LANDAUER MEDICAL PHYSICS
POWERFUL PARTNERSHIPS ADVANCING IMAGING AND THERAPY

Understanding IAC CT Accreditation

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Senior Vice President, Imaging Physics
LANDAUER Medical Physics

Disclosures

- Serve as one of two AAPM representatives to IAC CT Board of Directors,
- Serve as IAC representative to AAPM for focus group on accreditations
- Provide 3-hour online course on CT Radiation Safety, for users of CBCT

Outline

- Who is IAC and why do they accredit CT?
- IAC CT Standards and Guidelines
- Review of CBCT Principles
- Medical Physics Measurements for CBCT Systems – Medical and Dental
- IAC Accreditation Requirements and Process
- Summary and Conclusion

Learning Objectives

- Review the IAC CT Accreditation program and typical facilities seeking accreditation
- Review relevant Medical Physics processes and responsibilities unique to IAC CT Accreditation
- Review common problems with medical physics reports submitted to IAC CT Accreditation
- Review the process of applying for IAC CT Accreditation

Who is the IAC?

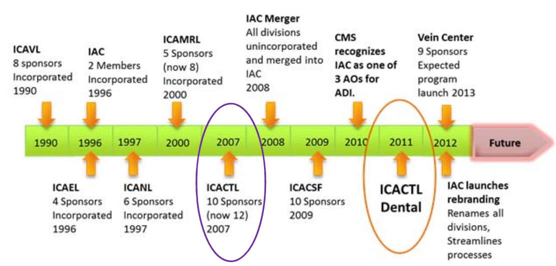
- Intersocietal Accreditation Commission
- 22 years of imaging accreditation experience
- Board of directors are specialists in various medical fields
- Over 12,000 accredited sites
- Recognized by CMS as an Accrediting Organization
- Earned ISO certification

ACCREDITED FACILITY · IAC INTERSOCIETAL ACCREDITATION COMMISSION · DENTAL CT ·

ISO 9001:2008 · ISO 27001:2005 QUALITY CERTIFIED ORGANIZATION

Improving health care through accreditation

IAC History



Improving health care through accreditation

- IAC
  - Vascular Testing | ICAVL - 1990
  - Echocardiography | ICAEL- 1996
  - Nuclear/PET | ICANL - 1997
  - MRI | ICAMRL - 2000
  - CT | ICACTL – 2007
  - Dental CT | ICACTL - 2011
  - Carotid Stenting | ICACSF - 2009
  - Vein Center - 2013

IAC CT Sponsoring Organizations

- American Academy of Neurology (AAN)
- American Academy of Otolaryngology — Head and Neck Surgery (AAO-HNSF)
- **American Academy of Oral and Maxillofacial Radiology (AAOMR)**
- **American Association of Oral and Maxillofacial Surgeons (AAOMS)**
- **American Association of Physicists in Medicine (AAPM)**
- American College of Cardiology (ACC)
- American Society of Nuclear Cardiology (ASNC)
- American Society of Radiologic Technologists (ASRT)
- Society for Cardiovascular Angiography and Interventions (SCAI)
- Society for Vascular Surgery (SVS)
- Society of Cardiovascular Computed Tomography (SCCT)
- Society of Nuclear Medicine and Molecular Imaging (SNMMI)
- Radiology at large members

Improving health care through accreditation

Benefits of Accreditation

- Commitment to quality
- Recognition of your skills
  - High quality services
  - Patients
- Educational tool
  - Continuous quality improvement

Improving health care through accreditation

Payment Policies

- **MIPPA Law 2008**
  - Nuclear, PET, MRI, CT
  - Accreditation required by 1/1/2012
  - 120 day CMS grace period
  - for adding new sites if currently accredited
  - Includes dentists that utilize CT scanners
  - Oral surgeon penalized by CMS for Medicare billing without accreditation
- **Private Insurers and State programs**
  - Some private insurers may require accreditation
  - California (CT), Minnesota (CT, Nuc/PET,MRI)

Improving health care through accreditation

Table 1: Information about CMS-Designated Accrediting Organizations

	American College of Radiology (ACR)	Intersocietal Accreditation Commission (IAC)	The Joint Commission (TJC)
Suppliers accredited, by modality[a]			
CT suppliers	3,636	1,361	64
MRI suppliers	4,035	1,052	68
NM suppliers	2,488	6,554	23
PET suppliers	1,009	635	7
Total unique suppliers	**6,855**	**8,491**	**98**
Accreditation fee (dollars)	1,800 to 2,400 (per unit of imaging equipment; varies by modality)[b]	2,600 to 3,800 (per application; varies by modality)[c]	8,740 to 14,890 (per facility; varies by patient volume and includes an on-site visit for all applicants)[d]

Source: GAO analysis of information from CMS and CMS-designated accrediting organizations.

[a]The number of accredited suppliers was provided by CMS on January 3, 2013. Each supplier may have multiple locations. The sum of the number of accredited suppliers by modality does not equal the total number of unique suppliers because some suppliers provide more than one imaging modality.

[b]Discounted fees are available for facilities with more than one imaging unit and multiple modalities. Additional fees of $780 to $3,315 apply for a phantom, a solid object designed to mimic critical imaging characteristics of patients, such as bone and tissue, that is imaged using suppliers' equipment to help assess performance parameters such as resolution and image uniformity. The price varies depending on the specific phantom and modality.

[c]Application fee varies by modality and covers the first unit of imaging equipment for MRI and CT; the fee for NM and PET covers all of the equipment. For MRI and CT, discounted fees are available for each additional unit for facilities with more than one imaging unit. For all modalities, there is a discount for facilities with more than one site.

[d]Additional fees apply for suppliers with more than one location or that require additional specialists. TJC accreditation for ADI is part of the accreditation program for ambulatory care facilities; its costs are based on the number of patient visits rather than on each imaging unit or modality. TJC accreditation fees include an on-site visit fee for all applicants and an annual fee billed each year during the 3-year accreditation cycle.

