PROGRAM LINEAR

VERSION 74-1 (MAY 1974)
VERSION 75-1 (APRIL 1975)
VERSION 76-2 (OCTOBER 1976)
VERSION 77-1 (JANUARY 1977)
VERSION 78-1 (JULY 1978)
VERSION 79-1 (JULY 1979) CDC-7600 AND CRAY-1 VERSION.
VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION.
VERSION 80-2 (DECEMBER 1980)
VERSION 81-1 (MARCH 1981)
VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY.
VERSION 83-1 (JANUARY 1983) *MAJOR RE-DESIGN.
*PAGE SIZE INCREASED - 1002 TO 3006. LINEAR
*ELIMINATED COMPUTER DEPENDENT CODING.LINEAR
*NEW, MORE COMPATIBLE I/O UNIT NUMBER.LINEAR
*ADDED OPTION TO KEEP ALL ORIGINAL LINEAR
ENERGY POINTS FROM EVALUATION. LINEAR
*ADDED STANDARD ALLOWABLE ERROR OPTION.LINEAR
(CURRENTLY 0.1 PER-CENT) LINEAR

VERSION 83-2 (OCTOBER 1983) IMPROVED BASED ON USER COMMENTS. LINEAR
VERSION 84-1 (APRIL 1984) IMPROVED BASED ON USER COMMENTS. LINEAR
VERSION 84-2 (JUNE 1984) *UPDATED FOR ENDF/B-6 FORMATS. LINEAR
*SPECIAL I/O Routines TO GUARANTEE LINEAR
ACCURACY OF ENERGY. LINEAR
*DOUBLE PRECISION TREATMENT OF ENERGY LINEAR
(required for narrow resonances). LINEAR

VERSION 85-1 (AUGUST 1985) *FORTRAN-77/H VERSION LINEAR
VERSION 86-1 (JANUARY 1986) *ENDF/B-6 FORMAT LINEAR
VERSION 87-1 (JANUARY 1987) *DOUBLE PRECISION TREATMENT OF CROSS LINEAR
SECTION LINEAR

VERSION 88-1 (JULY 1988) *OPTION ...INTERNALLY DEFINE ALL I/O LINEAR
FILE NAMES (SEE, SUBROUTINE FILEIO FOR DETAILS). LINEAR
*IMPROVED BASED ON USER COMMENTS. LINEAR

VERSION 89-1 (JANUARY 1989) *PSYCHOANALYZED BY PROGRAM FREUD TO LINEAR
INSURE PROGRAM WILL NOT DO ANYTHING LINEAR
CRAZY.
*UPDATED TO USE NEW PROGRAM CONVERT LINEAR
KEYWORDS. LINEAR
*ADDED LIVERMORE CIVIC COMPILER LINEAR
CONVENTIONS. LINEAR

VERSION 90-1 (JUNE 1990) *EXTENDED TO LINEARIZE PHOTON LINEAR
INTERACTION DATA, MF=23 AND 27 LINEAR
*ADDED FORTRAN SAVE OPTION LINEAR
*UPDATED BASED ON USER COMMENTS. LINEAR
*NEW MORE CONSISTENT ENERGY OUTPUT LINEAR
ROUTINE. LINEAR
*WARNING...INPUT PARAMETER FORMAT LINEAR
HAS BEEN CHANGED...SEE DESCRIPTION LINEAR
BELOW. LINEAR

VERSION 91-1 (JULY 1991) *ADDED INTERPOLATION LAW 6 - ONLY USED LINEAR
FOR CHARGED PARTICLE CROSS SECTIONS LINEAR
FOR COULOMB PENETRABILITIES. LINEAR

VERSION 92-1 (JANUARY 1992) *ADDED NU-BAR (TOTAL, DELAYED, PROMPT) LINEAR
POLYNOMIAL OR TABULATED ALL CONVERTED LINEAR
TO LINEARLY INTERPOLABLE LINEAR
*INCREASED PAGE SIZE FROM 3006 TO 5010 LINEAR
POINTS. LINEAR
*ADDED LIVERMORE CIVIC COMPILER LINEAR
CONVENTIONS. LINEAR

