Contrails

FOREWORD

This computer program is one of a series of digital computer programs developed as in-house effort in support of the Space Vehicle Thermal and Atmospheric Control Study. The study is sponsored by the Flight Dynamics Laboratory of the Research and Technology Division under Contract AF33(657)-8953 and is under the direction of W. Uhl of the Environmental Control Branch. R. E. Sexton of S&ID served as Project Manager of the study program. H. L. Nordwall reviewed and edited the contractor's report for publication as an FDL TDR.

The program described in this report represents the second stage in the development of a general configuration factor computer program. This report partly incorporates SID 62-393 (ASD TN 61-101), which describes CONFAC I, the first program developed under the Space Vehicle Thermal and Atmospheric Control Study.

This report may also be identified by Contractor's Report No. SID 63-1397.

Approved for Public Release

Contrails

Approved for Public Release

Contrails

ABSTRACT

A simple numerical method is derived for the determination of the geometric radiant-interchange factors used in radiant heat transfer and illumination. A FORTRAN II digital computer program utilizing this method is developed which provides a rapid and accurate means of computation of configuration and form factors. The source of flux may be any general plane polygon and the receiver may be any general plane or nonplanar polygon, the surface of an arbitrary polyhedron, or an arbitrary combination of such surfaces.

It is therefore possible to accurately determine configuration and form factors from a plane surface to another surface occluded by complex intervening surfaces. Form factors are computed rapidly -- averaging less than two seconds on the IBM 7094 for simple, unobstructed plane surfaces, and less than 30 seconds for simple polyhedra. Also, means are provided to internally generate a variety of regular polygons or polyhedra and to transform surface spatial coordinates for convenience of data entry and/or motion simulation. Simplicity of data entry, flexibility of application, and economy of operation are principal features of this program. Sample problems illustrating these important aspects are provided.

This report has been reviewed and is approved.

T. J. BAKER
Asst. for R&T
Vehicle Equipment Division
AF Flight Dynamics Laboratory

Approved for Public Release

Contrails

TABLE OF CONTENTS

Approved for Public Release

Contrails

ILLUSTRATIONS

Approved for Public Release

Contrails

ILLUSTRATIONS (cont'd)

Approved for Public Release

Contrails

NOMENCLATURE

A	Area
e	Exchange coefficient
c	Configuration factor (italicized)
f	Form factor (italicized)
h,k,l	Translation components
i,j,k	Unit vectors along the X-,Y-,Z-axis, respectively
O	Center of unit sphere, origin of coordinate system
R	Radius of sphere
S	Distance between two areas
X,Y,Z or x,y,z	Spatial coordinates of a point relative to X, Y, Z axis
α, β, γ	Direction angles of a line relative to X, Y, Z axis respectively
γ	Angle between Z axis and vector normal to plane
θ	Angle between two vectors
π	Numerical constant = 3.14159 +
ω	Solid angle

Subscripts

A,B,C	Points on an area
s	Sector
ΔA	Finite incremental area
dA	Differential area
dA-A	From a differential area to an area

Approved for Public Release

Contrails

NOMENCLATURE (cont'd)

Subscripts (cont'd)

1,2,	Areas 1,2,
12	Area 1 to area 2
ε	Elliptical

Approved for Public Release

Contrails

SECTION I

INTRODUCTION

The geometric form factor, $\mathcal{f}_{12}$, is defined as the fraction of radiant energy emanating from finite surface A_1 which is intercepted by another surface A_2.

$$\mathcal{f}_{12} = \frac{\text{Flux received by finite surface } A_2}{\text{Flux emitted by finite surface } A_1} \quad (1)$$

The geometric configuration factor, $\mathcal{C}_{12}$, is defined in a similar manner, except that the emitting surface is infinitesimal, (sometimes referred to as the point configuration factor),

$$\mathcal{C}_{12} = \frac{\text{Flux received by finite surface } A_2}{\text{Flux emitted by infinitesimal surface } dA_1} \quad (2)$$

The subscripts denote the direction of flow of net flux; $\mathcal{C}_{12}$ and $\mathcal{f}_{12}$ pertain respectively to the configuration and form factor from surface A_1 to surface A_2. It is assumed that each surface is isothermal and radiates diffusely, i.e., follows Lambert's cosine distribution law.

The "closed-form" determination of the configuration or form factor by classical integration techniques is impossible or impractical in most situations. Experimental techniques and devices have been reported in the literature (Reference 1), and probably the most useful is Pleijel's Globoscope (Reference 4). Experimental techniques produce only the configuration factor, however. Nonetheless, they are useful for many applications where only one or just a few configuration factors are required and nominal accuracy is sufficient.

However, if a large number of form factors are required in a short period of time, experimental techniques are not practical. This report presents a numerical method and a computer program which enables rapid and accurate computation of configuration and form factors between plane surfaces, and plane or solid surfaces. The source (surface 1) may be any general plane polygon; the receiver (surface 2) may be any arbitrarily oriented general plane or nonplanar polygon, the surface of an arbitrary solid, or an arbitrary combination of planes, nonplanes, or solids. Form factors (which nominally are derived from 625 configuration factors) are computed rapidly, averaging less than 2 seconds by IBM 7094 time for simple plane surfaces, and less than 30 seconds from simple plane surfaces to simple solids. Table 1 compares solutions obtained by CONFAC II to those given in Reference 1.

Manuscript released by the author January 1964 for publication as an FDL technical Documentary Report

Approved for Public Release

Contrails

Table 1, Comparison of Configuration and Form Factors Computed by CONFAC II to Those Given in Reference 1

Configuration			Reference 1	Computer (Trapezodial Rule) 24 x 24 grid	60 x 60 grid
P-1,	X = 1,	Y = 1	0.13853	0.138532	0.138532
	X = 0.1,	Y = 0.1	0.00314	0.003141	0.003141
	X = 1,	Y = 4	0.17527	0.175270	0.175270
	X = 0.1,	Y = 0.4	0.01147	0.011471	0.011471
	X = 1,	Y = ∞ *	0.17678	0.176777	0.176777
	X = 0.1,	Y = ∞ *	0.02488	0.024876	0.024876
P-2,	Ø = 30°,	L = 0, N = 1	0.4665	0.466506	0.466506
	Ø = 30°,	L - 1, N = 1	0.1759	0.175923	0.175923
	Ø = 30°,	L = 0, N = 4	0.4665	0.466506	0.466506
	Ø = 30°,	L = 4, N = 4	0.0964	0.096447	0.096447
	Ø = 120°,	L = 0, N = 1	0.125	0.125000	0.125000
	Ø = 120°,	L = 1, N = 1	0.0236	0.023554	0.023554
	Ø = 120°,	L = 0, N = 4	0.125	0.125000	0.125000
	Ø = 120°,	L = 4, N = 4	0.0077	0.007683	0.007683
**P-6,	E = 1,	D = 1	0.276	0.275	---
	E = 1,	D = 2	0.438	0.436	---
	E = 1,	D = ∞	0.500	0.498	---
	E = 2,	D = 1	0.724	0.722	---
	E = 2,	D = ∞	0.800	0.799	---
**P-8,	D = 4,	L = 2	0.08074	0.08055	---
	D = 2,	L = 4	0.24774	0.2472	---
A-1,	X = 1,	Y = 1	0.19982	0.19972	0.19981
	X = 0.1,	Y = 0.1	0.00316	0.00316	0.00316
	X = 1,	Y = 4	0.34596	0.34559	0.34590
	X = 0.1,	Y = 0.4	0.01207	0.01207	0.01207
	X = 1,	Y = ∞ *	0.41421	0.40549	0.41075
	X = 0.1,	Y = ∞ *	0.04988	0.04884	0.04946
A-2,	Ø = 30°,	L = 1, N = 1	0.6202+	0.61769	0.61878
	Ø = 30°,	L = 4, N = 4	0.3961+	0.39431	0.39450
	Ø = 120°,	L = 1, N = 1	0.0870+	0.08665	0.08662
	Ø = 120°,	L = 4, N = 4	0.0433+	0.04272	0.04235

* 10^8 was assumed to approximate ∞ for computer run

** 32 sided regular polygon used to simulate circular cross-section

\+ These values were obtained by numerical integration across surface A_1, according to Reference 1

Approved for Public Release

Contrails

The FORTRAN II Computer Program described herein, CONFAC II, is a follow-on development of an earlier version, CONFAC I (Reference 5). The original program has been extensively modified and significant improvements in the flexibility of application have been achieved. CONFAC I was developed principally to compute geometric form factors between plane surfaces; no application to nonplanar surfaces or bodies was originally intended. However, because of the particular analytical approach utilized and the data handling techniques developed, it was possible to use the basic plane-to-plane program to compute factors to nonplanar surfaces, provided proper restrictions were observed.

The principal similarities and differences between CONFAC I and CONFAC II are as follows:

1. Both CONFAC I and CONFAC II require that Surface 1 be a plane polygon; it may be arbitrarily oriented in the coordinate system in which it is described (entered) in data.

2. Both CONFAC I and CONFAC II specify that if Surface 2 is a plane polygon, it may be arbitrarily oriented with respect to Surface 1 and within its own coordinate system.

3. Both CONFAC I and CONFAC II require that, if Surface 2 is a nonplanar surface, then the surface boundaries must present a valid silhouette from any point on the active side of Surface 1.

4. CONFAC I specifies that no part of nonplanar Surface 2 may lie below the "horizon" of Surface 1 when viewed from the active side of Surface 1. CONFAC II does not require that all of a nonplanar Surface 2 appear above the horizon of Surface 1. CONFAC II will automatically bisect a nonplanar Surface 2 and compute the factor to only the part which Surface 1 "sees."

5. CONFAC I cannot, in general, be used to compute the factor to a solid surface. CONFAC II will compute the factor to arbitrary solid surfaces or regular solids such as parallepipeds, cylinders, cones, etc., with the restriction that all of the surface must appear above the horizon of Surface 1. CONFAC I cannot, in general, be used to compute factors to surfaces which are occluded or "shadowed" in a varying manner by intervening surfaces; on the other hand, the factor in such instances can be determined by CONFAC II with few restrictions.

6. CONFAC I has only two principal classes of data -- surface data and surface transformation data. No distinction of data entry is made between plane and nonplane surfaces. Surface data is distinguished from transformation data by the position of the data name on the data name card. CONFAC II, however, utilizes nine data classifications, as follows:

Approved for Public Release

Contrails

Class 1 - Plane polygon, silhouette developed directly from data

Class 2 - Nonplane polygon, silhouette developed directly from data

Class 3 - Internally generated disk, silhouette developed directly from generated data

Class 4 - Plane polygon, silhouette internally developed

Class 5 - Nonplane surface or solid, silhouette internally developed

Class 6 - Internally generated regular disk or solid, silhouette internally developed

Class 7 - Sphere

Class 8 - Multisurface, silhouette internally developed from all surfaces taken together

Class 9 - Transformation data

7. CONFAC II incorporates a silhouette generator subroutine which is utilized when the factor to solids or, in certain cases, to non-solids is requested. The silhouette generator computes the perspective of Surface(s) 2 from preselected positions on Surface 1 from which configuration factors are computed.

8. CONFAC II incorporates an internal automatic surface generator which computes the surface boundary coordinates of regular plane and solid surfaces from input data specifications. This feature enables the analyst to create surfaces such as circular or elliptical disks, parallelepipeds, pyramids, cones, truncated cones, cylinders, etc. An endless variety of regular surfaces can be created by CONFAC II.

9. CONFAC II incorporates extremely fast computation of factors to a sphere which is arbitrarily oriented with respect to Surface 1.

Approved for Public Release

Contrails

SECTION II

ANALYTICAL PROCEDURES

CONFIGURATION AND FORM FACTOR

The general equation that must be solved in the determination of the radiant-interchange form factor is (see Figure 1)

$$f_{12} = \frac{1}{A_1} \iint_{A_1} \iint_{A_2} \frac{\cos\theta_1 \cos\theta_2 \, dA_2 dA_1}{\pi S^2} \quad (1)$$

The following part of the integrand is the factor from the elemental surface dA_1 to the total surface A_2, referred to as the configuration factor or plane point factor, c_{12}.

$$c_{12} = \iint_{A_2} \frac{\cos\theta_1 \cos\theta_2}{\pi S^2} dA_2 \quad (2)$$

Therefore,

$$f_{12} = \frac{1}{A_1} \iint_{A_1} c_{12} \, dA_1 \quad (3)$$

A very simple geometric interpretation of Equation 2 is given by Nusselt. The principal value of the Nusselt concept is that the computational procedure is simplified and made more accurate by the fact that no mathematical or numerical integration is required to compute the configuration factor. However, the Nusselt method yields only the configuration factor from the elemental area dA_1; one must still integrate all such factors over surface A_1 to yield the form factor f_{12} as given in Equation 3.

The Nusselt concept utilizes a hemisphere of radius R constructed over the incremental plane area dA_1, as shown in Figure 1. Every point defining the boundary of surface A_2 is projected radially to the hemisphere surface and then vertically downward to the plane of dA_1, the equatorial plane of the hemisphere. The locus of all points thus projected encloses an area, A''_2, on the hemisphere base. This area A''_2, divided by the area of the base, is the configuration factor from dA_1 to A_2.

Approved for Public Release

Contrails

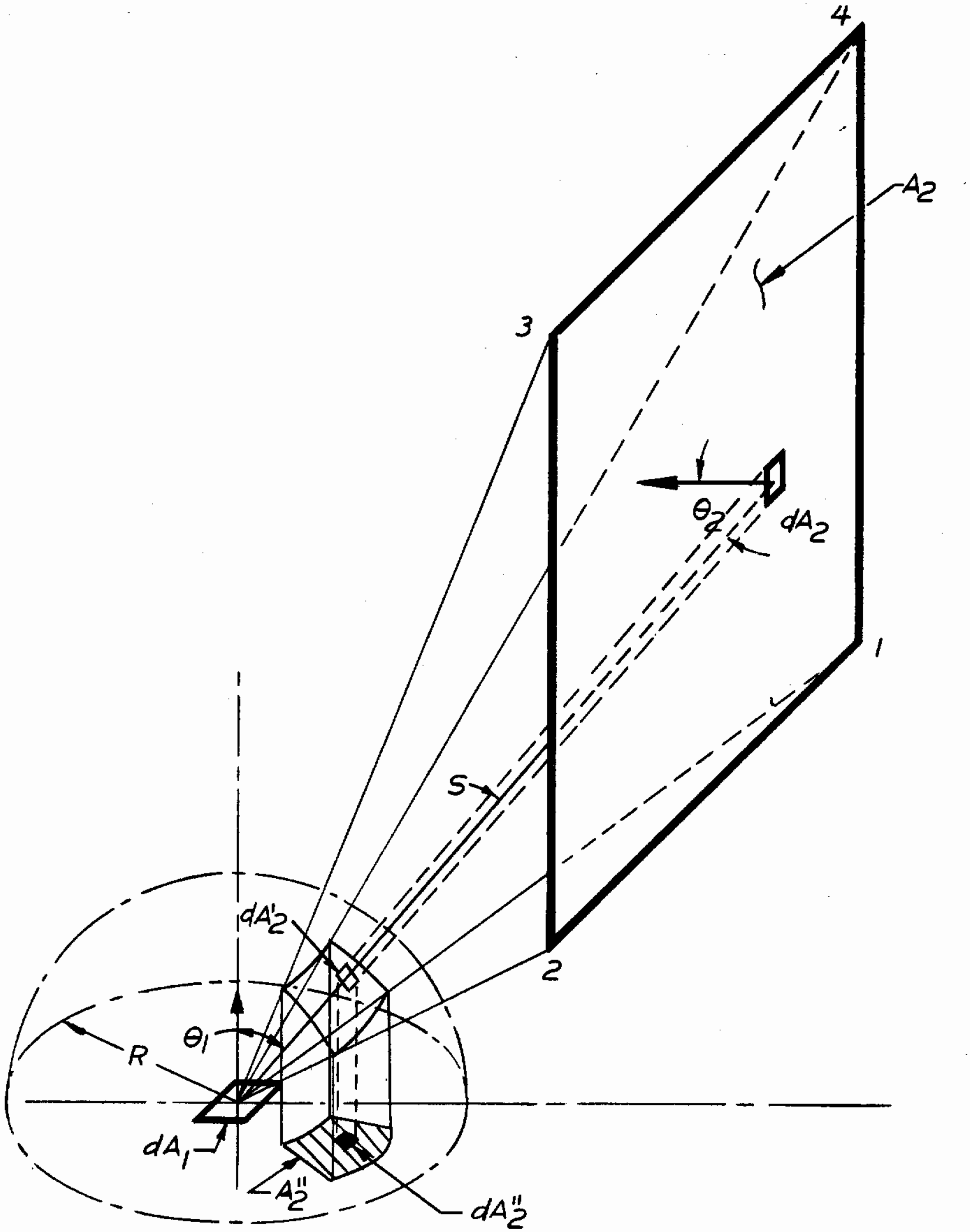

FIGURE 1. NUSSELT GEOMETRICAL RELATIONSHIPS

Approved for Public Release

Contrails

The validity of this conclusion can be demonstrated as follows. Note that the elemental area dA_2 is described in surface A_2 by the elemental solid angle $d\omega_1$, or

$$d\omega_1 = \frac{\cos\,\theta_2\ dA_2}{S^2} \tag{4}$$

Similarly, on the sphere having radius R,

$$d\omega_1 = \frac{dA_2'}{R^2} \tag{5}$$

Because dA_2'' is the projection of dA_2' on the hemisphere base,

$$dA_2' = \frac{dA_2''}{\cos\,\theta_1} \tag{6}$$

Inserting Equation 6 in Equation 5,

$$d\omega_1 = \frac{dA_2''}{R^2\cos\,\theta_1} \tag{7}$$

The right side of Equation 4 appears explicitly in Equation 1 and, because Equation 7 is identical to Equation 4, Equation 2 becomes

$$\mathscr{e}_{12} = \iint_{A_2} \frac{\cos\,\theta_1}{\pi} \left(\frac{dA_2''}{R^2\cos\,\theta_1} \right) = \frac{\iint_{A_2} dA_2''}{\pi R^2} = \frac{A_2''}{\pi R^2}$$

For a sphere of unit radius (unit sphere),

$$\mathscr{e}_{12} = \frac{A_2''}{\pi} \tag{8}$$

which completes the proof of Nusselt's method. By inserting Equation 8 in Equation 3, the original equation becomes greatly simplified; only one area integration is now required.

$$\mathscr{f}_{12} = \frac{1}{A_1}\iint_{A_1} \frac{A_2''}{\pi}\ dA_1 \tag{9}$$

Approved for Public Release

Contrails

The computer program described herein solves Equation 9 numerically by successive algebraic evaluation of A_2'' at preselected points on Surface A_1, with subsequent numerical integration to yield f_{12}, or

$$f_{12} = \frac{1}{A_1} \sum\sum_{A_1} \frac{A_2''}{\pi} \Delta A_1 \tag{10}$$

It should be emphasized that area A_2'' is, in fact, formed by the doubly projected silhouette of surface A_2 as it appears from dA_1.

The element dA_1 is assumed to be oriented in the XY plane and at the origin of the coordinate system of Surface A_2. The area A_2'' can be found from the line integral where $y_1 = F(x_1)$ is the locus of the boundary of A_2'',

$$A_2'' = \frac{1}{2} \int_C (x_1\, dy_1 - y_1\, dx_1) \tag{11}$$

Let $z = F(x,y)$ be the locus of the silhouette of A_2, and S the distance from dA_1 to the point (x,y,z) on the silhouette of A_2.

$$S = \sqrt{x^2 + y^2 + z^2}$$

From similar triangles,

$$x_1 = \frac{x}{S},\quad dx_1 = \frac{1}{S}\, dx + x\, d\left(\frac{1}{S}\right)$$

$$y_1 = \frac{y}{S},\quad dy_1 = \frac{1}{S}\, dy + y\, d\left(\frac{1}{S}\right)$$

Inserting in Equation 11

$$A_2'' = \frac{1}{2} \int_C \frac{xdy - ydx}{S^2} \tag{12}$$

Equation 12 can be transposed to finite difference form by replacing the differentials with increments for numerical evaluation. Because of the problems of increment size control, it appears desirable to solve Equation 12 for a finite line segment in space and to allow the analyst to control accuracy of configuration factor computation by suitable selection of line segments describing Surface 2. If the surface is actually a polygon or polyhedra, the simulation is perfect; if the surface boundary is curved, like a disk, for example, the validity of the result is a function of the number of line segments used.

Approved for Public Release

Contrails

However, a much simpler and more easily understood geometric derivation, using the unit sphere, yields the result in superior computational form. Referring to Figure 2, note that the radial projection of line segment AB on the hemisphere surface forms the circular arc A'B'. Projection of A'B' to the base plane produces the elliptical arc A"B", forming the elliptical section A"OB" with the origin.

If all line segments describing Surface 2 are similarly projected, the area A_2'' will be formed by a closed series of elliptical arcs. Surface A_2 does not have to be a plane. Actually, the area A_2'' results from the geometry of a silhouette; any surface or object projecting an identical silhouette in the same spatial position on the hemisphere surface will produce the same area A_2'' and the same point factor.

Inspection reveals that the magnitude of area A_2'' can be determined by computing the area of each elliptical sector, properly signed, followed by an algebraic summation.

In Figure 2, the area of elliptical sector A_ε is the projected area of circular sector A_s. If the angle between the plane of the circular sector A'OB' and the XY plane is γ, then

$$\cos \gamma = \frac{A_\varepsilon}{A_s} \tag{13}$$

The area A_s is computed from the usual polar equation, with θ in radians,

$$A_s = \frac{1}{2} R^2 \theta$$

For the unit radius sphere,

$$A_s = \frac{\theta}{2} \tag{14}$$

Substituting Equation 14 in Equation 13, and solving for A_ε,

$$A_\varepsilon = \frac{\theta}{2} \cos \gamma \tag{15}$$

For a polygon of N sides, the net area A_2'' is found by algebraic summation of all computed A_ε.

Approved for Public Release

Contrails

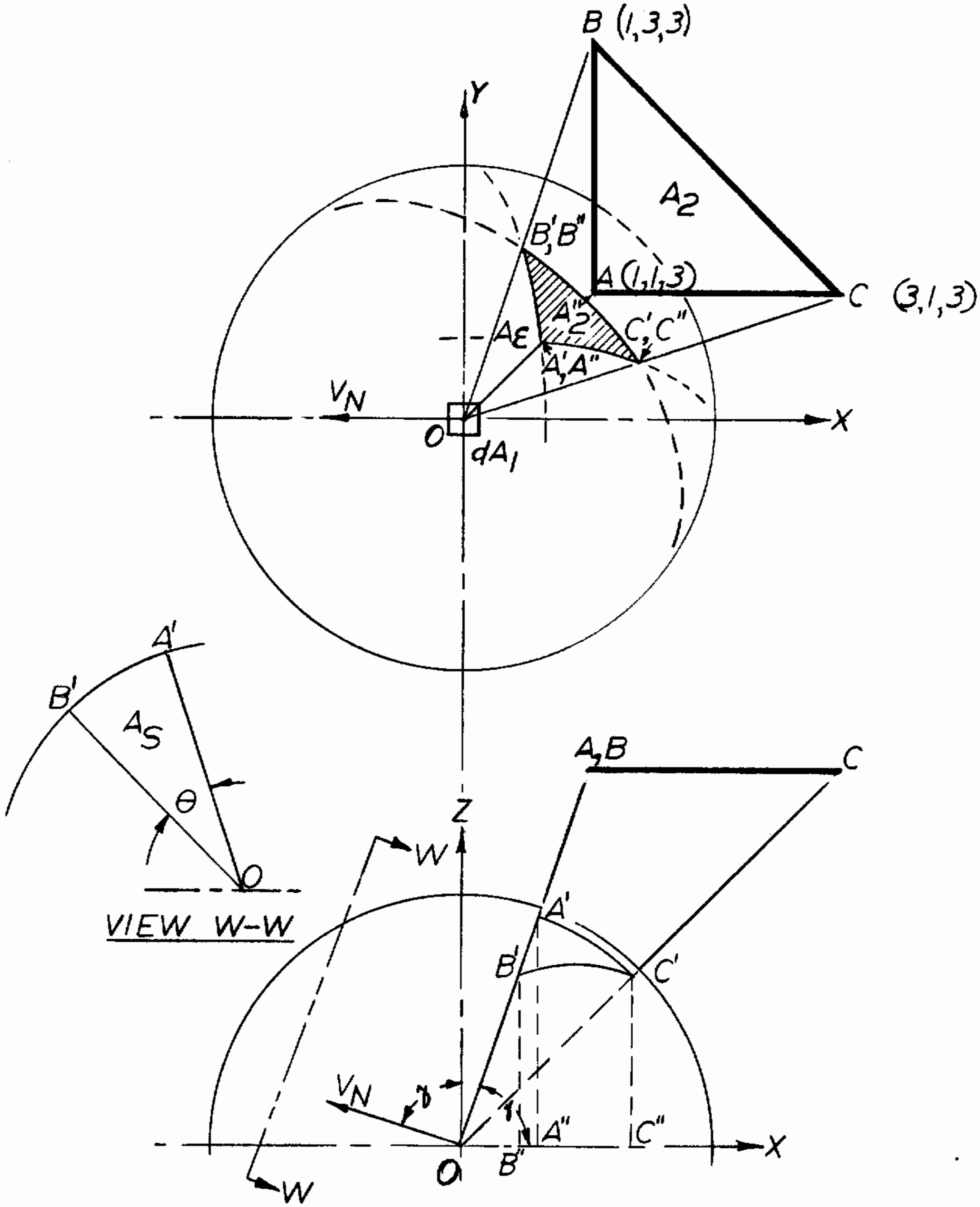

FIGURE 2. GEOMETRY OF NEW METHOD OF CONFIGURATION FACTOR COMPUTATION

Approved for Public Release

Contrails

$$A_2'' = \frac{1}{2} \left| \sum_{n=1}^{N} \theta_n \cos \gamma_n \right| \qquad (16)$$

Substituting in Equation 8, we have

$$\epsilon_{12} = \frac{1}{2\pi} \left| \sum_{n=1}^{N} \theta_n \cos \gamma_n \right| \qquad (17)$$

A general analytical derivation of this equation is given in Reference 3, and is reported to be originally developed by Omoto in 1924.

The absolute value notation will be explained later. The use of vector algebra greatly facilitates the computation of θ and $\cos \gamma$. Taking, for example, directed line segments of $\vec{OA}$ and $\vec{OB}$, the vector dot product is

$$\vec{OA} \cdot \vec{OB} = x_A x_B + y_A y_B + z_A z_B \qquad (18)$$

The cross product $\vec{OA} \times \vec{OB}$ in determinant form is

$$\vec{OA} \times \vec{OB} = \begin{vmatrix} i & j & k \\ x_A & y_A & z_A \\ x_B & y_B & z_B \end{vmatrix}$$

which, upon expansion, becomes the normal vector $\vec{V}_N$,

$$\vec{V}_N = \vec{OA} \times \vec{OB} = (y_A z_B - z_A y_B)i + (x_B z_A - z_B x_A)j + (x_A y_B - x_B y_A)k \qquad (19)$$

where i, j, and k are mutually orthogonal unit base vectors directed along the principal axes.

$\vec{V}_N$ is equal in magnitude to twice the area of the triangle AOB and is oriented normal to the plane of AOB so that the three vectors form a right-handed system. The magnitude is computed by the Pythagorean theorem,

Approved for Public Release

Contrails

$$\left|\vec{V}_N\right| = \sqrt{(y_A z_B - z_A y_B)^2 + (x_B z_A - x_A z_B)^2 + (x_A y_B - x_B y_A)^2} \qquad (20)$$

The angle θ may be evaluated from either the dot or the cross product by use of inverse functions, specifically

$$\theta = \cos^{-1}\left[\frac{\vec{OA} \cdot \vec{OB}}{|\vec{OA}|\,|\vec{OB}|}\right] \text{ or } \sin^{-1}\left[\frac{|\vec{V}_N|}{|\vec{OA}|\,|\vec{OB}|}\right]$$

However, an overall economy of computation results from the use of the arctan function,

$$\theta = \tan^{-1}\left[\frac{|\vec{V}_N|}{\vec{OA} \cdot \vec{OB}}\right] \qquad (21)$$

As noted earlier, the angle γ is defined as the angle between the plane of AOB and the XY plane. It is also the angle between the vector $\vec{V}_N$ and the Z axis; cos γ is therefore the direction cosine of $\vec{V}_N$ with respect to the Z axis. Using the Z component in Equation 19,

$$\cos\gamma = \frac{x_A y_B - x_B y_A}{|\vec{V}_N|} \qquad (22)$$

If the numerator and denominator are both divided by 2,

$$\cos\gamma = \frac{\frac{x_A y_B - x_B y_A}{2}}{\frac{|\vec{V}_N|}{2}}$$

This shows that cos γ is also equal to the ratio of the signed projected area of triangle AOB on the XY plane and the plane area of triangle AOB.

In the right-handed system shown, cos γ is positive when the order of computation of the vectors in the cross product causes the normal vector $\vec{V}_N$ to point in the direction of the +Z axis ($0<\gamma<90$). The order in which one proceeds from point to point on the boundary of Surface 2 will sign each elliptical sector accordingly; however, because the sectors are summed algebraically, the same absolute magnitude will result regardless of order. Because the point factor is always a positive number, the order is computationally unimportant. Nevertheless, the program requires that data be entered in counterclockwise order for other reasons. This will be discussed in more detail later.

Approved for Public Release

Contrails

The relative ease with which the point factor can be computed is best illustrated by an example. Using the triangle shown in Figure 2, and starting with line segment $\overline{AB}$, from Equation 18

$$\vec{OA} \cdot \vec{OB} = 1 + 3 + 9 = 13$$

from Equation 20

$$\left|\vec{V}_{AB}\right| = \left|\vec{OA} \times \vec{OB}\right| = \sqrt{(-6)^2 + 0 + (2)^2} = \sqrt{40}$$

From Equation 21

$$\theta_{AB} = \tan^{-1}\left[\frac{\sqrt{40}}{13}\right] \cong 0.453$$

From Equation 22

$$\cos\gamma_{AB} = \frac{2}{\sqrt{40}} = 0.316$$

Moving to BC,

$$\vec{OB} \cdot \vec{OC} = 3 + 3 + 9 = 15$$

$$\left|\vec{V}_{BC}\right| = \sqrt{6^2 + 6^2 + (-8)^2} = \sqrt{136}$$

$$\theta_{BC} = \tan^{-1}\left[\frac{\sqrt{136}}{15}\right] \cong 0.661$$

$$\cos\gamma_{BC} = \frac{-8}{\sqrt{136}} = -0.686$$

Approved for Public Release

Contrails

Finally, line segment $\overleftrightarrow{CA}$,

$$\overleftrightarrow{OC} \cdot \overleftrightarrow{OA} = 3 + 1 + 9 = 13$$

$$\vec{V}_{VA} = \sqrt{0 + 6^2 + (-2)^2} = \sqrt{40}$$

$$\theta_{CA} = \tan^{-1}\left(\frac{\sqrt{40}}{13}\right) \cong 0.453$$

$$\cos \gamma_{CA} = \frac{2}{\sqrt{40}} = 0.316$$

The configuration factor is, therefore, from Equation 17,

$$\mathcal{C}_{12} = \frac{1}{2\pi} \left| 2(0.453)(0.316) + (0.661)(-0.686) \right|$$

$$= \frac{1}{2\pi} \left| -0.167 \right|$$

$$\mathcal{C}_{12} = 0.0266$$

Note the repetitive nature of the computation. Thus, all surfaces represented by straight line segments in space can be analyzed in the simple, direct manner shown.

COORDINATE TRANSFORMATION

The task of computing factors, even when simple "closed-form" solutions are available, is oftentimes laborious because the surfaces under consideration appear in difficult, skewed relative positions. A significant part of this effort has been eliminated by the program through the capability of general coordinate transformation (translation and/or rotation). Surface data may be entered for each surface using an individually convenient local origin. The surfaces may then be linked together by transforming one or both surfaces to a convenient third origin which is common to both surfaces. The fact that internally generated surfaces may also be transformed (excluding multisurfaces) makes this feature a very powerful tool.

Approved for Public Release

Contrails

Actually, two different types of coordinate transformation are used by the program. The transformation discussed in the prior paragraph is termed a "primary" transformation, and is under control of the user through transformation data entry. The second type of transformation is termed an "auxiliary" transformation,and is under internal program control only. An auxiliary transformation transforms the surface coordinates of both surfaces into a new coordinate system formed so that the XY plane of the coordinate system lies in the reference plane of one of the surfaces. The reference plane of a surface is the plane formed by the first, second and last point describing that surface. The origin of an auxiliary coordinate system is located at point 1 in the particular surface controlling the transformation. The X-axis is directed along the line segment formed by points 1 and 2. The surface unit orientation vector becomes the Z axis; the Y axis is computed orthogonal to the X and Z axes, thus locating the XY plane in the control surface reference plane.

The auxiliary transformation actually serves two purposes. First, it is utilized by Subroutine DOICU to facilitate reconstruction of the "seen" part of surfaces which are not entirely seen by the other surface. Secondly, the program requires that prior to computation of the configuration factors, Surface 1 must appear in the XY plane of the final coordinate system along with Surface 2 in its proper relative position. This is necessary to enable Subroutine MAP to select points on Surface 1 from which factors to Surface 2 may be directly computed, or from which silhouettes of Surface 2 may be generated and factors computed.

For example, suppose Figure 3 represents the surfaces of various items of equipment appearing in a compartment. The unprimed coordinate system shown may be conveniently chosen at a corner or axis of symmetry, perhaps as shown on a mechanical drawing. This system may not be convenient for data entry of the disk, however. The primed coordinate system with the origin at the center of the disk is the more logical choice in this case. The previously described surface generator will generate the disk about this origin. The disk data can then be transformed from the primed to the unprimed system by a primary transformation. The choice of generating the cube and transforming, or directly entering data from the unprimed system, is left to the user as it requires about equal effort both ways. The plate coordinates can be easily entered from the unprimed system. Now, suppose we desire the form factor from the disk to the plate. If the data are entered as discussed above (including the transformation data), the program will generate the disk and then primary transform disk coordinates to the unprimed system. Since the disk is bisected by the plate, an auxiliary transformation of all coordinates, both disk and plate, will be made from the unprimed to the quad-primed system. Now, that portion of the disk appearing above the active side of the plate will be determined, and an auxiliary transformation of the plate and the truncated disk will be made to the double primed coordinate system, i.e., the reference plane of the disk. The disk is now in a position for mapping, and the plate coordinates are proper for obtaining the configuration factors. A similar manipulation of surface data would be made to obtain the form factor to the cube with one exception -no truncation of the disk would occur and the auxiliary

Approved for Public Release

Contrails

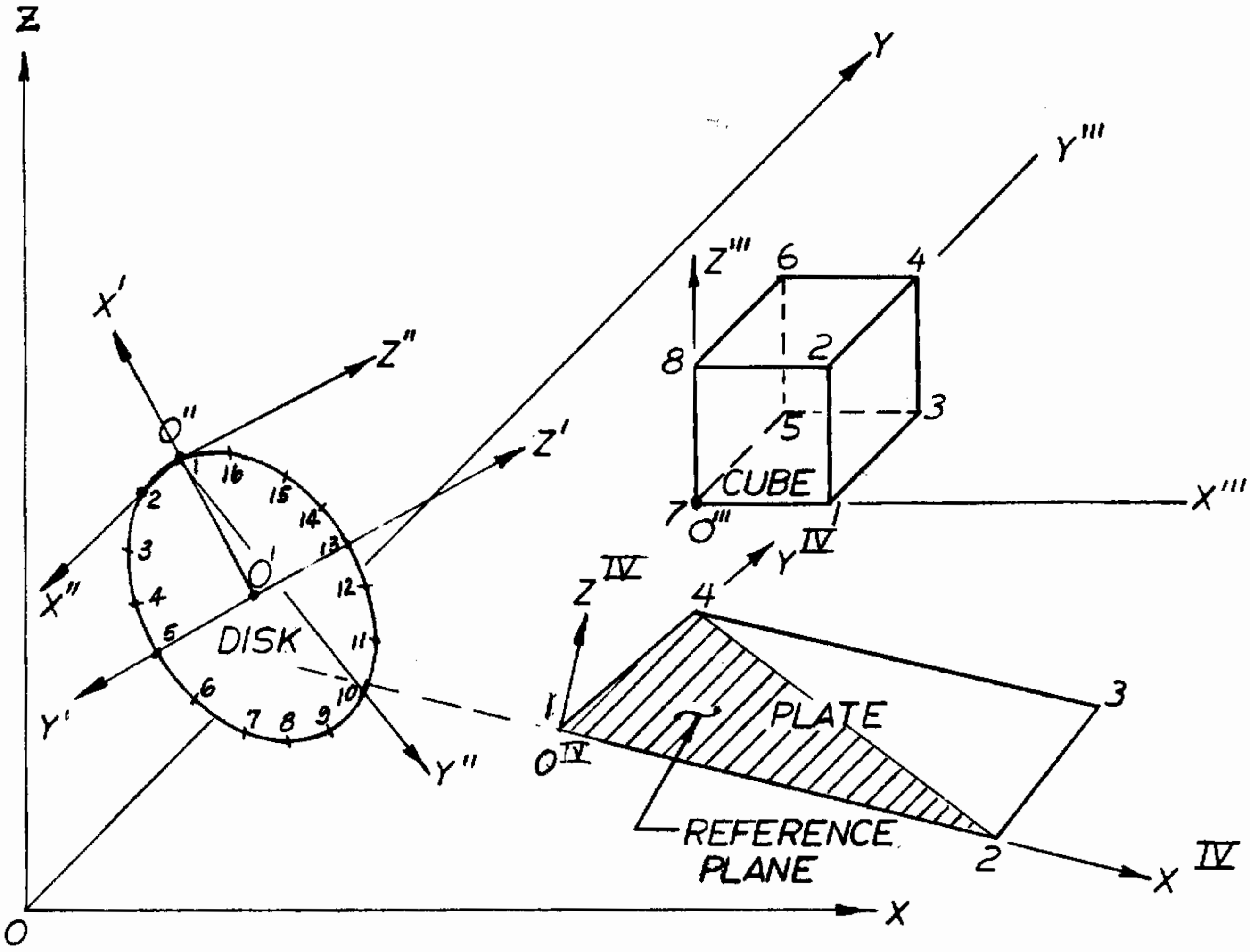

FIGURE 3. SURFACE COORDINATE TRANSFORMATION

Approved for Public Release

Contrails

transformation to the double-primed system would occur immediately after primary transformation.

The transformation technique utilized for a primary transformation differs from the customary method whereby "old" coordinates plus translation data and direction cosines or Euler angles are supplied, from which a "new" set of coordinates are derived. The program requires the coordinates of any three points (not in a line) measured from the new origin. These data are then used to derive direction cosines and translation terms, by which the old coordinates are then transformed to the new origin.

The reader may find it easier to visualize transformation in terms of the movement of the <u>surfaces</u> instead of the origins. In the case of the disk, again referring to Figure 3, we may say we generated the disk with its center at the origin of the unprimed system and in its XY plane, and then moved the surface to the position indicated by the primed system. This viewpoint appears more realistic when motion is simulated by transforming a surface along a particular path.

The mathematical treatment of primary and auxiliary transformation is presented in Appendix C.