GAO-13-246 5-31-13 Establishing Minimum National Standards and an Oversight Framework Would Help Ensure Quality and Safety of ADI services

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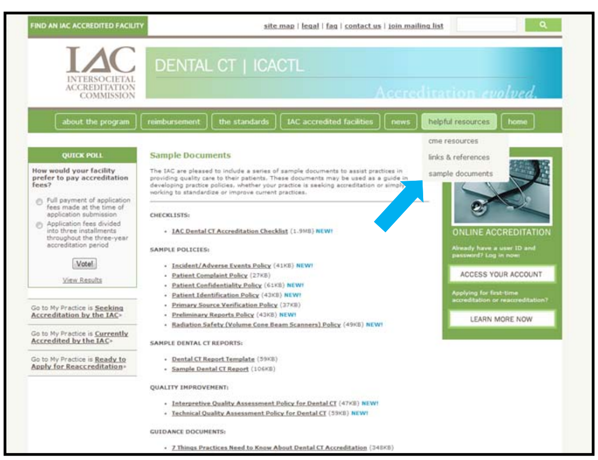
CT Standards

- Dental staff training and experience requirements
- Patient and employee safety policies
- Equipment QC
- Radiation oversight and safety adherence
- Report content
- Quality improvement program

Physics Guidance

- Radiation Protection Survey
- Image Quality and Dose Assessment

Improving health care through accreditation



IAC
INTERSOCIETAL ACCREDITATION COMMISSION
DENTAL CT | ICACTL

The Complete

IAC CT Standards for Dental/Maxillofacial Computed Tomography (CT) Practice Accreditation Using Cone Beam Technology

Parts I and II

http://www.intersocietal.org/ct/main/ct_standards.htm

IAC Standards and Guidelines for CT Accreditation

STANDARD – Medical Physicist or Qualified Expert

1.5A The medical physicist must be board certified by the American Board of Radiology, the American Board of Medical Physics, or the Canadian College of Medical Physics in a discipline that includes diagnostic imaging.

Comment: In states where medical physicists or qualified experts are licensed, registered or otherwise state-approved to measure dose and evaluate image quality at CT scanning facilities, these credentials are acceptable

1.5.1A Responsibilities

1.5.1.1A Other personnel, deemed by the medical physicist as competent to perform the assigned tasks, are permitted to assist the medical physicist or qualified expert in data collection.

1.5.2A Continuing Education (CE) Requirements

1.5.2.1A The medical physicist must document at least 15 hours of Category I AMA, Commission on Accreditation of Medical Physicists Educational Programs (CAMPEP) or the American College of Radiology (ACR) Medical Education for Physicists (MEP) approved physics related CE over a period of three years.

i. A minimum of three hours of the documented 15 hours of CE must be related to radiation safety.

ii. Yearly accumulated continuing education must be kept on file and available to IAC CT, when requested.

http://www.intersocietal.org/ct/standards/IACCTStandards2012.pdf

1. Which of the following is *not* true about the IAC CT Accreditation program?

20%	
20%	
20%	
20%	
20%	

a) Anyone with a BS degree or higher may perform CT annual medical physics surveys

b) The initial radiation protection survey must include measurements and calculations of exposure to persons in the vicinity of the scanner

c) Image quality evaluations must include slice thickness, uniformity, noise, and other parameters using a phantom chosen by the medical physicist

d) Dosimetry must include measurements and comparison with appropriate benchmarks, chosen by the medical physicist

e) The IAC CT Guidance document describes what is expected of the medical physicist

10

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b) The initial radiation survey must include measurements and calculations of exposure to persons in the vicinity of the scanner

c) Image quality evaluations must include slice thickness, uniformity, noise, and other parameters using a phantom chosen by the medical physicist

d) Dosimetry must include measurements and comparison with appropriate benchmarks, chosen by the medical physicist

e) The IAC CT Accredits about ¼ of all the CT scanners accredited

Ref: http://www.intersocietal.org/ct/main/standards.htm

GAO-13-246 5-31-13 Establishing Minimum National Standards and an Oversight Framework Would Help Ensure Quality and Safety of ADI services

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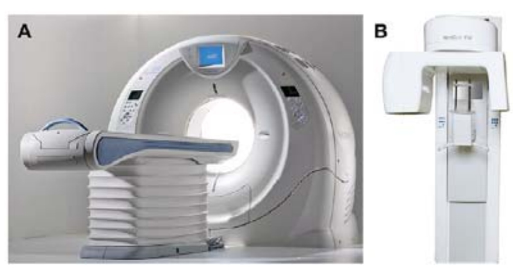
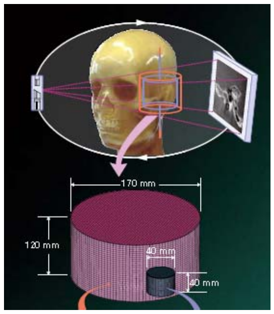
Toshiba Aquilion 64 MDCT and NewTom vGi CBCT Scanner (Dental)



A Comparison of Maxillofacial CBCT and Medical CT. Christos Angelopoulos

Basics of CBCT



Basics of CBCT

- During the rotation, multiple sequential planar projection images covered by the detector or the field of view (FOV) are acquired in an arc of 180º or greater
- These single projection transmission images constitute the raw primary data and are individually referred to as **basis, frame, or raw images**
- **Basis** images appear similar to cephalometric radiographic images
- There are usually several hundred projection-basis images that are reconstructed an image volume
- The complete series of images is referred to as the **projection data or volumetric dataset**

