# PRELIMINARY RESULTS OF CALCULATIONS OF U-238 TRANSMISSION AND SELF-INDICATION RATIOS USING THE ECCO/JEF-2.2 LIBRARY AND COMPARISONS WITH EXPERIMENT

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## 1. INTRODUCTION

Measurements of U-238 capture cross-section shielding factors in the energy range 1-35Kev have been reported by Oigawa et al (1991). These self-shielding factors have been derived from transmission and self-indication measurements. Dr Oigawa has kindly provided the results of these latter measurements to us so that we can examine the sources of any discrepancies more directly. It also enables us to make comparisons between these measurements and other transmission and self-indication measurements.

F. Fröhner (1991) has described comparisons between calculations made using his JEF-2 evaluation for U-238 in the unresolved resonance region (>10Kev) with the transmission measurements (4-120Kev) and self-indication measurements (10-120Kev) of Bokhovko et al (1988) and the transmission and self-indication measurements (10-92Kev) of Byoun et al (1972). These latter measurements cover a smaller range of thicknesses than the other two.

This work also provides us with reference calculations against which to test our ECCO/JEF-2.2 library calculations. F. Fröhner has made detailed point-energy calculations using cross-sections generated in the unresolved resonance region by sampling from the resonance parameter destibutions. Ladders of parameters are obtained by Monte Carlo sampling from the distributions and point-energy cross-sections are then calculated. These have been used directly in the transmission and self-indication calculations. The ECCO library contains data in a fine group structure (lethargy width = 1/120) together with sub-group or probability table data to represent the within-fine-group cross-section structure. There are typically about 10 sub-groups per fine group. The sub-group data were derived using the code CALENDF (P.Ribon) which first generates resonance ladders and point energy cross-sections in the unresolved resonance region. The transmission and self-indication ratios have been calculated directly using the sub-group data.

## 2. COMPARISONS WITH THE CALCULATIONS MADE BY F FROHNER

Comparing with the calculations corresponding to the measurements of Bokhovko et al (10-120Kev) we see that for the transmission ratio the agreement is within about 3% but for the self-indication ratio the differences increase to about 5% in the lower energy region. We believe that this is because we have neglected the effect of the thickness of the target in these calculations. (This effect is, in fact, within the measurement uncertainties).

## 3. COMPARISONS WITH THE MEASUREMENTS OF OIGAWA ET AL.

(a) Capture cross-section self-shielding factors.

Although there are no systematic effects there are some significant differences, e.g. 10% in the energy range 3-4Kev.

(b) Transmission and self-indication ratios.

For the self-indication ratios there is broad consistency between the measured and calculated values. In the energy ranges 2-3Kev, 3-4Kev and 8-10Kev there are indications of possible significant differences.
The transmission ratio measurements are more accurate and for these the calculated values are generally higher than the measured values, indicating a possible underestimation of the effective average total cross-section. The average underestimation is about 0.35 barns but in the energy range 2-3Kev it is 0.94 barns.

## 4. THE MEASUREMENTS OF BOKHOVKO ET AL AND BYOUN ET AL

There are no strong systematic differences in the comparisons with these experiments. For the transmission ratios measured in the energy range 10-40Kev the mean differences between the measured and calculated effective total cross-sections are:

| | |
|---|---|
| Oigawa et al | 0.24 + 0.04 barns |
| Bokhovko et al | 0.06 + 0.03 barns |
| Byoun et al | -0.08 + 0.05 barns |

## 5. CONCLUSIONS OF THIS PRELIMINARY STUDY

Although there is a systematic difference between the calculations and the transmission ratio measurements of Oigawa et al (corresponding to a difference in effective average total cross-section of about 0.35 barns in the energy range 1-35Kev) the measurements of Bokhovko et al and Byoun et al do not show such systematic differences.

## 6. REFERENCES

Bokhovko et al (1988) INDC(CCP)-322 (1990) p.5
Byoun, Block and Semler (1972) Proc. Kiamesha Lake Conf. p1115
Fröhner (1991) Kfk 4911
Ribon (1989) Seminar on NJOY and THEMIS - p220
Oigawa et al (1991) J. Nucl. Sci. + Tech. 28 (10) p 879.

transmission :

$$T_G(N_j) = \frac{\sum_g \left( \sum_i w_{gi} e^{-N_j \sigma_{t,gi}} \right) \cdot \Delta u_g}{\sum_g \Delta u_g}$$

self indication :

$$R_G(N_j) = \frac{\sum_g \left( \sum_i w_{gi} \sigma_{c,gi} e^{-N_j \sigma_{t,gi}} \right) \cdot \Delta u_g}{\sum_g \left( \sum_i w_{gi} \sigma_{c,gi} \right) \cdot \Delta u_g}$$

$N_j$ : - atoms/barn, thickness of the transmission sample

$\Delta u_g$ : lethargy width of fine group $g$

$w_{gi}$, $\sigma_{t,gi}$, $\sigma_{c,gi}$ subgroup data in fine group $g$

$w_{gi}$ : weight of subgroup $i$ in fine group $g$

$\sigma_{t,gi}$ : total cross-section for subgroup $i$ in fine group $g$

$\sigma_{c,gi}$ : capture cross-section for subgroup $i$ in fine group $g$.

Note: no correction has been made for the thickness of the self-indication target.

ckness (at./barns)
1 : 0.0091
2 : 0.0237
3 : 0.0474
4 : 0.0707
5 : 0.0943
6 : 0.19

Comparison of calculations using the ECCO library with the calculations of F. Fröhner (for the experiments of Bokhovko et al (1988)).

TRANSMISSION

| | Calcul ECCO T | Fröhner T | Difference % |
|---|---|---|---|
| 100 - 120 keV | | | |
| 1 | 0.897 | 0.898 | ( -0.07) |
| 2 | 0.755 | 0.756 | ( -0.14) |
| 3 | 0.571 | 0.574 | ( -0.45) |
| 4 | 0.436 | 0.439 | ( -0.78) |
| 5 | 0.332 | 0.333 | ( -0.39) |
| 6 | 0.112 | 0.114 | ( -1.47) |
| 90 - 100 keV | | | |
| 1 | 0.895 | 0.896 | ( -0.06) |
| 2 | 0.751 | 0.752 | ( -0.17) |
| 3 | 0.565 | 0.568 | ( -0.52) |
| 4 | 0.428 | 0.433 | ( -1.07) |
| 5 | 0.324 | 0.327 | ( -0.79) |
| 6 | 0.108 | 0.110 | ( -2.26) |
| 80 - 90 keV | | | |
| 1 | 0.894 | 0.894 | ( 0.01) |
| 2 | 0.748 | 0.749 | ( -0.13) |
| 3 | 0.562 | 0.564 | ( -0.41) |
| 4 | 0.425 | 0.429 | ( -0.87) |
| 5 | 0.322 | 0.322 | ( -0.02) |
| 6 | 0.107 | 0.108 | ( -0.51) |
| 60 - 70 keV | | | |
| 1 | 0.891 | 0.891 | ( 0.01) |
| 2 | 0.742 | 0.743 | ( -0.18) |
| 3 | 0.553 | 0.556 | ( -0.62) |
| 4 | 0.415 | 0.420 | ( -1.09) |
| 5 | 0.312 | 0.314 | ( -0.51) |
| 6 | 0.102 | 0.103 | ( -1.10) |
| 50 - 60 keV | | | |
| 1 | 0.889 | 0.890 | ( -0.08) |
| 2 | 0.738 | 0.740 | ( -0.26) |
| 3 | 0.548 | 0.551 | ( -0.59) |
| 4 | 0.411 | 0.416 | ( -1.32) |
| 5 | 0.308 | 0.309 | ( -0.31) |
| 6 | 0.100 | 0.101 | ( -1.04) |

