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===== Mixer
PROGRAM MIXER Mixer
===== Mixer
VERSION 76-1 (NOVEMBER 1976) Mixer
VERSION 81-1 (APRIL 1981) *IBM VERSION Mixer
VERSION 82-1 (AUGUST 1982) *COMPUTER INDEPENDENT VERSION Mixer
VERSION 84-1 (JUNE 1984) *SPECIAL I/O ROUTINES TO GUARANTEE Mixer
    ACCURACY OF ENERGY. Mixer
    *DOUBLE PRECISION TREATMENT OF ENERGY Mixer
    (REQUIRED FOR NARROW RESONANCES). Mixer
VERSION 86-1 (JANUARY 1986) *FORTRAN-77/H VERSION Mixer
VERSION 88-1 (JULY 1988) *OPTION...INTERNALLY DEFINE ALL I/O Mixer
    FILE NAMES (SEE, SUBROUTINE FILIO1 Mixer
    AND FILIO2 FOR DETAILS). Mixer
    *IMPROVED BASED ON USER COMMENTS. Mixer
VERSION 89-1 (JANUARY 1989) *PSYCHOANALYZED BY PROGRAM FREUD TO Mixer
    INSURE PROGRAM WILL NOT DO ANYTHING Mixer
    CRAZY. Mixer
    *UPDATED TO USE NEW PROGRAM CONVERT Mixer
    KEYWORDS. Mixer
    *ADDED LIVERMORE CIVIC COMPILER Mixer
    CONVENTIONS. Mixer
VERSION 92-1 (JANUARY 1992) *UPDATED BASED ON USER COMMENTS Mixer
    *ADDED PHOTON CROSS SECTIONS Mixer
    *ADDED FORTRAN SAVE OPTION Mixer
    *OUTPUT IN ENDF/B-VI FORMAT Mixer
    *COMPLETELY CONSISTENT I/O ROUTINES - Mixer
    TO MINIMIZE COMPUTER DEPENDENCE. Mixer
    *NOTE, CHANGE IN INPUT PARAMETER Mixer
    FORMAT. Mixer
VERSION 94-1 (JANUARY 1994) *VARIABLE ENDF/B DATA FILENAMES Mixer
    TO ALLOW ACCESS TO FILE STRUCTURES Mixer
    (WARNING - INPUT PARAMETER FORMAT Mixer
    HAS BEEN CHANGED) Mixer
    *CLOSE ALL FILES BEFORE TERMINATING Mixer
    (SEE, SUBROUTINE ENDIT) Mixer
    *INCREASED INCORE PAGE SIZE FROM Mixer
    1002 TO 4008. Mixer
VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE Mixer
    *IMPROVED COMPUTER INDEPENDENCE Mixer
    *ALL DOUBLE PRECISION Mixer
    *ON SCREEN OUTPUT Mixer
    *UNIFORM TREATMENT OF ENDF/B I/O Mixer
    *IMPROVED OUTPUT PRECISION Mixer
    *DEFINED SCRATCH FILE NAMES Mixer
    *INCREASED INCORE PAGE SIZE FROM Mixer
    4008 TO 12000. Mixer
VERSION 99-1 (MARCH 1999) *CORRECTED CHARACTER TO FLOATING Mixer
    POINT READ FOR MORE DIGITS Mixer
    *UPDATED TEST FOR ENDF/B FORMAT Mixer
    VERSION BASED ON RECENT FORMAT CHANGE Mixer
    *GENERAL IMPROVEMENTS BASED ON Mixer
    USER FEEDBACK Mixer
VERSION 99-2 (JUNE 1999) *ASSUME ENDF/B-VI, NOT V, IF MISSING Mixer
    MF=1, MT=451. Mixer
VERS. 2000-1 (FEBRUARY 2000) *GENERAL IMPROVEMENTS BASED ON Mixer
    USER FEEDBACK Mixer
VERS. 2002-1 (MAY 2002) *OPTIONAL INPUT PARAMETERS Mixer
VERS. 2004-1 (MARCH 2004) *ADDED INCLUDE FOR COMMON Mixer
    *INCREASED INCORE PAGE SIZE FROM Mixer
    12000 TO 60000. Mixer
VERS. 2005-1 (OCT. 2005) *CORRECTED MERGE ERROR Mixer

