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EXFOR Systems Manual
Nuclear Reaction Data
Exchange Format

Nuclear Data Centers Network

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Chapter 1

INTRODUCTION

This document describes EXFOR, the exchange format designed to allow transmission of nuclear reaction data between the members of the Nuclear Data Centers Network[1]. In addition to storing the data and its' bibliographic information, experimental information, including source of uncertainties, is also compiled. The status and history of the data set is also included, *e.g.*, the source of the data, any updates which have been made, and correlations to other data sets.

EXFOR was originally conceived for the exchange of neutron data through discussions held between personal from laboratories situated in Saclay, Vienna, Livermore and Brookhaven, and accepted as a result of a meeting of the neutron data centers at Saclay, Vienna, Brookhaven and Obninsk, held in Moscow in November, 1969. As a result of two meetings held in Vienna in 1975/1976 on Charged Particle Nuclear Data Compilation, attended by an increased number of data centers, the format was further developed and finally adapted to cover all types of nuclear reaction data.

EXFOR is designed for flexibility rather than optimization of data processing in order to meet the diverse needs of the nuclear reaction data centers. The exchange format should not be confused with a center-to-user format. Although users may obtain data from the centers in the EXFOR format, other center-to-user formats have been developed to meet the needs of the users within each center's own sphere of responsibility.

The exchange format, as outlined, is designed to allow a large variety of numerical data tables with explanatory and bibliographic information to be transmitted in an easily machine-readable format (for checking and indicating possible errors) and a format that can be read by personnel (for passing judgement on and correcting any errors indicated by the machine).

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[1] See Appendix P for a list of the Nuclear Reaction Data Centers and their areas of responsibility.

General structure of the exchange format

1. An EXFOR entry (work) is divided into bibliographic and descriptive information (alphanumeric) and data (numeric). The entries are further divided into subentries (data sets). Bibliographic or descriptive information and common data may be associated with the whole entry and/or with each subentry. A set of system identifiers has been devised for separating these logical blocks of information within an entry.

2. A set of information identifiers (keywords) has been devised so that each item of bibliographic or descriptive information may be identified for computer processing.

3. Each piece of bibliographic or descriptive information may have associated with it a standard set of codes. These codes, enclosed in parentheses, may be used, for example, for retrieval or for identifying a data set. A set of dictionaries is provided for defining the meaning of those codes which are not self-explanatory[2].

4. Unlimited free text is permitted with each information identifier.

5. The data for a subentry are presented in the form of a table of fixed field widths, but with no positional meaning. Each table is preceded by its data heading and data units; Dictionaries are provided to define a standard set of heading and unit codes.

6. Common data, meaning data values which are common throughout an entry or subentry, are treated in a similar way as the data (see 5, above), except that there is only one entry in each field.

7. The end of each record is reserved for an identification consisting of an accession number (entry), subaccession number (subentry), and record number within the subentry. This guarantees that each record may be uniquely referenced (*i.e.*, no two records will have the same identification).

8. Flags are used to indicate records altered since the previous transmission of a particular entry.

9. The record size is 80 characters.

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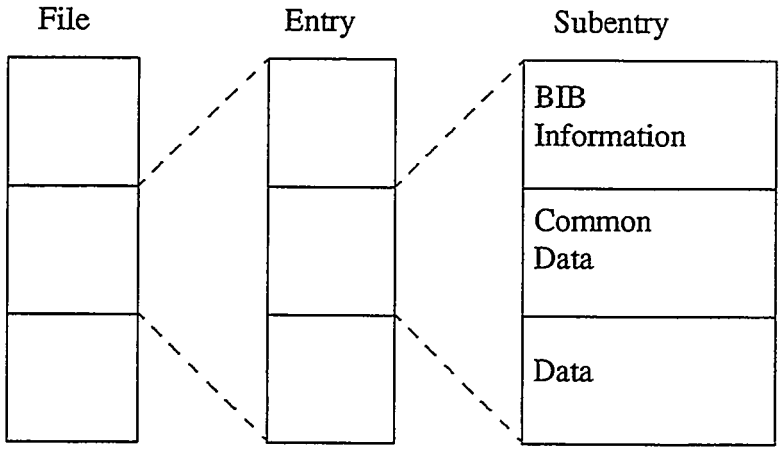
[2] Authors' names, for example, are self-explanatory, and no dictionary is needed.

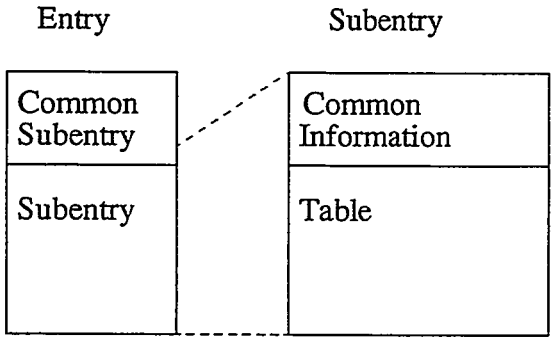
Summary of exchange file format

An exchange file contains a number of entries. Each entry (work) is divided into a number of subentries (data sets). The subentries are further subdivided into bibliographic or descriptive information (hereafter called BIB information), common data that applies to all lines of a data table in a subentry and, finally, a data table. The file may, therefore, be considered to be of the following form:



A number of ***system identifiers*** are used to define the beginning and end of each of the above units.

In order to avoid repetition of information that is common to all subentries within an entry or to all lines within a subentry, information may be associated with an entire entry or with an entire subentry. In order to accomplish this, the first subentry of each work (subaccession number 1) contains only information which applies to all other subentries. Within each subentry, the information common to all lines of the table precedes the table. Two levels of hierarchy are thereby established:



The common subentry and common information are further subdivided into common BIB information (alphanumeric) and common data (numeric) information.

Definition of a subentry

In order to avoid duplication of effort and to ensure that the identification scheme will be universally applicable, the originating center[3] is responsible for dividing entries into appropriate subentries prior to transmission. This ensures that an entry is divided into subentries in a unique manner which may be referenced by all centers.

A subentry is defined as:

1. A data table as a function of one or more independent variables: *i.e.*, X, X′ vs. Y with associated errors for X, X′ and Y (*e.g.*, X = energy; X′ = angle; Y = differential cross section) and any associated variables (*e.g.*, standard)

2. Independent variables precede dependent variables, and are monotonic in the left-most independent variable. Values in following independent-variable fields are monotonic until the value in the preceding independent-variable field changes.

3. When more than one representation of Y is present, the table may be X vs. Y and Y′, with associated errors for X, Y and Y′ (*e.g.*, X = energy, Y = absolute cross section, Y′ = relative cross section), and possible associated information. The criteria for grouping Y with Y′ is that they both be derived from the same experimental information by the author of the data.

4. Variables may appear either in the common data portion of a subentry (when uniformly applied to all points), or as a field of the data table (when applied pointwise).

5. For some data, the data table does not have an independent variable X but only a function Y. (*Examples*: Spontaneous ν; resonance energies without resonance parameters)

6. If the function Y is given for a single value of the variable X, and if this value of X is common for all subentries in a given entry, then X may be entered in the common data section of the first subentry. The following subentries may then contain only the value of Y in the data table.

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[3] Or designated center, see Data Compilation Responsibility, Appendix P.

Permitted character set

The following characters are permitted for use in the exchange format:

All Roman characters, A to Z and a to z
All numbers, 0 to 9
The special characters:

+ (plus)
- (minus)
. (decimal point/full stop)
) (right parenthesis)
((left parenthesis)
* (asterisk)
/ (slash)
= (equals)
' (apostrophe)
, (comma)
% (percent)
< (less than)
> (greater than)
: (colon)
; (semi-colon)
! (exclamation mark)
? (question mark)
& (ampersand)
#
[
]
"
~

Chapter 2

RECORD IDENTIFICATION

Columns 67-80 are used to identify uniquely each record and to flag altered records. These columns are divided into five fields as follows:

67-71	Center-assigned accession number
72-74	Subaccession number
75-79	Sequence number
80	Alter flag

Each of these fields is described in detail in this chapter.

File identification character

The first position of accession numbers, and the first position of an exchange file identification contain a character indicating the center at which the information originated and the type of data compiled[1]. The following file identification characters have assigned:

0	Preliminary	For internal center use (*i.e.*, not included on exchange files).
1	NNDC (Brookhaven)	Neutron nuclear data
2	NEA-DB (Paris)	Neutron nuclear data
3	NDS (Vienna)	Neutron nuclear data
4	CJD (Obninsk)	Neutron nuclear data
6	data from area 2	Data entered by NNDC; not part of the normal neutron nuclear
8	data from area 4	2, 3, 4 series.
9	NDS (Vienna)	Dictionary transmission (see page 7.1)
A	CAJaD (Moscow)	Charged-particle nuclear data
B	KaChaPaG (Karlsruhe)	Charged-particle nuclear data [2]
C	NNDC (Brookhaven)	Charged-particle nuclear data
D	NDS (Vienna)	Charged-particle nuclear data
E	"Study Group" (Sapporo)	Charged-particle nuclear data
F	VNIIEF (Sarov)	Charged-particle nuclear data
G	NDS (Vienna)	Photonuclear data
H	NNDC (Brookhaven)	Special internal use for relativistic particle reaction data
L	NNDC (Brookhaven)	Photonuclear data
M	CDFE (Moscow)	Photonuclear data
N	NEA-DB (Paris)	Special use for memos only
O	NEA-DB (Paris)	Charged-particle nuclear data
P	NNDC (Brookhaven)	Charged-particle nuclear data from MacGowen file[3]
Q	CJD (Obninsk)	Photonuclear data
R	RIKEN	Charged-particle nuclear data
S	CNDC	Charged-particle nuclear data
V	NDS (Vienna)	Special use for selected evaluated neutron data 'VIEN' file.

[1] Neutron, charged-particle, and photonuclear reaction data must be compiled in separate entries with appropriate identification, even if they are reported in the same publication. See Appendix P, Protocol, page P.3.

[2] Updates to these entries are the responsibility of CAJaD.

[3] Updates to these entries are the responsibility of NNDC. Originally corrected and coded by KaChaPaG.

Accession number (columns 67-71). Columns 67-71 contain a five-character accession number assigned by the originating center to a given work. Columns 67 is the file identification character; columns 68-71 contain a center-assigned entry number[4], allowing 9,998 entries for each file identification character (*e.g.*, A0198). The entries will appear on the exchange file in ascending number order[5].

An accession number is associated with one work throughout the life of the EXFOR system. If an entry is deleted from the system, the accession number is not reassigned to another work.

Subaccession number (columns 72-74). Columns 72-74 contain a three-digit subaccession number assigned by the originating center. The subaccession number is used to divide an entry into a number of subentries while maintaining an interrelationship between the subentries (*i.e.*, all subentries within a given entry contain the same accession number). Each subentry may be conceptually thought of as an individual data set (a data table and its associated descriptive information). Up to 998 subentries (data sets) may be associated with each entry (work), *i.e.*, subaccession numbers are sequentially assigned within each entry, starting at 1 and increasing toward 998[6].

A subaccession number is associated with a table throughout the life of the EXFOR system. If a subentry is deleted from the system, the subaccession number is not reassigned to another data table within the same entry.

Sequence number (columns 75-79). Columns 75-79 contain a five-digit sequence number, which is used to uniquely define a record within a subentry (all records within a subentry are labeled with the same subaccession number). The numbering is sequential within a subentry. Up to 99,999 records may be associated with each subentry, *i.e.*, the record numbering within each subentry begins at 1 and increases sequentially toward 99999[4].

The sequence number allows referencing at the record level during, *e.g.*, for updating and checking. A given sequence number need not be associated with a given record over time. The records within a subentry are renumbered sequentially following an update (alteration) procedure.

EXFOR records are always transmitted in sequential order.

Alter flag (column 80). Column 80 is used to indicate that a record or following records have been altered since the work was last transmitted. The flag will normally be blank (not zero) to indicate an unaltered record. See Chapter 9 for use of Alteration Flags.

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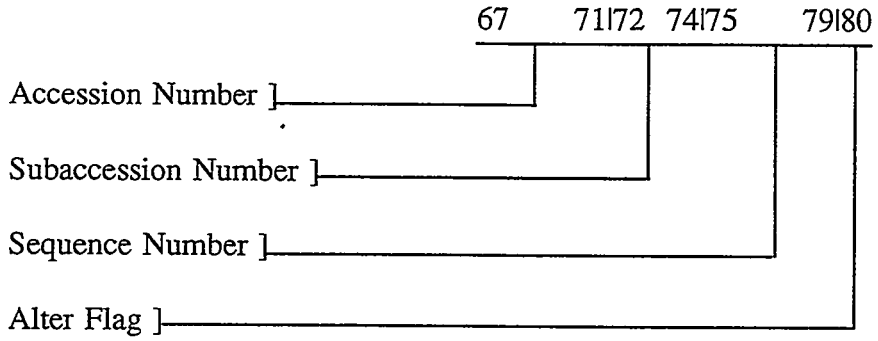
[4] See Appendix P, Protocol, page P.4, for more information on the assignment of accession numbers.

[5] Although, the accession numbers needn't be assigned sequentially

[6] Leading zeros should always be included on an exchange file.

Record identification summary

Columns 67-79 of each record are used to uniquely identify each record in the EXFOR system. This is accomplished by dividing the record identification into four fields as shown, below. Column 80 is used as an alteration flag.



The first field (column 67-71) is alphanumeric; the next 2 fields (columns 72-79) are strictly numeric and may vary over the following ranges:

1) Accession Number: File identification + 0001 to 9999[7]
2) Subaccession Number: 1 to 999[8]
3) Sequence Number: 1 to 99999[9]

They may be used in combination to uniquely reference information within the library at any of a number of levels as follows:

1) Columns 67-71: Uniquely identifies an entry within the EXFOR systems.
2) Columns 67-74: Uniquely identifies a subentry within the EXFOR system.
3) Columns 67-79: Uniquely identifies a record within the EXFOR system[10].

The first two fields (columns 67-74) are associated with a subentry throughout the life of the system; that is, if the subentry is deleted from the system, the same identification is not assigned to another subentry. The third field (columns 75-79) is maintained in sequential order, *i.e.*, the sequence number on a record my change after an alteration to the subentry.

The alter flag (column 80) is used to identify records that have been altered.

On a transmission file the records are in ascending order according to the record identification (columns 67 to 79).

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[7] The integer 9999 is always used to identify the end of a file (transmission tape).

[8] The integer 999 is always used to identify the end of an entry and a file.

[9] The integer 9999 is always used to identify the end of a subentry, entry, and file.

[10] Columns 67-79 are padded with zeros (0) rather than blanks on a exchange file. This allows the entire library to be handled by the standard sort/merge packages available on a wide variety of computers.

Chapter 3

SYSTEM IDENTIFIERS

Each of these basic system identifiers refers to one of the hierarchy of units contained on a transmission file. These units and their corresponding basic system identifiers are:

TRANS	- A transmission in the unit
ENTRY	- A work (entry) is the unit
SUBENT	- A sub-work (subentry) is the unit
BIB	- The BIB section of a complete work or sub-work is the unit
COMMON	- The common data section of a complete work or sub-work is the unit
DATA	- The data table section of a sub-work is the unit

These basic system identifiers are combined with the modifiers

NO
END

To indicate three conditions:

- The beginning of a unit (basic system identifier only)
- The end of unit (modifier END preceding the basic system identifier)
- A positive indication that a unit is intentionally omitted (modifier NO preceding the basic system identifier)

However, only those combinations of basic system identifiers and modifiers which are defined on the following pages, and are included in Dictionary 1, are used.

System identifier records

The general format of a system identifier record is:

1	11	22	33	66
SYSTEM IDENTIFIER		N1	N2	Free text

SYSTEM IDENTIFIER may be any of the permitted system identifiers, left adjusted to begin in column 1. N1 and N2 are integers, right adjusted to columns 22 and 33, respectively. The significance of N1 and N2 depends on the system identifier used.

Columns 34-68, with the exception of the special uses listed under the system identifiers, may contain any free text that a center wishes to use or may be used internally by the centers for additional coded information.

The following pages describe all permitted system identifier records in detail. The detailed description is followed by a brief summary of the characteristics of the system-identifier records.

TRANS. The **first record** of the exchange file.

N1 - The exchange file identification, consisting of:
column 19: the file-identification character[1],
column 20-22: a three-digit number (padded with zeros), sequentially assigned to allow other centers a simple means of determining whether or not they have received all exchange files.

N2 - A six-digit integer containing the data (year, month, and day) on which the exchange file was generated. The format is: yymmdd.

The record identification contains the file-identification character in column 67 and zero's in columns 68-79[1].

ENDTRANS. The **last record** of the transmission file.

N1 - The number of entries (accession numbers) on the file.
N2 - Presently unused (may be blank or zero).

The record identification contains a character, whose value is ≥ the file identification number of the previous record, in column 67 and 9's in columns 68-79.

[1] On files which contain entries with different file-identification characters (*i.e.*, other than exchange files), column 67 is assigned such that the record sorts at the beginning of the file (*e.g.*, equal to, or less than, the file-identification character of the first entry included on the file).

DICTION
ENDICTION
NODICTION
} (not part of an exchange file)[2]

ENTRY. The **first record** of each work.

N1 - 5-character accession number
N2 - Date of last update (or date of entry if never updated) (yymmdd)

The record identification contains the accession number (columns 67-71), the subentry number zero (000) (columns 72-74), and the sequence number one (00001) (columns 75-79).

The following special uses are made of the free text field in the ENTRY record:

NDS: For entries containing evaluated or recommended data, a "V" is inserted in column 44.

Columns 45-55 contain the initials of the physicist who complied the entry or made the last revision.

NNDC: Columns 43, 44 contain a compiler-identification code.

ENDENTRY. The **last record** of each work.

N1 - The number of subentries in the work[3].
N2 - Presently unused (may be blank or zero).

The record identification contains the accession number (columns 67-71), the subentry number 999 (columns 72-74), and the sequence number (99999) (columns 75-79).

[2] When dictionaries are transmitted, they must be in a separate file apart from the EXFOR data entries. See Chapter 7.

[3] When NOSUBENT records are included in an entry, they are counted as subentries when computing N1.

SUBENT. The **first record** of each subentry.

N1 - 8-character subaccession number (accession number and subentry number).
N2 - Date of last update (or date of entry if never updated) (yymmdd).

The record identification contains the subentry number (columns 67-74) and sequence number one (00001) (columns 75-79).

ENDSUBENT. The **last record** of each subentry.

N1 - The number of records within the subentry.
N2 - Presently unused (my be blank or zero).

The record identification contains the subaccession number (columns 67-74) and sequence number 99999 (columns 75-79).

NOSUBENT. This record indicates that a subentry number has been assigned by the center but that either the information associated with it was not ready at the time the file was transmitted by the center, or that the subentry has been deleted or combined with another subentry.

N1 - 8-character subaccession number (accession number and subentry number).
N2 - Date of last alter or blank (if merely assigned and not yet used).

The record identification is the same as on a SUBENT record.

BIB. The **first record** of each section containing descriptive information.

N1 - Number of information-identifier keywords in the BIB section.
N2 - Number of records in the BIB section.

ENDBIB. The **last record** of each BIB section.

N1 - Number of records in BIB section.
N2 - Presently unused (may be blank or zero).

NOBIB. A positive indication that no BIB section is given in the subentry.

N1 - Presently unused (may be blank or zero).
N2 - Presently unused (may be blank or zero).

COMMON. The **first record** of each common data section.

N1 - Number of common data fields.
N2 - Presently unused (may be zero or blank).

ENDCOMMON. The **last record** of each common data section.

N1 - Number of records within the common section.
N2 - Presently unused (may be zero or blank).

NOCOMMON. A positive indication that no common data section is given in the subentry.

N1 - Presently unused (may be blank or zero).
N2 - Presently unused (may be blank or zero).

DATA. The **first record** of each data table section. (May not appear in the first (SAN=1) subentry).

N1 - Number of fields (variables) associated with each line of a data table.
N2 - Number of data lines within the table (excluding headings and units). Note that if N1< 6, a ***line*** will consist of more than one record.

ENDDATA. The **last record** of each data table section. (May not appear in the first (SAN=1) subentry).

N1 - Number of records within the data section.
N2 - Presently unused (may be zero or blank).

NODATA. A positive indication that no data table section is given in the subentry. (May not appear in the first (SAN=1) subentry).

N1 - Presently unused (may be zero or blank).
N2 - Presently unused (may be zero or blank).

The record identification for these system identifiers contains the subaccession number (columns 67-71), and the sequence number, assigned sequentially within the subentry (columns 75-79).

System identifier record summary

The following similarities may be noted between system identifier records:

1. The TRANS, ENTRY, and SUBENT records all use N1 to uniquely identify the unit (file, entry, subentry, respectively) and N2 to give a date (TRANS - date file was generated; ENTRY and SUBENT - date of last update).
2. The **BIB, COMMON**, and **DATA** records (the units that actually contain information) use N1 and N2 to define the contents of the information records.
3. All **END**[System Identifier] records use N1 to indicate the number of sub-units within the unit:

   ENDTRANS - the number of entries;
   ENDENTRY - the number of subentries:
   ENDSUBENT, ENDBIB, ENDCOMMON, and **ENDDATA** - the number of records.