TRANSMISSION

| | | | Difference % |
|---|---|---|---|
| 40 - 50 keV | | | |
| 1 | 0.887 | 0.888 | ( -0.09) |
| 2 | 0.734 | 0.736 | ( -0.30) |
| 3 | 0.542 | 0.546 | ( -0.72) |
| 4 | 0.405 | 0.410 | ( -1.25) |
| 5 | 0.303 | 0.305 | ( -0.68) |
| 6 | 0.098 | 0.099 | ( -1.30) |
| 30 - 40 keV | | | |
| 1 | 0.885 | 0.885 | ( -0.04) |
| 2 | 0.729 | 0.732 | ( -0.44) |
| 3 | 0.536 | 0.541 | ( -0.98) |
| 4 | 0.399 | 0.407 | ( -2.08) |
| 5 | 0.297 | 0.301 | ( -1.21) |
| 6 | 0.095 | 0.098 | ( -2.80) |
| 26 - 30 keV | | | |
| 1 | 0.883 | 0.883 | ( 0.02) |
| 2 | 0.727 | 0.728 | ( -0.17) |
| 3 | 0.535 | 0.537 | ( -0.45) |
| 4 | 0.399 | 0.403 | ( -1.01) |
| 5 | 0.299 | 0.296 | ( 0.96) |
| 6 | 0.098 | 0.097 | ( 1.20) |
| 22 - 26 keV | | | |
| 1 | 0.882 | 0.882 | ( -0.01) |
| 2 | 0.725 | 0.725 | ( 0.00) |
| 3 | 0.534 | 0.535 | ( -0.28) |
| 4 | 0.399 | 0.401 | ( -0.55) |
| 5 | 0.299 | 0.296 | ( 1.16) |
| 6 | 0.100 | 0.097 | ( 2.93) |
| 18 - 22 keV | | | |
| 1 | 0.878 | 0.880 | ( -0.18) |
| 2 | 0.718 | 0.723 | ( -0.66) |
| 3 | 0.525 | 0.535 | ( -1.90) |
| 4 | 0.390 | 0.399 | ( -2.20) |
| 5 | 0.292 | 0.296 | ( -1.42) |
| 6 | 0.096 | 0.098 | ( -2.12) |
| 14 - 18 keV | | | |
| 1 | 0.878 | 0.878 | ( -0.02) |
| 2 | 0.718 | 0.719 | ( -0.13) |
| 3 | 0.526 | 0.532 | ( -1.11) |
| 4 | 0.392 | 0.398 | ( -1.41) |
| 5 | 0.294 | 0.295 | ( -0.23) |
| 6 | 0.098 | 0.099 | ( -1.14) |
| 10 - 14 keV | | | |
| 1 | 0.874 | 0.875 | ( -0.08) |
| 2 | 0.713 | 0.717 | ( -0.56) |
| 3 | 0.522 | 0.526 | ( -0.79) |
| 4 | 0.390 | 0.396 | ( -1.65) |
| 5 | 0.293 | 0.296 | ( -1.15) |
| 6 | 0.098 | 0.100 | ( -2.00) |

thickness (at./barns)

1 : 0.0237
2 : 0.0474
3 : 0.0707
4 : 0.0943
5 : 0.19

## SELF-INDICATION

(* No correction for target size effects in the ECCO library calculations)

| | Calcul ECCO* R | Frohner R | Difference % |
|---|---|---|---|
| 100 - 120 keV | | | |
| 1 | 0.747 | 0.751 | ( -0.55) |
| 2 | 0.559 | 0.565 | ( -0.99) |
| 3 | 0.422 | 0.431 | ( -2.07) |
| 4 | 0.318 | 0.324 | ( -1.77) |
| 5 | 0.104 | 0.102 | ( 1.78) |
| 80 - 90 keV | | | |
| 1 | 0.737 | 0.736 | ( 0.17) |
| 2 | 0.546 | 0.549 | ( -0.57) |
| 3 | 0.408 | 0.415 | ( -1.76) |
| 4 | 0.305 | 0.309 | ( -1.43) |
| 5 | 0.097 | 0.098 | ( -1.41) |
| 60 - 70 keV | | | |
| 1 | 0.727 | 0.728 | ( -0.20) |
| 2 | 0.531 | 0.538 | ( -1.37) |
| 3 | 0.392 | 0.400 | ( -2.16) |
| 4 | 0.289 | 0.295 | ( -2.05) |
| 5 | 0.088 | 0.092 | ( -4.53) |
| 40 - 50 keV | | | |
| 1 | 0.715 | 0.716 | ( -0.19) |
| 2 | 0.515 | 0.519 | ( -0.79) |
| 3 | 0.376 | 0.381 | ( -1.39) |
| 4 | 0.275 | 0.280 | ( -1.88) |
| 5 | 0.082 | 0.084 | ( -2.82) |
| 26 - 30 keV | | | |
| 1 | 0.698 | 0.696 | ( 0.27) |
| 2 | 0.495 | 0.495 | ( -0.07) |
| 3 | 0.357 | 0.357 | ( -0.02) |
| 4 | 0.259 | 0.260 | ( -0.76) |
| 5 | 0.076 | 0.076 | ( 0.31) |
| 18 - 22 keV | | | |
| 1 | 0.673 | 0.682 | ( -1.32) |
| 2 | 0.466 | 0.478 | ( -2.64) |
| 3 | 0.330 | 0.342 | ( -3.58) |
| 4 | 0.236 | 0.245 | ( -3.67) |
| 5 | 0.067 | 0.070 | ( -4.35) |
| 10 - 14 keV | | | |
| 1 | 0.642 | 0.654 | ( -1.94) |
| 2 | 0.435 | 0.455 | ( -4.70) |
| 3 | 0.305 | 0.317 | ( -3.98) |
| 4 | 0.217 | 0.229 | ( -5.56) |
| 5 | 0.062 | 0.065 | ( -5.50) |

# Comparison of the capture cross-section shielding factors derived by Oigawa et al from their transmission and self-indication measurements with the ECCO/JEF 2.2 calculations

| E (KeV) | Dilutions (barns) 1 | | 10 | | 100 | |
|---|---|---|---|---|---|---|
| 1-2 | .291 | .008 | .366 | .006 | .649 | .010 |
| JEF 2.2 | .295 | | .364 | | .611 | |
| 2-3 | .408 | .011 | .473 | .007 | .718 | .011 |
| JEF 2.2 | .381 | | .475 | | .713 | |
| 3-4 | .552 | .011 | .621 | .008 | .832 | .013 |
| JEF 2.2 | .487 | | .567 | | .793 | |
| 4-5 | .649 | .014 | .719 | .011 | .894 | .015 |
| JEF 2.2 | .650 | | .726 | | .901 | |
| 5-6 | .703 | .014 | .769 | .010 | .928 | .014 |
| JEF 2.2 | .669 | | .752 | | .918 | |
| 6-8 | .687 | .011 | .752 | .009 | .886 | .013 |
| JEF 2.2 | .673 | | .758 | | .915 | |
| 8-10 | .775 | .014 | .824 | .010 | .943 | .014 |
| JEF 2.2 | .766 | | .831 | | .947 | |
| 10-15 | .838 | .013 | .879 | .007 | .969 | .012 |
| JEF 2.2 | .813 | | .869 | | .962 | |
| 15-20 | .883 | .013 | .920 | .008 | .984 | .011 |
| JEF 2.2 | .837 | | .891 | | .971 | |
| 20-25 | .899 | .014 | .914 | .007 | .959 | .010 |
| JEF 2.2 | .880 | | .922 | | .981 | |
| 25-35 | .879 | .010 | .931 | .007 | .978 | .009 |
| JEF 2.2 | .907 | | .940 | | .986 | |

