

BROOKHAVEN NATIONAL LABORATORY

MEMORANDUM

DATE: May 23, 1983
TO: Distribution
FROM: V. McLane *vm*
SUBJECT: LEXFOR entry Errors

Memo CP-C/102

Enclosed is a proposed LEXFOR entry for Errors rewritten to take into account the new error format agreements. Also included are companion entries for Dosimetry Reaction Data and Standards.

Sol Pearlstein
Sol Pearlstein

VMcL:anl

Distribution

F. E. Chukreev
B. S. Ishkhanov
M. Manokhin
N. Tubbs
H. Tanaka

S. Pearlstein
J. J. Schmidt
NNDC (6)

cc. *Kullen*
Gandarias Coug
Laumer
Lemmel
Okamoto
Ohnuma
Pompaer
Schmidt
Schweser
Seits

df:103:1/VMcL/CP102

ErrorsInformation-Identifier Keyword ERR-ANALYS

Free text explanation of the error sources and of the numerical values of the uncertainties is given under the keyword ERR-ANALYS. In order to link the explanations to the numerical data given, the relevant data headings are in parentheses, starting in column 12, followed by free text; when only one data error is given, the data heading need not be given (see EXFOR page 8.E.2). Free text should contain a statement of error types included in the quoted uncertainties, and also those error types which are not included in the quoted uncertainties.

The numerical uncertainty values quoted in the COMMON or DATA section are of relevance only in context with an appropriate entry under ERR-ANALYS, explaining the type of uncertainty and percentage of contributing uncertainties. Therefore, the compiler should be most careful in defining the information given and should be aware of the following aspects which are required for a precise definition of the uncertainty:

1. error-type

Such as:

- statistical or random uncertainty (uncorrelated)
- systematic uncertainties (correlated)
 - sample related: mass, geometric effects, multiple scattering, self-absorption.
 - detector related: efficiency, calibration
 - normalization: monitor cross section, flux determination

2. total error or partial error

For example, the statistical uncertainty, which is most often a partial along with other uncertainties, may be the total uncertainty if other sources of uncertainty are negligible.

3. shape of error function

Such as:

- Gaussian, symmetric
- triangular, symmetric
- unsymmetric, for example $8.5+0.5/-0.2$

4. error measure

Such as:

- standard deviation = half-width at half-maximum of Gaussian error distribution function.
= 2/3 probability that the true value is within error bars
- confidence limits: when the errors are given as confidence limits, various definitions exist, for example, 95% probability which corresponds to approximately two standard deviations.
- errors supposed not to exceed: approx. 100% probability value is within error bars.

5. error correlations: within systematic uncertainties and with other quantities measured in same experiment; see also Inderdependent Data.Information-Identifier Keyword COVARIANCE

Covariance matrices, if given by the experimentalist, should be included, where possible, in structured form as free text under the keyword COVARIANCE. Only non-zero matrix elements need be given. If the matrices given are too bulky for inclusion in EXFOR, a reference to where the details can be found is sufficient.

Example:

```

COVARIANCE      VALUES GIVEN ONLY FOR ELEMENTS BELOW DIAGONAL OF
                  SYMMETRIC MATRIX ON SAME ENERGY GRID AS DATA.
                  1.0
                  0.98 1.0
                  0.90 0.97 1.0
                  0.70 0.82 0.93 1.0
                  0.54 0.68 0.83 0.96 1.0
                  0.64 0.75 0.85 0.92 0.95 1.0
                  0.72 0.78 0.83 0.83 0.83 0.95 1.0
                  0.64 0.67 0.69 0.69 0.68 0.83 0.93 1.0
                  0.60 0.61 0.60 0.58 0.56 0.74 0.87 0.98 1.0

```

Data Uncertainties

Information on the uncertainties associated with the data compiled is entered in one of two ways depending on whether a complete analysis of the uncertainties has been done.

In the case where a detailed analysis of the uncertainties has not been done or the compiler does not have enough information to know if a complete analysis has been done, the uncertainties should be entered either:

1. in the COMMON or DATA section under the Data-Heading Keywords, DATA-ERR, RATIO-ERR or SUM-ERR, with an explanation in free text under ERR-ANALYS. If two or more errors of different types are given referring to the same data, Data-Heading Keywords of the type DATA-ERR1 and DATA-ERR2 are used. Unsymmetric errors are identified with, e.g., +DATA-ERR and -DATA-ERR.
2. as free text information under ERR-ANALYS.

The detailed error formats are used when a complete analysis of the uncertainties associated with the data has been given.

1. Error fields will be identified as statistical (uncorrelated), systematic (correlated) or total. The numerical values for the uncertainties will be entered in the COMMON or DATA section under the headings ERR-S, ERR-T, ERR-1, etc. (see Dictionary 24). The definition of the different systematic uncertainties will be given in free text comments under ERR-ANALYS. Constant systematic uncertainties may, alternately, be entered in free text under ERR-ANALYS.
2. Only uncertainties which are one standard deviation (or the equivalent for systematic uncertainty) will be entered in this format. If the author gives 2- or 3-sigma uncertainties, they should be converted to one-sigma uncertainties. Other types of uncertainty information may be entered in free text.
3. The correlation factor for the systematic uncertainties should be given under ERR-ANALYS in free text.

See Example 7.

Priority should be given to the compilation of detailed information on the uncertainties for experimental data on neutron cross sections for standards (see Standards) and dosimetry reactions (see Dosimetry Reaction Data) in new and retransmitted data sets. When the required error information for these data types is not given in the literature, every effort should be made to obtain it from the experimentalists.

Energy, Secondary Energy and Angle Uncertainties

The numerical values for the uncertainty in the energy, secondary energy and angle should be entered in the COMMON or DATA section under the appropriate heading (see following) with a free text explanation under ERR-ANALYS.