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| VERS. 2007-1 (JAN. 2007) | *CHECKED AGAINST ALL ENDF/B-VII | Mixer |
| | *INCREASED INCORE PAGE SIZE FROM | Mixer |
| | 60,000 TO 240,000. | Mixer |
| VERS. 2007-2 (DEC. 2007) | *72 CHARACTER FILE NAMES. | Mixer |
| VERS. 2008-1 (JUNE 2008) | *ADDED GRAMS OR ATOMS INPUT | Mixer |
| VERS. 2010-1 (Apr. 2010) | *General update based on user feedback | Mixer |
| VERS. 2012-1 (Aug. 2012) | *Added CODENAME | Mixer |
| | *32 and 64 bit Compatible | Mixer |
| | *Added ERROR stop | Mixer |
| VERS. 2015-1 (Jan. 2015) | *Extended OUT9. | Mixer |
| | *Replaced ALL 3 way IF Statements. | Mixer |
| VERS. 2017-1 (May 2017) | *Increase max. points to 1,200,000 | Mixer |
| | *updated based on user feedbsck. | Mixer |
| | *All floating input parameters changed | Mixer |
| | to character input + IN9 conversion. | Mixer |

OWNED, MAINTAINED AND DISTRIBUTED BY

 THE NUCLEAR DATA SECTION
 INTERNATIONAL ATOMIC ENERGY AGENCY
 P.O. BOX 100
 A-1400, VIENNA, AUSTRIA
 EUROPE

ORIGINALLY WRITTEN BY

 Dermott E. Cullen

PRESENT CONTACT INFORMATION

 Dermott E. Cullen
 1466 Hudson Way
 Livermore, CA 94550
 U.S.A.
 Telephone 925-443-1911
 E. Mail RedCullen1@Comcast.net
 Website RedCullen1.net/HOMEPAGE.NEW

PURPOSE

 THIS PROGRAM IS DESIGNED TO CALCULATE THE ENERGY DEPENDENT CROSS
 SECTION FOR A COMPOSITE MIXTURE OF UP TO 10 DIFFERENT MATERIALS.

THE PRESENT VERSION WILL ONLY CALCULATE THE CROSS SECTION FOR ONE
 FINAL REACTION (ENDF/B SECTION), E.G. TOTAL CROSS SECTION, BUT NOT
 ANY OTHER REACTION.

NOTE, THIS PROGRAM WILL NOT COMBINE ALL REACTIONS FOR A MIXTURE
 OF MATERIALS DURING A SINGLE RUN - ONLY ONE REACTION WILL BE
 CREATED PER RUN.

EVALUATED DATA FORMAT

 THE CROSS SECTIONS ARE READ FROM THE ENDF/B FORMAT AND THE
 COMPOSITE CROSS SECTION IS CONVERTED TO AN EQUIVALENT BARN/ATOM
 FORM AND OUTPUT IN THE ENDF/B FORMAT WITH AN EQUIVALENT ATOMIC
 WEIGHT. THE USER MUST SPECIFY THE COMPOSITION BY GIVING THE ZA,
 MT AND GRAMS OR ATOMS OF EACH CONSTITUENT. IN ADDITION THE USER
 IDENTIFY THE COMPOSITE CROSS SECTION BY SPECIFYING THE ZA, MAT
 AND MT TO BE USED IN THE ENDF/B FORMATTED OUTPUT.

SINCE ONLY THE CROSS SECTIONS IN FILE 3 AND 23 ARE USED, AND THE
 FORMAT FOR FILE 3/23 IS THE SAME IN ALL VERSIONS ON ENDF/B, THIS

PROGRAM MAY BE USED WITH ANY VERSION OF ENDF/B DATA (I.E., ENDF/B-I, II, III, IV, V OR VI). DURING A SINGLE RUN IT MAY EVEN BE USED TO READ AND COMBINE EVALUATIONS WHICH ARE IN DIFFERENT VERSIONS OF THE ENDF/B FORMAT.

ENDF/B FORMATTED OUTPUT WILL BE IN THE ENDF/B-VI FORMAT REGARDLESS OF THE FORMAT OF THE INPUT ENDF/B DATA. THIS WILL ONLY EFFECT THE HOLLERITH SECTION (MF=1, MT=451). THE FORMAT OF CROSS SECTIONS (MF=3) IS THE SAME IN ALL VERSION OF THE ENDF/B FORMAT.