SILHOUETTE GENERATOR

As noted in the introduction, CONFAC I cannot, in general, be used to compute the form factor to solid surfaces. Subroutine FACTOR requires a single array be made available containing the surface boundary points, and only those points, which, when taken in numerical sequence, form a valid silhouette of Surface 2 from a particular point in Surface 1. It is impossible to generally satisfy this requirement with a single input array if Surface 1 is finite and Surface 2 is arbitrarily nonplanar or solid. It is the function of the silhouette generator to determine which points in a given set of Surface 2 data form the silhouette from preselected viewpoints on Surface 1.

The silhouette generator computes the silhouette from the perspective of Surface 2 developed on the Z-unity (Z = +1) plane. The perspective on the Z-unity plane is the locus formed in the plane by the boundary of the solid angle subtended by Surface 2.

For example, the view of a cube from two positions on the XY plane is shown in Figure 4. The coordinates of each point in the Z-unity plane are derived in the following manner from the coordinates of its corresponding point on the cube. Note the triangle formed by the origin, point 2 in the cube, and point Q, the vertical projection of point 2 on the XY plane. A similar triangle is constructed from point 2' to point N. From similar triangles,

$$\frac{\overline{ON}}{\overline{OQ}} = \frac{Z_2'}{Z_2} \qquad (22)$$

Approved for Public Release

Contrails

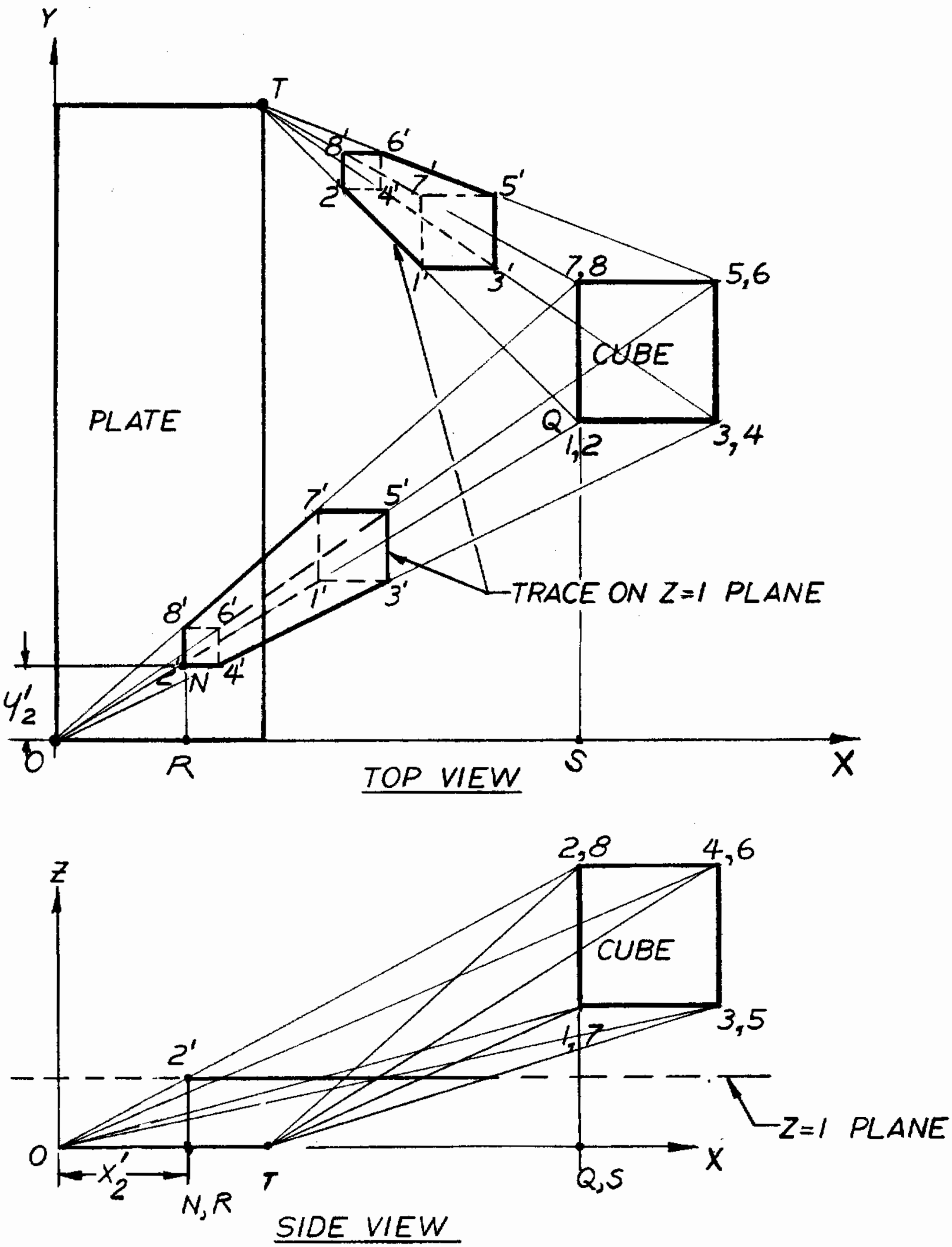

FIGURE 4. SIMPLE SILHOUETTE GEOMETRY

Approved for Public Release

Contrails

In like manner, using triangles RON and SOQ in the top view,

$$\frac{ON}{OQ} = \frac{OR}{OS} = \frac{NR}{QS}$$

but $OR = X_2'$, $OS = X_2$, $NR = Y_2'$, $QS = Y_2$ and $Z_2' = 1$.

Therefore,
$$\frac{X_2'}{X_2} = \frac{Z_2'}{Z_2} = \frac{1}{Z_2}$$

$$X_2' = \frac{X_2}{Z_2} \tag{23}$$

and similarly,

$$Y_2' = \frac{Y_2}{Z_2} \tag{24}$$

This reduction to two dimensions results in considerable simplification. Given the coordinates (X, Y) and point connections data, it is possible to determine the line segments forming the silhouette by application of a simple criterion; At each point on the silhouette, those line segments forming the largest included angle define the silhouette. For example, at point 2' in the lower silhouette in Figure 4, vectors 2' - 8', 2' - 1' and 2' - 4' emerge from the point. Vectors 2' - 8' and 2' - 4' obviously form the silhouette, and can be numerically selected by applying the criterion.

Figure 5 shows the development of the Z-unity plane silhouette of a multisurface . In contrast to point D, Surfaces S2 and S3 appear separated in the silhouette when viewed from C.

Note the line connecting 4 to 7 . This artifice -a "bridge" line - is utilized to cause the silhouette generator to include both surfaces in the silhouette, otherwise surface S3 would be ignored. Because the line has no width, it has no effect on the factor computation, but the silhouette generator follows the line as if it were a boundary of the multisurface S2 plus S3.

The distinguishing difference between the silhouettes shown in Figure 4 and Figure 5 is the fact that "crossover" occurs in Figure 5. The silhouette at a crossover is formed by intersecting line segments at a point between line segment extremities. The detection of such intersections, and the computation of the coordinates of the intersection, requires considerable analysis with resultant increased computer time. Because of this, silhouette analysis is termed "simple" if no investigation is made by the silhouette generator to detect crossovers, and "complex" when such is made. Only multisurface data (class 8) are run in the complex mode. All other surface data requiring the silhouette generator (classes 4, 5 and 6) are run in the simple mode.

Approved for Public Release

Contrails

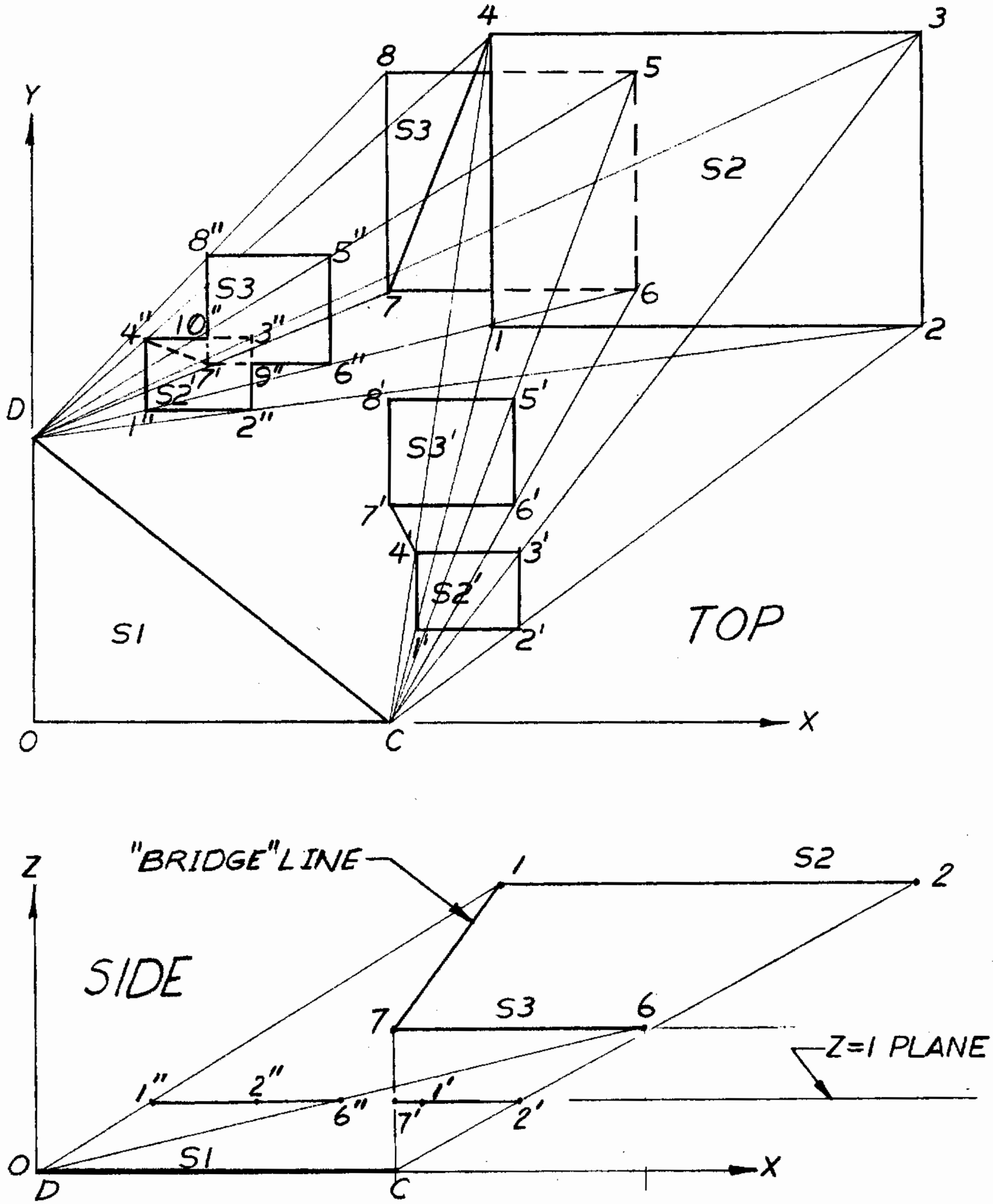

FIGURE 5. COMPLEX (MULTISURFACE) SILHOUETTE GEOMETRY

Approved for Public Release

Contrails

SURFACE GENERATOR

The program cannot directly compute factors to curved surfaces or boundaries such as disks, cylinders, etc. A series of line segments must be substituted for a curved line. In general, the more line segments used, the more accurate the simulation. Because every surface point requires 3 coordinates (and connecting points data, when the silhouette must be computed), preparation and entry of data for even a modest simulation of a cylinder can involve a considerable amount of effort. The internal surface generator eliminates practically all of this effort.

The surface generator is used to create surfaces entered under data classes 3 or 6. Regular plane polygons are created under Class 3, but no connections data are generated. A regular plane polygon or solid surface, including connections data, is created under a class 6 entry.

The surface generator "creates" a surface in accordance with cross section specifications. The following information is required to create a class 3 surface:

1. Number of cross section division (sides) $\geq$ 3

2. Coordinates (X, Y, Z) of center of polygon

3. X-axis Radius

4. Y-axis Radius

Because a class 6 surface may have one or more cross sections, the following data are required:

1. Number of cross section division (sides) $\geq$ 3

2. Number of cross sections

3. Coordinates (X, Y, Z) of first cross section

4. X-axis Radius of first cross section

5. Y-axis Radius of first cross section

If more than one cross section is specified, the following data are required for each additional cross section: X-axis radius, Y-axis radius and Z-coordinate. All cross sections are created parallel to the XY plane of the generator coordinate system, and must be specified above the XY plane. Note that X, Y coordinates are required to locate the first cross section only. If more than one is specified, all are oriented along the same vertical centerline to the position specified by the respective Z coordinate.

Approved for Public Release

Contrails

The basic generating element is the ellipse. Because only complete polygons are generated, the total angle of 2π radians about the vertical centerline is divided by the number of sides specified to yield the unit parametric angle ϕ in the equations of the ellipse:

$$\phi = \frac{2\pi}{N}$$

$$X = (XR)\cos\phi$$

$$Y = (YR)\sin\phi$$

Instead of the conventional semi-major and semi-minor expressions, the terms "X-Radius" and "Y-Radius" are utilized - the larger of the two becomes the semi-major axis as shown in Figures 6 (a), (b), and (c). When XR = YR, the generating figure is circular and a regular polygon of N sides results. Notice that the generating figure always circumscribes the generated polygon. The radius vector always starts in the same relative position parallel to X-axis and moves counterclockwise about the vertical centerline of the generated cross section. Considerable computing time is saved by using $\sin(\phi + \beta)$, $\cos(\phi + \beta)$ trigonometric formulae for computation of X, Y after unit values are obtained by use of computer library functions.

Figure 6 (d) shows an eight-sided polygon elevated above the XY plane. Figure 6 (e) indicates the order in which point numbers are assigned to a solid surface. The first point is always assigned to the first coordinates in the first cross section. Numbers are assigned in numerical sequence vertically until the last cross section is numbered, for a particular value of ϕ; the sequence is continued in similar manner with the first cross section and the next value of ϕ, until all points are defined.

Point connections data are also computed for each point for Class 6 surfaces. For example, in Figure 6 (e), points 2, 3 and 15 are computed for point 1; points 1, 4 and 16 are computed for point 2, etc. This information is used by the silhouette generator.

An example of the variety of objects which may be created by a few cards of specifications are shown in Figure 6 (f). The cone vertex is generated merely by specifying zero X-radius and Y-radius.

The internal surface generator also computes the surface area of the generated solid, if the cross sections are similar. Because the silhouette generator analyzes the solid figure, the total surface area is computed. For instance, the area of the prismatic cylinder shown in Figure 6 (e) would include the top and bottom polygons. The surface area computation analytical development is given in Appendix D.

Approved for Public Release

Contrails

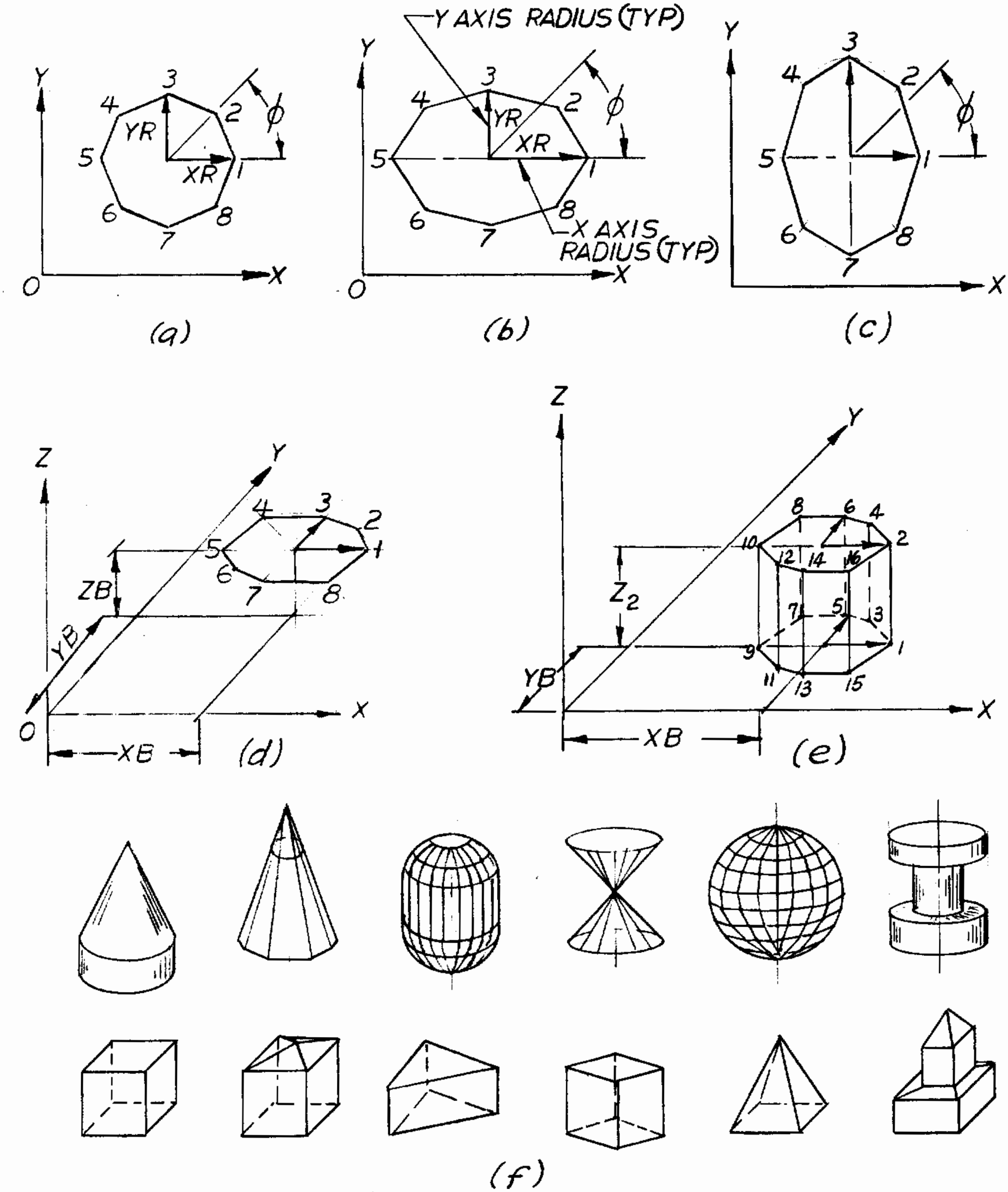

FIGURE 6. CONFAC II SURFACE GENERATOR

Approved for Public Release

Contrails

Approved for Public Release

Contrails

SECTION III

COMPUTER PROGRAM CONTENTS

PROGRAM DESCRIPTION

The program is written in IBM 7090 FORTRAN II source language. The source deck consists of the Main Program and Subroutines UNIVEC, TXFRM, COICU, MAP, SILFAC and FACTOR. An input-output tape compatibility Subroutine written in IBM 7090 (FAP) machine language is included. Algebraic routines required from library tape are SQRT (Square Root), ARCTAN (Inverse tangent trigonometric function), COS (Cosine trigonometric function), and SIN (Sine trigonometric function). The source programs are presently dimensioned so that a 32 K core size is required. NAA Library Subroutines COUNTV and TIMEV are also used by Subroutine SILFAC when operating in the NAA 7094 system.

Main Program

The functions performed by the Main Program are as follows:

1. Reads in surface, transformation and run data.
2. Processes input surface data and prints immediately upon completion. Run instruction data are read in and processed one card at a time and processed at once. No printout of the complete run instructions is given, as was in CONFAC I.
3. Selects the proper data for processing according to the run instructions.
4. Examines each run instruction and calls in proper subroutines for processing.
5. Prints diagnostic error indications when possible.
6. Prints standard or detailed output as indicated by run instructions.

Subroutine UNIVEC

This subroutine computes the components of a unit orientation vector normal to the reference plane formed by the first, second and last point in surface data classes 1, 3, 4 and plane 6. The cross product of vectors 1-2 and 1-last is computed and normalized. The vector is formed normal to point 1, and is located on the active side of the surface, thus orienting the surface.

It also computes a new fourth point normal to the new three points submitted in transformation data and an old fourth point normal to the old three points in the surface data to be transformed.

Approved for Public Release

Contrails

Subroutine TXFRM

The first section performs the auxiliary transformation. This transformation is used to reconstruct a surface which is bisected by the second surface. It also tests Surface 1 to determine if the reference plane is substantially in the XY plane of its coordinate system. If it is not, an auxiliary transformation is effected to move the surfaces to fulfill this requirement prior to computation of silhouettes or factors.

This subroutine also performs a primary transformation as indicated by run instructions and transformation data. This transformation, if indicated for a surface, is accomplished prior to entry to subroutine DOICU so that tests of the surface "view" of each other occur in their transformed position(s).

Subroutine DOICU

The function of this subroutine is conveyed literally by its name DO-I-C-U. Given surfaces A1 and A2 with the "active" side of each surface identified by the surface orientation unit vector, the question is asked; Is all, part, or none of surface A1 "seen" by A2? Conversely, does A2 see all, none, or part of A1? This is accomplished by computing the vector dot product formed by the unit vector in one surface with the vector formed by point 1 in the first surface and each point in the other surface (See Figure 7). The sign of the dot product indicates whether the angle between the vectors is less than or greater than 90°, which reveals the position of the point relative to the plane of the viewing surface. In Figure 7 (a) the dot products from surface A1 to A2 are all positive, and conversely, all from A2 to A1 are likewise positive: A1 sees all of A2; A2 sees all of A1. However, in Figure 7 (b) all dot products from A2 to A1 are positive, but all from A1 to A2 are negative. Hence, in general, if all dot products from one surface to another are all negative, then the surfaces do not see each other, even though the converse products may be positive. There is also the trivial case where all products are zero, in which case the surfaces are in the same plane, and obviously again cannot see each other.

Figure 7 (c) shows a surface A2 bisecting surface A1. In this case, some of the dot products from A2 and A1 are positive and some negative. In Figure 7 (d) both A1 and A2 are bisected. Nonplanar surface A3 was added to show how it would be bisected by A1. Surface A3 has no orientation vector and thus no test is made of the view from this surface. The vertical dashed line in A2 represents how the plane 1-2-5-6 in A3 might bisect A2. DOICU will not detect this condition. If the configuration factor, F_{23}, were required, DOICU would properly bisect A3. However, if the factor to the concave side only is desired, an error would result because part of A2 sees the convex side of A3. This represents one of the limitations of CONFAC I which is carried over to CONFAC II.

If a surface is bisected, DOICU reconstructs the surface data to exclude the area not seen by the other surface. If point 1 in the original surface is

Approved for Public Release

Contrails

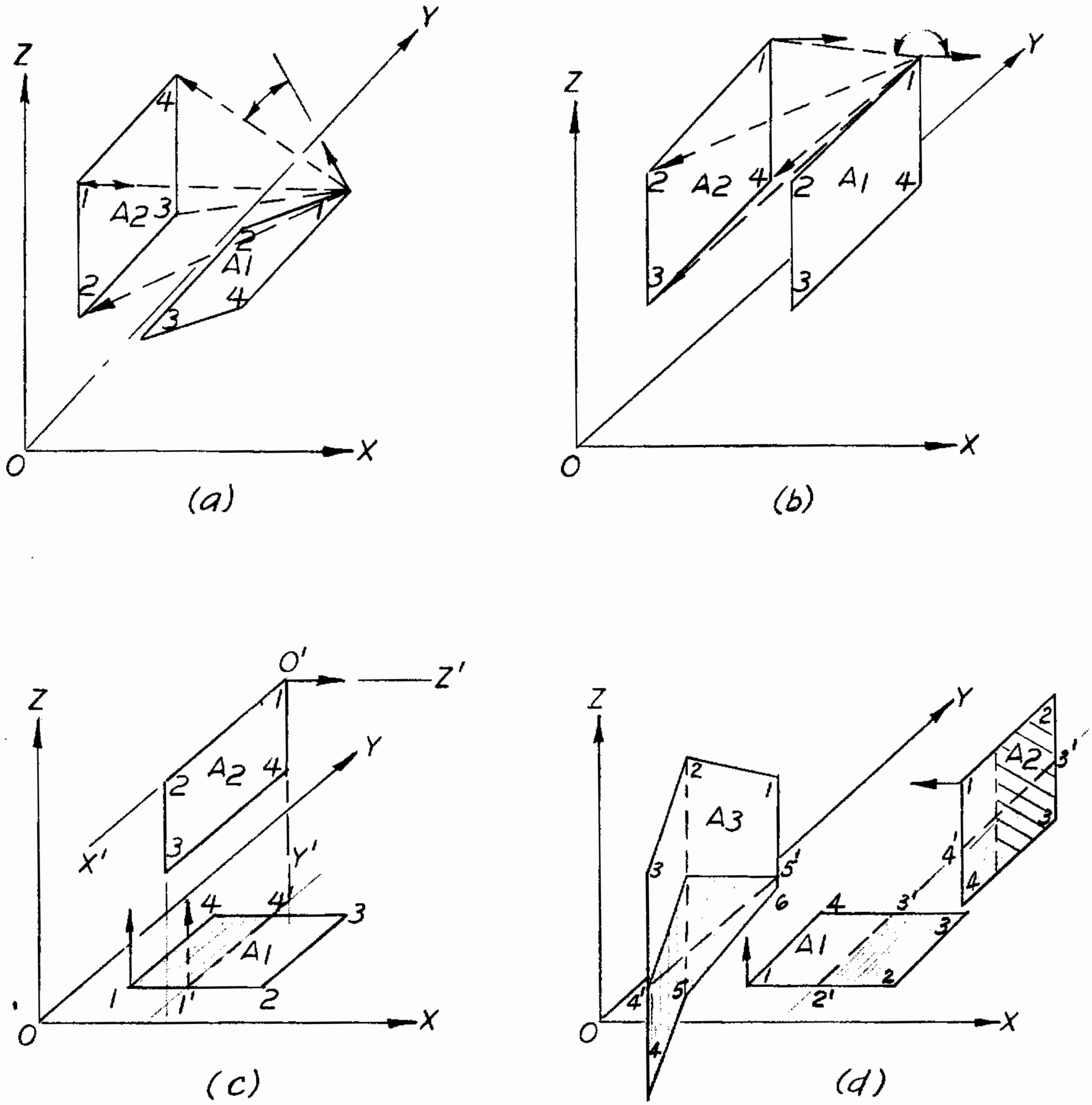

FIGURE 7. DOICU SURFACE ANALYSIS

Approved for Public Release

Contrails

removed as a result, a new orientation vector is created over the new point 1 as shown in Figure 7 (c). Notice that in reconstructing A3 [Figure 7 (d)], DOICU created the new array 1, 2, 3, 4', 5'. This "surface" is identical to the actual surface seen by A1 insofar as factor computation from A1 is concerned.

The bisection of a surface is done in a simple manner, with the aid of the auxiliary transformation capability. For example, in Figure 7 (c), the coordinates of both surfaces are transformed so that A2 lies in the XY plane of the auxiliary (primed) coordinate system. Each point in A1 is tested, in numerical order, until a change in the sign of the Z-coordinate occurs. The coordinates of the new points where the transition line segment crosses the X' Y' plane (Z' = 0) are obtained by computing X and Y intercepts of traces projected on X' Z', Y' Z' principal planes.

Subroutine MAP

The double integral in Equation (9) and its numerical counterpart in Equation (10) mathematically represent the volume under a surface defined by the configuration factor $\mathcal{C}_{12} = f(X,Y)$. Subroutine MAP decides the location (X,Y) from which each factor to Surface 2 will be computed.

It is assumed that Surface 1, being classed as a plane, is a plane surface throughout. The program insures only that the reference plane of Surface 1 is in the XY plane of the final coordinate system. MAP will use the X,Y coordinates of all points, and assumes a value of 0 for all Z coordinates. This procedure cannot properly map a nonplaner surface.

Subroutine MAP determines the maximum Y coordinate and the minimum Y coordinate from among the points defining Surface 1 (Figure 8). The total vertical distance between Y_{max} and Y_{min} is divided into equal vertical increments, as specified by the run instructions. Then, horizontal lines are scribed across (parallel to X-axis) the surface at each vertical increment position, including Y_{max} and Y_{min}. The point at which a horizontal line intersects the left (toward the negative X direction) boundary of Surface 1 is termed "X-left" and the intersection on the right, "X-right". Each horizontal line segment thus created is termed a "mapping line". Each mapping line segment is also divided into an equal number of increments as specified by the run instructions. All mapping lines are divided into the same number of increments, not necessarily the same size of increment. Obviously, if Surface 1 converges to a point instead of a line at Y_{max} or Y_{min}, the horizontal increment is 0. A configuration factor is computed at each increment point along a mapping line, including X-left and X-right, which means the number of factors per line is one greater than the number of increments.

The number of increments is automatically set to 24 horizontal and 24 vertical, but can be separately specified by input data to 3, 6, 18, 24, 30, 36, 42, 48, 54, or 60. The details are discussed in Section IV.

Approved for Public Release

Contrails

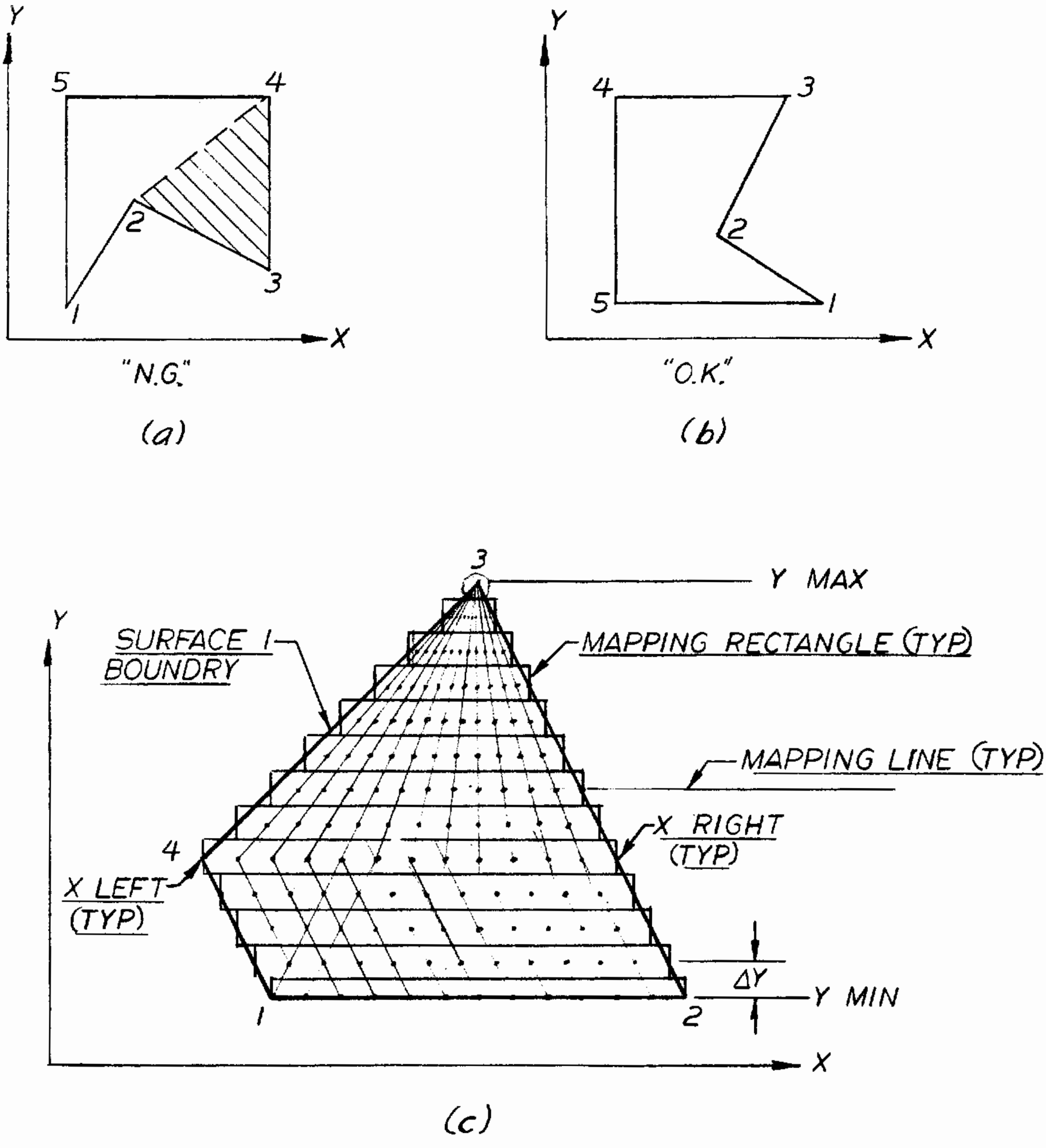

FIGURE 8. MAPPING PROCEDURE

Approved for Public Release

Contrails

A typical example of Surface 1 mapping using a standard (24 x 24) increment is shown in Figure 8 (c). The mapping area is also computed by Subroutine MAP; it is the sum of the rectangular areas formed by each mapping line. A measure of form factor accuracy is the degree with which the mapping area approximates the actual surface area.

Figure 8 (a) illustrates a Surface 1 orientation which cannot be satisfactorily mapped because the crosshatched area is ignored. The program does not detect more than one left and one right intersection between a mapping line and the surface boundary; therefore, point 3 is ignored. The same surface rotated sufficiently may be acceptable, however, clearing this restriction, as shown in Figure 8 (b).

Subroutine SILFAC

This subroutine computes the silhouette of Surface 2 which appears from the points selected on Surface 1 by Subroutine MAP, and then computes the configuration factor from this silhouette. After all configuration factors have been determined, the form factor is computed by numerical integration.

Surface data entered as Class 4, 5, 6, 7 or 8 is processed by SILFAC. Class 7 data, a sphere, is processed in this routine, but the silhouette generator is not utilized; a closed form solution is used instead (see Appendix E).

Classes 4, 5 and 6 are processed by the silhouette generator in the simple" mode; only those points given in connections data are analyzed to select the next point on the silhouette. Surfaces such as planes, cylinders, parallelpepids, etc. may be processed in the simple mode.

Class 8, a multisurface, is the only class processed in the complex mode. One or more (limitations on data are given at the end of this section and in Section IV) surfaces may be processed as a multisurface. Processing in the complex mode is complicated because the computer must test all line segments in all surfaces (including the surface in which the segment appears) in order to select the next point forming the silhouette, or to compute the next point on the silhouette. This analysis is further complicated by ambiguities resulting from normal imprecision in input data and internal arithmetic roundoff, necessitating the use of numerous time consuming tolerance tests. Consequently, a factor computation in the complex mode takes considerably longer than the simple mode.

If a surface is processed as simple when it should be complex, a wrong silhouette will be computed whenever a crossover (an intersection of two line segments) occurs. The configuration factor computed from that silhouette will be wrong.

It is possible to detect certain kinds of trouble in the silhouette generator from the detailed silhouette output which lists the points forming the

Approved for Public Release

Contrails

silhouette. Normally, the silhouette will start at the lowest leftmost point in the Z-unity plane perspective developed for the noted point in Surface 1, and move progressively from point to point in a counterclockwise manner, keeping the perspective area to the left. When a **crossover** occurs, the point is computed and assigned the next highest number in the silhouette array. For example, from point "D" in Figure 5, the silhouette derived in the complex mode would appear in the detailed silhouette output as "Line No., Point No., 1", 2", 9", 6", 5", 8", 10", 4", 1." However, if this problem were run as simple (both surfaces entered together as Class 4) instead, Surface S3 would be ignored because the **crossover** at point 9 would not be computed. The silhouette would appear normal, but actually be wrong, as follows:

Line No., Point No., 1", 2", 3", 4", 1".

A bad silhouette can sometimes be detected by the presence of internal "looping". Normally, a silhouette is completed by a return to the starting point. But, if, for some reason, a wrong path is chosen, it may loop a polygon within the perspective. Looping is characterized by the repeated appearance of the same sequence of numbers. No internal pattern recognition is attempted; the only detection is visual examination of the detailed output.

The coordinates of the silhouette on the Z = 1 plane are used directly for factor computation instead of the actual points on the surface in space. Because the Z - coordinate of each point is 1, the configuration factor equations for this special case can be simplified, and computing time reduced. SILFAC, therefore, contains its own equations for configuration factor computation and numerical integration across Surface 1. The integration process is similar to the procedure given in Subroutine FACTOR. Subroutine FACTOR has been retained from CONFAC I for factor computations not utilizing the silhouette generator.

Subroutine FACTOR

This subroutine computes configuration factors from each point on Surface 1 selected by MAP to Surface 2. The exchange coefficient is computed by numerical integration of configuration factors across Surface 1, from which the form factor is finally derived as the area-weighted mean of all configuration factors.

Factors are computed for each point along each mapping line, moving from X-left to X-right, by translating the origin of the Surface 2 coordinate system in X. The analysis and equations are organized for minimum computational time; constants at each loop level are computed once prior to loop entry. Because the usual output desired is only the form factor, configuration factors per se are not computed unless a detailed output is requested. A numerical integration of computed point function with respect to X is performed before proceeding to the next line. After all horizonal integrations are completed, these products are integrated with respect to Y, and divided by the mapping area computed in subroutine MAP.

Approved for Public Release

Contrails

A standard 24 X 24 grid results in 625 configuration factors to be computed. The question naturally arises as to whether this many configuration factors are actually required. If the configuration factor changes very little across Surface 1, then it is probably too many; but if there are sharp changes in the factor, and third place accuracy is desired, then it is probably sufficient. Contrary to off-hand expectations, a more sophisticated integration rule such as Simpson's or Weddle's is not as accurate as the trapezoidal rule for standard increments if the factor function slope changes rapidly. Weddle's rule was initially used which explains why the program increment control is in groups of six (except the initial 3 which is not in CONFAC I). If the factor varies smoothly, a 6 x 6 Weddle's rule integration (49 factors) is probably as accurate as the standard 625 factors presently used by the trapezoidal rule. The time saved is appreciable when running many factors. If desired, Weddle's rule may be inserted in the source deck and compiled with no other changes required.

The form factor computed by the above is from that part of Surface 1 which "sees" Surface 2. If Surface 1 is bisected, then the computed factor must be reduced in proportion to the area reduction. This is required because the total active side of Surface 1 entered in data is considered the radiant surface.

GENERAL RULES AND RESTRICTIONS

The following general rules and restrictions must be observed for normal program operation:

1. All data must be derived from <u>right</u>-handed rectangular coordinate systems.

2. Points 1, 2 and the last point in plane surface input data (Class 1 and 4) must not form a straight line in space.

3. The active side of a plane or nonplanar surface is established by entering the boundary points in <u>counterclockwise</u> order, as they appear when <u>facing</u> the active side.

4. If the factor to a Class 2 (nonplanar) surface is required, only the active surfaces should be seen from any point on Surface 1, and they must also be seen from every point on Surface 1.

5. All surfaces used as Surface 2 which utilizes the silhouette generator (Classes 5, 6, 8, or 4 if included in Class 8) must appear above the plane of Surface 1, i.e., all Z - coordinates must be nonzero and positive, prior to factor computation.

6. A primary transformation of Class 8 data is not permitted. Also, no auxiliary transformation is permitted; Surface 1 must be in the XY plane of the Multisurface coordinate system as entered in data.

