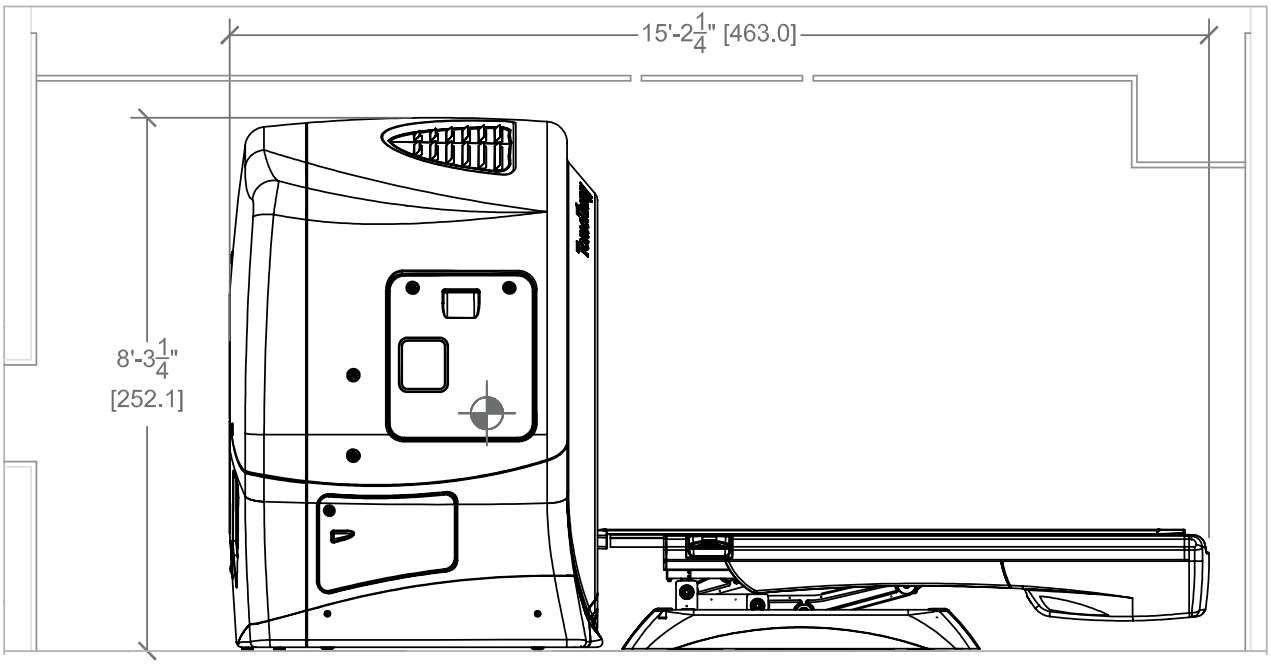
TomoTherapy®
ACCURAY®

TOMOHD™ TREATMENT SYSTEM

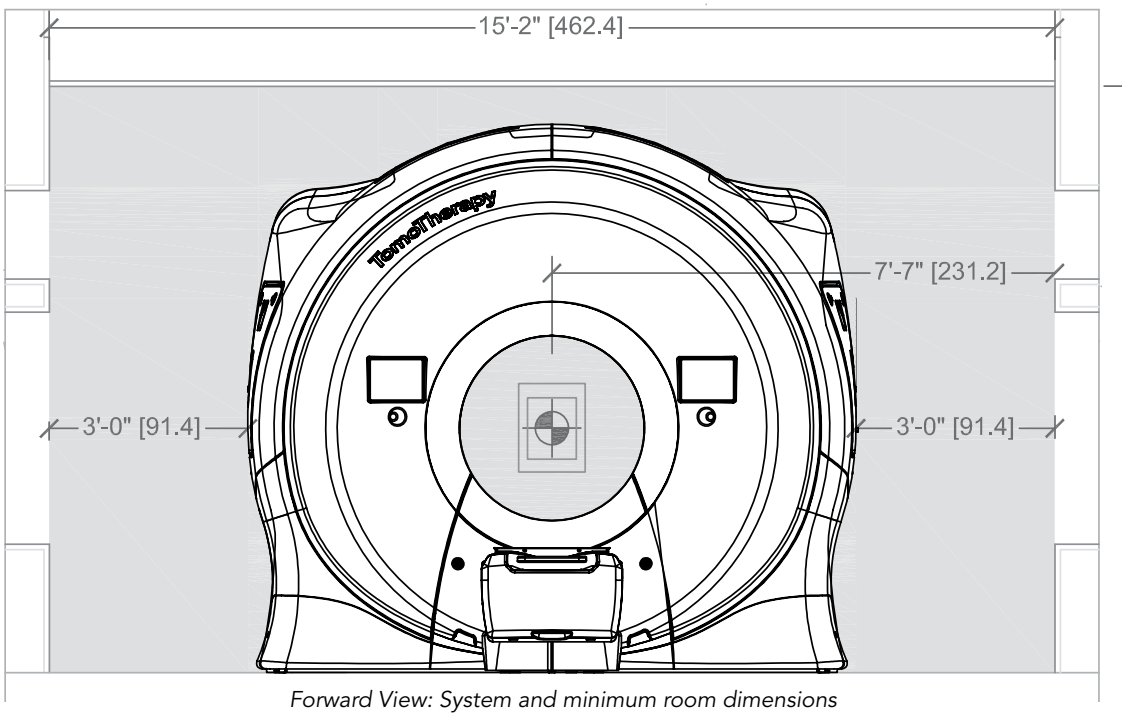
Product Specifications

1. Complete Treatment System

