```
====================================================================== Groupie
                                                                       Groupie
     PROGRAM GROUPIE                                                   Groupie
     ===============                                                   Groupie
     VERSION 76-1 (NOVEMBER 1976)                                      Groupie
     VERSION 79-1 (OCTOBER 1979) CDC-7600 AND CRAY-1 VERSION.          Groupie
     VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION                 Groupie
     VERSION 81-1 (JANUARY 1981) EXTENSION TO 3000 GROUPS              Groupie
     VERSION 81-2 (MARCH 1981) IMPROVED SPEED                          Groupie
     VERSION 81-3 (AUGUST 1981) BUILT-IN 1/E WEIGHTING SPECTRUM        Groupie
     VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY       Groupie
     VERSION 83-1 (JANUARY 1983)*MAJOR RE-DESIGN.                      Groupie
                               *ELIMINATED COMPUTER DEPENDENT CODING.  Groupie
                               *NEW, MORE COMPATIBLE I/O UNIT NUMBERS. Groupie
                               *NEW MULTI-BAND LIBRARY BINARY FORMAT.  Groupie
     VERSION 83-2 (OCTOBER 1983) ADDED OPTION TO ALLOW SIGMA-0 TO BE   Groupie
                                 DEFINED EITHER AS MULTIPLES OF        Groupie
                                 UNSHIELDED TOTAL CROSS SECTION IN EACH Groupie
                                 GROUP, OR POWERS OF 10 IN ALL GROUPS. Groupie
     VERSION 84-1 (APRIL 1984)   ADDED MORE BUILT IN MULTIGROUP ENERGY  Groupie
                                 STRUCTURES.                           Groupie
     VERSION 85-1 (APRIL 1985)  *UPDATED FOR ENDF/B-VI FORMATS.        Groupie
                               *SPECIAL I/O ROUTINES TO GUARANTEE      Groupie
                                ACCURACY OF ENERGY.                    Groupie
                               *DOUBLE PRECISION TREATMENT OF ENERGY   Groupie
                                (REQUIRED FOR NARROW RESONANCES).      Groupie
                               *MINIMUM TOTAL CROSS SECTION TREATMENT  Groupie
     VERSION 85-2 (AUGUST 1985) *FORTRAN-77/H VERSION                  Groupie
     VERSION 86-1 (JANUARY 1986)*ENDF/B-VI FORMAT                      Groupie
     VERSION 86-2 (JUNE 1986)   *BUILT-IN MAXWELLIAN, 1/E AND FISSION  Groupie
                                 WEIGHTING SPECTRUM.                   Groupie
     VERSION 88-1 (JULY 1988)   *OPTION...INTERNALLY DEFINE ALL I/O    Groupie
                                 FILE NAMES (SEE, SUBROUTINES FILIO1   Groupie
                                 FILIO2 FOR DETAILS).                  Groupie
                               *IMPROVED BASED ON USER COMMENTS.       Groupie
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO    Groupie
                                 INSURE PROGRAM WILL NOT DO ANYTHING   Groupie
                                 CRAZY.                                Groupie
                               *UPDATED TO USE NEW PROGRAM CONVERT     Groupie
                                KEYWORDS.                              Groupie
                               *ADDED LIVERMORE CIVIC COMPILER         Groupie
                                CONVENTIONS.                           Groupie
     VERSION 91-1 (JUNE 1991)   *INCREASED PAGE SIZE FROM 1002 TO 5010 Groupie
                                 POINTS                                Groupie
                               *UPDATED BASED ON USER COMMENTS         Groupie
                               *ADDED FORTRAN SAVE OPTION              Groupie
                               *COMPLETELY CONSISTENT ROUTINE TO READ  Groupie
                                FLOATING POINT NUMBERS.                Groupie
     VERSION 92-1 (JANUARY 1992)*ADDED RESONANCE INTEGRAL CALCULATION - Groupie
                                 UNSHIELDED AND/OR SHIELDED - FOR      Groupie
                                 DETAILS SEE BELOW                     Groupie
                               *INCREASED NUMBER OF ENERGY POINTS      Groupie
                                IN BUILT-IN SPECTRA - TO IMPROVE       Groupie
                                ACCURACY.                              Groupie
                               *ALLOW SELECTION OF ZA/MF/MT OR         Groupie
                                MAT/MF/MT RANGES - ALL DATA NOT        Groupie
                                SELECTED IS SKIPPED ON INPUT AND       Groupie
                                NOT WRITTEN AS OUTPUT.                 Groupie
                               *COMPLETELY CONSISTENT I/O ROUTINES -   Groupie
                                TO MINIMIZE COMPUTER DEPENDENCE.       Groupie
                               *NOTE, CHANGES IN INPUT PARAMETER       Groupie
                                FORMAT - FOR ZA/MF/MT OR MAT/MF/MT     Groupie
                                RANGES.                                Groupie
     VERSION 92-2 (JUNE 1992)   *MULTIBAND PARAMETERS OUTOUT AS         Groupie
                                 CHARACTER (RATHER THAN BINARY) FILE.  Groupie
     VERSION 93-1 (APRIL 1993)  *INCREASED PAGE SIZE FROM 5010 TO      Groupie
                                 30000 POINTS                          Groupie
                               *ELIMINATED COMPUTER DEPENDENCE.        Groupie
     VERSION 94-1 (JANUARY 1994)*VARIABLE ENDF/B DATA FILENAMES        Groupie
                                 TO ALLOW ACCESS TO FILE STRUCTURES     Groupie
                                 (WARNING - INPUT PARAMETER FORMAT     Groupie
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                          HAS BEEN CHANGED)                        Groupie
                         *CLOSE ALL FILES BEFORE TERMINATING       Groupie
                          (SEE, SUBROUTINE ENDIT)                  Groupie
VERSION 95-1 (JANUARY 1994)*CORRECTED MAXWELLIAN WEIGHTING         Groupie
                         *CHANGING WEIGHTING SPECTRUM FROM         Groupie
                          0.1 TO 0.001 % UNCERTAINTY               Groupie
VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                     Groupie
                         *IMPROVED COMPUTER INDEPENDENCE           Groupie
                         *ALL DOUBLE PRECISION                     Groupie
                         *ON SCREEN OUTPUT                         Groupie
                         *UNIFORM TREATMENT OF ENDF/B I/O          Groupie
                         *IMPROVED OUTPUT PRECISION                Groupie
                         *DEFINED SCRATCH FILE NAMES               Groupie
                         *UP TO 1000 GROUP MULTI-BAND              Groupie
                          CALCULATION (PREVIOUSLY 175)             Groupie
                         *MAXIMUM NUMBER OF GROUPS REDUCED         Groupie
                          FROM 3,000 TO 1,000                      Groupie
                         *UP TO 1000 MATERIALS                     Groupie
                          (PREVIOUSLY 100)                         Groupie
                         *CORRECTED USE OF MAXWELLIAN +            Groupie
                          1/E + FISSION SPECTRUM                   Groupie
                         *ONLY 2 BAND VERSION DISTRIBUTED          Groupie
                          (CONTACT AUTHOR FOR DETAILS)             Groupie
                         *DEFINED SCRATCH FILE NAMES               Groupie
VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING       Groupie
                          POINT READ FOR MORE DIGITS               Groupie
                         *UPDATED TEST FOR ENDF/B FORMAT           Groupie
                          VERSION BASED ON RECENT FORMAT CHANGE    Groupie
                         *GENERAL IMPROVEMENTS BASED ON            Groupie
                          USER FEEDBACK                            Groupie
VERSION 99-2 (JUNE 1999)    *ASSUME ENDF/B-VI, NOT V, IF MISSING   Groupie
                          MF=1, MT-451.                            Groupie
VERS. 2000-1 (FEBRUARY 2000)*ADDED MF=10, ACTIVATION CROSS SECTION Groupie
                          PROCESSING.                              Groupie
                         *GENERAL IMPROVEMENTS BASED ON            Groupie
                          USER FEEDBACK                            Groupie
VERS. 2002-1 (FEBRUARY 2002)*ADDED TART 700 GROUP STRUCTURE        Groupie
                         *ADDED VARIABLE SIGMA0 INPUT OPTION       Groupie
             (MAY 2002)     *OPTIONAL INPUT PARAMETERS             Groupie
             (NOV. 2002)    *ADDED SAND-II EXTENDED DOWN TO        Groupie
                          1.0D-5 EV.                               Groupie
             (JUNE 2003)    *CORRECTED SAND-II 620 AND 640 GROUP   Groupie
                          ENERGY BOUNDARIES DEFINITIONS.           Groupie
VERS. 2004-1 (SEPT. 2004)  *INCREASED PAGE SIZE FROM 30000 TO      Groupie
                          120000 POINTS                            Groupie
                         *ADDED "OTHER" AS ADDITIONAL REACTION     Groupie
                          TO IMPROVE MULTI-BAND FITTING            Groupie
                         *ADDED ITERATION FOR "BEST" PARTIAL       Groupie
                          PARAMETERS.                              Groupie
                         *DO NOT SKIP LOW TOTAL ENERGY RANGES      Groupie
                          WHEN DEFINING AVERAGE CROSS SECTIONS -   Groupie
                          THIS MAKES OUTPUT COMPATIBLE WITH        Groupie
                          ANY STANDARD AVERAGING PROCEDURE         Groupie
VERS. 2005-1 (JAN. 2005)   *ADDED OPTION TO CHANGE TEMPERATURE OF  Groupie
                          BUILT-IN STANDARD SPECTRUM.              Groupie
VERS. 2007-1 (JAN. 2007)   *CHECKED AGAINST ALL ENDF/B-VII.        Groupie
                         *INCREASED PAGE SIZE FROM 120,000 TO      Groupie