VERSION 92-2 (JULY 1992) *CORRECTED CONVERSION OF NU-BAR FROM LINEAR
POLYNOMIAL TO TABULATED - COPY LINEAR
SPONTANEOUS NU-BAR (BY DEFINITION LINEAR
THE SPONTANEOUS NU-BAR IS NOT AN LINEAR
ENERGY DEPENDENT QUANTITY). LINEAR
Vers. 93-1 (March 1993) *Updated for use with lahey compiler
*Increased page size from 5010 to 30000 points

Vers. 94-1 (January 1994) *Variable ENDF/B data filenames
*To allow access to file structures
*Warning - Input parameter format has been changed
*Close all files before terminating (see, subroutine ENDIT)

Vers. 96-1 (January 1996) *Complete re-write
*Improved computer independence
*All double precision
*On screen output
*Uniform treatment of ENDF/B I/O
*Improved output precision
*Defined scratch file names
*Always include thermal value
*Increased page size from 30000 to 60000 points

Vers. 99-1 (March 1999) *Corrected character to floating point read for more digits
*Updated test for ENDF/B format

Vers. 99-2 (June 1999) *Assume ENDF/B-VI, not V, if missing
*MF=1, MT=451.

Vers. 2000-1 (February 2000) *Added MF = 9 and 10 linearization
*General improvements based on user feedback

Vers. 2002-1 (May 2002) *Optional input parameters


*No subdivide below minimum XCLow

Vers. 2007-1 (Jan. 2007) *Checked against all ENDF/B-VII.
*Increased page size from 60,000 to 600,000 points


Vers. 2010-1 (Apr. 2010) *Skipped leading cross section = 0 up to effective start, unless keeping all original energy points.
*Replaced ETHRES by ESTART - it is not a threshold - just a minimum energy - if a section starts above this energy with a positive cross section, an additional point will be inserted with cross section = 0.

Vers. 2012-1 (Aug. 2012) *Minor updates based on user feedback
*Added codename


*Replaced all 3 way IF statements.
*Cosmetic changes based on FREUD psychoanalysis.

Vers. 2016-1 (June 2016) *Updated based on user feedback.
*Increased page size to 3,000,000.

Vers. 2017-1 (May 2017) *All floating input parameters changed to character input + IN9 conversion.


Vers. 2019-1 (June 2019) *Updated on-line output for all ENDFERROR.
*Additional interpolation law tests.
*Checked maximum tabulated energy to insure it is the same for all MTs - if not, print WARNING messages.
*Corrected END Histogram linearized - LINEAR
Previously assumed Y = 0 and deleted LINEAR
now whatever the value it is included LINEAR

VERS. 2020-1 (Dec. 2020)  
*Major Re-write of Convergence LINEAR
*Replaced INCORE9 by INCORE10. LINEAR
*Added Target Isomer Flag LINEAR
*Keep iterating toward MAX & MIN LINEAR

VERS. 2021-1 (Mar. 2021)  
*Complete re-write of convergence. LINEAR
*Optionally add MF/MT=1/451 comments LINEAR
*Updated from FORTRAN 2018 LINEAR
*Minimum Cross Section is no longer an input option = set to 1.0d-30. LINEAR

VERS. 2023-1 (Feb. 2023)  
*Decreased in-core page size from 6,000,000 ro 120,000 LINEAR

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Authors Message
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The report described above is the latest published documentation for this program. However, the comments below should be considered the latest documentation including all recent improvements. Please read all of these comments before implementation.

At the present time we are attempting to develop a set of computer independent programs that can easily be implemented on any one of a wide variety of computers. In order to assist in this project it would be appreciated if you would notify the author of any compiler diagnostics, operating problems or suggestions on how to improve this program. Hopefully, in this way future versions of this program will be completely compatible for use on your computer.

Purpose
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This program is designed to convert ENDF/B file 3, 23 and 27 data to linear-linear interpolable form. Any section that is already linear-linear interpolable will be thinned.

