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Handbook of Selected Organ Doses for Projections Common in Pediatric Radiology

HEW Publication (FDA) 79-8079

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# Handbook of Selected Organ Doses for Projections Common in Pediatric Radiology

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Food and Drug Administration

HEW Publication (FDA) 79-8079

# Handbook of Selected Organ Doses for Projections Common in Pediatric Radiology

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# INTRODUCTION

This handbook contains data from which absorbed dose (mrad) to selected organs can be estimated for common projections in pediatric radiology. The organ doses are for three reference patients: a newborn (0-6 months), a 1-year old child and a 5-year old child. One intent of the Handbook is to permit the user to evaluate the effect on organ dose to these reference pediatric patients as a function of certain changes in technical parameters used in or among facilities. A second intent is to permit a comparison to be made of organ doses as a function of age. This comparison can be extended to a reference adult by referring to the previous Handbook of Selected Organ Doses for Projections Common in Diagnostic Radiology, FDA 76-8031. Assignment of organ doses to individual pediatric patients using the Handbook data is not recommended unless the physical characteristics of the patient closely correlate with one of the three reference pediatric patients given in Appendix A.

For the following projections, data for one or more of the three pediatric patients have been tabulated:

AP, anteroposterior - radiation incident on the anterior skin surface (A special case of the AP projection is the Townes, in which the radiation field is incident at a 30 degree angle caudad on the anterior skin surface)

PA, posteroanterior - radiation incident on the posterior skin surface

LAT, lateral - radiation incident on the right or left lateral skin surface

OBL, oblique - radiation incident at 45 degrees to the normal on the anterior skin surface (designated as posterior oblique, PO)



The projections tabulated are:

| | Table Number | | | |
|---|---|---|---|---|
| | AP | PA | LAT | OBL |
| Townes (all ages) | 1 | | | |
| Skull (all ages) | 2 | | 4 | |
| (1- and 5-year old) | | 3 | | |
| Neck (1-year old) | 5 | | 6 | |
| Chest (all ages) | 7 | 8 | 9 | |
| (5-year old) | | | | 10 |
| Kidneys (all ages) | 11 | | | |
| Bladder (5-year old) | 12 | | | |
| (1- and 5-year old) | | | | 13 |
| Erect Abdomen (5-year old) | 14 | | | |
| Abdomen (all ages) | 15 | 16 | 17 | |
| Pelvis (all ages) | 18 | | | |
| Hip (5-year old) | 19 | | | |
| (1- and 5-year old) | | | | 20 |

The organs for which data are tabulated are: testes, ovaries, thyroid, active bone marrow, lungs and total body. The doses tabulated are the average dose to the organ after being weighted over its entire mass and the values tabulated are normalized to a 1 roentgen entrance exposure (free-in-air). Therefore, the user must apply the actual entrance exposures at a given facility to estimate local doses. The tabulated total body and active bone marrow doses can be converted to another useful quantity, integral dose (g-rad), using the conversion factors given in the Technical Notes on Table Entries, page 8.

The beam qualities (HVL, mm Al) listed are nominal values and have been selected and matched to x-ray spectra based on an observed narrow range of kVp, total filtration and waveform. Beam qualities significantly different from these conditions have not been investigated. The observed increase in dose per roentgen as a function of increasing HVL can be misleading, since the required entrance exposure to achieve a desired radiographic image is usually lower at the higher HVL's. Therefore, local exposure conditions must be applied.

Complete discussions on the reference pediatric phantoms, the selection of the pediatric radiology projections, the technique factors associated with each of those, and the methodology used to obtain the data tabulated in the Handbook are given in a companion reference "Quantification of Current Practice in Pediatric Roentgenography for Organ Dose Calculations," HEW Publication (FDA) 79-8078. In that report, pediatric phantoms for two additional reference patients (a 10-year old and a 15-year old) were included, along with projections and technical factors appropriate for those age groups. Unfortunately, the computer codes for these phantoms are not operational and no organ doses could be obtained at this time.

## INSTRUCTIONS FOR USE OF HANDBOOK

1. Select the radiographic projection (e.g. PA Abdomen). The field centers that were used in locating each of the radiographic projections are given in appendix B. The anatomical limits of the x-ray field sizes denoted as collimated to the body part are described in appendix C.

2. Determine the actual beam quality (HVL, mm Al) and entrance exposure free-in-air (roentgen) at the facility. If not determined by direct measurement, beam quality and radiation output can be estimated from references (1-8) when the kVp, total filtration and waveform of the x-ray machine are known.

3. Look up the organ dose (mrad) for 1 roentgen entrance exposure in tables 1-20. Since the listed HVL's are nominal and have not been fitted by a smooth function, selection of the closest table entry to the beam quality of interest is recommended. Source-to-image receptor distances (SID) within 10 inches (25 cm) of the listed SID will not result in variation in dose larger than 10 percent.

4. Multiply the organ dose (mrad) obtained in instruction 3 by the actual entrance exposure free-in-air (roentgen) to obtain the organ dose for the projection. The dose represents the value for the reference pediatric patients described in HEW Publication (FDA) 79-8078.



5. To obtain a selected organ dose for an examination consisting of multiple projections, repeat instructions 1 through 4 for each set of conditions and sum the resultant doses.

## TECHNICAL NOTES ON TABLE ENTRIES

Note 1. The symbol + in the table indicates no detectable contribution to organ dose was observed.

Note 2. A table entry in parenthesis ( ) indicates that the coefficient of variation was large in relationship to the differences in the mrad/R values as a function of HVL. Therefore, the trend for mrad/R as a function of HVL could not be resolved. Values given are the average of the mrad/R values obtained for all the indicated HVL conditions.

Note 3. The values for active bone marrow and total body given in mrad/R can be converted to integral dose per roentgen (g-rad/R) for each reference pediatric patient by multiplying by the following factors:

| | Active bone marrow | Total body |
|---|---|---|
| Newborn | 0.040 | 3.96 |
| 1-year old | 0.150 | 10.4 |
| 5-year old | 0.401 | 20.0 |

Note 4. The symbol * in the maximum coefficient of variation (%) column indicates the maximum coefficient of variation was greater than 50 percent.



The maximum coefficient of variation is the largest value obtained for any of the data in the row. Typically the coefficients of variation for all values in the row were about the same magnitude as the maximum. When this is not the case, the superscript [a] in this column indicates that the first value given is for the field size collimated to the body part and the second value given is for the field size collimated to the film size.

Note 5. The coefficient of variation is a measure of the reproducibility of the organ dose calculation, using a Monte Carlo dosimetry technique (see Organ Doses in Diagnostic Radiology, FDA 76-8030).

