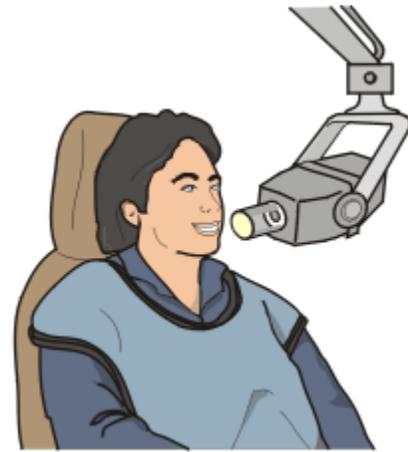


Synopsis of Intra-Oral X-ray Units (Project 05-02) (4/05)

A synopsis table for many currently available intraoral x-ray units can be found clicking on [Synopsis Table, Intraoral X-ray Units](#)

I. Summary of purchase and installation considerations covered in this article

- A. Measure the distance from the mounting location to the opposite side of the patient's head; order an appropriate x-ray unit arm reach.
- B. If a paralleling technique is utilized, order the long cone option.
- C. Decide if you want to use a corded trigger switch or if you want to mount a control panel on an external wall; order accordingly.
- D. Decide between alternating current (AC) and constant potential ("DC") units. See III.D. below.
- E. Take into account the possible need for wall reinforcement. Units can usually be mounted on wooden studs, but metal studs typically require reinforcement or a metal studded wall can be sandwiched between two plates. Follow manufacturers' mounting guidance.
- F. Shielding considerations. Typical gypsum wallboard construction will usually provide adequate shielding for most dental operatory installations, but clinics must consult with Bioenvironmental Engineering prior to installation of x-ray units to confirm that adequate shielding is present.
- G. Installation usually requires the addition of a dedicated electrical circuit. See III.G. below.



II. A review - Relating kVp, mA, and exposure time to density and contrast

Radiographic density - the overall degree of "darkness" or "blackness" of a radiograph.

Radiographic contrast - relates to the number of "grays" visible on a radiograph. "High" contrast (also called short-scale contrast) has few shades of gray. "Low" contrast (also called long-scale contrast) has many shades of gray.

mA (milliamperage) and exposure time - primary variables used to control film density. Tube electrical current (mA) and exposure time (seconds) are both directly related to the quantity of x-rays produced. While most dental x-ray units have a fixed mA setting and use exposure time to control film density, some units have adjustable mA as well as exposure time settings.

kVp (kilovoltage peak) - primary variable used to control film contrast. kVp controls the quality (wavelength and energy) of the x-ray beam. Lower kVp settings produce higher contrast films. Most dental x-ray units have a fixed kVp setting, but some units offer adjustable kVp settings. Low contrast films (many grays, high kVp) are often preferred for visualizing osseous changes. High contrast films (few grays, low kVp) are often preferred for visualizing caries and for endodontic procedures. The ability to vary the kVp setting on an x-ray unit to control contrast will become less important as clinics transition to digital imaging, as the contrast of digital images can be manipulated with imaging software.

Note: While mA and exposure time are the variables primarily used to control film density and kVp is the variable primarily used to control film contrast, a higher kVp will also cause an increase in density and must be compensated by decreasing the tube current (mA) or exposure time.

III. Selection and Installation Considerations

A. Arm length

When selecting an intraoral x-ray unit for installation in a dental treatment room, be sure to measure the distance from your proposed mounting location to the opposite side of the patient's head. Each manufacturer's tubehead is typically offered with multiple arm length configurations. Purchasing an arm length that is a little longer than necessary is better than purchasing one that is too short. Note that most manufacturers specify arm lengths assuming an 8" cone. Arm reaches will be 4" less for 12" cones.

