EXFOR Exchange Formats Manual

Revision 2008 edited by

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based on earlier work by

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Issued on behalf of the
Nuclear Reaction Data Centres Network

Abstract: EXFOR is the exchange format for the transmission of experimental nuclear reaction data between national and international nuclear data centers for the benefit of nuclear data users in all countries. This report contains the agreed coding rules and a description of the format.
Note:

The IAEA-NDS-reports should not be considered as formal publications. When a nuclear data library is sent out by the IAEA Nuclear Data Section, it will be accompanied by an IAEA-NDS-report which should give the data user all necessary documentation on contents, format and origin of the data library.

IAEA-NDS-reports are updated whenever there is additional information of relevance to the users of the data library.

For citations care should be taken that credit is given to the author of the data library and/or to the data center which issued the data library. The editor of the IAEA-NDS-report is usually not the author of the data library.

Neither the originator of the data libraries nor the IAEA assume any liability for their correctness or for any damages resulting from their use.

96/11

Citation guideline:

When quoting EXFOR data in a publication this should be done in the following way:

EXFOR is the database for experimental nuclear reaction data maintained by the international Network of Nuclear Reaction Data Centres (NRDC) co-ordinated by the IAEA Nuclear Data Section. This manual describes the EXFOR exchange format to be used by EXFOR compilers and software developers.

The various aspects of the EXFOR system are described in the following documents:

<table>
<thead>
<tr>
<th>Name</th>
<th>Report code</th>
<th>Topics</th>
<th>Intended readership</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXFOR Exchange Formats Manual</td>
<td>IAEA-NDS-207</td>
<td>Description of EXFOR exchange formats</td>
<td>Compilers, software developers</td>
</tr>
<tr>
<td>LEXFOR</td>
<td>IAEA-NDS-208</td>
<td>Quantity definitions and compilation guidelines</td>
<td>Compilers</td>
</tr>
<tr>
<td>EXFOR/CINDA Dictionary Manual</td>
<td>IAEA-NDS-213</td>
<td>Description of dictionary formats</td>
<td>Compilers, software developers</td>
</tr>
<tr>
<td>NRDC Protocol</td>
<td>NRDC Protocol</td>
<td>Procedures for EXFOR exchange between NRDC centres</td>
<td>Compilers, centre heads</td>
</tr>
<tr>
<td>NRDC Network document</td>
<td>INDC(NDS)-401</td>
<td>Scope of activities and cooperation of NRDC centres</td>
<td>Centre heads</td>
</tr>
<tr>
<td>EXFOR Basics Manual</td>
<td>IAEA-NDS-206</td>
<td>Explanation of basic formats</td>
<td>EXFOR users</td>
</tr>
</tbody>
</table>

**How to use this manual**

This manual serves two purposes: it may be used textbook-like as an introduction to the newcomer, and it serves as the format reference manual for compilers and software developers. It is strongly recommended to any newcomer to EXFOR to first take a little time to browse through the complete manual (this will save much time later during the compilation work), and then have it at hand as a reference manual whenever compilation or software development work is to be done.
Acknowledgements

The EXFOR Manual was originally written by Hans D. Lemmel of the IAEA Nuclear Data Section and subsequently rewritten and reorganized by Victoria McLane of the National Nuclear Data Center, Brookhaven National Laboratory, who was the editor of many later revisions, which included contributions also of other members of the Nuclear Reaction Data Centres Network.

For the present edition, special thanks go to Naohiko Otsuka from the Japan Nuclear Reaction Data Centre at Hokkaido University and to Sophiya Taova from the Center of Nuclear Physics Data, Sarov, Russia, who pointed out a number of typographical and editorial shortcomings in the previous edition.

O.S., February 2008
# Table of Contents

## INTRODUCTION

- History .................................................................................................................................................. 1
- EXFOR Format .................................................................................................................................... 1

## Chapter 1. GENERAL STRUCTURE OF THE EXCHANGE FORMAT

- Structure of an EXFOR Exchange File ................................................................................................. 1.1
- Definition of a subentry ........................................................................................................................ 1.2
- Permitted character set .......................................................................................................................... 1.3
- Identification of files, entries, and subentries ..................................................................................... 1.3
- Center identification characters ........................................................................................................... 1.4
- EXFOR records ..................................................................................................................................... 1.5
- Accession Number ................................................................................................................................. 1.5
- Subaccession number ............................................................................................................................. 1.5
- Sequence number .................................................................................................................................. 1.6
- Summary of record identification .......................................................................................................... 1.6

## Chapter 2. SYSTEM IDENTIFIERS

- System identifier records ..................................................................................................................... 2.1
- System identifier sequence ................................................................................................................... 2.5

## Chapter 3. BIB SECTION

- Information-identifier keywords .......................................................................................................... 3.1
- Coded (machine-retrievable) information .............................................................................................. 3.2
- Free text .................................................................................................................................................. 3.3
- Codes and free text ............................................................................................................................... 3.3
- Examples of BIB sections ....................................................................................................................... 3.4

## Chapter 4. COMMON AND DATA SECTIONS

- Multiple representations of independent variables .............................................................................. 4.1
- Repetition of data headings ................................................................................................................ 4.2
- COMMON section .................................................................................................................................... 4.2
- DATA section .......................................................................................................................................... 4.3
- Field sequence of a DATA table ........................................................................................................... 4.4
- Line sequence of a DATA table ............................................................................................................ 4.4

## Chapter 5. POINTERS

- Multiple Reaction Formalism ............................................................................................................. 5.1
- Vector Common Data ........................................................................................................................... 5.2
- BIB/DATA Links .................................................................................................................................... 5.2
- BIB/BIB Links ......................................................................................................................................... 5.3
- Alternative Results ............................................................................................................................... 5.4
Chapter 6. REACTION SPECIFICATION ................................................................. 6.1
  Coding of nuclides and compounds .......................................................... 6.2
  Reaction field ......................................................................................... 6.2
  Quantity field ....................................................................................... 6.5
  Data type field ...................................................................................... 6.6
  Reaction combinations ......................................................................... 6.6
  Multiple reaction formalism ................................................................. 6.7
  Variable nucleus .................................................................................. 6.8
  Variable number of emitted particles ................................................... 6.9
  Links between reaction quantity and data headings ............................. 6.9

Chapter 7. INFORMATION-IDENTIFIER KEYWORDS AND CODING RULES ...... 7.1
  Information identifier categories ........................................................... 7.1
  Information identifier coding rules ....................................................... 7.3
  ADD-RES ............................................................................................... 7.3
  ANALYSIS ............................................................................................ 7.3
  ASSUMED ............................................................................................ 7.3
  AUTHOR .............................................................................................. 7.4
  COMMENT ............................................................................................ 7.5
  CORRECTION ...................................................................................... 7.5
  COVARIANCE ..................................................................................... 7.5
  CRITIQUE ........................................................................................... 7.5
  DECAY-DATA ..................................................................................... 7.6
  DECAY-MON ...................................................................................... 7.8
  DETECTOR ........................................................................................... 7.8
  EN-SEC ............................................................................................... 7.9
  ERR-ANALYS ..................................................................................... 7.10
  EXP-YEAR .......................................................................................... 7.10
  FACILITY ............................................................................................ 7.11
  FLAG ................................................................................................... 7.11
  HALF-LIFE .......................................................................................... 7.12
  HISTORY ............................................................................................. 7.12
  INC-SOURCE ...................................................................................... 7.13
  INC-SPECT ........................................................................................ 7.13
  INSTITUTE .......................................................................................... 7.13
  LEVEL-PROP ..................................................................................... 7.14
  METHOD ............................................................................................. 7.16
  MISC-COL .......................................................................................... 7.16
  MOM-SEC ........................................................................................... 7.16
  MONITOR ............................................................................................ 7.17
  MONIT-REF ........................................................................................ 7.18
  PART-DET ........................................................................................... 7.19
  RAD-DET ............................................................................................ 7.20
  REACTION .......................................................................................... 7.20
  REFERENCE ......................................................................................... 7.21
  REL-REF ............................................................................................. 7.24
  RESULT ............................................................................................... 7.24
  SAMPLE .............................................................................................. 7.25
  STATUS ............................................................................................... 7.25
  TITLE .................................................................................................... 7.26
Chapter 8. UPDATING AND ALTERATIONS
Alterations to EXFOR entries ................................................................. 8.1
Deletion of individual subentries .......................................................... 8.2
Deletion of entries .............................................................................. 8.2
Alteration flags ................................................................................... 8.3

APPENDICES
Appendix A: Example of an EXFOR entry
Appendix B. Covariance Data File Format
Appendix C. Glossary
(Blank page)
INTRODUCTION

EXFOR is an exchange format designed to allow transmission of nuclear reaction data between the members of the Nuclear Reaction Data Centers Network (NRDC) which has been organized under the auspices of the International Atomic Energy Agency to coordinate the collection, compilation, and dissemination of nuclear data on an international scale. This document has been written for use by the members of the Network and includes matters of procedure as well as detailed rules for the compilation of data. Users may prefer to consult EXFOR Basics for a brief description of the format.

History

The “EXFOR System” consists, primarily, of all experimental nuclear reaction data that has been exchanged between the members of the NRDC, and presently includes neutron, charged-particle, and photonuclear data files.

The EXFOR format has been designed for flexibility rather than optimization of data processing in order to meet the diverse needs of the nuclear reaction data centers. It was originally conceived for the exchange of neutron data through discussions among personnel from centers situated in Saclay, Vienna, Livermore and Brookhaven. It was accepted as the official exchange format of the neutron data centers at Saclay, Vienna, Brookhaven and Obninsk, at a meeting held in November 1969. As a result of two meetings held in 1975 and 1976 in which several charged-particle data centers participated, the format was further developed and adapted to cover all nuclear reaction data.

The EXFOR format is continuously refined and expanded to include new types of data as the need arises. This is accomplished through discussions among the member centers of the NRDC.

EXFOR Format

The EXFOR format allows a large variety of numerical data tables with associated textual information, i.e., bibliographic and descriptive information, to be transmitted in a format:

- that is machine-readable (for checking and processing);
- that can be read easily by personnel (for updating, evaluating, etc.).

---

3 See IAEA report INDC(NDU)-16/N (December 1969).
4 See IAEA reports INDC(NDS)-69 (December 1975) and INDC(NDS)-77 (October 1976).
The format was designed for flexibility in order to allow a wide range of data types to be exchanged and stored. A series of keywords and codes have been designed to implement this; these keywords and codes are defined in the EXFOR Dictionaries.

The working language of EXFOR is English.

The following chapters describe the exchange format in detail, in addition to discussing the use of keywords and codes.

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.
Chapter 1

GENERAL STRUCTURE OF THE EXCHANGE FORMAT

Nuclear reaction data is exchanged within the EXFOR System on EXFOR exchange files (transmissions).

This section describes the general structure and the general format of an EXFOR exchange file. More specific information may be found in the following chapters.

Structure of an EXFOR Exchange File

An exchange file contains a number of entries (works). Each entry is divided into a number of subentries (data sets). The subentries are composed of bibliographic (including descriptive and bookkeeping) information, and data. The data is further divided into data values that are common throughout the subentry (common data) and a data table.

The file may, therefore, be considered to be of the following form:
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. To accomplish this, the first subentry of each work contains only information that 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:

**Definition of a subentry.**

The originating center\(^1\) 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.