                          600,000 POINTS                           Groupie
VERS. 2008-1 (JAN. 2008)   *72 CHARACTER FILE NAMES.               Groupie
                         *GENERAL UPDATES                          Groupie
VERS. 2010-1 (Apr. 2010)   *INCREASED WEIGHTING SPECTRUM TO 30,000 Groupie
                          FROM 3,000 ENERGY POINTS.                Groupie
                         *ADDED OUTPUT TO PLOT/COMPARE SHIELDED    Groupie
                          AND UNSHIELDED CROSS SECTIONS.           Groupie
VERS. 2011-1 (June 2011)   *Corrected TART 700 groups to extend up Groupie
                          to 1 GeV (1,000 MeV) - previously it     Groupie
                          was ERRONEOUSLY cutoff at 20 MeV.        Groupie
VERS. 2011-2 (Nov. 2011)   *Corrected TART 616 groups lowest       Groupie
                          energy from 1.0D-4 eV to 1.0D-5 eV.      Groupie
                         *Added TART 666 to 200 MeV (for TENDL).   Groupie
                         *Optional high energy cross section       Groupie
```

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                          extension above tabulated energy range Groupie
                          (either = 0 = standard, or constant)   Groupie
                          WARNING - ENDF/B standard convention   Groupie
                          is that the cross section = 0 where it Groupie
                          is not explicitly defined - extension  Groupie
                          = 0 is standard, constant is NOT, so   Groupie
                          constant extension is NOT RECOMMENDED. Groupie
VERS. 2012-1 (Aug. 2012)  *Added CODENAME                        Groupie
                         *32 and 64 bit Compatible               Groupie
                         *Added ERROR stop.                      Groupie
VERS. 2013-1 (Nov. 2013)  *Extended OUT9.                        Groupie
                         *Uses OUTG, not OUT10 for energies.     Groupie
VERS. 2015-1 (Jan. 2015)  *Corrected SPECTM - handle ALL included Groupie
                          group structures, i.e., even those     Groupie
                          that start above thremal range by      Groupie
                          ALWAYS constructing weigthing spectrum Groupie
                          to be AT LEAST 1.0D-5 eV to 20 MeV.    Groupie
                         *Extended OUTG                          Groupie
                         *Replaced ALL 3 way IF Statements.      Groupie
                         *Generalized TART Group Strructures.    Groupie
                         *Generalized SAND-II Group Structures.  Groupie
                         *Extended SAND-II to 60, 150, 200 MeV.  Groupie
VERS. 2015-2 (Mar. 2015)  *Deleted 1P from formats reading input  Groupie
                          parameters, causing incorrect scaling  Groupie
                         *Changed ALL data to "D" instead of     Groupie
                          "E" to insure it is REAL*8 and avoid   Groupie
                          Truncation ERRORS.                     Groupie
VERS. 2015-3 (July 2015)  *Insure no 10 digit output - not       Groupie
                          needed for multi-group and this makes  Groupie
                          listings simpler.                      Groupie
                         *Corrected High Energy Extension =      Groupie
                          Can effect highest energy group.       Groupie
VERS. 2016-1 (July 2016)  *Added UKAEA 1102 Group Structure.     Groupie
                         *Increased storage to accommodate       Groupie
                          much larger group structures =         Groupie
                          up to 20,000 Groups.                   Groupie
                         *Added output listing of the complete   Groupie
                          input parameters for URRFIT, including Groupie
                          the NJOY parameters LSSF and ICOMP.    Groupie
                         *Changed multiple IF statements to      Groupie
                          accommodate compiler optimizer         Groupie
                         *Cosmetic changes based on FREUD        Groupie
                          psychoanalysis.                        Groupie
                         *Updated multi-band treatment to        Groupie
                          explcitly handle small shielding       Groupie
                          limit - without this update the small  Groupie
                          limit becomes numerically unstable.    Groupie
VERS. 2017-1 (May  2017)  *Increased max. points to 3,000,000.   Groupie
                         *METHODB was incorrecctly named         Groupie
                          METHOD  in one routine = corrected.    Groupie
                         *Default multi-band is method #2 =      Groupie
                          conserve <x>, <1/(x+<x>>, <1/x>.       Groupie
                         *Definition of built-in group structure Groupie
                          using SUBROUTINE GROPE is identical    Groupie
                          for GROUPIE and VIRGIN.                Groupie
                         *All floating input parameters changed  Groupie
                          to character input + IN9 conversion.   Groupie
                         *Output report identfies MF now that    Groupie
                          this code does more than just MF=3.    Groupie
                         *Added NRO = energy dependent scatter   Groupie
                          radius to copying FILE2 parameters     Groupie
                          to define unresolved energy range.     Groupie
                         *Corrected energy dependent scatter     Groupie
                          for all resonance types (see, above    Groupie
                          comments) = for multi-band output      Groupie
VERS. 2018-1 (Jan. 2018)  *Added on-line output for ALL ENDERROR  Groupie
                                                                 Groupie
2015-2 Acknowledgment                                            Groupie
=====================                                            Groupie
I thank Chuck Whitmer (TerraPower,WA) and Andrej Trkov (NDS,IAEA)  Groupie
for reporting the errors that led to the 2015-2 Improvements in    Groupie
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this code. Groupie
Groupie
I thank Jean-Christophe Sublet (UKAEA) for contributing MAC Groupie
executables and Bojan Zefran (IJS, Slovenia) for contributing Groupie
LINUX (32 or 63 bit) executables. And most of all I must thank Groupie
Andrej Trkov (NDS, IAEA) for overseeing the entire PREPRO project Groupie
at IAEA, Vienna. This was a truly International team who worked Groupie
together to produce PREPRO 2015-2. Groupie
Groupie
OWNED, MAINTAINED AND DISTRIBUTED BY Groupie
---------- Groupie
THE NUCLEAR DATA SECTION Groupie
INTERNATIONAL ATOMIC ENERGY AGENCY Groupie
P.O. BOX 100 Groupie
A-1400, VIENNA, AUSTRIA Groupie
EUROPE Groupie
Groupie
ORIGINALLY WRITTEN BY Groupie
---------- Groupie
Dermott E. Cullen Groupie
Groupie
PRESENT CONTACT INFORMATION Groupie
---------- Groupie
Dermott E. Cullen Groupie
1466 Hudson Way Groupie
Livermore, CA 94550 Groupie
U.S.A. Groupie
Telephone 925-443-1911 Groupie
E. Mail RedCullen1@Comcast.net Groupie
Website RedCullen1.net/HOMEPAGE.NEW Groupie
Groupie
AUTHORS MESSAGE Groupie
---------- Groupie
THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION Groupie
FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED Groupie
THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE Groupie
READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY Groupie
THE COMMENTS CONCERNING MACHINE DEPENDENT CODING. Groupie
Groupie
AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER Groupie
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE Groupie
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT Groupie
IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY Groupie
COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO Groupie
IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF Groupie
THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR Groupie
COMPUTER. Groupie
Groupie
PURPOSE Groupie
------- Groupie
THIS PROGRAM IS DESIGNED TO CALCULATE ANY COMBINATION OF Groupie
THE FOLLOWING QUANTITIES FROM LINEARLY INTERPOLABLE TABULATED Groupie
CROSS SECTIONS IN THE ENDF/B FORMAT Groupie
Groupie
(1) UNSHIELDED GROUP AVERAGED CROSS SECTIONS Groupie
(2) BONDARENKO SELF-SHIELDED GROUP AVERAGED CROSS SECTIONS Groupie
(3) MULTI-BAND PARAMETERS Groupie
Groupie
IN THE FOLLOWING FOR SIMPLICITY THE ENDF/B TERMINOLOGY--ENDF/B Groupie
TAPE--WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE TAPE, CARDS, Groupie
DISK OR ANY OTHER MEDIUM. Groupie
Groupie
ENDF/B FORMAT Groupie
------------ Groupie
THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS Groupie
OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION Groupie
OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV OR V FORMAT). Groupie
Groupie
IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B Groupie
FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS Groupie
ASSUMED THAT THE MAT, MF AND MT ON EACH CARD IS CORRECT. SEQUENCE Groupie

NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE CORRECTLY OUTPUT ON ALL CARDS. 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.

ALL FILE 3 CROSS SECTIONS THAT ARE USED BY THIS PROGRAM MUST BE LINEARLY INTERPOLABLE IN ENERGY AND CROSS SECTION (ENDF/B INTERPOLATION LAW 2). FILE 3 BACKGROUND CROSS SECTIONS MAY BE MADE LINEARLY INTERPOLABLE USING PROGRAM LINEAR (UCRL-50400, VOL. 17, PART A). THE RESONANCE CONTRIBUTION MAY BE ADDED TO THE BACKGROUND CROSS SECTIONS USING PROGRAM RECENT (UCRL-50400, VOL. 17, PART B). IF THIS PROGRAM FINDS THAT THE FILE 3 CROSS SECTIONS ARE NOT LINEARLY INTERPOLABLE THIS PROGRAM WILL TERMINATE EXECUTION.