   To be consistent at all levels (*e.g.*, entry, subentry, record), the system identifier records ***are not*** included in the N1 total for **BIB, COMMON,** and **DATA** (see examples on following pages). N2 is presently unused on all **END**[System Identifier] records.

Since the above rules describe all of the system-identifier records, a minimum number of rules need to be remembered.

The following hierarchy has been established on the file:

1. A **transmission** is one logical file

Headed by	TRANS	CXXX	yymmdd
Ended by	ENDTRANS	N1	

   CXXX = file identification
   yymmdd = date file was generated
   N1 = number of entries on the file

2. **Entries** are:

Headed by	ENTRY	CXXXX	yymmdd
Ended by	ENDENTRY	N1	

   CXXXX = accession number
   yymmdd = date entry was last updated
   N1 = Number of subentries in the entry (including NOSUBENT's).

3. Entries are divided into subentries. Each subentry is:

   Headed by SUBENT N1 yymmdd
   N1 = subaccession number
   yymmdd = date subentry was last updated

   Ended by ENDSUBENT N1
   N1 = number of records in the subentry
   (excluding the SUBENT and ENDSUBENT records)

   Or if no subentry:
   NOSUBENT N1 yymmdd

4. Each subentry but the first contains three sections (there will always be a positive indication of no information in a section). The sections are:

   BIB Section:

   Headed by BIB N1 N2
   N1 = Number of keywords in the BIB section
   N2 = number of records in the BIB section

   Ended by ENDBIB N1
   N1 = number of records in the BIB section (excluding BIB and ENDBIB records)

   Or if no BIB section: NOENDFIELD BIB

   COMMON Section:

   Headed by COMMON N1 N2
   N1 = number of common data fields

   N2 = number or records in the common data section (including data titles and units, excluding COMMON and ENDCOMMON records)

   Ended by ENDCOMMON N1
   N1 = number or records in the common data section (including data titles and units, excluding COMMON and ENDCOMMON records)

   Or if no COMMON section: NOCOMMON

   DATA Section:

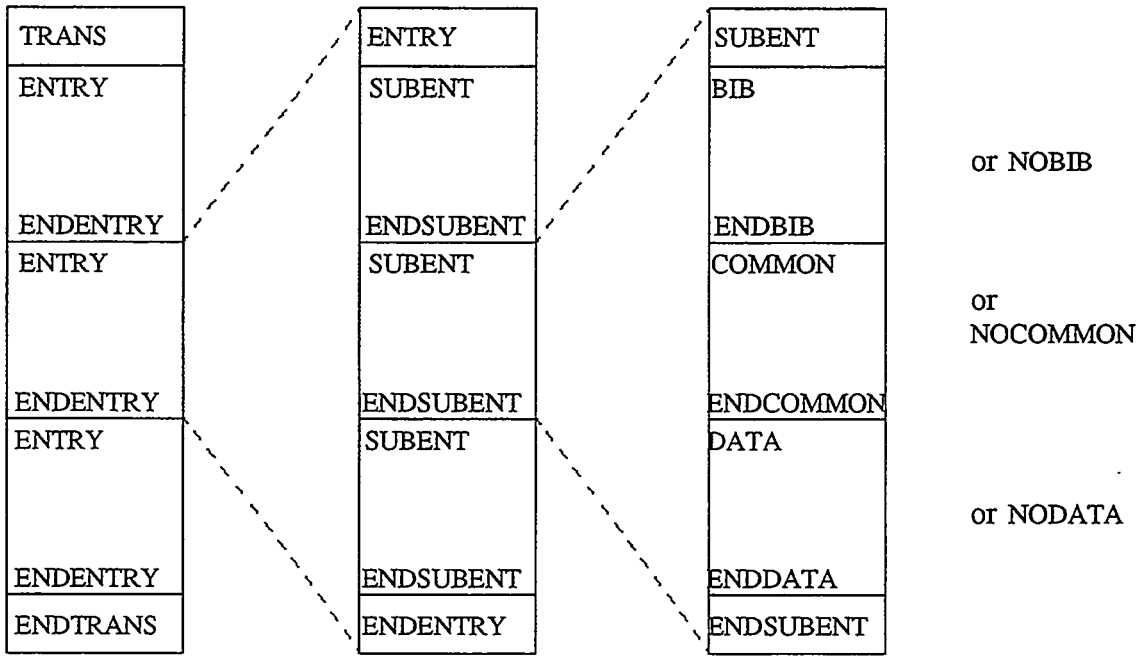
   Headed by DATA N1 N2
   N1 = number of fields in the data table
   N2 = number of lines (rows) in the data table

   Ended by ENDDATA N1
   N1 = number of records in the data table section (including data titles and units; excluding DATA and ENDDATA records)

   Or if no DATA section: NODATA

   The DATA section (or NODATA) does not appear in the first (or common) subentry.

The transmission file has the following form:



Note: DATA, ENDDATA, and NODATA do not appear in the first (all common) subentry.

System identifier sequence

The following tables specify the permissible order in which system identifiers may appear. The first table lists all records that may follow a given system identifier. The second table lists all records that may precede a given system identifier.

SYSTEM IDENTIFIER	LEGAL FOLLOWING RECORD
1) TRANS	ENTRY
2) ENDTRANS	(no information follows ENDTRANS
3) ENTRY	SUBENT, NOSUBENT
4) ENDENTRY	ENTRY, ENDTRANS
5) SUBENT	BIB, NOBIB
6) ENDSUBENT or NOSUBENT	SUBENT, ENDENTRY, NOSUBENT
7) BIB	(a bibliographic record)
8) ENDBIB or NOBIB	COMMON, NOCOMMON
9) COMMON	(a common data record)
10) ENDCOMMON or NOCOMMON	DATA[4], NODATA[5], ENDSUBENT[5]
11) DATA	(a data heading record)
(12) ENDDATA or NODATA	ENDSUBENT

SYSTEM IDENTIFIER	LEGAL PRECEDING RECORDS
(1) TRANS	(no information precedes TRANS)
(2) ENDTRANS	ENDENTRY
(3) ENTRY	ENDENTRY, TRANS
(4) ENDENTRY	ENDSUBENT, NOSUBENT
(5) SUBENT or NOSUBENT	ENTRY, ENDSUBENT, NOSUBENT
(6) ENDSUBENT	ENDDATA[5], NODATA[5], ENDCOMMON[6], NOCOMMON[6]
(7) BIB or NOBIB	SUBENT
(8) ENDBIB	(a bibliographic record)
(9) COMMON or NOCOMMON	ENDBIB, NOBIB
(10) ENDCOMMON	(a common data record)
(11) DATA or NODATA	ENDCOMMON, NOCOMMON
(12) ENDDATA	(a data heading record)

[4] Not in the first subentry (*i.e.*, subentry number = 001), where no data section is permitted.

[5] In the first subentry only (*i.e.*, subentry number = 001), where no data section is permitted.

Chapter 4

BIB SECTION

The BIB Section contains the bibliographic (*e.g.*, reference, authors), descriptive information (*e.g.*, neutron source, method, facility), and administrative information (*e.g.*, history) associated with the data presented. It is identified on an exchange file as that information between the system identifiers BIB and ENDBIB.

A BIB record consists of up to four parts:

columns 1-11:	information-identifier keyword field
columns 12-66:	information field, which may contain coded information and/or free text
columns 67-80:	identification field (see Chapter 2)

Information-identifier keywords are used to identify specific information, which may be given in coded form, with or without free text explanation, or in free text without codes. These keywords may, in general, appear in any order within the BIB section.

BIB information for a given subentry consists of the information contained in the BIB section of that subentry together with the BIB information in subentry 001. Therefore, information coded in subentry 001 applies to ***all other*** subentries in the same entry. A specific information-identifier keyword may be included in either subentry or both.

Information-identifier keywords

The information-identifier keyword is used to define the significance of the information given in columns 12-66. The keyword is left adjusted to begin in column 1, and does not exceed a length of 10 characters (column 11 is either blank, or contains a pointer, see following).

An information-identifier keyword is not repeated within any one BIB section. If ***pointers*** are present, they appear on the first record of the information to which they are attached and are not repeated on continuation records. A pointer is assumed to refer to all BIB information until either another pointer or a new keyword is encountered. As this implies, pointer-independent information for each keyword appears first. (See Chapter 6 for use of pointers).

A list of all Information Identifiers is given in EXFOR Dictionary 2. For detailed coding rules, see Chapter 8.

Machine-retrievable information

Machine-retrievable information may be used:

- to define the actual BIB information,
- as a link to the COMMON and DATA section,
- to code numerical data.

Machine-retrievable information (code) is enclosed in parentheses and left adjusted so that the opening parenthesis appears in column 12. Several pieces machine-retrievable information may be associated with a given information-identifier keyword.

For some keywords, a restriction is placed upon the maximum length of the associated machine-retrievable information[1]. For some cases, the information may be continued onto successive records; information on continuation records does not begin before column 12 (columns 1-10 are blank and column 11 is blank or contains a pointer (see Information-Identifier Keyword, above)). The machine-retrievable information is kept as concise as possible so that it may be used efficiently.

Note that some information identifier keywords have no machine retrievable-information associated with them and that, for many keywords which may have machine-retrievable information associated with them, it need not always be present.

See Chapter 8 for formats and coding rules, and Chapter 7 and the Dictionaries for codes.

---

[1] See page 7.10 for maximum length of codes.

Free text

Free text may be entered in columns 12-66 under each of the information-identifier keywords in the BIB section and may be continued onto any number of records. It may include parentheses, if necessary, although, a left parenthesis in the text ***will not*** be used in column 12 (as this implies the opening parenthesis of machine-retrievable information).

The language of the free text is English, and clear English phrasing should be used; no codes are to be used within the free text[2].

See also **LEXFOR Free Text.**

Codes and free text

If both coded information and free test are given under an information-identifier keyword, the free text may appear either on records given before the coded information, on the same record as code (always after the code), or on records following the code, as appropriate.

In general, coded information given with an information-identifier keyword is for the purpose of machine processing and the free text is self-explanatory. That is, coded information is expanded into clear English and amplified as necessary in the free text. However, for some keywords, such an expansion of the codes is not given, on the assumption that such expansion will be done by an editing program. For other keywords, an indication may be given that the coded information is not expanded in the free text.

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

either a decimal point/full stop immediately following the closing parenthesis,
or a completely blank field between the closing parenthesis and column 66.

If both coded information and free text are given, it is legal to start with free text and include the code(s) on following lines.

Example:

```
ERR-ANALYS      Total uncertainties are not given.
                (DATA-ERR) Statistical uncertainty.
```

See page 8.4 for details on specific information-identifier keywords.

[2] Expansions of these codes may be used, at the compiler's discretion, embedded in free text.

An example of several BIB information entries is given below:

```
1              11 12           22
ENTRY                    00001
SUBENT                00001001
BIB
AUTHOR            (J.W.DOW,M.P.JONES)  This space may contain any free text.
                                       The beginning of a new BIB entry is indicated by
                                       a non-blank in the keyword field (columns 1-10).
INSTITUTE         (3AAABBB)            Since the keyword field is non-blank, this is
                                       considered a new BIB entry.
INC-SOURCE        (ABC,WXYZ)           This is an example of a BIB entry with more than
                                       one piece of machine-retrievable information in
                                       one set of parenthesis.  The absence of a pointer
                                       in column 11 shows that this information refers
                                       to all data.
COMMENT           This is an example of a BIB entry without machine-retrievable
                  information.
                1 The pointer in column 11 indicates that this record, and the
                  following records until a new pointer is encountered, refer to
                  all data with the same pointer in all following subentries.
ENDBIB
NOCOMMON
ENDSUBENT
SUBENT                00001002
BIB
REACTION        1 (92-U-235(N,EL),,WID)          This is an example of multiple
                2 (92-U-235(N,F),,WID)           reactions with pointers
ANALYSIS        1 (CDEFG).       This is an example of a BIB entry with more than
                                 one piece of machine-retrievable information, each
                                 coded in its own
                2 (HIJ).         set of parenthesis.  Each part of the BIB entry is
                                 linked by a pointer in column 11 to other
                                 information in this subentry and in subentry 1 with
                                 the same pointer.  The point after the closing
                                 parenthesis indicates that the contents of the code
                                 in parenthesis is not expanded in free text, as
                                 would be required if the point were absent.
ENDBIB
NOCOMMON
DATA
EN                DATA         1 DATA-ERR     1 DATA         2
EV                MILLI-EV       MILLI-EV       MILLI-EV

ENDDATA
ENDSUBENT
ENDENTRY
```

Chapter 5

COMMON AND DATA SECTIONS

The format of the common data (COMMON) and point data (DATA) sections is identical; however, the significance of the content is different. Each section is a table of data with a heading and units associated with each field. The common data consists of fields containing constant parameters that apply to each line of a point data table; *i.e.*, there is only one data line in the common data table. The point data table contains fields of information; each field, generally, contains values as a function of one or more independent variables (*e.g.*, angle, angular error, cross section, cross section error), *i.e.*, more one or more lines of data.

The number of fields in a ***data line*** is restricted to 18. Each physical record may contain up to six information fields, each 11 columns wide. If more than six fields are used, the remaining information is contained on the following records. Therefore, there may be up to three ***physical records*** per data line.

Records are not packed; rather, individual point information is kept on individual records, (*i.e.*, if only four fields are associated with a point value, the remaining two fields are left blank, and, in the case of the data point table, the information for the next point begins on the following record. Similarly, if eight fields are used, the remaining four fields on the second record remain blank. These rules also apply to the headings and units associated with each field. (See example on page 6).

The content of the COMMON and DATA section are as follows:

- Data headings for each field (if more than six fields are needed, the headings are continued onto successive records). The data headings are left adjusted to the beginning of each field (columns 1, 12, 23, 34, 45, 56). The list of legal data headings is given in EXFOR Dictionary 24.

  A one-character pointer is placed in the last (eleventh) column of a field heading to link the field with specific BIB records, COMMON fields, and/or DATA fields of the same subentry or subentry 001. See page 6.1 for more information on pointers.

- Data units for each field (if more than six fields are needed, the units are continued onto successive records). The data units are left adjusted to the beginning of each field) columns 1, 12, 23, 34, 45, 56). The list of legal data units is given in EXFOR Dictionary 25.

- The numerical data which is fortran-readable using an "E" format. If more than six fields are used, the data is continued onto successive records.

  FORTRAN-readable according to an "E format means, in detail:

  - A decimal-point is always present, even for integers.
  - A decimal number without an exponent can have any position within the 11-character field.
  - No blank is allowed following a sign (+ or -).
  - A plus sign may be omitted, except that of an exponent when there is no E.
  - In an exponential notation, the exponent is right-adjusted within the 11-character field. The mantissa may have any position.

  The values are either zero or have absolute values between 1.0000E-38 and 9.999E+38. The following table contains examples of valid entries:

Fixed point numbers with a decimal point	**Floating point numbers with an exponent**
0.14	+0.0014E+01
0.14	0.0014E+2
0.14	0.0014E2
+0.14	.0014E+2
-0.140	-0.140E+00
-.14	-.14E0
	1.4E-1
	1.4-1
	1.40 E-01

The following two restrictions apply within the three sections:

COMMON section of subentry nnn ≠ 001,
DATA section of subentry nnn ≠ 001,
COMMON section of subentry 001 of same entry.

Multiple representations of independent variables: Only one representation of an independent variable may be given for each data line (*e.g.*, either angle ***or*** cosine my be given, ***not both***).

Repetition of data headings: No field heading (data heading plus, perhaps, a pointer) may be repeated except for the following cases. Fields with identical data headings will be adjacent and will appear within only one of the three sections mentioned above.

1. **Two or more unresolved secondary energies** are entered as follows:

E-LVL	E-LVL	E-LVL
MEV	MEV	MEV
0.077	0.107	0.177

Similarly, the data heading EN-RES may be repeated in the case of unresolved resonance energies.

2. **An angle given in degrees and minutes and/or seconds** is entered in two or three separate fields with the data heading ANG repeated, as follows:

ANG	ANG	ANG
ADEG	AMIN	ASEC
90.	47.	10.

Other data headings beginning with ANG- may be repeated in the same way.

3. **Half-life values in different units**, such as SEC, DAY, YR, are entered as follows:

HL	HL	HL
SEC	D	YR
	15.	
		28.3
4.8		

Any other data heading starting with HL... may be repeated in the same way. This usage cannot occur in a COMMON section.

4. **Errors or resolutions given in different units** over an energy range are entered as follows:

EN-RSL	EN-RSL
KEV	PER-CENT
20.	
	10.
20.	

5. **Two or more unresolved masses** (for mass yields) are entered as follows:

MASS	MASS
NO-DIM	NO-DIM
135.	136.

6. **Two or more flags** defined under the information-identifier keyword FLAG which apply to the same line of the data table are entered as follows:

FLAG	FLAG
NO-DIM	NO-DIM
1.	
3.	
2.	3.
1.	2.

Note: The data heading FLAG is not used in a COMMON section.

COMMON SECTION

The COMMON section is identified as that information between the system identifiers COMMON and ENDCOMMON. (See page 3.5 for details on the COMMON and ENDCOMMON records).

In the common data table, only one value is entered for a given field, and successive fields are not integrally associated with one another.

The data heading DATA and its derivatives are not used in the COMMON section, except for those derivatives which contain the suffix -ERR.

An example of a common data table:

```
1           12          23          34          45          56          66
COMMON
EN          EN-ERR      E           E-ERR
MEV         MEV         MEV         MEV
 2.73       0.16        1.38        0.21
ENDCOMMON
```

An example of a common data table with more than 6 fields:

```
1           12          23          34          45          56          66
COMMON
EN          EN-ERR      EN-RSL      E-LVL       E-LVL       ANG
ANG-ERR
MEV         MEV         MEV         MEV         MEV         ADEG
ADEG
 4.1        0.05        0.1         3.124       3.175       90.
 10.
ENDCOMMON
```

DATA SECTION

The DATA section is identified as that information between the system identifiers DATA and ENDDATA. (See page 3.5 for details on the DATA and ENDDATA records.)

In the DATA table, all entries on a record are integrally associated with an individual point. If more than six fields are used, the point data is continued on successive records (maximum of 3 records or 18 fields). The following record or records are then associated with the next point.

Every line in a data table gives data information. This means, for example, that a blank in a field headed DATA is permitted only when another field contains the data information on the same line, *e.g.*, under DATA-MAX. In the same way, each independent variable occurs at least once in each line (*e.g.*, either under data headings E-LVL or E-LVL-MIN, E-LVL-MAX, see example on page 9). Supplementary information, such as resolution or standard values, is not given on a line of a data table unless the line includes data information. Blanks are permitted in all fields.

An example of a point data table is shown below with its associated DATA and ENDDATA records.

```
1          |12        |23        |34        |45        |56        66|
DATA
ANG        |ANG-ERR   |DATA      |DATA-ERR  |DATA-MAX
ADEG       |ADEG      |MB/SR     |MB/SR     |MB/SR
 10.4      | 0.8      | 234.     | 8.7
 22.9      | 1.2      | 127.     | 4.2
 39.1      | 0.9                            |83.2
 59.1      | 0.7      | 14.8     | 2.9
ENDDATA    |          |          |          |          |          |
```

Field Sequence in a DATA Table

There are four categories of data occurring in data tables, namely

- independent variables (EN, EN-MIN, EN-RES, E, ANG, ...);
- dependent variables (DATA);
- associated quantities (EN-ERR, ANG-RSL, DATA-ERR, ...);
- additional information (MONIT, MISC, FLAG, HL, ...).

The division between different categories and families within categories is defined in EXFOR Dictionary 24 (Data Headings)[1]. (See page 7.9).

DATA tables are arranged as follows:

- all fields with **independent variables** precede fields with **dependent variables**. Fields to the left of the first dependent-variable field are considered as independent-variable fields, or independent-variable associated quantities.
- fields with **additional information** are, preferably, placed after the last dependent-variable field, but, if they refer to a specific field, they may be placed next to it.
- fields with **associated quantities** are placed right after the field to which they refer.

[1] Note that some data headings may be used either as independent variables or as additional information.

The EXFOR table will then look as follows.

DATA

independent variable(s)	dependent variable(s)
+ associated quantities	+ associated quantities
	+ additional information

ENDDATA

Line sequence of a DATA Table

Values of the independent variable increase or decrease monotonically throughout the table. If fields for more than one independent variable are given, they are arranged so that the rate with which the values change within each field increases from left to right. Values in a given independent-variable field increase or decrease monotonically until the value in the preceding independent-variable field changes or the end of the table is reached.

Example:

```
DATA
EN          EN-ERR      ANGLE       ANGLE-ERR   DATA
MEV         MEV         ADEG        ADEG        MB/SR
1.          .02         35.         10.          ...
1.          .02         60.         10.          ...
1.          .02         90.         10.          ...
2.          .02         30.          5.          ...
2.          .02         60.          5.          ...
2.          .02         90.          5.          ...
3.          .03         30.          5.          ...
3.          .03         60.          5.          ...
3.          .03         90.          5.          ...
ENDDATA
```

Alternatively, this table may be given in the ***vector common data*** formalism using pointers; see page 6.2.