1. A subentry is defined as 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 \(Y\) (\(e.g., X = \text{energy}; X' = \text{angle}; Y = \text{differential cross section}\) and any associated variables (\(e.g., \text{standard}\)).

2. 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 \(Y'\) (\(e.g., X = \text{energy}, Y = \text{absolute cross section}, Y' = \text{relative cross section}\), and possible associated information. The criteria for grouping \(Y\) with \(Y'\) are that they both be derived from the same experimental information by the author of the data.

3. 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 point-wise).

4. For some data, the data table does not have an independent variable \(X\) but only a function \(Y\). (\(Examples: \text{Spontaneous} \nu; \text{resonance energies without resonance parameters}\))

5. 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.

---

\(^1\) Or a designated center, see Compilation Responsibility, NRDC Protocol.
**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)  
, (comma)  
% (percent)  
< (less than)  
> (greater than)  
: (colon)  
; (semi-colon)  
! (exclamation mark)  
? (question mark)  
& (ampersand)  
# (number symbol)  
[ (opening bracket)  
] (closing bracket)  
" (quotation mark)  
~ (varies as sign)  
@ (at symbol)  
{ (left curly brace)  
} (right curly brace)  
| (vertical bar)

**Identification of Files, Entries, and Subentries.**

In order to track, access, and identify data within the EXFOR Exchange System, the following labeling systems have been adopted for files, entries and subentries.

- An EXFOR Exchange File is labeled using a four-character file identification.
- An entry is labeled using a five-character accession number.
- A subentry is labeled using an eight-character subaccession number.

Each of these labels includes a center-identification character as the first character in the string. The table on the following page lists the center-identification characters that have been assigned. These characters define both the center at which the information was compiled and the type of data compiled.²

---

² Neutron, charged-particle, and photonuclear reaction data must be compiled in separate entries with appropriate identification, even if they were reported in the same reference. See NRDC Protocol, Data Compilation Responsibility.
## Center Identification Characters

<table>
<thead>
<tr>
<th>Center</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Preliminary</td>
</tr>
<tr>
<td>1</td>
<td>NNDC (Brookhaven)</td>
</tr>
<tr>
<td>2</td>
<td>NEA-DB (Paris)</td>
</tr>
<tr>
<td>3</td>
<td>NDS (Vienna)</td>
</tr>
<tr>
<td>4</td>
<td>CJD (Obninsk)</td>
</tr>
<tr>
<td>6</td>
<td>data from area 2</td>
</tr>
<tr>
<td>8</td>
<td>data from area 4</td>
</tr>
<tr>
<td>9</td>
<td>NDS (Vienna)</td>
</tr>
<tr>
<td>A</td>
<td>CAJaD (Moscow)</td>
</tr>
<tr>
<td>B</td>
<td>KaChaPaG (Karlsruhe)</td>
</tr>
<tr>
<td>C</td>
<td>NNDC (Brookhaven)</td>
</tr>
<tr>
<td>D</td>
<td>NDS (Vienna)</td>
</tr>
<tr>
<td>E</td>
<td>JCPRG (Sapporo)</td>
</tr>
<tr>
<td>F</td>
<td>NPDC (Sarov)</td>
</tr>
<tr>
<td>G</td>
<td>NDS (Vienna)</td>
</tr>
<tr>
<td>H</td>
<td>NNDC (Brookhaven)</td>
</tr>
<tr>
<td>J</td>
<td>JCPRG (Sapporo)</td>
</tr>
<tr>
<td>K</td>
<td>JCPRG (Sapporo)</td>
</tr>
<tr>
<td>L</td>
<td>NNDC (Brookhaven)</td>
</tr>
<tr>
<td>M</td>
<td>CDFE (Moscow)</td>
</tr>
<tr>
<td>N</td>
<td>NEA-DB (Paris)</td>
</tr>
<tr>
<td>O</td>
<td>NEA-DB (Paris)</td>
</tr>
<tr>
<td>P</td>
<td>NNDC (Brookhaven)</td>
</tr>
<tr>
<td>Q</td>
<td>CJD (Obninsk)</td>
</tr>
<tr>
<td>R</td>
<td>RIKEN</td>
</tr>
<tr>
<td>S</td>
<td>CNDC</td>
</tr>
<tr>
<td>T</td>
<td>VNIIEF/NNDC</td>
</tr>
<tr>
<td>V</td>
<td>NDS (Vienna)</td>
</tr>
</tbody>
</table>

---

\(^3\) Updates of these entries are the responsibility of CAJaD.

\(^4\) Updates of these entries are the responsibility of NNDC.

\(^5\) Updates of these entries are the responsibility of JCPRG.
EXFOR Records

EXFOR Exchange files consist of 80 character ASCII records. The format of columns 1-66 varies according to the record type as outlined in the following chapters. Columns 67-79 is used to uniquely identify a record within the file. The records on the file are in ascending order according to the record identification. Column 80 is reserved for an alteration flag.

Record identification. The record identification is divided into three fields: the accession number (entry), subaccession number (subentry), and record number within the subentry. This guarantees that each record can be uniquely referenced (i.e., no two records on a given file will have the same identification).

The format of these fields is as follows.

- Columns 67-71: Center-assigned accession number
- Columns 72-74: Subaccession number
- Columns 75-79: Sequence number

Accession number (columns 67-71). Columns 67-71 contain the five-character accession number assigned by the originating center to a given work. Column 67 is the file identification character (see page 1.4); columns 68-71 contain a center-assigned entry number, allowing 9,998 entries for each file identification character (e.g., A0198). The entries will appear on the exchange file in ascending order by accession number.

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.

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.

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6 Leading zeros should always be included on an exchange file.
7 See NRDC Protocol, for more information on the assignment of accession numbers.
8 The integer 9999 is reserved for use in identifying the end of an exchange file (see Chapter 2).
9 The integer 999 is reserved for use in identifying the end of an entry or a file (see Chapter 2).
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 99998.

The sequence number allows referencing at the record level, 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.

Summary of Record Identification.

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
2) Subaccession Number: 001 to 999
3) Sequence Number: 00001 to 99999

Used in combination, these fields uniquely reference information within the EXFOR System 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.  

The first two fields (columns 67-74) are associated with a subentry throughout the life of the system; that is, if a subentry is deleted from the system, the same identification is not assigned to another subentry.

Column 80: Until 2007, the last column of each record was used for an alteration flag, to indicate that a record and/or following records has been altered (i.e., added, deleted or modified) since the work was last transmitted. Starting 2008, alterations are flagged in a different way, and column 80 remains blank. See Chapter 8 for the use of Alteration Flags.

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10 The integer 9999 is reserved for use in identifying the end of a subentry, entry, or file.
11 Columns 67-79 may be padded with zeros (0) or with blanks on an exchange file.
Chapter 2

SYSTEM IDENTIFIERS

Each of the following basic system identifiers refers to one of the hierarchy of units contained on an exchange file. These units and their corresponding basic system identifiers are:

<table>
<thead>
<tr>
<th>System Identifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANS</td>
<td>A transmission is the unit</td>
</tr>
<tr>
<td>ENTRY</td>
<td>An entry (work) is the unit</td>
</tr>
<tr>
<td>SUBENT</td>
<td>A subentry (data set) is the unit</td>
</tr>
<tr>
<td>BIB</td>
<td>The Bibliographic Information section (hereafter referred to as the BIB section) of a complete work or sub-work is the unit</td>
</tr>
<tr>
<td>COMMON</td>
<td>The Common Data section of a complete work or sub-work is the unit</td>
</tr>
<tr>
<td>DATA</td>
<td>The Data Table section of a sub-work is the unit</td>
</tr>
</tbody>
</table>

These basic system identifiers are combined with the modifiers

<table>
<thead>
<tr>
<th>Modifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>A positive indication that a unit is intentionally omitted (modifier NO preceding the basic system identifier)</td>
</tr>
<tr>
<td>END</td>
<td>The end of a unit (modifier END preceding the basic system identifier)</td>
</tr>
</tbody>
</table>