CONTENTS OF OUTPUT

IF ENDF/B FORMATTED OUTPUT IS REQUESTED ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE MULTI-GROUPED FILE 3 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 THREE COMMENT CARDS AT THE END OF EACH HOLLERITH SECTION TO DESCRIBE THE GROUP STRUCTURE AND WEIGHTING SPECTRUM, E.G.

********** PROGRAM GROUPIE (2018-1) **********
UNSHIELDED GROUP AVERAGES USING 69 GROUPS (WIMS)
MAXWELLIAN, 1/E AND FISSION WEIGHTING SPECTRUM

THE ORDER OF ALL SIMILAR COMMENTS (FROM LINEAR, RECENT AND SIGMA1) REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON THE DATA.

THESE COMMENT CARDS 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 SECTION MF=1, MT=451 OF EACH EVALUATION.

THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451. 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.

SELECTION OF DATA

THE PROGRAM SELECTS MATERIALS TO BE PROCESSED BASED EITHER ON MAT (ENDF/B MAT NO.) OR ZA. THE PROGRAM ALLOWS UP TO 100 MAT OR ZA RANGES TO BE SPECIFIED. THE PROGRAM WILL ASSUME THAT THE

```
ENDF/B TAPE IS IN EITHER MAT OR ZA ORDER, WHICHEVER CRITERIA IS    Groupie
USED TO SELECT MATERIALS, AND WILL TERMINATE WHEN A MAT OR ZA      Groupie
IS FOUND THAT IS ABOVE THE RANGE OF ALL REQUESTS.                  Groupie
                                                                   Groupie
ENERGY ORDER AND UNITS                                             Groupie
----------------------                                             Groupie
ALL ENERGIES (FOR CROSS SECTIONS, WEIGHTING SPECTRUM OR GROUP      Groupie
BOUNDARIES) MUST BE IN UNITS OF EV AND MUST BE IN ASCENDING        Groupie
NUMERICAL ORDER.                                                   Groupie
                                                                   Groupie
ENERGY GRID                                                        Groupie
-----------                                                        Groupie
ALTHOUGH ALL REACTIONS MUST TO LINEARLY INTERPOLABLE, THEY DO NOT  Groupie
ALL HAVE TO USE THE SAME ENERGY GRID. EACH REACTION CAN BE GIVEN   Groupie
BY AN INDEPENDENT ENERGY GRID. THIS PROGRAM WILL PROCEED FROM      Groupie
THE LOWEST TO HIGHEST ENERGY SELECTING EACH ENERGY INTERVAL OVER   Groupie
WHICH ALL DATA, FOR ANY GIVEN CALCULATION, ARE ALL LINEARLY        Groupie
INTERPOLABLE.                                                      Groupie
                                                                   Groupie
GROUP STRUCTURE                                                    Groupie
---------------                                                    Groupie
THIS PROGRAM IS DESIGNED TO USE AN ARBITRARY ENERGY GROUP          Groupie
STRUCTURE WHERE THE ENERGIES ARE IN EV AND ARE IN INCREASING       Groupie
ENERGY ORDER. THE MAXIMUM NUMBER OF GROUPS IS 20,000.              Groupie
                                                                   Groupie
THE USER MAY INPUT AN ARBITRARY GROUP STRUCTURE OR THE USER MAY    Groupie
USE USE ONE OF THE SEVEN BUILT-IN GROUP STRUCTURES.                Groupie
 (0) 175 GROUP (TART STRUCTURE)                                    Groupie
 (1)  50 GROUP (ORNL STRUCTURE)                                    Groupie
 (2) 126 GROUP (ORNL STRUCTURE)                                    Groupie
 (3) 171 GROUP (ORNL STRUCTURE)                                    Groupie
 (4) 620 GROUP (SAND-II STRUCTURE, UP TO 18 MEV)                   Groupie
 (5) 640 GROUP (SAND-II STRUCTURE, UP TO 20 MEV)                   Groupie
 (6)  69 GROUP (WIMS STRUCTURE)                                    Groupie
 (7)  68 GROUP (GAM-I STRUCTURE)                                   Groupie
 (8)  99 GROUP (GAM-II STRUCTURE)                                  Groupie
 (9)  54 GROUP (MUFT STRUCTURE)                                    Groupie
(10)  28 GROUP (ABBN STRUCTURE)                                    Groupie
(11) 616 GROUP (TART STRUCTURE TO 20 MeV)                          Groupie
(12) 700 GROUP (TART STRUCTURE TO 1 GEV)                           Groupie
(13) 665 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 18 MEV)        Groupie
(14) 685 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 20 MEV)        Groupie
(15) 666 GROUP (TART STRUCTURE TO 200 MeV)                         Groupie
(16) 725 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO  60 MEV)       Groupie
(17) 755 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 150 MEV)       Groupie
(18) 765 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 200 MEV)       Groupie
(19)1102 GROUP (UKAEA   STRUCTURE, 1.0D-5 eV, UP TO   1 GeV)       Groupie
                                                                   Groupie
GROUP AVERAGES                                                     Groupie
--------------                                                     Groupie
THIS PROGRAM DEFINES GROUP AVERAGED CROSS SECTIONS AS...           Groupie
                                                                   Groupie
          (INTEGRAL E1 TO E2) (SIGMA(E)*S(E)*WT(E)*DE)             Groupie
AVERAGE = ----------------------------------------                 Groupie
          (INTEGRAL E1 TO E2) (S(E)*WT(E)*DE)                      Groupie
WHERE...                                                           Groupie
                                                                   Groupie
AVERAGE  = GROUP AVERAGED CROSS SECTION                            Groupie
E1, E2   = ENERGY LIMITS OF THE GROUP                              Groupie
SIGMA(E) = ENERGY DEPENDENT CROSS SECTION FOR ANY GIVEN REACTION   Groupie
S(E)     = ENERGY DEPENDENT WEIGHTING SPECTRUM                     Groupie
WT(E)    = ENERGY DEPENDENT SELF-SHIELDING FACTOR.                 Groupie
                                                                   Groupie
ENERGY DEPENDENT WEIGHTING SPECTRUM                                Groupie
-----------------------------------                                Groupie
THE ENERGY DEPENDENT WEIGHTING SPECTRUM IS GIVEN BY AN ARBITRARY   Groupie
TABULATED LINERLY INTERPOLABLE FUNCTION WHICH CAN BE DESCRIBED     Groupie
BY AN ARBITRARY NUMBER OF POINTS. THIS ALLOWS THE USER TO          Groupie
SPECIFY ANY DESIRED WEIGHTING SPECTRUM TO ANY GIVEN DEGREE OF      Groupie
ACCURACY. REMEMBER THAT THE PROGRAM WILL ASSUME THAT THE SPECTRUM  Groupie
IS LINEARLY INTERPOLABLE BETWEEN TABULATED POINTS. THEREFORE THE   Groupie
```

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USER SHOULD USE ENOUGH POINTS TO INSURE AN ADEQUATE REPRESENTATION Groupie
OF THE SPECTRUM BETWEEN TABULATED DATA POINTS.                     Groupie
                                                                   Groupie
THE PRESENT VERSION OF THE CODE HAS THREE BULIT-IN WEIGHTING       Groupie
SPECTRA,                                                           Groupie
                                                                   Groupie
(1) CONSTANT                                                       Groupie
(2) 1/E                                                            Groupie
(3) MAXWELLIAN = E*EXP(-E/KT)/KT                (0.0 TO 4*KT)      Groupie
    1/E        = C1/E                           (4*KT TO 67 KEV)   Groupie
    FISSION    = C2*EXP(-E/WA)*SINH(SQRT(E*WB)) (ABOVE 67 KEV)     Groupie
                                                                   Groupie
    KT     = 0.253 EV (293 KELVIN)                                 Groupie
    WA     = 9.65D+5                                               Groupie
    WB     = 2.29D-6                                               Groupie
    C1, C2 = DEFINED TO MAKE SPECTRUM CONTINUOUS                   Groupie
                                                                   Groupie
    FISSION SPECTRUM CONSTANTS FROM                                Groupie
    A.F.HENRY, NUCLEAR REACTOR ANALYSIS, P. 11, MIT PRESS (1975)   Groupie
                                                                   Groupie
UNSHIELDED GROUP AVERAGES                                          Groupie
-------------------------                                          Groupie
FOR UNSHIELDED AVERAGES THE SELF-SHIELDING FACTOR (WT(E)) IS SET   Groupie
TO UNITY. THIS PROGRAM ALLOWS UP TO 20,000 GROUPS.                 Groupie
                                                                   Groupie
SELF-SHIELDED GROUP AVERAGES                                       Groupie
----------------------------                                       Groupie
IF SELF-SHIELDED AVERAGES AND/OR MULTI-BAND PARAMETERS ARE         Groupie
CALCULATED THIS PROGRAM ALLOWS UP TO 20,000 GROUPS. SELF-SHIELDED  Groupie
AVERAGES AND/OR MULTI-BAND PARAMETERS ARE CALCULATED FOR THE       Groupie