# ADDITIONS TO THE EFFECTIVE AVERAGE TOTAL CROSS-SECTION REQUIRED TO IMPROVE THE CALCULATED TRANSMISSION RATIOS

Measurements of Oigawa et al

| Energy Range (keV) | Average increase in total effective cross-section | Standard deviation of mean |
|---|---|---|
| 25 - 35 | 0.21 | 0.06 |
| 20 - 25 | 0.21 | 0.10 |
| 15 - 20 | 0.52 | 0.05 |
| 10 - 15 | 0.05 | 0.06 |
| 8 - 10 | 0.54 | 0.06 |
| 6 - 8 | 0.36 | 0.06 |
| 5 - 6 | 0.31 | 0.07 |
| 4 - 5 | 0.47 | 0.06 |
| 3 - 4 | 0.31 | 0.07 |
| 2 - 3 | 0.94 | 0.06 |
| 1 - 2 | 0.11 | 0.05 |

Oigawa et al. (1991)

Transmission (T)

thickness (at./barns)

| | |
|---|---|
| 1 : | 0.00738 |
| 2 : | 0.01474 |
| 3 : | 0.02408 |
| 4 : | 0.03858 |
| 5 : | 0.04823 |
| 6 : | 0.06257 |
| 7 : | 0.07205 |
| 8 : | 0.09614 |
| 9 : | 0.12013 |
| 10 : | 0.14437 |

| thickness N | Experimental T | Calculation T | Uncertainty % | (E-C)/E % |
|---|---|---|---|---|
| 25 - 35 keV | | | | |
| 1 | 0.91410 | 0.90359 | ( 0.98) | ( 1.15) |
| 2 | 0.81940 | 0.81781 | ( 1.07) | ( 0.19) |
| 3 | 0.72110 | 0.72175 | ( 0.96) | ( -0.09) |
| 4 | 0.60710 | 0.59659 | ( 0.87) | ( 1.73) |
| 5 | 0.52660 | 0.52655 | ( 0.96) | ( 0.01) |
| 6 | 0.43290 | 0.43859 | ( 1.00) | ( -1.31) |
| 7 | 0.37620 | 0.38929 | ( 1.06) | ( -3.48) |
| 8 | 0.28490 | 0.28900 | ( 1.05) | ( -1.44) |
| 9 | 0.20850 | 0.21616 | ( 1.15) | ( -3.67) |
| 10 | 0.15710 | 0.16212 | ( 1.26) | ( -3.20) |
| 20 - 25 keV | | | | |
| 1 | 0.91230 | 0.90237 | ( 0.97) | ( 1.09) |
| 2 | 0.81250 | 0.81605 | ( 1.07) | ( -0.44) |
| 3 | 0.73120 | 0.71991 | ( 0.45) | ( 1.54) |
| 4 | 0.60470 | 0.59529 | ( 0.87) | ( 1.56) |
| 5 | 0.52080 | 0.52576 | ( 0.96) | ( -0.95) |
| 6 | 0.42930 | 0.43860 | ( 1.00) | ( -2.17) |
| 7 | 0.38620 | 0.38979 | ( 1.04) | ( -0.93) |
| 8 | 0.28540 | 0.29047 | ( 1.04) | ( -1.78) |
| 9 | 0.21240 | 0.21823 | ( 1.13) | ( -2.74) |
| 10 | 0.15290 | 0.16449 | ( 1.26) | ( -7.58) |
| 15 - 20 keV | | | | |
| 1 | 0.91020 | 0.89982 | ( 0.91) | ( 1.14) |
| 2 | 0.80500 | 0.81215 | ( 1.00) | ( -0.89) |
| 3 | 0.69890 | 0.71529 | ( 0.91) | ( -2.35) |
| 4 | 0.58010 | 0.59072 | ( 0.53) | ( -1.83) |
| 5 | 0.50530 | 0.52160 | ( 0.91) | ( -3.23) |
| 6 | 0.42600 | 0.43523 | ( 0.94) | ( -2.17) |
| 7 | 0.37610 | 0.38696 | ( 0.99) | ( -2.89) |
| 8 | 0.27750 | 0.28889 | ( 0.99) | ( -4.10) |
| 9 | 0.20340 | 0.21760 | ( 1.08) | ( -6.98) |
| 10 | 0.15000 | 0.16455 | ( 1.19) | ( -9.70) |
| 10 - 15 keV | | | | |
| 1 | 0.90490 | 0.89654 | ( 0.77) | ( 0.92) |
| 2 | 0.80500 | 0.80725 | ( 0.84) | ( -0.28) |
| 3 | 0.71110 | 0.70961 | ( 0.76) | ( 0.21) |
| 4 | 0.59460 | 0.58509 | ( 0.69) | ( 1.60) |
| 5 | 0.51170 | 0.51634 | ( 0.76) | ( -0.91) |
| 6 | 0.42970 | 0.43066 | ( 0.79) | ( -0.22) |
| 7 | 0.38140 | 0.38284 | ( 0.83) | ( -0.38) |
| 8 | 0.28760 | 0.28577 | ( 0.82) | ( 0.64) |
| 9 | 0.21610 | 0.21522 | ( 0.89) | ( 0.41) |
| 10 | 0.15640 | 0.16270 | ( 0.99) | ( -4.03) |

wa et al. (1991)
Transmission (T)

kness (at./barns)

| | |
|---|---|
| 1 : | 0.00738 |
| 2 : | 0.01474 |
| 3 : | 0.02408 |
| 4 : | 0.03858 |
| 5 : | 0.04823 |
| 6 : | 0.06257 |
| 7 : | 0.07205 |
| 8 : | 0.09614 |
| 9 : | 0.12013 |
| 10 : | 0.14437 |

| thickness N | Experimental T | Calculation T | Uncertainty % | (E-C)/E % |
|---|---|---|---|---|
| 8 - 10 keV | | | | |
| 1 | 0.90210 | 0.89938 | ( 1.06) | ( 0.30) |
| 2 | 0.80740 | 0.81279 | ( 1.16) | ( -0.67) |
| 3 | 0.71680 | 0.71801 | ( 1.03) | ( -0.17) |
| 4 | 0.59500 | 0.59652 | ( 0.94) | ( -0.26) |
| 5 | 0.52480 | 0.52895 | ( 1.03) | ( -0.79) |
| 6 | 0.42530 | 0.44406 | ( 1.08) | ( -4.41) |
| 7 | 0.38310 | 0.39632 | ( 1.13) | ( -3.45) |
| 8 | 0.28660 | 0.29844 | ( 1.13) | ( -4.13) |
| 9 | 0.21040 | 0.22637 | ( 1.23) | ( -7.59) |
| 10 | 0.15520 | 0.17215 | ( 1.36) | (-10.92) |
| 6 - 8 keV | | | | |
| 1 | 0.89980 | 0.89313 | ( 0.94) | ( 0.74) |
| 2 | 0.80760 | 0.80352 | ( 1.03) | ( 0.51) |
| 3 | 0.70140 | 0.70702 | ( 0.93) | ( -0.80) |
| 4 | 0.58490 | 0.58494 | ( 0.85) | ( -0.01) |
| 5 | 0.50090 | 0.51765 | ( 0.94) | ( -3.34) |
| 6 | 0.42570 | 0.43370 | ( 0.97) | ( -1.88) |
| 7 | 0.37360 | 0.38674 | ( 1.02) | ( -3.52) |
| 8 | 0.28760 | 0.29103 | ( 1.00) | ( -1.19) |
| 9 | 0.21310 | 0.22102 | ( 1.09) | ( -3.72) |
| 10 | 0.15620 | 0.16857 | ( 1.21) | ( -7.92) |
| 5 - 6 keV | | | | |
| 1 | 0.89450 | 0.89771 | ( 1.17) | ( -0.36) |
| 2 | 0.80790 | 0.81022 | ( 1.27) | ( -0.29) |
| 3 | 0.71440 | 0.71484 | ( 1.14) | ( -0.06) |
| 4 | 0.58870 | 0.59296 | ( 1.04) | ( -0.72) |
| 5 | 0.51940 | 0.52533 | ( 1.14) | ( -1.14) |
| 6 | 0.43080 | 0.44053 | ( 1.19) | ( -2.26) |
| 7 | 0.38750 | 0.39291 | ( 1.24) | ( -1.40) |
| 8 | 0.29580 | 0.29546 | ( 1.23) | ( 0.11) |
| 9 | 0.21530 | 0.22386 | ( 1.34) | ( -3.98) |
| 10 | 0.15670 | 0.17005 | ( 1.49) | ( -8.52) |
| 4 - 5 keV | | | | |
| 1 | 0.90630 | 0.89414 | ( 1.00) | ( 1.34) |
| 2 | 0.82240 | 0.80418 | ( 1.09) | ( 2.22) |
| 3 | 0.69840 | 0.70644 | ( 0.99) | ( -1.15) |
| 4 | 0.57690 | 0.58203 | ( 0.90) | ( -0.89) |
| 5 | 0.49550 | 0.51327 | ( 1.00) | ( -3.59) |
| 6 | 0.41510 | 0.42738 | ( 1.04) | ( -2.96) |
| 7 | 0.36490 | 0.37934 | ( 1.10) | ( -3.96) |
| 8 | 0.26960 | 0.28159 | ( 1.10) | ( -4.45) |
| 9 | 0.19790 | 0.21044 | ( 1.20) | ( -6.34) |
| 10 | 0.14780 | 0.15754 | ( 1.31) | ( -6.59) |