However, only those combinations of basic system identifiers and modifiers that 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:

```
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, and are right adjusted to columns 22 and 33, respectively. The significance of N1 and N2 depends on the system identifier used (see following pages).
Columns 34-66, 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 the hierarchy of an exchange file and the use of system identifier records in detail.

1. An exchange file (transmission) is one logical file.

**TRANS** is the first record on an exchange file.

N1 - The exchange file identification (CXXX), consisting of:

- column 19: the center-identification character,
- 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 - An eight-digit integer containing the data (year, month, and day) on which the exchange file was generated. The format is: YYYYMMDD.

The record identification contains the file-identification character in column 67 and zeros in columns 68-79.

**ENDTRANS** is the last record of the exchange 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 \( \geq \) the file identification number of the previous record, in column 67 and 9's in columns 68-79.

2. An exchange file is made up of one or more entries (works).

**ENTRY** is the first record of each entry.

N1 - 5-character accession number

N2 - Date of last update (or date of entry if never updated) (YYYYMMDD)

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 compiled the entry or made the last revision.

---

1 On files that contain entries with different file-identification characters, column 67 is assigned such that the record sorts at the beginning of the file.
ENDENTRY is the last record of each entry.
N1 - The number of subentries in the work.²
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).

3. Entries are divided in subentries (data sets).

SUBENT is 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) (YYYYMMDD).

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

ENDSUBENT is the last record of each subentry.
N1 - The number of records within the subentry.³
N2 - Presently unused (may be blank or zero).

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

NOSUBENT is a positive indication that no subentry exists for a subaccession number.⁴
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.

4. Each subentry but the first contains three sections or, for each section, a positive indication that the section is not given. The sections are BIB, COMMON, and DATA. The first subentry (Common Subentry) does not contain a DATA section.

The record identification for these system identifiers contains the subaccession number (columns 67-74), and the sequence number, assigned sequentially within the subentry (columns 75-79).

² NOSUBENT records are counted as subentries when computing the number of subentries in an entry.
³ Not counting the SUBENT and ENDSUBENT records.
⁴ A subentry number has been assigned, 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.
**BIB section** contains bibliographic information.

**BIB** is the **first record** of each BIB section.
N1 - Number of information-identifier keywords in the BIB section.
N2 - Number of records within the BIB section.\(^5\)

**ENDBIB** is the **last record** of each BIB section.
N1 - Number of records within BIB section (same as N2 on BIB record).
N2 - Presently unused (may be blank or zero).

**NOBIB** is 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 section** contains common data.

**COMMON** is the **first record** of each common data section.
N1 - Number of common data fields.
N2 - Number of records within the common section.\(^6\)

**ENDCOMMON** is the **last record** of each common data section.
N1 - Number of records within the common section (same as N2 on COMMON record).
N2 - Presently unused (may be zero or blank).

**NOCOMMON** is 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 section** contains the data table.\(^7\)

**DATA** is 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** is 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.\(^8\)
N2 - Presently unused (may be zero or blank).

**NODATA** is 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).

\(^5\) Not counting the BIB and ENDBIB records.
\(^6\) Not counting the COMMON and ENDCOMMON records.
\(^7\) Does not appear in the first (common) subentry.
\(^8\) Not counting the DATA and ENDDATA records.
**System identifier sequence**

The following table specifies the permissible order in which system identifiers may appear.

<table>
<thead>
<tr>
<th>SYSTEM IDENTIFIER</th>
<th>LEGAL FOLLOWING RECORD</th>
<th>LEGAL PRECEDING RECORDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANS</td>
<td>ENTRY</td>
<td>No information precedes TRANS</td>
</tr>
<tr>
<td>ENDTRANS</td>
<td>(no information follows ENDTRANS)</td>
<td>ENDENTRY</td>
</tr>
<tr>
<td>ENTRY</td>
<td>SUBENT, NOSUBENT</td>
<td>ENDENTRY, TRANS</td>
</tr>
<tr>
<td>ENDENTRY</td>
<td>ENTRY, ENDTRANS</td>
<td>ENDSUBENT, NOSUBENT</td>
</tr>
</tbody>
</table>

The following applies to the first subentry (subentry number = 1).

| SUBENT            | BIB, NOBIB | ENTRY |
| ENDSUBENT         | SUBENT, ENDENTRY, NOSUBENT | ENDCOMMON, NOCOMMON |
| NOSUBENT          | SUBENT, ENDENTRY, NOSUBENT | ENTRY |
| BIB               | (a bibliographic record) | SUBENT |
| ENDBIB            | COMMON, NOCOMMON | (a bibliographic record) |
| NOBIB             | COMMON, NOCOMMON | (a bibliographic record) |
| COMMON            | (a common data record) | ENDBIB, NOBIB |
| ENDCOMMON         | ENDSUBENT | (a common data record) |
| NOCOMMON          | ENDSUBENT | ENDBIB, NOBIB |

The following apply to the remaining subentries (subentry number ≠ 1).

| SUBENT            | BIB, NOBIB | ENDSUBENT,NOSUBENT |
| ENDSUBENT         | SUBENT, ENDENTRY, NOSUBENT | ENDDATA, NODATA |
| NOSUBENT          | SUBENT, ENDENTRY, NOSUBENT | ENDSUBENT, NOSUBENT |
| BIB               | (a bibliographic record) | SUBENT |
| ENDBIB            | COMMON, NOCOMMON | (a bibliographic record) |
| NOBIB             | COMMON, NOCOMMON | SUBENT |
| COMMON            | (a common data record) | ENDBIB, NOBIB |
| ENDCOMMON         | DATA, NODATA | (a common data record) |
| NOCOMMON          | DATA, NODATA | ENDBIB, NOBIB |
| DATA              | (a data heading record) | ENDCOMMON, NOCOMMON |
| ENDDATA           | ENDSUBENT | (a data record) |
(Blank page)
Chapter 3

BIB SECTION

The BIB section contains the bibliographic information (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 three parts:
- columns 1-11: information-identifier keyword field,
- columns 12-66: information field, which may contain coded information and/or free text,
- columns 67-79: record identification field (see Chapter 1).

A set of information identifiers has been devised so that each item of BIB information can be identified for computer processing.

BIB information for a given data set consists of the information contained in the BIB section of its subentry together with the BIB information in subentry 001. That is, 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 Chapter 5). These keywords may, in general, appear in any order within the BIB section.

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 5 for use of pointers).

A list of all Information Identifiers is given in Dictionary 2. For detailed coding rules, see Chapter 7.
Coded (machine-retrievable) information

Some information-identifier keywords have associated with them a standard set of coded information. A set of dictionaries is provided for defining the meaning of any coded information that is not self-explanatory.1

Coded information may be used:
- to define the actual BIB information,
- as a link to the COMMON and DATA section,
- to enter associated numerical data.

Coded information may also be useful for retrieval or for identification of a data set.

Coded information is enclosed in parentheses and left adjusted so that the opening parenthesis appears in column 12. Several pieces of coded information may be associated with a given information-identifier keyword.

For some keywords, a restriction is placed upon the maximum length of the associated coded information.2 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 coded information is kept as concise as possible so that it may be used efficiently.

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

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 its own set of parenthesis starting in column 12, followed by free text, for example:

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

---

1 Authors’ names, for example, are self-explanatory, and no dictionary is needed.
2 See EXFOR/CINDA Dictionary Manual for maximum length of codes.
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 detailed coding rules for each information-identifier keyword in Chapter 7 and the Dictionaries (described in the EXFOR/CINDA Dictionary Manual) for codes.

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)

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, in general, a left parenthesis in the text must not be used in column 12 (as this implies the opening parenthesis of coded information).

The language of the free text is English, and clear English phrasing should be used; no EXFOR codes are to be used within the free text.3

Unlimited free text is permitted with each information identifier.

See also LEXFOR, Free Text.

Codes and free text

If both coded information and free text 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, when needed, 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.

3 Expansions of these codes may be used, at the compiler's discretion, embedded in free text.
An indication that the code is not expanded is given by:

- a decimal point (full stop) immediately following the closing parenthesis,
- a completely blank field between the closing parenthesis and column 66.

**Example:**

```
DETECTOR (GELI). to measure gamma spectra
(SCIN)
(HFGE) Co-axial high-purity Ge p-type detector
```

In this example, the first two codes are meant to be expanded, while the third one is not.

See Chapter 7 for details on specific information-identifier keywords.

### Example of BIB sections

<table>
<thead>
<tr>
<th>ENTRY</th>
<th>00001</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBENT</td>
<td>00010</td>
</tr>
<tr>
<td>BIB</td>
<td>(J.W.Dow, M.P.Jones)</td>
</tr>
<tr>
<td>AUTHOR</td>
<td>(3AAABB)</td>
</tr>
<tr>
<td>INSTITUTE</td>
<td>(ABC, WXYZ)</td>
</tr>
<tr>
<td>INC-SOURCE</td>
<td>(92-U-235 (N,EL),,WID)</td>
</tr>
<tr>
<td>REACTION</td>
<td>(CDEFG).</td>
</tr>
<tr>
<td>ANALYSIS</td>
<td>(HIJ).</td>
</tr>
<tr>
<td>ENDBIB</td>
<td></td>
</tr>
<tr>
<td>NOCOMMON</td>
<td></td>
</tr>
<tr>
<td>ENDSUBENT</td>
<td></td>
</tr>
<tr>
<td>SUBENT</td>
<td></td>
</tr>
<tr>
<td>BIB</td>
<td></td>
</tr>
<tr>
<td>ENDBIB</td>
<td></td>
</tr>
<tr>
<td>ENDENTRY</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 4

COMMON AND DATA SECTIONS

The format of the Common Data (COMMON) and Data Table (DATA) sections is identical; however, the significance of the content is different. Each section is a table of data with its associated data headings and units. 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 section. The 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., one or more lines of data. A data field that has a constant value over all rows of the DATA section, e.g., gamma-ray energy, could better be entered as a constant parameter in the COMMON section.

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, a data line consists of up to three physical records.

Records are not packed; rather, individual point information is kept on individual records; i.e., if only four fields are associated with a data line, the remaining two fields are left blank, and, in the case of the data table, the information for the next line 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 4.4).

The content of the COMMON and DATA sections 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 Dictionary 24 (see EXFOR/CINDA Dictionary Manual).

  A one-character pointer may be 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 Chapter 5 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 Dictionary 25 (see EXFOR/CINDA Dictionary Manual).
Records containing the numerical data (if more than six fields are used, the data is continued onto successive records). The numerical data is FORTRAN-readable using a floating-point format.

FORTRAN-readable according to a floating-point 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:

<table>
<thead>
<tr>
<th>Fixed point numbers with a decimal point</th>
<th>Floating point numbers with an exponent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.14</td>
<td>+0.014E+01</td>
</tr>
<tr>
<td>0.14</td>
<td>0.0014E+2</td>
</tr>
<tr>
<td>0.14</td>
<td>0.0014E2</td>
</tr>
<tr>
<td>+0.14</td>
<td>0.0014E+2</td>
</tr>
<tr>
<td>-0.14</td>
<td>-0.140E+00</td>
</tr>
<tr>
<td>-.14</td>
<td>-.14E0</td>
</tr>
</tbody>
</table>

A data set consists of the three sections:
- COMMON section of subentry nnn ≠ 001,
- DATA section of subentry nnn ≠ 001,
- COMMON section of subentry 001 of same entry.

The following restrictions apply within a data set.

**Multiple representations of independent variables.** Only one representation of an independent variable may be given for each data set (e.g., either angle or cosine may 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, *e.g.*, as follows:

\[
\begin{array}{ccc}
E\text{-LVL} & E\text{-LVL} & E\text{-LVL} \\
\text{MEV} & \text{MEV} & \text{MEV} \\
0.077 & 0.107 & 0.177
\end{array}
\]

Similarly, the data heading \text{EN\text{-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 \text{ANG} repeated, as follows:

\[
\begin{array}{ccc}
\text{ANG} & \text{ANG} & \text{ANG} \\
\text{ADEG} & \text{AMIN} & \text{ASEC} \\
90. & 47. & 10.
\end{array}
\]

Other data headings beginning with \text{ANG} may be repeated in the same way.

3. Half-life values in different units, such as \text{SEC}, \text{DAY}, \text{YR}, are entered as follows:

\[
\begin{array}{ccc}
\text{HL} & \text{HL} & \text{HL} \\
\text{SEC} & \text{D} & \text{YR} \\
15. & 28.3 & 4.8
\end{array}
\]

Any other data heading starting with \text{HL} (*e.g.*, \text{HL1}) may be repeated in the same way. This usage cannot occur in a \text{COMMON} section.

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

\[
\begin{array}{cc}
\text{EN\text{-RSL}} & \text{EN\text{-RSL}} \\
\text{KEV} & \text{PER\text{-CENT}} \\
20. & 10.
\end{array}
\]

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

\[
\begin{array}{cc}
\text{MASS} & \text{MASS} \\
\text{NO\text{-DIM}} & \text{NO\text{-DIM}} \\
135. & 136.
\end{array}
\]

6. Two or more flags defined under the information-identifier keyword \text{FLAG} that apply to the same line of the data table are entered as follows:

\[
\begin{array}{cc}
\text{FLAG} & \text{FLAG} \\
\text{NO\text{-DIM}} & \text{NO\text{-DIM}} \\
1. & 2. \\
2. & 3.
\end{array}
\]

**COMMON Section**

The \text{COMMON} section is identified as that information between the system identifiers \text{COMMON} and \text{ENDCOMMON}. (See page 2.4 for details on the \text{COMMON} and \text{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 that contain the suffix -ERR.

An example of a common data table:

```
<table>
<thead>
<tr>
<th>1</th>
<th>12</th>
<th>23</th>
<th>34</th>
<th>45</th>
<th>56</th>
<th>66</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN</td>
<td>EN-ERR</td>
<td>E</td>
<td>E-ERR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEV</td>
<td>MEV</td>
<td>MEV</td>
<td>MEV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.73</td>
<td>0.16</td>
<td>1.38</td>
<td>0.21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENDCOMMON</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

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

```
<table>
<thead>
<tr>
<th>1</th>
<th>12</th>
<th>23</th>
<th>34</th>
<th>45</th>
<th>56</th>
<th>66</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN</td>
<td>EN-ERR</td>
<td>EN-RSL</td>
<td>E-LVL</td>
<td>E-LVL</td>
<td>MONIT</td>
<td>MONIT-ERR</td>
</tr>
<tr>
<td>MEV</td>
<td>MEV</td>
<td>MEV</td>
<td>MEV</td>
<td>MB</td>
<td>MB</td>
<td></td>
</tr>
<tr>
<td>2.73</td>
<td>0.02</td>
<td>0.05</td>
<td>2.73</td>
<td>2.78</td>
<td>3.456</td>
<td>0.123</td>
</tr>
<tr>
<td>0.123</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENDCOMMON</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

**DATA Section**

The DATA section is identified as that information between the system identifiers DATA and ENDDATA. (See page 2.4 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 4.6). 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.