Advantages of CBCT

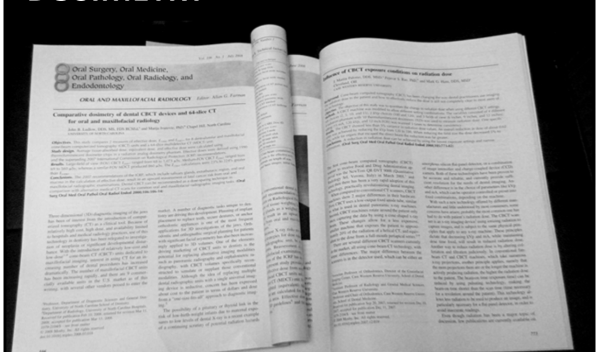
- Irradiated field of view (FOV) reduced to region of interest
  - Mechanical lead collimation or electronic masking
  - Only collimation reduces volume of tissue irradiated
  - One new system now allows operators to select
    - 5 different FOV
    - 3 different dose levels
    - Variable SID (magnification)
- Designed specifically for needs of ENT/Dental facilities
  - High resolution
  - Contrast and Dose optimized for air/bone (not soft tissue)
  - Point of Care application
  - Ease of use by MD or Dentist (may be changing…)

MDCT vs. CBCT

X-ray source	80-140 kVp 20-100 kW	80 – 120 kVp Stationary Anode Pulsed beam
Focal Spot	0.5 – 1.2 mm	0.5 – 1.2 mm
Detector	MD arrays 64 – 256+ rows	Flat panel Tl:CsI, Tr:GdOS
Spatial Res	0.5 – 0.625 mm	0.4 mm (20 cm FOV)
Contrast Res	~1 HU	~10 HU

A Comparison of Maxillofacial CBCT and Medical CT. Angelopoulos et al

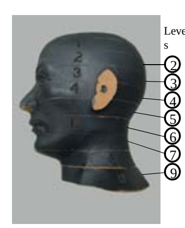
DOSIMETRY



OOOOE (Palomo, *et al.* & Ludlow, *et al.*)

Principles of CBCT – Dosimetry

Conclusions: **The Kodak 9000 3D provides doses that are *substantially lower* than previously reported doses produced by medium and large FOV CBCT units.** The digital panoramic mode provides a low dose alternative for panoramic examinations of the jaws using the same unit.



Ludlow JB: Dosimetry of Kodak 9000 3D Small FOV CBCT and Panoramic Unit, UNC School of Dentistry, Chapel Hill, NC, 2008.

Tissue-weighting factors for calculation of effective radiation dose, according to the International Commission on Radiological Protection's 1990 and 2007 recommendations.

TISSUE	TISSUE-WEIGHTING FACTOR	
	1990*	2007[†]
Bone Marrow	0.12	0.12
Breast	0.05	0.12
Colon	0.12	0.12
Lung	0.12	0.12
Stomach	0.12	0.12
Gonads	0.20	0.08
Bladder	0.05	0.04
Esophagus	0.05	0.04
Liver	0.05	0.04
Thyroid	0.05	0.04
Bone Surface	0.01	0.01
Brain	NA[‡]	0.01
Salivary Glands	Not included	0.01
Skin	0.01	0.01
Remainder Tissues	0.05[§]	0.12[¶]

Ludlow JB: Patient risk related to common dental radiographic examinations JADA 2008

Equivalent dose* to tissues and organs in the head and neck resulting from common dental radiographic examinations.

VALUES FROM RANDO PHANTOM,[†] BY TYPE OF EXAMINATION	TISSUE OR ORGAN						
	Bone Marrow	Thyroid	Esophagus	Skin	Bone Surface	Salivary Glands	Brain[‡]
FMX[§] with PSP[¶] or F-Speed Film and Rectangular Collimation	29	117	10	90	117	783	33
BW** with PSP or F-Speed Film and Rectangular Collimation	4	0	0	26	17	156	0
FMX with PSP or F-Speed Film and Round Cone	134	550	134	122	542	4,110	100
Panoramic Orthophos XC[††] (CCD[‡‡])	14	25	12	4	60	313	10
Panoramic ProMax[§§] (CCD)	20	67	7	6	82	761	17
Posteroanterior Cephalometric (PSP)	11	30	8	4	42	55	35
Lateral Cephalometric (PSP)	5	45	7	4	20	80	40

* In microsieverts.

Ludlow JB: Patient risk related to common dental radiographic examinations JADA 2008

Effective dose for commonly used dental radiographic examinations: comparison of International Commission on Radiological Protection (ICRP) methods from 1990* and 2007.[†]

TYPE OF EXAMINATION	EFFECTIVE DOSE (MICROSIEVERTS)		CHANGE IN EFFECTIVE DOSE 1990-2007 (%)
	ICRP 1990 Tissue Weights	ICRP 2007 Tissue Weights	
FMX[‡] with PSP[§] or F-Speed Film and Rectangular Collimation	12.2	34.9	186
BW[¶] with PSP or F-Speed Film and Rectangular Collimation	1.0	5.0	422
FMX with PSP or F-Speed Film and Round Cone	58.4	170.7	192
FMX with D-Speed Film and Round Cone*	133	388	192
Panoramic Orthophos XC** (CCD[††])	4.3	14.2	231
Panoramic ProMax[‡‡] (CCD)	7.1	24.3	241
Posteroanterior Cephalometric (PSP)	3.9	5.1	32
Lateral Cephalometric (PSP)	3.7	5.6	51

Ludlow JB: Patient risk related to common dental radiographic examinations JADA 2008

Table 2.3a: The range of effective dose and the median values in parentheses from dental CBCT in µSv. Studies are divided into "dento-alveolar" (small and medium FOV) and "craniofacial" (large FOV). The height of the dento-alveolar FOVs is smaller than 10cm allowing imaging of the lower and upper jaws. For the craniofacial FOVs, the height is greater than 10cm allowing maxillofacial imaging.

