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=====SIXPAK
PROGRAM SIXPAK
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VERSION 92-1 (JANUARY 1992)
VERSION 92-2 (FEBRUARY 1992)*INCREASED CORE ALLOCATION TO
    ACCOMMODATE JEF AND EFF EVALUATIONS.
VERSION 92-3 (APRIL 1992) *ADDED ADDITIONAL DATA TESTS.
VERSION 92-4 (SEPT. 1992) *CORRECTED KALBACH-MANN CALCULATIONS.
    *FOR PHOTON PRODUCTION OUTPUT MF=12
    (MULTIPLICITY), MF=14 (ISOTROPIC
    ANGULAR DISTRIBUTIONS) AND MF=15
    (SPECTRA) - PREVIOUSLY ONLY MF=15.
    *FIRST ORDER CORRECTIONS TRANSFORMING
    CENTER-OF-MASS SPECTRA TO LAB SYSTEM
    FOR OUTPUT IN MF=5
    *CORRECTED ISOTROPIC ANGULAR
    DISTRIBUTION FLAG (LI)
VERSION 94-1 (JANUARY 1994) *VARIABLE ENDF/B INPUT DATA FILENAME
    TO ALLOW ACCESS TO FILE STRUCTURES
    (WARNING - INPUT PARAMETER FORMAT
    HAS BEEN CHANGED)
    *CLOSE ALL FILES BEFORE TERMINATING
    (SEE, SUBROUTINE ENDIT)
    *INCREASED MAXIMUM TABLE SIZE FROM
    2000 TO 6000.
VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE
    *IMPROVED COMPUTER INDEPENDENCE
    *ALL DOUBLE PRECISION
    *ON SCREEN OUTPUT
    *UNIFORM TREATMENT OF ENDF/B I/O
    *IMPROVED OUTPUT PRECISION
VERSION 99-1 (MARCH 1999) *CORRECTED CHARACTER TO FLOATING
    POINT READ FOR MORE DIGITS
    *UPDATED TEST FOR ENDF/B FORMAT
    VERSION BASED ON RECENT FORMAT CHANGES
    *GENERAL IMPROVEMENTS BASED ON
    USER FEEDBACK
VERSION 99-2 (JUNE 1999) *ASSUME ENDF/B-VI, NOT V, IF MISSING
    MF=1, MT-451.
VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON
    USER FEEDBACK
VERS. 2002-1 (JANUARY 2002) *CORRECTED ANGULAR DISTRIBUTION (MF=4)
    OUTPUT TO INSURE USED FIELDS ARE 0
    (MAY 2002) *OPTIONAL INPUT PARAMETERS
    (NOV. 2002) *EXTENDED TO ALLOW CHARGED PARTICLE
    ANGULAR DISTRIBUTION IN MF=4 -
    WARNING - STRICTLY SPEAKING THIS IS
    NOT LEGAL, SINCE MF=4 IS SUPPOSED TO
    BE USED ONLY FOR NEUTRON ANGULAR
    DISTRIBUTIONS - BUT WHERE MT MAKES
    IT OBVIOUS THAT THE OUTGOING PARTICLES
    IS NOT A NEUTRON HOPEFULLY IT WILL
    NOT CAUSE A PROBLEM IF MF=4 IS USED
    FOR CHARGED PARTICLES.
VERS. 2004-1 (MARCH 2004) *ADDED INCLUDE FOR COMMON
    *INCREASED MAXIMUM TABLE SIZE FROM
    6,000 TO 12,000.
    *ADDED DUMMY A FOR ELEMENTS
    *CORRECTED OUTPUT INTERPOLATION LAWS
VERS. 2007-1 (JAN. 2007) *CHECKED AGAINST ALL ENDF/B-VII.
    *INCREASED MAXIMUM TABLE SIZE FROM
    12,000 TO 120,000.
VERS. 2007-2 (DEC. 2007) *72 CHARACTER FILE NAMES.
VERS. 2010-1 (Apr. 2010) *General update based on user feedback
VERS. 2011-1 (May 2011) *Added MF/MT=9/5 yield output starting
    from MF/MT=6/5 distributions.
    *Increased maximum Legendre order from
    30 to 1,000 - WARNING - using more
    than 30 results in NONSENSE = NOISE!!
VERS. 2012-1 (Oct. 2012) *Increased max. point count to 500,000
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	*Added CODENAME	SIXPAK
	*32 and 64 bit Compatible	SIXPAK
	*Added ERROR stop	SIXPAK
	*For photons, combine discrete and continuum into tabulated increasing energy order.	SIXPAK
	*Check energy output order increasing. Print WARNING if not increasing - do not STOP- stopping would prevent ALL output - the user may not be at all interested in the BAD data, but may be interested in other output data 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 = Recognized and ignored = no MF=5 equivalent.	SIXPAK
VERS. 2018-1 (Jan. 2018)	*Updated to skip Nu-Bar Data = there is no double-differential data to process.	SIXPAK
	*On-linr report for ALL ENDERROR	SIXPAK
VERS. 2019-1 (June 2019)	*Additional Interpolation Law Tests	SIXPAK
	*Checked Maximum Tabulated Energy to insure it is the same for all MTs - if not, print WARNING messages.	SIXPAK
	*WARNING MT=5 - not allowed in MF=4/5 see ENDF102 - but will translate here to allow diagnostic use ONLY.	SIXPAK
	*Corrected END Histogram - guarantee it ends with zero cross section, e.g., (E,Y) only defines upper energy of the last group - Y has no meaning, by ENDF convention it should be Y = 0	SIXPAK
VERS. 2020-1 (Mar. 2020)	*Added ENDFB.MF3 for MF/MT=3/5 parta based on MF=6/5.	SIXPAK
	*Added Target Isomer State	SIXPAK
VERS. 2021-1 (Jan. 2021)	*Updated for FORTRAN 2018	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
	ORIGINALLY WRITTEN BY	SIXPAK
	-----	SIXPAK
	Dermott E. Cullen	SIXPAK
	PRESENT CONTACT INFORMATION	SIXPAK
	-----	SIXPAK
	Dermott E. Cullen	SIXPAK
	1466 Hudson Way	SIXPAK
	Livermore, CA 94550	SIXPAK
	U.S.A.	SIXPAK
	Telephone 925-443-1911	SIXPAK
	E. Mail RedCullen1@Comcast.net	SIXPAK
	Website RedCullen1.net/HOMEPAGE.NEW	SIXPAK
	COLLABORATION	SIXPAK
	=====	SIXPAK
	DEVELOPED IN COLLABORATION WITH,	SIXPAK
	*THE NATIONAL NUCLEAR DATA CENTER, BROOKHAVEN NATIONAL LAB	SIXPAK
	*THE NUCLEAR DATA SECTION, IAEA, VIENNA, AUSTRIA	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 COMPUTERS	SIXPAK
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE	SIXPAK
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECTS	SIXPAK
IT WOULD BE APPRECIATED 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 15	SIXPAK
DATA OUTPUT BY THIS CODE. EARLIER VERSIONS CAN PLOT MF=4 AND 5.	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

$$F(E, EP, COS) = SIG(E) * Y(E) * G_0(E, EP) * F(E, EP, COS)$$
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

$$G_0(E, EP) = G_0(E, EP) * F(E, EP, COS) \text{ INTEGRATED OVER COS}$$
SIXPAK

$$F_0(E, COS) = G_0(E, EP) * F(E, EP, COS) \text{ INTEGRATED OVER EP}$$
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