```
<table>
<thead>
<tr>
<th>1</th>
<th>12</th>
<th>23</th>
<th>34</th>
<th>45</th>
<th>56</th>
<th>66</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANG</td>
<td>ANG-ERR</td>
<td>DATA</td>
<td>DATA-ERR</td>
<td>DATA-MAX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADEG</td>
<td>ADEG</td>
<td>MB/SR</td>
<td>MB/SR</td>
<td>MB/SR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.7</td>
<td>1.8</td>
<td>138</td>
<td>8.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.9</td>
<td>1.2</td>
<td>127</td>
<td>4.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39.1</td>
<td>0.9</td>
<td>83.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46.7</td>
<td>0.7</td>
<td>14.8</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENDDATA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```
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, etc.);
- dependent variables (DATA);
- associated quantities (EN-ERR, ANG-RSL, DATA-ERR, etc.);
- additional information (MONIT, MISC, FLAG, HL, etc.).

The division between different categories and families within categories is defined in EXFOR Dictionary 24 (Data Headings)¹ (see EXFOR/CINDA Dictionary Manual).

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.

The EXFOR table will then look as follows.

```
DATA
  independent variable(s) dependent variable(s) additional information
  + associated quantities  + associated quantities
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.

¹ Note that some data headings may be used either as independent variables or as additional information.
**Example:**

```
<table>
<thead>
<tr>
<th>DATA</th>
<th>EN</th>
<th>EN-ERR</th>
<th>ANGLE</th>
<th>ANGLE-ERR</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEV</td>
<td>MEV</td>
<td>ADEG</td>
<td>ADEG</td>
<td>MB/SR</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>.02</td>
<td>35.</td>
<td>10.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>.02</td>
<td>60.</td>
<td>10.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>.02</td>
<td>90.</td>
<td>10.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>.02</td>
<td>30.</td>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>.02</td>
<td>60.</td>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>.02</td>
<td>90.</td>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>.03</td>
<td>30.</td>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>.03</td>
<td>60.</td>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>.03</td>
<td>90.</td>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENDDATA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

Alternatively, this table may be given in the vector common data formalism using pointers; see page 5.2.

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:**

```
<table>
<thead>
<tr>
<th>DATA</th>
<th>E-LVL</th>
<th>E-LVL-MIN</th>
<th>E-LVL-MAX</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEV</td>
<td>MEV</td>
<td>MEV</td>
<td>MEV</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>0.506</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>0.81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>0.990</td>
<td>0.998</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>1.250</td>
<td>1.300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>1.400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>0.405</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENDDATA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```
Chapter 5

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 6.7 and LEXFOR, Multiple Reaction Formalism) 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,0),,EN)
2 (92-U-235 (N,0),,J)
3 (92-U-235 (N,TOT),,WID)
...
ENDBIB
COMMON
MOMENTUM L DATA-ERR 1
NO-DIM EV
...
ENDCOMMON
DATA
DATA 1 DATA 2 DATA 3 DATA-ERR
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 field in the COMMON section headed DATA-ERR is linked, by means of a pointer, to fields of the DATA section and to a specific REACTION code in the BIB Section with the pointer 1. Each field in the DATA section is linked to the REACTION code in the BIB Section with the same pointer.

2. Vector Common Data

Multi-dimensional tables may be coded using pointers. (See page 4.6 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 1 E 1 E-MIN 2 E-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 is used only for the specific cases listed in LEXFOR, Multiple Reaction Formalism.
**Example:**

```plaintext
<table>
<thead>
<tr>
<th>COMMON</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANG</td>
</tr>
<tr>
<td>ADEG</td>
</tr>
<tr>
<td>...</td>
</tr>
<tr>
<td>ENDCOMMON</td>
</tr>
<tr>
<td>DATA</td>
</tr>
<tr>
<td>EN</td>
</tr>
<tr>
<td>ENDCOMMON</td>
</tr>
</tbody>
</table>

**3. BIB/DATA Links**

Pointers used for multiple reactions or for vector common data may be also be used elsewhere in the BIB section in order to link certain information to one of the multiple reactions or vector common fields.

**Example:**

```plaintext
<table>
<thead>
<tr>
<th>BIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMMENT</td>
</tr>
<tr>
<td>ENDBIB</td>
</tr>
<tr>
<td>COMMON</td>
</tr>
<tr>
<td>ANG</td>
</tr>
<tr>
<td>ADEG</td>
</tr>
<tr>
<td>...</td>
</tr>
<tr>
<td>ENDCOMMON</td>
</tr>
<tr>
<td>DATA</td>
</tr>
<tr>
<td>EN</td>
</tr>
<tr>
<td>ENDCOMMON</td>
</tr>
</tbody>
</table>
```

or

```plaintext
<table>
<thead>
<tr>
<th>BIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>REACTION</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>PART-DET</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>ENDBIB</td>
</tr>
</tbody>
</table>
```

**Forbidden:**

```plaintext
<table>
<thead>
<tr>
<th>BIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>REACTION</td>
</tr>
<tr>
<td>PART-DET</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>ENDBIB</td>
</tr>
<tr>
<td>COMMON</td>
</tr>
<tr>
<td>MONIT</td>
</tr>
<tr>
<td>...</td>
</tr>
</tbody>
</table>
```
4. BIB/BIB Links
Pointers may be used to link pieces of BIB information, all referring to the same reaction. If the multiple-reaction or vector-common formalism is used, BIB/BIB links are used only to link to existing pointers, as in BIB/DATA Links.

Example:

```
BIB
REACTION  (…)
PART-DET  1 (…)
2 (…)
DETECTOR  1 (…)
2 (…)
ENDBIB
```

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.\(^2\) (See also LEXFOR, Status / Interdependent Data).

Example:

```
BIB
REACTION  1 (…)
2 (…)
ANALYSIS  1 (…)
2 (…)
ENDBIB
```

\(^2\) From a processing point of view, this is the same concept as multiple reactions (described on page 6.7)
Chapter 6

REACTION SPECIFICATION

The reaction and quantity for the data coded in the data table is specified using the information-identifier keyword REACTION, therefore, this keyword must always be present in a data set. Because of its importance, the use of this keyword will be given in detail in this chapter, along with information on its links to the data.

A REACTION unit consists of three major fields:

(reaction, quantity, data-type)

If a code string is too long to fit between columns 12 and 66, it 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 subfields should be the last character on the line.

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.

Coding of nuclides and compounds.................................6.2
Reaction field.................................................................6.2
  SF1. Target Nucleus
  SF2. Incident particle
  SF3. Process
  SF4. Reaction Product
Quantity field ...............................................................6.5
  SF5. Branch
  SF6. Parameter
  SF7. Particle considered
  SF8. Modifier
Data-type field.............................................................6.6
  SF9. Data type
Reaction Combinations..............................................6.6
Reaction ratios ...........................................................6.7
Multiple-Reaction Formalism.................................6.7
Variable nucleus.........................................................6.8
Variable number of emitted particles.........................6.9
Links between reaction quantity and data headings ........6.9
**Coding of nuclides and compounds**

Nuclides appear in the coding of many keywords. The general code format is $Z\cdot S\cdot A\cdot X$, where:

- $Z$ is the charge number; up to 3 digits, no leading zeros
- $S$ is the element symbol; 1 or 2 characters (Dictionary 8)
- $A$ is the mass number; 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 (see also LEXFOR, Isomeric States):

- **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)
- **L** if only one quasi-metastable state is regarded
- **L1** for the first quasi-metastable state, etc.

Exceptions to this coding are noted on the pages for each keyword. (See also LEXFOR, Elements). Valid nuclide codes are given in Dictionary 227 (see EXFOR/CINDA Dictionary Manual).

Compounds may in some cases replace the nuclide code. The general format for coding compounds is either the specific compound code, taken from Dictionary 209, the general form for an oxide $Z\cdot S\cdot OXI$, or the general code for a compound of the form $Z\cdot S\cdot CMP$. (See also LEXFOR, Chemical Compounds).

**Example:** 26-FE-CMP

**Reaction field**

The reaction field consists of four subfields, separated by commas or parentheses (not interchangeable):

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

**SF1. Target nucleus.** Contains one of the following:

a) $Z\cdot S\cdot A\cdot X$, as described above, but with the following exceptions:
   - $A = 0$ denotes natural isotopic mixture,
   - $X$ may not have the value $G$.

b) $Z\cdot S\cdot CMP$, see above.

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 6.8. 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 33 with an “allowed SF2 flag” (2).

b) for particles heavier than an $\alpha$, a code in the form $Z\cdot S\cdot A\cdot X$ ($X$ may not have the value $G$), as described above.
SF3. Process. Contains one of the following:

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

b) a particle code from Dictionary 33 with an “allowed SF3 flag” (3), which may be preceded by a multiplicity factor with a value of 2→99.1

   Examples:  
   A  
   4A

c) for particles heavier than α, a code in the form Z-S-A-X (see page 6.2, but the mass number may not have the value zero). No multiplicity factor is allowed; instead the nuclide code is repeated, if necessary.

   Examples:  
   8-0-16  
   8-0-16+8-0-16

d) combinations of a), b) and c), with the codes connected by ‘+’. Outgoing particles are ordered starting with the lightest2 at the left of the subfield, 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  
   X+N

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 6.5.

2) If SF5 contains the branch code (DEF)3 (it is not evident from the publication whether the reaction channel is undefined or defined), the particle codes given in SF3 may represent only the sum of emitted nucleons, implying that the product nucleus coded in SF4 has been formed via different reaction channels. For details see in LEXFOR, Particles.

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

---

1 In the few cases where the multiplicity factor may exceed 99, the Variable Number of Emitted Nucleons Formalism may be used, see page 6.9.
2 Lowest Z, then lowest A.
3 The code (DEF) is presently used only for charged particle reaction data.
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).

c) There is no reaction product given if the reaction specifies a resonance parameter (defined in Dictionary 236 by using the resonance flag ‘.’).

d) For certain reactions that 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.
   - for total, absorption, or nonelastic processes; SF3 contains the process codes TOT, ABS, or NON
   - if SF3 contains a combination of the process code X with a particle code, e.g., (P,G+X),SEQ.
   - if 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 X.

Coding: This subfield:

a.) either is blank, as in cases b, c, and d, above; the following comma is always present.

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

b.) or contains a code in the form Z-S-A-X, as described on page 6.2.

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 N, G, P, etc., 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. 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 6.2). (See LEXFOR, Isomeric States).

---

4 The code RAT is always given in SF6 when the arithmetical / appears in the isomer extension in SF4.
Examples: (92-U-235(N,F)54-XE-124,CUM,FY)  
(51-SB-123(N,G)51-SB-124-M1+M2/T,,SIG/RAT)

c.) or, if the reaction product is entered into the data table using the data headings ELEMENT, MASS, and/or ISOMER (see page 6.8, 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 6.8.

d.) or, if the number of particles emitted is entered into the data table using the data heading PART-OUT, it contains the code NPART.