Oigawa et al. (1991)

Transmission (T)

thickness (at./barns)

| | |
|---|---|
| 1 : | 0.00738 |
| 2 : | 0.01474 |
| 3 : | 0.02408 |
| 4 : | 0.03858 |
| 5 : | 0.04823 |
| 6 : | 0.06257 |
| 7 : | 0.07205 |
| 8 : | 0.09614 |
| 9 : | 0.12013 |
| 10 : | 0.14437 |

| thickness N | Experimental T | Calculation T | Uncertainty % | (E-C)/E % |
|---|---|---|---|---|
| 3 - 4 keV | | | | |
| 1 | **0.87390** | 0.87274 | ( 0.86) | ( 0.13) |
| 2 | **0.78710** | 0.77702 | ( 0.94) | ( 1.28) |
| 3 | **0.67680** | 0.67952 | ( 0.85) | ( -0.40) |
| 4 | **0.56120** | 0.56039 | ( 0.78) | ( 0.14) |
| 5 | **0.48970** | 0.49582 | ( 0.86) | ( -1.25) |
| 6 | **0.40770** | 0.41584 | ( 0.89) | ( -2.00) |
| 7 | **0.36590** | 0.37128 | ( 0.93) | ( -1.47) |
| 8 | **0.27910** | 0.28070 | ( 0.92) | ( -0.57) |
| 9 | **0.20510** | 0.21454 | ( 1.00) | ( -4.60) |
| 10 | **0.15150** | 0.16494 | ( 1.10) | ( -8.87) |
| 2 - 3 keV | | | | |
| 1 | **0.87060** | 0.86867 | ( 0.72) | ( 0.22) |
| 2 | **0.77540** | 0.77780 | ( 0.79) | ( -0.31) |
| 3 | **0.67180** | 0.68505 | ( 0.71) | ( -1.97) |
| 4 | **0.55680** | 0.57061 | ( 0.65) | ( -2.48) |
| 5 | **0.48700** | 0.50821 | ( 0.71) | ( -4.36) |
| 6 | **0.40240** | 0.43068 | ( 0.74) | ( -7.03) |
| 7 | **0.36110** | 0.38740 | ( 0.78) | ( -7.28) |
| 8 | **0.28100** | 0.29914 | ( 0.76) | ( -6.46) |
| 9 | **0.20710** | 0.23431 | ( 0.83) | (-13.14) |
| 10 | **0.15810** | 0.18532 | ( 0.90) | (-17.22) |
| 1 - 2 keV | | | | |
| 1 | 0.88360 | 0.88037 | ( 0.50) | ( 0.37) |
| 2 | 0.80300 | 0.79524 | ( 0.55) | ( 0.97) |
| 3 | 0.70000 | 0.70618 | ( 0.49) | ( -0.88) |
| 4 | 0.59450 | 0.59352 | ( 0.45) | ( 0.16) |
| 5 | 0.52810 | 0.53086 | ( 0.49) | ( -0.52) |
| 6 | 0.44570 | 0.45182 | ( 0.50) | ( -1.37) |
| 7 | 0.39970 | 0.40712 | ( 0.53) | ( -1.86) |
| 8 | 0.31910 | 0.31468 | ( 0.51) | ( 1.39) |
| 9 | 0.24340 | 0.24563 | ( 0.55) | ( -0.92) |
| 10 | 0.18680 | 0.19280 | ( 0.59) | ( -3.21) |

ovko et al. (1988)
Transmission (T)

kness (at./barns)
1 : 0.0047 ( 1 mm)
2 : 0.0091 ( 2 mm)
3 : 0.0237 ( 5 mm)
4 : 0.0474 (10 mm)
5 : 0.0707 (15 mm)
6 : 0.0943 (20 mm)
7 : 0.19 (40 mm)

| thickness N | Experimental T | Calculation T | Uncertainty % | (E-C)/E % |
|---|---|---|---|---|
| 100_120 keV | | | | |
| 1 | 0.95000 | 0.94558 | ( 0.42) | ( 0.47) |
| 2 | 0.90400 | 0.89741 | ( 0.44) | ( 0.73) |
| 3 | 0.76000 | 0.75496 | ( 0.39) | ( 0.66) |
| 4 | 0.57300 | 0.57144 | ( 52) | ( 0.27) |
| 5 | 0.44700 | 0.43562 | ( 67) | ( 2.55) |
| 6 | 0.33700 | 0.33170 | ( 0.59) | ( 1.57) |
| 7 | 0.11400 | 0.11235 | ( 1.75) | ( 1.45) |
| 90_100 keV | | | | |
| 1 | 0.95000 | 0.94452 | ( 0.53) | ( 0.58) |
| 2 | 0.89900 | 0.89546 | ( 0.44) | ( 0.39) |
| 3 | 0.75700 | 0.75070 | ( 0.40) | ( 0.83) |
| 4 | 0.56500 | 0.56504 | ( 0.53) | ( -0.01) |
| 5 | 0.44000 | 0.42841 | ( 0.68) | ( 2.63) |
| 6 | 0.32800 | 0.32444 | ( 0.61) | ( 1.09) |
| 7 | 0.11000 | 0.10757 | ( 1.82) | ( 2.21) |
| 80_ 90 keV | | | | |
| 1 | 0.94600 | 0.94377 | ( 0.63) | ( 0.24) |
| 2 | 0.89600 | 0.89412 | ( 0.45) | ( 0.21) |
| 3 | 0.75100 | 0.74805 | ( 0.40) | ( 0.39) |
| 4 | 0.56300 | 0.56170 | ( 0.71) | ( 0.23) |
| 5 | 0.43500 | 0.42529 | ( 0.92) | ( 2.23) |
| 6 | 0.32400 | 0.32193 | ( 0.62) | ( 0.64) |
| 7 | 0.10800 | 0.10745 | ( 1.85) | ( 0.51) |
| 60_ 70 keV | | | | |
| 1 | 0.94500 | 0.94211 | ( 0.42) | ( 0.31) |
| 2 | 0.89300 | 0.89111 | ( 0.45) | ( 0.21) |
| 3 | 0.74800 | 0.74169 | ( 0.40) | ( 0.84) |
| 4 | 0.55400 | 0.55260 | ( 0.72) | ( 0.25) |
| 5 | 0.42500 | 0.41546 | ( 0.94) | ( 2.24) |
| 6 | 0.31600 | 0.31241 | ( 0.63) | ( 1.14) |
| 7 | 0.10300 | 0.10188 | ( 1.94) | ( 1.09) |
| 50_ 60 keV | | | | |
| 1 | 0.94300 | 0.94111 | ( 0.42) | ( 0.20) |
| 2 | 0.88700 | 0.88931 | ( 0.45) | ( -0.26) |
| 3 | 0.74300 | 0.73808 | ( 0.40) | ( 0.66) |
| 4 | 0.54900 | 0.54778 | ( 0.73) | ( 0.22) |
| 5 | 0.42000 | 0.41060 | ( 0.95) | ( 2.24) |
| 6 | 0.30800 | 0.30803 | ( 0.65) | ( -0.01) |
| 7 | 0.10000 | 0.09996 | ( 2.00) | ( 0.04) |
| 40_ 50 keV | | | | |
| 1 | 0.94200 | 0.93991 | ( 0.42) | ( 0.22) |
| 2 | 0.88700 | 0.88717 | ( 0.45) | ( -0.02) |
| 3 | 0.73900 | 0.73378 | ( 0.41) | ( 0.71) |
| 4 | 0.54000 | 0.54211 | ( 0.74) | ( -0.39) |
| 5 | 0.41700 | 0.40493 | ( 0.96) | ( 2.89) |
| 6 | 0.30400 | 0.30293 | ( 0.66) | ( 0.35) |
| 7 | 0.09900 | 0.09773 | ( 2.02) | ( 1.28) |