7. Detailed restrictions and limitations upon input data are given in Section IV.

Approved for Public Release

Contrails

SECTION IV

INPUT DATA

DATA SPECIFICATIONS AND SPECIFIC RESTRICTIONS

Input data consists of externally computed surface data, specifications for internally created surfaces, transformation data and run instructions (factor requests). Also title and comments cards may be entered as required.

Data type is classified by the use of an integer from 1 to 9 placed in column 1 of the data name card, followed by a 1 to 5 FORTRAN character name to provide data identity within each class. The classes of data are described below.

Class 1 - Plane Polygon

The X, Y, and Z coordinates of each point defining the surface boundary are required. Only one side of a single plane surface can be made active i.e., may interchange radiant flux with another surface. The active side is established in the following manner: Face or look at the desired active side, and select any point on the surface boundary as point number one. Proceeding in a counterclockwise direction about the boundary of the surface, select the remaining points in sequence. If this rule is followed, the surface will always be on the left when moving along the boundary.

The X, Y, and Z coordinates of each point are entered on the data cards in the above sequence, and each point is numbered internally according to its position in the data.

It is assumed that a Class 1 surface is a plane surface. No internal check is made to verify this (in contrast to CONFAC I). If a substantially nonplanar surface is classed as a plane surface, serious errors in mapping could result if used as Surface 1, or wrong factors computed if used as Surface 2.

No point connections data are entered under Class 1; the silhouette generator is not used.

Class 2 - Nonplanar Surface

Two or more plane surfaces, not in the same plane, adjoining or connected, and entered as one package is termed a nonplanar surface.

A Class 2 surface can be used as a Surface 2 if the side of each facet selected as the active side, and only those sides, are seen from everywhere on the active side of Surface 1. The counterclockwise order of data

Approved for Public Release

Contrails

entry establishing the active side is also required as in Class 1, but no orientation vector is generated.

No connection data is required because the silhouette generator is not used.

Class 3 - Internally Generated Plane Polygon, No Connections Data

The internal surface generator will compute the coordinates of each point defining a plane polygon, parallel to the XY plane, with an orientation vector erected over point 1 and directed toward the +Z axis. A detailed description of the internal surface generator is given in Section II.

The data required for a Class 3 surface is:

No. of sides, $3 \leq N \leq 100$

X - Axis Radius

Y - Axis Radius

X, Y, and Z coordinates to center of polygon

A Class 3 surface is used in the same manner as a Class 1 surface. The same rules and restrictions apply.

Class 4 - Plane Polygon with Connections Data and Class 5 - Nonplanar Polygon or Solid Surface with Connections Data

A Class 4 surface is actually a Class 1 surface with connections data added making it possible for it to be processed with the silhouette generator. But, in general, no useful purpose is gained by the use of the silhouette generator to process a plane surface, unless combined with other surfaces. Therefore, a Class 4 surface is processed as a Class 1 surface, unless it is listed under a Class 8 entry.

A Class 5 surface is always processed in the simple mode by SILFAC unless listed under a Class 8 entry.

A maximum of 100 boundary points may be entered describing a Class 4 or 5 surface. Up to 4 connecting points for each boundary point may be entered. If more than four connecting points are required, one may enter more boundary data points having the same coordinates and connecting to each other, using the surplus (3) connections to satisfy the additional connections requirement. However, if more than two such identical boundary points are used, the surface cannot be processed in the simple mode. This restriction in most practical situations can be circumvented by separating the points slightly with little effect on the final form factor computed. If this cannot be done, the surface must be listed under a Class 8 name and processed in the complex mode.

Approved for Public Release

Contrails

Class 6 - Internally Generated Polygon or Polyhedron, Including Connections Data

A detailed description of the internal surface generator is given in Section II. A class 6 surface is always processed by SILFAC - in the simple mode if used directly, and complex if listed under Class 8. The data required to create a Class 6 surface are:

1. No. of cross sections

2. No. of cross sections divisions (sides)

3. Coordinates and generating radii of first cross section.

4. Z-coordinate and generating radii of additional cross sections, if any.

Attention is directed to general restrictions 4 and 5 in Section III.

Class 7 - Sphere

The radius and the X, Y, and Z coordinates of the sphere are required. A primary transformation of a sphere is pointless and therefore not permitted. Arbitrary orientation of both Surface 1 and sphere is allowed. One peculiarity exists which differs from the usual treatment of bisected surfaces. If the plane of Surface 1 bisects the sphere, the area of the spherical surface above the horizon of Surface 1 will be computed. Now the sphere cannot bisect Surface 1 in the usual sense, but it is possible a bisected sphere may be partly or totally inside the boundaries of Surface 1 - embedded in the surface. In this case, the program will merely assign a zero for the configuration factor when the viewpoint from Surface 1 is inside the sphere. This zero will be integrated as usual with the other factors computed along each mapping line. No computation of the Surface 1 area seeing the sphere is made, however, even though part of Surface 1 is not seen by the sphere.

Class 8 - Multisurface

A Multisurface consists of from one to eleven Class 4, 5, or 6 surfaces. A Class 8 surface, and only a Class 8 surface, is processed in the complex mode. The only data entry necessary to indicate the surfaces which comprise a Multisurface are the names assigned each surface.

Class 9 - Transformation Data

Transformation Data consists of the coordinates of three points in a surface, not in a straight line, derived from the "new position of a surface which has been moved in its coordinate system. One may, with equal validity, interpret the transformation to mean that the origin of the coordinate system is being moved to a different position, and the data are the coordinates of

Approved for Public Release

Contrails

each point taken from the new origin. The three points selected need not be chosen or entered in any particular order, nor must the same points be used if more than one different primary transformation of the same surface is desired.

Run Instructions

Run instructions specify, for each factor desired, the following:

1. The name of Surface 1 (emitter)

2. The name of Surface 2 (receiver)

3. Transformation data name(s) for Surface 1 and/or 2, if required.

4. Whether a standard or detailed output is desired, by inserting code letter "D" for detailed output.

5. The horizontal and/or vertical divisions to be used in mapping surface 1. The major divisions which may be used are 6, 12, 18, 24, 30, 36, 42, 48, 54 and 60, but in run instructions these divisions are specified, respectively, by the integers 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10. A special division of 2 may be specified by the integer 11.

DATA DIMENSION RESTRICTIONS

1. A maximum of 100 boundary points (300 coordinates) for each surface entered as Class 1, 2, 4, and 5.

2. A maximum of 100 points, equivalent to 100 sides, generated by Class 3 data.

3. For Class 6 data, the number of sides plus one, times the number of cross sections, must not exceed 101 if plane, and 102 if non-planar.

4. The grand total of surfaces entered or generated by Class 4, 5 and 6 must not exceed 11.

5. The grand total of surfaces entered or generated by Classes 1, 2, 3, 4, 5 and 6 must not exceed 26. If a detailed silhouette output is requested, the grand total must not exceed 16.

6. The total number of Class 7 data must not exceed 9.

7. The total number of Class 8 data must not exceed 12.

8. The total number of Class 9 data must not exceed 10.

Approved for Public Release

Contrails

PROGRAM CONTROL

The program deck setup is shown in Figure 36. Note the presence of a "T" card immediately following the * DATA Card and the variable format. A "T" card has a "T" in column 1, and serves two purposes. Columns 2 - 72 may contain job title, name of programmer, etc. and will be printed in the output of input data and each factor result. The "T" card also initializes data storage locations, so that new input data can be read in. This means, however, that the old data is effectively wiped out, and is no longer available for factor computations, unless re-entered as input data. It is obviously unnecessary to use the "T" card unless all available locations are used up.

Actually, a "T" card does not necessarily have to follow the variable format unless one desires the title to be printed, because the data location counters are automatically initialized at the start of the program. But subsequent reinitialization can be accomplished only by a card with a "T" in column 1.

It appears desirable to have separate identification of the various factors computed, and a comments card has been provided for that purpose. The comments card has a "C" in column 1, and a comment may appear in columns 2 - 72. A comments card may be inserted between run instruction cards, and the line of comment given on the card will be printed below the title on all output thereafter, unless superseded by another comments card.

Comments output may be entirely suppressed by using another comments card containing blanks in columns 2 - 72.

FORMAT

All data may be entered on NAA FORTRAN Fixed 10 Decimal Data sheets. Each line represents 12 card columns with six lines per card, making a total of 72 card columns available for data entry. Columns 73 - 80 are used for card identification and/or numerical sequencing for sorting purposes.

Title Card

A title card is characterized by an alphabetical "T" placed in column 1. Columns 2 - 72 available for job identification, as shown on Figure 9.

Comments Card

A comments card is characterized by an alphabetical "C" placed in column 1. Columns 2 - 72 are available for run comments, as shown on Figure 9.

Surface and Transformation Data

All surface and transformation data is preceded by a name card uniquely identifying the data. A name consists of six FORTRAN characters (a computer "word") and always occupies the first six columns of the name card. The data

Approved for Public Release

Contrails

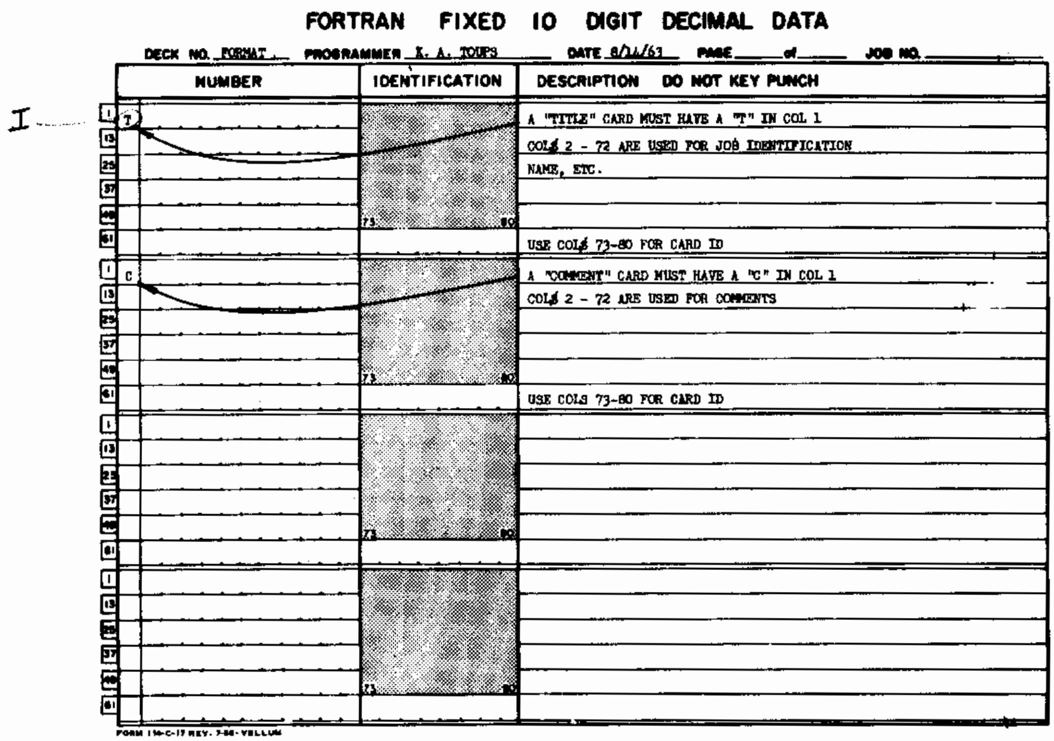

FIGURE 9. "T" and "C" Control Card Format

Approved for Public Release

Contrails

class, an integer from 1 to 9, must always be placed in column 1. The remainder of the name occupies columns 2 - 6, and it is important to note that a blank space is considered a character and a part of the name. For example, the name 1S1 is not the same as 1_S1 or 1_ _ _S1.

The next word on the name card, columns 7 - 12 must be left blank. The remainder of the name card, (columns 13 - 72) may be left blank or comments written to further identify the data, and will be printed out along with the name of the surface as part of the "Input Data" print out.

The data identified by the name card must follow the name card. There are seven different formats which must be adhered to in entering data.

Class 1 and 2

The number of points to be entered describing the surface appears on the first line, Figure 10, followed by the X, Y, and Z coordinates of each point in sequence. The order in which the points are selected in the surface is explained in detail in Section IV.

Class 3

The number of sides are entered on the first line, followed by the X, Y, and Z coordinates of the center of the internally generated polygon, the X-axis radius and the Y-axis radius as shown in Figure 11.

Class 4

The total number of points describing the surface are entered on the first line as shown in Figure 12. The X, Y, and Z coordinates of the first point follow on the next three lines. The fourth line, representing 12 columns, is divided into four equal parts of 3 columns each. Each point in the surface connecting to point 1 is entered, up to a maximum of four. The pattern is repeated for the remaining points describing the surfaces.

Class 6

The numbers of surface cross section boundary divisions (sides) is given on the first line as shown in Figure 13. The number of cross sections desired is specified on the second line, followed by the X, Y, and Z coordinates of the base (1st) cross section. The X-axis radius of the base cross section is given on the last line of the first card. The Y-axis radius is entered on the first line of the second card, followed by, if more than one cross section is specified, the following, repeated for each cross section: The height (Z-coordinate) of the cross section above the XY plane, the X-axis radius and the Y-axis.

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. FORMAT PROGRAMMER K. A. TOUPS DATE 8/14/63 PAGE ___ of ___ JOB NO. ___

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	N	X X X X X		NAME OF CLASS 1 OR 2 SURFACE, COLS 1-6
13				CLASS 1 - PLAN POLYGON, USE "1" IN COL. 1
25				CLASS 2 - NONPLANAR POLYGON, USE "2" IN COL. 1
37				IMPORTANT: COLS. 7-12 MUST BE BLANK!
49			73 80	USE COLS. 13-72 FOR ADDITIONAL DESCRIPTION
61				USE COLS. 73-80 FOR CARD ID, ALL CARDS
1	N	P		NO. OF POINTS DEFINING THE SURFACE
13	X	1		
25	Y	1		COORDINATES OF FIRST BOUNDARY POINT
37	Z	1		
49	X	2	73 80	
61	Y	2		COORDINATES OF SECOND BOUNDARY POINT
1	Z	2		
13	X	3		
25	Y	3		3RD
37	Z	3		
49			73 80	
61				etc.
1				
13				NOTE: 1) ALL DATA MUST USE DECIMAL POINT, EXCEPT
25				INTEGERS WHICH MAY BE ENTERED TO EXTREME RIGHT OF FIELD
37				2) DATA MUST BE DERIVED FROM RIGHT-HANDED
49			73 80	RECTANGULAR COORDINATE SYSTEM
61				

FORM 114-C-17 REV. 7-60-VELLUM

FIGURE 10. Class 1 and 2 Surface Input Data Format

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. FORMAT PROGRAMMER E. A. TOUPS DATE 8/14/63 PAGE ___ of ___ JOB NO. ___

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	3	X X X X X		NAME OF CLASS 3 SURFACE, COLS 1-6
13				USE "3" IN COL. 1 TO CREATE AN
25				INTERNALLY GENERATED PLANE POLYGON
37				IMPORTANT: COLS. 7-12 MUST BE BLANK!
49			73 80	USE COLS. 13-72 FOR ADDITIONAL DESCRIPTION
61				USE COLS. 73-80 FOR CARD ID, ALL CARDS
1	N	Ø		NO. OF POLYGON SIDES, ≥ 3
13	X			} COORDINATES OF CENTER
25	Y			
37	Z			
49	R	X	73 80	X - AXIS RADIUS
61	R	Y		Y _ AXIS RADIUS
1				
13				
25				
37				
49			73 80	
61				
1				NOTE: 1) ALL DATA MUST USE DECIMAL POINT, EXCEPT
13				INTEGERS WHICH MAY BE ENTERED TO EXTREME RIGHT OF FIELD
25				2) SURFACE IS GENERATED IN A RIGHT HANDED
37				RECTANGULAR COORDINATE SYSTEM
49			73 80	
61				

FORM 114-C-17 REV. 7-58- VELLUM

FIGURE 11. Class 3 Surface Specifications Input Data Format

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. FORMAT PROGRAMMER K. A. TOUPS DATE 8/14/63 PAGE ____ of ____ JOB NO. ____

Col	NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	N X X X X X		NAME OF CLASS 4 OR 5 SURFACE, COLS 1 - 6
13			CLASS 4 - PLANE POLYGON, USE "4" IN COL. 1
25			CLASS 5 - NONPLANAR POLYGON OR SOLID, USE "5" IN COL. 1
37			IMPORTANT: COLS. 7-12 MUST BE BLANK!
49		73 80	USE COLS 13-72 FOR ADDITIONAL DESCRIPTION
61			USE COLS 73-80 FOR CARD ID, ALL CARDS
1	N P		NO. OF POINTS DEFINING SURFACE
13	X 1		
25	Y 1		COORDINATES OF FIRST BOUNDARY POINT
37	Z 1		
49	N 1 | N 2 | N 3 | N 4	73 80	POINTS CONNECTING TO FIRST POINT (≤ 4)
61	X 2		
1	Y 2		COORDINATES OF SECOND BOUNDARY POINT
13	Z 2		
25	N 1 | N 2 | N 3 | N 4		POINTS CONNECTING TO SECOND POINT (≤ 4)
37			etc. IMPORTANT: ALL CONNECTING POINTS MUST BE
49		73 80	ENTERED AS INTEGERS TO RIGHT
61			OF FIELD OF 4 COLS. AS SHOWN.
1			NOTE: 1) ALL DATA MUST USE DECIMAL POINT, EXCEPT
13			INTEGERS WHICH MAY BE ENTERED TO EXTREME
25			RIGHT OF FIELD (NOTE ABOVE EXCEPTION)
37			2) DATA MUST BE DERIVED FROM RIGHT-HANDED
49		73 80	RECTANGULAR COORDINATE SYSTEM
61			

FORM 114-C-17 REV. 7-60-VELLUM

FIGURE 12. Class 4 and 5 Surface Input Data Format

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. FORMAT PROGRAMMER K. A. TOUPS DATE 8/14/63 PAGE ____ of ____ JOB NO. ____

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	6	X X X X X		NAME OF CLASS 6 SURFACE, COL$ 1 - 6
13				USE "6" IN COL. 1 FOR AN INTERNALLY
25				GENERATED PLANE POLYGON OR SOLID, WITH CONNECTIONS DATA
37				IMPORTANT: COL$ 7-12 MUST BE BLANK!
49			73 80	USE COL$ 13-72 FOR ADDITIONAL DESCRIPTION
61				USE COLS 73-80 FOR CARD ID, ALL CARDS
1	N	S		NO. OF POLYGON CROSS SECTION SIDES, ≥ 3
13	N	C		NO. OF CROSS SECTIONS DESIRED
25	X	1		
37	Y	1		COORDINATES OF FIRST CROSS SECTION CENTER
49	Z	1	73 80	
61	X	R 1		X-AXIS RADIUS, FIRST CROSS SECTION
1	Y	R 1		Y-AXIS RADIUS, FIRST CROSS SECTION
13	Z	2		HEIGHT (Z-COORD), SECOND CROSS SECTION (IF ANY)
25	X	R 2		X-AXIS RADIUS, " " " " "
37	Y	R 2		Y-AXIS RADIUS, " " " " "
49		↓	73 80	THIRD " " " "
61		etc.		↓ etc. " " " " "
1				" " " " "
13				NOTE: 1) ALL DATA MUST USE DECIMAL POINT, EXCEPT INTEGERS
25				WHICH MAY BE ENTERED TO EXTREME RIGHT OF FIELD
37				2) SURFACE IS GENERATED IN A RIGHT HANDED
49			73 80	RECTANGULAR COORDINATE SYSTEM
61				

FORM 114-C-17 REV. 7-60 - VELLUM

FIGURE 13. Class 6 Surface Specifications Input Data Format

Approved for Public Release

Contrails

Class 7

The sphere radius is entered on the first line, followed by the X, Y, and Z coordinates locating the center of the sphere as shown in Figure 14.

Class 8

The names of the surface (s) which are to be entered under this class are entered together on one card, without regard to order as shown in Figure 15. The card is equally divided into 12 words of six columns each. Each name to be entered must appear identically in a word-space as it appears in the word-space on the data name card.

Class 9

The first point to be transformed is entered on the first line, followed by the X, Y and Z coordinates of the "new" position of the point as shown in Figure 16. The second point to be transformed immediately follows on the fifth line followed by the X-coordinate of the new position of the second point, thus completing the first card. The Y and Z coordinates of the new position of the second point are entered on the first two lines of the second card, followed by the number of the third point to be transformed and its new X, Y, and Z coordinates.

All of the numbers entered in the above data may be entered as fixed or floating point numbers except connections data, which must be entered as decimal integers. If a decimal point is given (fractional numbers must have decimal points given), the floating number may be located anywhere in the field (line); if no decimal point is given, the number must be located to the extreme right of the field (no blanks to the right of the number).

Run Instructions

Six FORTRAN words comprise a set of run instructions; two sets may be entered on one card as shown in Figure 17. The first set starts at column 1 and the second set starts at column 37. Two words (12 columns) comprise one line on the data sheet. The name of the Surface 1 data is entered in the first word (columns 1 - 6) precisely as it appears in the first word of the surface data name card. The name of the Surface 2 data is entered in the second word (columns 8 - 12) precisely as it appears in the first word of the surface data name card. If a primary transformation of Surface 1 is desired, the desired transformation data name is entered in columns 13 - 18, otherwise, it is left blank. If a primary transformation of Surface 2 is desired, the name of the transformation data is entered in the fourth word, columns 19 - 24. If a detailed output is desired, the alphabetical character "D" is entered in column 25, or in column 31. If the "D" appears in either or both locations, a detailed output will result; if a blank is in both locations, a standard output will result. The horizontal mapping division "integer" appears in column 30, unless the integer 10 or 11 is used, in which case columns 29 and 30 are utilized. The vertical mapping division "integer" appears in column 36, un-

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. FORMAT PROGRAMMER K. A. TOUPS DATE 8/14/63 PAGE ___ of ___ JOB NO. ___

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	7	X X X X X		NAME OF CLASS 7 SURFACE, COLS 1-6
13				USE "7" IN COL 1 FOR A SPHERE
25				
37				IMPORTANT: COLS. 7-12 MUST BE BLANK!
49			73 80	USE COLS 13-72 FOR ADDITIONAL DESCRIPTION
61				USE COLS 73-80 FOR CARD ID, ALL CARDS
1	R	A		RADIUS OF SPHERE
13	X			COORDINATES OF CENTER
25	Y			
37	Z			
49			73 80	
61				
1				
13				
25				
37				
49			73 80	
61				
1				NOTE: 1) ALL DATA MUST USE DECIMAL POINT EXCEPT
13				INTEGERS WHICH MAY BE ENTERED TO
25				EXTREME RIGHT OF FIELD
37				2) DATA MUST BE DERIVED FROM RIGHT-
49			73 80	HANDED RECTANGULAR COORDINATE SYSTEM
61				

FORM 114-C-17 REV. 7-60-VELLUM

FIGURE 14. Class 7 Sphere Specification Input Data Format

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. FORMAT PROGRAMMER K. A. TOUPS DATE 8/14/63 PAGE ____ of ____ JOB NO. ____

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	8 X X X X X			NAME OF CLASS 8 SURFACE, COLS 1 - 6
13				USE "8" IN COL 1 FOR MULTISURFACE
25				
37				IMPORTANT: COLS 7-12 MUST BE BLANK!
49			73 80	USE COLS. 13-72 FOR ADDITIONAL DESCRIPTION
61				USE COLS. 73-80 FOR CARD ID. ALL CARDS
1	← 1st →	← 2nd →		ENTER NAMES OF SURFACES (≤ 11) WHICH
13	← 3rd →	← 4th →		ARE TO BE GROUPED TOGETHER
25	etc			
37	↓			
49			73 80	
61				
1				
13				
25				
37				
49			73 80	
61				
1				
13				
25				
37				
49			73 80	
61				

FORM 114-C-13 REV. 7-60-VELLUM

FIGURE 15. Class 8 Multisurface Specifications Input Data Format

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. FORMAT PROGRAMMER K. A. TOUPS DATE 8/14/63 PAGE ___ of ___ JOB NO. ___

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	9	X X X X X		NAME OF CLASS 9 DATA, COLS 1 - 6
13				USE "9" IN COL. 1 FOR TRANSFORMATION
25				DATA
37				IMPORTANT: COLS. 7-12 MUST BE BLANK!
49			73 80	USE COLS. 13-72 FOR ADDITIONAL DESCRIPTION
61				USE COLS. 73-80 FOR CARD ID, ALL CARDS
1	N	1		FIRST POINT TO BE TRANSFORMED
13	X	1		
25	Y	1		COORDINATES OF FIRST POINT FROM
37	Z	1		"NEW" ORIGIN
49	N	2	73 80	SECOND POINT TO BE TRANSFORMED
61	X	2		
1	Y	2		COORDINATES OF SECOND POINT FROM "NEW" ORIGIN
13	Z	2		
25	N	3		THIRD POINT, etc
37	X	3		
49	Y	3	73 80	COORDINATES, etc
61	Z	3		
1				
13				Note: 1) ALL DATA MUST USE DECIMAL POINT EXCEPT
25				INTEGERS WHICH MAY BE ENTERED TO EXTREME
37				RIGHT OF FIELD
49			73 80	2) DATA MUST BE DERIVED FROM A RIGHT-HANDED
61				RECTANGULAR COORDINATE SYSTEM

FORM 114-C-17 REV. 7-60-VELLUM

FIGURE 16. Class 9 Transformation Data Input Data Format

Approved for Public Release

Contrails

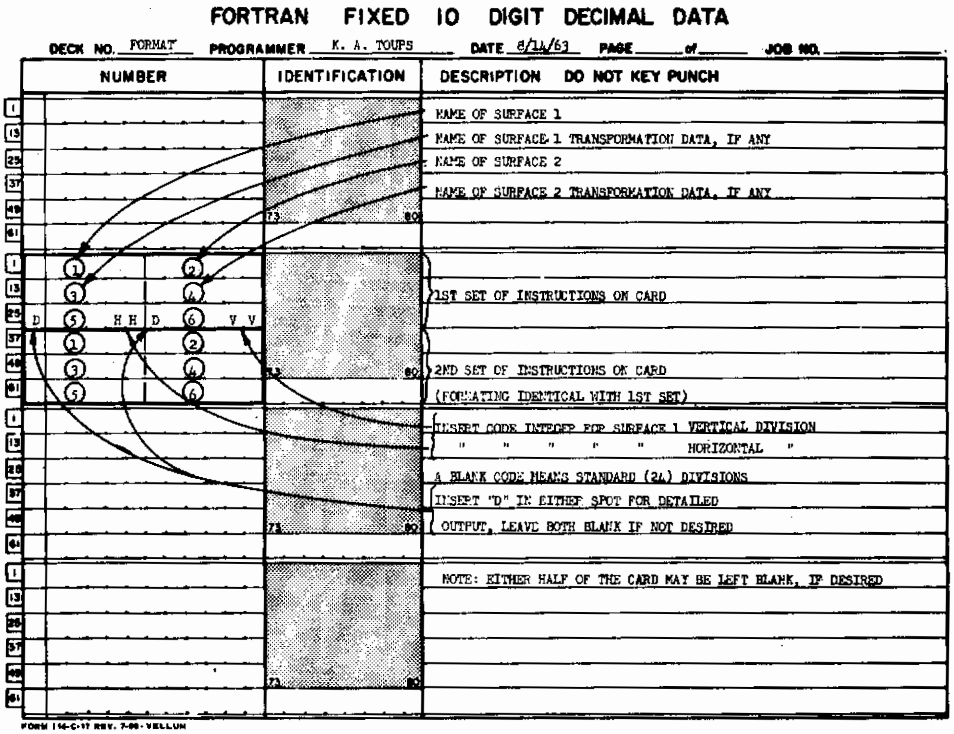

FIGURE 17. Run Instructions Input Data Format

Approved for Public Release

Contrails

less the integer 10 or 11 is used, in which case columns 35 and 36 are utilized. If columns 29 and 30 are both blank, a standard integer 4 meaning 24 horizontal divisions of each mapping line is used. If 35 and 36 are both blank, a standard vertical division of 24 will be used. The above format is repeated in the same manner, starting from column 37 on the fourth line, for the second set of run instructions on the card. There is no numerical limit to the number of run instructions which may be entered. The only requirement is, of course, that the data called for has been loaded in under the names used.

Approved for Public Release

Contrails

Approved for Public Release

Contrails

SECTION V

PROGRAM OUTPUT

Input data is processed and printed out prior to its use in factor computations for programmer verification. The orientation vector head end is also printed out for all plane surfaces, so that the "active" side used by the program is clearly shown. Class 3 and 6 specifications as read in are printed, along with the surface data generated by the specifications.

A standard "minimum" output is given when the code letter "D" does not appear in the run instructions, consisting of the following:

1. Run number

2. Run instructions

3. The computed form factor

4. The Surface 1 mapping area

5. The exchange coefficient (fA product)

6. The total area of Surface 1

7. If Surface 1 is bisected, the area seen by Surface 2

8. The total area of Surface 2, if Surface 2 area can be computed

9. If Surface 2 is bisected, the area seen by Surface 1, if that area can be computed

10. The time in seconds spent in Subroutine SILFAC, if utilized

If a detailed output is requested, the minimum output plus the following is printed:

1. The final coordinates of Surface 1 and Surface 2 prior to computation of configuration factors.

2. The X-Left and X-Right coordinates for each Y division of Surface 1 mapping, including horizontal and vertical divisions used.

3. Each configuration factor computed. The output is given in groups of factors easily identified because the last factor in a group occupies a line by itself. Each group contains the configuration factors computed on a mapping line. The first factor in the group is that computed at X-left and the last factor in the group is that

Approved for Public Release

Contrails

computed at X-right. The first group represents the first mapping line, the second group the second mapping line, etc.

4. If the silhouette generator was used, the silhouette computed for points selected on each mapping line is printed out. The first numeral given is the mapping line, the second is the point on the mapping line, moving from X-left to X-right. The numbers following represent the silhouette.

Approved for Public Release

Contrails

SECTION VI

REFERENCES

1. Hamilton, D. C. and W. R. Morgan. Radiant-Interchange Configuration Factors. National Advisory Committee for Aeronautics. NACA TN-2836 (1952).

2. Sokolnikoff, I. D., and R. M. Redheffer. Mathematics of Physics and Modern Engineering. New York: McGraw-Hill Book Company, Inc., (1958).

3. Moon, Parry. The Scientific Basis of Illuminating Engineering. New York: Dover Publications, Inc, (1961), pp. 312-318.

4. O'Brien, P. F. "Pleijel's Globoscope for Lighting Design," Illuminating Engineering, Vol. LVIII, No. 3 (3 March 1963).

5. Toups, Kempton A. A General Computer Program for the Determination of Radiant-Interchange Configuration Factors. NAA S&ID, SID 62-393, ASD Technical Note ASD-TN-61-101 (ASTIA No. 403027), (March 1963).

Approved for Public Release

Contrails

Approved for Public Release

Contrails

APPENDIX A

SAMPLE PROBLEMS

A number of sample problems have been devised to illustrate the capabilities and limitations of CONFAC II. The examples are arranged roughly in order of complexity, beginning with simple plane surfaces and concluding with a complicated "intervening surface" problem involving plane and solid surfaces.

The surface configurations upon which the example problems are based are shown in accompanying illustrations. Each illustration is conveniently grouped separately with the problem description pertaining to the surfaces shown in the illustration, along with the input data sheets, run instructions, program output and a short discussion.

Approved for Public Release

Contrails

SAMPLE PROBLEM GROUP A

The surfaces shown in Figure 18 are similar to the examples given in CONFAC I. The added CONFAC II capability of bisecting a nonplanar surface is demonstrated. The data sheets are shown in Figure 19 and the results are presented in Figure 20.

Problem 1A

In **Figure** 18 (A1), the factor between the floor of a cubical room (1FLOOR) and an adjacent wall (1WALL) is computed, using standard horizontal and vertical mapping divisions (24 x 24) on Surface 1. A detailed output is requested.

Note that because no primary or auxiliary transformation occurred, the final coordinate system is the same as the input data (unprimed) coordinate system. The first mapping line starts at the origin and extends to point 1 in 1FLOOR.

Problem 2A

In Figure 18 (A1), any plane surface may be used as Surface 1 providing it has been properly entered in data prior to the factor request. To demonstrate, the wall (1WALL) now acts as Surface 1, and the factor to the floor (1FLOOR) is requested.

Note that Surface 1WALL is not in the X-Y plane of its input (unprimed) coordinate system. The program, therefore, had to perform an auxiliary transformation of both surfaces to the primed system shown, prior to factor computation, to get Surface 1 in the XY plane.

Problem 3A

In Figure 18 (A2), the factor from the floor (1FLOOR) to two adjacent walls taken together (2WALLS) is requested. This is a valid request because the boundary data describing 2WALLS form a valid silhouette of 2WALLS from any point on 1FLOOR. The factor should be twice that to one wall alone.

Problem 4A

The program cannot validly compute the factor from a nonplanar surface. A Class 2 surface is assumed nonplanar. The factor from 2WALLS to 1FLOOR is requested in order to elicit the diagnostic, warning the user of this error.

The program does not test the surface, as in CONFAC I. If a nonplanar surface is erroneously entered as a Class 1 surface, it will not be rejected if used as Surface 1 - the responsibility lay with the user to insure that Surface 1 is planar.

Approved for Public Release

Contrails

Problem 5A

In Figure 18 (A3), the necessity for proper order in data entry is emphasized. The wall data are deliberately entered in a clockwise direction (1WALLR) looking at the active surface, instead of counterclockwise. Hence, the orientation vector points in the wrong direction. The factor from 1FLOOR to 1WALLR is requested in order to elicit the diagnostic which alerts the user to a possible error.

Problem 6A

In Figure 18 (A4), CONFAC II has the capability of bisecting a nonplanar (Class 2) surface. The factor from 1FLOOR to 2WALLZ, is requested, with a detailed output, to demonstrate this capability.

Subroutine DOICU bisected 2WALLZ at the XY plane, and reconstructed the surface by eliminating points 2, 3, and 4, as shown, and creating new points 2', 3', 4' and 5'. The dashed line 2' 3' divides Surface 1 (1FLOOR) into triangular parts, designated A and B. The view of the reconstructed 2WALLZ from anywhere in area B reflects a valid silhouette in the proper counterclockwise order. When reconstructed 2WALLZ is viewed from area A, the points still form a valid silhouette, but the order is reversed. This means the computed configuration factor will be to the hemispherical space not occupied by 2WALLZ, and will be negative. So, subroutine FACTOR subtracts this factor from 1.0 to yield the correct factor to 2WALLZ.