B. Focus to skin distance ("cone length") and collimation

Most x-ray units come with a standard 8" focus to skin cone length with an optional 12" cone length available. Using a manufacturer's longest available cone is recommended when the paralleling technique is used to expose radiographs. This will help minimize image magnification and maximize image definition. (While a 16" focus to film distance is preferred for the paralleling technique, most manufacturers offer a maximum 12" cone length.) Collimation refers to restricting the size and shape of an x-ray beam by passing it through a diaphragm of a given size and shape. Most x-ray units collimate the beam to a circular shape. As dental film is rectangular in shape, this results in a larger field of exposure than what may be necessary. The National Council on Radiation Protection published a report in 2003 (NCRP 145) , which recommends the use of rectangular collimation for dental periapical radiographs. Several dental x-ray manufacturers offer rectangular collimators as an accessory. Dentsply/Rinn also sells a rectangular collimator that slips over the end of most manufacturers' x-ray cones (Rinn Universal Collimator, part #540853).

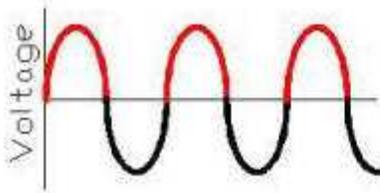
C. Exposure controls

Exposure settings may be indicated on the control panel with numerical values, anatomical images that represent preprogrammed settings, or both. Control panels and exposure trigger switches come in various configurations. Most manufacturers offer a corded exposure trigger switch either as standard equipment or as an option. Depending on the manufacturer, the exposure control panel (setting controls) may be located on the x-ray unit, may be remotely mounted, or may be configured as a removable faceplate that can either be mounted on the x-ray unit or remotely mounted. Some manufacturers also offer the option of a remotely mounted exposure trigger switch (as opposed to a remote control panel which includes the control settings as well as a trigger switch).

D. X-ray generator - alternating current versus constant potential

Until relatively recently, almost all dental x-ray generators applied alternating current to the tube when generating x-rays. Rather than utilizing alternating current, some newer units apply a nearly constant potential to the tube. These units are often referred to as direct current (DC) units. Constant potential generators produce a relatively constant stream of radiation and a greater percentage of higher energy "useful" radiation.

Alternating Current Generator



Alternating current x-ray generators produce x-rays only during one half of each 1/60th second alternating current cycle (the portion of the waves colored red). The sinusoidal waveform produces "bursts" of radiation rather than a constant stream. Only a portion of these "bursts" is usable radiation. The lower voltage portion of the "red lines" produces low energy, unusable radiation.

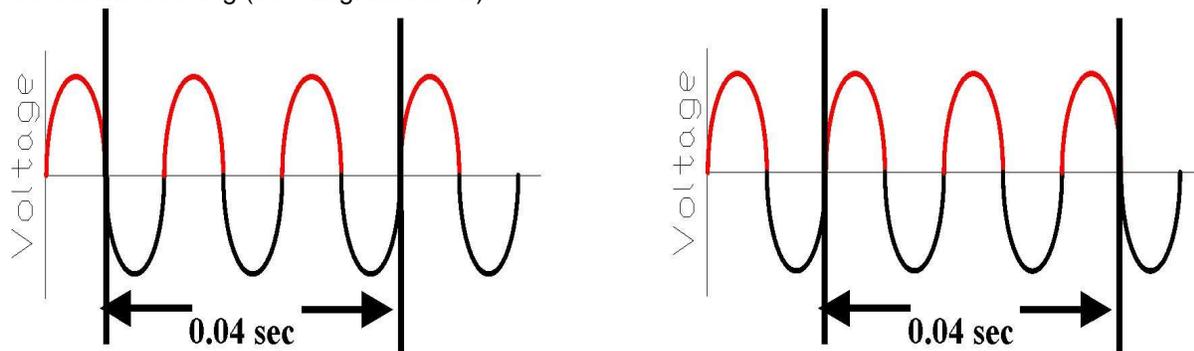
Constant Potential Generator



A constant potential generator produces a constant stream of radiation as well as a greater percentage of higher energy, "useful" radiation.

