MEMO CP-C/18

Date: August 15, 1977

From: V. McLane

Subject: I. Proposed EXFOR Manual, Section VIII
II. Proposed LEXFOR revisions Products, Ratios, Sums, Tautologies

Enclosed is the proposed revised Section VIII of the EXFOR Manual. It is based on Memos CP-D/20 and CP-D/23, but has been restructured as follows:

- A data-specification keyword section was created (Part 3).
- Remaining keywords were alphabetized, but pages are numbered using the first letter of a keyword, so that keywords could be combined onto one page.
- Details were standardized so that the sequence of information is the same for each keyword.
- Coding details which do not pertain to format were moved to LEXFOR, for example, enclosed entries for Product, Ratio, Sum and Tautology.

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VIII - Information-Identifier Keywords and Coding Rules

Introduction

This section gives the rules for the use of the information-identifier keywords and the structure of the codes associated with them. It does not, in general, give any information about specific codes from any dictionary, nor does it go into details of the physics content or additional free text explanations which may be required. For such information, the user should refer to LEXFOR.

Part 1 of this section gives a general outline of the coding formats and its relationship to the free text.

Part 2 of this section gives a concise over-all view of all keywords and the codes and dictionaries associated with them.

Part 3 of this section gives a detailed description of the coded information for the data-specification keywords.

Part 4 of this section is devoted to the specific rules for the use and coding of each keyword. However, keywords which require only free text, and no coded information, are not included.

The information given under each keyword in Parts 3 and 4 has the following structure:

1. Use.
2. Requirements.
3. Code format.
4. Format for 2 or more codes or code strings
5. , etc. Additional information

Information-Identifier Keywords

All valid informatin-identifier keywords are found in Dictionary 2.

These keywords are used in the BIB section to identify specific information; these may then be coded, with or without free text explanation, or may have only free text associated with them. Codes are used for retrieval purposes. Information in free text cannot be used for retrieval purposes. The keywords may, in general, appear in any order within the BIB section. (See LEXFOR, Information-Identifier Keywords-Sequence).

Use of Codes

Codes for use with a specific keyword are found in the relevent dictionary. In general, codes may be used singly or in conjunction with one or more codes from the same dictionary.

Rules to be used for combining codes for the keywords INSTITUTE, STATUS, FACILITY, N-SOURCE, METHØD, DETECTØR and ANALYSIS follow. For use of other codes see details under keyword writeups, parts 3 and 4 of this Section.

a) Both codes within the same set of parentheses, separated by a comma, for example:

KEYWORD (CODE1, CODE2) + free text , or

b) Each code enclosed in own set of parentheses followed by free text, with the stipulation that each new code entry start in column 12, for example:

KEYWORD (CODE1) + free text ...

free text ...

(CODE2) + free text

Both of these possibilities, or a combination of the two, are allowed, in general. However, for some keywords the coded string (between the parenthesis) may include retrievable information in addition to a code from the dictionary. In this case only b) is permitted.

See Parts 3 and 4 of this section for the explicit coding format and rules for each keyword, other than those listed below.

For the following keywords information is given in free text only and, therefore, they are not included in part 4 of this section.

COMMENT
CORRECTION
GEOMETRY
INC-SPECT
SAMPLE
TITLE

Codes and free text

1. In general, coded information given with keywords is for retrieval purposes and the free text should be self-explanatory. That is, coded information should be expanded into clear English and amplified as necessary in the free text. However, for some keywords, such an expansion of the codes is, in general, expressly forbidden*, on the assumption that such expansion will be done by an editing program. For some other keywords an indication can be given whether or not the coded information is expanded in the free text.

2. For the following keywords the coded information should not, in general be expanded in the free text*:

INSTITUTE
REFERENCE
REL-REF
ISO-QUANT, CMPD-QUANT, NUC-QUANT, REACTION
STANDARD, MONITOR
RAD-DET
HALF-LIFE
DECAY-DATA

3. For the following keywords coded information may or may not be expanded in free text:

METHOD	PART-DET
FACILITY	RESID-NUC
DETECTOR	ADD-RES
ANALYSIS	STATUS
N-SOURCE	

An indication that the code is not expanded is given by:

either a point immediately following the closing parenthesis,

or a completely blank field between the closing parenthesis and column 66.

4. For the following keywords which do not contain codes from dictionaries the free text must be self explanatory:

AUTHOR	MISC-COL
EXP-YEAR	ASSUMED
ERR-ANALYS	FLAG
	HISTORY

*Note: Expansions of these codes may be used, at the compiler's discretion, embedded in a free text comment.

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Embedded blanks

Embedded blanks are explicitly forbidden in the coding for many information-identifier keywords - see parts 3 and 4 of this section. With these exceptions, embedded blanks in the coding are allowed if they follow a code from a dictionary. They are not permitted before any code.

Examples:		
STATUS	(DEP)	Yes
STATUS	(DEP ,COREL)	Yes
STATUS	(COREL, DEP)	No
STATUS	(DEP, 10048007)	No

Keyword Categories

In the following list of information-identifier keywords, certain flags indicate which keywords must, or need not, be present and which keywords must, or need not, be followed by coded information.

Bibliographic Keywords

*	AUTHOR	(( ))
	EXP-YEAR	(( ))
*	INSTITUTE	(( ))
	MONIT-REF	(( ))
*	REFERENCE	(( ))
	REL-REF	(( ))
0	TITLE	

Data Specification Keywords

X	CMPD-QUANT	(( ))
X	ISO-QUANT	(( ))
X	NUC-QUANT	(( ))
X	REACTION	(( ))

Experimental and Data Description Keywords

	DECAY-DATA	(( ))		ASSUMED	( )+
	DECAY-MON	(( ))		PART-DET	( )+
	MONITOR	(( ))		RESID-NUC	( )+
	RAD-DET	(( ))			
	STANDARD	(( ))		EN-SEC	( )
				HALF-LIFE	( )
-	ANALYSIS	( )+			
-	DETECTOR	( )+		INC-SPECT	
-	FACILITY	( )+	Obs.	GEOMETRY	
-	METHOD	( )+		SAMPLE	
	N-SOURCE	( )+			
	CORRECTION	( )			
0	ERR-ANNALYS	( )			

Miscellaneous Keywords

	ADD-RES	( )
	COMMENT	
	FLAG	(( ))
*	HISTORY	(( ))
	MISC-COL	(( ))
0	STATUS	( )
Obs.	TABLE-NR	( )

For explanation of flags, see next page.