Approved for Public Release

Contrails

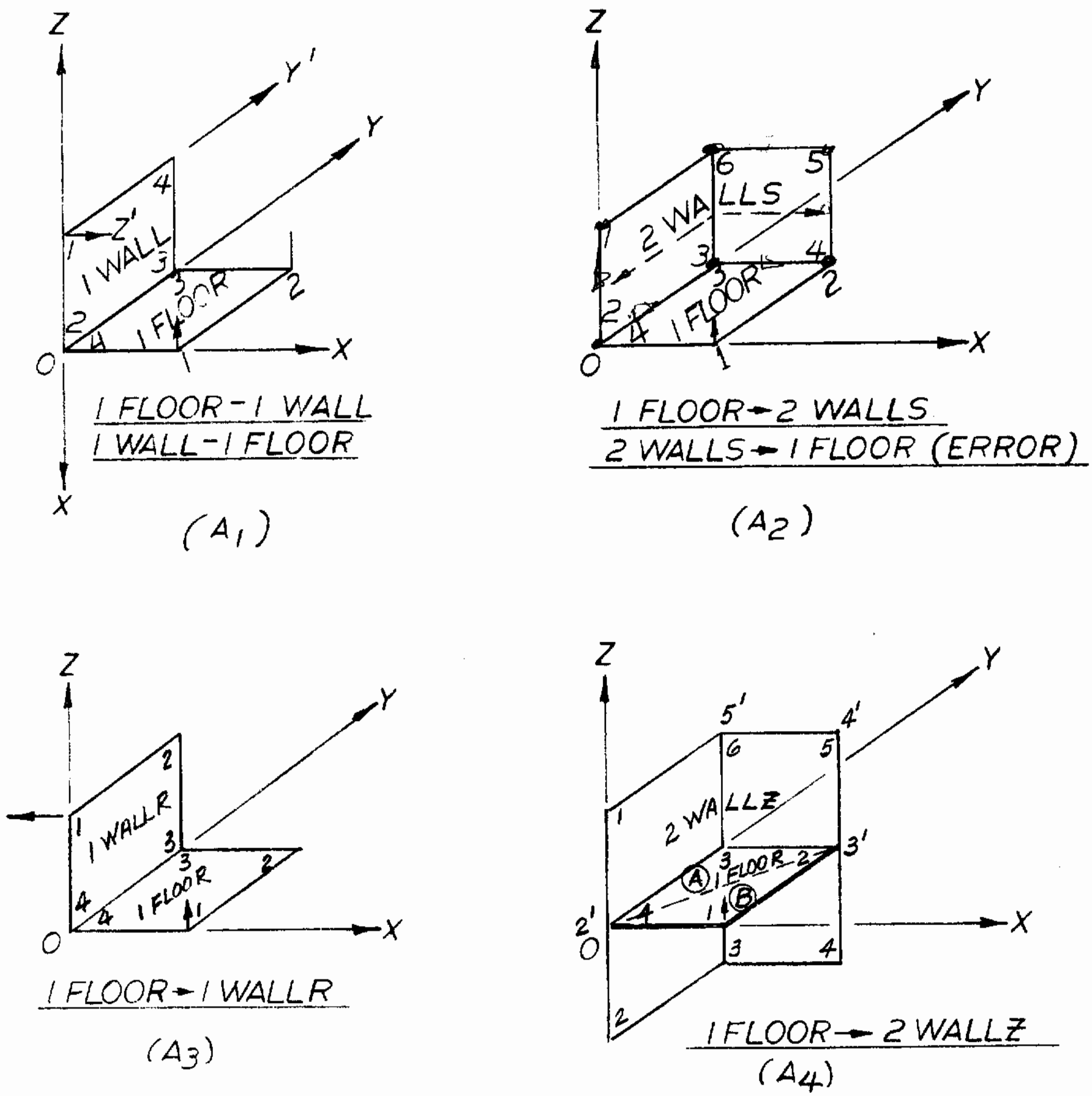

FIGURE 18. SAMPLE PROBLEMS - GROUP A

Approved for Public Release

Contrails

FORTRAN FIXED IO DIGIT DECIMAL DATA

DECK NO. DATA PROGRAMMER K. TOUPS DATE 11/4/63 PAGE 1 of 36 JOB NO. 2929-30

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	T	NAA CØNFAC		
13	I	I REPØRT ØA		
25	M	PLE PRØBLEM		
37	Ø	FRØM FIG.		
49		-K.A.TØU		
61	P	Ø,11/1/63	A010	
1	1	FLØØR		
13				
25	1	X1 ØQUARE		
37				
49				
61			A020	
1	4	.0		
13	1	.0		
25	0	.0		
37	0	.0		
49	1	.0		
61	1	.0	A030	
1	0	.0		
13	0	.0		
25	1	.0		
37	0	.0		
49	0	.0		
61	0	.0	A040	

FORM 114-C-17 REV. 7-61

FORTRAN FIXED IO DIGIT DECIMAL DATA

DECK NO. PROGRAMMER DATE PAGE 2 of 36 JOB NO. 2929-30

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	0	.0		
13				
25				
37				
49				
61			A050	
1	1	WALL		
13				
25	1	X1 ØQUARE T		
37	Ø	UCHING 1WAL		
49	L			
61			A060	
1	4	.0		
13	0	.0		
25	0	.0		
37	1	.0		
49	0	.0		
61	0	.0	A070	
1	0	.0		
13	0	.0		
25	1	.0		
37	0	.0		
49	0	.0		
61	1	.0	A080	

FORM 114-C-17 REV. 7-61

FIGURE 19. Group A Sample Problems Input Data Code Sheets

Approved for Public Release

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 3 of 36 JOB NO. 2929-30

	NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	1 . 0		
13			
25			
37			
49			
61		A 0 9 0	
1	1 W A L L R		
13	Ø A M E A Ø 1 W A L		
25	L , B U T W I T H		
37	D A T A E N T E R E D		
49	C L Ø C K W I Ø E		
61		A 1 0 0	
1	4 . 0		
13	0 . 0		
25	0 . 0		
37	1 . 0		
49	0 . 0		
61	1 . 0	A 1 1 0	
1	1 . 0		
13	0 . 0		
25	1 . 0		
37	0 . 0		
49	0 . 0		
61	0 . 0	A 1 2 0	

FORM 114-C-17 REV. 7-60

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 4 of 36 JOB NO. 2929-30

	NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	0 . 0		
13			
25			
37			
49			
61		A 1 3 0	
1	2 W A L L Ø		
13			
25	Ø I D E A N D B A C		
37	K W A L L T A K E N		
49	T Ø G E T H E R		
61		A 1 4 0	
1	6 . 0		
13	0 . 0		
25	0 . 0		
37	1 . 0		
49	0 . 0		
61	0 . 0	A 1 5 0	
1	0 . 0		
13	0 . 0		
25	1 . 0		
37	0 . 0		
49	1 . 0		
61	1 . 0	A 1 6 0	

FORM 114-C-17 REV. 7-60

FIGURE 19. Group A Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 5 of 36 JOB NO. 2929-30

Col.	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	0	. 0		
13	1	. 0		
25	1	. 0		
37	1	. 0		
49	C	. 0		
61	1	. 0	A 1 7 0	
1	1	. 0		
13				
25				
37				
49				
61			A 1 8 0	
1	2	W A L L Z		
13				
25	2	W A L L Ø B U T E		
37	X	T E N D E D B E L Ø		
49	W	T H E Ø U R F A C		
61	E	Ø F 1 F L Ø Ø R	A 1 9 0	
1	6	. 0		
13	C	. 0		
25	C	. C		
37	1	. 0		
49	0	. 0		
61	C	. 0	A 2 0 0	

FORM 114-C-17 REV. 7-64

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 6 of 36 JOB NO. 2929-30

Col.	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	-	1 . 0		
13	0	. 0		
25	1	. 0		
37	-	1 . 0		
49	1	. 0		
61	1	. 0	A 2 1 0	
1	-	1 . 0		
13	1	. 0		
25	1	. 0		
37	1	. 0		
49	0	. 0		
61	1	. 0	A 2 2 0	
1	1	. 0		
13				
25				
37				
49				
61			A 2 3 0	
1	2	B Ø X		
13				
25	A	L L Ø F Ø P A C		
37	E	Ø E E N B Y 1 F		
49	L	Ø Ø R		
61			A 2 4 0	

FORM 114-C-17 REV. 7-64

FIGURE 19. Group A Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 7 of 36 JOB NO. 2929-30

		NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	4	. 0		
13	0	. 0		
25	0	. 0		
37	0	. 0		
49	0	. 0		
61	1	. 0	A 2 5 0	
1	0	. 0		
13	1	. 0		
25	1	. 0		
37	0	. 0		
49	1	. 0		
61	1	. 0	A 2 6 0	
1	0	. 0		
13				
25				
37				
49				
61			A 2 7 0	
1	1	F L Ø Ø R 1 W A L L		
13				
25	D			
37	1	W A L L 1 F L Ø Ø R		
49				
61	D		A 2 8 0	

FORM 114-C-17 REV. 7-60

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 8 of 36 JOB NO. 2929-30

		NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	1	F L Ø Ø R 2 W A L L Ø		
13				
25	D			
37	2	W A L L Ø 1 F L Ø Ø R		
49				
61			A 2 9 0	
1	1	F L Ø Ø R 1 W A L L H		
13				
25				
37	1	F L Ø Ø R 2 W A L L Z		
49				
61	D		A 3 0 0	
1	1	F L Ø Ø R 2 B Ø X		
13				
25	D			
37				
49				
61			A 3 1 0	
1				
13				
25				
37				
49				
61				

FORM 114-C-17 REV. 7-60

FIGURE 19. Group A Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

```
                         NAA SPACE AND INFORMATION SYSTEMS DIVISION
                 T+A PROJECT RADIANT-INTERCHANGE CONFIGURATION FACTOR PROGRAM

                                      C O N F A C  I I

          NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (A)-K.A.TOUPS,11/1/63

                                      I N P U T   D A T A

***** DATA NAME- *1FLOOR       *              1X1 SQUARE

POINT        X              Y              Z             POINT       X              Y              Z
        0.1000000E 01  0.             0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1    0.1000000E 01  0.             0.                      2  0.1000000E 01  0.1000000E 01  0.
   3    0.             0.1000000E 01  0.                      4  0.             0.             0.

***** DATA NAME- *1WALL        *              1X1 SQUARE TOUCHING 1WALL

POINT        X              Y              Z             POINT       X              Y              Z
        0.1000000E 01  0.             0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1    0.             0.             0.1000000E 01           2  0.                   0.             0.
   3    0.             0.1000000E 01  0.                      4  0.                   0.1000000E 01  0.1000000E 01

***** DATA NAME- *1WALLR       * SAME AS 1WALL, BUT WITH DATA ENTERED CLOCKWISE

POINT        X              Y              Z             POINT       X              Y              Z
       -0.1000000E 01  0.             0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1    0.             0.             0.1000000E 01           2  0.                   0.1000000E 01  0.1000000E 01
   3    0.             0.1000000E 01  0.                      4  0.                   0.             0.

***** DATA NAME- *2WALLS       *              SIDE AND BACK WALL TAKEN TOGETHER

POINT        X              Y              Z             POINT       X              Y              Z
   1    0.             0.             0.1000000E 01           2  0.             0.             0.
   3    0.             0.1000000E 01  0.                      4  0.1000000E 01  0.1000000E 01  0.
   5    0.1000000E 01  0.1000000E 01  0.1000000E 01           6  0.             0.1000000E 01  0.1000000E 01
```

FIGURE 20. Group A Sample Problems Program Results
(24 pages)

Approved for Public Release

Contrails

***** DATA NAME- *2WALLZ * 2WALLS BUT EXTENDED BELOW THE SURFACE OF 1FLOOR

POINT	X	Y	Z	POINT	X	Y	Z
1	0.	0.	0.1000000E 01	2	0.	0.	-0.1000000E 01
3	0.	0.1000000E 01	-0.1000000E 01	4	0.1000000E 01	0.1000000E 01	-0.1000000E 01
5	0.1000000E 01	0.1000000E 01	0.1000000E 01	6	0.	0.1000000E 01	0.1000000E 01

FIGURE 20. Group A Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (A)-K.A.TOUPS,11/1/63

RUN NO.   1   DATA USED FOR THIS RUN- *IFLOOR*IWALL *
                                      *      *      *
                                      *D     *      *

THE FORM FACTOR FROM SURFACE *IFLOOR     * TO SURFACE *IWALL      * = 0.19996

THE EXCHANGE COEFFICIENT (FA)=   0.19996E-00 SQ UNITS

                 THE MAPPING AREA = 1.0000000E 00 SQ UNITS

THE AREA OF SURFACE *IFLOOR     * = 0.1000000E 01 SQ UNITS.

THE AREA OF SURFACE *IWALL      * = 0.1000000E 01 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *IFLOOR      *

POINT      X                Y               Z                POINT       X                Y                Z
      0.1000000E 01  0.                0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
  1   0.1000000E 01  0.                0.                   2   0.1000000E 01  0.1000000E 01  0.
  3   0.             0.1000000E 01  0.                   4   0.             0.             0.


***** DATA NAME- *IWALL       *

POINT      X                Y               Z                POINT       X                Y                Z
      0.1000000E 01  0.                0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
  1   0.             0.                0.1000000E 01        2   0.             0.             0.
  3   0.             0.1000000E 01  0.                   4   0.             0.1000000E 01  0.1000000E 01
COORDINATES OF POINTS ON BOUNDARY OF SURF    *IFLOOR      * FOR EACH Y INTERVAL

     X-LEFT          X-RIGHT          Y                  X-LEFT          X-RIGHT          Y

 0.              0.1000000E 01  0.                  0.              0.1000000E 01  0.4166667E-01
 0.              0.1000000E 01  0.8333333E-01       0.              0.1000000E 01  0.1250000E-00
```

FIGURE 20. Group A Sample Problems Program Results
(continued)

Approved for Public Release

0.	0.1000000E 01	0.1666667E-00	0.	0.1000000E 01	0.2083333E-00
0.	0.1000000E 01	0.2500000E-00	0.	0.1000000E 01	0.2916667E-00
0.	0.1000000E 01	0.3333333E-00	0.	0.1000000E 01	0.3750000E-00
0.	0.1000000E 01	0.4166666E-00	0.	0.1000000E 01	0.4583333E-00
0.	0.1000000E 01	0.5000000E-00	0.	0.1000000E 01	0.5416666E 00
0.	0.1000000E 01	0.5833333E 00	0.	0.1000000E 01	0.6250000E 00
0.	0.1000000E 01	0.6666666E 00	0.	0.1000000E 01	0.7083333E 00
0.	0.1000000E 01	0.7500000E 00	0.	0.1000000E 01	0.7916666E 00
0.	0.1000000E 01	0.8333333E 00	0.	0.1000000E 01	0.8750000E 00
0.	0.1000000E 01	0.9166666E 00	0.	0.1000000E 01	0.9583333E 00
0.	0.1000000E 01	0.1000000E 01			

NO. OF HORIZONTAL INCREMENTS= 24 NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.2500000E-00	0.2381714E-00	0.2264098E-00	0.2147805E-00	0.2033451E-00	0.1921608E-00
0.1812784E-00	0.1707421E-00	0.1605884E-00	0.1508463E-00	0.1415374E-00	0.1326757E-00
0.1242689E-00	0.1163187E-00	0.1088213E-00	0.1017688E-00	0.9514960E-01	0.8894909E-01
0.8315061E-01	0.7773592E-01	0.7268577E-01	0.6798038E-01	0.6359979E-01	0.5952419E-01
0.5573420E-01					
0.5000000E 00	0.3627489E-00	0.2993618E-00	0.2647417E-00	0.2406953E-00	0.2215649E-00
0.2051995E-00	0.1906369E-00	0.1773929E-00	0.1652008E-00	0.1539019E-00	0.1433944E-00
0.1336074E-00	0.1244870E-00	0.1159894E-00	0.1080764E-00	0.1007129E-00	0.9386608E-01
0.8750442E-01	0.8159761E-01	0.7611643E-01	0.7103273E-01	0.6631951E-01	0.6195098E-01
0.5790261E-01					
0.5000000E 00	0.4135154E-00	0.3496923E-00	0.3058146E-00	0.2737868E-00	0.2486091E-00
0.2276612E-00	0.2095478E-00	0.1934858E-00	0.1790103E-00	0.1658296E-00	0.1537498E-00
0.1426349E-00	0.1323835E-00	0.1229162E-00	0.1141671E-00	0.1060798E-00	0.9860413E-01
0.9169456E-01	0.8530921E-01	0.7940921E-01	0.7395829E-01	0.6892256E-01	0.6427036E-01
0.5997212E-01					
0.5000000E 00	0.4356336E-00	0.3801883E-00	0.3358659E-00	0.3006194E-00	0.2718642E-00
0.2476720E-00	0.2267755E-00	0.2083611E-00	0.1918990E-00	0.1770340E-00	0.1635191E-00
0.1511751E-00	0.1398664E-00	0.1294859E-00	0.1199457E-00	0.1111711E-00	0.1030969E-00
0.9566517E-01	0.8882340E-01	0.8252385E-01	0.7672266E-01	0.7137946E-01	0.6645701E-01
0.6192093E-01					
0.5000000E 00	0.4473657E-00	0.3990101E-00	0.3570122E-00	0.3213185E-00	0.2909358E-00
0.2647653E-00	0.2419023E-00	0.2216715E-00	0.2035842E-00	0.1872861E-00	0.1725157E-00
0.1590750E-00	0.1468093E-00	0.1355937E-00	0.1253244E-00	0.1159130E-00	0.1072821E-00
0.9936325E-01	0.9209505E-01	0.8542179E-01	0.7929282E-01	0.7366185E-01	0.6848651E-01

FIGURE 20. Group A Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

0.6372799E-01					
0.5000000E 00	0.4544209E-00	0.4112148E-00	0.3718966E-00	0.3369377E-00	0.3061129E-00
0.2789097E-00	0.2547786E-00	0.2332360E-00	0.2138885E-00	0.1964244E-00	0.1805977E-00
0.1662118E-00	0.1531066E-00	0.1411489E-00	0.1302257E-00	0.1202389E-00	0.1111026E-00
0.1027400E-00	0.9508227E-01	0.8806704E-01	0.8163780E-01	0.7574306E-01	0.7033587E-01
0.6537341E-01					
0.5000000E 00	0.4590002E-00	0.4194697E-00	0.3824940E-00	0.3486228E-00	0.3179568E-00
0.2903267E-00	0.2654469E-00	0.2430097E-00	0.2227285E-00	0.2043526E-00	0.1876684E-00
0.1724943E-00	0.1586752E-00	0.1460774E-00	0.1345840E-00	0.1240917E-00	0.1145086E-00
0.1057521E-00	0.9774738E-01	0.9042696E-01	0.8372935E-01	0.7759864E-01	0.7198393E-01
0.6683891E-01					
0.5000000E 00	0.4621056E-00	0.4252060E-00	0.3901042E-00	0.3573098E-00	0.3270483E-00
0.2993339E-00	0.2740546E-00	0.2510376E-00	0.2300914E-00	0.2110276E-00	0.1936706E-00
0.1778607E-00	0.1634541E-00	0.1503215E-00	0.1383464E-00	0.1274235E-00	0.1174575E-00
0.1083618E-00	0.1000575E-00	0.9247279E-01	0.8554240E-01	0.7920679E-01	0.7341176E-01
0.6810803E-01					
0.5000000E 00	0.4642506E-00	0.4292292E-00	0.3955579E-00	0.3636870E-00	0.3338817E-00
0.3062500E-00	0.2807856E-00	0.2574107E-00	0.2360083E-00	0.2164437E-00	0.1985776E-00
0.1822734E-00	0.1674011E-00	0.1538385E-00	0.1414719E-00	0.1301962E-00	0.1199146E-00
0.1105380E-00	0.1019848E-00	0.9418001E-01	0.8705545E-01	0.8054869E-01	0.7460294E-01
0.6916649E-01					
0.5000000E 00	0.4657200E-00	0.4320121E-00	0.3993846E-00	0.3682363E-00	0.3388398E-00
0.3113485E-00	0.2858183E-00	0.2622336E-00	0.2405308E-00	0.2206169E-00	0.2023829E-00
0.1857127E-00	0.1704894E-00	0.1565984E-00	0.1439300E-00	0.1323804E-00	0.1218524E-00
0.1122557E-00	0.1035067E-00	0.9552856E-01	0.8825074E-01	0.8160876E-01	0.7554382E-01
0.7000237E-01					
0.5000000E 00	0.4666782E-00	0.4338384E-00	0.4019193E-00	0.3712832E-00	0.3421993E-00
0.3148421E-00	0.2893024E-00	0.2656025E-00	0.2437138E-00	0.2235724E-00	0.2050913E-00
0.1881704E-00	0.1727031E-00	0.1585815E-00	0.1456994E-00	0.1339547E-00	0.1232505E-00
0.1134958E-00	0.1046060E-00	0.9650286E-01	0.8911442E-01	0.8237474E-01	0.7622363E-01
0.7060624E-01					
0.5000000E 00	0.4672204E-00	0.4348755E-00	0.4033667E-00	0.3730350E-00	0.3441448E-00
0.3168800E-00	0.2913482E-00	0.2675923E-00	0.2456034E-00	0.2253343E-00	0.2067115E-00
0.1896446E-00	0.1740338E-00	0.1597756E-00	0.1467662E-00	0.1349048E-00	0.1240948E-00
0.1142451E-00	0.1052704E-00	0.9709184E-01	0.8963658E-01	0.8283786E-01	0.7663463E-01
0.7097130E-01					
0.5000000E 00	0.4673959E-00	0.4352119E-00	0.4038375E-00	0.3736066E-00	0.3447819E-00
0.3175496E-00	0.2920227E-00	0.2682502E-00	0.2462298E-00	0.2259196E-00	0.2072507E-00
0.1901359E-00	0.1744778E-00	0.1601743E-00	0.1471226E-00	0.1352224E-00	0.1243771E-00
0.1144957E-00	0.1054947E-00	0.9728890E-01	0.8981130E-01	0.8299282E-01	0.7677215E-01
0.7109344E-01					
0.5000000E 00	0.4672204E-00	0.4348755E-00	0.4033667E-00	0.3730350E-00	0.3441448E-00
0.3168800E-00	0.2913482E-00	0.2675923E-00	0.2456034E-00	0.2253343E-00	0.2067115E-00
0.1896446E-00	0.1740338E-00	0.1597756E-00	0.1467662E-00	0.1349048E-00	0.1240948E-00

FIGURE 20. Group A Sample Problems Program Results (continued)

Contrails
Approved for Public Release

Contrails

0.1142451E-00	0.1052704E-00	0.9709184E-01	0.8963659E-01	0.8283786E-01	0.7663463E-01
0.7097130E-01					
0.5000000E 00	0.4666782E-00	0.4338384E-00	0.4019193E-00	0.3712832E-00	0.3421993E-00
0.3148421E-00	0.2893024E-00	0.2656025E-00	0.2437138E-00	0.2235724E-00	0.2050913E-00
0.1881704E-00	0.1727031E-00	0.1585815E-00	0.1456994E-00	0.1339547E-00	0.1232505E-00
0.1134958E-00	0.1046060E-00	0.9650286E-01	0.8911442E-01	0.8237474E-01	0.7622363E-01
0.7060624E-01					
0.5000000E 00	0.4657200E-00	0.4320121E-00	0.3993846E-00	0.3682363E-00	0.3388398E-00
0.3113485E-00	0.2858183E-00	0.2622336E-00	0.2405308E-00	0.2206169E-00	0.2023829E-00
0.1857127E-00	0.1704894E-00	0.1565984E-00	0.1439300E-00	0.1323804E-00	0.1218524E-00
0.1122557E-00	0.1035067E-00	0.9552856E-01	0.8825074E-01	0.8160876E-01	0.7554382E-01
0.7000237E-01					
0.5000000E 00	0.4642507E-00	0.4292292E-00	0.3955579E-00	0.3636870E-00	0.3338817E-00
0.3062500E-00	0.2807856E-00	0.2574107E-00	0.2360083E-00	0.2164437E-00	0.1985776E-00
0.1822734E-00	0.1674011E-00	0.1538385E-00	0.1414719E-00	0.1301962E-00	0.1199146E-00
0.1105380E-00	0.1019848E-00	0.9418002E-01	0.8705545E-01	0.8054869E-01	0.7460294E-01
0.6916649E-01					
0.5000000E 00	0.4621056E-00	0.4252061E-00	0.3901042E-00	0.3573098E-00	0.3270483E-00
0.2993339E-00	0.2740546E-00	0.2510376E-00	0.2300914E-00	0.2110276E-00	0.1936706E-00
0.1778607E-00	0.1634541E-00	0.1503215E-00	0.1383464E-00	0.1274235E-00	0.1174576E-00
0.1083618E-00	0.1000575E-00	0.9247279E-01	0.8554241E-01	0.7920679E-01	0.7341176E-01
0.6810803E-01					
0.5000000E 00	0.4590002E-00	0.4194697E-00	0.3824940E-00	0.3486228E-00	0.3179568E-00
0.2903267E-00	0.2654470E-00	0.2430097E-00	0.2227285E-00	0.2043526E-00	0.1876684E-00
0.1724943E-00	0.1586752E-00	0.1460774E-00	0.1345840E-00	0.1240917E-00	0.1145086E-00
0.1057521E-00	0.9774738E-01	0.9042696E-01	0.8372935E-01	0.7759864E-01	0.7198393E-01
0.6683891E-01					
0.5000000E 00	0.4544209E-00	0.4112148E-00	0.3718966E-00	0.3369377E-00	0.3061129E-00
0.2789097E-00	0.2547786E-00	0.2332360E-00	0.2138885E-00	0.1964244E-00	0.1805977E-00
0.1662118E-00	0.1531066E-00	0.1411489E-00	0.1302257E-00	0.1202390E-00	0.1111026E-00
0.1027400E-00	0.9508227E-01	0.8806705E-01	0.8163781E-01	0.7574307E-01	0.7033588E-01
0.6537342E-01					
0.5000000E 00	0.4473657E-00	0.3990101E-00	0.3570122E-00	0.3213185E-00	0.2909358E-00
0.2647653E-00	0.2419023E-00	0.2216715E-00	0.2035842E-00	0.1872861E-00	0.1725157E-00
0.1590750E-00	0.1468093E-00	0.1355937E-00	0.1253244E-00	0.1159130E-00	0.1072821E-00
0.9936326E-01	0.9209505E-01	0.8542179E-01	0.7929283E-01	0.7366186E-01	0.6848652E-01
0.6372799E-01					
0.5000000E 00	0.4356356E-00	0.3801883E-00	0.3358659E-00	0.3006195E-00	0.2718643E-00
0.2476720E-00	0.2267756E-00	0.2083611E-00	0.1918990E-00	0.1770340E-00	0.1635191E-00
0.1511751E-00	0.1398664E-00	0.1294859E-00	0.1199457E-00	0.1111711E-00	0.1030969E-00
0.9566518E-01	0.8882341E-01	0.8252385E-01	0.7672267E-01	0.7137946E-01	0.6645701E-01
0.6192094E-01					
0.5000000E 00	0.4135154E-00	0.3496924E-00	0.3058146E-00	0.2737868E-00	0.2486091E-00
0.2276612E-00	0.2095478E-00	0.1934858E-00	0.1790103E-00	0.1658296E-00	0.1537498E-00

FIGURE 20. Group A Sample Problems Program Results

(continued)

Approved for Public Release

0.1426349E-00	0.1323835E-00	0.1229162E-00	0.1141671E-00	0.1060798E-00	0.9860414E-01
0.9169456E-01	0.8530921E-01	0.7940921E-01	0.7395829E-01	0.6892256E-01	0.6427036E-01
0.5997213E-01					
0.5000000E 00	0.3627490E-00	0.2993619E-00	0.2647418E-00	0.2406956E-00	0.2215649E-00
0.2051995E-00	0.1906369E-00	0.1773929E-00	0.1652008E-00	0.1539019E-00	0.1433945E-00
0.1336074E-00	0.1244870E-00	0.1159894E-00	0.1080764E-00	0.1007129E-00	0.9386609E-01
0.8750442E-01	0.8159762E-01	0.7611643E-01	0.7103274E-01	0.6631952E-01	0.6195099E-01
0.5790261E-01					
0.2500000E-00	0.2381714E-00	0.2264098E-00	0.2147805E-00	0.2033451E-00	0.1921608E-00
0.1812784E-00	0.1707421E-00	0.1605884E-00	0.1508463E-00	0.1415374E-00	0.1326757E-00
0.1242689E-00	0.1163187E-00	0.1088213E-00	0.1017688E-00	0.9514960E-01	0.8894909E-01
0.8315061E-01	0.7773592E-01	0.7268577E-01	0.6798038E-01	0.6359979E-01	0.5952419E-01
0.5573420E-01					

FIGURE 20. Group A Sample Problems Program Results (continued)

Approved for Public Release

Contrails

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (A)-K.A.TOUPS,11/1/63

RUN NO.   2   DATA USED FOR THIS RUN- *1WALL  *1FLOOR*
                                       *       *       *
                                       *D      *       *

THE FORM FACTOR FROM SURFACE *1WALL      * TO SURFACE *1FLOOR      * = 0.19996

THE EXCHANGE COEFFICIENT (FA)=   0.19996E-00 SQ UNITS

              THE MAPPING AREA = 1.0000000E 00 SQ UNITS

THE AREA OF SURFACE *1WALL       * = 0.1000000E 01 SQ UNITS.

THE AREA OF SURFACE *1FLOOR      * = 0.1000000E 01 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

***** DATA NAME- *1WALL        *

POINT       X              Y                Z              POINT      X              Y              Z
        -0.            -0.             0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
  1     -0.            -0.             0.                    2   0.1000000E 01 -0.             0.
  3      0.1000000E 01  0.1000000E 01  0.                    4  -0.              0.1000000E 01  0.

***** DATA NAME- *1FLOOR       *

POINT       X              Y                Z              POINT      X              Y              Z
        -0.            -0.             0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
  1      0.1000000E 01 -0.             0.1000000E 01         2   0.1000000E 01  0.1000000E 01  0.1000000E 01
  3      0.1000000E 01  0.1000000E 01  0.                    4   0.1000000E 01 -0.             0.
COORDINATES OF POINTS ON BOUNDARY OF SURF    *1WALL       * FOR EACH Y INTERVAL

     X-LEFT        X-RIGHT            Y                 X-LEFT        X-RIGHT          Y

-0.            0.1000000E 01 -0.                       -0.            0.1000000E 01  0.4166667E-01
-0.            0.1000000E 01  0.8333333E-01            -0.            0.1000000E 01  0.1250000E-00
```

FIGURE 20. Group A Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

-0.	0.1000000E 01	0.1666667E-00	-0.	0.1000000E 01	0.2083333E-00
-0.	0.1000000E 01	0.2500000E-00	-0.	0.1000000E 01	0.2916667E-00
-0.	0.1000000E 01	0.3333333E-00	-0.	0.1000000E 01	0.3750000E-00
-0.	0.1000000E 01	0.4166666E-00	-0.	0.1000000E 01	0.4583333E-00
-0.	0.1000000E 01	0.5000000E-00	-0.	0.1000000E 01	0.5416666E 00
-0.	0.1000000E 01	0.5833333E 00	-0.	0.1000000E 01	0.6250000E 00
-0.	0.1000000E 01	0.6666666E 00	-0.	0.1000000E 01	0.7083333E 00
-0.	0.1000000E 01	0.7500000E 00	-0.	0.1000000E 01	0.7916666E 00
-0.	0.1000000E 01	0.8333333E 00	-0.	0.1000000E 01	0.8750000E 00
-0.	0.1000000E 01	0.9166666E 00	-0.	0.1000000E 01	0.9583333E 00
-0.	0.1000000E 01	0.1000000E 01			

NO. OF HORIZONTAL INCREMENTS= 24 NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.5573420E-01	0.5952419E-01	0.6359978E-01	0.6798038E-01	0.7268577E-01	0.7773592E-01
0.8315061E-01	0.8894909E-01	0.9514960E-01	0.1017688E-00	0.1088213E-00	0.1163187E-00
0.1242689E-00	0.1326757E-00	0.1415374E-00	0.1508464E-00	0.1605884E-00	0.1707421E-00
0.1812784E-00	0.1921608E-00	0.2033451E-00	0.2147805E-00	0.2264099E-00	0.2381714E-00
0.2500000E-00					
0.5790261E-01	0.6193098E-01	0.6631951E-01	0.7103273E-01	0.7611643E-01	0.8159761E-01
0.8750442E-01	0.9386608E-01	0.1007129E-00	0.1080764E-00	0.1159894E-00	0.1244870E-00
0.1336074E-00	0.1433945E-00	0.1539019E-00	0.1652008E-00	0.1773929E-00	0.1906369E-00
0.2051995E-00	0.2215649E-00	0.2406956E-00	0.2647418E-00	0.2993619E-00	0.3627491E-00
0.5000000E 00					
0.5997212E-01	0.6427035E-01	0.6892255E-01	0.7395828E-01	0.7940920E-01	0.8530921E-01
0.9169435E-01	0.9860413E-01	0.1060798E-00	0.1141671E-00	0.1229162E-00	0.1323835E-00
0.1426349E-00	0.1537498E-00	0.1658296E-00	0.1790103E-00	0.1934858E-00	0.2095478E-00
0.2276612E-00	0.2486091E-00	0.2737868E-00	0.3058146E-00	0.3496924E-00	0.4135155E-00
0.5000000E 00					
0.6192093E-01	0.6645700E-01	0.7137946E-01	0.7672266E-01	0.8252385E-01	0.8882340E-01
0.9566517E-01	0.1030969E-00	0.1111711E-00	0.1199457E-00	0.1294859E-00	0.1398664E-00
0.1511751E-00	0.1635191E-00	0.1770340E-00	0.1918990E-00	0.2083612E-00	0.2267756E-00
0.2476720E-00	0.2718643E-00	0.3006195E-00	0.3358659E-00	0.3801883E-00	0.4356357E-00
0.5000000E 00					
0.6372799E-01	0.6848651E-01	0.7366185E-01	0.7929282E-01	0.8542179E-01	0.9209504E-01
0.9936325E-01	0.1072821E-00	0.1159130E-00	0.1253244E-00	0.1355937E-00	0.1468093E-00
0.1590750E-00	0.1725157E-00	0.1872861E-00	0.2035842E-00	0.2216715E-00	0.2419023E-00
0.2647653E-00	0.2909358E-00	0.3213185E-00	0.3570122E-00	0.3990102E-00	0.4473658E-00

FIGURE 20. Group A Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

0.5000000E 00					
0.6537341E-01	0.7033587E-01	0.7574306E-01	0.8163780E-01	0.8806704E-01	0.9508226E-01
0.1027400E-00	0.1111026E-00	0.1202389E-00	0.1302257E-00	0.1411489E-00	0.1531066E-00
0.1662118E-00	0.1805977E-00	0.1964244E-00	0.2138885E-00	0.2332360E-00	0.2547786E-00
0.2789097E-00	0.3061129E-00	0.3369377E-00	0.3718967E-00	0.4112149E-00	0.4544210E-00
0.5000000E 00					
0.6683891E-01	0.7198393E-01	0.7759863E-01	0.8372935E-01	0.9042696E-01	0.9774738E-01
0.1057521E-00	0.1145086E-00	0.1240917E-00	0.1345840E-00	0.1460774E-00	0.1586752E-00
0.1724943E-00	0.1876684E-00	0.2043526E-00	0.2227285E-00	0.2430098E-00	0.2654470E-00
0.2903267E-00	0.3179569E-00	0.3486228E-00	0.3824940E-00	0.4194698E-00	0.4590003E-00
0.5000000E 00					
0.6810803E-01	0.7341175E-01	0.7920678E-01	0.8554240E-01	0.9247279E-01	0.1000575E-00
0.1083618E-00	0.1174575E-00	0.1274235E-00	0.1383464E-00	0.1503215E-00	0.1634541E-00
0.1778607E-00	0.1936706E-00	0.2110276E-00	0.2300914E-00	0.2510376E-00	0.2740546E-00
0.2993340E-00	0.3270483E-00	0.3573098E-00	0.3901042E-00	0.4252061E-00	0.4621057E-00
0.5000000E 00					
0.6915649E-01	0.7460293E-01	0.8054869E-01	0.8705545E-01	0.9418001E-01	0.1019848E-00
0.1105380E-00	0.1199146E-00	0.1301962E-00	0.1414719E-00	0.1538385E-00	0.1674011E-00
0.1822734E-00	0.1985776E-00	0.2164437E-00	0.2360083E-00	0.2574107E-00	0.2807856E-00
0.3062500E-00	0.3338818E-00	0.3636870E-00	0.3955580E-00	0.4292293E-00	0.4642507E-00
0.5000000E 00					
0.7000237E-01	0.7554381E-01	0.8160876E-01	0.8825074E-01	0.9552856E-01	0.1035067E-00
0.1122557E-00	0.1218524E-00	0.1323804E-00	0.1439300E-00	0.1565984E-00	0.1704894E-00
0.1857127E-00	0.2023829E-00	0.2206170E-00	0.2405309E-00	0.2622337E-00	0.2858183E-00
0.3113485E-00	0.3388399E-00	0.3682364E-00	0.3993846E-00	0.4320122E-00	0.4657200E-00
0.5000000E 00					
0.7060624E-01	0.7622362E-01	0.8237474E-01	0.8911441E-01	0.9650285E-01	0.1046060E-00
0.1134958E-00	0.1232505E-00	0.1339547E-00	0.1456994E-00	0.1585815E-00	0.1727031E-00
0.1881704E-00	0.2050914E-00	0.2235724E-00	0.2437138E-00	0.2656025E-00	0.2893024E-00
0.3148422E-00	0.3421993E-00	0.3712832E-00	0.4019193E-00	0.4338385E-00	0.4666783E-00
0.5000000E 00					
0.7097130E-01	0.7663462E-01	0.8283785E-01	0.8963658E-01	0.9709184E-01	0.1052704E-00
0.1142451E-00	0.1240948E-00	0.1349048E-00	0.1467662E-00	0.1597756E-00	0.1740339E-00
0.1896446E-00	0.2067116E-00	0.2253343E-00	0.2456034E-00	0.2675923E-00	0.2913482E-00
0.3168800E-00	0.3441449E-00	0.3730350E-00	0.4033668E-00	0.4348755E-00	0.4672204E-00
0.5000000E 00					
0.7109344E-01	0.7677215E-01	0.8299281E-01	0.8981130E-01	0.9728890E-01	0.1054927E-00
0.1144957E-00	0.1243771E-00	0.1352224E-00	0.1471226E-00	0.1601743E-00	0.1744778E-00
0.1901359E-00	0.2072507E-00	0.2259196E-00	0.2462298E-00	0.2682503E-00	0.2920227E-00
0.3175497E-00	0.3447820E-00	0.3736066E-00	0.4038376E-00	0.4352120E-00	0.4673960E-00
0.5000000E 00					
0.7097130E-01	0.7663463E-01	0.8283785E-01	0.8963658E-01	0.9709184E-01	0.1052704E-00
0.1142451E-00	0.1240948E-00	0.1349048E-00	0.1467662E-00	0.1597756E-00	0.1740339E-00
0.1896446E-00	0.2067116E-00	0.2253343E-00	0.2456034E-00	0.2675923E-00	0.2913482E-00

FIGURE 20. Group A Sample Problems Program Results
(continued)

Approved for Public Release

0.3168800E-00	0.3441449E-00	0.3730350E-00	0.4033668E-00	0.4348755E-00	0.4672204E-00
0.5000000E 00					
0.7060624E-01	0.7622352E-01	0.8237474E-01	0.8911441E-01	0.9650285E-01	0.1046060E-00
0.1134958E-00	0.1232505E-00	0.1339547E-00	0.1456994E-00	0.1585815E-00	0.1727031E-00
0.1881704E-00	0.2050914E-00	0.2235724E-00	0.2437138E-00	0.2656025E-00	0.2893024E-00
0.3148422E-00	0.3421993E-00	0.3712832E-00	0.4019193E-00	0.4338385E-00	0.4666783E-00
0.5000000E 00					
0.7000237E-01	0.7554381E-01	0.8160876E-01	0.8825074E-01	0.9552856E-01	0.1035067E-00
0.1122557E-00	0.1218524E-00	0.1323804E-00	0.1439300E-00	0.1565984E-00	0.1704894E-00
0.1857127E-00	0.2023829E-00	0.2206170E-00	0.2405309E-00	0.2622337E-00	0.2858183E-00
0.3113485E-00	0.3388399E-00	0.3682364E-00	0.3993846E-00	0.4320122E-00	0.4657200E-00
0.5000000E 00					
0.6916649E-01	0.7460293E-01	0.8054869E-01	0.8705545E-01	0.9418002E-01	0.1019848E-00
0.1105380E-00	0.1199146E-00	0.1301962E-00	0.1414719E-00	0.1538383E-00	0.1674011E-00
0.1822734E-00	0.1985776E-00	0.2164437E-00	0.2360083E-00	0.2574107E-00	0.2807856E-00
0.3062500E-00	0.3338818E-00	0.3636870E-00	0.3955580E-00	0.4292293E-00	0.4642507E-00
0.5000000E 00					
0.6810803E-01	0.7341175E-01	0.7920678E-01	0.8554240E-01	0.9247279E-01	0.1000575E-00
0.1083618E-00	0.1174576E-00	0.1274235E-00	0.1383464E-00	0.1503215E-00	0.1634541E-00
0.1778607E-00	0.1936706E-00	0.2110276E-00	0.2300914E-00	0.2510376E-00	0.2740546E-00
0.2993340E-00	0.3270483E-00	0.3573098E-00	0.3901042E-00	0.4252061E-00	0.4621057E-00
0.5000000E 00					
0.6683891E-01	0.7198393E-01	0.7759864E-01	0.8372935E-01	0.9042696E-01	0.9774738E-01
0.1057521E-00	0.1145086E-00	0.1240917E-00	0.1345840E-00	0.1460774E-00	0.1586752E-00
0.1724943E-00	0.1876684E-00	0.2043526E-00	0.2227285E-00	0.2430098E-00	0.2654470E-00
0.2903267E-00	0.3179569E-00	0.3486229E-00	0.3824940E-00	0.4194698E-00	0.4590003E-00
0.5000000E 00					
0.6537342E-01	0.7033587E-01	0.7574306E-01	0.8163780E-01	0.8806704E-01	0.9508227E-01
0.1027400E-00	0.1111026E-00	0.1202390E-00	0.1302257E-00	0.1411489E-00	0.1531066E-00
0.1662118E-00	0.1805977E-00	0.1964244E-00	0.2138885E-00	0.2332360E-00	0.2547786E-00
0.2789098E-00	0.3061129E-00	0.3369378E-00	0.3718967E-00	0.4112149E-00	0.4544210E-00
0.5000000E 00					
0.6372799E-01	0.6848651E-01	0.7366185E-01	0.7929282E-01	0.8542179E-01	0.9209504E-01
0.9936325E-01	0.1072811E-00	0.1159130E-00	0.1253244E-00	0.1355937E-00	0.1468093E-00
0.1590750E-00	0.1725157E-00	0.1872861E-00	0.2035842E-00	0.2216715E-00	0.2419023E-00
0.2647654E-00	0.2909358E-00	0.3213185E-00	0.3570123E-00	0.3990102E-00	0.4473658E-00
0.5000000E 00					
0.6192094E-01	0.6645700E-01	0.7137946E-01	0.7672266E-01	0.8252385E-01	0.8882340E-01
0.9566518E-01	0.1030969E-00	0.1111711E-00	0.1199457E-00	0.1294859E-00	0.1398664E-00
0.1511751E-00	0.1631191E-00	0.1770341E-00	0.1918990E-00	0.2083612E-00	0.2267756E-00
0.2476721E-00	0.2718643E-00	0.3006195E-00	0.3358659E-00	0.3801884E-00	0.4356357E-00
0.5000000E 00					
0.5997213E-01	0.6427036E-01	0.6892256E-01	0.7395829E-01	0.7940921E-01	0.8530921E-01
0.9169456E-01	0.9860414E-01	0.1060798E-00	0.1141671E-00	0.1229162E-00	0.1323835E-00