Coefficient of variation (in percent) =

$$\frac{100 \times \text{one standard deviation}}{\text{organ dose}}$$

## REFERENCES

### Beam Quality (mm Al HVL)


1. National Council on Radiation Protection and Measurements, "Medical X-ray and Gamma-ray Protection for Energies up to 10 MeV, Equipment Design and Use," NCRP Report No. 33, Washington, National Council on Radiation Protection and Measurements, 1968 (p. 43).

2. U.S. Department of Health, Education, and Welfare, PHS, Food and Drug Administration, Bureau of Radiological Health, "Gonad Dose and Genetically Significant Dose from Diagnostic Radiology, U.S., 1964 and 1970," HEW Publication (FDA) 76-8034 (Appendix E, Table E-8), Washington, Department of Health, Education, and Welfare.

3. National Council on Radiation Protection and Measurements, "Medical Radiation Exposure of Pregnant and Potentially Pregnant Women," NCRP Report No. 54, Washington, National Council on Radiation Protection and Measurements, 1977 (p. 17).

4. Kelly, J.P. and E.D. Trout, "Physical Characteristics of the Radiations from 2-pulse, 12-pulse, and 1000-pulse X-ray Equipment," Radiology 100, 653 (1971).




### Radiation Output (mR/mAs)


5. The Hospital Physicist's Association, "The Physics of Radiodiagnosis, Report B, Measurements Referring to Diagnostic X-ray Beams," HPA Report Series No. 8 (Appendix V), London.

6. U.S. Department of Health, Education, and Welfare, PHS, Food and Drug Administration, Bureau of Radiological Health, "Population Exposure to X Rays, U.S. 1970," HEW Publication (FDA) 73-8047, Washington, Department of Health, Education, and Welfare, 1973 (p.24).

7. Shulz, R.J. and C. Gignac, "Application of Tissue-air-ratios for Patient Dosage in Diagnostic Radiology," Radiology 120, 687, (1976).

8. McCullough, E.C. and J.R. Cameron, "Exposure Rates from Diagnostic X-ray Units," British Journal of Radiology 43, 448 (1970).

Table 1. TOWNES - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | 102 [40] | 102 [40] | 91 [36] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to film size #1 | 20 x 25 [8 x 10] | 20 x 25 [8 x 10] | |
| Collimated to film size #2 | | 25 x 30 [10 x 12] | 25 x 30 [10 x 12] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) ⟶ | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION ⟶ | | Film #1 | Film #2 | Film #1 | Film #2 | Film #1 | Film #2 | |
| Testes | Newborn | + | | + | | + | | |
| | 1-year | + | + | + | + | + | + | |
| | 5-year | | + | | + | | + | |
| Ovaries | Newborn | (2) | | (2) | | (2) | | * |
| | 1-year | + | + | + | + | + | + | |
| | 5-year | | + | | + | | + | |
| Thyroid | Newborn | (490) | | (490) | | (490) | | 22 |
| | 1-year | (270) | (410) | (270) | (410) | (270) | (410) | 19 |
| | 5-year | | (240) | | (240) | | (240) | 18 |
| Active Bone Marrow | Newborn | 57 | | 73 | | 78 | | 1.5 |
| | 1-year | 26 | 33 | 35 | 44 | 37 | 48 | 1.3 |
| | 5-year | | 23 | | 35 | | 42 | 1.0 |
| Lungs | Newborn | 142 | | 155 | | 193 | | 6.5 |
| | 1-year | 14 | (56) | 21 | (56) | 27 | (56) | 10 |
| | 5-year | | 15 | | 27 | | 29 | 8.7 |
| Total Body | Newborn | 297 | | 326 | | 345 | | 0.5 |
| | 1-year | 155 | 188 | 181 | 213 | 192 | 229 | 0.5 |
| | 5-year | | 97 | | 122 | | 132 | 0.5 |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.
* See Note 4, pages 8 and 9.

Table 2. AP SKULL - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | 102 [40] | 102 [40] | 91 [36] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to film size #1 | 20 x 25 [8 x 10] | 20 x 25 [8 x 10] | |
| Collimated to film size #2 | | 25 x 30 [10 x 12] | 25 x 30 [10 x 12] |



| | | ORGAN DOSE (mrad/R) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BEAM QUALITY (HVL, mm Al) ⟶ | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
| COLLIMATION ⟶ | | Film #1 | Film #2 | Film #1 | Film #2 | Film #1 | Film #2 | |
| Testes | Newborn | + | | + | | + | | |
| | 1-year | + | + | + | + | + | + | |
| | 5-year | | + | | + | | + | |
| Ovaries | Newborn | + | | + | | + | | |
| | 1-year | + | + | + | + | + | + | |
| | 5-year | | + | | + | | + | |
| Thyroid | Newborn | 682 | | 802 | | 857 | | 4.0 |
| | 1-year | 509 | 509 | 540 | 540 | 585 | 585 | 6.0 |
| | 5-year | | 467 | | 530 | | 636 | 6.2 |
| Active Bone Marrow | Newborn | 45 | | 58 | | 62 | | 1.7 |
| | 1-year | 26 | 38 | 35 | 51 | 36 | 54 | 1.4 |
| | 5-year | | 26 | | 34 | | 37 | 0.6 |
| Lungs | Newborn | 47 | | 68 | | 72 | | 10 |
| | 1-year | 18 | 66 | 23 | 77 | 31 | 82 | 8.8 |
| | 5-year | | 28 | | 40 | | 43 | 3.5 |
| Total Body | Newborn | 275 | | 307 | | 324 | | 0.6 |
| | 1-year | 161 | 200 | 188 | 232 | 198 | 248 | 0.5 |
| | 5-year | | 107 | | 124 | | 133 | 0.2 |

+ See Note 1, page 8.

