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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
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

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|  |       |
|--|-------|
| (3) (ENERGIES, CROSS SECTIONS) - MUST BE CORRECT, LINEARLY         | Mixer |
| =====  | Mixer |
| INTERPOLABLE, IN ASCENDING ENERGY ORDER OF (E, BARNS).             | Mixer |
| =====  | Mixer |
| TO CONVERT ENDF/B FORMATTED DATA TO THE REQUIRED INPUT FORM        | Mixer |
| THE FOLLOWING PROGRAMS MAY BE USED,                                | Mixer |
| LINEAR - CONVERT TABULATED CROSS SECTIONS TO LINEARLY              | Mixer |
| INTERPOLABLE FORM.   | Mixer |
| RECENT - RECONSTRUCT RESONANCE CONTRIBUTION, ADD TO BACKGROUND     | Mixer |
| CROSS SECTION AND OUTPUT THE COMBINATION IN LINEARLY               | Mixer |
| INTERPOLABLE FORM.   | Mixer |
| SIGMA1 - DOPPLER BROADEN CROSS SECTIONS TO ANY TEMPERATURE AND     | Mixer |
| OUTPUT THE RESULT IN LINEARLY INTERPOLABLE FORM.                   | Mixer |
|  | Mixer |
| DOCUMENTATION  | Mixer |
| -----  | Mixer |
| THE FACT THAT THIS PROGRAM HAS COMBINED THE DATA IS DOCUMENTED     | Mixer |
| IN THE OUTPUT ENDF/B FORMAT IN THE HOLLERITH SECTION BY FIRST      | Mixer |
| IDENTIFYING THE VERSION OF THIS PROGRAM THAT WAS USED, IN THE FORM | Mixer |
| ***** ( PROGRAM MIXER 2015-1) *****                                | Mixer |
|  | Mixer |
| THIS IS FOLLOWED BY THE TWO LINE IDENTIFICATION INPUT BY THE USER. | Mixer |
| THIS IS FOLLOWED BY COMPOSITION INPUT BY THE USER.                 | Mixer |
|  | Mixer |
| NEUTRON OR PHOTON DATA   | Mixer |
| -----  | Mixer |
| THIS PROGRAM WILL ALLOW YOU TO PROCESS EITHER NEUTRON OR PHOTON    | Mixer |
| CROSS SECTIONS - BUT YOU CANNOT MIX THE TWO TYPES TOGETHER. BY     | Mixer |
| INPUT YOU CAN SPECIFY THE OUTPUT MF = 3 (NEUTRONS) OR 23 (PHOTONS) | Mixer |
| WHATEVER TYPE YOU SPECIFIED FOR OUTPUT IS THE ONLY TYPE OF DATA    | Mixer |
| WHICH WILL BE PROCESSED BY THIS PROGRAM.                           | Mixer |
|  | Mixer |
| DEFINING THE COMPOSITION   | Mixer |
| -----  | Mixer |
| THE USER MAY SPECIFY UP TO 10 DIFFERENT SECTIONS OF DATA TO BE     | Mixer |
| COMBINED, EACH SECTION IDENTIFIED BY ZA AND MT NUMBER. THE         | Mixer |
| AMOUNT OF EACH MATERIAL IS SPECIFIED BY DEFINING THE NUMBER OF     | Mixer |
| GRAMS OF EACH MATERIAL IN THE COMPOSITE MIXTURE. THIS CAN BE       | Mixer |
| DERIVED FROM THE VOLUME FRACTION SIMPLY BY MULTIPLYING THE STP     | Mixer |
| DENSITY OF EACH MATERIAL BY ITS VOLUME FRACTION. NOTE, DO NOT      | Mixer |
| INPUT ATOM FRACTIONS.  | Mixer |
|  | Mixer |
| THE LIST OF SECTIONS TO BE COMBINED MAY BE SPECIFIED IN ANY        | Mixer |
| ORDER, I.E. THEY NEED NOT BE IN ZA ORDER OR THE ORDER THAT THE     | Mixer |
| EVALUATED DATA APPEARS ON THE ENDF/B FORMATTED TAPE.               | Mixer |
|  | Mixer |
| IF ANY REQUESTED SECTION OF DATA IS NOT FOUND ON THE ORIGINAL      | Mixer |
| ENDF/B FORMATTED FILE, THE PROGRAM WILL PRINT A LIST OF THE        | Mixer |
| MISSING SECTIONS AND TERMINATE. IF ALL REQUESTED SECTIONS ARE      | Mixer |
| FOUND THE PROGRAM WILL PRODUCE A COMPOSITE SECTION USING THE       | Mixer |
| UNION OF ALL ENERGIES FOUND IN ANY SECTION. THE COMPOSITE SECTION  | Mixer |
| WILL NOT BE THINNED.   | Mixer |
|  | Mixer |
| PRIOR TO LATER USE IN ANY APPLICATION THE NUMBER OF ENERGY POINTS  | Mixer |
| IN THE COMPOSITE CROSS SECTION MAY BE MINIMIZED BY USING PROGRAM   | Mixer |
| LINEAR, UCRL-50400, VOL. 17, PART B TO THIN THE DATA.              | Mixer |
|  | Mixer |
| ONLY LINEARLY INTERPOLABLE DATA                                    | Mixer |
| -----  | Mixer |
| THE CROSS SECTIONS TO BE COMBINED MUST BE IN LINEARLY INTERPOLABLE | Mixer |
| TABULATED FORM (I. E., FILE 3 OR 23, INTERPOLATION LAW 2).         | Mixer |
|  | Mixer |
| TO CONVERT TABULATED CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM  | Mixer |
| SEE, PROGRAM LINEAR, UCRL-50400, VOL. 17, PART A.                  | Mixer |
|  | Mixer |
| TO CONVERT RESONANCE PARAMETERS TO LINEARLY INTERPOLABLE FORM SEE, | Mixer |
| PROGRAM RECENT, UCRL-50400, VOL. 17, PART C.                       | Mixer |
|  | Mixer |
| TO DOPPLER BROADEN LINEARLY INTERPOLABLE DATA TO ANY TEMPERATURE   | Mixer |