IN ORDER TO GUARANTEE PROPER OPERATION OF THIS PROGRAM THE DATA MUST BE PROPERLY CODED IN THE ENDF/B FORMAT. NO ERROR CHECKING IS PERFORMED. IT IS PARTICULARLY IMPORTANT THAT THE FOLLOWING DATA BE CORRECT

- (1) ZA, MF, MT - MUST BE CORRECT IN ORDER TO ALLOW PROGRAM TO SELECT THE APPROPRIATE SECTIONS TO BE COMBINED.
- (2) AWRE - ATOMIC WEIGHT RATIO MUST BE CORRECT TO ALLOW PROGRAM TO CONVERT THE USER SPECIFIED GRAMS INTO ATOMS FOR PROPER ATOM RATIO MIXING.
- (3) (ENERGIES, CROSS SECTIONS) - MUST BE CORRECT, LINEARLY

INTERPOLABLE, IN ASCENDING ENERGY ORDER OF (E, BARNS).
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TO CONVERT ENDF/B FORMATTED DATA TO THE REQUIRED INPUT FORM THE FOLLOWING PROGRAMS MAY BE USED,
LINEAR - CONVERT TABULATED CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM.

RECENT - RECONSTRUCT RESONANCE CONTRIBUTION, ADD TO BACKGROUND CROSS SECTION AND OUTPUT THE COMBINATION IN LINEARLY INTERPOLABLE FORM.

SIGMA1 - DOPPLER BROADEN CROSS SECTIONS TO ANY TEMPERATURE AND OUTPUT THE RESULT IN LINEARLY INTERPOLABLE FORM.

DOCUMENTATION

THE FACT THAT THIS PROGRAM HAS COMBINED THE DATA IS DOCUMENTED IN THE OUTPUT ENDF/B FORMAT IN THE HOLLERITH SECTION BY FIRST IDENTIFYING THE VERSION OF THIS PROGRAM THAT WAS USED, IN THE FORM

***** (PROGRAM MIXER 2017-1) *****

THIS IS FOLLOWED BY THE TWO LINE IDENTIFICATION INPUT BY THE USER. THIS IS FOLLOWED BY COMPOSITION INPUT BY THE USER.

NEUTRON OR PHOTON DATA

THIS PROGRAM WILL ALLOW YOU TO PROCESS EITHER NEUTRON OR PHOTON CROSS SECTIONS - BUT YOU CANNOT MIX THE TWO TYPES TOGETHER. BY INPUT YOU CAN SPECIFY THE OUTPUT MF = 3 (NEUTRONS) OR 23 (PHOTONS) WHATEVER TYPE YOU SPECIFIED FOR OUTPUT IS THE ONLY TYPE OF DATA WHICH WILL BE PROCESSED BY THIS PROGRAM.

DEFINING THE COMPOSITION

THE USER MAY SPECIFY UP TO 10 DIFFERENT SECTIONS OF DATA TO BE COMBINED, EACH SECTION IDENTIFIED BY ZA AND MT NUMBER. THE AMOUNT OF EACH MATERIAL IS SPECIFIED BY DEFINING THE NUMBER OF GRAMS OF EACH MATERIAL IN THE COMPOSITE MIXTURE. THIS CAN BE DERIVED FROM THE VOLUME FRACTION SIMPLY BY MULTIPLYING THE STP DENSITY OF EACH MATERIAL BY ITS VOLUME FRACTION. NOTE, DO NOT INPUT ATOM FRACTIONS.

THE LIST OF SECTIONS TO BE COMBINED MAY BE SPECIFIED IN ANY ORDER, I.E. THEY NEED NOT BE IN ZA ORDER OR THE ORDER THAT THE EVALUATED DATA APPEARS ON THE ENDF/B FORMATTED TAPE.

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IF ANY REQUESTED SECTION OF DATA IS NOT FOUND ON THE ORIGINAL ENDF/B FORMATTED FILE, THE PROGRAM WILL PRINT A LIST OF THE MISSING SECTIONS AND TERMINATE. IF ALL REQUESTED SECTIONS ARE FOUND THE PROGRAM WILL PRODUCE A COMPOSITE SECTION USING THE UNION OF ALL ENERGIES FOUND IN ANY SECTION. THE COMPOSITE SECTION WILL NOT BE THINNED.

