Technical Specifications

Equinox™

External Beam Therapy System

Advancing Care, Expanding Possibilities

The Theratron® Equinox™ External Beam Therapy System is designed to support today's clinical applications, from simple treatment techniques to more complex techniques such as asymmetrical fields and beyond.

1.0 Regulatory Compliance

1.1 REGULATORY REQUIREMENTS

The Theratron® Equinox™ 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)
- Council of the European Communities Medical Device Directive 93/42/EEC
- IEC 60601-1, 60601-1-2 and 60601-2-11
- National Council for Radiation Protection (NCRP #102)
- International Commission for Radiation Units (ICRU#18)

2.0 Head Assembly

The head assembly of the Theratron® Equinox™ unit is a cast shell with lead and tungsten shield. Maximum capacity is 15,000 Curies of Cobalt-60 equivalent to a unit output of approximately 390 cGy/min Air Kerma Rate at isocentre for the 80 cm model and 250 cGy/min Air Kerma Rate at isocentre for the 100 cm model at maximum field size. Cobalt-60 sources are available in 1.5 cm and 2 cm diameters.

2.1 SOURCE DRAWER MECHANISM

The pneumatically driven linear source drawer on the Theratron® Equinox™ moves the source between the fully shielded and the fully exposed positions.

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 fully shielded position.

2.2 RADIATION SPECIFICATIONS

2.2.1 Relative Surface Dose

The relative absorbed dose on the radiation beam axis meets the requirements of IEC 60601-2-11.

2.2.2 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 "Beam On" position is less than 0.1% of the primary beam.

The Theratron® Equinox™ is designed to minimize leakage in accordance with IEC 60601-2-11 standards.

2.2.3 Collimator Leakage

The collimator transmission leakage is less than 2% of the useful beam exposure rate in accordance with IEC 60601-2-11.

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2.3 COLLIMATOR

A symmetrical/asymmetrical collimator assembly defines the X and Y axes relative to the collimator axis.

The X and Y leaf positions are displayed on the in-room display monitor(s).

2.3.1 Collimator Rotation

The collimator may be rotated ± 180° from its central position at variable speed, up to a maximum speed of 6°/sec.

2.3.2 Treatment Distance Indicators

Treatment distance indicators attach magnetically to collimator accessory pads and indicate 80 cm Source to Skin Distance (SSD) or 100 cm SSD accordingly.

The appropriate mechanical treatment distance indicator is a standard accessory included with the unit.

2.3.3 Field Size

Asymmetric Mode (Optional)
In asymmetric mode, the X1, X2, Y1 and Y2 collimator leaves travel to midline. The field size dimensions in asymmetric mode are as follows:

80 cm SAD	X1 (cm)	X2 cm)	Y1 (cm)	Y2 (cm)
Minimum	0	0	0	0
Maximum	–17.5	+17.5	–17.5	+17.5

100 cm SAD	X1 (cm)	X2 (cm)	Y1 (cm)	Y2 (cm)
Minimum	0	0	0	0
Maximum	–21.5	+21.5	–21.5	+21.5

Note: for the beamstopper configuration the maximum jaw position is limited to ±19.5 cm.

Symmetric Mode
The field size dimensions in symmetric mode are as follows:

	80 cm SAD
Minimum	1 cm x 1 cm
Maximum	35 cm x 35 cm

	100 cm SAD
Minimum	1 cm x 1 cm
Maximum	43 cm x 43 cm

Note: for the beamstopper configuration the maximum field size is limited to 39 cm.

2.3.4 Accessory Mounting Pad

Two magnetic pads on the collimator facilitate the mounting of a mechanical distance indicator.

2.4 WEDGES

2.4.1 Physical Wedges

An optional wedge kit is available for the Theratron® Equinox™. The kit includes 15°, 30°, 45° and 60° wedges and can be used for fields up to 15W cm x 20L cm at 80 cm SAD or 18.5W cm x 25L cm at 100 cm SAD.

2.4.2 Motorized Wedge (Optional)

A 60° wedge affixed to the inside of the collimator moves in the path of the beam to the "In" position for the wedged time entered at the control console. The effective wedge angle is determined by the ratio of time the wedge is in the beam and total exposure time.

The field size covered by the motorized wedge is as follows:

SAD	Wedged (cm)	Un-wedged (cm)
80 cm	15W	20L
100 cm	18.5W	25L

The motorized wedge travels from the "Out" position to the "In" position in 6 seconds.

