PRIMUS and PRIMUS^{PLUS}

Linear Accelerator Specifications

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Contents

Linear Accelerator

PRIMUS
PRIMUS^{PLUS}

The specifications describe the medical PRIMUS™ and PRIMUS^{PLUS} Linear Accelerators. PRIMUS provides a megavoltage X-ray or electron beam for clinical applications. The RF power for the energy generation is supplied by a stationary Magnetron for PRIMUS and by a stationary Klystron for PRIMUS^{PLUS}.

Note: All specifications are related to control console version 8.0 and higher.

- **PRIMEVIEW™ 3*i syngo*®-based graphical user interface**
- **All-digital platform**
- **Flexible energy configuration**
- **Modular design and embedded diagnostics for facilitated serviceability**
- **Standing wave accelerator structure**
- **10^{-8} mbar wave accelerator vacuum**
- **43 cm isocenter clearance**
- **Optional OPTIFOCUS™ or 3-D MLC**
- **Fully automated with SIMTEC™ AFS***
- **Fast IMRT with SIMTEC IM-MAXX™/IM-MAXX 2***
- **Insulated structure reduces noise**
- **Compact design**

** Standard on select models and available as an option on all others.*

PRIMUS

1 Nominal Treatment Beam Energies

Unit Type	Low X-ray (MV)	High X-ray (MV)	Electron Energy Range (MeV)
PRIMUS	4	–	–
	4	–	3-7
	6	–	–
	6	–	5-14
	6	6ST	5-14
	6	10	5-14
	6	15	5-14
PRIMUS^{PLUS}	4	10	5-15
	6	–	6-21
	6	6ST	6-21
	6	10	6-21
	6	15	6-21
	6	18	6-21
	6	23	6-21
	6	25*	6-21

The energy of the photon beam is defined as the percentage ionization for a 10 cm x 10 cm field with 100 cm Target-to-Surface Distance (TSD) measured on the central axis at 10 cm depth in water, relative to the central axis ionization at the depth of maximum ionization (d_{max}).

The energy of the electron beam is defined as the depth of the 80% ionization in water on the central axis for a 15 cm x 15 cm fixed electron applicator (95 cm) with 100 cm TSD. Depth values are given as the distance from the water surface to the center of a 0.084 cc thimble ionization chamber.

** The 25 MV energy configuration is not available in the US.*

2 X-ray Beam Parameters/Specifications

1 Maximum Depth and Relative Ionization in Water

d_{max} measured for a 10 cm x 10 cm field with 100 cm TSD unless another field size is listed in the table.

The off-axis ratios at the depth of maximum ionization for each X-ray energy in the table below will not exceed 110%.

Nominal Energy (MV)	D_{max} (cm)	% Ionization at 10 cm Water
4	1.0 ± 0.2	63 ± 1
6	1.5 ± 0.2	67 ± 1
6ST (PRIMUS^{PLUS})	1.8 ± 0.2 (for 5 cm x 5 cm)	64 ± 2
6ST (PRIMUS)	2.1 ± 0.2 (for 5 cm x 5 cm)	67 ± 2
10	2.5 ± 0.2	74 ± 1
15	3.0 ± 0.2	77 ± 1
18	3.2 ± 0.2	78 ± 1
23	3.5 ± 0.2	80 ± 1
25	3.6 ± 0.2	81 ± 1

2 X-ray Dose Rate

The fixed dose rate available for a 10 cm x 10 cm field, measured at d_{max} on central axis for 100 cm TSD, is shown in the table below.

Unit Type	Low X-ray (MV)	Dual Dose Rate for X Low (MU/min)	High X-ray (MV)	Dual Dose Rate for X High (MU/min)
PRIMUS	4	50 & 200	–	–
	6	50 & 200 or 250	–	–
	6	50 & 200 or 250	6ST	50 & 500
	6	50 & 200 or 250	10	50 & 300
	6	50 & 200 or 250	15	50 & 200
PRIMUS^{PLUS}	4	50 & 200	10	50 & 300
	6	50 & 200 or 300	–	–
	6	50 & 200 or 300	6ST	50 & 1000
	6	50 & 200 or 300	10	50 & 300 or 500
	6	50 & 200 or 300	15	50 & 300 or 500
	6	50 & 200 or 300	18	50 & 300 or 500
	6	50 & 200 or 300	23	50 & 300 or 500
	6	50 & 200 or 300	25*	50 & 300 or 500

