**=======================================================================SIXPAK**

 **SIXPAK**

 **PROGRAM SIXPAK SIXPAK**

 **============== SIXPAK**

 **VERSION 92-1 (JANUARY 1992) SIXPAK**

 **VERSION 92-2 (FEBRUARY 1992)\*INCREASED CORE ALLOCATION TO SIXPAK**

 **ACCOMMODATE JEF AND EFF EVALUATIONS. SIXPAK**

 **VERSION 92-3 (APRIL 1992) \*ADDED ADDITIONAL DATA TESTS. SIXPAK**

 **VERSION 92-4 (SEPT. 1992) \*CORRECTED KALBACH-MANN CALCULATIONS. SIXPAK**

 **\*FOR PHOTON PRODUCTION OUTPUT MF=12 SIXPAK**

 **(MULTIPLICITY), MF=14 (ISOTROPIC SIXPAK**

 **ANGULAR DISTRIBUTIONS) AND MF=15 SIXPAK**

 **(SPECTRA) - PREVIOUSLY ONLY MF=15. SIXPAK**

 **\*FIRST ORDER CORRECTIONS TRANSFORMING SIXPAK**

 **CENTER-OF-MASS SPECTRA TO LAB SYSTEM SIXPAK**

 **FOR OUTPUT IN MF=5 SIXPAK**

 **\*CORRECTED ISOTROPIC ANGULAR SIXPAK**

 **DISTRIBUTION FLAG (LI) SIXPAK**

 **VERSION 94-1 (JANUARY 1994) \*VARIABLE ENDF/B INPUT DATA FILENAME SIXPAK**

 **TO ALLOW ACCESS TO FILE STRUCTURES SIXPAK**

 **(WARNING - INPUT PARAMETER FORMAT SIXPAK**

 **HAS BEEN CHANGED) SIXPAK**

 **\*CLOSE ALL FILES BEFORE TERMINATING SIXPAK**

 **(SEE, SUBROUTINE ENDIT) SIXPAK**

 **\*INCREASED MAXIMUM TABLE SIZE FROM SIXPAK**

 **2000 TO 6000. SIXPAK**

 **VERSION 96-1 (JANUARY 1996) \*COMPLETE RE-WRITE SIXPAK**

 **\*IMPROVED COMPUTER INDEPENDENCE SIXPAK**

 **\*ALL DOUBLE PRECISION SIXPAK**

 **\*ON SCREEN OUTPUT SIXPAK**

 **\*UNIFORM TREATMENT OF ENDF/B I/O SIXPAK**

 **\*IMPROVED OUTPUT PRECISION SIXPAK**

 **VERSION 99-1 (MARCH 1999) \*CORRECTED CHARACTER TO FLOATING SIXPAK**

 **POINT READ FOR MORE DIGITS SIXPAK**

 **\*UPDATED TEST FOR ENDF/B FORMAT SIXPAK**

 **VERSION BASED ON RECENT FORMAT CHANGESIXPAK**

 **\*GENERAL IMPROVEMENTS BASED ON SIXPAK**

 **USER FEEDBACK SIXPAK**

 **VERSION 99-2 (JUNE 1999) \*ASSUME ENDF/B-VI, NOT V, IF MISSING SIXPAK**

 **MF=1, MT-451. SIXPAK**

 **VERS. 2000-1 (FEBRUARY 2000)\*GENERAL IMPROVEMENTS BASED ON SIXPAK**

 **USER FEEDBACK SIXPAK**

 **VERS. 2002-1 (JANUARY 2002) \*CORRECTED ANGULAR DISTRIBUTION (MF=4)SIXPAK**

 **OUTPUT TO INSURE USED FIELDS ARE 0 SIXPAK**

 **(MAY 2002) \*OPTIONAL INPUT PARAMETERS SIXPAK**

 **(NOV. 2002) \*EXTENDED TO ALLOW CHARGED PARTICLE SIXPAK**

 **ANGULAR DISTRIBUTION IN MF=4 - SIXPAK**

 **WARNING - STRICTLY SPEAKING THIS IS SIXPAK**

 **NOT LEGAL, SINCE MF=4 IS SUPPOSED TO SIXPAK**

 **BE USED ONLY FOR NEUTRON ANGULAR SIXPAK**

 **DISTRIBUTIONS - BUT WHERE MT MAKES SIXPAK**

 **IT OBVIOUS THAT THE OUTGOING PARTICLESIXPAK**

 **IS NOT A NEUTRON HOPEFULLY IT WILL SIXPAK**

 **NOT CAUSE A PROBLEM IF MF=4 IS USED SIXPAK**

 **FOR CHARGED PARTICLES. SIXPAK**

 **VERS. 2004-1 (MARCH 2004) \*ADDED INCLUDE FOR COMMON SIXPAK**

 **\*INCREASED MAXIMUM TABLE SIZE FROM SIXPAK**

 **6,000 TO 12,000. SIXPAK**

 **\*ADDED DUMMY A FOR ELEMENTS SIXPAK**

 **\*CORRECTED OUTPUT INTERPOLATON LAWS SIXPAK**

 **VERS. 2007-1 (JAN. 2007) \*CHECKED AGAINST ALL ENDF/B-VII. SIXPAK**

 **\*INCREASED MAXIMUM TABLE SIZE FROM SIXPAK**

 **12,000 TO 120,000. SIXPAK**

 **VERS. 2007-2 (DEC. 2007) \*72 CHARACTER FILE NAMES. SIXPAK**

 **VERS. 2010-1 (Apr. 2010) \*General update based on user feedbackSIXPAK**

 **VERS. 2011-1 (May 2011) \*Added MF/MT=9/5 yield output startingSIXPAK**

 **from MF/MT=6/5 distributions. SIXPAK**

 **\*Increased maximum Legendre order fromSIXPAK**

 **30 to 1,000 - WARNING - using more SIXPAK**

 **than 30 results in NONSENSE = NOISE!!SIXPAK**

 **VERS. 2012-1 (Oct. 2012) \*Increased max. point count to 500,000SIXPAK**

 **\*Added CODENAME SIXPAK**

 **\*32 and 64 bit Compatible SIXPAK**

 **\*Added ERROR stop SIXPAK**

 **\*For photons, combine discrete and SIXPAK**

 **continuum into tabulated increasing SIXPAK**

 **energy order. SIXPAK**

 **\*Check energy output order increasing.SIXPAK**

 **Print WARNING if not increasing - do SIXPAK**

 **not STOP- stopping would prevent ALL SIXPAK**

 **output - the user may not be at all SIXPAK**

 **interested in the BAD data, but may SIXPAK**

 **be interested in other output data SIXPAK**

 **that is o.k. SIXPAK**

 **VERS. 2015-1 (Jan. 2015) \*Extended OUT9. SIXPAK**

 **\*Replaced ALL 3 way IF Statements. SIXPAK**

 **\*Deleted unused coding. SIXPAK**

 **VERS. 2017-1 (May 2017) \*Increased max. point to 600,000 SIXPAK**

 **\*Updated based on user feedback SIXPAK**

 **VERS. 2017-2 (Oct. 2017) \*Updated for new P(nu) formats = SIXPAK**

 **Recognized and ignored = no MF=5 SIXPAK**

 **equivalent. SIXPAK**

 **VERS. 2018-1 (Jan. 2018) \*Updated to skip Nu-Bar Data = there SIXPAK**

 **is no double-differential data to SIXPAK**

 **process. SIXPAK**

 **\*On-linr report for ALL ENDERROR SIXPAK**

 **VERS. 2019-1 (June 2019) \*Additional Interpolation Law Tests SIXPAK**

 **\*Checked Maximum Tabulated Energy to SIXPAK**

 **insure it is the same for all MTs - SIXPAK**

 **if not, print WARNING messages. SIXPAK**

 **\*WARNING MT=5 - not allowed in MF=4/5 SIXPAK**

 **see ENDF102 - but will translate hereSIXPAK**

 **to allow diagnostic use ONLY. SIXPAK**

 **\*Corrected END Histogram - guarantee SIXPAK**

 **it ends with zero cross section,e.g.,SIXPAK**

 **(E,Y) only defines upper energy of SIXPAK**

 **the last group - Y has no meaning, SIXPAK**

 **by ENDF convention it should be Y = 0SIXPAK**

 **VERS. 2020-1 (Mar. 2020) \*Added ENDFB.MF3 for MF/MT=3/5 parta SIXPAK**

 **based on MF=6/5. SIXPAK**

 **\*Added Target Isomer State SIXPAK**

 **VERS. 2021-1 (Jan. 2021) \*Updated for FORTRAN 2018 SIXPAK**

 **VERS. 2023-1 (Feb. 2023) \*Decreased page siZe from 600,000 SIXPAK**

 **to 120,000 SIXPAK**

 **SIXPAK**

 **OWNED, MAINTAINED AND DISTRIBUTED BY SIXPAK**

 **------------------------------------ SIXPAK**

 **THE NUCLEAR DATA SECTION SIXPAK**

 **INTERNATIONAL ATOMIC ENERGY AGENCY SIXPAK**

 **P.O. BOX 100 SIXPAK**

 **A-1400, VIENNA, AUSTRIA SIXPAK**

 **EUROPE SIXPAK**

 **SIXPAK**

 **ORIGINALLY WRITTEN BY SIXPAK**

 **------------------------------------ SIXPAK**

 **Dermott E. Cullen SIXPAK**

 **SIXPAK**

 **PRESENT CONTACT INFORMATION SIXPAK**

 **--------------------------- SIXPAK**

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 **SIXPAK**