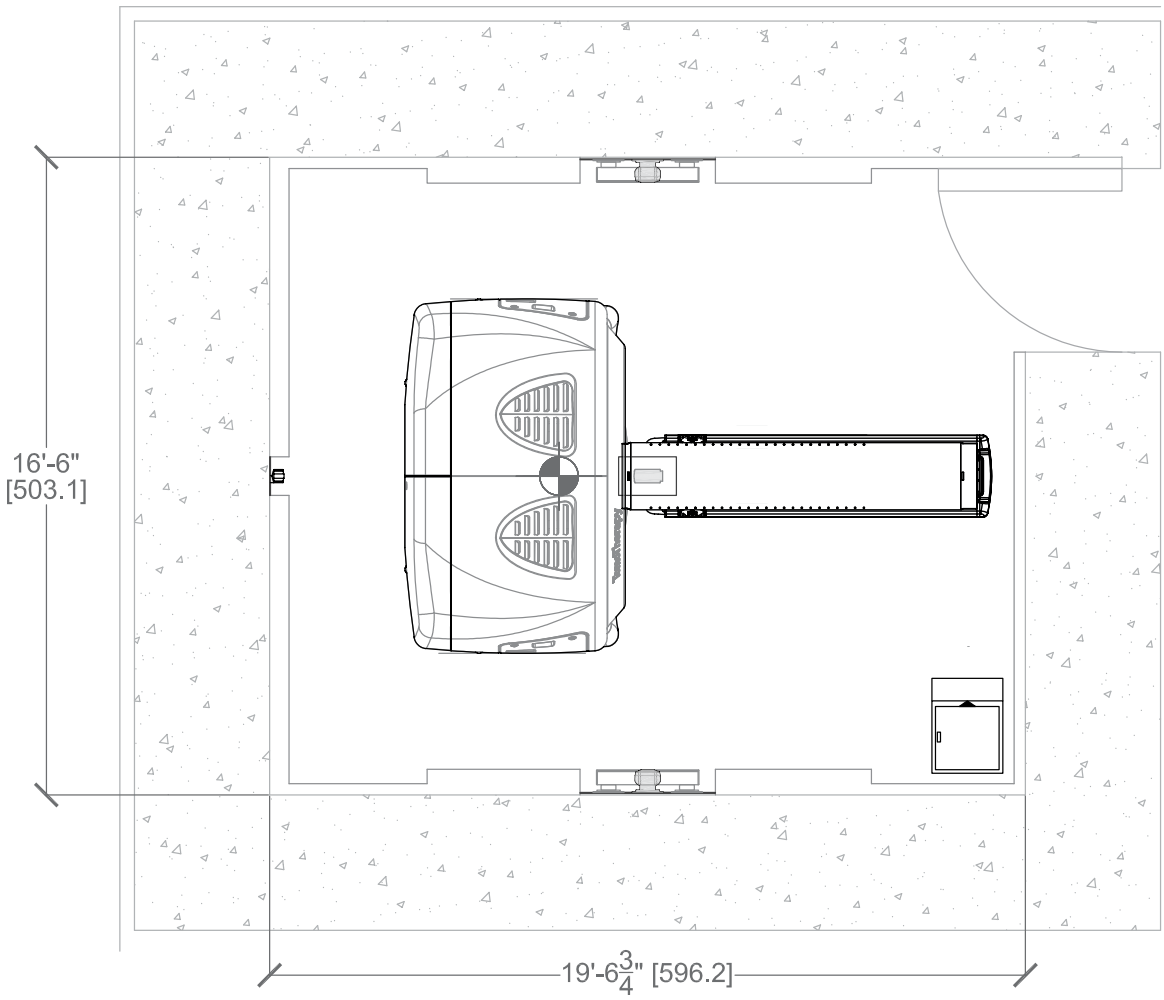
Dimensions	
• Height	8 ft., 3.25 in. (252.1 cm)
• Width	9 ft., 2.50 in. (280.6 cm)
• Length	15 ft., 2.25 in. (463.0 cm)
• Weight	10,000 lbs. (4,536 kg)