Table 3. PA SKULL - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| REFERENCE PATIENT | SID AND FIELD SIZE | | |
|---|---|---|---|
| | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | Not Applicable | 102 [40] | 91 [36] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to film size #1 | | 20 x 25 [8 x 10] | |
| Collimated to film size #2 | | 25 x 30 [10 x 12] | 25 x 30 [10 x 12] |



| | | ORGAN DOSE (mrad/R) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BEAM QUALITY (HVL, mm Al) ⟶ | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
| COLLIMATION ⟶ | | Film #1 | Film #2 | Film #1 | Film #2 | Film #1 | Film #2 | |
| Testes | Newborn | + | + | + | + | + | + | |
| | 1-year | | + | | + | | + | |
| | 5-year | | | | | | | |
| Ovaries | Newborn | + | + | + | + | + | + | |
| | 1-year | | + | | + | | + | |
| | 5-year | | | | | | | |
| Thyroid | Newborn | (130) | (130) | (130) | (130) | (130) | (130) | 35 |
| | 1-year | | (90) | | (90) | | (90) | 26 |
| | 5-year | | | | | | | |
| Active Bone Marrow | Newborn | 32 | 50 | 43 | 68 | 46 | 72 | 1.4 |
| | 1-year | | 35 | | 48 | | 51 | 1.1 |
| | 5-year | | | | | | | |
| Lungs | Newborn | 17 | 60 | 23 | 76 | 26 | 78 | 9.0 |
| | 1-year | | 27 | | 40 | | 47 | 6.4 |
| | 5-year | | | | | | | |
| Total Body | Newborn | 155 | 195 | 180 | 226 | 192 | 241 | 0.5 |
| | 1-year | | 105 | | 124 | | 131 | 0.4 |
| | 5-year | | | | | | | |



\+ See Note 1, page 8.
(*) See Note 2 for explanation of values in parenthesis, page 8.

Table 4. LAT SKULL - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | 102 [40] | 102 [40] | 91 [36] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to film size #1 | 25 x 20 [10 x 8] | 25 x 20 [10 x 8] | |
| Collimated to film size #2 | | 30 x 25 [12 x 10] | 30 x 25 [12 x 10] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | | Film #1 | Film #2 | Film #1 | Film #2 | Film #1 | Film #2 | |
| Testes | Newborn | + | | + | | + | | |
| | 1-year | + | + | + | + | + | + | |
| | 5-year | | + | | + | | + | |
| Ovaries | Newborn | + | | + | | + | | |
| | 1-year | + | + | + | + | + | + | |
| | 5-year | | + | | + | | + | |
| Thyroid | Newborn | (460) | | (460) | | (460) | | 13 |
| | 1-year | (300) | (380) | (300) | (380) | (300) | (380) | 20 |
| | 5-year | | 322 | | 364 | | 425 | 7.4 |
| Active Bone Marrow | Newborn | 35 | | 46 | | 48 | | 0.9 |
| | 1-year | 28 | 34 | 38 | 47 | 39 | 51 | 1.5 |
| | 5-year | | 26 | | 35 | | 38 | 0.6 |
| Lungs | Newborn | 16 | | 23 | | 27 | | 9.3 |
| | 1-year | 9 | 21 | 15 | 24 | 18 | 29 | 12 |
| | 5-year | | 10 | | 16 | | 17 | 5.4 |
| Total Body | Newborn | 240 | | 268 | | 278 | | 0.4 |
| | 1-year | 166 | 196 | 192 | 227 | 203 | 239 | 0.5 |
| | 5-year | | 107 | | 125 | | 133 | 0.2 |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.

Table 5. AP NECK - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | Not Applicable | 102 [40] | Not Applicable |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | | 16 x 14 [6.3x5.5] | |
| Collimated to film size | | 20 x 25 [8 x 10] | |



| | | ORGAN DOSE (mrad/R) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BEAM QUALITY (HVL, mm Al) ⟶ | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
| COLLIMATION ⟶ | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn<br>1-year<br>5-year | + | + | + | + | + | + | |
| Ovaries | Newborn<br>1-year<br>5-year | + | (3) | + | (3) | + | (3) | * |
| Thyroid | Newborn<br>1-year<br>5-year | 509 | 509 | 540 | 540 | 585 | 585 | 6.0 |
| Active Bone Marrow | Newborn<br>1-year<br>5-year | 20 | 54 | 28 | 71 | 30 | 76 | 1.2 |
| Lungs | Newborn<br>1-year<br>5-year | 41 | 234 | 54 | 287 | 63 | 301 | 4.1 |
| Total Body | Newborn<br>1-year<br>5-year | 98 | 204 | 115 | 240 | 124 | 254 | 0.3 |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.
** See Note 4, pages 8 and 9.

Table 6. LAT NECK - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | Not Applicable | 102 [40] | Not Applicable |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | | 15 x 13 [5.9x5.1] | |
| Collimated to film size | | 20 x 25 [8 x 10] | |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn 1-year 5-year | + | + | + | + | + | + | |
| Ovaries | Newborn 1-year 5-year | + | + | + | + | + | + | |
| Thyroid | Newborn 1-year 5-year | (370) | (470) | (370) | (470) | (370) | (470) | 15 |
| Active Bone Marrow | Newborn 1-year 5-year | 24 | 60 | 32 | 81 | 35 | 87 | 1.1 |
| Lungs | Newborn 1-year 5-year | 32 | 156 | 40 | 212 | 45 | 241 | 4.4 |
| Total Body | Newborn 1-year 5-year | 93 | 204 | 108 | 238 | 117 | 254 | 0.3 |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.

Table 7. AP CHEST - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | 102 [40] | 102 [40] | 183 [72] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | 13 x 16 [5.1x6.3] | 17 x 23 [6.7x9.1] | 21 x 30 [8.3x11.8] |
| Collimated to film size | 20 x 25 [8 x 10] | 25 x 30 [10 x 12] | 28 x 36 [11 x 14] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | 2.0 | | 2.5 | | 3.0 | | 3.5 | | |
|---|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | Body part | Film size | Body part | Film size | Body part | Film size | Body part | Film size | Max. CV (%)* |
| Testes — Newborn | (7) | (14) | (7) | (14) | (7) | (14) | | | * |
| Testes — 1-year | + | + | + | + | + | + | | | |
| Testes — 5-year | | | + | + | + | + | + | + | |
| Ovaries — Newborn | (6) | (50) | (6) | (50) | (6) | (50) | | | * |
| Ovaries — 1-year | (19) | (23) | (19) | (23) | (19) | (23) | | | * |
| Ovaries — 5-year | | | (2) | (3) | (2) | (3) | (2) | (3) | * |
| Thyroid — Newborn | 682 | 682 | 802 | 802 | 857 | 857 | | | 4.0 |
| Thyroid — 1-year | 509 | 509 | 540 | 540 | 585 | 585 | | | 6.0 |
| Thyroid — 5-year | | | 650 | 650 | 770 | 770 | 880 | 880 | 13 |
| Active Bone Marrow — Newborn | 81 | 129 | 111 | 169 | 116 | 188 | | | 1.5 |
| Active Bone Marrow — 1-year | 69 | 84 | 92 | 113 | 101 | 122 | | | 1.3 |
| Active Bone Marrow — 5-year | | | 88 | 103 | 121 | 140 | 127 | 153 | 1.1 |
| Lungs — Newborn | 530 | 530 | 610 | 610 | 630 | 630 | | | 3.6 |
| Lungs — 1-year | 445 | 455 | 522 | 547 | 554 | 586 | | | 2.7 |
| Lungs — 5-year | | | 537 | 537 | 656 | 656 | 656 | 656 | 2.2 |
| Total Body — Newborn | 240 | 447 | 274 | 501 | 289 | 534 | | | 0.4 |
| Total Body — 1-year | 194 | 277 | 227 | 320 | 240 | 342 | | | 0.4 |
| Total Body — 5-year | | | 211 | 273 | 255 | 323 | 261 | 335 | 0.4 |



\+ See Note 1, page 8.
( ) See Note 2 for explanation of values in parenthesis, page 8.
* See Note 4 for explanation of maximum coefficient of variation (Max. CV) values, pages 8 and 9.