 **COLLABORATION SIXPAK**

 **==================================================================SIXPAK**

 **DEVELOPED IN COLLABORATION WITH, SIXPAK**

 **SIXPAK**

 **\*THE NATIONAL NUCLEAR DATA CENTER, BROOKHAVEN NATIONAL LAB SIXPAK**

 **SIXPAK**

 **\*THE NUCLEAR DATA SECTION, IAEA, VIENNA, AUSTRIA SIXPAK**

 **SIXPAK**

 **\*CENTRO TECNICO AEROSPACIAL, SAO JOSE DOS CAMPOS, BRAZIL SIXPAK**

 **SIXPAK**

 **AS A PART OF AN INTERNATIONAL PROJECT ON THE EXCHANGE OF SIXPAK**

 **NUCLEAR DATA SIXPAK**

 **SIXPAK**

 **ACKNOWLEDGEMENT (VERSION 92-1) SIXPAK**

 **==================================================================SIXPAK**

 **THE AUTHOR THANKS SOL PEARLSTEIN (BROOKHAVEN NATIONAL LAB) FOR SIXPAK**

 **SIGNIFICANTLY CONTRIBUTING TOWARD IMPROVING THE ACCURACY AND SIXPAK**

 **COMPUTER INDEPENDENCE OF THIS CODE - THANKS, SOL SIXPAK**

 **SIXPAK**

 **ACKNOWLEDGEMENT (VERSION 92-4) SIXPAK**

 **==================================================================SIXPAK**

 **THE AUTHOR THANKS BOB MACFARLANE (LOS ALAMOS) FOR SUGGESTING HOW SIXPAK**

 **TO PROPERLY OUTPUT THE PHOTON PRODUCTION DATA TO PUT IT INTO SIXPAK**

 **EXACTLY THE FORM NEEDED FOR USE IN PROCESSING CODES. SIXPAK**

 **SIXPAK**

 **THE AUTHOR THANKS CHRIS DEAN (WINFRITH) FOR POINTING OUT ERRORS SIXPAK**

 **IN THE EARLIER TREATMENT OF THE KALBACH-MANN FORMALISM AND IN SIXPAK**

 **THE DEFINITION OF THE ISOTROPIC ANGULAR DISTRIBUTION FLAG (LI). SIXPAK**

 **SIXPAK**

 **AUTHORS MESSAGE SIXPAK**

 **==================================================================SIXPAK**

 **THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENTATION SIXPAK**

 **INCLUDING ALL RECENT IMPROVEMENTS. PLEASE READ ALL OF THESE SIXPAK**

 **COMMENTS BEFORE IMPLEMENTING AND USING THESE CODES. SIXPAK**

 **SIXPAK**

 **AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTERSIXPAK**

 **INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE SIXPAK**

 **OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECTSIXPAK**

 **IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY SIXPAK**

 **COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO SIXPAK**

 **IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF SIXPAK**

 **THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR SIXPAK**

 **COMPUTER. SIXPAK**

 **SIXPAK**

 **PURPOSE SIXPAK**

 **==================================================================SIXPAK**

 **1) CHECK ALL DOUBLE-DIFFERENTIAL DATA (MF=6) SIXPAK**

 **SIXPAK**

 **2) OUTPUT EQUIVALENT MF = 4, 5, 12, 14 AND 15 DATA. SIXPAK**

 **SIXPAK**

 **DATA CHECKING SIXPAK**

 **==================================================================SIXPAK**

 **ALL OF THE ENDF/B-VI MF=6 DATA IS CHECKED - FOR DETAILS SEE BELOW.SIXPAK**

 **SIXPAK**

 **THE MF=6 DATA IS NOT CORRECTED AND OUTPUT IN THE ENDF/B FORMAT. SIXPAK**

 **IT IS MERELY CHECKED. IF ERRORS ARE FOUND IT IS UP TO THE USER SIXPAK**

 **TO TAKE CORRECTIVE ACTION ON THE MF=6 DATA. SIXPAK**

 **SIXPAK**

 **IN CONTRAST WHEN PROBLEMS ARE FOUND IN DATA WHICH WILL BE OUTPUT SIXPAK**

 **IN THE ENDF/B FORMAT (MF=4, 5, 12, 14 AND 15), WHENEVER POSSIBLE SIXPAK**

 **CORRECTIVE ACTION WILL BE TAKEN. SIXPAK**

 **SIXPAK**

 **FURTHER CHECKS AND CORRECTIONS SIXPAK**

 **==================================================================SIXPAK**

 **ONCE THE DATA HAS BEEN OUTPUT IN MF = 4, 5, 12, 14 AND 15 FORMATS SIXPAK**

 **FURTHER CORRECTIVE ACTION CAN BE TAKEN AS FOLLOWS, SIXPAK**

 **SIXPAK**

 **PROGRAM LEGEND SIXPAK**

 **============== SIXPAK**

 **CAN BE USED TO CORRECT ANGULAR DISTRIBUTIONS WHICH ARE NEGATIVE, SIXPAK**

 **TO CONVERT FROM LEGENDRE COEFFICIENTS TO TABULATED ANGULAR SIXPAK**

 **DISTRIBUTIONS AND GENERALLY PERFORM MORE EXTENSIVE TESTS OF SIXPAK**

 **ALL MF=4 DATA. SIXPAK**

 **SIXPAK**

 **PROGRAM EVALPLOT SIXPAK**

 **================ SIXPAK**

 **VERSION 92-1 AND LATER VERSIONS CAN PLOT ALL OF THE MF=4, 5 AND 15SIXPAK**

 **DATA OUTPUT BY THIS CODE. EARLIER VERSIONS CAN PLOT MF=4 AND 5. SIXPAK**

 **GRAPHICS IS AN EXCELLENT WAY TO CHECK THIS DATA. SIXPAK**

 **SIXPAK**

 **PROGRAM PLOTTAB SIXPAK**

 **=============== SIXPAK**

 **THIS IS A GENERAL PLOTTING PROGRAM AND THERE IS AN INTERFACE IN SIXPAK**

 **THIS CODE TO PRODUCE OUTPUT FOR ANY MF=6 DATA IN THE PLOTTAB SIXPAK**

 **INPUT FORMAT. THIS PROGRAM CAN BE USED TO CHECK ALL OF THE MF=6 SIXPAK**

 **DATA AS WELL AS THE EQUIVALENT MF=4, 5, 12, 14 AND 15 DATA - AS SIXPAK**

 **WELL AS COMPARING THE ORIGINAL MF=6 AND EQUIVALENT DATA. SIXPAK**

 **SIXPAK**

 **DATA OUTPUT SIXPAK**

 **==================================================================SIXPAK**

 **THE ENDF/B MF=4, 5, 12, 14 AND 15 FORMATS ONLY ALLOW FOR NEUTRONS SIXPAK**

 **INCIDENTS SIXPAK**

 **SIXPAK**

 **THE ENDF/B MF=4 AND 5 FORMATS ONLY ALLOW FOR NEUTRONS OUTGOING. SIXPAK**

 **SIXPAK**

 **THE ENDF/B MF=12, 14 AND 15 ONLY ALLOWS FOR PHOTONS OUTGOING. SIXPAK**

 **SIXPAK**

 **THESE ARE THE ONLY COMBINATIONS OF DATA OUTPUT BY THIS CODE. SIXPAK**

 **SIXPAK**

 **ALL OTHER COMBINATIONS OF INCIDENT AND OUTGOING PARTICLES ARE SIXPAK**

 **CHECKED, BUT THE RESULTS CANNOT BE OUTPUT IN THE ENDF/B FORMAT. SIXPAK**

 **HOWEVER, USING THE PLOTTAB INTERFACE BUILT INTO THIS CODE THIS SIXPAK**

 **DATA CAN, AND HAS BEEN, OUTPUT AND CHECKED. SIXPAK**

 **SIXPAK**

 **THE NEUTRON DATA IN MF=4 CAN BE IN THE FORM OF EITHER TABULATED SIXPAK**

 **ANGULAR DISTRIBUTIONS OR LEGENDRE COEFFICIENTS. SIXPAK**

 **SIXPAK**

 **THE NEUTRON (MF=5) OR PHOTON (MF=15) SPECTRA ARE BOTH IN EXACTLY SIXPAK**

 **THE SAME FORMAT = ARBITRARY TABULATED FUNCTIONS - ENDF/B OPTION SIXPAK**

 **LF=1. SIXPAK**

 **SIXPAK**

 **ENDF/B DATA OUTPUT ORDER SIXPAK**

 **==================================================================SIXPAK**

 **ENDF/B DATA IS OUTPUT IN ASCENDING MAT, MF, MT ORDER. IN ORDER TO SIXPAK**

 **ALLOW THIS PROGRAM TO PRODUCE ALL OUTPUT IN A SINGLE PASS THROUGH SIXPAK**

 **THE MF=6 DATA, OUTPUT FOR EACH (MAT, MT) IS OUTPUT TO SEPERATE SIXPAK**

 **FILES FOR MF=4, 5, 12, 14 AND 15. SIXPAK**

 **SIXPAK**

 **FOR SUBSEQUENT USE THE ENDF/B FORMATTED DATA OUTPUT BY THIS CODE SIXPAK**

 **CAN BE MERGED TOGETHER USING PROGRAM MERGER (CONTAIN THE AUTHOR SIXPAK**

 **OF THIS CODE FOR A COPY OF MERGER), E.G., MERGE MF=12, 14 AND 15 SIXPAK**

 **DATA IN ORDER TO THEN CALCULATE PHOTON PRODUCTION DATA OR MF=4 SIXPAK**

 **AND 5 CAN BE MERGED TOGETHER TO CALCULATE NEUTRON TRANSFER - OR SIXPAK**

 **ALL OF THEM CAN BE MERGED TOGETHER TO PERFORM NEUTRON AND PHOTON SIXPAK**

 **CALCULATIONS. SIXPAK**

 **SIXPAK**

 **CORRELATED (MF=6) VS. UNCORRELATED (MF=4 AND 5) DATA SIXPAK**

 **==================================================================SIXPAK**

 **THE ENDF/B DOUBLE DIFFERENTAL = CORRELATED - DATA IN MF=6 SIXPAK**

 **REPRESENTS DATA IN THE FORM, SIXPAK**

 **SIXPAK**

 **F(E,EP,COS) = SIG(E)\*Y(E)\*G0(E,EP)\*F(E,EP,COS) SIXPAK**

 **SIXPAK**

 **SIG(E) = MF=3 CROSS SECTIONS SIXPAK**

 **Y(E) = YIELD (MULTIPLICITY) SIXPAK**

 **G0(E,EP) = ENERGY SPECTRUM SIXPAK**

 **F(E,EP,COS) = ANGULAR DISTRIBUTION SIXPAK**

 **SIXPAK**

 **IN A SITUATION WHERE YOU HAVE MONOENERGETIC AND MONODIRECTIONAL SIXPAK**

 **NEUTRONS INCIDENT YOU WILL BE ABLE TO OBSERVE CORRELATION EFFECTS SIXPAK**

 **IN THE NEUTRON SPECTRUM AND ANGULAR DISTRIBUTION. SIXPAK**

 **SIXPAK**

 **EVEN IN SITUATIONS WHERE YOU HAVE A NARROW SPECTRUM OF NEUTRONS SIXPAK**

 **THAT ARE HIGHLY DIRECTIONALLY ORIENTED YOU MAY BE ABLE TO OBSERVE SIXPAK**

 **THESE CORRELATION EFFECTS, E.G., A NARROW 14 MEV FUSION SOURCE SIXPAK**

 **INCIDENT ON THE FIRST WALL OF A CTR DEVICE. SIXPAK**

 **SIXPAK**

 **FOR SUCH SITUATIONS USE OF THE CORRELATED (MF=6) DATA IS REQUIRED SIXPAK**

 **IN CALCULATIONS. SIXPAK**

 **SIXPAK**

 **HOWEVER, IN MANY APPLICATIONS WHERE THERE IS A BROAD SPECTRUM OF SIXPAK**

 **NEUTRONS AND THE NEUTRON FLUX IS NOT HIGHLY DIRECTIONALLY SIXPAK**

 **ORIENTED, THE NEUTRON MULTIPLICATION, SPECTRUM AND ORIENTATION SIXPAK**

 **CAN BE FAIRLY ACCURATELY CALCULATED WITHOUT CONSIDERING SIXPAK**

 **CORRELATION EFFECTS. SIXPAK**

 **SIXPAK**

 **THE UNCORRELATED DATA PRODUCED BY THIS CODE REPLACES THE SIXPAK**

 **CORRELATED DATA, SIXPAK**

 **SIXPAK**

 **F(E,EP,COS) = SIG(E)\*Y(E)\*G0(E,EP)\*F(E,EP,COS) SIXPAK**

 **SIXPAK**

 **BY THE UNCORRELATED DATA, SIXPAK**

 **SIXPAK**

 **F(E,EP,COS) = SIG(E)\*Y(E)\*G0(E,EP)\*F0(E,COS) SIXPAK**

 **SIXPAK**

 **BY INTEGRATING G0(E,EP)\*F(E,EP,COS) OVER SECONDARY ENERGY (EP) SIXPAK**

 **TO DEFINE AN AVERAGE ANGULAR DISTRIBUTION, F0(E,COS). SIXPAK**

 **SIXPAK**

 **WHAT IS LOST IN THIS PROCESS IS THE CORRELATION BETWEEN EP AND COSSIXPAK**

 **SO THAT IN A TRANSPORT CALCULATION ALL MOMENTS OF THE FLUX WILL SIXPAK**

 **HAVE THE SAME SPECTRUM, G0(E,EP) AND EACH WILL BE EFFECTED BY THE SIXPAK**

 **AVERAGE ANGULAR DISTRIBUTION. SIXPAK**

 **SIXPAK**

 **FOR APPLICATIONS TO HIGH ENERGY FUSION APPLICATIONS CORRELATED SIXPAK**

 **DATA SHOULD BE USED. HOWEVER, FOR LOWER ENERGY APPLICATIONS, SIXPAK**

 **SUCH AS FISSION REACTORS, IT SHOULD BE ADEQUATE TO USE THE SIXPAK**

 **UNCORRELATED DATA - IN THIS CASE THE MOST IMPORTANT EFFECT SIXPAK**

 **WILL BE THE OVERALL NEUTRON MULTIPLICATION AND SPECTRUM. SIXPAK**

 **SIXPAK**

 **AN IMPORTANT CONSIDERATION IN DESIGNING THIS PROGRAM IS THAT SIXPAK**

 **MANY COMPUTER CODES - DATA PROCESSING AND TRANSPORT CODES - SIXPAK**

 **CANNOT USE THE CORRELATED (MF=6) DATA - NOR ARE THEY INTENDED SIXPAK**

 **FOR HIGH ENERGY USE. FOR THESE CODES THE UNCORRELATED DATA SIXPAK**

 **PRODUCED BY THIS CODE SHOULD BE ADEQUATE TO MEET THEIR NEEDS. SIXPAK**

 **SIXPAK**

 **WARNING - IT CANNOT BE STRESSED ENOUGH THAT THE OUTPUT OF THIS SIXPAK**

 **CODE SHOULD ONLY BE USED FOR LOW ENERGY APPLICATIONS - FAILURE SIXPAK**

 **TO HEED THIS WARNING CAN LEAD TO COMPLETELY UNRELIABLE RESULTS. SIXPAK**

 **SIXPAK**

 **ENDF/B FORMAT SIXPAK**

 **==================================================================SIXPAK**

 **THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS SIXPAK**

 **OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION SIXPAK**

 **OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT).SIXPAK**

 **SIXPAK**

 **IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B SIXPAK**

 **FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS SIXPAK**

 **ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE SIXPAK**

 **NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE SIXPAK**

 **CORRECTLY OUTPUT ON ALL LINES. THE FORMAT OF SECTION MF=1, MT=451 SIXPAK**

 **AND ALL SECTIONS OF MF=6 MUST BE CORRECT. THE PROGRAM SKIPS ALL SIXPAK**

 **OTHER SECTIONS OF DATA AND AS SUCH IS INSENSITIVE TO THE FORMAT SIXPAK**

 **OF ALL OTHER SECTIONS. SIXPAK**

 **SIXPAK**

 **CONTENTS OF OUTPUT SIXPAK**

 **==================================================================SIXPAK**

 **6 ENDF/B FORMATTED OUTPUT FILES ARE PRODUCED FOR NEUTRON INCIDENT SIXPAK**

 **DATA, SIXPAK**

 **SIXPAK**

 **1) ENDFB.MF4 - ANGULAR DISTRIBUTIONS AND LEGENDRE COEFFICIENTS SIXPAK**

 **FOR NEUTRONS SIXPAK**

 **2) ENDFB.MF5 - TABULATED NEUTRON ENERGY SPECTRA SIXPAK**

 **3) ENDFB.M12 - PHOTON EMISSION MULTIPLICITY SIXPAK**

 **4) ENDFB.M14 - PHOTON EMISSION ANGULAR DISTRIBUTIONS (ALWAYS SIXPAK**

 **ISOTROPIC) SIXPAK**

 **5) ENDFB.M15 - TABULATED PHOTON EMISSION SPECTRA SIXPAK**

 **6) ENDFB.MF3 - TABULATED Charged Particle Cross Section for MT=5 SIXPAK**

 **SIXPAK**

 **EMITTED PARTICLE YIELD SIXPAK**

 **==================================================================SIXPAK**

 **NEUTRONS SIXPAK**

 **======== SIXPAK**

 **IN MF=6 THE YIELD FOR EACH REACTION IS THE ACTUAL MULTIPLICITY OF SIXPAK**

 **THE REACTION, E.G., (N,2N) = 2. IN USING MF=4 AND 5 DATA THE SIXPAK**

 **ENDF/B CONVENTION IS THAT THE MULTIPLICITY IS IMPLIED BY THE SIXPAK**

 **MT NUMBER, E.G., MT=16 = (N,2N) = 2. SIXPAK**

 **SIXPAK**

 **THE ONLY EXCEPT IN ENDF/B-VI IS MT=201 = TOTAL NEUTRON PRODUCTION SIXPAK**

 **WHERE AN ACTUAL ENERGY DEPENDENT YIELD IS INCLUDED IN MF=6. SIXPAK**

 **HOWEVER, IN THIS CASE THE MF=3 CROSS SECTION INCLUDES THE SIXPAK**

 **MULTIPLICITY (S. PEARLSTEIN, PRIVATE COMMUNICATION, JAN. 1992), SIXPAK**

 **SIG(MT=201) = 2\*SIG(N,2N)+3\*SIG(N,3N).....ETC. SIXPAK**

 **SIXPAK**

 **SO THAT FOR ALL ENDF/B-VI DATA AS OF JANUARY 1992 THE MF=4 AND 5 SIXPAK**

 **DATA OUTPUT BY THIS CODE CAN BE USED IN CONJUNCTION WITH THE MF=3 SIXPAK**

 **CROSS SECTIONS - WITHOUT ANY REFERENCE TO THE MF=6 YIELD. SIXPAK**

 **SIXPAK**

 **PHOTONS SIXPAK**

 **======= SIXPAK**

 **UNLIKE THE NEUTRONS WHERE WITH ONLY ONE EXCEPTION (MT=201) THE SIXPAK**

 **MF=6 YIELD IS ENERGY INDEPENDENT, IN THE CASE OF PHOTON EMISSION SIXPAK**

 **ALMOST ALL OF THE PHOTONS HAVE AN ENERGY DEPENDENT YIELD. SIXPAK**

 **SIXPAK**

 **THIS PROGRAM WILL OUTPUT THE PHOTON MULTIPLICITY IN MF=12 AND SIXPAK**

 **INDICATE THAT THERE IS A NORMALIZED DISTRIBUTION IN MF=15 SIXPAK**

 **(LF=1 IN MF=12). SIXPAK**

 **SIXPAK**

 **THIS PROGRAM WILL OUTPUT THE NORMALIZED PHOTON SPECTRA IN MF=15. SIXPAK**

 **CONTINUOUS ENERGY SPECTRA AND DISCRETE PHOTONS WILL ALL BE OUTPUT SIXPAK**

 **AS NORMALIZED