TOTAL, ELASTIC, CAPTURE AND FISSION.                               Groupie
                                                                   Groupie
FOR THE TOTAL, ELASTIC, CAPTURE AND FISSION THE PROGRAM USES A     Groupie
WEIGHTING FUNCTION THAT IS A PRODUCT OF THE ENERGY DEPENDENT       Groupie
WEIGHTING SPECTRUM TIMES A BONDERENKO TYPE SELF-SHIELDING FACTOR.  Groupie
                                                                   Groupie
WT(E) = S(E)/(TOTAL(E)+SIGMA0)**N                                  Groupie
                                                                   Groupie
WHERE...                                                           Groupie
                                                                   Groupie
S(E)     - ENERGY DEPENDENT WEIGHTING SPECTRUM (DEFINED BY         Groupie
           TABULATED VALUES AND LINEAR INTERPOLATION BETWEEN       Groupie
           TABULATED VALUES).                                      Groupie
TOTAL(E) - ENERGY DEPENDENT TOTAL CROSS SECTION FOR ONE MATERIAL   Groupie
           (DEFINED BY TABULATED VALUES AND LINEAR INTERPOLATION   Groupie
           BETWEEN TABULATED VALUES).                              Groupie
SIGMA0   - CROSS SECTION TO REPRESENT THE EFFECT OF ALL OTHER      Groupie
           MATERIALS AND LEAKAGE (DEFINED WITHIN EACH GROUP TO BE  Groupie
           A MULTIPLE OF THE UNSHIELDED TOTAL CROSS SECTION WITHIN Groupie
           THAT GROUP OR POWERS OF 10 - INPUT OPTION).             Groupie
N        - A POSITIVE INTEGER (0, 1, 2 OR 3).                      Groupie
                                                                   Groupie
THE PROGRAM WILL USE ONE ENERGY DEPENDENT WEIGHTING SPECTRUM S(E)  Groupie
AND 25 DIFFERENT BONDERENKO TYPE SELF-SHIELDING FACTORS (25 SIGMA0 Groupie
AND N COMBINATIONS) TO DEFINE 25 DIFFERENT AVERAGE CROSS SECTIONS, Groupie
FOR EACH REACTION, WITHIN EACH GROUP.                              Groupie
                                                                   Groupie
THE 25 WEIGHTING FUNCTIONS USED ARE....                            Groupie
(1)   - UNSHIELDED CROSS SECTIONS (N=0)                            Groupie
(2-22)- PARTIALLY SHIELDED CROSS SECTIONS (N=1 ,VARIOUS SIGMA0)    Groupie
        THE VALUES OF SIGMA0 USED WILL BE EITHER,                  Groupie
        (A) THE VALUES OF SIGMA0 THAT ARE USED VARY FROM 1024      Groupie
        TIMES THE UNSHIELDED TOTAL CROSS SECTIONS IN STEPS OF 1/2  Groupie
        DOWN TO 1/1024 TIMES THE UNSHIELDED TOTAL CROSS SECTION    Groupie
        (A RANGE OF OVER 1 MILLION, CENTERED ON THE UNSHIELDED     Groupie
        TOTAL CROSS SECTION WITHIN EACH GROUP).                    Groupie
        (B) THE SAME CONSTANT VALUES OF SIGMA0 IN EACH GROUP. THE  Groupie
        VALUES OF SIGMA0 USED INCLUDE 40000, 20000, 10000, 7000,   Groupie
        4000, 2000, 1000, 700, 400, 200, 100, 70, 40, 20, 10, 7,   Groupie
        4, 2, 1, 0.7, 0.4 (A RANGE OF 100,000 SPANNING MORE THAN   Groupie
        THE RANGE OF SIGMA0 VALUES THAT MAY BE ENCOUNTERED IN      Groupie
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        ACTUAL APPLICATIONS)                                          Groupie
(23)  - TOTALLY SHIELDED FLUX WEIGHTED CROSS SECTION                  Groupie
        (N=1, SIGMA0=0)                                               Groupie
(24)  - TOTALLY SHIELDED CURRENT WEIGHTED CROSS SECTION               Groupie
        (N=2, SIGMA0=0)                                               Groupie
(25)  - TOTALLY SHIELDED COSINE SQUARED WEIGHTED CROSS SECTION        Groupie
        (N=3, SIGMA0=0)                                               Groupie
                                                                      Groupie
FOR ALL OTHER REACTIONS (EXCEPT TOTAL, ELASTIC, CAPTURE AND           Groupie
FISSION) THE PROGRAM WILL USE THE ENERGY DEPENDENT WEIGHTING          Groupie
SPECTRUM S(E) TO DEFINE THE UNSHIELDED (BONDERENKO N=0)               Groupie
AVERAGED CROSS SECTION WITHIN EACH GROUP.                             Groupie
                                                                      Groupie
CALCULATION OF RESONANCE INTEGRALS                                    Groupie
---------------------------------                                     Groupie
IN A PURE ELASTIC ISOTROPICALLY SCATTERING MATERIAL WITH A            Groupie
CONSTANT CROSS SECTION THE SPECTRUM WILL BE 1/E AND THERE WILL        Groupie
BE NO SELF-SHIELDING.                                                 Groupie
                                                                      Groupie
IN THIS CASE IF THE CROSS SECTION VARIES WITH ENERGY THE              Groupie
SPECTRUM WILL STILL BE 1/E AND THE SELF-SHIELDING FACTOR WILL         Groupie
BE EXACTLY 1/SIG-TOT(E) - WHERE SIG-TOT(E) = SIG-EL(E), SINCE         Groupie
THERE IS ONLY SCATTERING.                                             Groupie
                                                                      Groupie
IF WE HAVE AN INFINITELY DILUTE AMOUNT OF A MATERIAL UNIFORMLY        Groupie
MIXED WITH A PURE ELASTIC ISOTROPICALLY SCATTERING MATERIAL WITH      Groupie
A CONSTANT CROSS SECTION THE STANDARD DEFINITION OF THE RESONANCE     Groupie
INTEGRAL CAN BE USED TO DEFINE REACTION RATES FOR EACH REACTION.      Groupie
                                                                      Groupie
THE RESONANCE INTEGRAL IS DEFINED AS,                                 Groupie
                                                                      Groupie
RI      = (INTEGRAL E1 TO E2) (SIGMA(E)*S(E)*WT(E)*DE)                Groupie
                                                                      Groupie
WHERE NORMALLY,                                                       Groupie
S(E)    = 1/E                                                         Groupie
WT(E)   = 1    - NO SELF-SHIELDING                                    Groupie
                                                                      Groupie
FROM THE ABOVE DEFINITION OF GROUP AVERAGED CROSS SECTIONS THE        Groupie
RESONANCE INTEGRAL IS,                                                Groupie
                                                                      Groupie
RI      = AVERAGE * (INTEGRAL E1 TO E2) (S(E)*WT(E)*DE)               Groupie
                                                                      Groupie
FOR A 1/E SPECTRUM AND NO SELF-SHIELDING THIS REDUCES TO,             Groupie
                                                                      Groupie
RI      = AVERAGE* LOG(E2/E1)                                         Groupie
                                                                      Groupie
IN ANY OTHER SITUATION, INCLUDING ABSORPTION AND/OR ENERGY            Groupie
DEPENDENT CROSS SECTIONS, THE SPECTRUM WILL NOT BE 1/E -              Groupie
ABSORPTION WILL TEND TO DECREASE THE SPECTRUM PROGRESSIVELY           Groupie
MORE AT LOWER ENERGIES - ENERGY DEPENDENCE OF THE CROSS SECTION       Groupie
WILL LEAD TO SELF-SHIELDING.                                          Groupie
                                                                      Groupie
HERE WE WILL NOT ATTEMPT TO PERFORM A DETAILED SPECTRUM               Groupie
CALCULATION TO ACCOUNT FOR ABSORPTION.                                Groupie
                                                                      Groupie
HOWEVER, WE WILL EXTEND THE DEFINITION OF THE RESONANCE INTEGRAL      Groupie
TO ACCOUNT FOR SELF-SHIELDING EFFECTS BY ALLOWING FOR INCLUSION       Groupie
OF SELF-SHIELDING EFFECTS IN THE DEFINITION OF GROUP AVERAGES         Groupie
AND THEN DEFINING THE RESONANCE INTEGRAL AS,                          Groupie
                                                                      Groupie
RI      = AVERAGE* LOG(E2/E1)                                         Groupie
                                                                      Groupie
IN ORDER TO CALCULATE RESONANCE INTEGRALS YOU MUST FOLLOW THESE       Groupie
STEPS,                                                                Groupie
                                                                      Groupie
1) SELECT A 1/E SPECTRUM - ON FIRST LINE OF INPUT PARAMETERS.         Groupie
2) SELECT THE ENERGY BOUNDARIES - NORMALLY ONLY 1 GROUP FROM          Groupie
   0.5 EV UP TO 20 MEV - HOWEVER, YOU ARE FREE TO SELECT ANY          Groupie
   ENERGY RANGE THAT YOU WISH - YOU MAY EVEN SELECT MORE THAN         Groupie
   1 GROUP MERELY BY SPECIFYING MORE THAN 1 GROUP AS INPUT -          Groupie
   THIS CAN BE USED TO DEFINE THE CONTRIBUTIONS TO THE RESONANCE      Groupie
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   INTEGRAL FROM INDIVIDUAL ENERGY RANGES.                          Groupie