Example: (79-AU-197 (92-U-238, X) NPART, NUM, SIG, HF) Cross section for a given number on heavy fragments emitted; the number of fragments is given in the DATA or COMMON section under the heading PART-OUT.

**Quantity Field**

The quantity field consists of four subfields, each separated by a comma. If a subfield is omitted, the separating comma is included, except that trailing commas are omitted.

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

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 236 (see EXFOR/CINDA Dictionary Manual).

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. **This subfield must always be present.** Code(s) are taken from Dictionary 32.

SF7 Particle Considered. Provides particle or nuclide code(s) indicating to which of several outgoing particles or nuclides the quantity refers. When more than one particle/nuclide is entered, e.g., for a quantity describing the correlation between outgoing particles, all codes are entered, separated by a slash. For the case where a variable is given for a correlated pair, e.g., the center-of-mass energy of two or more emitted particles, the codes are separated by a plus sign (+). Contains either a code from Dictionary 33 with an “allowed SF7 flag” (7) (see LEXFOR, Particles), or, for particles heavier than α, a code in the form Z-S-A-X (see page 6.2, but the mass number may not have the value zero).

**Examples of SF7 entry:**

(... (..., F) 4-BE-9, , DA, 4-BE-9) angular distribution on ⁹Be product.

---

5 Note that the particle considered is not necessarily identical to the particle detected, e.g., the angular distribution of an outgoing particle that has been deduced from a recoil particle detected.
triple differential cross section as a function of the angle of the emitted neutron and proton and the center-of-mass energy of the emitted neutron-proton pair.

The particle considered should be omitted if there is no ambiguity. For integral data this subfield is in most cases 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.

Data Type Field
The data type field consists of one subfield.
(reaction,quantity,SF9)

SF9 Data type. 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.

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 (see Reaction Ratios, page 6.7, and LEXFOR, Ratios).
- = ( (------)=(-----) )  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\(^6\), i.e., the separator appears last 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))  

\(^6\) Except if the individual code unit by itself needs to be broken because of its length, see page 6.1.
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).

**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
MEV EV
 1.0  0.0253
ENDCOMMON
DATA
ELEMENT MASS DATA
NO-DIM NO-DIM NO-DIM
...
ENDDATA
```

**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. The use of this formalism is restricted to specific classes of data that are subject to the following constraints (see page 5.2 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 that may be coded using the multiple reaction formalism, see LEXFOR, Multiple Reaction Formalism.

---

7 See page 5.1 for general information on pointers.
Variable Nucleus

In the case of the processes specified below, the data table may contain yields or production cross sections for several nuclei that 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 (charge number) of the nuclide is given in the data table.
- **MASS** - if the A (mass number) 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 data or data table as variables under the data headings **ELEMENT** and/or **MASS** with the units NO-DIM.

If the data headings **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, etc.

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 page 7.6 and **LEXFOR, Flags**).

**Example:**

```
BIB
REACTION (... (... , F) ELEM/MASS, ...)
ENDBIB
NOCOMMON
DATA
EN MEV ELEMENT MASS ISOMER DATA
... 61. 148. 0. ...
... 61. 148. 1. ...
... 61. 149. ...
... 62. 149. ...
```

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

The variable nucleus formalism 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

See also **LEXFOR, Reaction Products**.

---

8 If the half-life is the only decay data given, this may be entered in the data table under the data heading **HL**, *although this is not recommended.*
Variable Number of Emitted Particles
If the data table contains yields or production cross sections as a function of the number of secondary particles, and the number of particles is entered as a variable in the data table, SF4 of the REACTION keyword contains the code NPART, SF5 contains the code NUM, and SF7 contains the particle considered:

See also LEXFOR, Particles.

Example:
```
BIB
  REACTION (...) (...) NPART,NUM,P)
...
ENDBIB
NOCOMMON
DATA
  EN PART-OUT DATA
  MEV NO-DIM B
...
ENDDATA
```

Links between reaction quantity and data headings
The quantity given under the REACTION code string requires the presence, or absence, of certain families of independent variables. The family code for a given data heading is given in Dictionary 24 (see EXFOR/CINDA Dictionary Manual).

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).

The keyword REACTION defines the data coded in the DATA section under the dependent variable data heading DATA. The independent variables required for each quantity are given, below, according to family code9.

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 is used when the quantity field contains a spectrum modifier MXW, SPA, FST, FIS, etc.

See also page 7.13, (INC-SPECT), and LEXFOR, Incident-Projectile Energy and Spectrum Average.

9 See Dictionary 24 for family codes.
Resonance Energy (Family C) is specified for resonance parameters. 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.

2. Secondary Energy (Family E) is coded when:
   - REACTION SF5 contains the modifier code PAR, or
   - REACTION SF6 contains the code DE or SPC.
   For specifying the secondary energies of more than one particle, see page 7.9 (EN-SEC), and LEXFOR, Secondary Particles.

3. 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 4.3)
   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.

4. Fitting Coefficient Number (Family N) is coded when REACTION SF8 contains a code denoting a fitting coefficient, e.g., LEG or COS. See also LEXFOR, Fitting Coefficients.

5. Half life (Family 6) is coded if SF4 of the REACTION code contains a product with a metastable state extension (see page 6.2), and the half-life is not coded under DECAY-DATA. See also LEXFOR, Half-Lives.

6. 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.

7. Element (Family I) will be coded when REACTION SF1 or SF4 contains the code ELEM (see page 6.8).

8. Mass (Family J) will be coded when REACTION SF1 or SF4 contains the code MASS (see page 6.8).

9. Number of Particles (Family P) will be coded when REACTION SF4 contains the code NPART (see page 6.9).

---

10 Resonance parameters are indicated using a resonance flag of ‘.’ (period) in Dictionary 236, see EXFOR/ CINDA Dictionary Manual).
## Cross References of Data Heading to Family Codes

<table>
<thead>
<tr>
<th>Data heading</th>
<th>Family code</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN</td>
<td>A</td>
<td>Incident energy</td>
</tr>
<tr>
<td>EN-RES</td>
<td>C</td>
<td>Resonance energy</td>
</tr>
<tr>
<td>E, E-LVL, etc.</td>
<td>E</td>
<td>Secondary energy</td>
</tr>
<tr>
<td>MOM-SEC</td>
<td>L</td>
<td>Secondary linear momentum</td>
</tr>
<tr>
<td>ANG</td>
<td>G</td>
<td>Angle of outgoing particle</td>
</tr>
<tr>
<td>ELEMENT</td>
<td>I</td>
<td>Element</td>
</tr>
<tr>
<td>MASS</td>
<td>J</td>
<td>Mass</td>
</tr>
<tr>
<td>PART-OUT</td>
<td>P</td>
<td>Number of particles</td>
</tr>
<tr>
<td>MOM</td>
<td>M</td>
<td>Incident beam linear momentum</td>
</tr>
<tr>
<td>NUMBER</td>
<td>N</td>
<td>Coefficient number</td>
</tr>
<tr>
<td>HL</td>
<td>6</td>
<td>Half life</td>
</tr>
<tr>
<td>MOMENTUM L</td>
<td>2</td>
<td>Angular momentum of resonance</td>
</tr>
</tbody>
</table>

11 As given by the family flag in Dictionary 24.
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Chapter 7

INFORMATION-IDENTIFIER KEYWORDS AND CODING RULES

This section gives detailed 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 that may be required. For such information, the user should refer to LEXFOR.

The keywords are ordered alphabetically.

The information given under each keyword includes use, plus the following;

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

See also Chapter 3 for a discussion of codes and free text.

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 table on the following page.

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.
<table>
<thead>
<tr>
<th>Keyword</th>
<th>Presence of keyword is obligatory</th>
<th>Obligatory with data heading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bibliography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TITLE</td>
<td>except when not relevant</td>
<td></td>
</tr>
<tr>
<td>AUTHOR</td>
<td>always</td>
<td></td>
</tr>
<tr>
<td>INSTITUTE</td>
<td>always</td>
<td></td>
</tr>
<tr>
<td>EXP-YEAR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REFERENCE</td>
<td>Always</td>
<td></td>
</tr>
<tr>
<td>REL-REF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MONIT-REF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data specification</td>
<td>always</td>
<td></td>
</tr>
<tr>
<td>REACTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESULT</td>
<td>when a code exists</td>
<td></td>
</tr>
<tr>
<td>Related data</td>
<td>except when not relevant</td>
<td>MONIT, etc.</td>
</tr>
<tr>
<td>MONITOR</td>
<td></td>
<td>ASSUM, etc.</td>
</tr>
<tr>
<td>ASSUMED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DECAY-DATA</td>
<td></td>
<td>DECAY-FLAG</td>
</tr>
<tr>
<td>DECAY-MON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PART-DET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAD-DET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HALF-LIFE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN-SEC</td>
<td></td>
<td>E1, etc.</td>
</tr>
<tr>
<td>LEVEL-PROP</td>
<td></td>
<td>LVL-FLAG</td>
</tr>
<tr>
<td>MOM-SEC</td>
<td></td>
<td>M1, etc.</td>
</tr>
<tr>
<td>MISC-COL</td>
<td></td>
<td>MISC, etc.</td>
</tr>
<tr>
<td>Physics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INC-SOURCE</td>
<td></td>
<td>EN-DUMMY, etc.</td>
</tr>
<tr>
<td>INC-SPECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAMPLE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>METHOD</td>
<td>one of these is obligatory</td>
<td></td>
</tr>
<tr>
<td>FACILITY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANALYSIS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DETECTOR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CORRECTION</td>
<td>except when not relevant</td>
<td>ERR-*, *-ERR</td>
</tr>
<tr>
<td>COVARIANCE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERR-ANALYS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADD-RES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRITIQUE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLAG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bookkeeping</td>
<td>except when not relevant</td>
<td></td>
</tr>
<tr>
<td>STATUS</td>
<td>always</td>
<td></td>
</tr>
<tr>
<td>HISTORY</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**ADD-RES.** Gives information about any additional results obtained in the experiment, but which are not compiled in the data tables.

1. Presence is optional. May contain free text or coded information and free text.

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

**ANALYSIS.** 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**.

1. At least one of the keywords METHOD, FACILITY, DETECTOR, or ANALYSIS must be present with coded information. If an existing code applies, it should be given, otherwise coded information is optional.

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

**ASSUMED** Gives information about values assumed in the analysis of the data, and about COMMON or DATA fields containing assumed values. See also **LEXFOR, Assumed values**.

1. Presence is obligatory when assumed values are given in the data under the heading ASSUM or its derivatives and coded information is required, with or without free text. Otherwise, free text information may be given.

2. The format of the code is: (heading, reaction, quantity)
   - **Heading field:** data heading to be defined.
   - **Reaction field and quantity field:** coded as under the keyword REACTION (see Chapter 6).

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

1. Presence is obligatory. Must have coded information.

2. 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 authors’ names (*i.e.*, after a comma), but are not permitted following initials. (For transliteration of authors’ 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 (R.W.McNally Jr)
**COMMENT.** Gives pertinent information that cannot logically be entered under any other of the keywords available. See also LEXFOR, Comments.

1. Presence is optional. Contains only free text.

**CORRECTION.** Gives information about corrections applied to the data in order to obtain the values given under DATA. See also LEXFOR, Corrections.

1. Presence is optional. Contains only free text.

**COVARIANCE.** Gives covariance information provided by the experimentalist, or to flag the existence of a covariance data file. See also LEXFOR, Covariance.

1. Presence is optional. Contains either free text only or the code COVAR, which indicates the existence of a covariance file, followed by free text.

2. See Appendix B for the Covariance Data File format.

**CRITIQUE.** Gives comments on the quality of the data presented in the data table. See also LEXFOR, Comments.

Presence is optional. Contains only free text.
**DECAY-DATA.** 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](#).

1. If the keyword `RAD-DET` is used, an entry should also be made for `DECAY-DATA`. Also, if decay flags appear in the data section, they must be linked to an entry under `DECAY-DATA`, see below. Otherwise, its presence is optional, and free text or coded information, with or without free text, may be given.

   If the keyword `DECAY-DATA` is present, the keyword `HALF-LIFE` may not be used. See also [LEXFOR, Half-Lives](#).

2. The general format of the coding string consists of three major fields which may be preceded by a decay flag:

   
   
   ```text
   ((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 subfields should be the last character on the line.