Dental CBCT unit type	Effective dose (µSv)	References
Dento-alveolar	11-674 (61)	Ludlow et al 2003 Ludlow and Ivanovic 2008 Lofthag-Hansen et al 2008 Hirsch et al 2008 Okano et al 2009 Loubele et al 2009 Roberts et al 2009 Suomalainen et al 2009 Qu et al 2010 Pauwels et al, in press
Craniofacial	30-1073 (87)	Ludlow et al 2003 Tsiklakis et al 2005 Ludlow et al 2006 Ludlow and Ivanovic 2008 Garcia Silva et al 2008a Okano et al 2009 Faccioli et al 2009 Loubele et al 2009 Roberts et al 2009 Pauwels et al, in press

RADIATION PROTECTION: **CONE BEAM CT FOR DENTAL AND MAXILLOFACIAL RADIOLOGY** Evidence based guidelines A report prepared by the SEDENTEXCT project www.sedentexct.eu 2011
supported by The Seventh Framework Programme of the European Atomic Energy Community (Euratom) for nuclear research and training activities

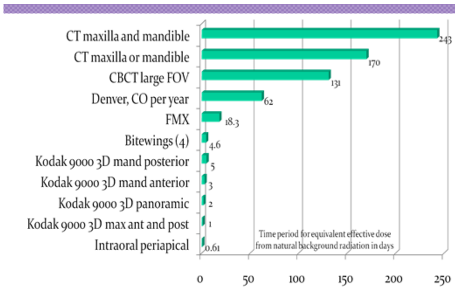
Tableau III: Summary of effective doses, DAPs (Kodak) and conversion factors (E) for the various adult procedures of this study

Procedure	E (ICRP 103) µSv	DAPmGyxcm²	Conversion factor DAP/(E) mSv/Gyxcm²
Panoramic (70kV, 143mAs)	7	70	0.10
Panoramic (80kV, 143mAs)	12.9	93	0.14
Mandibular incisor block (70kV, 107mAs)	4.7	188	0.026
Mandibular incisor block (80kV, 107mAs)	5.3	228	0.023
Maxillary molar block (70kV, 107mAs)	13.3	188	0.07
Maxillary molar block (80kV, 107mAs)	18.8	228	0.08

Dosimetric Evaluation in Dental Radiology Radiological procedures performed for panoramic and volume acquisitions with the Kodak 9000 3D device. Report n°2008-07 RADIOLOGICAL PROTECTION AND HUMAN HEALTH DIVISION (DRPH)

IRSN INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE

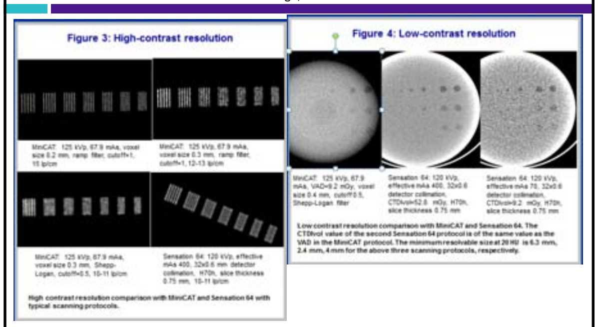
Principles of CBCT – Dosimetry



Ludlow JB: Dosimetry of Kodak 9000 3D Small FOV CBCT and Panoramic Unit, UNC School of Dentistry, Chapel Hill, NC (2008)

Dosimetry and Image Quality Evaluation of a Dedicated Cone-beam CT System for Sinus and Temporal-Bone Applications

Lifeng Yu, PhD, Thomas J. Vrieze, Michael R. Bruesewitz, James M. Kofler, PhD, Cynthia H. McCollough, PhD



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Medical Physics Responsibilities

- Reports follow Guidance Documents for
  - Radiation Protection Survey (one time)
  - Image Quality and Dose reports
- Phantom Images from Annual MP Survey
- Participate in Quarterly QC Committee Meetings

- 3 hour CT Radiation Safety Training (quiz=100%) for operators who are not RT's

CT Medical Physicist or Qualified Expert Report
Guidance Document

http://www.intersocietal.org/ct/forms/CT_Medical_Physicist_or_Qualified_Expert_Report.doc

1.	Report must be signed and dated by the medical physicist or qualified expert: IAC CT Standards for medical physicist or qualified expert: Board certified medical physicist or qualified expert. Is the medical physicist or qualified expert licensed by the state or otherwise authorized to perform dose measurements and evaluate CT image quality?	*IAC CT Standards Reference Section 1.2B – 1.6B*
2.	Report must indicate if acceptance test	
3.	Report must indicate if annual survey	
4.	Report must document recommended corrective actions	
5.	Dose report to include:	*Refer to Standard 1.4B*
	a. Dose reported for typical clinical protocols	
	b. Comparison of measured dose with some reference standard, using the same dose units. Report must include if results acceptable.	
	c. Dose should be in units of pitch corrected CTDI (preferably) or point dose at the central ray for cone-beam systems or MSAD.(or IAC approved acceptable methology)	*Refer to page 36**
	d. The ion chamber/electrometer manufacturer/model must be documented	
	e. Phantom used for dose analysis must be documented on report.	