Lateral View: System and minimum room dimensions



Forward View: System and minimum room dimensions



Top View: System and minimum room dimensions

2. Installation

Minimum room size - requirements	
• Height	8 ft., 10.13 in. (269.6 cm)
• Width	15 ft., 2.00 in. (462.4 cm)
• Length	19 ft., 6.75 in. (596.2 cm)
Typical schedule (receipt of system to first treatment)	30 days, although completion has been achieved within two weeks
Commissioning	Integrated system completely pre-commissioned in the factory and re-verified at customer site

3. Treatment Vault Environment

SPECIFICATION	REQUIREMENTS
Line voltage, VAC	480 volts, 3-phase; others may be supported
Ambient room temperature	68 - 75 degrees Fahrenheit (20 - 24 degrees Celsius)
Relative humidity	30% - 60%, noncondensing

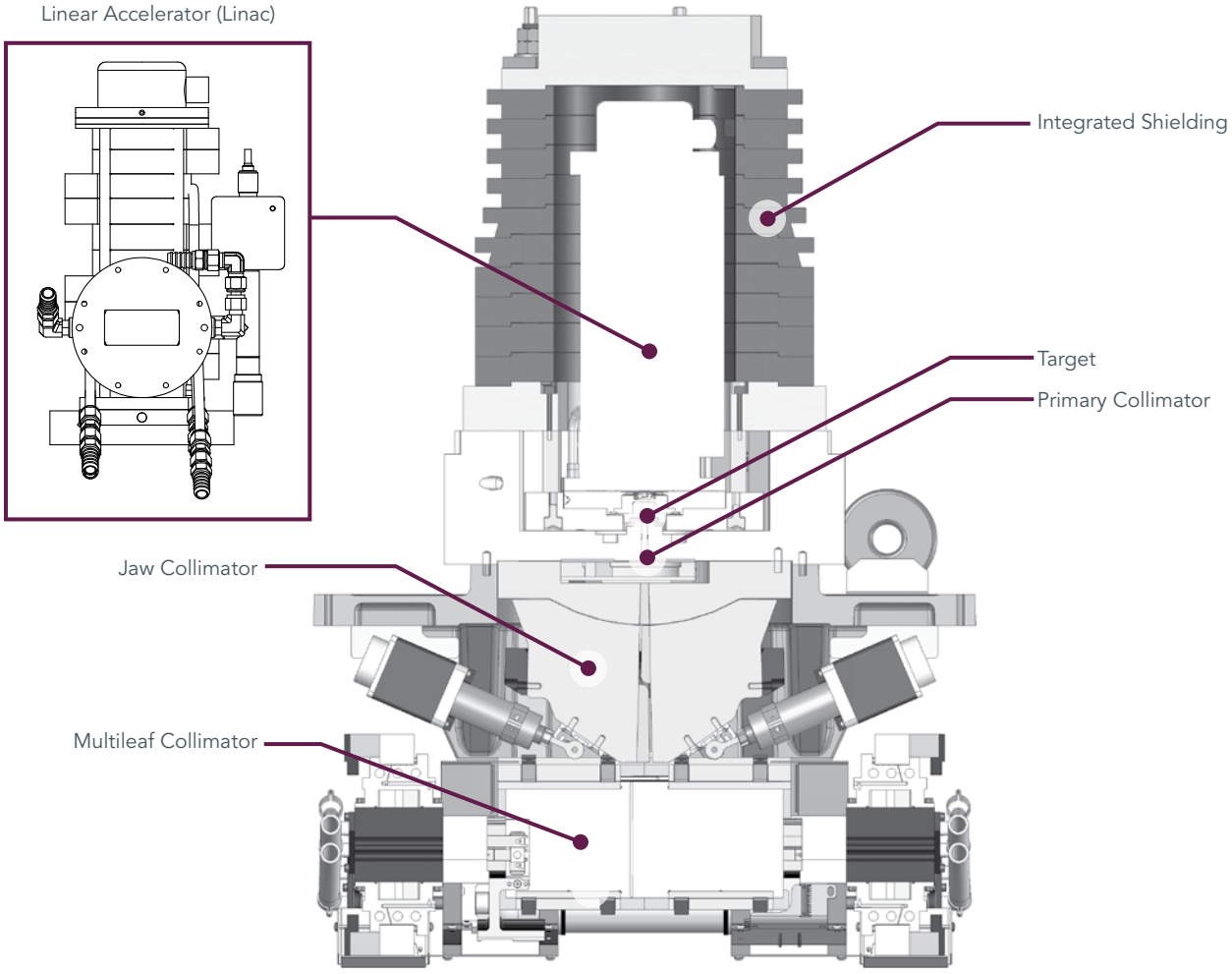
4. Mechanical Features

SPECIFICATION	PERFORMANCE
Gantry	
• Degrees of rotation	Rotates around IEC-y axis, continuous rotation
• Direction of rotation	Clockwise viewed from the foot of the couch
• Rotational angle accuracy	Within 0.5 degrees
• Speed of rotation	Varies; dependent upon plan
• Controls	Rotational speed set during treatment planning
• Source to axis distance	85 cm
• Mechanical to radiation isocenter offset	Included in beam model (within accuracy 0.25 mm)
• Mechanical isocenter stability	< 0.4 mm
• Position indicators	5-axis laser system
• Isocenter height	113 cm typical (dependent upon finished flooring)
• Cooling	Integrated onboard cooling system eliminates need for facility-chilled water loop

5. Photon Beam

SPECIFICATION	PERFORMANCE
Accelerator type	Standing Wave
• Length	0.3 meters
Microwave	
• Power	2.5 MW
• Source	Magnetron
Nominal dose rate at Dmax**	850 cGy/min
Nominal Dmax**	1.5 cm
Percentage depth dose at 10 cm**	Typical 61.4%
Number of beamlets	Plan dependent; system capable of efficiently delivering tens of thousands of beamlets which allows for very high fidelity intensity modulation
Nominal energy	6 MV, single energy
Nominal spot size	2 mm
Penumbra of treatment beam - IEC-y axis	The 80% - 20% penumbra widths are approximately 4.9 mm, 4.6 mm, and 4.1 mm (respectively for the 5.0 cm, 2.5 cm, and 1.0 cm field widths).