** The 25 MV energy configuration is not available in the US.*

3 X-ray Flatness and Symmetry

Measurement Conditions	Flatness (%) 4-23 MV	Flatness (%) 25 MV	Symmetry Mean Value (%)
• 10 cm x 10 cm and greater field size • 10 cm depth of water (5 cm depth for energies below 6 MV) • 100 cm Target-of-Axis Distance (TAD)	3	5	2

Systems with a 6/6ST energy configuration do not achieve the above values for flatness when in ST mode (using an unflattened beam).

4 X-ray Field Size

System Configuration	Min Field Size at Isocenter (cm x cm)	Max Field Size at Isocenter (cm x cm)
Counterweight	0 x 0	40 x 40
Retractable beamshield	0 x 0	40 x 39.2
ST mode (unflattened beam)	0 x 0	5 x 5

	Over Travel (cm)
X-leaves (outer collimators)	10
X-jaws (outer collimators)	2
Y-jaws (inner collimators)	10

Primary Collimator Circular Field Size	Nominal Size (cm)
At 100 cm TAD	50

5 X-ray Penumbra

Measurement Conditions Maximum distance along the major axes between the 80% and 20% points of the absorbed dose	Penumbra (mm) 4-23 MV		Penumbra (mm) 25 MV	
	MLC	HPD	MLC	HPD
• 10 cm x 10 cm (MLC) • 10 cm depth of water (5 cm depth for energies below 6 MV) • 100 cm TAD	7 ± 2	8 ± 2	8 ± 2	8 ± 2

HPD: High Precision Defining Head, a treatment head with four jaws, no MLC.

6 Dose Monitor Linearity and Reproducibility

Measurement Conditions Over a period of five working days (eight working hours per day)	Linearity Dose Rate of 50 MU/min (%)	Reproducibility
PRIMUS^{PLUS} 4/10 MV • Programmed range of 21 MU to 1000 MU for Monitor 1	± 1	≤ 1 MU or 2%, whichever is greater
All other energy configurations • Programmed range of 1 MU to 1000 MU for Monitor 1	± 1	≤ 1 MU or 2%, whichever is greater

7 Beam Formation

	PRIMUS (msec)	PRIMUS^{PLUS} (msec)
Beam stability typically achieved within	50	250

8 X-ray Arc Therapy

The dose-per-degree (MU/°) for X-ray arc therapy is based on the fixed-beam dose rate.

Fixed-beam Dose Rate	Dose-per-Degree Range	Linearity	Reproducibility Over a period of five working days (eight working hours/day)
MU/min	MU/°	Arcs greater than 60° upon completion	Arcs greater than 60° upon completion
1000	0.67 to 33.00	1 MU or 2%, whichever is greater	2 MU or 3%, whichever is greater
500	0.67 to 10.00	1 MU or 2%, whichever is greater	2 MU or 3%, whichever is greater
300	0.33 to 5.00	1 MU or 2%, whichever is greater	2 MU or 3%, whichever is greater
200	0.33 to 5.00	1 MU or 2%, whichever is greater	2 MU or 3%, whichever is greater

3 Electron Beam Parameters/Specifications

The PRIMUS Linear Accelerator comes with six user-selectable electron energies (4 MV option has five electron energies), unless configured as a photon energy system only. The electron energies are user selectable from the energy range given in Section 1.

1 Maximum Surface Dose and Relative Ionization

Depth values are given as the distances from the water surface to the center of the measuring device.

The surface dose is shown for a 15 cm x 15 cm fixed electron applicator with 100 cm TSD. Water equivalent plastic blocks are used in the buildup region to measure the dose. The values are expressed as a percentage of d_{max}.