Bokhovko et al. (1988)

Transmission (T)

thickness (at./barns)

| | | |
|---|---|---|
| 1 : | 0.0047 | ( 1 mm) |
| 2 : | 0.0091 | ( 2 mm) |
| 3 : | 0.0237 | ( 5 mm) |
| 4 : | 0.0474 | (10 mm) |
| 5 : | 0.0707 | (15 mm) |
| 6 : | 0.0943 | (20 mm) |
| 7 : | 0.19 | (40 mm) |

| thickness N | Experimental T | Calculation T | Uncertainty % | (E-C)/E % |
|---|---|---|---|---|
| 30_ 40 keV | | | | |
| 1 | 0.93900 | 0.93847 | ( 0.43) | ( 0.06) |
| 2 | 0.88300 | 0.88463 | ( 0.45) | ( -0.18) |
| 3 | 0.73100 | 0.72881 | ( 0.41) | ( 0.30) |
| 4 | 0.53600 | 0.53575 | ( 0.93) | ( 0.05) |
| 5 | 0.40800 | 0.39869 | ( 0.98) | ( 2.28) |
| 6 | 0.29800 | 0.29739 | ( 0.67) | ( 0.20) |
| 7 | 0.09500 | 0.09533 | ( 2.11) | ( -0.35) |
| 26_ 30 keV | | | | |
| 1 | 0.93900 | 0.93761 | ( 0.43) | ( 0.15) |
| 2 | 0.88100 | 0.88321 | ( 0.45) | ( -0.25) |
| 3 | 0.72200 | 0.72677 | ( 0.42) | ( -0.66) |
| 4 | 0.52700 | 0.53462 | ( 1.14) | ( -1.45) |
| 5 | 0.39800 | 0.39897 | ( 1.01) | ( -0.24) |
| 6 | 0.29200 | 0.29886 | ( 0.68) | ( -2.35) |
| 7 | 0.09300 | 0.09818 | ( 2.15) | ( -5.57) |
| 22_ 26 keV | | | | |
| 1 | 0.93700 | 0.93681 | ( 0.43) | ( 0.02) |
| 2 | 0.88100 | 0.88193 | ( 0.45) | ( -0.11) |
| 3 | 0.72400 | 0.72499 | ( 0.41) | ( -0.14) |
| 4 | 0.52700 | 0.53352 | ( 0.95) | ( -1.24) |
| 5 | 0.40200 | 0.39880 | ( 1.00) | ( 0.80) |
| 6 | 0.29500 | 0.29946 | ( 0.68) | ( -1.51) |
| 7 | 0.09400 | 0.09993 | ( 2.13) | ( -6.31) |
| 18_ 22 keV | | | | |
| 1 | 0.93500 | 0.93482 | ( 0.43) | ( 0.02) |
| 2 | 0.88000 | 0.87842 | ( 0.45) | ( 0.18) |
| 3 | 0.71900 | 0.71827 | ( 0.56) | ( 0.10) |
| 4 | 0.53100 | 0.52501 | ( 1.13) | ( 1.13) |
| 5 | 0.40000 | 0.39041 | ( 1.25) | ( 2.40) |
| 6 | 0.28800 | 0.29187 | ( 0.69) | ( -1.34) |
| 7 | 0.09300 | 0.09597 | ( 3.23) | ( -3.19) |
| 14_ 18 keV | | | | |
| 1 | 0.93700 | 0.93436 | ( 0.53) | ( 0.28) |
| 2 | 0.87600 | 0.87781 | ( 0.68) | ( -0.21) |
| 3 | 0.71700 | 0.71809 | ( 0.56) | ( -0.15) |
| 4 | 0.52300 | 0.52618 | ( 1.34) | ( -0.61) |
| 5 | 0.40500 | 0.39245 | ( 1.73) | ( 3.10) |
| 6 | 0.29600 | 0.29431 | ( 1.01) | ( 0.57) |
| 7 | 0.10200 | 0.09788 | ( 3.92) | ( 4.04) |
| 10_ 14 keV | | | | |
| 1 | 0.94000 | 0.93213 | ( 0.53) | ( 0.84) |
| 2 | 0.88400 | 0.87426 | ( 0.68) | ( 1.10) |
| 3 | 0.71800 | 0.71301 | ( 0.70) | ( 0.69) |
| 4 | 0.52500 | 0.52190 | ( 1.71) | ( 0.59) |
| 5 | 0.39800 | 0.38958 | ( 2.01) | ( 2.12) |
| 6 | 0.29900 | 0.29264 | ( 1.67) | ( 2.13) |
| 7 | 0.10400 | 0.09761 | ( 4.81) | ( 6.14) |

ovko et al. (1988)
Transmission (T)

kness (at./barns)
1 : 0.0047 ( 1 mm)
2 : 0.0091 ( 2 mm)
3 : 0.0237 ( 5 mm)
4 : 0.0474 (10 mm)
5 : 0.0707 (15 mm)
6 : 0.0943 (20 mm)
7 : 0.19 (40 mm)

| thickness N | Experimental T | Calculation T | Uncertainty % | (E-C)/E % |
|---|---|---|---|---|
| 8_ 10 keV | | | | |
| 1 | 0.94000 | 0.93416 | ( 0.74) | ( 0.62) |
| 2 | 0.87200 | 0.87808 | ( 0.69) | ( -0.70) |
| 3 | 0.71900 | 0.72162 | ( 0.83) | ( -0.36) |
| 4 | | | | |
| 5 | | | | |
| 6 | 0.29900 | 0.30488 | ( 2.01) | ( -1.97) |
| 7 | 0.10300 | 0.10413 | ( 5.83) | ( -1.10) |
| 6_ 8 keV | | | | |
| 1 | 0.93900 | 0.92965 | ( 0.85) | ( 1.00) |
| 2 | 0.88100 | 0.87092 | ( 0.79) | ( 1.14) |
| 3 | 0.71700 | 0.71067 | ( 0.84) | ( 0.88) |
| 4 | | | | |
| 5 | | | | |
| 6 | 0.29500 | 0.29731 | ( 2.37) | ( -0.78) |
| 7 | 0.10300 | 0.10301 | ( 6.80) | ( -0.01) |
| 4_ 6 keV | | | | |
| 1 | 0.93300 | 0.93164 | ( 0.86) | ( 0.15) |
| 2 | 0.88100 | 0.87386 | ( 0.91) | ( 0.81) |
| 3 | 0.71900 | 0.71396 | ( 0.97) | ( 0.70) |
| 4 | | | | |
| 5 | | | | |
| 6 | 0.29600 | 0.29435 | ( 3.04) | ( 0.56) |
| 7 | 0.09800 | 0.09705 | ( 8.16) | ( 0.97) |