A slight complication arises with families of independent variables referring to basically the same quantity, as, for instance, the fields referring to excitation energies of the residual nucleus in the following example. In this case, the monotone rule applies to the sequence of numbers consisting of the first (left-most) non-blank value within the group on each line.

Example:**9**

```
DATA
EN          E-LVL       E-LVL       E-LVL-MIN   E-LVL-MAX   DATA
MEV         MEV         MEV         MEV         MEV         B
3.0         0.506                                            ...
3.0         0.720       0.725                                ...
3.0         0.81                                             ...
3.0         0.990       0.998                                ...
3.0                                 1.250       1.300        ...
3.0         1.400                                            ...
4.5         0.405                                            ...
ENDDATA
```

Chapter 6

LINKS BETWEEN BIB, COMMON AND DATA SECTIONS

Pointers

Different pieces of EXFOR information may be linked together by pointers. A pointer is a numeric or alphabetic character (1,2...9,A,B,...Z) placed in the eleventh column of the information-identifier keyword field in the BIB section and in the field headings in the COMMON or DATA section.

Pointers may link, for example,

- one of several reactions with its data field;
- one of several reactions with a specific piece of information in the BIB section (*e.g.*, ANALYSIS), and/or with a value in the COMMON section, and/or with a field in the DATA section;
- a value in the COMMON section with any field in the DATA section.

In general, a pointer is valid for only one subentry. A pointer used in the first subentry applies to all subentries and has a unique meaning throughout the entire entry.

In the BIB section, the pointer is given on the first record of the information to which it is attached and is not repeated on continuation records. The pointer is assumed to refer to all BIB information until either another pointer is encountered, or until a new information-identifier keyword is encountered. This implies that pointer-independent information for each keyword appears first.

See also **LEXFOR Pointers**

The use of pointers is restricted to the five cases given on the following pages.

1. **Multiple Reaction Formalism**. In certain cases (see page 8.R.7 and **LEXFOR Multiple Reaction Formalism**)[1] more than one code unit may be given under the REACTION keyword for a subentry, each unit having its own data field(s). Each data field is then linked to the appropriate code string by means of a pointer.

   Example:

```
BIB
REACTION    1 (92-U-235(N,O),,EN)
            2 (92-U-235(N,O),,J)
            3 (92-U-2335(N,TOT),,WID)
            4 (92-U-235(N,F),,WID)
 .
 .
ENDBIB
COMMON
MOMENTUM L    DATA-ERR    3 DATA-ERR    4
NO-DIM        PER-CENT      PER-CENT
0.            8.            10.
ENDCOMMON
DATA
DATA        1 DATA        2 DATA        3 DATA        4
EV            NO-DIM        MILLI-EV      MILLI-EV
 .
 .
 .
ENDDATA
```

   In the example above, the field headed MOMENTUM L in the COMMON Section does not have a pointer and, therefore, relates to all fields of the DATA Section. The two fields headed DATA-ERR in the COMMON Section are linked, by means of pointers, to fields of the DATA Section and to specific reaction units in the BIB Section.

2. **Vector Common Data**. Multi-dimensional tables may be coded using pointers. (See page 5.6 for alternate coding of multi-dimensional tables).

   The following rules apply to the use of vector common data:

   - If a pointer links a set of independent-variable data headings, (*e.g.*, EN, ANG, E-LVL), one of which appears in the COMMON section, all other pointers will also link with the same set of independent-variable data headings, *i.e.*; the following is forbidden:

     ```
     E          1E          1E-MIN      2E-MAX      2
     ```

   - Units referring to a given independent variable will be the same for all pointers.
   - For a given independent variable, the number of data headings repeated for each pointer will be the same.
   - The ***vector common formalism*** may not be combined with the ***multiple reaction formalism***.

---

[1] The ***Multiple Reaction Formalism*** may be used only in the specific cases listed in LEXFOR under **Multiple Reaction Formalism**

Example:

```
COMMON
ANG          1 ANG          1 ANG          2 ANG          2
ADEG           AMIN           ADEG           AMIN
 30.            30.            40.            0.
ENDCOMMON
DATA
EN             DATA           DATA         2
MEV            MB/SR          MB/SR
...            ...            ...
```

3. **BIB/DATA Links**. Pointers used for ***multiple reaction*** or for ***vector common*** data may also be used elsewhere in the BIB Section in order to link, for example, certain information under MONITOR, ANALYSIS, COMMENT, *etc.*, to one of the multiple reactions or to one of the vector common data.

Example:

```
REACTION       (...)
COMMENT      1 Free text about first angle
             2 Free text about second angle
ENDBIB
COMMON
ANG          1 ANG          2
ADEG           ADEG
 10.            20.
ENDCOMMON
DATA
EN             DATA         1 DATA         2
....           ....           ....
```

or

```
REACTION     1 (....)
             2 (....)
PART-DET     1 (....)
             2 (....)
```

Forbidden:

```
REACTION       (----)
MONITOR      1 (----)
             2 (----)
ENDBIB
COMMON
MONIT        1 MONIT        2
```

4. **BIB/BIB Links**. Pointers may be used to link pieces of BIB information, all referring to the same reaction[2].

   Example:

```
REACTION      (....)
PART-DET   1  (G).
           2  (N).
DETECTOR   1  (ABCDE).
           2  (FGHIJ).
```

5. **Alternative results**. Different results for the same quantity in the same experiment, *e.g.*, by two different methods of analysis, may be entered in the same subentry, distinguished by the pointers. In this case, the code unit under the REACTION keyword is repeated[3]. (See also **LEXFOR Interdependent Data**).

   Example:

```
REACTION   1  (92-U-235(N,G),,WID)
           2  (92-U-235(N,G),,WID)
ANALYSIS   1  (AREA)
           2  (SHAPE)
```

Links between Information-Identifier Keywords and Data Headings

Certain information-identifier keywords and their codes ***require*** specific entries in the data (COMMON and DATA sections), and vice versa. These cases are listed, below, according to the information-identifier keyword. See Chapter 8 for details on the coding of information-identifier keywords.

The following shorthand is used throughout this section.

- **particle** is used to mean particle, nuclide or radiation.
- **data headings** as given are understood to include their derivatives (*e.g.*, for DATA, the headings DATA-CM, DATA-APRX, *etc.*, are also included).

---

[2] If the ***multiple-reaction*** or ***vector-common*** formalism is used, BIB/BIB links are only used to link to existing pointers, as in BIB/DATA Links.

[3] From a processing point of view, this is the same concept as multiple reactions described on page 6.2.

REACTION. The coded information under the keyword REACTION:

- defines the data coded in the DATA section under the dependent variable data heading DATA. These data headings are ***never*** used in the COMMON section; associated quantities for the dependent variable may, however, appear in the COMMON section, *e.g.*, DATA-ERR. At least one dependent variable data field will be present in each DATA section.
- requires the presence, or absence, of certain families of independent variables (see page 7.14). The family code for a given data heading is given in Dictionary 24, column 66.

1. **Incident Projectile Energy (Family A) or Incident Projectile Momentum (Family M)** is always present except in the following cases when it is forbidden:
   - if SF2 of REACTION contains 0 (zero);
   - if resonance energy is given (see below).

   KT, EN-DUMMY, or EN-MEAN are used when the quantity field contains the modifier MXW, SPA or SPA. See also page 19 (INC-SPECT).

   See also **LEXFOR Incident-Projectile Energy** and **Spectrum Average.**

2. **Resonance Energy (Family C)** is specified for resonance parameters (flagged in Dictionary 36, see page 7.12). It is coded either under the data heading EN-RES, or, if coded under REACTION (specified by the code EN given in REACTION SF6), under the heading DATA.

3. **Secondary Energy** (Family E) is coded when:

   a) REACTION SF5 contains the modifier code PAR

   b) REACTION SF6 contains the code DE or SPC

   For specifying the secondary energies of more than one particle, see page 19 (EN-SEC), and **LEXFOR Secondary Particles.**

4. **Angle of Outgoing Particle (Family G)** is coded when REACTION SF6 contains the code DA, except in the case of Legendre or cosine coefficients, see below. (For angles in degrees and minutes see page 5.3)

   If more than one angle is specified, *e.g.*, double-differential data, DA/DA.N/P, the angles must be given under ANG1, ANG2, *etc.*, in the same order as the particles are specified in REACTION SF7.

   See also **LEXFOR Angle.**

5. **Legendre or cosine coefficient Number** (Family N) is coded when REACTION SF8 contains the code LEG or COS.

   See also **LEXFOR Fitting Coefficients.**

6. **Half-life (Family 6)** is coded if SF4 of the REACTION keyword contains a product with a metastable state extension (see page 8.3), and the half-life is not coded under DECAY-DATA.

   See also **LEXFOR Half-Lives**.

7. **Angular Momentum (*l*) (Family 2)** will be coded when:

   - Reaction SF6 contains the code RED.
   - Reaction SF6 contains the code STF.

   It is coded either under the data heading MOMENTUM L, or, if coded under REACTION (specified by the code L in REACTION SF6), under the heading DATA.

   See also **LEXFOR Quantum Numbers**.

8. **Secondary Linear Momentum (family L)** will be coded when REACTION SF6 contains the code MCO.

9. **Secondary Effective Mass (family S)** will be coded when REACTION SF6 contains the code EMC.

10. **Variable Nucleus**. In the case of the processes specified, the data table may contain yield or production cross sections for several nuclei, which are entered as variables in the data table. In this case, either SF1 or SF4 of the REACTION keyword contain one of the following codes:

ELEM	- if the Z (Mass number) of the nuclide is given in the data table.
MASS	- if the A (atomic weight) of the nuclide is given in the data table.
ELEM/MASS	- if the Z ***and*** A of the nuclide are given in the data table.

    The nuclei are entered in the common or data table as variables under the data headings ELEMENT and/or MASS with units NO-DIM.

    If the data heading ELEMENT and MASS are used, a third field with the data heading ISOMER is used when isomer states are specified:

    0. = ground state (used only if nuclide has also an isomeric state),
    1. = first metastable state (or the metastable state when only one is known),
    2. = second metastable state.

    Decay data for each entry under ELEMENT/MASS(ISOMER) and their related parent or daughter nuclides may be given in the usual way under the information-identifier keyword DECAY-DATA. Entries under the data headings ELEMENT/MASS(ISOMER) are linked to entries under DECAY-DATA (and RAD-DET, if present) by means of a ***decay flag*** (see pages 18, 8.D.1, and **LEXFOR Flags**). If the half-life is the only decay data given, this may be entered in the data table under the data heading HL[4].

[4] Although this is not recommended.

Example

```
BIB
REACTION    (...(...,F)ELEM/MASS,.....)
ENDBIB
NOCOMMON
DATA
EN          ELEM        MASS        ISOMER      DATA
MEV         NO-DIM      NO-DIM      NO-DIM      B
 ---         61.         148.        0.          ---
 ---         61.         148.        1.          ---
 ---         61.         149.                    ---
 ---         62.         149.                    ---
ENDDATA
```

Restrictions of use: Only SF1 or SF4 may become variable by using this formalism.

The formalism of the ***variable nucleus*** may be used:

- for SF1, only when SF6 contains the code PN (delayed-neutron emission probability)
- for SF4, only when SF3 contains one of the process codes
  - X - production of the product nuclei specified
  - F - fission
  - XN - variable number or neutrons (see following)
  - YP - variable number of protons (see following)

See also **LEXFOR Reaction Products.**

11. **Variable Number of Emitted Nucleons.** In the case where mass and element distributions of product nuclei have been measured ***and*** the Z and/or A of the reaction product acts as an independent variable, the sum of outgoing neutrons and protons may be entered as variables in the data table. In this case SF3 of the REACTION keyword contains at least one of the following codes:

    XN - variable number of neutrons given in the data table.

    YP - variable number of protons given in the data table.

    The numerical values of the multiplicity factors X and Y are entered in the data table under the data headings N-OUT and P-OUT, respectively.

    See also **LEXFOR Particles.**

    Example

```
REACTION    (...(...,XN+YP).....)
            ------------
NOCOMMON
DATA
EN          N-OUT       Y-OUT       DATA
MEV         NO-DIM      NO-DIM      B
 ---         2.          2.          ---
 ---         2.          3.          ---
 ---         3.          2.          ---
ENDDATA
```

12. REACTION Ratios

If a ***reaction combination*** contains the separator "//", signifying that the numerator and denominator of a ratio have different values for one or more independent variables, then the data table will contain at least one independent variable pair with the data heading extensions -NM and -DN (see Dictionary 24).

Example:

```
BIB
REACTION    (((92-U-238(N,F)ELEM/MASS,CUM,FY,,FIS)/
            (92-U-238(N,F)42-MO-99,CUM,FY,,FIS))//
            ((92-U-235(N,F)ELEM/MASS,CUM,FY,,MXW)/
            (92-U-235(N,F)42-MO-99,CUM,FY,,MXW)))
RESULT      (RVAL)
----
ENDBIB
COMMON
EN-DUM-NM   EN-DUM-DN
MV          EV
1.0         0.0253
ENDCOMMON
DATA
ELEMENT     MASS          DATA
 ...         ...           ...
ENDDATA
```

MONITOR. The information identifier MONITOR is always present when the data heading MONIT is coded. If more than one monitor is given MONIT1, MONIT2, *etc.*, the data headings are repeated as codes under the keyword MONITOR; otherwise, MONIT1 refers the first monitor, MONIT2 to the second, *etc.* The data headings EN-NRM, ANG-NRM, E-NRM, *etc.*, are linked to the keyword MONITOR in the same way as their corresponding independent variables are linked to REACTION. (See also **LEXFOR Standards**).

ASSUMED. When assumed values are given in the data under the data heading ASSUM, they are defined under the keyword ASSUMED. (See also **LEXFOR Assumed Values**).

DECAY-DATA, RAD-DET. The keyword DECAY-DATA is always present when the data heading DECAY-FLAG is used in the DATA section. Fields headed by the data heading DECAY-FLAG contain fixed point numbers these are repeated as codes under the information-identifier keyword DECAY-DATA, and may also be repeated under the keyword RAD-DET. (See also **LEXFOR Flags**).

EMS-SEC. When the data is a function of the secondary effective mass of more than one particle (i.e.., the headings EMS1, EMS2, *etc.*, are used), the particles will be defined in coded form under the keyword EMS-SEC. A secondary effective mass which is not defined refers to the particle specified in the reaction code. (See **LEXFOR Secondary Particles**).

EN-SEC. When the data is function of the secondary energy of more then one particle (*i.e.*, the headings E1, E2, *etc.*, are used), the particles are defined in coded form under the keyword EN-SEC. A secondary energy which is not defined refers to the particle specified in the REACTION code. (See **LEXFOR Particles**).

ERR-ANALYS. This keyword is always present when a data heading having the modifier -ERR or ERR- is used. If more than one data heading having a modifier of this type exists, then the data heading is always repeated as a code under the keyword ERR-ANALYS. (See also **LEXFOR Errors**).

FLAG. This keyword is always present when the data heading FLAG is used in the DATA section. (There may be more than one field with the data heading FLAG, see page 5.4). Fields headed by the data heading FLAG contain fixed point numbers. These are all repeated as codes under the information-identifier keyword FLAG. (See also **LEXFOR Flags**).

HALF-LIFE. When more than one half-life is coded in the DATA section under the data headings HL1, HL2, *etc.*, these are defined in coded form under the information-identifier keyword HALF-LIFE. A half-life which is not defined under this keyword refers to the reaction product (or residual nucleus). (See also **LEXFOR Half-lives**).

INC-SPECT. When the data heading EN-DUMMY, EN-MEAN, or KT is used (*i.e.*, when the REACTION code contains the a spectrum average modifier *e.g.*, MXW, FIS or SPA), the spectrum is defined in free text under the keyword INC-SPECT. (See also **LEXFOR Spectrum Average**).

LEVEL-PROP. The keyword LEVEL-PROP is always present when the data heading LEVEL-FLAG is used in the DATA section. Fields headed by the data heading LEVEL-FLAG contain fixed point numbers. These are repeated as codes under the information-identifier keyword LEVEL-PROP. (See also **LEXFOR Flags**).

MISC-COL. This keyword is present when the data heading MISC is used in the data section. (MISC is never used in the COMMON section, however, associated error fields may be given in COMMON). If the data headings MISC1, MISC1, MISC2, *etc.*, are used, they are repeated as codes under the keyword MISC-COL. (See also **LEXFOR Miscellaneous**).

MOM-SEC. When the data is a function of the secondary linear momentum of more than one particle (*i.e.*, the data heading M1, M2, *etc.*, are used), the particles are defined in coded form under the keyword MOM-SEC . A secondary linear momentum which is not defined refers to the particle specified in the reaction code. (See **LEXFOR Secondary Particles**).

Cross-References of Data Heading to Information-identifier Keyword

Data heading	Family[1]	Information-identifier keyword	Page
EN	A	REACTION	14
EN-DUMMY,EN-MEAN,KT	A	REACTION	14
		INC-SPECT	19
EN-NRM		MONITOR	18
EN-RES	C	REACTION	14
E	E	REACTION	14
E1,E2,*etc.*	E	EN-SEC	19
EMS	S	REACTION	15
EMS1,EMS2,*etc.*	S	EMS-SEC	18
MOM-SEC	L	REACTION	15
MOM-SEC1,MOM-SEC2,*etc.*	L	MOM-SEC	19
E-NRM		MONITOR	18
ANG	G	REACTION	14
ANG-NRM		MONITOR	18
MOM	M	REACTION	15
NUMBER	N	REACTION	14
DATA		REACTION	14
MONIT		MONITOR	18
ASSUM,ASSUM1,*etc.*		ASSUMED	18
ELEMENT	I	REACTION	15
MASS,ISOMER	J	REACTION	15
N-OUT	O	REACTION	16
P-OUT	P	REACTION	16
HL	6	REACTION	15
HL1,HL2,*etc.*	6	HALF-LIFE	19
FLAG	Z	FLAG	19
DECAY-FLAG		REACTION	15
LVL-FLAG		DECAY-DATA,RAD-DET	18
		LEVEL-PROP	19
MOMENTUM L	2	REACTION	15
MISC1,MISC2,*etc.*		MISC-COL	19
-ERR, ERR-		ERR-ANALYS	19

1. As given by a flag in Column 66 of Dictionary 24.

Chapter 7

DICTIONARIES

Dictionary transmission files contain the keywords and codes used by the EXFOR system. They have much the same format as an EXFOR data transmission file. This section describes the structure of the dictionary transmission files, and the format of the dictionaries. Also included, is more detailed information for specific dictionaries of special interest.

The dictionaries contain explanations for all keywords and codes used in EXFOR. The format of the dictionaries is, in general, similar to that of the BIB Section in EXFOR entries.

Keyword or code field: keyword or code to be defined, given, left adjusted, in the first field, starting in column 1. The field is usually contained in columns 1-11, but, for codes related to quantities, may be longer. The keywords have a maximum length of 10 characters; some codes are restricted to a length of 3 or 5 characters. (See page 26).

Explanation field: usually starts in column 12 (in column 23, in the case of quantity codes) and usually, but with some exceptions, ends in column 66 of the first record.

Record identification field: (columns 67-79) of a dictionary record contains "30000" in columns 67-71, the dictionary identification number in columns 72-74 with leading zero(s), and the record sequence number with leading zeros in columns 75-79.

Flag field: column 80 is used to flag the following conditions for the code given on the same record.

Obsolete flag (O) indicates that the keyword or code is not permitted on new transmissions, however, it may still exist in entries which were transmitted previously. An explanation as to why the code is obsolete and which code (if any) replaces it is given in free text. Obsolete codes remain in the dictionary until ***all*** cooperating centers have removed them from their data files.

Extinct flag (X) indicates that the code given designates an extinct institute, journal, or report series. The code is still valid on transmissions, but will occur only in entries of old data.

Dictionary Transmission Files

The dictionary transmission files have much the same format as an EXFOR data transmission file.

- The **first record** is a TRANS record as described on page 3.2. For the transmission file identification, "9" is used as the originating center identification, although in column 67 the center identification "3" is used throughout the file.
- The **last record** is an ENDTRANS record as described on page 3.2, except that N1 is blank, and N2 contains the number of dictionaries transmitted. Trailing records to fill up the last block are repetitions of the ENDTRANS record.
- Each dictionary is identified by a ***dictionary identification number*** ranging between 001 and 099.

A dictionary transmission file will always include all dictionaries.

The beginning and the end of a dictionary are identified by two system-identifier records.

1. **DICTION**. The first on of each dictionary. N1 and N2 are interpreted as:

   N1 - The dictionary identification number
   N2 - Date of last alter (year, month, day - yymmdd).

   Columns 34-66 describe the contents of the dictionary in free text.

   The record identification (columns 67-79) contains "30000" in columns 67-71, the dictionary number in columns 72-74, and the record sequence number "00001" in columns 75-79.

