DISCLAIMER: TO THE EXTENT ALLOWED BY LOCAL LAW, THIS INFORMATION IS PROVIDED TO YOU BY THE AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, A NON-PROFIT ORGANIZATION ORGANIZED TO PROMOTE THE APPLICATION OF PHYSICS TO MEDICINE AND BIOLOGY, ENCOURAGE INTEREST AND TRAINING IN MEDICAL PHYSICS AND RELATED FIELDS ("AAPM"), 'AS IS' WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, WHETHER ORAL OR WRITTEN, EXPRESS OR IMPLIED. AAPM SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY, SATISFACTORY QUALITY, NONINFRINGEMENT AND FITNESS FOR A PARTICULAR PURPOSE. SOME JURISDICTIONS DO NOT ALLOW EXCLUSIONS OF IMPLIED WARRANTIES OR CONDITIONS, SO THE ABOVE EXCLUSION MAY NOT APPLY TO YOU. YOU MAY HAVE OTHER RIGHTS THAT VARY ACCORDING TO LOCAL LAW.

TO THE EXTENT ALLOWED BY LOCAL LAW, IN NO EVENT WILL AAPM OR ITS SUBSIDIARIES, AFFILIATES OR VENDORS BE LIABLE FOR DIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR OTHER DAMAGES (INCLUDING LOST PROFIT, LOST DATA, OR DOWNTIME COSTS), ARISING OUT OF THE USE, INABILITY TO USE, OR THE RESULTS OF USE OF THE PROVIDED INFORMATION, WHETHER BASED IN WARRANTY, CONTRACT, TORT OR OTHER LEGAL THEORY, AND WHETHER OR NOT ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. YOUR USE OF THE INFORMATION IS ENTIRELY AT YOUR OWN RISK. THIS INFORMATION IS NOT MEANT TO BE USED AS A SUBSTITUTE FOR THE REVIEW OF SCAN PROTOCOL PARAMETERS BY A QUALIFIED AND CERTIFIED PROFESSIONAL. USERS ARE CAUTIONED TO SEEK THE ADVICE OF A QUALIFIED AND CERTIFIED PROFESSIONAL BEFORE USING ANY PROTOCOL BASED ON THE PROVIDED INFORMATION. AAPM IS NOT RESPONSIBLE FOR A USER'S FAILURE TO VERIFY OR CONFIRM APPROPRIATE PERFORMANCE OF THE PROVIDED SCAN PARAMETERS. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF LIABILITY FOR DAMAGES, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

The disclaimer on page 1 is an integral part of this document.

LUNG CANCER SCREENING CT

NOTE: The Lung Cancer Screening Protocols described in this document are a set of reasonable protocols developed by the AAPM's Working Group on Standardization of CT Nomenclature and Protocols that are to be used in the specific context of Lung Cancer Screening. These protocols were based in part on manufacturers' Low Dose Chest protocols but were adapted based on the Working Group's experience with the National Lung Screening Trial and other screening studies.

The primary goal of lung cancer screening CT is to detect abnormalities that may represent lung cancer and may require further diagnostic evaluation. In addition, examinations should be reviewed for other abnormalities in accordance with the ACR–SCBT-MR–SPR-STR Practice Parameter for the Performance of Thoracic Computed Tomography (CT).

This document is ONLY meant to describe the technical elements of a lung cancer screening CT exam. **It is NOT intended to be a comprehensive description of the elements of a screening program (e.g. who should and should not be screened, the patient management process for following up a positive screen test)**. Some examples of guidance in such a program are the ACR–STR Practice Parameter for the Performance and Reporting of Lung Cancer Screening Thoracic Computed Tomography (CT), the USPSTF recommendations and the CMS Decision Memo on Lung Cancer Screening; these provide information on eligibility criteria, exam specifications, interpretation and reporting of these exams. Additional resources are available on the ACR Lung Cancer Screening Resources webpage.

Indications For individuals with no known signs or symptoms of lung cancer that have appropriate risk factors, such as those recommended by professional societies and health care organizations. See the ACR Lung Cancer Screening Resources webpage for more information.

Diagnostic Tasks (include but are not limited to)

- The primary goal of lung cancer screening CT is to detect abnormalities that may represent lung cancer and may require further diagnostic evaluation.
- Therefore, the primary task is to detect nodules or masses, and characterize their size, shape and relationships to organs;

Key Elements

- One breath-hold (thoracic motion is problematic);
- Thin image thicknesses (≤2.5 mm, ≤1.0 mm preferred); reconstruction of coronal and sagittal reformations as well as MIPS may be helpful and are encouraged.
- CTDIvol ≤ 3.0 mGy for a standard sized patient (see table), with adjustments made for smaller and larger patients.
- This typically requires a 16 detector row (or greater) scanner to meet these requirements.

Contrast

- **These studies are *performed without any contrast*:**
- **Oral**: None.
- **Injected**: None.

Patient Positioning

- Center the patient within the gantry; this is critical for proper functioning of AEC systems.

- Patient supine, arms above head;

Scan Range

- From top of lungs through the bottom of lungs.

Suspension of Respiration

- Patient should be instructed to hold his/her breath at end of inspiration during entire scan.

Additional Image Reconstructions

- Coronal and sagittal planar MPRs as well as axial MIPS may be helpful and are encouraged.
- Very thin images (approximately ≤ 1 mm) may need to be reconstructed to serve as source images for the sagittal and/or coronal reformatted images.
- Creation, use, and archival of these additional images are at the discretion of the supervising radiologist and/or departmental policy. Very large datasets may result from these additional reconstructions.

