English

Instructions for Use

Incisive CT

459801855453_A

PHILIPS

Revision History

Revision	Date	Reason for Change
459801855451_A	2020/08	Initial release
459801855451_B	2020/12	Update Information
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459801855452_A	2021/8	Update Information
459801855453_A	2021/11	Update Information

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1 Introduction

Philips CT systems are advanced continuous-rotation computed tomography systems suitable for a wide range of computed tomographic (CT) applications.

The CT system is used clinically as a diagnostic patient imaging device that produces images that correspond to tissue density. The quality of the images depends on the level and amount of X-ray energy delivered to the tissue. CT imaging displays high density tissues such as bone and soft tissue, and low density material such as air. When interpreted by a trained physician, CT images yield useful diagnostic information. The system is intended for use in the head and whole body.

Use and operation of this equipment is subject to the law in the jurisdiction(s) in which the equipment is being used. Both users and operators must only use and operate the equipment in such ways as do not conflict with applicable laws, or regulations which have the force of law.

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Caution

In the United States, Federal law restricts this device to sale, distribution, and use by or on the order of a physician.

Note

Equipment described in this manual is designed to be compatible with Philips products. It is designed to operate according to recognized and accepted compatibility standards. The equipment produces images, which may be transferred by the user to other Philips workstations by a network or other means. When doing so, the user or manufacturer of that workstation has the responsibility to validate that images are correctly transferred and displayed under all conditions of use. Use of incompatible equipment may result in the incorrect transfer, display, or other processing of the data.

1.1 About this guide

This manual is intended to assist users and operators in the safe and effective operation of the equipment described. It covers the information needed for your CT scanner.

- The “user” is considered the body with authority over the equipment.
- The “operators” are those persons who actually handle the equipment.

Before attempting to operate the equipment, you must read, note, and strictly observe all **DANGER** notices and safety markings on the CT System.

Before attempting to operate the equipment, you must read this manual thoroughly, paying particular attention to all **Warnings**, **Cautions** and **Notes** incorporated in it. You must pay special attention to all the information given and procedures described in the **SAFETY** section.

Warning

Directions, which if not followed, could cause fatal or serious injury to an operator, patient or any other person, or could lead to a misdiagnosis or mistreatment.

Caution

Directions, which if not followed, could cause damage to the equipment described in this Instructions for Use and/or any other equipment or goods, and/or cause environmental pollution.

Note

Highlight unusual points as an aid to an operator.

Within this **Instructions for Use**, the most extensive configuration of the system is described, with the maximum number of options and accessories. Not every function described may be available on your system.

This **Instructions for Use** was original in the English language under the product part code 459801855453.

1.2 Intended Purpose

Computed Tomography X-Ray System is intended to produce images of the head and body by computer reconstruction of X-Ray transmission data taken at different angles and planes. This device includes data acquisition system, detection management system and an operating

console with display monitors along with patient and system supporting devices, accessories and components.

1.3 Indications for use

The Incisive CT is a Computed Tomography X-Ray System intended to produce images of the head and body by computer reconstruction of X-Ray transmission data taken at different angles and planes. These devices may include signal analysis and display equipment, patient and equipment supports, components and accessories. The Incisive CT is indicated for head, whole body, cardiac and vascular X-ray Computed Tomography applications in patients of all ages.

These scanners are intended to be used for diagnostic imaging and for low dose CT lung cancer screening for the early detection of lung nodules that may represent cancer*. The screening must be performed within the established inclusion criteria of programs / protocols that have been approved and published by either a governmental body or professional medical society.

*Please refer to clinical literature, including the results of the National Lung Screening Trial (N Engl J Med 2011; 365:395-409) and subsequent literature, for further information.

1.4 Target population

The patient age may range from a newborn to an elderly patient. The patient may be conscious, unconscious, or sedated. In addition to external medical devices, the patient may have internal medical devices (e.g. pacemaker, orthopedic implants). The scan either may be scheduled or unscheduled (e.g. trauma). The patient generally does not interact with the system.

Radiation exposure is a concern in people of all ages; however, pediatric patients are more sensitive to radiation exposure because they have more rapidly dividing cells than adults. The younger the patient, the more sensitive they are to the detrimental effects of radiation exposure. In order to get vital diagnostic information for the patient this concern has to be weighed against medical necessity.

1.5 Clinical benefits

The Computed Tomography X-Ray System is intended to produce cross-sectional images of the body by computer reconstruction of X-ray transmission data taken at different angles and planes. This device may include signal analysis and display equipment, patient and equipment supports, component parts, and accessories.

The main clinical benefits of CT include:

- The ability to view single and/or progressive cross-sectional images of the body.
- Images and measurements of physical/physiological parameters obtained by a CT scan may, when interpreted by a trained physician, provide information that may assist patient diagnosis and therapy planning.
- Images can be obtained in multiple planes without repositioning the patient.
- Three-dimensional representations of anatomical structures can be obtained.
- Visual feedback can be obtained during interventional procedures.

1.6 Contraindications

No absolute contraindications are given for Computed Tomography. Due to nature of X ray procedures, the patient is exposed to radiation and adverse health effects exist and are well known. Therefore the responsible radiologist must assess risk and benefits and identify relative contraindications, depending for example on available alternative diagnostic technologies.

Special precautions must be taken and/or caution must be exercised in the following cases:

- Protection of embryo or fetus during computed tomography examination or treatment of woman known to be or possibly pregnant.
- Sensitive organs (for example, lens of eye, gonads) must be shielded whenever they are likely to be exposed to, or be in close proximity to the planned scan area. This is because stray radiation can also be harmful.
- Acute skin burns (patients)
- Acute hair loss (patients)

- Occupational Radiation exposure (staff).

1.7 Undesirable side-effects

Undesirable side-effects are form of harm that may affect any person near or in the device, due to a natural reaction arising from exposure to a device, during normal conditions of use, caused by factors other than failure of control.

Undesirable side-effects identified are as follows:

1 Radiation effects.

*Radiation exposure used for image creation. This type of ionizing radiation is essential for acquisition of an X-ray image suitable for clinically relevant diagnostic interpretation. The effects of this type of harm may manifest over an extended period of time (long-term effect of radiation exposure).

2 Emotional Trauma/Anxiety.

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1.8 Intended user

Philips CT scanners may be used by a trained healthcare professional as a diagnostic tool for the visualization and analysis of anatomical and pathological structures.

The intended user has the authority over the equipment and must ensure that the operator is qualified. A qualified operator is a person who has (a) received the education and official accreditation or certificate by local authorities and any other applicable governing authority to operate X-ray emitting devices on humans in general and computed tomography (CT) systems specifically; and (b) received training from the CT system manufacturer in operating the specific CT system/s that the person will be operating.

1.9 Training

Reference IEC 60601-1 Clause 7.9.1.

A qualified operator is a person who has (a) received the education and official accreditation or certificate required by local authorities and any

other applicable governing authority to operate X-ray emitting devices on humans in general and computed tomography (CT) systems specifically; and (b) received training from the CT system manufacturer in operating the specific CT system/s that the person will be operating.

Warning

Untrained or improperly trained operator can misuse the equipment and cause injury to people or equipment damage.

Operators of the CT system must have received adequate training on its safe and effective use before attempting to operate the equipment described in this Instructions for Use. Users must also ensure that operators receive adequate training in accordance with local laws or regulations which have the force of law.

If you require further information about training in the use of this equipment, please contact your local Philips Healthcare representative. Alternatively, contact:

Philips Medical Systems, Nederland B.V.
Veenpluis 6
5684 PC Best
The Netherlands

2 System description

2.1 Overview

Reference IEC 60601-2-44 Clause 201.7.9.3.1.

The CT system is an advanced continuous-rotation tomographic system that consists of these components:

- Operating Station
- CTBOX
- Gantry
- Patient Table

Caution

Never interrupt the electric current to the computer when it is on. Doing so could cause damage to the computing system or to the software.
The following is recommended to keep your system running efficiently:

- **Each day, make sure that all transfers are complete in the Job Manager.**
- **Routinely transfer image sets to avoid large data transfers to PACS, Workspace, CD, and DVD.**
- **Maintain the local disk at or below 75% capacity.**
- **After finishing use of an application, close or exit the application.**
- **Perform a host computer restart daily. Do a complete system shutdown and restart at least once a week. See System operation, on page 3-1.**

2.1.1 Computer hardware and IT network characteristics

Reference IEC 60601-1 Clause 7.9.2.5.

The system computer needs at least:

- Two CPUs, each CPU shall provide same or greater performance than Intel Silver 4114.
- A minimum of 64 GB system RAM.
- Operating System: A minimum of 2TB unformatted capacity.
- Application Data: A drive or array needs to be provided for application data with a single volume of a minimum capacity of 1TB raw data.

- The application data volume needs to be capable of 625 MB/s sequential write speed, while simultaneously performing a sequential read at the same speed.
- Two 10Mbps/100Mbps/1Gbps compatible Ethernet interface at the rear side.

If the Precise Image feature needs to be run, the system computer needs at least two CPUs, each CPU shall provide same or greater performance than Intel Gold 6230.

2.2 Operating station

The operating station is used to operate and monitor the scans being performed. It consists of the following components:

- Computing system
- CTBOX
- Monitor
- Keyboard and mouse
- Patient intercom

2.2.1 Monitor

A flat screen monitor displays images and the operating system. The power indicator LED lights when you turn on the monitor.

Warning

To maintain optimal adjustment and correlation with the filmed images, do not change the settings of the monitor.

Double click the **Incisive CT** icon on your monitor desktop to access the system software.

2.2.2 Patient intercom

The patient intercom is a system which allows you to communicate with the patient during a scan procedure. The patient portion of this system consists of a speaker and a microphone. The user portion of the system consists of a speaker and a microphone on the CTBOX.

Note

- **Using intermediate levels of intercom is recommended.**
- **Devices that produce a large amount of noise (e.g. AC, fans and other electronic devices) should be placed away from the table to reduce the noise in intercom.**

Recorder microphone

A recorder microphone is included with your system. This microphone is used to record messages that can be used during the scan process.

2.2.3 Data storage

These options are available for storing data:

- internal hard disk
- internal CD/DVD writer

Internal hard disk

The internal hard disk is used to store images, the operating system, raw files and calibration data.

Internal CD/DVD writer

The internal CD/DVD writer is a CD/DVD drive that stores DICOM images along with the necessary viewing software on a CD/DVD. It provides an alternative for archiving images or transferring patient images to referring physicians.

See **Copying studies**, on page 5-14 for more information.

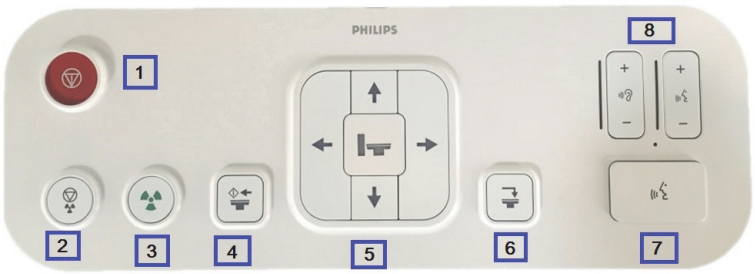
You can use the following types of discs on your system:

- DVD-R
- DVD-RW
- DVD+R
- DVD+RW
- CD-R
- CD-RW

2.3 CTBOX

Reference IEC 60601-2-44 Clause 203.107c and 203.5.2.4.1.

Once the scanning process has been initialized via the on-screen scan toolbox, you can control the remainder of the process using the CTBOX:



1 **Emergency Stop** button stops gantry motions, table motions and X-ray generation in the event of an emergency.

2 **Stop** button stops a scan. **Stop** button can terminate the exposure at any time during a scan, or series of scans.

Warning

Press Stop button to stop the scan sequence at any time.

3 **Scan** button for starting a scan.

Additionally, the control screen displays the X-ray indicator during X-ray production.

4 **Enable** button moves the table into the planned Start position.

5 **Table in/out, up/down** buttons move the Patient table in the respective directions (as applicable to your system).

You can find the position of gantry and table at the bottom of **Patient** interface.

6 **Patient release** moves the patient table (out and down) to position for easiest patient release at the end of the scanning procedure. The patient table moves to its maximum distance from the gantry and lowers to its minimal height. When the button is released before completing the process, all motion stops.

7 **Microphone/Microphone on** button allows you to speak to the patient.

8 **Volume control dials** set volume for the console and gantry speakers.

Note

- **Contact Philips service for repair if any of the LEDs for the enable buttons on the gantry control panel go out. The scanner can still be operated in this condition.**

Warning

- **Observe the condition of the patient when operating the CTBOX.**
- **Improper operation of the CTBox and gantry panel can cause people injury.**

2.4 Gantry

The gantry provides the support and means for rotating the X-ray tube, beam elements, detectors, and front end electronics (FEE). The gantry aperture is 72±1 cm. It supports frontal and lateral views of Surview scans. The OnPlan controls are used to activate the laser marker, control patient table movements and tilt the gantry. Maximum mechanical tilt of the gantry is ±30°. Scannable range is from -24° to 30° for standard table, -18° to 14.5° for bariatric table.

Available Gantry Rotation Speeds	0.35s/r±5%
	0.4s/r±5%
	0.5s/r±5%
	0.75s/r±5%
	1.0s/r±5%
	1.5s/r±5%

See **Emergency Procedure** in **Technical Reference Guide** for description of emergency procedures.

2.4.1 Gantry Ribbon Light

The incisive CT gantry ribbon light changes according to the system condition.

- When the system is standby, or **Start Exam** is clicked, ribbon light turns to white.

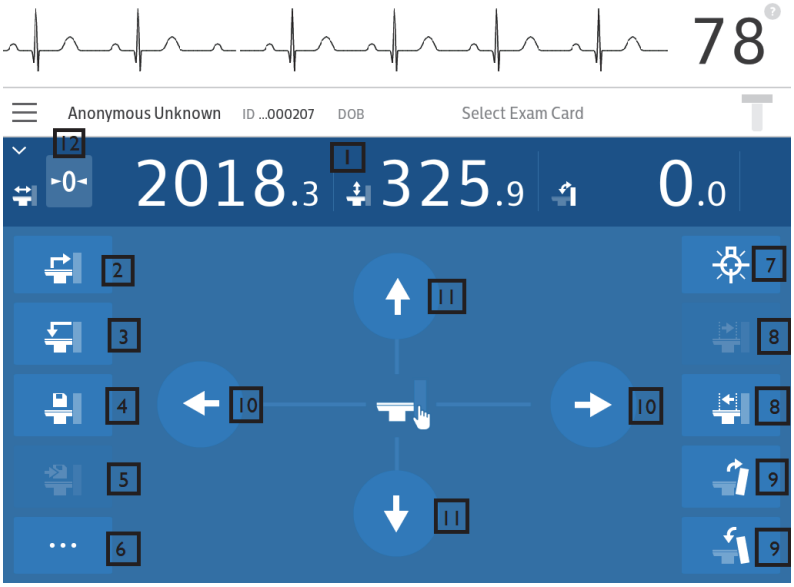
- When the series has low dose scan iterative reconstruction technology such as iDose, after clicking **Go** and before clicking **Scan** on CTBox, ribbon light turns to green.
- When it is scanning, ribbon light turns to yellow.
- When **End Exam** is clicked, ribbon light is off.

2.4.2 OnPlan

OnPlan is a brand new gantry operation panel on Incisive CT and is located on both sides of the gantry.

Control patient table and gantry

The panels control patient table and gantry interface control and display table and gantry movements.



1 **Control screen** indicates information about the table and gantry.

2 **Patient load** button moves the patient table up or down automatically and moves the table into the bore of the gantry.

3 **Patient release** button allows the patient table to move to its maximum distance from the gantry and lowers to its minimal height.

4 **Record position** button records the current patient table code.

5 **Move to the recorded position** button moves the patient table to the recorded position.

6 **Menu switch** button toggles between the simple menu and the complex menu.

7 **Laser on/off** button controls the laser markers used for positioning the patient in the image plane. Lasers automatically turn off after 1 minute.

8 **Index Out/In** button moves the patient table to the external laser maker (2 groups: one is on the scan plane internal maker, the other is on the gantry shell = external maker) and the internal laser maker.

9 **Gantry positive tilt/negative tilt** button tilts the gantry in the direction indicated by the arrows.

10 **Table in** and **out** buttons move the patient table in the respective directions.
- A single press of one of these buttons moves the table 1 mm (by default). You can select 0.5 mm, 2 mm, and 5 mm in **Incremental Move Settings**.
- Slide in and out to adjust table horizontal position in the respective directions at a rate of 1 mm/second through 300 mm/second.

11 **Table up** and **down** buttons move the patient table in the respective directions.
- Slide up and down to adjust table vertical height.

12 **Zero table** button sets the current Z position to zero. When activated, the Start value changes to 0 and the End value changes to the relative table position value. These new values are displayed both on the gantry control panel and console interface.

Warning

- **Be sure to observe the condition of the patient when operating the control panel.**
- **Please keep the OnPlan screen dry and clean.**

Note

Please refer to "CTBOX" for more information about emergency stop button.

Start a new exam

You can use OnPlan to start a new exam.

1 Select the patient in **Patient List** that is provided by RIS system.

OR

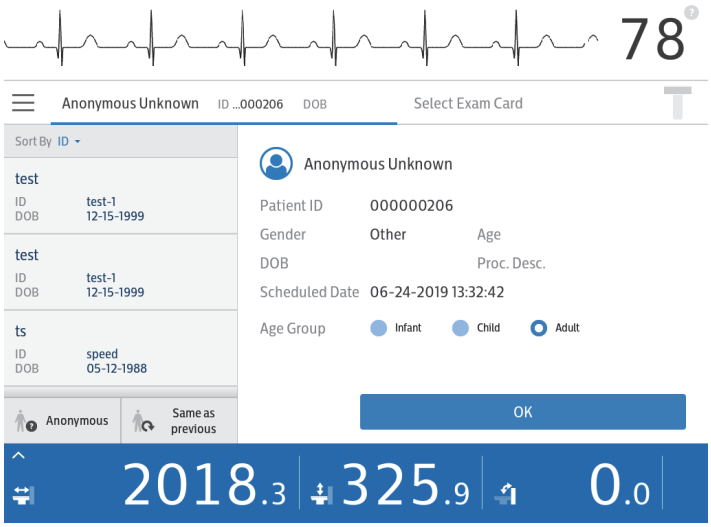
Click **Anonymous** or **Same as previous** in **Select Patient** to create a new patient.

2 Select a desired exam card in **Select Exam Card**.

3 Select the proper position.

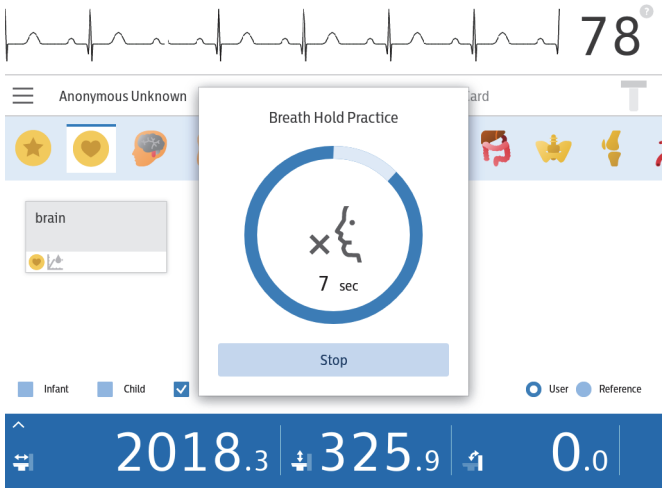
4 Click **Start Exam**.

5 Click **Go** on OnPlan or Console.



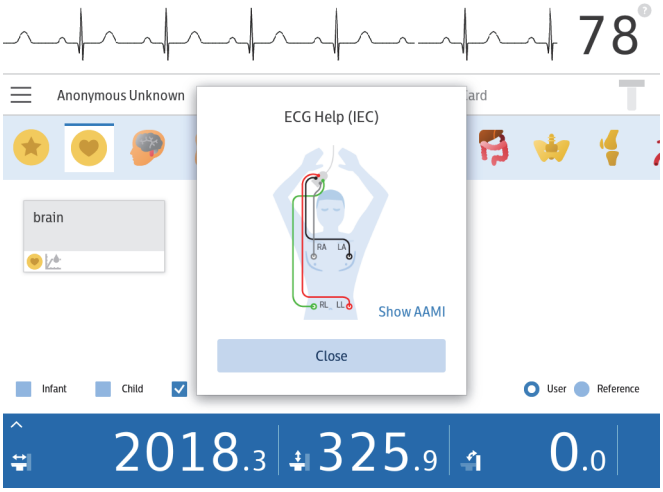
Breathing practice

Breathing practice interface displays the image for practicing breath holding and to prepare for breath holding. You can select voice language and message in this interface.



ECG display

When the ECG is connected, the ECG wave and heart rates appear on the top of the interface. Press the question mark, the ECG Help sample appears.



2.5 Patient table

Two types of patient table for the Incisive CT are provided, Standard Table and Bariatric Table. Please refer to the description of the patient table of your CT system for more information.

The patient table has following main components:

- Main patient table and base - table can move up or down, and in or out.
- Tabletop - can move independently in or out from the main patient table unit.
- Release devices
  - Standard Table: the floating switches on each side.
  - Bariatric Table: the floating sensors are located at the rear end of both table sides and rear handle, and the free-float pedal, located on the floor between the patient table and gantry.

Warning

To avoid risk of electric shock, do not connect accessory cables while touching patient.

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The patient table moves the patient to the scan position through the use of the gantry control panel. Using OnPlan, the operator makes fine adjustments in preparation for actual scan.

Movement of the patient table during the scan procedure is then controlled either from OnPlan or from the CTBOX.

Normal unloading of a patient, after completing the scanning procedure, is controlled from the OnPlan and CTBox.

Warning

The patient table moves when you initiate a scan.

The bariatric table supports a maximum patient weight of 307 kg, and the standard table supports a maximum patient weight of 205kg.

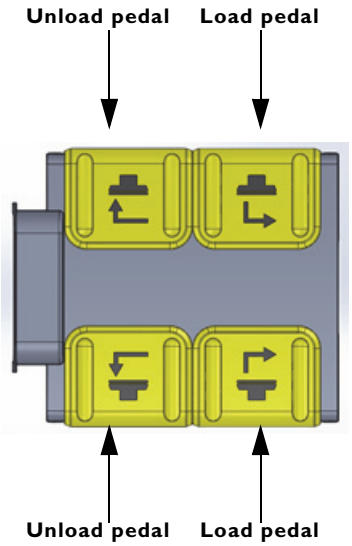
Warning

- **While moving the table and gantry, avoid placing your feet under the table side covers or between the gantry and patient table.**
- **Avoid inserting your fingers between the tabletop and the table carriage.**
- **Avoid placement of ancillary equipment (such as wheelchairs, IV pumps or beds) under the table. The table could collide with these items during movement.**
- **Avoid to collide with the table and gantry when external devices (beds with wheels, wheelchairs, stretcher and so on).**
- **Make sure all ancillary equipment is moved away from the table when moving table in/out and up/down.**
- **Failure to properly position the patient on the table can result in the inability to plan on the entire displayed Surview. When positioning the patient, all anatomy you wish to scan must be located between the gantry end of the patient table and the scan line on the pad to ensure the required anatomy is captured.**

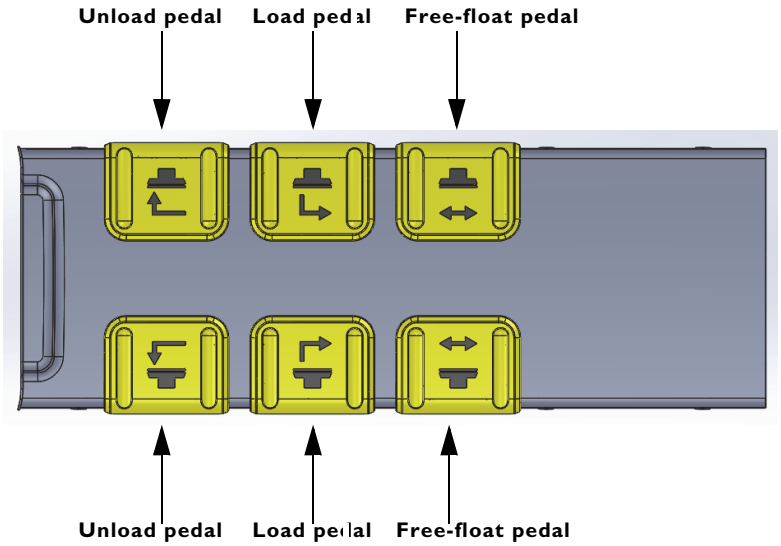
2.5.1 Foot Pedals

Use the foot pedals to load and unload a patient while leaving your free hands to guide the patient's IV lines, tubing, ECG wires, etc. into position. There are two foot pedals for standard table, and three foot pedals for bariatric table that can be operated from either side of the patient table. They are located on the floor between the base of the patient table and

the gantry. Starting at the base of the table, they include the unload pedal, the load pedal, and the free-float pedal (bariatric table only).



Standard Table



Bariatric Table

Load Pedal

The load pedal moves the patient table to a preset table height and table in position.

Procedure

1 Press and hold the Load pedal with your foot.

2 Hold the load pedal down until the patient table completes the move to the preset table height and desired table position.

Note

The patient table stops moving when you release the load pedal or the preset table height or table-in position is reached.

Unload Pedal

The unload pedal moves the patient table out of the gantry and down to the unload position.

Procedure

1 Press and hold the unload pedal with your foot.

2 Hold the unload pedal down until the patient table completes the move and stops in the unload position.

Note

The patient table stops moving when you release the unload pedal or the unload position is reached.

Free-Float Pedal (for Bariatric Table only)

The free-float pedal unlocks the table from its driving mechanism and allows it to be manually extended or retracted - a quick or emergency table release. You can manually move the table in and out of the gantry only, not up or down.

Procedure

1 Press the free-float pedal with your foot.

2 Hold the free-float pedal down and manually move the tabletop.

Note

The patient table re-engages when you release the Free-float pedal.

2.5.2 Patient table floating

To float the standard table, press the floating switch, operators can move the tabletop in or out manually.

To float the bariatric table, grab the touch sensors which are located at the rear end of both table sides and rear handle, or you can press the free-float pedal.

Note

- **Check the patient table floating range before next scanning, inappropriate patient table floating range can cause Non-Diagnostic Image.**
- **When the floating sensors are enabled or disabled, there will be a prompt voice.**

2.5.3 Operating the gantry and table

Press the appropriate buttons on OnPlan to move the patient table, switch the laser marker on or off. Please be aware of the maximum weight capacity marked on the patient table and make sure that the patient weight is less than the maximum value when the table is used.

Warning

Table movement or gantry position may harm larger patients. Ensure proper patient clearance before scanning. Also note that table lift and positioning ability may be affected by patient size.

When the patient is lying on the table, with legs towards the gantry, use the foot extension to support the patient's legs.

Use the axial head holder for head axial scans.

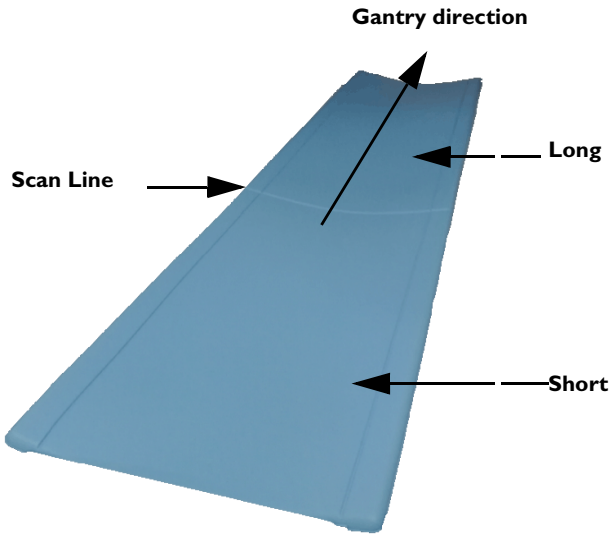
Warning

- **Blood and contrast medium are health risks. Take safety precautions when removing blood or residual contrast medium.**
- **Ensure the waterproof ring is clean before scanning the patient to assure proper image quality.**
- **Use a commercial biocide, approved by your governing authority, to clean the surface of the system including the waterproof ring, table, head holders, and accessories.**

Patient positioning in gantry

Scan line indicates that the area between the table front end (inside the gantry) and the line is scannable. The area between the line and the table back end (outside the gantry) is not scannable. Position your patient head first or feet first accordingly.

For standard table, there is a scan range line on the table pad.



For bariatric table, there are two scan range line markers on the table, one for axial scan limit and another for helical scan limit.

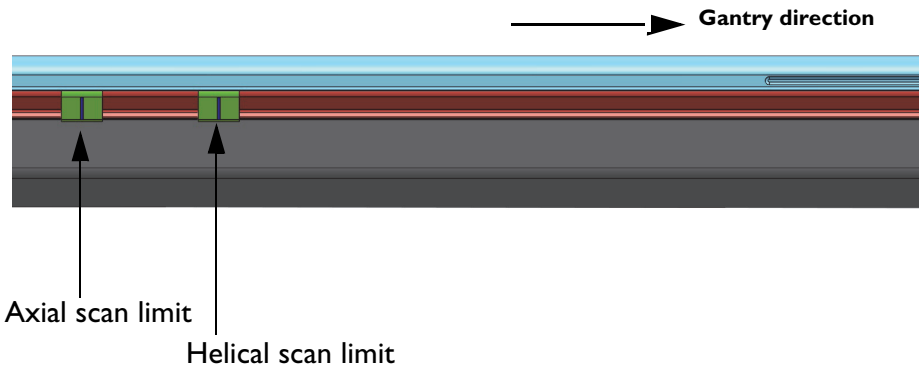


Table Up/Down

The table should be in the lowered position for the patient to sit, and then lay on the table. To vertically position the region to be scanned, use the Up and Down buttons to properly adjust the table position.

Foot pedals can load and unload patient, see **Foot Pedals**, on page 2-10 for more information.

Table In/Out

To bring the patient's region of interest into the gantry opening, use the **In** or **Out** buttons.

- A single press of the In or Out button will move the table in that direction.
- When an In or Out button is continuously held down, movement accelerates. For fine adjustments, press and release the button accordingly.

Warning

When bringing an unrestrained child into the gantry opening, be prepared to prevent the child from reaching out to grab the gantry panel (especially OnPlan buttons).

Note

The patient table motion stops within 10 mm upon actuation of an emergency stop control.

Foot pedals can load and unload patient, see **Foot Pedals**, on page 2-10 for more information.

2.6 Patient supports

Reference IEC 60601-2-44 Clause 201.7.9.3.1, and IEC 60601-1 Clause 7.9.2.14.

This section gives an overview of the standard and optional patient supports. Use the patient supports to position the patient safely and comfortably to prevent motion artifacts.

Note

Patient supports are prone to wear and tear. They must be replaced with original parts if they are dirty or damaged.

Warning

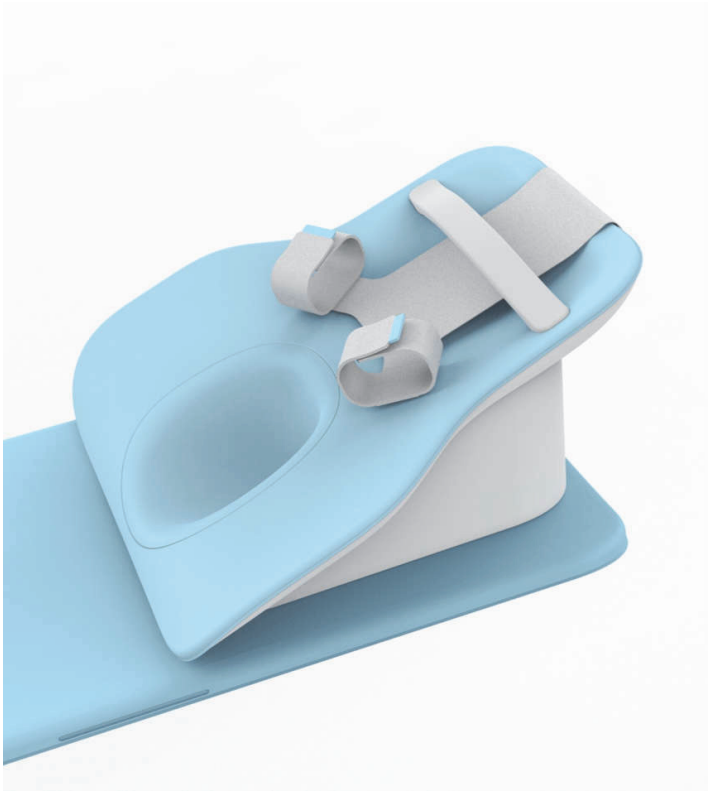
- **Do not use any positioning aids not mentioned in this chapter.**
- **Non-original patient supports may cause danger for the patient through collisions with the gantry. Image quality may also decrease.**
- **If a head holder or support is not engaged securely, it can come loose causing injury to the patient.**
- **Positioning aids must be used exclusively for their intended purpose. Use the head holder only for positioning the head.**
- **Using any accessories inside the gantry bore, ensure nothing collides to avoid harm or damage.**

2.6.1 Standard Table patient supports

The following patient supports are available for standard table.

Arm over Headrest

The foam head and armrest provides support and comfort to the patient during the scan. For additional arm support, you may use the straps.

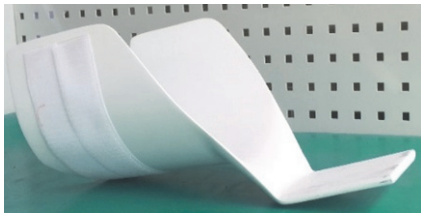


Warning

- **Make sure that the head over armrest is positioned on the table to support the full weight of the patient's head over arms.**
- **Do not scan through the head and arm rest.**

Head holder

The head holder can provide support and comfort to the patient during the examination.



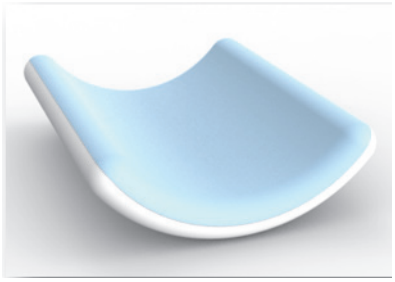
Common Head Rest

Flat Head Rest

Coronal Head Rest

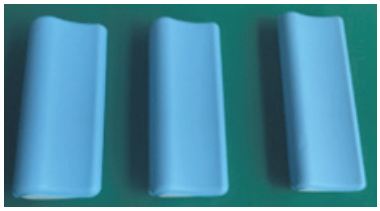
Flat head holder cushion

Flat head holder cushion provides comfort and support to the patient's head during the examination.



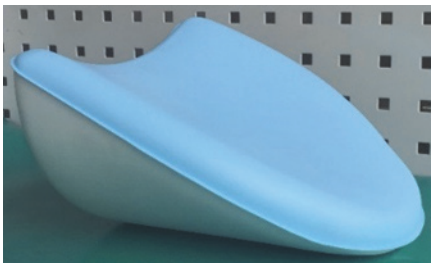
Head side cushion

Head side cushion (Large, Medium and Small) provides support for positioning the patient in the headrest during the examination.



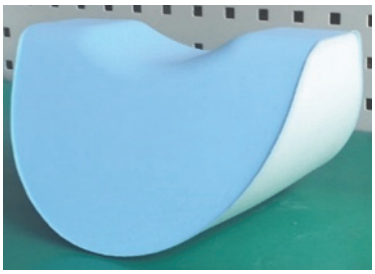
Headrest Cushion

Headrest Cushion provides comfort and support for the patient's head during the examination.



Head Coronal Cushion

Head Coronal Cushion provides comfort and facilitates good positioning of the patient for head coronal scanning.



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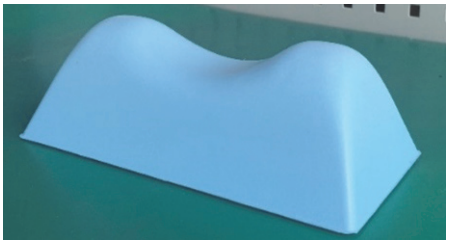
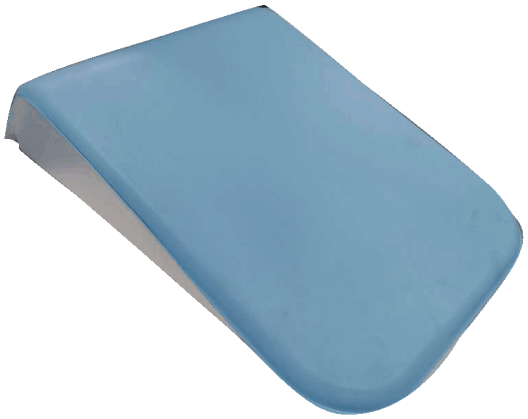
Neck Cushion

Neck Cushion provides comfort, and support for the patient.



Knee Pad

Knee Pad provides comfort and support for the patient during the examination.



Arm support

The arm support provides temporary support to allow you to begin an intravenous line for contrast while the patient is on the table. After you have completed the line insertion, remove the arm support to begin your scan.

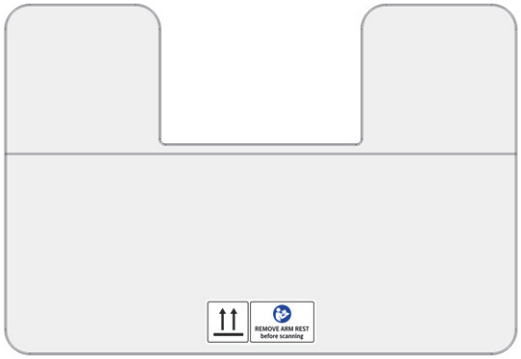


Table Pad

Table Pad provides patient comfort during the examination. There is a scan range line on the table pad.

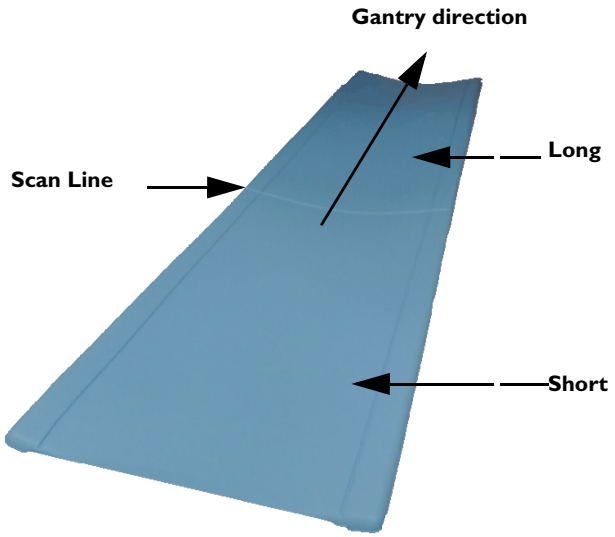
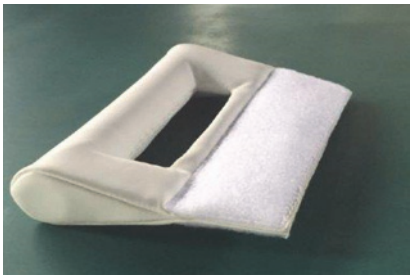


Table pad slicker

Table pad slicker provides patient comfort during the examination. Slip the table pad inside the slickers with the opening at the rear end of the patient table. Make sure the Velcro are well attached.

Table Side Handle

Table Side Handle helps the user move the couch top more easily.



IV pole

The IV pole can be mounted at each rear side of the couch. Patient injection bag can be hung on the IV pole bag holder.

Paper Roller

Paper Roll Holder can be mounted at rear end of the patient table. Mount the desired size paper roll on it.

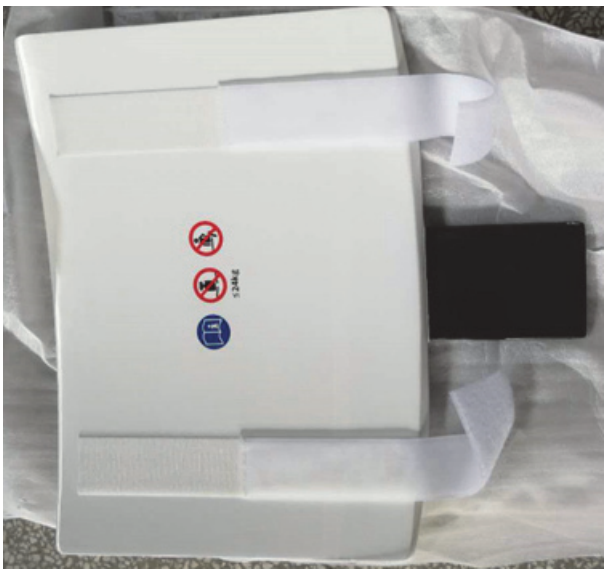
To replace a paper roll, follow the following instructions.

1. Hold both ends of the roller, then lift it up.
2. Move the roller along with paper roll horizontally, and put them on the patient table.
3. Replace the paper roll.
4. Lift the roller along with the paper roll holding both ends horizontally, and put the ends of the roller into the holder slot.

When using both IV pole and paper roll, ensure that the IV line is not trapped in the paper roll holder.

Foot extension

Use a foot extension for feet-first positioning of the patient. Examination up to the region of the thoracic spine is possible.



Caution

To avoid injuries, only the patient's feet should be placed on the foot extension, as it does not support body weight.

Warning

Do not use the foot extension when scanning head/brain as artifacts may be produced.

Foot extension cushion

Foot extension cushion is installed on the foot extension and provides comfort to the patient during feet first examination.

Patient straps and slideway

The patient straps provide immobilization patient during the examination. Insert the slip band of patient strap into slideway to combine the patient strap and patient table together. Then you can use the patient strap to immobilize the patient.

Warning

- **During all movements of the gantry (automatic and manual) and the patient table, keep the patient under continuous observation to prevent the patient from falling and pressing the patient against the gantry or between table parts, as well as to avoid disconnecting any infusion or resuscitation apparatus.**
- **During studies, the patient table or gantry movements are automatic. Make sure that there is enough clearance between the patient and the gantry to avoid injury. Before initiating the scan, perform manual movements to check the clearance.**
- **To ensure patient safety and image quality, use patient straps all the time.**
- **Make sure that the patient is strapped securely to avoid dangling of the hands. Ensure that the patient is placed securely on the patient table and is not in danger of falling.**
- **Beware straps may cause potential trip and injuries. Remove the straps or fold the straps when not in use.**

2.6.2 Bariatric table patient supports

The following patient supports are available for bariatric table.

Arm over Headrest

The foam head and armrest provides support and comfort to the patient during the scan. For additional arm support, you may use the straps.

Warning

- **Make sure that the head over armrest is positioned on the table to support the full weight of the patient's head over arms.**
- **Do not scan through the head and arm rest.**

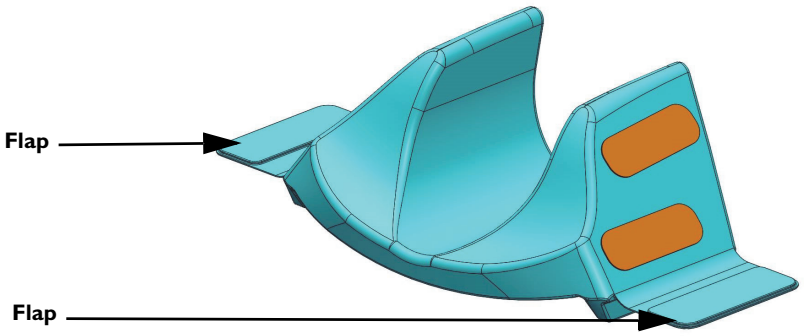
Head Holder

Head holder can be used for most routine adult CT head exams. The angle of the holder positions the head naturally for a routine brain scan and minimizes the required gantry angle (if applicable) to achieve optimal results.

Warning

Do not use the Head Holder if the cushion cover is damaged. Please contact your local Philips representative for more information.

To ensure high image quality, the head holder should be centered across the tabletop and positioned at the table front end.

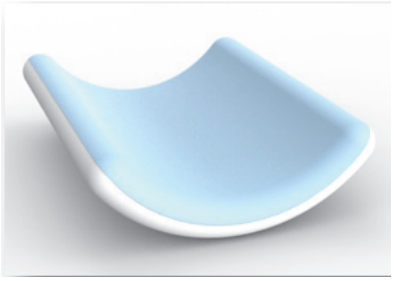


It is recommended to secure the head holder to the tabletop for optimal positioning:

1. Bring the patient table to a comfortable height.
2. Position the head holder with the attachment flaps on the table.
3. Align the Velcro on the attachment flap with the Velcro on both of the table side.
4. Press the Velcro sides together on each side of the table. Make sure the Velcro are well attached.
5. Use patient head straps to assist in patient positioning.

Flat head holder cushion

Flat head holder cushion provides comfort and support to the patient's head during the examination.

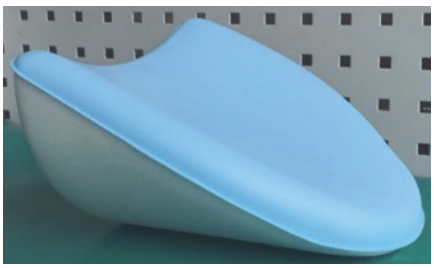


Head side cushion

Head side cushion provides comfort for the patient in the headrest during the examination.

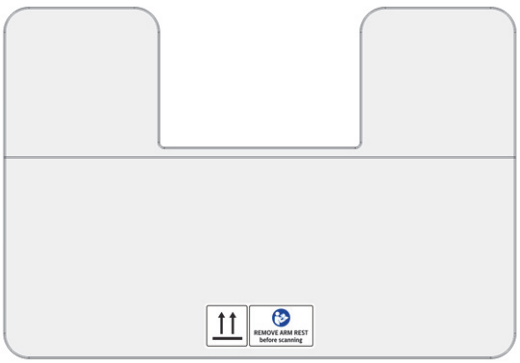
Headrest Cushion

Headrest Cushions provide comfort and support to the patient's head during the examination. The system provides two headrests of different angle.



Arm Support (for IV injection, pre-scan)

The arm support provides temporary support to allow you to begin an intravenous line for contrast while the patient is on the table. After you have completed the line insertion, remove the arm support to begin your scan.

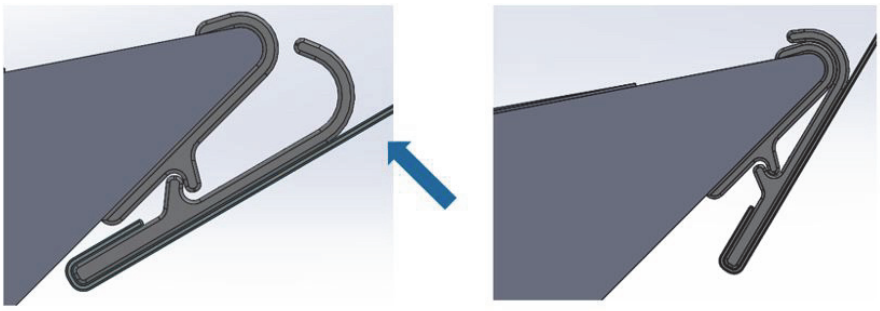


Tabletop Pad

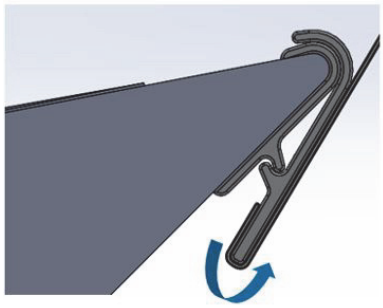
The tabletop pad provides patient comfort during an examination.

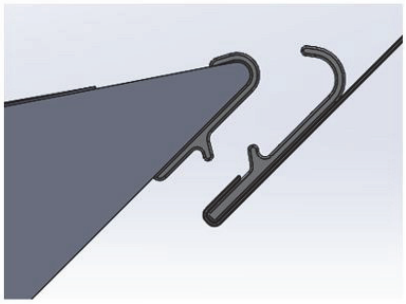
Patient straps

The patient straps help to provide patient immobilization during an examination. The patient straps come in two different sizes: Medium and Large. The patient straps are attached to the patient table with accessory rail.



Install the patient strap to patient table together





Take down the patient strap from the patient table

Accessory Rail

The accessory rails are glued to the tabletop at the both sides. It is the interface for fixing any accessory on the tabletop.

Warning

- **During all movements of the gantry (automatic and manual) and the patient table, keep the patient under continuous observation to prevent the patient from falling and pressing the patient against the gantry or between table parts, as well as to avoid disconnecting any infusion or resuscitation apparatus.**
- **During studies, the patient table or gantry movements are automatic. Make sure that there is enough clearance between the patient and the gantry to avoid injury. Before initiating the scan, perform manual movements to check the clearance.**
- **To ensure patient safety and image quality, use patient straps all the time.**
- **Make sure that the patient is strapped securely to avoid dangling of the hands. Ensure that the patient is placed securely on the patient table and is not in danger of falling.**
- **Beware straps may cause potential trip and injuries. Remove the straps or fold the straps when not in use.**

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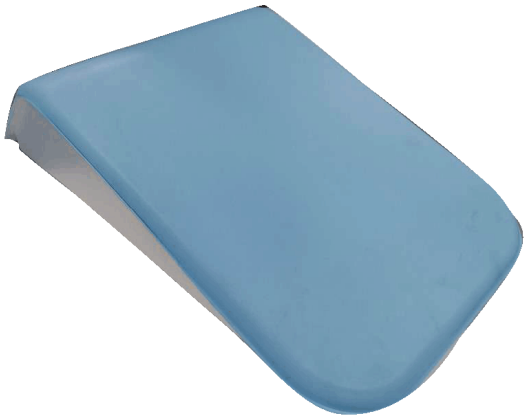
Knee pad

Knee pad provides patient comfort and support during an examination. It helps to decrease pressure at the bony prominences of the sacrum, trochanteric head, and heels of the patient.



IV pole

The IV pole can be mounted at each rear side of the couch. Patient injection bag can be hung on the IV pole bag holder.

Note

After taking off the IV pole, use the cap to cover the hole where the IV pole was installed. Keep the caps in the patient table box, when they are not in use.

Paper Roller

Paper Roll Holder can be mounted at rear end of the patient table. Mount the desired size paper roll on it.

To replace a paper roll, follow the following instructions.

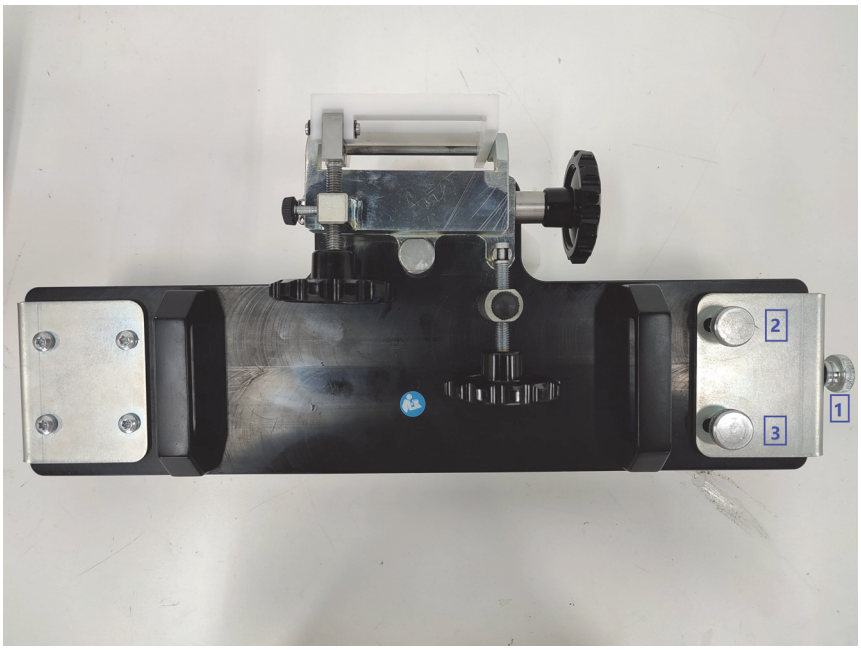
1. Hold both ends of the roller, then lift it up.
2. Move the roller along with paper roll horizontally, and put them on the patient table.
3. Replace the paper roll.
4. Lift the roller along with the paper roll holding both ends horizontally, and put the ends of the roller into the holder slot.

When using both IV pole and paper roll, ensure that the IV line is not trapped in the paper roll holder.

Phantom Holder

Phantom holder for patient table - install between the indication line on the patient table from the front of the couch, attaching on the table by tightening the silver screws.

Tighten screw No.1 first, then tighten screws No. 2 and No. 3.



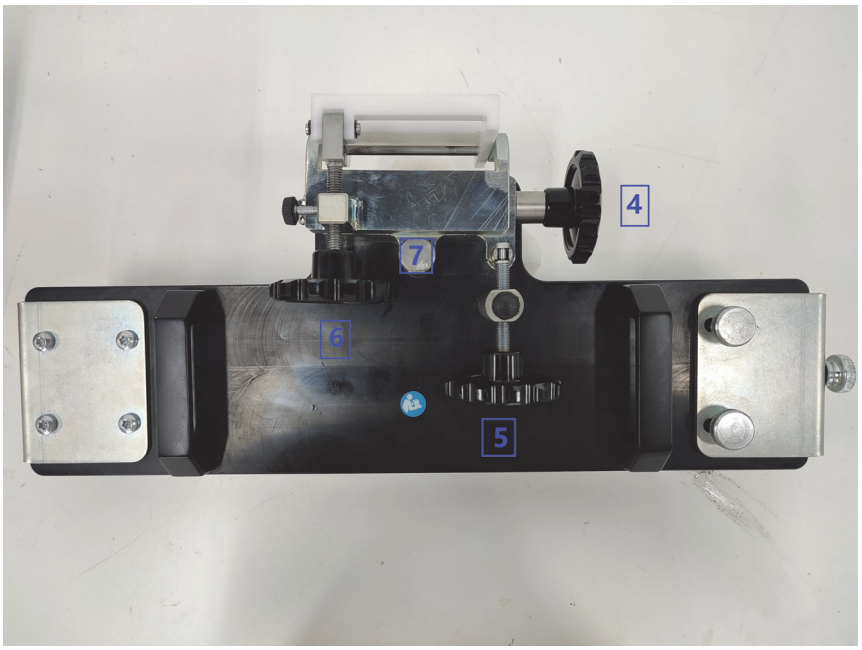
The phantom holder has three adjusting screws to change the mounting angle of the front assembly phantom.

Before adjust the screws, please loose screw screw No. 8 first.

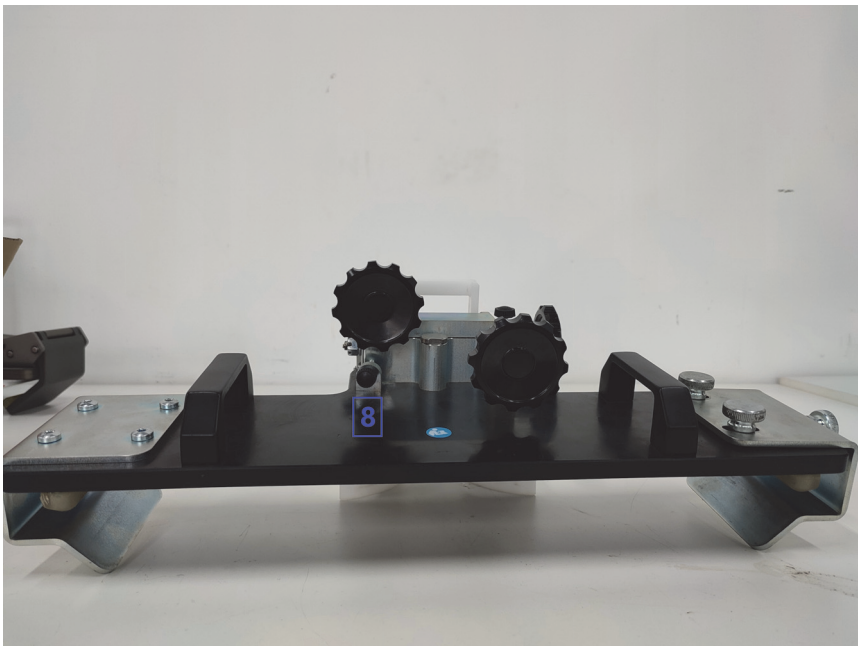
Rotate screw No. 4 to adjust the phantom horizontally.

Rotate screw No. 5, the phantom will move with respect to No.7.

Rotate screw No. 6 to adjust the phantom tilt.



Tighten screw No.8 to fix the phantom position.