In the following discussion for simplicity the ENDF/B terminology ---ENDF/B TAPE--- will be used. In fact the actual medium may be tape, cards, disk or any other medium.

ENDF/B format
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This program only uses the ENDF/B BCD or Card Image Format (as opposed to the binary format) and can handle data in any version of the ENDF/B format (i.e., ENDF/B-1, 2, 3, 4, 5, 6 format).

It is assumed that the data is correctly coded in the ENDF/B format and no error checking is performed. In particular it is
ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE CORRECTLY OUTPUT ON ALL LINES. THE FORMAT OF SECTION MF=1, MT=451 AND ALL SECTIONS OF MF=3 MUST BE CORRECT. THE PROGRAM COPIES ALL OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.

OUTPUT FORMAT

IN THIS VERSION OF LINEAR ALL ENERGIES WILL BE OUTPUT IN F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN WITH UP TO 9 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS TO THE 9 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE TO USE THE 9 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA DUE TO TRUNCATION OF ENERGIES TO 6 DIGITS DURING OUTPUT.

CONTENTS OF OUTPUT

ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE LINEARIZED DATA CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO INCLUDED.

DOCUMENTATION

THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED BY THE ADDITION OF 3 COMMENT LINES AT THE END OF EACH HOLLERITH SECTION IN THE FORM

***************** PROGRAM LINEAR (2023-1) ****************
FOR ALL DATA GREATER THAN 1.00000-30 IN ABSOLUTE VALUE DATA LINEARIZED TO WITHIN AN ACCURACY OF 0.1 PER-CENT

THE ORDER OF SIMILAR COMMENTS (FROM RECENT, SIGMA1 AND GROUPIE) PRESENT represents a complete history of all operations performed on the data by these programs.

THESE COMMENT LINES ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS, I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451 IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT SHOULD BE USED TO CREATE A HOLLERITH SECTION.

REACTION INDEX

THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN EACH EVALUATION. THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM YOU MAY USE PROGRAM DICTIN TO CREATE A CORRECT REACTION INDEX.

SECTION SIZE

SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.

FOR ANY LINEARIZED SECTION THAT CONTAINS 60000 OR FEWER POINTS THE ENTIRE OPERATION WILL BE PERFORMED IN CORE AND THE LINEARIZED DATA WILL BE OUTPUT DIRECTLY TO THE ENDF/B FORMAT. FOR ANY SECTION
THAT CONTAINS MORE POINTS THE DATA WILL BE LINEARIZED A PAGE AT A LINEAR TIME (1 PAGE = 60000 POINTS) AND OUTPUT TO SCRATCH. AFTER THE ENTIRE SECTION HAS BEEN LINEARIZED THE DATA WILL BE READ BACK FROM SCRATCH AND OUTPUT TO THE ENDF/B FORMAT.

SELECTION OF DATA

THE PROGRAM SELCTS DATA TO BE LINEARIZED BASED EITHER ON EITHER MAT (ENDF/B MAT NO.) OR ZA AS WELL AS MF AND MT NUMBERS. THIS PROGRAM ALLOWS UP TO 100 MAT/MF/MT OR ZA/MF/MT RANGES TO BE SPECIFIED BY INPUT PARAMETERS. THE PROGRAM WILL ASSUME THAT THE ENDF/B TAPE IS IN MAT ORDER, REGARDLESS OF THE CRITERIA USED TO RETRIEVE MATERIALS. IF RETRIEVAL IS BY MAT RANGE THE PROGRAM WILL TERMINATE WHEN A MAT IS FOUND THAT IS ABOVE ALL REQUESTED MAT RANGES. IF RETRIEVAL IS BY ZA RANGE THE PROGRAM WILL SEARCH THE ENTIRE ENDF/B TAPE.