Explanations:

* This keyword must always be present.

X One of these keywords must be present; they are mutually exclusive.

\- At least one of these keywords must be present; if a pertinent code in the relevant dictionary exists, then keyword and code should be given.

0 This keyword must always be present except when it is not relevant. For explanation of "not relevant" see in LEXFOR. For example: ERR-ANALYS is "not relevant" for qunatum-numbers.

(( )) If the keyword is present, coded information in parentheses must be given.

( ) Either free text or coded information in parentheses plus possibly free text may be given. If a pertinent code in the relevant dictionary exists, then keyword and code should be given.

\+ The coded information in parentheses must be repeated in the free text. Except when a point is entered in the position following the closing parenthesis, or when the free-text field up to col. tt is totally blank.

Obs. Obsolete. But may exist in older entries.

Data Specification Keywords

Data-specification keywords are used in the BIB section to specify the data which is presented in the data table.

One of the following keywords must be present, they are mutually exclusive: REACTION, ISO-QUANT, CMPD-QUANT, NUC-QUANT.

Coding for nuclides and compounds

Nuclides appear in the coding of many keywords. The general code format is Z-S-A-X

Where Z is the mass number, up to 3 digits, no leading zeroes
S is the element symbol; 1 or 2 characters (Dictionary 8)
A is the atomic weight; up to 3 digits, no leading zeroes, a single zero denotes natural isotopic composition
X is an isomer code denoting the isomeric state
This subfield may be omitted.
X may have the following values:
G for ground state
M if only one metastable state is regarded
M1 for the first metastable state
M2 for the second, etc.
T for sum of all isomers (limited to use in SF4 under REACTION)

Exceptions to this coding are noted on the pages for each keyword.

See also LEXFOR Elements.

Compounds may in some case replace the nuclide code. The general format for coding compounds is either the code, taken from Dictionary 9 or of the form Z-S-CMP. (e.g. 26-FE-CMP).

See LEXFOR for further information under Compound codes.

Reaction Combinations

In order to deal with experimental data sets referring to complex combinations of materials and reactions, the code units defined in this section can be connected into a single machine-retrievable field, with appropriate separators and properly balanced parentheses. In all cases of combined units, parentheses are used in exactly the same manner as in FORTRAN to define algebraic operations.

The permitted separators are:

+(Plus) :	Sum of 2 or more quantities.
-(Minus):	Difference between 2 or more quantities
*(Times):	Product of 2 or more quantities
1 (Over):	Ratio of 2 or more quantities
= (Also):	Tautologies (See LEXFOR Tautologies for usage)
, (And) :	Obsolete, but may be found in older NND entries. Used for multiple representations of the same quantity, which are now coded using pointers.

The complete reaction combination must be enclosed in parentheses.

The general form of these combinations are:

```
((------)+(-----))
((------)-(-----))
((------)*(-----))
((------)=(-----))
((------),(-----))
```

A code unit may not be broken for continuation on the next line. The separator should appear last on any line, with the first parenthesis of the next code unit beginning in column 12 of the next line. Thus blanks may follow a separator if the reaction combination is continued on the next line.

Example:
```
(((-------)+(------))/
(-------))
```

Note that the reaction combination formalism is not used for certain frequently occurring sums, ratios and products for which specific quantity codes have been introduced. (See LEXFOR Ratios, Sums, Products).

Multiple Reaction Formalism

Pointers may be used with these keywords, in which case the code fields associated with each pointer may be a reaction unit or a reaction combination.

See page VI.1 for general information on pointers.

The use of the multiple reactition formalism is presently restricted to:

- resonance parameters of the same isotope (Example 2a)
- multiple representations of the same data (Example 2b)
- isomeric data (branches, ratios, etc.) of the same reaction. (Example 2c)
- data for the same reaction obtained by different types of analysis on the same experimental data; in this case the reaction code must be repeated for each analysis. (Example 2.d)

REACTION

1. This keyword is used to specify data which is presented in the data-table in columns headed by DATA, RATIO and SUM (and similar headings such as DATA-MIN, DATA-MAX etc.)

2. This keyword must have coded information.

3. A reaction-unit consists of three major fields,

   (reaction, quantity, data-type)

   The detailed coding for each field is given following

   a) Reaction field. The reaction field consists of 4 subfields, separated by commas or parentheses (not interchangeable).

      (SF1(SF2,SF3)SF4,quantity,data-type)

      SF1. Target nucleus. The general format of the code is

      either Z-S-A-X, X may not have the value G,
      or Z-S-CMP

      See page VIII.3.1.

      SF2. Incident particle. This subfield contains

      either a particle code from dictionary 33 with the flag I in Col. 64.

      or for particles heavier than alpha, a code in the form Z-S-A (isomer field omitted), see page VIII.3.1.

      SF3. Process. This subfield contains

      either a) a process code from dictionary 30;

      or b) a particle code from dictionary 33 with the flag I in Col. 64, which may be preceded by a multiplicity factor;

      or c) for particles heavier than alpha, a code in the form Z-S-A-X, see VIII.3.1.

      or d) for more than one outgoing particle, any combination of b) and c), with the codes connected by '+'. Outgoing particles are ordered starting with the lightest at the left of the subfield (i.e. in the same order as in dictionary 33) followed by the Z-S-A-X formatted codes, in Z, A order. The exception to this order is if SF5 contains the code 'SEQ', which indicates that the particles are ordered in the sequence as the reaction proceeds.

      Examples of SF3 coding:

      TOT
      A
      4A
      8-Ø-16
      N+HE3+4A
      8-Ø-16+8-Ø-16
      HE3+8-Ø-16

SF4. Reaction Product. This subfield contains

either a) a code in the form Z-S-A-X, see page VIII.3.1.