SPECTRA. SIXPAK**

 **SIXPAK**

 **THIS PROGRAM WILL ALSO OUTPUT MF=14 PHOTON ANGULAR DISTRIBUTION SIXPAK**

 **DATA, ALWAYS USING THE ISOTROPIC FLAG TO MINIMIZE OUTPUT. SIXPAK**

 **SIXPAK**

 **WARNING OF ENERGY DEPENDENT YIELD SIXPAK**

 **================================= SIXPAK**

 **THIS PROGRAM WILL PRINT A WARNING MESSAGE IF A SECTION OF DATA SIXPAK**

 **BEING OUTPUT IN THE ENDF/B FORMAT HAS AN ENERGY DEPENDENT MF=6 SIXPAK**

 **YIELD AND THE EMITTED PARTICLE IS A NEUTRON - SINCE THE ENDF/B SIXPAK**

 **CONVENTION IS THAT FOR EACH MT NUMBER THE MULTIPLICITY IS IMPLIED SIXPAK**

 **WE DO NOT EXPECT AN ENERGY DEPENDENT MULTIPLICITY FOR NEUTRON SIXPAK**

 **EMISSION. SIXPAK**

 **SIXPAK**

 **USING THE OUTPUT SIXPAK**

 **==================================================================SIXPAK**

 **NOTE, THAT IN USING THIS DATA, STARTING FROM THE RELATIONSHIP, SIXPAK**

 **SIXPAK**

 **F(E,EP,COS) = SIG(E)\*Y(E)\*G0(E,EP)\*F0(E,COS) SIXPAK**

 **SIXPAK**

 **USING THE ENDF/B CONVENTION THAT THE MULTIPLICITY IS EITHER SIXPAK**

 **IMPLIED BY THE MT NUMBER (E.G., MT=16 = N,2N - MULTIPLICITY = 2) SIXPAK**

 **OR INCLUDED IN THE CROSS SECTION (E.G., MT=201 = TOTAL NEUTRON SIXPAK**

 **PRODUCTION) ALL THE INFORMATION REQUIRED FOR A CALCULATION IS SIXPAK**

 **AVAILABLE IN, SIXPAK**

 **SIXPAK**

 **MF=3 - SIG(E) SIXPAK**

 **MF=4 - F0(E,COS) - FOR OUTGOING NEUTRONS SIXPAK**

 **MF=5 - G0(E,EP) - FOR OUTGOING NEUTRONS SIXPAK**

 **MF=12 - Y(E) - FOR OUTGOING PHOTONS SIXPAK**

 **MF=14 - F0(E,COS) - FOR OUTGOING PHOTONS (ALWAYS ISOTROPIC) SIXPAK**

 **MF=15 - G0(E,EP) - FOR OUTGOING PHOTONS SIXPAK**

 **SIXPAK**

 **DOCUMENTATION SIXPAK**

 **==================================================================SIXPAK**

 **ONLY SECTIONS OF MF=4, 5, 12, 14, 15 ARE OUTPUT ON A ENDF/B FILE. SIXPAK**

 **THE ONLY DOCUMENTATION IS THE ENDF/B TAPE LABEL (FIRST RECORD OF SIXPAK**

 **EACH FILE) WHICH IDENTIFIES THE DATA AS SIXPAK OUTPUT. SIXPAK**

 **SIXPAK**

 **REACTION INDEX SIXPAK**

 **==================================================================SIXPAK**

 **THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN SIXPAK**

 **SECTION MF=1, MT=451 OF EACH EVALUATION. SIXPAK**

 **SIXPAK**

 **SECTION SIZE SIXPAK**

 **==================================================================SIXPAK**

 **ALL OF THE DATA IN ENDF/B-VI, MF=6 ARE QUITE SMALL TABLES. AS SUCHSIXPAK**

 **THIS PROGRAM ONLY ALLOWS TABLES OF UP TO 12000 POINTS (12,000 X, SIXPAK**

 **Y VALUES). THIS SIZE IS MORE THAN ADEQUATE TO HANDLE ALL OF THE SIXPAK**

 **CURRENT ENDF/B-VI DATA, AND IT CAN BE EASILY INCREASED TO HANDLE SIXPAK**

 **ANY NEWER DATA AS IT BECOMES AVAILABLE. SIXPAK**

 **SIXPAK**

 **PLEASE CONTACT THE AUTHOR IF YOU HAVE AN EVALUATION WHICH EXCEEDS SIXPAK**

 **THIS LIMIT. SIXPAK**

 **SIXPAK**

 **SELECTION OF DATA SIXPAK**

 **==================================================================SIXPAK**

 **THE PROGRAM SELECTS DATA TO BE PROCESSED BASED ON MAT/MT RANGES SIXPAK**

 **(MF=6 ASSUMED). THIS PROGRAM ALLOWS UP TO 100 MAT/MT RANGES TO BE SIXPAK**

 **SPECIFIED BY INPUT PARAMETERS. THE PROGRAM WILL ASSUME THAT THE SIXPAK**

 **ENDF/B TAPE IS IN MAT ORDER. THE PROGRAM WILL TERMINATE EXECUTION SIXPAK**

 **WHEN A MAT IS FOUND THAT IS ABOVE ALL REQUESTED MAT RANGES. SIXPAK**

 **SIXPAK**

 **PROGRAM OPERATION SIXPAK**

 **==================================================================SIXPAK**

 **EACH SECTION (MT) OF MF=6 DATA IS SUBDIVIDED INTO SUBSECTIONS - SIXPAK**

 **ONE SUBSECTION FOR EACH EMITTED PARTICLE. SIXPAK**

 **SIXPAK**

 **EACH SUBSECTION OF DATA IS CONSIDERED SEPARATELY. EACH SUBSECTION SIXPAK**

 **OF ENDF/B MF=6 DATA TO PROCESS IS IN THE FORM, SIXPAK**

 **SIXPAK**

 **F(E,EP,COS) = SIG(E)\*Y(E)\*G0(E,EP)\*F(E,EP,COS) SIXPAK**

 **SIXPAK**

 **SIG(E) = MF=3 CROSS SECTIONS SIXPAK**

 **Y(E) = YIELD (MULTIPLICITY) SIXPAK**

 **G0(E,EP) = ENERGY SPECTRUM SIXPAK**

 **F(E,EP,COS) = ANGULAR DISTRIBUTION SIXPAK**

 **SIXPAK**

 **G0(E,EP) = 1 WHEN INTEGRATED OVER EP (SECONDARY ENERGY) SIXPAK**

 **G0(E,EP)\*F(E,EP,COS) = 1 WHEN INTEGRATED OVER EP AND COS SIXPAK**

 **SIXPAK**

 **THIS PROGRAM WILL DEFINE THE ZEROTH ORDER MOMENTS OF THE SIXPAK**

 **ENERGY AND ANGULAR DISTRIBUTIONS, SIXPAK**

 **SIXPAK**

 **G0(E,EP) = G0(E,EP)\*F(E,EP,COS) INTEGRATED OVER COS SIXPAK**

 **F0(E,COS) = G0(E,EP)\*F(E,EP,COS) INTEGRATED OVER EP SIXPAK**

 **SIXPAK**

 **FOR NEUTRON INDUCED REACTIONS THE ENDF/B FORMATTED OUTPUT WILL BE SIXPAK**

 **SIXPAK**

 **F0(E,COS)- IN ENDFB.MF4 FOR NEUTRONS OUT OF A REACTION SIXPAK**

 **G0(E,EP) - IN ENDFB.MF5 FOR NEUTRONS OUT OF A REACTION SIXPAK**

 **- IN ENDFB.M15 FOR PHOTONS OUT OF A REACTION SIXPAK**

 **SIXPAK**

 **FOR NEUTRONS INCIDENT AND NEUTRONS EMITTED THIS DATA WILL BE SIXPAK**

 **OUTPUT IN MF=4 AND 5 FORMATS. SIXPAK**

 **SIXPAK**

 **FOR NEUTRONS INCIDENT AND PHOTONS EMITTED THIS DATA WILL BE SIXPAK**

 **OUTPUT IN MF=15 FORMAT - THE SPECTRA ARE OUTPUT AND THE SIXPAK**

 **ANGULAR DISTRIBUTION IS IGNORED. SIXPAK**

 **SIXPAK**

 **ALL PHOTON EMISSION IN THE ENDF/B-VI LIBRARY AS OF JANUARY 1992 SIXPAK**

 **IS ISOTROPIC AND AS SUCH NO DISTRIBUTION OF PHOTON ANGULAR SIXPAK**

 **DISTRIBUTIONS NEED BE OUTPUT - IT IS ALWAYS ISOTROPIC. SIXPAK**

 **SIXPAK**

 **FOR ALL OTHER COMBINATIONS INCIDENT AND EMITTED PARTICLES SIXPAK**

 **THERE WILL BE NO ENDF/B FORMATTED OUTPUT. SIXPAK**

 **SIXPAK**

 **VARIATIONS FROM ENDF/B MANUAL SIXPAK**

 **==================================================================SIXPAK**

 **LAW=1, LANG=2 = KALBACH-MANN SIXPAK**

 **============================ SIXPAK**

 **FOR THE DISTRIBUTIONS, SIXPAK**

 **SIXPAK**

 **F(MU,E,EP) = G0(E,EP)\*A\*(COSH(MU\*A)+R(E,EP)\*SINH(MU\*A)) SIXPAK**

 **SIXPAK**

 **G0(E,EP) = 1 - WHEN INTEGRATED OVER EP. SIXPAK**

 **SIXPAK**

 **A\*(COSH(MU\*A)+R(E,EP)\*SINH(MU\*A)) = 2 - WHEN INTEGRATD OVER MU SIXPAK**

 **SIXPAK**

 **THIS MEANS AS DEFINED IN THE ENDF/B MANUAL THE DISTRIBUTIONS SIXPAK**

 **ARE NORMALIZED TO 2, INSTEAD OF 1. IN ORDER TO OBTAIN CORRECTLY SIXPAK**

 **NORMALIZED DISTRIBUTIONS THE DISTRIBUTION SHOULD BE DEFINED SIXPAK**

 **TO INCLUDE A FACTOR OF 1/2 MULTIPLYING THE ANGULAR PART OF SIXPAK**

 **THE DISTRIBUTION. SIXPAK**

 **SIXPAK**

 **F(MU,E,EP) = G0(E,EP)\*0.5\*A\*(COSH(MU\*A)+R(E,EP)\*SINH(MU\*A)) SIXPAK**

 **SIXPAK**

 **THIS IS THE FORM USED IN THIS CODE SIXPAK**

 **SIXPAK**

 **LAW=1, ND NOT 