

### Universal Care, Economical Solutions

The Theratron® Phoenix™ is a highly practical model of the Theratron® family of external beam therapy systems (EBTS). Particularly appropriate for treatment centres requiring extended hours of daily operation and where budgetary considerations are a major concern.

Convenience and safety, combined with simplicity of design, makes the Theratron® Phoenix™ easy to use and easy to maintain. Routine maintenance can be done effectively and quickly, keeping machine down time to an absolute minimum.

Best® Theratronics is committed to ensuring the highest achievable standards of safety, quality and performance in the delivery of radiation therapy.

### 1.0 Basic Features

#### 1.1 REGULATORY REQUIREMENTS

The Theratron® Phoenix™ is designed to comply with the regulations and requirements of the following agencies:

- Canadian Nuclear Safety Commission (CNSC) Health Canada
- United States Nuclear Regulatory Commission (USNRC)
- United States Food and Drug Administration (USFDA)

- National Council for Radiation Protection (NCRP #102)
- International Commission for Radiation Units (ICRU #18) External Beam Therapy System



## 2.0 Head Assembly

The head of the Theratron® Phoenix™ is a cast shell with lead and tungsten shielding. Maximum capacity is 15,000 Curies equivalent to a unit output of approximately 390 cGy/min. Air Kerma Rate at isocentre. Sources are available in 1.5 and 2 cm diameters.

### 2.1 SOURCE DRAWER MECHANISM

The pneumatically driven linear source drawer on the Theratron® Phoenix™ moves the source between the fully shielded and the fully exposed positions. A carefully designed positioning mechanism ensures accurate source positioning.

A large air reservoir tank is provided which allows the source to cycle from the fully shielded position to the fully exposed position and back at least three (3) times in 30 seconds.

If the air pressure drops below a preset limit, the source is automatically returned to, or retained in, the fully shielded position.

In the event of a power failure, the source automatically returns to its shielded position.

### 2.2 RADIATION SPECIFICATIONS

#### 2.2.1 Head Leakage

The radiation leakage through the source housing with the source in the fully shielded “Beam Off” position, measured at survey points, is in accordance with NCRP #102.

Transmission through the head with the source in the fully exposed position is less than 0.1% of the primary beam.

#### 2.2.2 Beamstopper Transmission

Transmission through the beamstopper is less than 0.3% of the primary beam for all field sizes.

### 2.3 HEAD ROTATION

The head may be swivelled manually  $\pm 180^\circ$  in either direction from the isocentre. The head rotation angle scale can be read from both sides of the unit.

### 2.4 COLLIMATOR

A manually adjustable divergent collimator assembly defines the radiation beam. A fixed tungsten definer and two pair of leaves allow square and rectangular fields. The basic Source to Diaphragm Distance (SDD) is 45 cm, which may be increased to 55 cm with an optional trimmer set. The “X” and “Y” settings are indicated on mechanical scales located on the collimator.

#### 2.4.1 Field Size

	Minimum	Maximum
45 cm	5 cm x 5 cm	35 cm x 35 cm
55 cm	4 cm x 4 cm	34 cm x 34 cm

#### 2.4.2 Accessory Mounting Pad

A magnetic pad on the collimator provides easy mounting of the following:

- Mechanical distance indicator to indicate 80 cm SSD and 100 cm SSD
- Mechanical backpointer

### 2.5 FIELD LIGHT

The field light system consists of the following:

- An external parabolic mirror projector assembly designed to allow for quick and easy replacement of the quartz halogen lamp.
- A secondary parabolic mirror is mounted on the end of the source drawer. This refocuses and directs the beam downward through the collimator, producing a shadow of the cross wires at the image plane aligned with the axes of the field.

### 2.6 WEDGES

Wedges are available for use with the Theratron® Phoenix™. The wedges vary in angle ( $15^\circ$ ,  $30^\circ$ ,  $45^\circ$ ,  $60^\circ$ ), field size, and distance from source (45 cm or 55 cm). They are all made from lead-alloy except the  $15^\circ$ , which is made of brass (See Table 1).