In the case of isomeric ratios and sums (SF5 must contain the code ISM) the X field may contain a combination of codes separated by a slash or a plus sign. The use of these separators will be algebraic.

Examples: Z-S-A-N1+M2/G
Z-S-A-G/T

See LEXFOR Isomeric Ratios.

or b) it must be omitted if SF3 contains the process codes TOT, ABS, or NON. It may be omitted if SF3 contains the particle code 'F'. It may also be omitted for NND. The following comma must be included.

or c) When SF3 contains the codes F or X, it may contain the product codes ELEM, MASS, or ELEM/MASS. See page VI.4 and LEXFOR Reaction Products.

Examples of reaction-field coding:

```
(39-Y-89(P,3N+P)39-Y-86-G,.......
(51-SB-121(18-AR-40,12N+2P)69-TM-153,......
(92-U-238(P,F)46-PD-103,.....
(92-U-235(N,TOT),.....        (SF4 omitted, 'TOT' in SF3)
(62-SM-147(P,X)4-BE-7,.....
(92-U-235(N,F)ELEM/MASS,....
```

b.) Quantity field. The coding consists of 4 subfields each separated by a comma.

(reaction,SF5,SF6,SF7,SF8,data-type)

Any subfield may contain a combination of codes from the same dictionary, separated by a slash.

If a subfield is omitted, the extra separating comma must be included.

e.g. (reaction,,SF6,,SF8,data-type)

Only certain combinations of codes in the quantity field are meaningful. These are listed in dictionary 36. Note that if two or more codes are entered in a subfield, they must be in the same sequence as in dictionary 36.

SF5. Branch.
Code(s) from dictionary 31,
This subfield indicates a partial reaction if, for example, only one of several energy levels or particle groups has been considered.

SF6. Parameter.
Code(s) from dictionary 32.
This subfield contains information about the reaction-parameter given, such as integral or differential cross-section.

SF7. Particle considered.
Code(s) from dictionary 33.
This subfield provides particle codes(s) indicating to which of several outgoing particles the quantity refers.

The particle-designator can be omitted if there is no ambiguity. For integral data this subfield will usually be empty.

For a quantity describing the correlation between outgoing particles, two particle-designators are entered, separated by a slash.

It should be noted that the particle-considered is not necessarily identical with the particle-detected if, for example, the angular distribution of an outgoing particle has been deduced from a recoil particle detected.

SF8. Modifier.
Code(s) from dictionary 34.
This subfield contains information on the representation of the data, for example relative data, fitting coefficients, etc.

c.) Data-type field.

This field contains codes from dictionary 35.
If two or more codes are given they are separated by a slash.

This field may be omitted, in which case the trailing commas, indicating omitted subfields in the quantity-field, may also be omitted.
E.g. (reaction,,SF6).

This field indicates whether the data given are experimental, theoretical, evaluated etc. If the field is omitted, the data are experimental.

4. For reaction combinations and multiple reactions, see page VIII.3.2 and VIII.3.3.

ISO-QUANT

1. This keyword is used to specify the data which is presented in the data-table in columns headed by DATA and RATIO (and similar headings such as DATA-MIN, DATA-MAX etc.) when the quantity defined refers to a target nucleus.

2. This keyword must have coded information.

3. An isoquant-unit consists of two major fields,

   (isotope, quantity)

   The detailed coding for each field is given following.

a.) Isotope field. The isotope compiled is the target nucleus.

The general format of the code is Z-S-A-X, X may not have the value G. See page VIII.3.1.

b.) Quantity field. The coding consists of 4 subfields, each separated by a comma.

(isotope,SF1,SF2,SF3,SF4)

Any subfield may contain a combination of codes from the same dictionary, separated by a slash.

If a subfield is omitted, the extra separating comma must be included, except that no trailing commas need follow the last coded subfield.

e.g. (isotope,SF1,SF2,,SF4)
(isotope,SF1)

Only certain combinations of codes in the quantity field are meaningful. These are listed in dictionary 14. Note that if two or more codes are entered in a subfield, they must be in the same sequence as in dictionary 14.

SF1. Process/parameter designator
Code(s) from dictionary 10.
This subfield specifies the nuclear (or collective) process under study and/or parametric quantity derived for nucleus under study by experiment.

SF2. Function designator
Code(s) from dictionary 11.
This subfield specifies the aspect or parameter studied or a useful collective term.

SF3. Modifier designator
Code(s) from dictionary 12.
This subfield provides flags to indicate departure from the standard meaning of SF1 and SF2 or provides a combination of process/parameters and functions.

Note that the codes at the beginning of dictionary 12 which may be included in SF3 are not included in the code combinations in dictionary 14.

SF4. Particle designator
Code(s) from the first part of dictionary 13.
This subfield provides particle code(s) indicating which of several outgoing particles the quantity refers to.

The particle-designator can be omitted if there is no ambiguity.
For a quantity describing the correlation between outgoing particles, two particle-designators are entered, separated by a slash.

4. For iso-quant combinations and multiple iso-quants, see pages VIII.3.2 and VIII.3.3, respectively.

CMPD-QUANT (used only for NND)

1. This keyword is used to specify the data which is presented in the data-table in columns headed by DATA and RATIO (and similar headings such as DATA-MIN, DATA-MAX etc.) When the quantity defined refers to a target which is a compound, alloy or mixture.

2. This keyword must have coded information.

3. A compound-QUANT unit consists of two major fields, (compound, quantity)

   a.) Compound Field

   The general format of the code is Z-S-XXX, see page VIII.3.1.

   b.) Quantity Field

   The coding for this field is the same as for ISO-QUANT, see page VIII.3.(?)

NUC-QUANT (used only for NND)

1. This keyword is used to specify the data which is presented in the data-table in columns headed by DATA and RATIO (and similar headings such as DATA-MIN, DATA-MAX etc.) when the quantity defined does not refer to a target nucleus.