With an alternating current generator, voltage across the tube goes from zero up to the maximum kVp, then back to zero. This produces x-ray photons of varying energies. The lowest energy photons are filtered out, but the average photon energy produced by an alternating potential tube for a given kVp is still lower than the average photon energy produced by a constant potential tube at that same kV. Lower energy photons are more readily absorbed by the patient, so the more homogeneous beam of higher energy photons produced by constant potential units may slightly reduce patient exposure. When using conventional film, the lower average photon energy of an alternating current unit will produce films of higher contrast than will a constant potential unit (for a given kVp). However, constant potential units typically operate at 60 or 65 kV compared to the 70 kVp of an alternating unit which brings the contrast levels closer to each other. While most x-ray units operate at a single, fixed kVp, some models offer the user a choice of kVp settings.

Another consideration occurs at very low exposure times used in digital radiography. AC units may not provide exposures as consistent as constant potential units at these very short exposure times. This property can be illustrated using an example exposure time of 0.04 seconds (which is a very low setting). As stated above, alternating current produces a sinusoidal waveform and x-rays are generated only in the "positive" portion of the waves. A 0.04 second exposure time would cover two and one half 1/60th second alternating current waveforms. Depending on at what point in the waveform the exposure was initiated, as few as two or as many as three "usable" portions of the waves would be captured (at least some, and perhaps all AC units have no control over which segment of the waveform an exposure is initiated). At these very low exposure settings, this could result in a 1/3 difference in exposure for the same 0.04 second timer setting (see diagram below).



To summarize, AC and DC units are both capable of producing diagnostic images whether using conventional film or digital radiography. Constant potential units (DC) produce lower contrast conventional films compared to AC units at any given kVp, but these units typically operate at a slightly lower kV than AC units, which decreases this difference. Constant potential units may reduce patient exposure slightly and may produce more consistent exposures at the very short exposure times associated with digital radiography. These differences are relatively minor; AC and DC units are both capable of performing their intended function well.

E. Mounting considerations

Most units are manufactured for wall mounting. Many are available in mobile versions for transport between multiple operatories. A few units are available in ceiling mount configurations.

Probably the best location for an intraoral x-ray unit in a dental treatment room is on the "12 o'clock" wall behind the patient. If treatment room configuration will not allow this, an alternate location is one of the lateral walls. Lateral wall mounting also allows the option of mounting the x-ray unit in a pass-through cabinet to be shared between two treatment rooms. If pass-through cabinets are utilized, they should usually be purchased with a lead lining option as the wood/laminate cabinet doors do not provide the same degree of shielding that gypsum wallboard does.

When mounting the unit, manufacturer's instructions should always be followed, but as a general rule most intraoral units cannot be mounted on metal studs without bracing between the studs or sandwiching the wall between two plates. Units can usually be mounted on wood studs without additional bracing.

F. Radiation shielding

Radiation protection involves the patient, the operator, and other personnel in the area. Patient exposure is minimized through methods such as filtration, collimation, cone length, film speed, lead aprons, etc. The operator and other personnel are protected through the use of shielding. The primary factors that determine the amount of shielding required in a dental treatment room are: 1) the radiograph workload, 2) the direction of the primary beam and whether there are personnel in its path, 3) the distance of personnel from the x-ray source, and 4) the percentage of time that adjacent rooms are occupied and whether they are considered controlled or uncontrolled areas. Gypsum wallboard, as found in most dental facilities, provides some level of protection to personnel in adjacent rooms. The need for additional shielding (lead lining) in a given circumstance will depend on the answers to the above listed variables. As these variables can differ from facility to facility, Bioenvironmental Engineering should be contacted to perform a survey to determine the need for additional shielding prior to installation of an x-ray unit in a dental treatment room. Most surveys will show that typical gypsum wall construction will provide adequate shielding for usage levels typically encountered in dental treatment rooms.

Whenever possible, the operator should stand behind a barrier when exposing radiographs. If this is not possible, the operator should utilize the position and distance rule. This rule states that the operator should stand at least 6 feet away from the patient and in a safe quadrant at an angle between 90 and 135 degrees to the primary beam.