### 2.7 RADIATION FIELD ACCURACY

#### 2.7.1 Radiation Field Centre Coincidence

The maximum distance in any direction between the centres of the radiation field and the light field, measured at Source to Axis Distance (SAD) in a plane perpendicular to the collimator rotation axis, is:

Square fields up to 20 cm	$\pm 2$ mm
Larger fields	$\pm 1\%$ of field size

#### 2.7.2 Radiation Field Edge Coincidence

The maximum distance along the major axes between the light edge and the radiation field edge, measured at SAD for any particular field size, is:

#### 1.5 cm source

Square fields up to 25 cm	$\pm 2.5$ mm
Larger fields	$\pm 1\%$ of field size

#### 2 cm source

All field sizes	$\pm 3$ mm
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### 2.8 COLLIMATOR ACCURACY

#### 2.8.1 Collimator Centre Coincidence

The maximum distance in any direction between the light field centre and the collimator rotation axis, measured at Source Axis Distance (SAD) in a plane perpendicular to the collimator rotation axis, is:

#### Gantry at $0^\circ$ or $180^\circ$

Square fields up to 10 cm	$\pm 1$ mm
Larger fields	$\pm 1\%$ of field size

#### Gantry $90^\circ$ or $270^\circ$

Square fields up to 20 cm	$\pm 2$ mm
Larger fields	$\pm 1\%$ of field size

#### 2.8.2 Isocentric Accuracy

The unit isocentre is defined as the point where the collimator and gantry rotational axes intersect. This point lies within a sphere of radius of 1 mm as the gantry rotates through  $360^\circ$ .

### 2.9 OPTICAL DISTANCE INDICATOR

The Optical Distance Indicator (ODI) projects a scale on the patient’s skin surface and provides exceptional contrast against the skin surface. This minimizes line diffusion on the skin as well as other immobilization devices.

Range	60 cm to 100 cm
Increment	.5 cm
Accuracy	$\pm 1$ mm 70 cm to 90 cm
	$\pm 2$ mm 60 cm to 69 cm 90 cm to 100 cm

When the collimator rotates  $360^\circ$ , the maximum variation of the ODI reading at SAD relative to the reading at  $0^\circ$  is  $\pm 2$  mm.

## 3.0 Gantry

The gantry is capable of continuous rotation in both clockwise and counter clockwise directions. Two speeds are provided for gantry rotation to facilitate treatment setup. Gantry speed for rotational and arc treatment is adjustable up to 1 rpm.

The angle of the gantry is displayed on a circular scale located at the centre of the gantry.

### 3.1 BEAMSTOPPER

The beamstopper is a lead filled steel assembly, which acts as a beam absorber. The beamstopper attenuates 99.7% of the primary beam and the scatter radiation at an angle up to 30 degrees.

The optical backpointer is a standard feature on all beamstopper units; it indicates the centre of the beam at its exit point using a cross wire projection.

## 4.0 Covers

The covers are moulded from a flame-retardant material designed to allow for easy removal and servicing.

## 5.0 Controls and Indicators

The control system includes:

- Hand control(s)
- Remote control console
- Audible and visual indicators

### 5.1 HAND CONTROL

Ergonomically designed hand control rotates freely around unit, allowing for easy access and ease of operation.

The hand control features include:

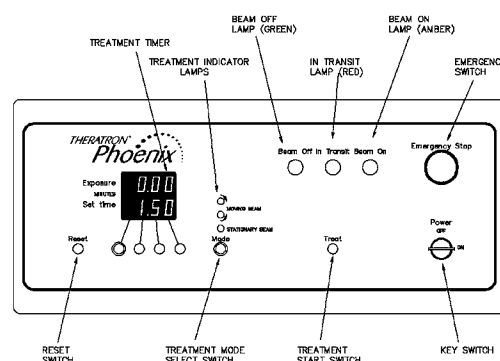
- Gantry rotation
- Treatment Simulate push-button switch
- Motion “enabled” indicator
- Motion “drive” indicator
- Motion enable bar
- Emergency push-button

### 5.2 REMOTE CONTROL CONSOLE

The control console incorporates a Single Channel Timer activated by the source positioning switches. A dual timer option is available.