Table 8. PA CHEST - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | 183 [72] | 183 [72] | 183 [72] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | 13 x 15 [5.1x5.9] | 17 x 23 [6.7x9.1] | 21 x 30 [8.3x11.8] |
| Collimated to film size | 20 x 25 [8 x 10] | 25 x 30 [10 x 12] | 28 x 36 [11 x 14] |



| | | ORGAN DOSE (mrad/R) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BEAM QUALITY (HVL, mm Al) → | | 2.0 | | 2.5 | | 3.0 | | 3.5 | | |
| COLLIMATION → | | Body part | Film size | Body part | Film size | Body part | Film size | Body part | Film size | Max. CV (%)* |
| Testes | Newborn | (3) | (18) | (3) | (18) | (3) | (18) | | | * |
| | 1-year | + | + | + | + | + | + | | | |
| | 5-year | | | + | + | + | + | + | + | |
| Ovaries | Newborn | (12) | (60) | (12) | (60) | (12) | (60) | | | * |
| | 1-year | (2) | (4) | (2) | (4) | (2) | (4) | | | * |
| | 5-year | | | (8) | (20) | (8) | (20) | (8) | (20) | * |
| Thyroid | Newborn | 137 | 194 | 171 | 264 | 215 | 315 | | | 26,16[a] |
| | 1-year | (120) | (190) | (120) | (190) | (120) | (190) | | | 32 |
| | 5-year | | | (160) | (190) | (160) | (190) | (160) | (190) | 31 |
| Active Bone Marrow | Newborn | 136 | 230 | 176 | 296 | 187 | 312 | | | 0.8 |
| | 1-year | 123 | 155 | 162 | 202 | 169 | 220 | | | 1.1 |
| | 5-year | | | 144 | 170 | 196 | 232 | 206 | 247 | 1.0 |
| Lungs | Newborn | 524 | 558 | 578 | 630 | 610 | 691 | | | 2.3 |
| | 1-year | 478 | 488 | 567 | 587 | 613 | 638 | | | 2.7 |
| | 5-year | | | 526 | 540 | 634 | 651 | 632 | 660 | 2.3 |
| Total Body | Newborn | 257 | 476 | 292 | 537 | 311 | 568 | | | 0.3 |
| | 1-year | 218 | 311 | 252 | 357 | 268 | 384 | | | 0.4 |
| | 5-year | | | 213 | 270 | 257 | 326 | 262 | 332 | 0.4 |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.
*,[a] See Note 4 for explanation of maximum coefficient of variation (Max. CV) values, pages 8 and 9.

Table 9. LAT CHEST - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | 102 [40] | 102 [40] | 183 [72] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | 13 x 16 [5.1x6.3] | 16 x 14 [6.3x5.5] | 21 x 30 [8.3x11.8] |
| Collimated to film size | 20 x 25 [8 x 10] | 25 x 30 [10 x 12] | 28 x 36 [11 x 14] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | 2.0 | | 2.5 | | 3.0 | | 3.5 | | |
|---|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | Body part | Film size | Body part | Film size | Body part | Film size | Body part | Film size | Max. CV (%)* |
| Testes | | | | | | | | | |
| Newborn | (6) | (8) | (6) | (8) | (6) | (8) | | | * |
| 1-year | + | + | + | + | + | + | | | |
| 5-year | | | + | (7) | + | (7) | + | (7) | |
| Ovaries | | | | | | | | | |
| Newborn | (5) | (60) | (5) | (60) | (5) | (60) | | | * |
| 1-year | (13) | (40) | (13) | (40) | (13) | (40) | | | * |
| 5-year | | | (10) | (19) | (10) | (19) | (10) | (19) | * |
| Thyroid | | | | | | | | | |
| Newborn | (410) | (600) | (410) | (600) | (410) | (600) | | | 16 |
| 1-year | (380) | (480) | (380) | (480) | (380) | (480) | | | 21 |
| 5-year | | | 440 | 440 | 510 | 510 | 560 | 560 | 17 |
| Active Bone Marrow | | | | | | | | | |
| Newborn | 102 | 160 | 146 | 225 | 173 | 281 | | | 1.0 |
| 1-year | 83 | 101 | 120 | 147 | 150 | 182 | | | 1.3 |
| 5-year | | | 93 | 111 | 132 | 153 | 138 | 162 | 1.2 |
| Lungs | | | | | | | | | |
| Newborn | 591 | 655 | 695 | 776 | 720 | 831 | | | 2.2 |
| 1-year | 544 | 551 | 629 | 654 | 706 | 730 | | | 2.4 |
| 5-year | | | 500 | 538 | 592 | 626 | 612 | 616 | 2.2 |
| Total Body | | | | | | | | | |
| Newborn | 244 | 433 | 296 | 520 | 320 | 563 | | | 0.3 |
| 1-year | 184 | 268 | 231 | 333 | 257 | 370 | | | 0.4 |
| 5-year | | | 185 | 246 | 225 | 294 | 230 | 298 | 0.4 |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.
* See Note 4 for explanation of maximum coefficient of variation (Max. CV) values, pages 8 and 9.

Table 10. PO CHEST - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| REFERENCE PATIENT | SID AND FIELD SIZE | | |
|---|---|---|---|
| | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | | | 183 [72] |
| Field size at image receptor (centimeters [inches]) | Not Applicable | Not Applicable | |
| Collimated to body part (App.C) | | | 21 x 30 [8.3x11.8] |
| Collimated to film size | | | 28 x 36 [11 x 14] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | | 2.5 | | 3.0 | | 3.5 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn<br>1-year<br>5-year | (4) | (18) | (4) | (18) | (4) | (18) | * |
| Ovaries | Newborn<br>1-year<br>5-year | (6) | (6) | (6) | (6) | (6) | (6) | * |
| Thyroid | Newborn<br>1-year<br>5-year | 620 | 620 | 720 | 720 | 860 | 860 | 13 |
| Active Bone Marrow | Newborn<br>1-year<br>5-year | 90 | 100 | 125 | 144 | 135 | 154 | 1.1 |
| Lungs | Newborn<br>1-year<br>5-year | 438 | 475 | 535 | 557 | 573 | 574 | 2.4 |
| Total Body | Newborn<br>1-year<br>5-year | 208 | 261 | 253 | 316 | 258 | 323 | 0.4 |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.
* See Note 4, pages 8 and 9.

