CALCULATION TECHNIQUE

DENTAL RADIOGRAPHIC SYSTEMS

(Test Procedure DRA - Form FDA 2785)

A. REPRODUCIBILITY

1. Refer to data items 12, 14, 16, and 18 of the Field Test Record. (Use data items 20, 22, 24, 26, 28, and 30, if ten exposures were made for reproducibility.)

a. Using the following equation, substituting n = 4 or n = 10, as appropriate, calculate the average exposure: $\overline{E}_1$

$$\overline{E_1} = \frac{1}{n}\sum_{i=1}^{n} X_i$$

where the X_i are the data items referred to above. Record the value of $\overline{E}_1$ at Result 1.

b. Calculate the coefficient of variation, C_1, as follows:

$$C_1 = \frac{1}{\overline{E}_1}\left(\sum_{i-1}^{n}\left(X_i - \overline{E_1}\right)^2/(n-1)\right)^{1/2}$$

where n = 4 or n = 10, depending on the number of exposures. Record the value of C_1 at Result 2.

2. Refer to data items 5, 6, and 7 on the Field Test Record, and compute the mAs, if item 7 is blank, by multiplying item 5 by item 6. If item 6 is given as pulses, convert to time in seconds by dividing the pulses by 60.

3. Calculate the average exposure per mAs, $\overline{X_1}$ as follows:

$$\overline{X_1} = \overline{E_1} / mAs_1$$

Record the value of $\overline{X_1}$ at Result 3.

4. Refer to data items 33-36, calculating the average exposure, $\overline{E}_2$, as follows:

$$\overline{E_2} = \frac{1}{n}\sum_{i=1}^{n} X_i$$

where the X_i are the data items referred to above. Record the value of $\overline{E}_2$ at Result 4.

5. Calculate the coefficient of variation, C_2, as before:

$$C_1 = \frac{1}{\overline{E_2}} \left(\sum_{i-1}^{n} (X_i - \overline{E_2})^2 / (n - 1) \right)^{1/2}$$

Record the value of C_2 at Result 5.

6. For controls manufactured before May 1994 refer to data items 6 and 32 and compute the mAs by multiplying item 6 by item 32. If item 6 is given in pulses, convert to time in seconds by dividing by 60. For controls manufactured on or after May 1994 item 32 should be in mAs units already.

7. Calculate the average exposure for mAs, $\overline{X_2}$, as follows:

$$\overline{X_2} = \overline{E_2} / mAs$$

Record the value of $\overline{X_2}$ at Result 6.

B. LINEARITY:

1. Refer to Results 3 and 6 and calculate the coefficient of linearity L, as follow:

$$L = \frac{\left| \overline{X_1} - \overline{X_2} \right|}{(\overline{X_1} + \overline{X_2})}$$

where $\overline{X_1}$ and $\overline{X_2}$ are average exposures per mAs. Record the value of L at Result 7.

C. BEAM QUALITY

1. Refer to data items 8-11 and convert to normalized exposures by dividing each item by E_1 (Result 1). Record the normalized exposures and the appropriate aluminum thickness at Result 8 through 11.

2. On semi-log paper, plot the five normalized exposures along the logarithmic scale with the corresponding thickness of aluminum attenuators along the linear axis. Draw a smooth curve fit to the points and determine the observed half-value layer (HVL_{obs}) as that thickness of added aluminum which would yield a normalized exposure of 0.50. Record the observed HVL and the selected kVp (data item 4 at Result 12.

3. To determine the actual HVL, correction for geometry effects and energy dependence must be made. For testing with the MDH X-Ray Monitor:

Actual HVL = (1.429 x HVL_{obs} - 0.394) mm (50-70 kVp)

Actual HVL = (1.250 x HVL_{obs} - 0.420) mm (above 70 kVp)

These equations do not represent a universal correction to the observed HVL. They are only applicable to observed HVL's in the vicinity of the limits specified in the x-ray Performance Standard. For extremely large observed HVL's, the equations underestimate the actual HVL. The intent of the equation is to enable accurate

compliance determination for x-ray beams with marginal observed HVL's. Record the value of the actual HVL and the selected kVp at Result 13.

D. TIMER ACCURACY

1. Refer to data item 6 on the Field Test Record. (Again, convert pulses to seconds by dividing pulses by 60.) If this item is blank, omit the timer accuracy calculation. Otherwise, record data item 6 at Result 14 as the indicated time setting.

2. Refer to data items 13, 15, 17 and 19 (21, 23, 25, 27, 29, 31). Choose the one value that has the largest deviation from the indicated time setting. Calculate this deviation at the absolute value of the measured time subtracted from the indicated time. Record the deviation at Result 15.

3. Calculate the timer inaccuracy as follows:

   % timer inaccuracy = maximum deviation x 100 / indicated timer setting

   Record the percent timer inaccuracy at Result 16.

E. MINIMUM SOURCE TO SKIN DISTANCE DETERMINATION

Refer to data item 39 on the Field Test Record, the measured outside separation (in cm) of the image of the focal spot strips, I. Calculate the minimum SSD as follows:

min SSD = ((136.65 / (I-6.35)) - 7.66) cm

Record "min SSD" at Result 17.

F. MAXIMUM FIELD SIZE AT MINIMUM SSD

Refer to data item 38 on the Field Test Record. Record this data item at Result 18.

RESULTS RECORD

DENTAL RADIOGRAPHIC SYSTEMS

(Test Procedure DRA-Form FDA 2785)

FIELD TEST
SERIAL NO._____

REPRODUCIBILITY AND LINEARITY

1. Average Exposure, $\overline{E_1}$ = _____ mR
2. Coefficient of Variation, C_1 = _____
3. Average Exposure/mAs, $\overline{X_1}$ _____ mR/mAs
4. Average Exposure, $\overline{E_2}$ = _____ mR
5. Coefficient of Variation, C_2 = _____
6. Average Exposure/mAs, $\overline{X_2}$ = _____ mR/mAs
7. Coefficient of Linearity, L = _____

BEAM QUALITY

Normalized Exposures:

8. N_4 = _____ at _____ mm Al
9. N_3 = _____ at _____ mm Al
10. N_2 = _____ at _____ mm Al
11. N_1 = _____ at _____ mm Al

    N_0 = 1.00 at 0.0 mm Al

12. Observed HVL = _____ mm Al at _____ kVp.
13. Actual HVL = _____ mm Al at _____ kVp.

TIMER ACCURACY

14. Indicated time setting = _____ seconds
15. Maximum deviation from indicated setting = _____ seconds
16. Percent timer inaccuracy = _____ %

SSD DETERMINATION

17. Minimum SSD = _____ cm

MAXIMUM FIELD SIZE AT MIN SSD

18. Field Size = _____ cm