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AEC RESEARCH AND DEVELOPMENT REPORT

Y-1615
Mathematics and
Computers

MASTER

A USERS MANUAL FOR HANDY
(A FORTRAN IV Program for Calculating Numerical
Coefficients of the General Second-Degree
Equation in Three Variables)

G. R. Handley
J. N. McLeod

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE Y-12 PLANT

operated for the ATOMIC ENERGY COMMISSION under U. S. GOVERNMENT Contract W-7405 eng 26

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OAK RIDGE Y-12 PLANT
P. O. Box Y
OAK RIDGE, TENNESSEE 37830

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ABSTRACT

HANDY is a FORTRAN IV program which calculates the coefficients of the ten terms of the second-degree or quadric equation in three variables. This users manual describes in detail the format of the input data required; and, as an aid to understanding the data, the input and output of a sample problem are supplied with comments.

CONTENTS

SUMMARY	5
INTRODUCTION	6
INPUT DATA FORMAT FOR HANDY	7
Data Description	7
SAMPLE PROBLEM	10
Input	10
Output	10
Operation Notes	16
REFERENCES	17
ACKNOWLEDGEMENTS	18

SUMMARY

HANDY, a FORTRAN IV program, calculates the ten numerical coefficients of any quadric or second-degree equation in three variables. It was written in order to simplify the geometry description input data for the KENO and O5R Monte Carlo transport theory codes. This users manual describes in detail the format of the input data required. As an aid to understanding, the input and output of a sample problem (including punched cards in the KENO and O5R format) have been included with comments.

INTRODUCTION

HANDY, written in FORTRAN IV language, simplifies the input data preparation for the generalized geometry input to KENO,⁽¹⁾ a Monte Carlo transport theory code. It may also be used for the same purpose in preparing the input for the O5R Monte Carlo code.⁽²⁾ These codes may require many second-degree equations to describe complicated configurations of fissile material and reflectors, and finite arrays of such configurations.

From a simple input, the numerical coefficients of the ten terms of the general second-degree equation in a reference X-Y-Z coordinate system are calculated by HANDY, punched on cards in the correct input format for KENO and O5R, and printed out together with the input data.

INPUT DATA FORMAT FOR HANDY

DATA DESCRIPTION

This section is intended to be used as a guide in preparing problems for HANDY. Three data cards are required for each equation to be generated. Figure 1 gives a sample data sheet which illustrates the format of the input.

The input data sheet should be completed as indicated in the outline that follows:

Card One

Block One Format (I3) - This block contains the number of the equation to be calculated. The block is duplicated on Cards 2 and 3 but may be left blank on the later cards.

Block Two Format (A1) - This block, also duplicated on Cards 2 and 3, already contains the letter A. The A, B, and C on the cards are only to help the user keep his cards in order.

Block Three Format (A4) - This block, labeled SHAPE, must be coded according to the geometrical shape required, for example: SPHE for sphere or ellipsoid, CONE for cone, CYLI for cylinder, PLAN for plane, TPLA for two parallel planes, IPLA for two intersecting planes, HYP1 for hyperboloid of one sheet, and HYP2 for hyperboloid of two sheets.

Block Four Format (A4) - The dimensioned data may be either all in inches or all in centimeters; accordingly, this block must contain INCH or CENT.

Blocks Five, Six, Seven Format (3F 15.6) - These blocks contain the values of the displacements (X_o , Y_o , Z_o) of the origin of the surface from the reference origin.

Card Two

Blocks One and Two - See Card 1.

Blocks Three, Four, and Five Format (3F 15.6) - These blocks contain the constants (a, b, c) of the equation of the surface in its nonrotated and nontranslated form. If any of the constants are not needed, the block should be left blank.

Blocks Six and Seven Format (2F 8.6) - These blocks contain the first two of the nine direction cosines ($\cos_{11}$, $\cos_{12}$, $\cos_{13}$, $\cos_{21}$, $\cos_{22}$, $\cos_{23}$, $\cos_{31}$, $\cos_{32}$, $\cos_{33}$) of the $X'-Y'-Z'$ coordinate system of the nonrotated and nontranslated form of the surface equation with respect to the $X-Y-Z$ reference coordinate system.

CODED BY _____
DATE _____ REQUEST NO. _____

FORTRAN

PROBLEM _____
PROGRAM _____
PAGE _____ OF _____

[illegible]

Figure 1. SAMPLE INPUT DATA SHEET.

Card Three

Blocks One and Two - See Card 1.

Blocks Three through Nine Format (7F 8.6) - These blocks contain the remainder of the direction cosines. (See Block Seven, Card Two.)

The constants, a , b , and c are found from the equations of the surfaces in their non-translated and nonrotated forms which are given in Figure 2.

Figure 2. FORMS OF THE NONROTATED AND NONTRANSLATED SURFACES ASSUMED.

SAMPLE PROBLEM

INPUT

The surface shown in Figure 3 may be described for KENO as a combination of second-order equations; ie, a sphere, cylinder, and cone. To obtain these three equations in the reference X-Y-Z system, the input given in Figure 4 is required. The output of this problem is reproduced in the section that follows.