Table 11. AP KIDNEYS - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
|---|---|---|---|
| Source-to-image receptor distance (SID) (centimeters [inches]) | 102 [40] | 102 [40] | 102 [40] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | 11 x 8 [4.3x3.1] | 16 x 14 [6.3x5.5] | 20 x 18 [7.9x7.1] |
| Collimated to film size | 25 x 20 [10 x 8] | 25 x 20 [10 x 8] | 30 x 25 [12 x 10] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn | (8) | (110) | (8) | (110) | (8) | (110) | *,47[a] |
| | 1-year | (12) | (19) | (12) | (19) | (12) | (19) | * |
| | 5-year | (4) | (20) | (4) | (20) | (4) | (20) | * |
| Ovaries | Newborn | (40) | 390 | (40) | 560 | (40) | 580 | *,11[a] |
| | 1-year | (150) | (210) | (150) | (210) | (150) | (210) | 40 |
| | 5-year | (70) | 270 | (70) | 370 | (70) | 400 | 32,11[a] |
| Thyroid | Newborn | (6) | (60) | (6) | (60) | (6) | (60) | * |
| | 1-year | (2) | (5) | (2) | (5) | (2) | (5) | * |
| | 5-year | (1) | (2) | (1) | (2) | (1) | (2) | * |
| Active Bone Marrow | Newborn | 39 | 149 | 54 | 206 | 57 | 214 | 1.6 |
| | 1-year | 36 | 67 | 52 | 98 | 57 | 104 | 1.6 |
| | 5-year | 27 | 50 | 39 | 73 | 44 | 78 | 1.5 |
| Lungs | Newborn | 178 | 491 | 201 | 552 | 214 | 620 | 3.5 |
| | 1-year | 38 | 158 | 48 | 179 | 51 | 206 | 3.9 |
| | 5-year | 29 | 129 | 39 | 155 | 44 | 182 | 4.1 |
| Total Body | Newborn | 100 | 346 | 114 | 389 | 122 | 411 | 0.5 |
| | 1-year | 97 | 174 | 114 | 201 | 121 | 216 | 0.4 |
| | 5-year | 85 | 149 | 101 | 175 | 109 | 187 | 0.3 |



+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.
*,[a] See Note 4, pages 8 and 9.

Table 12. AP BLADDER - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | Not Applicable | Not Applicable | 102 [40] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | | | 18 x 19 [7.1x7.5] |
| Collimated to film size | | | 25 x 20 [10 x 8] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn<br>1-year<br>5-year | (1,070) | (1,070) | (1,070) | (1,070) | (1,070) | (1,070) | 6.0 |
| Ovaries | Newborn<br>1-year<br>5-year | 270 | 270 | 370 | 370 | 400 | 400 | 11 |
| Thyroid | Newborn<br>1-year<br>5-year | + | + | + | + | + | + | |
| Active Bone Marrow | Newborn<br>1-year<br>5-year | 33 | 44 | 49 | 62 | 53 | 68 | 1.6 |
| Lungs | Newborn<br>1-year<br>5-year | (1) | (1) | (1) | (1) | (1) | (1) | 28 |
| Total Body | Newborn<br>1-year<br>5-year | 79 | 111 | 94 | 131 | 100 | 140 | 0.3 |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.

Table 13. PO BLADDER - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | Not Applicable | 102 [40] | 102 [40] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | | 16 x 16 [6.3x6.3] | 22 x 22 [8.7 x 8.7] |
| Collimated to film size | | 20 x 25 [8 x 10] | 25 x 30 [10 x 12] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn | (850) | (850) | (850) | (850) | (850) | (850) | 10 |
| | 1-year | 800 | 800 | 900 | 900 | 950 | 950 | 12 |
| | 5-year | | | | | | | |
| Ovaries | Newborn | 250 | 250 | 350 | 350 | 370 | 370 | 25 |
| | 1-year | (250) | (250) | (250) | (250) | (250) | (250) | 22 |
| | 5-year | | | | | | | |
| Thyroid | Newborn | + | + | + | + | + | + | |
| | 1-year | + | + | + | + | + | + | |
| | 5-year | | | | | | | |
| Active Bone Marrow | Newborn | 47 | 69 | 66 | 97 | 73 | 105 | 1.5 |
| | 1-year | 34 | 44 | 50 | 64 | 55 | 72 | 1.7 |
| | 5-year | | | | | | | |
| Lungs | Newborn | 2 | 7 | 3 | 11 | 4 | 12 | 19 |
| | 1-year | 1 | 2 | 1 | 3 | 1 | 4 | 30 |
| | 5-year | | | | | | | |
| Total Body | Newborn | 98 | 172 | 113 | 199 | 122 | 212 | 0.3 |
| | 1-year | 90 | 134 | 107 | 156 | 114 | 167 | 0.3 |
| | 5-year | | | | | | | |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.

Table 14. AP ERECT ABDOMEN - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | Not Applicable | Not Applicable | 102 [40] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | | | 23 x 30 [9.1x11.8] |
| Collimated to film size | | | 28 x 36 [11 x 14] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn<br>1-year<br>5-year | (50) | (150) | (50) | (150) | (50) | (150) | *,38[a] |
| Ovaries | Newborn<br>1-year<br>5-year | 270 | 270 | 370 | 370 | 400 | 400 | 11 |
| Thyroid | Newborn<br>1-year<br>5-year | (5) | (5) | (5) | (5) | (5) | (5) | * |
| Active Bone Marrow | Newborn<br>1-year<br>5-year | 57 | 74 | 83 | 110 | 89 | 116 | 1.4 |
| Lungs | Newborn<br>1-year<br>5-year | 118 | 175 | 137 | 220 | 151 | 233 | 3.3 |
| Total Body | Newborn<br>1-year<br>5-year | 159 | 205 | 189 | 242 | 202 | 259 | 0.3 |



+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.
*,[a] See Note 4, pages 8 and 9.