3) SELECT THIS OPTION FOR THE UNSHIELDED AND/OR SHIELDED OUTPUT     Groupie
   LISTING - ON THE SECOND LINE OF INPUT PARAMETERS.                Groupie
                                                                    Groupie
WHEN THIS OPTION IS USED THE PROGRAM WILL CALCULATE GROUP AVERAGED  Groupie
CROSS SECTIONS - AS DEFINED ABOVE - PRIOR TO OUTPUT THE RESULTS     Groupie
WILL MERELY BE MULTIPLIED BY THE WIDTH OF THE GROUP ASSUMING YOU    Groupie
HAVE SELECTED A 1/E SPECTRUM - THERE IS NO CHECK ON THIS - THE      Groupie
PROGRAM MERELY MULTIPLIES THE GROUP AVERAGED CROSS SECTIONS BY,     Groupie
                                                                    Groupie
LOG(E2/E1) - WHERE E2 AND E1 ARE THE GROUP ENERGY BOUNDARIES.       Groupie
                                                                    Groupie
WARNING - IT IS UP TO YOU TO INSURE THAT YOU FOLLOW EXACTLY THE     Groupie
          STEPS OUTLINED ABOVE IF YOU WISH TO OBTAIN MEANINGFUL     Groupie
          RESULTS.                                                  Groupie
                                                                    Groupie
NOTE - OUTPUT IN THE ENDF/B FORMAT IS ALWAYS GROUP AVERAGED CROSS   Groupie
       SECTIONS, REGARDLESS OF WHETHER YOU ASK FOR AVERAGED CROSS   Groupie
       SECTIONS OR RESONANCE INTEGRALS - THIS IS BECAUSE DATA IN    Groupie
       THE ENDF/B FORMAT IS EXPLICITLY DEFINED TO BE CROSS          Groupie
       SECTIONS.                                                    Groupie
                                                                    Groupie
       RESONANCE INTEGRAL OUTPUT CAN ONLY BE OBTAINED IN THE        Groupie
       LISTING FORMATS.                                             Groupie
                                                                    Groupie
MINIMUM TOTAL CROSS SECTION TREATMENT                               Groupie
------------------------------------                                Groupie
SINCE THE BONDARENKO SELF-SHIELDING DEPENDS ON 1/TOTAL CROSS        Groupie
SECTION, THE ALGORITHM WILL BECOME NUMERICALLY UNSTABLE IF THE      Groupie
TOTAL CROSS SECTION IS NEGATIVE (AS OCCURS IN MANY ENDF/B           Groupie
EVALUATIONS). IF THE TOTAL IS LESS THAN SOME MINIMUM ALLOWABLE      Groupie
VALUE (DEFINE BY OKMIN, PRESENTLY 1 MILLI-BARN) AN ERROR MESSAGE    Groupie
WILL BE PRINTED AND FOR THE SELF-SHIELDING CALCULATION ALL ENERGY   Groupie
INTERVALS IN WHICH THE TOTAL IS LESS THAN THE MINIMUM WILL BE       Groupie
IGNORED.                                                            Groupie
                                                                    Groupie
NOTE, FOR THE UNSHIELDED CALCULATIONS ALL CROSS SECTIONS WILL BE    Groupie
CONSIDERED WHETHER THEY ARE POSITIVE OR NEGATIVE. THEREFORE IF      Groupie
THE TOTAL CROSS SECTION IS NEGATIVE OR LESS THAN THE MINIMUM        Groupie
VALUE THERE MAY BE AN INCONSISTENCY BETWEEN THE UNSHIELDED AND      Groupie
THE SELF-SHIELDED CROSS SECTIONS. IF THE TOTAL CROSS SECTION IS     Groupie
NEGATIVE AND SELF-SHIELDED CROSS SECTIONS ARE CALCULATED THE        Groupie
PROGRAM WILL PRINT AN ERROR MESSAGE INDICATING THAT THE SELF-       Groupie
SHIELDED RESULTS ARE UNRELIABLE AND SHOULD NOT BE USED. THEREFORE   Groupie
IN THIS CASE THE PROGRAM WILL NOT ATTEMPT TO MODIFY THE UNSHIELDED  Groupie
RESULTS TO ELIMINATE THE EFFECT OF NEGATIVE CROSS SECTIONS, SINCE   Groupie
THE UNSHIELDED RESULTS ARE THE ONLY ONES WHICH TRULY REFLECT THE    Groupie
ACTUAL INPUT.                                                       Groupie
                                                                    Groupie
RESOLVED RESONANCE REGION                                           Groupie
-------------------------                                           Groupie
IN THE RESOLVED RESONANCE REGION (ACTUALLY EVERYWHERE BUT IN THE    Groupie
UNRESOLVED RESONANCE REGION) THE CROSS SECTIONS OUTPUT BY LINEAR-   Groupie
RECENT-SIGMA1 WILL BE ACTUAL ENERGY DEPENDENT CROSS SECTIONS AND    Groupie
THE CALCULATIONS BY THIS PROGRAM WILL YIELD ACTUAL SHIELDED AND     Groupie
UNSHIELDED CROSS SECTIONS.                                          Groupie
                                                                    Groupie
UNRESOLVED RESONANCE REGION                                         Groupie
---------------------------                                         Groupie
IN THE UNRESOLVED RESONANCE REGION PROGRAM RECENT USES THE          Groupie
UNRESOLVED RESONANCE PARAMETERS TO CALCULATE INFINITELY DILUTE      Groupie
AVERAGE CROSS SECTIONS. THIS PROGRAM WILL MERELY READ THIS          Groupie
INFINITELY DILUTE DATA AS IF IT WERE ENERGY DEPENDENT DATA AND      Groupie
GROUP AVERAGE IT. AS SUCH THIS PROGRAM WILL PRODUCE THE CORRECT     Groupie
UNSHIELDED CROSS SECTION IN THE UNRESOLVED RESONANCE REGION, BUT    Groupie
IT WILL NOT PRODUCE THE CORRECT SELF-SHIELDING EFFECTS.             Groupie
                                                                    Groupie
ACCURACY OF RESULTS                                                 Groupie
-------------------                                                 Groupie
ALL INTEGRALS ARE PERFORMED ANALYTICALLY. THEREFORE NO ERROR IS     Groupie
INTRODUCED DUE TO THE USE OF TRAPAZOIDAL OR OTHER INTEGRATION       Groupie
```

SCHEME. THE TOTAL ERROR THAT CAN BE ASSIGNED TO THE RESULTING Groupie
AVERAGES IS JUST THAT DUE TO THE ERROR IN THE CROSS SECTIONS Groupie
AND ENERGY DEPENDENT WEIGHTING SPECTRUM. GENERALLY SINCE THE Groupie
THE ENERGY DEPENDENT WEIGHTING SPECTRUM APPEARS IN BOTH THE Groupie
NUMERATOR AND THE DENOMINATOR THE AVERAGES RAPIDLY BECOME Groupie
INSENSITIVE TO THE WEIGHTING SPECTRUM AS MORE GROUPS ARE USED. Groupie
SINCE THE WEIGHTING SPECTRUM IS LOADED IN THE PAGING SYSTEM THE Groupie
USER CAN DESCRIBE THE SPECTRUM TO ANY REQUIRED ACCURACY USING Groupie
ANY NUMBER OF ENERGY VS. SPECTRUM PAIRS. Groupie
Groupie

MULTI-BAND PARAMETERS Groupie
---------- Groupie
MULTI-BAND PARAMETERS ARE CALCULATED FOR THE TOTAL, ELASTIC, Groupie
CAPTURE AND FISSION REACTIONS. WITH THE NUMBER OF GROUPS THAT Groupie
ARE NORMALLY USED (SEE BUILT IN GROUP STRUCTURES) ALL OTHER Groupie
REACTIONS RESULT IN A NEGLIGABLE AMOUNT OF SELF-SHIELDING. AS Groupie
SUCH THEIR EQUIVALENT BAND CROSS SECTION WILL MERELY BE THEIR Groupie
UNSHIELDED VALUE WITHIN EACH BAND. Groupie
Groupie

FOR ANY GIVEN EVALUATION, WITHIN ANY GIVEN GROUP THIS PROGRAM Groupie
WILL GENERATE THE MINIMUM NUMBER OF BANDS REQUIRED WITHIN THAT Groupie
GROUP. AS OUTPUT TO THE COMPUTER READABLE DISK FILE THE BAND Groupie
PARAMETERS FOR EACH EVALUATION WILL BE FORMATTED TO HAVE THE Groupie
SAME NUMBER OF BANDS IN ALL GROUPS (WITH ZERO WEIGHT FOR SOME Groupie
BANDS WITHIN ANY GROUP). THE USER MAY DECIDE TO HAVE OUTPUT Groupie
EITHER WITH THE MINIMUM NUMBER OF BANDS REQUIRED FOR EACH Groupie
EVALUATION (E.G. 2 BANDS FOR HYDROGEN AND 4 BANDS FOR U-233) OR Groupie
THE SAME NUMBER OF BANDS FOR ALL EVALUATIONS (E.G. 4 BANDS FOR Groupie
BOTH HYDROGEN AND U-233). Groupie
Groupie

FOR 2 OR FEWER BANDS THE PROGRAM USES AN ANALYTIC EXPRESSION Groupie
TO DEFINE ALL MULTI-BAND PARAMETERS. FOR MORE THAN 2 BANDS THE Groupie
PROGRAM PERFORMS A NON-LINEAR FIT TO SELECT THE MULTI-BAND Groupie
PARAMETERS THAT MINIMIZE THE MAXIMUM FRACTIONAL ERROR AT ANY Groupie
POINT ALONG THE ENTIRE SELF-SHIELDING CURVE. THE NUMBER OF BANDS Groupie
REQUIRED WITHIN ANY GIVEN GROUP IS DEFINED BY INSURING THAT THE Groupie
MULTI-BAND PARAMETERS CAN BE USED TO ACCURATELY DEFINE SELF- Groupie
SHIELDED CROSS SECTIONS ALONG THE ENTIRE SELF-SHIELDING CURVE Groupie
FROM SIGMA0 = 0 TO INFINITY. THE USER MAY DEFINE THE ACCURACY Groupie
REQUIRED. Groupie
Groupie

ENDF/B FORMATTED UNSHIELDED AVERAGES Groupie
---------- Groupie
UNSHIELDED MULTI-GROUP AVERAGED CROSS SECTIONS FOR ALL REACTIONS Groupie
MAY BE OBTAINED IN THE ENDF/B FORTRAN IN EITHER HISTOGRAM Groupie
(INTERPOLATION LAW 1) OR LINEARLY INTERPOLABLE (INTERPOLATION Groupie
LAW 2) FORM. SEE INPUT BELOW FOR DETAILS. Groupie
Groupie

MIXTURES OF MATERIALS AND RESONANCE OVERLAP Groupie
---------- Groupie
THE SELF-SHIELDED CROSS SECTIONS FOR THE INDIVIDUAL CONSTITUENTS Groupie
OF ANY MIXTURE CAN BE CALCULATED BY THIS PROGRAM BY REALIZING THAT Groupie
THIS PROGRAM ESSENTIALLY ONLY USES THE TOTAL CROSS SECTION AS A Groupie
WEIGHTING FUNCTION TO ACCOUNT FOR SELF-SHIELDING EFFECTS. FOR A Groupie
MIXTURE IT IS THEREFORE ONLY NECESSARY TO USE THE TOTAL CROSS Groupie
SECTION FOR THE MIXTURE IN PLACE OF THE ACTUAL TOTAL CROSS SECTION Groupie
FOR EACH CONSTITUENT AND TO RUN THIS PROGRAM. THIS CAN BE DONE BY Groupie
FIRST RUNNING PROGRAM MIXER TO CALCULATE THE ENERGY DEPENDENT Groupie
TOTAL CROSS SECTION FOR ANY COMPOSITE MIXTURE. NEXT, SUBSTITUTE Groupie