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PRIOR TO LATER USE IN ANY APPLICATION THE NUMBER OF ENERGY POINTS IN THE COMPOSITE CROSS SECTION MAY BE MINIMIZED BY USING PROGRAM LINEAR, UCRL-50400, VOL. 17, PART B TO THIN THE DATA.

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ONLY LINEARLY INTERPOLABLE DATA

THE CROSS SECTIONS TO BE COMBINED MUST BE IN LINEARLY INTERPOLABLE TABULATED FORM (I. E., FILE 3 OR 23, INTERPOLATION LAW 2).

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TO CONVERT TABULATED CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM SEE, PROGRAM LINEAR, UCRL-50400, VOL. 17, PART A.

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TO CONVERT RESONANCE PARAMETERS TO LINEARLY INTERPOLABLE FORM SEE, PROGRAM RECENT, UCRL-50400, VOL. 17, PART C.

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TO DOPPLER BROADEN LINEARLY INTERPOLABLE DATA TO ANY TEMPERATURE SEE PROGRAM SIGMA1, UCRL-50400, VOL. 17, PART B.

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PAGING SYSTEM

THERE IS NO LIMIT TO THE THE NUMBER OF DATA POINTS IN EACH OF THE SECTIONS TO BE COMBINED, NOR IS THERE A LIMIT TO THE NUMBER OF DATA POINTS IN THE COMPOSITE MIXTURE CROSS SECTION.

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ALL REQUIRED SECTIONS OF DATA ARE READ FROM THE ORIGINAL ENDF/B FORMATTED FILE. ANY SECTION OF 60000 OR FEWER POINTS WILL BE TOTALLY CORE RESIDENT. LARGER SECTIONS ARE LOADED INTO A PAGING SYSTEM USING A SCRATCH FILE WITH ONLY 60000 POINTS PER SECTION CORE RESIDENT AT ANY ONE TIME. SIMILARLY THE COMPOSITE SECTION WILL BE TOTALLY CORE RESIDENT IF IT CONTAINS 60000 OR FEWER POINTS AND LARGER COMPOSITE SECTIONS WILL BE LOADED INTO A PAGING SYSTEM WHERE ONLY 60000 POINTS ARE CORE RESIDENT AT ANY TIME. SINCE A PAGING SYSTEM MAY BE USED BY ANY SECTION OF DATA THERE IS NO LIMIT TO THE SIZE OF EITHER THE ORIGINAL SECTIONS, NOR TO THE COMPOSITE SECTION, E.G. A SECTION MAY CONTAIN 100,000 ENERGIES AND CROSS SECTIONS TO DESCRIBE A GIVEN REACTION.

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PAGE SIZE

THE PAGE SIZE USED IN THIS PROGRAM IS DEFINED BY THE PARAMETER NPAGE AND THE DIMENSIONS OF THE ARRAYS XTAB AND YTAB. IN ORDER TO ADAPT THIS PROGRAM FOR USE ON ANY COMPUTER THE PAGE SIZE MAY BE INCREASED OR DECREASED BUT THE FOLLOWING RULES MUST BE FOLLOWED

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- (1) NPAGE - MUST BE A MULTIPLE OF 3 IN ORDER TO ALLOW THE PROGRAM TO READ FULL CARDS OF ENDF/B DATA (3 POINTS PER LINE). FAILURE TO FOLLOW THIS RULE CAN LEAD TO LOSS OF DATA AND/OR PROGRAM ERRORS DURING EXECUTION.
- (3) YTAB - THE DIMENSION OF YTAB MUST BE (NPAGE,11).
- (4) XTAB - THE DIMENSION OF XTAB MUST BE (NPAGE,11).