Field size range at isocenter	Selectable 1.0 cm x 0.625 cm to 1.0 cm x 40 cm 2.5 cm x 0.625 cm to 2.5 cm x 40 cm 5.0 cm x 0.625 cm to 5.0 cm x 40 cm
Maximum radiation field length	150 cm with Couch at height of isocenter plane
Treatment volume - TomoHelical™	80 cm (transverse diameter) x 135 cm (longitudinal) for typical patient set-up; Actual treatment volume length is variable depending upon couch height; Note: Region of treatment used is determined by the planning CT image field of view (FOV) Provided the FOV is 80 cm or less and all patient anatomy is present in the planning image, the *TomoHD* system can import the image, plan, and treat.
Treatment volume - TomoDirect™	40 cm (transverse diameter) x 135 cm (longitudinal) for typical patient set-up; Actual treatment volume length is variable depending upon couch height.

** Performance based on 5 cm field size at SSD=85 cm.



Accelerator and collimator subsystems

Average MLC leakage	0.25% (typical)
Primary collimation	Tungsten block with rectangular, fixed aperture
Jaw collimation	
• Travel range	1.0 cm - 5.0 cm treatment field width at isocenter
• Axis of travel	IEC-y
• Speed of travel	Selectable fixed primary collimation widths set at the start of a given treatment
• Basic dimensional description	13.5 cm tungsten thickness
Multileaf collimation	
• Number of leaves	64 binary interlaced leaves (tongue and groove side profile)
• Basic dimensional description	10 cm leaf thickness in beam direction
• Mode of operation	Binary leaves either fully in or fully out of beam path
• Axis of travel	1 axis, longitudinal direction (IEC-y)
• Speed of travel	Binary leaf state changed within 20 msec
• Resolution	0.625 cm leaf widths in IEC-x direction at isocenter
• Leaf drive mechanism	Pneumatic
• Position indicator	Continuous monitoring with interlock, checks that leaves open and close at correct time

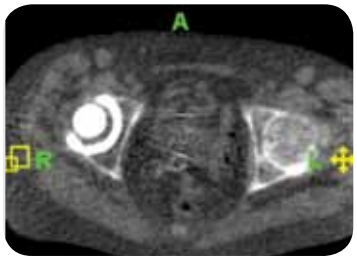
6. Dosimetry

SPECIFICATION	PERFORMANCE
Chamber type	Full beam transmission, hermetically sealed dual chamber
Precision	Within 1%
Linearity	Within 1%
Variation of dose rate vs. gantry angle	Within 2%
Beam-off interlocks	Radiation System; Dose Monitoring, Patient Table Position; Gantry Angle; Computer Communications; Vault Door; Facility E-stops