2. **ENDDICTION**. The last record of each dictionary. N1 and N2 are interpreted as:

   N1 - Number of records in the dictionary, excluding the DICTION and ENDDICTION records.
   N2 - Presently unused (may be blank or zero)

   The record identification is the same as in the DICTION record, except that the record sequence number is "99999".

The dictionaries contain the following items of information:

Keyword or code field

There are 4 keyword dictionaries:

Dict. 1	System identifiers (described in Chapter 3)	
Dict. 2	Information identifiers (described in Chapter 8)	
Dict. 24	Data headings	} used in COMMON and DATA sections (see Chapter 5)
Dict. 25	Data units	

Other dictionaries define codes used within the BIB Section under specific information-identifier keywords (see the Table of Dictionaries, page 26).

Explanation field: The explanation may be given:

- in free text,
- or in an "expanded form"
- or in an "expanded form" followed by free text.

Expanded forms[1] which are self-explanatory and easy to remember are provided in certain dictionaries (see page 26). The ***expanded form*** is enclosed in parentheses; the opening parenthesis is given in the first column of the explanation field (usually column 12). Only one set of parentheses may be associated with a dictionary entry. The expanded form is, in general, restricted to the length of the explanation field of one record, but, for certain dictionaries (see page 7.8), the expanded form may continue, within the explanation field, onto following records.

The **free text** may immediately follow the closing parenthesis of the expanded form or, if no expanded form is given, begin in the first column of the explanation field. It may continue, within the explanation field, onto any number of records. The free text may include parentheses, but a left parentheses which is part of the free text must not be entered in the first column of the explanation field (where it would signal the presence of an expanded form).

Other coded information is included within this field for some of the dictionaries (*e.g.*, the country of origin for journal codes, certain flags for checking purposes in the case of data-heading keywords). For detail see the dictionaries themselves, and pages 27 and following.

The order of entries in each dictionary has been chosen for ease of use by compilers. It is the prerogative of each center to rearrange the dictionary for their own purposes, *e.g.*, for optimum computer use, if they wish.

[1] The expanded form may be used to replace the code in an ***edit*** program, so that the EXFOR user may read the entries without having to consult the dictionaries to find the meaning of the codes.

Some example of dictionaries are shown below; columns 67-80 are omitted.

```
DICTION            2     760609 INFORMATION IDENTIFIER KEYWORDS
TITLE       KEYWORD OBLIGATORY EXCEPT WHEN NOT RELEVANT.
            FREE TEXT ONLY.
AUTHOR      KEYWORD + ALL NAMES IN PARENTHESES OBLIGATORY.
INSTITUTE   KEYWORD + CODES INFORMATION IN PARENTHESES OBLIGATORY.
            SEE DICTIONARY 3 FOR INSTITUTES.
EXP-YEAR    KEYWORD OPTIONAL.  IF KEYWORD PRESENT, THEN TWO DIGIT
            YEAR IN PARENTHESES OBLIGATORY.
REFERENCE   KEYWORD + CODED INFORMATION IN PARENTHESES OBLIGATORY.
            UP TO 6 SUBFIELDS IN CODE.
            SEE DICTIONARY 4 FOR REFERENCE-TYPE
            SEE DICTIONARY 5 FOR JOURNALS
            SEE DICTIONARY 6 FOR REPORTS
            SEE DICTIONARY 7 FOR CONFERENCES AND BOOKS


DICTION            5      760414 JOURNALS
AAA         (ASTRON.AND.ASTROPHYS.) ASTRONOMY AND ASTROPHYSICS     2GER
AAB         (AN.ACAD.BRASIL.CIENC.)ANAIS DA ACADEMIA BRASILEIRA    3BZL
            DE CIENCIAS
AAF         (ANN.ACAD.SCI.FENN.SER.A6) ANNALES ACADEMIAE           2SF
            SCIENTIARUM FENNICAE,SERIES A6:PHYSICA
ABS         (MEM.ACAD.ROY.BELG.CL.SCI.) MEMOIRES DE L'ACADEMIE     2BLG
            ROYAL E BELGIQUE,CLASSE DE SCIENCES
AC          (ANAL.CHEM.) ANALYTICAL CHEMISTRY 1USA
ACA         (ANAL.CHIM.ACTA) ANALITICA CHIMICA ACTA                2NED
ACH         (ANGEWANDTE CHEMIE)                                    2GER
ACJ         (ACTA CHEM.SCAND.) ACTA CHEMICA SCANDINAVICA           2DEN
ACR         (ACTA CRYSTALLOGR.) ACTA CRYSTALLOGRAPHICA             2DEN
            CONTINUED 1970 IN PARTS A AND B
ACR/A       (ACTA CRYSTALLOGR.,PART A) ACTA CRYSTALLOGRAPHICA,     2DEN
            PART A, STARTED WITH VOL.26 IN 1970
ACR/B       (ACTA CRYSTALLOGR.,PART B) FROM VOL.26(1970)           2DEN
```

Table of Dictionaries

Number	Name	Code length	Expansion provided	Status
#1.	System Identifiers	≤ 10	-	
#*2.	Information Identifiers	≤ 10	yes	
*3.	Institutes	5 to 7	yes[2]	
#*4.	Reference Type	1	yes	
*5.	Journals	≤ 6	yes	
*6.	Reports	≤ 11	-	
*7.	Conference and Books	≤ 10	yes[2]	
8.	Elements	≤ 6	yes	
#*9.	Chemical Compounds	7 to 10	yes	
10.	Process/Parameter (Quantity SF1)	≤ 3	-	Obsolete
11.	Function (Quantity SF2)	≤ 3	-	Obsolete
12.	Modifier (Quantity SF3)	≤ 3	-	Obsolete
#13.	Particle (PART-DET, RAD-DET, *etc.*)	≤ 3	yes	
14.	Quantity (SF1 - 4)	≤ 18	yes[2]	Obsolete
15.	History	1	yes	
16.	Status	≤ 5	yes	
17.	Rel-Ref	≤ 1	yes	
18.	Facility	≤ 5	yes	
19.	Incident Source	≤ 5	yes	
20.	Additional Results	≤ 5	yes	
21.	Method	≤ 5	yes	
22.	Detectors	≤ 5	yes	
23.	Analysis	≤ 5	yes	
*24.	Data Headings	≤10	-	
*25.	Data Units	≤10	-	
*27.	Nuclides	≤10	-	
#28.	Incident Particles (REACTION SF2)	≤ 3	yes	
#29.	Product Particles (REACTION SF3)	≤ 3	yes	
#30.	Process (REACTION SF3)	≤ 3	-	
#31.	Branch (REACTION SF5)	≤ 5	-	
#32.	Parameter (REACTION SF6)	≤ 3	-	
#33.	Particles Considered (REACTION SF7)	≤ 3	yes	
*#34.	Modifiers (REACTION SF8)	≤ 3	-	
35.	Data-Type(REACTION SF9)	≤ 5	yes	
*36.	Quantities (REACTION SF5-8)	≤44	yes[2]	
#37.	Result	≤ 5	yes	
41.	Conversion table of Quantity (Dict.14 to Reaction formalism)	≤18	yes	Obsolete
42.	Cinda Quantities	≤ 3	yes	

* Additional information given on the following pages.

\# Additions to these dictionaries require NRDC approval.

[1] Normally limited to 3-character code.

[2] Expansion may extend to follow-up records. In all other cases, expansion is restricted to the length of the explanation field of one record.

Additional information on specific dictionaries

Dictionary 2. Information-Identifier Keywords. The first record for each keyword in columns 1-11 has the following format:

Columns 12-33: Expansion

34-44: Code designating whether keyword is obligatory

- REQ - required
- XREQ - required except where not relevant
- AREQ - one of these codes required
- BREQ - each of these keywords is obligatory when relevant, but at least one of them must be present
- OBS - keyword obsolete; may exist in older entries

45-55: definition of coded information

- RCODE - code required
- OCODE - optional
- OCODE+ - optional; if given, may be repeated in free text

56-66: Pointer to dictionary used, '+' indicating additional coded information

Any following records contain free text information in columns 12-66.

Obsolete codes are marked by an O in column 66.

Dictionary 3. Institute. The 7-character code ABBBCCC is constructed as follows:

A = service-area code, 1, 2, 3 or 4 as defined among neutron data centers (see page 2.2)
BBB = country code
CCC = lab code (may be less than 3 characters, left adjusted)

The 3-character institute codes include all laboratory, university, institute, agency and commission codes in use in the EXFOR system, and ***must be unique***.

Where the code identifies only a country, the information in the country-code field (columns 2-4) is repeated in the lab-code field (columns 5-7), as for example: 1CANADA (Canada). For this reason, a lab code may not be identical to an country code.

Obsolete codes are marked with an O in column 80; extinct codes are marked by an X in column 80 (see page 7.1). The code which replaces it, if any, is given in all cases.

The dictionary is sorted by the code, thus grouping together the institutes for each area and country.

Dictionary 4. Type of reference. This dictionary is in the standard format except that columns 56-61 of the explanation field are reserved for the term "DICT n" pointing to the dictionary number "n" which contains the reference codes to be used with the given reference type. Columns 56-61 are blank when no dictionary applies.

Dictionary 5. Journals. The actual journal code is restricted to 4 characters or less. Where journals are subdivided into parts, the part is included in the dictionary with the journal code, and separated from it by a slash; the complete code is restricted to 6 characters, as for example:

ND/A = Nuclear Data, Part A.

The area code and country code (country of publication) are in columns 63 to 66.

The ***expanded form*** follows the commonly adopted style for journal titles, in particular, INIS [2]. However, some abbreviations have been expanded for clarity.

Obsolete codes are marked by an O in column 80; extinct codes are marked by an X in column 80 (see page 21).

The dictionary is sorted by codes.

Dictionary 6. Reports. Each code in the dictionary consists of the alphanumeric character string which precedes the actual report number. The final character of the codes given in the dictionary is always a hyphen (-), except in a few cases where the report codes are 11 character and the 12th character a hyphen. In such cases the hyphen is dropped in the dictionary.

Annual progress reports which do not have a report number given are assigned an EXFOR report code A-, followed by the 3-digit institute code; when coded, the code is followed by the year for which the report is given.

Example: A-ARK-84

The 7-character institute code (as in Dictionary 3) of the institute at which the report was issued is given in columns 60 to 66.

Obsolete codes are marked by an O in column 80; extinct codes are marked by an X in column 80 (see page 7.21).

The dictionary is sorted on the institute code and, within the institute code, by report code.

[2] Authority List for Journal Titles, IAEA-INIS-11

Dictionary 7. Conferences and Books. Codes are up to 8 characters[3].

Conference codes are composed of the ***year of the conference*** given in the first 2 digits of the code, followed by the place of the conference, which may have up to 6 characters.

Examples: 66PARIS
82ANTWER

Book codes give a concise short title of the book, or the family name of the first author.

Examples: ABAGJAN - *Group Constants for Nuclear Reactor Calculations,* Abagjan, et al., 1964

NEJTRONFIZ - *Neytronnaya Fizika,* P.Krupcicke, 1961

In the dictionary, books, sorted alphabetically by code, precede conferences, which are sorted alphabetically by code, within year.

Dictionary 9. Chemical Compounds[4]. The general compound code CMP can be combined with any element in the form (Z-S-CMP) without entry in this dictionary, which only lists special cases. The actual compound codes (*e.g.* OXI for oxide) are restricted to three characters. The codes are sorted by atomic number.

Dictionary 15. Status. This dictionary is in the standard format except that column 66 of the explanation field is reserved for a flag which indicates which codes may be followed by an accession number field:

S indicates the code may be followed by an accession number field;

R indicates that the code is always followed by an accession number field.

Dictionary 19. Incident Source. This dictionary is in the standard format except that column 66 of the explanation field is reserved for a field delimiter which indicates that another code is expected following the code given, and separated from it by the delimiter given.

[3] Some older codes may have a total length of 10 characters. The codes in this dictionary are also used by CINDA, which is restricted to 8-character codes.

[4] Codes are also used in CINDA.

Dictionary 24. Data Headings. The data headings are used in the COMMON and DATA sections to define the contents of data fields. No expanded form of the codes is given.

Codes should be unique within Dictionary 24 and 25, *i.e.*, a data heading may not be identical to any data unit.

Obsolete codes are marked with an O in column 80.

Column 66 is reserved for a flag. This flag is used for checking purposes and defines the category and the family (or independent variable type) within each category, according to the scheme in the following table.

Family	Flags		Category
	Variables	[5]Associated Quantities	
Incident energy	A	B	1
Resonance energy	C	D	
Secondary energy[6]	E	F	
Angle of outgoing particle	G	H	
Product charge	I		
Product mass	J		
Secondary linear momentum	L		
Linear momentum	M		
Coefficient number	N		
Neutrons out	O		
Protons out	P		
Secondary effective mass	S		
THICKNESS	K		2
FLAG	Z		
TEMP	8	9	
HL	6	7	
J	4		
Parity	0		

Category 1 pertains to independent variables.
Category 2 pertains to additional information which in certain cases may act as an independent variable.

[5] Associated quantities are those data heading keywords which contain the characters ERR or RSL.

[6] Except E-LVL-INI and E-LVL-FIN

Dictionary 25. Data Units. The data units are entered in the COMMON and DATA section below the data heading to define the units for the contents of each field.

Codes are unique within Dictionary 24 and 25, *i.e.*, a data unit may not be identical to any data heading.

The format of the dictionary is as follows:

Column	1 - 10	code
	11	blank
	12 - 44	explanation of code (no expanded form given)
	45 - 48	dimension code
	49 - 55	blank
	56 - 66	conversion factor

The dimension code provides a cross-link with Dictionary 36, (Quantity Dictionary) where the dimension code is also given (see page 33). This facilitates computerized cross-checks for consistency of quantities and units in a table.

The conversion factor is a floating-point number which may be used for transforming units with the same dimension to standard units, for example:

energies	to electron-volts;
angles	to degrees;
time	to seconds;
length	to meters;
cross sections	to barns.

Dictionary 27. Nuclides[7]. The format of the dictionary is:

Column	1 - 11	nuclide code
	12 - 26	flags in defined positions, enclosed in parentheses.

Free text may be given on successive records, starting in column 12.

The **nuclide code** has the format Z-S-A

where: Z = the charge number, up to 3 digits, no leading zeros;
S = the element symbol; 1 or 2 characters;
A = the mass number; up to 3 digits, no leading zeros; a single zero denotes natural isotopic composition.

[7] This dictionary is not intended as a ***Chart of the Nuclides***. Rare or short-lived nuclides will be added only when the nuclide is entered into EXFOR or CINDA.

Columns 12-26 have the following structure:

Column 12 (*Parenthesis*

13-23 Each column contains either a flag or blank:

13 used for REACTION SF1 SF2=0
- 1 indicates validity,
- X indicates a warning for unusual use.

14 used for REACTION SF2.
- 2 indicates validity.

15 used for REACTION SF3, REACTION SF4, REACTION SF7, plus other keywords which allow nuclide codes[8].
- 3 indicates validity,
- Z indicates validity except for those cases where the particle codes are used instead of the corresponding nuclide codes[8].

16 used for REACTION SF1 (SF2=0).
- 4 indicates validity.

17 used to indicate a fission product
- F indicates validity.

(18-21 are presently unused)

22 used for CINDA
- C indicates validity,
- T indicates validity for theoretical work only.

23 used to indicate a stable isotope.
- S indicates stability.

24-25 isomer field:
either blank, indicating that the nuclide has no isomeric states
or a number, right justified, indicating the maximum number of metastable states (*i.e.*, number of isomeric states not including the ground state).

26) *parenthesis*

The flags given in this dictionary cover the normal cases. A number of special rules as described in Chapter 8 under REACTION, DECAY-DATA, *etc.*, must also be considered.

Dictionary 34. Modifiers (REACTION). An expanded form is only given for those general-quantity modifiers (at the beginning of the transmission dictionary) which may be included in the REACTION code, but are not included in the codes in Dictionary 36.

[8] DECAY-DATA, DECAY-MON, EN-SEC, EMS-SEC, HALF-LIFE, MOM-SEC, PART-DET, RAD-DET

Dictionary 36. Quantities (REACTION). The format of this dictionary is as follows:

Column	1 - 18	quantity code
	19 - 21	dimension code
	22	flag
	23 - 66	expanded form and free text.

1. The **quantity code** is composed of the codes for the REACTION subfields 5 to 8. All meaningful combinations of the subfield codes that are in use are included. Note, however, that these quantity codes do not include the ***general-quantity modifiers*** from Dictionary 34.
2. The **dimension code** provides a cross-link to Dictionary 25 (Data Units), where the dimension code is also given (see page 31). This facilitates computerized checks of whether quantities and units given in a table are consistent.
3. Resonance parameters are flagged with a "." in column 22.
4. The expanded form is a short definition of the quantity. It may be used for edited output to users.
5. If the quantity code length is >18 characters, the code is continued on the same record, followed by blanks and "9" in column 66. The dimension code and the expansion follow on the next record in their assigned fields. Maximum code length = 44 characters.
6. Obsolete codes are marked with an O in column 80.

In order to keep the size of the dictionary to a minimum, specific particles are not included in the REACTION SF7 (particle designator). Instead, this field contains a code indicating that a particle designator (or designators) is legal for this quantity.

Code	Allowed particles
*	All codes from Dictionary 33, and nuclides from Dictionary 27 which have a "3" or a "Z" in column 15.
*FF	Fission fragment particle codes only, *i.e.*, FF, LF, HF.

If no particle designator inclusion code is given in the quantity string, a particle designator field is not allowed.

If more than one particle designator must be given (*e.g.*, for correlations), the codes are given for each particle, separated by slashes.

Examples: `PAR,TTY,*`

`,DA/CRL,*/*`

`,AKE,*FF`

Chapter 8

INFORMATION-IDENTIFIER KEYWORDS AND CODING RULES

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.

The first four pages of this chapter give general rules for keywords and codes, and contain some specific rules for the use and coding of each keyword.

The remaining pages contain detailed rules for the coding of each keyword. The keywords are ordered alphabetically and the pages are numbered accordingly.

The information given under each keyword has the following structure;

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

See also Chapter 4 for a discussion of codes and free text.

Use of codes. Codes for use with a specific keyword are found in the relevant dictionary. However, for some keywords, the code string may include retrievable information other than a code from one of the dictionaries.

In general, codes given in the dictionaries may be used singly or in conjunction with one or more codes from the same dictionary. Two options exist if more than one code is used:

a.) two or more codes within the same set of parenthesis, separated by a comma; for example:
KEYWORD (CODE1,CODE2) + free text

b.) each code on a separate record, enclosed in it's own set of parenthesis starting in column 12, followed by free text, for example:

```
KEYWORD  (CODE1) + free text ...
         free text ...
         (CODE2) + free text
```

Both of these options, or a combination of the two, are allowed, in general. However, for keywords for which the code string includes retrievable information in addition to a code, only (b) is permitted.

See keyword entry for explicit coding formats and rules.

Embedded blanks. For many information-identifier keywords, embedded blanks are explicitly forbidden in the codes. With those exceptions, embedded blanks in the coding are allowed if they ***follow*** a code from the dictionary. They are not permitted ***preceding*** any code.

Examples:	`STATUS`	`(DEP  )`
	`STATUS`	`(DEP  ,COREL)`
Forbidden:	`STATUS`	`(COREL,  DEP)`
	`STATUS`	`(DEP, 10048007)`

See detailed coding rules under each keyword.

Coding of 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 zeros
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 (limited to special cases as given under the specific keyword).
X	is an isomer code denoting the isomeric state (this subfield may be omitted) X may have the following values:

G	for ground state (of a nucleus which has a metastable 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 within an isomeric ratio in SF4 of the reaction string)

Exceptions to this coding are noted on the pages for each keyword. (See also **LEXFOR Elements**). Valid nuclide codes are given in Dictionary 27 (see page 7.10).

Compounds may in some cases replace the nuclide code. The general format for coding compounds is either the specific compound code, taken from Dictionary 9, or the general code for a compound of the form Z-S-CMP. (*e.g.*, 26-FE-CMP). (See also **LEXFOR Compounds**).

Information identifier categories. Detailed coding rules for each information identifier are given on the following pages. The keywords can be grouped in certain categories, which are shown in the following table.

The second and third columns of the table show that some of the keywords are:

- obligatory: these must be present in either subentry 001 or in ***all*** other subentries.
- obligatory, except when not relevant: these must usually be present, however, occasionally they are not relevant and may be absent; see the detailed coding rules.
- obligatory for specific data headings: these must be present when certain data headings are present in the COMMON or DATA section (see the detailed coding rules), otherwise, they are optional.

all other keywords are optional.

The fourth and fifth columns of the table indicate whether coded information and/or free text is obligatory. For certain keywords coded information is obligatory, for others optional.

It should be noted that the table serves only as an aide-memoire, and does not replace the detailed coding rules given on the subsequent pages.