Nominal Energy (MeV)	Maximum Surface Dose (% d_{max})	Relative 30% Ionization Depth (cm)	Relative 80% Ionization Depth (cm)
5	77	2.5	1.7 ± 0.2
6	79	2.8	2.0 ± 0.2
7	81	3.2	2.3 ± 0.2
8	83	3.7	2.7 ± 0.2
9	85	4.1	3.0 ± 0.2
10	87	4.6	3.4 ± 0.2
12	90	5.3	4.0 ± 0.2
14	92	6.0	4.5 ± 0.2
15	93	6.8	5.0 ± 0.2
16	93	7.3	5.3 ± 0.2
18	93	8.2	6.0 ± 0.2
20	93	9.3	6.5 ± 0.2
21	93	9.4	6.7 ± 0.2

2 Flatness and Symmetry

The maximum value of the ratio of the absorbed dose (averaged over not more than 1 cm^2) anywhere in the radiation field at the depth of 0.5 mm to the maximum absorbed dose on the radiation beam axis does not exceed 109%.

	Flatness for Fixed Field (%)				Symmetry (%)
Nominal Energy (MeV)	• Two points 1.5 cm inside 50% beam intensity • Relative to the beam intensity on the central axis • Measured at d_{max} • 100 cm TSD				15 cm x 15 cm and greater field measured along central axis at d_{max} size
	10 cm x 10 cm	15 cm x 15 cm	20 cm x 20 cm	25 cm x 25 cm	
5	5	6	6	6	2
6	4	5	5	5	2
7	4	5	5	5	2
8	4	5	5	5	2
9	3	4	4	5	2
10	3	4	4	4	2
12	3	3	4	4	2
14	3	3	3	4	2
15	3	3	3	4	2
16	3	3	3	4	2
18	3	3	3	4	2
20	3	3	4	4	2
21	3	3	4	6	2

Nominal Energy (MeV)	Flatness for Small Field Cones (%) • Two points 1.5 cm inside 50% beam intensity • Relative to the beam intensity on the central axis • Measured at d_{max} • 100 cm TSD				
	4 cm diameter	5 cm diameter	6 cm diameter	7 cm diameter	8 cm diameter
3	3	3	4	6	7
4	3	3	4	6	7
5	3	3	4	4	7
6	3	3	4	4	7
7	3	3	4	4	7
8	3	3	4	4	7
9	3	3	4	4	7
10	3	3	4	4	7
12	3	3	4	4	7
14	3	3	4	4	7
15	3	3	4	4	7
16	3	3	4	4	7
18	4	4	4	4	7
20	4	4	4	4	7
21	4	4	4	4	7

3 Dose Rate

Measurement Conditions	Normal Dose Rate (MU/min)	High Dose Rate (MU/min)
• 15 cm x 15 cm fixed field applicator • Measured at central axis at point of maximum ionization • 100 cm TAD	300	900

4 Electron Beam Linearity and Reproducibility

Measurement Conditions	Linearity Dose Rate of 50 MU/min (%)	Reproducibility
Over a period of five working days (eight working hours per day)	2	≤ 1 MU or 2%, whichever is greater

5 X-ray Contamination

The X-ray contamination of the electron beam is measured in water on the central axis 10 cm beyond the depth at which the electron beam intensity is 10% of the maximum value.

Nominal Energy (MeV)	X-ray Contamination (Maximum %)
3	0.5
4	0.5
5	1.0
6	1.3
7	1.5
8	1.7
9	2.0
10	2.0
12	2.0
14	3.0
15	3.0
16	3.2
18	3.5
20	4.0
21	4.0

6 Electron Arc Therapy

The dose-per-degree (MU/°) for electron arc therapy is based on the fixed-beam dose rate.

Electron Dose-per-Degree Range (MU/°)	
Minimum	Maximum
2	10

Electron Arc Linearity and Reproducibility for Arcs Greater than 60°	
Linearity	Reproducibility
1 MU or 2%, whichever is greater	2 MU or 3%, whichever is greater

4 Dosimetry System

The dual dosimetry system consists of an X-ray dose chamber and a thin-walled electron dose chamber, and is arranged in a primary/secondary combination. Dose monitor readouts display four digits.

The primary dose monitor system terminates the treatment when reaching coincidence with the preset value. Backup termination is provided by the secondary dose monitor and time interlock systems.

In case of power failure during treatment, MUs, arc, and time values, as well as all other treatment setup parameters, are stored in nonvolatile memory for recovery.

