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INTERNATIONAL ATOMIC ENERGY AGENCY

NUCLEAR DATA SERVICES

DOCUMENTATION SERIES OF THE IAEA NUCLEAR DATA SECTION

DAMSIG81

ECN RADIATION DAMAGE CROSS SECTION LIBRARY

Contents and Documentation

Abstract

DAMSIG81, the Radiation Damage Cross-Section Library by ECN, Netherlands, includes neutron cross-sections for about 20 reactor structural materials for calculating radiation damage by atomic displacements and by gas production, together with some additional related data. The data are presented in a 640 group structure similar to SAND-II. The library can be obtained free of charge from the IAEA Nuclear Data Section. The present version (DAMSIG81A) has a minor correction compared to the original version.

H.D. Lemmel
October 1982

DAMSIG81

Purpose of the library: Calculation of radiation damage in reactor materials

Originator: ECN Netherlands

Documentation: Report ECN-104 (Nov. 1981) by Willem L. Zijp, Henk H. Nolthenius, Henk Ch. Rieffe

Contents of the library: 76 files including 37 files of gas production cross-section data by hydrogen and helium production, 24 files of displacement cross-section data, 4 files of activation cross-sections for calculating the damage-to-activation ratio, and some related data.

For detailed table of contents, see the tables on the following pages.

Energy range: 10^{-4} eV up to 20 MeV

Group structure: 640 energy groups in an extended SAND-II format, supplementing the SAND-II groups with additional 20 groups with a width of 100 keV for the energy range from 18 to 20 MeV. Data are given in fine group cross-section values which can be used without ENDF/B conversion routines. Fine group means here that the actual spectrum and a constant neutron spectrum (used in the calculations of the fine group values) do not give appreciable differences.

Format: Record length 80, per record 5 data fields E10.5 with 5 spaces in between.
The 641 energy values are given in the first file; all the following files contain cross-section data for the same set of energy values. Each file starts with an alfanumeric heading record identifying the data given.

Origin of the data: Most of the data are based on ENDF/B-4

Graphical plots of the data and spectrum averaged cross-sections: See report ECN-104. Note that in figures 1, 31, 32 of ECN-104 the data are too large by a factor of 10.

The presently valid version (Oct. 1982) is DAMSIG81A which differs from the original version only by the correction of two inverted data set headings; see table 2 on page 3.

Table 1. Contents of DAMSIG81

File	Heading	Data	
1	641	The low energy boundaries [in MeV] of the energy intervals for which the cross-sections are given	
2	CD	Cd(n,tot) from ENDF/B-4	
3	B	B-10(n,tot) from ENDF/B-4	
4	AL	Al-27(n,tot) from ENDF/B-4	
5-41	37 files of gas production cross-section data, see Table 2		
42-65	24 files of radiation damage cross-section data, see Table 3		
66	PROPSIG	SIGMA-PROPOR	
67	SORTSIG	SIGMA-SQRT	
68	NEGLNSIG	SIGMA-NEGLN	artificial cross-sections,
69	UNISIG	SIGMA-UNIT	see ECN-104 p.10
70	UNISIG.1	SIGMA-UNIT.1	
71	UNISIG1.	SIGMA-UNIT1.	
72	FE54P5E	FE54(N,P)MN54	
73	NI58P5E	NI58(N,P)CO58	activation cross-sections
74	CO59G5E	CO59(N,G)CO60	from ENDF/B-5 dosimetry file
75	CU63A5E	CU63(N,A)CO60	
76	ST-A-PR	STEEL-A-PROB	steel radiation damage data taking into account also secondary displacement zones