Radiation Dose Management

- **CTDIvol must be ≤ 3.0 mGy** for a standard sized patient, as measured using the 32-cm diameter CTDI phantom. By definition, a standard sized patient is approximately 5'7" and 155 pounds or 170 cm and 70 kg, with a BMI ≈ 24.
- **Some form of scanner output adjustment for patient size must be used**. This adjustment may be accomplished through **either**:
    - Use of **automatic methods,** such as automatic exposure control (AEC) and/or automatic kV selection
    - Use of a **manual technique chart** that prescribes different tube current and/or kV values as a function of patient size.
        - Examples of manual adjustment may include (but are not limited to):
            - Reducing the mAs for small patients (defined below) by 50%
            - Increasing the mAs for large patients (defined below) by 50-100%
    - Either technique (automatic or manual) can be used effectively, but the automatic methods will adjust the CT scanner output based on the patient size (as measured on the CT localizer radiograph).
    - IT SHOULD BE NOTED that in this version, there are two sets of protocols provided for GE scanners:
        - One with automatic methods (smartmA)
        - One with manual methods (fixed tube current scans, but with mA values that can be adjusted to account for patient size).

- When AEC is used, careful attention must be paid to the values selected to define the desired level of image quality (e.g., Noise Index, Quality Reference mAs, Standard Deviation, Dose Right Index).
- Each manufacturer may have recommendations unique to their systems and system features. Be sure to work with your CT equipment manufacturer and a qualified medical physicist to ensure safe and appropriate operation of AEC systems.
- If more than one CT localizer radiograph is acquired, AEC systems from different manufacturers can differ with respect to which one is used to determine mA and/or kV settings. Please refer to individual manufacturer protocol instructions.

- AEC systems also may differ in response when the prescribed scan range extends beyond the boundaries of the CT localizer radiograph; please consult the user manual to identify how the AEC system will respond when this occurs.

Effective Dose

Effective dose is defined in ICRP 103 as a population dose metric and should not be used to estimate dose or risk to an individual. From a *screening population* point of view, one method to estimate the effective dose is to calculate the Dose Length Product (DLP) and then apply a conversion factor described in AAPM TG Report 96 to estimate the effective dose. For an idealized standard sized patient (defined above) and a 25 cm scan length, and using the k factor of 0.014 mSv/mGy*cm; these protocols should result in an effective dose below 1 mSv (see table below).

Dose values for an idealized standard sized patient (NOT for any individual)

Dose Descriptor	Value	Reported at Scanner (Y/N)
CTDIvol*	≤ 3.0 mGy	Y
DLP*	≤ 75 mGy*cm	Y
Effective Dose (DLP x .014)**	≤ 1.0 mSv	N**

* The CTDIvol and DLP values in this table are for an idealized patient only; individual patients may have higher or lower values to reflect adjustment for patient size.

** Effective Dose is calculated for a population and should NOT be reported for an individual

CTDI measurements and calculations

- Some manufacturers utilize a z-axis “flying focal spot”, in which two unique projections are acquired at the same z-axis table position. When this technique is used, we identify it with ******. The CTDIvol on the console accurately accounts for use of this feature.

Approximate Volume CT Dose Index (CTDIvol) Values

- Approximate values for CTDIvol are listed for three different patient sizes:

	Approx. Weight (kg)	Approx. Weight (lbs)	Approx. CTDIvol (mGy)
Small Patient	50-70	110-155	0.25 - 2.8
Average Patient	70-90	155-200	0.5 - 4.3
Large Patient	90-120	200-265	1.0 – 5.6

The approximate CTDIvol values are for reference only and represent a dose to the 32-cm diameter CTDI phantom under very specific conditions. The CTDIvol displayed on the scanner for a patient of a given size should be similar, but not necessarily an exact match, to those listed in the above table.

It is essential that users recognize that, when using automatic exposure control, the CTDIvol values reported on the user console prior to acquiring CT localizer radiographs on a particular patient do not represent the CTDIvol that will be delivered during that patient’s scan. CT systems rely on the CT localizer radiograph to 1) estimate the patient’s size, 2) determine the tube current settings for each tube angle and table position that will yield the requested level of image quality, and 3) calculate the average CTDIvol for the patient over the prescribed scan range. Until the CT localizer radiograph is acquired, the reported CTDIvol is not patient-specific, but is based on a generic patient size.

The CTDIvol values provided here are approximate and are intended only to provide reference ranges for the user to consider.

In this document, a small patient is approximately 50-70 kg (110-155 lbs), an average patient approximately 70-90 kg (155-200 lbs), and a large patient 90-120 kg (200-265 lbs). However, weight is not a perfect indication of patient size. A person's height, gender, and distribution of weight across the body also must be taken into account. The thickness of the body over the area to be scanned is the best indication of patient size. Body mass index (BMI) may also be considered:

- Underweight = BMI <18.5
- Normal weight = BMI of 18.5–24.9
- Overweight = BMI of 25–29.9
- Obesity = BMI of 30 or greater

It is recognized that the median (50th percentile) patient size for adults in the USA is larger than 70 kg. However, the 70 kg patient represents the "Reference Man", as defined by the International Commission on Radiation Protection (ICRP), upon which AEC systems and tissue weighting factors (used for effective dose estimation) are based.

References

ACR–STR Practice Parameter for the Performance and Reporting of Lung Cancer Screening Thoracic Computed Tomography (CT). Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CT-LungCaScr.pdf?la=en

United States Preventive Services Task Force (USPSTF) Recommendations on Lung Cancer Screening using Low Dose CT. Available at: http://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/lung-cancer-screening

CMS (Medicare) Decision Memo for Screening for Lung Cancer with Low Dose Computed Tomography (LDCT) (CAG-00439N) http://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=274

ACR Lung Cancer Screening Resources. Available at: http://www.acr.org/Quality-Safety/Resources/Lung-Imaging-Resources

ICRP Report 103
International Commission on Radiological Protection, "The 2007 Recommendations of the International Commission on Radiological Protection," *ICRP Publication 103* International Commission on Radiological Protection, Essen, 2007.

AAPM TG Report 96:
American Association of Physicists in Medicine, "The Measurement, Reporting and Management of Radiation Dose in CT: Report of AAPM Task Group 23". ISBN: 9781888340730 http://www.aapm.org/pubs/reports/RPT_96.pdf

INDEX OF LUNG CANCER SCREENING PROTOCOLS (by manufacturer)

Lung Cancer Screening CT (selected Canon scanners)

(Back to INDEX)

Scanogram: PA and LAT dual Scanogram; scan from top of shoulder through mid-liver.