   These quantities are:

   SF = spontaneous fission
   LDP = level-density parameter
   TEM = nuclear temperature
   SCO = spin-cut-off factor

   as well as any other quantities having one of the above codes in the first quantity-subfield, e.g., SF/NU; compare Dictionary 14.

2. This keyword must have coded information.

3. The coding rules for NUC-QUANT are all identical to those for ISO-QUANT. The isotope-field contains the code for the nucleus to which the data is pertinent instead of the target nucleus.

ADD-RES

1. This keyword is used to indicate that the publication contains other important data information which is not directly connected with the data given in the Exfor entry.

2. This keyword is optional. May contain free text or coded information and free text.

3. If coded information is given it may be in either of the general forms, see page VIII.1.2, with code(s) from Dictionary 20.

ANALYSIS

1. This keyword is used to give information on the analysis by which the data were obtained. See also LEXFOR Measurement Techniques.

2. At least one of the keywords METHOD, FACILITY, DETECTOR, ANALYSIS must be present with coded information. Within this restriction, coded information for ANALYSIS is optional.

3. If coded information is given it may be in either of the general forms, see page VIII.1.2, with code(s) from Dictionary 23.

ASSUMED (REACTION formalism)

1. This keyword is used to give information about values assumed in the analysis of the data, and COMMON- or DATA-sections headed by ASSUM and its derivatives.
2. The keyword is obligatory when such headings are present and coded information is required. The keyword may be used with free text only, if these headings are not present.
3. The format of the code is
   (heading, reaction, quantity)
   Heading field contains the heading to be defined. The reaction-field and the quantity-field are coded exactly the same for the keyword REACTION.
4. In the case of more than one assumed data-heading to be defined, each must be coded separately, starting in Col.12.

AUTHOR

1. This keyword is used to give the authors of the work reported.

2. This keyword is obligatory and must have coded information.

3. Authors names are entered in the normal way of writing a name, i.e., A.B. NAME, each name separated by a comma. Hyphenated family names, 2-character initials (as in the transliteration of some Russian names, and any other deviations from the normal name structure are permitted. For a family name modified by 'Junior', JR is entered following the family name and separated from it by a blank.

   All names are entered between one set of parenthesis.

   The authors names may be continued on the next record, but names should not be broken, i.e., the last character on the line to be continued should be a comma.

   Examples:

   Author (A.B.JONES, L.POZA-LOBO, YA.M.IVANOV, NGO-DINH-LONG, A. MORALES AMADO)

   Author (W.W.HAVENS JR)

DECAY-DATA

1. This keyword is used to give the decay data for any nuclide occurring in the reaction measured. See also lefor Decay Data.

2. Keyword is optional, except that when the keyword RAD-DET is present, DECAY-DATA must also be present. Coded information is obligatory, with or without free text.

3. The general format of the coding string consists of four major fields:

((flag) nuclide, half-life, readiation)

Embedded blanks are permitted in the code only at the beginning of a field or subfield. A code string may be broken for continuation onto the next record, but the break should come at the end of a field or subfield, i.e., the comma separating the fields should be the last charactar on the line.

Flag field. The general format of the code is (n.), where n will have a numerical value which appears in the data section under the data-heading keyword BIBFLAG.

This field may be omitted, in which case its parenthesis is also omitted.

See also LEXFOR Flags and page VI.6.

Nuclide field. The general format of the code is Z-S-A-X.
See page VIII.3.1

Half-life field. This field contains the actual half-life of the nuclide specified.

This field may be omitted, in which case the following comma must be included, unless the radiation-field is also omitted, in which case the closing parenthesis immediately follows the nuclide.

The format is n.nUNITS, no embedded blanks allowed, where: n.n is a valid floating-point number (see page V.3, but no blanks)
UNITS is a code from Dictionary 25 with the dimentsion TIME.

Example: 2.45MIN

Radiation field. This field may be omitted, in which case the closing parenthesis immediately follows the half-life. This field may also be repeated, each radiation field being separated by a comma. Absence of any subfield must be indicated by including the separating comma; trailing commas need not be included.

The field consists of three subfields

(nuclide, half-life,SF3,SF4,SF5)

SF3. Type-of-radiation.

A code from dictionary 13

SF4. Energy.

This gives the energy of the radiation in keV. It is coded as a floating-point number (see page V.3, but no blanks) no units are given in the code.

Two or more energies may be given, each separated by a slash.

SF5. Abundance.

This gives the abundance of the observed radiation per decay.

It is coded as a floating-point number (see page V.3, but no blanks).

4. If decay data is given in coded form for more than one nuclide, then each must be coded separately, starting in col. 12.

Examples of coding for DECAY-DATA

a. DECAY-DATA (40-ZR-89-M) (half-life and radiation omitted)

b. DECAY-DATA (60-ND-140,3.3D) (radiation-field omitted)
(59-PR-140,,B+,,0.500) (half-life and radiation-SF2 omitted)

c. DECAY-DATA (25-MN-50-G,0.286SEC,B+,6610.) (radiation-SF3 omitted)

d. DECAY-DATA (25-MN-50-M,1.76MIN,DG,785.,,B+) (two radiation-fields, the second with SF2 & SF3 omitted)

e. DECAY-DATA ((1.)60-ND-138,5.04HR,DG,328.,0.065) (all fields and subfields present)

f. DECAY-DATA (60-ND-139-G,30.0MIN,B+,,0.257,DG,405.,0.055 (two radiation fields)

(60-ND-139-M,5.5HR,DG,738.,0.37,DG,982..0.29,
DG,708..0.27,DG,403.,0.03,B+,,0.006) (five radiation-fields, extending over 2 records)

This last example could also be entered in the following way:

```
DECAY-DATA (60-ND-139-G,30.0MIN,B+,,0.257,
                                DG,405.,0.055)
           (60-ND-139-M,5.5HR,DG,738.,0.37,
                              DG,982.,0.29
                              DG,708.,0.27,
                              DG,403.,0.03,
                              B+,,0.006)
```

DECAY-MON

1. This keyword is used to give the decay data assumed by the author for any nuclide occurring in the moniter reaction used.
2. Keyword is optional, except it must only be used if the keyword MONITOR is present. Coded information is obligatory, with or without free text.
3. The coding rules for DECAY-MON are exactly the same as those for DECAY-DATA.