Table 2. Survey of gas production cross section data

File	reaction code	reaction name	ENDF/B-IV MAT	reactions taken into account
5	H-LI	LI-H-TOTAL	1271	Li-6(n,2nα)(n,p)
			1272	Li-7(n,p)
6	HE-Li	LI-HE-TOTAL	1271	Li-6(n,2nα)(n,n')
			1272	Li-7(n,2nα)(n,n')
7	H-B	B-H-TOTAL	1273	B-10(n,p)
			1160	B-11(n,p)
8	HE-B	B-HE-TOTAL	1273	B-10(n,α)
			1160	B-11(n,α)
9	HE-C	C-HE-TOTAL	1274	C(n,α)
10	H-N	N-H-TOTAL	1275	N(n,p)
11	HE-N	N-HE-TOTAL	1275	N(n,α)(n,2α)
12	H-O	O-H-TOTAL	1276	O(n,p)
13	HE-O	O-HE-TOTAL	1276	O(n,α)
14	H-AL	AL-H-TOTAL	1193	Al-27(n,p)
15	HE-AL	AL-HE-TOTAL	1193	AL-27(n,α)
16	H-SI	SI-H-TOTAL	1194	Si(n,n'p)(n,p)
17	HE-SI	SI-HE-TOTAL	1194	Si(n,n'α)(n,α)
18	H-TI	TI-H-TOTAL	1286	Ti(n,p)
19	HE-TI	TI-HE-TOTAL	1286	Ti(n,α)
20	H-V	V-H-TOTAL	1196	V-51(n,n'p)(n,p)
21	HE-V	V-HE-TOTAL	1196	V-51(n,n'α)(n,α)
22	H-CR	CR-H-TOTAL	1191	Cr(n,n'p)(n,p)
23	HE-CR	CR-HE-TOTAL	1191	Cr(n,n'α)(n,α)
24	H-MN	MN-H-TOTAL	1197	Mn-55(n,n'p)(n,p)
25	HE-MN	MN-HE-TOTAL	1197	Mn-55(n,n'α)(n,α)
26	H-FE	FE-H-TOTAL	1192	Fe(n,n'p)(n,p)
27	HE-FE	FE-HE-TOTAL	1192	Fe(n,n'α)(n,α)
28	HE-CO	CO-HE-TOTAL	1199	Co-59(n,α) *)
29	H-CO	CO-H-TOTAL	1199	Co-59(n,p) *)
30	H-NI	NI-H-TOTAL	1190	Ni(n,n'p)(n,p)
31	HE-NI	NI-HE-TOTAL	1190	Ni(n,α)
32	H-CU	CU-H-TOTAL	1295	Cu(n,n'p)(n,p)
33	HE-CU	CU-HE-TOTAL	1295	Cu(n,n'α)(n,α)
34	H-ZR	ZR-H-TOTAL	1284	Zr(n,p)
35	HE-ZR	ZR-HE-TOTAL	1284	Zr(n,α)
36	H-NB	NB-H-TOTAL	1189	Nb-93(n,p)
37	HE-NB	NB-HE-TOTAL	1189	Nb-93(n,n'α)(n,α)
38	H-TIALV	TIALV-H-TOTAL	Ti6Al4V alloy	
39	HE-TIALV	TIALV-HE-TOTAL	"	
40	H-STEEL	STEEL-H-TOTAL	AISI-31GL steel	
41	HE-STEEL	STEEL-HE-TOTAL	"	

*) Note: In the original version distributed between April and August 1982 the headings for the reactions (n,p) and (n,α) were inverted by mistake.

Table 3. Radiation damage cross-section included

Data for calculation of the number of displacements per second
for a particular neutron spectrum

File	Heading	Reaction name	explanation
42	C12-M-D	C12-M-DISPL	graphite data by Morgan
43	C12-R-D	C12-R-DISPL	graphite data by Reed
44	AL-G-D	ALUMINUMEWGRD	aluminum data recommended by EWGRD
45	AL27-L-D	AL27-L-DISPL	aluminum data by Lott
46	SI-L-D	SI-L-DISPL	silicon data by Lott
47	V-ALB-D	VANADIUMALBERMAN	vanadium data by Alberman
48	V-A2-D	VANADIUMALB	
49	CR-G-D	CHROMIUMEWGRD	chromium data recommended by EWGRD
50	CR-L-D	CR-L-DISPL	chromium data by Lott
51	FE-G-D	IRONEWGRD	iron data recommended by EWGRD
52	FE-L-D	FE-L-DISPL	iron data by Lott
53	STEEL-LD	STEEL-L-DISPL	steel data by Lott
54	ST-ASTM	ASTM-DISPL-STEEL	steel data according to ASTM standards
55	NI-G-D	NICKEL EWGRD	nickel data recommended by EWGRD
56	NI-L-D	NI-L-DISPL	nickel data by Lott
57	CU-L-D	CU-L-DISPL	copper data by Lott
58	ZR-G-D	ZIRCONIUM EWGRD	zirconium data recommended by EWGRD
59	ZR-L-D	ZR-L-DISPL	zirconium data by Lott
60	ZIR4-D	ZIR4-DISPL	zircaloy-4, from CR-L-D, FE-L-D, ZR-L-D
61	NB-ALB-D	NIOBIUM ALBERMAN	niobium data by Alberman
62	NB-A2-D	NIOBIUM ALB	
63	MO-G-D	MOLYBDENIUMEWGRD	molybdenum data recommended by EWGRD
64	MO-L-D	MO-L-DISPL	molybdenum data by Lott
65	W-L-D	W-L-DISPL	tungsten data by Lott