Byoun et al. (1972)
Transmission (T)

thickness (at./barns)
1 : 0.00758
2 : 0.01552
3 : 0.03155
4 : 0.04670
5 : 0.06206

| thickness N | Experimental T | Calculation T | Uncertainty % | (E-C)/E % |
|---|---|---|---|---|
| 92 - 83 keV | | | | |
| 1 | 0.91460 | 0.91130 | ( 0.84) | ( 0.36) |
| 2 | 0.83770 | 0.82715 | ( 0.84) | ( 1.26) |
| 3 | 0.68870 | 0.68106 | ( 0.86) | ( 1.11) |
| 4 | 0.57440 | 0.56764 | ( 0.87) | ( 1.18) |
| 5 | 0.48080 | 0.47259 | ( 0.89) | ( 1.71) |
| 83 - 75 keV | | | | |
| 1 | 0.91270 | 0.91024 | ( 0.78) | ( 0.27) |
| 2 | 0.82580 | 0.82518 | ( 0.78) | ( 0.08) |
| 3 | 0.68230 | 0.67774 | ( 0.79) | ( 0.67) |
| 4 | 0.57660 | 0.56352 | ( 0.80) | ( 2.27) |
| 5 | 0.48080 | 0.46802 | ( 0.81) | ( 2.66) |
| 75 - 83 keV | | | | |
| 1 | 0.91180 | 0.90926 | ( 0.73) | ( 0.28) |
| 2 | 0.82890 | 0.82340 | ( 0.74) | ( 0.66) |
| 3 | 0.68820 | 0.67487 | ( 0.74) | ( 1.94) |
| 4 | 0.57650 | 0.56008 | ( 0.76) | ( 2.85) |
| 5 | 0.48300 | 0.46432 | ( 0.77) | ( 3.87) |
| 68 - 62 keV | | | | |
| 1 | 0.90970 | 0.90831 | ( 0.73) | ( 0.15) |
| 2 | 0.82640 | 0.82169 | ( 0.73) | ( 0.57) |
| 3 | 0.67740 | 0.67220 | ( 0.74) | ( 0.77) |
| 4 | 0.57170 | 0.55701 | ( 0.75) | ( 2.57) |
| 5 | 0.47810 | 0.46117 | ( 0.77) | ( 3.54) |
| 62 - 56 keV | | | | |
| 1 | 0.90260 | 0.90743 | ( 0.73) | ( -0.54) |
| 2 | 0.81880 | 0.82012 | ( 0.73) | ( -0.16) |
| 3 | 0.67060 | 0.66982 | ( 0.75) | ( 0.12) |
| 4 | 0.55570 | 0.55434 | ( 0.76) | ( 0.24) |
| 5 | 0.45970 | 0.45847 | ( 0.78) | ( 0.27) |
| 56 - 50 keV | | | | |
| 1 | 0.87230 | 0.90655 | ( 0.77) | ( -3.93) |
| 2 | 0.80940 | 0.81858 | ( 0.75) | ( -1.13) |
| 3 | 0.64710 | 0.66750 | ( 0.79) | ( -3.15) |
| 4 | 0.54710 | 0.55173 | ( 0.79) | ( -0.85) |
| 5 | 0.44840 | 0.45583 | ( 0.83) | ( -1.66) |

| | | | | |
|---|---|---|---|---|
| - 46 keV | | | | |
| 1 | 0.90410 | 0.90567 | ( 0.74) | ( -0.17) |
| 2 | 0.79590 | 0.81698 | ( 0.77) | ( -2.65) |
| 3 | 0.64970 | 0.66494 | ( 0.78) | ( -2.35) |
| 4 | 0.54820 | 0.54872 | ( 0.80) | ( -0.09) |
| 5 | 0.43590 | 0.45265 | ( 0.85) | ( -3.84) |
| 46 - 41 keV | | | | |
| 1 | 0.89440 | 0.90496 | ( 0.76) | ( -1.18) |
| 2 | 0.81560 | 0.81575 | ( 0.76) | ( -0.02) |
| 3 | 0.66660 | 0.66315 | ( 0.78) | ( 0.52) |
| 4 | 0.54650 | 0.54677 | ( 0.79) | ( -0.05) |
| 5 | 0.45770 | 0.45074 | ( 0.81) | ( 1.52) |
| 41 - 37 keV | | | | |
| 1 | 0.90180 | 0.90418 | ( 0.74) | ( -0.26) |
| 2 | 0.82120 | 0.81446 | ( 0.74) | ( 0.82) |
| 3 | 0.66500 | 0.66142 | ( 0.77) | ( 0.54) |
| 4 | 0.55510 | 0.54506 | ( 0.77) | ( 1.81) |
| 5 | 0.45750 | 0.44927 | ( 0.79) | ( 1.80) |
| 37 - 34 keV | | | | |
| 1 | 0.89550 | 0.90306 | ( 0.75) | ( -0.84) |
| 2 | 0.80960 | 0.81250 | ( 0.75) | ( -0.36) |
| 3 | 0.66340 | 0.65854 | ( 0.77) | ( 0.73) |
| 4 | 0.54810 | 0.54190 | ( 0.78) | ( 1.13) |
| 5 | 0.45940 | 0.44615 | ( 0.81) | ( 2.88) |
| 34 - 31 keV | | | | |
| 1 | 0.89940 | 0.90215 | ( 0.76) | ( -0.31) |
| 2 | 0.81810 | 0.81080 | ( 0.76) | ( 0.89) |
| 3 | 0.65890 | 0.65569 | ( 0.77) | ( 0.49) |
| 4 | 0.54500 | 0.53836 | ( 0.79) | ( 1.22) |
| 5 | 0.44810 | 0.44219 | ( 0.83) | ( 1.32) |
| 31 - 28 keV | | | | |
| 1 | 0.89610 | 0.90158 | ( 0.73) | ( -0.61) |
| 2 | 0.80560 | 0.80993 | ( 0.73) | ( -0.54) |
| 3 | 0.65070 | 0.65472 | ( 0.74) | ( -0.62) |
| 4 | 0.52980 | 0.53760 | ( 0.76) | ( -1.47) |
| 5 | 0.43860 | 0.44173 | ( 0.78) | ( -0.71) |
| 28 - 25 keV | | | | |
| 1 | 0.88580 | 0.89953 | ( 0.69) | ( -1.55) |
| 2 | 0.80870 | 0.80669 | ( 0.69) | ( 0.25) |
| 3 | 0.64980 | 0.65093 | ( 0.71) | ( -0.17) |
| 4 | 0.54380 | 0.53444 | ( 0.72) | ( 1.72) |
| 5 | 0.44220 | 0.43964 | ( 0.75) | ( 0.58) |
| 25 - 23 keV | | | | |
| 1 | 0.89320 | 0.90128 | ( 0.68) | ( -0.90) |
| 2 | 0.80770 | 0.80989 | ( 0.68) | ( -0.27) |
| 3 | 0.65410 | 0.65595 | ( 0.70) | ( -0.28) |
| 4 | 0.53880 | 0.54019 | ( 0.71) | ( -0.26) |
| 5 | 0.44830 | 0.44550 | ( 0.74) | ( 0.62) |