The control console features include:

- Power On-Off keyswitch
- Emergency Stop push-button
- “Beam On” indicator
- “Beam Off” indicator



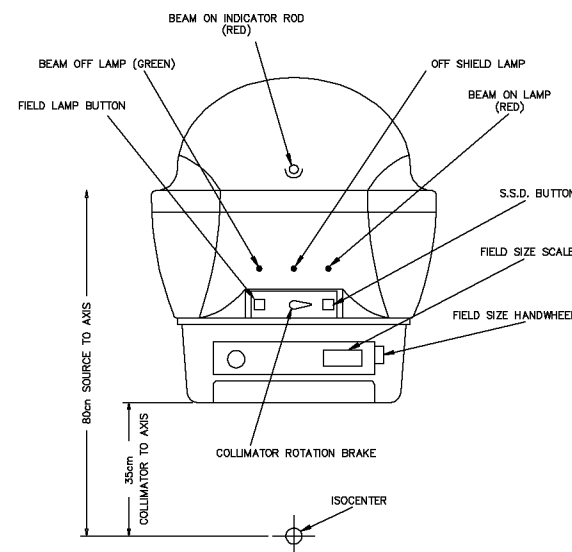
- “In Transit” indicator
- Timer reset push-button
- Treatment Mode select
- Treatment start push-button
- Treatment timer controls and display

### 5.3 AUDIBLE AND VISUAL INDICATORS

Audible and visual indicators inside the treatment room and at the control console reflect the position of the source and unit status. These include the following:

#### 5.3.1 Inside the Treatment Room

- A head panel mounted on the front of the head provides the visual indicators for “Beam On” and “Beam Off.”
- A mechanical indicator is retracted in the head when the source is in the fully shielded position and protrudes from the head when the source is in or near the fully unshielded position. The motion of the mechanical indicator rod is independent from the operation of the radiation monitors.



#### 5.3.2 At the Control Console

The source position is continuously monitored and visually indicated on the control panel located on the remote control console. The indicators reflect the following:

- “Beam Off,” “In-Transit” or “Beam On”
- Inhibit, inhibit reset and power indicators

## 6.0 Treatment Table 27M

Table vertical motion is motorized with max speed of 0.6 cm/sec from hand control. All other motions are manual with locking lever controls. Table positions are indicated by scales.

Vertical	2 cm above - 37 cm below isocenter
Lateral	+/- 20 cm
Longitudinal	78 cm
Iso Rotation	+/- 110 deg
Top Rotation	+/- 180 deg

## 7.0 Safety and Protective Interlocks

### 7.1 EMERGENCY STOP SWITCHES

The emergency stop switches, when activated, disable the power from the unit and the table motion drive circuits, causing the source to return to or remain in the fully shielded position. The emergency stop switches are located on the control console, the unit main frame, and the hand control(s).

### 7.2 “OFF SHIELD” INTERLOCK

The “Off Shield” interlock prevents the source from being moved to, or remaining in, the fully exposed position when the radiation beam is directed through a part of the room that is not adequately shielded. This interlock is set-up during the installation of the unit.

### 7.3 TREATMENT ROOM DOOR INTERLOCK

The treatment room door interlock inhibits treatment when the treatment room door is open. Should the treatment door open while a treatment is in progress, the treatment will be paused and the source returned to the fully shielded position.

### 7.4 HEADLOCK INTERLOCK

The headlock interlock prevents moving beam treatments (rotation or arc) when the headlock is disengaged. Should the headlock become

disengaged while a moving beam treatment is in progress, the treatment is paused and the source is returned to the fully shielded position.