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|-------|-------|---------|---|--|---|
| ----- | ----- | | | | Mixer |
| 2 | | | INPUT CARDS (BCD - 80 CHARACTERS/RECORD) | | Mixer |
| 10 | | | ORIGINAL EVALUATED DATA IN ENDF/B FORMAT (BCD - 80 CHARACTERS/RECORD) | | Mixer Mixer Mixer |
| | | | OUTPUT FILES | | Mixer |
| ----- | ----- | | | | Mixer |
| UNIT | | | DESCRIPTION | | Mixer |
| ----- | ----- | | | | Mixer |
| 3 | | | OUTPUT LISTING (BCD - 120 CHARACTERS/RECORD) | | Mixer |
| 11 | | | COMPOSITE EVALUATED DATA IN ENDF/B FORMAT (BCD - 80 CHARACTERS/RECORD) | | Mixer Mixer Mixer |
| | | | SCRATCH FILES | | Mixer |
| ----- | ----- | | | | Mixer |
| UNIT | | | DESCRIPTION | | Mixer |
| ----- | ----- | | | | Mixer |
| 12 | | | SCRATCH FILE FOR EACH OF THE 10 SECTIONS WHICH | | Mixer |
| 13 | | | WILL BE ADDED TOGETHER TO DEFINE THE FINAL | | Mixer |
| . | | | SECTION (BINARY - 60000 AND 480000 WORDS/RECORD) | | Mixer |
| . | | | . | | Mixer |
| . | | | . | | Mixer |
| 20 | | | . | | Mixer |
| 21 | | | . | | Mixer |
| 22 | | | SCRATCH FILE FOR COMBINED SECTION. (BINARY - 2004 WORDS/RECORD) | | Mixer Mixer Mixer |
| | | | STANDARD FILE NAMES (SEE SUBROUTINES FILIO1 AND FILIO2) | | Mixer |
| ----- | ----- | | | | Mixer |
| UNIT | | | FILE NAME | | Mixer |
| ----- | ----- | | | | Mixer |
| 2 | | | MIXER.INP | | Mixer |
| 3 | | | MIXER.LST | | Mixer |
| 10 | | | ENDFB.IN | | Mixer |
| 11 | | | ENDFB.OUT | | Mixer |
| 12-22 | | | (SCRATCH) | | Mixer Mixer Mixer |
| | | | INPUT CARDS | | Mixer |
| ----- | ----- | | | | Mixer |
| LINE | COLS. | FORMAT | NAME | DESCRIPTION | Mixer |
| ----- | ----- | ----- | ----- | ----- | Mixer |
| 1-2 | 1-66 | 16A4,A2 | TITLE | TWO LINE TITLE DESCRIBING PROBLEM (THIS TITLE IS USED TO IDENTIFY THE OUTPUT LISTING AND IS ALSO WRITTEN IN MF=1, MT=451 (HOLLERITH SECTION) OF THE ENDF/B FORMATTED OUTPUT TO IDENTIFY THE COMPOSITE MIXTURE). | Mixer Mixer Mixer Mixer Mixer |
| 3 | 1-72 | | | ENDF/B INPUT DATA FILENAME (STANDARD OPTION = ENDFB.IN) | Mixer Mixer |
| 4 | 1-72 | | | ENDF/B OUTPUT DATA FILENAME (STANDARD OPTION = ENDFB.OUT) | Mixer Mixer |
| 5 | 1-11 | I11 | IZAOUT | ZA IDENTIFICATION FOR COMBINATION | Mixer |
| 5 | 12-17 | I6 | MATOUT | MAT IDENTIFICATION FOR COMBINATION | Mixer |
| 5 | 18-19 | I2 | MFOUT | MF IDENTIFICATION FOR COMBINATION | Mixer |
| 5 | 20-22 | I3 | MTOUT | MT IDENTIFICATION FOR COMBINATION | Mixer |
| 5 | 23-33 | I11 | | DEFINE INPUT DENSITY = 0 = GRAMS = BACKWARDS COMPATIBLE > 0 = ATOMS = NEW IN 2008 | Mixer Mixer Mixer |
| 6-N | 1-11 | I11 | IZAGET | ZA (1000*Z+A) OF MATERIAL | Mixer |
| 6-N | 12-22 | I11 | MTGET | MT OF REACTION | Mixer |
| 6-N | 23-33 | E11.4 | DENSE | MATERIAL DENSITY (ATOMS OR GRAMS) | Mixer Mixer |
| | | | | THE SIXTH LINE IS REPEATED FOR EACH SECTION (FROM 2 TO 10). | Mixer |

SINCE THE ENDF/B FORMATTED OUTPUT IS IN BARNs/ATOM FORM A MINIMUM OF TWO SECTIONS MUST BE COMBINED (I.E., IF ONLY ONE SECTION IS SPECIFIED THE OUTPUT WOULD BE IDENTICAL TO THE INPUT AND AS SUCH THE PROGRAM WILL CONSIDER THIS TO BE AN ERROR AND NOT PERFORM THE CALCULATION). THE LIST OF SECTIONS IS TERMINATED BY A BLANK LINE.