THIS COMPOSITE TOTAL CROSS SECTION FOR THE ACTUAL TOTAL CROSS Groupie
SECTION OF EACH CONSTITUENT (IN EACH ENDF/B FORMATTED EVALUATION). Groupie
FINALLY, RUN THIS PROGRAM TO CALCULATE THE SELF-SHIELDED CROSS Groupie
SECTION FOR EACH CONSTITUENT, PROPERLY ACCOUNTING FOR RESONANCE Groupie
OVERLAP BETWEEN THE RESONANCES OF ALL OF THE CONSTITUENTS OF THE Groupie
MIXTURE. DURING THE SAME RUN THESE SELF-SHIELDED CROSS SECTIONS Groupie
CAN IN TURN BE USED TO CALCULATE FULLY CORRELATED MULT-BAND Groupie
Groupie

MULTI-BAND PARAMETER OUTPUT FORMAT Groupie
---------- Groupie
FOR VERSIONS 92-2 AND LATER VERSIONS THE MULTI-BAND PARAMETERS Groupie
ARE OUTPUT IN A SIMPLE CHARACTER FORMAT, THAT CAN BE TRANSFERRED Groupie

AND USED ON VIRTUALLY ANY COMPUTER. Groupie

Groupie

THE BINARY FORMAT USED IN EARLIER VERSIONS OF THIS CODE IS NO Groupie
LONGER USED. Groupie

Groupie

CONTACT THE AUTHOR IF YOU WOULD LIKE TO RECEIVE A SIMPLE PROGRAM Groupie
TO READ THE CHARACTER FORMATTED MULTI-BAND PARAMETER FILE AND Groupie
CREATE A BINARY, RANDOM ACCESS FILE FOR USE ON VIRTUALLY ANY Groupie
COMPUTER. Groupie

Groupie

THE FORMAT OF THE CHARACTER FILE IS, Groupie

Groupie

RECORD	COLUMNS	FORMAT	DESCRIPTION	
1	1-72	18A4	LIBRARY DESCRIPTION (AS READ)	Groupie
2	1-11	I11	MATERIAL ZA	Groupie
	12-22	I11	NUMBER GROUPS	Groupie
	23-33	I11	NUMBER OF BANDS	Groupie
	34-44	E11.4	TEMPERATURE (KELVIN)	Groupie
	45-55	1X,10A1	HOLLERITH DESCRIPTION OF ZA	Groupie
3	1-11	E11.4	ENERGY (EV) - GROUP BOUNDARY.	Groupie
	12-22	E11.4	TOTAL (FIRST BAND)	Groupie
	23-33	E11.4	ELASTIC	Groupie
	34-44	E11.4	CAPTURE	Groupie
	35-55	E11.4	FISSION	Groupie
4	1-11	-----	BLANK	Groupie
	12-22	E11.4	TOTAL (SECOND BAND)	Groupie
	23-33	E11.4	ELASTIC	Groupie
	34-44	E11.4	CAPTURE	Groupie
	35-55	E11.4	FISSION	Groupie

Groupie

LINES 3 AND 4 ARE REPEATED FOR EACH GROUP. THE LAST LINE FOR EACH Groupie
MATERIAL (ZA) IS, Groupie

Groupie

N	1-11	E11.4	ENERGY (EV) - UPPER ENERGY LIMIT OF LAST GROUP.	Groupie

Groupie

FOR EXAMPLE, A 175 GROUP, 2 BAND FILE, FOR EACH MATERIAL WILL Groupie
CONTAIN 352 LINES = 1 HEADER LINE, 175 * 2 LINES OF PARAMETERS, Groupie
AND 1 FINAL LINE WITH THE UPPER ENERGY LIMIT Groupie
OF THE LAST GROUP. Groupie

Groupie

INPUT FILES Groupie
----------- Groupie

UNIT	DESCRIPTION	
2	INPUT DATA (BCD - 80 CHARACTERS/RECORD)	Groupie
10	ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)	Groupie

Groupie

OUTPUT FILES Groupie
------------ Groupie

UNIT	DESCRIPTION	
31	MULTI-BAND PARAMETERS CHARACTER FILE - OPTIONAL	Groupie
	(BCD - 80 CHARACTERS/RECORD)	Groupie
32	SELF-SHIELDED CROSS SECTION LISTING - OPTIONAL	Groupie
	(BCD - 120 CHARACTERS/RECORD)	Groupie
33	MULTI-BAND PARAMETER LISTING - OPTIONAL	Groupie
	(BCD - 120 CHARACTERS/RECORD)	Groupie
34	UNSHIELDED CROSS SECTION LISTING - OPTION	Groupie
	(BCD - 120 CHARACTERS/RECORD)	Groupie
3	OUTPUT REPORT (BCD - 80 CHARACTERS/RECORD)	Groupie
11	MULTI-GROUP ENDF/B DATA - OPTIONAL	Groupie
	(BCD - 80 CHARACTERS/RECORD)	Groupie

Groupie

SCRATCH FILES Groupie
------------- Groupie

UNIT	FILENAME	DESCRIPTION	
8		ENERGY DEPENDENT WEIGHTING SPECTRUM	Groupie
		(BINARY - 40080 WORDS/BLOCK)	Groupie
9		TOTAL CROSS SECTION	Groupie

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      (BINARY - 40080 WORDS/BLOCK)                                      Groupie
 12   ELASTIC CROSS SECTION - ONLY FOR SELF-SHIELDING CALCULATION       Groupie
      (BINARY - 40080 WORDS/BLOCK)                                      Groupie
 13   CAPTURE CROSS SECTION - ONLY FOR SELF-SHIELDING CALCULATION       Groupie
      (BINARY - 40080 WORDS/BLOCK)                                      Groupie
 14   FISSION CROSS SECTION - ONLY FOR SELF-SHIELDING CALCULATION       Groupie
      (BINARY - 40080 WORDS/BLOCK)                                      Groupie
                                                                        Groupie
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINES FILIO1 AND FILIO2)        Groupie
-----------------------------------------------------------------       Groupie
UNIT  FILE NAME                                                         Groupie
----  ----------                                                        Groupie
  2   GROUPIE.INP                                                       Groupie
  3   GROUPIE.LST                                                       Groupie
  8   (SCRATCH)                                                         Groupie
  9   (SCRATCH)                                                         Groupie
 10   ENDFB.IN                                                          Groupie
 11   ENDFB.OUT                                                         Groupie
 12   (SCRATCH)                                                         Groupie
 13   (SCRATCH)                                                         Groupie
 14   (SCRATCH)                                                         Groupie
 31   MULTBAND.TAB                                                      Groupie
 32   SHIELD.LST                                                        Groupie
 33   MULTBAND.LST                                                      Groupie
 34   UNSHIELD.LST                                                      Groupie
                                                                        Groupie
 I/O UNITS USED                                                         Groupie
 --------------                                                         Groupie
 UNITS 2, 3 8, 9 AND 10 WILL ALWAYS BE USED.                            Groupie
 UNITS 31 THROUGH 34 AND 11 ARE OPTIONALLY USED DEPENDING ON THE        Groupie
 OUTPUT REQUESTED.                                                      Groupie
 UNITS 12, 13 AND 14 WILL ONLY BE USED IF SELF-SHIELDED OR              Groupie
 MULTIBAND OUTPUT IS REQUESTED.                                         Groupie
                                                                        Groupie
INPUT CARDS                                                             Groupie
-----------                                                             Groupie
CARD  COLS.  FORMAT  DESCRIPTION                                        Groupie
----  -----  ------  -----------                                        Groupie
  1    1-11    I11   SELECTION CRITERIA (0=MAT, 1=ZA)                  Groupie
  1   12-22    I11   NUMBER OF GROUPS.                                  Groupie
                     =.GT.0 - ARBITRARY GROUP BOUNDARIES ARE READ       Groupie
                              FROM INPUT FILE (N GROUPS REQUIRE         Groupie
                              N+1 GROUP BOUNDARIES). CURRENT            Groupie
                              PROGRAM MAXIMUM IS 20,000 GROUPS.         Groupie
                              BUILT-IN OPTIONS INCLUDE....              Groupie
                     =  0   - TART    175 GROUPS                        Groupie
                     = -1   - ORNL     50 GROUPS                        Groupie
                     = -2   - ORNL    126 GROUPS                        Groupie
                     = -3   - ORNL    171 GROUPS                        Groupie
                     = -4   - SAND-II 620 (665) GROUPS TO 18 MEV        Groupie
                     = -5   - SAND-II 640 (685) GROUPS TO 20 MEV        Groupie
                     = -6   - WIMS     69 GROUPS                       Groupie
                     = -7   - GAM-I    68 GROUPS                       Groupie
                     = -8   - GAM-II   99 GROUPS                       Groupie
                     = -9   - MUFT     54 GROUPS                       Groupie
                     =-10   - ABBN     28 GROUPS                       Groupie
                     =-11   - TART    616 GROUPS TO 20 MEV             Groupie
                     =-12   - TART    700 GROUPS TO 1 GEV              Groupie
                     =-13   - SAND-II 665 GROUPS TO 18 MEV             Groupie
                     =-14   - SAND-II 685 GROUPS TO 20 MEV             Groupie
                     =-15   - TART    666 GROUPS TO 200 MEV            Groupie
                     =-16   - SAND-II 725 GROUPS TO 60 MEV             Groupie
                     =-17   - SAND-II 755 GROUPS TO 150 MEV            Groupie
                     =-18   - SAND-II 765 GROUPS TO 200 MEV            Groupie
                     =-19   - UKAEA  1102 GROUPS TO   1 GeV            Groupie
  1   23-33    I11   MULTI-BAND SELECTOR                                Groupie
                     =  0 - NO MULTI-BAND CALCULATIONS                  Groupie
                     =  1 - 2 BAND. CONSERVE AV(TOT), AV(1/TOT)         Groupie
                            AND AV(1/TOT**2)                            Groupie