Figure 3. SAMPLE GEOMETRY TO BE DESCRIBED BY THE EQUATIONS OF THREE SURFACES. (Y and Y' Axes are Into the Paper; All Dimensions are in Inches)

OUTPUT

Figures 5 and 6 present the HANDY output for the sample problem described in the previous section. Two types of output are produced. The printed output of the equation also contains a list of the input data in centimeters and in inches. The punched-card output is in an E field with the "E" having been removed. It must be noted that the output equations are in centimeters only.

PROBLEM Sample Problem
PROGRAM _____
PAGE 1 OF 1

STATEMENT		PAGE		OF			
TYPE	NUMBER	CONT		FORTAN STATEMENT			
Eq	No A	Shape	Cent or Inch	Xo	Yo	Zo	
Eq	No B		a	b	c	COS ₁₁	COS ₁₂
Eq	No C		COS ₁₃	COS ₂₁	COS ₂₂	COS ₂₃	COS ₃₁
	1 A	S P H E	I N C H	11.0	0.0	11.0	
	1 B		9.0	9.0	9.0	1.0	0.0
	1 C	0.0	0.0	1.0	0.0	0.0	1.0
	2 A	C Y L I	I N C H	11.0	0.0	11.0	
	2 B		9.0	9.0		0.7071070	0.0
	2 C	-	0.7071070	0.0	0.0	0.7071070	0.0
	3 A	C Ø N E	I N C H	24.8	0.0	24.8	
	3 B		1.0	1.0	1.0	0.7071070	0.0
	3 C	-	0.7071070	0.0	0.0	0.7071070	0.0

Figure 4. SAMPLE PROBLEM INPUT DATA SHEET.

```

EQUATION NUMBER 1 SPHE
THE ORIGIN X= 11.000000 IN. Y= 0.0 IN. Z= 11.000000 IN.
              27.939987 CM.              0.0 CM.              27.939987 CM.
A= 9.000000 IN. B= 9.000000 IN. C= 9.000000 IN.
   22.859985 CM. 22.859985 CM. 22.859985 CM.

COS 11= 1.000000 COS 12= 0.0 COS 13= 0.0
COS 21= 0.0 COS 22= 1.000000 COS 23= 0.0
COS 31= 0.0 COS 32= 0.0 COS 33= 1.000000

*****
* 1.000000XSQ 1.000000YSQ 1.000000ZSQ 0.0 XZ 0.0 YX *
* 0.0 YZ -55.879974 X 0.0 Y -55.879974 Z 1038.706543 = 0 *
*****

EQUATION NUMBER 2 CYLI
THE ORIGIN X= 11.000000 IN. Y= 0.0 IN. Z= 11.000000 IN.
              27.939987 CM.              0.0 CM.              27.939987 CM.
A= 9.000000 IN. B= 9.000000 IN. C= 0.0 IN.
   22.859985 CM. 22.859985 CM. 0.0 CM.

COS 11= 0.707107 COS 12= 0.0 COS 13= -0.707107
COS 21= 0.0 COS 22= 1.000000 COS 23= 0.0
COS 31= 0.707107 COS 32= 0.0 COS 33= 0.707107

*****
* 1.000000XSQ 2.000000YSQ 1.000000ZSQ -2.000000 XZ 0.0 YX *
* 0.0 YZ 0.0 X 0.0 Y 0.0 Z -1045.157959 = 0 *
*****

EQUATION NUMBER 3 CONE
THE ORIGIN X= 24.799988 IN. Y= 0.0 IN. Z= 24.799988 IN.
              62.991959 CM.              0.0 CM.              62.991959 CM.
A= 1.000000 IN. B= 1.000000 IN. C= 1.000000 IN.
   2.540000 CM. 2.540000 CM. 2.540000 CM.

COS 11= 0.707107 COS 12= 0.0 COS 13= -0.707107
COS 21= 0.0 COS 22= 1.000000 COS 23= 0.0
COS 31= 0.707107 COS 32= 0.0 COS 33= 0.707107

*****
* 0.0 XSQ 1.000000YSQ 0.0 ZSQ -1.999999 XZ 0.0 YX *
* 0.0 YZ 125.983902 X 0.0 Y 125.983902 Z -7935.968750 = 0 *
*****

```

Figure 5. SAMPLE PROBLEM PRINTED OUTPUT.

5:58799+12 1:03870+3 5 IC CARD R

704 BINARY CARD

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13

OPERATION NOTES

No error messages have been incorporated in HANDY; therefore, the user must use caution in supplying the necessary data and should carefully check the printed output for data errors.

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- (1) Whitesides, G. E.; Personal Communications; Computing Technology Center, Union Carbide Corporation-Nuclear Division, Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee.
- (2) Irving, D. C., et al; OR5, A General-Purpose Monte Carlo Neutron Transport Code, ORNL-3622; Union Carbide Corporation-Nuclear Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee; February 1965.

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