Warning

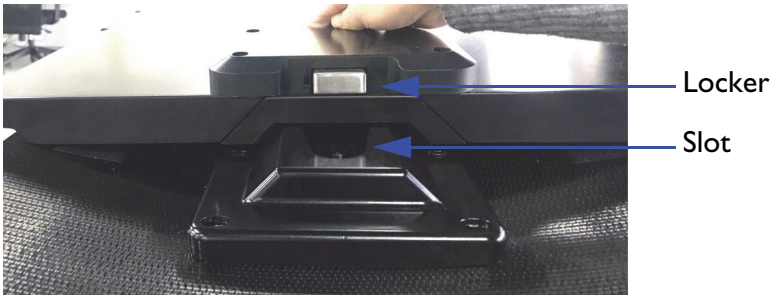
It is recommended to remove phantom first before removing the phantom holder.

Therapy flat table top

How to install the therapy flat table top

1 Place the therapy flat table top on the patient table.

2 Push therapy top to lock the locker. There is a click when the locker is locked.



How to remove the therapy flat table top

1 Press and hold the locker, push the therapy top locker out of the slot.

2 Remove the therapy flat table top from the patient table.

3 Place the Therapy Tabletop on the wall hang.

Warning

Place the Therapy Tabletop on the wall hang provided by Phillips.

Table Sag Measurements

Reference IEC 60601-2-44 Clause 201.101.4.

The measurements below show typical values for table sag over the distance indicated with a patient load of 135kg.

Table Travel Distance into Gantry						
Table Type	0 mm	400 mm	800 mm	1200 mm	1600 mm	1900 mm
Bariatric Table	0 mm	2.0 mm	2.6 mm	2.4 mm	1.6 mm	1.1 mm

2.7 Breathing navigation

Breathing Navigation is enabled when auto voice is activated. The breathing lights on the gantry will function according to the voice message.

2.8 X-ray and detection systems

2.8.1 X-ray tubes

Reference IEC 60601-2-44 Clause 203.6.7.3.

The X-ray tube, mounted on the gantry, has a 8 MHU rotating anode with a focal spot size of 0.5 mm x 1.0 mm and 1.0 mm x 1.0 mm (according to IEC 60336 standards).

2.8.2 X-ray power supply

The X-ray power supply consists of the rotor-mounted DC-to-high frequency inverters and the high voltage transformers. It is powered from the power cabinet through low-voltage slip rings and controlled by the computerized high voltage control unit.

2.9 Key technical data

Reference IEC 60601-1 Clause 7.9.3.3.

See the Introduction for additional technical information. If you need a detailed component list and circuit diagram, contact your Philips representative.

Large Focal spot (1.0 mm x 1.0 mm)	Maximum tube current 667mA for nominal voltage 120 kV
Small Focal spot (0.5 mm x 1.0 mm)	Maximum tube current 500 mA for nominal voltage 120 kV
Maximum tube voltage generated by high voltage generator	140 kV
Maximum tube current generated by high voltage generator	667 mA
Nominal electric power	80 kW, (at 120kV, 667mA, 4s)
Highest electric output power	80 kW, (at 140 kV, 571mA)

2.9.1 UPS (optional)

UPS is Uninterruptable Power System. It is installed in the control room to supply the computer with clean sine wave input power.

UPS Specifications	
Input voltage	230Vac nominal; variable based on output load
Output voltage	200/208/220/230/240Vac (user configurable); ±3%
Output power	900W

Warning

To avoid risk of electric shock, please refer to UPS user manual for more information about UPS regular inspection and maintenance.

Note

According to UPS manual statement, UPS doesn't have user serviceable parts except internal battery pack.

2.10 Bar code reader (optional)

The CT scanner software supports use of a bar code reader to enter patient data into the patient data form. This option can be used if HIS/RIS is implemented in your facility.

Note

Make sure the Patient ID is selected before the bar code is scanned.

Warning

- **Avoid pointing the bar code reader at the eyes. The laser light can cause eye damage.**
- **Avoid access to the bar code reader by untrained personnel.**

2.11 Injectors

Incisive CT supports the following injectors.

- MEDRAD Envision
- Medtron Injektron 82 CT
- Nemoto Auto Enhance A-60 injector (China Only)
- SHENZHEN DONGDA NSJ-200C (China Only)
- Tyco CT-9000
- Medrad-Vistron
- Medrad Stellant
- OptiVantage injector
- Ulrich OHIO tandem XD 2002
- Imaxeon Salient

Injector connector cable is plugged in console rear. To install or replace SAS injector, contact your Philips Service Representative.

Injector cable connect interface

3 System operation

3.1 Overview

This chapter covers these system operation procedures:

- Start Up the System
- Short Tube Conditioning
- Air calibration
- Shutdown the System

Review this information carefully before using the scanner.

3.2 Startup

Reference IEC 60601-2-44 Clause 201.5.7.

Before using your system, confirm that the room meets the appropriate conditions to ensure the system runs normally:

	Temperature	Temperature variation	Relative humidity	Air pressure
Scan Room	18°C ~ 24°C (64~75°F)	less than 5°C per hour	40% ~ 70% (no condensing)	70 - 106 kPa
Operating Room	10°C ~ 30°C (50~86°F)	less than 5°C per hour	20% ~ 80% (no condensing)	70 - 106 kPa

Use this procedure to start up your scanner when it has been completely shut down.

1. Turn ON the wall power (if gantry power is off).
2. Switch the Power Distribution Unit (PDU) to ON, if applicable.
3. Locate the power switch on the side of the gantry.
4. Turn on the gantry power.
5. If your system includes an Uninterruptable Power Source (UPS), turn it on.

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Note

Please refer to UPS user manual for more information about its operation.

6 Turn on the power to the computer, and monitor(s).

7 At the Windows Log on prompt, enter CT (no password).

8 Click **OK** to begin the system initialization.

9 When the OnPlan is operational, double click the **Incisive CT** host icon to activate the software.

10 Type the desired User name and password.

11 Click **OK**.

If there is a cabinet with your computer, make sure the cabinet is always locked, and the cabinet key as well as the computer key are in a safe place to keep personal data protected.

3.3 Short tube conditioning (STC)

Short tube conditioning process is required to be performed at least once daily before start the first scan, or after more than 8 hours without an exposure.

Warning

Short tube conditioning process is to avoid the risk of the tube property damage.

1 Check the scan room to be sure no people are present.

2 Click **Service** to access the service options.

3 Click **Short Tube Conditioning**. The Short Tube Conditioning interface opens.

4 Click **Start**. The system displays information regarding the progress in the message box.

Note

The Short Tube Conditioning can be stopped for emergency applications.

Warning

- **Do not perform Short Tube Conditioning when there is a person in the scan room, to avoid people receive unwanted ionizing radiation.**
- **During short tube conditioning, watch the Message box for error messages. If there is an emergency condition, press the Stop Scan button immediately.**
- **If a scan-terminating error occurs during this procedure, perform the procedure twice at most. If error continues please contact Customer Service for support.**

5 When the short tube conditioning is complete, click **Exit** to return to the **Patient** window. Your system is now ready to scan.

3.4 Air calibration

Air calibration is a part of normal system maintenance. In order to ensure proper operation of the scanner and image quality, conduct this procedure at least once per week. Because this procedure must be done at stable, operating temperature, perform it midday after a number of patients have been scanned. The air calibration feature is accessed from the Service menu.

1 Make sure the table is not in the gantry.

2 Raise the table to 330 mm or higher.

3 Click **Service** to access the service options.

4 Click **Air calibration**.

5 Click **Start**. The system displays a box containing a checklist for performing the calibration.

6 Click **Confirm** to continue. The system displays a box containing Speed, Collimation, Resolution and Voltage parameters to be included. You can select specific parameters, or you can select them all.

7 Click **Confirm** to begin the calibration.

If tube heat is less than 10%, the system automatically performs a short tube conditioning before conducting any air calibrations. Also, depending on the amount of time the system has been idle, a message may appear informing you of the last time air calibration was performed.

Warning

Stopping the Air Calibration function on the screen does not immediately end the physical process. Follow the on-screen prompts to avoid radiation.

Warning

Do not perform Air Calibration when there is a person in the scanning room, to avoid people receiving unwanted ionizing radiation.

3.5 Shutdown

Before shutting down the system, complete the following:

- Make sure all Reconstructions are complete.
- Click **End Exam** to ensure no study is in process.

Note

It is recommended that after generation of X-Rays, there should be at least 5 minutes before shutting down the system.

When these tasks are complete, proceed to the shutdown procedure.

1. Click **Service** to access the service options.
2. Click **Exit Console**. Click **Yes**.
3. A caution appears, **Turn off Anode?**
4. Click **Yes**, the anode will be turned off.
5. Click **Start**.
6. Click **Power Off**. The system displays the Shutdown Windows dialog box.

Note

Ensure it is more than 5 minutes after X-Ray exposure before clicking Yes to turn off anode.

7. Once the host is off, switch off UPS, if applicable.

Note

- **If the anode is not turned off, but the gantry power is turned off, the tube service life will be affected.**

8 Locate the power switch on the right side of the gantry.

9 Turn off the gantry power.

Note

If the system will be turned off for more than 2 days, switch off the Power Distribution Unit (PDU), after turning off the gantry. If applicable, turn off the Wall Power.

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4 Scan exam card parameters

4.1 Overview

This chapter covers the exam cards used during the scan procedure as well as the parameters available in each exam card. There are several scan modes:

- **Surview** scans are radiographic-like scans upon which the study is planned.
- **Axial** scans are the CT mode of slice-by-slice scanning while the Patient Table is motionless. The result is: n slice images (n is the product of the number of scans, and the number of slices/scan in the specific scanner, depending on the selected collimation).

	Axial scans range
Standard table	no less than 1860mm
Bariatric table	no less than 2000mm

- **Helical** (spiral) scans are multi-rotational scans while the Patient Table is incrementing continuously. The result is a series of slice images, reconstructed with flexible increment.

Pitch	0.15-1.5
Maximum continuous helical scan time	Up to 120s
Standard table continuous helical scan range	Up to 1830mm
Bariatric table continuous helical scan range	Up to 1900mm

Note

You are required to understand technical and physics parameters and their effect on each other in order to modify and approve scan procedures.

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4.2 Scan exam card parameter

The scan exam card parameter area allows you to select and review the scan and reconstruction parameters. Only after approving the parameters in the scan protocol can the scan or the reconstruction be executed.

Show All - Includes all the parameters.

4.2.1 General parameter tab

The following information includes the options available from the General parameters tab. Not all parameters are available in all scan modes.

Use Previous Surview - The Use Previous Surview parameter allows you to use the Surview from the previous patient for the current patient planning.

Start [mm]

- For clinical series: The Start value denotes the patient table position for the first image in the scan series. The value in this box is copied from the Plan on Surview. If there is no plan, and a number is typed in the Start field, the patient table is moved to this planned position during the scan process (while pressing and holding the Enable button). The Start position can be changed with an increment of 0.1 mm. When an asterisk (*) appears, the scan will start from the current patient table position (taken from the patient table in/out settings when the scanner is in the Ready for Scan state).
- For reconstruction series: The Start value denotes the recon start position.

Note

In axial biopsy mode, the table position default value (*) displays the center image that correlates to the laser light.

End

- For clinical series: The End value denotes the Patient table position for the last image in the scan series. The value in this box is copied from the Plan on Surview. If there is no plan, and a number is typed in the End Position field, this represents the end table location for the active scan. The End position can be changed with an increment of 0.1 mm. When an asterisk (*) appears, the scan ends based on the length entered into the Length field.

- For reconstruction series: The End value denotes the recon end position.

Reference IEC 60601-2-44 Clause 203.5.2.4.1 and 203.112.

Length [mm]

- For clinical series: The Length parameter indicates the region covered by the scan. Usually, the value in this box is copied from Plan on Surview but you can type any desired value. If the entered value is out of range (for example, the length that is needed to execute is more than the scanner capabilities), a message displays.
- For reconstruction series: The Length parameter indicates the recon length.

Orientation - Select the anatomical axis orientation (Axial, Coronal, or Sagittal) for reconstruction.

For Surview: Use this parameter to make your selection for surview scanning:
- Lateral
- Frontal
- Dual FL
- Dual LF

If a decubitus position is chosen, the system updates the selections accordingly.

Direction - The Direction setting determines whether the scan is performed as the Patient table moves into the gantry, or out of the gantry.

Scan Time

- Axial Scan - Gives the times of single cycle exposure time.
- Helical Scan - Gives the total time of the scan.

Increment [mm] - The Increment parameter is used to set the distance between two consecutive reconstructed slices in millimeters.

Warning

An increment of zero is allowed, but the scanned area will receive an increased amount of radiation. This mode is used for biopsies and for Bolus tests. It is suggested that the dose used in these cases should be as low as allowed by the specific application.

When the Thickness value is changed, the Increment is set automatically to the sum of the Slice Thickness achieved by one scan, unless it was zero. In that case, the Increment value remains set at zero and there is no table motion between adjacent scans.

Collimation

64-slice collimation apertures include:

- 2 x 0.625
- 4 x 0.625
- 12 x 0.625
- 16 x 0.625
- 16 x 1.25
- 12 x 1.25
- 32 x 0.625

128-slice collimation apertures include:

- 2 x 0.625
- 4 x 0.625
- 12 x 0.625
- 16 x 0.625
- 12 x 1.25
- 32 x 0.625
- 64 x 0.625
- 32 x 1.25

Resolution

High - The high resolution reconstruction CT images High Contrast resolution on X-Y plane is 16.0±10%lp/cm@0%MTF, >11.0lp/cm @10%MTF, >6.0lp/cm @50%MTF on the condition that the central dose is no more than 40mGy.

Standard - The standard resolution reconstruction CT images High Contrast resolution for head and body are:

- Head (the central dose is no more than 40mGy): 9.5±10% lp/cm @ 10%MTF.

Low Contrast Resolution

iDose[4]	Target	Head		Body	
		CTDI center	CTDI vol	CTDI center	CTDI vol
With	2mm@0.3%	≤39mGy	≤42mGy	≤23mGy	≤42mGy
	3mm@0.3%	≤29.5mGy	≤32mGy	≤12mGy	≤22mGy
	4mm@0.3%	≤22.5mGy	≤24.5mGy	≤8.5mGy	≤15.5mGy
	5mm@0.3%	≤19.5mGy	≤21mGy	≤7.5mGy	≤14mGy
Without	4mm@0.3%	N/A	N/A	N/A	≤25mGy

Cycle Time - The Cycle Time is the rotation time (Axial scans only) plus the inter-scan delay.

Cycles - The Cycles parameter indicates the number of full scan rotations (Axial scans only).

Tilt [deg] - The Tilt value (in degrees) is the Gantry Tilt angle for the planned scan on lateral (90 degree) Surview scan. The value in this box is copied from Plan on Surview, where it is interactively set by the Rotate function. The Gantry will tilt to the desired tilt angle before the scan start (while the Enable button is pressed and held).

Rotation time - This parameter defines the duration of one rotation of the gantry (in seconds). Be aware of the relationship between rotation time and resolution.

0.35s Rotation Speed function: It takes 0.35s to complete a 360° gantry rotation when the system performs axial scans or helical scans.

The rotation speed is depending on your system model.

Pitch (CT pitch factor) - The Pitch parameter represents the value of the patient table speed (this is a normalized speed; the motion of the table relative to the total collimation for one rotation of the gantry).

CT pitch factor = $\Delta d/T$

Where Δ**d** is the patient table travel in horizontal direction.

T is the collimation (nominal tomographic section thickness)

A larger Pitch enables a longer total coverage for a given scan time, but can sometimes produce a lower quality image in terms of image noise.

The values in the Pitch field are recommended from an image quality perspective.

Post injection delay - For timed scans (including the Tracker scan), this is the delay from injection to the start of the Tracker scan.

Edit before final Recon - Selecting this parameter gives you the option to edit preview image results before reconstruction.

4.2.2 Geometry parameters tab

The Geometry parameters are focused on lengths, angles, and size values. There are some parameters that are shared with General parameter tab.

Trim- Trim of the rotated result. When Trim is on, the scan geometry is set according to the middle point of the top and bottom facets instead of the edge of the facets. The acquisition is limited to the area of interest, eliminating portions of anatomy shown on the results that are not needed for clinical diagnosis.

Direct Result-With Direct Result the user is able to choose a desired result during scan planning phase and get the result for diagnosis without further intervention.

When a direct result reconstruction has failed, a red cross will appear in front of the reconstruction series.

4.2.3 Direct Result parameters tab

Render Mode - The Render Mode is used to select the desired image render mode (Average, MIP, MinIP).

Rotation Range- The Rotation Range is used to enter a value for the amount of rotation around the volume image.

Rotation Direction-The Rotation Direction is used to rotate the batch in the desired direction.

Image Count-The total image number of this batch.

Protocol-Select the desired protocol.

Slice Thickness-The Slice Thickness is used to change the thickness of the batch.

Increment-Defines the step size in mm between the first and last locations.

Orientation-Select the anatomical axis orientation (Axial, Coronal, or Sagittal) for batch.

Window Preset- Select the desired window preset.

Image No./Disc-Define the image numbers between 2 discs.

Save Batch-Select the desired batch type to save.

Note

- **Precise Spine function can only support adult scan and when:**
  -Cervical disc space with scan increment ≤ 2mm, FOV ≥ 58mm, scan length ≥ 40mm.
  -Lumbar disc space with FOV ≥ 70mm, slice thickness ≤ 3mm, slice increment ≤ 5mm, scan length ≥ 70mm.
- **When Precise Spine function is used, if there is obvious artifact in the image, the patient has serious osteoporosis, there is lumbar/cervical malformation, vertebral fusion, scoliosis, fracture, decreased intervertebral disc space, or the spine is not parallel with the table center line, the accuracy of plan box of batch function may be affected.**
- **When Precise Spine function is used, the corresponding body part should be included in the scan, otherwise the recognized result would be meaningless.**
- **If plan box of batch function fails, user is required to define the plan box of batch manually.**
- **If the image series does not contain the entire sacrum, the lumber disc can be generated but may not be labeled automatically.**
- **If the image series does not contain the entire C1-C2 vertebrae, the cervical disc can be generated but may not be labeled automatically.**

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- **Precise Spine only supports original DICOM images.**

Note

- **Precise Brain function can only support adult scans.**
- **Precise Brain function can only support: slice increment < 3mm, FOV >100mm, scan length > 50mm.**
- **When Precise Brain function is used, the corresponding body part should be included in the scan, otherwise the recognized result would be meaningless.**
- **When Precise Brain function is used, the scan needs to include the eyes without eye related diseases (ensure 2 items:1. Two eyes have similar CT value; 2. Eyes without serious shape deformation). And the acute angle between the mid-sagittal and the vertical line passing through the image should be less than 12 degrees (Assuming that the line connecting the center points of the two eyes is l, and the vertical line of l at the midpoint of l is called mid-sagittal). Otherwise, it will affect the accuracy of results.**
- **Precise Brain function can only support original DICOM images.**
- **Artifacts in the brain or eyes can affect the results.**
- **Precise Brain doesn't support loading images obtained with gantry tilt.**

Perfusion Map

Hematocrit Factor-Allows you to modify hematocrit factor. See **Modify hematocrit factor**, on page 13-9, for more information.

4.2.4 Dose Management parameters tab

The following options are available from the DoseRight tab. Not all options are available in all scan modes.

Reference IEC 60601-1-3 Clause 5.2.4.5 c.

Voltage [kV] - The Voltage parameter is used to set the voltage according to the absorption characteristics of the scanned body part.

Low or Medium voltages improve contrast resolution in small and medium objects or bodies, and therefore are preferred for scanning infants and normal size patients respectively. A High voltage (140 kV) scan provides greater penetration in large objects and reduces the noise of the images.

mAs or mAs/Slice - The mAs parameter sets the exposure value during the scan. It is determined by the Tube Current and by the Scan Time. A larger mAs factor decreases the image noise and enhances the contrast resolution, but also increases the radiation dose and the X-ray tube loading.

When the scan time is changed, the software changes the current to keep the mAs constant (up to the tube and generator power limitations).

Reference IEC 60601-2-44 Clause 203.5.2.4.1, 203.5.2.4.3, 203.112, and IEC 60601-1-3 Clause 6.4.5.

- **DLP [mGy x cm]** - DLP is a calculation of the $CTDI_{vol}$ multiplied by the total radiated length, and represents the total dose given to the patient in the current scan.
- **$CTDI_{vol}$ [mGy]** - The $CTDI_{vol}$ [mGy] parameter gives the average dose over the volume scanned with the scan parameters defined within the exam. The dose index depends on the Voltage, mAs, Slice Thickness, Slice Increment and the Scan Length. It is displayed for information only and cannot be modified.
- **SSDE [mGy]** - The SSDE is an estimate of the average absorbed dose to the scan volume that takes into account the anatomy of the patient being scanned and the radiation output of the CT scanner. It displays for information only and cannot be modified.

Reference IEC 60601-2-44 Clause 203.5.2.4.1 and 203.112.

Phantom Size - Phantom Size shows if the series phantom type is head or body.

Reference IEC 60601-2-44 Clause 203.106.

DoseRight Index - The DoseRight Index is unit-less integer with a value that is tightly coupled with the CTDI of the scan, and as a result, also with IQ. Steps in the DRI scale are designed in a way that increasing the DRI value by +1 decreases standard deviation of the image by 6%. The mAs value that is coupled with the DRI refers to the maximum mAs that is going to be applied on a patient defined by the age and weight group.

Liver/Brain Area DRI - The Liver and Brain Area DRI allow you to define a higher level local DRI value for the Brain or Liver region.

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Caution

Due to the limit of mA rate, the mAs value close to the Boost area could be affected when Brain/Liver Area DRI is on.

Note

In order to place the brain boost area, base of neck (top part of shoulder) should be included in the surview. Define the boost area manually with the right click menu if it is not automatically detected.

Change pitch to enable desired mAs - Check this option to enable the system to automatically adjust the Pitch value in order to get the desired mAs recommended by high level DRI.

3D Dose-Modulation - 3D Dose-Modulation is designed to modulate the tube current according to patient attenuation in every table position (Z-position) and tube angle according to Gantry angle, to reduce streak artifacts. Without 3D Dose-Modulation the same tube current (mA) is used for all angles around the Gantry.

3D Dose-Modulation is only available when using DoseRight Index.

The mAs displayed on the image is the actual mAs used for that particular slice. The image parameters, in cases where 3D Dose-Modulation was used, include both the planned exam mAs and the actual mAs used to create that slice. 3D Dose-Modulation is not used in these cases:

- Single axial scan
- Axial range with a scan angle of 240 degrees

For more information, see **Dose management**, on page 8-1.

4.2.5 Reconstruction parameters tab

Thin Slice Thickness - This parameter is used to define the thin slice thickness that is used to generate MPR images.

Label - This parameter is used to insert a description to appear on all the images of the series. You can type a description, select one from the drop-down, or leave the field blank.

Slice Thickness [mm] - Use the Slice Thickness parameter to set the tomographic thickness, which determines the spatial resolution in the axial direction (perpendicular to the plane of the slice). The thickness setting affects your increment options.

Enhancement - The Enhancement parameter allows you to add visual clarity to your scan. Select a setting to smooth (negative values) or sharpen (positive values) your image.

Auto Window - This function will calculate optimal WW/WL to display surview images.

Window (Window, WL and WW) - The Window function allows you to choose a window level and widow width setting pair, based on preset values. Click the Window button to view the options. You can also change the Window Level (**WL**) and Window Width (**WW**) values by typing in your desired settings.

X [mm], Y [mm] - X and Y set the Horizontal (X) and Vertical (Y) displacements, in millimeters (with resolution of 1.0 mm) of the reconstructed image relative to the center of the Gantry opening. They are used to center the region-of-interest in the image frame.

Usually, the Center X and Center Y values are copied from Plan on Surview as set by the Move function. Values within the range of ± FOV/2 may also be typed.

Planning Type - Planning Type allows you to enable Precise Planning. You can find more information in **Precise Planning**, on page 4-22.

iEvolving - iEvolving mode displays partially reconstructed images in a separate window prior to final reconstruction. Adjustments apply to the series reconstruction.

- **Zoom image** for magnifying and reducing the selected images.
- **Pan image** for moving the selected images within the window.

Click **OK** to start final reconstruction, for more information see **Start Final Reconstruction**, on page 6-7.

Recon Mode - Allows you to select Standard, iDose and Precise Image as the recon mode.

Level - The Level parameter is used to set a level for iDose or Precise Image.

Filter - The Filter parameter is used to set mathematical algorithm to identify the image sharpness (smoothness). The image noises (streak artifacts sometimes) increase with the increase of sharpness and decrease with the decrease of sharpness. Generally speaking, the low contrast resolution can decrease with the increase of the spatial resolution.

Some checks also include special filter except for universal filter.

The table identifies each filter and its functionality

Filter	Resolution		Brief Description	Description/Use	Effect on HU Values
	Standard	High			
A	X	X	Smooth	Smoothing filter for soft tissue	No Effect on HU Values
B	X	X	Standard	Standard filter for soft tissue	No Effect on HU Values
C	X	X	Sharp	Sharper than B	No Effect on HU Values
D	X	X	Detail	Edge enhancing filter for bone images	Increase to observed HU values
F		X	Edge Enhanced	Edge enhancing filter, often use in high resolution scan scenario such as lung, and bone	Increase to observed HU values
L	X	X	Edge Enhanced	Very sharp, edge enhancing filter, often use in high resolution scan scenario such as lung	Increase to observed HU Values
UA	X	X	Brain Smooth	Brain smooth, improves bone/brain interface, head scans only.	May affect observed HU values

Filter	Resolution		Brief Description	Description/Use	Effect on HU Values
	Standard	High			
UB	X	X	Brain Standard	Brain standard, improves bone/brain interface, head scans only.	May affect observed HU values
UC	X	X	Brain Sharp	Brain sharp, improves bone/brain interface, head scans only.	May affect observed HU values
YA	X		Y-Sharp	Sharp, recommended for lung and bone imaging in standard resolution.	No Effect on HU Values
YB	X		Y-Detail	Very sharp, recommended for bone in standard resolution.	No Effect on HU Values
YC		X	Y-Sharp	Sharp, recommended for lung, bone and IAC in high resolution.	Have effect on observed HU values
YD		X	Y-Detail	Very sharp, recommended for lung, bone and IAC in high resolution.	Have effect on observed HU values

Note

- **To obtain optimal IQ, it is recommended to use a slower rotation speed when utilizing the YD filter.**
- **Use YC with recon enhancement for High Resolution scans wherever applicable.**

Warning

There may be rings when YD filter used in conjunction with faster rotation speeds such as 0.4, 0.5 and 0.75.

Cardiac Reconstruction Filters

Filter	Brief Description	Description/Use	Effect on HU Values
CA	Cardiac Smooth	Very smooth, cardiac scan only	No Effect on HU Values
CB	Cardiac Standard	Smooth, cardiac scan only	No Effect on HU Values
CC	Cardiac Sharp	Sharp, cardiac scan only	May affect observed HU values
CD	Cardiac Detailed	Very sharp, cardiac scan only, recommended for stent imaging	May affect observed HU values

Brain/Head Reconstruction Filters

Warning

The following specialized Brain/Head filters elevate the CT number, except for structures such as white matter and cerebrospinal fluid.

Filter	Resolution		Description/Use	Effect on HU Values
	Standard	High		
SA	X		Brain soft, slightly enhances the hyper-dense structures.	Increase to observed HU values
SB	X		Brain soft, clearly enhances the hyper-dense structures.	Increase to observed HU values
SC	X		Brain routine, slightly enhances the hyper-dense structures.	Increase to observed HU values
SD	X		Brain routine, clearly enhances the hyper-dense structures.	Increase to observed HU values
SE	X		Brain sharp, slightly enhances the hyper-dense structures.	Increase to observed HU values
SF	X		Brain sharp, clearly enhances the hyper-dense structures.	Increase to observed HU values
HA		X	Brain soft, slightly enhances the hyper-dense structures.	Increase to observed HU values

Filter	Resolution		Description/Use	Effect on HU Values
	Standard	High		
HB		X	Brain soft, clearly enhances the hyper-dense structures.	Increase to observed HU values
HC		X	Brain routine, slightly enhances the hyper-dense structures.	Increase to observed HU values
HD		X	Brain routine, clearly enhances the hyper-dense structures.	Increase to observed HU values
HE		X	Brain sharp, slightly enhances the hyper-dense structures.	Increase to observed HU values
HF		X	Brain sharp, clearly enhances the hyper-dense structures.	Increase to observed HU values

Note

These specialized brain/head filters can affect reconstruction speed. Contact your Philips application specialist for additional information.

FOV [mm] (Field of View) - The FOV parameter denotes the diameter of the reconstructed image. The FOV value is typically copied from Plan on Surview where it is interactively set by the FOV function. The FOV value can be selected from a list or typed directly in its text box.

The 250 mm FOV is normally used for head, spine and infant scans. The 350 mm and 450 mm FOV are normally used for body scans.

Matrix - The Image Matrix parameter sets the number of pixels that the reconstructed image will contain. Select 512, 768, or 1024.

Recon Increment - The Increment parameter is used to set the distance between two consecutive reconstructed slices. If the Contiguous option is selected, the Increment is set equal to the slice thickness. If the Overlap option is selected, the Increment is set equal to half the slice thickness value.

WARP can reduce the windmill artifacts in helical exam. WARP algorithm will only become effective when overlap reconstruction is planned.

Adaptive Filter - The Adaptive filter enables reduction of the noise pattern (streaks) in nonhomogeneous bodies, with only a minor degradation in the resolution. The appearance of image noise is improved in areas such as the shoulders and the hip/pelvic area.

No. of Images - The Number of Images value is derived from the user defined Sequence Length, Scan Increment, and Slice Thickness defined for the results.

Note

The system automatically removes the blank images for MPR results. Hence, the actual output image number may differ from the image number shown on UI.

O-MAR - The O-MAR algorithm allows for Metal Artifact Reduction induced by orthopedic metal objects/implants.

Procedure - This parameter is set for the scan results, to assign different results to different scan procedures. Add the desired name(s) in **Procedure Description** while registering the patient. Enter the Scan UI, open **Show All** of the recon series and select the desired name from the drop down menu. This parameter can also be used for defining a split study.

High Priority - Selecting this option prioritizes the reconstruction for expedited processing. This will place it in the processing queue ahead of non-priority reconstructions.

4.2.6 Distribution parameters tab

The following information includes the options available from the Distribution parameters tab. Not all parameters are available in all scan modes.

Merge Series - Defined groups of results can be saved into the same DICOM series. Select the appropriate group (1 - 5) for your result. All results in the same group are saved into a single series. The label field is used as a descriptor (the label is taken from the first result in the group).

Auto Store - Check this to setup configuration in **Destinations**. Cancel **Auto Store** tick to disable Destinations, and all configuration in it will be cleaned up.

Destinations - Select this to open the Destinations dialog box. Make all your selections for storage as desired and click the **OK** button when finished.

Auto Filming - Check **Auto Film** and click **Setting,** you can select your auto filming parameters with this function.

Auto Launch- Select this to load the series to the desired viewer automatically.

Apply to all Series - This function allows you to apply your storage settings to all the series within the current study.

4.2.7 Contrast parameters tab

The following information includes the options available from the Contrast parameters tab. Not all parameters are available in all scan modes.

Contrast - Turns the contrast function on and off. When turned on, you can select in **Trigger** (Helical and Step & Shoot only):

- **Non-timed**
- **Timed**: A time bar appears along the bottom of the window when timed scanning is enabled.
- **Bolus Tracking**: A time bar appears along the bottom of the window when Bolus Tracking is enabled.

If you choose Bolus Tracking, the clinical scan begins automatically after the Tracker scan reaches the threshold setting. You can also set a post threshold delay (PTD). For more information, see **Bolus tracking**, on page 7-2.

Automatic Minimum Delay - Automatically calculates and sets the minimum threshold delay based on scan parameters.

Post Injection Delay (PID) - The delay from injection to start of the scan. Type the time in seconds.

Post Threshold Delay (PTD) - The delay between achieving threshold and start of the clinical scan.

4.2.8 Voice parameters tab

The Voice tab allows you to select autovoice options.

Enable - Auto Voice **Enable** turns the Auto Voice function on and off. When turned on, you can select a pre-recorded message set from the menu for pre-scan (for example, "hold your breath") and post-scan (for example, "you can relax now") directions.

Preview - This allows the technologist to give a sample breath hold or breathing instructions prior to the start of the study.

Voice Language - It allows to select the voice language.

4.2.9 CCT parameters tab

In order to activate the CCT mode, select an exam card that includes the appropriate Interventional scan. For more information, see **CCT scan parameters**, on page 7-14.

4.2.10 Cardiac parameters tab

Recon Phase - Selects a cardiac phase for reconstruction with the lowest cardiac motion. The duration of the phase depends on the heart rate. Initially, the default is 75% for Helical scans.

Tolerance - It can be used for retrospective cardiac scan. It provides the capability to extend the full dose area. Tolerance can be set by selecting a value which is up to 20, or entering a value which is up to 25.

Functional Dose - The mAs will be reduced by selecting a value (up to 20%) in non-target phase of cardiac cycle.

Phase Tolerance - Selects a value or enter a value not listed (up to 5%). mAs values are adjusted automatically. Selecting a Phase Tolerance adds an irradiation window. Used for Step & Shoot.

Edge correction - Is used for overlap scan, check **Edge correction** will remove the step artifacts and make the noise consistent in the overlap images.

For more information about Cardiac, please see **Cardiac**, on page 7-26

4.3 iDose^4 instructions for use

iDose^4 allows you to implement noise reduction. Level 1 is the least aggressive noise reduction; level 7 is the most aggressive noise reduction. In certain cases the maximum level may be limited to a value less than 7. In order to use the feature effectively, you will progressively design exams that apply noise reduction until the desired iDose^4 level and noise reduction combinations are reached.

Warning

iDose^4 should NOT be used for Calibration, CCT, or Bolus Tracking.

Note

- **Higher iDose^4 levels may cause an artificial look in the images depending on the study.**
- **Some higher iDose^4 levels may not be available for certain parameter combinations. Consult with your radiologist or physicist to verify mAs/kV settings with respect to spatial resolution and low contrast resolution.**

When using iDose^4 to reduce noise, follow these suggestions:

- Use an incremental approach when choosing your desired iDose^4 level. Start with iDose^4 Level 1.
- Review the image noise level of several patient exams with the current (new) settings before proceeding to the next level of iDose^4.
- Always review images with the reading radiologist when selecting a new iDose^4 level.
  - Follow the User Guide for iDose^4 (**User guide for iDose4**, on page 4-21) as a guide for the percent of noise reduction at each iDose^4 level.

4.3.1 Setting up iDose^4

To enable iDose^4 feature:

1 Select the desired Recon series.

2 Click the **Show All**.

3 Select iDose^4 in **Recon Mode** drop down menu in **Reconstruction** tab.

4 Select a level.

To create iDose^4 protocols:

1 Select exam card to use with iDose^4.

2 Create a duplicate exam card (in Exam Card Manager).

3 Modify the mAs to the desired mAs/kV setting and select the appropriate iDose^4 level.

- For example, if an exam card has a mAs value of 250 mAs you can modify the mAs to 200mAs and select an iDose^4 level of 1 to arrive at the desired result.

4 Save the new exam card with an iDose^4 label such as A/P w/200 iDose1.

5 Scan a patient using the new iDose^4 exam card.

6 Review the results.

7 Repeat steps 1-5, applying the next level of mAs/kV reduction each time you want to modify the protocol (until the desired results are achieved).

Note

The iDose^4 reconstruction technique can be used with or without a surview. iDose^4 information is annotated on the image and on the image parameters page. The raw data must be available to reconstruct using iDose^4.

4.3.2 User guide for iDose^4

Use this table to help create appropriate iDose^4 exams. Refer to the iDose^4 Instructions for Use for details on using this table.

Original mAs	iDose^4 Level and Preferred mAs							IQ Improvement
	1	2	3	4	5	6	7	
30	24	21	18	15	12			Original mAs + iDose Level (1-7)
35	28	25	21	18	14			
40	32	28	24	20	16	12		
45	36	32	27	23	18	14		
50	40	35	30	25	20	15	10	
75	60	53	45	38	30	23	15	
100	80	70	60	50	40	30	20	
125	100	88	75	63	50	38	25	
150	120	105	90	75	60	45	30	
175	140	123	105	88	70	53	35	
200	160	140	120	100	80	60	40	
225	180	158	135	113	90	68	45	
250	200	175	150	125	100	83	50	
275	220	193	165	138	110	83	55	
300	240	210	180	150	120	90	60	
325	260	228	195	163	130	98	65	
350	280	245	210	175	140	105	70	
375	300	263	225	188	150	113	75	
400	320	280	240	200	160	120	80	
425	340	298	255	213	170	128	85	
450	360	315	270	225	180	135	90	
475	380	333	285	238	190	143	95	
500	400	350	300	250	200	150	100	
600	480	420	360	300	240	180	120	
700	560	490	420	350	280	210	140	
800	640	560	480	400	320	240	160	
900	720	630	540	450	360	270	180	

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Original mAs	iDose[4] Level and Preferred mAs							IQ Improvement
	1	2	3	4	5	6	7	
1000	800	700	600	500	400	300	200	
1100	880	770	660	550	440	330	220	
1200	960	840	720	600	480	320	240	

Note

This is only a guideline. Image quality will vary by patient. Verify that image parameters selected will give the desired image quality.

4.4 Precise Planning

Precise Planning can automatically adjust the scan range of subsequent Axial or Helical scan series, based on the Surview Image. Confirm the scan range, and then click **Go** to complete the scans. It is a convenient assistant for you to set scan range.

Precise Planning supports Head, Lung, Lumbar Disc, Heart, Cervical Spine, Liver, Pelvis, Caput femoris recognition. The Head, Cervical Spine and Lumbar Disc Recognition are based on lateral Surview, the Heart Recognition is based on dual Surview, and the Lung and the other parts recognition is based on frontal Surview.

To recognize Lumbar Disc, the surview should include Lumbar spine and sacrum, and the starting position of the surview should be lower than 10th thoracic vertebra.

To recognize Caput femoris and Pelvis, the surview should include whole Pelvis, and the starting position of the surview should be lower than Shoulder.

The typical exam card in Reference Exam Card has activated the Precise Planning function to automatically adjust the scan range of series to be scanned after the Surview. Users can turn on and turn off the Precise Planning function by modifying Planning Type in Exam Card Management.

1 Select the desired exam card in **Exam Card Manager**.

2 Click **Edit**.

3 Select the desired series in process list.

4 Select planning type in Planning Type drop down list.

5 Click **Save As**.

6 Type a name in **Exam Card Name**.

7 Click **Save**.

Note

- **When Precise Planning is on, if there is obvious artifacts in the Surview of corresponding parts, the accuracy of Precise Planning will be affected.**
- **When Precise Planning is on, the corresponding body part should be included in the surview image, otherwise the recognized result would be meaningless.**
- **When digital tilt angle is out of range, Precise Planning will take the maximum or minimum digital tilt angle as the recognized result.**
- **The Liver Recognition can only recognize the upper edge of liver.**
- **The Lung recognition consists of two planning types: Lung planning and Lung Screening. Lung planning type supports to recognize the whole lung and includes part of the shoulders and epigastrium to ensure that the scan range covers the whole lung irrespective of patient inspiring or expiring. Lung Screening planning type only supports to recognize the whole lung, it provides low dose for the lung screening CT scan.**

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4.5 Metal artifact reduction for orthopedic implants

This information is intended to explain what Metal Artifact Reduction for Orthopedic Implants (O-MAR) is, why and when to apply O-MAR, and the workflow used to access O-MAR.

Images are included to demonstrate metal cases produced in original results, and results with O-MAR enabled. Also included are images that illustrate results when using O-MAR in studies with metal other than large orthopedic implants.

O-MAR may increase reconstruction time depending on image parameters and on the number of images containing metal. Images that do not have metal are not affected. O-MAR is available for all valid exams except:

- Cardiac
- Surview
- CCT
- TIBT
- Biopsy

4.5.1 O-MAR

Warning

O-MAR can be used to reduce metal artifacts resulting from large orthopedic implants. O-MAR is not intended for other metal objects, such as: external metal, implanted devices near skin surfaces, metal near air pockets and surgical screws or clips, as artifacts may result. Two reconstructions will be performed: with and without O-MAR. Both reconstructions should be reviewed.

The O-MAR algorithm allows for Metal Artifact Reduction induced by metal objects. O-MAR is applied to only those images that contain metal. Other images are not affected. Metal objects attenuate more X-rays than soft tissue and bone, so fewer photons can reach the detectors. This causes severe beam hardening, which results in bright or dark streaks, or star-like patterns on the images. Artifact-free images with metal cannot be obtained using standard reconstruction techniques.

O-MAR makes positive improvements in image quality for patients with large orthopedic implants. There are situations when O-MAR can introduce artifacts in the image. See **Examples of non recommended cases using O-MAR**, on page 4-28.

O-MAR data sets should be reviewed in conjunction with original data sets (non-O-MAR).

4.5.2 O-MAR scan workflow

Following are basic steps for using O-MAR.

1. Enter the Patient Demographic information, and select the appropriate group and exam card.
2. Verify the surview scan parameters and change them as desired. Click GO to acquire the Surview.
3. Plan the scan on the Surview, setting the parameters as needed. From the **Show All - Reconstruction**, click O-MAR.

- A message displays stating that an additional recon will be added that does not include O-MAR.
- After clicking Start Final Recon, a second, non-O-MAR reconstruction is added to the series list.

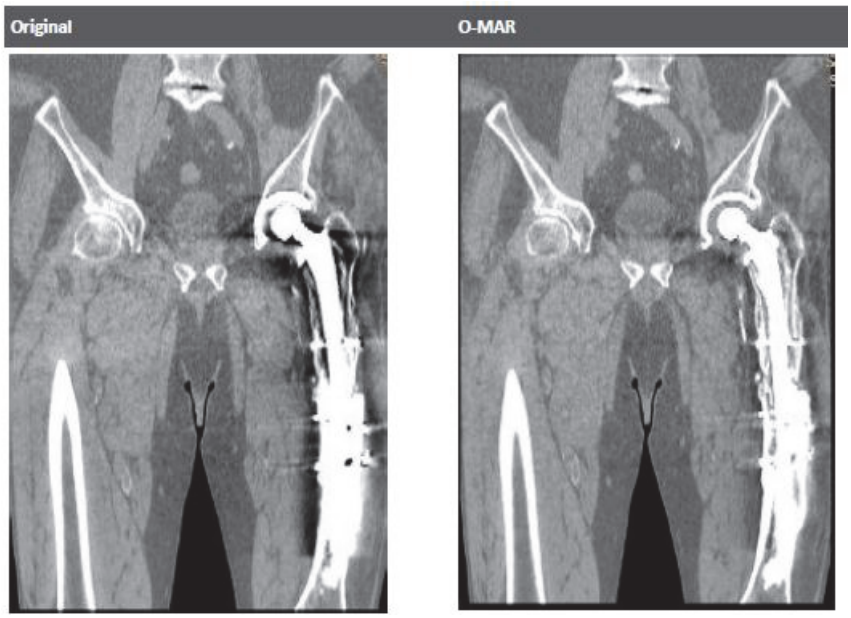
Note

You can also select O-MAR while performing offline reconstructions.

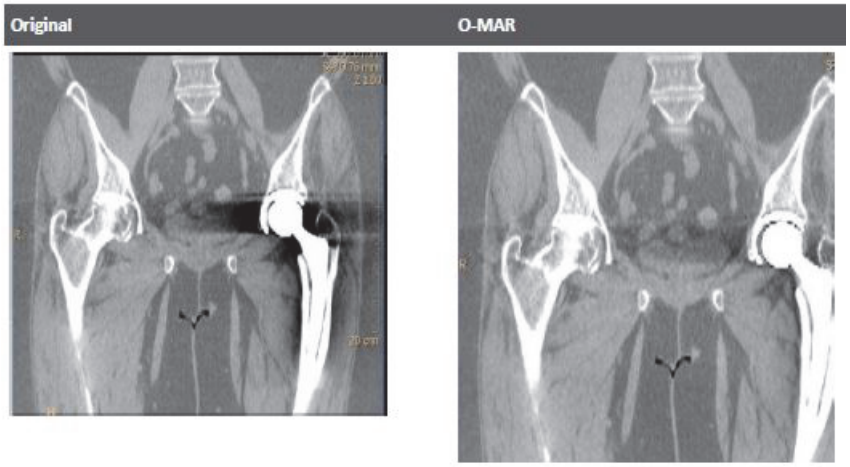
4.5.3 O-MAR image samples

The following images illustrate the benefit of O-MAR.

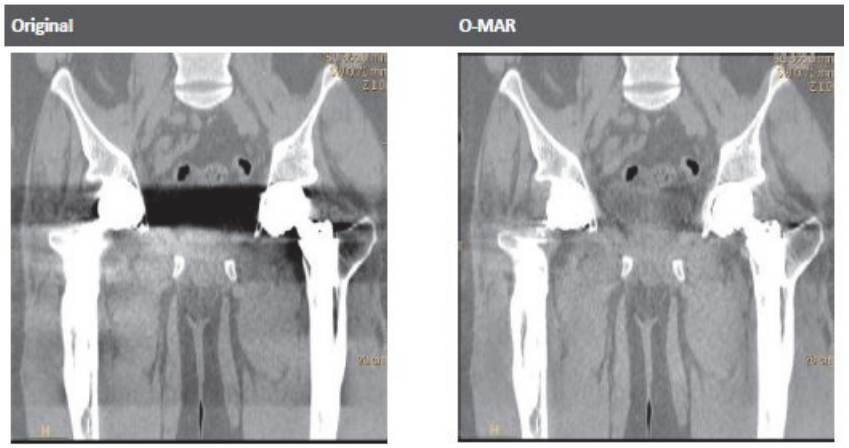
Hip Prosthesis



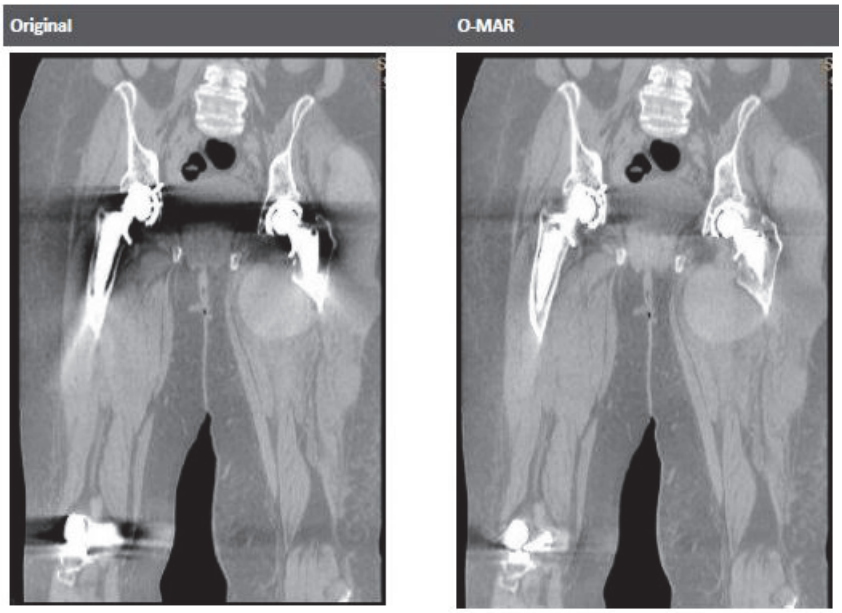
Hip Prosthesis



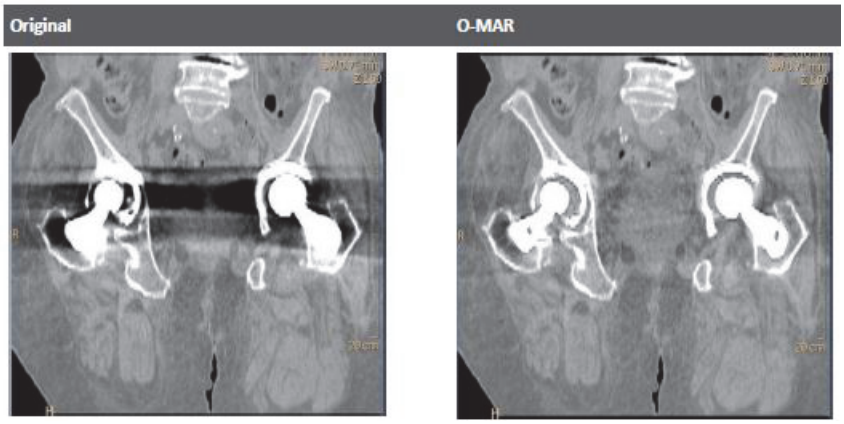
Bilateral Hip Prosthesis



Bilateral Hip Prosthesis



Bilateral Hip Prosthesis



O-MAR is not applicable to:

- External metals including bismuth shields.
- Implanted devices near skin surfaces.
- Metal in or near intra-body air spaces.
- Small surgical implanted devices, for example; screws, pins, clips, and so on.

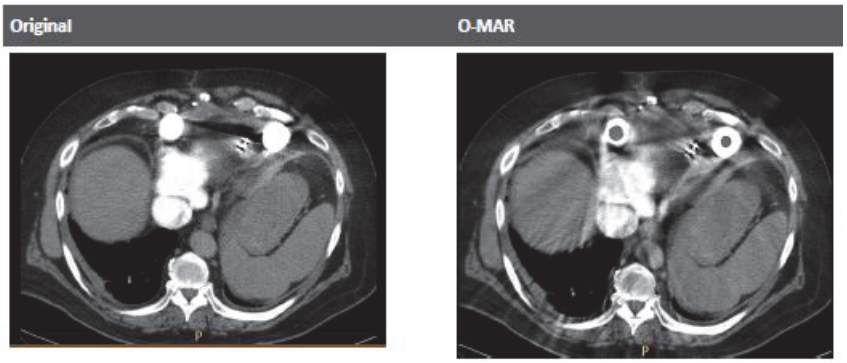
The types of cases in this section are examples of using O-MAR in studies that contain metal other than large orthopedic implants. These examples are not exhaustive but are illustrative. These cases are examples of the

known deficiencies and in no way constitute a full list of potential Metal Artifact Reduction situations.

See **Examples of non recommended cases using O-MAR**, on page 4-28.

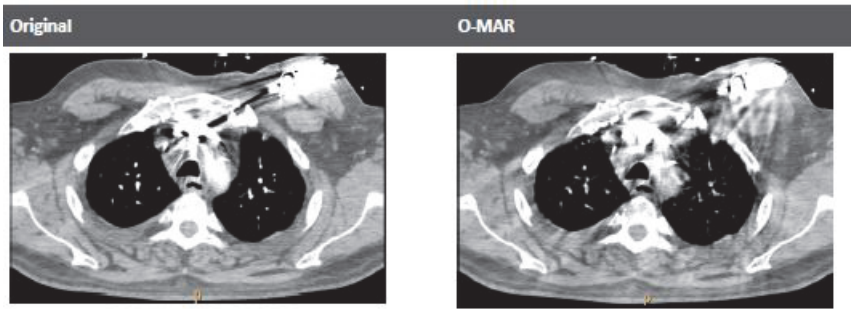
Examples of non recommended cases using O-MAR

Soft tissue Metal Artifact Reduction



Example of new soft tissue streaking being added.

Streaking, Extending Into the Lung

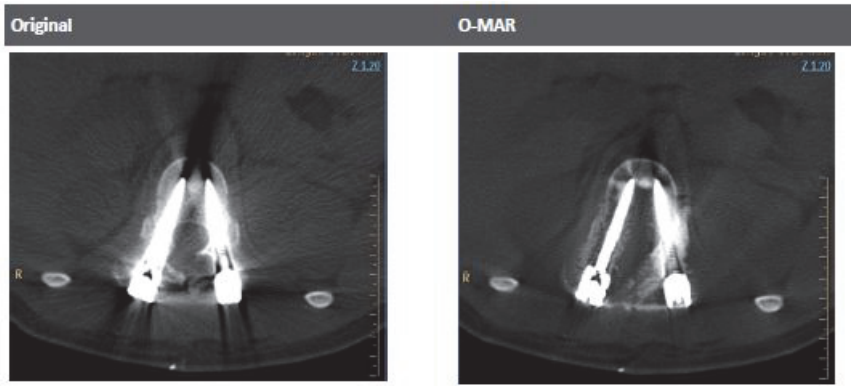


Example of streaking, extending into the lung. Lung Metal Artifact Reduction less apparent in lung window.

Note

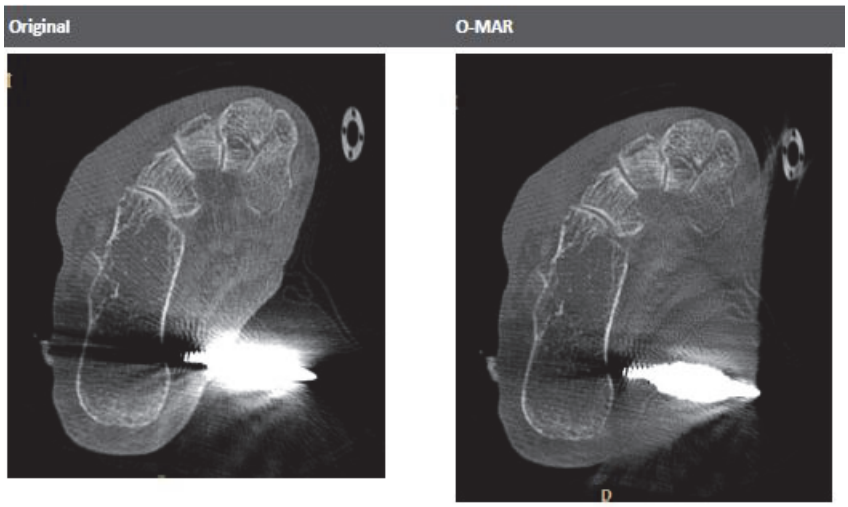
Do not use O-MAR with images that have spine screws.

Spine



Bony cortical and trabecular bone loss in vertebral body.

Metal Outside of the Body



Gross tissue growth in the presence of metal outside of the body.

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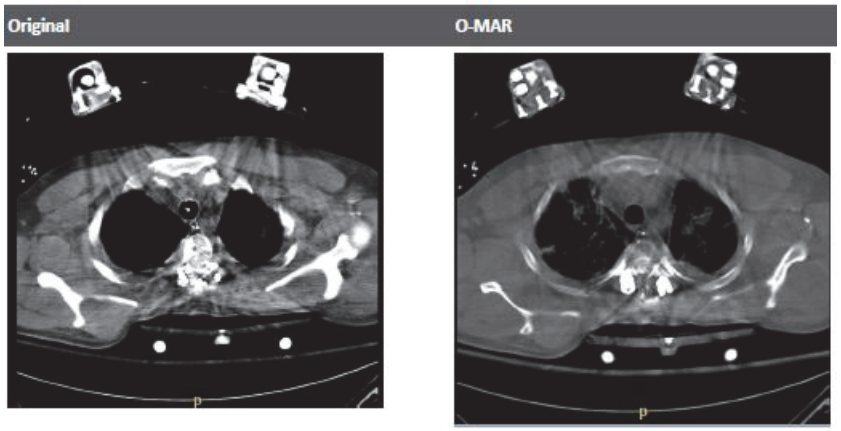
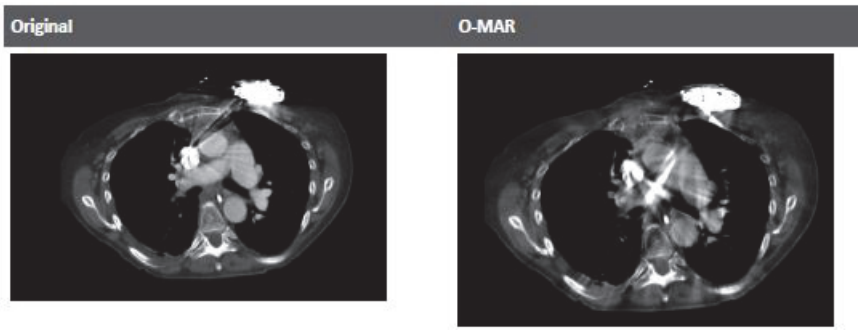
External Metal



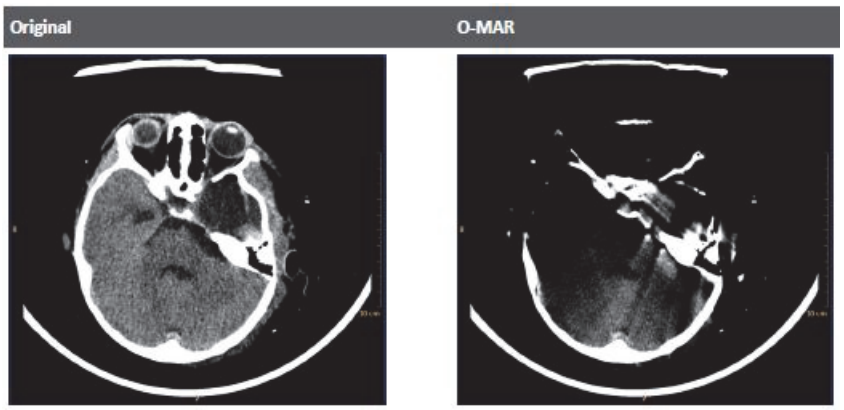
Bony cortical and trabecular bone loss, slight tissue growth in lungs.