CANON	Aq RXL	Aq Lightning (16 Rows)	Aq Lightning (80 Rows)	Aq PRIME (40 Rows)	Aq PRIME (80 Rows)
Scan Type	Helical	Helical	Helical	Helical	Helical
Rotation Time (s)	0.5	0.75	0.75	0.35	0.35
Detector Configuration	16 x 0.5 mm	16 x 1.0 mm	80 x 0.5 (mm)	40 x 0.5 mm	80 x 0.5 mm
Pitch	Fast (1.434)	Fast (1.438)	Standard (0.813)	Standard (0.825)	Standard (0.813)
kV	120	120	120	120	120
Minimum & Maximum mA	Min mA = 20 / Max mA = 110	Min mA = 10 / Max mA = 300	Min mA = 10 / Max mA = 300	Min mA = 20 / Max mA = 120	Min mA = 20 / Max mA = 120
SUREIQ Setting	Body Std Axial (5 mm Target Slice)	Body Std Axial (5 mm Target Slice)	Body Std Axial (5 mm Target Slice)	Body Std Axial (5 mm Target Slice)	Body Std Axial (5 mm Target Slice)
SUREExposure	ON	ON	ON	ON	ON
*SD	25*	20*	20*	25*	25*
**CTDIvol	1.8			1.8	1.8

* Create a new SureExp setting using Body Std Axial SureIQ with 5 mm Target Slice and the given SD, min and max mA values.
** For standard sized patient, defined as 5'7", 155 pounds. Do not adjust the SD as patient size varies. SureExposure modulates mA automatically based on patient size.

Recon 1 – Axial Soft Tissue

Type	Axial	Axial	Axial	Axial	Axial
SUREIQ Setting	Body Std Axial	Body Std Axial	Body Std Axial	Body Std Axial	Body Std Axial
AIDR 3D	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD
Thickness (mm)	1	1	1	1	1
Interval (mm)	1	1	1	1	1

Recon 2 – Axial Lung

Type	Axial	Axial	Axial	Axial	Axial
SUREIQ Setting	Lung Std Axial	Lung Std Axial	Lung Std Axial	Lung Std Axial	Lung Std Axial
AIDR 3D	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD
Thickness (mm)	1	1	1	1	1
Interval (mm)	1	1	1	1	1

Recon 3 – MPR Soft Tissue Volume***

Type	Volume***	Volume***	Volume***	Volume***	Volume***
SUREIQ Setting	Body Std Volume	Body Std Volume	Body Std Volume	Body Std Volume	Body Std Volume
AIDR 3D	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD
Thickness (mm)	0.5	1.0	0.5	0.5	0.5
Interval (mm)	0.3	0.8	0.3	0.3	0.3

*** Volume reconstructions are required in order to create Multiplanar reconstructions.

	Approx. Weight (kg)	Approx. Weight (lbs)	Approx. CTDIvol (mGy)
Small Patient	50-70	110-155	0.25 -1.7
Avg. Patient	70-90	155-200	0.5- 2.7
Large Patient	90-120	200-265	1.0 -3.4

Lung Cancer Screening CT (selected Canon scanners)

(Back to INDEX)

Scanogram: PA and LAT dual Scanogram; scan from top of shoulder through mid-liver.

CANON	Aq ONE/Premium	Aq ONE Vision	Aq ONE Genesis (160 row)	Aq ONE Genesis (320 row)
Scan Type	Helical	Helical	Helical	Helical
Rotation Time (s)	0.35	0.275	0.35	0.275
Detector Configuration	80 x 0.5 mm	80 x 0.5 mm	80 x 0.5 mm	80 x 0.5 mm
Pitch	Standard (0.813)	Standard (0.813)	Standard (0.813)	Standard (0.813)
kV	120	120	120	120
Minimum & Maximum mA	Min mA = 20 / Max mA = 120	Min mA = 20 / Max mA = 150	Min mA = 20 / Max mA = 600	Min mA = 20 / Max mA = 700
SUREIQ Setting	Body Std Axial (5 mm Target Slice)	Body Std Axial (5 mm Target Slice)	Body Std Axial (5 mm Target Slice)	Body Std Axial (5 mm Target Slice)
SUREExposure	ON	ON	ON	ON
***SD**	25*	25*	20*	20*
****CTDIvol**	1.7	1.6		

* Create a new SureExp setting using Body Std Axial SureIQ with 5 mm Target Slice and the given SD, min and max mA values.
** For standard sized patient, defined as 5'7", 155 pounds. Do not adjust the SD as patient size varies. SureExposure modulates mA automatically based on patient size.

Recon 1 – Axial Soft Tissue

Type	Axial	Axial	Axial	Axial
SUREIQ Setting	Body Std Axial	Body Std Axial	Body Std Axial	Body Std Axial
AIDR 3D	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD
Thickness (mm)	1	1	1	1
Interval (mm)	1	1	1	1

Recon 2 – Axial Lung

Type	Axial	Axial	Axial	Axial
SUREIQ Setting	Lung Std Axial	Lung Std Axial	Lung Std Axial	Lung Std Axial
AIDR 3D	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD
Thickness (mm)	1	1	1	1
Interval (mm)	1	1	1	1

Recon 3 – MPR Soft Tissue Volume***

Type	Volume***	Volume***	Volume***	Volume***
SUREIQ Setting	Body Std Volume	Body Std Volume	Body Std Volume	Body Std Volume
AIDR 3D	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD	AIDR 3D STD
Thickness (mm)	0.5	0.5	0.5	0.5
Interval (mm)	0.3	0.3	0.3	0.3

*** Volume reconstructions are required in order to create Multiplanar reconstructions.

	Approx. Weight (kg)	Approx. Weight (lbs)	Approx. CTDIvol (mGy)
Small Patient	50-70	110-155	0.25 -1.7
Avg. Patient	70-90	155-200	0.5- 2.7
Large Patient	90-120	200-265	1.0 -3.4

LUNG CANCER SCREENING CT (selected FUJIFILM scanners)

(Back to INDEX)

SCANOGRAM: PA; scan from top of shoulder through mid-liver.