DETECTOR

1. This keyword is used to give information about the detector(s) used in the experiments. See also LEXFOR Measurement Techniques.
2. At least one of the keywords METHOD, FACILITY, DETECTOR, ANALYSIS must be present with coded information. Within this restriction, coded information for DETECTOR is optional.
3. If coded information is given it may be in either of the general forms, see page VIII.1.2, with code(s) from Dictionary 22, but see exception below.
4. If the code 'COIN' is used, then the codes for the detectors used in coincidence must follow within the same parentheses;
   e.g. (COIN,NAICR,NAICR).
   In this case any other detectors used must be coded separately, starting in col.12.

EN-SEC

1. This keyword is used to give information about secondary energies, and to define secondary-energy columns given in the data.

2. This keyword is, in general, optional, but it is obligatory when the data-heading keywords E1,E2, etc., are used in the data. Free text may be given or coded information, with or without free text.

3. The format of the coded information is

(heading, particle)

Heading Field. This field contains the data-heading keyword to be defined.

Particle Field. This field contains the particle or nuclide to which the data-heading keyword refers. The code is:

either a particle-code from Dictionary 33 with an S in Col. 65.

or a nuclide coded in the standard format as described on page VIII.3.1.

4. In the case of more than one secondary-energy data-heading keyword to be defined, each must be coded separately, starting in Col.12, e.g.:

```
EN-SEC      (E1,G)
            (E2,N)
            (E-EXC,3-LI-7)
```

ERR-ANALYS

1. This keyword is used to explain the sources of errors and the values given in the COMMON or DATA sections under data-headings having the modifier -ERR. See also LEXFOR Errors.

2. The keyword is optional. May be free text or coded information with free text.

3. The coded information is of the form:

   (heading) free text

   However, if only one heading is to be defined, the coded information may be omitted. See also "Links between BIB, COMMON and DATA," page VI.5.

4. If two or more error columns are given, then the data-headings are repeated as codes for this keyword, each starting in col.12, followed by free text explanation.

   For example:

```
BIB
...
ERR-ANALYS      (EN-ERR) followed by explanation of energy error
                (DATA_ERRI) followed by explanation of first error
                (DATA-ERR2) followed by explanation of second error
...
ENDBIB
....
....
DATA
EN              EN-ERR          DATA            DATA-ERRI       DATA-ERR2
MEV             MEV             MB              MB              PER-CENT
...             ...             ...             ...             ...
```

EXP-YEAR

1. This keyword is used to define the year in which the experiment was performed.

2. This keyword is optional, but if present it must have coded information.

3. The format of the code is (yy) where yy is the two digits of the year, e.g.,(65).

FACILITY

1. This keyword is used to define the main apparatus used in the experiment. See also LEXFOR Measurement Techniques.

2. At least one of the keywords METHOD, FACILITY, DETECTOR, ANALYSIS must be present with coded information. Within this restriction, coded information for FACILITY is optional.

3. If coded information is given it may be in either of the general forms, see page VIII.1.2, with code(s) from Dictionary 18, or, the facility code from Dictionary 18 may be followed by an institute code from Dictionary 3.

4. When the second form of coding is used and more than one facility is given, then each must be coded separately, starting in col.12.

Example: (CHOPF,1USACOL)
(SPECC,1USABNL)

FLAG

1. This keyword is used to supply information to specific lines in a data table. See also LEXFOR Flags.

2. The keyword is optional, but if present it must have coded information. It must be present if flags are used in the data table.

3. The general format of the code is (n.), where n will have a numerical value which appears in the DATA-section under the data-heading FLAG. See also 'Links between BIB,COMMON and DATA', page VI.5.

4. If two or more codes are given, they must each start in col.12, followed by a free text explanation of the meaning of the flag.

Example:

```
BIB
...
FLAG        (1.)  Data averaged from 2 runs
            (2.)  Modified detector used at this energy
...
ENDBIB

...
DATA
EN          DATA        FLAG
KEV         MB          NO-DIM
1.2         123.        1.
2.3         234.
3.4         456.        2.
ENDDATA
```

HALF-LIFE

1. This keyword is used to give information about half-life values, and to define half-life columns given in the data. See also LEXFOR Half-lives.

2. Keyword is optional, with or without coded information. However, coded information must be included when the data-heading keywords, HL1,HL2, etc, are given in the COMMON- or DATA-sections.

3. The general coding format is

(heading, nuclide)

Heading field. This field contains the data-heading keyword to be defined.
Nuclide field. The general format of the code is Z-S-A-X, see page VIII.31.

4. If two or more half-lives are given, each must be coded separately starting in col.12.

See Example 17, and page V.8.

HISTORY

1. This keyword is used to document the handling of the date set. See also LEXFOR History.

2. This keyword is obligatory and must have coded information.

3. The general format of the code is (yymmddX)

where yymmdd is a date (year,month,day) on which some action was taken on the entry or sub-entry;
X is a code denoting what action was taken. X may be omitted.

The permitted values which X may have and their meanings are as follows:

R - DATA RECEIVED AT THE CENTRE
C - COMPILED AT THE CENTRE
L - ENTERED INTO LIBRARY
T - CONVERTED FROM PREVIOUS COMPILATION
E - TRANSMITTED TO OTHER CENTRES
A - IMPORTANT ALTERATIONS
U - UNIMPORTANT ALTERATIONS
D - ENTRY OR SUBENTRY DELETED. THIS MUST BE FOLLOWED BY FREE TEXT JUSTIFYING THE DELETION.

4. Each piece of coded information must start on a separate line, in col.12.

INSTITUTE

1. This keyword is used to define the laboratory, institute or university at which the experiment was performed, or, with which the authors are affiliated. See also LEXFOR Institute.

2. This keyword is obligatory and must have coded information.

3. The coded information is given in either of the general forms, see page VIII.1.2, with code(s) from Dictionary 3.

   In cases where the institute-code is less than 7 characters, trailing blanks may be omitted, however embedded blanks must be included, as they are considered part of the code.