Metal Artifact Reduction in the Presence of a Pacemaker



Example of O-MAR introducing severe streaking in the presence of a pacemaker.

Bismuth Shield



Bismuth shield with and without O-MAR.

O-MAR Labeling

O-MAR labeling includes three DICOM tags; two are public DICOM tags and one is a private DICOM tag. These labels should be made visible in DICOM or other workstations.

Note

O-MAR must be turned on in Preferences and titles must be activated in the viewport controls.

Tag Name	Tag ID
Series Description	0008,103E
Image Comments	0020,4000
Image Label (private)	00E1,0040

Warning

- **All O-MAR images should be labeled, however O-MAR labeling may not be automatically saved for all post-processing operations.**
- **O-MAR labeling may be lost in network transfer.**

4.6 Pediatric & Small Patients

Computed tomography (CT) is a valuable tool for diagnosing injury and disease but its use is not without risk. When a CT scan is necessary, Philips Healthcare encourages and supports the importance of reducing radiation dose to as low as reasonably achievable in all patients, especially pediatric and small patients.

Special care should be exercised when imaging patients outside the typical adult size range, especially smaller pediatric patients whose size does not overlap the adult size range (e.g., patients less than 50 kg (110 lb) in weight and 150 cm (59 in) in height, measurements which approximately correspond to that of an average 12 year old or a 5th percentile U.S. adult female. **[McDowell MA, Fryar CD, Ogden CL, Flegal KM. Anthropomorphic Reference Data for Children and Adults,**

United States, 2003-2006. National Health Statistics Reports 2008. 10:1-48.]

Exposure to ionizing radiation is of particular concern in pediatric patients because 1) for certain organs and tumor types, younger patients are more radiosensitive than adults (i.e., the cancer risk per unit dose of ionizing radiation is higher for younger patients); 2) younger patients have a longer expected lifetime over which the effects of radiation exposure may manifest as cancer and 3) use of equipment and exposure settings designed for adults of average size can result in excessive and unnecessary radiation exposure of smaller patients.

To help reduce the risk of excessive radiation exposure, you should follow the ALARA (As Low As Reasonably Achievable) principle and seek to reduce radiation dose to only the amount necessary to obtain images that are adequate clinically.

Contraindications, Warnings, and Precautions

CT imaging should only be performed in patients, particularly pediatric patients from birth to 21 years of age, if deemed medically necessary. Radiation exposure is a concern in people of all ages; however, pediatric patients are more sensitive to radiation exposure because they have more rapidly dividing cells than adults do. The younger the patient, the more sensitive they are to the detrimental effects of radiation exposure. In order to get vital diagnostic information for the patient this concern has to be weighed against medical necessity.

The medical team must consider a host of information including the importance of the CT results for answering the clinical question, the availability of prior CT results, the options for alternative non-radiation based imaging and the vulnerability of the population to which the patient belongs. The risk of not receiving a CT scan and, therefore, the information it provides must also be considered.

If CT imaging is deemed medically necessary, X-ray output should be reduced for small and pediatric patients to only the amount that is sufficient to achieve the desired image quality. Adult scanning techniques should never be applied to small or pediatric patients since smaller patients receive higher absorbed dose for the same X-ray output.

References for pediatric dose optimization:

The following resources provide information about pediatric imaging radiation safety and/or radiation safety for computed tomography devices:

1. FDA's Pediatric X-ray Imaging Website (www.fda.gov/radiation-emittingproducts/radiationemittingproductsandprocedures/medicalimaging/ucm298899.htm)
2. The Image Gently Alliance, Computed Tomography (www.imagegently.org/Procedures/Computed-Tomography).
3. American College of Radiology, Pediatric Radiology, Computed Tomography (https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CT-Ped.pdf)
4. The Image Gently Alliance, Interventional Radiology (http://www.imagegently.org/Procedures/Interventional-Radiology)
5. American College of Radiology, Pediatric Radiology, Interventional Radiology (https://www.acr.org/-/media/ACR/Files/Practice-Parameters/IRClin-Prac-Mgmt.pdf)
6. Society of Pediatric Radiology (SPR)

   (http://www.pedrad.org/)
7. National Cancer Institute (NCI)

   (http://www.nci.nih.gov/aboutnci)

Device specific features and instructions: Incisive CT provides the following specific design features and instructions that enable safer use of our device with pediatric patients:

Design Feature Important to Pediatric Imaging	Page Number
Dose Alerts	Page 8 - 8
Dose Efficiency Warning Message	Page 22 - 19
Dose Notification	Page 8 - 8
DoseRight Index	Page 8 - 2
Liver DRI	Page 8 - 5
Brain DRI	Page 8 - 5
3D Dose-Modulation	Page 8 - 1
iDose	Page 4 - 19
Pediatric positioning accessories	Page 4 - 35
Lower kVp	Page 4 - 37

Design Feature Important to Pediatric Imaging	Page Number
Pediatric Exam Cards	Page 4 - 36
Cardiac DoseRight	Page 7 - 32

Testing Information	Page Number
Estimated patient dosimetry covering pediatric size ranges	Page 4 - 38
Image quality assessment	Incisive CT Technical Reference Guide Page 4-1 to 4-15
Quality Control instructions including tests to ensure proper operation across a broad patient size range	Incisive CT Technical Reference Guide Page 4-1 to 4-15

Radiation Dose Reduction Strategies for Pediatric Patients

There are several steps that can be taken to reduce the amount of radiation that pediatric and small patients receive from CT examinations. The following information may assist in avoiding unnecessary patient exposure.

Only perform necessary CT scans

Is CT the most appropriate study?

Prior to any scan performed, it is important for the patient's physician and the radiologist to determine whether the patient actually needs to have a CT scan as well as review all of the indications and the appropriate techniques to be used. Things that must be taken into consideration include: reason for the scan, number of prior scans patient has had, and options for other available lower dose procedures. In all circumstances, the expected benefits of the scan must always exceed the overall risk.

Only scan the organ or anatomical region indicated

Scan coverage should be limited to only the organ or anatomical region of the body indicated to avoid unnecessary exposure.

Minimize multi-phase contrast CT scans

Scan only one series if possible. CT studies with and without contrast material are not always needed. Multi-phase imaging may double or triple the dose and may not add diagnostic information to the study. If multi-phase studies are needed, use a lower dose technique for the non-contrast series compared to the contrast series and limit the scan to only the organ or anatomical region indicated.

Properly Center All Patients in the Gantry

Careful patient centering allows the bow tie filters to permit transmission of X-rays only where they are needed and limit transmission where X-rays are not needed. Patients must be properly centered in the gantry for optimal X-ray exposure as well as optimal image quality.

Warning

It is recommended that the patient is centered in the gantry opening within ±2 cm of isocenter for all scans.

Use Pediatric Positioning accessories

These accessories are sometimes helpful in both securing and keeping the patient still, resulting in fewer repeat exams and radiation exposure due to patient motion.

- Papoose boards
- Neonatal immobilizers

Make a Child Friendly Environment

Pictures of animals on the wall or ceiling, stuffed animals, and games are all effective ways to help pediatric or small patients feel less scared. Depending on their age, explain the procedure so children know what to expect when they enter the scan room. This aids in patient cooperation and, potentially, fewer repeat studies and dose due to patient motion.

Limit the Signal-to-Noise Ratio

Limit the highest quality images to very specific indications such as angiography or visualizing small subtle brain lesions. Studies with higher

noise may be just as diagnostic for some studies (for example, brain ventricle size, sinuses, and so on) and require a much lower dose.

Use Dose Reduced Scan Parameters - Age and Weight Based Pediatric Protocols

Use pediatric exam cards based on the patient's age or weight and clinical indication to avoid unnecessary X-ray exposure. Reference pediatric exam cards are installed on the system and grouped according to patient age for head scans and patient weight for body scans. Exam cards are arranged in colors according to infant and child (infant exam cards are colored pink, child exam cards are blue). The reference exam cards should be considered as a vendor baseline. The reference pediatric exam cards were developed with engineering, clinical applications, and customer input and are intended to produce diagnostic images at lower doses for infants and children.

Note

- **Select the Infant Age Group and Infant Exam Card when scanning patients from newborn to 18 months of age.**
- **Select the Child Age Group and Child Exam Card when scanning patients from 18 months - 16 years of age.**

Use Dose Reducing Tools

Scanner dose modulation tools such as 3D Modulation and Z-Modulation are designed to reduce dose while maintaining the original protocol image quality.

Guidelines for Adjusting Individual Exposure Parameters

Pediatric Exam Cards

Optimize Pediatric Exam Cards for your Facility

You are encouraged to work with your radiologist and medical physicist to determine the lowest possible dose for the image quality desired. Remember the size of the patient within the scan region, rather than the size of the patient overall, should be considered when optimizing

parameters. For instance, the region of interest may be smaller or larger than what is indicated by the weight of the patient.

In addition to the information presented here, the references listed above in "References for pediatric dose optimization" are excellent resources for optimizing scanning protocols.

Lower kVp

For patients at the lower end of the weight range for a given weight category, consider decreasing the peak kilovoltage to 70 kVp, 80 kVp or 100 kVp. By default, when the kVp is decreased and DoseRight is enabled, the scanner automatically increases the mAs to maintain image quality. To reduce dose in smaller patients, you may choose to keep the mAs at the original value or increase it to a value less than that automatically provided by the scanner.

Note

The $CTDI_{vol}$ dose display can be used to determine the different combinations of kVp and mAs required to achieve the same dose value. For example, in order to maintain approximately the same dose for a technique of 120kVp and 100mAs you would need to use approximately:

- **70 kVp at 556 mAs**
- **80 kVp at 333 mAs**
- **100 kVp at 164 mAs**
- **140 kVp at 68 mAs**

Since lower kVp means lower X-ray penetration, it is important not to use a low kVp selection on a too large patient even if dose is maintained by increasing mAs because this could result in compromised image quality. Work with your radiologist and medical physicist to establish low kVp protocols and patient size limits.

Note

Lower kVp selections also increase HU ranges and improve image contrast. Therefore, the window width for viewing images may need to be changed to maintain a similar appearance.

Dose Reporting

$CTDI_{vol}$ values provide a measure of absorbed dose to a phantom of a specific size. $CTDI_{vol}$ values along with the phantom size used to measure the values are provided by the scanner according to international standards set forth by the International Electrotechnical Commission (IEC).

SSDE values provide an estimate of the absorbed dose that takes into account the patient's water equivalent diameter in the anatomical region scanned (expressed as Average Scan Size in units of cm) and the radiation output of the CT scanner (expressed as $CTDI_{vol}$ in units of mGy). SSDE values and Average Scan Size are provided by the scanner according to international standards set forth by the IEC.

Considerations

- $CTDI_{vol}$ values provide a measure of absorbed dose to a phantom of a specific size.
  - $CTDI_{vol}$ does not quantify dose to individual patients. The absorbed dose to patients smaller than the phantom (some pediatric patients) is greater than the reported $CTDI_{vol}$ while the absorbed dose to patients larger than the phantom (overweight and obese patients) is smaller than the reported $CTDI_{vol}$.
  - $CTDI_{vol}$ values are useful for making dose comparisons between different scan techniques or between similar exam cards on different scanners.
- Phantom sizes are provided along with $CTDI_{vol}$ values in the display and recording of dose.
  - CTDI is measured with a 32 cm phantom for Adult body scans, and a 16 cm phantom for head (both Infant and Adult) and Infant body scans.
- SSDE values provide an estimate of the absorbed dose that takes into account patient anatomy in the scanned region and the radiation output of the CT scanner.
  - SSDE does not quantify dose to individual patients. The accuracy of this estimate is better than that of $CTDI_{vol}$ but still differs from the actual absorbed dose to the scan volume by as much as ±20%. Special clinical scenarios which introduce additional uncertainty into the estimate of SSDE are listed below.
  - SSDE is calculated using a conversion factor appropriate for the Average Scan Size and the $CTDI_{vol}$ for the selected exam card. Selection of the conversion factor is based on the patient's water equivalent diameter in the anatomical region scanned (expressed as Average Scan Size in units of cm). Compared to $CTDI_{vol}$, SSDE therefore provides a more accurate absorbed dose adjusted to the patient size; the SSDE for smaller patients is greater than the

reported $CTDI_{vol}$ and the SSDE for larger patients is smaller than the reported $CTDI_{vol}$.
  - SSDE values are particularly useful for evaluating dose to small, pediatric patients since the actual absorbed dose to these patients is much higher (as much as 3 times higher) than indicated by the $CTDI_{vol}$ for a given exam card.
- Average Scan Sizes are provided along with SSDE values in the display and recording of dose.
  - SSDE is calculated using a SSDE conversion factor appropriate for the anatomy being scanned and the $CTDI_{vol}$ for the selected exam card. Selection of the conversion factor is based on the patient's WED within the planned scan region, which is determined from the surview image and reported in units of cm.

Note

When considering the actual absorbed dose to the patient, know that the dose may be higher than the reported $CTDI_{vol}$ if the part scanned is smaller than the phantom used to determine the displayed CTDIvol values. SSDE provides a more accurate estimate of absorbed dose as it is adjusted for patient size.

Limitations of SSDE in special clinical scenarios

Neck included in scanned anatomy

Additional uncertainty in SSDE of approximately 10% is expected for scans of the head and neck when the scan length in the head and neck region are approximately equal. This is because conversion factors for the head are applied to the entire scan length even though they are not as appropriate for the neck.

Range of scan projection radiograph exceeded

If the actual scan length exceeds the range of the scan projection radiograph, the manufacturer shall estimate WEB based on attenuation data acquired within the region of the scan projection radiograph, in the majority of clinical cases, the additional uncertainty in the SSDE is not expected to exceed 5 %.

Single or bilateral extremities are scanned

In the case of bilateral lower extremity scans or bilateral upper extremity scans where the arms are above the head, patient size estimates from the

surview image can be less accurate. This can have a minor impact on the SSDE but any additional uncertainty in the estimate is not expected to exceed 5%.

Patient is not positioned at the center of rotation along the source/detector direction

When patients are not properly centered, patient size estimates from the surview image can be less accurate. Any additional uncertainty in the estimate of SSDE is not expected to exceed 5%.

Patient anatomy outside the scan field of view

Patient anatomy outside the scan FOV will result an underestimation of patient size from the surview and an overestimation of SSDE. However, at large patient sizes, the conversion factors vary slowly with changes in patient size. Except for morbidly obese patients, any additional uncertainty in the estimate of SSDE is not expected to exceed 5%.

Foreign Objects in the Scan Field

When foreign objects (e.g., metal implants, radiation therapy planning hardware, life support devices, bismuth shields) are in the scan FOV, patient size estimates from the surview image can be less accurate. The magnitude of uncertainty in estimation of patient size will depend on the physical size of the foreign object and the attenuation of that material relative to bone and soft tissue. This may result in overestimation of patient size and an underestimation of SSDE causing additional uncertainty in the SSDE that may exceed 5%.

4.7 Modifying scan series exam card parameters

If the value in a specific field does not suit the case requirements, modify it this way:

- Select the desired parameter for modification by clicking in its field with the left mouse button. Type in a new value.
- If an arrow appears to the right of a field, click it to open a drop down menu of selections (some fields are limited to values listed in the menu).

Note

If two scans within the study are the same type, the plan information for the first will automatically populate the plan information for the second. The scans do not have to be sequential for this to occur.

When all the parameters are set as desired, click **Go**. Follow the scan procedures.

Note

If the preset parameter values are changed frequently, use the Exam Card Manager function to permanently replace them with frequently used values.

Warning

Make sure that the correct scan parameters are entered to ensure accurate left/right orientations.

4.8 Precise image

Precise image reconstruction is a recon mode where the system uses a trained deep learning neural network to generate noise reduction images and improve low contrast detectability with reduced dose compared with standard FBP recon mode.

Precise Image is not designed for pediatric scan (child and infant). If used with pediatric scan, artifact may be introduced.

Precise Image has 3 Image Definition: Soft Tissue, Bone, and Lung. and 5 noise reduction levels: Smoother, Smooth, Standard, Sharp, and Sharper. Level Sharper is the least aggressive noise reduction; level Smoother is the most aggressive noise reduction. In order to use the feature effectively, you will have to progressively design exams that apply noise reduction until the desired level and noise reduction combinations are reached.

When using Precise image to reduce noise, follow these suggestions:

Review the image noise level of several patient exams with the current (new) settings before proceeding to the next level of Precise image.

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Always review images with the reading radiologist when selecting a new Precise image level.

4.8.1 Setting up Precise Image

To enable Precise Image feature:

1. Click the **Show All**.
2. Select Precise Image in **Recon Mode** drop down menu in **Reconstruction** tab.
3. Select a tissue in Image Definition drop down menu.
4. Select a level.

Precise image has a 90 day probation period. To purchase the Precise image option, contact your Philips representative.

4.9 Precise Position

Precise Position is a camera based workflow designed to assist with positioning the patient automatically from console or OnPlan, it can:

- automatically select patient orientation.
- automatically set vertical centering & positioning of the patient to the Surview start and end positions.
- support editing Surview start & end range and scan direction.

Precise Position description

The precise position feature consists of hardware and software, for the hardware part, the camera with both RGB and depth function is installed in the ceiling of the scan room, in such a way so as to cover the entire patient on the patient table. The camera is suspended via camera mechanical installation kit as shown in the figure below. The camera control and image data are transmitted via the high speed fiber and copper hybrid USB cable as shown in the figure below figure. The power supply of the camera is from the gantry as shown in the figure below. Philips service engineer is responsible for the entire installation process. For the software part, Precise Position adopts the AI algorithm (Convolution Neural Network) to detect the joints of the patient body, and then identifies surview start/end position and patient orientation. The

algorithm can also support detection of target vertical height of scan anatomy.

The software displays the detection result including surview start/end position, target vertical height of scan anatomy, patient orientation in both console and gantry panel. The patient orientation and surview range can be modified by user in both console and gantry panel. Finally, the user can press and hold Smart Load to move the table to the start position and target vertical height of scan anatomy. The traditional patient positioning approach is still available at all times. User can conveniently switch between automatic camera detection mode and manual mode.

Camera mechanical installation kit an camera

Fiber and copper hybrid USB cable

Power cable

Warning

To avoid injury due to the equipment falling, please contact Philips Customer Service for maintenance whenever a loose part is found for the equipment.

Precise Position environmental requirements

Before using Precise Position confirm that the room meets the appropriate conditions to ensure Precise Position runs normally:

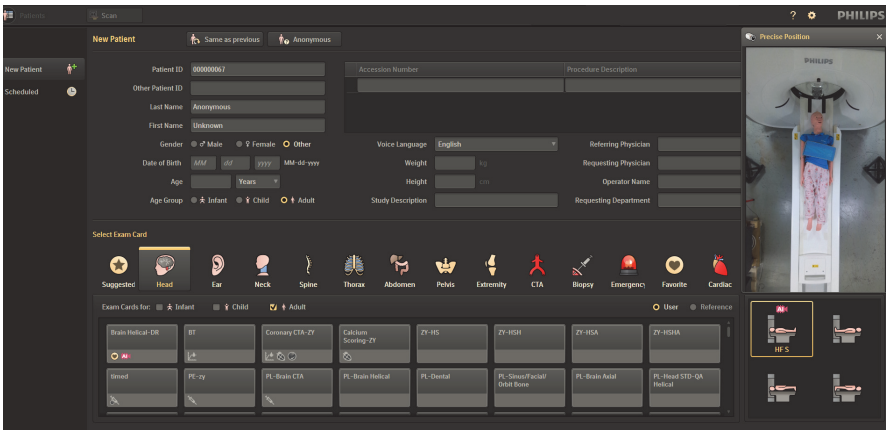
Temperature	Temperature variation	Relative humidity	Air pressure	Room lighting requirement
18°C ~ 24°C (64~75°F)	less than 5°C per hour	40% ~ 70% (no condensing)	70 - 106 kPa	≥75LUX

Use the Precise Position from the console

Follow these steps to use the Precise Position from the console:

1. Place the patient on the patient table when the table is at home position.
2. Ensure the **Precise Position** viewer is shown. To display the **Precise Position** viewer, click the camera icon at the bottom of the **New Patient** interface.
3. Select the patient from HIS/RIS or manually enter patient details, and complete the patient information as needed.
4. Select the desired exam card.
5. The patient orientation is selected automatically, which is with an AI

marker in a pink camera icon.



6 Click **Start Exam**, start and end positions of Surview range are shown on the console.

7 Adjust the Surview range by dragging the start/end lines with mouse and/or change the Surview direction by double clicking the arrow to the left, beside the start/end line if needed.

If desired, click **Reset Surview Range**, the original start and end positions of the Surview range are shown.

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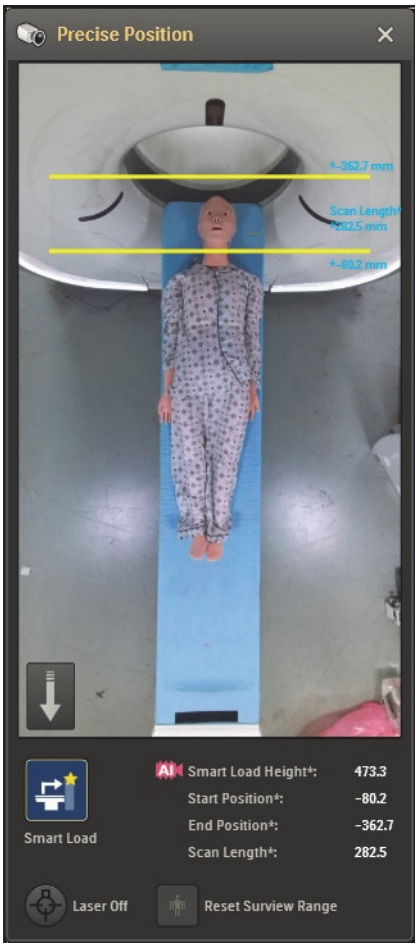


8 Click and hold down **Smart Load** to move the table to the start position.

9 Verify the position using the laser light if needed.

10 Click **GO** to initialize the scan.

Correct the Patient Orientation from the console

If the patient orientation automatically selected by Precise Position is incorrect, please follow these steps to correct it:

- Manually select the correct orientation in the **Select Patient Orientation** area, if you are in the **New Patient** interface.
- Open the **Select Patient Orientation** list by clicking the patient orientation icon in the left upper corner of the series list, and select the correct orientation.

Note

- **Currently, the Precise Position is supported in the following scan types: Head, Chest, Abdomen, Pelvis, CAP, AbdoPelvis, ChestAbdomen and HeadChestAbdomenPelvis. Only the exam cards with AI camera icons are available for Precise Position.**
- **Precise Position is only available for the first Surview of a new study.**
- **The Surview range can be modified before clicking Smart Load. The vertical position can just be shown in display, cannot be modified.**
- **Precise Position will go into sleep mode after 15 minutes of no activity. Once a new patient is started, Precise Position will become active automatically.**
- **If an error with Precise Position occurs, you can position the patient manually, or follow the on-screen instructions. If the error persists, please contact Customer Service.**

Use Precise Position from OnPlan

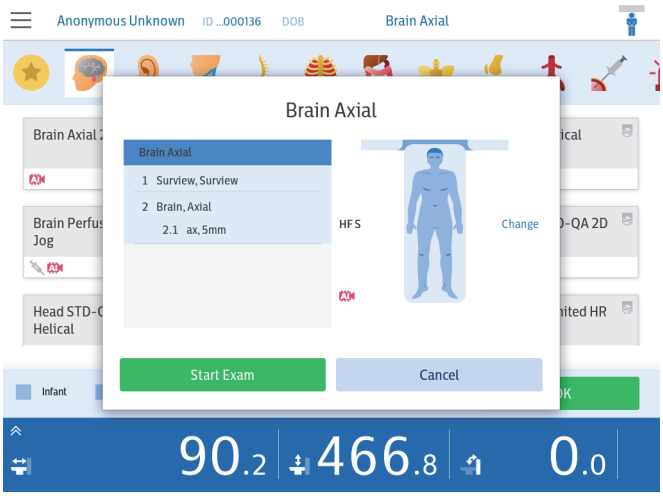
Follow these steps to use the Precise Position from OnPlan:

1 Place the patient on the patient table when the table is at home position.

2 Select the patient from the worklist and complete the patient information as needed.

3 Select the desired exam card.

4 The patient orientation is selected automatically, which is with an AI marker in a pink camera icon.



5 Click **Start Exam**, the start and end positions of the Surview range are shown on OnPlan.

6 Adjust the Surview range by dragging the start/end lines with your

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finger and change the Surview direction by clicking the arrow on the left, beside the start/end line.

If desired, click **Reset Surview Range**, the original start and end positions of the Surview range are shown.

7 Press and hold down **Smart Load** to move the table to the start position.

8 Verify the position using laser light.

9 Click **GO** to initialize the scan and go to the console room.

limitation for Precise Position

There is no limitation for Precise Position except below items:

- Patients below the age of 16 are not supported.
- Decubitus orientations are not supported.

The Precise Position display results may get affected by the following conditions:

- When the patient is covered by sheet, blanket etc.,
- When the patient is not completely covered by the ceiling camera view, e.g. blocked by the gantry or out of camera's FOV etc.
- When the patient is wearing clothes that reflects light, e.g. plastic-like clothes.
- When the patient is wearing black clothes.
- When the patient is wearing thick clothes.
- When there are other people around the patient.

5 Patients

5.1 Overview

This Patient interface includes the following contents:

- New Patient
- Scheduled
- Completed

Warning

Confirm personal information with the patient before scanning to avoid incorrect Patient Identification.

5.1.1 Workflow bar

Your operating process is guided by a simple graphical user interface, called the Workflow bar, that appears across the top of the window. The Workflow bar consists of several buttons that become highlighted to guide you as you work your way through an exam.

Patients - Toggles to the Patients window. This window schedule features creating new patient, scheduling new patient and a directory of completed studies including a series list, data list and a review window.

Scan - Specifies the parameters for the current study, reviews the result of the current study, exits the current study and returns to the Patient window.

Review - Accesses the image viewer. This window allows you to review images in 2D, MPR, Volume, and Endo modes (other modes may also be available on your system).

Analysis - Accesses the image analysis viewer. This window allows you to analyze images in Lung Nodule Analysis, CT Colonoscopy, Vessel Analysis, Dental Planning, Brain Perfusion, Dual Energy, Coronary Artery Analysis, Coronary Calcium Scoring, Cardiac Function Analysis.

IV - Accesses the image IV viewer. This window will help you to navigate the needle safely during the intervention.

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Filming - Displays and arranges the images for filming. It is always enabled.

Report - Accesses the report generated from the exported scan information. This feature is not active when information has not been sent.

Service - Accesses daily Service options for the scanner. These options include Air Calibration, Short Tube Conditioning, and Exam Card Manager (see corresponding sections for more information on Service applications).

Help - Displays the current software version for your system, and gives access to the Operator Manual and the Philips website.

Import IFU

1. Insert Incisive CT Instructions for Use disk/USB in computer.
2. Click **Help**.
3. Click **Operation Manual**.
4. Click **Import.**
5. Select the import path in Select Source Path.
6. Click **OK** to import the IFU.
7. Select the desired IFU in drop down list to view.

5.1.2 System status bar

Archive status can display several items depending on the current workstep:

- Date and time
- Tube heat storage percentage
- Available space on Local drive
- The gantry tilt angle
- The table height and the distance from the gantry
- Job Manager
- The current disc available space
- Precise Position
- Screen Lock

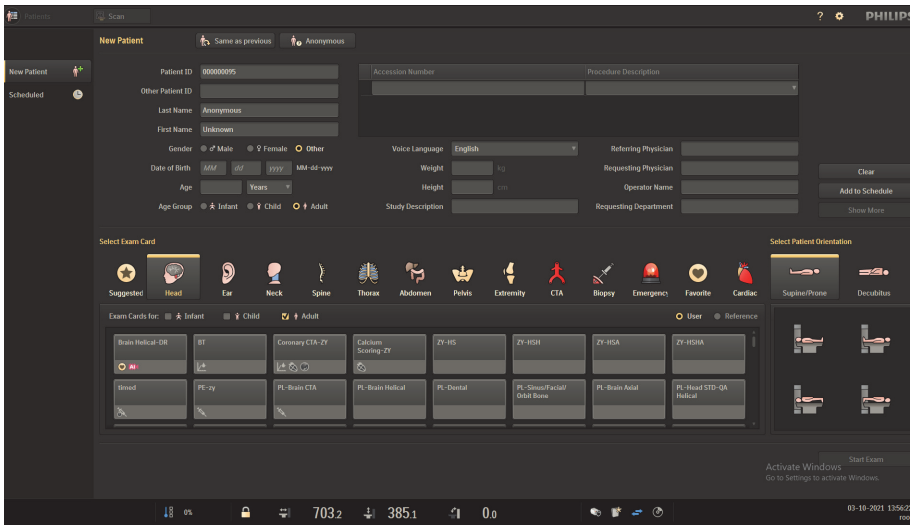
- New Software Available

Job Manager

Click **Job Manager** to open a window that includes some tabs: Reconstructing, Printing and Exporting. Reconstructing allows you to view the status of a reconstruction in progress. Options to start, stop, delete, pause, resume and move forward and backward studies in the list. The Printing and Exporting allow you to manage items as they are transferred to another disk, external media or to print.

5.2 New patient

"New Patient" window includes the following contents:



1 Patient Information panel	2 Select Exam Card panel
3 System Status bar	

5.2.1 Patient information

- **Same as previous** brings the details of the current patient (that was last entered) to the parameter fields.
- **Anonymous** fills a preset subset of generalized patient details for unidentified patients.

Note

After the scan has finished, you may operate a utility for correcting Anonymous patient image data retroactively in the patient catalog and in archives.

Patient data fields

You can customize the patient data form to display the fields relevant for your site (see **Patient registration settings**, on page 22-15). The Patient ID, Last Name, and Age Group are set as mandatory by the system.

You must select the appropriate setting for the age of the patient in the Age Group field. If the patient is a child up to 18 months, the appropriate setting is **Infant**.

Use the **Other** setting for Anonymous patients whose gender is anatomically unidentifiable, and whom is imported from HIS/RIS with no gender. It may also refer to anything other than a living creature (for example, minerals and phantoms).

Note

Mandatory fields must be completed in order to conduct a scan procedure. All mandatory fields display a red asterisk.

After completing the patient data form, you can select scan exam card. See **Exam cards**, on page 5-6 for more information.

Enter a new patient information

When entering a new patient, you must complete the highlighted mandatory fields:

1 Click **New Patient**.

2 Based on your system set-up, the **Patient ID** field automatically contains a value. If you want to change it, type a new patient ID for the patient.

3 In the **Last Nam**e field, type the last name of the patient.

4 In the **First Name** field, type the first name of the patient.

5 In the **Date of Birth** field, type the month, day and year of the patient's birth.

6 Select Infant, Child or Adult in **Age Group**.

7 Click the appropriate Gender for the patient:
- Male
- Female
- Other

The **Age Group** automatically populates based on **Date of Birth**. The exam cards then display according to Age group.

Note

Your system may be configured to make the Age Group mandatory instead of the Date of Birth.

8 Enter the rest of the patient's details, if desired.

Note

- **To reach a field from anywhere on the screen, click inside the text box. After typing the data, press Enter. The cursor jumps to the next field. <Tab> also jumps between consecutive fields.**
- **The value of the Age field can be typed directly. Once the Date Of Birth is entered, the patient's age and Age Group are automatically entered.**

Clear- clear all the actions in New Patient.

Add to Schedule - add the current patient to **Scheduled**.

Show More- shows the hidden parameters, which are set in Patient Registration Setting. See **Patient registration settings**, on page 22-15 for more information.

Split Study

Multiple accession numbers may be generated for a patient's CT Exam, however, only one acquisition is necessary.

Procedure Description-relevant for defining the split study.

See **Set Split Study**, on page 5-9 for split study exam cards.

1 Register patient information in **New Patient**,
2 Type a number in **Accession Number**.
3 Select or type a name in **Procedure Description**.
4 Repeat step 2 and 3, until you get the desired procedures.
5 Select desired exam cards by clicking the exam card.
6 Select an orientation in **Select Patient Orientation**.
7 Click **Start Exam** to start scan process.

Import a patient from Scheduled

1 Select multiple procedures of a patient by using the Ctrl or Shift key (the number of procedures you select determines the number of studies that will be split).
2 Click **Select Patient** to load the patient.
3 Select desired exam cards by clicking the exam card.
4 Select an orientation in **Select Patient Orientation**.
5 Click **Start Exam** to start scan process.

5.2.2 Exam cards

Exam Cards are selected on a per-patient basis, depending on the type of exam desired. The Exam Card stores the scan parameters, injection protocols, and required results for a given scan type.

When you select Exam Cards, numerals appear in sequence of each Card in yellow, indicating the order that the exams will load (for example 1, 2, 3 and so on). If you do not want to select an exam card anymore, click the exam card again to de-select it.

Exam Cards are created using the Exam Card Manager, but can also be modified and saved during the scan process.

User or Reference Exam Cards

Exam Cards are categorized according to User and Reference-created content. The Reference Exam Cards shipped with the system can be used as the basis for creating your own, specialized exams (User Exam Cards)

Exam Card Groups

The Exam Cards are further organized into groups based on anatomy, or the user-selected Suggested Exam Cards. Click on a group to see all of that group's available exam cards.

Exam Card suggestion settings

Exam Card suggestion settings enables the mapping of the user set of Exam Cards to the Procedure Description. At the start of an Exam, when filling in the patient details and receiving the procedure description from the HIS/RIS, the Suggested Exam Card group is populated accordingly.

Add suggestion exam card

1 In **Exam Card Manager**, click **Exam Card suggestion settings**.
2 **Exam Card suggestion setting** dialog box appears, select desired DICOM property in **Select dicom property** drop down menu.
3 Click **Add**.
4 Type a keyword in **Add** text box, press **Enter**.
5 Click **Close** to exit **Exam Card suggestion setting** dialog box.
6 Select a desired exam card, click **Edit**.
7 Click **Edit...**below **Suggest exam card for**.
8 **Suggest exam card for** dialog box appears, check the keyword.
9 Click **OK** to exit **Suggest exam card for** dialog box.

Import suggestion exam card

1 In **Exam Card Manager**, click **Exam Card suggestion settings**.
2 **Exam Card suggestion setting** dialog box appears, select desired DICOM property in **Select dicom property** drop down menu.
3 Click **Import** to import to **Add/Replace** keyword from HIS/RIS.
4 Click **Close** to exit **Exam Card suggestion setting** dialog box.
5 Select a desired exam card, click **Edit**.
6 Click **Edit...**below **Suggest exam card for**.
7 **Suggest exam card for** dialog box appears, check the keyword.
8 Click **OK** to exit **Suggest exam card for** dialog box.

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Select suggested exam card

1 Click **Patients**. In **New Patient** or **Scheduled** interface.

2 When the keyword in Procedure Description is same as suggested exam card, Click **Suggested** in **Select Exam Card**.

3 The corresponding exam card appears.

Select Exam Card

Reference IEC 60601-1-3 Clause 5.2.4.4.

The scan procedure requires you to select an exam card. To acquire optimal images, it is recommended that you use factory-set exam card.

1 Click an exam card group to select it. The system displays the exam cards for that group.

- It includes **User Exam Cards** and **Reference Exam Cards**.
- Hold the mouse over an exam card to display its specific options.
- Philips exam cards can be identified by the Philips logo.
- Exam cards are color-coded: pink for infant and blue for child.

2 Click the desired Exam card to select it.

Edit Exam Card

This function is used for creating, changing, deleting or duplicating Scan exam cards.

1 Click **Service** to display the Service options.

2 Click **Exam Card Manager**. The Exam Card Manager display.

Note

- **The Philips logo displays on factory set protocols. These factory protocols cannot be edited or deleted. Use the Save As feature to create a new protocol containing the changes to default settings. It is recommended that you use factory protocols to create new protocols.**
- **The STD-QA exam card is designed only for system service use or IQ checks only. This exam card should not be used for clinical examination and user exam card creation.**

3 Select the exam card to be edited and click **Edit** to enter **Edit**.

4 Edit the parameters, select age group and weight group as necessary.

5 After all parameters settings are complete, select one of the buttons at the left bottom of the interface:
- **Save** - Allows you to permanently replace the parameters in an exam card with the changes you have just made. Use this option to change an existing exam card (not applicable with factory set exam cards).
- **Save As** - Allows you to generate a new exam card with the changes you have just made. After selecting this, you are prompted to select an exam card group and enter a new exam card name.
- **Delete** - Allows you to delete the selected exam card from the set of exam cards. The system prompts you to confirm your selection. You cannot delete factory set exam cards.
- **Cancel** - Allows you to exit the Generate exam cards application.

Location - Results can be linked to other results planned over the same surview. To use Location, select Location from the drop-down list. For results that have the same body part, (as set in Exam Card Manager) the second result inherits the geometry parameters of the first result. Once a result is selected, identical link between the result plan boxes is broken; press CTRL button and adjust the result plan box for the first result to re-synchronize planning for the following results. Location is only applicable to axial results.

Set Split Study

1 Set **Exam Card Suggestion Setting** as desired.

2 Select an exam card, click **Edit**.

3 Select the Recon series in Process List.

4 Select the desired keyword in **Reconstruction** tab **Procedure** list.

5 Adjust parameters as desired.

6 Save the exam card.

7 Enter **Accession Number** and **Procedure Description** during patient registration.

8 Select the saved exam card to perform the scan.

Export or import exam cards

Use the Export and Import exam cards options to transfer exam cards onto and off from your system using removable media.

1 Click **Service** to display the Service options.
2 Click **Exam Card Manager**.
3 Select the desired exam card.
4 Click **Export** exam cards or **Import** exam cards. The applicable form opens.
5 Select the destination of export to.
6 Select **Exam Cards** to export.
7 Fill a name in **File Name** for **Export** exam card (Export exam cards only).

Change the exam protocol order

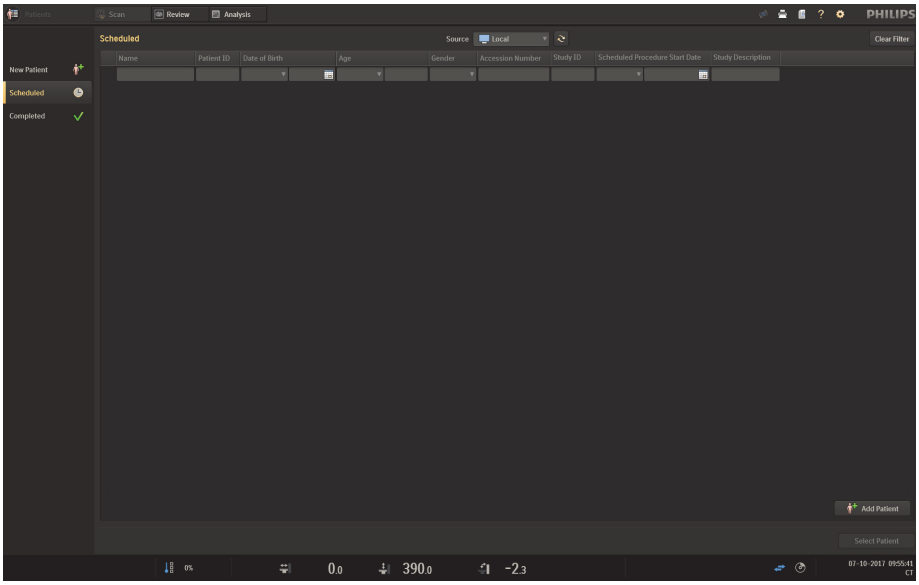
1 Click **Service** to display the Service options.
2 Click **Exam Card Manager**.
3 Select the desired exam card.
4 Drag and drop to change the order of the exam cards.

Start New Patient Exam

1 Enter patient information in **New Patient**.
2 Select the appropriate exam card in **Select Exam Card**. Emergency patients can select **Trauma** exam card.
3 Select the proper position in **Select Patient Orientation**.
4 Click **Start Exam** to display the scan interface.

5.3 Scheduled

Click **Scheduled** to access the patient catalog.



- The Scheduled displays only those patients who are scheduled to be scanned.
- The **Worklist** (if applicable) displays patient information provided by the HIS/RIS.
  - **MPPS** function: If the patient is from the Worklist and the MPPS function is enabled, feedback regarding the study status of the patient can be sent to the hospital HIS/RIS.

Warning

Confirm personal information when select patient in Worklist to avoid incorrect Patient Identification.

Note

When HIS/RIS is enabled, you also have the option of displaying the medical alerts stored in the database.

Add Patient

1 Click **Add Patient** to add a new patient to the list. The system displays the patient data form.

2 Enter the patient information.

3 Click **Add to Schedule** to add the patient to the list.

4 Click **Back to Schedule** to return the **Scheduled** interface.

Delete Patient

1 Select the desired name from the patient list.

2 Click **Delete** in right click menu to remove the patient.

Modify a patient

1 Select the desired name from the patient list and double click.

2 The system displays the information for the selected patient. Change the patient information as desired.

3 Click **Save** to save the changes.

4 Click **Back to Schedule** to return the **Scheduled** interface.

Scan from patient catalog

1 To begin a scan from the Schedule catalog, select the desired name from the patient list.

2 Click **Select Patient**.

3 Select the appropriate exam card in **Select Exam Card**. Emergency patients can select **Trauma** exam card.

4 Select the proper position in **Select Patient Orientation**.

5 Click **Start Exam** to display the scan interface (see **Scan procedure**, on page3-10).

5.4 Completed

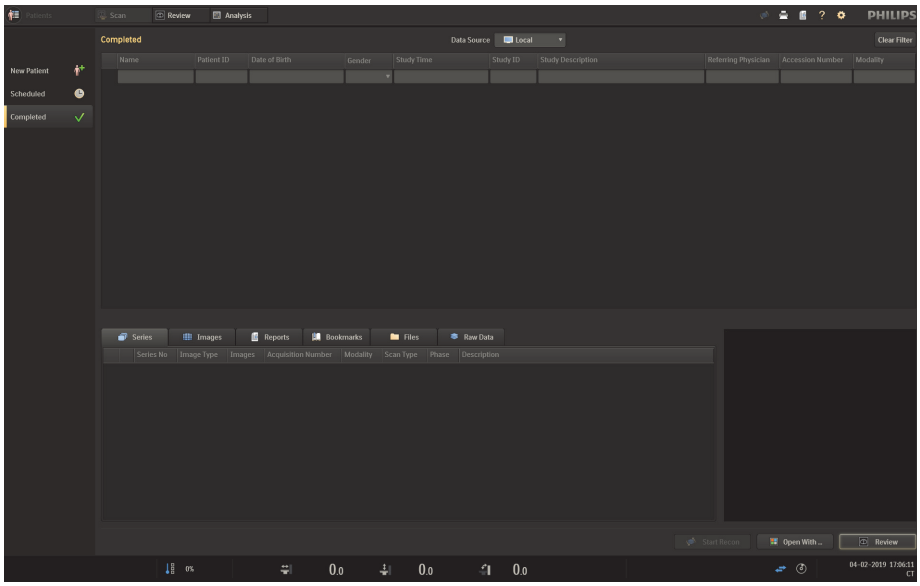
Several options are available while in the **Completed** window:

- Select and retrieve images from local and remote storage devices.
- Copy images and files from one device to another.
- Access reconstruction information.
- Film images.
- View sample images.
- Erase data from local devices.

Be sure to familiarize yourself with this information before conducting any scan procedures.

5.4.1 Completed window

Click **Completed** in **Patient** interface to display **Completed** window.



The **Completed** window consists of these items:

1 patient list	2 series, reports and raw data tabs
3 image preview window	

5.4.2 Completed

Completed - Displays information for all scanned patients in the current database.

Data Source list - Allows you to select a device from which to access patient data. To prevent patient list confusion, only one device may be selected at a time (in this case, the Local drive).

- Click the down-arrow next to the selected device icon to view the device list. The list offers local and remote devices.
- Click on the device you want to access.

Patient Search

- Enter keywords in Name, Patient ID, Study ID, Description, Referring Physician, Accession Number, Modality.
- Select search time in Date of Birth and Study Time.

- Select search patient gender in Gender.

Clear Filter - Returns the patient list back to its original state before filters were enabled.

Right-click on a patient study to access the following functions:

- **Lock** - Allows you to turn the lock on and off. You cannot remove locked patient data from the system.

Warning

When the raw data disk capacity reaches the limit, the system deletes the raw data of the earliest unlocked study to create enough space for the next scan. Offline reconstruction is not possible for a scan without raw data.

- **Film** - Sends selected study to the **Filming** application
- **Send current image to Report** - Allows you to send the selection to the **Report** application.
- **Edit** - Allows you to edit the details of a patient who was previously entered in the system.
- **De-Identify Patient** - Allows you to permanently eliminate the patient data from selected study to protect patient privacy. A duplicate study is created without the identifying patient data.

Note

The original study is not deleted.

- **Copy to** - Allows you to copy the currently selected items to another device. A dialog box opens with lists of available Local and Remote archive devices.
- **Start New Exam** - Allows you to start a new scan.
- **Delete RawData** - Allows you to delete the selected patient's raw data.
- **Delete Patient** - Allows you to delete the selected patient and corresponding data.

Warning

Please ensure the images have finished filming or archived to avoid missing images, before deleting them.

Copying studies

You have the option to copy studies to external media using the **Copy To** function.

1 Select the desired images from the Study list in the **Complete** window.

2 Right click to select **Copy To**.

3 Select the device that has been set in System Setting.

4 Click **Save.**

Removable Media Devices

Caution

Patient health-related information recorded on removable media may become accessible to unauthorized individuals and thus create a privacy protection risk. Please refer to the Security of System and Data section (in Technical Reference Guide) for information.

One removable-media device, the CD/DVD drive, is included in the standard configuration of your system to read, write and copy DICOM files as desired. Also included in the standard configuration is USB capability, used to backup and restore clinical data, and used for OS and application Installation.

Load data into Review or Analysis

1 Select the desired images from the Study list in the **Complete** window.

2 Click **Open With** at the right bottom of the interface**.**

3 Select review mode in **Open With** list.

Series, Images, Reports, Bookmarks, Files, and Raw Data tab

The data area includes the **Series** tab, **Images** tab, **Reports** tab, **Bookmarks** tab, **Files** tab and **Raw Data** tab.

- **Series** tab displays the available series for the patient selected in the study tab.

Right click any series to use the following functions:

- **Review** - Allows you to load the selected series for **Review** application.
- **Add series to Review** - Allows you to add series from the same

patient to Review application.
  - **Send to Film** - Sends selected series to the **Filming** application
  - **Send current image to Report** - Allows you to send the selection to the **Report** application.
  - **Copy to** - Allows you to copy the currently selected items to another device.
  - **Combine** - Allows you to choose the desired number to select every 2nd image, 3rd image, and so on until 10th image.
  - **Delete** - Allows you to delete the selected series data.
- **Images** tab displays a list of the images from the series selected in the series tab. Scroll through the list, select the image that displays in the Image Preview area.
  - Review - Allows you to view the selected image in Review viewer.
- **Reports** tab shows available reports created for the selected series.

Right click any report to use the following functions:
  - **View Report** - Allows you to load the selected report to **Report** application.
  - **Delete** - Allows you to delete the selected report.
- **Bookmarks** tab displays the list of bookmarks related to the current study. Double click the bookmark in image preview window, the application launches and the study appears at the same point of progress as when the bookmark was saved.
  - **Delete** - Allows you to delete the selected bookmark.
- **Files** tab displays the video files which you have saved.
  - **Open Video** - Allows you to open the video file, then click **Play** to play the video. Or, you can double click the video file to open it.
  - Copy to - Allows you to copy the currently selected videos to another device.
  - **Delete** - Allows you to delete the selected movie.
- **Raw Data** tab shows raw data, after an exam is completed.

Clicking **Recon** allows you to access the reconstruction parameters to reconstruct raw data. For more information, see **Offline reconstruction**, on page 9-2

Warning

- **Verify that images are filmed or archived before you delete them.**
- **If images are lost, perform offline reconstruction using raw data.**

Image Preview

Image Preview allows you to simply review the selected series image. Use right click menu to review image information.

Dose information page

The Dose Information Page (DIP) is created automatically from the exam's details upon completion of each study. Access the Dose Information Page as follows:

1 Click **Completed**.

2 From the **Completed** window, select a study.

3 In the **Series** tab, click **Dose Info**.

The DIP includes the following study information: Study ID, Study date, study time, total dose (total DLP) and estimated dose savings throughout the exam.

The DIP includes the list of acquisitions performed in the exam, with the following details for each acquisition:

- Series Number
- Series Description
- Scan Mode
- mAs
- kV
- N*T [mm]
- $CTDI_{vol}$ [mGy]
- DLP [mGy*cm]
- Phantom Type [cm]
- SSDE [mGy]
- Avg Scan Size [cm]

If Dose Modulation is used, the displayed $CTDI_{vol}$ and mAs values are the scan's average $CTDI_{vol}$ and average mAs values.

Note

The phantom size has two optional values: Head 16 or Body 32, depending on the scan.

If the surview scan covers both head and neck, then the 16 cm phantom should be used and specified. If one surview scan covers a greater length, then the 32 cm body phantom should be used and specified for the total surview scan.

The DIP is saved as a standard DICOM Secondary Capture image and the DIP has a separate series number.

The 16 cm diameter CTDI phantom is used for head scans. The 32 cm diameter CTDI phantom is used for body scans. The exception is, the 16 cm CTDI phantom is used for infant body scans.

Reference IEC 60601-2-44 Clause 203.5.2.4.1 and 203.112

Note

- **The 16 cm CTDI phantom for infant body scans are more representative of infant bodies than a 32 cm diameter phantom. To approximate the comparable dose index with a 32 cm diameter phantom, divide the posted CTDIvol by 2.**
- **The accuracy of the displayed and recorded values of CTDIvol and DLP is ± 20% or 1mGy. (take the larger one as standard).**

Burn CD/DVD

1. Insert a CD or DVD into the burner.
2. Select the desired images from the **Study** tab in the **Completed** window.
3. Right-click and select **Copy to** then select CDR or DVDR from the menu. Click **Save**.
4. Click the arrow beside the Local drive icon, select CDR or DVDR.
   - Review the data to be burned to the media. You can delete a study by right-clicking on the item and selecting **Delete** from the menu.
   - Click **Clear** to delete the contents of the Copy to folder.
   - The system displays the amount of used and free space on the media.
5. Click **Burn** to begin copying. The system allows the recording of up to ten discs. Studies are copied into different disc folders if there is not enough free space.

   Or you can click **Cancel** to cancel burning.
6. When all burning is finished, click **Clear** to remove all image data in

one disc.

Remove image data

1 Select the desired image data.

2 Click **Delete** in right click menu to remove the image data.

Note

- **If one CDR or DVDR does not have the enough space to burn the single study image data, the system will split study data automatically, but will not split images within a single series.**
- **Always use a blank CD/DVD for recording.**
- **Upon completion of the writing process, verify that all required information has been written to the CD/DVD.**
- **Click Cancel to quit the dialog box, the CDR or DVDR will keep the selected image data.**

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6 Scanner

6.1 Overview

A typical scan procedure consists of these steps:

- enter patient information
- select patient position
- select an exam card
- perform scan

The scanning process is set-up and initialized from the Scan control panel and tabs on the screen. Table movement is controlled from the Scan control box outside of the scan room or the gantry control panels inside of the scan room. This section provides detailed steps to complete a typical exam procedure, as well as descriptions of the available options.

Note

- **If message "There is problem with Adobe Acrobat/Reader. If it is running, please exit and try again" appears at any time, click OK to continue.**

1 Click **Patients**. The Patient data form displays: Enter the patient data (mandatory fields are with red star). You have several options for entering patient data:
- For a new patient, enter patient information directly.
- For an anonymous patient, click **Anonymous**. The system fills in some basic information, including an ID number.
- For the previous patient, click **Same as previous**. The system fills the fields with the information from the last patient entered.

Note

You can also begin a scan by selecting a scheduled patient from the Scheduled page.

Warning

Before proceeding to exam card selection, verify that the patient information loaded into the patient data fields (from any source) is correct. Failure to do so could result in scanning a patient with the wrong information thus requiring another scan on the patient.

2 Select patient orientation.

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3 Click the desired Exam card to select it.

4 Click **Start Exam** to enter **Scan** interface.

5 Alter the scan series as desired (see **Edit the preset scan series** for details about performing these functions). Note that not all of these options are available for the Surview:
- **Add exam card** - Opens the Insert exam card window to add scans to the series, or replace the current exam card.
- **Duplicate Series** - Creates a second instance of the selected exam card.
- **Add Direct Result**-Creates a direct result. See **Direct Result parameters tab**, on page 4-6 for more information

6 Right-click on the procedure to open an additional menu that includes Copy, Delete, Paste, and Perform Air Calibration functions.

7 Set other parameters as desired. Click **Show All** to change other parameters:
- General
- Geometry
- Dose Management
- Reconstruction
- Distribution
- Contrast
- Voice
- Cardiac
- Direct Result

Type the desired information into the correct field, or make a selection from the drop-down menu to alter the parameters for each Series. See **Scan exam card parameters** for more information.

8 Click **GO**. Follow the on-screen instructions for scanning (the surview displays in real time). Upon completion, the system shows the images in the viewer window.

9 If your exam card includes a Surview, you may now plan on your Surview scan.

10 If you are finished with the exam, you can end it and begin another. Click **End Exam**.

In addition to the scanning options you also have the option to film and conduct post-processing analysis.

Priority Transfer

This function, if enabled, ensures that results from the list of planned scans will be transferred to the designated storage location before lower priority results.

Edit the preset scan series

Insert Exam Card

1 To insert exam card after scanning the surview. Click **Add Exam Card**.

2 The **Exam Card** window appears.

3 Select the **Exam Card** group.

4 Select the desired **Exam Card**, click **Insert Exam Card**. The previous surview scan is the first scan series in the scan series list. The check mark next to the Surview indicates the scan was already performed.
- In **Use previous surview** dialog box select **No**, the second (new) surview will be added in scan series list.
- In **Use previous surview** dialog box select **Yes**, the second (new) surview will not be added in the scan series list.

5 If you have already clicked **End Exam** and want to add a new exam card for the current patient, click **Same as previous**. The current patient's data populates automatically.

6 Select the patient orientation.

7 Select exam card. Click **Start Exam**.

8 Select **Use Previous Surview**. The previous surview replaces, or is Scan window inserted into the new series list. You may now plan the new scan on the surview image you previously scanned.

Copy, paste, and delete scan series

1 Right-click a scan series to display the shortcut menu.

2 In the shortcut menu select the desired option:

- Copy to copy the series to the clipboard.
- Paste to paste the series in the clipboard to the series list. The pasted series is inserted below the selected series.
- Delete to delete the series.

Surview

The surview scan is a non-rotational scan that is used for planning the clinical scans. This scan can be performed either anterior to posterior (from below, 180 degrees) or laterally (from the side, 90 degrees). The option of dual surview may also be used. The dual surview performs both scans, one after the other, for planning using both scans. See **Plan on Surview**, on page 6-5 for more information.

After completing the scan, the system displays an overlay of the planned scan coverage area.

Warning

Patients must be properly centered in the gantry for optimal x-ray exposure as well as optimal image quality.

Note

Calculation of the planned accumulated CTDIvol [mGy], Size specific Dose estimation (SSDE) and planned accumulated DLP [mGy*cm] are updated once a new acquisition step is added or removed, and every time a dose related parameter is changed (mAs, kV, Collimation, Scan length).

Should you manipulate the planned area, the system will automatically update the corresponding exam card. Right click on the image to:

- Using tools to edit surview
- Window preset
- Reverse Scan Direction
- Show

- Unselected Series
- Image Information
- Images Area
- Trim Scan
- Grid
- Show Cycle Lines For Axial Scans
- Show Gantry Center Line-View the Gantry center line on the image.

- Delete Series-Delete the active series step.
- Delete All Series

Right-click on the surview name in the Procedure list to:

- Copy
- Delete
- Replan
- Paste
- Perform air calibration

Warning

Pay attention to the measurement on Surview, the measuring result is only for reference.