FIGURE 20. Group A Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

Contrails

0.1426349E-00	0.1537498E-00	0.1658296E-00	0.1790103E-00	0.1934838E-00	0.2095478E-00
0.2276613E-00	0.2486091E-00	0.2737869E-00	0.3058147E-00	0.3496924E-00	0.4135156E-00
0.5000000E 00					
0.5790261E-01	0.6195098E-01	0.6631951E-01	0.7103273E-01	0.7611643E-01	0.8159761E-01
0.8750442E-01	0.9386609E-01	0.1007129E-00	0.1080764E-00	0.1159894E-00	0.1244870E-00
0.1336074E-00	0.1433945E-00	0.1539020E-00	0.1652008E-00	0.1773929E-00	0.1906369E-00
0.2051995E-00	0.2215649E-00	0.2406956E-00	0.2647418E-00	0.2993620E-00	0.3627491E-00
0.5000000E 00					
0.5573420E-01	0.5952419E-01	0.6359978E-01	0.6798038E-01	0.7268577E-01	0.7773592E-01
0.8315061E-01	0.8894909E-01	0.9514960E-01	0.1017688E-00	0.1088213E-00	0.1163187E-00
0.1242689E-00	0.1326757E-00	0.1415374E-00	0.1508464E-00	0.1605884E-00	0.1707421E-00
0.1812784E-00	0.1921608E-00	0.2033451E-00	0.2147805E-00	0.2264099E-00	0.2381714E-00
0.2500000E-00					

FIGURE 20. Group A Sample Problems Program Results (continued)

Approved for Public Release

Contrails

```
                    NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.   (A)-K.A.TOUPS,11/1/63

RUN NO.   3   DATA USED FOR THIS RUN- *1FLOOR*2WALLS*
                                      *      *      *
                                      *D     *      *

THE FORM FACTOR FROM SURFACE *1FLOOR        * TO SURFACE *2WALLS        * = 0.39992
THE EXCHANGE COEFFICIENT (FA)=   0.39992E-00 SQ UNITS
               THE MAPPING AREA = 1.0000000E 00 SQ UNITS
THE AREA OF SURFACE *1FLOOR        * = 0.1000000E 01 SQ UNITS.
     .EA OF S

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

***** DATA NAME- *1FLOOR        *
POINT      X              Y              Z              POINT     X              Y              Z
  1   0.1000000E 01  0.                            0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
  3   0.1000000E 01  0.                            0.                 2   0.1000000E 01  0.1000000E 01  0.
      0.             0.1000000E 01                 0.                 4   0.             0.             0.

***** DATA NAME- *2WALLS        *
POINT      X              Y              Z              POINT     X              Y              Z
  1   0.             0.             0.1000000E 01     2   0.             0.             0.
  3   0.             0.1000000E 01  0.                4   0.1000000E 01  0.1000000E 01  0.
  5   0.1000000E 01  0.1000000E 01  0.1000000E 01     6   0.             0.1000000E 01  0.1000000E 01
COORDINATES OF POINTS ON BOUNDARY OF SURF    *1FLOOR        * FOR EACH Y INTERVAL
   X-LEFT        X-RIGHT          Y                    X-LEFT          X-RIGHT          Y
0.             0.1000000E 01  0.                    0.             0.1000000E 01  0.4166667E-01
0.             0.1000000E 01  0.8333333E-01         0.             0.1000000E 01  0.1250000E-00
```

FIGURE 20. Group A Sample Problems Program Results (continued)

Approved for Public Release

0.	0.1000000E 01	0.1666667E-00	0.	0.1000000E 01	0.2083333E-00
0.	0.1000000E 01	0.2500000E-00	0.	0.1000000E 01	0.2916667E-00
0.	0.1000000E 01	0.3333333E-00	0.	0.1000000E 01	0.3750000E-00
0.	0.1000000E 01	0.4166666E-00	0.	0.1000000E 01	0.4583333E-00
0.	0.1000000E 01	0.5000000E-00	0.	0.1000000E 01	0.5416666E 00
0.	0.1000000E 01	0.5833333E 00	0.	0.1000000E 01	0.6250000E 00
0.	0.1000000E 01	0.6666666E 00	0.	0.1000000E 01	0.7083333E 00
0.	0.1000000E 01	0.7500000E 00	0.	0.1000000E 01	0.7916666E 00
0.	0.1000000E 01	0.8333333E 00	0.	0.1000000E 01	0.8750000E 00
0.	0.1000000E 01	0.9166666E 00	0.	0.1000000E 01	0.9583333E 00
0.	0.1000000E 01	0.1000000E 01			

NO. OF HORIZONTAL INCREMENTS= 24 NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.3057342E-00	0.2960740E-00	0.2863820E-00	0.2767014E-00	0.2670731E-00	0.2575342E-00
0.2481173E-00	0.2388501E-00	0.2297549E-00	0.2208487E-00	0.2121436E-00	0.2036470E-00
0.1953623E-00	0.1872899E-00	0.1794275E-00	0.1717712E-00	0.1643161E-00	0.1570571E-00
0.1499895E-00	0.1431093E-00	0.1364138E-00	0.1299013E-00	0.1235719E-00	0.1174268E-00
0.1114684E-00					
0.5595242E 00	0.4246999E-00	0.3636322E-00	0.3311987E-00	0.3091820E-00	0.2919007E-00
0.2771834E-00	0.2640486E-00	0.2519958E-00	0.2407446E-00	0.2301255E-00	0.2200291E-00
0.2103795E-00	0.2011226E-00	0.1922136E-00	0.1836202E-00	0.1753158E-00	0.1672778E-00
0.1594883E-00	0.1519355E-00	0.1442029E-00	0.1374897E-00	0.1305899E-00	0.1239019E-00
0.1174268E-00					
0.5635998E 00	0.4798349E-00	0.4186149E-00	0.3771940E-00	0.3474486E-00	0.3243521E-00
0.3052598E-00	0.2887545E-00	0.2740344E-00	0.2606191E-00	0.2482043E-00	0.2365876E-00
0.2256277E-00	0.2152214E-00	0.2052909E-00	0.1957759E-00	0.1866285E-00	0.1778109E-00
0.1692932E-00	0.1610523E-00	0.1530710E-00	0.1453377E-00	0.1378451E-00	0.1305899E-00
0.1235719E-00					
0.5579804E 00	0.5066683E 00	0.4541465E-00	0.4125885E-00	0.3799122E-00	0.3535020E-00
0.3314015E-00	0.3123179E-00	0.2954166E-00	0.2801497E-00	0.2661484E-00	0.2531557E-00
0.2409864E-00	0.2295030E-00	0.2186003E-00	0.2081965E-00	0.1982266E-00	0.1886393E-00
0.1793945E-00	0.1704612E-00	0.1618167E-00	0.1534453E-00	0.1453377E-00	0.1374897E-00
0.1299013E-00					
0.5725836E 00	0.5234821E 00	0.4784193E-00	0.4395360E-00	0.4067402E-00	0.3790028E-00
0.3551923E-00	0.3343750E-00	0.3158515E-00	0.2991128E-00	0.2837889E-00	0.2696075E-00
0.2563639E-00	0.2439011E-00	0.2320965E-00	0.2208530E-00	0.2100930E-00	0.1997548E-00
0.1897902E-00	0.1801621E-00	0.1708436E-00	0.1618167E-00	0.1530710E-00	0.1446029E-00

FIGURE 20. Group A Sample Problems Program Results
(continued)

Approved for Public Release

0.1364138E-00					
0.5777359E 00	0.5360185E 00	0.4965240E-00	0.4607200E-00	0.4290327E-00	0.4011951E-00
0.3766571E-00	0.3548360E-00	0.3352207E-00	0.3173952E-00	0.3010304E-00	0.2858681E-00
0.2717044E-00	0.2585769E-00	0.2457549E-00	0.2337323E-00	0.2222237E-00	0.2111601E-00
0.2004874E-00	0.1901645E-00	0.1801621E-00	0.1704612E-00	0.1610523E-00	0.1519335E-00
0.1431093E-00					
0.5831506E 00	0.5465046E 00	0.5111643E 00	0.4781591E-00	0.4479860E-00	0.4206968E-00
0.3960787E-00	0.3738087E-00	0.3535477E-00	0.3349841E-00	0.3178484E-00	0.3019134E-00
0.2869899E-00	0.2729203E-00	0.2595732E-00	0.2468396E-00	0.2346297E-00	0.2228704E-00
0.2115041E-00	0.2004874E-00	0.1897902E-00	0.1793945E-00	0.1692932E-00	0.1594883E-00
0.1499895E-00					
0.5889491E 00	0.5559717E 00	0.5258102E 00	0.4932011E-00	0.4645918E-00	0.4381509E-00
0.4138425E-00	0.3915121E-00	0.3709522E-00	0.3519438E-00	0.3342781E-00	0.3177654E-00
0.3022378E-00	0.2875489E-00	0.2735720E-00	0.2601988E-00	0.2473381E-00	0.2349151E-00
0.2228704E-00	0.2111601E-00	0.1997548E-00	0.1886393E-00	0.1778109E-00	0.1672778E-00
0.1570571E-00					
0.5951496E 00	0.5649635E 00	0.5353090E 00	0.5067291E 00	0.4795999E-00	0.4541207E-00
0.4303417E-00	0.4082091E-00	0.3876069E-00	0.3683887E-00	0.3503984E-00	0.3334823E-00
0.3174958E-00	0.3023059E-00	0.2877932E-00	0.2738522E-00	0.2603924E-00	0.2473381E-00
0.2346297E-00	0.2222237E-00	0.2100930E-00	0.1982266E-00	0.1866285E-00	0.1753158E-00
0.1643161E-00					
0.6017688E 00	0.5757963E 00	0.5461792E 00	0.5193303E 00	0.4935607E-00	0.4690655E-00
0.4459324E-00	0.4241647E-00	0.4037055E-00	0.3844608E-00	0.3663163E-00	0.3491491E-00
0.3328353E-00	0.3172556E-00	0.3022978E-00	0.2878599E-00	0.2738522E-00	0.2601988E-00
0.2468396E-00	0.2337323E-00	0.2208530E-00	0.2081965E-00	0.1957758E-00	0.1836202E-00
0.1717712E-00					
0.6088213E 00	0.5826676E 00	0.5567546E 00	0.5314052E 00	0.5068769E 00	0.4833481E-00
0.4609195E-00	0.4396239E-00	0.4194409E-00	0.4003122E-00	0.3821539E-00	0.3648669E-00
0.3483446E-00	0.3324786E-00	0.3171629E-00	0.3022978E-00	0.2877932E-00	0.2735720E-00
0.2595732E-00	0.2457549E-00	0.2320965E-00	0.2186003E-00	0.2052909E-00	0.1922130E-00
0.1794275E-00					
0.6163187E 00	0.5917073E 00	0.5672590E 00	0.5432331E 00	0.5198442E 00	0.4972514E-00
0.4755552E-00	0.4548023E-00	0.4349934E-00	0.4160927E-00	0.3980374E-00	0.3807454E-00
0.3641224E-00	0.3480677E-00	0.3324786E-00	0.3172556E-00	0.3023059E-00	0.2875489E-00
0.2729202E-00	0.2583769E-00	0.2439011E-00	0.2295029E-00	0.2152213E-00	0.2011216E-00
0.1872899E-00					
0.6242689E 00	0.6010033E 00	0.5778468E 00	0.5550126E 00	0.5326816E 00	0.5109937E 00
0.4900439E-00	0.4698833E-00	0.4505236E-00	0.4319424E-00	0.4140900E-00	0.3968953E-00
0.3802718E-00	0.3641224E-00	0.3483446E-00	0.3328353E-00	0.3174958E-00	0.3022378E-00
0.2869899E-00	0.2717044E-00	0.2563639E-00	0.2409863E-00	0.2256277E-00	0.2103795E-00
0.1953623E-00					
0.6326757E 00	0.6106148E 00	0.5886253E 00	0.5668858E 00	0.5455506E 00	0.5247425E 00
0.5045483E 00	0.4850188E-00	0.4661698E-00	0.4479863E-00	0.4304256E-00	0.4134231E-00
0.3968953E-00	0.3807454E-00	0.3648669E-00	0.3491491E-00	0.3334823E-00	0.3177654E-00

FIGURE 20. Group A Sample Problems Program Results (continued)

Approved for Public Release

0.3019134E-00	0.2858681E-00	0.2596075E-00	0.2531556E-00	0.2365876E-00	0.2200290E-00
0.2036470E-00					
0.6415374E 00	0.6205801E 00	0.5996680E 00	0.5789533E 00	0.5585693E 00	0.5386236E 00
0.5191947E 00	0.5003300E 00	0.4820461E-00	0.4643307E-00	0.4471448E-00	0.4304256E-00
0.4140900E-00	0.3980374E-00	0.3821539E-00	0.3663163E-00	0.3503984E-00	0.3342781E-00
0.3178484E-00	0.3010303E-00	0.2837889E-00	0.2661484E-00	0.2482043E-00	0.2301255E-00
0.2121436E-00					
0.6508463E 00	0.6309207E 00	0.6110224E 00	0.5912836E 00	0.5718205E 00	0.5527283E 00
0.5340769E 00	0.5159097E 00	0.4982419E-00	0.4810617E-00	0.4643307E-00	0.4479862E-00
0.4319424E-00	0.4160927E-00	0.4003122E-00	0.3844608E-00	0.3683887E-00	0.3519438E-00
0.3349841E-00	0.3173951E-00	0.2991127E-00	0.2801497E-00	0.2606190E-00	0.2407445E-00
0.2208487E-00					
0.6605884E 00	0.6416435E 00	0.6227150E 00	0.6039190E 00	0.5853585E 00	0.5671177E 00
0.5492597E 00	0.5318231E 00	0.5148214E 00	0.4982419E-00	0.4820461E-00	0.4661698E-00
0.4505236E-00	0.4349934E-00	0.4194409E-00	0.4037055E-00	0.3876069E-00	0.3709521E-00
0.3535477E-00	0.3352207E-00	0.3158515E-00	0.2954165E-00	0.2740344E-00	0.2519958E-00
0.2297549E-00					
0.6707421E 00	0.6527425E 00	0.6347538E 00	0.6168797E 00	0.5992120E 00	0.5818268E 00
0.5647808E 00	0.5481091E 00	0.5318231E 00	0.5159097E 00	0.5003300E 00	0.4850188E-00
0.4698833E-00	0.4548023E-00	0.4396239E-00	0.4241647E-00	0.4082091E-00	0.3915121E-00
0.3738087E-00	0.3548360E-00	0.3343750E-00	0.3123179E-00	0.2887545E-00	0.2640486E-00
0.2388501E-00					
0.6812784E 00	0.6641997E 00	0.6471309E 00	0.6301660E 00	0.6133881E 00	0.5968665E 00
0.5806533E 00	0.5647809E 00	0.5492597E 00	0.5340769E 00	0.5191947E 00	0.5045483E 00
0.4900438E-00	0.4755551E-00	0.4609195E-00	0.4459324E-00	0.4303416E-00	0.4138425E-00
0.3960787E-00	0.3766570E-00	0.3551922E-00	0.3314013E-00	0.3052598E-00	0.2771833E-00
0.2481173E-00					
0.6921608E 00	0.6759857E 00	0.6598238E 00	0.6437608E 00	0.6278734E 00	0.6122257E 00
0.5968665E 00	0.5818268E 00	0.5671177E 00	0.5527282E 00	0.5386236E 00	0.5247425E 00
0.5109937E 00	0.4972513E-00	0.4833481E-00	0.4690654E-00	0.4541206E-00	0.4381509E-00
0.4206968E-00	0.4011951E-00	0.3790027E-00	0.3535020E-00	0.3243520E-00	0.2919007E-00
0.2575342E-00					
0.7033451E 00	0.6880612E 00	0.6727969E 00	0.6576316E 00	0.6426369E 00	0.6278734E 00
0.6133881E 00	0.5992120E 00	0.5853584E 00	0.5718205E 00	0.5585693E 00	0.5455506E 00
0.5326816E 00	0.5198442E 00	0.5068768E 00	0.4935607E-00	0.4795999E-00	0.4645918E-00
0.4479860E-00	0.4290317E-00	0.4067402E-00	0.3799122E-00	0.3474486E-00	0.3091820E-00
0.2670731E-00					
0.7147804E 00	0.7003773E 00	0.6860028E 00	0.6717317E 00	0.6576316E 00	0.6437608E 00
0.6301660E 00	0.6168797E 00	0.6039190E 00	0.5912836E 00	0.5789533E 00	0.5668858E 00
0.5550126E 00	0.5432331E 00	0.5314052E 00	0.5193303E 00	0.5067290E 00	0.4932011E-00
0.4781591E-00	0.4607200E-00	0.4395360E-00	0.4125884E-00	0.3771939E-00	0.3311986E-00
0.2767014E-00					
0.7264098E 00	0.7128772E 00	0.6993846E 00	0.6860028E 00	0.6727969E 00	0.6598238E 00
0.6471309E 00	0.6347538E 00	0.6227150E 00	0.6110224E 00	0.5996680E 00	0.5886253E 00

FIGURE 20. Group A Sample Problems Program Results
(continued)

Approved for Public Release

0.5778468E 00	0.5672590E 00	0.5567545E 00	0.5461792E 00	0.5353090E 00	0.5238101E 00
0.5111642E 00	0.4965240E-00	0.4784192E-00	0.4541465E-00	0.4186148E-00	0.3636320E-00
0.2863819E-00					
0.7381714E 00	0.7254978E 00	0.7128772E 00	0.7003773E 00	0.6880612E 00	0.6759857E 00
0.6641996E 00	0.6527425E 00	0.6416435E 00	0.6309207E 00	0.6205801E 00	0.6106148E 00
0.6010033E 00	0.5917073E 00	0.5826676E 00	0.5737963E 00	0.5649635E 00	0.5559717E 00
0.5465046E 00	0.5360184E 00	0.5234821E 00	0.5066682E 00	0.4798348E-00	0.4246997E-00
0.2960740E-00					
0.5000000E-00	0.7381714E 00	0.7264098E 00	0.7147805E 00	0.7033451E 00	0.6921608E 00
0.6812784E 00	0.6707421E 00	0.6605884E 00	0.6508463E 00	0.6415374E 00	0.6326757E 00
0.6242689E 00	0.6163187E 00	0.6088213E 00	0.6017688E 00	0.5951496E 00	0.5889491E 00
0.5831506E 00	0.5777359E 00	0.5726858E 00	0.5679804E 00	0.5635998E 00	0.5595242E 00
0.3057342E-00					

FIGURE 20. Group A Sample Problems Program Results (continued)

Approved for Public Release

Contrails

```
                    NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (A)-K.A.TOUPS,11/1/63

RUN NO.   4   DATA USED FOR THIS RUN- *2WALLS*1FLOOR*
                                      *      *      *
                                      *      *      *

A NONPLANAR SURFACE CANNOT BE USED AS SURFACE 1-THIS RUN ABORTED.
```

FIGURE 20. Group A Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (A)-K.A.TOUPS,11/1/63


RUN NO.   5   DATA USED FOR THIS RUN-  *1FLOOR*1WALLR*
                                        *      *      *
                                        *      *      *


NONE OF SURFACE *1FLOOR      * IS SEEN BY SURFACE *1WALLR      *

IF THE ABOVE RESULT IS UNEXPECTED, DO NOT BECOME ALARMED- IT HAPPENS TO THE BEST OF EM. JUST CHECK YOUR
DATA-ESPECIALLY BE SURE THAT YOU ENTERED ALL POINTS IN COUNTERCLOCKWISE ORDER, AS THEY APPEAR WHEN
FACING THE ACTIVE SIDE OF THE SURFACE, AND DERIVED FROM A RIGHT-HANDED COORDINATE SYSTEM.
```

FIGURE 20. Group A Sample Problems Program Results (continued)

Approved for Public Release

Contrails

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (A)-K.A.TOUPS,11/1/63

RUN NO.   6   DATA USED FOR THIS RUN- *1FLOOR*2WALLZ*
                                      *     *     *
                                      *D    *     *

THE FORM FACTOR FROM SURFACE *1FLOOR     * TO SURFACE *2WALLZ     * = 0.39992

THE EXCHANGE COEFFICIENT (FA)=   0.39992E-00 SQ UNITS

           THE MAPPING AREA = 1.0000000E 00 SQ UNITS

THE AREA OF SURFACE *1FLOOR     * = 0.1000000E 01 SQ UNITS.

ONLY A PART OF SURFACE *2WALLZ     * SEES SURFACE *1FLOOR     *

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *1FLOOR     *

POINT      X              Y              Z              POINT     X              Y              Z
       0.1000000E 01  0.             0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.1000000E 01  0.             0.                    2   0.1000000E 01  0.1000000E 01  0.
   3   0.             0.1000000E 01  0.                    4   0.             0.             0.


***** DATA NAME- *2WALLZ     *

POINT      X              Y              Z              POINT     X              Y              Z
   1   0.             0.             0.1000000E 01         2   0.             0.             0.
   3   0.1000000E 01  0.1000000E 01  0.                    4   0.1000000E 01  0.1000000E 01  0.1000000E 01
   5   0.             0.1000000E 01  0.1000000E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1FLOOR     * FOR EACH Y INTERVAL

      X-LEFT        X-RIGHT         Y                    X-LEFT        X-RIGHT         Y
```

FIGURE 20. Group A Sample Problems Program Results

(continued)

Approved for Public Release

0.	0.1000000E 01	0.	0.	0.1000000E 01	0.4166667E-01
0.	0.1000000E 01	0.8333333E-01	0.	0.1000000E 01	0.1250000E-00
0.	0.1000000E 01	0.1666667E-00	0.	0.1000000E 01	0.2083333E-00
0.	0.1000000E 01	0.2500000E-00	0.	0.1000000E 01	0.2916667E-00
0.	0.1000000E 01	0.3333333E-00	0.	0.1000000E 01	0.3750000E-00
0.	0.1000000E 01	0.4166666E-00	0.	0.1000000E 01	0.4583333E-00
0.	0.1000000E 01	0.5000000E-00	0.	0.1000000E 01	0.5416666E 00
0.	0.1000000E 01	0.5833333E 00	0.	0.1000000E 01	0.6250000E 00
0.	0.1000000E 01	0.6666666E 00	0.	0.1000000E 01	0.7083333E 00
0.	0.1000000E 01	0.7500000E 00	0.	0.1000000E 01	0.7916666E 00
0.	0.1000000E 01	0.8333333E 00	0.	0.1000000E 01	0.8750000E 00
0.	0.1000000E 01	0.9166666E 00	0.	0.1000000E 01	0.9583333E 00
0.	0.1000000E 01	0.1000000E 01			

NO. OF HORIZONTAL INCREMENTS= 24 NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.1807342E-00	0.2960740E-00	0.2863820E-00	0.2767014E-00	0.2670731E-00	0.2575342E-00
0.2481173E-00	0.2388501E-00	0.2297549E-00	0.2208487E-00	0.2121436E-00	0.2036470E-00
0.1953624E-00	0.1872899E-00	0.1794275E-00	0.1717712E-00	0.1643161E-00	0.1570571E-00
0.1499895E-00	0.1431093E-00	0.1364138E-00	0.1299013E-00	0.1235719E-00	0.1174268E-00
0.1114684E-00					
0.5595242E 00	0.4246999E-00	0.3636322E-00	0.3311987E-00	0.3091820E-00	0.2919007E-00
0.2771834E-00	0.2640487E-00	0.2519958E-00	0.2407446E-00	0.2301256E-00	0.2200291E-00
0.2103795E-00	0.2012126E-00	0.1922131E-00	0.1836202E-00	0.1753158E-00	0.1672778E-00
0.1594883E-00	0.1519335E-00	0.1446029E-00	0.1374897E-00	0.1305899E-00	0.1239020E-00
0.1174268E-00					
0.5635998E 00	0.4798349E-00	0.4186149E-00	0.3771940E-00	0.3474486E-00	0.3243521E-00
0.3052598E-00	0.2887546E-00	0.2740344E-00	0.2606191E-00	0.2482043E-00	0.2365877E-00
0.2256277E-00	0.2152214E-00	0.2052909E-00	0.1957759E-00	0.1866285E-00	0.1778109E-00
0.1692932E-00	0.1610523E-00	0.1530711E-00	0.1453377E-00	0.1378451E-00	0.1305899E-00
0.1235719E-00					
0.5679804E 00	0.5066683E 00	0.4541465E-00	0.4125885E-00	0.3799123E-00	0.3535020E-00
0.3314013E-00	0.3123179E-00	0.2954166E-00	0.2801498E-00	0.2661484E-00	0.2531557E-00
0.2409864E-00	0.2295030E-00	0.2186003E-00	0.2081965E-00	0.1982266E-00	0.1886393E-00
0.1793945E-00	0.1704612E-00	0.1618167E-00	0.1534453E-00	0.1453377E-00	0.1374897E-00
0.1299013E-00					
0.5726858E 00	0.5234821E 00	0.4784193E-00	0.4395360E-00	0.4067402E-00	0.3790028E-00

FIGURE 20. Group A Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

Contrails

0.3551923E-00	0.3343750E-00	0.3158515E-00	0.2991128E-00	0.2837889E-00	0.2696075E-00
0.2563639E-00	0.2439011E-00	0.2320965E-00	0.2208530E-00	0.2100930E-00	0.1997549E-00
0.1897902E-00	0.1801621E-00	0.1708436E-00	0.1618167E-00	0.1530711E-00	0.1446029E-00
0.1364138E-00					
0.5777359E 00	0.5360185E 00	0.4965240E-00	0.4607200E-00	0.4290327E-00	0.4011951E-00
0.3765571E-00	0.3548360E-00	0.3352207E-00	0.3173951E-00	0.3010304E-00	0.2858681E-00
0.2717044E-00	0.2583770E-00	0.2457549E-00	0.2337324E-00	0.2222237E-00	0.2111601E-00
0.2004874E-00	0.1901645E-00	0.1801621E-00	0.1704612E-00	0.1610523E-00	0.1519335E-00
0.1431093E-00					
0.5831506E 00	0.5465046E 00	0.5111643E 00	0.4781591E-00	0.4479860E-00	0.4206968E-00
0.3960787E-00	0.3738087E-00	0.3535477E-00	0.3349841E-00	0.3178484E-00	0.3019134E-00
0.2869899E-00	0.2729203E-00	0.2595732E-00	0.2468396E-00	0.2346297E-00	0.2228704E-00
0.2115041E-00	0.2004874E-00	0.1897902E-00	0.1793945E-00	0.1692932E-00	0.1594883E-00
0.1499895E-00					
0.5889491E 00	0.5559717E 00	0.5238102E 00	0.4932011E-00	0.4645918E-00	0.4381509E-00
0.4138425E-00	0.3915121E-00	0.3709522E-00	0.3519438E-00	0.3342781E-00	0.3177654E-00
0.3022378E-00	0.2875489E-00	0.2735720E-00	0.2601988E-00	0.2473381E-00	0.2349151E-00
0.2228704E-00	0.2111601E-00	0.1997548E-00	0.1886393E-00	0.1778109E-00	0.1672778E-00
0.1570571E-00					
0.5951496E 00	0.5649635E 00	0.5353090E 00	0.5067290E 00	0.4795999E-00	0.4541207E-00
0.4303417E-00	0.4082091E-00	0.3876069E-00	0.3683887E-00	0.3503984E-00	0.3334823E-00
0.3174958E-00	0.3023059E-00	0.2877932E-00	0.2738522E-00	0.2603924E-00	0.2473381E-00
0.2346297E-00	0.2222237E-00	0.2100930E-00	0.1982266E-00	0.1866285E-00	0.1753158E-00
0.1643161E-00					
0.6017688E 00	0.5737963E 00	0.5461792E 00	0.5193303E 00	0.4935607E-00	0.4690655E-00
0.4459324E-00	0.4241647E-00	0.4037055E-00	0.3844608E-00	0.3663163E-00	0.3491491E-00
0.3328353E-00	0.3172556E-00	0.3022978E-00	0.2878600E-00	0.2738522E-00	0.2601988E-00
0.2468396E-00	0.2337324E-00	0.2208530E-00	0.2081965E-00	0.1957759E-00	0.1836202E-00
0.1717712E-00					
0.6088213E 00	0.5826676E 00	0.5567546E 00	0.5314052E 00	0.5068769E 00	0.4833481E-00
0.4609195E-00	0.4396239E-00	0.4194409E-00	0.4003122E-00	0.3821539E-00	0.3648669E-00
0.3483447E-00	0.3324787E-00	0.3171629E-00	0.3022978E-00	0.2877932E-00	0.2735720E-00
0.2595732E-00	0.2457549E-00	0.2320965E-00	0.2186003E-00	0.2052909E-00	0.1922130E-00
0.1794275E-00					
0.6163186E 00	0.5917073E 00	0.5672590E 00	0.5432331E 00	0.5198442E 00	0.4972513E-00
0.4755551E-00	0.4548023E-00	0.4349934E-00	0.4160927E-00	0.3980374E-00	0.3807454E-00
0.3641224E-00	0.3480677E-00	0.3324786E-00	0.3172556E-00	0.3023059E-00	0.2875489E-00
0.2729203E-00	0.2583769E-00	0.2439011E-00	0.2295030E-00	0.2152214E-00	0.2011216E-00
0.1872899E-00					
0.6242689E 00	0.6010033E 00	0.5778468E 00	0.5550126E 00	0.5326816E 00	0.5109937E 00
0.4900439E-00	0.4698833E-00	0.4505236E-00	0.4319424E-00	0.4140900E-00	0.3968953E-00
0.3802718E-00	0.3641224E-00	0.3483447E-00	0.3328353E-00	0.3174958E-00	0.3022378E-00
0.2869899E-00	0.2717044E-00	0.2563639E-00	0.2409864E-00	0.2256277E-00	0.2103795E-00
0.1953624E-00					

FIGURE 20. Group A Sample Problems Program Results (continued)

Approved for Public Release

0.6326757E 00	0.6106148E 00	0.5886253E 00	0.5668858E 00	0.5455506E 00	0.5247425E 00
0.5045483E 00	0.4850188E-00	0.4661698E-00	0.4479862E-00	0.4304256E-00	0.4134230E-00
0.3968953E-00	0.3807454E-00	0.3648669E-00	0.3491491E-00	0.3334823E-00	0.3177654E-00
0.3019134E-00	0.2858681E-00	0.2696075E-00	0.2531557E-00	0.2365876E-00	0.2200290E-00
0.2036470E-00					
0.6415373E 00	0.6205801E 00	0.5996680E 00	0.5789533E 00	0.5585693E 00	0.5386236E 00
0.5191947E 00	0.5003300E 00	0.4820461E-00	0.4643307E-00	0.4471448E-00	0.4304256E-00
0.4140900E-00	0.3980374E-00	0.3821539E-00	0.3663163E-00	0.3503984E-00	0.3342781E-00
0.3178484E-00	0.3010303E-00	0.2837889E-00	0.2661484E-00	0.2482043E-00	0.2301255E-00
0.2121436E-00					
0.6508463E 00	0.6309207E 00	0.6110224E 00	0.5912836E 00	0.5718205E 00	0.5527282E 00
0.5340769E 00	0.5159097E 00	0.4982419E-00	0.4810617E-00	0.4643307E-00	0.4479862E-00
0.4319424E-00	0.4160927E-00	0.4003122E-00	0.3844608E-00	0.3683887E-00	0.3519438E-00
0.3349841E-00	0.3173951E-00	0.2991128E-00	0.2801497E-00	0.2606190E-00	0.2407446E-00
0.2208487E-00					
0.6605884E 00	0.6416435E 00	0.6227150E 00	0.6039190E 00	0.5853584E 00	0.5671177E 00
0.5492596E 00	0.5318231E 00	0.5148214E 00	0.4982419E-00	0.4820461E-00	0.4661698E-00
0.4505236E-00	0.4349934E-00	0.4194409E-00	0.4037054E-00	0.3876069E-00	0.3709521E-00
0.3535477E-00	0.3352207E-00	0.3158515E-00	0.2954165E-00	0.2740344E-00	0.2519958E-00
0.2297549E-00					
0.6707421E 00	0.6527425E 00	0.6347538E 00	0.6168797E 00	0.5992120E 00	0.5818268E 00
0.5647808E 00	0.5481091E 00	0.5318231E 00	0.5159097E 00	0.5003300E 00	0.4850188E-00
0.4698833E-00	0.4548023E-00	0.4396238E-00	0.4241647E-00	0.4082091E-00	0.3915121E-00
0.3738087E-00	0.3548360E-00	0.3343750E-00	0.3123179E-00	0.2887545E-00	0.2640486E-00
0.2388501E-00					
0.6812784E 00	0.6641996E 00	0.6471309E 00	0.6301659E 00	0.6133881E 00	0.5968665E 00
0.5806533E 00	0.5647808E 00	0.5492597E 00	0.5340769E 00	0.5191947E 00	0.5045483E 00
0.4900438E-00	0.4755551E-00	0.4609195E-00	0.4459324E-00	0.4303416E-00	0.4138425E-00
0.3960787E-00	0.3766570E-00	0.3551922E-00	0.3314013E-00	0.3052598E-00	0.2771833E-00
0.2481173E-00					
0.6921608E 00	0.6759857E 00	0.6598238E 00	0.6437608E 00	0.6278734E 00	0.6122257E 00
0.5968665E 00	0.5818268E 00	0.5671177E 00	0.5527282E 00	0.5386236E 00	0.5247425E 00
0.5109917E 00	0.4972513E-00	0.4833481E-00	0.4690654E-00	0.4541206E-00	0.4381509E-00
0.4206968E-00	0.4011951E-00	0.3790027E-00	0.3535020E-00	0.3243520E-00	0.2919007E-00
0.2575342E-00					
0.7033451E 00	0.6880612E 00	0.6727969E 00	0.6576316E 00	0.6426369E 00	0.6278734E 00
0.6133881E 00	0.5992120E 00	0.5853584E 00	0.5718205E 00	0.5585693E 00	0.5455506E 00
0.5326816E 00	0.5198442E 00	0.5068768E 00	0.4935607E-00	0.4795999E-00	0.4645918E-00
0.4477850E-00	0.4290327E-00	0.4067402E-00	0.3799122E-00	0.3474486E-00	0.3091820E-00
0.2670731E-00					
0.7147804E 00	0.7003773E 00	0.6860028E 00	0.6717317E 00	0.6576316E 00	0.6437608E 00
0.6301659E 00	0.6168797E 00	0.6039190E 00	0.5912836E 00	0.5789533E 00	0.5668858E 00
0.5550126E 00	0.5432351E 00	0.5314052E 00	0.5193303E 00	0.5067290E 00	0.4932011E-00
0.4781591E-00	0.4607200E-00	0.4395360E-00	0.4125884E-00	0.3771939E-00	0.3311986E-00

FIGURE 20. Group A Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

Contrails

0.2767014E-00					
0.7264098E 00	0.7128772E 00	0.6993846E 00	0.6860028E 00	0.6727969E 00	0.6598238E 00
0.6471309E 00	0.6347538E 00	0.6227150E 00	0.6110224E 00	0.5996680E 00	0.5886253E 00
0.5778468E 00	0.5672590E 00	0.5567545E 00	0.5461792E 00	0.5353090E 00	0.5238101E 00
0.5111642E 00	0.4965239E-00	0.4784192E-00	0.4541465E-00	0.4186147E-00	0.3636320E-00
0.2863820E-00					
0.7381714E 00	0.7254978E 00	0.7128772E 00	0.7003773E 00	0.6880612E 00	0.6759857E 00
0.6641996E 00	0.6527425E 00	0.6416435E 00	0.6309207E 00	0.6205801E 00	0.6106148E 00
0.6010033E 00	0.5917073E 00	0.5826676E 00	0.5737963E 00	0.5649635E 00	0.5559717E 00
0.5465046E 00	0.5360184E 00	0.5234821E 00	0.5066682E 00	0.4798348E-00	0.4246997E-00
0.2960740E-00					
0.7500000E 00	0.7381714E 00	0.7264098E 00	0.7147804E 00	0.7033451E 00	0.6921608E 00
0.6812784E 00	0.6707421E 00	0.6605884E 00	0.6508463E 00	0.6415373E 00	0.6326757E 00
0.6242689E 00	0.6163187E 00	0.6088213E 00	0.6017688E 00	0.5951496E 00	0.5889491E 00
0.5831506E 00	0.5777359E 00	0.5726858E 00	0.5679804E 00	0.5635998E 00	0.5595242E 00
0.1807342E-00					

FIGURE 20. Group A Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

SAMPLE PROBLEM GROUP B

The geometrical relationships used in this example are presented in Figure 21. The data sheets are shown in Figure 22 with results in Figure 23.

Problem 1B

The use of the surface generator and double bisection of surfaces is demonstrated. The plane Surface 1PLAT1 is entered as usual in the data, but the octagonal disk 3DISK is created by specifications to the surface generator. Note that no connections data are created for a Class 3 surface, but would be if the disk were named 6DISK.

The double bisection is easily seen in side view of 1PLAT1 and 3DISK. The results of the factor request from 1PLAT1 and 3DISK is shown in Run #1 output, indicating the areas in each surface seen by the other. The number of points defining 3DISK has been reduced to 7 and reorganized because of the bisection, as seen along the dotted line.

Problem 2B

The converse factor, 3DISK to 1PLAT1, is requested as Run #2. Because the disk is now Surface 1, the final coordinate system in 3DISK is aligned so that the X'Y' plane is the plane of the disk. Point 1' becomes the origin, and line segment 1'2' the X' axis. Note that the exchange coefficients (ƒA) are very nearly equal, as they should be because of the reciprocity theorem.

Notice that the factor from one surface to the other along the line of bisection is, in reality, zero, but the output is, in some cases, non-zero though quite small (10^{-8} order of magnitude). This is caused by accumulated internal truncation error, and is not significant enough to warrant concern here. (This is not the case, however, with some silhouette generator computations).

Problem 3B

The capability of coordinate transformation is illustrated. Run #3 requests the factor from 1PLAT1 to 3DISK transformed to the position shown by the transformation data 9TDISK. The program detected, after transforming 3DISK, that it bisected 1PLAT1. As the output shows, the part of 1PLAT1 actually mapped was the trapezoid indicated in the top view, and in the output final coordinate data.

Problem 4B

It is quite feasible to generate or manually input a surface, transform the surface to a different location, and then ask for the factor between the original surface and the transformed surface. This is shown by Run #4, where 3DISK is used as Surface 1, and 3DISK transformed by 9TDISK is used as

Approved for Public Release

Contrails

Surface 2. The output shows a bisection of 3DISK, removing the 4th boundary point, and therefore adding a point to the final 3DISK surface boundaries, making it 9 instead of 8.

Problem 5B

The factor from the transformed disk, 3DISK9TDICK, to 1PLAT1 is requested as Run #5, demonstrating program flexibility in that Surface 1 is now transformed. The resulting exchange coefficient is very nearly equal to Run #3, as it should be.