                     =  2 - 2 BAND. CONSERVE AV(TOT), AV(1/TOT)         Groupie
                            AND AV(1/(TOT+SIGMA0)) WHERE                Groupie
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                              SIGMA0 = AV(TOT) IN EACH GROUP          Groupie
                          = 3-5- MULTI-BAND FIT. CONSERVE AV(TOT) AND Groupie
                              MINIMIZE FRACTIONAL ERROR FOR ENTIRE    Groupie
                              SELF-SHIELDING CURVE (SIGMA0 = 0 TO     Groupie
                              INFINITY)                               Groupie
                          IF THE SELECTOR IS POSITIVE (1 TO 5) THE    Groupie
                          MINIMUM NUMBER OF BANDS WILL BE OUTPUT FOR  Groupie
                          EACH ISOTOPE INDEPENDENTLY. IF THE SELECTOR Groupie
                          IS NEGATIVE (-1 TO -5) THE SAME NUMBER OF   Groupie
                          BANDS (ABS(SELECTOR)) WILL BE OUTPUT FOR    Groupie
                          ALL ISOTOPES.                               Groupie
    1   34-44    I11      NUMBER OF POINTS USED TO DESCRIBE ENERGY    Groupie
                          DEPENDENT WEIGHTING SPECTRUM S(E).          Groupie
                          = -2    - MAXWELLIAN - UP TO 0.1 EV         Groupie
                            1/E       - 0.1 EV TO 67 KEV            Groupie
                            FISSION   - ABOVE 67 KEV                Groupie
05/01/20------------------ADDED OPTION TO ALLOW TEMPERATURE OF THE    Groupie
                          MAXWELLIAN TO BE CHANGED - SEE INPUT LINE 4, Groupie
                          COLUMNS 55 - 66.                            Groupie
                          = -1    - 1/E                               Groupie
                          = 0 OR 1- ENERGY INDEPENDENT (SO CALLED FLAT Groupie
                              WEIGHTING SPECTRUM).                    Groupie
                          = .GT.1 - READ THIS MANY POINTS FROM INPUT  Groupie
                              TO DESCRIBE WEIGHTING SPECTRUM.         Groupie
                              NO LIMIT TO THE NUMBER OF POINTS        Groupie
                              USED TO DESCRIBE WEIGHTING.             Groupie
    1   45-55   E11.4   MULTI-BAND CONVERGENCE CRITERIA.             Groupie
                          ONLY USED FOR 3 OR MORE BANDS. THE NUMBER OF Groupie
                          BANDS IN EACH GROUPS IS SELECTED TO INSURE  Groupie
                          THAT THE ENTIRE SELF-SHIELDING CURVE CAN BE Groupie
                          REPRODUCED TO WITHIN THIS FRACTIONAL ERROR. Groupie
                          = .LT. 0.0001 - USE STANDARD 0.001          Groupie
                                          (0.1 PER-CENT)              Groupie
                          = .GE. 0.0001 - USE AS CONVERGENCE CRITERIA Groupie
    1   56-66    I11      SIGMA-0 DEFINITION SELECTOR.                Groupie
                          < 0 - 21 VALUES OF SIGMA0 ARE READ INPUT AND Groupie
                              INTERPRETED AS FIXED VALUES = SAME AS   Groupie
                              = 1 DESCRIPTION BELOW                   Groupie
                              INPUT VALUES MUST ALL BE,               Groupie
                              1) GREATER THAN 0                       Groupie
                              2) IN DESCENDING VALUE ORDER            Groupie
                          = 0 - SIGMA-0 WILL BE DEFINED AS A MULTIPLE Groupie
                              OF THE UNSHIELDED TOTAL CROSS SECTION   Groupie
                              IN EACH GROUP (VALUES OF 1/1024 TO      Groupie
                              1024 IN STEPS OF A FACTOR OF 2 WILL     Groupie
                              BE USED AS THE MULTIPLIER).             Groupie
                          = 1 - SIGMA-0 WILL BE DEFINED AS THE SAME   Groupie
                              NUMBER OF BARNS IN EACH GROUP (VALUES   Groupie
                              40000 TO 0.4 BARNS WILL BE USED. WITHIN Groupie
                              EACH DECADE VALUES OF 10, 7, 4, 2, 1    Groupie
                              BARNS WILL BE USED).                    Groupie
    1   67-70    I4       High energy extension = definition of cross Groupie
                          section above highest tabulated energy.     Groupie
                          = 0 = cross section = 0 (standard ENDF/B)   Groupie
                          = 1 = cross section = constant (equal to    Groupie
                              value at highest tabulated energy).     Groupie
  2-4    1-66 6E11.4   IF SIGMA-0 DEFINITION SELECTOR < 0, THE NEXT  Groupie
                          4 LINES OF INPUT ARE THE 22 VALUES OF SIGMA0, Groupie
                          6 PER LINE.                                 Groupie
    2    1-72    A72      ENDF/B INPUT DATA FILENAME                  Groupie
                          (STANDARD OPTION = ENDFB.IN)                Groupie
    3    1-72    A72      ENDF/B OUTPUT DATA FILENAME                 Groupie
                          (STANDARD OPTION = ENDFB.OUT)               Groupie
                                                                      Groupie
  THE FOURTH INPUT CARD IS USED TO SELECT ALL DESIRED OUTPUT MODES.   Groupie
  EACH OUTPUT DEVICE MAY BE TURNED OFF (0) OR ON (1). THEREFORE       Groupie
  THEREFORE EACH OF THE FOLLOWING INPUT PARAMETERS MAY BE EITHER      Groupie
  ZERO TO INDICATE NO OUTPUT OR NON-ZERO TO INDICATE OUTPUT.          Groupie
                                                                      Groupie
    4     1-11    I11      SELF-SHIELDED CROSS SECTION LISTING         Groupie
                          = 1 - CROSS SECTIONS                        Groupie
```

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                        = 2 - RESONANCE INTEGRALS                          Groupie
       4     12-22   I11   MULTI-BAND PARAMETER LISTING                     Groupie
       4     23-33   I11   MULTI-BAND PARAMETERS COMPUTER READABLE           Groupie
       4     34-44   I11   UNSHIELDED CROSS SECTIONS IN ENDF/B FORMAT        Groupie
                           = 1 - HISTOGRAM FORMAT (INTERPOLATION LAW 1)      Groupie
                           = 2 - LINEAR-LINEAR (INTERPOLATION LAW 2)         Groupie
       4     45-55   I11   UNSHIELDED CROSS SECTIONS LISTING                 Groupie
                           = 1 - CROSS SECTIONS                              Groupie
                           = 2 - RESONANCE INTEGRALS                         Groupie
05/01/20 - ADDED THE BELOW OPTION                                            Groupie
       4     56-66   E11.4 IF THE STANDARD BUILT-IN SPECTRA IS USED,         Groupie
                           INPUT LINE 1, COLUMNS 34-44 = 2, THIS FIELD       Groupie
                           CAN BE USED TO OPTIONALLY CHANGE TEMPERATURE      Groupie
                           OF THE MAXWELLIAN.                                Groupie
                           INPUT IS IN EV (0.0253 EV = ROOM TEMPERATURE)     Groupie
                           = 0 - USE DEFAULT 0.0253 EV, ROOM TEMPERATURE     Groupie
                           > 0 - USE THIS AS THE TEMPERATURE                 Groupie
                           RESTRICTION - TEMPERATURE CANNOT EXCEED           Groupie
                           1000 EV.                                          Groupie
                                                                             Groupie
       5      1-80   18A4  LIBRARY IDENTIFICATION. ANY TEXT THAT THE         Groupie
                           USER WISHES TO IDENTIFY THE MULTI-BAND            Groupie
                           PARAMETERS. THIS LIBRARY IDENTIFICATION IS        Groupie
                           WRITTEN INTO THE COMPUTER READABLE MULTI-BAND     Groupie
                           DATA FILE.                                        Groupie
                                                                             Groupie
      6-N     1- 6    I6   LOWER MAT OR ZA LIMIT                            Groupie
              7- 8    I2   LOWER MF LIMIT                                   Groupie
              9-11    I3   LOWER MT LIMIT                                   Groupie
             12-17    I11  UPPER MAT OR ZA LIMIT                            Groupie
             18-19    I2   UPPER MF LIMIT                                   Groupie
             20-22    I3   UPPER MT LIMIT                                   Groupie
                           UP TO 100 RANGES MAY BE SPECIFIED, ONE RANGE      Groupie
                           PER LINE. THE LIST OF RANGES IS TERMINATED        Groupie
                           BY A BLANK CARD. IF THE UPPER MAT OR ZA           Groupie