Plan on Surview

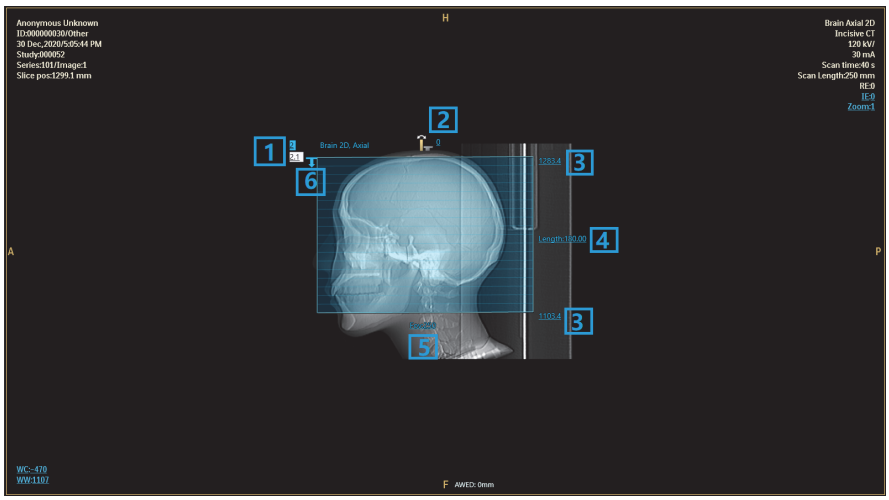
When the Surview scan is complete, a plan box will appear on the Surview. Move the plan box to the desired location.

Scan box

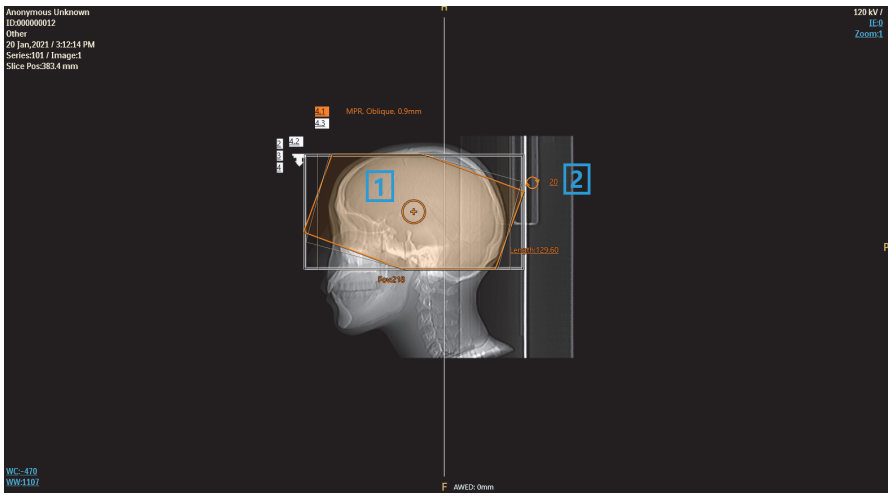
1 If desired, adjust the planned scan box over the desired area.
- Click and drag the box to move it.
- Drag on a point on the box to expand or contract it.

Number	Description
1	Click the No. to select the active series
2	Gantry tilt (For axial scan only)
3	Start/End position
4	Scan Length
5	FOV

Number	Description
6	Double click arrow to change scan direction



Number	Description
1	Recon. Center
2	Click the number to change rotation degree. Select and drag the circle to change rotation degree. Then it shows the MPR Oblique area.



The system adjusts the parameters accordingly.

2 Click **Go** to execute the planned scan. The system displays the final image when the scan is complete.

View the Executed Scan (ES) lines

After scanning a clinical series, to view the ES lines:

1 Load the images (including the surview) into the viewer.
2 Click **Select Image** or **Select Series**.
3 Select surview.
4 Click **Save** to save the surview with the ES lines as a secondary capture.

General rules for multiple scan series studies:

To ensure accurate planning and execution, do not move the table up or down after planning on the Surview scan.

If the patient's position requires changing, restart the procedure.

Timed scans

Timed scans allow you to use contrast and start the clinical scan after a post injection delay. Use this procedure to create a timed scan.

1 Click the **Show All** parameter tab.
2 Select **Contrast** in **Contrast**.
3 Set the **Trigger** type to **Timed**.
4 You can adjust the **Post Inject Delay** or select **Automatic Minimum Delay** in **Contrast**.

Start Final Reconstruction

When **Edit before final recon** is enable, you can edit the scan results in Scan window, before final reconstruction starting. Click **Start Final Reconstruction**, the **Scan** window allows you to see the final results of your scan before post-processing is performed. The system displays the last reconstructed image of your planned series.

You can use this window to ensure the quality of the images, as well as send specific images to print. Right-click on the image to access several common tools and other options.

Following the Examination Flow, you can choose to Repeat or Extend.

Filming images

The **Film** icon is available in the common tools area, and can be use to send the selected images, window or series to the Filming application.

Use this procedure to film images from an application:

1. Click on the appropriate selection mode. In some applications, only the displayed image can be filmed.
2. Launch the film option by clicking the **Film** icon on the toolbar.
3. Edit and print images as desired. See **Filming** for more information.

7 Working with specialized exams

7.1 Test injection bolus timing

7.1.1 Overview

The Test Injection Bolus Timing application analyzes time dependent processes, in particular the uptake and dispersion of contrast material with relation to time. Information measured via the application is then used to help identify the delay time and amount of contrast to inject for a clinical scan.

When using a test injection the vessel or organ of interest is scanned with the use of contrast. An axial scan over the area of interest is performed with a cycle time based on the expected rate of enhancement change. The scan images are then loaded into the Test Injection Bolus Timing application.

ROIs are drawn over the regions whose changes are to be measured. The average pixel values of the ROIs are plotted over time for a graphical description of the time variations.

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7.1.2 Procedure

The Test Injection Bolus Timing (TIBT) procedure consists of the following steps:

1. From the **Select Exam Card**, select the TIBT from appropriate exam card group.
2. Conduct the Surview scan followed by the TIBT scan.
3. When both scans are complete.
4. Draw the ROI on the vessel or organ tracked.
5. View the results on the right of the view port.
6. Use the results from the TIBT graph to set the injection delay by dragging Post Injection delay lines and amount of contrast to use in the clinical scan.

Note

The study must be scanned at 0 (zero) increment. Images not scanned with 0 increment cannot be loaded into the application.

7 Select the clinical scan in the Procedure list and begin the clinical scan.

Note

Graphic elements are not saved or filmed.

7.2 Bolus tracking

7.2.1 Overview

Reference IEC 60601-2-44 Clause 203.107 e and 203.5.2.4.1.

The Bolus tracking function maximizes the efficiency of CT scans that are enhanced with the use of a contrast agent.

When a contrast agent is used to enhance the visualization of organs, the enhancing effect varies over time as a function of the agent's concentration in the blood. Ideally, the Clinical scan is performed when the level of the contrast agent is at its peak enhancement.

Bolus tracking is designed to help the user time the Clinical scan with precision. This is done by preceding the Clinical scan with Locator and Tracker scans.

The Locator scan is a fused Axial scan that is used to locate an ROI and to set a threshold of contrast agent attenuation at that ROI position. During a Bolus tracking operation, the Tracker scan tracks the contrast agent level at the selected ROI, and, when the threshold is reached or exceeded, the Clinical scan is automatically started.

The Bolus tracking function provides the following advantages and features:

- Precise control over scan timing in relation to contrast agent level.
- The ability to improve the differentiation between the blood cycle phases (such as the Arterial phase, Portal and Venous phase, and organ uptake).
- Automatic scan triggering based on threshold value.

- Scan start based on injector trigger (purchasable SAS option is then prerequisite).
- Protocol planning and modifications for the basic Bolus tracking scans: Locator (fused Axial), Tracker (fused Axial) and Clinical (Helical).
- The contrast level threshold is operator-defined; the system default is 150 HU (except Cardiac is 110HU).
- The available minimum delay time is 2 seconds.
- The start of the Clinical scan is automatically initiated when the programmable threshold is reached.
- A manual override is permitted, thus terminating the Tracker scans and initiating the Clinical (helical) scan sequence.
- A programmable time delay is available between termination of the Tracker scan and the start of the Clinical study.
- If desired, additional Clinical helical scans can be planned. They are also automatically started.
- The densities of the ROIs are calculated and displayed at intervals equal to the Cycle time. The consequent Hounsfield unit progress displays on the same graph as the threshold level.

Note

Only the threshold determined by the first ROI terminates the Tracker scan and initiates the Clinical run. Information for other ROIs is recorded but does not affect operation.

Hardware requirements

A power injector, manually controlled by the operator, is the minimum requirement.

Optionally, the injector may be equipped with scan trigger. Then the time from injection start is counted down, and the scanner is automatically initiated after a preset interval. This delay helps save patient irradiation at the beginning of the injection, before the time when the contrast agent can be viewed.

Note

In order to use the injector scan trigger feature, you must have the Spiral Auto Start (SAS) option on your system. This feature is for use with only Philips-approved injectors.

Warning

Route all cables between the injector, the patient, the table and the CT scanner so that they are not damaged and do not impede the free movement or avoid tripping of personnel.

7.2.2 Bolus tracking scan series

The basic Bolus tracking operation consists of a set of three scans, Locator, Tracker, and Clinical. These scans are preceded by a standard Surview scan and optionally followed by additional Clinical scans.

Note

The Locator and the Tracker scans are executed at the same position and therefore they appear as a single line on the Surview.

The **Locator** scan is a single fused scan series, which can be replanned for better patient positioning. It is performed before administration of the contrast agent. It allows you to set the patient position and the ROI locations for the Tracker scan.

The **Tracker** scan is a fused axial scan series with fixed intervals between scans, determined by the Cycle Time. The Tracker and Clinical scan(s) are performed after the administration of the contrast agent. The Tracker scan monitors the concentration of contrast agent at the specified ROI, and compares it to the set threshold. As soon as the threshold is exceeded, the Tracker scan is terminated, the patient table moves to the Clinical scan start location and the Start Clinical scan is performed automatically.

Note

The Tracker scan may be terminated manually, by clicking the "Start Clinical Scan" dialog box, before the threshold is reached. Manual termination of the Tracker scan is followed by the same sequence of events (table movement and Clinical scan) that occurs after automatic threshold termination.

Warning

- **To avoid patient receiving unwanted ionizing radiation due to rescan, monitor the bolus values on the images during the Tracker scan to ensure the scan is proceeding as planned.**

- **In SAS scan, pausing the injector will disable SAS function. Use the Scan button on the CTBox to start the scan.**

The **Clinical scan** is targeted to run when the level of the contrast agent has reached the threshold.

The first Clinical scan may be followed by the addition of consecutive Clinical scans. Optional Clinical scans are pre-planned together with the first Clinical scan.

The following pages provide instructions for conducting a Bolus tracking scan.

Use this procedure to conduct a scan:

1 In **New Patient**, enter the patient information in the patient data form.

2 Select the desired exam card from **Select Exam Card**.

3 Click **Start Exam**.

4 In Scan, click **Go** to start the Surview scan. The system displays the Surview image.

Note

The Locator and Tracker scans may already be included in the exam card you select, however they can also be added during the scan setup.

Now that the Surview is complete, you can continue to the Bolus tracking scan.

- If the Locator and tracking scans are included in your protocol, continue to **Planning the locator and tracker scans**, step **4**.
- If the Locator and tracking scans are not included in your protocol, continue to **Planning the locator and tracker scans**, step **1**.

Planning the locator and tracker scans

If your protocol did not include the bolus tracking option, you must add the Locator and Tracker scans:

1 Click **Show All** in Scan.

2 In **Contrast**, select Bolus Tracking from Trigger. Click **Close**.

The system displays Locator and Tracker scans in the Procedure list.

3 Click **Locator** in the Procedure list. The system displays a locator line on the image.

4 Move the locator line to the desired anatomical location.

Note

Click Help (question mark) to display a mini-image with a suggestion for placing the locator.

5 Click **Tracker** in Procedure list. The system displays the tracker line in the same location where you placed the locator line (the lines are connected, moving one causes the other to move). Ensure line placement defines the desired area of interest.

6 Click the Clinical scan in the series list. A time ruler appears at the bottom of the screen showing the scan length and the start point relative to the injection start.

7 To add a Clinical scan, click **Add exam card** and select an appropriate scan exam card.
- Up to ten additional scans can be programmed.
- To change the parameters, click **Show All**, in **Show All**, change the parameters.

Note

The Post Threshold Delay (PTD) of the additional Clinical scan is, by default, the shortest available for a given situation. Like the PTD of the first Clinical scan, It is measured relative to the time that the Threshold has been reached, at the end of the Tracker scan.

Warning

Do not manually change the patient table up/down position during or between the Locator, Tracker, or Clinical scans, to avoid patient receiving unwanted ionizing radiation due to rescan.

8 Verify all scan parameters.

9 Click **Go** to begin Locator scan.

10 When you are satisfied with your Locator scan results, you can place the ROIs (the Auto ROI cursor is ready following the completion of the Locator scan.).

Other ROI options are available with the right-click menu. You can select Add Manual ROI in right-click menu to draw ROIs on image. You can add up to five ROIs on the Locator image.

Set a ROI as the Trigger ROI by right-clicking on it and selecting **Set as Trigger ROI**. The triggering ROI is the ROI that triggers the clinical scan when the threshold is met.

The baseline for the Bolus Tracker graph is set according to the Triggering ROI average HU value.

11 Do the following as needed:
- Drag a completed ROI to a new location.
- Click **Draw (new) Tracker ROI** to delete current ROI so that you can redraw.
- Click **Replan Locator** to repeat the locator scan.

Note

The average CT value appears next to the ROI. The value automatically adjusts if the ROI is changed.

12 If desired, you can change the locator threshold position in the graph.

13 After placing the ROI, click **GO**.

14 Verify there is no error message above the time ruler on the bottom of the window. Messages may be due to one of these errors:
- long PTD
- ROI is out of the image boundary
- scan parameter selection does not fit the PTD

Note

The Scan is planned to start with a programmable delay after the threshold has been met. This delay is called Post Threshold Delay (PTD). A warning will display if the PTD is not acceptable with the scan parameters set. The PTD is automatically set to the minimum available value, if the Automatic Minimum Delay is checked.

Note

When using manual voice, give breathing instruction to the patient when the tracker crosses the threshold.

15 The system displays the resulting images.

Auto ROI

1 Place the cursor in the middle of the desired vessel, away from calcifications if possible.

2 The automatic ROI algorithm accepts initial ROI values between 0 and 400 HU. If you place a ROI on an area with values outside those limits, a message is displayed.

3 The Auto ROI algorithm compensates for normal patient movements and ignores streaks and calcifications. The ROI may move within the vessel during tracking to compensate for movement or to withdraw from calcified areas.

7.2.3 Executing Bolus tracking

Execution sequence - Tracker and Clinical scans

These two scans together should be considered as one sequence. After the Locator scan, the left side view port is allocated to the Contrast enhancement vs. Time graph while the right side displays the images on which the contrast enhancement is measured.

The protocols of the Clinical scan(s) which follow the Tracker scan can be partially edited at this stage.

Note

- **The Auto Start mode: When the system prompts, press the Injector start button. The Tracker scan starts with the delay defined in the Tracker scan protocol after the injection start.**
- **The Manual Start mode: Simultaneously press the Scan button (to start the Tracker scan) and the Injector start button. The scan starts after a lapse of time equal to that defined as Delay in the Tracker scan protocol. Since the Delay is counted down from the moment the Scan button is pressed, it is important to press both the Scan and the Injector buttons simultaneously.**

As the Tracker scan begins, the images containing the ROI measurements appear at a rate equal to the previously defined cycle

time. The computed averaged densities also appear on the graph, which is updated at the same rate.

The measured density within the ROI should reach the threshold value and then the Clinical scan should start.

Note

Periodic checks of CT number correctness is essential for the accuracy of the Contrast vs. Time plot and consequently for the precision of the Clinical start timing.

If you wish to start the Clinical scan before the threshold is reached, click **Start Clinical Scan**.

The Clinical scan starts after a lapse of time equal to that defined in the Tracker scan protocol and after the table reaches the pre-defined position.

A time ruler displays the countdown time to the end of the scan and to the start of the next Clinical scan, if any.

Warning

Watch the monitor screen during the Tracker scan. If an anomaly appears during the Tracker scan execution, for example:

- **The graph does not appear.**
- **The plot is not updated.**
- **The images do not appear.**
- **The contrast intake does not reach the threshold after a reasonable lapse of time.**

Then proceed as follows:

- **If visual examination of the CT images shows that the contrast intake is reasonable, then click on Start Clinical Scan and proceed quickly to the start of the Clinical scan.**
- **If the anomaly does not allow you to see if the contrast intake is reasonable, or if it is clear that the contrast intake is not sufficient, then immediately stop the scanning procedure (by pressing the STOP button on the CTBox) and then stop the injection, to avoid patient receiving unwanted ionizing radiation and unwanted contrast dose.**

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Execution sequence - additional clinical scan

The additional **Clinical** scan(s) normally starts following the corresponding PTD (Post Threshold Delay) as defined during the plan.

Note

The PTD length is at least 4 seconds (depending on the scanner model). If the Scan start position is different between the Tracker and the Clinical scans, then the PTD is longer.

If Bolus tracking cannot be performed at the default location, minimize bed movement by setting a Tracker location as close as possible to the start position of the first **Clinical s**can.

Voice - Another parameter affecting the PTD value is the message. It is recommended that the Clinical scans are programmed without any message (or with the shortest available messages). Instruction by intercom can occur close to the **Tracker** scan stop, when the ROI value almost reaches the threshold level.

Higher injection rates result in better contrast enhancement. High injection rates (if the physician assesses that the patient can tolerate them) are desirable mainly for shorter injection times.

Alternatively, a short scan time may allow moderate injection rate with acceptable contrast level and relatively low Contrast agent administration.

Thus, for arterial examinations, the scan time should be as short as possible.

In the case of a first-phase Aortic scan, it is recommended to set the Threshold Level at 150 HU in order to enable the system to start the first **Clinical** Scan at the optimal contrast level.

Locator Default Parameters - In order to avoid miscalculation of contrast agent attenuation within the ROI, the software restricts the use of certain parameters to default values as follows:

- Reconstruction mode (On Line)

- Scan Increment (0)
- Image Matrix (512^2)
- Resolution (STD)
- Number of slices (1)

Tracker Parameters - The following parameters are set by the software to be identical with their Locator values:

- Slice thickness
- Filter
- Center X,Y
- Field of View
- Location
- kVp
- mAs

Fixed Parameters - The following parameters are predefined, and cannot be changed:

- Matrix (512^2)

Note

If desired, all Tracker Scans can be reconstructed in Off-line Recon.

Note

Pay particular attention to the Injector display during the bolus administration. Use the display information as the basis for your procedure control decisions.

7.3 Continuous CT (option)

7.3.1 Overview

Reference IEC 60601-2-44 Clause 203.107 e and 203.5.2.4.1.

Continuous CT (CCT) is a scanning mode that allows the physician to perform extended, low-dose scans while performing a biopsy. You can control the scan by pressing the foot-pedal switch in the gantry room or by pressing the Scan button on the CTBox.

In addition to the console, the resulting images are displayed on a remote monitor in the scan room, providing visual feedback during the biopsy. The remote monitor is attached to a cart.

CCT components

These are the components required to use the Continuous CT application:

- A **Foot-pedal,** used by the physician to activate the CCT scan from within the scan-room.
- CCT system with monitor in gantry room.

7.3.2 Principles of operation

The displayed images are labeled according to the patient orientation selected. The needle may be seen in more than one slice location and, by identifying the needle-tip, the next table translation can be planned.

Table movements are supported during the CCT procedure to reposition the patient for the next scan session.

As the pedal is released at the end of the burst-session, the last image display remains on the screen. These images are also registered in the normal study-viewer and can be used for archiving and filming.

Stop, pause, and table movement

Between scans, you can move the table. If the table position is changed, the scan can continue without cancelling the whole scan. In the axial scan, the system does not scan while the patient table is moving.

Note

The system can remain in ready mode for 15 minutes.

7.3.3 Safety instructions for CCT accessories

Foot pedal

CCT has a special foot pedal to activate scans from the gantry room. Make sure the foot pedal is free of foreign objects to ensure easy and safe access during operation.

Caution

Take care not to collide with or step on the pedal housing.

Monitor cart

The monitor cart inside the scanner room should not be used to hold anything but the original monitor. The monitor-base should always be secured properly. When not in use, the cart and its cables should be moved to a corner of the room so they do not interfere with routine activities in the scanner room. Care must be taken not to collide with the monitor stand or trip on the monitor cables.

Warning

A visual inspection is necessary before using cables, and if any defects are noted, please contact Customer Service.

Monitor Ceiling Support

The additional monitor ceiling support is a heavy device, which is attached to the gantry-room ceiling and carries two flat monitors. Do not hang any other items on this support such as aprons or other accessories. When not in use, the additional monitor support should be folded and out of the way of the patients and the technologists on site.

7.3.4 Preparations for CCT

The following preliminary preparations must be done before beginning the procedure.

- Position the monitor in the gantry room at a convenient location, taking into account the expected direction of approach to the patient.
- Check that the foot pedal is free from interfering objects and is easily accessible to the interventional operator.
- Prepare sterile materials, if necessary. For example, a clear sterile sheet with an adhesive strip may be attached over the Gantry panel for operating the table motions from the Gantry room.
- Check the intercom for clear bi-directional communication between the Interventionist and the console operator.
- Prepare the appropriate radiation shielding equipment and materials.
- Prepare the intervention kit and accessories.

Note

Make sure that the cables connected to the device are not in the way of the patient or the personnel in the scan room.

Warning

- **This procedure should be done with two staff members. The individual at the console should proceed only as instructed by the individual conducting the CCT procedure to avoid injury to both the patient and staff.**
- **The laser remains ON until the end of the clinical series. If the patient's eyes are in the path of the laser, turn off laser to avoid injury.**

7.3.5 CCT scan parameters

Mode selection

In order to activate the CCT mode, you must select an exam card that includes the appropriate interventional scan.

There are three CCT scan protocols that are comprised of two different CCT scan modes.

- **Single Mode**- Activates a scan each time the pedal is pressed. All images created in this mode are saved in the directory.
- **Continuous Mode**- Activates sequential scans as long as the pedal is being pressed. One scan is executed for each cycle time. The system saves only the last image displayed each time the pedal is released.

- **Fluoro Mode**-Operates with the X-ray continuously on, completing scans as long as the pedal is pressed. Images are reconstructed in a rate of eight images per second (RT is 0.5). The system saves all acquired images.

Set these options in **Show All**.

Collimation

Collimation apertures include:
- 4 x 0.625
- 12 x 0.625
- 16 x 0.625
- 32 x 0.625
- 12 x 1.25
- 16 x 1.25
- 64 x 0.625

The table below are the slice Thickness of 1 x 1,1 x 3 and volume image display mode for different collimation.

	Slice Thickness		
Collimation	**1 x 1 mode**	**1 x 3 mode**	**Volume mode**
4 x 0.625	2.5 mm	0.8mm	1
12 x 0.625	7.5 mm	2.5 mm	1
16 x 0.625	10 mm	3.33mm	1
32 x 0.625	20 mm	6.66 mm	1
12 x 1.25	15 mm	5 mm	1
16 x 1.25	20 mm	6.66 mm	1
64 x 0.625	40 mm	13.33 mm	1

Note

The Cycle Time parameter is a static indicator that displays the actual time to make an exposure, based on scan angle.

Rotation Time

Depending on your system configuration, 0.5 and 0.75 second rotation times are available for CCT.

View Convention

A list of possible view conventions includes: right on left, view from feet and view from bed.

7.3.6 Starting the CCT procedure

This function can be best performed with minimum of two staff members.

- a technologist, and
- an interventional doctor who conducts the procedure in the scanner room.

To shorten the procedure, the doctor should activate the foot-pedal during the procedure.

The interventional procedure starts by positioning the patient on the table according to the planned area. In general, a surview and a sequence of scans are performed to help locate the lesion (Target) and plan the insertion path (Entry) of the needle. A relevant slice is then selected, and using distance and angle measurements, the interventional planning is performed.

The insertion point is marked on the patient skin and the procedure is initiated. The biopsy needle is inserted and its location can be viewed at almost real-time on the monitor. The interventional doctor activates the pedal and either a set of scans (Continuous or Fluoro mode) or a single image scan (Single mode) are executed with low dose axial scanning. As the pedal is released the scans and the radiation stop.

During scans, the images display on the remote monitor in the format as selected previously in the exam.

A reference series can be added to a 1, 3 image or Volume display layout. Choose it from the **Layout** parameter.

- The reference series can be any axial result from the current exam.
- By default the first axial result is displayed. You can choose a different result using the right-click menu.

You can change some basic parameters without pausing the procedure, while the interventional images are still displayed. Click **Change Parameters**.

- On pedal press
- Display mode
- Collimation
- Slice Thickness
- mAs

Note

The system may set the optimal slice thickness according to the other parameter settings.

Click **GO** in the dialog box when changes are complete. A new scan is created automatically, with a new step added to the series list.

The doctor follows the needle-tip as he/she proceeds with the insertion toward the target.

Warning

If the needle tip is not visible in any of the displayed images, it implies that the needle tip is not present in the beam path indicated by the slice thickness in the corresponding table location. The table location must be changed so the needle tip is clearly visible in an appropriate slice.

Table and gantry movements are supported during CCT procedure to reposition the patient for the next scan session.

Note

Moving the patient table while X-ray is on may affect image quality.

As the pedal is released at the end of the X-ray, the last image remains on the screen. These images are also registered in the normal study-viewer and can be used for storing and filming. The last image can be inversed, windowed, flipped, panned and zoomed, and these settings are kept for the next scan.

Warning

- **This procedure should be done with two staff members. The individual at the console should proceed only as instructed by the individual conducting the CCT procedure to avoid injury to both the patient and staff.**
- **During interventional process, please pay close attention to the patient to avoid patient injury.**

Warning

If radiation does not stop when pedal is released, these conditions could exist:

- **The pedal is stuck.**
- **There is a short due to cable damage.**

Press the Emergency STOP button to stop the radiation.

Interventional Controls

When using an interventional exam card, Interventional Controls appear in the lower left viewing area, next to the Scan Ruler. Use these options to configure couch positions for repeated use in an interventional procedure.

Work Position: Position with couch outside the gantry bore to perform work on the patient.

Save Current Position as Work Position: Saves the current position of the couch as the Work Position.

Scan Position: At the selected position on the patient body, for example, at or near a tumor to be treated. Select **Save Scan Position** in right click menu to save the current position as scan position.

Couch In or **Out**: Moves patient towards or away from the gantry. Moves table in and out of gantry. The drop down menu allows you to select movement increment.

Needle Position: Shows the needle positions. Select **Save Needle Position** in right click menu to save the current position as needle position.

Edit Needle: Opens the Edit Needle dialog box.

Move: Moves couch to the selected position.

Switch laser light: Turns on/off laser light.

To move the couch by small increments, select the distance to be moved from the drop down menu, then click the couch **In** or **Out** buttons to move the couch in or out by the selected increment. This is a relative move. For example, if the distance selection is 5 mm, the couch will move In or Out by 5mm when the button is clicked.

Saving Scan and Needle Positions

- Scroll to the desired image from a previously acquired series in the **Scan** window, right-click on the image, and click **Save Needle Position** to open the needle **Position** dialog box, or click **Save Scan Position** to establish it as the **Scan Position**.
- In the needle **Position** dialog, select the needle number, type of needle location (entry or tip), and modify the needle label if necessary. Click **Save** to store the position and close the dialog box.
- When a needle position is added for the first time, a new row for the needle position appears in the interventional toolbar area with two selections: One for needle number and another for needle position type.
- When a scan position is saved, the slice location of the selected image appears in the Scan Position selection in the interventional toolbox.
- The last CCT scan is automatically saved as the Scan Position, and overwrites the existing Scan Position.

Edit Needle Positions

- Click the **Edit** next to the **Needle Position** drop down to open the **Edit Needle** dialog box.
- Using the dialog, you can edit any needle labels, existing positions, or delete a position.

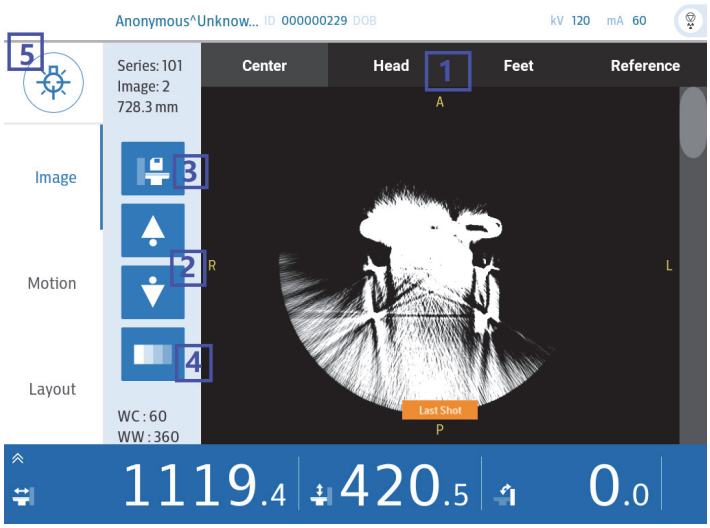
Saving Work Position

Move the couch to a position where it is comfortable to work on the patient, and click **Save Current position as work position** to save the current couch position as the Work Position.

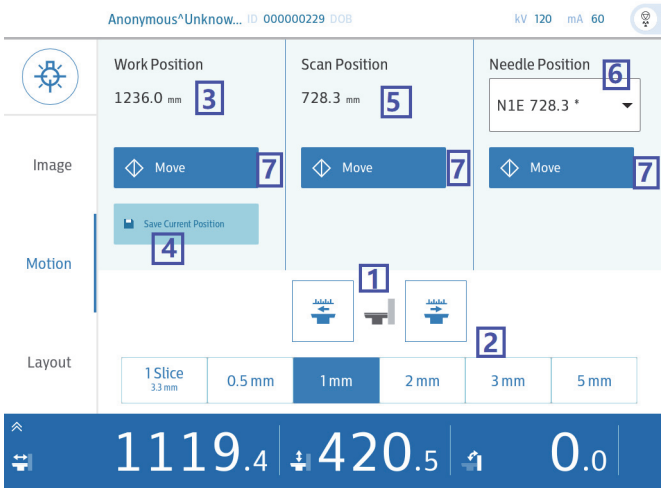
Moving to a Selected Position

In the Interventional Controls toolbox area, click and hold the Move button below Work Position, Scan Position or Needle Position. The patient table will move to the selected position. Progress is indicated by a circular progress indicator next to the button. The couch motion will stop if the mouse button is released before the destination is reached.

OnPlan Interventional Control



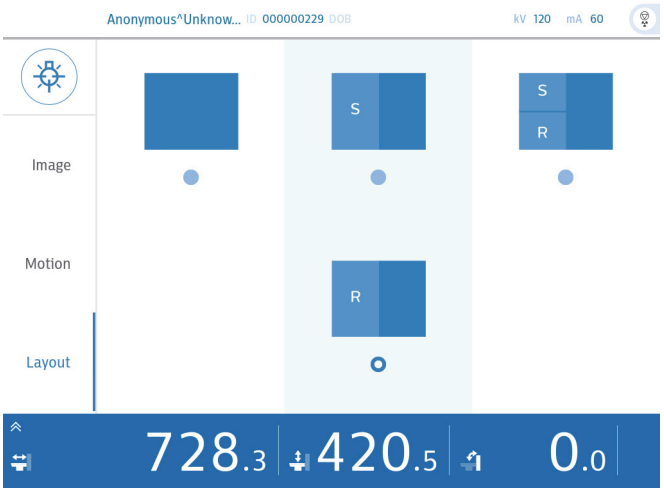
	Description
1	Click to view the different images.
2	Scroll Up and Scroll Down
3	Save positions
4	Windowing setting
5	Switches the laser On/Off



	Description
1	Moves patient table in and out of gantry.
2	Selects movement increment.
3	Position with couch outside the gantry bore to perform work on the patient.
4	Saves the current position of the couch as the work position.
5	Selects position on the patient body.
6	Saved needle position.
7	Moves couch to the selected position

Philips 459801855453_A

Layout viewport allows you to select the layout.



7.3.7 Precise Intervention Viewer

In Precise Intervention viewer there are several tools, they will help you to navigate the needle safely during the intervention.

The following needle types are supported in Precise Intervention viewer:

- Straight needle
- 15G to 30G needles

Draw Needle Plan

Target: Allows you to mark the intended location for the needle tip.

Entry: Allows you to mark the location for the needle to enter the body.

Delete: Allows you to remove the needle plan.

Set Needle Plan

1 Click **Target**, click on the image to mark location.

2 Click **Entry**, click on the image to mark location. The planned needle path appears in blue.

If the needle path is not satisfactory.

3 Select the mark location, drag the mark location to the desired

location.

Or

4 Right click on the image, in right click menu select **Target/Plan Entry** to redefine the mark location.

Safety Region: Allows you to set safety region diameter.

Show Safety Region: Allows you to show or hide safety region.

Edit Needle Track

If the needle path is not auto detected or not satisfactory, you can define or adjust the path manually.

Tip: Allows you to mark the location for actual needle tip.

Entry: Allows you to mark the location for actual needle entry.

Delete: Allows you to remove the needle path.

Set Needle Path

If the needle path is not auto detected, do the following steps to define:

1 Click Tip, click on the image to mark location.

2 Click Entry, click on the image to mark location. The needle path appears in green.

If the needle path is not satisfactory, do the following steps to adjust:

3 Select the mark location, drag the mark location to the desired location.

Or

4 Right click on the image, in right click menu select **Tip/Track Entry** to redefine the mark location.

Needle Track Method

Based on Plan: This method uses the **Target/Plan Entry** coordinates to track the needle.

Based on Track: This method uses the **Tip**/**Track Entry** coordinates to track the needle.

Needle Information

Depth Track: It shows the length between the **Tip** and **Track Entry** point.

Depth Plan: It shows the length between the **Target** and **Plan Entry** point.

Precise Intervention limitation

Scan type	Precise Intervention does not support loading images of following data: Axial, Locator, Tracker, TIBT, Perfusion, Cardiac, Gated scan.
Needle Tracking Supported	Precise Intervention viewer: only supports tracking one needle at a time.
OMAR for Precise Intervention	OMAR is not designed for reducing artifacts of needle, when OMAR is enabled in a Helical scan for Precise Intervention viewer, there may be a delay for displaying the image. User can only select OMAR series to be auto launched to Precise Intervention viewer and need to manually launch Non-OMAR images to Precise Intervention viewer.
Entry Point Position	Place the entry point on the patient's skin level for needle plan.
Render Mode	Precise Intervention viewer does not support VR display mode
Image Thickness limitation	1mm slice thickness is preferred. When slice thickness is greater than 3mm, the system does not allow Manual or Auto Launch the data into the Precise Intervention viewer.
Image Number Limitation	Supports loading images >8. If less than 8, the system does not allow to Auto or Manual launch into Precise Intervention Viewer.
Display Mode	Precise Intervention viewer only supports Display Mode "Volume" of CCT Scan
Gantry Tilt Image	Precise Intervention viewer does not support loading images obtained with gantry tilt.
CCT Continuous scan	Precise Intervention viewer only loads the last shot of CCT continuous scan.

Note

- **When patient orientation is changed in between shots (Scans) in Needle Tracking, make a new Plan for the new patient position.**
- **The distance of the actual entry from planned entry should be less than 10mm.**
- **The length of the actual needle in the volume dataset should be more than 40mm.**
- **Image artifact may affect needle detection.**
- **Precise Intervention viewer doesn't support Fluoro mode.**
- **The needles should be inserted towards the planned target.**
- **The actual needle entry on skin and its surrounding tissue should be included in scan range.**

7.3.8 Radiation information

The CCT mode is intentionally designed to activate the X-rays and CT scanning while a member of the medical staff is present in the gantry room.

Scanning is initiated by pressing a foot pedal, which powers the X-ray generator. In general, the gantry room is equipped with warning lights and a buzzer to signal when X-rays are on.

Warning

The shielding of the scanner room does not provide any protection to the medical staff present in the gantry room. The staff should be aware of the hazard imposed by direct and scattered radiation.

During CCT mode, the Technologist and other personnel should be aware that the activation of X-rays could be originated in the gantry room or from the main console.

The dose to the patient (per cycle) is displayed upon selecting the exam card. If the table increment is zero, the number of the repeated scans multiplies the dose to the patient.

Warning

If there is any indication that X-rays are not turned off after releasing the foot pedal switch, press the STOP button on one of the gantry control panels, or the Pause button on the scan control

box. This stops the generation of X-rays, scanner rotation, and patient table motion.

For details about the STOP condition, refer to **Technical Reference Guide**.

7.4 Cardiac

This information includes helical retrospective tagging, Step & Shoot, and Axial Prospective Gating instructions. When it contains material that is specific to one scan type, it is clearly indicated.

Note

The patient's heart rate must be 35-180 bpm to perform a cardiac scan.

Helical Retrospective Tagging

Helical retrospective cardiac scanning allows the system to acquire a volume of data while the patient's ECG is recorded. The acquired data is tagged and reconstructed retrospectively at any desired phase of the cardiac cycle. Images that are reconstructed at the mid-diastolic phase of the cardiac cycle show the least cardiac motion and highest level of coronary artery flow. This phase is considered to be optimal for coronary artery evaluation. A special phase correction is applied in the software to track the diastolic phase of the heart rate at variable heart rates. This is critical when performing advanced 3-D imaging of the heart for coronary CT angiography, and cardiac functional analysis.

Axial Prospective Gating

Reference IEC 60601-2-44 Clause 203.106.

Axial prospective gating allows the use of an external ECG gating system to synchronize individual axial scans with the patient's heartbeat. The ECG-triggered scans significantly minimize heart motion artifacts. This scan type is primarily used for Calcium Scoring.

Step & Shoot

Step & Shoot Cardiac provides high quality CT images of the coronary arteries and heart anatomy at very low radiation dose levels (up to 80% reduction when compared to retrospective scanning).

During Step & Shoot Cardiac, X-rays are generated only during the cardiac phase of interest. This produces coronary CT angiography examinations with reduced effective dose (the actual dose reduction depends on scan technique, patient size and scan coverage).

Warning

Avoid using Step & Shoot scan for patient with pacemaker.

Arrhythmia Compensation

When you select **Handle irregularities on-line** feature.

- After you start the Step & Shoot Cardiac scan, the planned scanning sequence proceeds normally until an arrhythmia (if any) is detected.
- The irradiation is stopped during the arrhythmia.
- The system waits for the heart cycle to stabilize.
- Radiation begins on the next heart cycle or the third heart cycle irrespective of arrhythmia if arrhythmias persists.

Patient Qualifications

Not all patients qualify for the Step & Shoot Cardiac scan. To acquire images with satisfactory quality, it is recommend that the scanned patient:

- have a stable heart rate, with mean between 35 BPM~70 BPM
- have no severe known arrhythmias
- not be extremely obese

Compatibility with Other CT Cardiac Applications

Step & Shoot Cardiac is compatible with all currently available CT cardiac applications, including Coronary Artery Analysis (CAA).

Note

No functional analysis is available for the Step & Shoot Cardiac scan.

7.4.1 Preparing the equipment

Because the Cardiac procedures involve the use of additional equipment, you must familiarize yourself with the functionality of the equipment as well as this procedure before conducting any patient scans.

Two sets of leads are included in the monitor shipment.

- The United States uses the leads from the Association for the Advancement of Medical Instrumentation (AAMI). The ECG lead colors are white, black, green, and red. Use this set of ECG leads in the US.
- Europe and the rest of the world uses the leads from the International Electro technical Commission (IEC). These ECG lead colors are red, yellow, black, and green. Use this set of ECG leads in Europe and the rest of the world.
- In all countries, properly dispose of the IEC lead set.

Patient Interface Module (PIM)

Note

The PIM is NOT a cardiac monitor. It is only for use when performing cardiac scans with the Incisive CT system. If the patient requires ECG monitoring, a separate ECG monitor is required.

The PIM monitors the patient's Electrocardiogram (ECG) wave and delivers it to the system for further use. The PIM monitoring system is composed of three main components:

- Four ECG leads
- PIM
- Data cable

The electrical activity in the heart is monitored through the ECG leads to the PIM device. The device performs operations on the

acquired signals and delivers the processed information, through the data cable, to the system. The ECG signal displays on the Gantry.

Warning

Do not allow external devices to come in direct contact with the patient's skin. Some material can cause skin irritation and allergic reaction.

Connecting and Disconnecting the PIM

Warning

- **To avoid risk of electric shock, do not connect accessory cables while touching patient.**
- **To avoid damage of PIM and gantry port, we recommend shutting down the system before connecting PIM with gantry.**

Depending on your system model, the PIM may be detachable. You can insert the PIM by plugging it into the PIM socket.

Standard Table: The socket is on left side of the gantry.

Bariatric Table: The socket is in the patient table box.

Lay the PIM in the box, when the PIM is not in use.

Insert the PIM by plugging it into the PIM socket. Take care when connecting the PIM as the plug pins are fragile and can be damaged by incorrect insertion.

- Align the dot on the plug collar with the arrow on the socket before insertion.
- The plug locks into place, rotate the plug collar clockwise.

To disconnect the PIM, rotate the plug collar counterclockwise pressing inward with your thumb while pulling gently on the PIM cable.

Testing the PIM

Before using the PIM for the first time, you should test it with a simulator or a volunteer.

1 Connect the PIM to a simulator or a volunteer. Follow the Patient Preparation steps if using a volunteer.

2 Have the patient assume the posture for the scan (raising the hands above the head) and simulate a breath hold.

3 Observe the ECG signal during the breath hold and verify the acquisition of the ECG wave. If a clean ECG signal does not display on the scanner, make sure that the electrodes are placed properly, and the contacts are good. You may need to reposition the electrodes or redo the skin preparation and apply new electrodes.
   - A detection algorithm on the PIM detects a point along the QRS complex instead of the R point.
   - The QRS algorithm can properly tag the ECG wave if the patient has an inverted ECG wave.
   - If missing QRS tags occur, make sure that the electrodes are placed properly and the contacts are good.
   - A clean ECG signal should look as follows:

4 Observe sinus rhythm for three minutes with arms raised.

- Click on the HR (Heart rate) tab to observe any variation in the heart rate.
- If ECG rhythm is other than a sinus rhythm, consider the risks and the benefits of continuing to scan.
- If three or more premature beats occur, consider the risks and benefits of continuing to scan.
- If one or more premature beats occur, it is recommended that you do not scan using Cardiac DoseRight.

Preparing the Patient

In order to achieve the best results possible, it is important that you prepare the patient correctly.

General Information

- Ask the patient to refrain from stimulants (caffeine) prior to scan.
- Do not give oral contrast.
- The Cardiac scan is usually a short scan time. Ask the patient not to take in a deep breath, while holding their breath for the scan.

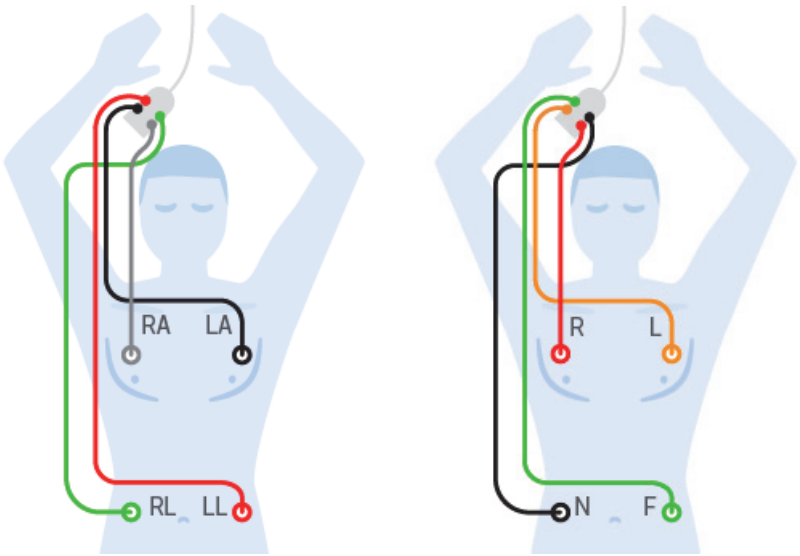
Ask the patient to simulate a 10 second breath-hold during the cardiac scan.

- Review voice commands prior to examination.
- The patient should have good IV access (18-21G, if possible). The IV is usually placed in the antecubital vein.

Pre-scan Preparation

1. Clean the contact sites thoroughly with alcohol and use ECG skin prep tape to abrade the skin. Ideally, shave sites having hair to ensure acceptable electrode contact with the skin.
2. Apply clean, wet-gel electrodes (not dry) certified for medical use. Refer to the graphics below. Ensure the electrodes are not in the field of view.
3. Connect the leads as shown. Secure the leads to the body with adhesive tape to prevent any movement.
4. Connect the leads to the PIM. Do not loop the leads.

Connecting the ECG Leads



RA-Right Mid-Thorax (gray)	R-Right Mid-Thorax (red)
LA-Left Mid-Thorax (black)	L-Left Mid-Thorax (yellow)
LL-Left Mid-Abdomen (red)	F-Left Mid-Abdomen (green)
RL-Right Mid-Abdomen (green)	N-Right Mid-Abdomen (black)

Note

Route all cables between the PIM, the patient, the patient table, and the CT scanner so that they do not impede the free movement of personnel.

Cardiac DoseRight

Check **Reduce dose for other phases** in **Show all Cardiac** tab to turn on Cardiac DoseRight.

Cardiac DoseRight is used during Helical Retrospective tagging scanning to reduce the amount of radiation to the patient, while maintaining acceptable image quality. This technique is also called ECG dose modulation. When Cardiac DoseRight is enabled, the scanner uses the planned mAs during the phase(s) selected for coronary reconstruction. These phase(s) are used for coronary artery evaluation.

In other areas of the heart cycle, such as those phases used for functional analysis, the mAs is reduced to a level equal to the selecting **Functional Dose** of the planned mAs value.

Cardiac DoseRight is optimal with low and steady heart rates. For example, with heart rates of less than or equal to 60 beats per minute (bpm), radiation dose savings can reach up to 40%.

Note

When Cardiac DoseRight is activated, the actual DLP and CTDIvol will be less than planned. The actual DLP and CTDIvol depend on tolerance, functional dose and actual heart rate.

Determine Contrast Parameters

Contrast parameters for Step & Shoot scans and cardiac helical scans should be similar at your medical facility.

Handle Irregularities Online

Handle Irregularities online is a feature that can be used for Step & Shoot and helical coronary CTA scanning.

This feature is found on **Show All - Cardiac** tab.

For Helical Retrospective tagging, reduce dose for other phases must be selected for this feature to be enabled.

Helical Retrospective Tagging

The complete helical retrospective tagging process includes these scans:

- Surview
- Bolus tracking
- Helical scan

The ECG Viewer is displayed at the bottom of the viewer, to the left of the Scan Ruler.

Functional phase and Coronary phase bars display on the ECG viewer.

You can select Handle irregularities on-line in **Show All Cardiac**. This option affects Cardiac DoseRight if an arrhythmia is encountered during the scan. For more information, see **Dose setting**, on page 22-18.

You can select **Single Cycle Reconstruction** for clearer images if the patient breathes during the scan, has irregular rhythm, or low heart rate.

In addition to the Parameters available in the **Show All Cardiac**, more options are accessible from the right-click menu of each series:

- When main reconstruction uses the **Apply recon settings to all phases** option, all main reconstruction parameters are applied to additional reconstruction except Recon Phase.
- When additional reconstruction uses the **Apply recon settings to all functional phases** option, all parameters of current additional reconstruction are applied to other additional reconstruction except Recon Phase.

Step & Shoot

The complete Step & Shoot process includes these scans:

- Surview
- Bolus tracking
- Axial scan

An automatic Heart Rate analysis is performed after planning a Step & Shoot scan on the Surview. The patient's average heart rate for the previous 30 seconds is examined. If the rate exceeds the maximum recommended rate, the system displays a message.

Note

If you continue the scan on a patient having a heart rate greater than the recommended rate, the resulting image quality may be deteriorated due to motion artifacts, and the performance of the arrhythmia correction function may be deteriorated.

The Scan at phase field in Cardiac tab controls the Step & Shoot acquisition.

You can view the limited FOV sloped areas and also the step marks in the Reconstruction of the Clinical series. The limited FOV areas indicate the entire coverage to be reconstructed, however, the images at the upper and lower (sloped) will have limited FOV.

Modifying a Scan at phase will shift all the results accordingly when phase tolerance is applied.

- mAs values are adjusted automatically to preserve similar image quality.
- Select from the listed values (0 up to 5%).

The collimation value is set automatically to ensure the anatomy is covered with an optimized number of steps.

You can select the **Full coverage, longer cycle time** option. This is useful for gated chest applications where the temporal resolution is of less importance. This option increases the step size, thereby cutting down on the number of cycles (and breath hold) for longer scans. You can reconstruct the entire coverage without overlap.

Review Patient's Heartbeat and any Arrhythmias for Step & Shoot Scan

When a clean ECG wave is obtained from the patient, visually inspect the ECG wave to confirm that the conditions for Step & Shoot scan are met:

- The patient's heartbeat should be within the recommended range.
- Any arrhythmia is within acceptable limits.

Warning

The ECG wave should not be used to diagnose patient health condition. Use it only to help confirm patient suitability for the Step & Shoot Cardiac scan, help plan and select optimal phase(s) for reconstruction, and to analyze the reconstructed images.

Cardiac Filters

It is recommended that you use a cardiac filter for scanning. The cardiac filters include a special adaptive algorithm for noise optimization. See **Filter**, on page 4-8 for more information.

Acquisition & View

The online ECG displays at the bottom of the window as long as the Exam Card is open. The offline ECG displays the patient ECG/HR during the acquisition.

ECG Viewer and Editing Tools for Reconstruction

Use the ECG Viewer to view the ECG wave and make changes to the QRS tags and the programmed reconstruction phases before beginning a gated phase reconstruction.

There are two types of ECG viewers: Online ECG Viewer and Offline ECG Viewer. The online ECG viewer is available before and during image acquisition (used for scan planning). The offline ECG viewer is available after the acquisition is complete. The viewer encompasses the portion of the ECG that is captured during the scan.

You can choose the view of the ECG by clicking on a tab:

- ECG only
- HR only

Note

The ECG Viewer should not be used as a patient monitoring device.

Online ECG Viewer

The ECG is displayed for gated scans when an ECG signal is detected. Use the following tools to control the ECG Viewer:

Function	Description
Pause/Play Real-Time Wave	Click to pause the real-time ECG; click the Play button to restart.
Measure	Enables you to measure the time between two points on the ECG.
Show/Hide ECG legend	Show or hide ECG legend.

In the ECG mode, you can measure the time along the graph using this procedure:

1 Click **Measure**.

2 Click and drag from any starting point along the graph.

3 Release the mouse button at the desired stopping point. The time between the start and end points displays.

4 Click **Measure** again to disable measure function.

ECG Viewer Right-click Menu Option

Rescale X axis default X-axis to one of the preset time periods. Units are measured in seconds.

- 5 seconds
- 10 seconds
- 15 seconds

Heart Rate Graph

Click the HR tab to switch to the Heart Rate graph, which displays the current heart rate and R-R interval.

Offline ECG Viewer

Before Start Final Reconstruction the ECG editing tools are available.

Function	Description
Measure	Enables you to measure the time between two points on the ECG.
Show/Hide ECG legend	Show or hide ECG legend.
Undo	Undo most recent change.
Reset All	Reset to the original wave; delete all changes.

- Move an existing R point, drag and drop or right-click and select **Move R-peak**.
- To add an R point, move the mouse to the desired position when the cursor turns to green"+", then click on the wave.
- To delete an R point, right-click and select **Remove R-peak**.
- Move phase bar by clicking and dragging.
- Right-click on an arrhythmia to Accept or Reject.

Note

There are 2 sets of arrhythmia nomenclature: USA (PVC & PAC) and Non-USA (VPB & APB). The nomenclature is configurable in Service-System Setting-Cardiac.

Precise Cardiac

Precise Cardiac is a reconstruction technique with the potential to provide compensation for cardiac motion.

Limited temporal resolution of Cardiac CTA causes motion artifacts resulting in sub-optimal diagnostic performance of the coronary segments. Precise Cardiac has the potential to improve the diagnostic capability of Cardiac CTA by reducing the coronary motion blurring.

Precise Cardiac reconstruction shall be applied only on cardiac anatomy in order to potentially reduce motion induced effects and improve the coronary image quality. Precise Cardiac can be applied either in cardiac ECG-gated helical or ECG-gated axial scans (i.e., Step & Shoot Cardiac). Data from a predefined region around the target ECG phase is used for the reconstruction.

Precise Cardiac data sets should be reviewed in conjunction with original data sets (non-Precise Cardiac).

Reconstruction time for Precise Cardiac series may be increased depending on image parameters. Reconstruction time may also be increased when more than one Precise Cardiac result is created. Results without Precise Cardiac will not be affected.

Note

- **Precise Cardiac performance may be impacted by noise caused due to dose modulation.**
- **Precise Cardiac reconstruction shall be applied for the assessment of the coronary anatomy, therefore Philips recommends the reconstruction of Precise Cardiac to be with an FOV ≤250mm to avoid sub-optimal image quality.**

Warning

- **Two reconstructions will be performed: with and without Precise Cardiac.**
- **Two results will be available, with and without Precise Cardiac.**
- **Both results should be reviewed.**

ECG-gated Axial (Step & Shoot Cardiac)

For Step & Shoot Cardiac scan a minimum Phase Tolerance is required to allow additional data from a pre-defined region around the target ECG phase, in order to enable Precise Cardiac.

ECG-gated Helical scans

When Single Cycle option is checked - Precise Cardiac is not enabled. In order to enable Precise Cardiac, uncheck Single Cycle option.

For Cardiac Dose Right option, Precise Cardiac can be enabled:

- When Cardiac Dose Right is OFF.
- When Cardiac Dose Right is ON, only coronary series can be effected.

Note

- **Precise Cardiac is supported for phases between 10%-89%.**
- **Precise Cardiac is supported for 512 Matrix.**
- **When using Precise Cardiac, in order to reduce motion induced effects, it is recommended to:**

- Apply Precise Cardiac on contrast-enhanced scans (use of improper bolus timing or missed bolus can affect the compensation for cardiac motion).
- Apply Precise Cardiac on native coronary arteries. It is not recommended for use in cases of bypass grafts (CABG), prosthetic valves etc.
- Precise Cardiac cannot be applied in patients with metallic implants, wires, pacemaker leads, etc. due to artifacts in the region of the coronary arteries.

- **While applying Precise cardiac, recommended to use slice thickness equal or less than 1mm for assuring the best resolution of coronary vessels.**

Precise Cardiac Scan Workflow

In order to enable Precise Cardiac for Exam Cards:

1 Click **Service**.

2 Select **Daily**, click **System Setting**.

3 Select **Cardiac** tab.

4 Enable **Precise Cardiac** checkbox.

In order to apply Precise Cardiac option in an Exam Card:

1 Enter the Patient Demographic information and select the appropriate group and exam card.

2 Verify the Surview scan parameters and change them as desired. Click **GO** to acquire the Surview.

3 Plan the scan on the Surview, setting the parameters as needed. From the **Show All**> **Cardiac** tab > check **Precise Cardiac**.

Informative text will be displayed stating that an additional recon will be added to create Precise Cardiac result.

After clicking Start Final Recon, a second, Precise Cardiac reconstruction is added on top of the reconstruction without Precise Cardiac. 2 results are created with and without Precise Cardiac.

Note

Precise Cardiac can be applied while performing offline reconstructions, in the above-mentioned workflows.

Examples of clinical situations that Precise Cardiac may have sub-optimal image quality

Precise Cardiac is a reconstruction technique with the potential to provide compensation for cardiac motion.

Precise Cardiac reconstruction shall be applied only on cardiac anatomy focusing on native coronary arteries in order to potentially reduce motion induced effects and improve the coronary image quality.

Warning

- **Two reconstructions will be performed: with and without Precise Cardiac.**
- **Two results will be available, with and without Precise Cardiac.**
- **Both results should be reviewed.**

Note

Precise Cardiac data sets should be reviewed in conjunction with original data sets (non-Precise Cardiac):
- To reduce potential risk of missing/obscuring pathology leading to a potential misdiagnosis.
- To reduce the risk of misdiagnosis of pathology caused by Precise Cardiac induced image quality artifacts.

In the following clinical situations, Precise Cardiac may have sub-optimal image quality, below are few examples:

- Precise Cardiac performance may be impacted by noise caused by for example selection of inadequate scan parameters, dose modulation, etc. and may result in artifacts.
- Precise Cardiac reconstruction shall be applied for the assessment of the coronary anatomy, therefore Philips recommends the reconstruction of Precise Cardiac to be with an FOV≤ 250mm to avoid sub-optimal image quality.