5 Mechanical Parameters and Control

1 Gantry and Collimator

	Resolution (°)	Accuracy (°)
Gantry	0.1	± 0.5
Collimator	0.1	± 1.0

	Gantry	Collimator
Nominal rotation range (°)	± 190	270
Nominal speed (RPM)	1.0	1.0
Nominal speed (°/sec)	6	6
Nominal target-to-isocenter distance (cm)	100	–

Term	Definition
Isocenter tolerance	The distance between the mechanical and radiation isocenter shall not exceed 1.0 mm.
Mechanical isocenter	The point in space that minimizes the collimator axis error for all orientations of the gantry and collimator.
Radiation isocenter	The point in space that minimizes the radiation axis error for all orientations of the gantry and collimator (with symmetric openings).
Radiation axis error	The distance between the radiation isocenter and the radiation axis, measured normal to the radiation axis.
Isocenter height	The nominal distance between floor and isocenter is 130.8 cm.
Collimator axis error	The distance between the mechanical isocenter and the collimator axis, measured normal to the collimator axis.

2 Field Parameter

	Field Size Resolution (mm)	Field Size Accuracy
OPTIFOCUS	1.0	± 1.0 mm or 1%, whichever is greater
3-D MLC	1.0	± 2.0 mm or 1%, whichever is greater
HPD	1.0	± 2.0 mm or 1%, whichever is greater

Measurement Conditions	X-ray-to-Light Field Coincidence
• Corresponding X-ray field edge (50% intensity at d_{max}) • Visible field edge of light field • Field sizes 5 cm x 5 cm to 40 cm x 40 cm • At all gantry positions	2 mm or 1%, whichever is greater

6 Accessories

1 Distance Indicator

	Range (cm)	Resolution (cm)	Accuracy (cm) at TSD 100 cm
Optical Range Finder	75 to 130	0.5	± 0.2
Mechanical Front Pointer	85 to 110	1.0	± 0.2
Backpointer Indicator	80 to 150	0.6	0.6

2 Wedge Filters

All wedge filters are coded and interlocked for the correct field size.

	Wedge Angles (°)			
	15	30	45	60
In-plane (toe in/toe out)	Yes	Yes	Yes	Yes
Cross-plane (toe left/toe right)	Yes	Yes	Yes	Yes
Field size in wedge direction (cm)	25	25	25	20
Field size in non-wedge direction (cm)	30	30	30	30

	Half Wedge Angles (°)		
	15	30	45
In-plane (toe in/toe out)	Yes	Yes	Yes
Cross-plane (toe left/toe right)	Yes	Yes	Yes
Field size in wedge direction (cm)	20	20	20
Field size in non-wedge direction (cm)	30	30	30

3 Beam Blocks and Trays

	Beam Block and Tray Weight
Maximum	15 kg (33 lbs)

For detailed information, please refer to the Accessories Data Sheet.

4 Electron Applicators

	Fixed Electron Applicators				
	10 cm x 10 cm	15 cm x 15 cm	20 cm x 20 cm	25 cm x 25 cm	5 cm diameter
Nominal distance from target (cm)	95	95	95	95	95

	Small Field Round Cones – Diameter (cm)						
	2	3	4	5	6	7	8
Nominal distance from target (cm)	95	95	95	95	95	95	95

	Digital Electron Variable Applicator (DEVA)
Nominal distance from target (cm)	90
Minimum field size (cm)	3 x 3
Maximum field size (cm)	25 x 25

	Rotational Electron Applicator
Nominal distance from target (cm)	72.5
Maximum field size (cm)	6 x 25

7 Leakage and Transmission

	% of Un-Attenuated Useful Beam
Radiation to the patient plane • Over a circular area of 2 m radius • Centered on and perpendicular to the central axis of the beam at isocenter • Outside the projection of the primary collimator	0.1
Radiation outside the patient plane • 1 m from the path of the accelerated electrons • Measured with a 30 cm^3 ionization chamber with a 1 cm thick buildup cap	0.1
Collimator transmission • Max value measured according to IEC 601-2-1 • The X-ray transmission through one set of adjustable collimator jaws	1.0

8 Beamshield

For PRIMUS systems with beamshield, the following parameters deviate from the values listed throughout the document.