   **Flag.** The general format of the code is \((n,)\), where \(n\) has a numerical value that 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](#).

   **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 6.2.

   **Half-life field.** Contains the actual half-life of the nuclide specified, coded as a number, readable in an E11.4 format (see page 4.2, 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.

   **Examples:**

   ```text
   2.45MIN
   3.6E+03YR
   ```

   **Radiation field.** Consists of three subfields. 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. The absence of any subfield must be indicated by including the separating comma; trailing commas are not included.

   **SF1. Type-of-radiation.** A code from Dictionary 33 with a `D` in the 1st position of the allowed subfields flags.

   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).

---

\(^1\) Decay data relevant to the monitor reaction are coded under the keyword `DECAY-MON`, not under `DECAY-DATA`.  

---

7.6 February 2008
SF2. Energy. The energy of the radiation in keV, coded as a floating-point number (see page 4.2, 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 radiation per decay, coded as a floating-point number (see page 4.2, no blanks permitted).

3. 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 DECRY-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, (five radiation fields extending over 2 records)
   DG, 708., 0.27, DG, 403., 0.03, B+, 0.006)

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)

February 2008
**DECAY-MON.** Gives the decay data assumed by the author for any nuclide occurring in the monitor reaction used.

1. Presence is optional; may only be used if the keyword MONITOR is present. Coded information is obligatory, with or without free text.

2. The coding rules for DECAY-MON are exactly the same as those for DECAY-DATA (see preceding), except that the flag field is replaced with a heading field:

   ((heading)nuclide,half-life,radiation).

   **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.

3. For more than one monitor decay, each is coded on a separate record, starting in column 12. Entries under DECAY-MON and MONITOR may be linked:

   a) using pointers (see page 5.4, BIB/BIB links)

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

   **Example:**
   
   DECAY-MON  ((MONIT1)26-SC-46-G,83.81D,DG,889.3,0.99984
   DG,1120.5,0.99870)
   ((MONIT2)26-SC-47,3.345D,DG,159.4,0.683)

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

1. At least one of the keywords METHOD, FACILITY, DETECTOR, or ANALYSIS must be present with coded information. If an existing code applies, it should be given, otherwise coded information is optional.

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

3. If one of the codes COIN, TELES, or SPEC is used, then the codes for the detectors used in coincidence, in the telescope, or in the spectrometer system, follow within the same parenthesis.

   **Example:** DETECTOR   (COIN,NAICR,NAICR)

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

4. Similarly, the code PS (position-sensitive detector) will be followed by a specific detector code. To denote a position-sensitive solid state detector:

   **Example:** DETECTOR   (PS,SOLST)
EN-SEC. Gives information about secondary energies, and defines secondary-energy fields given in the data table. See LEXFOR, Secondary Particles.

1. Must be present when the data headings $E_1$, $E_2$, etc., are used in the data set. Otherwise its presence is optional and free text or coded information, with or without free text, may be given.

2. 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, -APRX, -NM, or -DN.

   Particle Field. Contains the particle or nuclide to which the data heading refers. The code is:
   - either a particle code from Dictionary 33 with a D in the 1st position of the allowed subfields flags.
   - or a nuclide coded in the standard format as described on page 6.2.

3. For two or more particle codes, they are separated by a slash, and ordered lightest to heaviest as for REACTION subfield 3 (see page 6.3). For relative energies of correlated pairs, the separator + is used.

   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.** 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.

1. Presence is obligatory, except when not relevant. May contain free text or coded information with free text. However, coded information is obligatory when more than one error field is given in the data set.

2. 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.

3. 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  PER-CENT
   ...
   ```

**EXP-YEAR.** Defines the year in which the experiment was performed when it differs significantly from the date of the references given (e.g., classified data published years later).

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

2. The format of the code is (YYYY) where YYYY is the year.

   **Example:** EXP-YEAR (1965)
**FACILITY.** Defines the main apparatus used in the experiment. See also LEXFOR, Measurement Techniques.

1. 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.

2. If coded information is given it may be given:
   - in either of the general forms (see page 3.2) with code(s) from Dictionary 18,
   - or a 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 institutes are given under the keyword INSTITUTE, then a facility code is always followed by the appropriate institute code.

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

1. Must be present if the data heading FLAG is used in the data table. Otherwise presence is optional (but not meaningful). If present, it must have coded information.

2. The format of the code is a fixed-point number \((n)\) that appears in the data section under the data heading FLAG. The code must be followed by free text containing the comment attached to the flag.

3. 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. 2.
   
   3.4 456. 2.
   
   ENDDATA

   More than one FLAG field may be coded (see Repetition of data headings, page 4.2).
HALF-LIFE. Gives information about half-life values and defines half-life fields given in the data table. See also LEXFOR, Half-lives.

1. Must be present with coded information when the data headings, HL1, HL2, etc., are given in the data set. Otherwise presence is optional. If present may have free text or coded information with or without free text.

2. 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 6.2. Permitted nuclei must be listed in Dictionary 227.

3. 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. Documents the handling of an entry or subentry. See also LEXFOR, History.

1. Presence is obligatory with coded information and with or without free text.

2. The general format of the code is: (YYYYMMDDX),
   
   **where:** YYYYMMDD: 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.

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

   **Example:**
   
   HISTORY (19940312C)
   (19960711A) Data units corrected.
INC-SOURCE. Gives information on the source of the incident particle beam used in the experiment. See also LEXFOR, Measurement Techniques and Incident-Projectile Energy.

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

2. Coded information, if given, may be in either of the general forms, see page 3.2, with code(s) from Dictionary 19, but see exceptions below.

3. a) 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)

   b) If the code MPH, followed by the separator = is present, the next field contains a reaction string coded as under the keyword REACTION, SF1-4.
   Example: INC-SOURCE (MPH=(13-AL-27(N,A)11-NA-24))

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

INC-SPECT. Provides information on the characteristics and resolution of the incident-projectile beam. See also LEXFOR, Incident-Projectile Energy.

1. Must be present when a spectrum average modifier (e.g., MXW, SPA, or FIS) is present in REACTION SF8. See also LEXFOR, Spectrum Average. Otherwise its use is optional. No coded information.

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

1. Presence is obligatory with coded information.

2. The coded information is given in either of the general forms, see page 3.2, 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.

   Institute codes may be continued onto the next record(s), but codes should not be broken, i.e., the last character on the line to be continued must be a comma.

   Examples: INSTITUTE (1USAGA, 1USALAS)
              INSTITUTE (2FR SAC)
**LEVEL-PROP.** Gives information on the spin and parity of excited states. See also **LEXFOR, Flags.**

1. If a level flag is given in the data set, it must be defined under **LEVEL-PROP**, see following. Otherwise presence is optional, but, if present, coded information must be given.

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

   ((flag) nuclide, level identification, level 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 that appears in the data section under the data heading LVL-FLAG. See also **LEXFOR, Flags.**

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 6.2. This field must be present.

**Level identification field.** Identifies the level for which properties are specified. If the field is not present, its separating comma is omitted. If there is no flag field, a level identification field must be present. The following level identifiers are permitted.

**Level Energy.** The field identifier E-LVL= followed by the excited state energy in MeV, coded as a floating-point number (see page 4.2, 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, n, where n has a numerical value which also appears in the data section under the data heading LVL-NUMB.

**Isobaric analog state number.** The level identifier IAS-NUMB= followed by the level number of the isobaric analog state, n, where n has a numerical value which also appears in the data section under the data heading IAS-NUMB. See also **LEXFOR, Isobaric Analog Resonances.**

**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 4.2, 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 +1. or -1.
3. If information on 2 or more levels is given, each is entered in a separate code string, starting in column 12.

**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.)
LEVEL-PROP (23-V-46,IAS-NUMB=0.,SPIN=0.,PARITY=+1.)
```
METHOD. Describes the experimental technique(s) employed in the experiment. See also LEXFOR, Measurement Techniques.

1. At least one of the keywords METHOD, FACILITY, DETECTOR, or ANALYSIS must be present with coded information. If an existing method code applies, it should be given, otherwise coded information is optional.

2. Coded information may be in either of the general forms, see page 3.2, with code(s) from Dictionary 21.

MISC-COL. Defines fields in the COMMON or DATA sections headed by MISC and its derivatives. See also LEXFOR, Miscellaneous Data.

1. Must be present if miscellaneous fields are given in the data table. Otherwise presence is optional. Free text may be given, or coded information plus free text.

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

3. If more than one miscellaneous field is given, then the data headings must be given as codes, 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

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

1. Must be present with coded information when the data headings MOM-SEC1, MOM-SEC2, etc., are used in the data. Otherwise its presence is optional and free text or coded information, with or without free text, may be given.

2. 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 33 with a D in the 1st position of the allowed subfields flags,

   or a nuclide coded in the standard format as described on 6.2.

3. 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, -APRX, -DN, or -NM.
**MONITOR.** 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.

1. 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.

2. 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).

3. 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 5.3, BIB/DATA Links)

   **Example:**

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

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

   **Example:**

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

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

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

   \((\text{heading})\text{subaccession#},\text{author},\text{reference})\)

   Embedded blanks are not permitted within the code, except within an author's name (see coding rules under AUTHOR, page 7.4).

   **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. \(C_{nnnn}001\) refers to the entire entry \(C_{nnnn}\). \(C_{nnnn}000\) refers to a yet unknown subentry within the entry \(C_{nnnn}\). 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 7.21 and following).

   Specific coding rule for evaluated data libraries:

   \((...,3,\text{code-version},\text{date})\) or

   \((...,3,\text{code-version},\text{MAT-number},\text{date})\)

   with a code from Dictionary 144 (Data Libraries).

3. 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:

   c) using pointers (see page 5.4, BIB/BIB links)

   d) using the data headings MONIT1, MONIT2, etc.

**Examples:**

- MONIT-REF \((\text{MONIT1})\text{B0017005,}\text{J.GOSHAL,}\text{J,PR,80,939,1950})\)
  \((\text{MONIT2})\text{A.G.PANONTIN+,}\text{J,JIN,30,2017,1968})\)
- MONIT-REF \((\text{,A.G.PANONTIN+},\text{J,JIN,30,2017,1968})\)
- MONIT-REF \((\text{B0016005,}\text{J.GOSHAL,}\text{J,PR,80939,1950})\)
- MONIT-REF \((\text{MONIT),H.Matsunobu+},\text{3,JENDL-3.3,,2002})\)
- MONIT-REF \((\text{,L.W.Weston+},\text{3,JEFF-3.1,9228,2005})\)
PART-DET. Gives information about the particles detected directly in the experiment. Particles detected in a standard/monitor reaction are not coded under this keyword. See also LEXFOR, Particles.