6.	Image quality report to include:	*Refer to Standard 1.4B*
	a. Low-contrast resolution (N/A for Cone Beam CT)	
	b. High-contrast spatial resolution	
	c. Reconstructed slice thickness accuracy (N/A for Cone Beam CT)	
	d. Alignment of laser light (if available on system)	
	e. CT number accuracy	
	f. Noise	
	g. Are parameters compared with a reference standard or manufacturer's specification? (Some may be N/A.)	
	h. QC phantom for quality analysis must be documented on the report	

7.	Confirmation of Shielding Plan or completion at installation: The Radiation Protection Survey at installation should include:	*Refer to Standard 1.2B*
	a. Layout showing equipment location in the room and type of occupancy for adjacent areas (i.e., office, toilet, outside, corridor, etc.)	
	b. Exposure (mR, mSV or uR, uSV) or exposure rate (mR/hr or mSv /hr) measurements at multiple locations including at least the operator position and areas adjacent to (but outside of) the scanner room. Measurements outside may be omitted under some situations.	
	c. Determination of weekly workload (mAs per scan x # patients per week) or some other accept methodology	
	d. Occupancy factors specified for surrounding areas	
	e. Calculation weekly exposure to persons inside and outside the room, corrected for occupancy factor	
	f. Final assessment of results as "Acceptable," "ALARA," within restricted vs. unrestricted guidelines	
	g. Report is signed and dated by the qualified medical physicist	
	h. Recommendations, actions needed, or issues to be addressed to the facility must be included on the report, if applicable	
	Comment: The IAC CT accreditation program outlines the training and experience requirements that the medical physicist/qualified expert must meet in order to perform CT quality assurance testing. The analysis and evaluation of the quality control testing is left to the judgment of the qualified medical physicist. The primary purpose of the submission of the phantom images with the results is to verify/document the image quality analysis.	

2. CT Dosimetry Reports for all scanners, including volume CT (VCT) or cone-beam CT (CBCT) scanners, must include:

   a. Measurements of exposure, and calculations of dose or dose index (or other appropriate dosimetry metric) which include comparison with some applicable reference standard, using the same units as the reference standard. The report must be clear about whether the results are acceptable, and identify corrective actions if the results are not acceptable.

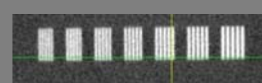
   b. Dosimetry should be in units of pitch-corrected CTDI, point dose at the central ray, or MSAD for typical clinical protocols. The clinical protocol factors must be listed.

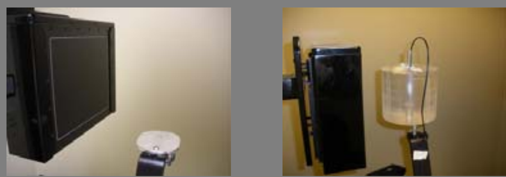
   c. Although CTDI is not rigorously defined for VCT or CBCT scanners, CTDI is also not rigorously defined for multislice CT scanner with beam thickness more than 1.0 cm. While imperfect, CTDI is the only metric for which reference standards currently exist. If possible, VCT or CBCT systems should be configured to use a z-axis collimation that is less than the length of the pencil chamber (if such a chamber is used). For example, temporal bone imaging protocols found on ENT scanners often meet this criterion. As new techniques for CT dosimetry are published, more rigorous methods should be used.

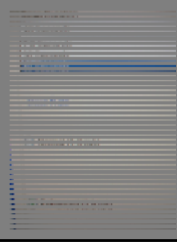
   d. The report must identify the phantom and radiation detection system used.

Adapt CT measurement techniques

- Challenges
  - Image Quality phantom size
  - AAPM Head dosimetry OK
  - Use of detector entrance exposure?
  - Positioning phantoms – not trivial!
  - Multiple FOV, SID choices







2. For dental CBCT systems, what are the minimum requirements for measurement of dose and image quality?

- 20% a) The methods described in the ACR CT accreditation program QC Manual (2012)
- 20% b) Only dose measurements performed using TLD's in a Rando head phantom are acceptable
- 20% c) Physicist must adapt the standard CT testing methods to the unique challenges of CBCT systems
- 20% d) Dose measurements are not necessary because all new systems are self-calibrating

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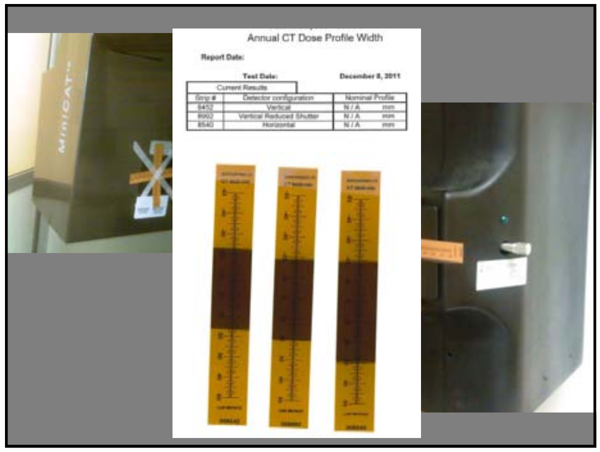
b) Only dose measurements performed using TLD's in a Rando head phantom are acceptable
c) Physicist must adapt the standard CT testing methods to the unique challenges of CBCT systems
d) Dose measurements are not necessary because all new systems are self-calibrating

Ref. http://www.intersocietal.org/iac/search.htm?q=guidance
Dosimetry of two extraoral direct digital imaging devices: NewTom cone beam CT and Orthophos Plus DS panoramic unit, Ludlow, Daview-Ludlow and Brooks. Dentomaxillofascial Radiology (2003) 32 229-234



Correct for Geometry to Image Receptor

Distances, from CJ, IMTEC	inches	mm		Approx CTDP
FS to detector	31	787.4	V:	40.5mm
FS to tube cover (for CTDP)	6.347	161.2	H:	51mm
FS to axis of rotation	24	609.6	V2:	29mm
Patient (axis of rotation) to detector	7	177.8		
FS to detector active depth	31.607	802.8		

	CTDP at tube cover (mm)	half length	Exposed length of pencil chamber (assuming point source)
Full Field	40.5	20.25	76.6
Reduced Field	29	14.5	54.8
Horizontal	51	25.5	

Table I: Technical parameters used in panoramic mode and in volume mode.