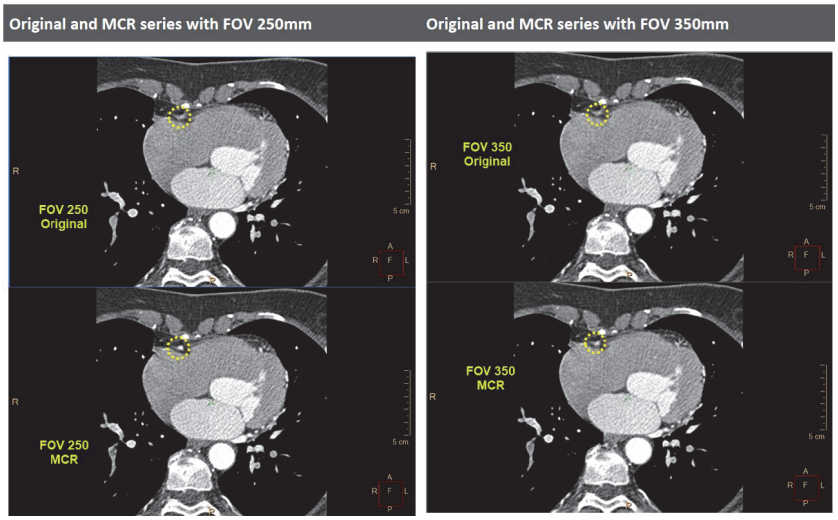
When using Precise Cardiac, in order to reduce motion induced effects, it is recommended to:

- Apply Precise Cardiac on contrast-enhanced scans (use of improper bolus timing or missed bolus can affect the compensation for cardiac motion).
- Apply Precise Cardiac on native coronary arteries. It is not recommended for use in cases of bypass grafts (CABG), prosthetic valves etc.
- Precise Cardiac cannot be applied in patients with metallic implants, wires, pacemaker leads, etc. due to artifacts in the region of the coronary arteries.

The types of clinical situations in this section are examples of using Precise Cardiac in studies that have high noise, presence of metals such as wires, etc. These examples are not exhaustive but are illustrative. These cases are examples of the known deficiencies and in no way constitute a full list of potential Motion Compensated Reconstruction situations.

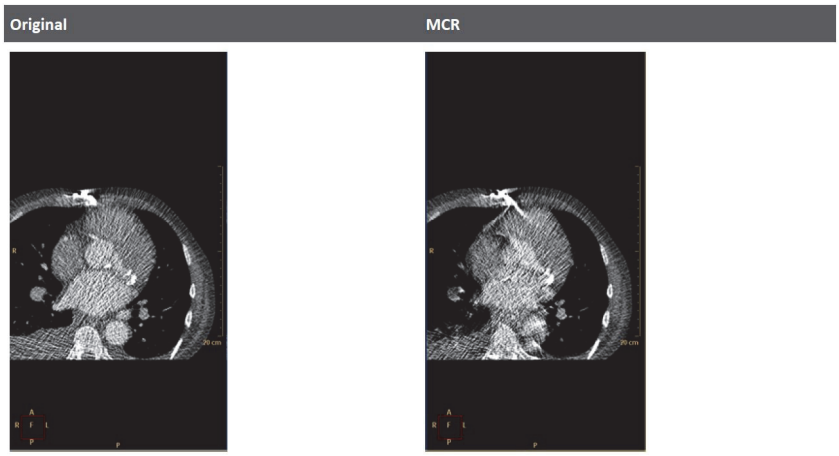
Results of using Precise Cardiac in clinical situations that Precise Cardiac performance may have a degradation

Precise Cardiac with FOV > 250mm



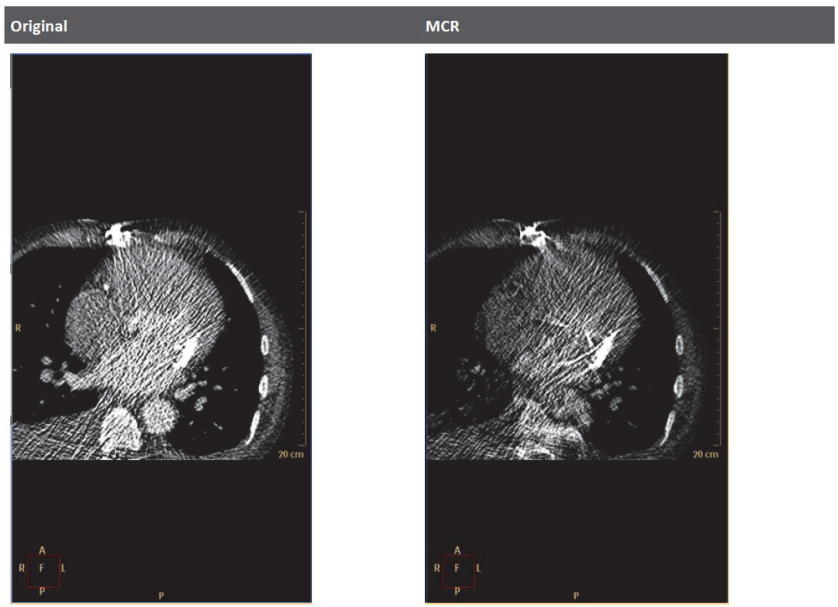
Example of degradation in Precise Cardiac algorithm due to a decrease in spatial resolution.

Precise Cardiac with in the presence of wires



The performance of Precise Cardiac may be affected in the presence of metallic implants, wires, pacemaker leads, etc. due to the presence of streaks.

Precise Cardiac with the presence of noise and wires



The presence of noise (for example caused by low tube output during ECG tube modulation) could affect the performance of Precise Cardiac.

7.5 Dual energy

Reference IEC 60601-2-44 Clause 203.107 e and 203.5.2.4.1.

Conventional CT is not able to distinguish between high density materials such as iodine and calcium. Adding a second scan in a different energy level provides additional information for each pixel. This information can then be used to resolve the various materials, and assist with patient diagnosis. The Incisive CT system implements Dual Energy scans as Sequential Dual Energy. The system acquires the data in two scans, each with a different kV and mAs.

Note

The system runs the Dual Energy scan in one couch position, performing two axial scans with minimal delay between.

Scan Flow

1. Enter the patient data and select the appropriate exam card.
2. Click **Start Exam**.
3. Change parameters as desired and perform the Surview.
4. Plan on the **Surview**.
5. Perform the **Axial Dual Energy**.

Note

- **The system automatically adjusts all acquisition and reconstruction parameters (except kV and mAs) to be identical in both the first and second scan.**
- **Repeat and Extend are not available for Dual Energy acquisitions.**

7.6 Brain perfusion

Reference IEC 60601-2-44 Clause 203.107 e and 203.5.2.4.1.

During perfusion scans, images of the same anatomy are obtained after the injection of contrast material in order to track the contrast enhancement on a voxel basis.

Incisive CT supports Axial Brain Perfusion.

7.6.1 Perfusion Modes & Jog

Perfusion scans may use a jog scan sequence that moves back and forth to cover the same anatomy multiple times with a delay between scans at the same locations. Time-density analysis of this type allows the measurement of such functional parameters as blood flow, blood volume and transit times.

Perfusion modes:

- Axial Non Jog (increment of zero)
- Axial Jog (two table positions)

Axial Non Jog perfusion mode scans are performed over the same anatomical region with a fixed scan delay. During a complete cycle, there is one table position and one collimation.

Axial jog mode allows an increase of the coverage of CT axial perfusion scans by allowing the patient table to move back and forth over the same anatomical region. During a complete axial jog cycle, the scanner performs an axial scan, moves the patient table by one collimation, performs another axial scan and returns the table to the original position (the axial jog is limited to two table positions). An even temporal sampling is achieved in all locations.

During the scan, the system displays the perfusion sequence progress on the scan ruler at the bottom of the window.

7.6.2 Scan Flow

1. Enter the patient data and select the appropriate exam card.
2. Click **Start Exam**.
3. Change parameters as desired and perform the Surview.
4. Perfusion scans must be planned on the Surview.
5. Perform the Axial Brain Perfusion.

Warning

A proper scanning procedure is essential for obtaining meaningful perfusion images. You must take special care to ensure that:

- **The scan duration should be long enough to cover a pre-contrast period and entire first cycle of the injected contrast bolus. (It is recommended to have a 60 second scan duration.)**
- **The scan increment should be spaced no more than 2.5 seconds. (It is recommended: 1.0 second temporal spacing.)**
- **The contrast injection should be as rapid as possible in order to provide reasonable enhancement in white matter (4 – 5 HU enhancement), at the same time maintain a relatively small injection volume. (It is recommended: injection of 4 - 5 cc per second contrast for 10 seconds.)**

Follow all the requirements above, otherwise reliable perfusion images can not be created.

Note

Scan technique parameters(e.g., kV mAs) for CT perfusion studies should be set at values lower than those used for routine diagnostic scanning of the same anatomical area, CT perfusion images will be much noisier than images of the same body region and that this level of image quality is sufficient for the calculation of perfusion parameters.

Warning

- **Avoid Scanning through radiosensitive area (especially the orbits) by patient positioning and / or gantry tilting if necessary.**

7.6.3 Computed tomography perfusion normative

Purpose of CT Perfusion Studies

Computed Tomography (CT) perfusion studies are used to assess the delivery and perfusion of blood to an organ and/or its tissues. Such studies may be valuable for evaluating blood supply to neoplastic and non-neoplastic tissue (including normal and ischemic tissue). In particular, CT perfusion imaging allows the evaluation of cerebral ischemia or of the extent of angiogenesis associated with a tumor. CT Perfusion should be performed only for a valid medical reason and with the minimum radiation dose necessary to achieve an adequate exam. Use of perfusion scans in children should be particularly reviewed for clinical impact and justified. Pediatric patients are more radiosensitive than adults and have a longer post-exam life expectancy, so particular attention should be paid to the displayed CTDIvol and SSDE when modifying exam cards.

CT perfusion imaging relies on the linear relationship between CT attenuation, expressed in Hounsfield Units (HU) and represented in a particular pixel of an image, versus the amount of iodinated contrast material perfusing the corresponding region of tissue attenuating the x-rays. Dynamic CT (Perfusion acquisition mode) scanning enables the calculation of perfusion parameters maps, e.g., anatomic images where pixel value represents mean transit time, blood flow, blood volume, or permeability, depending upon the post-processing algorithm used.

Scan technique parameters (e.g., kV, mAs) for CT perfusion studies should be set at values lower than those used for routine diagnostic scanning of the same anatomical area. Perfusion imaging involves visualization of temporal changes in iodine enhancement, rather than resolution of small or subtle anatomical detail. The post-scan software processing of the data is relatively insensitive to increased noise levels; hence perfusion scans do not require use of the same radiation levels. In general, lower kV improves visualization of iodine contrast and consequently allows use of lower radiation doses. Lower kV settings are therefore recommended to be used as long as sufficient image quality for perfusion post-processing can be obtained. Body perfusion imaging of obese patients, for example, may be an application that requires use of higher kV values. Users should carefully review Philips' reference perfusion exam cards, which reflect the recommended kV, mA, and scan time for a typical perfusion acquisition. Additional guidance may be obtained from professional societies, regulatory agencies, educational textbooks, or peer-reviewed literature. The American Association of Physicists in Medicine provides a set of reasonable exam cards for CT brain perfusion imaging that is freely available to users via its public webpage. (See **RECOMMENDED READING**, on page 7-53.)

Because CT perfusion requires specialized post-processing software, a CT perfusion acquisition should not be performed unless this software is readily available to the institution. All users should be trained in both CT perfusion acquisitions and post-processing and should follow professional society perfusion practice guidelines. Before any changes are made to Philips' reference exam cards, both a radiologist and medical physicist familiar with CT perfusion should be

consulted. Changes in exam cards and the reason for the changes should be communicated to the radiologic technologist. Any changes to the exam cards should be evaluated with respect to the image quality (less than diagnostic level), temporal sampling and radiation dose of Philips' original reference perfusion exam cards. It is essential that all users understand that CT perfusion images will be much noisier than images of the same body region acquired for most other diagnostic purposes, and that this level of image quality is sufficient for the calculation of perfusion parameters.

Components of a CT Brain Perfusion Study

Assessment of tissue perfusion for stroke includes a diagnostic quality non-contrast brain exam, an optional CT angiogram of the circle of Willis that may include the carotid arteries, and a CT perfusion brain exam. It may also include a post-contrast CT scan of the brain for assessment of residual lesion enhancement. In the assessment of tumors, a non-contrast scan for localization of the area of interest is often done prior to the CT perfusion exam.

In all cases, the CT perfusion exam should have technique factors that are lower than those used for the other components of the study (e.g. the non-contrast, post-contrast and angiogram scans). Specific acquisition times for perfusion exams depend on the post-processing algorithm used, but in all cases the exam must be performed over a relatively long period of time (typically 40-50 seconds, and potentially up to 3 minutes; consult the Philips' user manual and a radiologist) in order to measure the time-dependent physiologic process of blood flow through the brain. Since the scan location is fixed, the same anatomy is irradiated repeatedly during this scan time. Ensure scan duration is appropriate based on the concentration, volume, and rate of delivery of contrast agents.

The lenses of the eyes are more radiosensitive than the skin. Scanning through the orbits should be avoided, if possible, by the use of patient positioning and/or gantry tilting. Consult the medical physicist to ascertain appropriate deterministic thresholds across the body.

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Body Perfusion Considerations

Perfusion scanning of the torso, typically referred to as body perfusion CT is not currently performed as frequently as head perfusion scans. It is essential to refer to Philips' reference exam cards and to involve a radiologist and medical physicist familiar with the principles and techniques for body CT perfusion imaging, as well as communicate with the radiologic technologist. Because of the higher attenuation of the torso, body perfusion scans may require

a higher kV than head perfusion scanning. Again, the image quality obtained should be noisier than most conventional body CT scans as the post-processing algorithm is able to extract the needed time attenuation information from the noisy data set. Respiratory motion is an important consideration in body perfusion CT. In the rare event that a body perfusion scan would be performed in a pediatric patient, sedation in small children may be required.

Perfusion Acquisition Types

On some types of CT equipment (non-Philips scanners), perfusion scans are performed in a continuous exposure mode, in which the table does not move and the x-rays are turned on over the entire scan period. This provides the highest temporal sampling; however, such temporal sampling may not be required for a particular application. This acquisition mode delivers the highest dose to the patient, since the x-ray beam is always on.

Instead of a continuous exposure mode, Philips utilizes the axial perfusion mode on the default exam cards—where the table does not move but the x-rays are turned on intermittently during the scan (axial perfusion). To minimize dose, the temporal sampling rate should be as described in the Scan Modes for Acquisition of Perfusion Data table. These temporal sampling rates may not be compatible with other vendors' post-processing software.

Philips' axial jog mode is specially designed for perfusion scanning and can extend the coverage of tissue imaged, thus dispersing the dose over a wider area and decreasing peak skin dose. The temporal

sampling rate is reduced for any specific anatomic location compared with continuous and intermittent exposure modes where the table remains stationary. In axial jog mode, scanning is performed at two adjacent axial locations by automatically moving the table between intermittent x-ray exposures. For this mode, the operator must ensure that the sampling frequency remains adequate for the post-processing software.

The temporal sampling rate can affect the total dose for the scan however; the rate varies based on the acquisition mode selected. The following table summarizes the various scan modes that can be used for acquisition of perfusion data. This information should be shared with the qualified medical physicist and radiologist:

Scan Mode	Coverage	Temporal Sampling Rate	Acquisition/Dose Considerations	Clinical Considerations
Cine/Continuous	N/A	N/A	Highest dose due to continuous scanning/ highest temporal resolution	Not available on Philips scanners
Axial	20mm/40mm	2.0 sec. cycle time (0.5 sec. RT)	Lower dose due to intermittent scanning/ Limited coverage	30 jog cycles recommended; up to 50 cycles selectable
Axial Jog	40mm	(0.5 sec. RT)	Lower dose due to intermittent scanning/ Limited coverage	15 jog cycles recommended; up to 50 cycles selectable. Jog is selected if coverage need exceeds 20mm
Axial Jog	80mm	(0.5 sec. RT)	Lower dose due to intermittent scanning/ Limited coverage	15 jog cycles recommended; up to 50 cycles selectable. Jog is selected if coverage need exceeds 40mm

Tab. 1: Scan Modes for Acquisition of Perfusion Data

The exam duration for tumor perfusion needs to extend over a longer time interval than a general perfusion scan, starting prior to the arrival of the contrast bolus and include a period of approximately 3 to 3.5 minutes to adequately support collection of data for the computation of permeability maps. Initially, the temporal sampling rate must be the same as that used for stroke protocols in order to adequately measure the first passage of contrast material through the

region. Subsequently, sparser sampling can occur, with temporal intervals ranging from 5 to 20 seconds. This reduces the dose by decreasing the number of exposures.

Scan Parameters Effects on Dose

kV: Effects on Dose

The effect on dose from changing kV is non-linear. Holding all other parameters constant, changing from 80 kV to 120 kV will result in approximately three-fold increase in dose. See chapter **CTDI and dose analysis information** in Technical Reference Guide for more details on the effect of kV changes on CTDI.

mA, mAs: Effects on Dose

Changing the mA or mAs has a linear effect on dose. Holding all other parameters constant, doubling the mA or mAs will double the dose.

Note that the effects of kV and mA or mAs on dose are multiplicative. For example, a three-fold increase in dose that occurs from increasing kV combined with a two-fold increase in dose from doubling the mA will result in a six-fold increase in overall dose.

Considerations for peak skin dose

The highest radiation dose accruing at a single site in a patient's skin, referred to as the peak skin dose, is an important parameter in assessing risk of erythema (skin reddening) and epilation (hair loss). The necessity for repeated scanning of the same location over extended times should result in skin doses that can be higher than those associated with routine CT applications. Factors that influence these doses include kV, mA, scan time, perfusion acquisition type and table movement, if any, during the perfusion acquisitions. As with patient dose, lower kV settings are recommended and should be used appropriately to achieve appropriate image quality for perfusion evaluation with respect to image noise based on body size, region scanned and scanner type. In all cases, user should carefully refer to

the Philips reference perfusion exam cards (Refer to protocol book section)to determine appropriate kV, mA/mAs and scan times for typical perfusion acquisitions. Additional guidance may be found at professional society and/or regulatory websites (see **RECOMMENDED READING**, on page 7-53).

Required Imaging Attributes for Perfusion Imaging

The purpose of a CT perfusion series is to assess tissue perfusion and delivery of blood to the organ and/or tissues of the organ; the acquisition parameters are different from those needed for routine low contrast CT imaging applications. The acceptable noise level in CT perfusion is typically higher than that for acquisitions routinely used in diagnostic imaging. Automatic exposure control (AEC) should not be used unless the manufacturer's reference perfusion protocol employs it. Exam cards (protocols) should be adjusted accordingly for patient age, injection rate, injection volume, and exam type (stroke versus tumor evaluation and head versus body).

CT perfusion scans need to acquire data over a sufficiently long duration to accommodate the transit time associated with the physiological process of the contrast bolus moving through the vascular system. The acquisition duration for a stroke study must cover the time from prior to the arrival of the contrast material bolus through the approach of the venous signal to baseline. The scan acquisition duration should be no less than 30 seconds. Scans are more typically 60 seconds in duration. The brain perfusion acquisitions should be spaced no more than 2.5 seconds apart, and 2.0 seconds is recommended in most cases. This duration is directly dependent on the volume of contrast material injected, the rate of injection and the patient's cardiac output. If contrast material volumes or injection rates change from exam to exam, the scan duration will need to be adjusted accordingly. The user should consult the perfusion scanning and post-processing information in the user manuals for more detailed imaging and CT perfusion information.

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Contrast injection considerations

As the iodine concentration of contrast material decreases, contrast material volume or flow rate may need to be adjusted to deliver the required enhancement. Operators should pay close attention to the shape of the bolus, consider following the bolus with saline and utilize an injector capable of delivering the required injection rates.

The contrast injection rate should be determined by contrast agent labeling, professional guidelines, and in consultation with a physician. Special considerations should be given for children due to their smaller size.

Other considerations and references

Due to the necessity of obtaining data over an extended time period in order to calculate relevant perfusion parameters, repeated scanning of the same location is required. As a result, CT perfusion acquisitions produce peak skin doses higher than those associated with routine diagnostic CT imaging. Deterministic effects (e.g., tissue reactions such as skin reddening, hair loss) are dose-threshold phenomena that can appear with peak skin dose >2 Gy. As with all CT scanning, the CTDIvol and SSDE value displayed on the operator console should always be confirmed prior to the scan. For CT perfusion without table motion, the value of the CTDIvol tends to overestimate the actual peak skin dose by approximately a factor of two (see reference to Bauhs, chapter "**RECOMMENDED READING**"). User manuals may contain an informative section that describes means for conversion of the displayed CTDIvolor dose profile to an estimated phantom peripheral dose, which may serve as an estimate for peak skin dose. A typical CT perfusion study should not result in a console-displayed CTDIvol of more than 1000 mGy. Care should be taken and consideration given prior to rescanning a patient within a short time with a perfusion acquisition over the same anatomy due to concerns about reaching a cumulative peak skin dose value greater than the deterministic threshold for skin injury.

Radiology departments/CT departments should have a QA program for oversight and review of any exam card changes. As with other

scan types, the CTDIvol and SSDE for a CT perfusion acquisition is recorded in both the DICOM screen capture and the DICOM CT dose structured report and should be used for QA follow-up for all scanning.

Additional information on CT perfusion may be obtained in the user manuals for the CT perfusion scanning and post-processing software, from the ACR practice guide for CT perfusion, from the AAPM website that contains reference perfusion protocols as well as other perfusion related information (visit FDA Website for documents related to radiation dose quality assurance). See **RECOMMENDED READING**, on page 7-53.

All the reference exam cards provided within the software of this system, including those for CT perfusion, are included in the applications protocol document supplied with the system. This document provides a concise description of each scanning series with the exam card, technique factors and dose information for each.

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RECOMMENDED READING

J. A. Bauhs, T.J. Vrieze, A.N. Primak, M.R. Bruesewitz, and C.H. McCollough, 2008, "CT dosimetry: comparison of measurement techniques and devices," Radiographics Vol. 28, pp. 245-253.

ACR–ASNR–SPR Practice Parameter for the Performance of Computed Tomography (CT) Perfusion in Neuroradiologic Imaging - https://www.acr.org/-/media/ACR/Files/Practice-Parameters/ct-perfusion.pdf

AAPM CT Scan Protocol Website - https://aapm.org/pubs/ctprotocols/

Radiation Dose Quality Assurance: Questions and Answers - https://www.fda.gov/Radiation-EmittingProducts/RadiationSafety/RadiationDoseReduction/ucm232550.htm

7.7 DoseRight (aka) Automatic Exposure Control (AEC)

Patients come in all shapes and sizes. For the purpose of achieving a desirable image quality with a scan technique that reflects the patient's size and shape, there are several approaches employing automatic and manual mA setting modes of CT operation. These approaches are designed to adjust the x-ray output of the system according to the x-ray attenuation presented by a patient's anatomy. For example, the patient's weight or body mass index (BMI) may be used as a guide to set a fixed mAs for the acquisition. Alternatively, some measure of patient thickness or girth, such as anterior-posterior (AP) thickness, lateral width, or patient circumference can be used as a basis to choose an appropriate fixed mAs value, i.e., a value that yields an image adequate for diagnosis with a patient dose as low as reasonably achievable. However, these methods have at least two inherit limitations. First, as they produce a fixed mAs value, they do not adjust for differences in body-region thickness and associated variation in x-ray attenuation along the patient length and/or around the patient circumference. Second, the use of weight, thickness or circumference is an incomplete surrogate for x-ray attenuation, which is one of the most relevant physical parameters affecting image quality and which depends on the elemental composition and density of human tissue as well as on its shape and thickness.

DoseRight (aka) Automatic Exposure Control (AEC), on the other hand, is designed to adjust the scanner radiation output to meet a desired, pre-set level of image quality/noise criterion by empirically assessing the patient's attenuation and automatically modulating the mA accordingly. DoseRight can provide a desired level of image quality/noise at a more optimal patient dose than would be possible with a fixed scanner radiation output. DoseRight accomplishes attenuation based tube current modulation in two ways:

1. Modulating the mA dynamically during scanning in the X-Y and/or Z dimensions to adapt to variations in the patient's attenuation.

2. Adjusting the mAs to a fixed value based on measurement and calculation of the patient's overall attenuation: the mAs is constant

during scanning, but its value has been quantitatively determined so as to yield an average pre-set level of image noise.

How DoseRight Works

On the basis of a patient's attenuation, DoseRight sets mA values as the x-ray tube rotates around the patient. The technology uses knowledge about the scanner's imaging chain and the measured attenuation of the patient to appropriately adjust mA values in order to achieve the desired, constant image noise/quality criterion.

Larger patients typically require scanning at a higher mAs than the mAs used for smaller patients. Similarly, thicker projections (e.g., laterally through the shoulders versus AP through the shoulders) typically require more mAs to achieve the same resultant image noise/quality criterion. Finally, anatomy with greater attenuation (e.g., abdomen or pelvis compared to lungs) requires more mAs to achieve the same image noise/quality criterion.

Adaptation to Anatomy

As patient attenuation changes throughout the course of the scan, either rotationally around the patient or along the length of the patient, DoseRight is designed to adjust dynamically the mA for each body part and projection. If the attenuation does not change, DoseRight sets the mA at a constant value that is appropriate for the overall patient thickness and that achieves the desired image quality/noise criterion.

When to Use DoseRight

DoseRight technology has the greatest impact when the portion of the patient being scanned has non-uniform size, shape, or density. In these cases, DoseRight adjusts scanner radiation output to the changing anatomy and modulates the mA in the Z-direction along the patient's length only (ZDOM) or in both the Z-direction and the XY-direction around the patient (3DDOM). Even though DoseRight is used, the operator must still select scan parameters before

scanning including DoseRight parameters, which provide a desired image noise/quality criterion. Scan parameters, including DoseRight parameters, must be chosen to carefully balance patient radiation dose and image performance.

Even when the patient's anatomy has consistent size, shape, and density throughout the planned scan range, DoseRight technology chooses the appropriate exposure settings to achieve the image noise/quality criterion requested by the user.

When bismuth or other shields are considered for use in the planned scanned range, refer to the Metal Artifact Reduction for Orthopedic Implants section for specific information.

When NOT to use DoseRight

If users do not understand the relationship between DoseRight parameters, image noise, and dose, DoseRight tools should not be used. Also, if the patient cannot be centered in the scanner, ZDOM and 3DDOM are not recommended because dose modulation is designed to work optimally for a patient centered in the in the gantry. Finally, if there is any question, radiologic technologists should always consult their medical physicist and radiologist to ensure that proper exposure techniques are used.

Do not use DoseRight when scanning anatomy that extends off the couch, In addition, do not use DoseRight when using the Infant Cradle off the end of the couch.

DoseRight and Radiation Doses

Use of DoseRight does not always result in dose reduction, especially when compared to a fixed mA/mAs protocol. For example, when providing the desired image noise/quality criterion setting for a large patient, DoseRight might appropriately increase the scanner radiation output as compared to that for an average-sized patient. For most examinations of average-sized or small patients, and for the same image noise/quality criterion settings, DoseRight use will result in the same or lower CTDIvol as that of a fixed mA/mAs protocol.

(However, a larger patient would appropriately require more fixed mA than for a smaller patient.)

Note

Radiologic technologists must be fully aware that proper patient centering is critical for accurate Doseright function. Improper patient centering can result in an exposure that is either too high or too low to achieve the desired image noise/quality criterion. Note that proper patient centering can be more challenging for smaller pediatric patients, so special care should be taken.

DoseRight-Effect of DoseRight Control Setting

For a given patient, changing the image noise/quality criterion setting in DoseRight will affect the patient dose: asking for lower image noise/higher image quality criterion will result in more dose to the patient (e.g., increasing Dose Right Index (DRI)). In contrast, asking for higher image noise/lower image quality criterion (e.g., decreasing DRI) will result in less dose to the patient.

DoseRight- Considerations for Patient Size, Shape, Composition and Age

For a given DoseRight image noise/quality criterion setting, larger patients and more attenuating body regions may result in a higher scanner radiation output. Smaller patients and less attenuating body regions DoseRight may result in a lower scanner radiation output.

While DoseRight can be an effective dose-reduction tool for pediatric patients, special care should be taken with this patient group.

DoseRight-Dynamic Scanning

When exam card contains multiple x-ray tube rotations at the same table location, the effect on patient dose of incorrect selection of parameters will be multiplied by the number of rotations. For such protocols, operators must take extra care when setting manual mAs or DoseRight parameters to achieve the desired level of image

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noise/quality criterion. For example, in perfusion scanning, the image noise can often be much higher (yielding a lower dose) than for

routine diagnostic scanning of the same region because the primary application of perfusionscan data is for quantitative analysis and characterization of perfusion parameters rather than for diagnostic visualization. Philips' reference exam cards indicate whether use of DoseRight is or is not recommended with these scan modes.

DoseRight- How to Tell if the Dose Has Changed

For every patient, and any time DoseRight settings are changed, in order to confirm a correct level of scanner radiation output for that patient's size and clinical indication, users should examine the predicted CTDIvol, SSDE and DLP displayed prior to performing the scan, as a step in operator confirmation of system settings. When a large patient is scanned at a particular setting of image noise/quality criterion, the CTDIvol, SSDE and DLP will be higher than for a smaller patient at the same DoseRight settings. Predicted CTDIvol, SSDE and DLP values are displayed on the scanner's dose display on the user interface prior to confirmation of settings for scanning.

After scanning, the values are updated to reflect the average of the actual mAs values used in the scan and are displayed on the user interface as well as recorded in the DICOM radiation dose structured report.

Summary

DoseRight tools are a versatile and powerful and designed to tailor the scanner's radiation output to each patient based on the patient's size, shape and attenuation and the user's requested level of image noise/quality criterion. DoseRight technology uses measured patient attenuation values to adjust the mA dynamically in order to achieve the requested level of image noise/quality criterion. However, DoseRight settings must be chosen with the same care

used to choose all other parameters that affect radiation dose to the patient. Before the scan parameters are confirmed, careful attention must be paid to CTDIvol, SSDE and DLP displayed on the user interface; scanner radiation output associated with the prescribed exam card must be checked and confirmed prior to scanning. Used properly, DoseRight is a key technology to help ensure that the appropriate radiation dose is used for every patient.

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8 Dose management

8.1 Overview

Dose Management is a set of principles and practices focused on lowering radiation dose for patients and staff. Philips focuses on system design optimization, current (mA) optimization, and increasing dosage awareness to reduce the cumulative risk of radiation while obtaining high-quality images.

8.2 Dose modulation

8.2.1 3D Dose-Modulation (angular and longitudinal modulation)

Reference IEC 60601-2-44 Clause 203.106.

3D Dose-Modulation is a scanner function which modulates the tube current in two ways simultaneously. First, the tube current is modulated during each rotation based on patient body symmetry change using specially developed hardware and software algorithms. Second, the tube current is modulated longitudinally according to the attenuation of the patient.

In rotational asymmetrical objects (for example, ellipsoids), readings from lower signals contribute to higher noise, while readings from higher signals make only minor contributions to the total noise. Angular modulation is used to reduce the mA in the rotational direction of the high signal. The modulation calculation is carried out online during the scan. This modulation results in dose savings for rotationally asymmetrical objects.

In the longitudinal direction, the mA is modulated to achieve the same image quality for the reconstructed images. Using the surview, a mAs along the Z-axis is calculated, so that the same noise level is maintained in all of the slices along the Z-axis of the plan. The protocol mAs chosen by the DoseRight Index is the average of each image slice mAs. Based on the mAs range, the minimal mAs will be used for the region of the body with

the lowest attenuation, and the maximal mAs will be used for the region of the body with the highest attenuation. This modulation results in dose saving for objects that vary in the longitudinal direction.

The mAs displayed on the image is the actual mAs used for that particular slice.

3D Dose-Modulation can only be operated simultaneously with DoseRight Index. When DoseRight Index is used with 3D Dose-Modulation, the system suggests a mAs value based on the patient's attenuation from the surview. You have the option to use this value or modify it without disabling the 3D Dose-Modulation feature.

3D Dose-Modulation is not used in the following cases:

- Axial scans

Note

- **At least 70% of the planned scan region must be located within the surview, otherwise the 3D Dose-Modulation function is disabled.**
- **When 3D Dose-Modulation is activated and all the planned scan region is located within the surview, the actual average dose of the scan will not be greater than the planned dose with maximum deviation margin of ±20% or 1mGy(take the higher one as standard)**

8.2.2 DoseRight Index

The DoseRight Index (DRI) offers the benefit of consistent image quality for different patients using the following methodology:

Warning

- **Ensure that the patient has removed all external metal before entering the scan room as it can affect the surview image.**
- **DoseRight Index should NOT be used for Calibration, CCT, or Tracker.**
- **To avoid people receiving unwanted ionizing radiation and output Non-Diagnostic Image, always check that the DoseRight Index recommended mAs corresponds to the actual patient size.**
- **If not familiar with DoseRight, you are not recommended to use it. Contact your Philips representative for more information or training.**

- **DoseRight Index does not guarantee reduction of radiation doses in all patients, it offers the optimal radiation doses for patients.**
- **Pay attention to radiological dose with use of children and infant exam card scanning with DoserRight.**
- **DoseRight can only be used for helical scanning rather than axial scanning.**

1 The system measures, using the Surview image, the maximum body size of each patient scanned.

2 The maximum size of the patient is then compared to a pre-defined reference size according to Exam Card selection.

3 A maximum mAs value is automatically calculated based on the comparison of patient sizes. This mAs value appears as the recommended value.

Note

The DoseRight parameter is only available on Exam Cards that include Surview scans. When creating Exam Cards, ensure that the DRI and mAs values are appropriate for the reference size of the selected patient.

Warning

- **Even though DRI is used, before scanning the operator must still select scan parameters, including DRI parameters, which provide a desired image noise/quality criterion. Scan parameters including DRI parameters must be chosen to carefully balance patient radiation dose and image performance.**
- **When bismuth or other shields are considered for use in the planned scanned range, consult the system user manual or Philips representative for specific information.**
- **When DRI is available, if users do not understand the relationship between DRI parameters, image noise, and dose, DRI should not be used. Also, if the patient cannot be centered in the scanner, DRI is not recommended because the attenuation calculations used for DRI are designed with the assumption that the patient is centered in the gantry. Finally, if there is any question, radiologic technologists should always consult their medical physicist and radiologist to ensure that proper exposure techniques are used.**
- **Radiologic technologists must be fully aware that proper patient centering is critical for accurate DRI function. Improper patient centering can result in an exposure that is either too high or too low to achieve the desired image noise/quality criterion. Note that proper patient centering can be more challenging for smaller pediatric patients, and so special care should be taken.**

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- **DRI settings must be chosen with the same care used to choose all other parameters that affect radiation dose to the patient. Before the scan parameters are confirmed, careful attention must be paid to CTDIvol and DLP displayed on the user interface; scanner radiation output associated with the prescribed protocol must be checked and confirmed prior to scanning. Used properly, DRI is a key technology to help ensure that the appropriate radiation dose is used for every patient.**

Note

- **Use of DRI does not always result in dose reduction, especially when compared to a fixed mA/mAs protocol. For example, when providing the desired image noise/quality criterion setting for a large patient, DRI might appropriately increase the scanner radiation output as compared to that for an average-sized patient. For most examinations of average-sized or small patients, and for the same image noise/quality criterion settings, DRI use will result in the same or lower CTDIvol as that of a fixed mA/mAs protocol.**
- **For a given patient, changing DRI setting will affect the patient dose: asking for higher DRI/lower image noise/higher image quality criterion will result in more dose to the patient. In contrast, asking for lower DRI/higher image noise/lower image quality criterion will result in less dose to the patient.**
- **For a given DRI setting, larger patients and more attenuating body regions may require result in a higher scanner radiation output. Smaller patients and less attenuating body regions may result in a lower scanner radiation output. While DRI can be an effective dose reduction tool for pediatric patients, special care should be taken with this patient group. Infant and child factory exam cards are without DRI by default.**
- **For every patient, and any time DRI settings are changed, in order to confirm a correct level of scanner radiation output for that patient's size and exam protocol, users should examine the predicted CTDIvol and DLP displayed prior to performing the scan, as a step in operator confirmation of system settings. When a large patient is scanned at a particular setting of image noise/quality criterion, the CTDIvol and DLP will be higher than that for a smaller patient at the same DRI settings. Predicted CTDIvol and DLP values are displayed on the scanner's dose display on the user interface prior to confirmation of settings for scanning. After scanning, the values are updated to reflect the average of the actual mAs values used in the scan and are displayed on the user interface as well as recorded in the DICOM radiation dose structured report.**
- **When user switches DRI to manual mAs mode, the system will provide the mAs of the original protocol.**

- **EPPD is a better estimation for peak skin dose than CTDIvol, the following provides possible method for calculating an Estimated Phantom Peripheral Dose. We are establishing a relationship between CTDIvol and EPPD. From physics viewpoint, the relationship depends on kVp, phantom size. The formula is as below:**

EPPD=CTDIvol*EPPD_facter(kV, phantom_size)

Table 1: EPPD factor table

	70kV	80kV	100kV	120kV	140kV
Phantom size: 16cm	1.06	1.05	1.04	1.04	1.03
Phantom size: 32cm	1.28	1.26	1.24	1.22	1.21

8.2.3 Liver Area DoseRight Index

When the Liver Area DRI is applied, the system automatically detects the liver and presents it on the Surview. The set Index level is then applied to the detected area.

- To increase the X-ray exposure through the liver area, choose Liver Area DRI of +1 to +8. The default setting is **Same as the rest of the scan**.
- Adjust the detection area lines as desired.
- To scan the liver area using the same X-ray exposure as the entire planned scan, select **Same as the rest of the scan**.

Warning

Applying the Liver Area DRI will raise a patient's overall DoseRight Index through the detected area. Confirm and adjust the settings as needed before scanning.

8.2.4 Brain Area DoseRight Index

Brain Area DoseRight Index (DRI) is focused in the brain area. Once DoseRight is enabled, you have the option to select a Brain Area DoseRight Index level.

When the Brain Area DRI is applied, the system automatically detects the head line and presents it on the Surview. The set Index level is then applied to the detected head area.

- To increase the X-ray exposure through the head area, choose Brain Area DRI of +2 to +14. The default setting is **Same as the rest of the scan**.

- Adjust the detection area lines as desired.
- To scan the head area using the same X-ray exposure as the entire planned scan, select **Same as the rest of the scan**.

Warning

Applying the Brain Area DRI will raise a patient's overall DRI through the detected area. Confirm and adjust the settings as needed before scanning.

8.3 General rules for DoseRight

You can change the DoseRight Index, thus changing the maximum mAs.

- A frontal versus lateral Surview may result in slightly different mAs recommendations for the same anatomy.
- When a dual Surview is performed only the first Surview data is used for DoseRight.
- DoseRight is modified for each different kV value. The mAs recommendations are based on the kVp selected.

DoseRight has reference sizes (Water Equivalent Diameter) for different body parts.

8.4 Dose check

The Philips Dose Check function provides a mechanism to reduce the incidents of accidental exposure due to user errors or utilization of improper scan parameters.

Note

Dose Check must be initially enabled by your Philips service engineer. Access to the various functions should follow your site-specific rules and regulations.

Dose Check produces two forms of dose-exposure information:

- Dose Notification messages
- Dose Alert messages

The Dose messages appear before scanning, when the estimated dose is planned to exceed the preset levels.

Dose Reduction Initiative

The U.S. Food and Drug Administration has established the "Initiative to Reduce Unnecessary Radiation Exposure from Medical Imaging." The initiative requires manufacturers of Computed Tomography systems to incorporate safeguards into equipment to prevent unintended overdosing.

The Philips Dose Check function conforms to:

- "Computed Tomography Dose Check," the MITA implementation of the FDA's initiative [NEMA Standards Publication XR 25-2010].
- The DICOM Standard, Supplement 127: "CT Radiation Dose Reporting (Dose SR)," which defines the template for Diagnostic X-ray CT Dose Reporting.

Functions of Dose Check

- **Dose Level accumulation** of $CTDI_{vol}$ and DLP - Is calculated for every study.
- **Dose Notification** - Levels apply to each scan. When the Dose Notification level is exceeded, the operator is notified and the event is entered in the Dose Report.
- **Dose Alert** - Applies to a body part (head or body scan), to a protocol, or to an exam. When the accumulated **Dose Alert** level is exceeded the operator is alerted. The cause of the alert and the operator's response to the alert are entered in the Dose Report. Dose Alert may be configured to require a password before the scan can proceed.

Note

- **The default $CTDI_{vol}$ and DLP Dose Alert level is factory-set, but can be changed in Service.**

- **Dose Reports** - Are maintained for 400 days and can be exported in HTML format for review.
- **Dose SR** (Structured Reporting) - Automatically generates a report from scan and dose information. The reports are produced in DICOM format, which can be read by generic vendor-independent tools.

8.4.1 Dose Notification

The Dose Notification values for each scan of the current exam card can be specified when CTDI Vol Limit & DLP limit in **Exam card manager** is active.

Note

- **The CTDI Vol and DLP Value fields may be left with 0, it means that the limits are not set.**
- **CTDI Vol Limit & DLP limit in Exam card manager will be active only for the users other than the CT user such as administrator, or service**

Dose Notification message

If the $CTDI_{vol}$ or DLP level of a scan has exceeded the specified limit, a Dose Notification opens.

The scan will not start unless:

- You enter the required information and confirm the notification. This results in a Dose Report entry.

  OR
- You adjust the scan parameters so that the dose values are below the limit.

8.4.2 Dose Alert

The Dose Alert levels of accumulated $CTDI_{vol}$ and DLP are computed for each planned scan. The Dose Alert values are specified in **Dose setting**.

- In the display, the dose levels are accumulated separately for Head and Body.
- The accumulated dose levels are updated if a scan is added/removed or if scan parameters that affect $CTDI_{vol}$/DLP are changed.
- If the exam is continued (or if the previous surview is used) the accumulation of dose continues (is not reset to zero).

Note

- **Surview scans are accumulated according to their protocol group, the body part of the next scan, or the body part of the previous scan if there are no steps following.**

- **If a notification value is set, the planned $CTDI_{vol}$ and planned DLP will be compared to the set limit. The comparison is done in Plan, each time a step is confirmed.**
- **In multicycle scans (such as Tracker scans) the calculation assumes the maximum number of cycles in the protocol will be performed.**
- **The CTDIvol and DLP Value fields may be left with 0, it means there is no limited.**

Dose Alert Message

Dose Alert informs you when the current study's accumulated $CTDI_{vol}$ or DLP value has exceeded a specified limit.

If any of the current setting limits are exceeded, the Dose Alert message is displayed. The scan will not start unless:

- You enter the proper information and confirm the message. This results in a Dose Report entry.

  OR
- You adjust the scan parameters so that the dose values are below the limit.

Note

If both the Dose Alert and Dose Notification are triggered, the Dose Alert displays first.

8.4.3 Settings of Dose Check

The following settings are found in **Dose setting** in Service.

Perform Dosecheck

Turn Dose Check on or off.

Uncheck **Perform DoseCheck**, it will disable Dosecheck function.

Exam Dose Limits (DoseCheck)

Set Dose Alert accumulated upper limits. The limits for $CTDI_{vol}$ and DLP are set individually for Body and Head.

Require password validation to continue after dose alert

Turn the password validation (displayed in the Alert message) on or off.

For more information about, please see **Dose setting**, on page 22-18.

8.4.4 Dose Check Report

The Dose Check Report keeps a record of all series that have exceeded the Dose Notification or Dose Alert limits. You can view the reports to audit exam cards and review the Dose limits.

Dose Check Reports are maintained for 400 days and can be exported to a USB device in HTML format for review/audit. Click **Dose check report** in Service.

- The Report file includes dose information, study ID, date and time, a copy of the message displayed to the operator, and the diagnostic reason (if entered).
- Reports maintained in chronological order (newest entries are at the bottom).
- Select the check report, click the **Export** button to export the report file to an attached USB device.

8.4.5 Dose SR (Dose Structured Reporting)

The Dose SR feature records patient dosimetric information using a standardized DICOM convention.

A “Radiation Dose Information” file is automatically created after the patient scan. The Dose SR file can be read by any tool that supports DOSE SR.

Dose Structured Reporting (SR) References

- NEMA Standards Publication XR 25-2010
- AAPM Dose Check Guidelines version 1.0
- DICOM Standards Committee, Supplement 127: CT Radiation Dose Reporting (Dose SR)

For Pediatric & Small Patients information, please see **Pediatric & Small Patients**, on page 4-31.

8.5 User Dose & Imaging Information

The scanner is designed for scanning the head and the body. Therefore, dose and image quality information are provided separately for head and body scans according to the Code of Federal Regulations (21 CFR).

Phantoms & Measurement Methods

Dose Phantoms

The CT Dosimetry Phantom is the phantom used for determining the dose delivered by a CT X-ray system. The phantoms are right circular cylinders of polymethyl methacrylate, at least 14 cm long. Their density is 1.19 ± 0.01 grams/cc. The phantom for testing CT imaging of the body has a diameter of 32 cm, and the phantom for the head has a diameter of 16 cm.

The phantom provides means for the placement of dosimeter(s) along its axis of rotation and along a line parallel to the axis of rotation, 1.0 cm from the outer surface and within the phantom.

Dose Profiles & Dose Measurements

The dose profiles were measured using an X-ray sensitive, film-type media. Actual dose values were measured with a 10 cm long, pencil-shaped ionization chamber.

CTDI Definition

Computed Tomography Dose Index (CTDI) is the integral of the dose profile along a line perpendicular to the tomographic plane divided by the product of the nominal tomography section thickness and the number of tomograms produced in a single scan, as follows:

- For N × T less than or equal to 40 mm

$$CTDI_{100} = \int_{-50mm}^{+50mm} \times \frac{D(z)}{N \times T}\, dz$$

- For N ×T greater than 40 mm (all CT conditions of operation except collimation are kept the same for these measurements)

$$CTDI_{100} = \int_{-50mm}^{+50mm} \frac{D_{Ref}(z)}{(N \times T)_{Ref}}\, dz \times \frac{CTDI_{freeair,N\times T}}{CTDI_{freeair,Ref}}$$

where,

- D(z) is the dose profile representative of a single axial scan along a line z perpendicular to the tomographic plane, where dose is reported as absorbed dose in air and is evaluated within a polymethylmethacrylate (PMMA) dosimetry phantom;
- $(N \times T)_{Ref}$ is 20 mm;
- $D_{Ref}(z)$ is the dose profile representative of a single axial scan along a line z perpendicular to the tomographic plane, where dose is reported as absorbed dose in air and is evaluated within a polymethylmethacrylate (PMMA) dosimetry phantom for $(N \times T)_{Ref}$ =32x0.625;
- $CTDI_{free\ air,N \times T}$ is the $CTDI_{free\ air}$ for a specific value of N × T;
- $CTDI_{free\ air,Ref}$ is the $CTDI_{free\ air}$ for $(N \times T)_{Ref}$ =32x0.625;
- N is the number of tomographic sections produced in a single axial scan of the X-ray source;
- T is the nominal tomographic section thickness.

for axial scanning

$CTDI_W = \frac{1}{3} CTDI_{100}$ (center) + $\frac{2}{3} CTDI_{100}$ (peripheral)

$$CTDI_{vol} = \frac{N \times T}{\Delta d} CTDI_W$$

with these definitions:

- N = the number of tomographic sections produced in a single axial scan of the X-ray source
- T = the nominal tomographic thickness
- Δd = the patient support travel in z-direction between consecutive scans.

for helical scanning

$CTDI_W = \frac{1}{3} CTDI_{100}$ (center) + $\frac{2}{3} CTDI_{100}$ (peripheral)

$$CTDI_{vol} = \frac{CTDI_w}{CT_{pitch\ factor}}$$

for scanning without movement of the patient support

$CTDI_W = \frac{1}{3} CTDI_{100}$ (center) + $\frac{2}{3} CTDI_{100}$ (peripheral)

CTDIvol = n x CTDIw

- n = the maximum number of pre-programmed rotations

The value for $CTDI_{vol}$ is expressed in milligrays (mGy).

9 Image reconstruction

9.1 Overview

Image reconstruction allows you to perform reconstructions of raw scan data using one of these methods:

- Online reconstruction begins when enough data is collected for reconstruction during the scan.
- Offline reconstruction is accomplished when patient files are accessed in the reconstruction interface and reconstructed.

9.2 Online reconstruction

Online reconstruction of the clinical scan occurs immediately after the scan is complete.

9.2.1 Add reconstruction

You have the option of inserting a reconstruction into the current study. Using this feature results in a real-time reconstruction.

1 To insert a reconstruction into the current study, click **Duplicate serirs**.

2 If desired, edit the parameters.

You can delete recons by selecting one from the list and clicking **Delete** in right click menu.

Edit before final recon allows you to edit image results before reconstruction.

9.3 Offline reconstruction

Use this procedure to reconstruct patient data.

1. Select patient raw data from the **Raw Data** tab in the **Completed** window.
2. Click **Start Recon**. The system loads the information and displays the reconstruction parameters.

   The displayed parameters correspond with the type of scan that was performed.
3. Change the reconstruction parameters, if desired.
4. When you have entered the settings, click **Start Recon**.

10 Review mode

10.1 Overview

The system is equipped with a variety of viewers for reviewing patient images.

- **2D** is for reviewing original axial images in stack or tile mode.
- **MPR** is for reviewing three orthogonal images (or slab images) simultaneously. MPR also allows creating curved planes.
- **Volume** is for reviewing full volume images in different rendering techniques.
- **Endo** is for reviewing air or contrast-filled structures in the navigation mode.

Each viewing mode has its own clinical usages and has specific visualization tools associated with it. These uses will be further described in this chapter.

There are two ways to access the Review.

1 Select a study from study list.

2 Click the **Review** button under image preview viewport in the Patient Complete window;

OR

1 Select a study from study list.

2 Click the **Open With** button under image preview viewport in the Patient Complete window;

or click **Open With** button below the selected study.

Note

- **The loading data must comply with DICOM 3.0 protocol.**
- **All the system applications are based on the loaded DICOM data.**
- **Image quality of 3D reconstructions will be reduced for slice thickness more than 3mm.**
- **Double click any viewport to enlarge it to full screen. Double click again to revert.**
- **The length in 2D/3D image can be measured with the line tool. The line tool can measure with an accuracy of ±5% when a length of 200mm is measured on a phantom located at the isocenter.**

- **Angle between two lines in values between 0-180 degrees in 2D/3D image measured by angle tool should match with actual angle of phantom with known angle with deviation of ± 5% of actual angle.**

MPR Restrictions

The slices that are reformatted have to comply with the following conditions:

- They belong to the same series.
- The spacing between the images should be the same.
- The reconstruction matrix, zoom and pan of all images should be the same.
- Their orientation (tilt angles) should be the same.
- The slice number should be no less than 8.

10.2 Review tools

10.2.1 Common tools

The common tool area contains a variety of general tools that are used with the Review, Analysis, and Filming applications. The common tool area is located in the lower left corner of the viewer window, and on the top of the image viewport.

Save Image, **Save Batch** and **Save Display** - Saves image, batch or viewer window page to a storage device.

In **Save Image** dialog box, you can select or create a description. Click **Config** to **Add/Delete** a preset.

Check **De-Identify Patient**, the saved image is without identifying the patient.

Note

- **Clicking the Save button opens the Save As dialog box. If you choose Derived DICOM as the save method, you can save the image with the graphic overlay included.**
- **You can save images of the same type and with the same description in one series by checking Same Series.**

Send Image to Report and **Send Batch to Report** - Selects images or batch to send to the Reporting application for use during report creation.

You can send maximum 32 images to the reporting application at a time.

Send Image to Film, Send Batch to Film, and **Send Display to Film** - Sends selected images, batch or display to the Filming application.

Invert - Reverses the gray levels of the image. (The result is a negative image).

Windowing preset - Allows you to choose the relevant predefined windowing presets (Brain, Abdomen, Bone, or Lungs, for example).

Scroll - Scrolling through the slices using the mouse wheel or the left mouse button.

Pan - Centers the feature of interest in the image frame by dragging the image in the image window.

Zoom - Magnifies or reduces the selected images.

Rotate - Rotates image view.

Window Width Center - Allows you to adjust the window width.

Enhance - Allows you to sharpen or smooth the image by changing the enhancement value.

Pixel Value - Measures an individual pixel value.

Show Information - Displays or hides the selected images corner information.

Delete All Annotations - Removes all the annotation and measurement.

Information List - Displays the selected image's scan parameters.

Reset All - Resets the studies images to the state they were in upon loading.

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Bookmark

Save Bookmark - Allows you to save the current status of an application during a work session.

Open Bookmark - Allows you to open the saved bookmark.

Region of Interest tools

Ellipse, **Polygon, Circle, Rectangle, Freehand -** Allows you to define ROIs to measure area, mean, and standard deviation of the pixel values.

Measurement tools

Line - Measures the distance between two points on the image.

Polyline - Measures the drawn polyline distance on the image.

Arrow - Points to features of interest on the image.

Angle - draws two lines, joined at a vertex, which may be placed on two image points to measure the angle between them.

Text - Types text on the images.

10.2.2 Right-click menu options

Each viewport includes right-click menu options, which duplicate functions found in the tool panel. You can refer to the tool panel in each mode and common tools see **Common tools**, on page 10-2. Not all right-click menu options are available in all viewers.

Copy - Copies the selected annotation or measurement from the current series.

Cut - Cuts the selected annotation or measurement from the current series.

Delete - Removes the selected annotation or measurement from the current series.

Paste Annotation - Pastes the copied annotation or measurement into another series.

Delete All Annotation - Removes all annotations or measurements from the current series.

Surview for various surview options:
- Set as surview
- Cancel surview
- Show plan lines
- Show all location lines

Image Overlays for various image overlays options:

- **Show Information** displays the patient images scan parameters.
- **Show Ruler** for viewing the measurement ruler on the image.
- **Show Orientation** for viewing the image direction.
- **Gray Level Reference** for viewing the image in gray scale.
- **Image Overlays** shows the all annotation and measurement which are saved as derived image.

Reset Current Series - Resets the current series to the state it was in upon loading.

Grid - Displays a grid pattern on the active image. The default grid spacing is 20 mm, and grid center is image center.

- **Set Grid** - You can select the Grid Center and input the Grid Spacing in Set Grid dialog box.

Delete - Removes the selected annotation or measurement.

Background color - Changes background color of VR viewport for various options:

- Black
- Gray
- Blue
- White

Synchronization Zoom - Synchronizes the image size in all viewports.

10.2.3 Keyboard Functions

Use the following key to view the images.

Key	Function	Viewport
Up	Scroll to the previous image	2D, MPR
Down	Scroll to the next image	2D, MPR

Key	Function	Viewport
0~9	Windowing preset	2D, MPR

Note

You can find the corresponding number in right click menu Windowing Preset.

To move the selected viewport content to another viewport: Press and hold the Ctrl key, use the right button of the mouse to drag to the desired viewport (MPR, Volume, Endo, LNA, CTC, CAA, CFA, DE, and VA support this function).

10.3 Create movie or series

A batch is a sequential set of patient images obtained from the original study, or from images processed in a viewer, or from an analysis application. You determine the composition of the batch by performing the desired image preparation functions and then specifying the starting and ending images of the batch. A batch can be saved as a movie file for viewing on a personal computer.

Set Range on Surview - Allows you to define a batch on surview image.

Start Range - Allows you to define the starting image of the batch.

End Range - Allows you to define the end image of the batch.

From/To - Changes the number of the first and last images of the batch.

All Images - Selects all images for the batch.

Include every - Indicates how many images to skip between each image you want to include in the batch.

Information Image - Adds information image to Batch.

Surview - Adds surview to Batch.

Preview - Allows you to view the series as a continuous loop of images. You can control the speed of the cine, low or high, and pause the cine.

Reset - Deletes the batch information.

Mini Image - Places a small image of the reference viewport in the lower-right corner.

Slice Increment - Defines the step size in mm between the first and last locations.

No. of Images - Defines the number of images between the first and last locations.

Slice Thickness - Changes the thickness of the batch.

Common Batch workflow

1 Define Batch Range,
- type the slice numbers in From and To.
- scroll the image to identify the start and end locations desired.
- click All Images.

2 Set Batch Parameters,
- type a number in Include every.
- type a number in Slice Thickness.
- type a number in Slice Increment.
- type a number in No. of Image.