Parameter	Systems with Beamshield
Isocenter tolerance (mm)	2.0
Maximum field size for collimator position 0°, 90°, 180°, or 270° (cm)	40 x 39.2
Field size for other collimator angles	Firmware prevents the geometric field from exceeding the beamshield
Maximum transmission (%)	0.2
Average transmission (%)	0.1
Backpointer	
• Range (cm)	80 – 150
• Resolution (cm)	0.6
• Accuracy (cm) at TSD 100 cm	0.6

9 Utility Requirements

For additional information, please refer to the Product Planning Guide for the ONCOR Linear Accelerator.

1 Incoming Power Requirements

	Incoming Power (VAC)	3-Phase Delta	Frequency (Hz)
USA	480	Yes	50 or 60
International	400	Yes	50 or 60

2 Facility Water Cooling Specifications and Recommendations

Facility Water	PRIMUS	PRIMUS^{PLUS}
Constant facility cooling water – to be provided by customer	11 l/min (3 gal/min)	28 l/min (7.5 gal/min)
Maximum inlet pressure	552 kPa (80 PSI)	552 kPa (80 PSI)
Minimum pressure drop	35 kPa (5 PSI)	241 kPa (35 PSI)
Maximum inlet temperature	25° C (77° F)	25° C (77° F)
Minimum inlet temperature	10° C (50° F)	16° C (60° F)
Optimum inlet temperature	18° C (65° F)	18° C (65° F)

	Water Quality (PPM)
Total dissolved solids ($CaCO_3$)	< 250
Annual average of total suspended solids ($CaCO_3$)	< 30
Dissolved gas (hydrogen sulfide H_2S)	< 0.05
Total hardness ($CaCO_3$)	< 85

A 50-micron in-line filter with 95% efficiency is required. Water shall be free of iron bacteria and manganese bacteria.

Heat Dissipation from Linear Accelerator to Water	PRIMUS	PRIMUS^{PLUS}
In standby mode	0.5 kW (2000 BTU/hr)	7.0 kW (24000 BTU/hr)
In treatment mode	8.6 kW (29000 BTU/hr)	30.0 kW (102000 BTU/hr)

3 Air Conditioning

Air Conditioning	
Room temperature	20° C (68° F) to 26° C (78° F)
Relative humidity	40 – 65%
Adequate ventilation	Required
Minimum room volume per hour	2 (depending on room size and airflow pattern)

Heat Dissipation from Linear Accelerator in Air	PRIMUS	PRIMUS^{PLUS}	Console Node
In standby mode	2.0 kW (6800 BTU/hr)	2.7 kW (9200 BTU/hr)	0.2 kW (800 BTU/hr)
In treatment mode	4.1 kW (14000 BTU/hr)	6.5 kW (22000 BTU/hr)	0.2 kW (800 BTU/hr)

10 Dimensions and Weights

For additional information, please refer to the Product Planning Guide for the PRIMUS Linear Accelerator.

Unit Type	Height	Length	Width	Weight	Counterweight
PRIMUS	260.4 cm 102.5 in	297.0 cm 117.0 in	132.0 cm 51.8 in	7030 kg 15,466 lbs	2155 kg 4,741 lbs
PRIMUS^{PLUS}	260.4 cm 102.5 in	310.0 cm 122.0 in	143.0 cm 56.5 in	7730 kg 17,000 lbs	2155 kg 4,741 lbs
Universal Base Frame	33.0 cm 13.0 in	339.1 cm 133.5 in	160.0 cm 63.0 in	592 kg 1,302 lbs	–

11 Standard Components

PRIMEVIEW 3*i*

The PRIMEVIEW 3*i* graphical user interface connects the PRIMUS with a flexible Oncology Information Management System.

An effective Oncology Workflow Solution™ for radiation therapy treatment delivery and recording, PRIMEVIEW 3*i* provides the following clinical advantages:

- Automatic portal image acquisition (Portal imaging system is optional)
- DICOM RT support – multi-segment fields and fractional MUs
- OPTIFOCUS and 3-D MLC support (MLC is optional)
- Single user interface for most clinical activities

For additional information, please refer to the PRIMEVIEW 3i Data Sheet.

