# Technical Specifications

# GammaBeam™ 100-80

**Based on the Phoenix platform**

**External Beam Gamma Teletherapy System**

## Universal Care, Economical Solutions

The GammaBeam™ 100-80 is a highly practical model of the GammaBeam™ family of External Beam Therapy System (EBTS). Particularly appropriate for treatment centers requiring extended hours of daily operation and where budgetary considerations are a major concern.

Convenience and safety, combined with simplicity of design, make the GammaBeam™ 100-80 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 high performance in the delivery of radiation therapy.


### 1.0 Regulatory Compliance

- Canadian Nuclear Safety Commission (CNSC)
- United States Nuclear Regulatory Commission (USNRC)
- United States Food and Drug Administration (USFDA)
- Council of the European Communities Medical Device Directive 93/42/EEC and 2007/47/EC
- IEC 60601-1 (ED.3), 60601-1-2(ED.3) and 60601-2-11(ED.2)
- National Council for Radiation Protection (NCRP #102)
- International Commission for Radiation Units (ICRU#18)

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## 2.0 Head Assembly

The head assembly of the GammaBeam™ 100-80 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 isocenter 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 GammaBeam™ 100-80 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 battery backup allows the unit to treat for an additional 4 hours before 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

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 GammaBeam™ 100-80 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.

### 2.3 HEAD ROTATION

The head may be swivelled manually ± 180° in either direction from the isocenter. The head rotation angle scale can be read from both sides of the unit.

### 2.4 COLLIMATOR

A manually adjustable, divergent asymmetrical collimator defines the X and Y axes relative to the collimator axis. The Source to Diaphragm Distance (SDD) is 45 cm. The X and Y leaf positions are displayed on mechanical scales located on the collimator.

#### 2.4.1 Collimator Rotation

The collimator may be rotated ± 180° from its central position and locked in any given position using a brake located on the front of the head.

#### 2.4.2 Treatment Distance Indicators

A treatment distance indicator attaches

magnetically to collimator accessory pads and indicate 80 cm Source to Skin Distance (SDD). The mechanical treatment distance indicator is a standard accessory included with the unit.

### 2.4.3 Field Size

The field size dimensions are as follows:

| | X1 (cm) | X2 (cm) | Y1 (cm) | Y1 (cm) |
|---|---|---|---|---|
| **Minimum** | 0 | 0 | 0 | 0 |
| **Maximum** | -17.5 | +17.5 | -17.5 | +17.5 |
| Minimum total field size is 1 cm x 1 cm | | | | |

## 2.5 WEDGES

Wedges are available for the GammaBeam™ 100-80. The wedges vary in angle (15°, 30°, 45° and 60°) and field size. They are made from lead-alloy except the 15°, which is made of brass.

## 2.6 FIELD LIGHT SYSTEM

- An automatic timer turns off the field light at the start of the treatment or after 2 minutes
- The maximum distance in any direction between the field light center and the collimator rotation axis, measured at SAD is:
  - o Square field up to 10 cm ±1 mm
  - o Larger square fields ±1% of field size

## 2.7 RADIATION FIELD ACCURACY

### 2.7.1 Radiation Field Center Coincidence

The maximum distance in any direction between the center 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 |

### 2.7.2 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 20 cm | ± 2.5 mm |
| Larger fields | ± 1% of field size |
| | |
| **2.0 cm source** | |
| All field sizes | ± 3 mm |

The maximum distance in any direction between the light field center 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 10 cm | ± 2 mm |
| Larger fields | ± 1% of field size |

### 2.7.2 Isocentric Accuracy

The unit's isocenter 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°.

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

| | | |
|---|---|---|
| Range | 60 cm to 100 cm | |
| Increments | 0.5 cm | |
| Accuracy | ± 1 mm | (70 cm to 90 cm SSD) |
| | ± 2 mm | (60 cm to 69 cm & 90 cm to 100 cm SSD) |

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## 3.0 Gantry

The gantry rotates in both clockwise and counter clockwise directions and is capable of continuous rotation. Variable speed control is provided for gantry rotation to facilitate treatment set-up. The angle of the gantry is displayed on a circular scale located at the center of the gantry.