PROGRAM OPERATION

EACH SECTION OF DATA IS CONSIDERED SEPARATELY. EACH SECTION OF ENDF/B DATA TO LINEARIZE IS REPRESENTED BY A TABLE OF ENERGY VS. CROSS SECTION AND ANY ONE OF FIVE ALLOWABLE INTERPOLATION LAWS BETWEEN ANY TWO TABULATED POINTS. THIS PROGRAM WILL REPLACE EACH SECTION OF DATA CROSS SECTIONS BY A NEW TABLE OF ENERGY VS. CROSS SECTION IN WHICH THE INTERPOLATION LAW IS ALWAYS LINEAR IN ENERGY AND CROSS SECTION BETWEEN ANY TWO TABULATED POINTS.

DATA IS READ AND LINEARIZED A PAGE AT A TIME (ONE PAGE CONTAINS 60000 DATA POINTS). IF THE FINAL LINEARIZED SECTION CONTAINS TWO PAGES OR LESS, DATA POINTS IT WILL BE ENTIRELY CORE RESIDENT AFTER IT HAS BEEN LINEARIZED AND WILL BE WRITTEN DIRECTLY FROM CORE TO THE OUTPUT TAPE. IF THE LINEARIZED SECTION IS LARGER THAN TWO PAGES, AFTER EACH PAGE IS LINEARIZED IT WILL BE WRITTEN TO SCRATCH. AFTER THE ENTIRE SECTION HAS BEEN LINEARIZED IT WILL BE READ BACK FROM SCRATCH, TWO PAGES AT A TIME, AND WRITTEN TO THE OUTPUT TAPE.

KEEP EVALUATED DATA POINTS

SOMETIMES IT IS CONVENIENT TO KEEP ALL ENERGY POINTS WHICH WERE PRESENT IN THE ORIGINAL EVALUATION AND TO MERELY SUPPLEMENT THESE POINTS WITH ADDITIONAL ENERGY POINTS IN ORDER TO LINEARIZE THE CROSS SECTIONS. FOR EXAMPLE, IT IS OFTEN CONVENIENT TO KEEP THE THERMAL VALUE (AT 0.0253 EV) OR THE VALUE AT 14.1 MEV.

THE CURRENT VERSION OF THIS PROGRAM WILL ALLOW THE USER TO KEEP ALL ORIGINAL EVALUATED DATA POINTS BY SPECIFYING 1 IN COLUMNS 34-44 OF THE FIRST INPUT LINE. THIS WILL TURN OFF THE BACKWARD THINNING (SEE UCRL-50400, VOL. 17, PART A FOR EXPLANATION) AND RESULT IN ALL ORIGINAL ENERGY POINTS BEING KEPT. CAUTION SHOULD BE EXERCISED IN USING THIS OPTION SINCE IT CAN RESULT IN A CONSIDERABLE INCREASE IN THE NUMBER OF DATA POINTS OUTPUT BY THIS CODE.

FOR ALL USERS WHO ARE NOT INTERESTED IN THIS OPTIONS NO CHANGES ARE REQUIRED IN THE INPUT TO THIS PROGRAM, I. E. IF COLUMNS 34-44 ARE BLANK (AS FOR ALL PREVIOUS VERSIONS OF THIS CODE) THE PROGRAM WILL OPERATE EXACTLY AS IT DID BEFORE.

ALLOWABLE ERROR

ALLOWABLE ERROR MUST ALWAYS BE SPECIFIED IN THE INPUT TO THIS PROGRAM AS A FRACTION, NOT A PER-CENT. FOR EXAMPLE, INPUT THE ALLOWABLE FRACTIONAL ERROR 0.001 IN ORDER TO OBTAIN DATA THAT IS ACCURATE TO WITHIN 0.1 PER-CENT.