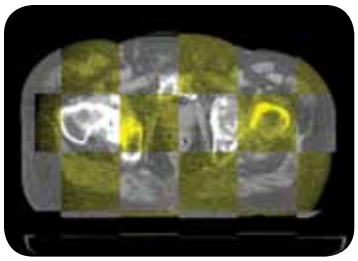
7. CTrue™ Imaging

SPECIFICATION	PERFORMANCE
Geometry	Fan-beam
Dose per MVCT image (typical)	0.5 - 3 cGy depending on resolution and body thickness
Detector configuration	528 channels, single-row xenon ion chamber array used for image acquisition
Image resolution (xy)	512 x 512 (0.78 mm pixels)
Slice spacing available	2 mm, 4 mm, 6 mm
Scan time	Typically 2 minutes per 10 cm length at 4 mm slice spacing
Field of view (FOV)	40 cm diameter
Source to detector distance	145 cm
Isocenter to detector distance	60 cm
Image noise	2% - 4%
Image uniformity	Within 2.5%
Spatial resolution	Nominal 0.5 lp/mm at 10% MTF
Contrast resolution	2% density for 2 cm object (typical)
Image reconstruction algorithm	Filtered backprojection
Image reconstruction time	Real-time; slice-by-slice at time of acquisition
Image registration tools	MVCT/kVCT image overlay with adjustable checkerboard; manual or automatic registration (maximization of mutual information) using bone and/or soft tissue; translations and pitch/roll/yaw determination
Application of adjustments obtained via image registration	Translations applied via couch, roll applied via gantry
Frequency of correction for geometry flexion	None required; rigid ring gantry platform
Image guidance mode	Daily 3D MVCT matched with 3D kVCT

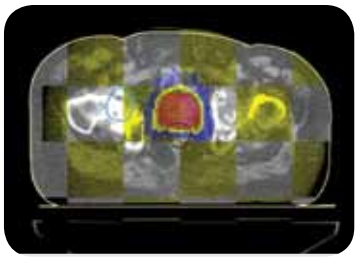
Prostate visibility



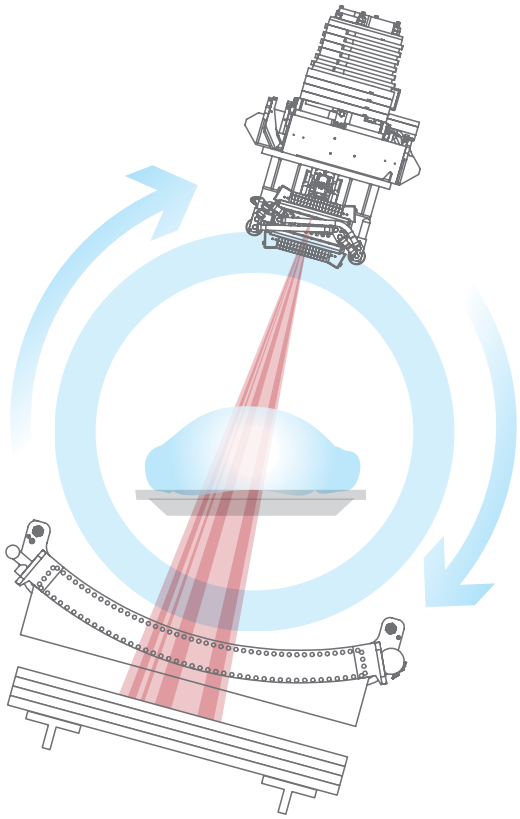
No high-Z artifact



Multi-planar image overlay



Overlay images, structures, dose



Common imaging and treatment subsystem

8. Safety Features

Integrated treatment planning: Planning and treatment systems use a common database

Integrated quality assurance: Patient-specific QA via a dedicated application on the planning station

Integrated R&V: Built-in record and verify in addition to DICOM compliant MOSAIQ™ and Aria™ interfaces

Single database: Common database for planning, imaging and treatment data

No plan data transfer: Planning data retrieved by treatment system from common database

Common imaging and treatment beam source: Imaging geometry consistent with treatment geometry (imaging and treatment source are the same), thus avoiding the need for repeated geometric calibration of 2 different sources

Fully enclosed gantry: Integrated gantry enclosures protecting the patient from beam delivery system components