FUJIFILM	ECLOS 16	Supria 16/32	Supria 64	SCENARIA	SCENARIA View
Scan Type	Volume	Volume	Volume	Volume	Volume
Rotation Time (s)	0.8	0.75	0.75	0.5	0.5
Detector Collimation- T	1.25 mm	1.25 mm	0.625 mm	0.625 mm	0.625 mm
Number of Active Channels	16	16	64	64	64
Detector Configuration	1.25 x 16	1.25 x 16	0.625 x 64	0.625 x 64	0.625 x 64
Pitch	1.31	1.31	0.83	0.83	0.83
Speed (mm/rot)	26.25	26.25	33.13	33.13	33.13
kV*	120	120	120	120	120
mA*	50	55	35	50	45
Adaptive mA/IntelliEC	No	No	No	No	No
SFOV	500	500	500	500	500
CTDIvol*	2.6	2.6	2.5	2.7	2.3
RECON 1					
Series Description	Lung	Lung	Lung	Lung	Lung
Type	Axial	Axial	Axial	Axial	Axial
Filter	21 Lung	21 Lung	21 Lung	21 Lung	IPV - H Lung LV2
Thickness (mm)	1.25	1.25	1	1	1
Interval (mm)	0.625	0.625	0.5	0.5	0.5
RECON 2					
Series Description	Soft Tissue	Soft tissue	Soft Tissue	Soft Tissue	Soft Tissue
Type	Axial	Axial	Axial	Axial	Axial
Filter	31 Abdomen	31 Abdomen	31 Abdomen	31 Abdomen	IPV Abd STD LV2
Thickness (mm)	1.25	1.25	1	1	1
Interval (mm)	0.625	0.625	0.5	0.5	0.5

* For standard sized patient, defined as 5'7", 155 pounds. For small patients, mA may be reduced by as much as 50%; for large patients, mA may be increased by 50-100%.

	Approx. Weight (kg)	Approx. Weight (lbs)	mA	Approx. CTDIvol (mGy)
Small Patient	50-70	110-155	25-50	1.3-2.7
Avg. Patient	70-90	155-200	50-75	2.6-4.1
Large Patient	90-120	200-265	75-100	3.9-5.4

LUNG CANCER SCREENING CT (Selected GE scanners) with AEC (smartmA) on (Back to INDEX)

SCOUT: AP S60-I400; from top of shoulder through mid-liver, if automatic exposure control is used. PA scout if manual mA is used.

	LightSpeed 16	BrigthSpeed 16	LightSpeed VCT	Optima 660
Scan Type	Helical	Helical	Helical	Helical
Rotation Time (s)	0.5	0.5	0.5	0.5
Beam Collimation (mm)	43758	20	40	40
Detector Configuration	16x0.625 / 16x1.25	16x1.25	64x0.625	64x0.625
Pitch	1.375	1.375	0.984	0.984
Speed (mm/rot)	13.75 / 27.50	27.5	39.36	39.36
kV	120	120	120	120
min mA	40	40	30	30
max mA	130	130	110	110
Noise Index (smart mA)[1]	34	29.5	34	20
SFOV	Large Body	Large Body	Large Body	Large Body
CTDIvol	2.6 / 2.4 mGy	2.4 mGy	2.2 mGy	2.2 mGy

RECON 1

Plane	Axial	Axial	Axial	Axial
Algorithm	Lung or Bone	Lung or Bone	Lung or Bone	Lung or Bone
Recon Mode	Full or Plus	Full or Plus	Full or Plus	Full or Plus
Thickness (mm)	2.5	2.5	2.5	2.5
Interval (mm)	1.25	1.25	1.25	1.25
ASiR/ASIR-V (if used)			70	70

RECON 2

Plane	***Axial DMPR	**Axial DMPR	**Axial DMPR	**Axial DMPR
Algorithm	Bone or Lung	Bone or Lung	Bone or Lung	Bone or Lung
Recon Mode	Full	Full	Full	Full
Thickness (mm)	0.625	0.625	0.625	0.625
Interval (mm)	0.625	0.625	0.625	0.625
ASiR/ASIR-V (if used)	50	50	50	50

[1] Noise Index value of 32 ONLY applies if the 2.5 mm reconstructed image thickness is selected as the first reconstruction; if other slice thicknesses (e.g. 0.625mm or 1.25 mm) are selected for the first reconstruction, then a different Noise Index value must be chosen in order to achieve the CTDIvol values described here; This is because the Noise Index value is related to the image thickness of the first reconstruction.

** These protocols use direct multi-planar reconstruction (DMPR) on Recon 2 to automatically create Sagittal and Coronal reformats. The user may select the thickness of the Sagittal and Coronal images to be 1.25 - 5mm.

***For LightSpeed 16/BrightSpeed 16 and depending on system configuration, DMPR could be used if available. If DMPR is not available, user will need to create Sag/Cor images manually in Reformat, using an image thickness of 1.25 - 5mm.

	Approx. Weight (kg)	Approx. Weight (lbs)	mA	Approx. CTDIvol (mGy)
Small Patient	50-70	110-155	25-50	0.9-2.3
Avg. Patient	70-90	155-200	50-75	1.8-3.6
Large Patient	90-120	200-265	75-100	2.7-4.6

LUNG CANCER SCREENING CT (Selected GE scanners) with AEC (smartmA) on (Back to INDEX)

SCOUT: AP S60-I400; from top of shoulder through mid-liver, if automatic exposure control is used. PA scout if manual mA is used.