   Examples:

   INSTITUTE (1USAGA,IUSALAS)

   INSTITUTE (2FR SAC)

METHOD

1. This keyword is used to describe the experimental technique(s) employed in the experiment. See also LEXFOR Measurement Techniques.

2. At least one of the keywords METHOD, FACILITY, DETECTOR, ANALYSIS must be present with coded information. Within this restriction, coded information for METHOD is optional.

3. If coded information is given it may be in either of the general forms, see page VIII.1.2, with code(s) from Dictionary 21.

MISC-COL

1. This keyword is used to define columns in the COMMON- or DATA-sections headed by MISC and its derivatives.

2. This keyword is optional, but must be present if miscellaneous columns are present in the sub-work. Free text may be given or coded information plus free text.

3. If only one miscellaneous column is given, (namely MISC) then no coded information is required.

4. If two or more miscellaneous columns are given, then the data-headings are repeated as codes for this keyword, starting in col.12, followed by free text explanation.

Example:
(MISC1) Free text
(MISC2) Free text

See also 'Links between BIB,COMMON and DATA', page VI.5.

MONITOR (REACTION Formalism)

1. This keyword is used to give information about the monitor used in the experiment and to define monitor information coded in the COMMON and DATA sections. See also LEXFOR Standard.

2. This keyword is obligatory, except when not relevant. Information may be entered either in free text only or in coded form with or without free text. However, coded information must be included when the corresponding data is given in the COMMON-or DATA-sections. See 'Links between BIB, COMMON and DATA', page VI.4.

3. The general format of the code is

   (reaction, quantity, data type)

   The embedded blanks are permitted within the code. Reaction, quantity and data-type are coded in exactly the same way as for the keyword REACTION, see page VIII.3.4.

4. In the case of two or more monitors, each monitor must be coded separately, starting in Col. 12.

MONIT-REF (REACTION formalism)

1. This keyword is used to give information about the reference from which the monitor used in the experiment is taken.

2. Keyword is optional, but if present must include coded information. It must only be used when the keywood MONITOR is present.

3. The general format of the code contains 3 main fields:

(subaccession#, author, reference)

Subaccession Number Field. EXFOR subaccession number of monitor data.

Author Field. The first author (coded as under AUTHOR), followed by '+' when more than author exists.

Reference Field. This field must be present and may contain up to 6 subfields, coded exactly as under REFERENCE. In case the subaccession number and/or authors are omitted, the corresponding commas must be given, e.g.: (,,reference)

4. In the case of more than one monitor reference, each must be coded separately, starting in Col. 12. Entries under MONIT-REF and MONITOR may be linked by pointer.

N-SOURCE

1. This keyword is used to give information on the source of the incident particle beam use in the experiment. See also LEXFOR Measurement Techniques and Incident-Particle Energy.

2. This keyword is optional. May be either free text or coded information and free text.

3. Coded information, if given, may be in either of the general forms, see page VIII.1.2, with code(s) from Dictionary 19, but see exception below.

4. If the code 'POLNS' is used, then the code for the polarized source, if given, must follow in the same parenthesis.

   In this case other sources must be coded separately, starting in Col. 12.

PART-DET

1. This keyword is used to give information about the particle detected. See also LEXFOR Particles.

2. This keyword is not compulsory, but should always be present when the particle detected is not evident from the code given under the data-specification keyword, and is not given under RAD-DET and DECAY-DATA.

3. The code is
   either a code from Dictionary 33 having a P in Col. 66*
   or, for particles heavier than alpha particles, a code of the form Z-S-A-X, see page VIII.1.2.

4. Two or more particles detected

   a.) If the data specification keyword contains only one coding-unit, or, one coding-unit per reaction string of a multiple reaction (i.e., there are no reaction combinations), the coded information may be given in either of the general forms, see page VIII.1.2.

   b.) For reaction combinations, the particles detected pertaining to different reaction-units within a reaction combination, should be coded on separate lines in the same order as the corresponding reaction units. (See page VIII.3.2 for reaction combinations).

*Note: In entries using the -QUANT formalism, the code is taken from Dictionary 13.

RAD-DET

1. This keyword is used to give information about the radiations and/or particles, and nuclides related to the decays pertinent to the reaction measured.

2. This keyword is not compulsory, but either RAD-DET or PART-DET must be present when the radiation or particle detected is not evident from the code given under the data-specification keyword, or under DECAY-DATA. Must contain coded information, with, or without, free text.

   Note: If this keyword is present the keyword DECAY-DATA must also be present.

3. The general format of the code is

   ((flag) nuclide, radiation)

   No embedded blanks are permitted in the code.

   Flag Field. The general format of the code is (n.), where n will have a numerical value which appears in the data section under the data heading keyword BIBFLAG.
   This field may be omitted, in which case its parenthesis is also omitted.

   See also LEXFOR Flags and page VI. 6, 'Links between BIB, COMMON, AND DATA'.

   Nuclide field. The general format of the code is Z-S-A-X, see page VIII.3.1

   Radiation field consists of one or more codes from dictionary 33, each separated by a comma.

4. Two or more nuclides. The coded information for each nuclide must be given separately, each code starting in col12. Pointers may be used to link the RAD-DET codes with the REACTION codes and the DECAY-DATA codes.

   Examples: a) RAD-DET (96-CM-240,A)

   b) RAD-DET (25-MN-52-G,DG)

   c) RAD-DET (25-MN-52-M,DG,B+)

   d) RAD-DET (48-CD-115-G,B-)
   (49-IN-115-M,DG)

   e) RAD-DET 1(94-PU-237-M1.SF)
   2(94-PU-237-M2,SF)

REFERENCE

1. Used to give information on reference directly pertaining to work coded See also LEXFOR Reference.

2. Keyword is compulsory and must have coded information.

3. The general coding format consists of 3 main fields,

   (type of reference, reference, date)

   No embedded blanks are allowed

   Type of Reference. This field must be present and must contain a code from Dictionary 4.

