

Nuclear Engineering Laboratory

M O N T E C U C C O L I N O

memorandum

Nuclear Reactor Physics

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MAT numbers table for isotope processing with NJoy

To process cross sections libraries with NJoy¹, in order to obtain a complete thermal treatment of the elements which a material is made of, the single isotopes of interest are identified - unlike the common zaid standard - via a numeric, up to four digit code, the s.c. MAT number.

To determine the correct code to be used for each isotope, it's important to understand the logic lying beside it's definition. It's possible, then, to separate the code in two groups:

- the first one represents the atomic number Z of the isotope, so it can be one or two digit long;
- the second group is a two digits fixed length unique identifier of the isotope. The numeration of all the isotopes referring to a single element in the periodic table begins by assigning the label 25 to the main of these (the most common). Every other isotope, characterized by incrementing or decrementing its mass number A of an integer quantity $N = A - A_{\text{base}}$ with respect to the main isotope one, is then identified by the label $25 + 3N$.

Such a 3-step based numeration was chosen to introduce the possibility of a couple isomers (metastables or generically excited states of the same isotope) description for every single isotope.

The following table presents the most common isotopes and their MAT numbers, as defined by the simple rule yet introduced.

zaid	isotope	MAT
01001	01H_001	125
01002	01H_002	128
01003	01H_003	131
02003	02He003	225
02004	02He004	228
03006	03Li006	325
03007	03Li007	328
04009	04Be009	425
05010	05B_010	525

¹R. E. MacFarlane and D. W. Muir. The NJOY Nuclear Data Processing System Version 91. Technical Report LA-12740-M, Los Alamos National Laboratories, October 1994.

05011	05B_011	528
06000	06C_000	600
07014	07N_014	725
07015	07N_015	728
08016	08O_016	825
08017	08O_017	828
09019	09F_019	925
11023	11Na023	1125
12000	12Mg000	1200
12024	12Mg024	1225
13027	13Al027	1325
14000	14Si000	1400
14028	14Si028	1425
14029	14Si029	1428
14030	14Si030	1431
15031	15P_031	1525
16000	16S_000	1600
16032	16S_032	1625
17000	17Cl000	1700
17035	17Cl035	1725
17037	17Cl037	1731
18040	18Ar040	1837
19000	19K_000	1900
19041	19K_041	1931
20000	20Ca000	2000
21045	21Sc045	2125
22000	22Ti000	2200
22046	22Ti046	2225
22047	22Ti047	2228
22048	22Ti048	2231
22050	22Ti050	2237
23000	23V_000	2300
24050	24Cr050	2425
24052	24Cr052	2431
24053	24Cr053	2434
24054	24Cr054	2437
25055	25Mn055	2525
26054	26Fe054	2625
26056	26Fe056	2631
26057	26Fe057	2634
26058	26Fe058	2637
27059	27Co059	2725

28058	28Ni058	2825
28059	28Ni059	2828
28060	28Ni060	2831
28061	28Ni061	2834
28062	28Ni062	2837
28064	28Ni064	2843
29063	29Cu063	2925
29065	29Cu065	2931
31000	31Ga000	3100
32072	32Ge072	3231
32073	32Ge073	3234
32074	32Ge074	3237
32076	32Ge076	3243
33075	33As075	3325
34074	34Se074	3425
34076	34Se076	3431
34077	34Se077	3434
34078	34Se078	3437
34080	34Se080	3443
34082	34Se082	3449
35079	35Br079	3525
35081	35Br081	3531
36078	36Kr078	3625
36080	36Kr080	3631
36082	36Kr082	3637
36083	36Kr083	3640
36084	36Kr084	3643
36085	36Kr085	3646
36086	36Kr086	3649
37085	37Rb085	3725
37086	37Rb086	3728
37087	37Rb087	3731
38084	38Sr084	3825
38086	38Sr086	3831
38087	38Sr087	3834
38088	38Sr088	3837
38089	38Sr089	3840
38090	38Sr090	3843
39089	39Y_089	3925
39090	39Y_090	3928
39091	39Y_091	3931

40000	40Zr000	4000
40090	40Zr090	4025
40091	40Zr091	4028
40092	40Zr092	4031
40093	40Zr093	4034
40094	40Zr094	4037
40095	40Zr095	4040
40096	40Zr096	4043
41093	41Nb093	4125
41094	41Nb094	4128
41095	41Nb095	4131
42000	42Mo000	4200
42092	42Mo092	4225
42094	42Mo094	4231
42095	42Mo095	4234
42096	42Mo096	4237
42097	42Mo097	4240
42098	42Mo098	4243
42099	42Mo099	4246
42100	42Mo100	4249
43099	43Tc099	4325 ²
44096	44Ru096	4425
44098	44Ru098	4431
44099	44Ru099	4434
44100	44Ru100	4437
44101	44Ru101	4440
44102	44Ru102	4443
44103	44Ru103	4446
44104	44Ru104	4449
44105	44Ru105	4452
44106	44Ru106	4455
45103	45Rh103	4525
45105	45Rh105	4531
46102	46Ph102	4625
46104	46Pd104	4631
46105	46Pd105	4634
46106	46Pd106	4637
46107	46Pd107	4640
46108	46Pd108	4643
46110	46Pd110	4649

²Unlike official table, presented, in JEFF2.2 library this isotope is identified by the 4331 MAT number.