G. Electrical considerations

While x-ray units do not require a great deal of electricity and usually run on 120 volts, manufacturers typically recommend that x-ray units be supplied with a dedicated circuit. If there are other loads on the line, the required power may not be available when the exposure is made and this can result in light films. When x-ray units are installed in multiple DTRs, a facility may be able to use one circuit to supply more than one x-ray unit as long as there are no other loads on this circuit. There is minimal chance that more than one x-ray unit on the circuit would be firing at the same time.

Intraoral X-ray Units*

| Model | <p style="text-align: center;">Air Techniques Provecta 70</p>  | <p style="text-align: center;">Focus X-ray</p>  |
|---|--|---|
| Company | Air Techniques 70 Cantiague Rock Road P.O. Box 870 Hicksville, NY 11802 (800) 247-8324 | Instrumentarium Dental, Inc. 300 West Edgerton Avenue Milwaukee, WI 53207-6025 (800) 558-6120 |
| Website | www.airtechniques.com | |
| Gov't point of contact | Eugene Heil (423) 753-9909 gheilgov@aol.com | Call company to obtain info on regional rep: (800) 558-6120 |
| Retail price | \$5,040 | \$4,885 |
| Gov't price | \$2,283.86 | \$2,969.80 |
| Warranty | 2 years | 2 years |
| AC/DC | AC | DC |
| Arm reach options (inches)* | 61.25", 68.5", 80" | 69", 75", 85" |
| Focus to skin distance ("cone length") | 8" standard | 9" standard 12" option |
| Rectangular collimator offered?** | no | yes |
| Exposure control panel | numerical and anatomical | numerical and anatomical |
| Exposure controls | corded trigger switch - standard remote control panel - optional remote trigger switch - optional | corded trigger switch - optional remote control panel - standard |
| Exposure time range | 0.02 - 3.2 seconds | 0.02 - 3.2 seconds |
| kVp | 70 kVp | 60, 70 kVp |
| mA | 8 mA | 7 mA |
| Electrical requirements | 108-132V, 60 Hz | 115 - 230V, 50/60Hz |
| Mounting systems available | wall | wall |
| Mobile version available? | yes | no |

* Most companies specify arm length with an 8" cone. For 12" cone, subtract 4".

** For those units not offering their own rectangular collimator, Dentsply/Rinn sells a rectangular collimator that slips over the end of most manufacturers' cones (Rinn Universal Collimator part #540853).

USAF Dental Evaluation & Consultation Service

| Model | Dent-X Endos AC  | Dent-X Endos ACP  | Dent-X Endos DC  |
|---|--|--|---|
| Company | Dent-X Corporation USA 250 Clearbrook Road Elmsford, NY 10523 (800) 225-1702 | Dent-X Corporation USA 250 Clearbrook Road Elmsford, NY 10523 (800) 225-1702 | Dent-X Corporation USA 250 Clearbrook Road Elmsford, NY 10523 (800) 225-1702 |
| Website | www.dent-x.com | www.dent-x.com | www.dent-x.com |
| Gov't point of contact | Adam Rabinovitch (914) 592-6100 x 210 | Adam Rabinovitch (914) 592-6100 | Adam Rabinovitch (914) 592-6100 |
| Retail price | \$3,939 | \$4,139 | \$5,139 |
| Gov't price | \$2,300 | \$2,400 | \$2,900 |
| Warranty | 2 years | 2 years | 2 years |
| AC/DC | AC | AC | DC |
| Arm reach options (inches)* | 56", 68", 76" | 56", 68", 76" | 59", 71", 78 " |
| Focus to skin distance ("cone length") | 8" standard 12" optional | 8" standard 12" optional | 8" standard 12" optional |
| Rectangular collimator offered?** | yes | yes | yes |
| Exposure control panel | numerical | numerical and anatomical | numerical and anatomical |
| Exposure controls | corded trigger switch - standard remote trigger switch - optional | corded trigger switch - standard remote trigger switch - optional | corded trigger switch - standard removable control panel faceplate for remote mounting - standard remote trigger switch - optional |
| Corded exposure switch | standard | standard | standard |
| Remote exposure switch | optional | optional | optional |
| Exposure time range | 0.02 - 3.2 seconds | 0.02 - 3.2 seconds | 0.01 - 2.0 seconds |
| kVp | 70 kVp | 70 kVp | 65 kVp |
| mA | 8 mA | 8 mA | 4, 5 mA |
| Electrical requirements | 120V,60Hz or 230V,50Hz | 120V,60Hz or 230V,50Hz | 110/120V, 50/60Hz or 220/230/240V, 50/60Hz |
| Mounting systems available | wall and ceiling | wall and ceiling | wall and ceiling |
| Mobile version available? | yes | yes | yes |