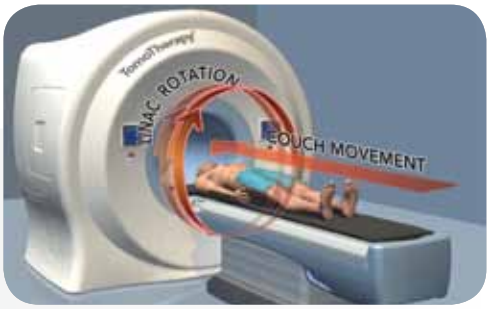
No auxiliary beam collimation: Integrated binary MLC provides all beam collimation and modulation, removing the possibility of incorrect component installation and maintaining maximum physical patient clearance; also reduces handling of hazardous material

No bending magnet: No beam bending required, therefore eliminating the possibility of geometry errors resulting from redirection of the beam

No electron mode: The treatment system cannot be set to an unintended mode of delivery (note that helical IMRT with 6 MV x-rays can be planned to deliver treatments similar to electron mode treatments)

Full system integration: Level of system integration results in software for all components being designed and tested in unison, reducing concerns of disparate system interfaces and compatibility concerns across products and across companies

9. TomoHelical™ Treatment Delivery Mode



The gantry rotates around the patient in TomoHelical *delivery mode, delivering radiation in a continuous spiral pattern*

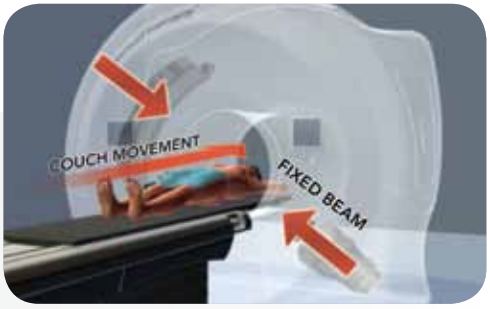
The *TomoHelical* delivery mode provides IMRT and 3D CRT treatment delivery in a continuous (360°) helical pattern, using thousands of narrow beamlets, which are individually optimized to target the tumor. The *TomoHelical* mode maximizes conformality and uniformity of dose to the tumor while minimizing exposure to healthy tissue.

The user is able to create a treatment plan that defines dose goals and constraints for target and avoidance structures, the level of modulation for the plan, as well as the fractionation schedule.

During treatment delivery, the linear accelerator completes multiple 360° rotations around the patient while the couch passes through the bore of the system, initiated by a single turn of the operator console key.

Targets of up to 135 cm in length* can be treated, with no need to reposition the patient and with no field junctioning.

10. TomoDirect™ Treatment Delivery Mode



2 – 12 discrete gantry angles can be used in TomoDirect *delivery mode*

The *TomoDirect* delivery mode is a discrete angle, non-rotational delivery mode.

TomoDirect allows creation of treatment plans that include between 2 and 12 target-specific gantry angles. It also allows the user to define the level of modulation for the plan, including a 3D delivery mode. Treatment planning is completed rapidly due to the power of the system's computing platform.

During treatment delivery, all beams for each target are delivered sequentially with the couch passing through the bore of the system at an appropriate speed for each gantry angle. The complete treatment delivery is initiated by a single turn of the operator console key.

Targets of up to 135 cm in length* can be treated, with no need to reposition the patient and with no field junctioning.

11. High Performance Couch

The High Performance Couch, with Medical Intelligence indexing system, provides sub-millimeter accuracy and precision in point-to-point and translational positioning.

Clinical workflow is enhanced with ergonomically designed dual Couch Control Keypads mounted to each side of the couch. The Couch Control Keypads allow motorized patient position modification in the X, Y and Z directions with simple, single-handed operation.

The custom patient couch has a high strength carbon-fiber top with an indexing system designed to accommodate immobilization systems from multiple vendors.

See High Performance Couch brochure for additional specification information.

12. Laser Positioning System

The *TomoHD* system configuration includes stationary green lasers for virtual isocenter and moveable red lasers for patient positioning and registration.

* Typical patient set-up; Actual treatment volume lengths are variable depending upon couch height.

13. Computing Hardware

Includes the following items, housed in a rack enclosure (dimensions: 78”/198 cm H x 26”/66 cm W x 38”/97 cm D):

- The High Performance Optimization Cluster, which comprises a Blade Server chassis plus 14 server blades (used for treatment plan optimization and dose calculation);
- The Data Server and Storage Area Network (SAN), which stores data required to run the treatment system and deliver prescribed treatments to the patient. It also stores patient planning information (CT images, contours, dose volumes, and plans). The Data server is connected to the Optimization Server, Planning Stations, Operator Station and the Treatment Delivery System;
- The TomoGateway™ system hardware enables remote system diagnostics and monitoring by TomoTherapy Technical Support (note: additional software may be required which must be purchased separately);
- Tape drive system for database backup;
- KVM and LCD display for administration of the Optimizer/Data Server assembly;
- Uninterruptible Power Supplies (UPS) to support the complete Optimizer/Data Server assembly;
- Network switch and firewalls.