Parameter	Panoramic mode	Volume mode
Covered field	4mm x 126mm to 613mm from x-ray focal spot	48mm x 60mm to 690mm from x-ray focal spot
Image receiver size	CCD - 6.55mm x 129.4mm	CMOS-48mm x 60mm
Position of object	500mm: distance from incisors / from x-ray focal spot	440mm from x-ray focal spot
High voltage (kV)	from 60 to 90	from 60 to 90
Intensity (mA)	from 2 to 15	from 2 to 15
Total filtration	2.5mm eq. Al including 1.2mm of Al (glass-ware, oil) at 70kV.	2.5mm eq. Al including 1.2mm of Al (glass-ware, oil) at 70kV.
CDA	5.2mm Al at 90kV	5.2mm Al at 90kV
Exposure time	14.3 s (adult), 10.8 s (child)	30ms per acquisition. (full test = 360 acquisitions)

Dosimetric Evaluation in Dental Radiology Radiological procedures performed for panoramic and volume acquisitions with the Kodak 9000 3D device. Report n°2008-07 RADIOLOGICAL PROTECTION AND HUMAN HEALTH DIVISION (DRPH)

IRSN INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE

Regarding assessment of beam collimation in CBCT systems:

a) Scanning of GafChromic media images may be used, corrected for geometry
b) CR or film based imaging systems must be used to detect the x-ray beam
c) This is not necessary because CBCT systems collimate automatically
d) Is not possible to be performed in the field by a medical physicist

3. What is the accepted way to assess beam collimation in CBCT systems:

20% a) Scanning of GafChromic media images may be used, corrected for geometry
20% b) CR or film based imaging systems must be used to detect the x-ray beam
20% c) This is not necessary because CBCT systems collimate automatically
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3. What is the accepted way to assess beam collimation in CBCT systems:

a) Scanning of GafChromic media images may be used, corrected for geometry
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c) This is not necessary because CBCT systems collimate automatically
d) Is not possible to be performed in the field by a medical physicist

Ref: Application of Gafchromic film in the study of dosimetry methods in CT phantoms. Martin CJ, Gentle DJ, Sookpeng S, Loveland J., J Radiol Prot. 2011 Dec;31(4):389-409

Morita 3D Accuitomo 170

Special thanks to
Aditya Tadinada, BDS,
UConn

Reduced Dosage
Dosage has been reduced 30% to 40% compared to the previous Accuitomo model.

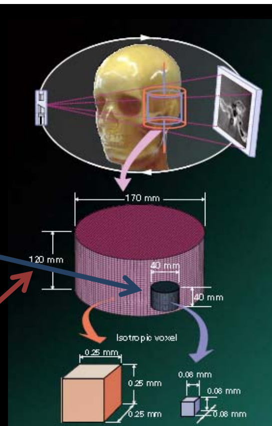
Four Imaging Modes
A mode to serve every purpose. High Resolution Mode and High Fidelity Mode can be used for the highest quality of images. High Speed Mode reduces motion artifacts. Standard Mode can be used for both limited and broad fields of view.

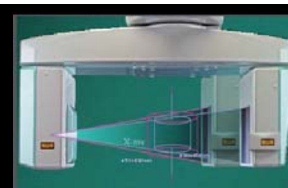
Nine Field of View (FOV) Sizes
A wide FOV range, from 40 x 40 mm up to 170 x 120 mm, captures a couple teeth up to the entire head and neck area.

Five Resolution Levels
Select the voxel size that best suits your diagnostic needs: 80 µm, 125 µm, 160 µm, 200 µm, or 250 µm.

3D Accuitomo 170 offers nine FOV:
40 x 40 mm to 170 x 120 mm.
Enables examination of temporal bone, paranasal sinuses, mandible, and skull base.

FOV:
- Ø 40 x H 40 mm
- Ø 60 x H 60 mm
- Ø 80 x H 80 mm
- Ø 100 x H 100 mm
- Ø 100 x H 50 mm
- Ø 140 x H 50 mm
- Ø 140 x H 100 mm
- Ø 170 x H 50 mm
- Ø 170 x H 120 mm



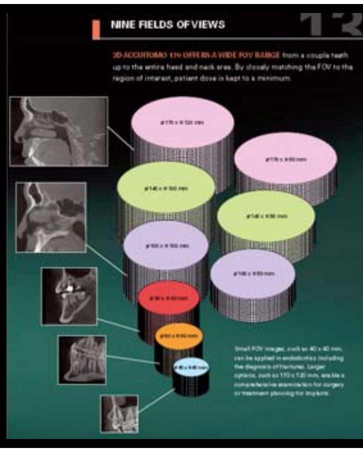


Flat Panel Detector (FPD) Position Adjustment

Adjusting the position of the FPD reduces X-ray dosage, provides higher resolution, and minimizes distortion.

For regions such as 140 x 100 mm, moving the FPD slightly farther away from the center of the exposure area results in a better orthographic projection, which reduces distortion and improves resolution.

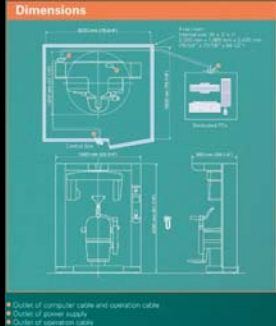
Optimizing collimation of the beam, depending on the size of the area, also reduces X-ray dosage and X-ray scattering as well.