Approved for Public Release

Contrails

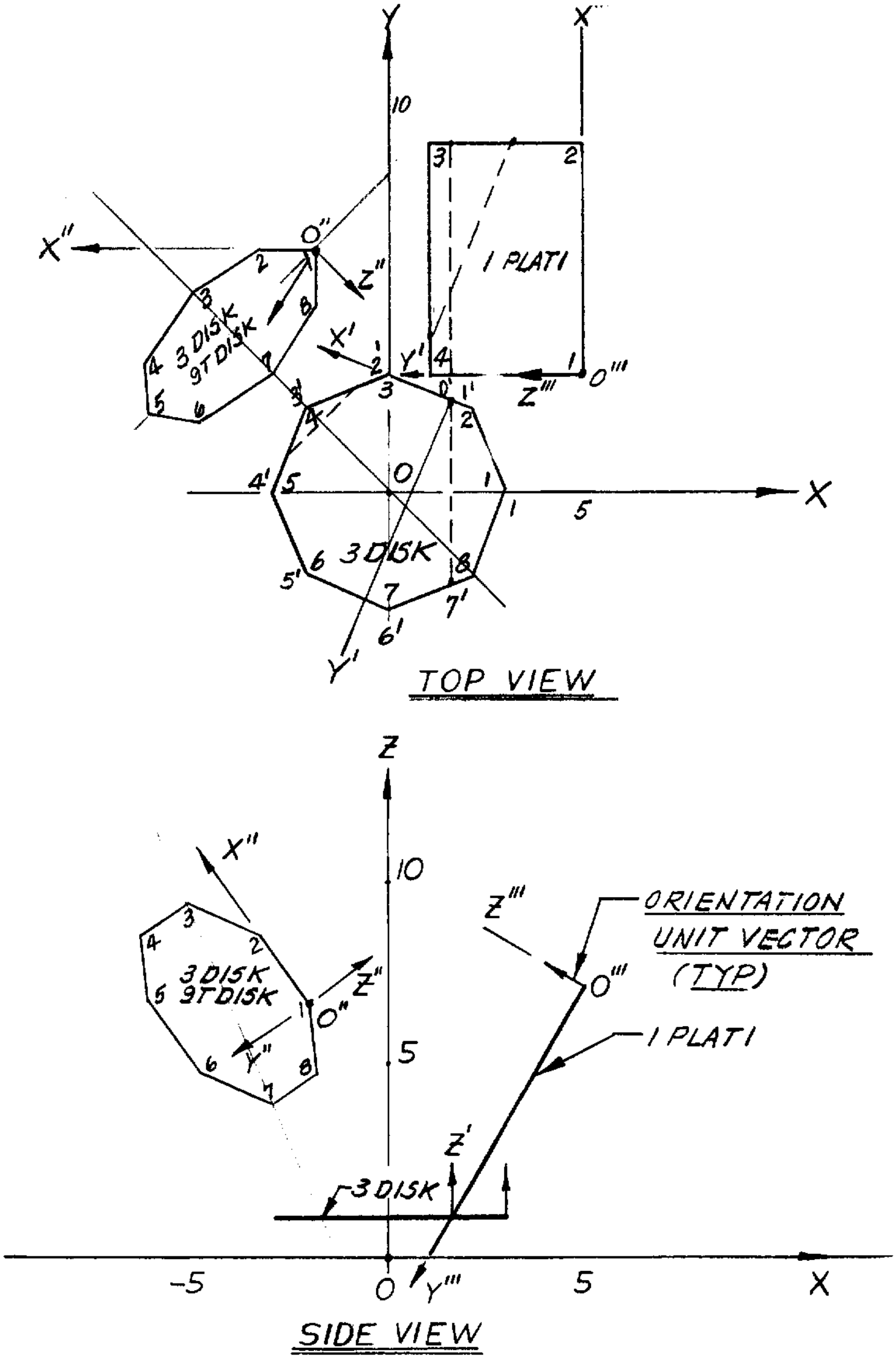

FIGURE 21. GROUP B SAMPLE PROBLEMS GEOMETRY

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 9 of 36 JOB NO. 2929-30

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	T	N A A C Ø N F A C		
13	I	I R E P Ø R T Ø A		
25	M	P L E P R Ø B L E M		
37	Ø	F R Ø M F I G .		
49		- K . A . T Ø U	73 80	
61	P	Ø , 1 1 / 1 / 6 3	B 0 1 0	
1	1	P L A T 1		
13		A Ø K E W E D		
25	R	E C T A N G U L A R		
37	Ø	U R F A C E		
49			73 80	
61			B 0 2 0	
1	4	. 0		
13	5	. 0		
25	3	. 0		
37	7	. 0		
49	5	. 0	73 80	
61	9	. 0	B 0 3 0	
1	7	. 0		
13	1	. 0		
25	9	. 0		
37	0	. 0		
49	1	. 0	73 80	
61	3	. 0	B 0 4 0	

FORM 114-C-17 REV. 7-66

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 10 of 36 JOB NO. 2929-30

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	0	. 0		
13				
25				
37				
49			73 80	
61			B 0 5 0	
1	3	D I Ø K		
13				
25	Ø	C T A G Ø N A L D I		
37	Ø	K		
49			73 80	
61			B 0 6 0	
1	8	. 0		
13	0	. 0		
25	0	. 0		
37	1	. 0		
49	3	. 0	73 80	
61	3	. 0	B 0 7 0	
1	9	T D I Ø K		
13	T	R A N Ø F Ø R M Ø 3		
25	D	I Ø K T Ø Ø K E W		
37	E	D P Ø Ø I T I Ø N		
49	I	N I I Q U A D R A	73 80	
61	N	T	B 0 8 0	

FORM 114-C-17 REV. 7-66

FIGURE 22. Group B Sample Problems Input Data Code Sheets

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 11 of 36 JOB NO. 2929-30

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	1	.0		
13	-	1.9393398		
25	6	.1819806		
37	6	.598075		
49	3	.0		
61	-	5.1213204	B090	
1	5	.1213204		
13	9	.1961500		
25	7	.0		
37	-	3.0		
49	+	3.0		
61	+	4.0	B100	
1	1	PLAT13DIØK		
13				
25	D			
37	3	DIØK 1PLAT1		
49				
61	D		B110	
1	1	PLAT13DIØK		
13		9TDIØK		
25	D			
37	3	DIØK 3DIØK		
49		9TDIØK		
61	D		B120	

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 12 of 36 JOB NO. 2929-30

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	3	DIØK 1PLAT1		
13	9	TDIØK		
25	D			
37				
49				
61			B130	
1				
13				
25				
37				
49				
61				
1				
13				
25				
37				
49				
61				
1				
13				
25				
37				
49				
61				

FIGURE 22. Group B Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

Contrails

```
                    NAA SPACE AND INFORMATION SYSTEMS DIVISION
           T+A PROJECT RADIANT-INTERCHANGE CONFIGURATION FACTOR PROGRAM

                                 C O N F A C  I I

        NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (B)-K.A.TOUPS,11/1/63

                                 I N P U T   D A T A


***** DATA NAME- *1PLAT1       *    A SKEWED RECTANGULAR SURFACE

POINT      X              Y              Z           POINT      X              Y              Z
      0.4131757E 01  0.3000000E 01  0.7496139E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1  0.5000000E 01  0.3000000E 01  0.7000000E 01        2  0.5000000E 01  0.9000000E 01  0.7000000E 01
   3  0.1000000E 01  0.9000000E 01  0.                   4  0.1000000E 01  0.3000000E 01  0.


***** DATA NAME- *3DISK        *              OCTAGONAL DISK

SURFACE SPECIFICATIONS-

NO OF X-SECTIONS =  1           NO OF X-SECTION BOUNDARY DIVISIONS =  8

LOCATION OF VERTICAL CENTERLINE, X= 0.            , Y= 0.

X-SECTION NO.       X-AXIS RADIUS      Y-AXIS RADIUS      ELEVATION ABOVE XY PLANE
     1              0.3000000E 01      0.3000000E 01      0.1000000E 01

THE FOLLOWING INTERNALLY GENERATED SURFACE DATA RESULTED FROM THE ABOVE SPECIFICATIONS-

POINT      X              Y              Z           POINT      X              Y              Z
      0.3000000E 01  0.             0.2000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1  0.3000000E 01  0.             0.1000000E 01        2  0.2121320E 01  0.2121320E 01  0.1000000E 01
   3  0.5587935E-07  0.3000000E 01  0.1000000E 01        4 -0.2121320E 01  0.2121320E 01  0.1000000E 01
   5 -0.3000000E 01  0.1117587E-06  0.1000000E 01        6 -0.2121320E 01 -0.2121320E 01  0.1000000E 01
   7 -0.1788139E-06 -0.3000000E 01  0.1000000E 01        8  0.2121320E 01 -0.2121320E 01  0.1000000E 01


***** DATA NAME- *9TDISK       * TRANSFORMS 3DISK TO SKEWED POSITION IN II QUADRANT

TRANSFORMATION DATA-
```

FIGURE 23. Group B Sample Problems Program Results
(27 pages)

Approved for Public Release

POINT	X	Y	Z
1	-0.1939340E 01	0.6181981E 01	0.6598075E 01
7	-0.3000000E 01	0.3000000E 01	0.4000000E 01

POINT	X	Y	Z
3	-0.5121320E 01	0.5121320E 01	0.9196[illegible]50E 0[illegible]

FIGURE 23. Group B Sample Problems Program Results (continued)

Contrails

Approved for Public Release

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (B)-K.A.TOUPS,11/1/63

RUN NO.   1   DATA USED FOR THIS RUN- *1PLAT1*3DISK *
                                     *       *     *
                                     *D      *     *

THE FORM FACTOR FROM SURFACE *1PLAT1      * TO SURFACE *3DISK       * = 0.00954

THE EXCHANGE COEFFICIENT (FA)=   0.46132E-00 SQ UNITS

                THE MAPPING AREA = 0.4146303E 02 SQ UNITS

ONLY A PART OF SURFACE *1PLAT1      *, COMPRISING AN AREA OF  0.4146303E 02   SQ UNITS,
SEES SURFACE *3DISK       *

THE AREA OF SURFACE *1PLAT1      * = 0.4837355E 02 SQ UNITS.

ONLY A PART OF SURFACE *3DISK       *, COMPRISING AN AREA OF  0.2113364E 02   SQ UNITS,
SEES SURFACE *1PLAT1      *

THE AREA OF SURFACE *3DISK       * = 0.2545584E 02 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *1PLAT1      *

POINT       X              Y              Z            POINT      X              Y           Z
        0.             -0.            0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1    0.             -0.            0.                  2   0.6000000E 01 -0.            0.
   3    0.6000000E 01  0.6910507E 01  0.                  4   0.                0.6910507E 01  0.


***** DATA NAME- *3DISK       *

POINT       X              Y              Z            POINT      X              Y           Z
      -0.0509071E 00  0.6042253E 01  0.4961389E-00---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1  -0.6509071E 00  0.6910507E 01  0.                  2   0.                0.7690154E 01  0.1364382E 0.
```

FIGURE 23. Group B Sample Problems Program Results (continued)

Approved for Public Release

Contrails

Contrails

```
  3  -0.8786797E 00  0.8742623E 01  0.3206204E 01      4  -0.3000000E 01  0.9178570E 01  0.3969112E 01
  5  -0.5121320E 01  0.8742623E 01  0.3206204E 01      6  -0.6000000E 01  0.7690154E 01  0.1364382E 01
  7  -0.5349093E 01  0.6910507E 01  0.

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1PLAT1      * FOR EACH Y INTERVAL

     X-LEFT        X-RIGHT          Y                  X-LEFT        X-RIGHT         Y

 0.            0.6000000E 01 -0.                    0.            0.6000000E 01  0.2879378E-00
 0.            0.6000000E 01  0.5758756E 00         0.            0.6000000E 01  0.8638133E 00
 0.            0.6000000E 01  0.1151751E 01         0.            0.6000000E 01  0.1439689E 01
 0.            0.6000000E 01  0.1727627E 01         0.            0.6000000E 01  0.2015564E 01
 0.            0.6000000E 01  0.2303502E 01         0.            0.6000000E 01  0.2591440E 01
 0.            0.6000000E 01  0.2879378E 01         0.            0.6000000E 01  0.3167315E 01
 0.            0.6000000E 01  0.3455253E 01         0.            0.6000000E 01  0.3743191E 01
 0.            0.6000000E 01  0.4031129E 01         0.            0.6000000E 01  0.4319066E 01
 0.            0.6000000E 01  0.4607004E 01         0.            0.6000000E 01  0.4894942E 01
 0.            0.6000000E 01  0.5182880E 01         0.            0.6000000E 01  0.5470817E 01
 0.            0.6000000E 01  0.5758755E 01         0.            0.6000000E 01  0.6046693E 01
 0.            0.6000000E 01  0.6334631E 01         0.            0.6000000E 01  0.6622569E 01
 0.            0.6000000E 01  0.6910507E 01

NO. OF HORIZONTAL INCREMENTS= 24  NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

 0.1059385E-01  0.1024098E-01  0.9877514E-02  0.9506416E-02  0.9130518E-02  0.8752485E-02
 0.8374781E-02  0.7999687E-02  0.7629241E-02  0.7265234E-02  0.6909221E-02  0.6562512E-02
 0.6226195E-02  0.5901136E-02  0.5587984E-02  0.5287228E-02  0.4999155E-02  0.4723928E-02
 0.4461556E-02  0.4211954E-02  0.3974939E-02  0.3750235E-02  0.3537521E-02  0.3336416E-02
 0.3146497E-02
 0.1145886E-01  0.1105647E-01  0.1064295E-01  0.1022179E-01  0.9796299E-02  0.9369567E-02
 0.8944445E-02  0.8523560E-02  0.8109187E-02  0.7703333E-02  0.7307714E-02  0.6923744E-02
 0.6552560E-02  0.6195040E-02  0.5851823E-02  0.5523325E-02  0.5209775E-02  0.4911237E-02
 0.4627613E-02  0.4358698E-02  0.4104184E-02  0.3863686E-02  0.3636740E-02  0.3422844E-02
 0.3221470E-02
 0.1241369E-01  0.1195360E-01  0.1148192E-01  0.1100278E-01  0.1052006E-01  0.1003737E-01
 0.9558026E-02  0.9084978E-02  0.8620835E-02  0.8167814E-02  0.7727791E-02  0.7302275E-02
 0.6892434E-02  0.6499135E-02  0.6122980E-02  0.5764290E-02  0.5423177E-02  0.5099562E-02
 0.4793240E-02  0.4503833E-02  0.4230874E-02  0.3973815E-02  0.3732063E-02  0.3504949E-02
```

FIGURE 23. Group B Sample Problems Program Results
(continued)

Approved for Public Release

0.3291805E-02					
0.1346930E-01	0.1294174E-01	0.1240230E-01	0.1185584E-01	0.1130694E-01	0.1075984E-01
0.1021834E-01	0.9685834E-02	0.9165245E-02	0.8659048E-02	0.8169245E-02	0.7697431E-02
0.7244792E-02	0.6812140E-02	0.6399971E-02	0.6008496E-02	0.5637652E-02	0.5287209E-02
0.4956736E-02	0.4645682E-02	0.4353382E-02	0.4079099E-02	0.3822038E-02	0.3581367E-02
0.3356246E-02					
0.1463810E-01	0.1403141E-01	0.1341276E-01	0.1278794E-01	0.1216235E-01	0.1154093E-01
0.1092812E-01	0.1032773E-01	0.9743105E-02	0.9176931E-02	0.8631350E-02	0.8108005E-02
0.7608049E-02	0.7132197E-02	0.6680797E-02	0.6253848E-02	0.5851092E-02	0.5472041E-02
0.5116042E-02	0.4782271E-02	0.4469833E-02	0.4177753E-02	0.3905009E-02	0.3650563E-02
0.3413374E-02					
0.1593417E-01	0.1523436E-01	0.1452286E-01	0.1380655E-01	0.1309185E-01	0.1238452E-01
0.1168973E-01	0.1101183E-01	0.1035450E-01	0.9720696E-02	0.9112681E-02	0.8532079E-02
0.7979947E-02	0.7456823E-02	0.6962809E-02	0.6497666E-02	0.6060816E-02	0.5651479E-02
0.5268644E-02	0.4911226E-02	0.4577999E-02	0.4267719E-02	0.3979076E-02	0.3710792E-02
0.346[illegible]88E-02					
0.1737342E-01	0.1656367E-01	0.1574294E-01	0.1491953E-01	0.1410102E-01	0.1329424E-01
0.125[illegible]07E-01	0.1173854E-01	0.1099871E-01	0.1028872E-01	0.9610910E-02	0.8966815E-02
0.8357309E-02	0.7782653E-02	0.7242615E-02	0.6736565E-02	0.6263544E-02	0.5822350E-02
0.5411590E-02	0.5029779E-02	0.4675323E-02	0.4346625E-02	0.4042077E-02	0.3760094E-02
0.3499136E-02					
0.1897386E-01	0.1803380E-01	0.1708419E-01	0.1613500E-01	0.1519530E-01	0.1427308E-01
0.1337520E-01	0.1250730E-01	0.1167385E-01	0.1087813E-01	0.1012247E-01	0.9408213E-02
0.8735887E-02	0.8105341E-02	0.7515879E-02	0.6966346E-02	0.6455251E-02	0.5980889E-02
0.5541356E-02	0.5134683E-02	0.4758834E-02	0.4411804E-02	0.4091602E-02	0.3796300E-02
0.3524071E-02					
0.2075583E-01	0.1966070E-01	0.1855842E-01	0.1746107E-01	0.1637949E-01	0.1532312E-01
0.1429984E-01	0.1331600E-01	0.1237641E-01	0.1148446E-01	0.1064226E-01	0.9850768E-02
0.9110030E-02	0.8419281E-02	0.7777164E-02	0.7181822E-02	0.6631106E-02	0.6122612E-02
0.5653834E-02	0.5222212E-02	0.4825171E-02	0.4460224E-02	0.4124946E-02	0.3817023E-02
0.3534278E-02					
0.2274213E-01	0.2146169E-01	0.2017788E-01	0.1890543E-01	0.1765737E-01	0.1644480E-01
0.1527682E-01	0.1416044E-01	0.1310077E-01	0.1210108E-01	0.1116307E-01	0.1028709E-01
0.9472402E-02	0.8717369E-02	0.8019719E-02	0.7376714E-02	0.6785291E-02	0.6242243E-02
0.5744260E-02	0.5288099E-02	0.4870544E-02	0.4488544E-02	0.4139166E-02	0.3819669E-02
0.3527490E-02					
0.2495825E-01	0.2345529E-01	0.2195475E-01	0.2047465E-01	0.1903072E-01	0.1763608E-01
0.1630110E-01	0.1503345E-01	0.1383831E-01	0.1271855E-01	0.1167514E-01	0.1070744E-01
0.9813571E-02	0.8990688E-02	0.8235284E-02	0.7543439E-02	0.6910975E-02	0.6333630E-02
0.5807192E-02	0.5327529E-02	0.4890729E-02	0.4493059E-02	0.4131045E-02	0.3801458E-02
0.3501314E-02					
0.2743235E-01	0.2566083E-01	0.2390030E-01	0.2217307E-01	0.2049820E-01	0.1889112E-01
0.1736357E-01	0.1592371E-01	0.1457639E-01	0.1332370E-01	0.1216534E-01	0.1109914E-01
0.1012160E-01	0.9228211E-02	0.8413833E-02	0.7673001E-02	0.7000153E-02	0.6389747E-02

FIGURE 23. Group B Sample Problems Program Results (continued)

Approved for Public Release

Contrails

0.5836448E-02	0.5335105E-02	0.4881088E-02	0.4469793E-02	0.4097171E-02	0.3759460E-02
0.3453237E-02					
0.3019509E-01	0.2809746E-01	0.2602353E-01	0.2400110E-01	0.2205336E-01	0.2019840E-01
0.1844924E-01	0.1681414E-01	0.1529708E-01	0.1389857E-01	0.1261633E-01	0.1144595E-01
0.1038158E-01	0.9416474E-02	0.8543354E-02	0.7754841E-02	0.7043617E-02	0.6402620E-02
0.5925195E-02	[illegible]	0.4836535E-02	0.4414502E-02	0.4033946E-02	0.3690646E-02
0.3380717E-02					
0.3327884E-01	0.3078258E-01	0.2832877E-01	0.2595242E-01	0.2368178E-01	0.2153789E-01
0.1953471E-01	0.1767980E-01	0.1597531E-01	0.1441904E-01	0.1300558E-01	0.1172727E-01
0.1057508E-01	0.9539226E-02	0.8609730E-02	0.7775782E-02	0.7030939E-02	0.6363389E-02
0.5765932E-02	0.5231091E-02	0.4752077E-02	0.4322774E-02	0.3937698E-02	0.3591962E-02
0.3281215E-02					
0.3671609E-01	0.3372868E-01	0.3081164E-01	0.2800948E-01	0.2535664E-01	0.2287701E-01
0.2058465E-01	0.1846501E-01	0.1657688E-01	0.1485308E-01	0.1330411E-01	0.1191747E-01
0.1067975E-01	0.9577259E-02	0.8596594E-02	0.7724987E-02	0.6950550E-02	0.6262407E-02
0.5650657E-02	0.5106493E-02	0.4621977E-02	0.4190124E-02	0.3804746E-02	0.3460401E-02
0.3152276E-02					
0.4053586E-01	0.3693769E-01	0.3345215E-01	0.3013632E-01	0.2703178E-01	0.2416459E-01
0.2154690E-01	0.1917950E-01	0.1705472E-01	0.1515904E-01	0.1347543E-01	0.1198512E-01
0.1065894E-01	0.9508239E-02	0.8483390E-02	0.7584186E-02	0.6789916E-02	0.6089437E-02
0.5471080E-02	0.4924575E-02	0.4440895E-02	0.4012190E-02	0.3631595E-02	0.3293146E-02
0.2991659E-02					
0.4475620E-01	0.4039032E-01	0.3620258E-01	0.3226653E-01	0.2863112E-01	0.2532207E-01
0.2234570E-01	0.1969355E-01	0.1734764E-01	0.1528351E-01	0.1347432E-01	0.1189255E-01
0.1051166E-01	0.9306879E-02	0.8255680E-02	0.7337931E-02	0.6535886E-02	0.5834026E-02
0.5218865E-02	0.4678755E-02	0.4203640E-02	0.3784872E-02	0.3415021E-02	0.3087699E-02
0.2797407E-02					
0.4956860E-01	0.4492565E-01	0.3896590E-01	0.3428337E-01	0.3003200E-01	0.2623096E-01
0.2287289E-01	0.1993268E-01	0.1737492E-01	0.1515963E-01	0.1324620E-01	0.1159585E-01
0.1017291E-01	0.8945536E-02	0.7885734E-02	0.6969253E-02	0.6175245E-02	0.5485912E-02
0.4886096E-02	0.4362942E-02	0.3905529E-02	0.3504610E-02	0.3152324E-02	0.2842013E-02
0.2568003E-02					
0.5430407E-01	0.4770080E-01	0.4155645E-01	0.3598643E-01	0.3103997E-01	0.2671527E-01
0.2297685E-01	0.1977050E-01	0.1703437E-01	0.1470620E-01	0.1272752E-01	0.1104573E-01
0.9614835E-02	0.8395292E-02	0.7355598E-02	0.6461544E-02	0.5695500E-02	0.5035735E-02
0.4465802E-02	0.3971967E-02	0.3542769E-02	0.3168636E-02	0.2841524E-02	0.2554704E-02
0.2302494E-02					
0.5935640E-01	0.5110827E-01	0.4362728E-01	0.3703649E-01	0.3135156E-01	0.2651930E-01
0.2245086E-01	0.1904488E-01	0.1620135E-01	0.1382890E-01	0.1184767E-01	0.1018986E-01
0.8798837E-02	0.7627888E-02	0.6638687E-02	0.5799884E-02	0.5085900E-02	0.4475827E-02
0.3952561E-02	0.3502066E-02	0.3112811E-02	0.2775277E-02	0.2481584E-02	0.2225192E-02
0.2000636E-02					
0.6399733E-01	0.5360066E-01	0.4453607E-01	0.3686799E-01	0.3050483E-01	0.2528390E-01
0.2102489E-01	0.1755737E-01	0.1473235E-01	0.1242513E-01	0.1053395E-01	0.8977028E-02

FIGURE 23. Group B Sample Problems Program Results (continued)

Approved for Public Release

0.7689145E-02	0.6618482E-02	0.5723893E-02	0.4972657E-02	0.4338700E-02	0.3801149E-02
0.3343234E-02	0.2951424E-02	0.2614743E-02	0.2324252E-02	0.2072633E-02	0.1853878E-02
0.1663004E-02					
0.6689905E-01	0.338[illegible]548E-01	0.4311004E-01	0.3456716E-01	0.2782882E-01	0.2253425E-01
0.1837075E-01	0.1508468E-01	0.1247712E-01	0.1039467E-01	0.8720072E-02	0.7363857E-02
0.6257719E-02	0.5349309E-02	0.4598320E-02	0.3973521E-02	0.3450555E-02	0.3010314E-02
0.2637696E-02	0.2320689E-02	0.2049683E-02	0.1816937E-02	0.1616179E-02	0.1442296E-02
0.1291100E-02					
0.6462940E-01	0.4890992E-01	0.3730368E-01	0.2876140E-01	0.2243616E-01	0.1770874E-01
0.1413778E-01	0.1141016E-01	0.93[illegible]220E-02	0.7657754E-02	0.6359036E-02	0.5323673E-02
0.4490437E-02	0.3813943E-02	0.3260169E-02	0.2803377E-02	0.2423884E-02	0.2106523E-02
0.1839467E-02	0.15[illegible]4[illegible]9E-02	0.1421107E-02	0.1256608E-02	0.1115241E-02	0.9932169E-03
0.8874408E-03					
0.4830583E-01	0.33444[illegible]8E-01	0.2400334E-01	0.1770987E-01	0.1336350E-01	0.1027887E-01
0.8039944E-02	0.6382834E-02	0.5134819E-02	0.4180039E-02	0.3459163E-02	0.2856819E-02
0.2393719E-02	0.20[illegible]E-02	0.1719458E-02	0.1472162E-02	0.1268048E-02	0.1098326E-02
0.9562250E-03	0.8364910E-03	0.7350130E-03	0.6485291E-03	0.5744472E-03	0.5106864E-03
0.4555598E-03					
0.	0.	-0.	0.2964492E-09	0.	0.2223369E-08
0.	0.116[illegible]797[illegible]-08	0.	0.	0.	0.
-0.	0.	0.	0.	0.	0.
0.	0.2964497[illegible]-09	0.	0.1334021E-08	0.	0.1482246E-09
0.					

FIGURE 23. Group B Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

Contrails

```
                         NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (B)-K.A.TOUPS,11/1/63


RUN NO.   2   DATA USED FOR THIS RUN- *3DISK *1PLAT1*
                                      *      *      *
                                      *D     *      *

THE FORM FACTOR FROM SURFACE *3DISK       * TO SURFACE *1PLAT1      * = 0.01815

THE EXCHANGE COEFFICIENT (FA)=   0.46198E-00 SQ UNITS

                  THE MAPPING AREA = 0.2112591E 02 SQ UNITS


ONLY A PART OF SURFACE *3DISK       *, COMPRISING AN AREA OF  0.2113364E 02  SQ UNITS,
SEES SURFACE *1PLAT1      *

THE AREA OF SURFACE *3DISK       * = 0.2545584E 02 SQ UNITS.


ONLY A PART OF SURFACE *1PLAT1      *, COMPRISING AN AREA OF  0.4146304E 02  SQ UNITS,
SEES SURFACE *3DISK       *

THE AREA OF SURFACE *1PLAT1      * = 0.4837355E 02 SQ UNITS.


THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *3DISK       *

POINT       X              Y              Z           POINT       X              Y             Z
         0.             0.             0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1     0.             0.            -0.                  2    0.1700902E 01  0.              -0.
   3     0.3324490E 01  0.1623588E 01  0.                  4    0.3324490E 01  0.3919689E 01  0.
   5     0.1700902E 01  0.5543277E 01 -0.                  6   -0.5951983E 00  0.5543277E 01 -0.
   7    -0.1797918E 01  0.4340557E 01 -0.


***** DATA NAME- *1PLAT1      *

POINT       X              Y              Z           POINT       X              Y             Z
```

FIGURE 23. Group B Sample Problems Program Results (continued)

Approved for Public Release

```
   -0.2116343E 01 -0.1581153E 01  0.6496139E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
 1 -0.2918495E 01 -0.1913417E 01  0.6000000E 01       2  -0.6223947E 00 -0.7456694E 01  0.6000000E 01
 3  0.2545192E 01 -0.6144637E 01  0.                   4   0.2490914E-00 -0.6013597E 00  0.

COORDINATES OF POINTS ON BOUNDARY OF SURF    *3DISK        * FOR EACH Y INTERVAL

     X-LEFT          X-RIGHT          Y                      X-LEFT          X-RIGHT          Y

  0.               0.1700902E 0.   0.                    -0.9567086E-01   0.1931872E 01   0.2309699E-00
 -0.1913417E-00    0.2162842E 01   0.4619397E-00         -0.2870126E-00   0.2393812E 01   0.6929096E 00
 -0.3826834E-00    0.2624781E 01   0.9238795E 00         -0.4783543E-00   0.2855751E 01   0.1154849E 01
 -0.5740251E 00    0.3086721E 01   0.1385819E 01         -0.6696960E 00   0.3317691E 01   0.1616789E 01
 -0.7653669E 00    0.3324490E 01   0.1847759E 01         -0.8610377E 00   0.3324490E 01   0.2078729E 01
 -0.9567085E 00    0.3324490E 01   0.2309699E 01         -0.1052379E 01   0.3324490E 01   0.2540668E 01
 -0.1148050E 01    0.3324490E 01   0.2771638E 01         -0.1243721E 01   0.3324490E 01   0.3002608E 01
 -0.1339392E 01    0.3324490E 01   0.3233578E 01         -0.1435063E 01   0.3324490E 01   0.3464548E 01
 -0.1530734E 01    0.3324490E 01   0.3695518E 01         -0.1626404E 01   0.3317691E 01   0.3926487E 01
 -0.1722075E 01    0.3086722E 01   0.4157457E 01         -0.1750048E 01   0.2855752E 01   0.4388427E 01
 -0.1519078E 01    0.2624782E 01   0.4619397E 01         -0.1288108E 01   0.2393812E 01   0.4850367E 01
 -0.1057138E 01    0.2162842E 01   0.5081337E 01         -0.8261686E 00   0.1931872E 01   0.5312307E 01
 -0.5951983E 00    0.1700902E 01   0.5543277E 01

NO. OF HORIZONTAL INCREMENTS= 24  NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

  0.              0.1011853E-01   0.2005937E-01   0.2957023E-01   0.3842510E-01   0.4645351E-01
  0.5355685E-01   0.5970795E-01   0.6493755E-01   0.6931489E-01   0.7292916E-01   0.7587553E-01
  0.7824513E-01   0.8012217E-01   0.8158001E-01   0.8268203E-01   0.8348208E-01   0.8402561E-01
  0.8435086E-01   0.8448995E-01   0.8446994E-01   0.8431364E-01   0.8404035E-01   0.8366646E-01
  0.8320594E-01
  0.              0.8153679E-02   0.1620881E-01   0.2400304E-01   0.3138345E-01   0.3822174E-01
  0.4442571E-01   0.4994393E-01   0.5476371E-01   0.5890409E-01   0.6240645E-01   0.6532537E-01
  0.6772117E-01   0.6965456E-01   0.7118317E-01   0.7235985E-01   0.7323180E-01   0.7384060E-01
  0.7422241E-01   0.7440857E-01   0.7442607E-01   0.7429817E-01   0.7404490E-01   0.7368352E-01
  0.7322892E-01
  0.1185797E-08   0.6932360E-02   0.1380240E-01   0.2048838E-01   0.2687289E-01   0.3285276E-01
  0.3834710E-01   0.4330212E-01   0.4769192E-01   0.5151559E-01   0.5479246E-01   0.5755506E-01
  0.5984560E-01   0.6170937E-01   0.6319227E-01   0.6433847E-01   0.6518902E-01   0.6578127E-01
  0.6614862E-01   0.6632067E-01   0.6632345E-01   0.6617973E-01   0.6590941E-01   0.6552985E-01
```

FIGURE 23. Group B Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

0.6505618E-01					
0.2371593E-08	0.6063825E-02	0.1209266E-01	0.1797826E-01	0.2362666E-01	0.2895043E-01
0.3387778E-01	0.3835692E-01	0.4235750E-01	0.4586970E-01	0.4690110E-01	0.5147268E-01
0.5361458E-01	0.5536225E-01	0.5675338E-01	0.5782561E-01	0.5861510E-01	0.5915555E-01
0.5947779E-01	0.5960964E-01	0.5957594E-01	0.5939870E-01	0.5909738E-01	0.5868910E-01
0.5318891E-01					
0.1185797E-08	0.5403147E-02	0.1077991E-01	0.1604525E-01	0.2111539E-01	0.2591350E-01
0.3037474E-01	0.3445001E-01	0.3810771E-01	0.4133354E-01	0.4412863E-01	0.4650655E-01
0.4849001E-01	0.5010765E-01	0.5139127E-01	0.5237368E-01	0.5308718E-01	0.5356254E-01
0.5382837E-01	0.5391086E-01	0.5383368E-01	0.5361806E-01	0.5328288E-01	0.5284491E-01
0.5231894E-01					
0.2371593E-08	0.4867717E-02	0.9720069E-02	0.1448181E-01	0.1907838E-01	0.2344060E-01
0.2750898E-01	0.3123704E-01	0.3459314E-01	0.3756066E-01	0.4013683E-01	0.4233042E-01
0.4415913E-01	0.4564676E-01	0.4682080E-01	0.4771038E-01	0.4834480E-01	0.4875240E-01
0.4895992E-01	0.4899210E-01	0.4887176E-01	0.4861906E-01	0.4825240E-01	0.4778809E-01
0.4724064E-01					
0.	0.4420661E-02	0.8834779E-02	0.1317433E-01	0.1737161E-01	0.2136324E-01
0.2509399E-01	0.2851974E-01	0.3160930E-01	0.3434488E-01	0.3672118E-01	0.3874379E-01
0.4042661E-01	0.4179053E-01	0.4285916E-01	0.4365898E-01	0.4421689E-01	0.4455924E-01
0.4471121E-01	0.4469633E-01	0.4453623E-01	0.4425056E-01	0.4385704E-01	0.4337153E-01
0.4280816E-01					
0.	0.4038320E-02	0.8077422E-02	0.1205490E-01	0.1590838E-01	0.1957911E-01
0.2301532E-01	0.2617500E-01	0.2902763E-01	0.3155482E-01	0.3374969E-01	0.3561552E-01
0.3716382E-01	0.3841219E-01	0.3938232E-01	0.4009824E-01	0.4058482E-01	0.4086682E-01
0.4096804E-01	0.4091090E-01	0.4071613E-01	0.4040269E-01	0.3998770E-01	0.3948655E-01
0.3891297E-01					
0.2371593E-08	0.3512397E-02	0.7033769E-02	0.1051489E-01	0.1390615E-01	0.1715997E-01
0.2023328E-01	0.2308956E-01	0.2570035E-01	0.2804607E-01	0.3011602E-01	0.3190773E-01
0.3342587E-01	0.3468085E-01	0.3568732E-01	0.3646285E-01	0.3702665E-01	0.3739862E-01
0.3759860E-01	0.3764580E-01	0.3755844E-01	0.3735348E-01	0.3704662E-01	0.3665211E-01
0.3618290E-01					
0.	0.3076318E-02	0.6166942E-02	0.9232371E-02	0.1223250E-01	0.1512838E-01
0.1788396E-01	0.2046769E-01	0.2285378E-01	0.2502295E-01	0.2696276E-01	0.2866735E-01
0.3013688E-01	0.3137660E-01	0.3239589E-01	0.3320714E-01	0.3382483E-01	0.3426467E-01
0.3454286E-01	0.3467556E-01	0.3467849E-01	0.3456664E-01	0.3435408E-01	0.3405386E-01
0.3367797E-01					
0.1185797E-08	0.2714047E-02	0.5445834E-02	0.8163061E-02	0.1083276E-01	0.1342255E-01
0.1590201E-01	0.1824384E-01	0.2042490E-01	0.2242700E-01	0.2423713E-01	0.2584764E-01
0.2725581E-01	0.2846342E-01	0.2947596E-01	0.3030191E-01	0.3095198E-01	0.3143837E-01
0.3177415E-01	0.3197279E-01	0.3204771E-01	0.3201194E-01	0.3187801E-01	0.3165768E-01
0.3136196E-01					
0.1185797E-08	0.2409344E-02	0.4836601E-02	0.7260942E-02	0.9648862E-02	0.1197514E-01
0.1421381E-01	0.1634120E-01	0.1833667E-01	0.2018332E-01	0.2186834E-01	0.2338317E-01
0.2472337E-01	0.2588834E-01	0.2688081E-01	0.2770630E-01	0.2837235E-01	0.2888892E-01

FIGURE 23. Group B Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

0.2926585E-01	0.2951442E-01	0.2964601E-01	0.2967188E-01	0.2960304E-01	0.2945002E-01
0.2922280E-01					
0.3557390E-08	0.2150391E-02	0.4321988E-02	0.6492229E-02	0.8637888E-02	0.1073581E-01
0.1276370E-01	0.1470086E-01	0.1652895E-01	0.1823242E-01	0.1979899E-01	0.2121980E-01
0.2248941E-01	0.2360565E-01	0.2456923E-01	0.2538356E-01	0.2605397E-01	0.2658757E-01
0.2699261E-01	0.2727818E-01	0.2745379E-01	0.2752912E-01	0.2751380E-01	0.2741719E-01
0.2724827E-01					
0.1185797E-08	0.1928355E-02	0.3878601E-02	0.5831566E-02	0.7767420E-02	0.9666294E-02
0.1150886E-01	0.1327701E-01	0.1495433E-01	0.1652668E-01	0.1798243E-01	0.1931279E-01
0.2031177E-01	0.2157618E-01	0.2250540E-01	0.2330108E-01	0.2396687E-01	0.2450801E-01
0.2493095E-01	0.2524308E-01	0.2545233E-01	0.2556698E-01	0.2559537E-01	0.2554579E-01
0.2542629E-01					
0.3557390E-08	0.1736511E-02	0.3495177E-02	0.5259539E-02	0.7012530E-02	0.8736948E-02
0.1041595E-01	0.1203355E-01	0.1357511E-01	0.1502773E-01	0.1638056E-01	0.1762505E-01
0.1875499E-01	0.1976656E-01	0.2065816E-01	0.2143025E-01	0.2208508E-01	0.2262645E-01
0.2305935E-01	0.2338972E-01	0.2362415E-01	0.2376968E-01	0.2383353E-01	0.2382297E-01
0.2374518E-01					
0.1778695E-08	0.1569655E-02	0.3161414E-02	0.4761040E-02	0.6353738E-02	0.7924502E-02
0.9458550E-02	0.1094173E-01	0.1236093E-01	0.1370440E-01	0.1496209E-01	0.1612578E-01
0.1718926E-01	0.1814832E-01	0.1900072E-01	0.1974603E-01	0.2038546E-01	0.2092162E-01
0.2135833E-01	0.2170034E-01	0.2195308E-01	0.2212252E-01	0.2221488E-01	0.2223653E-01
0.2219386E-01					
0.2964492E-08	0.1423676E-02	0.2869188E-02	0.4324139E-02	0.5775602E-02	0.7210414E-02
0.8615529E-02	0.9978367E-02	0.1128715E-01	0.1253118E-01	0.1370114E-01	0.1478925E-01
0.1578940E-01	0.1669710E-01	0.1750998E-01	0.1822663E-01	0.1884759E-01	0.1937456E-01
0.1981038E-01	0.2015881E-01	0.2042433E-01	0.2061194E-01	0.2072700E-01	0.2077509E-01
0.2076185E-01					
0.1778695E-08	0.1293503E-02	0.2608373E-02	0.3933798E-02	0.5258459E-02	0.6570801E-02
0.7859297E-02	0.9112753E-02	0.1032059E-01	0.1147311E-01	0.1256172E-01	0.1357908E-01
0.1451928E-01	0.1537789E-01	0.1615190E-01	0.1683978E-01	0.1744128E-01	0.1795740E-01
0.1839015E-01	0.1874244E-01	0.1901788E-01	0.1922067E-01	0.1935536E-01	0.1942678E-01
0.1943989E-01					
0.1185797E-08	0.1125652E-02	0.2270660E-02	0.3426779E-02	0.4585369E-02	0.5737536E-02
0.6874352E-02	0.7987025E-02	0.9067106E-02	0.1010667E-01	0.1109850E-01	0.1203620E-01
0.1291432E-01	0.1372845E-01	0.1447523E-01	0.1515235E-01	0.1575853E-01	0.1629348E-01
0.1675779E-01	0.1715281E-01	0.1748059E-01	0.1774373E-01	0.1794529E-01	0.1808867E-01
0.1817752E-01					
0.3389558E-03	0.1312960E-02	0.2301836E-02	0.3299427E-02	0.4299321E-02	0.5294936E-02
0.6279637E-02	0.7246872E-02	0.8190276E-02	0.9103816E-02	0.9981871E-02	0.1081937E-01
0.1161183E-01	0.1235542E-01	0.1304707E-01	0.1368439E-01	0.1426573E-01	0.1479015E-01
0.1525738E-01	0.1566771E-01	0.1602207E-01	0.1632181E-01	0.1656871E-01	0.1676492E-01
0.1691283E-01					
0.1306356E-02	0.2613826E-02	0.3425916E-02	0.4238623E-02	0.5047863E-02	0.5849534E-02
0.6639575E-02	0.7414014E-02	0.8169038E-02	0.8901041E-02	0.9606661E-02	0.1028285E-01

FIGURE 23. Group B Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

0.1092687E-01	0.1153636E-01	0.1210934E-01	0.1264421E-01	0.1313975E-01	0.1359515E-01
0.1400996E-01	0.1438407E-01	0.1471770E-01	0.1501140E-01	0.1525593E-01	0.1548234E-01
0.1566185E-01					
0.3015924E-02	0.3670362E-02	0.4323964E-02	0.4974276E-02	0.5618839E-02	0.6255228E-02
0.6881065E-02	0.7494049E-02	0.8091968E-02	0.8672744E-02	0.9234444E-02	0.9775276E-02
0.1029363E-01	0.1078809E-01	0.1125743E-01	0.1170061E-01	0.1211681E-01	0.1250540E-01
0.1286594E-01	0.1319820E-01	0.1350210E-01	0.1377775E-01	0.1402544E-01	0.1424553E-01
0.1443859E-01					
0.3996468E-02	0.4514200E-02	0.5028753E-02	0.5538715E-02	0.6042714E-02	0.6539383E-02
0.7027412E-02	0.7505522E-02	0.7972497E-02	0.8427262E-02	0.8868549E-02	0.9295542E-02
0.9707288E-02	0.1010294E-01	0.1048179E-01	0.1084320E-01	0.1118666E-01	0.1151170E-01
0.1181800E-01	0.1210532E-01	0.1237350E-01	0.1262247E-01	0.1285229E-01	0.1306301E-01
0.1325484E-01					
0.4776642E-02	0.5175037E-02	0.5569779E-02	0.5960123E-02	0.6345350E-02	0.6724747E-02
0.7097636E-02	0.7463333E-02	0.7821270E-02	0.8170797E-02	0.8511366E-02	0.8842452E-02
0.9163569E-02	0.9474267E-02	0.9774147E-02	0.1006285E-01	0.1034005E-01	0.1060548E-01
0.1085891E-01	0.1110016E-01	0.1132908E-01	0.1154556E-01	0.1174935E-01	0.1194103E-01
0.1212000E-01					
0.5383751E-02	0.5680026E-02	0.5973156E-02	0.6262784E-02	0.6548562E-02	0.6830165E-02
0.7107262E-02	0.7379540E-02	0.7646702E-02	0.7908456E-02	0.8164542E-02	0.8414695E-02
0.8658684E-02	0.8896278E-02	0.9127270E-02	0.9351472E-02	0.9568713E-02	0.9778833E-02
0.9981708E-02	0.1017721E-01	0.1036523E-01	0.1054570E-01	0.1071855E-01	0.1088372E-01
0.1104118E-01					

FIGURE 23. Group B Sample Problems Program Results
(continued)

Approved for Public Release

```
                 NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (B)-K.A.TOUPS,11/1/63

RUN NO.   3   DATA USED FOR THIS RUN- *1PLAT1*3DISK *
                                      *      *9TDISK*
                                      *D     *      *

THE FORM FACTOR FROM SURFACE *1PLAT1      * TO SURFACE *3DISK 9TDISK* = 0.02579

THE EXCHANGE COEFFICIENT (FA)=   0.124766E 01 SQ UNITS

                  THE MAPPING AREA = 0.3686819E 02 SQ UNITS

ONLY A PART OF SURFACE *1PLAT1      *, COMPRISING AN AREA OF  0.3686761E 02  SQ UNITS,
SEES SURFACE *3DISK 9TDISK*

THE AREA OF SURFACE *1PLAT1      * = 0.4837355E 02 SQ UNITS.