Keyword	The presence of the keyword is		when keyword present, coded information is	coded information repeated in free text
	O = obligatory X = obligatory when relevant	obligatory with the data heading		
Bibliography				
TITLE	X		(free text only)	-
AUTHOR	O		obligatory	no
INSTITUTE	O		obligatory	no
EXP-YEAR			obligatory	no
REFERENCE	O		obligatory	no
REL-REF			obligatory	no
MONIT-REF			obligatory	no
Data Specification				
REACTION	O		obligatory	no
RESULT	X		obligatory	no
Related Data				no
MONITOR	X	MONIT, *etc.*	obligatory	no
ASSUMED		ASSUM, *etc.*	optional	
DECAY-DATA		DECAY-FLAG	optional	no
DECAY-MON			obligatory	no
PART-DET			obligatory	optional
RAD-DET			obligatory	no
HALF-LIFE		HL1, *etc.*	optional	no
EN-SEC		E1, *etc.*	optional	no
EMS-SEC		EMS1, *etc.*	optional	no
MOM-SEC		M1, *etc.*	optional	no
MISC-COL		MISC, *etc.*	optional	no
FLAG		FLAG	obligatory	no
Physics				
INC-SOURCE		optional	optional	
INC-SPECT		EN-DUMMY,EN-MEAN,KT	(free text only)	-
SAMPLE			(free text only)	-
METHOD	one of these is obligatory		optional	optional
FACILITY			optional	optional
ANALYSIS			optional	optional
DETECTOR			optional	optional
CORRECTION	X		(free text only)	-
COVARIANCE			optional	no
ERR-ANALYS		ERR-, or -ERR1, *etc.*	optional	no
Other				
ADD-RES			optional	optional
COMMENT			(free text only)	-
CRITIQUE			(free text only)	-
Bookkeeping				
STATUS	X		optional	no
HISTORY	O		obligatory	no

ADD-RES

1. Gives information about any additional results obtained in the experiment, but which are not compiled in the data tables.

2. Presence 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 8.3, with code(s) from Dictionary 20.

ANALYSIS

1. Gives information as to how the experimental results have been analyzed to obtain the values given under the heading DATA which actually represent the results of the analysis. See also **LEXFOR Analysis.**

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

3. Coded information, if given, may be in either of the general forms, see 8.3, with code(s) from Dictionary 23.

ASSUMED

1. Gives information about values assumed in the analysis of the data, and about COMMON or DATA fields headed by ASSUM or its derivatives. See also **LEXFOR Assumed values.**

2. Presence is obligatory when such headings are present and coded information is required. 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: data heading to be defined.

   Reaction field and the **quantity field**: coded as under the keyword REACTION.

4. In the case of more than one assumed data heading (ASSUM1, ASSUM2, *etc.*) to be defined, each must be coded on a separate record, starting in column 12.

   Example:

```
ASSUMED     (ASSUM1,AAAAA)
            (ASSUM2,BBBBB)
 ...
DATA
EN          DATA          ASSUM1        ASSUM2
 ...
```

AUTHOR

1. Gives the authors of the work reported. See also **LEXFOR Author.**

2. Presence is obligatory. 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 Cyrillic characters), 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. Blanks are permitted between author's names (*i.e.*, after a comma), but are not permitted following initials. (For transliteration of author names given in Cyrillic characters, see **LEXFOR Author**).

   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, JA.M.IVANOV,NGO-DINH-LONG,
        A.MORALES AMADO)
AUTHOR (W.W. HAVENS JR)
```

COMMENT

1. Gives pertinent information which cannot logically be entered under any other of the keywords available. See also **LEXFOR Comment.**
2. Presence is optional. Contains only free text.

CORRECTION

1. Gives information about corrections applied to the data in order to obtain the values given under DATA. See also **LEXFOR Correction.**
2. Presence is optional. Contains only free text.

COVARIANCE

1. Gives covariance information provided by the experimentalist, or to flag the existence of a covariance data file. See also **LEXFOR Covariance.**
2. Presence is optional. Contains either free text only or the code COVAR, which indicates the existence of a covariance file, followed by free text.

   See Appendix B for the Covariance Data Filed format.

CRITIQUE

1. Gives comments on the quality of the data presented in the data table. See also **LEXFOR Comments.**
2. Presence is optional. Contains only free text.

DECAY-DATA

1. Gives the decay data for any nuclide occurring in the reaction measured as assumed or measured by the author for obtaining the data given[1]. See also **LEXFOR Decay-Data.**

2. Presence is optional, but if the keyword RAD-DET is used, an entry should also be made for DECAY-DATA. Free text may be given or coded information, with or without free test.

   If the keyword DECAY-DATA is present, the keyword HALF-LIFE may not be used. See also **LEXFOR Half-Lives.**

3. The general format of the coding string consists of three major fields which may be preceded by a decay flag: ((flag)nuclide,half-life,radiation).

   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 must come at the end of a field or subfield, *i.e.*, the comma separating the fields should be the last character on the line.

   Flag. The general format of the code is (n.), where n has a numerical value which also appears in the data section under the data heading DECAY-FLAG. The flag may be omitted, in which case its parentheses are also omitted. See also **LEXFOR Flags** and page 6.8.

   Nuclide field. The general format of the code is Z-S-A-X, except that when the ground state of a nuclide is given, the use of the extension G is optional. See page 8.3. Permitted nuclei are indicated in Dictionary 27 by a "3" in column 15.

   Half-life field. Contains the actual half-life of the nuclide specified, coded as a number, readable in an E11.4 format (see page 5.2, no blanks are allowed), followed by a unit which consists of a code from Dictionary 25 with the dimension TIME; no embedded blanks are allowed.

   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.

   Example:
   ```
   2.45MIN
   3.6E+03YR
   ```

   Radiation field. Consists of three subfields: (nuclide,half-life,SF1,SF2,SF3)

   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 are not included.

---

[1] Decay data relevant to the monitor reaction are coded under the keyword DECAY-MON and not under DECAY-DATA.

SF1. Type-of-radiation. A code from Dictionary 13.

Where two or more different decay modes are possible and are not distinguished in the measurement, two or more codes may be given; each separated by a slash. (See *Example* b, following page).

SF2. Energy. The energy of the radiation in keV, coded as a floating-point number (see page 5.2, no blanks permitted); no units are given in the code.

In the case of two or more unresolved decays, two or more energies, or a lower and upper energy limit, are given, each separated by a slash. (See Example f and **LEXFOR Decay Data**.)

SF3. Abundance. The abundance of the observed per decay, coded as a floating-point number (see page 5.2, no blanks permitted).

4. If decay data is given in coded form for more than one nuclide, each is coded on a separate record, starting in column 12.

Examples of coding for DECAY-DATA

a. `DECAY-DATA (40-ZR-89-M)` (half-life and radiation omitted) in this case, information on the decay data for the nucleus specified is given in free text)

b. `DECAY-DATA (60-ND-140,3.3D)` (radiation field omitted)
`(59-PR-140,,B+/EC,,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 2nd with SF2 and SF3 omitted)

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

f. `DECAY-DATA (60-ND-139-M,5.5HR,DG,708./738.,0.64)` (the abundance given is the total abundance of both γ rays)

g. `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 be entered in the following way for improved readability:

```
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. Gives the decay data assumed by the author for any nuclide occurring in the monitor reaction used.

2. Presence is optional; may 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 (see page 8.D.1), except that the flag field is not permitted.

DETECTOR

1. Gives information about the detector(s) used in the experiment. See also **LEXFOR Measurement Techniques.**

2. At least one of the keywords METHOD, FACILITY, DETECTOR, or ANALYSIS is always present with coded information. Within this restriction, coded information for DETECTOR is optional, except that, if a relevant code is given in the dictionary, then it is used.

3. If coded information is given it may be in either of the general forms, see page 8.2, with code(s) from Dictionary 22, but see exception below.

4. If the code COINC is used, then the codes for the detectors used in coincidence follow within the same parenthesis;

   Example: `DETECTOR (COINC,NAICR,NAICR)`

   In this case any other detectors used are coded on a separate record, starting in column 12.

EMS-SEC

1. Gives information about secondary squared effective mass of a particle or particle system, and to define secondary-mass fields given in the data table. See **LEXFOR Secondary Particles.**

2. Keyword is, in general, optional, but is obligatory when the data headings EMS1, EMS2, *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 or the root of the data heading to be defined. Root means that the data heading given will also define the same heading followed by -MIN, -MAX or -APRX.

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

either	a particle code from Dictionary 13.
or	a nuclide coded in the standard format as described on page 8.3.

   Permitted nuclei are indicated in Dictionary 27 by a "3" in column 15.

4. If more than one effective mass data heading is defined, each is coded on a separate record, starting in column 12.

   Example:
   ```
   EMS-SEC     (EMS1,N)
               (EMS2,P+D)
   ```

EN-SEC

1. Gives information about secondary energies, and to define secondary-energy fields given in the data table. See **LEXFOR Secondary Particles.**

2. Presence is, in general, optional, but is obligatory when the data headings 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. Contains the data heading or the root of the data heading to be defined. Root means that the data heading given also defines the heading followed by -MIN, -MAX or -APRX.

   Particle Field. Contains the particle or nuclide to which the data heading refers. The code is:

either	a particle code from Dictionary 13.
or	a nuclide coded in the standard format as described on page 8.3. Permitted nuclei are indicated in Dictionary 27 by a "3" in column 15.

4. If more than one secondary-energy data heading is defined, each is coded on a separate record, starting in column 12.

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

ERR-ANALYS

1. Explains the sources of uncertainties and the values given in the COMMON or DATA sections under data headings of the type ERR- or -ERR. See also **LEXFOR Errors.**

2. Presence is obligatory, except when not relevant. May contain free text or coded information with free text. However, if only one data heading is to be defined, the coded information may be omitted. See also page 6.8, **Links between BIB, COMMON and DATA.**

3. The coded information is of the form: (heading,correlation factor) free text

   Heading Field. Contains the data heading or the root of the data heading to be defined. Root means that the data heading given also defines the heading preceded by + or -.

   Correlation Factor Field. Contains the correlation factor, coded as a floating point number. This field is optional and is used only with systematic data uncertainty headings of the form ERR-1, *etc.* If this field is not given, the trailing comma is omitted.

4. If two or more error fields are given, then the data headings are given as codes under this keyword, each on a separate record, starting in column 12, and followed by free text explanation.

   Example:

```
BIB
...
ERR-ANALYS  (EN-ERR)    followed by explanation of energy error
            (ERR-T)     followed by explanation of total uncertainty
            (ERR-S)     followed by explanation of statistical uncertainty
ENDBIB
NOCOMMON
DATA
EN          EN-ERR      DATA        ERR-T       ERR-S
MEV         MEV         MB          MB          PERCENT
...         ...         ...         ...         ...
```

EXP-YEAR

1. Defines the year in which the experiment was performed when it differs significantly from the data of the references given. (***Example***: classified data published years later).

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

3. The format of the code is (yy) where yy is the last two digits of the year.
   Example: `EXP-YEAR (65)`

FACILITY

1. Defines the main apparatus used in the experiment. See also **LEXFOR Measurement Techniques.**

2. Keyword must be present except when not relevant. At least one of the keywords METHOD, FACILITY, DETECTOR, or 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 8.2, with code(s) from Dictionary 18, or the facility code from Dictionary 18 may be followed by an institute code from Dictionary 3, which specifies the location of the facility. When two or more codes are given under the keyword INSTITUTE, then a facility code ***is always*** followed by the appropriate institute code.

4. When the second form of coding is used and more than one facility is given, then each is coded on a separate record, starting in column 12.

   Example:

```
FACILITY     (CHOPF,1USACOL)
             (SPECC,1USABNL)
```

FLAG

1. Provides information to specific lines in a data table. See also **LEXFOR Flags.**

2. Presence is optional, but, if present, it must have coded information. Always present if flags are used in the data table.

3. The format of the code is a fixed-point number which appears in the data section under the data heading FLAG. The code must be followed by a free text comment. See also page 6.8, **Links between BIB, COMMON and DATA.**

4. If two or more codes are given, each is coded on a separate record, starting in column 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
```

   More than one FLAG field may be coded (see Repition of data headings, page 5.4).

HALF-LIFE

1. Gives information about half-life values and defines half-life fields given in the data table. See also **LEXFOR Half-lives.**

2. Presence is optional, with or without coded information. However, coded information *is always* included when the data headings, HL1, HL2, *etc.*, are given in the COMMON or DATA section.

3. The general coding format is: (heading,nuclide)

   Heading field: Data heading to be defined.

   Nuclide field: General format of the code is Z-S-A-X, see page 8.3. Permitted nuclei are indicated in Dictionary 27 by a "3" in column 15.

4. If two or more half-lives are given, each is coded on a separate record starting in column 12. See **LEXFOR Half-lives** for a coding example.

   Example:

```
HALF-LIFE     (HL1,41-NB-94-G)
              (HL2,41-NB-94-M)
```

Note: Decay data, including the half-life, is preferably coded under the keyword DECAY-DATA or DECAY-MON, as appropriate.

HISTORY

1. Documents the handling of an entry or subentry. See also **LEXFOR History**.

2. Presence is obligatory with coded information.

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

   where: yymmdd: date (year,month,day) on which some action was taken on the entry or subentry;

   X: a code from Dictionary 15 indicating what action was taken. X may be omitted.

4. Each item of coded information is coded on a separate record, starting in column 12.

   Example:

```
HISTORY      (940312C)
             (960711A) Data units corrected.
```

INC-SOURCE

1. Gives information on the source of the incident particle beam used in the experiment. See also **LEXFOR Measurement Techniques and Incident-Particle Energy**.

2. Presence is optional. May contain either free text, or coded information and free text.

3. Coded information, if given, may be in either of the general forms, see page 35, with code(s) from Dictionary 19, but see exception below.

4. If the code POLNS is used, the code for the polarized source, if given, must follow within the same set of parenthesis.

   Example:

   ```
   INC-SOURCE    (POLNS,D-T)
   ```

   If the code MPH, followed by the separator = is present, the next field contains a reaction string coded as under the keyword REACTION.

   In both these cases, other sources are coded on a separate record, starting in column 12.

INC-SPECT

1. Provides information on the characteristics and resolution of the incident-projectile beam. See also **LEXFOR Incident-Projectile Energy**.

2. Required when a spectrum average modifier (*e.g.*, MXW, SPA, or FIS) is present in REACTION SF8 (see page 6.8); otherwise, optional. See also **LEXFOR Spectrum Average**. No coded information.

INSTITUTE

1. Designates the laboratory, institute, or university at which the experiment was performed, or with which the authors are affiliated. See also **LEXFOR Institute**.

2. Presence is obligatory with coded information.

3. The code information is given in either of the general forms, see page 8.2, with code(s) from Dictionary 3.

   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, 1USALAS)
INSTITUTE     (2FR SAC)
```

LEVEL-PROP

1. Gives information on the spin and parity of excited states.

2. Presence is optional, but, if present, includes code information.

3. The code string consists of three fields which may be preceded by a decay flag:

   ((flag) nuclide, level identification, lever properties)

   Embedded blanks are permitted only at the beginning of a field or subfield. If a code string is continued onto the next record, the break must come at the end of a field or subfield, *i.e.*, the comma separating the fields should be the last character on the line.

   Flag. Coded as (n), where n will have a numerical value which appears in the data section under the data heading LEVEL-FLAG. See also **LEXFOR Flags** and page 6.8.

   The flag may be omitted, in which case its parentheses are also omitted. If the flag is omitted, a level identification field must be present.

   Nuclide field. Coded is Z-S-A-X, except that for the ground state of a nuclide, the use of the extension G is optional. See page 8.3. This field must be present. Permitted nuclei are indicated in Dictionary 27 by a "3" in column 15.

   Level identification field. Identification of the level whose properties are specified, given as ***either*** a level energy or a level number. If the field is not present, its separating comma is omitted. If there is ***no flag field***, a level identification field ***must*** be present.

   Level Energy. The field identifier E-LVL= followed by the excited state energy in MeV, coded as a floating-point number (see page 5.2, no blanks permitted) which also appears in the data section under the data heading E-LVL. No units are given in the code.

   Level Number. The field identifier LVL-NUMB= followed by the level number of the excited state, coded as "n", where n has a numerical value which also appears in the data section under the data heading LVL-NUMB.

   Level properties field. One or more properties for the excited state, each preceded by a subfield identification. At least one of the fields must be present. If the field is not present, its separating comma is omitted.

   Spin. The field identifier SPIN=, followed by the level spin coded as a floating point number (see page 5.2, but no blanks). For an uncertain spin assignment, two or more spins may be given, each separated by a slash.

   Parity. The field identifier PARITY=, followed by the level parity, coded as *e.g.*, +1. or -1.

Examples:

```
LEVEL-PROP    (82-PB-206,E-LVL=0.,SPIN=0./1.,PARITY=+1.)
              (82-PB-206,E-LVL-1.34,SPIN+3.,PARITY=+1.)

LEVEL-PROP    ((1.)82-PB-206,,SPIN=0./1.,PARITY=+1.)
              ((2.)82-PB-206,,SPIN=3.,PARITY=+1.)

LEVEL-PROP    (82-PB-207,LVL-NUMB=2.,SPIN=1.5,PARITY=-1)
```

METHOD

1. Describes the experimental technique(s) employed in the experiment. See also **LEXFOR Measurement Techniques.**

2. Presence is obligatory, except when not relevant. At least one of the keywords METHOD, FACILITY, DETECTOR, or ANALYSIS must be present with coded information. Within this restriction, coded information is optional.

3. Coded information may be in either of the general forms, see page 8.2, with code(s) from Dictionary 21.

MISC-COL

1. Defines fields in the COMMON or DATA sections headed by MISC and it derivatives. See also **LEXFOR Miscellaneous.**

2. Presence is optional, but must be present if miscellaneous fields are given in the data table. Free text may be given, or coded information plus free text.

3. The code is a miscellaneous data heading from Dictionary 24, *e.g*, MISC.

4. If more than one miscellaneous field is given, then the data headings must be repeated as codes for this keyword, enclosed in parentheses starting in column 12, followed by free text explanation.

Example:
```
MISC-COL     (MISC1)      Free text describing 1st
miscellaneous field
                          (MISC2)      Free text describing
2nd miscellaneous field
```

See also page 6.8, **Links between BIB, COMMON and DATA.**

MOM-SEC

1. Gives information about secondary linear momentum, and defines secondary-momentum fields given in the data table. See also **LEXFOR Secondary Particles.**

2. Presence is obligatory when the data headings MOM-SEC1, MOM-SEC2, *etc.*, are used in the data, otherwise presence is optional. 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: the data heading or root[2] of the data heading to be defined.

   Particle Field: the particle or nuclide to which the data heading refers. The code is:

   either a particle code from Dictionary 13.

   or a nuclide coded in the standard format as described on 8.3. Permitted nuclei are indicated in Dictionary 27 by a "3" in column 15.

4. When more than one linear-momentum data heading is to be defined, each must be coded on a separate record, starting in column 12.

   Example:
   ```
   MOM-SEC     (MOM-SEC1,26-FE-56)
               (MOM-SEC2,26-FE-57)
   ```

[2] Root means that the data heading given will also define the same heading followed by -MIN, -MAX or -APRX.

MONITOR

1. Gives information about the standard reference data (standard, monitor) used in the experiment and defines information coded in the COMMON and DATA sections under the data heading MONIT, *etc.* See also **LEXFOR Standards**.

2. Presence is obligatory, except when not relevant. Information is entered either as free text, 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 page 6.8, **Links between BIB, COMMON and DATA.**

3. The general coding format is a REACTION string which may be preceded by a field containing a data heading: ((heading) reaction)

   Heading Field. Contains the data heading of the field in which the monitor value is given. The heading may be omitted, in which case, its parenthesis is omitted.

   Reaction Field. The coding rules are identical to those for REACTION, except that subfields 5 to 9 may be omitted when only the reaction is known. (In this case, no monitor information will be given in the COMMON or DATA section).

4. In the case of two or more monitors, each is coded on a separate record, starting in column 12. The respective monitor values coded are linked to the monitor codes:

   a.) using pointers (see page 6.3, BIB/DATA Links)

   Example:

```
REACTION    1(AAAAA)
            2(BBBBB)
MONITOR     1(CCCCC)
            2(DDDDD)
...
DATA
EN          DATA        1DATA       2MONIT      1MONIT      2
...
```

   b.) using the data headings MONIT1, MONIT2, *etc.* This formalism is used when two or more monitors are given for one reaction.[3]

   Example:

```
REACTION    (AAAAA)
MONITOR     ((MONIT1)CCCCC)
            ((MONIT2)DDDDD)
...
DATA
EN          DATA        MONIT1      MONIT2
...
```

[3] On EXFOR entries compiled before 1985, the heading field was not included in the monitor code string.

MONIT-REF

1. Gives information about the source reference for the standard (or monitor) data used in the experiment.

2. Presence is optional, but, if present, includes coded information. Used only when the keyword MONITOR is present.

3. The code contains 3 main fields which may be preceded by a heading field:

   ((heading)subaccession#,author,reference)

   Embedded blanks are not permitted within the code, except within an author's name (see coding rules under AUTHOR, page 8.A.2).

   Heading Field: Data heading of the field in which the standard value is given. The heading may be omitted, in which case, its parentheses is also omitted.