                           LIMIT IS LESS THAN THE LOWER LIMIT THE UPPER      Groupie
                           IS SET EQUAL TO THE LOWER LIMIT. IF THE UPPER     Groupie
                           MF OR MT LIMIT IS ZERO IT WILL BE SET EQUAL       Groupie
                           TO ITS MAXIMUM VALUE, 99 OR 999, RESPECTIVELY     Groupie
                           IF THE FIRST REQUEST LINE IS BLANK IT WILL        Groupie
                           TERMINATE THE LIST OF REQUESTS AND CAUSE ALL      Groupie
                           DATA TO BE RETRIEVED (SEE EXAMPLE INPUT).         Groupie
                                                                             Groupie
      VARY     1-66  6E11.4 ENERGY GROUP BOUNDARIES. ONLY REQUIRED IF        Groupie
                           THE NUMBER OF GROUPS INDICATED ON THE FIRST       Groupie
                           INPUT CARD IS POSITIVE. ALL ENERGIES MUST         Groupie
                           BE IN ASCENDING ENERGY IN EV. THE PRESENT         Groupie
                           LIMITS ARE 1 TO 20,000 GROUPS. FOR N GROUPS       Groupie
                           N+1 BOUNDARIES WILL BE READ FROM THE              Groupie
                           INPUT FILE, E.G. IF THE FIRST INPUT CARD          Groupie
                           INDICATES 20 GROUPS, 21 ENERGY BOUNDARIES         Groupie
                           WILL BE READ FROM THE INPUT FILE.                 Groupie
                                                                             Groupie
      VARY     1-66  6E11.4 ENERGY DEPENDENT WEIGHTING SPECTRUM. ONLY        Groupie
                           REQUIRED IF THE NUMBER OF POINTS INDICATED        Groupie
                           ON FIRST CARD IS MORE THAN ONE. DATA IS           Groupie
                           GIVEN IN (ENERGY, WEIGHT) PAIRS, UP TO 3          Groupie
                           PAIRS PER CARD, USING ANY NUMBER OF CARDS         Groupie
                           REQUIRED. ENERGIES MUST BE IN ASCENDING           Groupie
                           ORDER IN EV. THE SPECTRUM VALUES MUST BE          Groupie
                           NON-NEGATIVE. THE ENERGY RANGE OF SPECTRUM        Groupie
                           MUST AT LEAST SPAN THE ENERGY RANGE OF THE        Groupie
                           ENERGY GROUPS. SINCE SPECTRUM IS STORED IN        Groupie
                           PAGING SYSTEM THERE IS NO LIMIT TO NUMBER         Groupie
                           OF POINTS THAT CAN BE USED TO DESCRIBE THE        Groupie
                           WEIGHTING SPECTRUM.                               Groupie
                                                                             Groupie
    EXAMPLE INPUT NO. 1                                                      Groupie
    ------------------                                                       Groupie
    REQUEST DATA BY MAT AND PROCESS ALL DATA (ALL MAT BETWEEN 1 AND          Groupie
    9999). USE THE TART 175 GROUP STRUCTURE, GENERATE 2 BAND                 Groupie
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    PARAMETERS (THE FOR ALL ISOTOPES) TO 0.1 PER-CENT ACCURACY         Groupie
    IN THE SELF-SHIELDING CURVE. OUTPUT ALL  LISTING, COMPUTER         Groupie
    READABLE AND ENDF/B FORMAT GROUP AVERAGES.                         Groupie
                                                                       Groupie
    EXPLICITLY SPECIFY THE STANDARD FILENAMES.                         Groupie
                                                                       Groupie
    THE FOLLOWING 7 INPUT LINES ARE REQUIRED.                          Groupie
                                                                       Groupie
         0          0         -2          0 1.00000-03          0      Groupie
ENDFB.IN                                                               Groupie
ENDFB.OUT                                                              Groupie
         1          1          1          1          1                 Groupie
TART 175 GROUP, 2 BAND LIBRARY TO 0.1 PER-CENT ACCURACY                Groupie
    1 1  1  9999 0  0                                                  Groupie
                     (BLANK CARD TERMINATES REQUEST LIST)              Groupie
                                                                       Groupie
    EXAMPLE INPUT NO. 2                                                Groupie
    -------------------                                                Groupie
    THE SAME EXAMPLE 1, AS ABOVE, ONLY THE ENDF/B DATA WILL BE READ    Groupie
    FROM \ENDFB6\SIGMA1\K300\ZA092238 (U-238 AT 300 KELVIN) AND        Groupie
    WRITTEN TO \ENDFB6\GROUPIE\K300\ZA092238                           Groupie
                                                                       Groupie
    THE FOLLOWING 7 INPUT LINES ARE REQUIRED.                          Groupie
                                                                       Groupie
         0          0         -2          0 1.00000-03          0      Groupie
\ENDFB6\SIGMA1\K300\ZA092238                                           Groupie
\ENDFB6\GROUPIE\K300\ZA092238                                          Groupie
         1          1          1          1          1                 Groupie
TART 175 GROUP, 2 BAND LIBRARY TO 0.1 PER-CENT ACCURACY                Groupie
    1 1  1  9999 0  0                                                  Groupie
                     (BLANK CARD TERMINATES REQUEST LIST)              Groupie
                                                                       Groupie
    EXAMPLE INPUT NO. 3                                                Groupie
    -------------------                                                Groupie
    PROCESS ALL DATA. USE 1/E WEIGHTING IN ORDER TO CALCULATE          Groupie
    UNSHIELDED ONE GROUP CROSS SECTIONS OVER THE ENERGY RANGE 0.5 EV   Groupie
    TO 1 MEV (NOTE THAT THE RESULTS ARE SIMPLY PROPORTIONAL TO THE     Groupie
    RESONANCE INTEGRAL FOR EACH REACTION). OUTPUT UNSHIELDED LISTING.  Groupie
                                                                       Groupie
    LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL     Groupie
    THEN USE STANDARD FILENAMES.                                       Groupie
                                                                       Groupie
    THE FOLLOWING 7 INPUT CARDS ARE REQUIRED.                          Groupie
                                                                       Groupie
         0          0          1         -1                    0      Groupie
                     (USE STANDARD FILENAME = ENDFB.IN)                Groupie
                     (USE STANDARD FILENAME = ENDFB.OUT)               Groupie
         0          0          0          0          1                 Groupie
RESONANCE INTEGRAL CALCULATION (FROM 0.5 EV TO 1 MEV)                  Groupie
                     (RETRIEVE ALL DATA, TERMINATE REQUEST LIST)       Groupie
5.00000-01 1.00000+06                                                  Groupie
                                                                       Groupie
    EXAMPLE INPUT NO. 4                                                Groupie
    -------------------                                                Groupie
    THIS EXAMPLE USES A USER DEFINED GROUP STRUCTURE AND WEIGHTING     Groupie
    FUNCTION - THESE ARE NOT REALISTIC IN TERMS OF ACTUAL ENERGIES     Groupie
    AND WEIGHTS - THEY ARE ONLY INTENDED TO ILLUSTRATE THE ORDER OF    Groupie
    THE INPUT PARAMETERS.                                              Groupie
                                                                       Groupie
         0         11          0          6                    0      Groupie
RECENT.OUT                                                             Groupie
GROUPIE.OUT                                                            Groupie
         1          1          1          1          1                 Groupie
Example with users defined groupus and spectrum weighting              Groupie
    1 1  1  999999999                                                  Groupie
                     (blabk line terminates request list)              Groupie
1.00000-05 1.00000-04 1.00000-03 1.00000-02 1.00000-01 1.00000+00 grou Groupie
1.00000+01 1.00000+02 1.00000+03 1.00000+04 1.00000+05 1.00000+06 grou Groupie
1.00000-05 1.0        1.00000-02 0.1        1.00000+00 0.01       weig Groupie
1.00000+02 0.001      1.00000+04 0.0001     1.00000+06 0.000001   weig Groupie
                                                                       Groupie
```

========== Groupie