THE AREA OF SURFACE *3DISK 9TDISK* = 0.2545584E 02 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *1PLAT1      *

POINT       X               Y               Z            POINT      X              Y             Z
       0.              0.              0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1  -0.             -0.             -0.                   2   0.6000000E 01  0.             0.
   3   0.6000000E 01   0.3692350E 01   0.                   4   0.7340150E 00  0.8062258E 01  0.
   5   0.              0.8062258E 01   0.


***** DATA NAME- *3DISK 9TDISK*

POINT       X               Y               Z            POINT      X              Y             Z
       0.2569609E 01   0.3055901E 01   0.5542007E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.3181981E 01   0.3791845E 01   0.5825626E 01        2   0.3310661E 01  0.2877146E 01  0.7927730E 01
   3   0.2121322E 01   0.3114787E 01   0.9877364E 01        4   0.3106624E-00  0.4365562E 01  0.1053246E 02
   5  -0.1060657E 01   0.5896783E 01   0.9509268E 01        6  -0.1189337E 01  0.6811482E 01  0.7407164E 01
   7   0.              0.6373841E 01   0.5457530E 01        8   0.1810661E 01  0.5323066E 01  0.4802435E 01
```

FIGURE 23. Group B Sample Problems Program Results

(continued)

Approved for Public Release

Contrails

COORDINATES OF POINTS ON BOUNDARY OF SURF *1PLAT1 * FOR EACH Y INTERVAL

X-LEFT	X-RIGHT	Y	X-LEFT	X-RIGHT	Y
-0.	0.6000000E 01	0.	0.	0.6000000E 01	0.3359274E-00
0.	0.6000000E 01	0.6718548E 00	0.	0.6000000E 01	0.1007782E 01
0.	0.6000000E 01	0.1343710E 01	0.	0.6000000E 01	0.1679637E 01
0.	0.6000000E 01	0.2015564E 01	0.	0.6000000E 01	0.2351492E 01
0.	0.6000000E 01	0.2687419E 01	0.	0.6000000E 01	0.3023347E 01
0.	0.6000000E 01	0.3359274E 01	0.	0.6000000E 01	0.3695201E 01
0.	0.5591753E 01	0.4031129E 01	0.	0.5186941E 01	0.4367056E 01
0.	0.4782130E 01	0.4702983E 01	0.	0.4377318E 01	0.5038911E 01
0.	0.3972507E 01	0.5374838E 01	0.	0.3567696E 01	0.5710766E 01
0.	0.3162884E 01	0.6046693E 01	0.	0.2758073E 01	0.6382620E 01
0.	0.2353261E 01	0.6718548E 01	0.	0.1948450E 01	0.7054475E 01
0.	0.1543638E 01	0.7390402E 01	0.	0.1138827E 01	0.7726330E 01
0.	0.7340150E 00	0.8062258E 01			

NO. OF HORIZONTAL INCREMENTS= 24 NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.5559791E-01	0.5516987E-01	0.5456313E-01	0.5377758E-01	0.5281553E-01	0.5168177E-01
0.5038360E-01	0.4893071E-01	0.4733510E-01	0.4561082E-01	0.4377369E-01	0.4184095E-01
0.3983085E-01	0.3776222E-01	0.3565405E-01	0.3352504E-01	0.3139323E-01	0.2927561E-01
0.2718784E-01	0.2514402E-01	0.2315651E-01	0.2123585E-01	0.1939074E-01	0.1762802E-01
0.1595279E-01					
0.5792052E-01	0.5745775E-01	0.5680004E-01	0.5594723E-01	0.5490189E-01	0.5366945E-01
0.5225817E-01	0.5067912E-01	0.4894592E-01	0.4707457E-01	0.4508302E-01	0.4299079E-01
0.4081851E-01	0.3858737E-01	0.3631865E-01	0.3403316E-01	0.3175087E-01	0.2949041E-01
0.2726882E-01	0.2510126E-01	0.2300084E-01	0.2097855E-01	0.1904325E-01	0.1720172E-01
0.1545878E-01					
0.6012321E-01	0.5962029E-01	0.5890544E-01	0.5797850E-01	0.5684240E-01	0.5550331E-01
0.5397063E-01	0.5225695E-01	0.5037775E-01	0.4835119E-01	0.4619761E-01	0.4393908E-01
0.4159879E-01	0.3920049E-01	0.3676788E-01	0.3432404E-01	0.3189087E-01	0.2948870E-01
0.2713589E-01	0.2484856E-01	0.2264046E-01	0.2052289E-01	0.1850471E-01	0.1659246E-01
0.1479048E-01					
0.6215342E-01	0.6160375E-01	0.6082468E-01	0.5981604E-01	0.5858122E-01	0.5712729E-01
0.5546497E-01	0.5360856E-01	0.5157567E-01	0.4938684E-01	0.4706505E-01	0.4463513E-01

FIGURE 23. Group B Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

0.4212305E-01	0.3955529E-01	0.3695811E-01	0.3435686E-01	0.3177545E-01	0.2923582E-01
0.2675755E-01	0.2435761E-01	0.2205021E-01	0.1984674E-01	0.1775587E-01	0.1578369E-01
0.1393388E-01					
0.6395211E-01	0.6334791E-01	0.6249651E-01	0.6139791E-01	0.6005607E-01	0.5847910E-01
0.5667926E-01	0.5467230E-01	0.5247968E-01	0.5012309E-01	0.4762890E-01	0.4502488E-01
0.4233999E-01	0.3960353E-01	0.3684438E-01	0.3409021E-01	0.3136683E-01	0.2869769E-01
0.2610343E-01	0.2360167E-01	0.2120682E-01	0.1893017E-01	0.1677995E-01	0.1476152E-01
0.1287771E-01					
0.6545474E-01	0.6476690E-01	0.6385414E-01	0.6265671E-01	0.6119935E-01	0.5949142E-01
0.5754692E-01	0.5538432E-01	0.5302617E-01	0.5049857E-01	0.4783043E-01	0.4505272E-01
0.4219746E-01	0.3929666E-01	0.3638236E-01	0.3348393E-01	0.3062910E-01	0.2784264E-01
0.2514601E-01	0.2255719E-01	0.2009055E-01	0.1775695E-01	0.1556389E-01	0.1351582E-01
0.1161442E-01					
0.6659267E-01	0.6585080E-01	0.6482677E-01	0.6352129E-01	0.6194004E-01	0.6009390E-01
0.5799885E-01	0.5567384E-01	0.5315025E-01	0.5045128E-01	0.4761113E-01	0.4466400E-01
0.4164505E-01	0.3858936E-01	0.3553089E-01	0.3250159E-01	0.2953058E-01	0.2664362E-01
0.2386268E-01	0.2120576E-01	0.1868684E-01	0.1631603E-01	0.1409983E-01	0.1204147E-01
0.1014130E-01					
0.6729540E-01	0.6646801E-01	0.6534219E-01	0.6391937E-01	0.6220644E-01	0.6021603E-01
0.5796641E-01	0.5548121E-01	0.5278890E-01	0.4992195E-01	0.4691590E-01	0.4380826E-01
0.4063727E-01	0.3744072E-01	0.3425485E-01	0.3111333E-01	0.2804649E-01	0.2508072E-01
0.2223807E-01	0.1953617E-01	0.1698822E-01	0.1460326E-01	0.1238646E-01	0.1033959E-01
0.8461465E-02					
0.6749370E-01	0.6616843E-01	0.6550011E-01	0.6378110E-01	0.6192983E-01	0.5979097E-01
0.5738532E-01	0.5473946E-01	0.5188506E-01	0.4885799E-01	0.4569715E-01	0.4244325E-01
0.3913740E-01	0.3581985E-01	0.3252875E-01	0.2929909E-01	0.2616192E-01	0.2314378E-01
0.2026635E-01	0.1754643E-01	0.1499605E-01	0.1262281E-01	0.1043029E-01	0.8418553E-02
0.6584729E-02					
0.6712344E-01	0.6608768E-01	0.6472650E-01	0.6304357E-01	0.6104917E-01	0.5876030E-01
0.5620056E-01	0.5339961E-01	0.5039246E-01	0.4721833E-01	0.4391938E-01	0.4053926E-01
0.3712165E-01	0.3370880E-01	0.3034026E-01	0.2705181E-01	0.2387466E-01	0.2083492E-01
0.1795341E-01	0.1524562E-01	0.1272202E-01	0.1038844E-01	0.8246601E-02	0.6294717E-02
0.4528110E-02					
0.6613036E-01	0.6497192E-01	0.6347869E-01	0.6165604E-01	0.5951643E-01	0.5707948E-01
0.5437175E-01	0.5142612E-01	0.4828089E-01	0.4497849E-01	0.4156404E-01	0.3808376E-01
0.3458337E-01	0.3110632E-01	0.2769355E-01	0.2438037E-01	0.2119768E-01	0.1817061E-01
0.1531853E-01	0.1265520E-01	0.1018915E-01	0.7924175E-02	0.5859952E-02	0.3992732E-02
0.2315988E-02					
0.6447521E-01	0.6318328E-01	0.6155095E-01	0.5958567E-01	0.5730238E-01	0.5472357E-01
0.5187886E-01	0.4880438E-01	0.4554148E-01	0.4213551E-01	0.3863410E-01	0.3508545E-01
0.3153663E-01	0.2803201E-01	0.2461194E-01	0.2131170E-01	0.1816085E-01	0.1518289E-01
0.1239525E-01	0.9809558E-02	0.7432087E-02	0.5264405E-02	0.3304051E-02	0.1545277E-02
0.9999797E 00					
0.6213899E-01	0.6081376E-01	0.5919140E-01	0.5727933E-01	0.5509078E-01	0.5264493E-01

FIGURE 23. Group B Sample Problems Program Results

(continued)

Approved for Public Release

Contrails

0.4996653E-01	0.4708541E-01	0.4403567E-01	0.4085467E-01	0.3758186E-01	0.3425747E-01
0.3092127E-01	0.2761133E-01	0.2436295E-01	0.2120780E-01	0.1817328E-01	0.1528211E-01
0.1255218E-01	0.9996601E-02	0.7623980E-02	0.5438760E-02	0.3441710E-02	0.1630454E-02
0.4594962E-08					
0.5912766E-01	0.5778175E-01	0.5618242E-01	0.5433681E-01	0.5225655E-01	0.4995769E-01
0.4746050E-01	0.4478913E-01	0.4197098E-01	0.3903606E-01	0.3601613E-01	0.3294380E-01
0.2985164E-01	0.2677126E-01	0.2373252E-01	0.2076280E-01	0.1788648E-01	0.1512451E-01
0.1249425E-01	0.1000929E-01	0.7679664E-02	0.5511905E-02	0.3509409E-02	0.1672734E-02
0.4446738E-08					
0.5547543E-01	0.5412674E-01	0.5256767E-01	0.5080493E-01	0.4884846E-01	0.4671141E-01
0.4441000E-01	0.4196322E-01	0.3939248E-01	0.3672116E-01	0.3397401E-01	0.3117660E-01
0.2835467E-01	0.2553351E-01	0.2273741E-01	0.1998911E-01	0.1730937E-01	0.1471662E-01
0.1222674E-01	0.9852915E-02	0.7605597E-02	0.5492568E-02	0.3519067E-02	0.1687963E-02
0.4446738E-08					
0.5124604E-01	0.4991634E-01	0.4841724E-01	0.4675477E-01	0.4493720E-01	0.4297502E-01
0.4088081E-01	0.3866909E-01	0.3635606E-01	0.3395931E-01	0.3149748E-01	0.2898988E-01
0.2645608E-01	0.2391556E-01	0.2138721E-01	0.1888913E-01	0.1643815E-01	0.1404970E-01
0.1173750E-01	0.9513462E-02	0.7387611E-02	0.5368041E-02	0.3460949E-02	0.1670715E-02
0.5780759E-08					
0.4653128E-01	0.4524511E-01	0.4382717E-01	0.4228260E-01	0.4061805E-01	0.3884159E-01
0.3696268E-01	0.3499203E-01	0.3294146E-01	0.3082374E-01	0.2865235E-01	0.2644130E-01
0.2420488E-01	0.2195739E-01	0.1971293E-01	0.1748516E-01	0.1528709E-01	0.1313090E-01
0.1102778E-01	0.8987790E-02	0.7019776E-02	0.5131332E-02	0.3328754E-02	0.1617055E-02
0.2816267E-08					
0.4144655E-01	0.4022969E-01	0.3891425E-01	0.3750441E-01	0.3600527E-01	0.3442279E-01
0.3276381E-01	0.3103590E-01	0.2924736E-01	0.2740705E-01	0.2552432E-01	0.2360889E-01
0.2167069E-01	0.1971975E-01	0.1776604E-01	0.1581935E-01	0.1388919E-01	0.1198461E-01
0.1011415E-01	0.8285732E-02	0.6506575E-02	0.4783149E-02	0.3121135E-02	0.1525403E-02
0.2223369E-08					
0.3612378E-01	0.3500137E-01	0.3380846E-01	0.3254825E-01	0.3122443E-01	0.2984121E-01
0.2840327E-01	0.2691574E-01	0.2538414E-01	0.2381435E-01	0.2221254E-01	0.2058509E-01
0.1893856E-01	0.1727958E-01	0.1561483E-01	0.1395093E-01	0.1229436E-01	0.1065146E-01
0.9028287E-02	0.7430611E-02	0.5863851E-02	0.4333039E-02	0.2842772E-02	0.1397202E-02
0.1482246E-08					
0.3070248E-01	0.2969712E-01	0.2864397E-01	0.2754526E-01	0.2640353E-01	0.2522154E-01
0.2400233E-01	0.2274917E-01	0.2146554E-01	0.2015508E-01	0.1882164E-01	0.1746917E-01
0.1610173E-01	0.1472343E-01	0.1333846E-01	0.1195097E-01	0.1056512E-01	0.9184973E-02
0.7814522E-02	0.6457618E-02	0.5118008E-02	0.3799204E-02	0.2504553E-02	0.1237188E-02
0.5928984E-09					
0.2532002E-01	0.2445017E-01	0.2354993E-01	0.2262076E-01	0.2166422E-01	0.2068203E-01
0.1967600E-01	0.1864806E-01	0.1760025E-01	0.1653467E-01	0.1545354E-01	0.1435912E-01
0.1325375E-01	0.1213978E-01	0.1101962E-01	0.9895685E-02	0.8770398E-02	0.7646165E-02
0.6525367E-02	0.5410355E-02	0.4303422E-02	0.3206803E-02	0.2122659E-02	0.1053064E-02
0.					

FIGURE 23. Group B Sample Problems Program Results (continued)

Approved for Public Release

Contrails

0.2010261E-01	0.1938139E-01	0.1864237E-01	0.1788638E-01	0.1711432E-01	0.1632712E-01
0.1552576E-01	0.1471129E-01	0.1388477E-01	0.1304733E-01	0.1220009E-01	0.1134425E-01
0.1048100E-01	0.9611587E-02	0.8737242E-02	0.7859230E-02	0.6978812E-02	0.6097267E-02
0.5215855E-02	0.4335844E-02	0.3458487E-02	0.2585021E-02	0.1716655E-02	0.8545947E-03
0.					
0.1515802E-01	0.1459266E-01	0.1401798E-01	0.1343437E-01	0.1284228E-01	0.1224214E-01
0.1163443E-01	0.1101963E-01	0.1039822E-01	0.9770712E-02	0.9137528E-02	0.8499501E-02
0.7856870E-02	0.7210288E-02	0.6560311E-02	0.5907510E-02	0.5252448E-02	0.4595707E-02
0.3937865E-02	0.3279494E-02	0.2621180E-02	0.1963499E-02	0.1307028E-02	0.6523373E-03
0.					
0.1057084E-01	0.1016274E-01	0.9750507E-02	0.9334293E-02	0.8914265E-02	0.8490595E-02
0.8063459E-02	0.7633030E-02	0.7199495E-02	0.6763036E-02	0.6323844E-02	0.5882109E-02
0.5438030E-02	0.4991799E-02	0.4543621E-02	0.4093695E-02	0.3642227E-02	0.3189423E-02
0.2735494E-02	0.2280644E-02	0.1825086E-02	0.1369030E-02	0.9126860E-03	0.4562729E-03
0.					
0.6400494E-02	0.6145768E-02	0.5889678E-02	0.5632264E-02	0.5373567E-02	0.5113631E-02
0.4852502E-02	0.4590217E-02	0.4326826E-02	0.4062370E-02	0.3796898E-02	0.3530456E-02
0.3263088E-02	0.2994843E-02	0.2725768E-02	0.2455909E-02	0.2185314E-02	0.1914035E-02
0.1642116E-02	0.1369606E-02	0.1096564E-02	0.8230286E-03	0.5490540E-03	0.2746903E-03
0.					

FIGURE 23. Group B Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
                   NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (B)-K.A.TOUPS,11/1/63

RUN NO.   4   DATA USED FOR THIS RUN- *3DISK  *3DISK *
                                      *       *9TDISK*
                                      *D      *      *

THE FORM FACTOR FROM SURFACE *3DISK       * TO SURFACE *3DISK 9TDISK* = 0.01981

THE EXCHANGE COEFFICIENT (FA)=   0.50423E 00 SQ UNITS

                  THE MAPPING AREA = 0.2487100E 02 SQ UNITS

ONLY A PART OF SURFACE *3DISK       *, COMPRISING AN AREA OF  0.2487759E 02  SQ UNITS,
SEES SURFACE *3DISK 9TDISK*

THE AREA OF SURFACE *3DISK       * = 0.2545584E 02 SQ UNITS.

THE AREA OF SURFACE *3DISK 9TDISK* = 0.2545584E 02 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

***** DATA NAME- *3DISK       *

POINT       X              Y               Z          POINT       X               Y                Z
         0.            -0.            0.9999997E 00---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   -0.            -0.            -0.                 2    0.2296101E 01  -0.               0.
   3    0.3919689E 01  0.1623588E 01  0.                 4    0.3919689E 01   0.2640801E 01   0.
   5    0.3015380E 01  0.4823998E 01  0.                 6    0.2296102E 01   0.5543276E 01   0.
   7    0.             0.5543276E 01  0.                 8   -0.1623587E 01   0.3919689E 01   0.
   9   -0.1623588E 01  0.1623589E 01  0.

***** DATA NAME- *3DISK 9TDISK*

POINT       X              Y               Z          POINT       X               Y                Z
         0.6801507E 01  0.1666199E 01  0.6098074E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1    0.7601610E 01  0.2197613E 01  0.5598074E 01      2    0.8245276E 01   0.3415303E 01   0.7435191E 01
   3    0.7839380E 01  0.5543275E 01  0.8196149E 01      4    0.6621689E 01   0.7334990E 01   0.7435190E 01
```

FIGURE 23. Group B Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
 5   0.5305511E 01  0.7740887E 01  0.5598074E 01        6   0.4661845E 01  0.6523197E 01  0.3760958E 01
 7   0.5067741E 01  0.4395225E 01  0.2999999E 01        8   0.6285432E 01  0.2603510E 01  0.3760958E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF     *3DISK      * FOR EACH Y INTERVAL

     X-LEFT          X-RIGHT          Y                  X-LEFT          X-RIGHT           Y

 -0.              0.2296101E 01 -0.                 -0.2309697E-00  0.2527071E 01  0.2309698E-00
 -0.4619395E-00   0.2758041E 01  0.4619397E-00      -0.6929092E 00  0.2989010E 01  0.6929095E 00
 -0.9238790E 00   0.3219980E 01  0.9238794E 00      -0.1154849E 01  0.3450950E 01  0.1154849E 01
 -0.1385818E 01   0.3681920E 01  0.1385819E 01      -0.1616788E 01  0.3912890E 01  0.1616789E 01
 -0.1623588E 01   0.3919689E 01  0.1847759E 01      -0.1623588E 01  0.3919689E 01  0.2078729E 01
 -0.1623588E 01   0.3919689E 01  0.2309698E 01      -0.1623588E 01  0.3919689E 01  0.2540668E 01
 -0.1623588E 01   0.3865495E 01  0.2771638E 01      -0.1623587E 01  0.3769824E 01  0.3002608E 01
 -0.1623587E 01   0.3674153E 01  0.3233578E 01      -0.1623587E 01  0.3578483E 01  0.3464548E 01
 -0.1623587E 01   0.3482812E 01  0.3695517E 01      -0.1616789E 01  0.3387141E 01  0.3926487E 01
 -0.1385819E 01   0.3291470E 01  0.4157457E 01      -0.1154849E 01  0.3195799E 01  0.4388427E 01
 -0.9238792E 00   0.3100129E 01  0.4619397E 01      -0.6929095E 00  0.2989011E 01  0.4850367E 01
 -0.4619397E-00   0.2718041E 01  0.5081327E 01      -0.2309699E-00  0.2527072E 01  0.5312306E 01
  0.              0.2296102E 01  0.5543276E 01

NO. OF HORIZONTAL INCREMENTS= 24  NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

 0.1922567E-01  0.1937664E-01  0.1952126E-01  0.1965897E-01  0.1978916E-01  0.1991121E-01
 0.2002446E-01  0.2012821E-01  0.2022176E-01  0.2030435E-01  0.2037520E-01  0.2043350E-01
 0.2047841E-01  0.2050905E-01  0.2052453E-01  0.2052390E-01  0.2050623E-01  0.2047050E-01
 0.2041572E-01  0.2034084E-01  0.2024482E-01  0.2012656E-01  0.1998499E-01  0.1981900E-01
 0.1962749E-01
 0.1937100E-01  0.1958004E-01  0.1978143E-01  0.1997421E-01  0.2015736E-01  0.2032980E-01
 0.2049037E-01  0.2063786E-01  0.2077098E-01  0.2088837E-01  0.2098858E-01  0.2107009E-01
 0.2113134E-01  0.2117015E-01  0.2118629E-01  0.2117644E-01  0.2113924E-01  0.2107274E-01
 0.2097494E-01  0.2084376E-01  0.2067711E-01  0.2047285E-01  0.2022879E-01  0.1994274E-01
 0.1961251E-01
 0.1942545E-01  0.1969859E-01  0.1996336E-01  0.2021833E-01  0.2046192E-01  0.2069244E-01
 0.2090808E-01  0.2110686E-01  0.2128666E-01  0.2144525E-01  0.2158017E-01  0.2168887E-01
 0.2176860E-01  0.2181646E-01  0.2182940E-01  0.2180418E-01  0.2173744E-01  0.2162567E-01
 0.2146521E-01  0.2125231E-01  0.2098310E-01  0.2065366E-01  0.2026003E-01  0.1979822E-01
 0.1926430E-01
```

FIGURE 23. Group B Sample Problems Program Results (continued)

Approved for Public Release

Contrails

0.1939185E-01	0.1973329E-01	0.2006646E-01	0.2038935E-01	0.2069972E-01	0.2099514E-01
0.2117290E-01	0.2153005E-01	0.2176337E-01	0.2196937E-01	0.2214424E-01	0.2228386E-01
0.2238382E-01	0.2243937E-01	0.2244544E-01	0.2239665E-01	0.2228730E-01	0.2211142E-01
0.2186278E-01	0.2153492E-01	0.2112122E-01	0.2061495E-01	0.2000936E-01	0.1929775E-01
0.1847365E-01					
0.1927449E-01	0.1968658E-01	0.2009145E-01	0.2048646E-01	0.2086863E-01	0.2123461E-01
0.2158066E-01	0.2190260E-01	0.2219578E-01	0.2245506E-01	0.2267478E-01	0.2284871E-01
0.2297006E-01	0.2303144E-01	0.2302486E-01	0.2294175E-01	0.2277296E-01	0.2250879E-01
0.2213908E-01	0.2165330E-01	0.2104061E-01	0.2029011E-01	0.1939094E-01	0.1833258E-01
0.1710510E-01					
0.1907893E-01	0.1956216E-01	0.2004028E-01	0.2050999E-01	0.2096750E-01	0.2140845E-01
0.2182788E-01	0.2222013E-01	0.2257879E-01	0.2289665E-01	0.2316563E-01	0.2337668E-01
0.2351977E-01	0.2358389E-01	0.2355690E-01	0.2342566E-01	0.2317600E-01	0.2279279E-01
0.2226010E-01	0.2156135E-01	0.2067963E-01	0.1959798E-01	0.1829989E-01	0.1676984E-01
0.1499389E-01					
0.1881166E-01	0.1936484E-01	0.1991606E-01	0.2046139E-01	0.2099622E-01	0.2151512E-01
0.2201176E-01	0.2247877E-01	0.2290765E-01	0.2328863E-01	0.2361056E-01	0.2386076E-01
0.2402496E-01	0.2408717E-01	0.2402961E-01	0.2383273E-01	0.2347526E-01	0.2293434E-01
0.2218572E-01	0.2120428E-01	0.1996443E-01	0.1844100E-01	0.1661016E-01	0.1445059E-01
0.1194490E-01					
0.1847993E-01	0.1910030E-01	0.1972285E-01	0.2034313E-01	0.2095571E-01	0.2155405E-01
0.2213035E-01	0.2267534E-01	0.2317807E-01	0.2362573E-01	0.2400341E-01	0.2429383E-01
0.2447722E-01	0.2453103E-01	0.2442988E-01	0.2414550E-01	0.2364675E-01	0.2289994E-01
0.2186928E-01	0.2051767E-01	0.1880783E-01	0.1670394E-01	0.1417352E-01	0.1119002E-01
0.7735614E-02					
0.1870471E-01	0.1934307E-01	0.1998426E-01	0.2062361E-01	0.2125546E-01	0.2187293E-01
0.2246777E-01	0.2303013E-01	0.2354833E-01	0.2400863E-01	0.2439492E-01	0.2468851E-01
0.2486783E-01	0.2490823E-01	0.2478178E-01	0.2445718E-01	0.2389985E-01	0.2307214E-01
0.2193388E-01	0.2044324E-01	0.1855806E-01	0.1623769E-01	0.1344530E-01	0.1015089E-01
0.6334633E-02					
0.1891679E-01	0.1956964E-01	0.2022566E-01	0.2088005E-01	0.2152685E-01	0.2215888E-01
0.2276744E-01	0.2334212E-01	0.2387052E-01	0.2433800E-01	0.2472734E-01	0.2501843E-01
0.2518800E-01	0.2520931E-01	0.2505195E-01	0.2468168E-01	0.2406047E-01	0.2314676E-01
0.2189600E-01	0.2026161E-01	0.1819649E-01	0.1565505E-01	0.1259601E-01	0.8985800E-02
0.4802561E-02					
0.1909527E-01	0.1976021E-01	0.2042851E-01	0.2109514E-01	0.2175391E-01	0.2239728E-01
0.2301609E-01	0.2359934E-01	0.2413389E-01	0.2460416E-01	0.2499171E-01	0.2527501E-01
0.2542898E-01	0.2542472E-01	0.2522918E-01	0.2480504E-01	0.2411054E-01	0.2310028E-01
0.2172480E-01	0.1993257E-01	0.1767125E-01	0.1489012E-01	0.1154323E-01	0.7593443E-02
0.3017018E-02					
0.1923765E-01	0.1991198E-01	0.2058965E-01	0.2126542E-01	0.2193279E-01	0.2258386E-01
0.2320899E-01	0.2379655E-01	0.2433264E-01	0.2480066E-01	0.2518097E-01	0.2545051E-01
0.2558234E-01	0.2554527E-01	0.2530355E-01	0.2481662E-01	0.2403904E-01	0.2292080E-01
0.2140786E-01	0.1944341E-01	0.1696962E-01	0.1393048E-01	0.1027531E-01	0.5963463E-02

FIGURE 23. Group B Sample Problems Program Results
(continued)

Approved for Public Release

0.9696838E-03					
0.1934158E-01	0.2001568E-01	0.2069283E-01	0.2136775E-01	0.2203386E-01	0.2268315E-01
0.2330586E-01	0.2389019E-01	0.2442200E-01	0.2488440E-01	0.2525739E-01	0.2551738E-01
0.2363678E-01	0.2558358E-01	0.2532094E-01	0.2480692E-01	0.2399438E-01	0.2283116E-01
0.2126059E-01	0.1922269E-01	0.1665594E-01	0.1350008E-01	0.9699846E-02	0.5209764E-02
0.					
0.1940496E-01	0.2007043E-01	0.2073844E-01	0.2140374E-01	0.2205988E-01	0.2269896E-01
0.2331137E-01	0.2388553E-01	0.2440754E-01	0.2486080E-01	0.2522565E-01	0.2547890E-01
0.2559336E-01	0.2553747E-01	0.2527482E-01	0.2476382E-01	0.2395755E-01	0.2280361E-01
0.2124557E-01	0.1922188E-01	0.1666956E-01	0.1352560E-01	0.9730856E-02	0.5234536E-02
0.					
0.1942599E-01	0.2007945E-01	0.2073471E-01	0.2138657E-01	0.2202867E-01	0.2265323E-01
0.2325084E-01	0.2381010E-01	0.2431740E-01	0.2475648E-01	0.2510810E-01	0.2534952E-01
0.2545415E-01	0.2539101E-01	0.2512433E-01	0.2461320E-01	0.2381129E-01	0.2266688E-01
0.2112314E-01	0.1911867E-01	0.1658999E-01	0.1347177E-01	0.9702066E-02	0.5225704E-02
0.					
0.1940314E-01	0.2004125E-01	0.2068019E-01	0.2131481E-01	0.2193886E-01	0.2254469E-01
0.2312303E-01	0.2366276E-01	0.2415055E-01	0.2457056E-01	0.2490397E-01	0.2512865E-01
0.2521866E-01	0.2514381E-01	0.2486920E-01	0.2435486E-01	0.2355546E-01	0.2242017E-01
0.2089296E-01	0.1891312E-01	0.1641655E-01	0.1333769E-01	0.9612510E-02	0.5182529E-02
0.					
0.1933528E-01	0.1995476E-01	0.2057388E-01	0.2118760E-01	0.2178971E-01	0.2237271E-01
0.2292753E-01	0.2344329E-01	0.2390701E-01	0.2430326E-01	0.2461376E-01	0.2481703E-01
0.2488794E-01	0.2479722E-01	0.2451105E-01	0.2399065E-01	0.2319204E-01	0.2206577E-01
0.2055713E-01	0.1860659E-01	0.1615085E-01	0.1312455E-01	0.9462839E-02	0.5105206E-02
0.					
0.1924112E-01	0.1983799E-01	0.2043305E-01	0.2102126E-01	0.2159651E-01	0.2215143E-01
0.2267716E-01	0.2316308E-01	0.2359656E-01	0.2396265E-01	0.2424369E-01	0.2441896E-01
0.2446422E-01	0.2435134E-01	0.2404784E-01	0.2351648E-01	0.2271500E-01	0.2159587E-01
0.2010641E-01	0.1818911E-01	0.1578246E-01	0.1282250E-01	0.9245016E-02	0.4988804E-02
0.					
0.1972696E-01	0.2026837E-01	0.2080187E-01	0.2132219E-01	0.2182309E-01	0.2229711E-01
0.2273545E-01	0.2312779E-01	0.2346196E-01	0.2372378E-01	0.2389673E-01	0.2396164E-01
0.2389645E-01	0.2367578E-01	0.2327068E-01	0.2264839E-01	0.2177203E-01	0.2060060E-01
0.1908899E-01	0.1718834E-01	0.1484667E-01	0.1200998E-01	0.8623988E-02	0.4636388E-02
0.					
0.2012116E-01	0.2059705E-01	0.2105902E-01	0.2150167E-01	0.2191874E-01	0.2230290E-01
0.2264560E-01	0.2293695E-01	0.2316551E-01	0.2331809E-01	0.2337953E-01	0.2333250E-01
0.2315728E-01	0.2283150E-01	0.2232991E-01	0.2162428E-01	0.2068318E-01	0.1947202E-01
0.1795309E-01	0.1608586E-01	0.1382745E-01	0.1113350E-01	0.7959288E-02	0.4261426E-02
0.					
0.2039665E-01	0.2079712E-01	0.2117796E-01	0.2153385E-01	0.2185865E-01	0.2214530E-01
0.2238571E-01	0.2257065E-01	0.2268959E-01	0.2273057E-01	0.2268002E-01	0.2252265E-01
0.2224125E-01	0.2181656E-01	0.2122714E-01	0.2044926E-01	0.1945682E-01	0.1822137E-01

FIGURE 23. Group B Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

Contrails

0.1671223E-01	0.1489667E-01	0.1274028E-01	0.1020759E-01	0.7262875E-02	0.3871211E-02
0.					
0.2052221E-01	0.2083680E-01	0.2112693E-01	0.2138755E-01	0.2161289E-01	0.2179648E-01
0.2193097E-01	0.2200813E-01	0.2201866E-01	0.2195220E-01	0.2179715E-01	0.2154058E-01
0.2116819E-01	0.2066413E-01	0.2001101E-01	0.1918981E-01	0.1817983E-01	0.1695878E-01
0.1550280E-01	0.1378666E-01	0.1178401E-01	0.9467732E-02	0.6810490E-02	0.3785403E-02
0.3669136E-03					
0.2046247E-01	0.2067682E-01	0.2086469E-01	0.2102256E-01	0.2114562E-01	0.2122879E-01
0.2126642E-01	0.2125226E-01	0.2117944E-01	0.2104035E-01	0.2082667E-01	0.2052928E-01
0.2013821E-01	0.1964260E-01	0.1903066E-01	0.1828971E-01	0.1740607E-01	0.1636516E-01
0.1515146E-01	0.1374866E-01	0.1213970E-01	0.1030698E-01	0.8232535E-02	0.5898336E-02
0.3286634E-02					
0.2017830E-01	0.2029373E-01	0.2038356E-01	0.2044466E-01	0.2047361E-01	0.2046672E-01
0.2041993E-01	0.2032884E-01	0.2018873E-01	0.1999440E-01	0.1974029E-01	0.1942041E-01
0.1902828E-01	0.1855695E-01	0.1799902E-01	0.1734658E-01	0.1659120E-01	0.1572399E-01
0.1473559E-01	0.1361616E-01	0.1235548E-01	0.1094299E-01	0.9367839E-02	0.7619011E-02
0.5685494E-02					
0.1962749E-01	0.1965210E-01	0.1965371E-01	0.1963016E-01	0.1957917E-01	0.1949828E-01
0.1938487E-01	0.1923613E-01	0.1904910E-01	0.1882056E-01	0.1854715E-01	0.1822526E-01
0.1785108E-01	0.1742057E-01	0.1692947E-01	0.1637331E-01	0.1574735E-01	0.1504666E-01
0.1425608E-01	0.1340025E-01	0.1244359E-01	0.1139036E-01	0.1023466E-01	0.8970473E-02
0.7591673E-02					

FIGURE 23. Group B Sample Problems Program Results (continued)

Approved for Public Release

Contrails

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (B)-K.A.TOUPS,11/1/63

RUN NO.   5   DATA USED FOR THIS RUN- *3DISK *1PLAT1*
                                      *9TDISK*      *
                                      *0      *     *

THE FORM FACTOR FROM SURFACE *3DISK 9TDISK* TO SURFACE *1PLAT1      * = 0.04739

THE EXCHANGE COEFFICIENT (FA)=   0.12064E 01 SQ UNITS

                 THE MAPPING AREA = 0.2545277E 02 SQ UNITS

THE AREA OF SURFACE *3DISK 9TDISK* = 0.2545584E 02 SQ UNITS.

ONLY A PART OF SURFACE *1PLAT1      *, COMPRISING AN AREA OF  0.3686761E 02  SQ UNITS,
SEES SURFACE *3DISK 9TDISK*

THE AREA OF SURFACE *1PLAT1      * * 0.4837355E 02 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *3DISK 9TDISK*
                                                      Z           POINT        X              Y              Z
POINT        X               Y                  0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
          0.             -0.                                        2    0.2296100E 01 -0.             0.
   1      0.             -0.                    -0.                 4    0.3919687E 01  0.3919687E 01  0.
   3      0.3919687E 01   0.1623588E 01          0.                 6    0.             0.5543275E 01  0.
   5      0.2296100E 01   0.5543275E 01          0.                 8   -0.1623587E 01  0.1623588E 01  0.
   7     -0.1623587E 01   0.3919688E 01          0.


***** DATA NAME- *1PLAT.      *
                                                      Z           POINT        X              Y              Z
POINT        X               Y                  0.6115361E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
         -0.3085678E 01 -0.9331043E 00                              2   -0.3664933E 01 -0.5949895E 01  0.2724745E 0
   1     -0.4001189E 01 -0.1218412E 01          0.6398980E 01       4   -0.7171818E 01  0.2594583E 01  0.
   3     -0.5135836E 01 -0.3938528E 01          0.
   5     -0.7212955E 01  0.3173413E 01          0.4494908E-00
```