Table 15. **AP ABDOMEN** - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| | SID AND FIELD SIZE | | |
|---|---|---|---|
| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | 102 [40] | 102 [40] | 102 [40] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | 13 x 13 [5.1x5.1] | 18 x 21 [7.1x8.3] | 23 x 30 [9.1x11.8] |
| Collimated to film size | 20 x 25 [8 x 10] | 25 x 30 [10 x 12] | 28 x 36 [11 x 14] |



| | | ORGAN DOSE (mrad/R) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BEAM QUALITY (HVL, mm Al) ⟶ | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
| COLLIMATION ⟶ | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn | 86 | 910 | 144 | 1,000 | 152 | 1,120 | 23,4.7[a] |
| | 1-year | (105) | (1,070) | (105) | (1,070) | (105) | (1,070) | 32,6[a] |
| | 5-year | (125) | (1,070) | (125) | (1,070) | (125) | (1,070) | 30,6[a] |
| Ovaries | Newborn | 390 | 390 | 560 | 560 | 580 | 580 | 11 |
| | 1-year | 270 | 270 | 370 | 370 | 400 | 400 | 11 |
| | 5-year | 270 | 270 | 370 | 370 | 400 | 400 | 11 |
| Thyroid | Newborn | (5) | (25) | (5) | (25) | (5) | (25) | * |
| | 1-year | + | (9) | + | (9) | + | (9) | * |
| | 5-year | + | (3) | + | (3) | + | (3) | * |
| Active Bone Marrow | Newborn | 91 | 159 | 127 | 211 | 137 | 225 | 1.6 |
| | 1-year | 69 | 99 | 100 | 140 | 112 | 151 | 1.6 |
| | 5-year | 55 | 69 | 83 | 101 | 90 | 112 | 1.5 |
| Lungs | Newborn | 49 | 439 | 66 | 497 | 67 | 498 | 5.4,3.7[a] |
| | 1-year | 35 | 227 | 48 | 255 | 55 | 290 | 5.4,3.7[a] |
| | 5-year | 39 | 102 | 47 | 123 | 54 | 135 | 5.3,3.0[a] |
| Total Body | Newborn | 186 | 375 | 212 | 419 | 226 | 440 | 0.4 |
| | 1-year | 167 | 263 | 196 | 305 | 210 | 323 | 0.4 |
| | 5-year | 158 | 202 | 188 | 239 | 202 | 256 | 0.2 |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.
*,[a] See Note 4, pages 8 and 9.

Table 16. PA ABDOMEN - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| REFERENCE PATIENT | Newborn | 1-year old | 5-year old |
|---|---|---|---|
| | SID AND FIELD SIZE | | |
| Source-to-image receptor distance (SID) (centimeters [inches]) | 102 [40] | 102 [40] | 102 [40] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | 13 x 13 [5.1x5.1] | 18 x 21 [7.1x8.3] | 23 x 30 [9.1x11.8] |
| Collimated to film size | 20 x 25 [8 x 10] | 25 x 30 [10 x 12] | 28 x 36 [11 x 14] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn | (105) | (440) | (105) | (440) | (150) | (440) | 35,12[a] |
| | 1-year | (47) | 200 | (47) | 210 | (47) | 260 | 44,16[a] |
| | 5-year | 40 | 40 | 110 | 110 | 140 | 140 | * |
| Ovaries | Newborn | (430) | (430) | (430) | (430) | (430) | (430) | 25 |
| | 1-year | 280 | 280 | 320 | 320 | 400 | 400 | 28 |
| | 5-year | 220 | 220 | 250 | 250 | 280 | 280 | 28 |
| Thyroid | Newborn | (2) | (20) | (2) | (20) | (2) | (20) | * |
| | 1-year | (6) | (14) | (6) | (14) | (6) | (14) | * |
| | 5-year | (1) | (9) | (1) | (9) | (1) | (9) | * |
| Active Bone Marrow | Newborn | 190 | 276 | 247 | 361 | 259 | 376 | 1.0 |
| | 1-year | 148 | 185 | 197 | 249 | 214 | 266 | 1.0 |
| | 5-year | 135 | 149 | 183 | 207 | 197 | 225 | 1.1 |
| Lungs | Newborn | 46 | 414 | 62 | 459 | 67 | 499 | 5.6,1.7[a] |
| | 1-year | 37 | 224 | 51 | 259 | 56 | 283 | 5.5,1.6[a] |
| | 5-year | 35 | 96 | 47 | 126 | 51 | 143 | 5.4 |
| Total Body | Newborn | 190 | 379 | 218 | 427 | 232 | 451 | 0.3 |
| | 1-year | 170 | 264 | 199 | 305 | 213 | 327 | 0.2 |
| | 5-year | 161 | 206 | 192 | 242 | 206 | 259 | 0.3 |



+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.
*,[a] See Note 4, pages 8 and 9.

Table 17. LAT **ABDOMEN** - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| REFERENCE PATIENT | | SID AND FIELD SIZE Newborn | 1-year old | 5-year old |
|---|---|---|---|---|
| Source-to-image receptor distance (SID) (centimeters [inches]) | | 102 [40] | 102 [40] | 102 [40] |
| Field size at image receptor (centimeters [inches]) | | | | |
| Collimated to body part (App.C) | | 13 x 14 [5.1x5.5] | 18 x 21 [7.1x8.3] | 21 x 31 [8.3x12.2] |
| Collimated to film size | | 20 x 25 [8 x 10] | 25 x 30 [10 x 12] | 28 x 36 [11 x 14] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn | (300) | (480) | (300) | (480) | (300) | (480) | 20,12[a] |
| | 1-year | (70) | (240) | (70) | (240) | (70) | (240) | 44,15[a] |
| | 5-year | (130) | (180) | (130) | (180) | (130) | (180) | 46 |
| Ovaries | Newborn | (430) | (430) | (430) | (430) | (430) | (430) | 23 |
| | 1-year | 270 | 270 | 430 | 430 | 420 | 420 | 30 |
| | 5-year | 190 | 190 | 230 | 230 | 300 | 300 | 30 |
| Thyroid | Newborn | (3) | (30) | (3) | (30) | (3) | (30) | *,36[a] |
| | 1-year | (3) | (10) | (3) | (10) | (3) | (10) | * |
| | 5-year | + | + | + | + | + | + | |
| Active Bone Marrow | Newborn | 151 | 216 | 198 | 280 | 208 | 295 | 1.1 |
| | 1-year | 107 | 136 | 150 | 182 | 152 | 195 | 1.2 |
| | 5-year | 83 | 90 | 111 | 127 | 125 | 132 | 1.4 |
| Lungs | Newborn | 74 | 522 | 87 | 587 | 85 | 628 | 5.0,1.5[a] |
| | 1-year | 32 | 232 | 43 | 267 | 54 | 293 | 5.6,1.6[a] |
| | 5-year | 30 | 70 | 35 | 87 | 45 | 101 | 5.6 |
| Total Body | Newborn | 199 | 359 | 224 | 403 | 239 | 425 | 0.3 |
| | 1-year | 152 | 226 | 179 | 261 | 190 | 280 | 0.3 |
| | 5-year | 134 | 158 | 157 | 185 | 169 | 198 | 0.4 |



+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.
*,[a] See Note 4, pages 8 and 9.