1. 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.

2. The code is:
   • either a code from Dictionary 33 with a D in the 1st position of the allowed subfields flags,
   • or, for particles heavier than α particles, a code of the form Z-S-A-X (see page 6.2).

3. If two or more particles detected, their codes are given in either of the general forms, see page 3.2. 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 6.6 for examples of reaction combinations.)
RAD-DET. Gives information about the decay radiation (or particles) and nuclides observed in the reaction measured. See also LEXFOR, Particles.

1. If the decay radiation detected is not evident from the DECAY-DATA code, it must be specified either under this keyword, 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.

2. 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. See also LEXFOR, Flags.

   Nuclide Field: A code of the form \(Z-S-A-X\), see page 6.2.

   Radiation Field: One or more codes from Dictionary 33 with a D in the 1st position of the allowed subfields flags, each separated by a comma.

No embedded blanks are permitted in the code.

3. To specify information about 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. Specifies the data presented in the DATA section in fields headed by DATA\(^4\).

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

2. See Chapter 6 for detailed coding rules and use.

\(^4\) And similar headings such as DATA-MIN, DATA-MAX, etc.
REFERENCE. Gives information on references that contain information about the data coded. Other related references are not coded under this keyword (see REL-REF, MONIT-REF). See LEXFOR, Reference.

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

2. 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 is fixed, although some subfields may be omitted. If a subfield is omitted, the separating comma is included, except in the case:
     - of a parenthesized subfield,
     - for certain reference types, 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 yyyyymmdd (year, month, day); the month and day may be omitted. Field must always be present.

3. 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.

4. 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: 
     
8. If a code string is continued onto the next record, a code unit must not be broken, i.e., the separator appears last on the record, with the first parenthesis of the next code unit beginning in column 12 of the next record.

5. 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-4567,196605) Graph only
     - (C,66PARIS,196605) Abstract

6. 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),196912)
     - (J,XYZ,9,999(1573),196912)
   b) If this is not possible then the order in which they appear on the page is used.
   - Example:
     - (J,XYZ,8,888(1),196911)
     - (J,XYZ,8,888(2),196911)
Following are the specific coding rules for each reference type.

**Type of Reference = A or B or C; Conference Abstracts, Books, or Conferences.** The reference field may contain up to 4 subfields: code, volume, part, page (paper number).

General coding forms: (A or B or C, code, volume, (part), page (paper #), date)

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

(A or B or C, code, , page (paper #), date)

(A or B or C, code, , date)

**Code subfield:** a code from Dictionary 7 (Conferences) or Dictionary 207 (Books).

**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 may be alphanumeric 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:**


e) (C, 77KIEV,, 197704) = 1977 Kiev Conference, page and paper number unknown.

**Date subfield.** For reference type A or C, the date coded must always be the date of the conference itself, not the date of publication of the proceedings. The reason is that sometimes an entry can be made from an abstract or poster obtained at the conference, prior to the publication of proceedings. (However, if the entry is made of proceedings published in a journal or in a regular report series, with reference types J or S, the date of this publication must be used.)

**Type of Reference = J or K: Journals or Journal Abstracts.** The reference field may contain up to 4 subfields: code, volume, issue #, page.

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

(J or K, code, volume, page (paper #), date)

**Code subfield:** a code from Dictionary 5.

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

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

**Page (paper #) subfield:** the page number, which may be alphanumeric, 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:

(J, XYZ, 5, (2), 89, 196602) = Journal XYZ, Volume 5, issue#2, page 89, February 1966

Type of Reference = P or R or S: Progress Reports / Reports / Conference 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\(^5\).

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.

Page subfield: alphanumeric field; if omitted, the following comma is also omitted. If there are two works on a page they may be distinguished as described on preceding page; for example: 123(1) and 123(2).

Examples:

c) \((P, WASH-1068, 185, 196603)\) = WASH progress report number 1068, page 185, published in March 1966.
d) \((R, BNL-325, (2A), 1966)\) = a well-known, example for the Volume or Part field

Type of Reference = T or W or X: Thesis or Private Communication or Preprint. 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: alphanumeric field; if omitted, the following comma is also omitted.

Note: Reference type X is used also for ‘electronic preprints’ available through the Internet.

Examples:

a) \((W, BENZI, 19661104)\) = private communication from Benzi received on November 4, 1966.

\(^5\) The hyphen acting as separator is included in Dictionary 6, except when the code itself is 11 characters long. For details on report codes and on the definition of the separator, see EXFOR/CINDA Dictionary Manual, Chapter 1.3.
**REL-REF.** Used to give information on references related to, but not directly pertaining to, the work coded. See also **LEXFOR, Reference.**

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

2. The general format of the code contains four main fields:
   
   \[(\text{code,subaccession#,author,reference})\]

   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. \text{Cnnnn}001 refers to the entire entry \text{Cnnnn}. \text{Cnnnn}000 refers to a yet unassigned subentry within the entry \text{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 7.22 and following). This field must always be present.

   **Example:** \((\text{C,B9999001,A.B.NAME+,J,XYZ,5,(2),90,197701}) = \) Critical remarks by A.B.Name, \textit{et al.}, in journal XYZ, volume 5, issue \#2, p. 90, January 1977.

**RESULT.** Describes commonly used quantities that are coded as REACTION combinations.

1. Presence is obligatory when relevant, and must contain coded information.

2. Contains a code from Dictionary 37, with or without free text. Only one code is entered for each Reaction Combination.

   **Example:** \(\text{REACTION } (((92-U-238 (N,F) ELEM/MASS, CUM, FY, , FIS))/\) 
   
   \((92-U-238 (N,F) 42-MO-99, CUM, FY, , FIS))/ //\) 
   
   \((92-U-238 (N,F) ELEM/MASS, CUM, FY, , MXW)) \) 
   
   \((92-U-238 (N,F) 42-MO-99, CUM, FY, , MXW)) \) 

   \(\text{RESULT 1(FRCUM)} \)

   \(2(FRIND)\)

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

   **Example:** \(\text{REACTION 1(}((Z-S-A (N,F) ELEM/MASS, CUM, FY) /}\) 
   
   \((Z-S-A (N,F) MASS, CHN, FY)) \) 
   
   \(2((Z-S-A (N,F) ELEM/MASS, IND, FY) /}\) 
   
   \((Z-S-A (N,F) MASS, CHN, FY)) \) 

   \(\text{RESULT 1(FRCUM)} \)

   \(2(FRIND)\)
**SAMPLE.** Used to give information on the structure, composition, shape, etc., of the measurement sample.

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

**STATUS.** For use of this keyword see LEXFOR, Status.

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

2. The coded information is entered in:
   a) either of the general forms with codes from Dictionary 16.
   b) or 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:**

   STATUS (SPSDD,10048009)  - this subentry is superseded by subentry 10048009.

3. For case 2.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)

4. For use of the code DEP see LEXFOR, Dependent Data.
   For others, see Status.
TITLE. Used to enter a title for the work referenced. See LEXFOR, Title.

1. Presence is obligatory except when not relevant. Information is given in free text only.
Chapter 8

UPDATING AND ALTERATIONS

Alterations to EXFOR entries

Alterations to EXFOR entries are normally transmitted only by the center responsible for those entries (see also NRDC Protocol).1

When an entry is altered, those subentries that 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 that 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 information-identifier 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 alteration flags. The alteration flag is used to inform other centers when an alteration procedure has been performed on an entry.

Alteration flags are not accumulated over a number of transmissions (i.e., alter flags are set only to indicate those subentries 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 alteration flag.

All corrections will be documented with an appropriate entry under HISTORY. HISTORY entries are accumulated, so that all changes made to an entry since its compilation are kept on record.

See also LEXFOR, History.

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1 The NRDC may, however, agree to certain exceptions, e.g. performing certain corrections centrally on the common EXFOR master file, with proper procedures and information of the responsible centre.
Deletion of individual subentries

If a subentry is to be deleted, a NOSUBENT record (with the appropriate subaccession number) is transmitted, together with the first subentry and a HISTORY entry giving the reason for the deletion. This will have the effect of deleting this subentry from the master file, while the rest of the entry (all other subentries) will not be affected.

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

Example: Deletion of subentry 5, while no other changes are made to the entry

```
ENTRY     C      00000   20081110
SUBENT    C   00000001   20081110
........
HISTORY    (19990524C) N.K.
(20081110A) Subentry 5 deleted because of duplication
ENDSUBENT
NOSUBENT      00000005
ENDENTRY
```

Special case: If a series of subentries (X through Y) have been combined into one subentry, the new subentry X will contain all combined data, while subentries X+1 through Y will be deleted as described above. An entry should be made under HISTORY in the combined subentry.

Example: Combination of subentries 23 – 25 into new subentry 23

```
ENTRY     C      00000   20081110
SUBENT    C   00000001   20081110
........
HISTORY    (19990512C) N.K.
(20081110A) Subentries 23-25 combined
ENDSUBENT
SUBENT    C   00000023   20081110
... (combined data)
HISTORY    (20081110A) Data from tables 4,5 of main ref. added
ENDSUBENT
NOSUBENT      00000024
NOSUBENT      00000025
ENDENTRY
```

Deletion of entries

If an entire entry is to be deleted, NOSUBENT records must be included for each subentry that has been previously transmitted, except for subentry 1. Subentry 1 will be kept on the file for the record. Not all keywords must be retained; in general, the following information-identifier keywords must be included (left) in the BIB section: REFERENCE, TITLE, AUTHOR, INSTITUTE, and HISTORY.

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 of a deleted entry may never be used for another data set.
Example:

ENTRY     C      C0615   20080129
SUBENT    C   C0615001   20080129
BIB                 12         19
INSTITUTE  (1USAPTN)
REFERENCE  (J,PR,167,1070,196803)
            (T,CRAWLEY,1965)
AUTHOR     (G.M.CRAWLEY,G.T.GARVEY)
TITLE      Inelastic Scattering in the 2s-1d Shell. Odd-A Nuclei.
FACILITY   (CYCLO,1USAPTN)
STATUS     Data taken from thesis.
HISTORY    (20000329C) VM
            (20080128D) Entry deleted. Duplication with C0828
ENDBIB
NOCOMMON
ENDSUBENT
NOSUBENT      C0615002   20080129
NOSUBENT      C0615003   20080129
NOSUBENT      C0615004   20080129
NOSUBENT      C0615005   20080129
NOSUBENT      C0615006   20080129
NOSUBENT      C0615007   20080129
NOSUBENT      C0615008   20080129
NOSUBENT      C0615009   20080129
NOSUBENT      C0615010   20080129
NOSUBENT      C0615011   20080129
ENDENTRY

Alteration flags

As of January 2008, alteration flags in retransmitted entries/subentries are given on the entry/subentry level, i.e. in col. 11 of the ENTRY and SUBENT records.