   Reference. The coding for this field consists of up to four subfields depending on the type of reference. The first subfield must not be omitted. If a subfield is omitted the comma must be included, except in the case:

   a) of a parenthesied subfield
   b) when the omitted subfield is the page number

   See type of reference; followed pages, for specific coding rules for this field.

   Date. This field must be present and must contain a code of the form YYMMDD (year, month, day, each two digits). The month and day may be omitted.

4. In the case of more than one reference, each reference must be coded separately, starting in Col 12.

5. When referencing a document which has more than one identification number, all these numbers shall be included within one set of parentheses, each one being in parentheses connected by an = sign.

   e.g. ((R,USNDC-7,143,7306)=(R,EANDC(US)-181,143,7306))

   The same rules apply for continuation cards as those given under Reaction Combinations, page VIII.3.2.

6. The remaining character positions on the line following the closing parenthesis of the coding are reserved for a "mini-comment", giving further information about the reference

   e.g. GRAPH ONLY
   or ABSTRACT.

   This "mini-comment" could then be used in a printed index. Any further information about the reference can be given on a second line starting in Col. 12, following the normal practice in the exchange format.

7. Coding of reference field for given reference types.

Type of Reference = B or C; Books and Conferences

The reference field may contain up to 4 subfields:

(code, volume, (part), page (paper number))

Code subfield contains a code from Dictionary 7.

Volume subfield may have any content.

Part subfield, if present, is enclosed in parentheses and may have any content.

Page (paper number) subfield, if present, contains:
the page number which must be numeric
and/or
the paper number, enclosed in parenthesis,
which may have any content.

Examples:

a) (C,67KHARKOV,,(56),6702) = 1967 Kharkov Conference proceedings, paper number 56, February 1967.

b) (C,66WASH,1,456,6603) = 1966 Washington Conference proceedings, Volume No. 1, page 456, March 1966.

c) (B,ABAGJAN,,123,64)=Book by Abagjan, page 123, published in 1964.

d) (B,MARION,4,(1),157,60) = Book by Marion, Volume 4, part 1, page 157 published in 1960.

Type of Reference = J: Journals

The reference field may contain up to 4 subfields:

(code, volume, (issue-number), page (page number))

Code subfield contains a code from Dictionary 5.

Remaining subfields are coded as for Books and Conferences, above, except that 'issue-number' replaces 'part'.

Examples:

a) (J,PR,104,1319,5612) = Phys.Rev. Volume 104, page 1319, December 1956

b) (J,XYZ,5,(2),89,6602) = Journal XYZ, Volume 5, issue-number 2, page 89, February 1966.

Type of Reference = P or R or S: Reports

The reference field for reports may contain up to 3 subfields,

(code-number, (volume or Part), page)

Code-number subfield contains:

a.) a code taken from Dictionary 6.

b.) the number, which may have any format, for example:
3058-39
4648-MS
66-12-9
630-1X-A/PR

The separators between the code and the number is a hyphen. Since the Code and the Number may both contain hyphens, the separator is defined as the first hyphen which is followed by a digit, for example:

separator
↓
AERE-C/R-159-MS

Code number

The hyphen acting as separator is included in Dict.6, except when the code itself is 11 characters long.

Volume or part subfield, if present, is enclosed in parenthesis and may have any content.

Page subfield, if present, should be numeric. If there are two works on a page they may be distinguished in the same way as described for journals, for example: 123(1) and 123(2)

Examples:

a) (R,UCRL-5341,5806) = UCRL report number 5351, published in June 1958.

b) (R,JINR-P-2713,6605) = Dubna report, series P, number 2713, published in May 1966.

c) (P,WASH-1068,185,6603)= WASH progress report number 1068, page 185, published in March 1966

d) (R,BNL-325,(2ED,SUPPL.2,VOL.2A),6602 = an extreme but well-known example for the Vol. or Part field.

Type of Reference = T. or W: Thesis or Private Communication

The reference field may contain up to 2 subfields: (author, page)

Author subfield contains the last name of the first author.

Page subfield, if present, must be numeric.

Examples:

a) (W,BENZI,661104) = private communication from Benzi received in November 4, 1966.

b) (T,ANONYMOUS,586802) = Page 58 of thesis by Anonymous, published in February 1968.

REL-REF

1. Used to give information on references relevant to, but not directly pertaining to, work coded. See also LEXFOR Reference.

2. This keyword is optional, but, if present, must have coded information, with or without free text.

3. The general format of the code contains three main fields.

   (code,(sub)accession#, author, reference)

   Code field. This field must be present and must contain a code from Dictionary 17.

   (Sub)accession # field contains the EXFOR accession number or subaccession number for the reference given, if it exists.

   Author field contains the first author, coded as under AUTHOR, followed by + when more than one author exists.

   Reference field. This field contains up to 8 subfields coded as under REFERENCE.

   Example:

   (C,B9999,A.B.NAME+,J,XYZ,5,(2),90,7701)=Critical remarks by A. B. Name, et al. in Journal XYZ, Volume 5, issue-number 2, page 90, January 1977.

RESID-NUC (-QUANT formalism)

1. This keyword is used to define the residual nucleus for a reaction defined under the keyword ISO-QUANT. See LEXFOR Residual Nucleus.

2. This keyword is optional. May have coded information with or without free text.

3. The general format of the code is Z-S-A-X (A ≠ 0), see page VIII.3.1.

4. Two or more residual nuclei

   a) If the data specification keyword contains only one coding-unit, or, is one coding-unit per reaction string of a multiple reaction (i.e., there are no reaction combinations), the coded information may be given in either of the general forms, see page VIII.1.2.

   b) For reaction combinations, the residual nuclei pertaining to different reaction-units, within a reaction combination, should be coded on separate lines in the same order as the corresponding reaction units. (See page VIII.3.2 for reaction combinations)

STANDARD (-QUANT formalism)

1. This keyword is used to give information about the standard(s) used in the experiment and to define standard information coded in the COMMON and DATA sections.

2. Keyword obligatory, except when not relevant. Information may be entered either in free text only or in coded form with or without free text. However, coded information must be included when the corresponding data is given in the COMMON-or DATA-sections. See 'Links between BIB, COMMON and DATA', page VI.4.