0 = DISCRETE SECONDARY ENERGY DISTRIBUTION SIXPAK**

 **======================================================== SIXPAK**

 **THE ENDF/B MANUAL SAYS THESE ARE FLAGGED WITH NEGATIVE ENERGIES. SIXPAK**

 **IN ENDF/B-VI ALL OF THESE HAVE POSITIVE ENERGY. THIS CODE DOES SIXPAK**

 **NOT CONSIDER THE ENDF/B-VI DATA TO BE IN ERROR. SIXPAK**

 **SIXPAK**

 **WITH THE CONVENTION ACTUALLY USED IN ENDF/B-VI ALL SECONDARY SIXPAK**

 **ENERGIES SHOULD BE NON-NEGATIVE AND IN ASCENDING ENERGY ORDER SIXPAK**

 **FOR EACH INCIDENT ENERGY. SIXPAK**

 **SIXPAK**

 **FROM THE ENDF/B MANUAL IT IS NOT OBVIOUS WHAT G0(E,EP) SHOULD BE SIXPAK**

 **FOR DISCRETE PHOTONS - PHYSICALLY THIS IS A DELTA FUNCTION. IN SIXPAK**

 **ENDF/B-VI IT IS ENTERED AS 1.0 = INTERPRETING IT AS INTEGRATED SIXPAK**

 **OVER SECONDARY ENERGY - IN WHICH CASE THE DELTA FUNCTION = 1.0. SIXPAK**

 **SIXPAK**

 **LIMITATIONS SIXPAK**

 **==================================================================SIXPAK**

 **CHECKING DATA SIXPAK**

 **==================================================================SIXPAK**

 **THIS PROGRAM CHECKS ALL ENDF/B-VI MF=6 DATA. THE FOLLOWING CHECKS SIXPAK**

 **ARE PERFORMED. SIXPAK**

 **SIXPAK**

 **PARAMETERS SIXPAK**

 **========== SIXPAK**

 **ALL PARAMETERS ARE CHECKED FOR CONSISTENCY. IF PARAMETERS ARE SIXPAK**

 **NOT CONSISTENT THE PROGRAM MAY NOT BE ABLE TO PERFORM THE SIXPAK**

 **FOLLOWING TESTS AND WILL MERELY SKIP A SECTION OF DATA. SIXPAK**

 **SIXPAK**

 **INTERPOLATION LAWS SIXPAK**

 **================== SIXPAK**

 **ALL INTEGRATIONS ARE PERFORMED USING THE INTERPOLATION LAW GIVEN SIXPAK**

 **FOR SECONDARY ENERGY AND/OR COSINE. INTEGRATIONS ARE NOT SIXPAK**

 **PERFORMED OVER INCIDENT - ONLY INTEGRATION OVER SECONDARY ENERGY SIXPAK**

 **AND/OR COSINE ARE PERFORMED AT EACH INCIDENT ENERGY. THEREFORE SIXPAK**

 **THE INTERPOLATION LAW FOR INCIDENT ENERGY IS NOT USED BY THIS SIXPAK**

 **CODE. SIXPAK**

 **SIXPAK**

 **ALL INTERPOLATION LAWS ARE CHECKED. ALL DATA ASSOCIATED WITH SIXPAK**

 **INTERPOLATION LAWS ARE CHECKED, E.G., NO NON-NEGATIVE VALUES SIXPAK**

 **REQUIRING LOG INTERPOLATION. IN ORDER TO PERFORM REQUIRED SIXPAK**

 **INTEGRALS OVER COS AND EP IT IS IMPERATIVE THAT THE INTERPOLATION SIXPAK**

 **LAWS BE COMPATIBLE WITH THE DATA. SIXPAK**

 **SIXPAK**

 **ENDF/B-VI ALLOWS NEW INTERPOLATION LAWS FOR CORRESPONDING POINT SIXPAK**

 **AND UNIT BASE TRANSFORMATION INTERPOLATION. NONE OF THESE NEW SIXPAK**

 **INTERPOLATION LAWS ARE USED IN THE ENDF/B-VI LIBRARY AS OF SIXPAK**

 **JANUARY 1992 TO INTERPOLATE IN SECONDARY ENERGY OR COSINE. SIXPAK**

 **THEREFORE THIS PROGRAM CAN PERFORM ALL OF THE REQUIRED INTEGRALS SIXPAK**

 **OVER SECONDARY ENERGY AND/OR COSINE USING ONLY THE OLDER SIXPAK**

 **INTERPOLATION CODES. THIS PROGRAM ONLY PERFORMS INTEGRALS FOR SIXPAK**

 **EACH INCIDENT ENERGY, SO THAT INTERPOLATION IN INCIDENT ENERGY SIXPAK**

 **IS NOT PERFORMED BY THIS PROGRAM. SIXPAK**

 **SIXPAK**

 **NEW INTERPOLATION SCHEMES ARE USED FOR INCIDENT ENERGY - FOR SIXPAK**

 **EXAMPLE, CORRESPONDING POINT INTERPOLATION IS SPECIFIED TO ALLOW SIXPAK**

 **INTERPOLATION IN G0(E,EP) TO SIMULATE CASES WHERE THE INPUT ENERGYSIXPAK**

 **LIMIT IS DEFINED BY E-EP = A DIAGONAL CURVE ACROSS (E,EP) SPACE. SIXPAK**

 **THIS INTERPOLATION CODE CANNOT BE SPECIFIED IN THE MF=5 OUTPUT SIXPAK**

 **OF THIS CODE - MF=5 ONLY ALLOWS THE OLDER INTERPOLATION LAWS SIXPAK**

 **INT=1 THROUGH 5. THEREFORE THIS PROGRAM WILL USE THE CLOSEST SIXPAK**

 **CORRESPONDING INTERPOLATION CODE FOR OUTPUT TO MF=5. FOR USE SIXPAK**

 **WHERE THE OUTPUT OF THIS CODE = LOW ENERGY APPLICATIONS - THIS SIXPAK**

 **SHOULD HAVE LITTLE EFFECT ON RESULTS. SIXPAK**

 **SIXPAK**

 **FOR CONSISTENCY WITH EARLIER VERSIONS OF ENDF/B IN CREATING THE SIXPAK**

 **ENDF/B OUTPUT, IF ANY INPUT INTERPOLATION LAW IS NOT IN THE SIXPAK**

 **RANGE 1-5, IT WILL FIRST BE TESTED TO SEE IF MOD(10) IT IS SIXPAK**

 **IN THIS RANGE, FINALLY IF EVEN THIS DOESN'T WORK IT IS SET SIXPAK**

 **EQUAL TO 2 (LINEARLY INTERPOLATION). THIS METHOD WILL EFFECTIVELY SIXPAK**

 **REPLACE CORRESPONDING POINT AND UNIT BASE TRANSFORMATION BY THE SIXPAK**

 **CLOSEST RELATED INTERPOLATION LAW 1 THROUGH 5 - AGAIN NOTE, AS SIXPAK**

 **OF JANUARY 1992 NONE OF THESE NEW LAWS ARE USED IN ENDF/B-VI. IF SIXPAK**

 **THIS MUST BE DONE FOR INTERPOLATION IN SECONDARY ENERGY OR COSINE SIXPAK**

 **AN ERROR MESSAGE WILL BE PRINTED - SINCE THIS WOULD EFFECT THE SIXPAK**

 **ACCURACY OF THE INTEGRALS PERFORMED BY THIS PROGRAM. IF THIS MUST SIXPAK**

 **BE DONE FOR INCIDENT ENERGY NO MESSAGE IS PRINTED - SINCE THIS SIXPAK**

 **WILL NOT EFFECT THE ACCURACY OF THE INTEGRALS PERFORMED BY THIS SIXPAK**

 **PROGRAM. SIXPAK**

 **SIXPAK**

 **SPECTRA AND ANGULAR DISTRIBUTIONS SIXPAK**

 **================================= SIXPAK**

 **ALL SPECTRA AND ANGULAR DISTRIBUTIONS ARE CHECKED TO INSURE SIXPAK**

 **THEY ARE NORMALIZED AND DO NOT INCLUDE ANY NEGATIVE VALUES. SIXPAK**

 **SIXPAK**

 **LEGENDRE COEFFICIENTS SIXPAK**

 **===================== SIXPAK**

 **THE NORMALIZATION, F0, CANNOT BE NEGATIVE. SIXPAK**

 **SIXPAK**

 **LEGENDRE COEFFICIENTS IN NORMAL FORM ARE CHECKED TO INSURE SIXPAK**

 **THEY ARE IN THE RANGE -1 TO +1 = THE LEGENDRE EXPANSION OF A SIXPAK**

 **DELTA FUNCTION AT COS=+1 OR -1 - COEFFICIENTS SHOULD NOT SIXPAK**

 **EXCEED WHAT YOU GET FROM A DELTA FUNCTION. SIXPAK**

 **SIXPAK**

 **ANGULAR DISTRIBUTIONS ARE CHECKED AT COS = -1, 0 AND +1. SIXPAK**

 **SIXPAK**

 **CREATING ENDF/B OUTPUT SIXPAK**

 **==================================================================SIXPAK**

 **THIS PROGRAM CAN CREATE EQUIVALENT MF =4, 5, 12, 14, 15 DATA FOR SIXPAK**

 **ALL OF THE DATA INCLUDED IN ENDF/B-VI AS OF JANUARY 1992, EXCEPT SIXPAK**

 **FOR 1 SECTION OF LAW=6 DATA (SEE DETAILS BELOW). SIXPAK**

 **SIXPAK**

 **THIS PROGRAM HAS NOT BEEN TESTED ON OTHER DATA LIBRARIES, E.G., SIXPAK**

 **JEF, JENDL, ETC. SIXPAK**

 **SIXPAK**

 **THE PROGRAM HAS THE FOLLOWING LIMITATION AS FAR AS CREATING SIXPAK**

 **ENDF/B FORMATTED OUTPUT. SIXPAK**

 **SIXPAK**

 **ISOTROPIC PHOTON EMISSION SIXPAK**

 **========================= SIXPAK**

 **FOR PHOTON EMISSION THE DISTRIBUTIONS ARE ASSUMED TO BE ISOTROPIC SIXPAK**

 **AND ONLY THE MULTIPLICITY IS OUTPUT IN MF=12, ISOTROPIC ANGULAR SIXPAK**

 **DISTRIBUTIONS IN MF=14 AND THE SPECTRA IN MF=15. ALL ENDF/B-VI SIXPAK**

 **MF=6 DATA AS OF JANUARY 1992 INCLUDE