Uncertainty in monochromatic incident-neutron energy or the uncertainty of the central energy in an incident-neutron spectrum: EN-ERR or other data heading given in Dictionary 24 with family B.

Uncertainty in mean secondary energy: E-ERR or other code from Dictionary 24 with family F.

Uncertainty in mean angle: ANG-ERR or COS-ERR.

See also page 8.E.2.

Note: The terms error and resolution are often misused in the literature. Distinguish where possible. See Resolution.

Other Uncertainties

Numerical values for the uncertainty on standards, half-lives, beam polarization, etc., should be entered in the COMMON or DATA section under the appropriate heading (see Dictionary 24) with a free text explanation under ERR-ANALYS.

Dosimetry Reaction Data

Priority should be given to the compilation of cross section data for use in reactor neutron fission and fusion dosimetry.

A list of the 'most-needed' reaction data identified follows.

Activation Reactions (for use with neutron threshold detectors)

3-LI-6(N,X)HE PROD	28-NI-58(N,P)27-CO-58
5-B-10(N,X)HE PROD	28-NI-58(N,2N)28-NI-57 → 27-CO-57
7-N-14(N,P)6-C-14	28-NI-60(N,P)27-CO-60
9-F-19(N,2N)9-F-18	29-CU-63(N,A)27-CO-60
11-NA-23(N,G)11-NA-24	29-CU-63(N,2N)29-CU-62
11-NA-23(N,2N)11-NA-22	29-CU-63(N,G)29-CU-64
12-MG-24(N,P)11-NA-24	29-CU-65(N,2N)29-CU-64
13-AL-27(N,A)11-NA-24	30-ZN-64(N,P)29-CU-64
13-AL-27(N,P)12-MG-27	30-ZN-64(N,2N)30-ZN-63
15-P-31(N,P)14-SI-31	40-ZR-90(N,P)39-Y-90
16-S-32(N,P)15-P-32	40-ZR-90(N,2N)40-ZR-89
21-SC-45(N,G)21-SC-46	41-NB-93(N,INL)41-NB-93-M
21-SC-45(N,2N)21-SC-44	41-NB-93(N,2N)41-NB-92-M
21-SC-45(N,2N)21-SC-44-M	42-MO-98(N,G)42-MO-99 → 43-TC-99-M
22-TI-46(N,P)21-SC-46	45-RH-103(N,INL)45-RH-103-M
22-TI-47(N,N+P)21-SC-46	47-AG-109(N,G)47-AG-110-M
22-TI-47(N,D)21-SC-46	49-IN-115(N,INL)49-IN-115-M
22-TI-47(N,P)21-SC-47	49-IN-115(N,G)49-IN-116-M
22-TI-48(N,P)21-SC-48	53-I-127(N,2N)53-I-126
22-TI-48(N,N+P)21-SC-47	73-TA-181(N,G)73-TA-182
25-MN-55(N,2N)25-MN-54	74-W-186(N,G)74-W-187
25-MN-55(N,G)25-MN-56	79-AU-197(N,G)79-AU-198
26-FE-54(N,P)25-MN-54	79-AU-197(N,2N)79-AU-196
26-FE-54(N,A)24-CR-51	79-AU-197(N,3N)79-AU-195
26-FE-56(N,P)25-MN-56	79-AU-197(N,4N)79-AU-194
26-FE-58(N,G)26-FE-59	80-HG-199(N,INL)80-HG-199-M
27-CO-59(N,P)26-FE-59	90-TH-232(N,2N)90-TH-231
27-CO-59(N,A)25-MN-56	90-TH-232(N,G)90-TH-233 → 91-PA-233
27-CO-59(N,2N)27-CO-58	92-U-238(N,G)92-U-239 → 93-NP-237
27-CO-59(N,G)27-CO-60	

Fission Reactions

90-TH-232(N,F)
 92-U-235(N,F)
 92-U-238(N,F)
 93-NP-237(N,F)
 94-PU-239(N,F)
 95-AM-241(N,F)

Entry of standard values into DATA or COMMON

1. If standard values are given at several energies, these values are given in the data table as an additional field under the data heading MONIT (see example 4a).
2. If only one standard value is given, there are two possibilities:
 - the standard is entered as in case 1, above; the field headed by MONIT is blank for all but one line.
 - the standard is entered in the COMMON section under the data heading MONIT. The incident energy, secondary energy, and/or angle at which the normalization was done are entered under the data headings EN-NRM, E-NRM, ANG-NRM, respectively. These are omitted if the data table includes only one data point for which the independent variables are the same as those for the normalization value.
3. If the originally measured ratio (data/standard) is also given, see Example 2b.
4. If the data are normalized at two or more energies in an unspecified way, this should be noted in free text in an appropriate place.

Note: Every data line must have a dependent variable entry, therefore, standards may not be entered on a separate line in the data table.
5. If two or more standard reactions are given for the same data set, see EXFOR page 8.M.2 for coding rules.

List of commonly accepted standards.

1-H-1(N,EL)1-H-1	SIG, DA	1 keV to 20 MeV
2-HE-3(N,P)1-H-3	SIG	< 50 keV
3-LI-6(N,A)2-HE-4	SIG	<100 keV
5-B-10(N,A)3-LI-7	SIG to gnd, 1st exc.st.	<100 keV
6-C-12(N,EL)6-C-12	SIG, DA	< 2 MeV
25-MN-55(N,G)25-MN-56	SIG	thermal
27-CO-59(N,G)27-CO-60	SIG	thermal
79-AU-197(N,G)79-AU-198	SIG	thermal, 200 - 3500 keV
92-U-235(N,F)	SIG	100 keV - 20 MeV