| | | | | |
|---|---|---|---|---|
| 23 - 21 keV | | | | |
| 1 | 0.89670 | 0.89914 | ( 0.68) | ( -0.27) |
| 2 | 0.80840 | 0.80620 | ( 0.69) | ( 0.27) |
| 3 | 0.65070 | 0.65062 | ( 0.71) | ( 0.01) |
| 4 | 0.53340 | 0.53441 | ( 0.71) | ( -0.19) |
| 5 | 0.43070 | 0.43983 | ( 0.74) | ( -2.12) |
| 21 - 19 keV | | | | |
| 1 | 0.89860 | 0.89739 | ( 0.68) | ( 0.13) |
| 2 | 0.80970 | 0.80328 | ( 0.68) | ( 0.79) |
| 3 | 0.65850 | 0.64649 | ( 0.68) | ( 1.82) |
| 4 | 0.54410 | 0.52990 | ( 0.70) | ( 2.61) |
| 5 | 0.45260 | 0.43531 | ( 0.73) | ( 3.82) |
| 19 - 17 keV | | | | |
| 1 | 0.88430 | 0.89886 | ( 0.68) | ( -1.65) |
| 2 | 0.79210 | 0.80607 | ( 0.68) | ( -1.76) |
| 3 | 0.63730 | 0.65122 | ( 0.69) | ( -2.18) |
| 4 | 0.52160 | 0.53568 | ( 0.71) | ( -2.70) |
| 5 | 0.42810 | 0.44159 | ( 0.72) | ( -3.15) |
| 17 - 15 keV | | | | |
| 1 | 0.88160 | 0.89604 | ( 0.67) | ( -1.64) |
| 2 | 0.79690 | 0.80155 | ( 0.67) | ( -0.58) |
| 3 | 0.63830 | 0.64550 | ( 0.69) | ( -1.13) |
| 4 | 0.52210 | 0.53017 | ( 0.71) | ( -1.55) |
| 5 | 0.43900 | 0.43684 | ( 0.71) | ( 0.49) |
| 15 - 13 keV | | | | |
| 1 | 0.89020 | 0.89516 | ( 0.66) | ( -0.56) |
| 2 | 0.79310 | 0.79962 | ( 0.67) | ( -0.82) |
| 3 | 0.64470 | 0.64156 | ( 0.68) | ( 0.49) |
| 4 | 0.53610 | 0.52474 | ( 0.69) | ( 2.12) |
| 5 | 0.44090 | 0.43027 | ( 0.70) | ( 2.41) |
| 13 - 12 keV | | | | |
| 1 | 0.89130 | 0.89708 | ( 0.65) | ( -0.65) |
| 2 | 0.79840 | 0.80366 | ( 0.65) | ( -0.66) |
| 3 | 0.63790 | 0.64923 | ( 0.67) | ( -1.78) |
| 4 | 0.52640 | 0.53471 | ( 0.68) | ( -1.58) |
| 5 | 0.43330 | 0.44165 | ( 0.72) | ( -1.93) |
| 12 - 11 keV | | | | |
| 1 | 0.88730 | 0.89394 | ( 0.64) | ( -0.75) |
| 2 | 0.80110 | 0.79848 | ( 0.65) | ( 0.33) |
| 3 | 0.64600 | 0.64196 | ( 0.67) | ( 0.63) |
| 4 | 0.53270 | 0.52672 | ( 0.68) | ( 1.12) |
| 5 | 0.44280 | 0.43353 | ( 0.68) | ( 2.09) |
| 11 - 10 keV | | | | |
| 1 | 0.89030 | 0.89159 | ( 0.64) | ( -0.14) |
| 2 | 0.79860 | 0.79432 | ( 0.64) | ( 0.54) |
| 3 | 0.65080 | 0.63571 | ( 0.66) | ( 2.32) |
| 4 | 0.53180 | 0.51971 | ( 0.68) | ( 2.27) |
| 5 | 0.44370 | 0.42638 | ( 0.68) | ( 3.90) |

ı et al. (1991)
Self_Indication (R)

ıess (at./barns)
: 0.00738
2 : 0.01474
3 : 0.02400
4 : 0.03125
5 : 0.03874
6 : 0.04795
7 : 0.06297
8 : 0.07205
9 : 0.09614
10 : 0.12037

| thickness N | Experimental R | Calculation R | Uncertainty % | (E-C)/E % |
|---|---|---|---|---|
| 25 - 35 keV | | | | |
| 1 | 0.88570 | 0.89276 | ( 2.46) | ( -0.80) |
| 2 | 0.77670 | 0.79868 | ( 2.23) | ( -2.83) |
| 3 | 0.69400 | 0.69579 | ( 2.27) | ( -0.26) |
| 4 | 0.59590 | 0.62551 | ( 2.52) | ( -4.97) |
| 5 | 0.56650 | 0.56111 | ( 2.15) | ( 0.95) |
| 6 | 0.47710 | 0.49200 | ( 2.47) | ( -3.12) |
| 7 | 0.38790 | 0.39801 | ( 2.34) | ( -2.61) |
| 8 | 0.34950 | 0.35097 | ( 2.39) | ( -0.42) |
| 9 | 0.24570 | 0.25301 | ( 2.60) | ( -2.98) |
| 10 | 0.17890 | 0.18354 | ( 3.19) | ( -2.59) |
| 20 - 25 keV | | | | |
| 1 | 0.84180 | 0.88779 | ( 2.82) | ( -5.46) |
| 2 | 0.77230 | 0.79046 | ( 2.50) | ( -2.35) |
| 3 | 0.68030 | 0.68516 | ( 2.57) | ( -0.71) |
| 4 | 0.57870 | 0.61387 | ( 2.85) | ( -6.08) |
| 5 | 0.56120 | 0.54901 | ( 2.43) | ( 2.17) |
| 6 | 0.46120 | 0.47985 | ( 2.80) | ( -4.04) |
| 7 | 0.37790 | 0.38654 | ( 2.65) | ( -2.29) |
| 8 | 0.31830 | 0.34016 | ( 2.77) | ( -6.87) |
| 9 | 0.24740 | 0.24424 | ( 2.89) | ( 1.28) |
| 10 | 0.17360 | 0.17676 | ( 3.59) | ( -1.82) |
| 15 - 20 keV | | | | |
| 1 | 0.89230 | 0.87637 | ( 2.85) | ( 1.79) |
| 2 | 0.77510 | 0.77215 | ( 2.59) | ( 0.38) |
| 3 | 0.66920 | 0.66218 | ( 2.68) | ( 1.05) |
| 4 | 0.59320 | 0.58920 | ( 2.93) | ( 0.67) |
| 5 | 0.52150 | 0.52373 | ( 2.53) | ( -0.43) |
| 6 | 0.46340 | 0.45485 | ( 2.90) | ( 1.85) |
| 7 | 0.36300 | 0.36331 | ( 2.79) | ( -0.09) |
| 8 | 0.31540 | 0.31836 | ( 2.90) | ( -0.94) |
| 9 | 0.22880 | 0.22654 | ( 3.13) | ( 0.99) |
| 10 | 0.16330 | 0.16286 | ( 3.87) | ( 0.27) |
| 10 - 15 keV | | | | |
| 1 | 0.88710 | 0.86526 | ( 2.80) | ( 2.46) |
| 2 | 0.76290 | 0.75512 | ( 2.64) | ( 1.02) |
| 3 | 0.63510 | 0.64181 | ( 2.75) | ( -1.06) |
| 4 | 0.55400 | 0.56803 | ( 2.98) | ( -2.53) |
| 5 | 0.50780 | 0.50268 | ( 2.61) | ( 1.01) |
| 6 | 0.43350 | 0.43469 | ( 2.94) | ( -0.27) |
| 7 | 0.34240 | 0.34538 | ( 2.89) | ( -0.87) |
| 8 | 0.30950 | 0.30193 | ( 3.00) | ( 2.45) |
| 9 | 0.22240 | 0.21391 | ( 3.25) | ( 3.82) |
| 10 | 0.16130 | 0.15340 | ( 4.05) | ( 4.90) |