ONLY ISOTROPIC PHOTON SIXPAK**

 **EMISSION - SO THAT THIS IS NOT A LIMITATION ON TRANSLATING SIXPAK**

 **ENDF/B-VI DATA. SIXPAK**

 **SIXPAK**

 **EITHER TABULATED OR LEGENDRE COEFFICIENTS SIXPAK**

 **========================================= SIXPAK**

 **FOR LAW=2 THE REPRESENTATION, EITHER TABULATED OR LEGENDRE SIXPAK**

 **COEFFICIENTS, CAN BE SPECIFIED FOR EACH INCIDENT ENERGY. SIXPAK**

 **SIXPAK**

 **IN ORDER TO OBTAIN CORRECT ENDF/B OUTPUT THE REPRESENTATION SIXPAK**

 **MUST BE THE SAME FOR ALL INCIDENT ENERGIES = MF=4 DATA CAN ONLY SIXPAK**

 **BE TABULATED OR LEGENDRE OVER THE ENTIRE ENERGY RANGE. SIXPAK**

 **SIXPAK**

 **YIELD AND OUTPUT NORMALIZATION SIXPAK**

 **============================== SIXPAK**

 **THE YIELD INCLUDED WITH EACH SECTION OF DATA IS NOT USED FOR SIXPAK**

 **OUTPUT FOR NEUTRONS, BUT IS INCLUDED IN THE OUTPUT FOR PHOTONS. SIXPAK**

 **IN ALL CASES THE ANGULAR DISTRIBUTIONS AND SPECTRA OUTPUT ARE SIXPAK**

 **NORMALIZED TO UNITY. SIXPAK**

 **SIXPAK**

 **LAW=0 SIXPAK**

 **===== SIXPAK**

 **NO OUTPUT - INCIDENT NEUTRON - EMITTED PHOTON OR NEUTRON SIXPAK**

 **REACTIONS ARE NOT EXPECTED. SIXPAK**

 **SIXPAK**

 **LAW=1 SIXPAK**

 **===== SIXPAK**

 **FOR EACH INCIDENT ENERGY DISCRETE AND CONTINUOUS EMISSION SPECTRA SIXPAK**

 **CANNOT BE MIXED TOGETHER - THEY MUST BE ALL EITHER DISCRETE OR SIXPAK**

 **CONTINUOUS. IF DISCRETE EMISSION IS GIVEN ONLY 1 SECONDARY SIXPAK**

 **ENERGY (NEP=1) MAY BE GIVEN = A NORMALIZED DISTRIBUTION FOR A SIXPAK**

 **SINGLE DISCRETE EMISSION ENERGY. ALL OF THE ENDF/B-VI DATA AS SIXPAK**

 **OF JANUARY 1992 CONFORM TO THESE LIMITATIONS. SIXPAK**

 **SIXPAK**

 **SINCE THE FLAG NA, TO INDICATE ISOTROPIC DISTRIBUTIONS, IS ONLY SIXPAK**

 **GIVEN FOR EACH SECONDARY ENERGY (EP) THE PROGRAM CANNOT DECIDE SIXPAK**

 **IN ADVANCE WHETHER OR NOT THE DISTRIBUTION WILL BE ISOTROPIC SIXPAK**

 **AT ALL INCIDENT ENERGIES. THEREFORE ISOTROPIC DISTRIBUTIONS SIXPAK**

 **WILL BE OUTPUT EITHER: LANG = 1 - AS 1 LEGENDRE COEFFICIENT = 0.0 SIXPAK**

 **OR LANG = NOT 1 - AS A 2 POINT ANGULAR DISTRIBUTION AT COS = -1.0 SIXPAK**

 **AND +1.0 WITH BOTH VALUES EQUAL TO 0.5 (A NORMALIZED ISOTROPIC SIXPAK**

 **DISTRIBUTION). SIXPAK**

 **SIXPAK**

 **DISCRETE PHOTONS ARE OUTPUT IN MF=15 AS 3 POINT DISTRIBUTIONS SIXPAK**

 **WITH SECONDARY ENERGY POINTS AT EP-DEP, EP, EP+DEP, WHERE SIXPAK**

 **DEP=0.001\*EP. THE VALUES AT EP-DEP AND EP+DEP ARE 0.0, AND SIXPAK**

 **AT EP THE VALUE IS 1000.0/EP TO NORMALIZE THE DISTRIBUTION. SIXPAK**

 **SIXPAK**

 **LAW=2 SIXPAK**

 **===== SIXPAK**

 **NO LIMITATION ON REPRESENTATIONS. SIXPAK**

 **SIXPAK**

 **LAW=3 SIXPAK**

 **===== SIXPAK**

 **NO LIMITATION ON REPRESENTATIONS. SIXPAK**

 **SIXPAK**

 **LAW=4 SIXPAK**

 **===== SIXPAK**

 **NO OUTPUT - INCIDENT NEUTRON - EMITTED PHOTON OR NEUTRON SIXPAK**

 **REACTIONS ARE NOT EXPECTED. SIXPAK**

 **SIXPAK**

 **LAW=5 SIXPAK**

 **===== SIXPAK**

 **NO OUTPUT - INCIDENT NEUTRON - EMITTED PHOTON OR NEUTRON SIXPAK**

 **REACTIONS ARE NOT EXPECTED. SIXPAK**

 **SIXPAK**

 **LAW=6 SIXPAK**

 **===== SIXPAK**

 **NO OUTPUT - ENDF/B-VI ONLY INCLUDES 1 SECTION OF THIS TYPE OF DATASIXPAK**

 **FOR (N,D) 2N,P. SIXPAK**

 **SIXPAK**

 **LAW=7 SIXPAK**

 **===== SIXPAK**

 **FOR EACH INCIDENT ENERGY THE REPRESENTATION MUST BE EITHER, SIXPAK**

 **SIXPAK**

 **1) SQUARE = FOR EACH INCIDENT COSINE EXACTLY THE SAME SECONDARY SIXPAK**

 **ENERGIES. SIXPAK**

 **SIXPAK**

 **2) LINEAR = FOR EACH INCIDENT COSINE THE INTERPOLATION LAW SIXPAK**

 **BETWEEN SECONDARY ENERGIES MUST BE LINEAR. SIXPAK**

 **SIXPAK**

 **THESE 2 PRESENTATIONS ARE THE ONLY ONES PRESENTED IN ENDF/B-VI SIXPAK**

 **AS OF JANUARY 1992 - SO THIS PROGRAM CAN TRANSLATED ALL LAW=7 SIXPAK**

 **DATA FOR ENDF/B-VI. SIXPAK**

 **SIXPAK**

 **LABORATORY VS. CENTER-OF-MASS SYSTEM SIXPAK**

 **==================================================================SIXPAK**

 **IN MANY CASES PEOPLE ASSUME THAT FOR HEAVY (HIGH ATOMIC WEIGHT) SIXPAK**

 **MATERIALS THE CENTER-OF-MASS AND LAB SYSTEMS ARE ALMOST IDENTICAL,SIXPAK**

 **SINCE IN THIS CASE THE CENTER-OF-MASS ENERGY WILL BE MUCH SMALLER SIXPAK**

 **THAN THE INCIDENT ENERGY. FOR A PROCESS SUCH AS ELASTIC SCATTERINGSIXPAK**

 **WHERE FOR HEAVY MATERIALS THE SECONDARY ENERGY, EP, WILL ALWAYS SIXPAK**

 **BE A LARGE FRACTION OF THE INCIDENT ENERGY, THIS ASSUMPTION IS SIXPAK**

 **VALID. HOWEVER, FOR THE TYPICAL REACTIONS INCLUDED IN MF=6 THIS SIXPAK**

 **IS NOT ALWAYS TRUE - IN MANY OF THESE CASES THE SECONDARY ENERGY SIXPAK**

 **CAN EXTEND ALL THE WAY DOWN TO ZERO, AND IN PARTICULAR IT CAN SIXPAK**

 **BE SMALL COMPARED TO THE CENTER-OF-MASS ENERGY - WHICH MAKES THE SIXPAK**

 **TRANSFORMATION FROM CENTER-OF-MASS TO LAB IMPORTANT. THEREFORE SIXPAK**

 **GENERALLY TO TREAT MF=6 DATA WE MUST CONSIDER THIS TRANSFORMATION.SIXPAK**

 **SIXPAK**

 **THE FOLLOWING DISCUSSING ONLY APPLIES TO SPECTRA THAT MAY BE SIXPAK**

 **OUTPUT IN MF=5 = ONLY DATA FOR NEUTRONS INCIDENT AND EMITTED - SIXPAK**

 **IN PARTICULAR THE FOLLOWING DEFINITIONS ARE NOT GENERAL - THEY SIXPAK**

 **ARE ONLY VALID FOR INCIDENT AND EMITTED NEUTRONS. SIXPAK**

 **SIXPAK**

 **DOUBLE DIFFERENTIAL DATA IN MF=6 MAY BE GIVEN IN EITHER THE LAB SIXPAK**

 **OR C.M. SYSTEM. SIMILARLY ANGULAR DISTRIBUTIONS IN MF=4 MAY BE SIXPAK**

 **GIVEN IN EITHER THE LAB OR C.M. SYSTEM. IN CONTRAST ENERGY SIXPAK**

 **SPECTRA IN MF=5 CAN ONLY BE GIVEN IN THE LABORATORY SYSTEM. SIXPAK**

 **SIXPAK**

 **THE ANGULAR DISTRIBUTIONS OUTPUT BY THIS CODE IN MF=4 ARE IN THE SIXPAK**

 **SAME SYSTEM IN WHICH THEY ARE GIVEN IN MF=6 - EITHER LAB OR SIXPAK**

 **CENTER-OF-MASS SYSTEM. SIXPAK**

 **SIXPAK**

 **THE ENERGY SPECTRA OUTPUT BY THIS CODE IN MF=5 MUST BE IN THE LAB SIXPAK**

 **SYSTEM - THIS IS THE ONLY ALLOWED FORM FOR MF=5 DATA. SIXPAK**

 **SIXPAK**

 **FOR MF=6 SPECTRA GIVEN IN THE LAB SYSTEM THIS MERELY REQUIRES SIXPAK**

 **COPYING THE GIVEN SPECTRA TO MF=5 OUTPUT. SIXPAK**

 **SIXPAK**

 **FOR MF=6 SPECTRA GIVEN IN THE CENTER-OF-MASS SYSTEM ONLY FIRST SIXPAK**

 **ORDER CORRECTIONS IN THE SPECTRA AND USED AND THEY ARE THEN SIXPAK**

 **OUTPUT IN MF=5 AS IN THE LAB SYSTEM - THE FIRST ORDER CORRECTIONS SIXPAK**

 **ARE DESCRIBED BELOW. SIXPAK**

 **SIXPAK**

 **DEFINING, SIXPAK**

 **MM = CENTER OF MASS MOTION SIXPAK**

 **CM = OUTGOING (EMITTED) PARTICLE IN CENTER OF MASS SIXPAK**

 **LAB = OUTGOING (EMITTED) PARTICLE IN LAB SIXPAK**

 **THETA = CM