2.5 FIELD LIGHT SYSTEM

The field light system consists of the following:

- An external parabolic mirror projector assembly which is designed to allow for quick and easy replacement of the quartz halogen lamp.
- An automatic timer turns off the light field at the start of the treatment and may be configured for a pre-set time between 1 to 3 minutes, extending the usage of the light field.

2.6 RADIATION FIELD ACCURACY

2.6.1 Radiation Field Centre Coincidence

The maximum distance in any direction between the centre of the radiation field and the light field, measured at SAD in a plane perpendicular to the collimator rotation axis, is:

Square fields up to 20 cm	± 2 mm
Larger fields	± 1% of field size

2.6.2 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	± 2.5 mm
Larger fields	± 1% of field size

2 cm source	
All field sizes	± 3 mm

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

Gantry at 0° or 180°	
Square fields up to 10 cm	± 1 mm
Larger fields	± 1% of field size

Gantry at 90° or 270°	
Square fields up to 20 cm	± 2 mm
Larger fields	± 1% of field size

2.7.2 ISOCENTRIC ACCURACY
The unit's isocentre is defined as the point where the collimator and gantry rotational axes intersect. This point lies within a sphere of 1 mm radius as the gantry rotates through 360°.

2.8 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. The focusing attributes of the ODI minimize line diffusion on the skin and on any immobilization devices.

2.8.1 Optical Distance Indicator Scale

	80 cm SAD
Range	60 cm to 100 cm
Increments	0.25 cm
Accuracy	± 1 mm 70 cm to 90 cm SSD
	± 2 mm 60 cm to 69 cm 90 cm to 100 cm SSD
	100 cm SAD
Range	80 cm to 120 cm
Increments	0.25 cm
Accuracy	± 1 mm 90 cm to 110 cm SSD ± 2 mm 80 cm to 89 cm ±4 mm 111 cm to 120 cm

2.9 COLLISION DETECTION DEVICE (Optional)
A Collision Detection Device (CDD) attached to the collimator stops unit and table motions when the CDD detects a possibility of a collision between the head of the unit and the table, patient, operator or any standard accessory attached to either the patient or the table.

3.0 Gantry

The gantry rotates in both clockwise and counterclockwise directions. Variable speed control is provided for gantry rotation to facilitate treatment set-up. The range of gantry rotation is ± 360°.

The angle of the gantry is displayed on the in-room monitor(s) and at the control console.

The system automatically determines and controls the appropriate gantry speed for a single pass defined arc. The range of gantry speed is variable between 0.01 to 1.0 rpm.

3.1 BEAMSTOPPER (Optional)
The beamstopper is a lead filled steel assembly, which acts as a beam absorber. The beamstopper attenuates 99.7% of the primary beam. 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

State of the art covers are moulded from flame-retardant material whose design allows for easy removal and servicing.

5.0 Control System and Indicators

5.1 CONTROL CONSOLE
The computerized control console located outside the treatment room consists of the following:
- Control panel
- Display monitor
- Mouse and keyboard

5.1.1 Control Panel
The control panel includes the following functions:
- A push-button interface for Treatment Enable, Pause, Terminate, Auto set-up (gantry motion) and Confirm Parameters
- A motion enable button for remote unit motions
- An emergency stop

5.1.2 Display Monitor
15-inch LCD screen monitor displays system information, such as:
- Start up information
- Set and actual unit and table parameters
- Treatment time
- Service screens showing status of unit by color coding of controls and voltage signals

• System status and interlock information

The simple design provides ease of navigation between fixed and arc treatments. The service screens facilitate unit configuration, servicing and maintenance.

Access to the system is controlled by user authentication for the operator, administrator and technician.

5.1.3 Mouse and Keyboard

The two-button mouse and the keyboard are standard. All functions can be selected by using the mouse or the function keys on the keyboard.

5.2 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.

5.2.1 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.
- The monitor displays the following unit parameters:
    - Arc/Fixed treatment
    - Symmetric or Asymmetric Field size
    - Gantry angle
    - Collimator angle
    - Wedge code
    - Table lateral position
    - Table longitudinal
    - Table vertical position
    - Table angle
    - Beamshaping tray code (if installed)

A second in-room monitor is optional.

5.2.2 Control Console

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

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

5.3 HAND CONTROL

Ergonomically designed hand control rotates freely around unit. Backlit faceplate is easily read during patient set-up.