THE CONVERSION OF THE DATA FROM THE GENERAL INTERPOLATION FORM TO LINEARLY INTERPOLABLE FORM CANNOT BE PERFORMED EXACTLY. HOWEVER, IT CAN BE PERFORMED TO VIRTUALLY ANY REQUIRED ACCURACY AND MOST IMPORTANTLY CAN BE PERFORMED TO A TOLERANCE THAT IS SMALL COMPARED TO THE UNCERTAINTY IN THE CROSS SECTIONS THEMSELVES. AS SUCH THE
CONVERSION OF CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM CAN BE LINEAR PERFORMED WITH ESSENTIALLY NO LOSE OF INFORMATION. THE ALLOWABLE ERROR MAY BE ENERGY INDEPENDENT (CONSTANT) OR ENERGY DEPENDENT. THE ALLOWABLE ERROR IS DESCRIBED BY A TABULATED FUNCTION OF UP TO 20 (ENERGY,ERROR) PAIRS AND LINEAR INTERPOLATION BETWEEN TABULATED POINTS. IF ONLY ONE TABULATED POINT IS GIVEN THE ERROR WILL BE CONSIDERED CONSTANT OVER THE ENTIRE ENERGY RANGE. ANY GIVEN APPLICATION BY USING A SMALL ERROR IN THE ENERGY RANGE OF INTEREST AND A LESS STRINGENT ERROR IN OTHER ENERGY RANGES. DEFAULT ALLOWABLE ERROR IN ORDER TO INSURE CONVERGENCE OF THE LINEARIZING ALGORITHM THE ALLOWABLE ERROR MUST BE POSITIVE. IF THE USER INPUTS AN ERROR THAT IS NOT POSITIVE IT WILL AUTOMATICALLY BE SET TO THE DEFAULT VALUE (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT) AND INDICATED AS SUCH IN THE OUTPUT LISTING. COULOMB PENETRABILITY (INTERPOLATION LAW = 6) INTRODUCED FOR ENDF/B-VI. THIS IS DEFINED AS, SIG(E) = C1*EXP(-C2/SQRT(E - T)) THIS PROGRAM ONLY CONSIDERS EXOTHERMIC REACTIONS - T = 0 SIG(E) = C1*EXP(-C2/SQRT(E)) WARNING...THIS INTERPOLATION LAW SHOULD ONLY BE USED FOR REACTIONS WHICH HAVE A POSITIVE Q-VALUE (EXOTHERMIC REACTIONS), SINCE HERE WE ONLY CONSIDER T = 0.0 IN THE FORMALISM. IN ALL OTHER CASES A WARNING MESSAGE WILL BE PRINTED. INPUT FILES ---- UNIT DESCRIPTION 2 INPUT LINES (BCD - 80 CHARACTERS/RECORD) 10 ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD) OUTPUT FILES ---- UNIT DESCRIPTION 3 OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD) 11 FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD) SCRATCH FILES ---- UNIT DESCRIPTION 12 SCRATCH FILE (BINARY - 180000 WORDS/RECORD) OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILEIO) ---- UNIT FILE NAME 2 LINEAR.INP 3 LINEAR.LST 10 ENDFB.IN 11 ENDFB.OUT 12 (SCRATCH) INPUT PARAMETERS FOR VERSIONS EARLIER THAN 90-1 THIS PROGRAM ONLY ALLOWED THE USER TO SPECIFY BY INPUT PARAMETERS WHICH MATERIALS (MAT) TO PROCESS. FOR EACH REQUESTED MATERIAL NEUTRON INTERACTION CROSS SECTIONS
(MF=3) would be linearized and the remainder of the material would be copied.

For versions 90-1 and later this program will allow the user to specify by input parameters exactly what sections of data to process. For each section of data, specified by MAT, MF, MT ranges, sections of MF=3, 23 and 27 will be linearized and all other requested sections will be copied. All sections which are not explicitly requested will be skipped and will not appear on ENDF/B file output by this program.

With this new procedure you can minimize the size of the ENDF/B file output by this program, e.g., if you only want neutron cross sections for subsequent processing you need only request only MF=3 data.

However, you must understand that only those sections which you explicitly request will appear on the ENDF/B file output by this program. For example, if you wish to document exactly how you linearized the data by including comments in MF=1, MT=451 then you must explicitly request that MF=1, MT=451 be processed for each material that you request. Similarly if you want the entire evaluation you must request all MF and MT to be output.