### 7.5 LOW AIR PRESSURE INTERLOCK

The low air pressure interlock prevents or pauses the treatment when the air pressure in the compressor air storage tank drops below a preset limit. This ensures that the source cannot be moved to, or remain in, the fully exposed position unless there is sufficient air reserve to return the source to the fully shielded position.

### 7.6 USER DOCUMENTATION

One User Manual and one Service Package are included with the unit.

## 8.0 Accessories

There are a number of accessories available for the Theratron® Phoenix™: (See Table 2).

## 9.0 Factory Installed Options

### 9.1 BACKLINE LASER INDICATION

Longitudinal laser line projection for patient alignment. Use with pendulum units only.

### 9.2 PHOENIX DUAL TIMER

Factory fitted dual timer modification kit is available which includes a wedge filter interlock.

## 10.0 Unit Installation

The Theratron® Phoenix™ must be installed by qualified Best® Theratronics personnel, or by personnel appointed by a Best® Theratronics authorized agent.

**Installation includes:**

1. Set-up of unit in a suitable location provided by the purchaser, installing all cables and connecting the unit and control console to a suitable source of electric power provided by the purchaser.
2. Loading of the source into the head of the unit.
3. A complete operational test of the unit and control equipment is performed on installation.
4. Training of facility personnel on equipment controls and functionality.

**10.1 INSTALLATION REQUIREMENTS**

**10.1.1 Electrical**

Power requirements:

- 115 V AC or 230 V AC ± 10% single phase, 50/60 Hz, 1.7 kVA.
- A circuit breaker rated at 20 amps is required for line protection.
- All external connections to the unit are made to the panel within the mainframe. Connections are available for the following:
  - Treatment room door interlock
  - Remote “Beam On” and “Beam Off” indicator lights
  - Remote emergency stop switch(es)

**10.1.2 Environmental Requirements**

- Ambient Operating Temperature Range: 10°C - 40°C
- Humidity Operating Range: 30% to 75% RH

**10.1.3 Room Layout Requirements**

Suggested room layout drawings are available on request.

**11.0 General Information**

**11.1 UNIT DIMENSIONS**

Weight (includes table)	4,707 kg (10,375 lb.)
Maximum unit height (above finished floor)	235 cm (93 in.)
Maximum swing radius of gantry (with head at 0°)	109 cm (43 in.)
Isocentric height from finished floor	116 cm (45 in.)

**11.2 PROJECTED FLOOR AREA**

3.19 m<sup>2</sup> (34 sq. ft.) based on frame dimensions  
127 cm x 251 cm (50 in. x 99 in.)

**11.3 FLOOR LOADING**

Typically 1800 kg/m<sup>2</sup> (360 lb./sq. ft.) including table



**Table 1**

Standard Wedges			
45 cm SDD			
Wedge Angle	30 degrees	45 degrees	60 degrees
	6W cm x 15L cm	6W cm x 15L cm	6W cm x 15L cm
	8W cm x 15L cm	8W cm x 15L cm	8W cm x 15L cm
	10W cm x 15L cm	10W cm x 15L cm	10W cm x 15L cm
Part Number	G85-151	G85-152	G85-153
55 cm SDD			
Wedge Angle	30 degrees	45 degrees	60 degrees
	6W cm x 15L cm	6W cm x 15L cm	6W cm x 15L cm
	8W cm x 15L cm	8W cm x 15L cm	8W cm x 15L cm
	10W cm x 15L cm	10W cm x 15L cm	10W cm x 15L cm
Part Number	G85-174	G85-175	G85-176
Wedge Sets			
	45 cm SDD	55 cm SDD	
Wedge Angle	30/45/60 degrees	30/45/60 degrees	
	10W cm x 15L cm	10W cm x 15L cm	
Part Number	G85-154	G85-155	
Large Field Wedge			
45 cm SDD			
Wedge Angle	15 degrees	30 degrees	45 degrees
	15W cm x 20L cm	15W cm x 20L cm	15W cm x 20L cm
Part Number	G85-282E	G85-151E	G85-152E





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BT/MTS 8012 (1)

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