3 Add to **Batch**,
- Surview.
- Information Image.
- Mini Image.
- Reference Image.

4 Click **Preview** to play batch.

5 Click **Save Batch** to save batch.

OR

Click **Clear** to reset batch.

10.4 2D viewer mode

In 2D Viewer mode you can review original axial images as acquired by the scanner.

Native 2D images can be reviewed side-by-side in tile viewing mode (1x1, 2x2, 3x3, and 4x4 layout), or in stack viewing mode, by scrolling through the data set.

The scrolling method in stack view is an efficient way to quickly review patient images.

Graphic tools like arrows, text, and ROIs are available for annotations and measuring.

10.4.1 2D common tools

These tools are available in the 2D Viewer.

Compare- See **2D viewer mode**, on page 10-7.

Layout - The Layout function controls how the images display in the viewport. Click the Layout down arrow to select from four image layout arrangements, 1 x 1 (which is used to scroll through images), 2x2, 3x3, 4x4, and Custom.

Custom Layout - In addition to the four standard layouts, you can use mouse cursor to select the number of images in the rows and columns, from 1 to 8.

Selection Mode - Single, **Series**, and **All** - These options allow you to make changes to a single frame, series or all frames.

Flip Horizontally - Rotates the selected image(s) horizontally, 180 degrees.

Flip Vertically - Rotates the selected image(s) vertically, 180 degrees.

Rotate Clockwise - Rotates the selected image(s) clockwise.

Rotate Counterclockwise - Rotates the selected image(s) counter-clockwise.

DICOM Information - Allows you to view the series DICOM information. There is a search function to find words in it.

10.4.2 Series

Series List displays a list of the phase series loaded into the Review. It only contains original images.

Compare

Compare series mode is on by default in 2D viewer. The window adjusts so that each viewport contains a series. Each series can be independently manipulated. If there is no need to compare all the series, click Compare/Un-Compare to separate them.

Select All - Icon allows linking images to perform the same manipulation on the images of your choice.

1 Click **Series** to select the series which need to be compared.

2 Click **Compare/Un-Compare** to compare the series.

3 Click **Select All** icon to link the images, if necessary.

10.4.3 2D create movie or series

You can batch a sequence of 2D (original) images from part of a study. This allows you to exclude anatomy that is not in your region of interest, or to skip every two or more intervening images while batching the sequence. This results in a smaller study, which saves on processing and storage requirements.

Use Set Range on Surview to create 2D Batch

1 Define Batch Range, click on clinical images, check **Set Range on Surview**, surview appears in main viewport:
- type the slice numbers in **From** and **To**.
- scroll the two reference images to identify the start and end locations desired.

2 Set **Batch Parameters**, type a number in **Include Every**.

3 Select **Information Image** or **Surview** to **Add to Batch**.

4 Click **Preview** to Play Batch.

5 Click **Save Batch** to save batch.

6 Click **Reset** to reset batch.

10.5 MPR mode

Use the MPR mode to view three-plane orthogonal images. In this mode, the three shown planes can be easily correlated. Three orthogonal cut planes are shown:

- Axial Orientation
- Coronal Orientation
- Sagittal Orientation

10.5.1 MPR common tools

MPR tools provide methods to alter the view of the images in order to follow the path of a specific organ. The following tools are available:

Show Crosshairs - Toggles crosshairs on or off.

Image Layout tools - Three arrangements are available for displaying images.

- 1x2 Series Layout.
- 1x3 Series Layout.
- 2x2 Series Layout.

Orthogonal Planes - Allows you to change the crosshairs from orthogonal rotation to non-orthogonal rotation.

10.5.2 Tools

Curve

Add Curve enables the curve definition function.

1. Click the **Add Curve** button.
2. Click on the desired starting point for the curve.
3. Move the mouse in the desired path, clicking to set points as you move.
4. When done, double click to end the curve and display results in the top right viewport.

Note

If the path does not display, click Show Curve.

When a curve is selected, you can edit a single point or an entire curve:

- Edit Single Point: click and drag one point on a curve.
- Edit Whole Curve: click and drag the entire curve.

These options are available for changing the render mode:

- MinP: minimum intensity projection.

- AIP: average intensity projection (default).
- MIP: maximum intensity projection.

For more common tools information, see **Common tools**, on page 10-2.

10.5.3 Series

Link allows you to link the compare series.

See **Series**, on page 10-8, for more information.

10.5.4 MPR Create Movie or Series

The Batch **Preset** function allows you to create and save batch protocols that you use commonly. You can save the **Slice Thickness**, **Slice Increment**, **No. of Images** and **Render Mode**.

Create Batch Preset

1 Mark the **Start Range** and **End Range**.

OR

Click **All Images**.

2 Manipulate the image parameters as needed for the desired results.

3 Click **Preset** drop down menu, click **Save Preset**, **Save Batch Preset** dialog box appears.

4 Name the batch and click **Save**.

Modify Batch Preset

1 In Preset drop down menu click **Manage Presets**, **Manage Batch Presets** dialog box appears.

2 Select **CustomBatch** in drop down menu.

3 You can edit and delete a preset.

Precise Spine and Precise Brain

MPR Batch has default preset lumbar, cervical disc and brain protocols to define the batch for the lumbar, cervical disc spaces and brain.

1 Select a plan box of batch protocol in the drop-down list of **Preset**.

2 Click **Confirm Label** to name the disc spaces when the label is named correctly.

OR

If the label is named incorrectly, you can rename it manually. See **Labeling Plan Box of Batch**, on page 10-13, for more information.

3 Presets can be modified using duplicate and delete. The batch range and/or tilt angle displayed in the user interface can also be adjusted and you can label the group.

4 Save or send the batch.

5 Click **Manage presets** to edit or add new preset in **Manage Batch Presets** window.

Note

- **Precise Spine function can only support adult scans and when:**
  -Cervical disc space with scan increment ≤ 2mm, FOV ≥ 58mm, scan length ≥ 40mm.
  -Lumbar disc space with FOV ≥ 70mm, slice thickness ≤ 3mm, slice increment ≤ 5mm, scan length ≥ 70mm.
- **When Precise Spine function is used, if there is obvious artifact in the image, the patient has serious osteoporosis, there is lumbar/cervical malformation, vertebral fusion, scoliosis, fracture, decreased intervertebral disc space, or the spine is not parallel with the table center line, the accuracy of plan box of batch function may be affected.**
- **When Precise Spine function is used, the corresponding body part should be included in the scan.**
- **If plan box of batch function fails, user is required to define the plan box of batch manually.**
- **If the image series does not contain the entire sacrum, the lumber disc can be generated but may not be labeled automatically.**
- **If the image series does not contain the entire C1-C2 vertebrae, the cervical disc can be generated but may not be labeled automatically.**
- **Precise Spine only supports original DICOM images.**

Note

- **Precise Brain function can only support adult scan.**
- **Precise Brain function can only support: slice increment < 3mm, FOV >100mm, scan length > 50mm.**
- **When Precise Brain function is used, the corresponding body part should be included in the scan, otherwise the recognized result would be meaningless.**
- **When Precise Brain function is used, the scan needs to include the eyes without eye related diseases (ensure 2 items:1. Two eyes have similar CT value; 2. Eyes without serious shape deformation). And the acute angle between the mid-sagittal and the vertical line**

passing through the image should be less than 12 degrees (Assuming that the line connecting the center points of the two eyes is l, and the vertical line of l at the midpoint of l is called mid-sagittal). Otherwise, it will affect the accuracy of results.

- **Precise Brain function can only support original DICOM images.**
- **Artifacts in the brain or eyes can affect the results.**
- **Precise Brain doesn't support loading images obtained with gantry tilt.**

Move Plan Box of Batch

1 Move the mouse cursor to the end of the desired plan box of the batch, when the mouse cursor turns to a square (which consists of 4 triangles and 1 circle).

2 Hold the left mouse button down and drag your mouse to desired position.

Labeling Plan Box of Batch

1 Move the mouse cursor to the desired plan box of batch, when the mouse cursor turns to a little hand, right click on it.

2 Select a plan box of batch name in right click menu, the selected name appears on the plan box of batch.

Labeling A Group of Plan Box of Batch

1 Move the mouse cursor to the desired plan box of batch, when the mouse cursor turns to a little hand, right click on it.

2 Move the mouse cursor to Group in right click menu.

3 Select a plan box of batch name in Group right click menu, the selected name appears on the plan box of batch. Neighbouring plan box of batches are labeled name automatically.

Tilt Plan Box of Batch Angle

1 Move the mouse cursor to the outer 1/4th of the desired plan box of batch.

2 When the mouse cursor turns to a yellow circle, hold the left mouse button down and drag your mouse to tilt the plan box of batch angle.

For more information see **Create movie or series**, on page 10-6.

Copy, Paste Plan Box of Batch

1 Select a plan box of batch protocol in the drop-down list of **Preset**.

2 Adjust the plan box of batch as desired.

3 In right click menu, click **CopyBatch**.

4 Switch to another series, click **PasteBatch** in right click menu.

10.6 Volume mode

The volume mode is used to display CT scanner data in a full volume image. It provides basic tools for image editing and generation of cine movies.

10.6.1 Volume common tools

Image Layout tools - These functions are available for displaying images.

- 1x3 Series Layout
- 2x2 Series Layout.

Show Related Position - Displays the related location of the crosshairs on the reference images to a single point on the volume image.

Calculate Volume - Determines the dyed tissue volume and displays the result on the image. The length, width and height of the volume are also shown.

Orientations (Axial, Coronal, Sagittal) - Alters the orientation of the selected image.

Flip Horizontally - Rotates the selected image(s) horizontally, 180 degrees.

Flip Vertically - Rotates the selected image(s) vertically, 180 degrees.

Show/Hide Protocol - Opens a window containing mini images of all the existing protocols specific for the loaded volume:

- Double click on a protocol mini image to apply the protocol to the volume.
- Click the **Show/Hide Protocol** button again to hide the protocol window.

Edit Protocol - Allows you to create and edit the viewing protocols available under Show/Hide protocols.

The viewing protocols are manipulated using an opacity curve. Each opacity curve consists of a number of points, each of which can be manipulated separately to define the curve position.

Add protocol allows you to create a new protocol:

1 With the protocols list open, click **Edit protocol**. The Edit protocol box displays.

2 Click and drag a point on the curve to move it. Type a desired protocol name.

3 When you have completed the protocol, click **Save As** to accept it. The system closes the **Edit protocol** dialog box and displays a mini image of the new protocol in the mini image list.

Edit protocol allows you to edit a protocol:

1 Select a protocol by clicking its mini image.

2 Click **Edit protocol**. The Edit protocol box displays.

3 Click and drag a point on the curve to move it.

4 When you have completed the protocol, click **Save** to accept it. The system closes the Edit protocol dialog box and displays a mini image of the new protocol in the mini image list.

Delete protocol allows you to delete a protocol:

1 Select a protocol by clicking its mini image.

2 Click **Delete protocol**. The system prompts you to confirm the deletion:
- Click **OK** to delete the selected mini image from the list.
- Click **Cancel** to keep the selected mini image.

Note

System reference protocols cannot be edited or deleted.

10.6.2 Tools

Tissue Segments

The Tissue Segments function allows you to control the display of the volume image.

The segmentation function lists the tissue definitions that have been created for the current study. The list includes tissues defined in the current work session as well as those defined during previous work sessions, and from other applications (if they are loaded with the study).

Lock - Click this icon to lock or unlock tissue. No cutting operation will be applicable for the locked tissue or tissues.

Name - Each tissue is identified by its name. Double click a name to change it.

Visible - When visible is checked, the part of the volume defined by the tissue is visible on the view port. When unchecked, the volume defined by the tissue is subtracted from the volume shown in the view port.

Color - Click this icon to select a color for the tissue. You can select a color from a matrix of pre-defined colors, or you can define new colors by selecting "Custom".

Opacity - Ranged from 0 to 100, where 0 is completely transparent, and 100 is opaque.

Add Tissue Segment - Allows you to add the dyed tissue into tissue management.

To delete the tissue, right click on the new added tissue, click **Delete**.

Edit Selected Tissue

Inject Dye - Allows you to create a tissue of the volume of interest. You can control the speed of inject dye by selecting from the drop-down list: Slow, Medium and Fast.

Viscosity - Allows you to adjust the viscosity of the injection. Injection is fastest at 1 and slowest at 10.

Expand - Allows you to increase the edges of the tissue. Each click expands the edge by a one-voxel increment.

Fill - Adds to the injected tissue and fills in holes within the volume.

Erase - Allows you to remove the contrast from reference images. Use this function as you would need a traditional eraser to rub out the unwanted areas.

Cut Selected/ Cut Unselected - Allows you to exclude (subtract from the image) the volume within the region, or to include (keep in the image) only what is within the region.

Remove Couch

Load data to Viewer, Click **Remove Couch** the system will remove the couch, head holder, and other non-body data automatically. The user can decide to show the non-body data or not with the "Couch" check box in the **Tissue Segments** list. In addition, the opacity and color of the non-body data can be changed.

Note

- **If the patient is in an unusual position, such as the arms by the patient's side for a chest and abdomen scan, or if a head scan is completed in the head holder without cushion, the Remove Couch result may be affected.**
- **If the user isn't satisfied with the removal result, recover the original data and remove non-body data manually by using sculpting tools.**
- **If the axial image does not contain the whole body data, the removal result may be affected.**
- **The FOV should be larger than 200mm.**

Clip

Mask Volume - Is used for analyzing small objects. By moving any edge of MPR image you change the cube's total dimensions.

Clipping Plane - This is a single, movable, plane that cuts through ("slices") the true volume. The clipping plane removes the volume on the one side of the plane and leaves a volumetric view on the other side of the plane, showing a cross-section of the anatomy at the plane.

Show Bounding Box - Allows you to show or hide the clip box in the 3D window. By moving any edge of MPR image you change the cube's total dimensions.

Reset Bounding Box - Allows you to reset the clip box in 3D window.

To remove bones:

1 Click the **Manual Remove Bone** button.

2 Click to place the seed in volume window image.

The system removes the bones according to the threshold defined and the location of the seed.

3 If bone removal dose not remove smaller, unattached volumes completely, the **Remove Bone Residue** tool may be helpful. You can define the residual volume in the box.

Cut Tissue as Bone - Allows you to remove and re-segment the tissue as bone. The cut tissue can be found in Bone.

Cut Tissue as Volume - Allows you to remove and re-segment the tissue as volume. The cut tissue can be found in Volume.

Undo/Redo - Reverses your most recent action.

DSA

A non-contrast and arterial phase is needed to perform DSA. Loading a non-contrast and arterial phase image data of a head and neck will allow DSA to perform a bone removal using subtraction.

Auto DSA - Allows you to perform auto registration and display vessels reconstructed image in the VR viewport. The bone that has been removed will display with a color overlay in the reference images.

Save - Allows you to save the angiography results to Local as a new series which has bone removed.

Note

- **A maximum of two series are used for DSA.**
- **When the slice thickness and slice increment of loading series are different, a system message will show that DSA functions are not available.**
- **DSA function can only be used on head and neck data.**
- **The results of DSA are for reference only, it should not be used as the SOLE incontrovertible basis for clinical diagnosis.**

10.6.3 Series

See **Series**, on page 10-8 for more information.

10.6.4 Volume Create Movie or Series

Single Axis

Rotation Direction (Left, Right, Up, Down) - Enables you to rotate the batch in the desired direction. Enter a desired value in the Degree field.

Rotation Range - Allows you to enter a value for the amount of rotation around the volume image.

Click one of the 4 icons that corresponds to the direction you want the volume to turn.

- Click the left-pointing arrow for a batch that rotates to the left.
- Click the up-pointing arrow for a batch that rotates upwards.
- Click the right-pointing arrow for a batch that rotates to the right.
- Click the down-pointing arrow for a batch that rotates downwards.

Freestyle

1 Scroll or rotate the volume image to the view you want to be the first image of the batch.

2 Click **Start Range**.

3 After the First image has been designated, scroll or rotate the volume image to the view you want to be the last image of the batch.

4 Click **End Range**.

For more information see **Create movie or series**, on page 10-6, for more information.

10.7 Endo mode

The CT Endo viewer is a review function that allows you to perform a general fly-through of any suitable anatomical structure that is filled with air or with contrast material, including general vessels, cardiac vessels, the bronchus, and the colon.

You can activate a cine function while performing the navigation, and the application will remember your path. After you have finished, you can activate the playback mode and review your path in a cine mode.

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After you have found an object you want to examine, you can stop and use the reference viewports to view the object in detail, zooming and panning as desired. You can also view the anatomy of interest in oblique MPR planes.

Main viewport

The Main viewport displays a rendered perspective image of the study. The protocol is set to the default for the application, but you can change it.

Reference viewports

The Reference viewports display axial, coronal, and sagittal images. Yellow markings show the camera direction and angle in the upper and lower images, with the view plane in the center image.

10.7.1 Endo Common Tools

Image Layout tools - Four arrangements are available for displaying images.

- 1x3 Layout
- 2x2 Layout
- 1x2 Layout
- 2+3 Layout

Show/Hide Protocol - Allows you to open a window containing mini images of all the existing protocols specific for the loaded data.

10.7.2 Endo Tools

Follow Mode

Follow Cursor allows you to navigate manually, guiding the path with the mouse.

Follow Trajectory allows you to create one or more trajectories to automatically perform the navigation.

Manual navigation

Set Camera Position allows you to set camera position on MPR.

If the cine bar is hidden, move the mouse cursor to the bottom of the main viewport.

1 Click **Follow Cursor**.

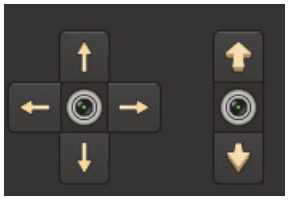
2 Click **Set Camera position**, click on a MPR image to set camera position.

3 Click on the main viewport and hold down the left mouse key to fly-through.
   - Click **Reverse** to change navigation direction.
   - Use **Camera Speed** to change fly-through speed.

OR

Select the main viewport and click the left mouse button to fly-through step by step.

Move Camera



Up, **Down**, **Right**, **Left**, **Backward** and **Forward** buttons are for moving through the structure.

Keyboard Navigation

Keyboard Navigation shows a list of Keyboard hot keys, and you can reset the hot keys.

Keyboard shortcuts can be edited by selecting the function and pressing the desired shortcut key.

Controlled navigation

1. Use **Set Camera Position** buttons and left click on a reference image to define position and direction.
2. Move the mouse and left click on the reference image to change the navigation direction.
3. Hold the left mouse button down on **Forward/Backward**, the fly-through begins.
4. To stop the fly-through, release the mouse button.

   OR

   Click on **Forward/Backward** to fly-through step by step.

Auto navigation

Add Camera Trajectory - Allows you to define the trajectory on MPR.

1. Click **Follow Trajectory**.
2. Click **Add Camera Trajectory**.
3. Click and draw on MPR to define camera trajectories.
4. Select one of the curves.
5. Click on **Show Protocol** to select an appropriate protocol.
6. Move the mouse to the bottom of the main viewport. The movie bar appears.
7. Click **Play Trajectory**. The navigation begins.

- Click **Reverse** to change navigation direction.

- Use **Camera Speed** to change play speed.

8 To stop the fly-through, click **Pause.**

Show camera trajectory - Allows you to show or hide camera trajectory.

Movie recording

Endo application supports to record a navigation movie.

Automatic Navigation Record

1 Define a navigation path.
2 Click **Play Trajectory**, click **Start Record** to record the movie.
3 Click **End Record**, **Save Image** dialog box appears.
4 Select **Movie** in **Save As**.
5 Select or type in a description in **Description**.
Click **Config** to manage description preset.
6 Select a destination, and click **Save**.

Manual Navigation Record

1 Define a navigation path.
2 Click on the main viewport and use the mouse key to fly-through.
3 Click **Start Record** to record the movie.
4 Click **End Record**, **Save Image** dialog box appears.
5 Select **Movie** in **Save As**.
6 Select or type in a description in **Description**.
Click **Config** to manage description preset.
7 Select a destination, and click **Save**.

10.7.3 Bronchus Tool

Segmentation

Select the desired series in **Patient**, select **Bronchus Tool**, an auto segmentation of bronchus is performed.

Extract a bronchus

1 Move the mouse cursor to the desired bronchus, the center line appears.

2 Right click on the desired center line.

3 Select a bronchus name in right click menu, click **OK**.

Rename a bronchus

1 Right click on the desired bronchus in **Bronchus List**.

2 Select a bronchus name in **Choose Bronchus Name**.

3 Click **OK**.

Delete a bronchus

1 Right click on the desired bronchus in **Bronchus List**.

2 Click **Delete**.

3 A message appears, click **Yes** to delete the selected bronchus.

Or

Click **No** to exit the message box.

Show Center Line - When you check, center line displays.

Show Bronchus Color - When you check, the bronchus color displays on MPR images.

When you select **1+5 Layout**, you can navigate the bronchus which you selected in main viewport.

Navigation

Click Navigation, you can fly-through and record the bronchus along the centerline. If the centerline is not satisfactory, drag the seed to edit it in CPR viewport.

10.7.4 Series

See **Series**, on page 10-8, for more information.

10.7.5 Endo Create Movie or Series

For Endo Batch information see **Create movie or series**, on page 10-6, for more information.

11 Lung nodule analysis (option)

11.1 Overview

The Lung Nodule Analysis (LNA) application allows the user to perform semiautomatic segmentation and quantification of pulmonary nodules and lesions of comparing two studies and the growth of nodules can be tracked over time.

Workflow stages

Two workflow stages are provided in Lung Nodule Analysis:

1 **Detection & Segmentation** Stage
- **Mark Nodule**, click **Mark Nodule**, click on the nodule to mark.
- **Verify Contours**, use **Edit Contour** and **Draw Adjacent Contour** to verify contours. The result will appear in nodule table.

2 **Comparison & Match** Stage
- **Mark Additional Nodules**, use **Mark Nodule**, **Edit Contour** and **Draw Adjacent Contour** to mark and edit the contour.
- **Match Nodules**, select two nodules from nodule list, click **Match Nodule**.

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11.2 LNA common tools

The tool panel contains the Common Tools, which are available in all applications. See **Common tools**, on page 10-2.

Orientation

You can select from three viewing orientations, **Axial Orientation**, **Coronal Orientation**, **Sagittal Orientation. Flip** orientation of the VR image is also available. The Orientations are not supported with the Axial images. The **Flip** button becomes available when you select the cubic and VR image.

Layouts

There are two layout selections available from the factory for two stages:

1 **Detection & Segmentation** Stage
- 1 +5 Layout (default)
- 2 x 2 Layout

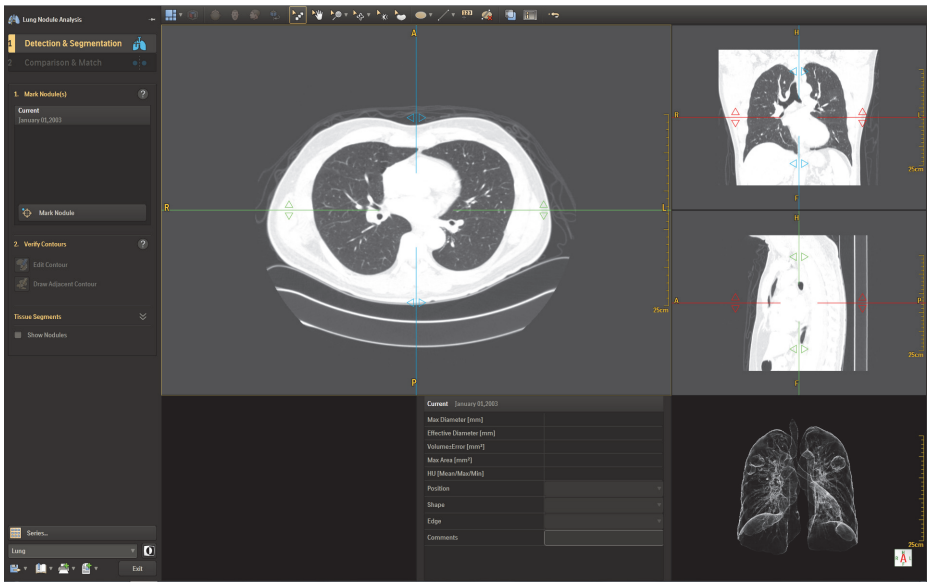
2 **Comparison & Match** Stage
- 4+2+4 Layout (default)
- 2+4 Layout

Show/Hide Protocol

Show/Hide Protocol refers to **Show/Hide Protocol** in **Volume mode**, on page 10-14.

11.3 Detection & segmentation

11.3.1 LNA opening window



Axial Slab - The main viewport displays an axial Slab image, shown in the default Lung window. This is the image you may use to examine for nodules. It can be manipulated like any 2D image.

Reference Images, Coronal, and Sagittal - These reference images appear on the window's right side and are displayed in the minimum slice thickness. After nodules are marked and accepted, these images visually indicate the locations of the nodules by surrounding each of them with a yellow circle and a lesion number.

Transparent Image of Active Lesion - In the transparent image in the lower-right, the lungs are shown, and tissue management function allows you to modify the display of the volume image. After nodules are marked and accepted, this image visually indicates the locations of the nodules by surrounding each of them with a yellow circle and a lesion number.

Volume Image of Active Lesion - Initially contains no image if a lesion is not yet selected. After you mark a lesion, it is segmented as a volume rendered image.

You can access reference images (Coronal MPR, Sagittal MPR, Nodule 3D Cube, Axial Inspect, and VR) via right mouse click options.

11.3.2 Mark nodules

Mark Nodule - The Mark nodule tool is always available. When your inspection indicates the existence of a nodule:

1. Click the **Mark Nodule** button to make it active. A cross cursor appears.
2. Click the cross pointer on the nodule. A yellow circle appears around the nodule to bring attention to it.
3. An identification number is automatically assigned and the nodule is automatically accepted, named, and added to the Nodule list. After nodules are segmented, defined, and accepted, they appear in the Nodule List.

- A circle also appears around the nodule in both reference viewports, and also on the transparent image in the lower right corner.
- After nodules are marked and accepted, the transparent image in the lower right corner will be replaced by the Axial Inspect image. Also the **Edit Contour** button is activated.
- To delete a nodule
  - right-click on the nodule in the list
  - select **Delete Nodule**
  - press **OK**

- To rename a nodule
  - right-click on the nodule in the list
  - select **Rename**
  - type the new name in the dialog box
  - press **OK**

4 A volume rendered image of the nodule appears in the bottom left viewport, with a lesion measurement table in the bottom middle viewport.

5 Repeat this process as needed until all nodules have been detected. Clicking any other tool makes the **Mark Nodule** button inactive.

Note

If the reset name is the same as the existing name or the name is empty, a prompt message will appear.

11.3.3 Verify contours

The application allows you to manually segment the nodule.

Be sure to review each nodule for correct segmentation. A blue overlay with a yellow contour appears on the segmented nodules.

The **Edit Contours** and **Draw Adjacent Contour** functions are used to correct the segmentation of the nodules, if necessary.

1 Select the nodule you want to edit from the Nodules list.

2 Use the Scroll, Pan, and Zoom functions (in Common tools) to obtain the best views of the nodule.

3 Click the **Edit Contours** button, control points appear around the contour of the lesion in the bottom right viewport.

4 Click and drag the control points to the desired location. The blue overlay updates as you edit the contour.

5 Continue correcting the nodule segmentation by scrolling to adjacent slices.

6 Click the **Edit Contours** button again to turn it off when you finish editing the nodule.

Or

1 Select the nodule you want to edit from the Nodules list.

2 Click the **Draw Adjacent Contour** button; the cross cursor appears.

3 Scroll to the last image and go to next image for drawing the contour.

4 Draw the contour by clicking along the edge of the nodule. Double click to complete the **Draw Adjacent Contour** function.

5 The contour is updated and a blue overlay appears on the nodule.

6 Continue drawing contours by scrolling to adjacent slices and repeating the above steps.

Measurement results

For each nodule that is segmented a lesion measurement table is created with the measurements for that individual nodule, showing the selected nodule, with measurements that include max diameter [mm], effective diameter [mm], volume ± error [mm^3], max area [mm^2], HU [Mean/Max/Min] and you can fill position, shape, edge and comments.

Images can be saved, sent to film or report at any time during the analysis. After segmentation has been done, the identified nodules and results can be saved, filmed, and sent to report.

Tissue segments

See **Tissue Segments**, on page 10-15 for more information.

Show Nodules

This function controls the circle around a marked nodule, when the nodule is marked, the function is ON by default. When you uncheck it, the circle is removed from all images. The nodule overlay color remains on when Show Nodules is unchecked.

11.4 Comparison & match

Warning

Verify the correctness of the Lung nodules registration. Do not mismatch nodules. Doing so could lead to misdiagnosis.

Use the additional workflow stage, **Comparison & Match**, when performing a follow up LNA procedure. Use the Comparison & Match stage to compare the two studies (Previous & Current) and assess changes over time. After you have matched nodules between the studies,

you can generate a report that includes calculations of nodule volume changes and projected doubling time.

11.4.1 Comparison & match procedure

1. Click **Comparison & Match**. The **Comparison & Match** workflow stage opens. The middle-left viewport displays the image of **Current** series and the middle-right viewport displays the image of **Previous** series.
2. Use **Mark Nodule**, **Edit Contour** and **Draw Adjacent Contour** to Mark Additional Nodules.
3. Evaluate the images shown in the two series to find matching nodules. When you find a matching set of nodules between the two series, select nodules and click **Match Nodule**. The summary table is created automatically at the bottom of the window. Continue matching nodules.
4. **Unmatch Nodule** can be used for nodules that were mistakenly Matched. This is useful only on a matched nodule, marked in the **Match** list. As nodules are matched, they appear as **Matched Nodules** in the **Matched** list.

Link allows you to lock images to perform the same manipulation on the matched images, such as Scroll, Pan, or Zoom.

1. Click **Series**, the **Series** panel appears
2. Select the series in **Series** panel
3. Click **Link** to link the series.

Show Measurement Results

Selecting **Single nodule**, the lesion measurement table shows the nodule measure result which has been selected in nodules list.

Selecting **All nodules**, summary table shows all nodules measure results.

Summary table includes all the measurements for the segmented nodules. The Growth Rate[%] and Doubling Time [days] only appear in the table when matching current and previous studies.

- **Maximum Diameter [mm]** - This is the Maximum Diameter of the nodule.
- **Effective Diameter [mm]** - This is the Effective Diameter and it is calculated by considering the nodule as a sphere. This means that if the nodule was a sphere with the calculated volume, the Effective Diameter would be the diameter of the sphere.

- **Volume +/- Error [mm3]** - The volume error estimation is calculated by assuming there is a half of a voxel error on the surface. Thus, it is half of the volume of the surface voxels. For large nodules, this is a reasonable measure, but for small nodules, it could be relatively large due to the large surface to body ratio. The error in volume calculation is related to the fact that the border of the nodule may not cover a full voxel. In that case the volume of the nodule is calculated by counting the voxels in the contour but around the surface boundary there are a lot of voxels that do not completely form a part of the contour and these voxels contribute to the error in the volume calculation.
- **Maximum Area [mm2]** - This is the area within the contour for the largest slice of the nodule in 2-D.
- **HU [Mean/Max/Min]** - These are mean, max, and min Hounsfield Unit values within the segmented nodule.
- **Doubling Time [day]** - The doubling days of a nodule is computed using the two volumes of that nodule and the time interval between the two studies. The doubling time is calculated assuming exponential doubling time (assuming the growth follow exponential curve). It is calculated using the formula:

$$Doubling \quad Time = \frac{\ln(2)\Delta t}{\ln(v_2 / v_1)}$$

Where:

Δt is the time interval between the two studies.

V_2 is the volume of the second study (the later study).

V_1 is the volume of the first study (the former study).

- **Growth Rate [%]** - The percentage the nodule has grown from the prior scan.

11.4.2 Series

See **Series**, on page 10-8, for more information.

12 CT Colonoscopy (option)

12.1 Overview

CT Colonoscopy (CTC) application enables fast and easy visualization of colon scans, using acquired CT images.

Caution

The CT Colonoscopy application is not equivalent to conventional invasive colonoscopy.

Workflow stages

Three workflow stages are provided in CT Colonoscopy:

Definition - When a study is loaded, the application automatically segments the air-filled colon and displays a calculated center line.

Navigation - In this stage you can examine the virtual colon and search for and view suspected colon polyps.

Comparison - This stage allows you to view similar areas of interest between two patient orientations (Supine and Prone), in side-by-side views.

12.2 CTC common tools

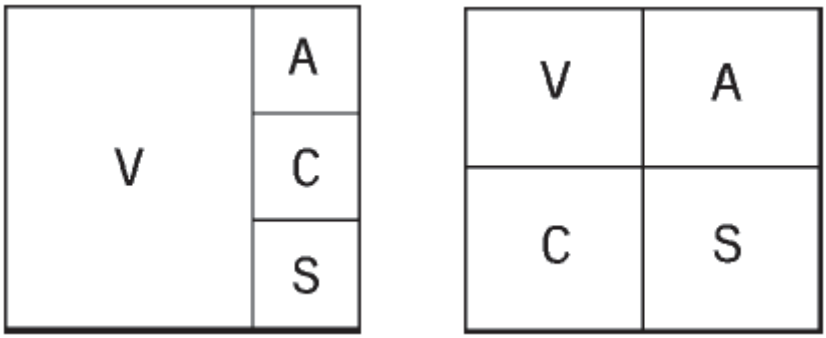
Axial Orientation, **Coronal Orientation**, **Sagittal Orientation** - Selects the viewing orientation of the main viewport: axial, coronal, or sagittal.

Flip - Flips the volume image vertically.

Layout - Two default layouts are available, 1x3 and 2x2. The currently active layout is displayed as the icon. Click the down arrow to select the alternate layout.

In the 1 x 3 layout, the images consist of the volume image in the main viewport and the axial, coronal, and sagittal images from top to bottom in the reference viewports.

The 2 x 2 layout has the same views as 1 x 3, but is arranged differently, as shown in the diagrams below.



Show/Hide Protocol - Selects, edit or save protocols for volume rendering views. It also allows you to set a protocol as default protocol in right-click menu option and apply it in the next time you use the application.

Show Related Position - Displays the related location of the crosshairs on the reference images to a single point on the volume image.

12.2.1 Definition right-click menu options

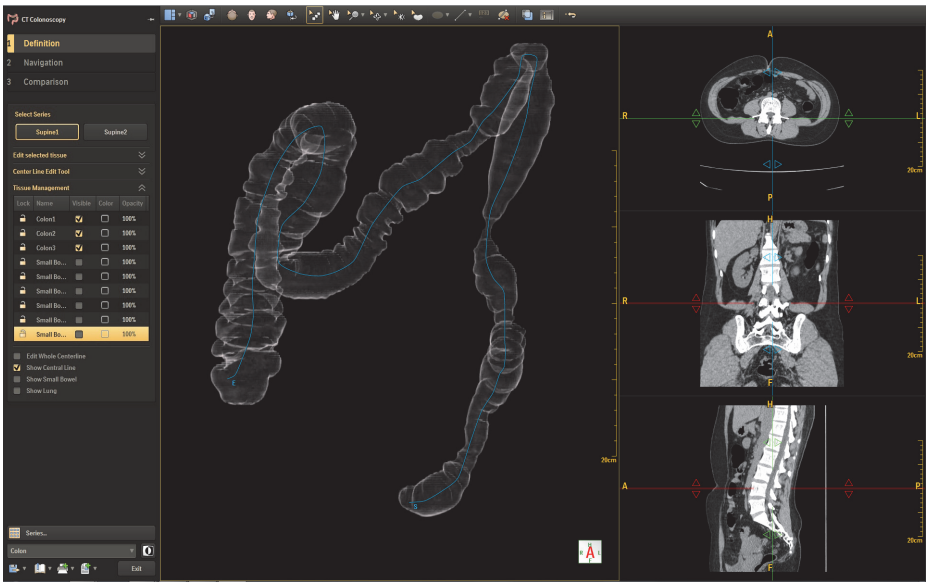
In the Definition stage, each viewport includes right-click menu options, which duplicate functions found in the tool panel except the following two.

Show Bounding Box - Shows a clip box on the volume image viewport if the **Show Bounding Box** is selected in the right-click menu options.

Reset Box - Resets the bounding box operations to the original state.

Refer to the tool panel in this chapter and common tools (See **Common tools**, on page 10-2) in Review chapter.

12.3 Definition



Click on the CT Colonoscopy application icon once you have selected the appropriate colonoscopy studies.

12.3.1 Select series

Select Series allows you to select the desired series.

12.3.2 Edit selected tissue

Cut Tools cuts the 3D model to reveal inner details or to remove unwanted features from the display.

- **Cut Selected** - Cut Selected volume in freehand region(3D).
- **Cut Unselected -** Cut Unselected volume from freehand region(3D).

Undo/Redo reverses your most recent cut action.

12.3.3 Center line edit tool

If the colon is produced with more than one segment, or the auto segmentation is not satisfactory, click **Re-Segment** to reset the segments to the unconnected state and edit the centerline.

Mark Colon

Previous Colon - Selects the previous colon segment.

Next Colon - Selects the next colon segment.

Connect Colon - If more than one colon segment is produced, you can click this button to connect them.

Remove Current Colon - Removes the active segment from the image.

Undo/Redo - Reverses your most recent action.

Verify Centerline

Switch Start Point and End Point - Exchanges the start and end points of the centerline in the current selected segment.

Edit Centerline - Allows you to edit the centerline on Cross-sectional and CPR image.

When finished editing, click **Confirm Segmentation** to move to the next stage.

Edit Entire Centerline - Allows you to edit the centerline on Cross-sectional image.

Show Central Line - Displays or hides the centerline.

Show Small Bowel - Displays or hides small bowel.

Show Lung - Displays or hides the lung.

12.3.4 Tissue management

See **Tissue Segments**, on page 10-15, for more information.

12.3.5 Series list

See **Series**, on page 10-8, for more information.

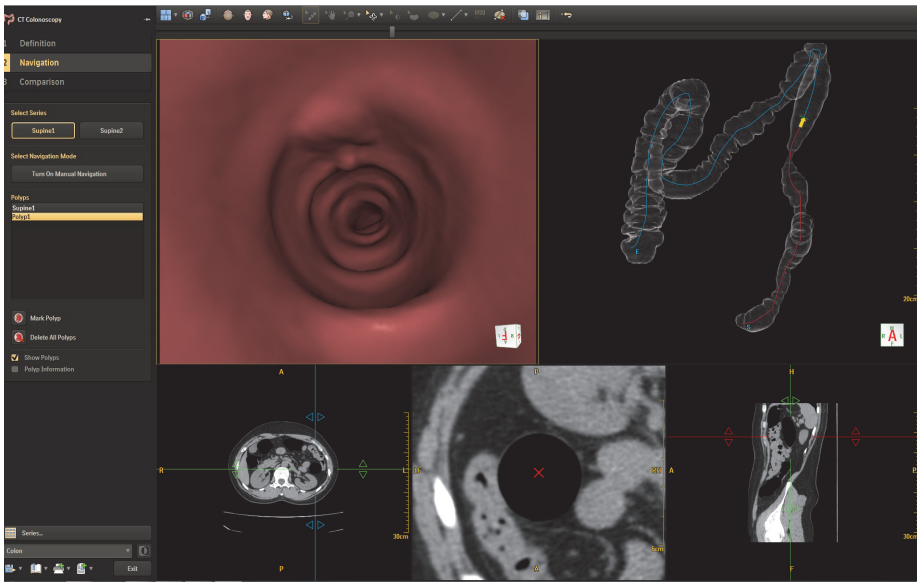
12.4 Navigation

In this stage you can examine the virtual colon to search for and view suspected colon polyps. Various image types and display layouts are available for viewing, including navigation.

When examining the colon, both manually and automatically, you can mark the identified polyps in a list and send the results as images to the **Local** folder in the **Completed**, **Filming** and **Report** functions.

12.4.1 Navigation windowing

In the **Navigation** stage you can choose from several layouts to depict the colon in different combinations of viewing modes to suit user preferences.

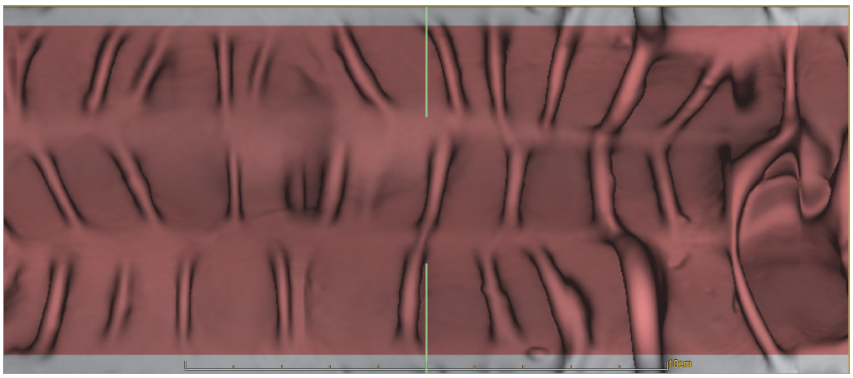


Filet

The Filet image gives a virtual dissection projection that is, in effect, like cutting a section of the colon open longitudinally and spreading it from top to bottom in the viewport, so the entire wall circumference of the colon section can be seen in one view.

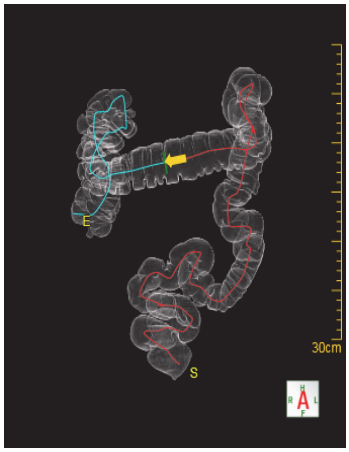
The Filet view is formed with an overlap of 20-degrees at the top and bottom, yielding a 380-degree image. The overlap guarantees full viewing coverage.

The overlap is marked by shaded portions at the top and bottom of the viewport.



Volume

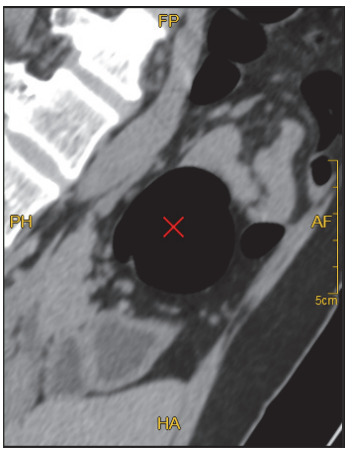
This is a translucent or surface rendered image of the colon that helps orient you to the partial views presented in other viewports on the display.



Cross-section

The Cross-sectional view is perpendicular to the centerline. The centerline is identified by the red crosshair.

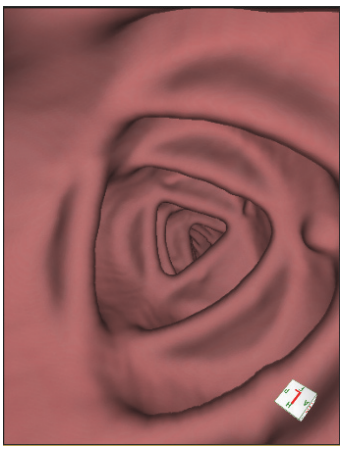
The Cross-sectional view of the colon is formed by a plane cutting through it at right angle to the centerline.



Endo

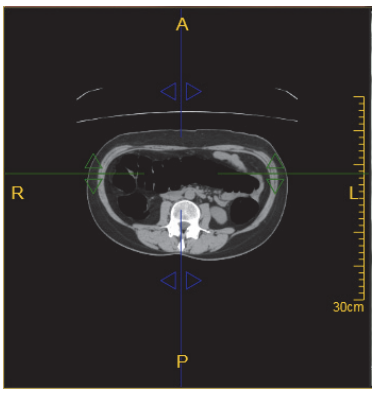
This is an Endoscopic view of the colon. The view direction is toward the end of the colon, the cecum (default).

The 3D Endo-luminal view of the colon is displayed when the (virtual) camera is oriented parallel to the centerline passing through the colon.



Axial

The centerline is identified by the crosshair of the 2 lines on the image.



You can switch the view between sagittal and coronal from the right mouse menu.

1. Right-click in the axial images.
2. Move the axial images to the Volume viewport by clicking **Swap Volume**.
3. Right-click in the Volume viewport.
4. From **Swap MPR**, select **Swap with Axial**, **Swap with Coronal** or **Swap with Sagittal**.
5. Right-click on the axial images, select **Swap Volume**.

12.4.2 Layout of navigation display viewports

Note

You can Enlarge any of the images in any of the layouts with a left mouse double click in the desired viewport.

Layout

2+3 Layout- Is the default layout. In the upper half of the image area are the Endo and Volume views. In the lower half are the axial, cross section, and sagittal images. There is no filet view.

1+3 Layout - In the upper half of the image area is the Filet view. In the lower half are the Volume, the cross section, and Endo images. This layout is unavailable if no centerline.

2 x 2 Layout- In the upper half of the image area is the Volume and Endo images. In the lower half are the cross section, and the axial images.

12.4.3 Navigation tab

Select Navigation Mode

Turn on/off Manual Navigation - Switches the navigation between manual and automatic by clicking this button.

The Automatic Navigation lets you "fly" through the colon in cine fashion continuously.

The Manual Navigation lets you "fly" through the colon by steering the view, using your mouse on the Endo image.

Reverse - Reverses the fly-through direction.

Camera Speed - Controls the speed of navigation.

Start Record- Allows to record a navigation movie.

Manual Navigation

1 Click **Turn on Manual Navigation**.

2 Select the Endo viewport and hold down the left mouse key to fly-through.

OR

Select the Endo viewport and click the left mouse button to navigate step by step.

Automatic Navigation

Play Trajectory - Starts the navigation from the start point. Pay attention to the navigation direction. Click **Reverse** button to reverse the direction.

1 Click **Play Trajectory**.

2 Click **Pause** to pause the navigation.

Record a Movie

1 Click **Start Record** to record the movie.
2 Choose a navigation mode to navigate the colon.
3 When finished recording, click **End Record**.
4 Select or type in a description in **Description**.
5 Click **Config** to manage description preset.
6 Select a destination, and click **Save**.

12.4.4 Polyps

During Navigation stage, search for, display, and mark polyps that may exist in the virtual colon images.

Mark Polyp

1 Click **Mark Polyp**.
2 Place mouse cursor over the area of interest.
3 Click on the area to mark it.
4 This area is automatically located on all viewports.

Delete All Polyps - Removes all polyps in the list. All marked polyps are removed from the image area.

Remove a Polyp

1 Right-click on the polyp name in Polyps list.
2 Click **Delete Polyp** to remove the selected polyp. The selected polyp is removed from the image area and the list.

Show Polyps - Shows or hide the selected polyp. The relevant mark appears or disappears from the image area.

Polyp Information - Shows the polyp information. You can send the results as images to the **Local** folder in **Patient** or to **Filming** and **Report** functions.

You can edit a polyp measurements, shape, and segment on the **Polyp Information** window.

1 Click **Polyp Information**. The **Polyp Information** table opens.
2 Manually measure the max diameter, min diameter and area of the

polyp by using the **Line** and **Polygon** in common tools.

Note

The distance is from the start point to the polyp.

3 Fill the results in the **Polyp Information** table.

4 Define the shape or segment by selecting the appropriate option from the **Shape** or **Segment** drop-down, as needed.

5 Click **Save Table** to save the Polyp Information table.

6 **Save Image** dialog box appears, select the device you want to save.

7 Click **Save** to save the table.

8 Click **X** on the top right to exit Polyp Information table.

Send Table To Film- Sends the table to film.

Send Table To Report - Sends the table to report.

12.5 Comparison

The Comparison stage allows you to view two series of the same patient, prone and supine, and perform comparison analysis between them.

To use the Comparison stage:

1 Load both series at the same time when opening the CT Colonoscopy application. (Select both series of a study in **Completed** interface by holding down the **Ctrl** key when clicking the second one.)

2 View, verify, and accept the centerlines of both series in the Definition stage.

3 Click **Comparison**. The Comparison window opens.

12.5.1 Comparison tool panel

When you enter the Comparison work stage, the tool panel is nearly the same as in the Navigation stage, except that it shows polyp information of two series in Polyp Tab.

The **Lock/Unlock** button in **Series**.

Lock to lock series together to perform the same manipulation on the image(s) of your choice, such as automatic navigation, pan, or zoom.

Unlock to release the lock.

The layout in Comparison stage is different from the Navigation stage.

2 x 2 Layout- In the upper half of the image area are the Endo images of the 2 series. In the lower half are the axial images of the 2 series.

2 x 1 Layout- In the upper half of the image area is the Filet view of the first series. In the lower half is the Filet view of the second series. This layout is unavailable if no centerline.

2+3 Layout- In the upper portion of the image area are the Endo images of the 2 series. In the middle portion are the volume image. In the lower portion are the axial images.

To switch the view between axial, sagittal and coronal, see Axial in this chapter for more information.

12.5.2 Comparison procedure

The image area of the opening window will display one series on the left and one on the right.

1. Select a desired layout by selecting from the drop-down list: **2 x 2 Layout**, **2 x 1 Layout**, **2+3 Layout**. The desired image type will appear in the windows for both series.
2. Navigate the colon to locate the same anatomical position in both series.

Now all navigation will be done together in both series so you can perform the comparison analysis.

13 Brain perfusion (option)

13.1 Overview

Brain Perfusion is a blood flow imaging application that analyzes the uptake of injected contrast in order to determine perfusion-related information about one or more regions of interest.

Intravenous contrast is injected into the patient and the region is scanned repeatedly for a period of time. The Hounsfield unit enhancement is tracked for each voxel over time to produce tissue specific time-density curves.

Measurements made from the time-density curves and user-selected input regions are used to create various parametric perfusion images as well as statistical data and calculation tables.

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Note

- **This application is applicable to processing at brain perfusion image data of the same scan space.**
- **At least three to five non-contrasted concurrent time points are required in a brain perfusion scan.**
- **Brain perfusion application results cannot be used as sole means of diagnosis.**
- **When selecting reference artery, please select the earliest enhancing artery such as internal carotid artery, anterior cerebral artery or middle cerebral artery.**
- **When selecting reference vein, please select the densest vein such as the superior sagittal sinus.**

13.2 Brain perfusion window

The image below shows the initial view of the brain perfusion window with active viewports. The set of images will automatically load into the application.

Viewport 1	tMIP/Average images
Viewport 2	Artery and Vein Activity Table
Viewport 3	Artery and Vein Activity Chart (time - density curves for reference vessel)

After the series is loaded, you will complete this series of steps:

- Vessel Definition
- Perfusion Maps

13.3 Vessel definition

Mode

There are three modes you can select to review the original images, tMIP, Average and 4D modes.

A tMIP image is time maximum intensity projection (across the time domain) for each z-axis location. This provides a way to view arteries and

veins in the same image, unaffected by time. tMIP is the default rendering mode.

Average renders the image according to the average value along the path (X-ray) through the patient.

4D allows you to observe dynamically the brain vessel blood flow.

Note

The slice number should be no less than 8, otherwise the 4D mode will be not activated.

Correct Motion

To correct the presence of motion artifacts:

1. Switch to **Average** mode.
2. Move the mouse cursor to the bottom of the main viewport, turn on cine mode.
3. Press **Play** to play the motion.
4. Click Remove time points, when motion artifacts are found.

The time points are marked with green line in Artery and Vein Activity Chart, and the removed time points are dashed lines.

Remove time points - Allows you to remove time points in the sequence.

Bring back deleted points - Allows you to bring back removed time points.

Note

- **Brain Perfusion can be moved up to 8 time points, and up to 2 continuous time points can be removed.**
- **In such cases, the application shall recalculate and generate tMip images with the time point removed.**
- **Please note removing a time point is possible when reviewing the study in Average rendering mode. The vertical line on the Time Attenuation Curves signifies currently viewed time point. It is not possible to remove a time point when reviewing in tMIP mode.**

Cine Mode

In Average and 4D mode, move the mouse cursor to the bottom of the main viewport, the **Movie** bar will be displayed. The Movie bar supports time points in the same slice position.

Play - Begin viewing the sequence of images. By default, the images are displayed in order, from beginning to end in the same slice position.

Next Image - Manually moves to the next image.

Previous Image - Manually moves to the previous image.

Frame Rate - Allows you to adjust the Cine speed.

Auto Hide - Allows you to hide or show Cine mode.

In **4D** mode, you can record a movie.

1 Click **Play** to select the start position.

2 Click **Start Record** to record the movie.

3 Click **End Record** to save the movie in **Save Image** dialog.

Verify Cerebral Mask

Check the cerebral mask and verify all brain tissue is included in the mask. Adjustments of the mask can be done by adjusting the threshold value.

1 Select the **Show Cerebral Mask** to display the mask.

2 Raise or lower the Threshold settings until the mask correctly defines the brain volume.

3 Click **Apply** to apply the threshold changes.

Or click **Reset** to reset the threshold value.

Skull Threshold - Allows you to set the threshold for skull tissue of interest.

Note

Skull threshold value should be reset after the current patient usage.

Brain Min.Threshold and Brain Max.Threshold - Allows you to set the threshold for brain tissue of interest.

Mark and Select Artery and Vein

The Brain Perfusion application performs artery and vein selection automatically. You must verify the correctness of the automated selection. If required, you can use the following functions to manually define artery and vein.

Draw Artery ROI(s)

To use this tool, encircle the area containing the artery you want to define. (The recommended artery is the anterior cerebral artery.) The application searches for the optimal pixel and marks it as the reference artery with a colored crosshair and labels it "Artery."

Mark Artery Point(s)

To use this tool, click the pencil pointer on an optimal pixel in an artery of interest. The application marks the pixel as the reference artery with a crosshair, assigns it a color code, and labels it "Artery."

Draw Vein ROI(s)

To use this tool, encircle the area containing the vein you want to define. The application searches for the optimal pixel and marks it as the reference vein with a blue crosshair and labels it "Vein."

Mark Vein Point(s)

To use this tool, point the mouse cursor to select a single point in a vein of interest. The application marks the point as the reference vein with a blue crosshair and labels it "Vein."

The artery and vein you define appear in Artery and Vein Activity Table and are color coded. The artery's red curve and vein's blue curve appear in Artery and Vein Activity Chart. The removed points are hollow shape on the curves.

You can delete the labeled Artery and Vein if you desire.

1 Right click on the labeled Artery or Vein.

2 Click **Delete**.

Show Mirror Line - Allows you to turn off and on the mirror line. The mirror line should bisect the brain into hemispheres. You may need to adjust the line.

1 Approach the line with the mouse cursor until drawing control boxes appear at each end of the line.

2 Drag each box to the correct position so that the line divides the brain into hemispheres.

3 Editing the mirror line is applicable to all slices. Verify the correctness of the mirror line on all slices, after editing has taken place.

Note

- **You can draw an artery/vein on any slice in the study. You can draw only one artery/vein. If you draw another artery/vein, the previous one is replaced.**
- **A vein and an artery must be defined before a perfusion map can be generated.**

13.4 Perfusion maps

13.4.1 Windowing

Viewport 1	Main Viewport
Viewport 2	Perfusion Maps Viewport
Viewport 3	ROI Statistics and Activities Table
Viewport 4	ROI Statistics and Activities Chart (time - density curves for ROI and reference vessel)

Perfusion Maps Viewport

This viewport displays perfusion and time values in five different color mapped images:

- ALL: CBV, MTT, CBF and TTP in a viewport.
- CBV (ml/100g): Cerebral Blood Volume.
- CBF (ml/100g/min): Cerebral Blood Flow.
- MTT (sec): Mean Transit Time.
- TTP (sec): Time to Peak.

In the right click menu, you can select the Color Schemes that can be applied to the maps:

- Rainbow
- Black and White

- Thallium
- Royal

ROI Statistics and Activities Chart

The default curve displays the statistics for all the user-drawn ROI curves, artery and vein curves.

To show/hide all the curves, check/un-check name the on the right of this viewport.

ROI Statistics and Activities Table

As you draw ROIs, each is automatically assigned a unique color and number. The color is correlated to the ROI statistics in the table, and to the ROI curve graphs.

13.4.2 Mark perfusion area (ROIs)

Note

Before mark measurement ROI, please be sure the position and angle of mirror line is correct.

There are 2 tools to mark perfusion measurement ROI.

- Ellipse
- Freehand

1. Use one of the manually Draw ROI(s) tools and mark an appropriate artery location.
2. Draw ROI in the CT image or perfusion maps. The mirrored ROI will be generated system automatically.

To edit a ROI

1. Place the mouse on the ROI you want to use to change the shape.
2. The cursor becomes an arrowhead with a white square. click and drag one of the active point to change the ROI shape.

To move a ROI

1. Place the mouse on the ROI to make it active.
2. Move the mouse along the ROI until the cursor changes to cross.
3. Click and drag the ROI to the desired location.