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LINE COLS.  DESCRIPTION

1-11  SELECTION CRITERIA (0=MAT, 1=ZA)

12-22  MONITOR MODE SELECTOR
        = 0 - NORMAL OPERATION
        = 1 - MONITOR PROGRESS OF LINEARIZING OF THE DATA.
        EACH TIME A PAGE OF DATA POINTS IS WRITTEN TO THE
        SCRATCH FILE PRINT OUT THE TOTAL NUMBER OF DATA
        POINTS ON SCRATCH AND THE LOWER AND UPPER ENER
        GY LIMITS OF THE PAGE (THIS OPTION MAY BE USED IN
        ORDER TO MONITOR THE EXECUTION SPEED OF LONG
        RUNNING JOBS).

23-33  MINIMUM CROSS SECTION OF INTEREST (BARNs).

34-44  KEEP ORIGINAL EVALUATED DATA POINTS.
        = 0 - NO.
        = 1 - YES - ADDITIONAL POINTS MAY BE ADDED IN ORDER
        TO LINEARIZE DATA, BUT ALL ORIGINAL DATA POINTS
        WILL BE INCLUDED IN THE RESULTS.

2-172  ENDF/B INPUT DATA FILENAME
        (STANDARD OPTION = ENDFB.IN)

3-172  ENDF/B OUTPUT DATA FILENAME
        (STANDARD OPTION = ENDFB.OUT)

4-N  1-6  LOWER MAT OR ZA LIMIT
     7-8  LOWER MF LIMIT
     9-11  LOWER MT LIMIT
    12-17  UPPER MAT OR ZA LIMIT
    18-19  UPPER MF LIMIT
    20-22  UPPER MT LIMIT

VARY 1-11  ENERGY FOR ERROR LAW
12-22  ALLOWABLE FRACTIONAL ERROR FOR ERROR LAW.

The acceptable linearizing error may be specified to
BE EITHER ENERGY INDEPENDENT (DEFINED BY A SINGLE LINEAR ERROR), OR ENERGY DEPENDENT (DEFINED BY UP TO 20 LINEAR ENERGY, ERROR PAIRS). FOR THE ENERGY DEPENDENT CASE LINEAR INTERPOLATION WILL BE USED TO DEFINE THE ERRORLINEAR AT ENERGIES BETWEEN THOSE AT WHICH IT IS TABULATED. LINEAR IN ALL CASES THE ERROR LAW IS TERMINATED BY A BLANK LINE. IF ONLY ONE ENERGY, ERROR PAIR IS GIVEN THE LINEAR LAW WILL BE CONSIDERED TO BE ENERGY INDEPENDENT. IF MORE THAN ONE PAIR IS GIVEN IT WILL BE CONSIDERED LINEAR TO BE ENERGY DEPENDENT (NOTE, ENERGY INDEPENDENT LINEAR FORM WILL RUN FASTER THAN THE EQUIVALENT ENERGY LINEAR DEPENDENT FORM). FOR AN ENERGY DEPENDENT ERROR LAW LINEAR ALL ENERGIES MUST BE ASCENDING ENERGY ORDER. FOR LINEAR CONVERGENCE OF THE LINEARIZING ALGORITHM ALL ERRORS MUST BE POSITIVE. IF AN ALLOWABLE ERROR IS NOT LINEAR POSITIVE IT WILL BE SET EQUAL TO THE STANDARD OPTION LINEAR (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT). IF THE FIRST ERROR LINE IS BLANK IT WILL TERMINATE LINEAR THE ERROR LAW AND THE ERROR WILL BE TREATED AS LINEAR ENERGY INDEPENDENT, EQUAL TO THE STANDARD OPTION LINEAR (CURRENTLY 0.1 PER-CENT). (SEE EXAMPLE INPUT 4).

EXAMPLE INPUT NO. 1
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RETRIEVE DATA BY ZA IN ORDER TO FIND ALL URANIUM ISOTOPES AND THORIUM 232. RETRIEVE ALL NEUTRON INTERACTION CROSS SECTIONS (MF=3). ALL ENERGY INTERVALS IN WHICH THE CROSS SECTION IS AT LEAST 1 MICRO-BARN (1.0E-06 BARNES) WILL BE SUBDIVIDED. BACKWARD THINNING WILL BE PERFORMED FROM 0 TO 100 EV LINEARIZE TO WITHIN 0.1 PER-CENT ACCURACY. FROM 100 EV TO 1 KEV VARY ACCURACY BETWEEN 0.1 AND 1.0 PER-CENT. ABOVE 1 KEV USE 1 PER-CENT ACCURACY.