Table 18. AP PELVIS - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| REFERENCE PATIENT | SID AND FIELD SIZE | | |
|---|---|---|---|
| | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | 102 [40] | 102 [40] | 102 [40] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | 15 x 15 [5.9x5.9] | 21 x 21 [8.3x8.3] | 28 x 25 [11.0x9.8] |
| Collimated to film size | 25 x 20 [10 x 8] | 30 x 25 [12 x 10] | 36 x 28 [14 x 11] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn | 910 | 910 | 1,000 | 1,000 | 1,120 | 1,120 | 4.7 |
| | 1-year | (1,070) | (1,070) | (1,070) | (1,070) | (1,070) | (1,070) | 6.0 |
| | 5-year | (1,070) | (1,070) | (1,070) | (1,070) | (1,070) | (1,070) | 6.0 |
| Ovaries | Newborn | 390 | 390 | 560 | 560 | 580 | 580 | 11 |
| | 1-year | 270 | 270 | 370 | 370 | 400 | 400 | 11 |
| | 5-year | 270 | 270 | 370 | 370 | 400 | 400 | 11 |
| Thyroid | Newborn | + | + | + | + | + | + | |
| | 1-year | + | + | + | + | + | + | |
| | 5-year | + | + | + | + | + | + | |
| Active Bone Marrow | Newborn | 97 | 117 | 132 | 155 | 138 | 164 | 2.0 |
| | 1-year | 67 | 76 | 96 | 106 | 104 | 119 | 2.0 |
| | 5-year | 48 | 50 | 72 | 73 | 76 | 80 | 2.0 |
| Lungs | Newborn | 18 | 46 | 24 | 60 | 26 | 66 | 10 |
| | 1-year | (6) | (13) | (6) | (13) | (6) | (13) | 15 |
| | 5-year | (2) | (4) | (2) | (4) | (2) | (4) | 25 |
| Total Body | Newborn | 212 | 299 | 236 | 332 | 249 | 351 | 0.5 |
| | 1-year | 166 | 220 | 192 | 249 | 204 | 267 | 0.4 |
| | 5-year | 140 | 159 | 165 | 186 | 175 | 199 | 0.4 |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.

Table 19. AP HIP - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| REFERENCE PATIENT | SID AND FIELD SIZE<br>Newborn | 1-year old | 5-year old |
|---|---|---|---|
| Source-to-image receptor distance (SID) (centimeters [inches]) | | | 102 [40] |
| Field size at image receptor (centimeters [inches]) | Not Applicable | Not Applicable | |
| Collimated to body part (App.C) | | | 13 x 19 [5.1x7.5] |
| Collimated to film size | | | 20 x 25 [8 x 10] |



| | | ORGAN DOSE (mrad/R) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BEAM QUALITY (HVL, mm Al) ⟶ | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
| COLLIMATION ⟶ | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn<br>1-year<br>5-year | (420) | (1,070) | (420) | (1,070) | (420) | (1,070) | 13,6[a] |
| Ovaries | Newborn<br>1-year<br>5-year | (160) | (210) | (160) | (210) | (160) | (210) | 22 |
| Thyroid | Newborn<br>1-year<br>5-year | + | + | + | + | + | + | |
| Active Bone Marrow | Newborn<br>1-year<br>5-year | 21 | 29 | 31 | 42 | 33 | 46 | 1.9 |
| Lungs | Newborn<br>1-year<br>5-year | (1) | (2) | (1) | (2) | (1) | (2) | 32 |
| Total Body | Newborn<br>1-year<br>5-year | 52 | 93 | 62 | 111 | 66 | 119 | 0.3 |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.
*,[a] See Note 4, pages 8 and 9.

Table 20. PO HIP (ONE) - organ dose (mrad) for 1 R entrance exposure (free-in-air)

| REFERENCE PATIENT | SID AND FIELD SIZE | | |
|---|---|---|---|
| | Newborn | 1-year old | 5-year old |
| Source-to-image receptor distance (SID) (centimeters [inches]) | Not Applicable | 102 [40] | 102 [40] |
| Field size at image receptor (centimeters [inches]) | | | |
| Collimated to body part (App.C) | | 10 x 16 [3.9x6.3] | 13 x 22 [5.1x8.7] |
| Collimated to film size | | 20 x 25 [8 x 10] | 20 x 25 [8 x 10] |



ORGAN DOSE (mrad/R)

| BEAM QUALITY (HVL, mm Al) → | | 2.0 | | 2.5 | | 3.0 | | Maximum coefficient of variation (%) |
|---|---|---|---|---|---|---|---|---|
| COLLIMATION → | | Body part | Film size | Body part | Film size | Body part | Film size | |
| Testes | Newborn | (900) | (900) | (900) | (900) | (900) | (900) | 14 |
| | 1-year | (780) | (900) | (780) | (900) | (780) | (900) | 12 |
| | 5-year | | | | | | | |
| Ovaries | Newborn | (280) | (420) | (280) | (420) | (280) | (420) | 29 |
| | 1-year | (140) | (240) | (140) | (240) | (140) | (240) | 22 |
| | 5-year | | | | | | | |
| Thyroid | Newborn | + | + | + | + | + | + | |
| | 1-year | + | + | + | + | + | + | |
| | 5-year | | | | | | | |
| Active Bone Marrow | Newborn | 37 | 73 | 50 | 103 | 57 | 110 | 1.6 |
| | 1-year | 10 | 21 | 16 | 34 | 19 | 36 | 2.2 |
| | 5-year | | | | | | | |
| Lungs | Newborn | 1 | 9 | 2 | 11 | 3 | 15 | 20 |
| | 1-year | 1 | 1 | 1 | 2 | 1 | 2 | 26 |
| | 5-year | | | | | | | |
| Total Body | Newborn | 71 | 184 | 83 | 213 | 89 | 224 | 0.3 |
| | 1-year | 52 | 85 | 62 | 101 | 67 | 108 | 0.3 |
| | 5-year | | | | | | | |



\+ See Note 1, page 8.
() See Note 2 for explanation of values in parenthesis, page 8.