FEATURES

- Super high resolution, 80 µm voxel, CsI FPD
- Very low effective dose: 170 x 120 mm (entire head/neck area) is 25% less dosage than an FMX, F-speed film*
- 14 bit grayscale
- Zoom reconstruction feature – no need to re-take images
- Flat panel detector
- Scan time - 18 sec. or less 360° scan; 9 sec. or less 180° scan
- One Data Viewer – 3D images can be viewed on any computer without special software
- Volume rendering function
- Intra-clinic network compatibility
- Compact: 63-3/4" x 47-1/4"
- 9 FOV from Ø 40 x H 40 mm to Ø 170 x H 120 mm

Dimensions

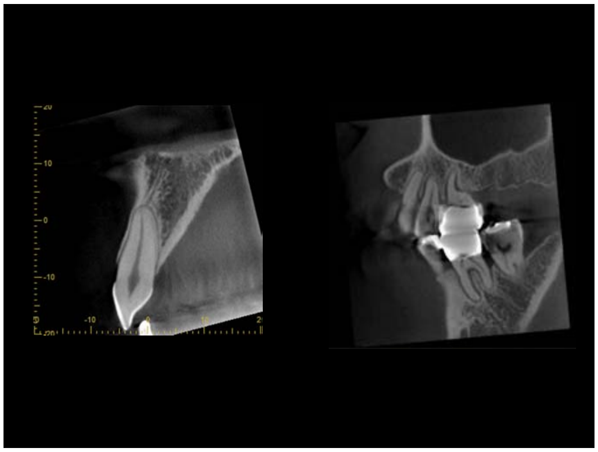


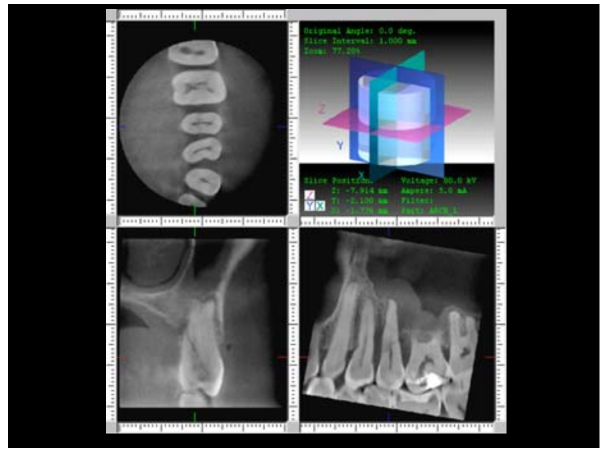
Specifications

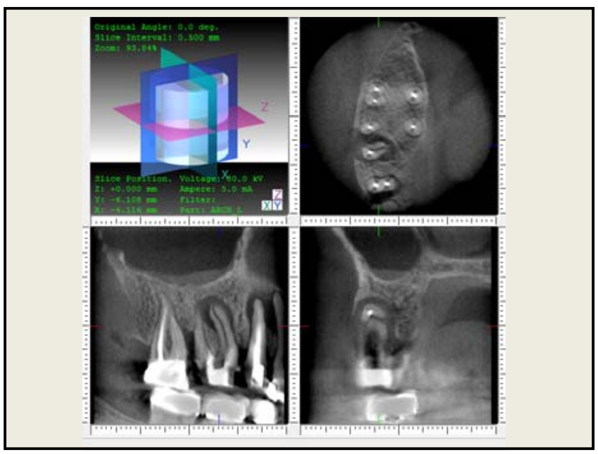
Trade Name	3D Accuitomo
	XYZ Slice View Tomograph
Model	MCT-1
Type	EX1/2 F17
Input Voltage	100/110/120VAC
	220/230/240VAC
Power Consumption	max. 2.0 kVA
X-ray Head	
Tube Voltage	60 - 90 kV
Tube Current	1-10 mA
Focal Spot Size	0.5 mm
Exposure Time	18 seconds or less
Size of Imaging Area	Diameter 40 x Height 40 mm, Diameter 60 x Height 60 mm Diameter 80 x Height 80 mm, Diameter 100 x Height 100 mm Diameter 170 x Height 120 mm
Voxel Size	80 µm, 125 µm, 160 µm, 250 µm
Outer Dimensions	
Main Unit (W x D x H)	1,620 mm x 1,200 mm x 2,080 mm (63-3/4" x 47-1/4" x 81-7/8")
Control Box (W x D x H)	96 mm x 40 mm x 115 mm (3-3/4" x 1-5/8" x 4-1/2")
Weight	Approx. 400 kg. (882 lb)

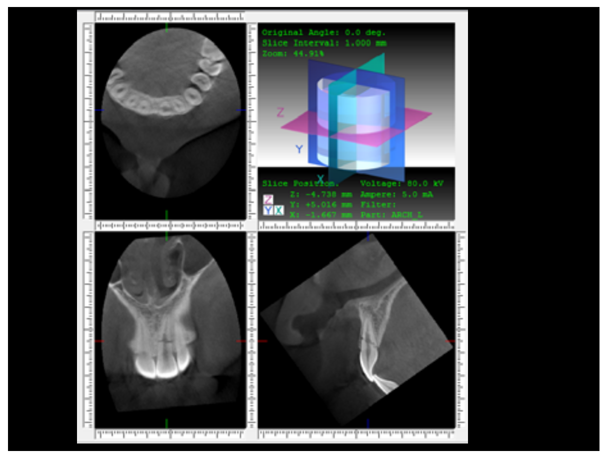
* X-ray protection should be provided for the patient when X-rays are emitted
* Design and specifications are subject to change without notification

Images and Clinical cases









Displayed CTDI, mGy	Imaging Mode		
FOV	Std	Hi-Fi	Hi-Res
40x40	8.1	12.8	
60x60	10.2	16.1	
80x80	11.8	18.5	
100x100	12.2	19.2	
100x50	14.1	22.7	
140x50	17.7	27.8	
140x100		22.8	

Table 7. Published adult DRLs for $CTDI_{vol}$ (mGy)

	Head	
	$CTDI_{vol}$	DLP
Sweden 2002 [31]	75	1,200
United Kingdom 2003 [7]	65*, 100†	930
European Commission 2004 [12]	60	—
The Netherlands 2008 [32]	—	—
ACR 2008 [4]	75	—
Switzerland 2010 [33]	65	1,000

McCollough et al, J Am Coll Radiol 2011;8:795-803

Outline

- Who is IAC and why do they accredit CT?
- IAC CT Standards and Guidelines
- Review of CBCT Principles
- Medical Physics Measurements for CBCT Systems – Medical and Dental
- IAC Accreditation Requirements and Process
- Summary and Conclusion

The IAC Accreditation Checklist for CT

Use the following checklist as a guide when preparing your IAC accreditation application for CT.