SCATTERING ANGLE RELATIVE TO INCIDENT DIRECTION SIXPAK**

 **COS(CM) = COSINE OF THE CM SCATTERING ANGLE SIXPAK**

 **SIXPAK**

 **FOR NEUTRONS INCIDENT WITH AN ENERGY, E, AND THEREFORE A SPEED, SIXPAK**

 **SIXPAK**

 **VN(E) = 2\*SQRT(E)/MASS(IN) SIXPAK**

 **SIXPAK**

 **THE CENTER-OF-MASS SPEED IS GIVEN BY, SIXPAK**

 **SIXPAK**

 **V(MM) = VN(E)/(1 + A) SIXPAK**

 **SIXPAK**

 **AND THE CENTER OF MASS ENERGY BY, SIXPAK**

 **SIXPAK**

 **E(MM) = 1/2\*MASS(IN)\*V(MM)\*\*2 SIXPAK**

 **= 1/2\*MASS(IN)\*VN(E)\*\*2/(1 + A)\*\*2 SIXPAK**

 **= E/(1 + A)\*\*2 SIXPAK**

 **SIXPAK**

 **FOR DISTRIBUTIONS GIVEN IN MF=6 IN THE CM, THE SPEED, V(CM), SIXPAK**

 **SHOULD BE VECTORIALLY ADDED TO THAT OF OUTGOING PARTICLES TO SIXPAK**

 **DEFINE THE OUTGOING PARTICLES LAB VELOCITY, AND IN TURN IT'S SIXPAK**

 **ENERGY, SIXPAK**

 **SIXPAK**

 **V(LAB)\*COS(LAB) = V(MM) + V(CM)\*COS(CM) SIXPAK**

 **V(LAB)\*SIN(LAB) = V(CM)\*SIN(CM) SIXPAK**

 **SIXPAK**

 **V(LAB)\*\*2 = V(MM)\*\*2 + V(CM)\*\*2 + 2\*COS(CM)\*V(MM)\*V(CM) SIXPAK**

 **SIXPAK**

 **EP(LAB) = 0.5\*MASS(OUT)\*V(LAB)\*\*2 SIXPAK**

 **SIXPAK**

 **= E(MM) + EP(CM) + 2\*COS(CM)\*SQRT(E(MM)\*EP(CM)) SIXPAK**

 **SIXPAK**

 **WE CAN ALSO DEFINE THE REVERSE TRANSFORMATION USING, SIXPAK**

 **SIXPAK**

 **V(CM)\*COS(CM) = V(LAB)\*COS(LAB) - V(MM) SIXPAK**

 **V(CM)\*SIN(CM) = V(LAB)\*SIN(LAB) SIXPAK**

 **SIXPAK**

 **V(CM)\*\*2 = V(MM)\*\*2 + V(LAB)\*\*2 - 2\*COS(LAB)\*V(MM)\*V(LAB) SIXPAK**

 **SIXPAK**

 **EP(CM) = 0.5\*MASS(OUT)\*V(CM)\*\*2 SIXPAK**

 **SIXPAK**

 **= E(MM) + EP(LAB) - 2\*COS(LAB)\*SQRT(E(MM)\*EP(LAB)) SIXPAK**

 **SIXPAK**

 **WE CAN DEFINE COS(LAB) FROM THE RELATIONSHIP, SIXPAK**

 **SIXPAK**

 **V(LAB)\*COS(LAB) = V(MM) + V(CM)\*COS(CM) SIXPAK**

 **SIXPAK**

 **COS(LAB) =[V(MM) + V(CM)\*COS(CM)]/V(LAB) SIXPAK**

 **SIXPAK**

 **[V(MM) + V(CM)\*COS(CM)] SIXPAK**

 **COS(LAB) =--------------------------------------------- SIXPAK**

 **SQRT[V(MM)\*\*2+V(CM)\*\*2+2\*COS(CM)\*V(MM)\*V(CM)] SIXPAK**

 **SIXPAK**

 **OR COS(CM) FROM THE RELATIONSHIP, SIXPAK**

 **SIXPAK**

 **V(CM)\*COS(CM) = V(LAB)\*COS(LAB) - V(MM) SIXPAK**

 **SIXPAK**

 **COS(CM) =[V(LAB)\*COS(LAB) - V(MM)]/V(CM) SIXPAK**

 **SIXPAK**

 **[V(LAB)\*COS(LAB) - V(MM)] SIXPAK**

 **COS(CM) =------------------------------------------------ SIXPAK**

 **SQRT[V(LAB)\*\*2+V(CM)\*\*2-2\*COS(LAB)\*V(LAB)\*V(MM)] SIXPAK**

 **SIXPAK**

 **THE JACOBIAN CAN BE DEFINED FROM, SIXPAK**

 **SIXPAK**

 **V(LAB)\*COS(LAB) = V(MM) + V(CM)\*COS(CM) SIXPAK**

 **SIXPAK**

 **J = D[COS(CM)]/D[COS(LAB)] = V(LAB)/V(CM) SIXPAK**

 **= SQRT[EP(LAB)/EP(CM)] SIXPAK**

 **SIXPAK**

 **WITH THESE DEFINITIONS OF EP(LAB) AND COS(LAB) IN TERMS OF E(MM), SIXPAK**

 **EP(CM) AND COS(CM) IT IS POSSIBLE TO PERFORM A POINT-BY-POINT SIXPAK**

 **TRANSFORMATION OF DISTRIBUTIONS FROM THE CM TO LAB SYSTEM USING SIXPAK**

 **THESE DEFINITIONS - OR IF WE WISHED WE COULD PERFORM THE REVERSE SIXPAK**

 **TRANSFORMATION USING THE ABOVE RELATIONSHIPS AND THE IDENTITY, SIXPAK**

 **SIXPAK**

 **F(E,EP(LAB),COS(LAB))\*D(COS(LAB))=F(E,EP(CM),COS(CM))\*D(COS(CM)) SIXPAK**

 **SIXPAK**

 **THIS IS NOT WHAT WILL BE DONE HERE, SINCE WE WILL ONLY BE SIXPAK**

 **INTERESTED IN THE ZEROTH ORDER MOMENTS OF THESE DISTRIBUTIONS, SIXPAK**

 **BUT WE WILL BE INTERESTED IN DEFINING THOSE MOMENTS IN THE SIXPAK**

 **LAB SYSTEM IN TERMS OF MF=6 SPECTRA GIVEN IN THE CM SYSTEM USING, SIXPAK**

 **SIXPAK**

 **F(E,EP(LAB),COS(LAB)) = F(E,EP(CM),COS(CM))\*J SIXPAK**

 **SIXPAK**

 **THE LIMITS OF EP(LAB) ARE DEFINED BY SETTING COS(CM) = +1 OR -1, SIXPAK**

 **SIXPAK**

 **EP(LAB) = (SQRT(EP(CM)) + SQRT(E(MM)))\*\*2 FOR COS(CM) = +1 SIXPAK**

 **= (SQRT(EP(CM)) - SQRT(E(MM)))\*\*2 FOR COS(CM) = -1 SIXPAK**

 **SIXPAK**

 **IN THIS FORM WE CAN SEE THAT AS LONG AS THE SECONDARY ENERGY IN SIXPAK**

 **THE CENTER-OF-MASS SYSTEM, EP(CM), IS MUCH LARGER THAN THE SIXPAK**

 **ENERGY OF THE CENTER-OF-MASS, E(MM), THE CENTER-OF-MASS AND LAB SIXPAK**

 **ENERGIES WILL BE ALMOST EQUAL - SIMILARLY FOR THE COSINE, IN SIXPAK**

 **THIS CASE COS(LAB) AND COS(CM) WILL BE ALMOST EQUAL - HOWEVER, SIXPAK**

 **FOR THE MF=6 DATA WE CANNOT ASSUME THAT THIS IS TRUE. SIXPAK**

 **SIXPAK**

 **TO FIRST ORDER THE ANGULAR DEPENDENCE CAN BE IGNORED, SIXPAK**

 **SIXPAK**

 **EP(LAB) = E(MM) + EP(CM) SIXPAK**

 **SIXPAK**

 **ALL THIS SAYS IS THAT TO FIRST ORDER THE EFFECT OF TRANSFORMING SIXPAK**

 **FROM THE CM TO LAB SYSTEM IS TO INCREASE THE ENERGY OF THE SIXPAK**

 **EMITTED PARTICLE IN THE CENTER-OF-MASS SYSTEM BY THE ENERGY OF SIXPAK**

 **THE CENTER-OF-MASS TO DEFINE THE LAB ENERGY. SIXPAK**

 **SIXPAK**

 **NOT ONLY THE ENERGY, BUT ALSO THE SPECTRA MUST BE TRANSFORMED. SIXPAK**

 **STARTING FROM THE DOUBLE DIFFERENTIAL DATA IN THE LAB SYSTEM, SIXPAK**

 **F(E,EP,COS(LAB)), WE CAN DEFINE THE LAB SCALAR SPECTRUM AS, SIXPAK**

 **SIXPAK**

 **G0(E,EP) = INTEGRAL F(E,EP,COS(LAB))\*D(COS(LAB)) SIXPAK**

 **SIXPAK**

 **THIS IS THE NORMAL CALCULATION DEFINED ABOVE AND USED FOR DATA SIXPAK**

 **GIVEN IN THE LAB SYSTEM. SIXPAK**

 **SIXPAK**

 **STARTING FROM DATA IN THE CENTER OF MASS SYSTEM F(E,EP,COS(CM)), SIXPAK**

 **WE CAN USE THE RELATIONSHIP, SIXPAK**

 **SIXPAK**

 **F(E,EP,COS(LAB))\*D(COS(LAB)) = F(E,EP,COS(CM))\*J\*D(COS(LAB)) SIXPAK**

 **SIXPAK**

 **J = SQRT(EP(LAB)/EP(CM)) - THE JACOBIAN SIXPAK**

 **SIXPAK**

 **= E(MM)/EP(CM) + 1 + 2\*COS(CM)\*SQRT(E(MM)/EP(CM)) SIXPAK**

 **SIXPAK**

 **AS IN THE CASE OF THE ENERGY, IN THIS FORM WE CAN SEE THAT AS SIXPAK**

 **LONG AS THE SECONDARY ENERGY IN THE CENTER-OF-MASS SYSTEM, SIXPAK**

 **EP(CM), IS LARGE COMPARED TO THE CENTER-OF-MASS ENERGY, E(MM), SIXPAK**

 **THE JACOBIAN IS ESSENTIALLY UNITY AND THE CENTER-OF-MASS AND LAB SIXPAK**

 **SPECTRA WILL BE VERY SIMILAR - AGAIN, GENERALLY WE CANNOT SIXPAK**

 **ASSUME THAT THIS IS TRUE FOR THE MF=6 SPECTRA. SIXPAK**

 **SIXPAK**

 **THEREFORE WE CAN ALSO DEFINE THE LAB SCALAR SPECTRUM IN TERMS OF SIXPAK**

 **THE CM SPECTRUM IN THE FORM, SIXPAK**

 **SIXPAK**

 **G0(E,EP) = INTEGRAL F(E,EP,COS(CM))\*J\*D(COS(LAB)) SIXPAK**

 **SIXPAK**

 **CONSISTENT WITH THE ABOVE ASSUMPTION THAT THE ANGULAR DEPENDENCE SIXPAK**

 **OF EP(LAB) CAN BE IGNORED THE JACOBIAN WILL NOT BE USED IN SIXPAK**

 **PERFORMING THESE INTEGRALS - IN WHICH CASE THE INTEGRAL REDUCES SIXPAK**

 **TO EXACTLY THE SAME FORM AS IF THE DATA WERE IN THE LAB SYSTEM. SIXPAK**

 **SIXPAK**

 **IT SHOULD BE NOTED