igawa et al. (1991)
Self_Indication (R)

hickness (at./barns)

| | |
|---|---|
| 1 : | 0.00738 |
| 2 : | 0.01474 |
| 3 : | 0.02400 |
| 4 : | 0.03125 |
| 5 : | 0.03874 |
| 6 : | 0.04795 |
| 7 : | 0.06297 |
| 8 : | 0.07205 |
| 9 : | 0.09614 |
| 10 : | 0.12037 |

| thickness N | Experimental R | Calculation R | Uncertainty % | (E-C)/E % |
|---|---|---|---|---|
| 8 - 10 keV | | | | |
| 1 | 0.86720 | 0.85465 | ( 3.80) | ( 1.45) |
| 2 | 0.71990 | 0.73980 | ( 3.60) | ( -2.76) |
| 3 | 0.61110 | 0.62481 | ( 3.73) | ( -2.24) |
| 4 | 0.52240 | 0.55135 | ( 4.06) | ( -5.54) |
| 5 | 0.46640 | 0.48701 | ( 3.58) | ( -4.42) |
| 6 | 0.40740 | 0.42063 | ( 4.00) | ( -3.25) |
| 7 | 0.30840 | 0.33403 | ( 4.00) | ( -8.31) |
| 8 | 0.27370 | 0.29204 | ( 4.17) | ( -6.70) |
| 9 | 0.19700 | 0.20700 | ( 4.49) | ( -5.08) |
| 10 | 0.14110 | 0.14844 | ( 5.60) | ( -5.20) |
| 6 - 8 keV | | | | |
| 1 | 0.79980 | 0.81896 | ( 3.17) | ( -2.40) |
| 2 | 0.63830 | 0.68831 | ( 3.60) | ( -7.83) |
| 3 | 0.55380 | 0.56555 | ( 3.69) | ( -2.12) |
| 4 | 0.46310 | 0.49054 | ( 4.08) | ( -5.93) |
| 5 | 0.44320 | 0.42677 | ( 3.57) | ( 3.71) |
| 6 | 0.34730 | 0.36278 | ( 4.09) | ( -4.46) |
| 7 | 0.29430 | 0.28197 | ( 3.98) | ( 4.19) |
| 8 | 0.23760 | 0.24388 | ( 4.29) | ( -2.64) |
| 9 | 0.17190 | 0.16893 | ( 4.77) | ( 1.73) |
| 10 | 0.11420 | 0.11905 | ( 6.42) | ( -4.25) |
| 5 - 6 keV | | | | |
| 1 | 0.82950 | 0.82787 | ( 3.88) | ( 0.20) |
| 2 | 0.71980 | 0.69791 | ( 3.69) | ( 3.04) |
| 3 | 0.57750 | 0.57295 | ( 3.91) | ( 0.79) |
| 4 | 0.47840 | 0.49582 | ( 4.21) | ( -3.64) |
| 5 | 0.44240 | 0.43004 | ( 3.80) | ( 2.79) |
| 6 | 0.36620 | 0.36398 | ( 4.17) | ( 0.61) |
| 7 | 0.26240 | 0.28072 | ( 4.43) | ( -6.98) |
| 8 | 0.24110 | 0.24162 | ( 4.50) | ( -0.22) |
| 9 | 0.16910 | 0.16525 | ( 4.96) | ( 2.28) |
| 10 | 0.11930 | 0.11505 | ( 6.42) | ( 3.56) |
| 4 - 5 keV | | | | |
| 1 | 0.83460 | 0.80775 | ( 4.10) | ( 3.22) |
| 2 | 0.66290 | 0.66896 | ( 3.97) | ( -0.91) |
| 3 | 0.51120 | 0.54004 | ( 4.28) | ( -5.64) |
| 4 | 0.45540 | 0.46266 | ( 4.57) | ( -1.59) |
| 5 | 0.38040 | 0.39801 | ( 4.19) | ( -4.63) |
| 6 | 0.32590 | 0.33430 | ( 4.65) | ( -2.58) |
| 7 | 0.22990 | 0.25563 | ( 4.93) | (-11.19) |
| 8 | 0.20120 | 0.21923 | ( 5.17) | ( -8.96) |
| 9 | 0.14400 | 0.14897 | ( 5.68) | ( -3.45) |
| 10 | 0.09890 | 0.10324 | ( 7.59) | ( -4.39) |

;awa et al. (1991)
Self_Indication (R)

ickness (at./barns)
1 : 0.00738
2 : 0.01474
3 : 0.02400
4 : 0.03125
5 : 0.03874
6 : 0.04795
7 : 0.06297
8 : 0.07205
9 : 0.09614
10 : 0.12037

| thickness N | Experimental R | Calculation R | Uncertainty % | (E-C)/E % |
|---|---|---|---|---|
| 3 - 4 keV | | | | |
| 1 | 0.73500 | 0.67754 | ( 3.64) | ( 7.82) |
| 2 | 0.54440 | 0.50873 | ( 3.61) | ( 6.55) |
| 3 | 0.43440 | 0.38462 | ( 3.84) | ( 11.46) |
| 4 | 0.36700 | 0.32100 | ( 4.29) | ( 12.53) |
| 5 | 0.30330 | 0.27244 | ( 3.99) | ( 10.17) |
| 6 | 0.25890 | 0.22767 | ( 4.42) | ( 12.06) |
| 7 | 0.19160 | 0.17524 | ( 4.56) | ( 8.54) |
| 8 | 0.15920 | 0.15162 | ( 4.96) | ( 4.76) |
| 9 | 0.11010 | 0.10629 | ( 5.60) | ( 3.46) |
| 10 | 0.08290 | 0.07642 | ( 7.20) | ( 7.82) |
| 2 - 3 keV | | | | |
| 1 | 0.61910 | 0.58681 | ( 3.84) | ( 5.22) |
| 2 | 0.40280 | 0.43413 | ( 4.29) | ( -7.78) |
| 3 | 0.28850 | 0.32812 | ( 4.92) | (-13.73) |
| 4 | 0.24410 | 0.27341 | ( 5.35) | (-12.01) |
| 5 | 0.20860 | 0.23113 | ( 5.08) | (-10.80) |
| 6 | 0.17620 | 0.19183 | ( 5.59) | ( -8.87) |
| 7 | 0.12140 | 0.14589 | ( 6.22) | (-20.17) |
| 8 | 0.11530 | 0.12543 | ( 6.31) | ( -8.79) |
| 9 | 0.08200 | 0.08706 | ( 6.89) | ( -6.17) |
| 10 | 0.06030 | 0.06264 | ( 8.56) | ( -3.88) |
| 1 - 2 keV | | | | |
| 1 | 0.54660 | 0.48505 | ( 3.87) | ( 11.26) |
| 2 | 0.34070 | 0.33500 | ( 4.72) | ( 1.67) |
| 3 | 0.23170 | 0.24393 | ( 5.74) | ( -5.28) |
| 4 | 0.18420 | 0.20043 | ( 6.41) | ( -8.81) |
| 5 | 0.15420 | 0.16808 | ( 6.63) | ( -9.00) |
| 6 | 0.12820 | 0.13879 | ( 7.24) | ( -8.26) |
| 7 | 0.09080 | 0.10523 | ( 8.15) | (-15.89) |
| 8 | 0.08200 | 0.09044 | ( 8.46) | (-10.29) |
| 9 | 0.05990 | 0.06284 | ( 9.13) | ( -4.91) |
| 10 | 0.05040 | 0.04531 | ( 11.10) | ( 10.10) |