	Revolution HD / Discovery CT 750	Revolution EVO	Revolution Frontier	Revolution CT
Scan Type	Helical	Helical	Helical	Helical
Rotation Time (s)	0.5	0.5	0.5	0.35
Beam Collimation (mm)	40	40	40	40
Detector Configuration	64x0.625	64x0.625	64x0.625	128x0.625
Pitch	1.375	1.375	1.375	0.992
Speed (mm/rot)	55	55	55	79.4
kV	120	120	120	120
min mA	20	20	20	20
max mA	290	290	290	290
Noise Index (smart mA)[1]	32	32	32	32
SFOV	Large Body	Large Body	Large Body	Large Body
CTDIvol	2.2 mGy	2.2 mGy	2.2 mGy	2.3mGy

RECON 1

Plane	Axial	Axial	Axial	Axial
Algorithm	Lung or Bone	Lung or Bone	Lung or Bone	Lung or Bone
Recon Mode	Full or Plus	Full or Plus	Full or Plus	Full or Plus
Thickness (mm)	5	5	5	5
Interval (mm)	3	3	3	3
ASiR/ASIR-V (if used)	30	30	30	10

RECON 1

Plane	Axial	Axial	Axial	Axial
Algorithm	Lung or Bone	Lung or Bone	Lung or Bone	Lung or Bone
Recon Mode	Full or Plus	Full or Plus	Full or Plus	Full or Plus
Thickness (mm)	1.25	1.25	1.25	1.25
Interval (mm)	0.625	0.625	0.625	0.625
ASiR/ASIR-V (if used)	30	30	30	10

RECON 3

Plane	**Axial DMPR	**Axial DMPR	**Axial DMPR	**Axial DMPR
Algorithm	Bone or Lung	Bone or Lung	Bone or Lung	Bone or Lung
Recon Mode	Full	Full	Full	Full
Thickness (mm)	0.625	0.625	0.625	0.625
Interval (mm)	0.625	0.625	0.625	0.625
ASiR/ASIR-V (if used)	50	50	50	50

[1] Noise Index values ONLY apply if the 5 mm reconstructed image thickness is selected as the first reconstruction; if other slice thicknesses (e.g. 0.625mm or 1.25 mm) are selected for the first reconstruction, then a different Noise Index value must be chosen in order to achieve the CTDIvol values described here; This is because the Noise Index value is related to the image thickness of the first reconstruction.

** These protocols use direct multi-planar reconstruction (DMPR) on Recon 3 to automatically create Sagittal and Coronal reformats. The user may select the thickness of the Sagittal and Coronal images to be 1.25 - 5mm.

	Approx. Weight (kg)	Approx. Weight (lbs)	mA	Approx. CTDIvol (mGy)
Small Patient	50-70	110-155	25-50	0.9-2.3
Avg. Patient	70-90	155-200	50-75	1.8-3.6
Large Patient	90-120	200-265	75-100	2.7-4.6

LUNG CANCER SCREENING CT (Selected GE scanners) with constant mA

(Back to INDEX)

SCOUT: AP S60-I400; scan from top of shoulder through mid-liver, if automatic exposure control is used.
PA scout if manual mA is used.

	LightSpeed 16 Brightspeed 16	Optima 660	LightSpeed VCT	Revolution HD Discovery 750 HD	Revolution EVO	Revolution Frontier	Revolution CT Revolution CT/ES
Scan Type	Helical	Helical	Helical	Helical	Helical	Helical	Helical
Rotation Time (s)	0.5	0.6	0.5	0.5	0.5	0.5	0.35
Beam Collimation (mm)	20-Oct	40	40	40	40	40	40
Detector Configuration	16x0.625/ 16x1.25	64x0.625	64x0.625	64x0.625	64x0.625	64x0.625	64x0.625
Pitch	1.375	1.375	0.984	0.984	0.984	0.984	0.984
Speed (mm/rot)	13.75/ 27.50	55	39.37	39.37	39.37	39.37	39.375
kV*	120	120	120	120	120	120	120
mA*	60	50	50	50	50	50	80
SFOV	Large Body	Large Body	Large Body	Large Body	Large Body	Large Body	Large Body
CTDIvol*	2.6/ 2.4 mGy	1.8 mGy	1.9 mGy	1.9 mGy	1.9 mGy	1.9 mGy	1.94 mGy

RECON 1

Plane	Axial	Axial	Axial	Axial	Axial	Axial	Axial
Algorithm	Bone or Lung	Bone or Lung	Bone or Lung	Bone or Lung	Bone or Lung	Bone or Lung	Bone or Lung
Recon Mode	Full	Full	Full	Full	Full	Full	Full
Thickness (mm)	1.25 or 2.5	1.25 or 2.5	1.25 or 2.5	1.25 or 2.5	1.25 or 2.5	1.25 or 2.5	1.25 or 2.5
Interval (mm) ≤ slice width	1.25 or 2.5	1.25 or 2.5	1.25 or 2.5	1.25 or 2.5	1.25 or 2.5	1.25 or 2.5	1.25 or 2.5
ASIR/ ASIR-V (if used)	50	50	50	50	50	50	50

RECON 2

Plane	***Axial DMPR	**Axial DMPR	**Axial DMPR	**Axial DMPR	**Axial DMPR	**Axial DMPR	**Axial DMPR
Algorithm	Bone or Lung	Bone or Lung	Bone or Lung	Bone or Lung	Bone or Lung	Bone or Lung	Bone or Lung
Recon Mode	Full	Full	Full	Full	Full	Full	Full
Thickness (mm)	0.625	0.625	0.625	0.625	0.625	0.625	0.625
Interval (mm)	0.625	0.625	0.625	0.625	0.625	0.625	0.625
ASIR/ ASIR-V (if used)	50	50	50	50	50	50	50

* For standard sized patient, defined as 5'7", 155 pounds. For small patients, mA may be reduced by as much as 50%; for large patients, mA may be increased by 50-100%.
** These protocols use direct multi-planar reconstruction (DMPR) on Recon 2 to automatically create Sagittal and Coronal reformats. The user may select the thickness of the Sagittal and Coronal images to be 1.25 - 5mm.
***For LightSpeed 16/BrightSpeed 16 and depending on system configuration, DMPR could be used if available. If DMPR is not available, user will need to create Sag/Cor images manually in Reformat, using an image thickness of 1.25 - 5mm.