* Most companies specify arm length with an 8" cone. For 12" cone, subtract 4".

** For those units not offering their own rectangular collimator, Dentsply/Rinn sells a rectangular collimator that slips over the end of most manufacturers' cones (Rinn Universal Collimator part #540853).

| Model | <p style="text-align: center;">Gendex 765DC</p>  | <p style="text-align: center;">Gendex GX-770</p>  | <p style="text-align: center;">Gendex GX-1000</p>  |
|---|---|---|--|
| Company | Gendex Dental Systems 340 E. Main Street Lake Zurich, IL 60047 (888) 275-5286 | Gendex Dental Systems 340 E. Main Street Lake Zurich, IL 60047 (888) 275-5286 | Gendex Dental Systems 340 E. Main Street Lake Zurich, IL 60047 (888) 275-5286 |
| Website | www.gendex.com | www.gendex.com | www.gendex.com |
| Gov't point of contact | Call Gendex to obtain info on regional rep: (888) 275-5286 | Call Gendex to obtain info on regional rep: (888) 275-5286 | Call Gendex to obtain info on regional rep: (888) 275-5286 |
| Retail price | \$5,125 | \$4,380 | \$16,292 |
| Gov't price | \$2,722.50 | \$2,524.50 | \$5,688.65 current price \$8,960.61 new price to be effective soon |
| Warranty | 2 years | 2 years | 2 years |
| AC/DC | DC | AC | AC |
| Arm reach options (inches)* | 59", 69", 79" | 65", 74" | 68" |
| Focus to skin distance ("cone length") | 8" standard 12" optional | 8" standard 12" optional | 8" standard 12" optional 16" optional |
| Rectangular collimator offered?** | yes | no | no |
| Exposure control panel | numerical and anatomical | numerical | numerical |
| Exposure controls | corded trigger switch - optional removable control panel faceplate for remote mounting - standard remote trigger switch - optional | corded trigger switch - standard remote control panel - optional remote trigger switch - optional | remote control panel - standard |
| Exposure time range | 0.02 - 2.0 seconds | 0.05 - 1.65 seconds | 0.05 - 5.0 seconds |
| kVp | 65 kVp | 70 kVp | 50-100 kVp |
| mA | 7 mA | 7 mA | 10, 15 mA |
| Electrical requirements | 115V, 60Hz or 230V, 50Hz | 110-130V, 60Hz | 110-130V, 60 Hz 220V, 50Hz model avail |
| Mounting systems available | wall | wall | wall |
| Mobile version available? | no | no | no |

* Most companies specify arm length with an 8" cone. For 12" cone, subtract 4".