EXPLICITLY SPECIFY THE STANDARD FILENAMES.

IN THIS CASE THE FOLLOWING 11 INPUT LINES ARE REQUIRED

1 0 1.00000- 6 0
ENFDB.IN
ENFDB.OUT
92000 3 0 92999 3999
90232 3 0 0 3 0 (UPPER LIMIT AUTOMATICALLY SET TO 90232 3999)
(END OF REQUEST LIST)
0.00000+ 0 1.00000-03
1.00000+ 2 1.00000-03
1.00000+ 3 1.00000-02
1.00000+ 9 1.00000-02
(END OF ERROR LAW)

EXAMPLE INPUT NO. 2
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SAME AS THE ABOVE CASE, EXCEPT LINEARIZE ALL DATA TO WITHIN THE STANDARD ACCURACY (CURRENTLY 0.1 PER-CENT). IN ORDER TO USE THE STANDARD ACCURACY YOU NEED NOT SPECIFY ANY ERROR LAW AT ALL. IN THIS CASE INCLUDE THE HOLLERITH SECTION, MF=1, MT=451, FOR EACH MATERIAL.

LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL THEN USE STANDARD FILENAMES.

IN THIS CASE THE FOLLOWING 9 INPUT LINES ARE REQUIRED

1 0 1.00000- 6 0
(USE DEFAULT FILENAME = ENFDB.IN)
(USE DEFAULT FILENAME = ENFDB.OUT)
92000 1451 92999 1451
90232 3 0 90232 3999
90232 3 0 0 3 0 (UPPER LIMIT AUTOMATICALLY SET TO 90232 3999)
(END OF REQUEST LIST)
(0.1 PER-CENT ERROR, END OF ERROR LAW)
EXAMPLE INPUT NO. 3

LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO WITHIN AN ACCURACY OF 0.5 PER-CENT (0.005 AS A FRACTION). IN THIS CASE YOU NEED NOT SPECIFY THE MAT, MF, MT RANGES.

READ THE ENDF/B DATA FROM \ENDFB6\ZA092238 AND WRITE THE ENDF/B DATA TO \ENDFB6\LINEAR\ZA092238.

IN THIS CASE THE FOLLOWING 6 INPUT LINES ARE REQUIRED

(MAT, 1.0E-10 BARNS, THIN)
\ENDFB6\ZA092238
\ENDFB6\LINEAR\ZA092238
(RETRIEVE ALL DATA, END REQUEST LIST)
5.00000-03
(END OF ERROR LAW)

NOTE THAT IN THIS CASE IF THE INPUT HAD SPECIFIED AN EQUIVALENT ENERGY DEPENDENT ERROR LAW BY GIVING A NUMBER OF ENERGY POINTS AT EACH OF WHICH THE ERROR IS 0.5 PER-CENT THE PROGRAM WOULD TAKE LONGER TO RUN (I.E., ONLY USE AN ENERGY DEPENDENT ERROR LAW WHEN IT IS NECESSARY).

EXAMPLE INPUT NO. 4

IN ORDER TO LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO THE STANDARD OPTION OF 0.1 PER-CENT IT IS ADEQUATE TO INPUT A SET OF COMPLETELY BLANK LINES WHICH WILL AUTOMATICALLY INVOKE ALL OF THE STANDARD OPTIONS.

LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL THEN USE STANDARD FILENAMES.

IN THIS CASE THE FOLLOWING THREE INPUT LINES ARE REQUIRED

(MAT, 1.0E-10 BARNS, THIN)
(USE DEFAULT FILENAME = ENDFB.IN)
(USE DEFAULT FILENAME = ENDFB.OUT)
(RETRIEVE ALL DATA, END REQUEST LIST)
(0.1 PER-CENT ERROR, END OF ERROR LAW)