47107	47Ag107	4725
47109	47Ag109	4731
47111	47Ag111	4737
48000	48Cd000	4800
48106	48Cd106	4825
48108	48Cd108	4831
48110	48Cd110	4837
48111	48Cd111	4840
48112	48Cd112	4843
48113	48Cd113	4846
48114	48Cd114	4849
48115	48Cd115	4852
48115	48Cd115m	4853
48116	48Cd116	4855
49000	49In000	4900
49113	49In113	4925
49115	49In115	4931
50112	50Sn112	5025
50114	50Sn114	5031
50115	50Sn115	5034
50116	50Sn116	5037
50117	50Sn117	5040
50118	50Sn118	5043
50119	50Sn119	5046
50120	50Sn120	5049
50122	50Sn122	5055
50123	50Sn123	5058
50124	50Sn124	5061
50125	50Sn125	5064
50126	50Sn126	5067
51121	51Sb121	5125
51123	51Sb123	5131
51124	51Sb124	5134
51125	51Sb125	5137
51126	51Sb126	5140
52120	52Te120	5225
52122	52Te122	5231
52123	52Te123	5234
52124	52Te124	5237
52125	52Te125	5240
52126	52Te126	5243
52127	52Te127	5246
52127	52Te127m	5247

52128	52Te128	5249
52129	52Te129	5252
52129	52Te129m	5253
52130	52Te130	5255
52132	52Te132	5261
53127	53I_127	5325
53129	53I_129	5331
53130	53I_130	5334
53131	53I_131	5337
53135	53I_135	5349
54124	54Xe124	5425
54126	54Xe126	5431
54128	54Xe128	5437
54129	54Xe129	5440
54130	54Xe130	5443
54131	54Xe131	5446
54132	54Xe132	5449
54133	54Xe133	5452
54134	54Xe134	5455
54135	54Xe135	5458
54136	54Xe136	5461
55133	55Cs133	5525
55134	55Cs134	5528
55135	55Cs135	5531
55136	55Cs136	5534
55137	55Cs137	5537
56134	56Ba134	5637
56135	56Ba135	5640
56136	56Ba136	5643
56137	56Ba137	5646
56138	56Ba138	5649
56140	56Ba140	5655
57139	57La139	5728
57140	57La140	5731
58140	58Ce140	5837
58141	58Ce141	5840
58142	58Ce142	5843
58143	58Ce143	5846
58144	58Ce144	5849
59141	59Pr141	5925
59142	59Pr142	5928
59143	59Pr143	5931

60142	60Nd142	6025
60143	60Nd143	6028
60144	60Nd144	6031
60145	60Nd145	6034
60146	60Nd146	6037
60147	60Nd147	6040
60148	60Nd148	6043
60150	60Nd150	6049
61147	61Pm147	6149
61148	61Pm148	6152
61148	61Pm148m	6153
61149	61Pm149	6155
61151	61Pm151	6161
62144	62Sm144	6225
62147	62Sm147	6234
62148	62Sm148	6237
62149	62Sm149	6240
62150	62Sm150	6243
62151	62Sm151	6246
62152	62Sm152	6249
62153	62Sm153	6252
62154	62Sm154	6255
63151	63Eu151	6325
63152	63Eu152	6328
63153	63Eu153	6331
63154	63Eu154	6334
63155	63Eu155	6337
63156	63Eu156	6340
63157	63Eu157	6343
64152	64Gd152	6425
64154	64Gd154	6431
64155	64Gd155	6434
64156	64Gd156	6437
64157	64Gd157	6440
64158	64Gd158	6443
64160	64Gd160	6449
65159	65Tb159	6525
65160	65Tb160	6528
66160	66Dy160	6637
66161	66Dy161	6640
66162	66Dy162	6643
66163	66Dy163	6646
66164	66Dy164	6649

67165	67Ho165	6725
68166	68Er166	6837
68167	68Er167	6840
71175	71Lu175	7125
71176	71Lu176	7128
72000	72Hf000	7200
72174	72Hf174	7225
72176	72Hf176	7231
72177	72Hf177	7234
72178	72Hf178	7237
72179	72Hf179	7240
72180	72Hf180	7243
73181	73Ta181	7328
73182	73Ta182	7331
74000	74W_000	7400
74182	74W_182	7431
74183	74W_183	7434
74184	74W_184	7437
74186	74W_186	7443
75185	75Re185	7525
75187	75Re187	7531
77191	77Ir191	7725
77193	77Ir193	7731
79197	79Au197	7925
82000	82Pb000	8200
82206	82Pb206	8231
82207	82Pb207	8234
82208	82Pb208	8237
83209	83Bi209	8325
90230	90Th230	9034
90232	90Th232	9040
91231	91Pa231	9131
91232	91Pa232	9134
91233	91Pa233	9137
92232	92U_232	9219
92233	92U_233	9222
92234	92U_234	9225
92235	92U_235	9228
92236	92U_236	9231
92237	92U_237	9234
92238	92U_238	9237

93236	93Np236	9343
93237	93Np237	9346
93238	93Np238	9349
93239	93Np239	9352
94236	94Pu236	9428
94237	94Pu237	9431
94238	94Pu238	9434
94239	94Pu239	9437
94240	94Pu240	9440
94241	94Pu241	9443
94242	94Pu242	9446
94243	94Pu243	9449
94244	94Pu244	9452
95241	95Am241	9543
95242	95Am242	9546
95242	95Am242m	9547
95243	95Am243	9549
96241	96Cm241	9628
96242	96Cm242	9631
96243	96Cm243	9634
96244	96Cm244	9637
96245	96Cm245	9640
96246	96Cm246	9643
96247	96Cm247	9646
96248	96Cm248	9649
97249	97Bk249	9752
98249	98Cf249	9852
98250	98Cf250	9855
98251	98Cf251	9858
98252	98Cf252	9861
98253	98Cf253	9864
99253	99Es253	9913