SEE PROGRAM SIGMA1, UCRL-50400, VOL. 17, PART B.

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#### PAGING SYSTEM

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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

Mixer

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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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#### DOPPLER BROADENING

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THE COMPOSITE CROSS SECTION OUTPUT FROM THIS PROGRAM SHOULD NOT BE DOPPLER BROADENED USING PROGRAM SIGMA1, OR THE EQUIVALENT. THE ATOMIC WEIGHT USED TO IDENTIFY THE COMPOSITE MIXTURE IS BASED ON THE ATOM FRACTION OF EACH CONSTITUENT AND CANNOT BE USED TO CHARACTERIZE THE BROADENING OF ANY GIVEN RESONANCE IN THE MIXTURE DUE TO THE CONTRIBUTION OF ONE CONSTITUENT. IN ORDER TO CONSIDER DOPPLER BROADENING FIRST USE PROGRAM SIGMA1 TO BROADEN THE CROSS SECTION FOR EACH OF THE CONSTITUENTS AND THEN COMBINE THE BROADENED DATA USING PROGRAM MIXER.

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#### EXAMPLE USE

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THE OUTPUT FROM THIS PROGRAM HAS BEEN FOUND TO BE EXTREMELY USEFUL IN THE FOLLOWING APPLICATIONS...

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- (1) CALCULATE A COMPOSITE TOTAL CROSS SECTION FOR LATER USE AS A WEIGHTING FUNCTION IN SELF-SHIELDING THE CROSS SECTIONS OF EACH CONSTITUENT OF THE MIXTURE SEPARATELY.

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PROGRAM GROUPIE CAN USE THE CALCULATED COMPOSITE TOTAL CROSS SECTION AS THE TOTAL CROSS SECTION FOR EACH CONSTITUENT OF THE MIXTURE IN ORDER TO CALCULATE SELF-SHIELDED CROSS SECTION FOR EACH CONSTITUENT OF THE MIXTURE.

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- (2) CALCULATE COMPOSITE TOTAL AND FISSION CROSS SECTIONS IN ORDER TO CALCULATE THE TRANSMISSION AND SELF-INDICATION THROUGH COMPOSITE MATERIALS. GENERALLY IN THIS CASE THE TOTAL CROSS SECTION WILL BE CALCULATED FOR THE COMPOSITION OF THE SAMPLE AND THE FISSION CROSS SECTION WILL BE CALCULATED FOR THE COMPOSITION OF THE FISSION CHAMBER (WHICH GENERALLY WILL HAVE A DIFFERENT COMPOSITION THAN THE SAMPLE).

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|     |       |       |        |                                     |       |
|-----|-------|-------|--------|-------------------------------------|-------|
|     |       |       |        | IN MF=1, MT=451 (HOLLERITH SECTION) | Mixer |
|     |       |       |        | OF THE ENDF/B FORMATTED OUTPUT TO   | Mixer |
|     |       |       |        | IDENTIFY THE COMPOSITE MIXTURE).    | Mixer |
| 3   | 1-72  |       |        | ENDF/B INPUT DATA FILENAME          | Mixer |
|     |       |       |        | (STANDARD OPTION = ENDFB.IN)        | Mixer |
| 4   | 1-72  |       |        | ENDF/B OUTPUT DATA FILENAME         | Mixer |
|     |       |       |        | (STANDARD OPTION = ENDFB.OUT)       | 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                       | Mixer |
|     |       |       |        | = 0 = GRAMS = BACKWARDS COMPATIBLE  | Mixer |
|     |       |       |        | > 0 = ATOMS = NEW IN 2008           | 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 |

THE SIXTH LINE IS REPEATED FOR EACH SECTION (FROM 2 TO 10).  
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 | Mixer |
| (NOTE - THIS LINE IS REALLY BLANK)                      | Mixer |
| (NOTE - THIS LINE IS REALLY BLANK)                      | Mixer |
| 26800 4000 3 1  | Mixer |
| 26000 1 5.88676 (NOTE, GRAMS INPUT FOR EACH             | Mixer |
| 24000 1 1.150448 CONSTITUENT, E.G. FOR IRON THE         | Mixer |
| 28000 1 0.533928 STP DENSITY IS 7.87 GRAMS.             | Mixer |
| 25055 1 0.1486 THE INPUT VALUE OF 5.88676 IS            | Mixer |
| 14000 1 0.0233 0.748 X 7.87, I.E. VOLUME                | Mixer |
| 6012 1 0.0044958 FRACTION TIMES STP DENSITY).           | Mixer |
| (BLANK LINE TERMINATES INPUT LIST)                      | Mixer |
| =====   | Mixer |