THE LIST OF SECTIONS TO BE COMBINED MAY BE SPECIFIED IN ANY ORDER, I.E. THEY NEED NOT BE IN ZA ORDER OR THE ORDER THAT THE EVALUATED DATA APPEARS ON THE ENDF/B FORMATTED TAPE.

EXAMPLE INPUT NO. 1

CREATE THE TOTAL CROSS SECTION (MT=1) FOR STAINLESS STEEL AND IDENTIFY THE COMBINED MATERIAL WITH ZA=26800 AND MAT=4000, THE COMPOSITION BY VOLUME OF THE STEEL WILL BE...

THE DATA FROM \ENDFB6\K300\LIBRARY.DAT AND WRITE DATA TO \MIXER\STEEL.DAT

IRON - 74.8 PER-CENT
CHROMIUM - 16.0
NICKEL - 6.0
MANGANESE - 2.0
SILICON - 1.0
CARBON - 0.2

THE INPUT MUST SPECIFY THE COMPOSITION BY GRAMS OR ATOMS. THIS IS DEFINED AS THE PRODUCT OF THE STANDARD DENSITY (GRAMS) TIMES THE VOLUME FRACTION. FOR THIS EXAMPLE THE FOLLOWING 12 INPUT CARDS ARE REQUIRED...

STAINLESS STEEL. COMPOSITION BY PER-CENT VOLUME IS 74.8-IRON, 16-CHROME, 6-NICKEL, 2-MANGANESE, 1-SILICON, 0.2-CARBON
\ENDFB6\K300\LIBRARY.DAT

\MIXER\STEEL.DAT

| | | | | | |
|-------|------|---|---|-----------|--------------------------------|
| 26800 | 4000 | 3 | 1 | 0 | |
| 26000 | | | 1 | 5.88676 | (NOTE, GRAMS INPUT FOR EACH |
| 24000 | | | 1 | 1.150448 | CONSTITUENT, E.G. FOR IRON THE |
| 28000 | | | 1 | 0.533928 | STP DENSITY IS 7.87 GRAMS. |
| 25055 | | | 1 | 0.1486 | THE INPUT VALUE OF 5.88676 IS |
| 14000 | | | 1 | 0.0233 | 0.748 X 7.87, I.E. VOLUME |
| 6012 | | | 1 | 0.0044958 | FRACTION TIMES STP DENSITY). |

(BLANK LINE TERMINATES INPUT LIST)

EXAMPLE INPUT NO. 2

THE SAME EXAMPLE AS THE ABOVE PROBLEM, ONLY USE THE STANDARD ENDF/B DATA FILENAMES - ENDFB.IN AND ENDFB.OUT (THIS CAN BE DONE BY LEAVING THE THIRD AND FOURTH INPUT LINES BLANK). FOR THIS EXAMPLE THE FOLLOWING 12 INPUT CARDS ARE REQUIRED...

STAINLESS STEEL. COMPOSITION BY PER-CENT VOLUME IS 74.8-IRON, 16-CHROME, 6-NICKEL, 2-MANGANESE, 1-SILICON, 0.2-CARBON
(NOTE - THIS LINE IS REALLY BLANK)
(NOTE - THIS LINE IS REALLY BLANK)

| | | | | | |
|-------|------|---|---|-----------|--------------------------------|
| 26800 | 4000 | 3 | 1 | | |
| 26000 | | | 1 | 5.88676 | (NOTE, GRAMS INPUT FOR EACH |
| 24000 | | | 1 | 1.150448 | CONSTITUENT, E.G. FOR IRON THE |
| 28000 | | | 1 | 0.533928 | STP DENSITY IS 7.87 GRAMS. |
| 25055 | | | 1 | 0.1486 | THE INPUT VALUE OF 5.88676 IS |
| 14000 | | | 1 | 0.0233 | 0.748 X 7.87, I.E. VOLUME |
| 6012 | | | 1 | 0.0044958 | FRACTION TIMES STP DENSITY). |

(BLANK LINE TERMINATES INPUT LIST)

Mixer

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