12 Optional Components

1 Oncology Management System

The PRIMUS Linear Accelerator can be supplied with an information management system capable of record and/or verification, as well as database management. The LANTIS™ Oncology Management System is a complete Electronic Medical Record (EMR) and one of the most comprehensive Oncology Management Systems in the market.

LANTIS provides the most advanced tools to manage, track, and evaluate a patient through all stages of the therapy process. A variety of modules allows for customizing the LANTIS solution to meet the needs of the institution.

For additional information, please refer to the LANTIS Oncology Management System Data Sheet.

2 SIMTEC – Treatment Automation System

SIMTEC AFS enhances the productivity of the PRIMUS system in combination with VIRTUAL WEDGE™, MLC, the treatment table control, OPTIVUE™, and verification option.

The SIMTEC IM-MAXX and SIMTEC IM-MAXX 2 options provide an immediate delivery of IMRT segments, which enables PRIMUS to deliver IMRT quickly and efficiently.

3 Treatment Tables

The PRIMUS Linear Accelerator can be configured with either the 550 TxT™ Treatment Table or the ZXT™ Treatment Table.

The 550 TxT Treatment Table is engineered to meet increasing demands for accuracy, stability, and precision, and to fulfill the current and future clinical requirements of modern radiation oncology departments. Innovative features improve patient positioning to new standards while providing a unique lifting mechanism and exceptional mechanical strength that allow for a load capacity of 550 pounds (250 kg).

In addition, a newly designed user interface provides ergonomic controls with tactile feedback, allowing the user to control the treatment table with a choice of manual or motorized movements. Backlit buttons, easy-to-read LED displays, and integrated flashlight assist staff with their daily routines and patient positioning.

The ZXT Treatment Table has a load capacity between 300 and 410 pounds (136 to 186 kg), depending on the tabletop.

Parameter	550 TxT Treatment Table	ZXT Treatment Table
Fully motorized table motions	Yes	Yes
All motions are available simultaneously	Yes	Yes
Free-float tabletop motion capability	Yes	Yes
Programmable upward and downward motion stops help to position patient safely and minimize collisions	Yes	Yes
Absolute accuracy	Linear: ± 0.5 mm Angular: ± 0.5°	Linear: ± 2.0 mm Angular: ± 1.0°
Speed control	Long and Lat: 1.0 & 4.0 cm/s Vertical: 1.0 & 4.0 cm/s Isocentric: 1.0 & 4.0° /s	Long and Lat: 0.8 & 2.5 cm/s Vertical: 1.0 & 3.0 cm/s Isocentric: 0.5 & 3.0° /s
Range of motion	Vertical: 105 cm Lateral: ± 25 cm Longitudinal: 90 cm Isocentric rotation: ±120° Column rotation: ±180°	Vertical: 110 cm Lateral: ± 25 cm Longitudinal: 90 cm Isocentric rotation: ±120° Column rotation: ±180°
Readouts in standard or IEC convention	Yes	Yes
Absolute and delta motions	Yes	Yes

For additional information, please refer to the 550 TxT Treatment Table Data Sheet, as well as the ZXT Treatment Table Data Sheet.

4 OPTIVUE a-Si Flat Panel Positioning System

The OPTIVUE amorphous Silicon (a-Si) portal imager option is fully integrated within PRIMUS, the control console, and the in-room hand pendant.

For additional information, please refer to the OPTIVUE Data Sheet

	OPTIVUE 500	OPTIVUE 1000ST
Fully automated deployment/retraction	Yes	Yes
Collision detection system	Yes	Yes
Active imaging area (cm)	40 x 40	40 x 40
Resolution (pixel)	512 x 512	1024 x 1024
Pixel depth (bit)	16	16
Pixel pitch (mm)	0.8 (800 microns)	0.4 (400 microns)
Positional repeatability (mm)	±1.0	±1.0
Positional accuracy (mm)	± 2.0	± 2.0
Vertical travel range/SID (cm)	115.0 to 160.0	115.0 to 160.0
Imaging modes	Free running mode, single, or continuous scan mode	Free running mode, single, or continuous scan mode

5 MVision – Megavoltage Cone Beam Imaging

The MVision™ Megavoltage Cone Beam Imaging Package from Siemens is a volumetric in-line target imaging solution for advanced radiotherapy. Designed to be efficient and accurate, MVision represents a simple and cost-effective solution for Image-Guided Radiation Therapy (IGRT). The same megavoltage source is used for imaging and treatment, so maximum accessibility is maintained, as well as patient comfort. No additional calibrations or isocenter adjustments are needed, making patient repositioning versatile and efficient.