14. Planning Stations

Two TomoTherapy® Planning Stations allow the definition and management of treatment plans and initiation of plan optimization. Delivery Quality Assurance (DQA) tools are also integrated into the Planning Station software. The Planning Stations further include the Data Management System application software, for archiving and management of patient data. Each Planning Station is provided with a color printer capable of printing treatment plans. An Uninterruptible Power Supply, high-resolution LCD monitor, keyboard, mouse, and required cables are included with each Planning Station.

An optional third Planning Station is available for purchase.

15. Operator Station

One TomoTherapy® Operator Station, which connects to the *TomoHD* treatment system database and provides control of CTrue™ MVCT imaging, patient treatment and quality assurance delivery, and basic record & verify functionality.

The Operator Station is provided with a color printer capable of printing *CTrue* images and treatment data, plus an LCD monitor, keyboard, mouse, and required cables.

16. TomoPortal™ Remote Viewer

The TomoPortal™ Remote Viewer securely and easily provides a web-enabled link to patient information stored in the *TomoHD* treatment system. It is possible to review plan, registration and treatment data from down the hall or across a continent. Price includes server hardware and software required to run up to 2 concurrent system users.

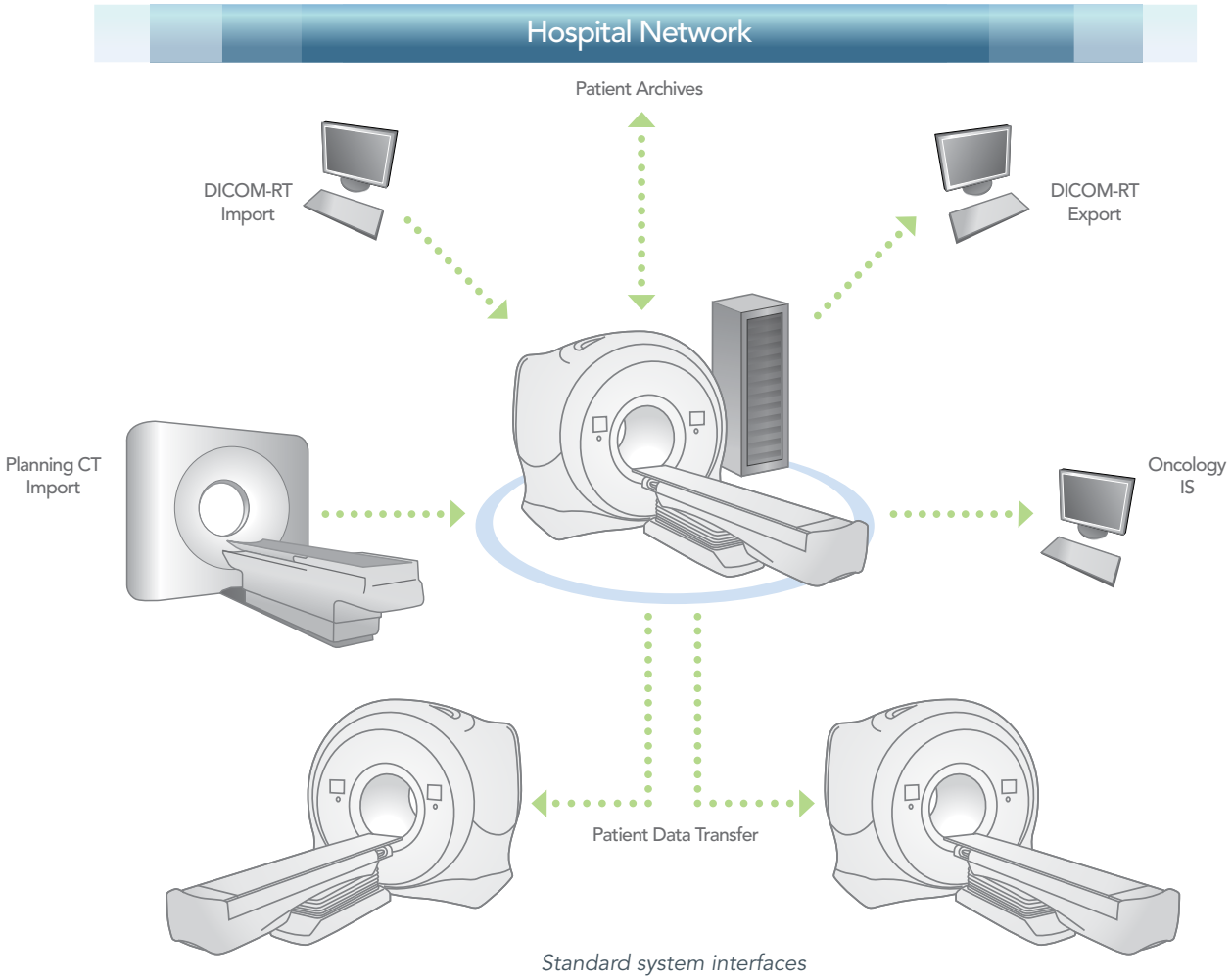
Options to purchase up to six additional* TomoPortal *Remote Viewer licenses are available.

