frequency electric and magnetic fields that can penetrate walls, ceilings and floors. It cannot be prevented that components of these fields exist in the vicinity of the device. Sensitive electronic instruments, that are in the immediate vicinity of the Auto-Therm 390, can be adversely affected by these fields. This danger largely depends on the distance between the devices. Therefore, the Auto-Therm 390 must not be installed any closer than 5 meters from other sensitive devices, if possible farther. The applicators should never be applied to sensitive devices, e.g. neuromuscular electrical stimulators or their electrodes or cables.

This problem can be completely eliminated when the Auto-Therm 390 is installed in a shielded room, i.e. one containing a Faraday cage. (A Faraday cage is enclosed by a metal housing or grid that prevents the penetration of electric fields.)

Use of absorbing curtains is enough for most treatment rooms.

We recommend that operators and other persons keep a distance of at least 2 meters to applicators and cables while they are in use. In case of doubt, it is recommended to measure the field strength.
Preventive Maintenance

6.3 Routine Maintenance

1. Standard medical electrical safety checks should be performed annually by qualified biomedical engineers or technicians trained to perform these procedures.

2. Inspect cables and associated connectors for damage.
6.4 Troubleshooting the Auto-Therm 390

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nothing lights when main power switch is turned on.</td>
<td>Is line cord connected to outlet? Does the outlet have power?</td>
</tr>
<tr>
<td>2. E232 displays in the Output Display Window.</td>
<td>Patient pulled Patient Safety Pull-Cord to stop the unit’s output. Find out why the cord was pulled and check the patient’s skin under the applicator(s), if necessary.</td>
</tr>
<tr>
<td>3. E233 displays in the Output Display Window.</td>
<td>Coupling error - Can occur during RFM treatment</td>
</tr>
<tr>
<td>4. E234 displays in the Output Display Window.</td>
<td>Inductive drum applicator is connected with capacitive soft rubber pad selected on membrane panel.</td>
</tr>
<tr>
<td>5. E235 displays in the Output Display Window.</td>
<td>Inductive drum applicator not connected when the inductive drum is selected on the membrane panel.</td>
</tr>
<tr>
<td>6. E20, 21, 100, 201, 209, 210, 216-219 or 224-226 displays in the Output Display Window</td>
<td>Try turning the unit on and off again to see if the error code is resolved. If not the unit requires servicing.</td>
</tr>
</tbody>
</table>

If problem is not addressed above, or if additional troubleshooting guidance is desired, call (800) 854-9305 or 1-714-533-2221 (outside the USA), or email our service department at service@mettlerelectronics.com.
Spare Parts

Example of Spare Parts list

- Fuses, knobs, castors, cables, switches, transformer can possibly be found locally
- IC and PC Boards and (probably) display need to come from the manufacturer
Safety Considerations

Dangers of Short Wave Diathermy

- Burns.
- Faintness due to lowered blood pressure.
- Sparking if one electrodes touched during the application of the current.
- Electric shock. During diathermy treatment, the patient becomes a part of the electrical field. Touching a bare metal object, such as a cabinet, during diathermy can cause a shock or burn.
- Overdose will cause severe pain.

Contra Indications (situations in which the procedure should not be used)

- Patients with implanted metal devices, such as a pacemaker, a prosthesis, or an intrauterine device. The electromagnetic energy used in diathermy can cause extreme heat in metal devices such as bone pins, dental fillings, and metal sutures. This could cause burns in adjacent tissues.
- Patients with impaired thermal sensation.
- Do not apply over pregnant uterus.

This unit works with significant power and high voltage. It is not battery operated.
The creation of this presentation was supported by a grant from THET:
see https://www.thet.org/