	Approx. Weight (kg)	Approx. Weight (lbs)	mA	Approx. CTDIvol (mGy)
Small Patient	50-70	110-155	25-50	0.9-2.3
Avg. Patient	70-90	155-200	50-75	1.8-3.6
Large Patient	90-120	200-265	75-100	2.7-4.6

LUNG CANCER SCREENING CT (selected NEUSOFT scanners)

(Back to INDEX)

SCOUT: PA, scan from top of shoulder through mid-liver. Adjust Displayed FOV to 1 cm beyond the rib cage.

NEUSOFT	NeuViz 16	NeuViz 16	NeuViz64I NeuViz64IN NeuViz64E NeuViz 64EN	NeuViz64I NeuViz64IN NeuViz64E NeuViz 64EN	NeuViz128	NeuViz128
Scan Type	Helical	Helical	Helical	Helical	Helical	Helical
Patient size	AVERAGE	LARGE	AVERAGE	Large	AVERAGE	Large
Rotation Time (s)	0.6	0.6	0.5	0.5	0.5	0.5
Collimation	16 x 1.5	16 x 1.5	64 x 0.625*	64 x 0.625*	128*0.625*	128*0.625*
kVp	120	140	120	120	120	120
Reference mAs	35	35	45	85	45	85
Pitch	1.2	1.2	1.2	1.2	1.2	1.2
Displayed FOV(mm)	300	350	300	350	300	350
Resolution	Standard	Standard	Standard	Standard	Standard	Standard
Dose Modulation	ACS & DOM	ACS & DOM	O-DOSE	O-DOSE	O-DOSE	O-DOSE
ClearView	N/A	N/A	20%	30%	20%	30%
SNR Level	N/A	N/A	1	1	1	1
Reference Phantom Size	33cm	40cm	33cm	40cm	33cm	40cm
CTDIvol*	2.8*mGy	4.3**mGy	3.0*mGy	5.6**mGy	3.0	**5.6
RECON 1			**Thin Lung**			
Type	Axial	Axial	Axial	Axial	Axial	Axial
Filter	Lung B	Lung B	Lung20	Lung20	Lung20	Lung20
Thickness (mm)	1.5	1.5	1	1	1	1
Increment (mm)	0.75	0.75	0.5	0.5	0.5	0.5
ClearView	N/A	N/A	20%	30%	20%	30%
RECON 2			**Thin Mediastinum**			
Type	Axial	Axial	Axial	Axial	Axial	Axial
Filter	SB	SB	F20	F20	F20	F20
Thickness (mm)	1.5	1.5	1	1	1	1
Increment (mm)	0.75	0.75	0.5	0.5	0.5	0.5
ClearView	N/A	N/A	20%	30%	20%	30%

* For standard sized patient, defined as 5'7", 155 pounds.
** Technique exceeds 3.0 mGy due to large body habitus
*** Indicates that a z-axis "flying focal spot" technique is used to obtain twice as many projections per rotation

	Approx. Weight (kg)	Approx. Weight (lbs)	Approx. CTDIvol (mGy)
Small Patient	50-70	110-155	1.0-2.8
Avg. Patient	70-90	155-200	1.9-4.3
Large Patient	90-120	200-265	3.3-5.6

Lung Cancer Screening CT (selected PHILIPS scanners)

(Back to INDEX)

SURVIEW: PA; scan from top of shoulder through mid-liver.

PHILIPS	Brilliance 16 slice	Brilliance 64 slice	Ingenuity CT	Ingenuity CT w/iPatient
Scan Type	Helical	Helical	Helical	Helical
Rotation Time (s)	0.5	0.5	0.4	0.4
Collimation	16 × 1.5 mm	64 × 0.625 mm	64 × 0.625 mm	64 × 0.625 mm
Coverage (mm)	24	40	40	40
kV	120	120	120	120
DRI / (mAs/slice)*	DoseRight 26 mAs/slice	DoseRight 26 mAs/slice	DoseRight 26 mAs/slice	DoseRight DRI = 6
Tube current modulation	ZDOM	ZDOM	ZDOM	3D Modulation
Pitch	1.0	1.0	1.1	1.1
CTDIvol**	1.8 mGy	1.7 mGy	1.7 mGy	1.7 mGy
RECON 1 – Lung				
Type	Axial	Axial	Axial	Axial
Filter	YA	YA	YA	YA
Thickness (mm)	2	1	1	1
Increment (mm)	1	0.5	0.5	0.5
Matrix	768^2	768^2	768^2	768^2
iDose^4 Level	5	5	5	5
RECON 2 – Soft tissue				
Type	Axial	Axial	Axial	Axial
Filter	A	A	A	A
Thickness (mm)	3	3	3	3
Increment (mm)	1.5	1.5	1.5	1.5
Matrix	512^2	512^2	512^2	512^2
iDose^4 Level	5	5	5	5

*Dose Right Index (DRI) is available on scanner models with the iPatient interface.

** For standard sized patient, defined as 5'7", 155 pounds.

	Approx. Weight (kg)	Approx. Weight (lbs)	Approx. CTDIvol (mGy)
Small Patient	50-70	110-155	0.9-1.8
Avg. Patient	70-90	155-200	1.7-2.7
Large Patient	90-120	200-265	2.7-3.6

Lung Cancer Screening CT (selected PHILIPS scanners)

(Back to INDEX)

SURVIEW: PA; scan from top of shoulder through mid-liver.