To delete a ROI

1 Place the mouse on the ROI to make it active.

2 Right click on the ROI.

3 Click Delete to delete the selected pair of ROIs.

Note

- **At maximal 8 pairs of ROIs can be drawn.**
- **The calculation excludes vessels.**

13.4.3 Verify vessel exclusion

Check the Exclude Vessels box to eliminate pixels from the calculation and from the color perfusion images. Removed pixels are colored black (zero value).

For additional accuracy, you can use the Vessel Threshold function to exclude the blood flow in larger vessels from the statistical calculation. The Vessel Threshold is expressed as a pixel value in the CBV image. The default threshold value is 9. This means that any pixel in the CBV image with the value 9ml/100g and greater is not displayed on the perfusion maps or included in the ROI measurements.

Note

Depending on the case, you may need to adjust the default value if the results are not as expected. This may be caused by too many vessels removed or too many vessels remaining after Vessel Removal.

13.4.4 Modify hematocrit factor

The hematocrit factor is the radio of red blood cells to the total volume of blood. The factor is used to convert contrast enhancement (in HU) to CBV (in ml/100g of tissue).

Note

- **Do not change the Hematocrit value unless you have measured the patient's hematocrit factor and it is different from the default value.**
- **Hematocrit Factor should only be set up by an advanced user.**

14 Vessel analysis (option)

14.1 Overview

Vessel Analysis (VA) offers a set of tools for general vascular analysis. With VA you can easily remove bone and extract vessels. You can also perform measurements such as intra-luminal diameter, cross-sectional lumen area, and length.

Various review modes may be used such as Volume Rendering, Maximum Intensity Projection, Axial/Coronal/Sagittal orientation, and Curved MPR view with cross-sections. You can delineate aneurysms, view the presence of mural calcification and lining mural thrombus, branch vessels (iliofemoral arterial runoff circulation), and iliac.

Caution

- **Always use the original CT images to correlate existing pathology and/or anatomical study.**
- **Vessel Analysis should not be used as the SOLE incontrovertible basis for clinical diagnosis.**
- **Verify that Bone Removal does not remove vessel segments.**
- **Bone Removal may be used on skull bone (but is not optimized for it).**
- **Verify the accuracy of the centerline curves on the screen and correct them manually when required.**
- **Verify the accuracy of the cross-sectional lines on the screen and correct them manually when required.**

Caution

The volume image displays the anatomy according to the defined protocol. Do not use the volume image as the sole basis for a diagnosis.

14.1.1 Clinical benefits of vessel analysis

- Advanced visualization
- Volume rendering and bone removal
- Automated centerline tracking

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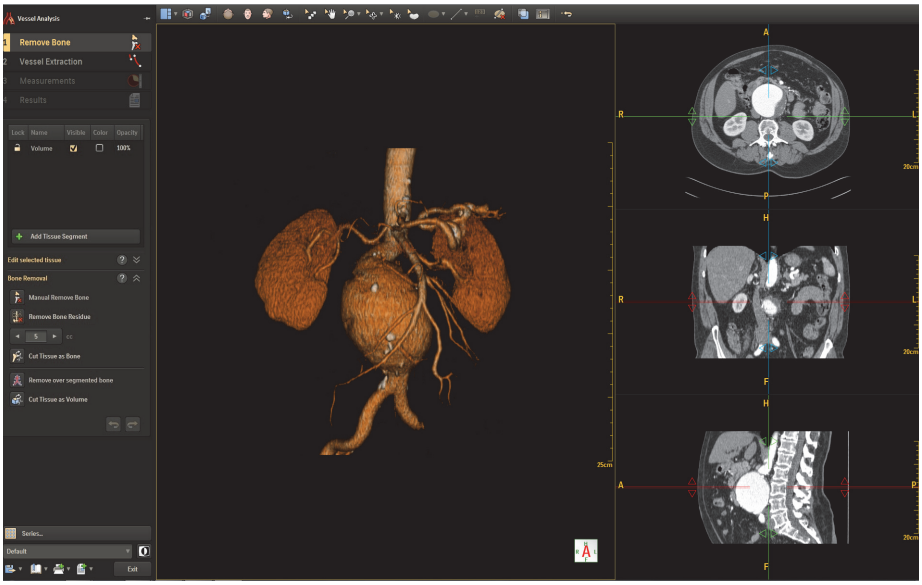
  - Determine a true longitudinal dimension between selected cross-sectionals of the subrenal aorta and the iliac vessels proximal to the iliac bifurcation
- Vessel diagnosis aid
- Stenosis quantification and aneurysm assessment
  - Determine presence and severity (percentage) of stenosis aneurism
  - Measure length and dimension of stenosis
  - Measure area and mean intraluminal diameters
- Measurements
  - Cross-section diameter and area

14.2 VA window

The typical VA display consists of the tool panel along the left, an image viewport area in the middle and three reference viewports on the right.

The central main viewport contains a 3D volume rendering. The three reference viewports on the right have Axial, Coronal, and Sagittal views (by default).

The main viewport may have MIP views and, depending on the stage in the workflow, the reference viewports may have cross-sectional or MPR views. Any of the viewports can be enlarged to fill the entire image area (double-click in the viewport).



14.3 VA common tools


Select a view button to alter the orientation of the volume image: **Axial**, **Coronal**, **Sagittal**, and **Flip** the image.

Show/Hide Protocol - Allows you to open a window containing mini images of all the existing protocols specific for the loaded volume.

Layout - Allows you to select layout. They are 1x3 Layout and 2x2 Layout.

Show Related Position - Displays the related location of the crosshairs on the reference images to a single point on the volume image.

Common tools

All common tools are located at the top of the viewer and applications. (see **Common tools**, on page 10-2, for more information).

14.4 Remove bone

The Bone Removal stage of VA contains a variety of tools used to reveal the vessel(s) of interest.

14.4.1 Bone Removal

To remove bones:

1. Click the **Manual Remove Bone** button.
2. Click to place the seed in volume window image.

   The system removes the bones according to the threshold defined and the location of the seed.
3. If bone removal dose not remove smaller, unattached volumes completely, the **Remove Bone Residue** tool may be helpful. You can define the residual volume in the box.

Cut Tissue as Bone - Allows you to remove and re-segment the tissue as bone. The cut tissue can be found in **Bone**.

Remove Over Segmented Bone - When tissue is segmented as bone, use this icon to re-segment it as Volume.

1 Check **Bone** in Tissue Segmentation list.

2 Click **Remove Over Segmented Bone**, place seeds by clicking on the desired tissue, after the last seed is placed, click **Completed** in right click menu.

3 The re-segment tissue is stored in **Volume**.

Cut Tissue as Volume - Allows you to remove and re-segment the tissue as volume. The cut tissue can be found in Volume.

See **Tissue Segments**, on page 10-15, for more Tissue Segmentation information.

Undo/Redo - Reverses your most recent action.

14.4.2 Edit selected tissue

Mask Volume - Shows a box shape allowing to hide structures from the volume image. It can be manipulated directly on volume images or MPR images.

Reset Bounding Box - Allows you to reset the clip box in volume window.

Show Bounding Box - Allows you to show or hide the clip box in the volume window.

Cut Selected / Cut Unselected - Allows you to eliminate the undesired tissue and isolate the volume of interest. The cut tissue can be found in Cut Tissue.

Remove Couch - Allows you to remove the couch, head holder and other non-body data automatically.

See **Edit Selected Tissue**, on page 10-16, for more information.

Caution

Verify segmentation correctness. If necessary, correct tracing with correction tools.

Tissue management

See **Tissue Segments**, on page 10-15, for more information.

Series

See **Series**, on page 10-8, for more information.

14.5 Vessel extraction

The Vessel Extraction stage is used for extracting the vessel path, either automatically or manually.

- The automatic method uses the Centerline Calculation algorithm.
- The manual method employs "simple line smoothing."

Depending on the extent of the workflow, the central main viewport displays either 3D volume rendering, slab, MIP, or MPR views.

The three reference viewports on the right usually display the Axial, Coronal, and Sagittal views. When editing a centerline or contour, Cross-Sectional / Curved MPR/ Perpendicular views display.

14.5.1 Extract vessels

Extract Body Vessels

This procedure requires that you place at least two points in the vessel for centerline start and end.

1. Click the **Extract Body Vessels**.
2. If needed, adjust the maximum and minimum threshold values.
3. Place a start seed by clicking in the vessel. You can place the seed in either the main volume rendered image or the reference images.
4. Place a second seed in the vessel.
5. After two points are marked, click **Complete** in right click menu.

   or

   Click **Delete Last Point**.

You can place 10 seed at most to extract a body vessel.

6 Select a name in **Choose Vessel Name** list.

or click **Add Vessel Name**, type a new name in blank.

7 Click **OK**. The path appears.

The centerline will be traced on the main volume rendered image and on the two curved MPR views.

Caution

Verify the correctness of the centerline curve on screen and correct manually when required.

Extract brain vessel

1 Click the **Extract Brain Vessel**.

2 Place a start seed by clicking in the vessel. You can place the seed in either the main volume rendered image or the reference images.

3 Place a second seed in the vessel.

4 After two points are marked, click **Complete** in right click menu.

OR

Click **Delete Last Point**.

You can place 10 seed at most to extract a body vessel.

5 Select a name in **Choose Vessel Name** list.

OR

Click **Add Vessel Name**, type a new name in blank.

6 Click **OK**. The path appears.

Auto Extract Brain Vessels allows to extract the brain vessel automatically, the following major head and neck vessels' centerlines (if present) will be extracted, the major vessels will be named and displayed in the vessel naming list automatically, and vessel contours will be generated accordingly. You can use **Rename** and **Delete** to edit the vessel.

- Right Internal Carotid Artery
- Left Internal Carotid Artery
- Right Vertebral Artery
- Left Vertebral Artery

Note

- **Auto Extract Brain Vessels only support adult scan.**
- **The extraction (segmentation) result for neck-only scans cannot be guaranteed.**
- **The extraction (segmentation) result does not include soft plaques or calcium deposits within the vessel contour's boundaries.**
- **Strong dental or metal artifacts may impair the accuracy of the extraction (segmentation) results. This may compromise vessel quality near affected regions.**
- **Proper contrast timing is required for good results. Poor contrast timing can cause veins to have higher HU than arteries. Contrast in the jugular vein, for example, can cause it to be extracted, sometimes instead of the artery, or sometimes together with the artery.**
- **When Auto Extract Brain Vessels is deployed, if there is obvious artifact in volume images, for example the patient has strong dental or metal artifacts, high image noise, preexisting intravascular stent, soft plaques, calcium deposits, improper or poor contrast timing, the accuracy of extraction (segmentation) results may be affected.**

Extend Brain Vessel allows to extend the intracranial segment of the vessel up to the aortic arch.

Manual extract vessel

This procedure requires that you place multiple seeds in the vessel centerline.

1 Click the **Manual Extract Vessel** button.

2 Place seeds in a MPR image. Use the middle mouse wheel to change image location.

Or

You can also place seeds by clicking in the vessel in the main volume rendered image.

Note

It is recommended that you use the reference images to manually define the centerline.

3 When you have finished placing seeds, double click

or click **Complete** in right click menu.

4 Select a name in **Choose Vessel Name** list

or click **Add Vessel Name**, type a new name in blank.

5 Click **OK**. The path appears.

14.5.2 Verify centerline

You can modify the center line in volume viewport and reference viewport.

Rename the vessel

1 Select a desired vessel in **Labeled vessels** list.

2 Its centerline turns blue.

3 Right click on the desired vessel, click **Rename** in right click menu.

4 **Choose Vessel Name** list opens, you can rename the vessel.

Delete the vessel

1 Select a desired vessel in **Labeled vessels** list.

2 Its centerline turns blue.

3 Right click on the desired vessel, click **Delete** in right click menu to delete the selected vessel.

Edit vessel center line

1 Select a desired vessel in **Labeled vessels** list

or find and click a vessel to work with by hovering the mouse over it.

2 Its centerline turns blue.

3 Click and drag the seed to the desired location.
- To delete seed, click and drag a seed to overlap another seed.
- To add seed, when the cursor turns cross "+", click desired location on the center line.

Extend vessel center line

If the vessel center line needs to be extended, use the following methods.

Method 1

1 Click **Tissue Management**, check **Volume**.

2 Move the mouse cursor to the centerline, drag the seed to the desired position.

3 Click **Update Vessel After Edit Center Line**. The updated vessel appears.

Method 2

1 Click **Extend Upper End/Extend Lower End**.

2 Move the mouse cursor to the centerline, place the seeds on the desired place.

3 When you have finished placing seeds, click **Complete** in right click menu. The updated vessel appears.

Show Center Line - When you check, vessel center line is displayed.

14.6 Measurements

The Measurements stage of VA allows you to perform general measurements to gather data about vessels.

14.6.1 Set lesion and references

1 Select a vessel from **Labeled vessels** list. The center line appears in the straightened MPR image.

2 Scroll the image in the viewport, click **Add Lesion** when you find a lesion

or drag the reference marker along the centerline in a viewport.

3 Click **Add Lesion** when you find a lesion.

4 Edit the lesion contours if possible.

5 Click **Confirm locations and contours** on the cross-sectional image.

OR

Right click on the desired vessel, click **Confirm** in right click menu.

14.6.2 Verify lesion contours

If automatic contouring is not enough, the contours can be corrected by:

Extract contour manually

This tool calculates average density difference between a point marked in the center of the vessel and points marked outside the vessel. A smooth contour is then drawn.

1 Click **Extract contour manually**.

2 Place a seed in vessel ROI.

3 Place a seed outside vessel ROI.

4 The contour appears.

Edit Contour

1 Move the mouse cursor to contour to active seeds.

2 Click and drag the seed to the desired location.
- To delete seed, click and drag a seed to overlap another seed.
- To add seed, when the cursor turns cross "+", click desired location on the center line.

Show One Reference Line- When you check, only one reference line is displayed.

Show Vessel Center Line - When you check, vessel center line is displayed.

Show Vessel Contour Line - When you check, vessel contour line is displayed.

Show Diameter/Area Graph - When you check, diameter/area graph is displayed.

Show Color Map - When you check, color map is displayed.

Caution

Do not use the table measurements as the sole basis for a diagnosis.

14.7 Results

You can export the measure results in **Results**.

1 Select a finding in **Findings** list.

2 Click **Save finding**.

3 Select a device you want to save in **Save Image**.

4 Click **Save** to export the select finding to the desired device.

15 Dental planning (option)

15.1 Overview

You can use the Dental Planning application to create true-size (life size) film images of the mandible and maxilla for assisting oral surgeons in planning implantation of prostheses. Using a special dental planning procedure, this scan can be put into the Dental planning application. The procedure consists of these steps:

- defining panoramic views
- defining cross-sectional planes
- filming the reference, panoramic and cross-sectional images in true size

Warning

The volume image displays the anatomy according to the defined protocol. Do not use the volume image as the sole basis for diagnosis.

15.2 Dental common tools

Layout - Are available for displaying images.

Orientations (Axial, Coronal, Sagittal) - Alters the orientation of the selected image.

Show/Hide Protocol - Opens a window containing mini images of all the existing protocols specific for the loaded volume:

- Click on a protocol mini image to apply the protocol to the volume.
- Click the **Show/Hide Protocol** button again or click **Close protocol window** button to hide the protocol window.

Cut Selected / Cut Unselected - Allows you to eliminate the undesired tissue and isolate the volume of interest.

Undo Cut - Allows you to undo the 3D sculpting.

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Common tools

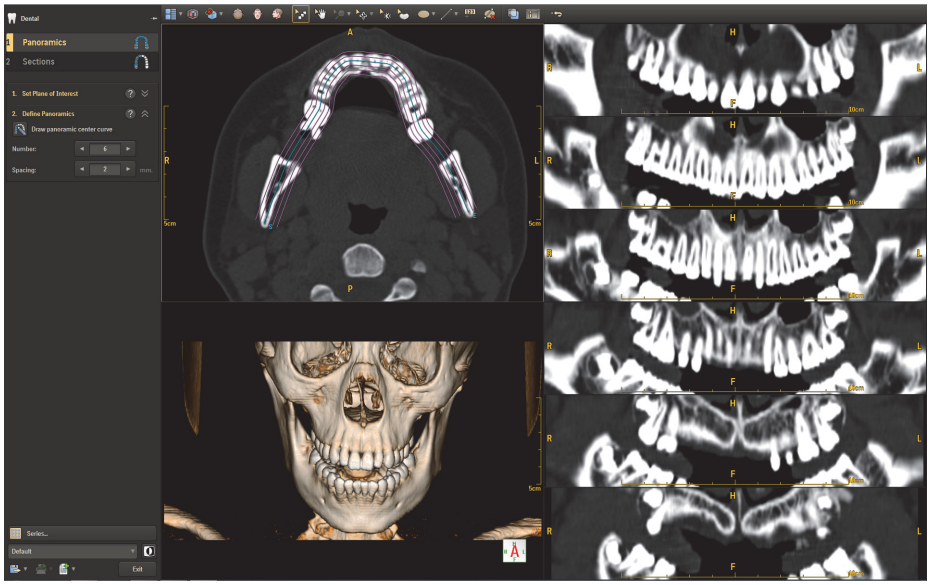
The common toolbox contains a variety of general tools that are used with the CT Viewers and applications. See **Common tools**, on page 10-2, for more information.

15.3 Panoramics

After loading the study into the Dental application, scroll through the axial images or rotate the crosshairs on the reference images to find the one on which the dental plan (of either the maxilla or the mandible) can be most easily viewed. This allows you to more accurately define the curve for your panoramic images.

The default parameters for panoramic planning are six curves (including the center curve) equally spaced 2mm apart.

15.3.1 Panoramics windowing



The Dental application opens in the Panoramics stage, in the default layout (Layout A).

Top left viewport shows axial images of the study. Draw a curved line on this image to define the desired panoramic images. You can scroll through the images to find the optimum view.

Bottom left viewport shows a volumetric image of the study.

Right viewport shows the panoramic images produced from your curved line on the axial image.

15.3.2 Set plane of interest.

1 Roll or rotate on the main viewport, or the crosshairs on the reference images until the required plane is displayed.

2 Click **Confirm Plane**.

15.3.3 Define panoramics

Draw one curve on the axial viewport, approximately following the tooth centers. When you finish, the application displays your curve, and also creates and displays additional curves (in parallel to your original curve). Up to six curves can be seen at one time in the right-side viewport. The **Number** and **Spacing** options of the curves can be changed at any time.

Draw a panoramic center curve

1 Click the **Draw panoramics center curve**.

2 Point the cursor in the axial image viewport and click where you want to start the curve.

3 Click as you move along the proposed curve (creating control points). A blue line forms showing your progress.

4 Double-click on the end point of the curve or click **Complete** in right-click menu to complete it.
- Violet parallel lines appear on each side of the blue line. These lines are shown in the right-side panoramic images.

5 Verify that the panoramic images are in the desired plane.

Note

You can eliminate the current planning curve and begin a new one by repeating the Define panoramic procedure.

Modify the curve shape

1 To move a control point, click and drag it to the desired location.

2 To add a control point, move the mouse cursor to the curve, when the cursor turns to a cross, click on the blue curve where you want a new point.

3 To delete a control point, click and drag it to the near point.

Move the Curve

1 Move the mouse cursor to the curve, when the cursor turns to a cross arrow.

2 Click and drag the entire line to the desired location.

Curve spacing and quantity

Use this procedure to change the number and spacing of curves:

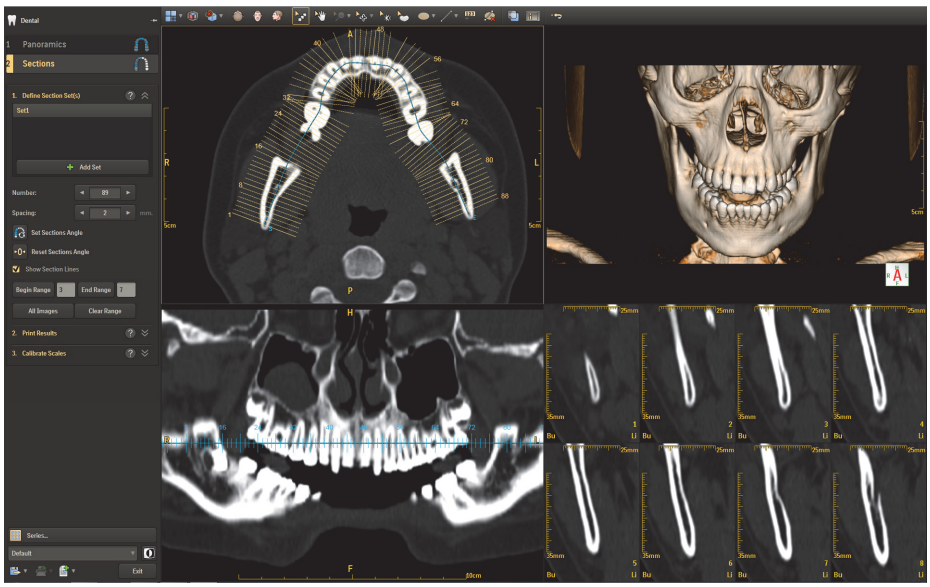
1 Type in the desired number of sections (from 1 to 9) or use the arrow buttons to decrease or increase the value.

2 Use the Space text box to define the space between the panoramic curves (from 0.5 mm to 10 mm).

15.4 Sections

The Sections workflow displays cross-section dental images of the patient. The images are regularly spaced along the panoramic curve of the Mandible or the Maxilla.

15.4.1 Sections windowing



Top left viewport. Shows an axial image, overlaid with a diagram of cross-sectional cuts along the panoramic curve.

Top right viewport. Shows the volume image.

Bottom left viewport. Shows a panoramics image, displayed as a flattened view.

Bottom right viewport. Shows the section images. The slice number displays on the right edge of each image. The cross section images are labeled Bu and Li, identifying the Buccal and Lingual sides of the teeth. Measurement scales on the images are for true-size measuring of dental features.

Click **Layout** to select a different layout than the one shown (the default layout: Layout A).

15.4.2 Define section set(s)

Use the **Add Set** function to add additional cross-sectional images to the defined curve. If there is enough space on the curve, a new set of section lines is created to the right of the last set, with the same number of the same spacing between lines. The set name appears in **Define Section Set(s)** list.

Edit section set(s)

1. Click **Add Set**. If there is enough space on the curve, a new set of section lines is created.
   - **Number**. The number of sections in the active set.
   - **Spacing**. The spacing between sections in the active set.
2. Click **Set Sections Angle**.
3. Click and drag the sets and swivel to the optimum position.
   - Click **Set Sections Angle** to end this function.
   - Restore the original perpendicular angles by selecting **Reset Sections Angle.**

Note

The Number is not limited to 9 as in the Panoramic mode, instead it depends on the length of the curve.

Delete Section Set

1 Select the desired set in top left viewport. The set turns to yellow.

2 Right-click on the section set, click **Delete**.

OR

1 Select the desired set from **Define Section Set(s)** list.

2 Right-click on the set, click **Delete**.

Move Section Set

1 Move the mouse cursor to the desired set in top left viewport. Click on it and the section set turns to yellow.

2 Click and drag the set to the desired location along the curve.

Show Section Lines allow you to show or hide the section set lines.

Batch

Start Range - Allows you to define the starting section image of the batch.

End Range - Allows you to define the end section image of the batch.

All Images - Selects all section images for the batch.

Clear Range - Deletes the batch information.

1 Click to select a section image in bottom right viewport as the first batch image, click **Start Range**.

2 Click to select a section image in bottom right viewport as the last batch image, click **End Range**.

3 Click **Save Batch** to save.

OR

Click **Send Batch to Report**.

15.4.3 Print results

Once you have completed the creation of the desired sections, there are two ways to send the results to Film:

- Send Pairs to Film
- Print Preview

15.4.4 Send pairs to film

Send Pairs to Film allows printing of the pair layout images which has 8 cross sectional images as a group. These images appear in the filming window. You cannot edit this view.

The pairs which are already sent to film cannot be removed. If the pairs in film are not satisfied:

1 Reset the set pairs.
2 Click **Print Results**, click **Send Pairs to Film**.
3 A message appears, click **Cancel** to cancel the print job.

Or

4 Click **OK**, the new set pairs will replace the existing pairs in **Filming**.

Print preview

Print preview allows to select the layout and the images selection for one-click filming.

1 Click **Print Preview**. The Print Preview dialog box appears.
2 Click a viewport in **Select Container**.
3 Click one of 7 icons in **Select Content**, the icons represent
   - Axial with Section Lines
   - Sections
   - Add All Sections
   - Axial with Panoramics Lines
   - Main Panoramics
   - Panoramics
   - Volume Image.
4 If you desire, check **Add axial reference to each page** box to display the axial image in the first viewport in each page.
5 Repeat step 2 to 4 until the viewports contain all contents you need.

   Reset deletes the entire preset content.
6 Click **Send to Film** to send the content to Film.

   OR

   Click **Default** to set the preset as default.
7 Click **Cancel** to exit Print Preview dialog box.

Calibrate scales

Before calibrating, make sure a printer is properly installed and appears in the film printer list.

Warning

Calibration should be performed only by qualified service personnel. Calibration should be completed the first time Dental application is performed, and each time the film format, film image or the Dental Scan protocol on the scanner are changed. Any time you change the page layout, header, or footer of the film, you must re-calibrate the dental application to get true size measurements. The calibration factor (DFOV) sets the size on film. After changing the factor, use a scale to measure the horizontal and vertical scales on the film to ensure true-size.

1. In Sections stage, set up one of the cross section images to have both vertical and horizontal scales.
2. Click a print button to send the image to Film.
3. Open the Film application, select a printer and print the image to the printer. The required film size for True Size filming is 14x17 inch film, using the 2x3 format.
4. Return to Dental application Sections stage. From the Calibration step, record the scale lengths on the images into the Image column (for example, vertical=50 mm, horizontal=20 mm)
5. On the printed film, suing an accurate scale, measure the actual scale lengths (for example, vertical=49 mm, horizontal=21 mm)
6. Type the measured values in the table under the Film Scale column.
7. Click **Calibration** and see that the value of DFOV has changed to a new value.

16 Cardiac calcium scoring (option)

16.1 Overview

The Cardiac Calcium Scoring application is used to quantify the buildup of calcium plaque on the walls of the patient's coronary arteries and other relevant locations. The potential calcifications are highlighted by the application during launch.

As you examine the patient's study, you will mark calcified plaque to accept it and name it.

As you mark calcifications, the application accumulates the calcium data and calculates the patient's Calcium Score based on a scoring protocol. A compare function allows you to evaluate scoring results from two studies of the same patient, the original and a follow-up.

Note

On the scanner, one of the Cardiac Calcium Scoring-specific scan protocols should be selected for getting the best results from the Cardiac Calcium Scoring application.

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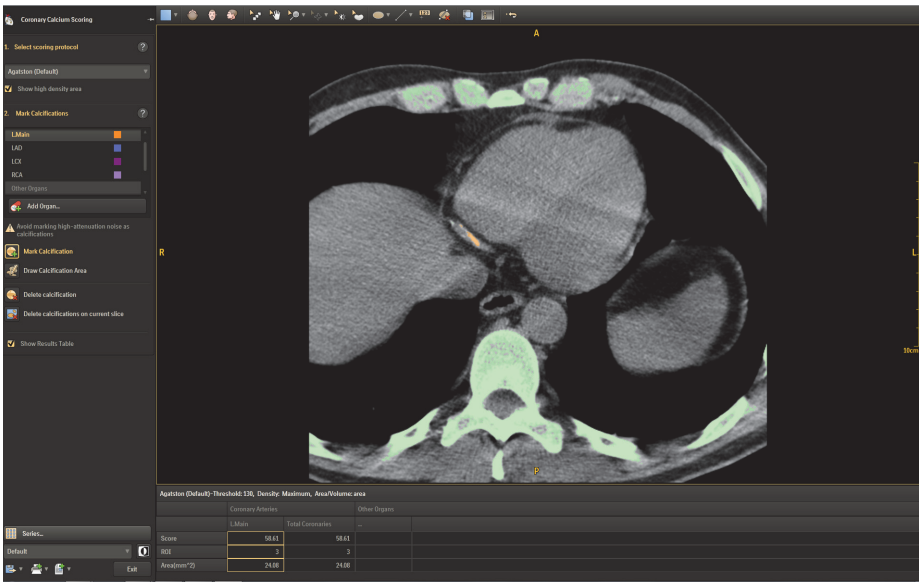
16.2 Cardiac calcification scan suggestion

The following suggestions can help users performing calcium scoring scan function to obtain the best patient images.

- Use ECG gate to reduce cardiac pulsation artifact.
- Patient needs to hold breath during scanning.
- Use the tomography method, make use of forward scan mode to reduce the dose of radiation patient received.
- Scan before the injection of contrast agent in calcification angiography to exclude the interference of the high density contrast agent.
- The scan area is through the coronary arteries.

16.3 CCS window

The Cardiac calcium scoring window shows the selected images. Areas of pixel values above the density are marked in green when the **Show high density area** is on (default state).



16.4 CCS common tools

Layout - You can set the number of images using the Layout tools. These options are available:

- Layout 1x1 (default)
- Layout 1x2
- Layout 2x2
- Layout 3x3

Orientation - Use the orientation buttons to change the viewing orientation of the selected image to axial, coronal, or sagittal.

See **Common tools**, on page 10-2, for details.

16.5 Select scoring protocol

Select scoring protocol allows you to select the scoring method used for the study.

16.5.1 Agatston method

The Agatston method is the commonly used scoring method. The comparison scores are stored onboard in the Score database. The resulting percentile score helps the physician assess the patient's risk of cardiovascular events.

Note

When the kV value of the selected is not equal to 120kV, the system will prompt the user to select an appropriate protocol.

16.5.2 Mass score method

The patient's calcification mass is obtained by calculating the mean CT number of the calcifications, multiplying the mean value by the calcification's volume, and applying a calibration factor. The Mass Score method requires you to specify a Lateral Thickness value.

Select Lateral Thickness

You can calculate Lateral Thickness from Surview.

1. Click **From Surview**, the Surview image appears.
2. A line appears on the Surview image and you can adjust the line through the control point.
3. Measure distance from left most part of patient to right most part of patient 2cm below the carina.
4. The system will automatically match the required thickness when getting the results.

You can also select Small, Medium, or Large (but no Surview image appears with any of these selections).

- Small: < 32.0 cm lateral thickness
- Medium: 32.0 - 38.0 cm lateral thickness
- Large: > 38.0 cm lateral thickness

Note

Mass scoring protocol is only applicable to 120kV inspection.

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16.5.3 Manage protocols

Manage protocols allows you to add and delete protocols.

- Add a protocol

1 Click **Add Protocol**.

2 Type a name in **Name**.

3 Select a scoring method in **Type**.

4 Fill in **Min. Area** and **Threshold**.

5 Click **OK** to store the protocol and close the dialog box.

- Delete a protocol.

1 Select a protocol in protocol.

2 Click the trashcan next to the protocol.

3 Click **OK**.

Users cannot delete the factory default protocol.

16.6 Mark calcifications

Organ list

You have the option to add, edit or delete items in the vessel list.

• To add an organ to the list

1 Click **Add Organ**.

2 Type a name in Organ Name.

3 Select Coronary Artery or Other in **Organ Type**.

4 Select a color.

5 Click **OK** to save the new organ and exit.

• To edit an organ color

1 Click the color next to the organ.

2 Select a color in **Colors**.

3 Click **OK** to save and exit.

• To delete an organ from the list

1 Select the organ.

2 Right click on the organ.

3 Click **Delete vessel**.

4 Click **Yes** to delete the select vessel.

Note

Delete vessel option is not available for factory default vessels.

Mark Calcification

1 Select an organ to mark from the vessel list. The organ in the list becomes highlighted. Note that each vessel name has a different color.

2 Click the desired tool to mark the region of interest.
- Mark calcifications: Select vessel from the Vessel list. Click on highlighted calcification area in the selected area. The system automatically identifies calcification entities (If calcification is continuous, automatic tools will detect multiple layers of calcium) and change the color of the corresponding area. Then the score calculation result will display in the scoring result table.
- Draw calcification area. Hold down the left click to draw ROI in the calcification area. The system displays color and the score calculation result in the scoring result table.

3 Check the scoring information in the scoring result table.

4 You can define ROIs in each image you want to analyze. For each vessel, an unlimited number of ROIs per image are allowed.

5 To mark additional vessels, select another vessel from the Artery list and repeat steps 2 through 4.

Delete calcification

To delete the ROI created with the Mark calcification function.

1 Click **Delete calcification**.

2 Click on the ROI you want to delete.

3 The ROI is deleted from all the slices which belong to this calcified volume that was marked with Mark calcification.

Delete calcifications on current slice

To delete a manual ROI (only from the current slice) created with the Draw calcification Area function.

1 Click **Delete calcifications on current slice**.

2 Click on the ROI you want to delete.

3 The ROI is deleted from the current slice.

Scoring Results Table

You can view the calcium score in result table.

Show Results Table

Click **Show Results Table** to toggle on or off the scoring results table. The system calculates the scoring along with the changes in the ROIs set for all the marked organs.

Right click on the table to access these options:

- **Save Table** - Saves the table information.
- **Send Table To Film** - Sends the table information to film.
- **Send Table to Report** - Sends the table information to the report.
- **Reset All** - Resets the study's images to the state they were in upon loading.

16.7 Series

Using **Compare** to evaluate scoring results from two series of the same patient. The score results of two series and changes(%) will be displayed in the scoring result table.

See **Series**, on page 10-8, for more information.

17 Cardiac function analysis (option)

17.1 Overview

Cardiac Function Analysis (CFA) application is used to assess the state of the left ventricle (LV) and to analyze functional heart data.

Note

- **Only the CT images according with the DICOM 3.0 standard and ECG gated cardiac multi-phase enhancement scanning images can be used in the Cardiac Function Analysis.**
- **Select the phase position of End-Systole (ES) and End - Diastole (ED) to reconstruct and get the axial images of cardiac ES and ED.**
- **Users can select the best series from multi-phase images to perform Cardiac Function Analysis.**

17.1.1 Workflow

1 Load multi-phase images into Cardiac Function Analysis interface.

2 LV Segmentation

- The system will automatically perform the left ventricle (LV) segmentation, then display the volume image.
- If the segmentation is not correct, use tools in **Modify LV Segmentation** to edit the LV segmentation. Use of **Re-segment** function to re-segment LV can also be used.

3 ED and ES Definition

Set ED and ES phases in this stage.

4 LV Measurement

Analyze the cardiac images using analysis tools and evaluate the left ventricular function using measurement result table.

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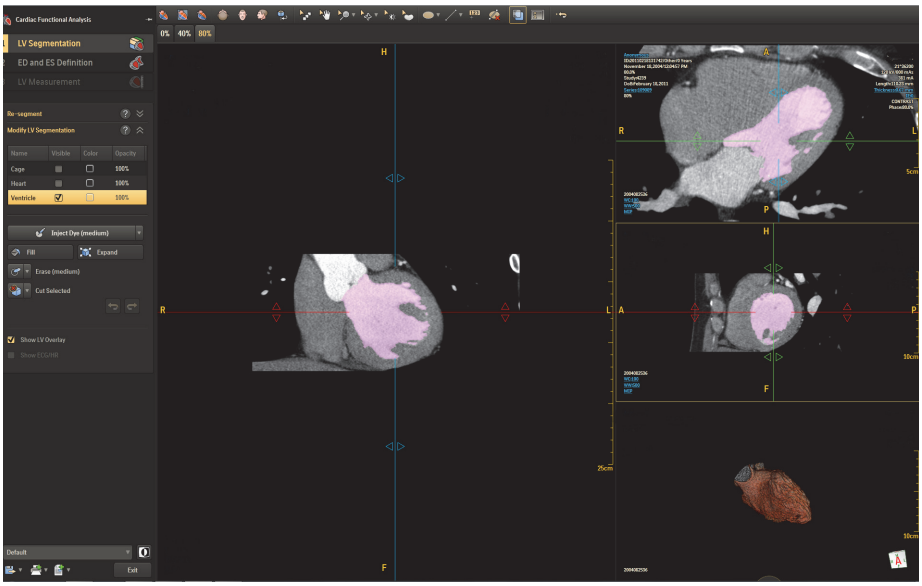
17.2 CFA window

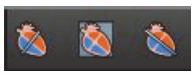
The initial Segmentation window consists of an axial image in the main viewport and two orthogonal images and one volume image in the reference viewports.



17.3 CFA common tools

Orientation

You can change the image orientation between the General Axes and the Cardiac Axes modes.



Cardiac axes - The Cardiac axes orient the views of the heart as follows:

- Cardiac short view
- Cardiac horizontal long view
- Cardiac vertical long view

General axes - The General axes are the standard anatomical orientations:

- Axial Orientation
- Coronal Orientation
- Sagittal Orientation

Use the **Flip** button to flip the active volume viewport 180 degrees.

17.4 LV segmentation

When you load a heart study, the CFA application automatically performs segmentation. The segmentation process is repeated for every phase that is being loaded. You can select the phase from the top of main viewport. The segmentation tissue is pink. The left ventricle is segmented and appears at the right bottom viewport.

17.4.1 Modify LV segmentation

The automatic segmentation that is initially performed by the CFA Segmentation function requires your review. The LV tissue definitions may be incomplete, or may exceed or fall short of the actual tissue boundaries. Use Modify LV Segmentation function to edit LV segmentation.

Segmentation List

The segmentation list includes the segmented volume tissues.

- Cage
- Heart
- Ventricle

Check boxes indicate whether the tissue is displayed or hidden. Default is Ventricle box checked, showing volume ventricle tissue.

Modify LV segmentation

Inject Dye - Colors additional unsegmented areas and adds them to the active tissue. The rate and threshold of the injection can be controlled by the relevant boxes.

Fill - A mode button which, while pressed, fills all the gaps in the color overlay of the active tissue.

Expand - Allows you to expand the edges of the contrasted tissue. Each click expands the edge by a one-voxel increment.

Erase - Removes volume from the active tissue.

Cut Selected/Unselected - Cuts selected/unselected volume in freehand region (3D).

Show LV Overlay - Shows or hides the LV color tissue overlay.

Show ECG/HR - Click the Show ECG strip and HR graph. For more information, refer to **Show ECG/HR** in **Manual segmentation tools**, on page 18-3.

17.4.2 Re-segment

This function is used if the automatic segmentation fails.

1 Click **Re-segment**.

2 Adjust high and low threshold value in the relevant boxes.
- Type a desired threshold value in Low and High box.
- Click the box arrow to increase or decrease threshold value.

3 Click **Re-segment** to re-segment LV.

17.5 ED and ES definition

ED and ES definition allows you to define ED and ES phases.

- End-Systole is the end of the pumping (ejecting) phase of the left ventricle (LV).
- End-Diastole is the end of the filling phase of the left ventricle (LV).

Set ED and ES phases

1 Select a phase in **End Diastolic** list.

2 Select a phase in **End Systolic** list.

3 ED and ES tags display on the selected phase image.

4 Click **LV Measurement**.

17.6 LV measurement

Once all manual corrections and settings have been made, you can measure left ventricle.

17.6.1 Select measuring method

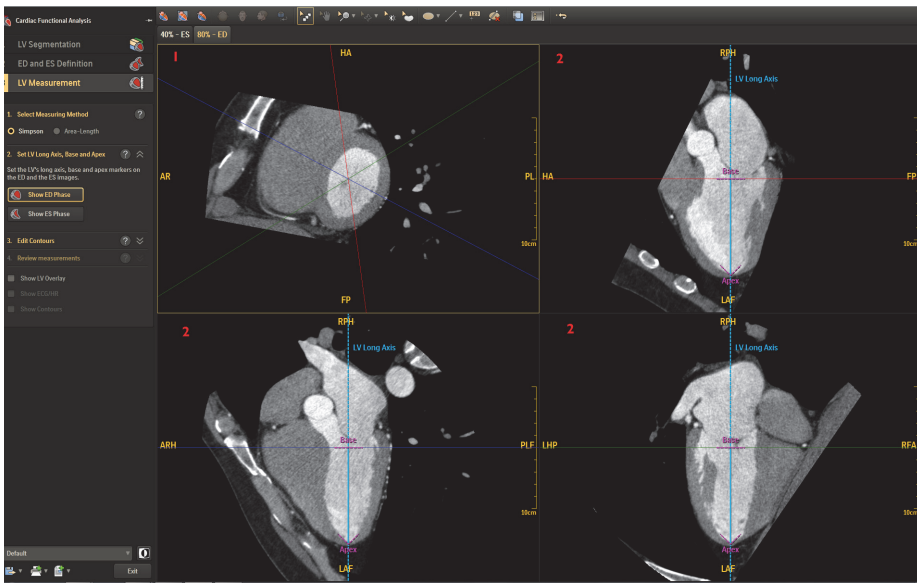
You can choose from two methods of functional analysis of the heart chambers.

- **Simpson** - The Simpson method uses the short axis images and segmentation to extract contours and uses the contours (cross-sectional areas) and section thickness to approximate the various functional parameters.
- **Area-Length** - The Area-Length method uses the manually drawn ventricular area and length from apex to the mitral value plane to approximate the various functional parameters.

17.6.2 Simpson method

1 Select Simpson Method

Windowing



Viewport 1	Short axis view. Three colored lines 60 degrees apart mark the planes of the 2-chamber, 3-chamber, and 4 chamber echo views (red, green, and blue, respectively). You can rotate intersection and the lines.
Viewport 2	The 2-chamber, 3-chamber, and 4-chamber (respectively) echo views. The vertical blue reference line in each viewport is the calculated long axis. In each view the Base (valve plane) and Apex of the heart are marked with pink dashed lines, which are moveable to correct them.

2 Set LV Long Axis, Base and Apex

For all loaded phases, examine the position of the base and apex planes and correct them if needed. (The long axis maintains the same position and orientation for all phases.)

Correct the apex setting by dragging the Apex (V-shaped dashed line) to the correct position. If necessary, correct the Mitral valve plane by dragging Base (straight dashed line) to the correct position.

1 Click **Show ED/ES Phase**.

2 Examine the Short Axis image. If corrections are necessary, first correct the apex location on the short axis image.

3 Move the pointer cursor to a blue line (the LV long axis). The pointer will change to either a Rotate cursor at the edges of the line, or to a Move cursor, when it is closer to the center of the line.

4 Dragging the left mouse cursor causes the image to either rotate or pan relative to the fixed blue line.

3 Edit contours

This function allows you to correct the chamber wall contours. Select Edit Contours, the view changes to 3x3 layout with inner and outer myocardial contours.

Modify contour number

1 Type a number in box.

2 Click **Confirm**.

3 The number of viewport is changed.

Note

All edits of the image contour will be cleared after click "Modify contour number" function.

Contour Editing

In Edit Contours mode, two contours are shown at the same time on all viewport.

- Pink = Endocardium contour
- Green = Epicardium contour

Edit Any Contour

1 Select Show ED Phase or Show ES Phase.

2 Select a viewport to edit contour.

3 Move the mouse cursor to the contour.

4 With the mouse, drag the control points to the correct locations.

- To delete seed, click and drag a seed to overlap another seed.

  Or

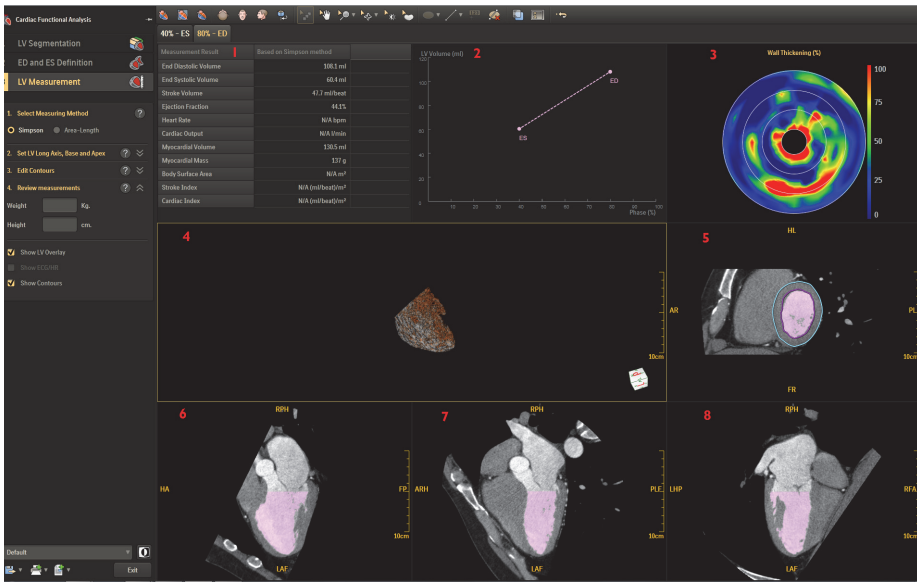
  Hold down the Ctrl button on the keyboard until the cursor turns to "×", click the seed to delete.
- To add seed, when the cursor turns cross "+", click desired location on the contour line.

4 Review Measurements

Click on **Review Measurements**, you can see the measurement details in this stage.

Windowing

Select ED or ES phases tab in the upper left corner of the display, the screen has 8 regions:



Viewport 1	Measurement Result Table
Viewport 2	LV Volume graph
Viewport 3	Polar map
Viewport 4	Volume image
Viewport 5	ED or ES short axis view with contours.
Viewport 6, 7 and 8	Image of ED or ES phase

Measurement Result Table

The results table shows the calculations.

End Diastolic Volume	The ventricle volume at end-diastole.
End Systolic Volume	The ventricle volume at end-systole.
Stroke Volume	ED volume minus ES volume.
Ejection fraction	The difference between ED volume and ES volume, divided by ED volume, times 100.
Heat Rate	If ECG strip is loaded to CCA, the HR value is the mean HR during scan. If the ECG is not loaded, the HR is taken from the DICOM information and it is the initial HR before the scan.
Cardiac Output	Ventricular Stroke volume times heart rate.
Myocardial Volume	Calculated using the myocardial segmentation results for the ED phase.
Myocardial Mass	MVx1.05 1.05 is the specific gravity of myocardium.
Body Surface Area	The total surface area of the patient's body.
Stroke Index	SI = SV/ BSA
Cardiac Index	CI= CO/BSA

The Body Surface Area Calculation

Body surface area is the total surface area of the patient's body.

1. Type in the patient's weight and height.
2. Press Enter on the keyboard.
3. You can see the calculation result in Measurement Result Table.

LV Volume graph

The graph displays the change over time of the left ventricle (LV) volume (in ml). The horizontal scale uses the cardiac phase (%) as the reference time unit.

As blood is ejected from the LV, the volume decreases to its minimum, which is the ES volume. As the blood fills the LV, the volume increases to its maximum (0% phase at right), which is the ED volume.

Using right click menu to select the display results:

- Show ED/ES phases
- Show all loaded phases

Polar Maps

Color-scaled Polar Maps to show the functional parameters for each segment of the left ventricle.

Wall Thickening

Each circle on the map corresponds to a specific short axis slice, where the inner circle near the center of the polar map image represents the Left Ventricular apex and the outer circle represents Left Ventricular base.

ES Wall Thickness

This map represents the left ventricular wall thickness of the loaded cardiac phase with the largest ventricular volume and smallest wall thickness.

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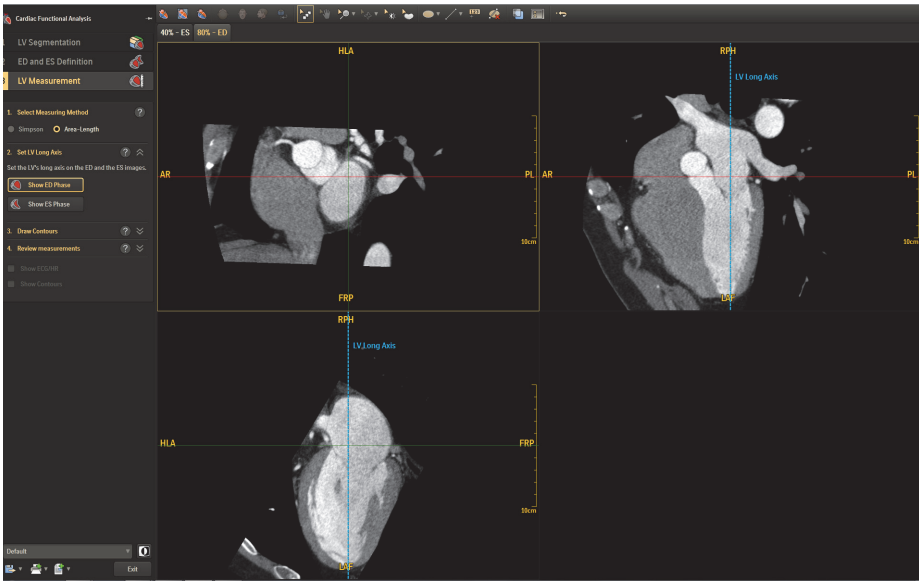
17.6.3 Area-Length method

1 Select Area-Length Method

Windowing



Viewport 1	Short axis view. Two colored lines 90 degrees apart mark the planes of the 2-chamber, 3-chamber, echo views (red and green respectively). You can rotate intersection and the lines.
Viewport 2	The 2-chamber, 3-chamber echo views. The vertical blue reference line in each viewport is the calculated long axis.

2 Set LV Long Axis

1. Click Show ED/ES Phase.
2. Examine the LV Long Axis.
3. Move the pointer cursor to a blue line (the LV long axis). The pointer will change to either a Rotate cursor at the edges of the line, or to a Move cursor, when it is closer to the center of the line.
4. Dragging the left mouse cursor causes the image to either rotate or pan relative to the fixed blue line.

3 Draw Contours

1 Click **Draw LV contours**.

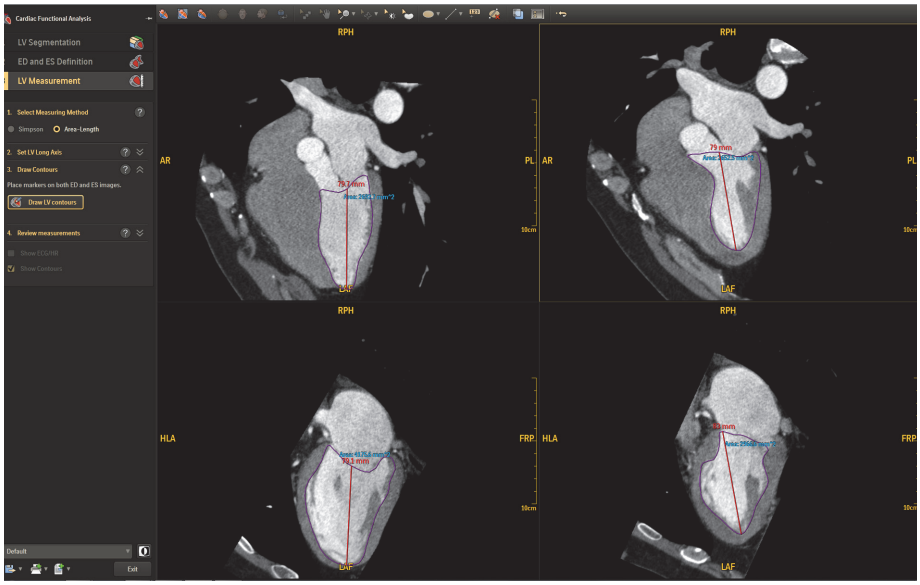
2 Select ED and ES viewport to draw contours.

3 Click repeatedly in the viewport, following the anatomy, to draw a new contour.

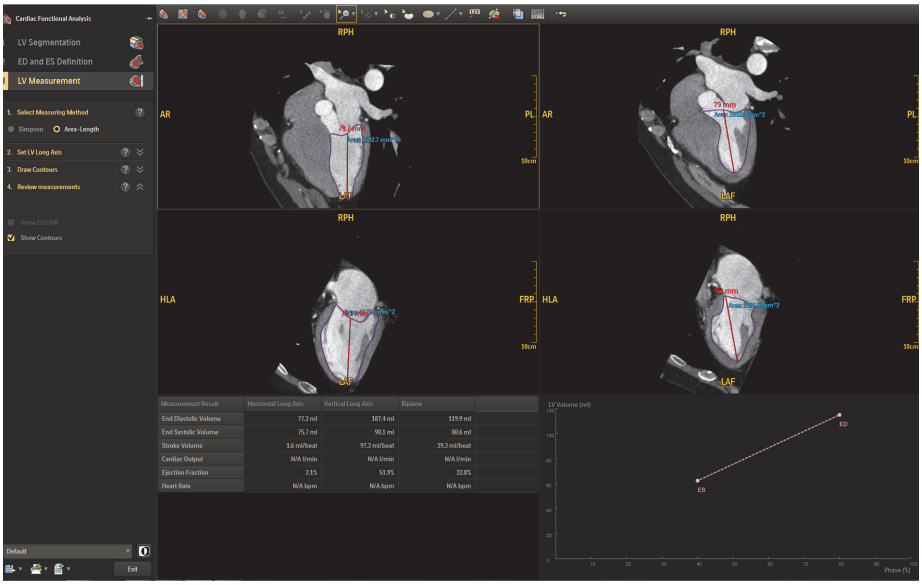
4 Double click to end drawing.

5 If needed, you can refine the contours.
- To edit the seed, click and drag the seed to the desired location.
- To add seed, when the cursor turns cross "+", click desired location on the contour line.
- To delete seed, click and drag a seed to overlap another seed

or hold down the Ctrl button on the keyboard until the cursor turns to "×", click the seed to delete.



4 Review Measurements



Measurement Result Table

The results table shows the calculations.

End Diastolic Volume	The ventricle volume at end-diastole.
End Systolic Volume	The ventricle volume at end-systole.
Stroke Volume	ED volume minus ES volume.
Cardiac Output	Ventricular Stroke volume times heart rate.
Ejection Fraction	The difference between ED volume and ES volume, divided by ED volume, times 100.
Heat Rate	If ECG strip is loaded to CCA the HR value is the mean HR during scan. If the ECG is not loaded the HR is taken from the DICOM information and it is the initial HR before the scan.

LV Volume graph.

Please refer to **LV Volume graph**, on page 17-9, for more information.

18 Cardiac artery analysis (option)

18.1 Overview

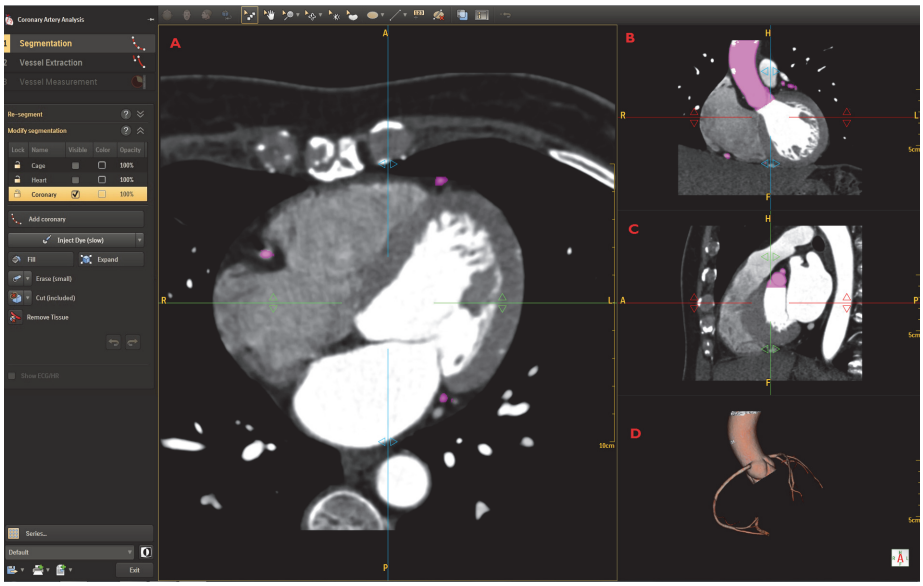
The Coronary Artery Analysis provides viewing and measuring tools that allow you to perform dimensional and quantitative measurements of the coronary arteries to help you identify and examine the patient study for stenosis.

Note

Only the CT images according with the DICOM 3.0 standard and gated cardiac enhancement scanning images can be used in the Coronary Artery Analysis.

18.2 CAA window

The initial Segmentation window consists of an axial image in the main viewport. Two orthogonal images and one volume image are in the reference viewports. The crosshair colors on the MPR images correspond to different orientations.



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A	Main slab image with the colored tissue overlays. This image is displayed as default in Axial orientation.
B	Reference slab image with the colored tissue overlays. This image is displayed as default in Coronal orientation.
C	Reference slab image with the colored tissue overlays. This image is displayed as default in Sagittal orientation.
D	Volume color coded image displaying the segmented tissues with its specific color. You can choose Cage, Heart and Coronary to display.