   Subaccession Number Field: Subaccession number for the monitor data, if the data is given in an EXFOR entry. Cnnnn001 refers to the entire entry Cnnnn. Cnnnn000 refers to a yet unknown subentry within the entry Cnnn. This field may be omitted, but the following comma is always included.

   Author Field. The first author (coded as under AUTHOR), followed by "+" when more than one author exists. This field may be omitted, but the following comma is always included.

   Reference Field. Must be present. May contain up to 6 subfields, coded exactly as under REFERENCE. (See page 8.R.8 and following).

4. For more than one monitor reference, each is coded on a separate record, starting in column 12. Entries under MONIT-REF and MONITOR may be linked:

   a.) using pointers (see page 6.4, BIB/BIB links)

   b) using the data headings MONIT1, MONIT2, *etc.*

   Examples:
   ```
   MONIT-REF    ((MONIT1)B0017005,J.GOSHAL,J,PR,80,939,50)
                ((MONIT2),A.G.PANONTIN+,J,JIN,30,2017,68)
   ```

PART-DET

1. Gives information about the particles (not decay radiations) detected directly in the experiment. Particles detected in a standard/monitor reaction are not coded under this keyword. See also **LEXFOR Particles.**

2. Presence is optional, but, if the particle is not evident from the REACTION code, it must be given, either under this keyword, or under RAD-DET or DECAY-DATA. If the keyword is present, coded information is obligatory.

3. The code is:
   - either a code from Dictionary 13,
   - or, for particles heavier than α particles, a code of the form Z-S-A-X, see page 8.3. Permitted nuclei are indicated in Dictionary 27 by a "3" in column 15.

4. If two or more particles detected, their codes are given in either of the general forms, see page 8.2. Particles detected pertaining to different reaction units within a reaction combination are coded on separate records in the same order as the corresponding reaction units. (See page 8.R.6 for examples of reaction combinations.)

RAD-DET

1. Gives information about the radiations and/or particles and nuclides observed in the reaction measured. See also **LEXFOR Particles.**

2. If the particle is not evident from the REACTION code, it must be specified either under this keyword, or under PART-DET or DECAY-DATA, otherwise presence of this keyword is optional. If the keyword is present, it must have coded information, with or without free text.

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

3. The general format of the code is: ((flag)nuclide, radiation)

   Flag Field: a code of the form (n), where n has the numerical value which appears in the data section under the data heading DECAY-FLAG. This field may be omitted, in which case its' parentheses are also omitted.

   Nuclide field. A code of the form Z-S-A-X, see page 8.3. Permitted nuclei are indicated in Dictionary 27 by a "3" in column 15.

   Radiation field: one or more codes from Dictionary 33, each separated by a comma.

   No embedded blanks are permitted in the code.

   See also **LEXFOR Flags** and page 6.9, **Links between BIB, COMMON, AND DATA.**

4. **Two or more nuclides.** The information for each nuclide is coded on a separate record, each code starting in column 12. Pointers may be used to link the RAD-DET codes with variable product nuclei coded in the DATA table and with 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-M2,SF)
              2(94-PU-237-M2,SF)
f) RAD-DET     ((1.)48-CD-115-G,B-)
               ((2.)49-IN-115-M,DG)
```

REACTION

1. Specifies the data presented in the DATA section in fields headed by DATA[4].

2. Presence is obligatory with coded information; use of free text is optional.

3. A REACTION unit consists of three major fields:
   (reaction, quantity, data-type)

4. More than one reaction unit may be given as a ***Reaction Combination*** or in the ***Multiple-reaction Formalism.***

Detailed coding rules are given on the following pages.

[4] And similar headings such as DATA-MIN, DATA-MAX, *etc.*

SF1-4 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. Contains one of the following:

a) Z-S-A-X, as described on page 8.3 with the following exceptions:
A = 0 denotes natural isotopic mixture,
X may not have the value G.

Permitted nuclei are indicated in Dictionary 27 either by a "1" in column 13, or, if SF2 contains a zero, a 4 in column 16.

b) Z-S-CMP, see page 8.3.

c) the code ELEM/MASS when the target nucleus is entered into the data table using the heading codes ELEMENT, MASS, (ISOMER) ***(Variable Nucleus Formalism)***.

Use of this formalism is restricted to the cases specified on page 6.6. See **LEXFOR Target Nucleus** for details.

Example: `(ELEM/MASS(0,B-),,PN)`

SF2. Incident projectile. Contains one of the following:

a) a particle code from Dictionary 28.

b) for particles heavier than an α, a code in the form Z-S-A (isomer field omitted), see page 8.3. Permitted nuclei are indicated in Dictionary 27 by a "2" in column 14.

SF3. Process. Contains one of the following:

a) a process code from Dictionary 30, *e.g.*, TOT.

For use of the process codes XN and YP, see page 6.7, **Variable Number of Emitted Nucleons.** See also **LEXFOR Particles**.

b) a particle code from Dictionary 29 which may be preceded by a multiplicity factor, whose value may be 2→99[5].

Examples: `A`
`4A`

c) for particles heavier than α, a code in the form Z-S-A-X, see page 8.3, (the atomic weight may not have the value zero). Permitted nuclei are indicated in Dictionary 27 by a "3" in column 15. No multiplicity factor is allowed; instead the nuclide code is repeated, if necessary.

Examples: `8-O-16`
`8-O-16+8-O-16`

---

[5] In the few cases where the multiplicity factor may exceed 99, the ***Variable Number of Emitted Nucleons Formalism*** may be used, see page 6.7.

d) combinations of a), b) and c), with the codes connected by "+". Outgoing particles are ordered starting with the "lightest" at the left of the subfield[6], followed by the Z-S-A-X formatted codes, in Z, A order, followed by process codes given in the same order as given in Dictionary 30.

An exception to this order is when SF5 contains the code SEQ, which indicates that the particles and/or processes are ordered in the sequence in which the reaction proceeds. (See **LEXFOR Particles**).

Examples: `HE3+8-0-16`
`A+XN+YP`

Notes on SF3

1.) Gammas are coded **only**:
- for a capture process, *e.g.*, (P,G)
- when they are needed to define the partial reaction considered, *e.g.*, (N,G+F),SEQ.

In all other cases, gammas are considered as self-evident and are, therefore, not coded, *e.g.*, (P,N) is coded, not (P,G+N). Compare SF7, Particle Considered, page 8.R.6.

2.) If SF5 contains the branch code UND[7] (undefined), the particle codes given in SF3 represent only the sum of emitted nucleons, implying that the product nucleus coded in SF4 has been formed via different reaction channels. The code (DEF) in SF5 denotes that it is not evident from the publication whether the reaction channel is undefined or defined. For details see in **LEXFOR Particles.**

3.) For coding of SF3 in the case of scattering see **LEXFOR Scattering.**

SF4. Reaction Product. In general, the heaviest of the products is defined as the reaction product (also called residual nucleus). In the case of two reaction products with equal mass, the one with the larger Z is considered as the "heavier' product. Exceptions or special cases are:

a.) If SF5 contains the code SEQ, indicating that the sequence of several outgoing particles and/or processes coded in SF3 is meaningful, the nuclide to be coded in SF4 is the heaviest of the final products.

Example: `5-B-10(N,A+T)2-HE-4,SEQ,SIG)`

b.) There is no reaction product if a nuclear quantity is given (*i.e.*, SF2 contains the code 0), or if SF3 contains the process code TOT, ABS, or NON.

c.) There is no reaction product given if the reaction specifies a resonance parameter (defined in Dictionary 36 by a period in column 22).

---

[6] Lowest Z, then lowest A.

[7] The code UND is presently used only for charged particle reaction data.

d) For certain reactions which are implicit sums, the reaction product is not defined if no specific reaction product is considered. This may occur:
   - for fission processes; SF3 contains the process code F.
   - if SF3 contains a combination of the process code X with a particle code, *e.g.*, (P,G+X),SEQ.
   - the reaction is measured for a target of natural isotopic composition.

e) Where emission cross sections, production cross sections, product yields, *etc.*, are given for specified nuclides, particles, or gammas, the product considered is defined as the reaction product (even if it is not the heaviest of several reaction products).
   - SF3 contains the process code F, X, XN, or YP.

Coding: This subfield:

either is blank, as in cases b, c, and d (see preceding); the following comma is always present.

Examples:
```
(92-U-235(N,F),,SIG)
(26-FE-56(N,EL),,WID)
(40-ZR-0(N,G),,SIG)
```

or contains a code in the form Z-S-A-X, as described on page 8.3. Permitted nuclei are indicated in Dictionary 27 by a "3" in column 15.

If light particles or gammas are defined as the reaction product, these are coded using the Z-S-A formalism (*i.e.*, the particle codes A, HE3, T, D, P, N, G are not used in SF4).

Example: `(28-NI-0(N,X)0-G-0,,SIG)` γ production cross section

For scattering on a target nucleus which is a natural isotopic mixture (A=0) (see **LEXFOR Scattering**), A=0 is given for the product nucleus; otherwise, A=0 is not used in SF4.

In the case of isomeric ratios and sums, the isomer code may consist of a combination of codes separated by a slash or a plus sign.[8] The use of these separators is algebraic, *e.g.*, M1+M2/G. The code T is used in an isomeric ratio to denote the sum over all isomers (see page 8.3). (See **LEXFOR Isomeric States**).

Examples:
```
(92-U-235(N,F)54-XE-124,CUM,FY)
(51-SB-123(N,G)51-SB-124-M1+M2/T,,SIG/RAT)
```

or, if the reaction product is entered into the data table using the data headings ELEMENT, MASS, and/or ISOMER (see page 6.6, Variable Nucleus), it contains one of the following codes:

ELEM	if only the data heading ELEMENT is used in the data table,
MASS	if only the data heading MASS is used in the data table,
ELEM/MASS	if the data headings ELEMENT and MASS are used in the data table.

Example: `(92-U-235(N,F)ELEM/MASS,CUM,FY)`

Use of this formalism is restricted to those cases given on page 6.6.

---

[8] The code RAT or SUM is always given in SF6 when the arithmetical / or + appears in the isomer extension in SF4.

SF5-8 Quantity Field. These four subfields are each separated by a comma. If a subfield is omitted, the separating comma is included, except that trailing commas are omitted.

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

All combinations of codes allowed in the quantity field are given in Dictionary 36 (see page 7.12).

SF5 Branch. Indicates a partial reaction, for example, only one of several energy levels or particle groups has been considered. Code(s) are taken from Dictionary 31.

SF6 Parameter. Contains information about the reaction parameter given, such as, integral or differential cross section. Code(s) are taken from Dictionary 32.

SF7 Particle Considered. Provides particle code(s) indicating to which of several outgoing particles the quantity refers.[9] When more than one particle code is entered, *e.g.*, for a quantity describing the correlation between outgoing particles, all particles are entered, separated by a slash. Code(s) are taken from Dictionary 33. (See **LEXFOR Particles**).

The particle considered may be omitted if there is no ambiguity. For integral data this subfield is generally not used.

SF8 Modifier. Contains information on the representation of the data, for example, relative data, fitting coefficients. Code(s) are taken from Dictionary 34. General quantity modifiers, as noted in Dictionary 34, should trail other modifiers.

SF9 Data Type Field. Indicates whether the data are experimental, theoretical, evaluated, *etc.* If two or more data types are given, they are each separated by a slash. Code(s) are taken from Dictionary 35. (See **LEXFOR Data Type).**

If this field is omitted, the data are experimental.

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 complete ***reaction combination*** must be enclosed in parentheses.

[9] Note that the particle considered is not necessarily identical to the particle detected, *e.g.*, the angular distribution of an outgoing particle which has been deduced from a recoil particle detected.

The permitted separators are:

+	((------)+(-----))	Sum of 2 or more quantities (see **LEXFOR Sums).**
-	((------)-(-----))	Difference between 2 or more quantities.
*	((------)*(-----))	Product of 2 or more quantities (see **LEXFOR Products).**
/	((------)/(-----))	Ratio of 2 or more quantities (see **LEXFOR Ratios).**
//	((------)///(-----))	Ratio of 2 quantities, where the numerator and denominator refer to different values for one or more independent variables.
=	((------)=(-----))	Tautologies (see **LEXFOR Tautologies** for usage).
,		***Obsolete***, but may be found in older neutron entries. Used for multiple representations of the same quantity, which are now coded using pointers.

If a code string is continued onto the next record, a code unit must not be broken, *i.e.*, the separator appears on the record, with the first parenthesis of the next code unit beginning in column 12 of the next record. Thus blanks may follow a separator if the reaction combination is continued on the next record.

Examples:
```
((92-U-235(N,F),,SIG)/(79-AU-197(N,G)79-AU-198,,SIG))

(((28-NI-58(N,N+P)27-CO-57,,SIG)+(28-NI-58(N,D)27-CO 57,,SIG))/
(13-AL-27(N,A)11-NA-24,,SIG))
```

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

If pointers are used with the REACTION keyword, the code fields associated with each pointer may be a reaction unit or a reaction combination. (See page 6.1 for general information on pointers). The use of this formalism is restricted to specific classes of data which are subject to the following constraints. See page 6.2 for coding example.

1. The incident projectile and the target nucleus are constant.
2. Quantities are functions of the same independent variables.
3. Quantities are integrally related to each other.

For the specific classes of data which may be coded using the ***multiple reaction formalism***, see **LEXFOR Multiple Reaction Formalism.**

REFERENCE

1. Gives information on references which contain information about the data coded. Other related references are not code under this keyword (see REL-REF, MONIT-REF). See **LEXFOR Reference.**

2. Presence is compulsory with coded information, with or without free text.

3. The general coding format consists of 3 main fields: (reference type, reference, date)
   No embedded blanks are allowed

   Reference Type: a code from Dictionary 4. Field must always be present.

   Reference: up to four subfields depending on reference type; the ***first subfield is always present.*** The order of the subfields in the code fixed, although some subfields may be omitted. If a subfield is omitted, the separating comma is included, except in the case:

   a) of a parenthesized subfield

   b) when the omitted subfield is the page number

   See reference types on following pages for specific coding rules for each subfield.

   Date: code of the form yymmdd (year, month, day, each two digits); the month and day may be omitted. Field must always be present.

4. Where there is more than one reference, each reference is coded on a separate record, starting in column 12. The main reference is given first.

5. If a document has more than one identification, each may be coded within one set of parenthesis, each code being in parentheses and separated from the other codes by "=" (an equal sign). The primary code is given first. (see **LEXFOR Reference** for the definition of primary reference.)

   Example: `((R, USNDC-7,143,7306)=(R,EANDC(US)-181,143,7306))`

   If a code string is continued onto the next record, a code unit must not be broken, *i.e.*, the separator appears on the record, with the first parenthesis of the next code unit beginning in column 12 of the next record.

6. The free text on the record following the closing parenthesis of the code string is reserved for a "mini-comment" giving further information about the reference.

   Examples:
   ```
   (R,ANL-4567,6605)  Graph only
   (C,66PARIS,6605) Abstract
   ```

7. In the few cases (particularly with abstracts), when two works are referenced which appear on the same page of a journal or report, the following practice is followed:
   a) If a paper number or paragraph number is available it is enclosed in parentheses following the page number.

      Example: `(J,XYZ,9,999(1122),6912)`
      `(J,XYZ,9,999(1573),6912)`

   b) If this is not possible then the order in which they appear on the page is used.

      Example: `(J,XYZ,8,888(1),6911)`
      `(J,XYZ,8,888(2),6911)`

Following are the specific coding rules for each reference type.

Type of Reference = B or C; Books and Conferences

The reference field may contain up to 4 subfields: code, volume, part, page (paper number).

General coding forms:

(B or C,code,volume,(part),page(paper #),date)
(B or C,code,volume,page(paper #),date)
(B or C,code,,page(paper #),date)
(B or C,code,,date)

Code subfield: a code from Dictionary 7.

Volume subfield: may have any content, except commas or parentheses.

Part subfield: if present, it is enclosed in parentheses and may have any content, except commas or parentheses. If omitted, the following comma is also omitted.

Page (paper number) subfield, if present, contains the page number which must be numeric ***and/or*** the paper number, enclosed in parentheses, which may have any content, except commas or parentheses. If omitted, the following comma is omitted.

Examples:

a) `(C,67KHAROV,,(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.

e) `(C,77KIEV,,7404)` = 1977 Kiev Conference, page and paper number unknown.

Type of Reference = J: Journals

The reference field may contain up to 4 subfields: code, volume, issue#, page.

General coding forms: (J,code,volume,(issue #),page,date)
(J,code,volume,page(paper #),date)

Code subfield: a code from a Dictionary 5.

Volume subfield: the volume number; may have any content, except commas or parentheses.

Issue # subfield: the issue number, enclosed in parentheses and may have any content, except commas or parentheses. Presence optional; if omitted, the following comma is also omitted.

Page (paper #) subfield: If present, contains the page number which must be numeric ***and/or*** the paper #, enclosed in parentheses, which may have any content, except commas or parentheses. If omitted, the following comma is also omitted.

Examples:

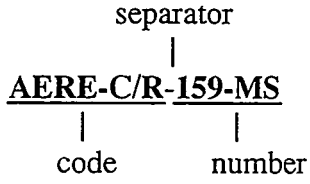
a) `(J,PR,104,1319,5612)` = Phys. Rev. Volume 104, page 1319, December 1956
b) `(J,XYZ,5,(2),89,6602)` = Journals XYZ, Volume 5, issue#2, page 89, February 1966

Type of Reference = P or R or S; Reports

The reference field for reports may contain up to 3 subfields, code number, volume/part, page.

General coding forms: (P or R or S,code-number,date)
(P or R or S,code-number, page,date)
(P or R or S,code-number,(volume/part),page,date)

Code-number subfield: contains a code taken from Dictionary 6, ***and*** the number, which may have any format, but may not contain a comma (for example: 3058-39, 4648-MS, 66-12-9, 630-1X-A/PR). The **separator** between the code and the number is a hyphen[10]. Since the code and the number may both contain hyphens, the separator is defined as the first hyphen which is followed by a digit or an opening parenthesis, for example:



Volume or part subfield: may have any content, except commas or parentheses, and is enclosed in parentheses; if omitted, the following comma is also omitted.

[10] The hyphen acting as separator is included in Dictionary 6, except when the code itself is 11 characters long.

Page subfield: numeric field; if omitted, the following comma is also omitted. If there are two works on a page they may be distinguished as described on page 8.R.9; 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 Volume or Part field

Type of Reference = T, or W; Thesis or Private Communication

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

General coding forms: (W or T,author,date)
(W or T,author,page,date)

Author subfield: family name of the first author.

Page subfield: numeric field; if omitted, the following comma is also omitted.

Examples:

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

b) `(T,ANONYMOUS,58,6802)` = Thesis by Anonymous, page 58, published in February 1968.

REL-REF

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

2. Presence is optional, but, if present, will have coded information, with or without free text.

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

   (code,subaccession#,author,reference)

   Embedded blanks are not permitted within the code.

   Code field: code from Dictionary 17. This field must be present.

   Subaccession# field: EXFOR subaccession number for the reference given, if it exists. Cnnnn001 refers to the entire entry Cnnnn. Cnnnn000 refers to a yet unassigned subentry within the entry Cnnnn. This field is optional; if omitted, the following comma is always included.

   Author field: first author, coded as under AUTHOR, followed by + when more than one author exists. This field is optional; if omitted, the following comma is always included.

   Reference field: up to 8 subfields, coded as under the keyword REFERENCE. (See page 8.R.8 and following). This field must always be present.

   Example:

   `(C,B9999001,A.B.NAME+,J,XYZ,5,(2),90,7701)` = Critical remarks by A.B.Name, *et al.*, in journal XYZ, volume 5, issue #2, p. 90, January 1977.

RESULT

1. Describes commonly used quantities that are coded as REACTION combinations.

2. Presence is obligatory when relevant. Contains a code from Dictionary 37, with or without free text. Only one code is entered for each REACTION combination.

   Example:

   ```
   REACTION    ((Z-S-A(N,F)ELEM/MASS,CUM,FY)
                /(Z-S-A(N,F)MASS,CHN,FY))
   RESULT      (FRCUM)
   ```

3. If more than one code is entered, each will be on a separate record, preceded by the relevant pointer.

SAMPLE

1. Used to give information on the structure, composition, shape, *etc.*, of the measurement sample.

2. Presence is optional. Contains only free text information.

STATUS

1. For use of this keyword see **LEXFOR Status.**

2. Presence is obligatory when relevant. May contain coded information and/or free text.

3. The coded information is entered in:

   a.) either of the general forms, see page 8.2., with codes from Dictionary 16.

   b.) as coded information with two fields: (code,subaccession#)

   Code Field: code from Dictionary 16.

   Subaccession# Field: cross-reference to an EXFOR subaccession number. Cnnnn001 refers to the entire entry Cnnnn. Cnnnn000 refers to a yet unassigned subentry within the entry Cnnnn. This field is only permitted for the codes COREL, DEP, OUTDT, RNORM, and SPSDD.

   The subaccession number field ***is always*** included for these codes, with the following exceptions:

   - the codes SPSDD and OUTDT, where, in some cases, no cross-reference may exist.
   - older subentries for which this field was not entered.

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

4. For case 3.b, if more than one status code or a cross-reference to more than one subaccession number is given, each is coded on a separate record, starting in column 12.

   Examples:

```
STATUS      (DEP,12345002)
            (DEP,12345004)

STATUS      (DEP,34567004)
            (APRVD)
```

5. For use of the following codes see the corresponding **LEXFOR** entries:

COREL	**Interdependent Data**
DEP	**Dependent Data**
Others	**Status**

TITLE

1. Used to enter a title for the work referenced. See **LEXFOR Title.**

2. Presence is obligatory except when not relevant. Information is given in free text only.

Chapter 9

UPDATING AND ALTERATIONS

Alterations to EXFOR entries

Alterations to EXFOR entries are transmitted only by the center responsible for those entries. (See Appendix P, Protocol, page P.3).

When an entry is altered, those subentries which have been altered will be retransmitted, accompanied by the retransmission of the first subentry (SAN=1). The minimum unit transmitted is a subentry (***not*** just the altered records). Those subentries which are not altered need not be included on the transmission file. The appropriate ENTRY and ENDENTRY records are included.

Serious corrections (*e.g.*, those involving changes to the data or to the essential BIB keywords, such as REACTION, MONITOR) will be transmitted as quickly as possible.

Subentries added to a previously transmitted entry are transmitted accompanied only by the first subentry; other unchanged subentries need not be transmitted.

All corrections will be properly marked with alter flags. The alter flag is used to inform other centers when an alteration procedure has been performed on an entry.

Alter flags are not accumulated over a number of transmissions (*i.e.*, alter flags are set ***only*** to indicate those records which have been altered since the last time the work was transmitted). Therefore, all flags are considered, at least conceptually, reset to blank after the work has been transmitted. The procedure that is actually carried out at each center of course depends upon the use that the center intends to make of the information conveyed by the alter flag.

All corrections will be documented with an appropriate entry under HISTORY. (See **LEXFOR History**).

Deletion of entries and subentries

If an entire entry is to be deleted, at least NOSUBENT records must be included for ***each*** subentry which has been previously transmitted. Column 80 alter flags are used throughout the "deleted" entry or subentry as usual.

In general, the following keywords must be included (left) in the BIB for an entry or subentry to be deleted: REFERENCE, TITLE, AUTHOR, INSTITUTE, REACTION, HISTORY.

The ENDBIB record is usually followed by NOCOMMON and NODATA.

An entry is made under HISTORY, with the date of deletion and the code D. Free text information giving the reason for the deletion must be included.

The accession number/subaccession number of a deleted entry/subentry may never be used for another data set.

Retransmission of subentries which have been combined into one entry

In the case where a series of subentries (X through Y) have been combined into one subentry (X), the following simplified flagging system may be used.

Enter under HISTORY in the combined subentry:

(yymmddA) Subentries X through Y combined

For subentries X+1 through Y, NOSUBENT records are entered, with a deleted subentry flag in Column 80.

Alter flags

The following alter flags are used in column 80 to indicate an alteration:

C the record flagged has been corrected. When a subentry is updated, the flag C is also added to the ENTRY and SUBENT records and the date of last updated is changed (N2 field, see pages 3.3 and 3.4).

D a record or records has been deleted ***following*** the record flagged.

I the record flagged has been inserted. When an entire subentry is inserted, the flag I is attached to the SUBENT record, and ***only*** the SUBENT.

T two updates have occurred as follows:
a) the record flagged has been inserted or corrected ***and***
b) a record or records has been deleted following the record flagged.

R the record flagged is a replacement. This is used when a large block of records is revised, *e.g.*, the complete BIB section or a section of the data table. The flag (R) appears in each replacement record. An entry is made under the information identifier HISTORY explaining the alteration.

Examples:

```
HISTORY     (710608A)  Between 1.0 eV and 700 eV data replaced by a new
                       set calculated from the old one averaging over five
                       data points
            (710709A)  BIB section rewritten, full paper published.
```

* The entry or subentry has been deleted (used only on an ENTRY or SUBENT record).

Alterations to dictionaries[1]

Dictionary alterations include additions, corrections and deletions, as well as the addition of status flags.

Format of dictionary updates

The format of dictionary update records and the resulting alterations (actions) are described in the following:

First record:

Column 1 - 5 ALTER
6 - 16 blank
17 - 22 Date of update (yymmdd)
23 - 44 blank
45 - 80 Free text. Contains the date of the run and reference to relevant CP-Memo(s).

Last record:

Column 1 - 8 ENDALTER
9 - 11 blank
12 - 80 Free text

Standard records:

1. **Change**

Column 1 - 11 Same as column 1 - 11 of the record to be changed
12 - 66 New text to replace old text
67 - 79 Identification of record to be changed
80 C

Action: The record having the specified identification has the old text (Column 12-66 replaced by the new text (if column 1 - 11 agree) and flagged as a change (C). The obsolete/extinct flag remains unaltered.

2. **Delete**

Column 1 - 11 Same as column 1 - 11 of the record to be deleted
12 - 66 Free text, *e.g.*, reason for deletion and/or reference to relevant CP-Memo
67 - 79 Identification of record to be deleted
80 D

Action: The record having the specified Identification is deleted (if Column 1 - 11 agree), and the preceding record flagged.

---

[1] Responsibilities for maintaining the dictionaries are outlined in Appendix P, page P.6.

3. **Insert**

a) Single insertion

Column 1 - 66 Text of record to be inserted
67 - 79 ID of record ***after*** which insert is to be made
80 I

b) Several consecutive insertions

First record as above.

Continuation records:

Column 1 - 66 Text of record to be inserted
67 - 74 As (a) above.
75 - 80 Continuation number, starting with 2, no leading zeros

Action: The records are inserted following the record having the ID specified on the first insert record, and each inserted record is flagged (I).

c) Insertion of a new dictionary

First record:

Column 1 - 7 DICTION
21 - 22 Dictionary number
35 - 66 Free text (title of dictionary)
67 - 79 300000nnn00001 (nnn=dictionary number)
80 I

Dictionary records:

Column 1 - 66 Dictionary information
67 - 74 300000nnn (nnn = dictionary number)
75 - 80 Blank

Last record:

Column 1 - 10 ENDDICTION
11 - 66 blank
67 - 79 300000nnn99999 (nnn = dictionary number)
80 blank

4. **Obsolete**

Column 1 - 11 Same as column 1 -11 of the record to be marked as obsolete.
12 - 66 Free text, *e.g.*, reason for obsolescence and/or reference to relevant CP-Memo.
67 - 79 Identification of record to be marked as obsolete.
80 O (letter O).

Action: The record having the specified Identification has the obsolete flag set to O (if column 1 - 11 agree). The alter flag remains unchanged.

Notes:

1. Records may be in any order, except for the ALTER and ENDALTER records, which are first and last, respectively; however, for a multiple insertion, the records will be in the correct order by continuation number.
2. The date field on the ALTER record is normally blank. The facility for inserting a date is included in case of emergency (such as the master file being destroyed). In such a case, and identical master can be regenerated by inserting the date of the previous updated in this field and using the previous update records.
3. If a specific ***code*** (as opposed to its associated text) is to be changed, the record must be deleted and the new code and text inserted. (Changes of a code rarely happen.)
4. In order to remove an obsolete code the record must be deleted, and the same record inserted, without the flag O.
5. A record cannot be inserted and marked obsolete at the same time. It must be inserted and then marked obsolete at the next update run.

Appendix B

COVARIANCE DATA FILE FORMAT

Covariance data may be stored on a separate covariance file. There are three record types in the covariance file:

- comment records,
- data records,
- end records.

Comment record format

Column	1	C
	2 - 9	Data set number (subaccession number)
	10	(blank)
	11 - 80	Comment which includes covariance type and format

Data record format

Column	1	D
	2 - 9	Data set number (subaccession number)
	10	(blank)
	11 - 80	Data in format given on comment record

End record format

Column	1	E
	2 - 9	Data set number (subaccession number)
	10 - 80	(blank)

See also **LEXFOR Covariance.**

Appendix C

GLOSSARY

This glossary includes definitions of terms used in this manual, listed alphabetically.

Common data: data common to a whole work or sub-work, which is presented in the common data section.

Data heading: a keyword defining the content of a data field in the COMMON or DATA section.

Data set: the data given in a subentry (sub-work).

Data unit: a keyword defining the units for the data presented in a data field in the COMMON or DATA section.

Exchange file: a file used to transmit data exchanged in the EXFOR format.

Exchange format: format used for the exchange of nuclear reaction data; EXFOR format.

Field heading: the 11-column heading to a data field which contains the data heading plus, perhaps, pointer.

File identification character: A character which identifies the originating center and type of data; used as the first character in the exchange file identification and in the accession number.

General quantity modifier: modifier codes which may be added to any REACTION string given in Dictionary 36, *e.g.*, MXW, REL.

Information identifier: a keyword defining the content of a record in the BIB section.

Record identification: information given in columns 67-79 on every record in a transmission file which uniquely identifies the record.

System identifier: a keyword defining a unit (section) of an transmission file, *e.g.*, ENTRY, BIB, NODATA.

Appendix D

Archive Dictionaries

The EXFOR/CINDA Dictionary Archive consists of a dictionary index file and a set of dictionary files, one for each dictionary, and contains all information necessary for the production of the DANIEL data base, and the EXFOR and CINDA dictionaries. The dictionary numbers do not necessarily correspond to the EXFOR dictionary numbers.

All dictionary updates are made on the Master Archive by the Nuclear Data Section and transmitted periodically to the other Nuclear Reaction Data Centers, either in the form of an EXFOR Dictionary transmission file or as a DANIEL update file.

The format and contents of the Archive Dictionary files are described on the following pages.

Table of Contents

General Format

Dictionary Index

The dictionary index contains a list of all the dictionary files stored, along with supplemental information.

The format of dictionary index line is:

Column(s)	1-3:	Dictionary number
	5-34:	Dictionary name
	36-37:	# of DANIEL keys
	39-78:	DANIEL record format

Dictionary Files

The dictionary files consist of two types of records: MASTER records and COMMENT records.

The general format of a MASTER record is:

Column(s)	1:	Alter flag
	2-4:	Status Code
	6-11:	Data of entry or last update
	13-32:	Key
	34-113:	Codes, expansions, etc. Format and contents given under each dictionary.

The general format of a COMMENT record is (exceptions are noted under each dictionary):

Columns	1-33:	blank
	34-88:	comment

List of Archive Dictionaries

1	EXFOR System Identifiers
2	EXFOR Information Identifiers
3	Institute Codes
4	Reference Type
5	Journal Codes
6	Report Codes
7	Book and Conference Codes
8	Elements
10	Standard Reactions (CSISRS)
11	Forbidden Reactions (CINDA)
12	CINDA Quantities
13	REACTION Type (for Dictionary 36)
14	REACTION Dimensions (for Dictionary 36)
15	History Codes
16	Status Codes
17	Related Reference Codes
18	Facility Codes
19	Incident Source
20	Additional Information
21	Method
22	Detector
23	Analysis
24	Data Headings
25	Data Units
26	Family Flags
27	Natural Elements, Nuclides and Compounds
30	Process Codes (for REACTION)
31	Branch Codes (for REACTION)
32	Parameter Codes (for REACTION)
33	Particles
34	Modifiers (for REACTION)
35	Data Type
36	Quantities
37	Result
43	NLIB for Evaluated Libraries
44	Data Libraries
50	List of Dictionaries

Alter Flags

Dictionary updates are recorded on the Master Archive files by adding an alteration flag and the date of alteration. When a new transmission is run the flags are used to process the records for the output files, and are deleted from the Master Archive files.

The following flags are used to indicate an alteration to a dictionary record.

A	The record has been added
D	The record is marked for deletion
M	A modification has been made to the Code-expansion field
S	The status has been changed

Status Codes

A list of legal status codes (for all dictionaries) follows.

CIN	CINDA use
EXT	extinct
INT	internal
OBS	obsolete
PRE	preliminary
PRO	proposed
TRA	transmitted

Contents of Dictionaries

The contents of the operating dictionaries are given on the following pages, along with the format of the MASTER records and any exceptions to the format of the COMMENT records.
For each MASTER record, the primary key is given first with the actual length of the key. (Note, however, that all primary keys are stored as 20-character strings.) Following the primary key, the secondary key (for the DANIEL data base), if it exists, and the contents of the dictionary line fields are given. Note that the secondary key is also the first dictionary line field. The dictionary line is stored as an 80-character string.

Dictionary 1: SYSTEM IDENTIFIERS

MASTER RECORD:
- KEY: EXFOR CODE (A10)
  - field 1: INTERNAL NUMERICAL EQUIVALENT (I9)
  - field 2: EXPANSION (A55)

Dictionary 2: INFORMATION IDENTIFIERS

MASTER RECORD:
- KEY: EXFOR CODE (A10)
  - field 1: EXPANSION (A25)
  - field 2: KEYWORD REQUIRED (A1)
    - R - required
    - B - one required
    - X - required when relevant
  - field 3: INTERNAL NUMERICAL EQUIVALENT (I2)
  - field 4: CODE REQUIRED OR OPTIONAL (A1)
    - R - required code
    - O - optional code
  - field 5: blank (A1)
  - field 6: EXFOR REQUIREMENT CODES (A22)
  - field 7: EXFOR dictionary (A11)

Dictionary 3: INSTITUTE CODES

MASTER RECORD:
- KEY1: EXFOR CODE (A7)
- KEY2: field 1: 3-character CINDA CODE (A3)
  - field 2: AREA, COUNTRY CODE (A4)
  - field 3: EXPANSION (A53)
  - field 4: COUNTRY, ORG. CODE FOR CINDA (A15)

COMMENTS:
- column 34: comment flag
  - = CINDA comment
- columns 35-88: comment

Dictionary 4: REFERENCE TYPE

MASTER RECORD:
- KEY: EXFOR CODE (A1)
  - field 1: SHORT EXPANSION (A4)
  - field 2: POINTER TO RELATED DICTIONARY (A3)
  - field 3: LONG EXPANSION (A35)

Dictionary 5: JOURNAL CODES

MASTER RECORD
KEY1: EXFOR CODE (A6)
KEY2: field 1: CINDA CODE (A4)
field 2: AREA-COUNTRY CODE (A4)
field 3: ADDITIONAL AREA-COUNTRY OR ORGANIZATION CODE (A4)
1st character = area code: 2nd country of origin

= 'T': country of original publication
= blank: organization code (1st code = nZZZ)
field 4: SHORT EXPANSION (A20)
field 5: EXPANSION (A48)
COMMENTS:
column 34: comment flag
+ addition to title
* full title
. translation of title
= CINDA comment
columns 35-88: comment

Dictionary 6: REPORT CODES

MASTER RECORD:
KEY: EXFOR CODE (A11) (CINDA key is 8-character truncation of code)
field 1: INSTITUTE CODE (A7)
field 2: EXPANSION (A48)
field 3: CINDA FLAG (A1)
* Expansion not entered in CINDA book dictionary
COMMENTS:
column 34: comment flag
= CINDA comment
columns 35-88: comment

Note: This dictionary contains CINDA codes flagged with the status code CIN, which are not simply truncations of the 10-character EXFOR code.

Dictionary 7: BOOK AND CONFERENCE CODES

MASTER RECORD:
KEY: EXFOR CODE (A10) (CINDA key is 8-character truncation of code)
field 1: EXPANSION (A53)
field 2: AREA-COUNTRY CODE (A4)
field 3: 2ND AREA-COUNTRY OR ORGANIZATION CODE (A4)
1st character = area code: 2nd country of origin

= 'T': country of original publication
= blank: organization code (1st code = nZZZ)
field 4: CINDA SHORT CODE (A10)

COMMENTS:
column 34: comment flag
(EXFOR long expansion
= CINDA comment
columns 35-88: comment

Dictionary 8: ELEMENTS

MASTER RECORD:
KEY1: Z-NUMBER OF ELEMENT (I3)
KEY2: field 1: ELEMENT SYMBOL (A2)
field 2: ELEMENT NAME (A20)

Dictionary 10: STANDARD REACTIONS (CSISRS)

MASTER RECORD:
KEY: CSISRS CODE line format output (A2)
field 1: EXPANSION (A24)
field 2: INTERNAL NUMERICAL EQUIVALENT (A56)

Dictionary 11: FORBIDDEN REACTIONS (CINDA)

MASTER RECORD:
KEY: EXFOR CODE (A8)
field 1: EXFOR CODE (A50)

Dictionary 12: CINDA QUANTITIES

MASTER RECORD:
KEY: CINDA CODE (A3)
field 1: FISSION FLAG (A1)
field 2: INTERNAL NUMERICAL EQUIVALENT (I4)
field 3: CINDA SHORT EXPANSION (A14)
field 3: EXPANSION (A50)

Dictionary 13: REACTION TYPE (for Dictionary 36)

MASTER RECORD:
KEY: EXFOR CODE (A3)
field 1: COMPUTATION FORMAT (A5)
field 2: ONLINE SYSTEM CODE (A4)
field 3: INDEPENDENT VARIABLE FAMILY CODE (I10)
field 4: EXPANSION (A65)

Dictionary 14: REACTION DIMENSIONS (for Dictionary 36)

MASTER RECORD:
KEY: EXFOR CODE (A1)
field 1: EXPANSION (A55)

Dictionary 15: HISTORY CODES

MASTER RECORD:
KEY: EXFOR CODE (A1)
field 1: SHORT EXPANSION (A15)
field 2: LONG EXPANSION (A45)

Dictionary 16: STATUS CODES

MASTER RECORD:
KEY: EXFOR CODE (A5)
field 1: INTERNAL NUMERICAL EQUIVALENT (I5)
field 2: EXPANSION (A55)
field 3: SUBACCESSION # FIELD FLAG (A1):
R - code must be followed by subaccession #
S - code may be followed by subaccession #

Dictionary 17: RELATED REFERENCE CODES

MASTER RECORD:
KEY: EXFOR CODE (A1)
field 1: EXPANSION (A53)

Dictionary 18: FACILITY

MASTER RECORD:
KEY: EXFOR CODE (A5)
field 1: EXPANSION (A53)
field 2: SPECIAL USE CODE (A4)
NEUT, PHOT

Dictionary 19: INCIDENT SOURCE

MASTER RECORD:
KEY: EXFOR CODE (A5)
field 1: EXPANSION (A53)
field 2: SPECIAL USE CODE (A4)
NEUT, PHOT
field 3: DELIMITER CODE (A1)

Dictionary 20: ADDITIONAL INFORMATION

MASTER RECORD:
KEY: EXFOR CODE (A5)
field 1: EXPANSION (A53)

Dictionary 21: METHOD

MASTER RECORD:
KEY: EXFOR CODE (A5)
field 1: EXPANSION (A53)
field 2: SPECIAL USE CODE (A4)
FY, NEUT, PHOT

Dictionary 22: DETECTOR

MASTER RECORD:
KEY: EXFOR CODE (A5)
field 1: EXPANSION (A53).
field 2: SPECIAL USE CODE (A3)
FY, NEU, GAM

Dictionary 23: ANALYSIS

MASTER RECORD:
KEY: EXFOR CODE (A5)
field 1: EXPANSION (A53)
field 2: SPECIAL USE CODE (A4)
PHOT, RP

Dictionary 24: DATA HEADINGS

MASTER RECORD:
KEY: EXFOR CODE (A10)
field 1: DATA TYPE (2I1)
1st integer 1: (unused)
2: data
2nd integer 2: ratio
3: sum
3: resonance parameter
2nd integer 1: quantum number
2: energy
4: incident energy
2nd integer 2: momentum
5: secondary energy
2nd integer 1: particle energy
2: level energy
3: excitation energy
4: Q value
5: energy degradation
6: energy gain
7: level number
6: angle
2nd integer 1: angle
2: cosine
5: coefficient number
7: other variable
2nd integer 1: half-life
2: sample temperature
3: sample thickness
7: polarization
8: isotope/particle identification
2nd integer 1: element
2: mass
3: isomer
4: monitor element
5: monitor mass
9: emitted nucleons
9: monitor/assumed value
2nd integer 5: assumed value
field 3: FAMILY CODE (A1)

Dictionary 24: DATA HEADINGS (continued)

field 4: PLOTTING FLAGS (I7)
col 1-3 - independent variable
col 4-6 - dependent variable
col 1 & 4: variable
1 - value
2 - minimum
3 - maximum
4 - approximate
5 - one of multiple variables
9 - uncertainty or resolution
if col 1 = 1-5:
col 2: 1 - numerator
2 - denominator
if col 1 or 4 = 9:
col 2 & 5: +error; col 3 & 6: -error
1 - error
2 - resolution
3 - half resolution
4 - statistical error
5 - partial error
col 7 - reference frame flag
1 - c.m. system
field 5: UNIT CODE (A4)
field 6: SPECIAL USE FLAG (A1)
H = for relativistic heavy-ion data
field 7: EXPANSION (A55)

Dictionary 25: DATA UNITS

MASTER RECORD:
KEY: EXFOR CODE (A10)
field 1: EXPANSION (A35)
field 2: FAMILY CODE (A4)
field 3: CONVERSION FACTOR (E11)
field 4: SORTING CODE (A3)

Dictionary 26: UNIT FAMILY CODES

MASTER RECORD
KEY: UNIT FAMILY CODE (A4)
field 1: DICTIONARY 24 USE (I2)
field 2: DICTIONARY 25 USE (I2)
field 3: DICTIONARY 36 USE (I2)
field 4: EXPLANATION (A50)

Dictionary 27: NATURAL ISOTOPIC MIXTURES, NUCLIDES AND COMPOUNDS

MASTER RECORD:
- KEY1: EXFOR CODE (A10)
- KEY2: field 1: CINDA CODE (A5)
  - field 2: INTERNAL NUMERICAL EQUIVALENT (I6)
  - field 3: NUCLIDE USES (A13)
    - (See EXFOR Chapter 7 for field contents)
  - field 4: SPIN (E5)
  - field 5: for isotopes, ISOTOPIC ABUNDANCE (E11)
    - for natural element, ATOMIC WEIGHT (E11)
  - field 6: EXPANSION (A25)
  - filed 7: COMPOUND FLAG (A1) = '*'

COMMENT RECORD
- Col. 34-35: OUTPUT DICTIONARY NUMBER FOR DANIEL (I2)
  - (blank after 1st MASTER Record).
  - 36-88: COMMENT

Dictionary 30: PROCESS CODES

MASTER RECORD:
- KEY: EXFOR CODE (A3)
  - field 1: INTERNAL NUMERICAL EQUIVALENT (I10)
  - field 2: EXPANSION (A55)

Dictionary 31: BRANCH CODES

MASTER RECORD:
- KEY: EXFOR CODE (A3)
  - field 1: INTERNAL NUMERICAL EQUIVALENT (I10)
  - field 2: EXPANSION (A55)

Dictionary 32: PARAMETER CODES

MASTER RECORD:
- KEY: EXFOR CODE (A3)
  - field 1: INTERNAL NUMERICAL EQUIVALENT (I10)
  - field 2: EXPANSION (A55)
  - field 3: SPECIAL USE CODE (A4)

Dictionary 33: PARTICLES

MASTER RECORD:
KEY: EXFOR CODE (A3)
field 1: INTERNAL NUMERICAL EQUIV: Reaction SF2,3 (I6)
field 2: INTERNAL NUMERICAL EQUIV: Reaction SF7 (I5)
field 3: ALLOWED SUBFIELD FLAG (A4)
D - BIB keyword other than REACTION; 1st character
1 - REACTION SF2; 2nd character
2 - REACTION SF3; 3rd character
7 - REACTION SF7; 4th character
field 4: EXPANSION (A40)
COMMENT RECORD
Col. 34-35: OUTPUT DICTIONARY NUMBER FOR DANIEL (I2)
36-88: COMMENT

Dictionary 34: MODIFIERS

MASTER RECORD:
KEY: EXFOR CODE (A3)
field 1: INTERNAL NUMERICAL EQUIVALENT (I10)
field 2: GENERAL QUANTITY MODIFIER FLAG (A5)
field 3: EXPANSION (A55)
COMMENT RECORD
Col. 1: Flag, '*' = replaces EXFOR expansion
35-89: Comment

Dictionary 35: DATA TYPE

MASTER RECORD:
KEY: EXFOR CODE (A5)
field 1: INTERNAL NUMERICAL EQUIVALENT (I10)
field 2: EXPANSION (A40)

Dictionary 36: QUANTITIES

MASTER RECORD:
- KEY: EXFOR CODE (A18)
  - field 1: INTERNAL NUMERICAL EQUIV. Reaction SF5 (I6)
  - field 2: INTERNAL NUMERICAL EQUIV. Reaction SF6 (I6)
  - field 3: INTERNAL NUMERICAL EQUIV. Reaction SF7 (I6)
  - field 4: INTERNAL NUMERICAL EQUIV. Reaction SF8 (I6)
  - field 5: REACTION TYPE (A3)
  - field 6: REACTION MODIFIER (A1)
  - field 7: FAMILY CODE (A4)
  - field 8: EXPANSION (A48)

COMMENT RECORD
- Col. 34-77: COMMENT

Dictionary 37: RESULT

MASTER RECORD:
- KEY: EXFOR CODE (A5)
  - field 1: EXPANSION (A53)

Dictionary 43: NLIB for Evaluated Libraries

MASTER RECORD:
- KEY: NLIB NUMBER (A2)
  - field 1: LIBRARY NAME (A40)

Dictionary 44: Data Libraries

MASTER RECORD:
- KEY: LIBRARY NAME (A20)
  - field 1: AREA-COUNTRY CODE (A4)
  - field 2: AREA-COUNTRY, ORGANIZATION CODE (A4)
    - 1st character = area code; 2nd country of origin
    - = blank; organization code (1st code = nZZZ)
  - field 3: EXPANSION (A55)

Archive/EXFOR Dictionary Correspondence

EXFOR	Title	Archive Source
1	EXFOR System Identifiers	1
2	EXFOR Information Identifiers	2
3	Institute Codes	3
4	Reference Type	4
5	Journal Codes	5
6	Report Codes	6
7	Book and Conference Codes	7
8	Elements	8
9	Compounds	27
13	Particles	33
15	History Codes	15
16	Status Codes	16
17	Related Reference Codes	17
18	Facility Codes	18
19	Incident Source	19
20	Additional Information	20
21	Method	21
22	Detector	22
23	Analysis	23
24	Data Heading Keywords	24
25	Data Unit Keywords	25
27	Nuclides	27
28	Incident Particles (REACTION SF2)	33
29	Product Particles (REACTION SF3)	33
30	Process Codes (REACTION SF3)	30
31	Branch Codes (REACTION SF3)	31
32	Parameter Codes (REACTION SF6)	32
33	Particles Considered (REACTION SF7)	33
34	Modifiers (REACTION SF8)	34
35	Data Type (REACTION SF9)	35
36	Quantities (REACTION SF5-8)	36
37	Result	37
42	CINDA Quantities	12
43	NLIB for Evaluated Libraries	43

Appendix P

PROTOCOL
FOR COOPERATION BETWEEN
THE NUCLEAR REACTION DATA CENTERS

The general scope of EXFOR data is all experimental microscopic nuclear reaction data.

Data tapes are exchanged regularly between the Nuclear Reaction Data Centers (NRDC) in the EXFOR format in accordance with the conventions laid down in the EXFOR Manual. Modifications to the general scope of EXFOR data can be adopted only as a result of an agreement between the NRDC.

The working language of EXFOR is English, and all free text comments within all EXFOR entries shall be in English.

All matters that affect EXFOR, in general, must be agreed to by the Nuclear Reaction Data Centers.

Table of Contents

Data Compilation Responsibility

The data centers are responsible for compiling nuclear reaction data as given in the following sections.

Neutron, charged-particle, and photonuclear reaction data ***must be compiled in separate entries***, with appropriate identification, even if they are reported in the same publication.

Neutron Reaction Data Compilation

The responsibility for the collection, compilation and dissemination of neutron data information is shared among the four major neutron data compilation centers, each being responsible for a defined service area.

The four neutron data centers and their respective service areas are:

1. The National Nuclear Data Center (NNDC) services the U.S.A. and Canada.
2. Nuclear Energy Agency Data Bank (NEA-DB) services the non-American member Countries of the O.E.C.D.
3. The Russian Nuclear Data Center (CJD), services the countries of the former U.S.S.R.
4. The I.A.E.A. Nuclear Data Section (NDS) services I.A.E.A. Member States not included in the service areas of the above three centers.

Within the scope of this protocol each center is expected to compile the data measured in its service area as fast and as thoroughly as possible. If two institutions from different service areas are involved, the center responsible is defined by the primary institute. The primary institute is defined by the following rules.

1) If a publication reports the results of different experiments, done at different laboratories, or, of data measured at one laboratory and, subsequently, analyzed at another laboratory, and the laboratories are in different service areas, the results should be compiled in separate entries by the center responsible for each institute.
2) If an itinerant group uses the facility of another institution, the primary institute is the institute of the itinerant group.
3) In an ambiguous case, the institution from which one is more likely to obtain further information of the experiment is defined as the primary institute.

Where the primary institute is not clear, the centers concerned should consult each other before compiling the data in order to avoid duplicate entry of the same data.

All neutron reaction data published after 1 July, 1970, should be coded in EXFOR (where new is defined as data collected by the centers at the time of, or after, formal transmission of data was initiated). Earlier data will be compiled as time permits.

Although each center may compile data measured outside its service area, regular transmission of EXFOR data from any one center shall include data only from its own service area.

Each center shall keep an archival copy of the latest version of each of the EXFOR entries which it originated and shall be ready to provide the data to any center should it be required.

All matters concerning the exchange of neutron data must be agreed to by the four neutron data centers.

Charged-Particle Reaction Data Compilation

The following four nuclear reaction data centers have the responsibility for the collection, compilation, and dissemination of charged-particle data information from their respective countries from 1989 and later.

- National Nuclear Data Center (NNDC) for the United States and Canada,
- Japan Charged-Particle Reaction Group (JCPRG) for data from Japan,
- ATOMKI for data from Hungary and Jülich,
- Russian Nuclear Structure and Reaction Data Center (CaJaD) for all countries not covered by other centers.

If two institutions from different service areas are involved, the center responsible is defined by the primary institute, see Neutron Reaction Data Compilation, preceding.

For other countries and for all charged-particle reaction data published until 1979, with the exception of data measured in Japan, CaJaD will be responsible for coordinating the compilation of the data. JCPRG will be responsible for all data measured in Japan.

The following procedures should be followed.

New Data (1980→)

A center wishing to compile data (C1) will contact the center in whose area of responsibility the data were produced (C2) with a list of the data sets to be compiled. C2 will inform C1, as quickly as possible, whether the data either have been compiled or are in the process of being compiled by another center.

If the data are not compiled or being compiled, C2 will either agree to compile them with priority, or ask that C1 compile the data and send them to C2 to be included in the next regular C2 transmission file.

Old Data (→1979)

A center wishing to compile data (C1) will contact all other centers with a list of the data sets to be compiled. The center responsible for the data (Sapporo or ЦАЯД) will inform C1, as quickly as possible, whether the data either have been compiled or are in the process of being compiled by another center.

If the data are not compiled or being compiled, C1 will compile the data and include it in the next regular C1 transmission file.

1. The center wishing to compile data should notify CaJaD of the data sets that they intend to compile.
2. CaJaD will check that the data set has not been compiled, and is not being compiled by another center, and will let the originating center know if they may go ahead with the compilation.

CaJaD will be responsible for checking that the data sets transmitted do not duplicate existing data.

Photonuclear Reaction Data Compilation

The Center for Photonuclear Experimental Data (CDFE) will be responsible for coordinating the compilation of photonuclear reaction data.

For photonuclear data there is no requirement for completeness.

EXFOR Transmissions

Assignment of Accession Numbers

The methods of assigning accession numbers may be different at each center. That is to say, a center may assign them manually or automatically (by computer). A center may assign legal EXFOR accession numbers only to works within its agreed area of responsibility. Where the responsibility for compiling a given data set is not clear, the centers concerned should consult each other before compiling the data in order to avoid duplicate entry of the same data. (See **LEXFOR Institute**) .

Procedure for files received with errors

There are two cases to be considered for files received with errors.

1.) If a file can not be physically read, in part or whole, then the originating center should be requested to send another identical file, which should be done with minimum delay.

2.) If there are errors (format, structure, *etc.*) in one or more entries, then the originating center should be notified of the errors by 4C- or CP-Memos with the usual distribution.

Alterations to EXFOR entries

Alterations to EXFOR entries are, ***in general,*** transmitted only by the originating center and are included in the regular EXFOR transmissions. However, retransmission of entries belonging to a center which is no longer active in an area compilation may be done at another center by agreement of the cooperating centers.

Serious corrections (for example, those involving the COMMON or DATA section, or essential BIB keywords such as REACTION, MONITOR, *etc.*) will be transmitted as quickly as possible. Less serious corrections can be made and transmitted as workloads permit.

Communication between Centers

Discussion among the cooperating centers on the subjects of data compilation, the EXFOR system and its further development, EXFOR Manual and Dictionaries, and EXFOR transmission files, are continued by means of memos, which are called:

- **CP Memos** for the communication of proposals, programming details and other general considerations which touch upon the overall aspect of EXFOR. This series of memoranda are numbered as follows:

  . . . . . Memo-CP-n/m

- **Four-Center Memos** for the communication of details dealing only with neutron data or other Four-Center (non-EXFOR) matters, *e.g.*, CINDA.

  . . . . . Memo 4C-n/m

where n is the center identification number, and m the chronological memo number within the center.

CP-Memos are distributed to the cooperating centers. Other compiling groups are informed, as needed, by their center of contact.

Such memos should conform to the following general format:

1.) For memos covering more than one topic,
   - The contents of each memo will be summarized in a covering-page index.
   - Each subject should begin on a new page to facilitate distribution to the appropriate staff at each center for action.
   - Items requiring agreement of the cooperating centers should be flagged with a special symbol in the index and on the appropriate page.
   - The memo number will appear on each page.

2.) All proposed changes and additions to the dictionaries, EXFOR Systems Manual, and LEXFOR should contain (where possible) a revised entry in the format of the appropriate document in addition to the usual documentation.

3.) In case of disagreement the originating center is responsible for collecting the points of agreement and issuing a final wording in the format of the appropriate document(s).

Exchange Format Memos are used for the transmittal of updating EXFOR Manual pages. This series of memoranda is issued by the NNDC only, to each of the other centers, and is numbered as follows:

Memo X4-m

where m is the chronological memo number.

EXFOR Dictionaries

Routine transmission of Dictionaries

To prevent duplications and conflicts, the IAEA Nuclear Data Section (NDS) is responsible for the coordination and the updating of the EXFOR dictionaries. For this purpose, an archival dictionary file is maintained at NDS in the DANIEL format (see Appendix D).

Each dictionary update is transmitted to all cooperating centers in the form of a listing of the input records. Such update pages are numbered sequentially.

At least every three months, or whenever a major alteration is made, NDS will transmit the complete dictionary file to the cooperating centers, either in the EXFOR or DANIEL format, as they prefer.

It is the responsibility of each center to verify that EXFOR information is compiled in accordance with the latest version of the dictionaries.

Addition of new codes

The cooperating centers may propose new codes or any other dictionary alteration by means of CP-Memos. The proposal should include the code and explanation to be entered in the dictionary and, if appropriate, a corresponding Manual entry (*e.g.*, LEXFOR entry) and/or a pertinent bibliographic reference.

The center responsible for updating the dictionaries is also responsible for checking the consistency of proposed alterations with other codes and with the EXFOR Manual. The cooperating centers should assist by checking, within their respective areas, the up-to-date status of the dictionaries for laboratories and bibliographic references. Some latitude is allowed in the formulation of a proposed dictionary entry, but the meaning must not be changed without the approval of the originating center. In questionable cases, the other centers should be consulted.

A proposed dictionary alteration which appears to be trivial (inconsequential) will be added to the dictionaries within a week after receipt. Other proposals, which appear less trivial (consequential, in particular, alterations to Dictionaries 1, 2, 4, 16, 24, 28-37, or any alterations which may entail changes in computer programs) will be entered into the dictionaries only after approval by the centers. Also, alterations of EXFOR dictionary entries which entail changes to data already transmitted cannot be implemented without specific NRDC approval.

If a center uses a new dictionary code in a data transmission prior to its inclusion in the relevant dictionary, the center must be prepared to correct the entry and retransmit it, if the new code is not approved.

In general, a dictionary alteration becomes effective upon it transmission to the cooperating centers.

Changes to Scope and Format of EXFOR

No changes in the structure of EXFOR will be allowed without NRDC agreement.

If any one of the NRDC proposes an alteration which would result in changes of the EXFOR structure and content, it will be the responsibility of the center originating such proposal to obtain NRDC agreement, following the procedure outlined, below.

The following procedure should be followed by each of the NRDC in obtaining the agreement for changes or revisions; all communications with regard to such proposals shall be in the form of CP Memos.

1.) The initial proposal should be disseminated to all centers. Wherever possible proposals affecting the content of the EXFOR Manual should contain proposals for specific wording to be inserted in the Manual.

2.) In the case where there is discussion on a proposal, the initiating center shall then collect and digest all comments, suggestions and counter proposals.

3.) In this review, the initiating center shall consider such facts which would affect the EXFOR associated computer codes.

4.) A change in EXFOR will not oblige centers to change existing entries (whether they have been transmitted or not) unless stated explicitly in the proposal and approved by the data centers.

5.) The initiating center shall then distribute a technical evaluation of alternatives to the other centers.

6.) After receiving the response to this technical evaluation, the initiating center shall:

   a.) In the case of positive agreement participating centers, submit the proposed alteration to the center responsible for the EXFOR Manual updating.

   b.) Otherwise, submit it for inclusion in the agenda of the next NRDC meeting. Proposals for changes to be considered at NRDC meetings should be sent out one month prior to the meeting date to allow center personnel time to review them.

Whenever decisions are made which require Manual changes, the new updates are to be prepared and sent out as soon as possible after the draft minutes are received. The proposed changes should be written into the minutes in such a way that they can be inserted directly into the Manual if they are accepted.

1) Suggestions for additions to LEXFOR will be accompanied by adequate explanation and documentation to help in preparing LEXFOR entries.

2) Any proposals for new quantity terms will be supported by the expansion, a full explanation of its use and limits, a list of corresponding Dictionary 36 entries, and a reference.

Manuals

Updating of Manual Pages

The center responsible for the updating of the Manuals is the National Nuclear Data Center (NNDC).

The NNDC may introduce changes for the purpose of editing. However, proposed Manual wordings submitted in CP-Memos are entered in the Manuals substantially unchanged, unless an objection is expressed in due time. The NNDC is also responsible for maintaining the internal consistency of the Manual; that means, *e.g.*, to check whether an agreed proposal entails changes (cross-references, *etc.*) in other parts of the Manual.

A non-editorial change on a Manual page, as compared to its previous version, is marked by a vertical line in the left-hand margin. The date of the latest revision to that page is given at the bottom of each page.

Where such proposals do receive unanimous NRDC approval, different views on matters of minor importance may all be included in LEXFOR as far as these views are in agreement with the EXFOR Manual and do not cause ambiguities in the definitions of codes.

Updated pages of the EXFOR Manual will be issued as soon as possible.

EXFOR Processing and Retrieval Codes

Some codes are used by more than one data center. Each center is invited to contribute suggestions for updates to the EXFOR check programs and other programs. The originating center will coordinate all program updates.

If another center wishes to update a code, that center should communicate their intention to the originating center ***before*** any updates are done in order to avoid duplication of programming effort The updated code should be transmitted immediately to the originating center.

Only the originating center will transmit corrected versions to the other centers.

Cooperating Centers and Groups

NNDC	National Nuclear Data Center, Bldg. 197D Brookhaven National Laboratory Upton, NY, U.S.A. 11973-5000 Email: NNDC@BNL.GOV or NNDC*nn*@BNL.GOV[1]
NEA-DB	NEA Data Bank 12, boulevard des Iles 92130 Issy-les-Moulineaux, FRANCE Email: NEA@NEA.FR or *name*@NEA.FR
NDS	IAEA Nuclear Data Section Wagramerstr. 5, P.O.Box 100 A-1400 Vienna, Austria Email: *name*@iaeand.iaea.or.at
CJD	Federal Research Center IPPE Centr Yadernykh Dannykh Ploschad Bondarenko 249 020 Obninsk, Kaluga Region, RUSSIA Email: manokhin@cjd.obninsk.su
CAJaD	National Scientific Research Center Kurchatov Institute Russia Nuclear Center 46 Ulitsa Kurchatova 123 182 Moscow, RUSSIA Email: CHUKREEV@CAJAD.KIAE.SU
CDFE	Institute of Nuclear Physics Moskovskiy Gos. Universitet Vorob'evy Gory 119 899 Moscow, RUSSIA Email: VARLAMOV@CDFE.NPI.MSU.SU

[1] *nn* = first and last initial of person to be contacted, *e.g.*, NNDCCD@BNL.GOV.

CNDC	China Nuclear Data Center China Institute of Atomic Energy P.O. BOX 275 (41) Beijing 102413, China Email: cndc@mipsa.ciae.ac.cn
RIKEN	The Institute of Physical & Chemical Research (RIKEN) 2-1 Hirosawa, Wako-Shi Saitama-ken 351-01, JAPAN Email: TENDOW@postman.RIKEN.GO.JP
Japan Charged Particle Reaction Group	Dept. of Physics Hokkaido University Kita-10 Nisha-8, Kita-ku Sapporo 060, JAPAN Email: kato@nucl.phys.hokaido.ac.jp
ATOMKI	Dr. F. T. Tárkányi Cyclotron Application Department ATOMKI, Institute of Nuclear Research Bem Tér 18/c, P. O. Box 51 H-4001 Debrecen, HUNGARY Email: tarkanyi@atomki.hu
Sarov	Russian Federal Center - VNIIEF Sarov, Nizhni Novgorod Region 607 190 pr. Mira 37, RUSSIA Email: "dunaeva@expd.vniif.ru"

The following center has contributed in the past, but is no longer compiling data.

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