The hand control offers variable speed controls for the following unit and table motions:

Unit Mode
- Gantry rotation
- Collimator motions

Table Mode
- Isocentric rotation
- Vertical, lateral and longitudinal motion

The additional features that can be controlled from the hand control include:

- Sym/asymm collimator
- Patient load/unload (Avanza™ table)
- "Zero" position (Avanza™ table)
- Auto set-up
- Simulate
- Collision override
- Room lights
- Field light
- ODI
- Back-pointer
- Room lasers

A second hand control is optional.

5.3.1 Auto Set-up

The auto set-up feature allows the operator to move the gantry, field size and collimator rotation at the touch of a button from the hand control. The treatment parameters are entered at the control console and the operator is able to move the unit from inside the treatment room to position the field size and the collimator rotation to the entered value.

The gantry can be moved remotely from outside the treatment room at the control console.

6.0 Patient Positioning Table

The Avanza™ Patient Positioning Table is completely integrated with the Theratron® Equinox™. The table can be moved using the hand control or by using the table controls located on each side of the table. Please refer to the Avanza™ Technical Specifications for additional information.

7.0 Safety and Protective Interlocks

7.1 Automatic Collimator Closure

The collimator leaves automatically move to midline (closed collimator) and the motorized wedge (if installed) automatically moves to the "In" position during source irregularities, minimizing exposure to patient and personnel.

7.2 EMERGENCY STOP SWITCHES

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

7.3 "OFF SHIELD" INTERLOCK
The "Off Shield" interlock prevents the source from being moved to, or remain 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.

7.4 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.

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

7.6 WEDGE FILTER/TRAY INTERLOCK
The wedge filter interlock prevents treatment if the wedge filter number and beamshaping tray number (if installed) are not verified, prior to commencement of treatment.

If either of these parameters is changed during treatment, the verification signal will be disabled and the treatment terminated, returning the source to the fully shielded position.

The wedge filter interlock is a standard feature of the Theratron® Equinox™.

7.7 UNEXPECTED MOTION INTERLOCK
If unexpected motion of gantry or collimator is detected, treatment is paused or an inhibit interlock is set.

7.8 TREATMENT VERIFICATION INTERLOCK
Treatment is prevented until the actual gantry and collimator positions are moved to the set treatment parameters.

8.0 Scales
All scales comply with IEC 60601-2-11 and 61217 relating to accuracy, polarity and scale numbering convention.

9.0 User Documentation
Two User Manuals and one Service Package are included with the unit.

10.0 Accessories
Please refer to the Accessories Specifications for a list of accessories available for use with the Theratron® Equinox™.

11.0 Unit Installation
Our global network of qualified service engineers install the Theratron®Equinox™ to ensure equipment performance and patient safety.

Installation includes:
1. Set-up of unit in a licensed bunker as per Best® Theratronics drawings, 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 Cobalt-60 source into the head of the unit.
3. A complete operational test of the system upon completion of installation to ensure it meets specifications.
4. Familiarization training of facility personnel in the unit's functions and use of all controls.

11.1 INSTALLATION REQUIREMENTS
11.1.1 Electrical
Power requirements:
- 115 V AC or 230 V AC ± 10% single phase, 50/60 Hz, 2 kVA
- A circuit breaker rated at 20 amps is required for line protection
- All external connections to the unit connections 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)
- Auxiliary interlock

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

11.1.3 Room Layout Requirements
A false wall must be installed between the fixed unit covers and the treatment room walls as detailed in the room layout instructions.

Recommended room layout is provided on request.

12.0 General Information

12.1 STANDARD UNIT DIMENSIONS

Model	Pendulum 80 cm SAD
Weight (includes table)	6000 kg (13,200 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.)

Model	Pendulum 100 cm SAD
Weight (includes table)	6600 kg (14,520 lb.)
Maximum unit height (above finished floor)	285 cm (112 in.)
Maximum swing radius of gantry (with head at 0°)	130 cm (51 in.)
Isocentric height from finished floor	132 cm (52 in.)

12.2 PROJECTED FLOOR AREA

3.19 m2 (34 sq. ft.) based on frame dimensions 127 cm x 251 cm (50 in. x 99 in.)

12.3 FLOOR LOADING

Typically 1800 kg/m^2 (360 lb./sq. ft.) including table.

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Notes

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