<table>
<thead>
<tr>
<th>Alteration</th>
<th>Flag in col.11 ENTRY/SUBENT record</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (first transmission)</td>
<td>(blank)</td>
</tr>
<tr>
<td>Changed</td>
<td>C</td>
</tr>
<tr>
<td>Inserted</td>
<td>I (SUBENT only)</td>
</tr>
<tr>
<td>Deleted</td>
<td>(No flag, SUBENT replaced by NOSUBENT)</td>
</tr>
</tbody>
</table>

If any subentry of a transmitted entry has an alteration flag, the ENTRY record must be flagged with C.

All transmitted alterations must be recorded in a HISTORY entry, giving not only the date of the alteration but also the main changes made.

Note: Until December 2007, alteration flags were used on record level. These old-style alteration flags must no longer be transmitted. They might however still be seen on old transmission files. Therefore they are summarized on the next page.
**Historical note: Alteration flags as used until 2007 (must no longer be transmitted!)**

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 2.2 and 2.3).

**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 or in the first record of a series of replacement records. An entry is made under the information identifier HISTORY explaining the alteration.

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

Example of an EXFOR Entry

This appendix contains an example of a complete entry in the EXFOR format
TRANS     X023  20000424
ENTRY     X0055  20000424
SUBENT    X0055001  20000424
BIB       11  20
INSTITUTE (USAPEN, 4RUSKUR)
REFERENCE (J, PR/C, 49, 2549, 199405)
TITLE Observation of 12C cluster transfer by angular correlation measurements
FACILITY (VDGT, 1USAPEN)
SAMPLE A 30 microg/cm^2 self-supporting 12C target used.
METHOD (BCINT, SITA)
DETECTOR (MAGSP) Deuterons were momentum analyzed in a double focusing magnetic spectrometer.
(PSSSD) Deuterons were detected in the focal plane with double-sided position sensitive silicon detector covered with a Ta foil to stop beam particles that otherwise might strike the detector.
ADD-RES (COMP). Distorted Wave Born Approximation and Hauser Feshbach Formalism.
STATUS (APRVD) Approved by author, 5 April 2000.
HISTORY (20000327C)

REACTION (6-C-12(7-N-14,D+A)10-NE-20, PAR, DA/CRL, D/D+A) (E-EXC1, 12-MG-24) (E-EXC2, 10-NE-20)
ANG1 is angle between incident beam and deuterons.
ANG2 is angle between deuterons and alpha particles.
DETECTOR An annular detector subdivided into ten segments, also used at small angles. Each annulus had a width of 12 mm and was separated from adjacent segments with 1-mm wide inactive masks.
ERR-ANALYS (DATA-ERR) Uncertainty read from figures.
(ANG2-ERR) Data-point reader uncertainty.
FLAG (1.) Data taken with the annular detector.
(2.) Data taken with position sensitive strip detectors.
STATUS (CURVE) Data scanned from Fig. 3 in reference.

DATA 5 95
EN ANG2-CM DATA DATA-ERR FLAG
MEV ADEG ARB-UNITS ARB-UNITS NO-DIM
33. 8.0 71.1 16.1 8.0 1.0
33. 11.3 14.5 7.1 6.1 1.0
33. 14.7 34.0 7.1 7.1 2.0
33. 17.3 26.0 5.1 7.1 1.0
33. 10.0 11.0 4.0 2.0

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Data-Err</th>
<th>Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(6-C-12(7-N-14,D+A)10-NE-20,PAR,DA,D)</td>
<td>Relative uncertainty given.</td>
<td>Data taken from Table III in reference.</td>
<td></td>
</tr>
<tr>
<td>(6-C-12(7-N-14,D+A)10-NE-20,PAR,SIG)</td>
<td>Absolute uncertainty given.</td>
<td>Data taken from text in reference.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EN</th>
<th>MEV</th>
<th>Data</th>
<th>Data-Err</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.01</td>
<td>0.39</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>12.3</td>
<td>0.40</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>18.3</td>
<td>0.27</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>30.4</td>
<td>0.28</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>36.5</td>
<td>0.27</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EN</th>
<th>MEV</th>
<th>Data</th>
<th>Data-Err</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.</td>
<td>13.45</td>
<td>3.6</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Appendix B

COVARIANCE DATA FILE FORMAT

Covariance data may be stored on a separate covariance file. This is mandatory if

a) the file is too big to be included conveniently as free text within the EXFOR entry (under the keyword COVARIANCE); and/or
b) the file is in a format which does not fit within columns 12 - 66 available for free text (e.g. ENDF-6 File 33 format).

The covariance file is named

aaaaasss.cov

with aaaaa being the accession number, sss the subentry number of the corresponding subentry (e.g. 35001002.cov).

There are three record types in the covariance file:
- comment records,
- data records,
- end records.

The actual covariance data can be given either in a free format, defined in the comment records, or in ENDF-6 File 33 format. In the latter case, the cross section may be included also (in File 3 format) for easy processing.

Comment record format

<table>
<thead>
<tr>
<th>Column</th>
<th>1</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 – 9</td>
<td>Data set number (subaccession number)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>(blank)</td>
<td></td>
</tr>
<tr>
<td>11 - 80</td>
<td>Comment which includes covariance type and format</td>
<td></td>
</tr>
</tbody>
</table>

Data record format

a) Free format:

<table>
<thead>
<tr>
<th>Column</th>
<th>1</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 – 9</td>
<td>Data set number (subaccession number)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>(blank)</td>
<td></td>
</tr>
<tr>
<td>11 - 80</td>
<td>Data in format given on comment record</td>
<td></td>
</tr>
</tbody>
</table>
b) ENDF 6 File 3/33 format:

First record:

<table>
<thead>
<tr>
<th>Column</th>
<th>1 - 80</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
</tr>
<tr>
<td>2 - 9</td>
<td>Data set number (subaccession number)</td>
</tr>
<tr>
<td>10</td>
<td>(blank)</td>
</tr>
<tr>
<td>11 - 14</td>
<td>MAT number used</td>
</tr>
<tr>
<td>15</td>
<td>(blank)</td>
</tr>
<tr>
<td>16 - 25</td>
<td>File numbers given, separated by commas (e.g. 3,33)</td>
</tr>
<tr>
<td>26 - 80</td>
<td>Comment</td>
</tr>
</tbody>
</table>

Following records:

<table>
<thead>
<tr>
<th>Column</th>
<th>1 - 80</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 80</td>
<td>As in ENDF-6</td>
</tr>
</tbody>
</table>

**End record format**

<table>
<thead>
<tr>
<th>Column</th>
<th>1 - 80</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E</td>
</tr>
<tr>
<td>2 - 9</td>
<td>Data set number (subaccession number)</td>
</tr>
<tr>
<td>10 - 80</td>
<td>(blank)</td>
</tr>
</tbody>
</table>

See also LEXFOR, Covariance.

**Example 1: Covariance data in free format as defined in comment records**

C10034002 Values given only for elements below diagonal of symmetric matrix on same energy grid as data format.
C10034002 FORMAT(9E5.2)
D10034002 1.0
D10034002 0.98 1.0
D10034002 0.90 0.97 1.0
D10034002 0.70 0.82 0.93 1.0
D10034002 0.54 0.68 0.83 0.96 1.0
D10034002 0.64 0.75 0.85 0.92 0.95 1.0
E10034002
Example 2: Cross section and Covariance data in ENDF-6 File 3/33 format

C35001002 Covariance file for subentry 35001002
C35001002 The file is in ENDF File 33 format, also cross section as File 3
F35001002 6210 3,33 Cross section and covariances in ENDF-6 format
0.000000+0 0.000000+0 0 0 0 06210 0 0 0
6.215000+4 1.496234+2 0 0 0 06210 3102 1
8.256831+6 8.256831+6 0 0 1 316210 3102 2
31 2 6210 3102 3
0.110000+4 0.244474+2 0.135000+4 0.236065+2 0.162500+4 0.218750+4 6210 3102 4
0.187500+4 0.196988+2 0.225000+4 0.153861+2 0.275000+4 0.153043+2 6210 3102 5
0.350000+4 0.127367+2 0.450000+4 0.100073+2 0.625000+4 0.184880+2 6210 3102 6
0.875000+4 0.656557+1 0.112500+5 0.501474+1 0.137500+5 0.457034+1 6210 3102 7
0.175000+5 0.387133+1 0.225000+5 0.394818+1 0.275000+5 0.314252+1 6210 3102 8
0.350000+5 0.258191+1 0.450000+5 0.232481+1 0.550000+5 0.184880+2 6210 3102 9
0.700000+5 0.157094+1 0.900000+5 0.117749+1 0.110000+6 0.997426+0 6210 3102 10
0.135000+6 0.992993+0 0.162500+6 0.757935+0 0.187500+6 0.734009+0 6210 3102 11
0.225000+6 0.678500+0 0.275000+6 0.492988+0 0.350000+6 0.418481+0 6210 3102 12
0.450000+6 0.372564+0 0.550000+6 0.284066+0 0.700000+6 0.247658+0 6210 3102 13
0.900000+6 0.194466+0 0.000000+0 0.000000+0 0.000000+0 0.000000+0 6210 3102 14
0.000000+0 0.000000+0 0 0 0 06210 0 0 15
6.215100+4 1.496234+2 0 0 0 0621033102 16
0.000000+0 0.000000+0 0 1 0 0621033102 17
0.100000+4 0.120000+4 0.150000+4 0.175000+4 0.200000+4 0.250000+4 6210 33102 18
0.100000+4 0.120000+4 0.150000+4 0.175000+4 0.200000+4 0.250000+4 6210 33102 19
0.100000+4 0.120000+4 0.150000+4 0.175000+4 0.200000+4 0.250000+4 6210 33102 20
0.100000+4 0.120000+4 0.150000+4 0.175000+4 0.200000+4 0.250000+4 6210 33102 21
0.100000+4 0.120000+4 0.150000+4 0.175000+4 0.200000+4 0.250000+4 6210 33102 22
0.200000+6 0.250000+6 0.300000+6 0.400000+6 0.500000+6 0.600000+6 6210 33102 23
0.800000+6 0.100000+7 0.000000+0 0.000000+0 0.000000+0 0.000000+0 6210 33102 24
0.300769-2 0.190133-2 0.194659-2 0.199179-2 0.196701-2 0.199724+26210 33102 103
0.208640-2 0.362495-2 0.197938-2 0.202161-2 0.201359-2 0.205954+26210 33102 104
0.216937-2 0.302796-2 0.208438-2 0.207471-2 0.212723-2 0.225324+26210 33102 105
0.345695-2 0.212488-2 0.218017-2 0.231748-2 0.376135-2 0.218460+26210 33102 106
0.232702-2 0.326855-2 0.242255-2 0.444583-2 0.444583-2 0.444583-2 6210 33102 107
0.000000+0 0.000000+0 0 0 0 06210 0 0 108
E 35001002
(Blank page)
Appendix C

GLOSSARY

This glossary includes definitions of terms used in this manual, listed alphabetically.
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**BIB information**: the information presented in the BIB section which includes bibliographic, descriptive and administrative information.

**Center 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 (and subaccession number).

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

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

**Data set**: the data for a given subentry (sub-work); includes the common data and data table for the subentry along with the common data for subentry 001.

**Data table**: the information given in the DATA section of a subentry.

**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 among data centres.

**Exchange format**: format used for the exchange of nuclear reaction data; i.e., the EXFOR format.

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

**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.

**Transmission (TRANS) file**: same as Exchange file
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