3. If coded information is given the coding rules for STANDARD are all identical to those for the corresponding-QUANT,e.e.,ISO-QUANT,CMPD-QUANT or NUC-QUANT.

4. Two or more standards given in coded form.

   Each standard must be coded separately, starting in col.12.

STATUS

1. For use of this keyword see LEXFOR Status.

2. Keyword optional with coded information and/or free text.

3. The coded information may be entered in:

   a.) either of the general forms, see page VIII.1.2, with codes from Dictionary 16.

   b.) as coded information with two fields

   (code, subaccession #)

   Code Field contains a code from Dictionary 16, as for a.)

   Subaccession # Field contain a cross reference to an EXFOR subaccession number.

   This format is only permitted for the codes SPSDD,DEP,CORREL,OUTDT, and RNORM. The codes DEP, CORREL, and RNORM must always be coded in, this format, although older data may still exist codes without a subaccession number cross-reference.

   Example:
   (SPSDD,10048009) - this means that the present subentry is superseded by subentry 10048009.

4. For case 6, if more than one status code is to be given or a cross-reference to more than one subaccession number, they must be coded separately, starting in Col. 12.

Example:	STATUS	(DEP,12345002)
		(DEP,12345004)

Products

1. Products of 2 or more reactions can be expressed as a reaction combination using the separator '* .

   Examples:

   REACTION ((42-MO-98(N,TOT),,WID)*(42-MO-98(N,EL),,WID))

   ISO-QUANT ((42-Mo-98,TOT/WID)*(42-Mo-98,EL/WID))

2. Products implicit in the quantity codes

   For certain products which can be measured directly, or are frequently used, special quantity have been introduced.

   The following factors are coded using special codes in the modifier field:

   σo = SO

   g,ag,2g,2ag = G,Ag,2G,2AG

   $\sqrt{E}$ = RTE

   4π = 4PI

   $(---)^2$ = SQ

   $\frac{4\pi}{\sigma el}$ = RS

See also Fitting Coefficients.

Ratios

1. Ratios of 2 or more reactions can be expressed as a reaction combination using the separator '/'.

   Examples:

   REACTION ((3-LI-6(N,T)2-HE-4,,SIG)/(92-U-235(N,F),,SIG))

   ISO-QUANT ((3-LI-6,NT)/(92-U-235,NF))

2. Ratios implicit in the quantity codes.

   For certain frequently used ratios, special quantity codes have been introduced.

   $\frac{\sigma Y}{\sigma f}$ = ALF (see LEXFOR Alpha)

   $\frac{\nu\sigma f}{\sigma abs}$ = ETA (see LEXFOR Neutron Yield)

   $\frac{4\pi}{\sigma el}$ (---) = RS modifier

3. Isomeric Ratios are coded:

   a.) REACTION formalism - using the separator '/' in the isomer field of the reaction product (SF4), see Isomeric States.

   b.) ISO-QUANT formalism - as in Section 1, above.

   ISO-QUANT ((41-NB-93,INL,,MS)/(41-NB-93,INL,,GND))

4. Data-Heading Keyword RATIO

   The Data-Heading Keyword RATIO may be used instead of the keyword DATA with, and only with, ratios expressed isomeric ratios, see Section 3.

   It should not be used for implicit ratios, see Section 2, above.

SUMS

1. Sums of 2 or more reactions can be expressed as a reaction combination using the separator '+'.

   Examples:

   a.) Single - target nucleus; sum of reactions

   ```
   REACTION   ((28-NI - 58(N,N+P)27-CO-57,,SIG)+
               (28-NI-58(N,D)27-CO-57,,SIG))
   ISO-QUANT  ((28-NI-58,NNP)+(28-NI-58,ND))
   ```

   b.) More than one target nucleus: more than one reaction

   ```
   REACTION   ((28-NI-58(N,P)27-CO-58,,SIG)+
               (28-NI-60(N,T)27-CO-58,,SIG))
   ISO-QUANT  ((28-NI-58,NP)+(28-NI-60,NT))
   ```

2. Sum reactions such as absorption or nuclide production, where the individual competing reactions may not be known, cannot be coded using the form above.

3. Sums of reactions to isomeric states are coded:

   a.) REACTION formalism - using the separator '+' in the isomer field of the reaction product, see Isomeric States.

   b.) ISO-QUANT formalism - as in Section 1, above

   ```
   ISO-QUANT  ((41-NB-93,INC,,MS)+(41-NB-93,INL,,GND))
   ```

4. Data-Heading Keyword SUM

   The data heading keyword SUM may be used instead of the keyword DATA with, and only with, sums expressed as reaction combinations, see Section 1, above, or, sums of reactions to isomeric states, see Section 3.

Tautologies

Tautologies can be expressed as a reaction combination using the separator ' = ' (see coding rules page VIII.3.2). Its use is optional, i.e., at the discretion of the compiler.
It may be used when a data set can be equally well described by two or more reactions, which are identical in the energy range considered. If it is used, the sequence of the reactions should be such that that with the narrowest definition (as outlined below) is given first.

Two types of tautologies are considered:

1. Below thresholds
   Example: Total scattering equals elastic scattering below the inelastic threshold.

2. Emission cross sections, for certain secondary energies.
   Example: Gamma emission cross section equals inelastic gamma cross section for some gamma energies.

For such cases the narrower definition should be coded first.

The broader definitions should, in general, only be used when two or more competing reactions are present. This rule seems to avoid any real case of a tautology. However, in the case where the author uses the broader definition to define the reaction, it may be useful to code both for purposes of identification.

The tautology formalism should not be used in the following cases:

1. When a data set extends beyond a known threshold, the broader definition, and only the broader definition, should always be used. See also Thresholds.
2. In the case where a compiler has doubts about which quantity is actually given in a data set, the compiler must decide in favor of one of the possible codes.
3. In old papers obsolete designations like "inelastic collision cross-section" for nonelastic or "absorption" for (n,γ) may have been used.

   In these cases the presently valid definition should be used. The author's designation may be given in free text.