The PRIMUS operating in arc therapy mode, in combination with the OPTIVUE 1000ST a-Si flat panel, is employed to acquire images at different positions around the patient.

A large number of 2D projection images are then acquired with photons primarily in the mega-electron volt (MeV) energy range. A cone beam CT image is reconstructed from this set of open field projection images acquired at different angles.

	MVision
Distance source to detector (cm)	145
Angle covered (°)	200
Image acquisition	One projection per degree 270° to 110°
Gantry rotation orientation	Clockwise
Acquisition time	Depends on dose. For 10 MU: 45 sec.
Total dose	Adjustable, typically 5 MU for head & neck and 12 MU for pelvis
Positional accuracy (mm)	± 2.0

For additional information, please refer to the MVision Data Sheet.

6 OPTIFOCUS MLC and 3-D Multileaf Collimator

Built-in multileaf collimators for accurate and flexible beam shaping are available on PRIMUS. Customers have the choice between the OPTIFOCUS and the 3-D MLC. Both are fully integrated within PRIMUS and PRIMEVIEW 3*i*, as well as the control console and single in-room hand pendant.

For additional information, please refer to the 3-D MLC and OPTIFOCUS Data Sheet.

Parameter	OPTIFOCUS	3-D MLC
Field size (cm x cm)	40 x 40	40 x 40
Number of leaf pairs	41	29
Leaf size (cm)	1 (outer leaf pairs 0.5)	1 (outer leaf pairs 6.5)
Leaf transmission (%)	< 1%	< 1%
Leaf positioning accuracy (mm)	± 1	± 2
Penumbra (mm)	7 ± 2	7 ± 2
Over travel (cm)	10	10
Leaf speed (cm/sec)	2.0	2.0

7 Gated Therapy

The PRIMUS system is available with a Gated Therapy option. Gated Therapy allows the clinical user to choose the type of external control device to use with PRIMUS. Input signals from such a device can be the result of patient parameters such as chest movement, respiratory cycle, or a switching mechanism. A special Gated Therapy mode and user interface provide for a seamless delivery process.

Organ motion in the thorax and abdomen can present significant limitations during the entire RT process: imaging, planning, and delivery. During radiation delivery, respiratory motion causes a smearing of the dose distribution, resulting in a deviation between the intended dose and the dose actually delivered. The Gated Therapy option allows an external device, such as the ANZAI gating system, to control the radiation delivery functions of the PRIMUS Linear Accelerator during Gated Therapy treatments.

Gated Input Signal	
Maximum toggle frequency for gated input signal	1 Hz
Minimum pulse width (msec)	250

8 OPTIGARD – Collision Avoidance System

OPTIGARD™, the Siemens collision avoidance system, is a laser-based system that automatically detects impending collision in a defined detection zone around the accessory tray holder. Upon detection of impending collision, OPTIGARD provides a signal to the linear accelerator and triggers an interlock.

9 ModuLeaf mMLC

Siemens offers a unique add-on MLC, the ModuLeaf™, for small-field IMRT and stereotactic applications. Its resolution, transmission values, and field size provide the customer with a flexible tool for a large variety of clinical applications.

Parameter	ModuLeaf
Field size (cm x cm)	10 x 12
Number of leaf pairs	40
Leaf size (cm)	0.25
Leaf transmission (%)	< 2%
Leaf positioning accuracy (mm)	± 0.5
Penumbra (mm)	< 4 (5 cm x 5 cm field)
Over travel (cm)	5.6
Leaf speed (cm/sec)	2.0

For additional information, please refer to the ModuLeaf Data Sheet.

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