** For those units not offering their own rectangular collimator, Dentsply/Rinn sells a rectangular collimator that slips over the end of most manufacturers' cones (Rinn Universal Collimator part #540853).

| | | |
|---|--|---|
| Model | <p>Planmeca Intra</p>  | <p>Progeny JB-70</p>  |
| Company | Planmeca USA 100 N. Gary Ave., Suite A Roselle, IL 60172 (630) 529-2300 | Progeny Dental 1407 Barclay Boulevard Buffalo Grove, Illinois 60089 (888) 924-3800 |
| Website | www.planmeccausa.com | www.progenydenal.com |
| Gov't point of contact | Michelle Bottino (630) 529-2300 ext 3015 michelle.bottino@plameccausa.com | Tony Bavuso (847) 850-3800, ext 239 abavuso@progenydenal.com |
| Retail price | \$4,737 | \$4,500 |
| Gov't price | \$2,484 | \$2,525 |
| Warranty | 2 years | 2 years |
| AC/DC | DC | AC |
| Arm reach options (inches)* | 57", 65", 74", 77", 85" | 56", 66", 76" |
| Focus to skin distance ("cone length") | 8" standard 12" optional | 8" standard 12" optional |
| Rectangular collimator offered?* | yes | yes |
| Exposure control panel | numerical and anatomical | numerical and anatomical |
| Exposure controls | corded trigger switch - optional remote control panel - standard | corded trigger switch - optional removable control panel faceplate for remote mounting - standard |
| Exposure time range | 0.01 - 3.2 seconds | 0.05 - 1.65 seconds |
| kVp | 50, 52, 55, 57, 60, 63, 66, 70 kVp | 70 kVp |
| mA | 2, 3, 4, 5, 6, 7, 8 mA | 7 mA |
| Electrical requirements | 100/110/220/240V; 50/60 Hz | 120V, 50/60Hz; or 230V, 50/60 Hz |
| Mounting systems available | wall and ceiling Cat5 cable pre-wired through arm for connection to digital sensor | wall |
| Mobile version available? | yes | no |

* Most companies specify arm length with an 8" cone. For 12" cone, subtract 4".

** For those units not offering their own rectangular collimator, Dentsply/Rinn sells a rectangular collimator that slips over the end of most manufacturers' cones (Rinn Universal Collimator part #540853).

| | Sirona Heliodent DS | Sirona Heliodent Vario |
|---|---|---|
| Model |  |  |
| Company | Sirona Dental Systems LLC 4835 Sirona Drive Suite 100 Charlotte, NC 28273 (800) 659-5977 | Sirona Dental Systems LLC 4835 Sirona Drive Suite 100 Charlotte, NC 28273 (800) 659-5977 |
| Website | www.sirona.com | www.sirona.com |
| Gov't point of contact | Patricia Czaplinsky (800) 659-5977, Ext. 117 Patricia.Czaplinsky@Sirona.com | Patricia Czaplinsky (800) 659-5977, ext. 117 Patricia.Czaplinsky@Sirona.com |
| Retail price | \$4,845 | \$3,895 |
| Gov't price | \$2,822.25 | \$2,406.15 |
| Warranty | 2 Years Replacement Parts | 2 Years Replacement Parts |
| AC/DC | DC | AC |
| Arm reach options (inches)* | 59", 71", 80" | 59", 71", 79" |
| Focus to skin distance ("cone length") | 8" standard 12" optional | 8" standard 12" optional |
| Rectangular collimator offered?*** | yes | yes |
| Exposure control panel | numerical and anatomical | numerical and anatomical |
| Exposure controls | corded trigger switch - standard remote control panel - optional remote trigger switch - optional | corded trigger switch - standard remote trigger switch - optional |
| Exposure time range | 0.01 - 3.2 seconds | 0.03 - 3.2 seconds |
| kVp | 60 kVp | 70 kVp |
| mA | 7 mA | 7 mA |
| Electrical requirements | 100-125V or 208-230V, 50/60 HZ | 120 or 220V, 50/60 HZ |
| Mounting systems available | wall | Wall |
| Mobile version available? | yes | yes |

* Most companies specify arm length with an 8" cone. For 12" cone, subtract 4".

** For those units not offering their own rectangular collimator, Dentsply/Rinn sells a rectangular collimator that slips over the end of most manufacturers' cones (Rinn Universal Collimator part #540853).