The range of gantry speed is variable between 0.0125 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 99.9% of the primary beam.

The optical back pointer is an optional feature on beamstopper units; it indicates the center 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

The control system includes:

- Control cabinet
- Control console
- Hand control
- Audible and visual indicators

### 5.1 CONTROL CABINET

The control cabinet houses the source exposure control system based on two independent timers.


### 5.2 CONTROL CONSOLE

The control console located outside the treatment room features the following:

- A push-button interface for Treatment Enable
- Emergency Stop
- Power on-off and Inhibit key switches
- A LCD touch screen interface displays:
  - o System information
  - o Start up information
  - o Set and actual unit parameters
  - o Treatment time
  - o Service screens showing status of unit by color coding of controls and voltage signals
  - o System status and interlock information

The service screens facilitate unit configuration, servicing and maintenance.

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


### 5.3 HAND CONTROL

Ergonomically designed hand control originates from the rear of the table. Backlit faceplate is easily read during patient set-up. The hand control features include:

- Gantry rotation
- Table vertical positioning
- Room lights switch
- Room lasers switch
- Motion “enable” indicator
- Motion enable bar
- Emergency push-button

### 5.4 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.

#### 5.4.1 Inside the Treatment Room

- A head panel mounted on the front of the head provides the visual indicators for “Beam On”, “Beam Off” & ”Off-Shield”.
- 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.

#### 5.4.2 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

## 6.0 Patient Positioning Table 27M

The 27M Patient Positioning Table is completely integrated with the GammaBeam™ 100-80. The table vertical motion is motorized with max speed of 2.25 cm/sec from the 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° |
| Top Rotation | ± 180° |

## 7.0 Safety and Protective Interlocks

### 7.1 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, the table 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 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.

### 7.5 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 GammaBeam™ 100-80.

### 7.6 UNEXPECTED MOTION ENABLE INTERLOCK

During patient setup, if power at the gantry motor or table vertical motor is detected, without the motion enable bars on the hand control being activated, an inhibit interlock is set.

During treatment, if motion of gantry or table vertical gets enabled, treatment is paused and an inhibit interlock is set.

## 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

User Manuals, Service Manual and Service Drawings 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 GammaBeam™ 100-80.

## 11.0 Unit Installation

Our global network of qualified service engineers install the GammaBeam™ 100-80 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:

- Single phase AC, 115 V ± 10%, 60 Hz ± 3 Hz or 230 V ± 10% 50 Hz ± 3Hz , 750 VA max (average power consumption is 200 W)
- A fused (fuse or circuit breaker) disconnect switch rated at 10 A is required for line protection

Other required electrical connections:

- Treatment room door interlock (NO contact, rated at least 0.1 A at 24 V)

Available to user external connections:

- Remote emergency stop switch(es)
- Auxiliary interlock
- Remote "Beam On/Off" indicator light (max 3 A @ 230 V)
- Room lights (max 3 A @ 230 V)
- Lasers (max 3 A @ 230 V)

All external connections to the unit are made at the terminal block within the control box.

#### 11.1.2 Environmental Requirements

- Ambient Operating Temperature Range: 5°C - 40°C
- Humidity Operating Range: 5% to 90% RH (non-condensing)
- Atmospheric pressure between 54 kPa and 106 kPa (operation on elevations up to 5000 m above sea level)

#### 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. General Information

### 12.1 UNIT DIMENSIONS

| | |
|---|---|
| Weight (includes table) | ~5000 kg (~11023 lb.) |
| Maximum unit height (above finished floor) | 230 cm (90.5 in.) |
| Maximum swing radius of gantry (with head at 0°) | 109 cm (43 in.) |
| Isocentric height from finished floor | 116cm (45 in.) |

### 12.2 PROJECTED FLOOR AREA

3.19 $m^2$ (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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Krishnan Suthanthiran
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