## APPENDIX A. ANTHROPOMETRIC CHARACTERISTICS OF REFERENCE PEDIATRIC PHANTOMS

| | Newborn | 1-year old | 5-year old |
|---|---|---|---|
| Height | 52 cm | 76 cm | 112 cm |
| Weight | 3.96 kg | 10.4 kg | 20.0 kg |
| Distance from vertex to: | | | |
| External acoustic meatus (EAM) | 7.7 cm | 12.0 cm | 12.6 cm |
| Thyroid (center) | 11.5 cm | 15.8 cm | 17.2 cm |
| Sternal notch | 13.3 cm | 18.2 cm | 20.2 cm |
| Nipples | 17.7 cm | 25.5 cm | 29.7 cm |



| | | | |
|---|---|---|---|
| Umbilicus | 27.7 cm | 40.0 cm | 48.4 cm |
| Ovaries | 29.4 cm | 43.2 cm | 52.5 cm |
| Hip Joint | 31.3 cm | 46.4 cm | 57.0 cm |
| Symphysis Pubis | 31.7 cm | 46.9 cm | 57.7 cm |
| Testes (center) | 34.0 cm | 50.3 cm | 62.0 cm |
| Phantom Dimensions: | | | |
| Head, Thickness | 11.2 cm | 16 cm | 17.6 cm |
| Width | 10.6 cm | 13.6 cm | 13.6 cm |
| Thorax, Thickness | 11.2 cm | 14 cm | 16.4 cm |
| Width | 12.4 cm | 17.2 cm | 22 cm |
| Abdomen, Thickness | 11.2 cm | 14 cm | 16.4 cm |
| Width | 12.4 cm | 17.2 cm | 22 cm |

## APPENDIX B. FIELD CENTERS FOR X-RAY PROJECTIONS

| Projection | Distance from Phantom Vertex (cm) | Distance from nearest anatomical landmark: Landmark | (cm) | Distance from phantom midline (cm) |
|---|---|---|---|---|
| | | NEWBORN | | |
| Townes | 4.1 | ext. acoustic meatus | 0 | 0 |
| AP,LAT SKULL | 3.7 | ext. acoustic meatus | 4 above | 0 |
| AP,PA,LAT Chest | 15.2 | nipples | 2.5 above | 0 |
| AP Kidneys | 23.5 | umbilicus | 4 above | 0 |
| AP,PA,LAT Abdomen | 27.7 | umbilicus | 0 | 0 |
| AP Pelvis | 31.3 | symphysis pubis | 0.4 above | 0 |
| | | ONE-YEAR OLD | | |
| Townes | 6.5 | ext. acoustic meatus | 0 | 0 |
| AP,PA,LAT SKULL | 8.0 | ext. acoustic meatus | 4 above | 0 |
| AP Neck | 14.9 | sternal notch | 3.1 above | 0 |
| LAT Neck | 14.9 | ext. acoustic meatus | 3.1 below | 0 |
| AP,PA,LAT Chest | 22.8 | nipples | 2.7 above | 0 |
| AP Kidneys | 36.5 | umbilicus | 3.5 above | 0 |
| AP,PA,LAT Abdomen | 40.0 | umbilicus | 0 | 0 |
| AP Pelvis, PO Hip | 46.4 | symphysis pubis | 0.5 above | 0 |
| PO Bladder | 46.9 | symphysis pubis | 0 | 1.7 to patient's right |
| | | FIVE-YEAR OLD | | |
| Townes | 6.7 | ext. acoustic meatus | 0 | 0 |
| AP,PA,LAT Skull | 10.1 | ext. acoustic meatus | 2.5 above | 0 |
| AP,PA,LAT,PO Chest | 26.4 | nipples | 3.3 above | 0 |
| AP Kidneys | 43.2 | umbilicus | 5.2 above | 0 |
| AP Erect Abdomen | 45.9 | umbilicus | 2.5 above | 0 |
| AP,PA,LAT Abdomen | 48.4 | umbilicus | 0 | 0 |
| AP Bladder | 56.4 | symphysis pubis | 1.3 above | 0 |
| AP Pelvis | 57.0 | symphysis pubis | 0.7 above | 0 |
| AP Hip | 57.0 | symphysis pubis | 0.7 above | $\pm$5.5 |
| PO Hip | 57.0 | symphysis pubis | 0.7 above | $\pm$3.9 |
| PO Bladder | 57.7 | symphysis pubis | 0 | 2.2 to patient's right |

## APPENDIX C

## DESCRIPTION OF X-RAY FIELDS COLLIMATED TO THE BODY PART

| PROJECTION | VERTICAL LIMITS OF FIELD IN PHANTOM MIDPLANE | HORIZONTAL LIMITS OF FIELD IN PHANTOM MIDPLANE |
|---|---|---|
| AP,LAT Neck (1-year old) | 2.5 cm above EAM[b] to 2.5 cm below sternal notch | to width of head |
| AP,PO,PA,LAT CHEST (all ages) | EAM[b] to bottom of 12th rib | 1 cm beyond chest walls[a] |
| AP,PA,LAT Abdomen (all ages) | Diaphragm to inferior margin of pelvis | 1 cm beyond abdominal walls[a] |
| AP Erect Abdomen (5-year old) | 2.5 cm above diaphragm to 2.5 cm above inferior margin of pelvis | 1 cm beyond abdominal walls[a] |
| AP Kidneys (all ages) | Diaphragm to 2.5 cm below umbilicus | to abdominal walls[a] |
| AP Bladder (5-year old) | Umbilicus to 8 cm below bladder center | to outer margins of pelvis |
| PO Bladder (5-year old) | Umbilicus to 9.3 cm below symphysis pubis | 5.6 cm to either side of bladder center |
| (1-year old) | Umbilicus to 0.7 cm below symphysis pubis | 4.4 cm to either side of bladder center |
| AP Pelvis (5-year old) | 2.5 cm above umbilicus to 11.1 cm below hip joint | 1 cm beyond width of trunk |
| (1-year old) | 2.5 cm above umbilicus to 8.9 cm below hip joint | 1 cm beyond width of trunk |
| (newborn) | 2.5 cm above umbilicus to 6.1 cm below hip joint | 1 cm beyond width of trunk |
| AP,PO Hip (5-year old) | Iliac crest to 8.6 cm below hip joint | to width of upper leg |
| (1-year old) | Iliac crest to 6.4 cm below hip joint | to width of upper leg |

[a] Abdominal and chest walls defined as the width of the ribcage plus two layers of skin.

[b] External acoustic meatus.





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