THAT SINCE IN THIS CASE THE MF=4 ANGULAR SIXPAK**

 **DISTRIBUTIONS ARE GIVEN IN THE CM SYSTEM AND WHEN USED IN ANY SIXPAK**

 **APPLICATION THEY WILL BE TRANSFORMED TO THE LAB SYSTEM - WHEN SIXPAK**

 **THIS IS DONE THE JACOBIAN WILL BE APPLIED. SIXPAK**

 **SIXPAK**

 **IN THIS CODE WHERE WE ARE MOSTLY CONCERNED WITH CONSERVING THE SIXPAK**

 **NUMBER OF EMITTED PARTICLES AND AVERAGE ENERGIES THE NEUTRON SIXPAK**

 **SPECTRA OUTPUT IN MF=5 WILL NOT BE COMPLETELY CONVERTED TO THE SIXPAK**

 **LAB SYSTEM - ONLY FIRST ORDER CORRECTIONS WILL BE INCLUDED BY SIXPAK**

 **INCREASING THE EMITTED PARTICLE ENERGY BY THE CENTER OF MASS SIXPAK**

 **ENERGY, I.E., FOR A CENTER OF MASS SPECTRUM TABULATED AT CENTER SIXPAK**

 **OF MASS ENERGIES EP(CM) THESE WILL ALL BE UNIFORMLY INCREASED SIXPAK**

 **BY E(MM) TO ACCOUNT FOR THE CENTER OF MASS MOTION - THE SPECTRA SIXPAK**

 **WILL NOT BE MODIFIED BY THE JACOBIAN FACTOR SQRT(EP(LAB)/EP(CM)) SIXPAK**

 **SINCE THIS WOULD REQUIRE A DETAILED TRANSFORMATION IN ENERGY AND SIXPAK**

 **COS(THETA) SPACE - WHICH IS JUDGED NOT TO BE WORTH PERFORMING SIXPAK**

 **WITHIN THE LIMITS OF WHERE THE OUTPUT FROM THIS CODE IS INTENDED SIXPAK**

 **TO BE USED. SIXPAK**

 **SIXPAK**

 **SINCE THE ANGULAR DISTRIBUTION IS ALWAYS OUTPUT IN THE SAME SIXPAK**

 **SYSTEM AS WHICH IT IS GIVEN IN MF=6, NO TRANSFORMATION IS SIXPAK**

 **REQUIRED FOR THE MF=4 OUTPUT. SIXPAK**

 **SIXPAK**

 **WHEN USED IN LOW ENERGY APPLICATIONS (E.G., FISSION REACTORS) THE SIXPAK**

 **HIGH ENERGY SPECTRA PRESENTED IN MF=6 WILL BE MOSTLY IMPORTANT SIXPAK**

 **SIMPLY IN CONSERVING PARTICLES, (E.G., AS IN (N,2N)) AND ENERGY SIXPAK**

 **AND THE DETAILS OF THE CORRELATION AND GROSS ENERGY SPECTRA WILL SIXPAK**

 **NOTE PLAY THAT IMPORTANT A ROLE. IN THIS CASE THE SPECTRA OUTPUT SIXPAK**

 **BY THIS PROGRAM IN MF=5 SHOULD BE ADEQUATE. SIXPAK**

 **SIXPAK**

 **PLOTTAB FORMATTED OUTPUT SIXPAK**

 **==================================================================SIXPAK**

 **THIS PROGRAM CONTAINS ROUTINES TO PRODUCE OUTPUT THAT CAN BE USED SIXPAK**

 **AS INPUT TO THE PLOTTAB CODE TO OBTAIN GRAPHIC RESULTS. SIXPAK**

 **SIXPAK**

 **THESE ROUTINES ARE DESIGNED ONLY FOR USE BY THE AUTHOR TO CHECK SIXPAK**

 **THIS CODE. USERS ARE ASKED NOT TO ACTIVATE OR TRY TO USE THESE SIXPAK**

 **ROUTINES. UNLESS YOU COMPLETELY UNDERSTAND THIS CODE THE RESULTS SIXPAK**

 **CAN BE UNRELIABLE IF YOU ACTIVATE THESE ROUTINES. SIXPAK**

 **SIXPAK**

 **INPUT FILES SIXPAK**

 **==================================================================SIXPAK**

 **UNIT DESCRIPTION SIXPAK**

 **---- ----------- SIXPAK**

 **2 INPUT LINES (BCD - 80 CHARACTERS/RECORD) SIXPAK**

 **10 ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD) SIXPAK**

 **SIXPAK**

 **OUTPUT FILES SIXPAK**

 **==================================================================SIXPAK**

 **UNIT DESCRIPTION SIXPAK**

 **---- ----------- SIXPAK**

 **3 OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD) SIXPAK**

 **11 ENDF/B DATA MF=4 (BCD - 80 CHARACTERS/RECORD) SIXPAK**

 **12 ENDF/B DATA MF=5 (BCD - 80 CHARACTERS/RECORD) SIXPAK**

 **14 ENDF/B DATA MF=15 (BCD - 80 CHARACTERS/RECORD) SIXPAK**

 **17 ENDF/B DATA MF=12 (BCD - 80 CHARACTERS/RECORD) SIXPAK**

 **18 ENDF/B DATA MF=14 (BCD - 80 CHARACTERS/RECORD) SIXPAK**

 **15 PLOTTAB INPUT PARAMETERS (BCD - 80 CHARACTERS/RECORD) SIXPAK**

 **16 PLOTTAB FORMATTED OUTPUT (BCD - 80 CHARACTERS/RECORD) SIXPAK**

 **SIXPAK**

 **SCRATCH FILES SIXPAK**

 **==================================================================SIXPAK**

 **NONE SIXPAK**

 **SIXPAK**

 **OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILIO1 AND FILIO2) SIXPAK**

 **==================================================================SIXPAK**

 **UNIT FILE NAME SIXPAK**

 **---- ---------- SIXPAK**

 **2 SIXPAK.INP SIXPAK**

 **3 SIXPAK.LST SIXPAK**

 **10 ENDFB.IN SIXPAK**

 **11 ENDFB.MF4 SIXPAK**

 **12 ENDFB.MF5 SIXPAK**

 **14 ENDFB.M15 SIXPAK**

 **17 ENDFB.M12 SIXPAK**

 **18 ENDFB.M14 SIXPAK**

 **19 ENDFB.MT9 SIXPAK**

 **20 ENDFB.MT3 SIXPAK**

 **15 PLOTTAB.INP SIXPAK**

 **16 PLOTTAB.CUR SIXPAK**

 **SIXPAK**

 **SIXPAK**

 **INPUT PARAMETERS SIXPAK**

 **==================================================================SIXPAK**

 **LINE COLS. DESCRIPTION SIXPAK**

 **---- ----- ----------- SIXPAK**

 **1 1-72 ENDF/B INPUT DATA FILENAME SIXPAK**

 **(STANDARD OPTION = ENDFB.IN) SIXPAK**

 **2-N 1-6 MINIMUM MAT FOR REQUESTED RANGE SIXPAK**

 **9-11 MINIMUM MT FOR REQUESTED RANGE SIXPAK**

 **12-17 MAXIMUM MAT FOR REQUESTED RANGE SIXPAK**

 **20-22 MAXIMUM MT FOR REQUESTED RANGE SIXPAK**

 **SIXPAK**

 **LEAVE THE DEFINITION OF THE FILENAME BLANK - THE PROGRAM WILL SIXPAK**

 **THEN USE THE STANDARD FILENAME (ENDFB.IN). SIXPAK**

 **SIXPAK**

 **UP TO 100 MAT/MT RANGES MAY BE SPECIFIED. THE LIST OF RANGES IS SIXPAK**

 **TERMINATED BY A BLANK LINE. IF THE FIRST INPUT LINE IS COMPLETELY SIXPAK**

 **BLANK ALL DATA WILL BE PROCESSED. SIXPAK**

 **SIXPAK**

 **EXAMPLE INPUT NO. 1 SIXPAK**

 **------------------- SIXPAK**

 **PROCESS ALL MF=6 DATA ON AN ENDF/B TAPE. USE THE STANDARD INPUT SIXPAK**

 **DATA FILENAME ENDFB.IN IN THIS CASE THE USER CAN EITHER EXPLICITLYSIXPAK**

 **SPECIFY THE FILENAME AND MAT/MT RANGE BY THE FOLLOWING 2 INPUT SIXPAK**

 **LINES, SIXPAK**

 **SIXPAK**

 **ENDFB.IN SIXPAK**

 **1 1 9999 999 SIXPAK**

 **(BLANK LINE, TERMINATES REQUEST LIST) SIXPAK**

 **SIXPAK**

 **OR BY INPUTTING 2 BLANK LINE = PROCESS EVERYTHING. SIXPAK**

 **SIXPAK**

 **EXAMPLE INPUT NO. 2 SIXPAK**

 **------------------- SIXPAK**

 **PROCESS BE-9, MAT=425, MT=16. READ THE DATA FROM ENDFB6\BE9. SIXPAK**

 **IN THIS CASE THE FOLLOWING 3 INPUT LINES ARE REQUIRED, SIXPAK**

 **SIXPAK**

 **ENDFBB6\BE9 SIXPAK**

 **425 16 425 16 SIXPAK**

 **(BLANK LINE, TERMINATES REQUEST LIST) SIXPAK**

 **SIXPAK**

 **EXAMPLE INPUT NO. 3 SIXPAK**

 **------------------- SIXPAK**

 **PROCESS ALL MT=16 (N,2N) DATA. THIS CAN BE DONE BY SPECIFYING THE SIXPAK**

 **MAXIMUM MAT RANGE = 1 TO 9999, AND MT=16 FOR THE MINIMUM AND SIXPAK**

 **MAXIMUM MT RANGE. READ THE DATA FROM ENDFB6\K300. IN THIS CASE SIXPAK**

 **CASE THE FOLLOWING 3 INPUT LINES ARE REQUIRED, SIXPAK**

 **SIXPAK**

 **ENDFB6\K300 SIXPAK**

 **1 16 9999 16 SIXPAK**

 **(BLANK LINE, TERMINATES REQUEST LIST) SIXPAK**

 **SIXPAK**

 **=======================================================================SIXPAK**