Step 1: Before You Begin

- ☐ **Read and Review the *IAC Standards and Guidelines for CT Accreditation***
  The Standards are the basis for the accreditation program, defining the minimum requirements for all CT facilities to provide high quality care. It is imperative to read and understand the Standards. Always follow the most current version of the Standards, which are posted on the CT website at: ***intersocietal.org/ct/main/ct_standards.htm***
- ☐ **Explore the Website**
  There are many helpful tools on the website:
  - **Sample Documents** – checklists, sample policies and guidance documents. ***intersocietal.org/ct/seeking/sample_documents.htm***
  - **On Demand Webcasts** – learn about accreditation at your leisure, 24 hours a day/7 days a week, for free. ***intersocietal.org/ct/main/on_demand.htm***
  - **Frequently Asked Questions** – find answers to commonly asked questions. ***intersocietal.org/ct/main/faq.htm***
  - **CME Resources** – list of resources for CME both live and online. ***intersocietal.org/ct/main/cme_resources.htm***
  - **Links and References** – a variety of online resources from CT-related organizations, journals. ***intersocietal.org/ct/main/links_references.htm***
- ☐ **Perform a Thorough Facility Self Assessment**
  Prior to completing the application, facilities must identify and correct potential problems; when necessary revising protocols and Quality Improvement programs to be in compliance with the *Standards*.
- ☐ **IAC Accreditation Agreement**
  It is important to have the appropriate people at your facility review the agreement in the event it is decided to request changes to the agreement. Be sure to have the Accreditation Agreement filled out completely and signed in all areas. The signed document must be submitted with the application. For complete instructions, review "Legal, IAC Agreement" at ***intersocietal.org/iac/legal/agreement.htm***.

Step 2: Gather Information

All facilities are required to submit the items listed below as part of the Online Accreditation application.

- ☐ **Equipment Information** (serial number, software version, date of installation, field strength)
- ☐ **Physician Medical License** (for each state the interpreting physician is licensed to practice)
- ☐ **Training/Experience Qualification Pathways for Physicians and Technologists**
- ☐ **Certificate/Credential Information** (i.e., ABMS or board certification for physicians; (RT (CT), CNMT, RT) for technologists)
- ☐ **Procedure Volumes** (estimated annual staff and facility procedure volume information)
- ☐ **Attestations** (Medical Director and staff and Technical Director and staff)
- ☐ **CME/CE Information for All Interpreting Physicians and Technologists**
  Specific course/lecture title, date of attendance, type and number of credits earned. All staff members are required to submit 15 CME/CE relevant to CT every three years, even if they are new to the facility.

For instructions on how to upload attachments to the online application, visit ***intersocietal.org/ct/seeking/attachments.htm***.

POLICIES AND PROTOCOLS

The following policies and/or protocols must be in place prior to application submission:

- ☐ **Patient and Personnel Safety Policy**
  A policy to ensure patient and personnel safety to include medical emergencies, patient radiation safety, and personnel radiation exposure monitoring.
  - ☐ **Acute Medical Emergency Policy**
    A written policy for patient management that includes rapid recognition, response and handling of the emergency situation.
  - ☐ **Incident Report/Adverse Events Policy** *(e.g., extravasations, patient falls and complaints)* A policy for documentation of incidents or adverse events in the facility must be in place.
- ☐ **Patient Confidentiality Policy**
  A policy that all facility personnel must ascribe to professional principles of patient confidentiality as legally required by federal, state, local or institutional policy or regulation.
- ☐ **Patient Identification Policy**
  A policy that outlines the process that assures accurate patient identification immediately prior to initiating the procedure.

[POLICIES AND PROTOCOLS CONTINUED ON NEXT PAGE ...]

The Medical Physicist should clearly identify for each facility

☐ **Equipment Quality Control**

- ☐ Quality Control Acceptance Test Results (QC test results performed after installation or after major upgrade or room design)
- ☐ 5 days of daily QC tests (with test results and corresponding phantom images)
- ☐ Annual Preventive Maintenance Report
- ☐ Radiation Shielding Verification Survey (post-installation)
- ☐ Physicist Annual Survey (to include image quality, phantom images and patient dose assessment)

Improving health care through accreditation

IAC INTERSOCIETAL ACCREDITATION COMMISSION

Mid-cycle Audits

- 100% of facilities will get a random audit or site visit
- Date is randomly selected - may happen at any time during the course of the facility's accreditation – may be in the form of an unannounced site visit
- No additional cost to the facility for the site visit
- Failure to submit audit documents or agree to the site visit may result in suspension or loss of accreditation

Improving health care through accreditation

IAC INTERSOCIETAL ACCREDITATION COMMISSION

4. For IAC CT accreditation, facilities must submit:

20%	a) Dosimetry provided by the manufacturer
20%	b) TLD's mounted to the surface of the ACR accreditation phantom
20%	c) Images of the ACR CT accreditation phantom, reconstructed at the minimum slice thickness
20%	d) Reports and image quality assessments performed by a medical physicist or other individual state approved to perform these measurements in CT facilities
20%	e) The standard ACR dosimetry report for an adult abdomen

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Ref: http://www.intersocietal.org/ct/main/ct_standards.htm

Summary

- IAC accredits about ¼ of all CT scanners that are accredited
- IAC CT Standards and Guidelines
- Medical Physics Measurements for CBCT Systems – Medical and Dental
- IAC Accreditation Requirements and Process

Conclusion

- The medical physicist can make a significant contribution to dental imaging facilities through careful measurements , education and consultation