17. Standard System Interfaces

OIS Connect™ Software

The *OIS Connect* software provides the ability to interface a *TomoHD* treatment system to a compatible Oncology Information System (OIS). The software facilitates greater integration of the *TomoHD* treatment system into the radiation oncology department, by:

- Allowing scheduling of TomoTherapy℠ treatments on the OIS;
- Providing automatic capture of *TomoTherapy* procedures on the OIS;
- Aiding in charge capture and billing (where applicable);
- Aiding in integrating *TomoTherapy* treatments into patients’ electronic medical records, via the OIS.



Standard system interfaces

The *OIS Connect* software is based on DICOM-RT Worklist communication, as specified in DICOM Supplements 74 and 96.

DICOM Export

The DICOM Export Data Services Package allows the following DICOM objects to be sent from the *TomoHD* treatment system to third-party systems and clinical/research databases:

- DICOM-CT Image Set
- DICOM-RT Structure Set
- DICOM-RT Dose
- DICOM-RT Plan

Network Data Storage

This feature allows patient archives created on the *TomoHD* treatment system to be sent to, or retrieved from, a storage location outside of the treatment system network.

Network Data Storage provides configuration of the system firewall, workstation configuration and FTP system set up for data transfer via network.

Patient Data Transfer

Patient Data Transfer allows the transfer of patient data from the *TomoHD* treatment system upon which it is installed, to another *TomoTherapy* treatment system.

Patient Data Transfer provides configuration of the system firewall, workstation configuration and FTP system set up for data transfer via network, and an external USB hard drive for physical data transfer.

18. Quality Assurance

QA Package (Plan quality assurance)

The standard QA package includes quality monitoring and performance testing phantoms. Components include the following:

- One Slit Beam Virtual Water;
- One TomoTherapy® Phantom & Holder ("Cheese Phantom") with Density Plug Set;
  12 density plugs are included, representing the following materials: LN-300 Lung, LN-450 Lung, Adipose, Breast BR12, Brain, CT Solid Water, Liver, B200 Bone Mineral, CB2-30% CaCO3, CB2-50% CaCO3, Cortical Bone and Inner Bone;
- Two Calibrated Mini Ion Chambers, and approximately 59' (18 m) Interconnect Cables;
- One Calibrated CT Slice Ion Chamber, Buildup Cap and Jig.

Tomo® Quality Assurance (TQA™) Total Package (Machine quality assurance)

The *TQA* application is a calendar-based productivity tool that simplifies the collection and analysis of machine performance data for the *TomoHD* treatment system.

The application leverages internally-generated data to provide results quickly and easily. The *TQA* application offers trending and reporting of many system and dosimetric parameters that allow physicists to monitor the performance of the *TomoHD* system. All data may be exported.

The Total Package includes the base *TQA* package, Enhanced Dosimetry package, Longitudinal Beam Profile package, and the LINAC Alignment package, plus the *TQA* Step-Wedge Phantom.

See TQA brochure for more information.

19. Installation Services

Includes:

- Pre-installation Site Planning and Project Management services;
- Installation and commissioning;
- Completion of Acceptance Test Procedure (ATP) and system handover.

20. Partner Marketing Portal

The Partner Marketing Portal web site is offered as an online resource to assist TomoTherapy customers in promoting their investment in cancer care. Marketing resources available via the site include:

- Printed patient and referring physician materials available for order;
- Full image library, including product and patient photography;
- Embeddable animations and video for treatment centers' websites;
- Customizable TomoTherapy-focused TV spots;
- Suggested press release template for technology introduction.

Register for access at TomoTherapy.com/marketing

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