PHILIPS	Brilliance iCT SP	Brilliance iCT SP w/ iPatient	Brilliance iCT	Brilliance iCT w/ iPatient	IQon Spectral CT
Scan Type	Helical	Helical	Helical	Helical	Helical
Rotation Time (s)	0.4	0.4	0.4	0.4	0.4
Collimation	64 × 0.625 mm	64 × 0.625 mm	128 × 0.625 mm	128 × 0.625 mm	64 × 0.625 mm
Coverage (mm)	40	40	80	80	40
kV	120	120	120	120	120
DRI / (mAs/slice)*	DoseRight 23 mAs/slice	DoseRight DRI = 5	DoseRight 23 mAs/slice	DoseRight DRI = 5	DoseRight DRI = 5
Tube current modulation	ZDOM	3D Modulation	ZDOM	3D Modulation	3D Modulation
Pitch	1.0	1.0	0.9	0.9	1.0
CTDIvol**	1.7 mGy	1.7 mGy	1.6 mGy	1.6 mGy	1.7 mGy
RECON 1 - Lung					
Type	Axial	Axial	Axial	Axial	Axial
Filter	YA	YA	YA	YA	YA
Thickness (mm)	1	1	1	1	1
Increment (mm)	0.5	0.5	0.5	0.5	0.5
Matrix	768^2	768^2	768^2	768^2	768^2
iDose^4 Level	5	5	5	5	5
RECON 2 – Soft tissue					
Type	Axial	Axial	Axial	Axial	Axial
Filter	A	A	A	A	A
Thickness (mm)	3	3	3	3	3
Increment (mm)	1.5	1.5	1.5	1.5	1.5
Matrix	512^2	512^2	512^2	512^2	512^2
iDose^4 Level	5	5	5	5	5

*Dose Right Index (DRI) is available on scanner models with the iPatient interface.

** For standard sized patient, defined as 5'7", 155 pounds.

	Approx. Weight (kg)	Approx. Weight (lbs)	Approx. CTDIvol (mGy)
Small Patient	50-70	110-155	0.8-1.7
Avg. Patient	70-90	155-200	1.6-2.6
Large Patient	90-120	200-265	2.4-3.4

LUNG CANCER SCREENING CT (selected SIEMENS scanners)

(Back to INDEX)

TOPOGRAM: PA; scan from top of shoulder through mid-liver.

SIEMENS	Emotion 16	Perspective 64	Sensation 64
Software version	VC40	VC40	VB42
Scan Mode	Spiral	Spiral	Spiral
Rotation Time (s)	0.6	0.6	0.5
Detector Configuration	16 x 0.6 mm	*64 x 0.6 mm (32x0.6 mm = 19.2 mm)	*64 × 0.6 mm (32x0.6 mm = 19.2 mm)
Pitch	1.5	1.5	1.4
kV	110	110	120
Quality ref. mAs	20	20	20
CARE Dose4D	ON	ON	OFF
CARE kV	NA	NA	OFF
CTDIvol***	1.5 mGy	1.5 mGy	1.5 mGy

RECON 1

Type	Axial	Axial	Axial
Kernel, IR	B41s	B41s I41, strength = 2**	B31f
Slice (mm)	1.0	1.0	1.0
Increment (mm)	0.7	0.7	0.7

RECON 2

Type	Axial	Axial	Axial MIP
Kernel, IR	B70s	B70s I80, strength = 2**	B70f
Slice (mm)	1.0	1.0	1.0
Increment (mm)	0.7	0.7	0.7

*Indicates that a z-axis “flying focal spot” technique is used to obtain twice as many projections per rotation as detector rows. Or it refers to IVR (Interleaved Volume Reconstruction).
**With Iterative Reconstruction (IRIS).
***For standard sized patient, defined as 5’7”, 155 pounds. Do not adjust the Quality Reference mAs as patient size varies.

	Approx. Weight (kg)	Approx. Weight (lbs)	Approx. CTDIvol (mGy)
Small Patient	50-70	110-155	0.8-2.5
Avg. Patient	70-90	155-200	1.6-3.8
Large Patient	90-120	200-265	2.4-5.0

LUNG CANCER SCREENING CT (selected SIEMENS scanners, continued)

(Back to INDEX)

TOPOGRAM: PA; scan from top of shoulder through mid-liver.

SIEMENS	Somatom go.Now / go.Up	Somatom go.All / go.Top	Somatom go.OpenPro/go.Sim	Somatom x.Cite	Somatom x.Ceed
Software	VA40	VA40	VA40	VA40	VA40
Scan Mode	Spiral	Spiral	Spiral	Spiral	Spiral
Rotation Time (s)	0.8	0.33	0.35	0.3	0.3
Detector Configuration	16 × 0.7 mm/ 32 × 0.7 mm	32 × 0.7 mm/ 64 × 0.6 mm	32 × 0.6 mm/ 64 × 0.6 mm	64 x 0.6 mm	64 x 0.6 mm
Pitch	0.8	0.8	0.8	0.6	0.6
kV	Sn110****	Sn100****	Sn100****	Sn100****	Sn100****
CARE Dose4D &CARE kV	Full	Full	Full	Full	Full
CARE/FAST kV IQ level	15	15	15	15	15
Quality ref. mAs	62	108/179	130/224	114	115
CTDIvol***	1.0 mGy / 0.9 mGy	1.0 mGy / 0.9 mGy	1.0 mGy / 0.8 mGy	1.0 mGy	1.0 mGy

RECON 1

Type	Cor/Sag/Ax. MPR	Cor/Sag/Ax. MPR	Cor/Sag/Ax. MPR	Cor/Sag/Ax. MPR	Cor/Sag/Ax. MPR
Kernel, IR	Br40, strength = 3**	Br40, strength = 3**	Br40, strength = 3**	Br40, strength = 3**	Br40, strength = 3**
Slice (mm)	1.0	1.0	1.0	1.0	1.0
Increment (mm)	0.7	0.7	0.7	0.7	0.7

RECON 2

Type	Cor/Sag/ Ax. MPR Thin	Cor/Sag/ Ax. MIP Thin	Cor/Sag/ Ax. MIP Thin	Cor/Sag/ Ax. MIP Thin	Cor/Sag/ Ax. MIP Thin
Kernel, IR	Br60, strength = 3**	Br60, strength = 3**	Br60, strength = 3**	Br60, strength = 3**	Br60, strength = 3**
Slice (mm)	1.0	1.0	1.0	1.0	1.0
Increment (mm)	0.7	0.7	0.7	0.7	0.7

* Indicates that a z-axis “flying focal spot” technique is used to obtain twice as many projections per rotation as detector rows. This is referred to as IVR (Interleaved Volume Reconstruction) on the Perspective system.
** With Iterative Reconstruction (SAFIRE or ADMIRE)
*** For standard sized patient, defined as 5’7”, 155 pounds. Do not adjust the Quality Reference mAs as patient size varies. CAREDose4D adjusts for patient size automatically.
**** Can be operated with tin (Sn) filtration. This removes lower energy photons and hence a higher Quality ref. mAs is required. The Sn filter thickness is different on the systems, therefore Quality ref. mAs is different too.