18.3 CAA common tools

Show Related Position - Displays the related location of the crosshairs on the reference images to a single point on the volume image.

Orientation - Changes the image of the General Axes orientation.

- Axial
- Coronal
- Sagittal

Flip - Use the Flip button to flip the active volume viewport 180 degrees.

18.4 Segmentation

When you first load a cardiac study, the application performs a full segmentation procedure. The aortic root and the coronary arteries are detected automatically by the application. The image identifies the segmented vessel with a pink overlay. A tree of the coronary artery is generated.

Verify the accuracy of the automatic segmentation. If necessary, manually correct the segmentation using **Modify Segmentation** tools.

18.4.1 Modify segmentation

Add Coronary

1 Examine the Coronary tree.

2 Scroll through the images. Examine the segmentation of the coronary arteries.

3 If corrections are necessary to the Coronary tree, click **Add Coronary**, click on a coronary vessel which was not segmented to add seed points.

4 To remove the last seed, in right click menu, click **Delete Last Point**.

5 Continue scrolling with the mouse wheel and adding coronaries until all corrections are made.

6 Right click on the image, click **Complete** in right click menu. The algorithm will attempt to detect the vessel.

Manual segmentation tools

The manual segmentation tools allow you to correct the segmentation of tissues.

Inject Dye - Adds the additional unsegmented areas and adds them to the artery tissue. The viscosity of the injection can be controlled by **Viscosity** box.

Fill - Fills all the holes in the color overlay of the artery tissue.

Expand - Increases the edges of the contrasted tissue. Each click expands the edge by a one-voxel increment.

Erase - Removes volume from the artery tissue.

Cut Selected/Unselected - Cuts selected/unselected volume in freehand region (3D)

Remove Tissue - Removes the undesired segmentation on the volume image.

1 Click **Remove Tissue**.

2 Click on an undesired segmentation to remove it from the artery tissue.

Undo/Redo - Reverses your most recent action.

Show ECG/HR - Click to display:

- the ECG strip along the bottom of the screen. When scrolling through the images, the position of the ECG is continuously updated. The ECG strip is colored yellow for the duration of the scan (while radiation was applied).
  - Measure: Enables you to measure the time between two points on the ECG.
- the Mean HR.

In the ECG mode, you can measure the time along the graph using this procedure:

1. Click the Measure ECG Curve button.
2. Click and drag from any starting point along the graph.
3. Release the mouse button at the desired stopping point. The time between the start and end points displays.

Note

Show ECG/HR feature is available only when they are loaded.

Show Color Overlay - Shows or Hides the color tissue overlay (in right click menu).

18.4.2 Re-segment

If the automatic segmentation fails, or if the coronaries not segmented, you can redo the segmentation process using Re-segment function, which uses manually placed landmarks to perform the segmentation.

The Re-segment process is initialized by manually placing Seeds on these 3 anatomical locations:

- Mark Aorta
- Mark LCA Ostium
- Mark RCA Ostium

1. Click **Re-segment**.
2. Click **Mark Aorta**, the location names become active.
3. Using the mouse wheel, scroll on the axial images to position above the left ostium and place a seed point inside the aortic vessel. The designated name is displayed.

4 Click **Mark LCA ostium** and **Mark RCA ostium** and place the seeds on the coronary arteries near the ostia.

5 After placing all three seeds, click "**Re-segment**" and **Yes**. The system displays the segmentation.

Series

See **Series**, on page 10-8, for more information.

18.5 Vessel extraction

After you have completed the Segmentation stage, click 2 Vessel Extraction to access Vessel Extraction stage.

The Coronary Extraction tools allow you to:

- Label Vessels, specify a name (label) for an automatically extracted vessel.
- Extract vessels manually, extract a new vessel (one that was not automatically extracted).
- Edit Centerline, edit a vessel's centerline.

18.5.1 Label vessels

The system automatically extract and name 3 vessels - RCA, LAD and LCX.

1 Select vessel from the **Labeled Vessels** list, the selected vessel centerline turns blue.

2 Check the selected vessel, select and drag the seed to the desired position to correct vessel center line.

3 Click **Confirm Label** in the volume image to name the label.

4 Repeat step 1 to 4 to name RCA, LAD and LCX.

Label other vessels except RCA, LAD and LCX.

1 Move the cursor over the volumetric image. As the cursor moves over a segmented vessel the vessel centerline becomes yellow.

2 Click on a centerline to select it. The centerline turns blue. The Vessel name selection list displays.

3 Select the desired name from the list.

Or type an appropriate name in Add Vessel Name at the bottom of the list.

4 Repeat step 1 to 3 to name all desired vessels.

Working with Vessel Labels

Rename the vessel

1 Select a desired vessel in Labeled Vessels list.
2 The centerline will turn blue.
3 Right click on the desired vessel, click **Rename** in right click menu.
4 **Choose Vessel Name** list opens, you can rename the vessel.

Delete the vessel

1 Select a desired vessel in **Labeled Vessels** list.
2 The centerline will turn blue.
3 Right click on the desired vessel, click **Delete** in right click menu to delete the selected vessel.

Edit vessel center line

1 Select a desired vessel in Labeled Vessels list.

   Or

   Find and click a labeled vessel to work with by hovering the mouse over the volume image.
2 The centerline will turn blue.
3 Click and drag the seed to the desired location.

   Control points appear along the centerline in the Curved planar reformed and volume views. A cross-section cut also displays the centerline location at the selected control point. You can edit any point by dragging it to the correct location, including the cross-sectional cut.
   - To delete seed, click and drag a seed to overlap another seed, these two seeds combine to one seed.

   Or

   Hold down the Ctrl button on the keyboard until the cursor turns to "×", click the seed to delete.

- To add seed, when the cursor turns cross "+", click desired location on the center line.

18.5.2 Extract vessels manually

This function allows you to define a new vessel centerline by marking control points along the path.

Mark Vessel End

1. Click **Mark Vessel End**.
2. Click on the end location of vessel that you wish to define.
3. The system calculates and displays a new centerline and displays the Choose Vessel Name list.
4. Name the vessel using the procedure described earlier.
5. Edit the centerline if necessary.

Mark Vessel Start and End

1. Click **Mark Vessel Start and End**.
2. Click on the start and end location of vessel that you wish to define.
3. The system calculates and displays a new centerline and displays the Choose Vessel Name list.
4. Name the vessel using the procedure described earlier.
5. Edit the centerline if necessary.

18.5.3 Edit centerline

This function allows you to add vertices beyond the distal and proximal ends of the extracted vessel centerline.

Extend Proximal End

1. Select the vessel to be continued.
2. Decide which end you want to continue, click **Extend Proximal End** or **Extend Distal End**. The main window is switched to MPR image.
3. Locate the continuing vessel using the axial image.
4. Page up in the main window and left click to place seed points in the proximal position needed for extension.
5. Click the end point on the axial image to continue the vessel.

6 When the vessel extension is complete, right click on the image and click **Complete** to end the procedure.

7 The main window switches to VR image.

Note

Only labeled vessels centerline can be extended.

Show Centerline - When this function is checked, the selected vessel's centerline is shown. When un-checked, the centerline is not shown.

18.5.4 Vessel measurement

The Vessel Measurement provides viewing and measuring tools that allow you to perform dimensional and quantitative measurements of the coronary arteries to help you identify and examine the patient study for stenosis.

The Vessel Measurement stage automatically contours the coronary arteries that were segmented and named in the Vessel Extraction stage of the CAA application.

Movable colored reference lines are provided in all the images.

- the Red line is used to mark the stenosis location.
- the Blue line is used to mark the proximal reference location.
- the Orange line is used to mark the distal reference location.

Add Stenosis

1 Click **Add Stenosis**, place stenosis and reference line markers on key vessel locations to define the extent of the stenosis.

2 Verify the correctness of the automatic contours and edit if needed.
   - Set the reference and stenosis lines: move the cursor on the line, drag the line to the desired position.
   - Edit the lumen contours: move the cursor on lumen lines, drag the seed of the lumen lines as needed to accurately position the contours on the lumen walls.

3 Click **Confirm locations and contours** on the image.

4 Find the results on vessel measurement table.

In Labeled Vessels list, the stenosis can be deleted and renamed by using the right click menu.

Vessel measurement table

Vessel measurement table includes the following information.

Vessel measurement definitions	
Effective Diameter	Calculated on the basis of Lumen area.
Lumen area	The area of the Lumen.
Position	The distance along the centerline from the beginning of the centerline to the lesion and the reference lines.
Distance to lesion	The distance between the proximal reference line and the stenosis line. The distance between the distal reference line and the stenosis line.

Right click on the table to access these options:

- **Save Table** - Saves the table information.
- **Send Table To Film** - Send the table information to film.
- **Send Table to Report** - Send the table information to the report
- **Reset All** - Reset the study's images (after segmentation) to the state they were in upon loading.

Show Contour - Displays the counter in the MPR viewports.

Show Color Map - Displays a color map based on HU on the curved MPR, the straightened MPR and cross-sectional images.

Show Diameter/Area Graph - Displays a graph showing different parameters along the straightened vessel.

Show One Reference Line- When you check, only one reference line is displayed.

19 Dual energy (option)

19.1 Overview

Dual energy Viewer is an application for review and analysis of CT dual energy scans. The viewer needs to use the DICOM data to enable all spectrum analysis and review function.

19.2 Load the data into the dual energy viewer

19.2.1 Registration

The Registration stage provides tools for rigid registration of two scans of the same patient acquired at different energies.

Registration Workflow

1. Select the Base and Aligned series and start Registration.
2. Select registration method, Manual Registration or Auto Registration.
3. Click “Confirm Registration”. Accept the registration. The Spectral combined series is created.
4. Use the Weighted Energy slider to select the weighted energy to create different, multiple series with different KV values using the same base and aligned series.
5. When verified, move to stage 2-Separate Materials.

Registration Tools

Use these tools to accurately align the Aligned series over the Base series.

Select the Base and Aligned Series

Each series is displayed with its kV value to help with selection. The Base series does not move. The Aligned series appears as a translucent layer for you to move over the Base series. If desired, you can switch the series.

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Switch series

Click this button to switch the two series between Base and Aligned.

Show overlay

Click this button to show or hide the Aligned series.

Select Overlay Color

Use the **Select Overlay Color** function as a visual aid during image alignment of the Base and Aligned series. The **Select Overlay Color** function lets you choose a predefined overlay for the Aligned series.

1 Click the **Select Overlay Color** to activate the function. The Edit Colors dialog opens.
2 Select **Standard** tab.
3 Select the desired color from the Available Colors.
4 Click **OK**, the selected color applies on Aligned series.

OR

1 Click the **Select Overlay Color** to activate the function. The Edit Colors dialog opens.
2 Select **Custom** tab.
3 Select the desired color.
4 Click **OK**, the selected color applies on Aligned series.

Select registration method

Automatic registration - Clicks this button after selecting Base and Aligned series. The system will perform automatic registration.

If you are not satisfied with the result of automatic registration, you can perform manual registration.

Manual Registration - Uses these tools to manually align the Aligned series over the Base series.

Move overlay - Uses the Move button to pan the aligned data according to the base data.

Rotate overlay - Uses the Rotate button to move the aligned data according to the base data.

Windowing Overlay - Uses this button to adjust the window width of Aligned series.

Subtract Overlay - Gets rid of the superposition of the Base series and the Alignment series

Confirm Registration - Clicks **Confirm registration** button to automatically generate a weighted energy series of intermediate energy.

Adjust Weighted Energy

The Weighted Energy slider controls how the High energy series and Low energy series are combined. Moving the slider to the right results in a combined series with more high-energy data. Moving the slider to the left results in a combined series with more low-energy data.

- Click **Adjust** to apply the new weighted energy.

Save Series

The combined spectral volume is created as a temporary series. It is not saved to the database by default. To save it:

- Click **Save Series** to save the series into Local.

Warning

The Dual Viewer volume image is created by combining high- and low-energy data. Combined images should not be used as the SOLE basis for clinical diagnosis.

Series

From more information, refer to **Series**, on page 10-8.

19.3 Separate materials

At this stage, you can analyze different levels of spectrum.

Each tissue pixel in the scanned volume has two CT values, one for high energy and one for low energy.

When opening **Separate Materials** stage, each pixel in the CT image is characterized by the ratio of low and high energy values, and displayed on an Energy Map, shown in the viewport at right below.

An Energy Map displays, plotting values on a 2-dimensional diagram, where the vertical axis is its low-energy value and the horizontal axis is its high-energy value. (The corresponding CT image, in the left viewport above, is also displayed. The CT image will be used for review and analysis in the third stage, Segmentation.)

Select Separation Method

You can choose from three methods of Spectral Analysis:

- Graph
- Vector

Define Materials

Threshold

Setting this allows you to define the lower limit for the CT values that should be separated and displayed on the Tissue Maps.

Preset

There are 5 factory protocols in default.

1. Click Preset.
2. Select protocol in **Manage Separation Presets**.
3. Click **Load Preset** to apply the selected separation presets on the series.
4. Click Close to exist **Manage Separation Presets**.

Or the current separation can be saved as a new protocol.

1 Click Preset.

2 Type the new protocol name in **Manage Separation Presets** text box.

3 Click **Save current separation as Preset**.

4 Click Close to exist **Manage Separation Presets**.

Review Attenuation

1 Check Show Attenuation Curve box.

2 Use Ellipse/Rectangle/Freehand function to drawing a ROI on the MPR image.

3 As a result, only the pixels within the ROI will be displayed on the Attenuation Graph.

- You may define several ROIs.
- To move the ROI, move the mouse cursor on the ROI when the cursor turns to cross and drag with the mouse.
- To change the ROI shape, move the mouse cursor on the ROI when the cursor turns to square and drag with the mouse.

More options are available from a right click menu inside the ROI:

- Delete
- Line Color
- Line Style
- Line Thickness
- Information

Separate by Graph Line

Graph Separation into Two Materials

When you choose Graph separation, a blue separation line is displayed on the energy map, with X-marks at each end. Attached to the lower point of the blue line is a gray line which represents the Threshold value.

• All pixels on the energy map below the Threshold line are not included in the Spectral Analysis.

• All pixels above the threshold line and above the blue line are classified as one substance (colored in dark green in the CT image).

• All pixels above the threshold line and below the blue line are classified as another substance, (colored in pink in the CT image).

To move the separation and threshold lines, the blue line can be edited by moving the X-mark at either end in any direction. The lower X-mark also moves the Threshold line. (You can also change the position of the Threshold line by changing the Threshold parameter in the toolbox.)

Graph Separation into Three Materials

By adding a second separation line you can define a third material.

1 Right-mouse click in the map and select "Add Line."

OR

Click Add Line in Tissue List.

2 Click on the graph viewport, a blue line is added to the graph viewport below the red line.

3 You can change the location of the line by dragging the line by its edge.

4 Right-mouse click on the line, select Delete Line to remove the line.

With two separation lines on the Energy Map, all pixels above the threshold line and below the second separation line are classified as a third substance (colored in green in the CT image).

Separate Materials by Vectors

This method of separating materials assumes that the CT value of each voxel may be analyzed as a composition of two materials. When you select this method, two vector lines, green and purple, are displayed on the Energy Map. You should position these two vector lines on the corresponding material axis which represents the "pure" behavior of the two chosen materials.

Changing Vector Parameters

Meeting point - The green and purple vector lines are tied together and define the meeting point of the Energy Map. You can change meeting point location by selecting one of the following parameters:

- Water. The vector lines are tied in water reading (0, 0).

- Air. The vector lines are tied in air reading (-1000, -1000).
- User Defined. You can change the meeting point to any desired coordinate value.

Threshold - In the Vector method works the same as it does in the Graph method. But, unlike in the Graph method, the gray line is not tied to the meeting point.

Note

When adjusting the meeting point, it should be placed on the threshold line.

19.4 Segmentation Stage

The Segmentation scene allows the viewing and analysis of the spectral tissues which were created in stage two. The tissues are available from within the tissue management tab. Also in the tissue management tab are tools for manual editing of the tissues.

Segmentation common tool

Layout are available for displaying images.

- Layout 1+3
- Layout 2x2

Show/Hide Protocol - Opens a window containing thumbnail of all the existing protocols specific for the loaded volume:

- Double click on a protocol thumbnail to apply the protocol to the volume.
- Click the **Show/Hide Protocol** button again to hide the protocol window.

Calculate Volume - Allows you to calculate the volume of the currently displayed tissue(s).

Show Related Position - Displays the related location of the crosshairs on the reference images to a single point on the volume image.

Flip - Flips the volume image vertically.

Tissue Segment

Tissue Segment tab displays the list of tissues of the active series. Use it to control display of tissues. Spectral tissues which were created in the second stage appear as Tissue 1, Tissue 2, etc. in the tissue list.

Edit selected Tissue

Inject Dye - Is used on the reference images to create a tissue of the volume of interest.

Fill - Adds to the injected soft tissue, filling in any holes within the volume. The holes are filled as long as the button is pressed.

Expand - Allows you to expand the edges of the tissue.

Erase - Allows you to remove the dyed area from reference images by hovering over the contrast and clicking the left mouse button (you can also hold down the button and drag). The Eraser is a sphere whose radius you can choice (Small, Medium, Large).

Clip

Mask Volume - Shows a box shape allowing to hide structures from the volume image. It can be manipulated directly on volume images or MPR images.

Show Bounding Box - Allows you to show or hide the clip box in the volume window.

Reset Bounding Box - Allows you to reset the clip box in volume window

Cut Selected / Cut Unselected - Allows you to eliminate the undesired tissue and isolate the volume of interest.

Undo/Redo - Reverses your most recent action.

To remove bones:

1 Click the **Remove Bone** button.

2 Click to place the seed in volume window image.

The system removes the bones according to the thresholds defined and the location of the seed.

See **Clip**, on page 10-17 for more information.

20 Filming

20.1 Overview

The Filming application is used for viewing, rearranging, windowing and zooming images prior to sending them to be printed.

- Better organization and economy of films can be achieved by filming in the Multiformat mode.
- Measurements and annotations (done with graphic elements) can be added or deleted from the images.

Warning

Measurements on 3D images are in the screen plane and not on the three-dimensional curved surfaces.

Filming workflow

1 From the **Complete** interface in **Patients** window, select the desired series and studies in Local.

2 Right click on selected series, click **Film**.

3 Click **Filming** in workflow bar. The selected images display in the Filming application.

4 Select a printer in **Printer**.

5 **Select Layout and Preview**, such as **Orientation**, **Sort**, and **Insert**.

6 Set Copies, and Pages in **Print**, then click **Print**.

Note

The system does not support mix two patient images into one film page.

20.2 Filming common tools

Display

There are two Display settings, Normal and Multi-view.

- **Normal View** - Shows one film page at a time and displays the film in the selected page layout.

- **Multi-View** - Shows twelve film pages at a time and displays the film in the selected page layout.

Layout tools

This feature allows you to change the layout of the film.

Standard Option

- 3x4 Layout
- 4x5 Layout
- 4x6 Layout
- 5x7 Layout

Custom Layout - Allows you to choose the number of rows and columns for the page layout. You can enter a maximum of ten rows and nine columns. Click **OK** to apply the page layout.

Selection

Select Single - Allows you to select an image.

Invert Selection - Allows you to select all the remaining images, which you did not select last time.

Select All Images Backward - Allows you to select all the images after the first- selected image (the first-selected image included).

Select All Images Forward - Allows you to select all the images before the first- selected image (the first-selected image included).

Select Series - Allows you to select a series.

Select All - Allows you to select all images.

Flip/Rotate tools

Flip Horizontally - Allows to turn the axial image left-to-right.

Flip Vertically - Allows to turn the axial image top-to-bottom.

Rotate

The **Rotate Clockwise** and **Rotate Counterclockwise** tool rotates the image in 90 degree increments clockwise.

Common tools

The common toolbox contains a variety of general tools that are used with the Filming application. See **Common tools**, on page 10-2, for details.

Patient List

The images can be sent from different patients and from different applications to **Film**. **Patient List** can hold up to ten patients at once. Only one patient can be viewed and printed at one time. You can select the patient in **Patient Lis**t drop down menu.

20.3 Filming window

Click on the **Filming** button from the **Workflow** bar to open the Filming window.

The filming window consists of these items:

20.4 Select printer

The system may be connected to several printers. To select a different printer than the one currently set for your system:

20.4.1 Printer

You can select the desired printer from the **Printer** list. The printer supports two DICOM print mode color and black-and-white.

Reset a printer

1 Click **Manage Printers** to open the **Printers Management** dialog box.

2 Select the printer you want to edit.

3 Configure the desired item.

4 Click **OK** to confirm the new setting.

Add a printer

1 Click **Manage Printers** to open the **Printers Management** dialog box.

2 Click **Add Printer**, fill the box with red star.

3 Click **Test** to test the new printer.

4 Once the test has passed, click OK to save the new printer.

Delete a printer

1 Click **Manage Printers** to open the **Printers Management** dialog box.

2 Select the desired printer.

3 Click the garbage can beside the printer.

4 Click **Yes** to delete the printer.

20.4.2 Calibrate

Click **Calibrate** to open the Gray Calibration dialog box. There are four test images to select: **TG18-QC-1k-01**, **TG18-QC-2k-01**, **bwhtest**, and **smpte**. After you select the desired test image, the dialog box will show the corresponding **Image Preview** and **Image Description** on the right.

20.5 Select layout and preview

You can select the way to display images, layouts, orientation, and some images options in **Select Layout and Preview**.

Orientation - Allows you to change the page orientation to Landscape or Portrait format.

Sort - Allows to **Sort Regularly** or **Sort Inversely**.

- **Sort Regularly** allows you to set images in their original order after they have been moved.
- **Sort Inversely** displays images in reverse order of current view.

Insert Blank Image - Allows you to insert a blank image in front of the active image.

Show Surview as Mini Image - Includes a mini image of the Surview in each frame.

Group allows you to divide a single film frame into different groups where different image layout and size can be set as desired.

1. Click **Edit Group**. The current film frame becomes a group.
2. Use the mouse to drag the edge or edges of the group to resize the group as desired.
3. Click **Add Group**.
4. Click on any blank area of the film frame to add a new group.
5. Repeat step 2 to 4 as desired.
6. Click **Confirm Editing** to finish editing the current film frame.

You can click **Save Protocol** to save the current film frame protocol.

Edit Protocol

1. Click **Edit Protocol**, **Print Protocol Editor** dialog box appears.
2. Select a protocol, click **Edit Protocol** next to the protocol name.
3. Use **Add Page**, **Page Layout**, **Remove Current Page** and **Insert Group** to edit the protocol.
4. Click **Save/Save As** to save the current film frame.

20.6 Print

Choose a printer from the Printer List.

Copies - If desired, change the number of images printed by entering the desired number of copies in the Number of Copies (up to 100).

Pages - Prints the **Current** (or **All**) film Pages.

Show Header - Allows you to show or hide header.

Clear after printing - Selects **Clear after printing,** the films which has been printed will automatically be cleared from Filming preview.

Note

When Clear after printing is selected, and the Current page is printed, the footer page will be restart from one.

Open Print Task/Save Print Task

Save Print Task - Stores copies of all current films. If you want to load the saved print task, you can access the Open Print Task and select a Named Print Task from the list and load.

Print Queue - Allows you to manage items as they are transferred to print.

Edit Header/Footer

The **Film Header/Footer Editor** category allows you to define what information appears in the header and footer of the film.

1. Drag the element, then place it in the desired purple area to set the element in **Template Element**.

   OR

   Drag the element out of the purple area to remove the element.
2. Select a font in **Font Family.**
3. Select a size in **Font Size.**
4. Adjust logo position by using **Horizontal** and **Vertical** drop down menu.
5. Adjust logo size by using **Zoom In** and **Zoom Out**.
6. Select a style in **Style** drop down menu.
7. Click **Save** to save the format, it will apply to the current film and will be the default format.

To change the Logo, right click on the preexisting logo and click **Delete**. Drag **Logo** from **Template Element** to the desired location in the purple area, select the new Logo and open it.

New - Allows you to format header and footer from blank.

Restore - Allows you to restore the factory default header and footer.

20.6.1 Right-click menu options

Filming viewport includes right-click menu options, which duplicate functions found in the tool panel. You can refer to the tool panel in Filming mode. Also see **Common tools**, on page 10-2 for details.

Edit Image

Copy - Copies the image(s) you selected. The copied image(s) remain in the cut/copy clipboard and can be pasted.

Cut - Cuts the image(s) you selected. The cut image(s) remain in the cut/copy clipboard and can be pasted.

Paste - Pastes images that are currently in the cut/copy clipboard, select the image after which you want to paste, then click Paste.

Delete - Deletes the image(s) currently selected.

Note

Before sending the images to printer, check the followings to avoid mixing different patients in one film.

- **Each image is in the desired location.**
- **The patient information, such as patient name, patient ID, in every image is consistent with the Film header.**

Image Overlays

Show Ruler - Displays the ruler in each image.

Gray Level Reference - Displays the gray level bar in each image.

Only on First Image - The patient information only displays on the first image.

Image Overlays - Allows you to choose show or hide the image overlays.

Show/Hide Location Line - Allows you to choose show or hide the location lines.

Show All Location Lines - Displays the first and last line. Alternately, all lines display on the image.

Show/Hide Surview - Includes a mini image of the Surview in each frame (It links with **Show Surview as Mini Image** and duplicates its function).

Reset Current Selection

Reset Current Selection - Resets the current images to the state it was in upon loading.

21 Reporting

21.1 Overview

The Reporting package allows you to create customized reports using pre-formatted templates. A template is a specially designed formatting document that places the analytical information and images that you send from an application into an organized report which can be printed and saved.

Note

Additional templates can be created. Contact your Philips representative for more information on Report templates.

21.2 Report window

To access the report window:

1. Click **Send Image to Report** in Analysis window.
2. Click **Report** on the Workflow bar.
3. The system displays a new report with patient information from the current patient.
4. Click the **Report** button on the patient name tab to show the report, and click the **Image** button to show the image viewer.
5. To close a report, click **Close Report** beside the patient name.

To open a saved report, you can go to **Patient Complete** interface, select the report in **Report** tab and click **View Report** in right-click menu option.

21.2.1 Report

The buttons for Report are as below:

Save - Saves the current patient report. The saved report is listed in the **Report** tab in **Patient Compare** interface.

Approve - Approves the current patient report. Reports are saved as XPS files. You can only activate this function after you save the report.

Once a report is approved it cannot be modified.

Print Preview - Previews the report to be printed.

Click **Print Preview** and the **Print Preview** dialog box appears.

Copy - Allows you to copy the desired contents in the report.

Zoom In - Allows you to zoom in the report.

Zoom Out - Allows you to zoom out the report.

Actual Size - Allows you to reset the report to its actual size.

Fit to Width - Allows you to adjust the report size to fit to width.

Whole Page - Allows you to display the report in one whole page.

Two Pages - Allows you to display the report in two pages.

Multi-page - Allows you to display the report in multi-page.

Print - Prints report. Printing of reports is done directly via the Windows printer queue.

Replace - Replaces the **Description** and **Diagnosis** content in the report with the content in selected case template or glossary.

Append - Appends the content from the selected case template or glossary to the **Description** and **Diagnosis** in the report.

Clear - Removes all contents in **Description** and **Diagnosis**.

Export Report - Exports the report to external device such as USB disk or CD/DVD.

Note

Only a saved and approved report can be exported to an external device.

Report Setting - Sets the following report config: Report Title, Report Logo, Print Size, Report Template, Report Printer and Show Philips Logo.

21.2.2 Image

The buttons for Image are as below:

Layout - Shows the images in 1x1, 2x2, or 3x3 layout.

Insert Image into Report - Selects the image to be added, then click this button to insert the image to the **Key Images** of report.

For other button functions, see **Common tools**, on page 10-2.

The image viewer displays the images saved to the reporting application. Images are separated by patient (see tabs along the left upper corner of the window). Click a tab and click the **Image** button on the tab to view the images associated with a specific patient.

Use this procedure to place images into the body of a report:

1. Click on the desired image in the image viewer. A yellow box identifies the selected image.
2. Click the **Insert Image into Report** button to send the image to report.

To remove an image from the body of a report, right-click on it and select **Delete**.

Using the following procedures to remove annotations from the image :

1. Select and click on the desired annotation.
2. Press **Delete** on the keyboard.
3. OR

   Click **Delete** in right-click menu to remove the annotation.

To remove all annotations from the images, click the **Delete All** button.

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21.2.3 Template

You can create a new, general template:

1. Click the **Report** button on the patient name tab.
2. Click the **Report Setting** button.
3. In the **Report Setting** window, click the **Edit Report Template** button. This opens the **Report Template Setting** window.
4. In the **Report Template Setting** window, click the **Edit** button. This opens the **Report Template Designer** window.
5. Click **New** on the tool bar. Select items on the left and drag them to the template as desired.
6. To save the file, click **Save** or **Save As** button on the tool bar.
   - Select **Save** to save the template as named. This will replace the previously existing template with your new template changes.
   - Select **Save As** to save the changes as a new template. Type a new file name and click **Save**.
7. In the **Report Template Setting** window, select the template name in **Local Template** list.
8. Click the **Confirm** button.

Note

You can change the **Application** or **Set as Default Template** in **Report Template Setting** window if you desire.

21.2.4 Case template

You can create a template based on a specific protocol:

1. In the **Case Template** box, right-click on the **Template** and select **Add Subfolder**.
2. Double click on the new folder to make it editable. Type in a name. Press **Enter**.
3. Right-click on the new folder and select **Add Subnode**.
4. In the **Case Template** window, type your desired **Nodule Name, Description** and **Diagnosis**.
5. Click the **Confirm** button.

To change the content of the node, right-click it and select **Modify Contents**.

To delete the node, right-click it and select **Delete Subnode**.

You can search the content in case template.

1 Select the **Case Template** tab.

2 Type the keywords you want to search in the text box right beside a small magnifier icon.

3 Press the **Enter** key in keyboard.

4 The result shows in **Case Template** box.

21.2.5 Glossary

You can create a template based on a specific protocol:

1 In the **Glossary** box, right-click on the Template and select **Add Subfolder**.

2 Double click on the new folder to make it editable.

3 Type in a name.

4 Right-click on the new folder and select **Add Subnode**.

5 In the **Glossary** window, type your desired **Nodule Name** and **Vocabulary**.

6 Click the **Confirm** button.

To change the content of the node, right-click it and select **Modify Contents**.

To delete the node, right-click it and select **Delete Subnode**.

You can search the glossary.

1 Select the **Glossary** tab.

2 Type the keywords you want to search in the text box right beside a small magnifier icon.

3 Click the **Search** button.

4 The result shows in **Glossary** box.

21.2.6 Relevant report

The Relevant Report lists the following reports saved in the system:

- all reports of the current patient;
- the approved reports with the same body part.

If the **Body Part** of your desired report is the same as the current report, you can select it in **Relevant Report**, and double click it to open.

Search the relevant report

1 Select the **Relevant Report** tab.

2 Type the keywords you want to search in the text box right beside a small magnifier icon.

3 Click the **Search**.

4 The result shows in **Relevant Report** box.

Note

Contact your Philips representative for assistance with creating new templates.

Warning

Make sure that you have the correct patient information for the image you have placed in your report.

22 Service

22.1 Overview

There are several customizable features included in the scanner software packages. This chapter provides information and procedures for setting up the system according to your needs. Make sure you complete the system setup before scanning any patients.

Daily service functions include these items:

- Short Tube Conditioning
- Air Calibration
- Constancy
- QA (Image quality assurance)
- System Setting
- Exam Card Manager
- Dose Check Report
- Bug Reports
- Audit Trail

Note

Significant changes in temperature or humidity in the scan room can result in ring artifact shadow or central shadow to be generated in the scan image. See the table in Startup, for appropriate room condition guidelines.

Note

Make sure there are no objects in the gantry during the sensitivity calibration operation.

22.2 Short tube conditioning

Short Tube Conditioning process is to avoid the risk of the tube property damage. (see **Short tube conditioning (STC)**).

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22.3 Air calibration

Air Calibration is a part of normal system maintenance that ensures proper operation of the scanner (see **Air calibration**).

22.4 Constancy

Constancy testing is performed to ensure that the image quality of the CT scanner remains at the highest standards at all times. It can be performed periodically at the discretion of the local authorities. Constancy Test results are compared to the baseline generated by the Acceptance test.

Quality assurance checks can be found in the Technical Reference Guide.

22.5 QA

This quality assurance testing allows you to measure the Mean CT, Uniformity, Noise, and Low Contrast Resolution parameters. These four are the main image quality parameters of the CT image. This test is generally performed as part of the daily QA procedure.

Daily and monthly quality assurance checks can be found in the Technical Reference Guide.

22.6 System setting

System Setting allows you to customize a variety of system options to best suit the needs of your facility.

22.6.1 Voice manager

Use Voice manager to add new custom auto voice phrases, or edit and delete existing custom auto voice phrases that may be used during the scan process.

Creating a new language or adding to an existing language

1 Select **System Setting** from the Service menu.

2 Select **Voice Manager**. The Voice Manager dialog box displays.
- The left side of the box displays the stored languages.
- The right side of the box displays the sets of instructions available in each language.

3 To add a new language
   1 Click **Add** below the Language area.
   2 Type the name for the new set. Click **OK**. The system displays the new name.

Adding a new action set

Note

Use the microphone that shipped with your system to record new action sets. When recording, turn down the volume control on the gantry to reduce background noise and improve sound quality.

1 Click **Add** below the Action Sets area. The **Add Voice** dialog box opens.

2 Select **Record new phrase**. Use existing phase or type descriptive text into **Input new phrase**. Click **OK**.

3 Select the newly created action set from the Action Sets area.

4 Select the **Show Prescan** tab (you must record the prescan and postscan messages separately).

5 Click **Record**. Click **Yes**. Recording starts immediately.

6 Click **Stop** to end the recording.

7 To review your recording, click **Play**.

8 Click **Apply**. Click **OK** to close the dialog box.

Additional Voice Manager functions

Delete - Deletes a language or action set, click the desired item and click Delete in right click menu.

Set Default - Selects a language as the default language, click on the language, then click **Set Default** in right click menu.

Surview Default - Selects an action set as the default for Surview scans, click on the action set, then click Surview Default.

Axial Default - Selects an action set as the default for clinical scans, click on the action set, then click Axial Default.

22.6.2 Data source

Display data equipment list. The list consists of name, type and path.

Add - Allows you to add new data sources.

Edit - Allows you to edit the existing data sources.

Delete - Allows you to delete the existing data sources.

22.6.3 Image information settings

Image information settings - Allows you to select from a variety of categories to configure the items which display on the screen.

Changing image information settings:

1. Select a category in Module drop down list.
2. Select elements to be displayed in the Top Left, Top Right, Bottom Left, or Bottom Right of the display by selecting the element and then clicking the appropriate button:
   - The single arrow moves the element onto a line by itself.
   - The double arrow moves the element onto a line, or separate the elements to two lines.
   - Up or Down moves the element above or below in the list.

22.6.4 Window setting

Window setting - Allows you to alter image window width and window center values.

Adding new window settings:

1. Click **Add**. The **Add** dialog box appears.
2. Fill **Display Mode Name**, **Window Width** and **Window Center**,

and select a type.

3 Click **Add**.

4 Click **OK** to exit.

Changing window settings:

1 Select a display mode name. The fields of **Display Mode Name**, **Window Width**, and **Window Center** will populate with the current settings.

2 Click in the desired field and type a new setting.

3 Click **Edit**.

4 Click **OK** to exit.

Deleting window settings:

1 Select a display mode name.

2 Click **Delete**.

3 Click **Yes** to delete the selected item.

22.6.5 Display

Display test

This function is designed for use with DIN 6868-157 standard Display Test for image display systems. If the DIN 6868-157 standard (or an equivalent standard) is not followed, this procedure is not required.

Caution

This test procedure is only for the Philips CT system which complies with DIN 6868-157.

Display Test function is to support Acceptance and Constancy test, which provides necessary test images.

- Acceptance test:

  A set of tests performed after a system installation or significant changes to system to determine that the CT system complies with the applicable requirements specified in DIN 6868-157, and to determine the reference values for the Constancy test.

Note

Acceptance test is defined to be executed after a CT system installation or after Significant changes to the CT system. If any change occurs, please contact your Philips Service Engineer.

- Constancy test:

  A set of tests performed at regular intervals to determine and document changes relative to the initial state described by the reference values of the CT system being tested, following the applicable requirements specified in DIN 6868-157.

Visual test and metrological test are required for both Acceptance test and Constancy test.

Test equipment

Test equipment shall satisfy the following requirements:

- Illuminance meter

  An illuminance meter with a measuring range of 1 lx to 1000 lx, a measurement uncertainty of not more than 10% and a repeatability of at most 5% shall be used for testing.

  Illuminance meter used for testing must be calibrated and within the period of validity.
- Luminance meter

  Luminance meter, which correspond to at least Class B as defined in DIN 5032-7, shall be used for testing.

  Luminance meter used for testing must be calibrated and within the period of validity.

  For Constancy test, a close-range luminance meter in combination with a luxmeter may also be used, if supplied with a factory calibration and checked at regular intervals in accordance with the manufacturer's instructions.

Test prerequisites

- Check and make sure the display is installed in accordance with the manufacturer’s instructions.
- Check and make sure the display under testing is placed at the pre-defined position.
- To make the tested system stable, switch on system, including displays, and keep them standby or working for at least 30 minutes,

particularly, keep the displays working without sleeping for 30 minutes before testing.
- Check room-lighting appliances, for example, windows, light boxes, clothing, etc., make sure there is no spurious reflections on the viewing surface of displays due to them.
- Clean the viewing surface of displays in accordance with operating instructions, if needed.
- Check and adjust ambient illumination, ensure it complies with defined value, and make sure it remains consistent and stable.
- Check and adjust displays to meet DICOM Greyscale Standard Display Function (GSDF) setting according to the current ambient illumination, if needed.

Note

Test images provided by system cover the entire area of the screen used for medical image display. The displaying of test image is with the way of one pixel on the test image corresponding to one pixel on the display, make sure if this requirement is applicable for the tests.

In order to ensure that the test is complete and accurate, Philips highly recommends to document the following information / data before testing.

Room class and ambient illumination.

Device information/data.

- Image display device.
  - Manufacturer
  - Type / version
  - Serial number
- System information.
  - Manufacturer/type
  - Serial number or identification
  - Application software/version
  - Console computer type/service tag

Note

If the device information item is different from acceptance test, see Significant changes to system for more information.

Reference values determined after the last Acceptance test for metrological tests (For Semi-annually Constancy Test).

- E Illuminance (lx)
- L_{amb} ambient luminance (cd/m^2)
- L'_{max} maximum luminance (cd/m^2)
- L'_{min} minimum luminance (cd/m^2)

Document the following information of measuring equipment.

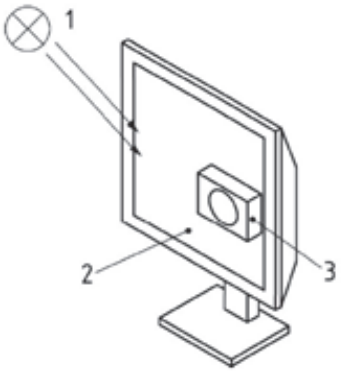
- **Luminance meter (For Semi-annually Constancy Test)**
  - Manufacture/type
  - Serial number or identification
  - Expiration date of its calibration
  - Results to demonstrate that it corresponds to at least Class B as defined in DIN 5032-7, for Acceptance test
- **Illuminance meter (For Semi-annually Constancy Test)**
  - Manufacture/type
  - Serial number or identification
  - Expiration date of its calibration

Measurements with devices

To obtain the accurate measurement result, please strictly follow the instruction of your test equipment. More attention shall be paid to the part of instructions on angle, distance and position of measured area.

Illuminance measurement

Illuminance shall be measured orthogonally to the screen surface.

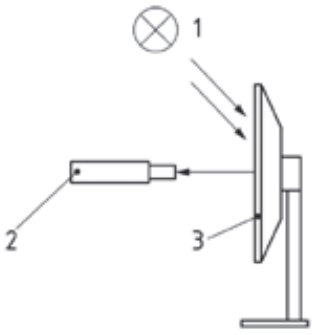


1	Ambient Light
2	Display
3	Illuminance meter

Luminance measurement

Luminance measurement with a luminance meter based on the telescope principle.

The measurements are conducted with a telescopic luminance meter.

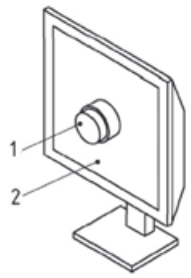


1	Ambient Light
2	Telescopic luminance meter
3	Display

If the luminance meter, which is with focusing optics (lens), is equipped, the luminance measurement must be focused on the screen surface.

Luminance measurement with a close-range luminance meter

A close-range photometer delivers a measurement of luminance without taking account of ambient light.

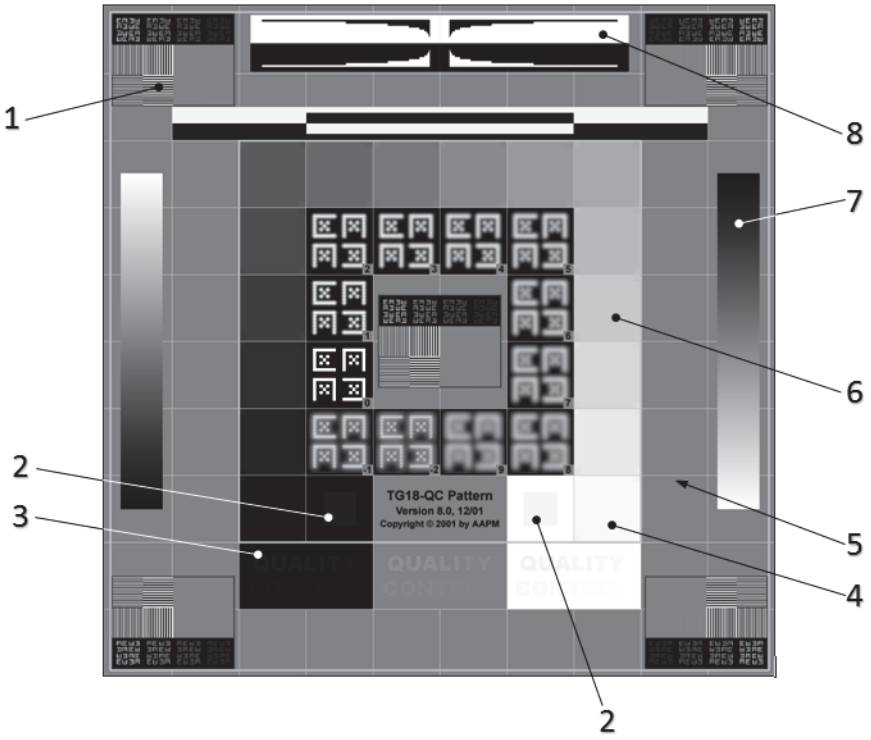


1	Closed-rang luminance meter
2	Display

As the measurement is taken without taking account of ambient light, it is to be combined with a measurement of L_{amb}.

Daily constancy test

Overall image quality



1	Line-pair patterns
2	5% and 95% fields
3	Low-contrast letters
4	Low-contrast corners within the luminance patches
5	Line of the raster
6	Luminance patches
7	Luminance ramps
8	Black-white and white-black transitions

The following visual tests shall be conducted and documented:

- Visibility of the two-PIXEL-wide, low-contrast line-pair targets in the center and in the four corners of the test image (test image element 1).
- Visibility of the low-CONTRAST letters ('QUALITY CONTROL', test image element 3).

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- Visibility of the borders and lines of the raster and the centering of the raster in the active area of the display (test image element 5).
- Continuity of the appearance of the luminance ramps (test image element 7).

Test Criteria

- Undistorted visibility of the line-pair targets without streaks, blurring or drop-outs, along with visibility of the two-PIXEL-wide, low-CONTRAST line-pair targets in the center and in the four corners of the test image (test image element 1).
- 1) In the white and grey fields: 'QUALITY CONTROL' for all room classes.
  2) In the black field:
  - i) RK2 (≤100 lx): 'QUALITY CONT'
  - ii) RK3 (≤500 lx): 'QUALITY CON'
- The borders and lines of the raster and the centering of the raster in the active area can be observed clearly.
- The appearance of the luminance ramps is continuous.

Semi-annually constancy test

The following tests shall be conducted and documented:

Visual test

- Luminance uniformity

Select the test image: TG18-UN80.

The test for luminance uniformity is carried out by visual evaluation of test image TG18-UN80 for disturbing inhomogeneities, when scanning from the center to the edges.

Test Criteria: Smaller scale non-uniformities that have dimensions in the order of 1 cm shall not be visible.

- Color impression and uniformity

Select the test image: TG18-UN80.

The visual test of color impression is performed using test image TG18-UN80. Here, the color uniformity of the displayed test image over the screen shall be checked.

Test Criteria: Smaller scale color non-uniformities that have dimensions in the order of 1 cm shall not be visible.

Metrological test

- Illuminance [(a)]
  - Tool: Illuminance meter.
  - Test Images: None
  - Measure Illuminance *E* at screen center and orthogonal to the screen surface with the display switched off.
- Ambient luminance [(a) (b)]
  - Tool: Luminance meter, based on the telescope principle.
  - Test Images: None
  - Measure ambient luminance L_{amb} at the center of the screen under the condition of defined ambient light, with the display switched off.
- Minimum luminance
  - Tool: Luminance meter, based on the telescope principle.
  - Test Images: TG18-LN-01
  - Measure minimum display luminance L_{min} at the screen center under totally dark conditions (i.e., no ambient light). Calculate minimum luminance L'_{min} according to the equation: $L'_{min} = L_{min} + L_{amb}$
- Maximum luminance
  - Tool: Luminance meter, based on the telescope principle.
  - Test Images: TG18-LN-18
  - Measure maximum display luminance L_{max} at the screen center under totally dark conditions (i.e., no ambient light). Calculate maximum luminance L'_{max} according to the equation: $L'_{max} = L_{max} + L_{amb}$
- Maximum luminance ratio
  - Tool: None
  - Test Images: None
  - Calculate Maximum luminance ratio, according to the equation: $r' = L'_{max}/L'_{min}$
- Luminance response curve [(a)(c)]
  - Tool: Luminance meter, based on close-range measurement.
  - Test Images: TG18-LN-01 through TG18-LN-18.
  - Measure the luminance at the screen center for each test image, TG18-LN-01 through TG18-LN-18. Analyze whether the test value is in compliance with DICOM GSDF.

Note

The analysis of the test value requires a software tool which complies with DICOM GSDF and is qualified by your organization.

(a) Not applicable to RK3. L_{amb} may be disregarded, provided that the value from the Constancy test is below the reference value for the acceptance test.

(b) The test is necessary only if there are abnormalities in the minimum luminance.

(c) If the measured values from test images TG18-LN-01 through TG18-LN-18 differ from the reference values of the acceptance test, the DICOM luminance response curve shall be recalculated and measured using the changed values. For this newly defined response curve, the specifications in defined criteria for this test continue to apply.

Metrological test criteria:

- If the measured values deviate more than 20% from the reference values obtained during the acceptance test, it is recommended that action be taken to prevent further deviations, or contact your Philips service engineer.
- If the measured values deviate more than 30% from the reference values of the acceptance test or exceed any limiting value, troubleshooting and remedial action shall be performed, or contract with Philips service engineer.

Note

After completing the remedial action, depending on the error/deviation involved, a Constancy test or an acceptance test shall be conducted.

How to get constancy test images:

1 Select **Daily** tab in **Service** interface.

2 Click **System Setting**.

3 Select **Display**.

4 Click **Display Test** to access test interface.

5 In right click menu, move mouse cursor on **Constancy Test,** select the desired test image.

Note

TG18-LN contains 18 images, and TG18-UN contains 2 images. You can change images by scrolling.

6 Press **Esc** on your keyboard to exit **Display Test** interface.

Caution

- **Zoom in right click menu is only for Acceptance test.**
- **To ensure accurate testing, do not move the image in test.**

If the test image has been Zoomed or Panned, please reload the image to continue the current test.

Significant changes to system

The following describes the significant changes to the system, together with measures to be taken after these changes:

- After a change of room class: Acceptance test.
- After replacement of display: Acceptance test.
- After replacement of display controller or console computer: Acceptance test shall be re-performed if there is a specific instruction accompanying with components; if not, Constancy test.
- After a change of display controller driver: Constancy test.
- After a change to the Application software: Acceptance test shall be re-performed if there is a specific instruction accompanying with this Console software package; if not, Constancy test.
- If a display is relocated without a change of room class: Need to conduct visual tests of constancy test and measurement of ambient luminance.

If the Constancy test after a significant change was unsuccessful, another Acceptance test shall be carried out after completion of the remedial work to ensure that the minimum requirements are met.

22.6.6 Patient registration settings

Patient Registration Settings includes options for creating the patient data form.

- Select the check box next to the parameters you would like to display in **New Patient** interface.
- Select the check box in **Required** column you would like to make mandatory.

Note

Last name, Patient ID and Age Group are mandatory by system default.

- Type new Anonymous Setting names as desired.

- In the Keyboard Language field, select the specific keyboard configuration for your site.

Keyboard Language	Character Set
English	ISO_IR 100
Spanish	ISO_IR 100
German	ISO_IR 100
Italian	ISO_IR 100
Portuguese	ISO_IR 100
French	ISO_IR 100
Russian	ISO_IR 144
Japanese	GB18030
Chinese	GB18030

22.6.7 ID generator

ID Generator allows you to generate Patient ID and Study Patient ID.

PID Generator/Study ID Generator

1 Select desired format in drop down menu.
- None
- String
- Date Time
- Number

2 Click Setting. Setting dialog box appears
- Type some word in String Setting dialog box, click OK.
- Select a format in Date/Time Setting dialog box, click OK.
- Input number in From, To and Step in Number Setting dialog box, click OK.

3 Click **Apply** to save the new settings.

22.6.8 Scanner option

Scanner option allows you to define view convention and scan workflow.

You can select Sample ECG or Realtime ECG.

Select check box to open the following functions.

- SAS (Start inject to trigger timed scan)

- Continue rotating gantry in between scans.

Use **Light Start** and **Light Stop** to turn gantry ribbon light on and off.

View Conventions

Select the Image view convention and the Decubitus image view convention. Click the appropriate arrow to view the options.

Scanner Direction Display

Use this menu to select the appropriate gantry orientation to ensure visual accuracy on the Patient page.

- Gantry left of table
- Gantry right of table

Precise Position

Allows you to enable Precise Position.

22.6.9 Cardiac

If cardiac arrhythmia is detected during the scan, disable Cardiac DoseRight (scan all phases with full dose). There are two options you can select. **For Cardiac** is applied to Coronary CTA exam card. **For Gated Chest** is applied to Gated Helical CTA exam card.

- Select **Disable Cardiac Doseright for next heartbeat only**, if an arrhythmia is encountered, this option turns cardiac Doseright off until the heart rate returns to normal.
- Select **Disable Cardiac Doseright for rest of the scan**, if an arrhythmia is encountered, this option turns cardiac Doseright off for the rest of the scan.

Automatic retrospective arrhythmia detection

Enables the automatic detection algorithm. When arrhythmia is detected, the arrhythmia will be labeled on offline ECG wave.

Note

This function is not available for Step and Shoot.

Cardiac arrhythmia nomenclature

Allows you to select an arrhythmia nomenclature.

- USA: PVC (Premature ventricular contraction) & PAC (Premature atrial contraction)
- Non-USA: VPB (Ventricular premature beat) & APB (Atrial premature beat)

Precise Cardiac

Turn on the ability to select Precise Cardiac result option.

22.6.10 Dose setting

Use the parameters on this page to set the Dose Check Alert values and other options. See **Dose check** for details.

Exam Dose Limit

Enter the Head and Body CTDI and DLP values for the Dose Check function. See **Dose check** for information.

Require password validation to continue after dose alert

Enable or disable the **Dose Check** option and the associated password function.

Series Dose Limits

Enable custom mAs limits for DRI/DOM series -Allows you to access this parameter from the scan protocols. (see Absolute Min/Max mAs for information about this parameter).

Dose Reports

Automatically generate DICOM Dose Report - Enables the system automatically generate DICOM dose report when the exam is performed.

Send Dose Report to PACS after exam - Automatically sends the dose report to PACS along with the images. If this is not enabled, the

dose report will only be saved in the Complete directory.

Scan Location Dose Limitd

Warning if CTDIvol for same Scan Location exceeds - If the accumulated CTDIvol for one same location in 0 increments axial scan, CCT or perfusion for instance, reaches the warning limit, a warning appears.

Same scan location CTDIvol Limit - If the accumulated CTDIvol for that reaches the value which is setting, system will not allow to have more dose to the position.

Various

Display Dose Geometric Efficiency Message before Scanning enables the system to show the Dose Efficiency Warning when applicable.

22.6.11 Machine information

Allows you to check machine usage status.

22.6.12 Hospital information

Allows you to check and record hospital information and device information.

22.6.13 User management

Allows you to set user levels.

Add User

1. Click **Add** at the bottom of **User Management** area.
2. Type the **User Name**, **Password** and **Confirm Password**.
3. Select **User Profile** type and **Valid period for password** time in drop down menu.
4. Click **Confirm**.

Edit User

1. Select the desired user name.
2. Click **Edit** at the bottom of **User Management** area.

3 Type the **User Name**, **Password**, **New Password** and **Confirm Password**.

4 Select **User Profile** type and **Valid period for password** time in drop down menu.

5 Click **Confirm**.

Delete User

1 Select the desired user name.

2 Click **Delete** at the bottom of **User Management** area.

3 Delete user message appears.

4 Click **Yes** to delete the selected user.

OR

Click **No** to exit the message.

Reset Password

1 Select the desired user name.

2 Click **Reset Password**.

3 **Reset Password** dialog box appears.

4 Type a new password in **Password** and **Confirm Password.**

5 Click **Confirm** to reset the password.

22.6.14 Option key setup

Option Key function is only available to advanced user and service engineer.

Open Option Key

1 Click **Add Key**.

2 Fill the option key in **Key** area

3 Click **OK** to activate the module

The status will change from closed to opened.

22.6.15 Security Setting

Audit Trail Setting

Allows you to enable audit trail.

See "**Audit Trail**" in **Technical Reference Guide** for more information.

Blank Screen

Allows you to enable automatic blank screen.

See "**Automatic Screen Blanking**" in **Technical Reference Guide** for more information.

Emergency Setting

Allows you to enable emergency account.

See "**Emergency Login**" in **Technical Reference Guide** for more information.

22.6.16 Reference Surview

Reference Surview allows you to send the reference Surview (Surview with reference lines) to PACS.

1. Check **Send Reference Surview**.
2. Click **Select Destination(s)**.
3. In **Reference Surview Destination View**, select the desired PACS.
4. Click **OK**.

22.7 Exam card manager

Exam Card Manager - Allows you to manipulate exam cards.

- Create, change, delete, or copy scan protocols. See **Edit Exam Card**.
- Change the exam card order. See **Change the exam protocol order**.

- Export protocols to another media type. See **Export or import exam cards**.

22.8 Dose check report

Dose Check Report displays the studies that prompted a Dose Notification or Dose Alert. See **Dose check** for details.

22.9 Bug reports

Allows you to save relevant information about a specific problem for remote analysis.

Click **Bug report** to open the bug report procedure. Follow the on-screen prompts.

22.10 Audit Trail

Allows you view the audit trail results in this interface.

See "**3.3.15 Audit Trail**" in **Technical Reference Guide** for more information.

22.11 Switch user

Allows you login as a different operator. Follow the on-screen prompts.

22.12 Exit console

Allows you to exit Incisive CT software.

22.13 Remote console

Remote Console is a utility used by the Philips Customer Support Specialist to remotely access your scanner application. Any remote session must be approved by the CT technologist before access is permitted. The Customer Support Specialist will inform you about any safety and privacy guidelines before the application is started.

Note

The Remote Console application must be enabled by Philips Service and your facility's IT department.

The Philips Customer Support Specialist will guide you through the process of starting the Remote Console application.

Note

If necessary, you can Click Disable or Stop to terminate the remote session.

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Philips Healthcare is part of Royal Philips

www.healthcare.philips.com
healthcare@philips.com

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Philips Healthcare (Suzhou) Co., Ltd.

Manufacturing address:

Philips Healthcare (Suzhou) Co., Ltd.
No. 258, ZhongYuan Road, Suzhou Industrial Park
215024 Suzhou, Jiangsu Province
PEOPLE'S REPUBLIC of CHINA

EC REP

Philips Medical Systems, Nederland B.V.
Veenpluis 6
5684 PC Best
The Netherlands

European importer

Philips Medical Systems
Nederland B.V.
High Tech Campus 52,
5656AG Eindhoven
The Netherlands

Copyright address:

Philips Medical Systems, Nederland B.V.
Veenpluis 6
5684 PC Best
The Netherlands

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