LUNG CANCER SCREENING CT (selected SIEMENS scanners, continued)

(Back to INDEX)

TOPOGRAM: PA; scan from top of shoulder through mid-liver.

SIEMENS	Definition EdgePlus (128 slice)	Somatom Drive (Dual source 128-slice)	Definition Flash (Dual source 128-slice)	Definition Force (Dual source 192-slice)
Software version	VB20	VB20	VB20	VB20
Scan Mode	Spiral	Spiral	Spiral	Spiral
Rotation Time (s)	0.5	0.5	0.5	0.5
Detector Configuration	*128 × 0.6 mm (64 x 0.6 mm = 38.4 mm)	*128 × 0.6 mm (64 x 0.6 mm = 38.4 mm)	*128 × 0.6 mm (64 x 0.6 mm = 38.4 mm)	*192 × 0.6 mm (96 x 0.6 mm = 57.6 mm)
Pitch	1.2	1.2	1.2	1.2
kV	Sn100****	Sn100****	120	Sn100****
Quality ref. mAs	160	81	20	101
CARE Dose4D	ON	ON	ON	ON
CARE kV	ON	ON	ON	ON
CTDIvol***	0.6 mGy	0.6mGy	1.3 mGy	0.4 mGy

RECON 1

Type	Axial	Axial	Axial	Axial
Kernel, IR	Bf37, strength =3**	Bf37, strength = 3**	Bf37, strength = 3**	Br40, strength = 3**
Slice (mm)	1.0	1.0	1.0	1.0
Increment (mm)	0.7	0.7	0.7	0.7

RECON 2

Type	Axial	Axial	Axial	Axial
Kernel, IR	Bl57, strength =3**	Br59, strength = 3**	Br59, strength = 3**	Br64, strength = 3**
Slice (mm)	1.0	1.0	1.0	1.0
Increment (mm)	0.7	0.7	0.7	0.7

* Indicates that a z-axis “flying focal spot” technique is used to obtain twice as many projections per rotation as detector rows. This is referred to as IVR (Interleaved Volume Reconstruction) on the Perspective system.
** With Iterative Reconstruction (SAFIRE or ADMIRE)
*** For standard sized patient, defined as 5’7”, 155 pounds. Do not adjust the Quality Reference mAs as patient size varies. CAREDose4D adjusts for patient size automatically.
**** Can be operated with tin (Sn) filtration. This removes lower energy photons and hence a higher Quality ref. mAs is required. The Sn filter thickness is different on the systems, therefore Quality ref. mAs is different too.

LUNG CANCER SCREENING CT (selected United Imaging scanners)

(Back to INDEX)

TOPOGRAM: PA; scan from top of shoulder through mid-liver.

United Imaging	uCT530-20	**uCT530-40**	**uCT550-40**	**uCT550-80**	**uCT760**	**uCT780**	**uCT Atlas**
Scan Type	Helical	Helical	Helical	Helical	Helical	Helical	Helical
Rotation Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Collimation	20 x 1.1mm	40 x 0.55mm	40 x 0.55mm	40 x 0.55mm*	80 x 0.5mm@	80 x 0.5mm@	160 x 0.5mm*
Coverage (mm)	22	22	22	22	40	40	80
KV	120	120	120	120	120	120	120
mAs	25	25	25	25	25	25	25
Tube Current Modulation	static	static	static	static	static	static	static
Pitch	0.95	0.975	0.975	0.975	0.9875	0.9875	0.9937
SFOV (mm)	500	500	500	500	500	500	420
CTDIvol**	2.10	2.10	2.10	2.10	2.11	2.11	1.74
DLP	67.70	66.71	67.80	67.89	71.75	71.75	66.30
RECON 1							
Type	Axial	Axial	Axial	Axial	Axial	Axial	Axial
Window	Soft Tissue	Soft Tissue	Soft Tissue	Soft Tissue	Soft Tissue	Soft Tissue	Soft Tissue
Filter	B_Soft_B	B_Soft_B	B_Soft_B	B_Soft_B	B_Soft_B	B_Soft_B	B_Soft_B
Enhancement	0	0	0	0	0	0	0
Thickness	2	2	2	2	2	2	2
Increment	2	2	2	2	2	2	2
Matrix	512 x 512	512 x 512	512 x 512	512 x 512	512 x 512	512 x 512	512 x 512
Karl Level	5	5	5	5	5	5	5
RECON 2							
Type	Axial	Axial	Axial	Axial	Axial	Axial	Axial
Window	Lung	Lung	Lung	Lung	Lung	Lung	Lung
Filter	B_Sharp_C	B_Sharp_C	B_Sharp_C	B_Sharp_C	B_Sharp_C	B_Sharp_C	B_Sharp_C
Enhancement	2	2	2	2	2	2	2
Thickness	2	2	2	2	2	2	2
Increment	2	2	2	2	2	2	2
Matrix	768 x 768	768 x 768	768 x 768	768 x 768	768 x 768	768 x 768	768 x 768
Karl Level	0	0	0	0	0	0	0

* Indicates that a z-axis "flying focal spot" technique is used to obtain twice as many projections per rotation
** Indicates for a standard sized patient, defined as 5'7", 155 pounds
*** Effective Dose is calculated for a population and should NOT be reported for an individual
@ Indicates that the system uses an overlap reconstruction algorithm