FIGURE 23. Group B Sample Problems Program Results

(continued)

Approved for Public Release

COORDINATES OF POINTS ON BOUNDARY OF SURF *3DISK 9TDISK* FOR EACH Y INTERVAL

X-LEFT	X-RIGHT	Y	X-LEFT	X-RIGHT	Y
0.	0.2296100E 01	-0.	-0.2309697E-00	0.2527070E 01	0.2309698E-00
-0.4619394E-00	0.2758039E 01	0.4619396E-00	-0.6929091E 00	0.2989009E 01	0.6929094E 00
-0.9238788E 00	0.3219979E 01	0.9238792E 00	-0.1154848E 01	0.3450949E 01	0.1154849E 01
-0.1385818E 01	0.3681919E 01	0.1385819E 01	-0.1616788E 01	0.3912888E 01	0.1616789E 01
-0.1623587E 01	0.3919687E 01	0.1847758E 01	-0.1623587E 01	0.3919687E 01	0.2078728E 01
-0.1623587E 01	0.3919687E 01	0.2309698E 01	-0.1623587E 01	0.3919687E 01	0.2540668E 01
-0.1623587E 01	0.3919687E 01	0.2771637E 01	-0.1623587E 01	0.3919687E 01	0.3002607E 01
-0.1623587E 01	0.3919687E 01	0.3233577E 01	-0.1623587E 01	0.3919687E 01	0.3464547E 01
-0.1623587E 01	0.3919687E 01	0.3695517E 01	-0.1616789E 01	0.3912888E 01	0.3926486E 01
-0.1385819E 01	0.3681919E 01	0.4157456E 01	-0.1154849E 01	0.3450949E 01	0.4388426E 01
-0.9238793E 00	0.3219979E 01	0.4619396E 01	-0.6929095E 00	0.2989009E 01	0.4850365E 01
-0.4619397E-00	0.2758040E 01	0.5081335E 01	-0.2309700E-00	0.2527070E 01	0.5312305E 01
0.	0.2296100E 01	0.5543275E 01			

NO. OF HORIZONTAL INCREMENTS= 24 NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.9553849E-01	0.9263247E-01	0.8982160E-01	0.8710299E-01	0.8447382E-01	0.8193132E-01
0.7947276E-01	0.7709530E-01	0.7479694E-01	0.7257454E-01	0.7042584E-01	0.6834841E-01
0.6633991E-01	0.6439805E-01	0.6252061E-01	0.6070541E-01	0.5895035E-01	0.5725339E-01
0.5561256E-01	0.5402591E-01	0.5249161E-01	0.5100783E-01	0.4957283E-01	0.4818490E-01
0.4684243E-01					
0.9995365E-01	0.9635510E-01	0.9289416E-01	0.8956606E-01	0.8636610E-01	0.8328971E-01
0.8033241E-01	0.7748983E-01	0.7475772E-01	0.7213193E-01	0.6960844E-01	0.6718334E-01
0.6485282E-01	0.6261322E-01	0.6046098E-01	0.5839264E-01	0.5640488E-01	0.5449448E-01
0.5265834E-01	0.5089347E-01	0.4919697E-01	0.4756607E-01	0.4599811E-01	0.4449049E-01
0.4304075E-01					
0.1040466E-00	0.9974768E-01	0.9563510E-01	0.9170157E-01	0.8794001E-01	0.8434353E-01
0.8090540E-01	0.7761909E-01	0.7447824E-01	0.7147670E-01	0.6860849E-01	0.6586784E-01
0.6324917E-01	0.6074709E-01	0.5835642E-01	0.5607213E-01	0.5388944E-01	0.5180370E-01
0.4981049E-01	0.4790554E-01	0.4608478E-01	0.4434429E-01	0.4268034E-01	0.4108935E-01
0.3956791E-01					
0.1077341E-00	0.1027431E-00	0.9799166E-01	0.9346962E-01	0.8916701E-01	0.8507414E-01
0.8118163E-01	0.7748037E-01	0.7396153E-01	0.7061660E-01	0.6743733E-01	0.6441578E-01

FIGURE 23. Group B Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

0.6154429E-01	0.5881552E-01	0.5622239E-01	0.5375813E-01	0.5141625E-01	0.4919055E-01
0.4707508E-01	0.4506419E-01	0.4315247E-01	0.4133481E-01	0.3960629E-01	0.3796226E-01
0.3639831E-01					
0.1109341E-00	0.10527[illegible]E-00	0.9991401E-01	0.9483380E-01	0.9002229E-01	0.8546665E-01
0.8115451E-01	0.7707388E-01	0.7321322E-01	0.6956138E-01	0.6610764E-01	0.6284167E-01
0.5975355E-01	0.5683380E-01	0.5407332E-01	0.5146342E-01	0.4899580E-01	0.4666257E-01
0.4445621E-01	0.4236958E-01	0.4039590E-01	0.3852875E-01	0.3676205E-01	0.3509004E-01
0.3350729E-01					
0.1135665E-00	0.1072853E-00	0.1013564E-00	0.9576203E-01	0.9048540E-01	0.8551028E-01
0.8082113E-01	0.7640297E-01	0.7224140E-01	0.6832259E-01	0.6463319E-01	0.6116047E-01
0.5789216E-01	0.5481656E-01	0.5192249E-01	0.4919931E-01	0.4663688E-01	0.4422558E-01
0.4195627E-01	0.3982034E-01	0.3780962E-01	0.3591641E-01	0.3413344E-01	0.3245390E-01
0.3087134E-01					
0.1155558E-00	0.1087137E-00	0.1022782E-00	0.9622743E-01	0.9054079E-01	0.8519867E-01
0.8018239E-01	0.7547406E-01	0.7105654E-01	0.6691334E-01	0.6302867E-01	0.5938737E-01
0.5597496E-01	0.5277757E-01	0.4978200E-01	0.4697569E-01	0.4434670E-01	0.4188374E-01
0.3957614E-01	0.3741379E-01	0.3538723E-01	0.3348752E-01	0.3170629E-01	0.3003568E-01
0.2846831E-01					
0.1168323E-00	0.1095107E-00	0.1026450E-00	0.9620898E-01	0.9017824E-01	0.8453008E-01
0.7924302E-01	0.7429659E-01	0.6967123E-01	0.6534816E-01	0.6130937E-01	0.5753760E-01
0.5401631E-01	0.5072970E-01	0.4766271E-01	0.4480100E-01	0.4213099E-01	0.3963983E-01
0.3731538E-01	0.3514625E-01	0.3312167E-01	0.3123161E-01	0.2946667E-01	0.2781805E-01
0.2627753E-01					
0.1103959E-00	0.1036693E-00	0.9734592E-01	0.9140361E-01	0.8582190E-01	0.8058168E-01
0.7566483E-01	0.7105404E-01	0.6673269E-01	0.6268478E-01	0.5889484E-01	0.5534800E-01
0.5202991E-01	0.4892680E-01	0.4602547E-01	0.4331330E-01	0.4077826E-01	0.3840892E-01
0.3619444E-01	0.3412460E-01	0.3218971E-01	0.3038069E-01	0.2868900E-01	0.2710663E-01
0.2562607E-01					
0.1038448E-00	0.9772513E-01	0.9195486E-01	0.8651623E-01	0.8139284E-01	0.7656929E-01
0.7203092E-01	0.6776361E-01	0.6375372E-01	0.5998798E-01	0.5645351E-01	0.5313779E-01
0.5002868E-01	0.4711443E-01	0.4438370E-01	0.4182559E-01	0.3942965E-01	0.3718587E-01
0.3508474E-01	0.3311721E-01	0.3127468E-01	0.2954906E-01	0.2793268E-01	0.2641834E-01
0.2499928E-01					
0.9744465E-01	0.9190788E-01	0.8666917E-01	0.8171508E-01	0.7703315E-01	0.7261157E-01
0.6843892E-01	0.6450414E-01	0.6079637E-01	0.5730492E-01	0.5401932E-01	0.5092926E-01
0.4802465E-01	0.4529563E-01	0.4273263E-01	0.4032633E-01	0.3806777E-01	0.3594830E-01
0.3395962E-01	0.3209382E-01	0.3034335E-01	0.2870102E-01	0.2716003E-01	0.2571394E-01
0.2435668E-01					
0.9123259E-01	0.8625067E-01	0.8151852E-01	0.7702686E-01	0.7276695E-01	0.6873031E-01
0.6490862E-01	0.6129358E-01	0.5787694E-01	0.5465041E-01	0.5160573E-01	0.4873462E-01
0.4602890E-01	0.4348046E-01	0.4108136E-01	0.3882376E-01	0.3670008E-01	0.3470294E-01
0.3282519E-01	0.3105997E-01	0.2940071E-01	0.2784109E-01	0.2637513E-01	0.2499710E-01
0.2370160E-01					
0.8524000E-01	0.8078159E-01	0.7652825E-01	0.7247453E-01	0.6861509E-01	0.6494454E-01

FIGURE 23. Group B Sample Problems Program Results
(continued)

Approved for Public Release

0.6145734E-01	0.5814777E-01	0.5500992E-01	0.5203768E-01	0.4922480E-01	0.4656489E-01
0.4405148E-01	0.41678[illegible]E-01	0.3943825E-01	0.3732550E-01	0.3533352E-01	0.3345609E-01
0.3168716E-01	0.3002084E-01	0.2845147E-01	0.2697355E-01	0.2558184E-01	0.2427133E-01
0.2303723E-01					
0.7949237E-01	0.7552369E-01	0.7171933E-01	0.6807723E-01	0.6459514E-01	0.6127036E-01
0.5809994E-01	0.5508037E-01	0.5220788E-01	0.4947831E-01	0.4688720E-01	0.4442988E-01
0.4210142E-01	0.3989679E-01	0.3781087E-01	0.3583847E-01	0.3397441E-01	0.3221355E-01
0.3055083E-01	0.2898117E-01	0.2750003E-01	0.2610239E-01	0.2478385E-01	0.2353995E-01
0.2236657E-01					
0.7400925E-01	0.7049493E-01	0.6710833E-01	0.6385034E-01	0.6072137E-01	0.5772113E-01
0.5484879E-01	0.5210291E-01	0.4948155E-01	0.4698226E-01	0.4460220E-01	0.4233816E-01
0.4018654E-01	0.3814389E-01	0.3620600E-01	0.3436892E-01	0.3262852E-01	0.3098061E-01
0.2942105E-01	0.2794569E-01	0.2655046E-01	0.2523135E-01	0.2398449E-01	0.2280608E-01
0.2169248E-01					
0.6880454E-01	0.6570843E-01	0.6270763E-01	0.5980559E-01	0.5700490E-01	0.5430733E-01
0.5171388E-01	0.4922484E-01	0.4683983E-01	0.4453792E-01	0.4237765E-01	0.4029712E-01
0.3831404E-01	0.3642582E-01	0.3462961E-01	0.3292240E-01	0.3130096E-01	0.2976202E-01
0.2330221E-01	0.2691816E-01	0.2560650E-01	0.2436387E-01	0.2318698E-01	0.2207262E-01
0.2101762E-01					
0.6388679E-01	0.61172[illegible]E-01	0.5852563E-01	0.5595124E-01	0.5345386E-01	0.5103690E-01
0.4870290E-01	0.4645536E-01	0.4428986E-01	0.4221212E-01	0.4022007E-01	0.3831292E-01
0.3648945E-01	0.3474809E-01	0.3308691E-01	0.3150377E-01	0.2999630E-01	0.2856200E-01
0.2719825E-01	0.2590234E-01	0.2467154E-01	0.2350308E-01	0.2239421E-01	0.2134223E-01
0.2034446E-01					
0.5918941E-01	0.5682849E-01	0.5451066E-01	0.5224280E-01	0.5003063E-01	0.4787882E-01
0.4579106E-01	0.4377020E-01	0.4181827E-01	0.3993662E-01	0.3812595E-01	0.3638644E-01
0.3471776E-01	0.3311918E-01	0.3158963E-01	0.3012774E-01	0.2873189E-01	0.2740027E-01
0.2613093E-01	0.2492179E-01	0.2377070E-01	0.2267544E-01	0.2163378E-01	0.2064348E-01
0.1970231E-01					
0.5280634E-01	0.5094730E-01	0.4911375E-01	0.4731100E-01	0.4554354E-01	0.4381514E-01
0.4212892E-01	0.4048739E-01	0.3889253E-01	0.3734581E-01	0.3584825E-01	0.3440050E-01
0.3300284E-01	0.3165526E-01	0.3035746E-01	0.2910891E-01	0.2790892E-01	0.2675659E-01
0.2565090E-01	0.2459070E-01	0.2357477E-01	0.2260181E-01	0.2167048E-01	0.2077937E-01
0.1992709E-01					
0.4727155E-01	0.4581179E-01	0.4436684E-01	0.4294051E-01	0.4153607E-01	0.4015636E-01
0.3880378E-01	0.3748034E-01	0.3618772E-01	0.3492723E-01	0.3369994E-01	0.3250660E-01
0.3134775E-01	0.3022371E-01	0.2913462E-01	0.2808041E-01	0.2706092E-01	0.2607581E-01
0.2512463E-01	0.2420688E-01	0.2332193E-01	0.2246911E-01	0.2164767E-01	0.2085683E-01
0.2009578E-01					
0.4245410E-01	0.4131346E-01	0.4018125E-01	0.3906003E-01	0.3795205E-01	0.3685930E-01
0.3578352E-01	0.3472520E-01	0.3368863E-01	0.3267189E-01	0.3167686E-01	0.3070427E-01
0.2975469E-01	0.2882855E-01	0.2792615E-01	0.2704768E-01	0.2619321E-01	0.2536273E-01
0.2455615E-01	0.2377329E-01	0.2301393E-01	0.2227776E-01	0.2156446E-01	0.2087364E-01
0.2020489E-01					

FIGURE 23. Group B Sample Problems Program Results

(continued)

Contrails

Approved for Public Release

0.3824555E-01	0.3736104E-01	0.3648120E-01	0.3560766E-01	0.3474188E-01	0.3388517E-01
0.3303872E-01	0.3220355E-01	0.3138059E-01	0.3057063E-01	0.2977436E-01	0.2899237E-01
0.2822514E-01	0.2747310E-01	0.2673657E-01	0.2601581E-01	0.2531099E-01	0.2462226E-01
0.2394968E-01	0.2329326E-01	0.2265300E-01	0.2202881E-01	0.2142060E-01	0.2082823E-01
0.2025152E-01					
0.3455581E-01	0.3387764E-01	0.3320196E-01	0.3252975E-01	0.3186192E-01	0.3119927E-01
0.3054255E-01	0.2989242E-01	0.2924951E-01	0.2861435E-01	0.2798741E-01	0.2736914E-01
0.2675991E-01	0.2616004E-01	0.2556983E-01	0.2498950E-01	0.2441926E-01	0.2385927E-01
0.2330965E-01	0.2277052E-01	0.2224193E-01	0.2172393E-01	0.2121652E-01	0.2071971E-01
0.2023346E-01					
0.3130981E-01	0.3079837E-01	0.3028820E-01	0.2977986E-01	0.2927385E-01	0.2877064E-01
0.2827068E-01	0.2777434E-01	0.2728202E-01	0.2679406E-01	0.2631074E-01	0.2583237E-01
0.2535919E-01	0.2489145E-01	0.2442934E-01	0.2397305E-01	0.2352275E-01	0.2307857E-01
0.2364064E-01	0.2220907E-01	0.2178396E-01	0.2136537E-01	0.2095335E-01	0.2054797E-01
0.2014926E-01					
0.2844475E-01	0.2805838E-01	0.2769262E-01	0.2731776E-01	0.2694406E-01	0.2657175E-01
0.2620108E-01	0.2583227E-01	0.2546552E-01	0.2510101E-01	0.2473893E-01	0.2437945E-01
0.240227[illegible]E-01	0.2360688E-01	0.2331804E-01	0.2297036E-01	0.2262593E-01	0.2228487E-01
0.2194726E-01	0.2161319E-01	0.2128273E-01	0.2095595E-01	0.2063290E-01	0.2031366E-01
0.1999826E-01					

FIGURE 23. Group B Sample Problems Program Results (continued)

Approved for Public Release

Contrails

Contrails

SAMPLE PROBLEM GROUP C

The geometrical relationships for this sample problem are shown in Figure 24. The data sheets are presented in Figure 25 and the results are shown in Figure 26.

Problem 1C

In this problem, a solid surface which could not be created by the program surface generator is entered manually along with the necessary connections data. A cube with four truncated corners, named 5CUBE, is entered in data from a convenient location in its coordinate system, i.e., at the origin, as shown in Figure 24. Only three points were computed and entered as 9TCUBE transformation data to move the surface to the desired position shown over Surface 1, 1PLAT5. The factor from 1PLAT5 to 5CUBE9TCUBE is requested as Run #1.

The silhouette generator was used to compute the silhouette from each point in 1PLAT5, and because a detailed output was requested with 6 horizontal and 6 vertical divisions of 1PLAT5, 49 silhouettes were computed as shown in Figure 26. The numbers following each identifying mapping line and mapping point number are the boundary point numbers which form the silhouette when connected together. It was possible, since there are no crossovers in the silhouette, to run this problem in the simple mode in SILFAC at greater speed. The mapping divisions were deliberately set at 6 x 6 to reduce the output; some experimentation is required to determine how many divisions are required to yield the factor to the accuracy desired.

Problem 2C

The silhouette generator requires that all points in Surface 2 be above the plane of Surface 1 when operating in either the simple or complex mode. A view of 5CUBE in its original position from 1PLAT5 clearly shows part of 5CUBE below the surface of 1PLAT5; the run is therefore rejected with a diagnostic indicating this condition.

Approved for Public Release

Contrails

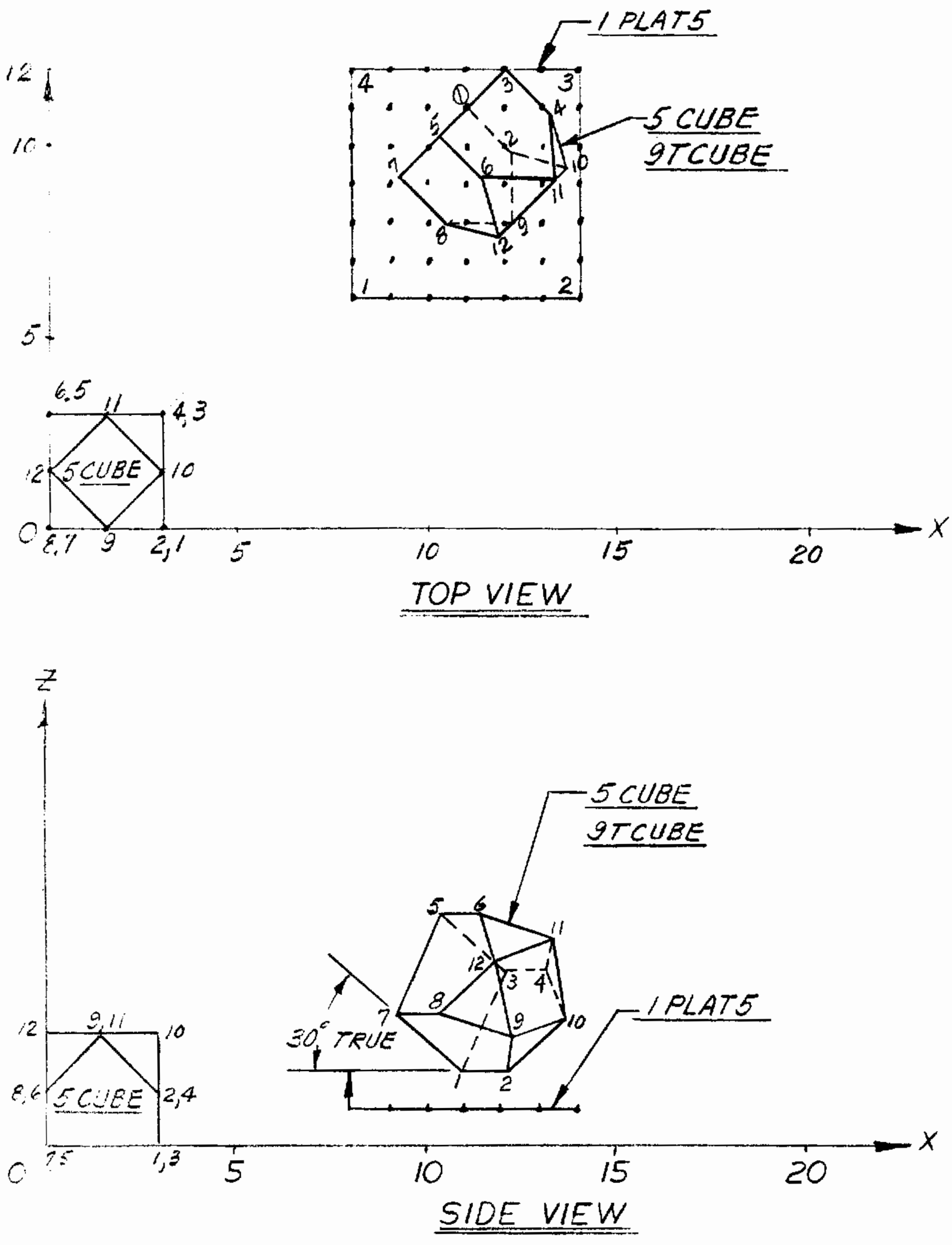

FIGURE 24. GROUP C SAMPLE PROBLEMS GEOMETRY

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 13 of 36 JOB NO. 2929-30

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	T	NAA CØNFAC		
13	I	I REPØRT ØA		
25	M	PLE PRØBLEM		
37	Ø	FRØM FIG.		
49		-K.A.TØU	73 80	
61	P	Ø, 11/1/63	C010	
1	1	PLAT5		
13				
25	6	X6 PLATE PA		
37	R	ALLEL TØ XY		
49		PLANE, Z=1	73 80	
61			C020	
1	4	.0		
13	8	.0		
25	6	.0		
37	1	.0		
49	1	4.0	73 80	
61	6	.0	C030	
1	1	.0		
13	1	4.0		
25	1	2.0		
37	1	.0		
49	8	.0	73 80	
61	1	2.0	C040	

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 14 of 36 JOB NO. 2929-30

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	1	.0		
13				
25				
37				
49			73 80	
61			C050	
1	5	CUBE		
13	3	UNITØ ØN A		
25		ØIDE, WITH		
37	F	ØUR ADJACEN		
49	T	CØRNERØ TR	73 80	
61	U	NCATED	C060	
1	1	2.0		
13	3	.0		
25	0	.0		
37	0	.0		
49		2 7 3	73 80	
61	3	.0	C070	
1	0	.0		
13	1	.5		
25		1 9 10		
37	3	.0		
49	3	.0	73 80	
61	0	.0	C080	

FIGURE 25. Group C Sample Problems Input Data Code Sheets

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 15 of 36 JOB NO. 2929-30

Col.	NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	5 2 4		
13	3.0		
25	3.0		
37	1.5		
49	10 11 3	73 80	
61	0.0	C090	
1	3.0		
13	C.C		
25	3 7 6		
37	0.C		
49	3.0	73 80	
61	1.5	C100	
1	5 11 12		
13	0.C		
25	0.C		
37	0.0		
49	1 5 8	73 80	
61	C.0	C110	
1	0.0		-
13	1.5		
25	7 9 12		
37	1.5		
49	C.C	73 80	
61	3.C	C120	

FORM 116-C-17 REV. 7-56-VELLUM

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 16 of 36 JOB NO. 2929-30

Col.	NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	2 8 10 12		
13	3.0		
25	1.5		
37	3.0		
49	2 9 11 4	73 80	
61	1.5	C13C	
1	3.0		
13	3.C		
25	10 12 6 4		
37	0.0		
49	1.5	73 80	
61	3.0	C140	
1	9 8 5 11		
13			
25			
37			
49		73 80	
61		C150	
1	9TCUBE		
13	TRANSFØRMS 5		
25	CUBE TØ SKEW		
37	ED PØSITIØN		
49	IN 1ST QUAD.	73 80	
61		C160	

FORM 116-C-17 REV. 7-56-VELLUM

FIGURE 25. Group C Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 17 of 36 JOB NO. 2929-30

Col.		NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	1	.0		
13	1	1.0		
25	1	1.0		
37	2	.0		
49	2	.0	73 80	
61	1	2.0606602	C170	
1	9	.9393398		
13	2	.0		
25	7	.0		
37	9	.1628835		
49	9	.1628835	73 80	
61	3	.5	C180	
1	1	PLAT55CUBE		
13		9TCUBE		
25	D	1 1		
37	1	PLAT55CUBE		
49			73 80	
61	D	1 1	C190	
1	5	CUBE 1PLAT5		
13				
25				
37				
49			73 80	
61			C200	

FORM 116-C-17 REV. 7-58- VELLUM

FIGURE 25. Group C Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

Contrails

```
                       NAA SPACE AND INFORMATION SYSTEMS DIVISION
                T+A PROJECT RADIANT-INTERCHANGE CONFIGURATION FACTOR PROGRAM

                                  C O N F A C  I I

            NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (C)-K.A.TOUPS,11/1/63

                                 I N P U T   D A T A

***** DATA NAME- *1PLAT5       *              6X6 PLATE PARALLEL TO XY PLANE, Z=1

POINT       X               Y               Z           POINT       X               Y               Z
      0.8000000E 01   0.6000000E 01   0.2000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1  0.8000000E 01   0.6000000E 01   0.1000000E 01       2   0.1400000E 02   0.6000000E 01   0.1000000E 01
   3  0.1400000E 02   0.1200000E 02   0.1000000E 01       4   0.8000000E 01   0.1200000E 02   0.1000000E 01


***** DATA NAME- *5CUBE       * 3 UNITS ON A SIDE, WITH FOUR ADJACENT CORNERS TRUNCATED

POINT       X               Y               Z           POINT       X               Y               Z
   1  0.3000000E 01   0.              0.                  2   0.3000000E 01   0.              0.1500000E 01
   3  0.3000000E 01   0.3000000E 01   0.                  4   0.3000000E 01   0.3000000E 01   0.1500000E 01
   5  0.              0.3000000E 01   0.                  6   0.              0.3000000E 01   0.1500000E 01
   7  0.              0.              0.                  8   0.              0.              0.1500000E 01
   9  0.1500000E 01   0.              0.3000000E 01      10   0.3000000E 01   0.1500000E 01   0.3000000E 01
  11  0.1500000E 01   0.3000000E 01   0.3000000E 01      12   0.              0.1500000E 01   0.3000000E 01

POINT  CONNECTING POINTS   POINT  CONNECTING POINTS   POINT  CONNECTING POINTS   POINT  CONNECTING POINTS
   1      2,  7,  3, -0       2      1,  9, 10, -0       3      5,  1,  4, -0       4     10, 11,  3, -0
   5      3,  7,  6, -0       6      5, 11, 12, -0       7      1,  5,  8, -0       8      7,  9, 12, -0
   9      2,  8, 10, 12      10      2,  9, 11,  4      11     10, 12,  6,  4      12      9,  8,  6, 11


***** DATA NAME- *9TCUBE       * TRANSFORMS 5CUBE TO SKEWED POSITION IN 1ST QUAD.

TRANSFORMATION DATA-

POINT       X               Y               Z           POINT       X               Y               Z
   1  0.1100000E 02   0.1100000E 02   0.2000000E 01       2   0.1206066E 02   0.9939340E 01   0.2000000E 01
```

FIGURE 26. Group C Sample Problems Program Results
(7 pages)

Approved for Public Release

Contrails

```
7   0.9162883E 01   0.9162883E 01   0.3500000E 01
```

FIGURE 26. Group C Sample Problems Program Results
(continued)

Approved for Public Release

NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG. (C)-K.A.TOUPS,11/1/63

RUN NO. 1 DATA USED FOR THIS RUN- *1PLAT5*5CUBE *
* *9TCUBE*
D 1 1*

MAPPING LINE	PT	SURFACE 2 SILHOUETTE COMPUTED FROM MAPPING POINT SHOWN									
1	1	12	9	2	1	7	5	6	12		
1	2	12	9	10	2	1	7	5	6	12	
1	3	12	9	10	2	1	7	5	6	12	
1	4	12	11	10	2	1	7	8	12		
1	5	12	11	10	2	1	7	8	12		
1	6	12	11	10	2	1	7	8	12		
1	7	12	11	10	2	1	7	8	12		
2	1	12	9	2	1	7	5	6	12		
2	2	12	9	2	1	7	5	6	12		
2	3	12	9	10	2	1	7	8	12		
2	4	12	9	10	2	1	7	8	12		
2	5	12	11	10	2	1	7	8	12		
2	6	12	11	10	2	1	7	8	12		
2	7	12	11	10	2	1	7	8	12		
3	1	12	9	2	1	3	5	7	8	12	
3	2	12	9	2	1	7	8	12			
3	3	12	9	10	2	1	7	8	12		
3	4	12	9	10	2	1	7	8	12		
3	5	12	9	10	2	1	7	8	12		
3	6	12	11	10	2	1	7	8	12		
3	7	12	11	10	4	3	1	7	8	12	
4	1	9	2	1	3	5	7	8	9		
4	2	9	2	1	7	8	9				
4	3	9	2	1	7	8	9				
4	4	9	10	2	1	7	8	9			
4	5	9	10	2	1	7	8	9			
4	6	9	10	4	3	1	7	8	9		
4	7	9	12	11	10	4	3	1	7	8	9
5	1	9	2	1	3	5	7	8	9		
5	2	9	2	1	3	5	7	8	9		
5	3	9	2	1	7	8	9				
5	4	9	10	2	1	7	8	9			
5	5	9	10	4	3	1	7	8	9		
5	6	9	10	4	3	1	7	8	9		

FIGURE 26. Group C Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

```
   5    7    9   10    4    3    1    7    8    9
   6    1    9    2    1    3    5    7    8    9
   6    2    9    2    1    3    5    7    8    9
   6    3    9    2    1    3    5    7    8    9
   6    4    9    2   10    4    3    5    7    8    9
   6    5    9   10    4    3    1    7    8    9
   6    6    9   10    4    3    1    7    8    9
   6    7    9   10   11    4    3    1    2    9
   7    1    9    2    1    3    5    7    8    9
   7    2    9    2    1    3    5    7    8    9
   7    3    9    2   10    4    3    5    7    8    9
   7    4    9    2   10    4    3    5    7    8    9
   7    5    9   10    4    3    5    7    8    9
   7    6    9   10    4    3    1    2    9
   7    7    9   10   11    4    3    1    2    9

TOTAL TIME IN SILFAC =    1.869 SECONDS.

THE FORM FACTOR FROM SURFACE *1PLAT5       * TO SURFACE *5CUBE 9TCUBE* = 0.20965

THE EXCHANGE COEFFICIENT (FA)=   0.75473E 01 SQ UNITS

                THE MAPPING AREA = 0.3600000E 02 SQ UNITS

THE AREA OF SURFACE *1PLAT5       * = 0.3600000E 02 SQ UNITS.

THE AREA OF SL                                          NITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *1PLAT5       *

POINT        X               Y                 Z             POINT       X               Y              Z
            0.              0.              0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1        0.              0.              0.                  2    0.6000000E 01  0.              0.
   3        0.6000000E 01   0.6000000E 01   0.                  4    0.             0.6000000E 01   0.


***** DATA NAME- *5CUBE 9TCUBE*
```

FIGURE 26. Group C Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

POINT	X	Y	Z	POINT	X	Y	Z
1	0.3000000E 01	0.5000000E 01	1.0000000E 00	2	0.4060660E 01	0.3939340E 01	1.0000000E 00
3	0.4060660E 01	0.6060661E 01	0.3598076E 01	4	0.5121321E 01	0.5000000E 01	0.3598076E 01
5	0.2223543E 01	0.4223543E 01	0.5098077E 01	6	0.3284203E 01	0.3162883E 01	0.5098077E 01
7	0.1162883E 01	0.3162883E 01	0.2500001E 01	8	0.2223543E 01	0.2102223E 01	0.2500001E 01
9	0.4202761E 01	0.1960121E 01	0.1750000E 01	10	0.5651650E 01	0.3409010E 01	0.2299038E 01
11	0.5263422E 01	0.3020782E 01	0.4348076E 01	12	0.3814533E 01	0.1571893E 01	0.3799039E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF *1PLAT5 * FOR EACH Y INTERVAL

X-LEFT	X-RIGHT	Y	X-LEFT	X-RIGHT	Y
0.	0.6000000E 01	0.	0.	0.6000000E 01	0.1000000E 01
0.	0.6000000E 01	0.2000000E 01	0.	0.6000000E 01	0.3000000E 01
0.	0.6000000E 01	0.4000000E 01	0.	0.6000000E 01	0.5000000E 01
0.	0.6000000E 01	0.6000000E 01			

NO. OF HORIZONTAL INCREMENTS= 6 NO. OF VERTICAL INCREMENTS= 6

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.5542873E-01	0.7322678E-01	0.8797613E-01	0.1046541E-00	0.1106668E-00	0.9935260E-01
0.7777963E-01					
0.7041412E-01	0.1026427E-00	0.1477862E-00	0.1783285E-00	0.1793724E-00	0.1513113E-00
0.1085884E-00					
0.7518837E-01	0.1433698E-00	0.2343451E-00	0.2974624E-00	0.2748546E-00	0.2056391E-00
0.1440602E-00					
0.9988021E-01	0.1681767E-00	0.3042028E-00	0.4090476E-00	0.3782529E-00	0.2721936E-00
0.1778483E-00					
0.1146046E-00	0.1867433E-00	0.2718263E-00	0.3895978E-00	0.3953245E-00	0.3070930E-00
0.1880566E-00					
0.1082963E-00	0.1633228E-00	0.2125377E-00	0.2438396E-00	0.3081478E-00	0.2582763E-00
0.1756396E-00					
0.8843643E-01	0.1208751E-00	0.1563164E-00	0.1802528E-00	0.1773333E-00	0.1757886E-00
0.1340541E-00					

FIGURE 26. Group C Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

Contrails

```
                      NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (C)-K.A.TOUPS,11/1/63

RUN NO.    2   DATA USED FOR THIS RUN- *1PLAT5*5CUBE *
                                       *      *      *
                                       *D    1*     1*

 MAPPING   SURFACE 2 SILHOUETTE COMPUTED FROM MAPPING POINT SHOWN
LINE  PT

SURF 2 HAS A 0 OR - Z-COORD REL TO SURF 1-THIS RUN ABORTED.
```

FIGURE 26. Group C Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
                    NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (C)-K.A.TOUPS,11/1/63

RUN NO.   3   DATA USED FOR THIS RUN- *5CUBE *1PLAT5*
                                      *      *      *
                                      *      *      *

A NONPLANAR SURFACE CANNOT BE USED AS SURFACE 1-THIS RUN ABORTED.
```

FIGURE 26. Group C Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

SAMPLE PROBLEM GROUP D

The geometrical relationship for this sample problem are presented in Figure 27. The data sheets are shown in Figure 28 and the results are presented in Figure 29.

Problem 1D

The referenced figure, Figure 27, shows a truncated-cone-on-cylinder and a disk, skewed with respect to the cylinder-cone centerline. The cylinder-cone is created by the surface generator as 6CYTR, a 32-sided solid in its final position in the unprimed coordinate system. The disk is also internally generated, but because the generator (in its present version) is limited to cross sections parallel to XY plane, the disk, 3DISKC, had to be transformed to the skewed position by transformation data 9TDSKC. The results are shown in Figure 29. The simple mode was used for processing because no line segment crossovers are present, which enabled the use of transformations to construct the problem. The warning note concerning the difference between the mapping area and the actual 3DISK surface area is supplied to attract attention to possible errors in Surface 1 data entry of the choice of mapping increments. As indicated in the comments on Problem 1 of Sample Problem Group C, the coarse increment 6 x 6 was selected to reduce output. A finer increment should probably be used to insure accuracy to the third place, if such is desired. It must be emphasized that the form factor obtained in Run #1 is the factor to the solid figure, 6CYLTR, which, of course, includes the bases. Since the factor to the skin is the desired number, it is necessary to subtract the factors to the ends. The upper end is obviously not seen ($f = 0$), so the factor to the base only must be obtained. The base is easily created by the surface generator (3DISKB), but it is created with the orientation vector pointing toward the +Z axis--the wrong way. It is necessary to turn it around by a primary transformation--(9TDSKD). Thus, the full capability of the primary transformation feature is utilized and exemplified, shown by Run #2. The factor to the skin of 6CYLTR is obtained by subtracting the results of Run #2 from Run #1, or

$$f_{skin} = f_{total} - f_{base}$$

$$f = 0.18946 - 0.09955$$

$$f = .08991$$

The exchange coefficient is computed in a similar manner.

Approved for Public Release

Contrails

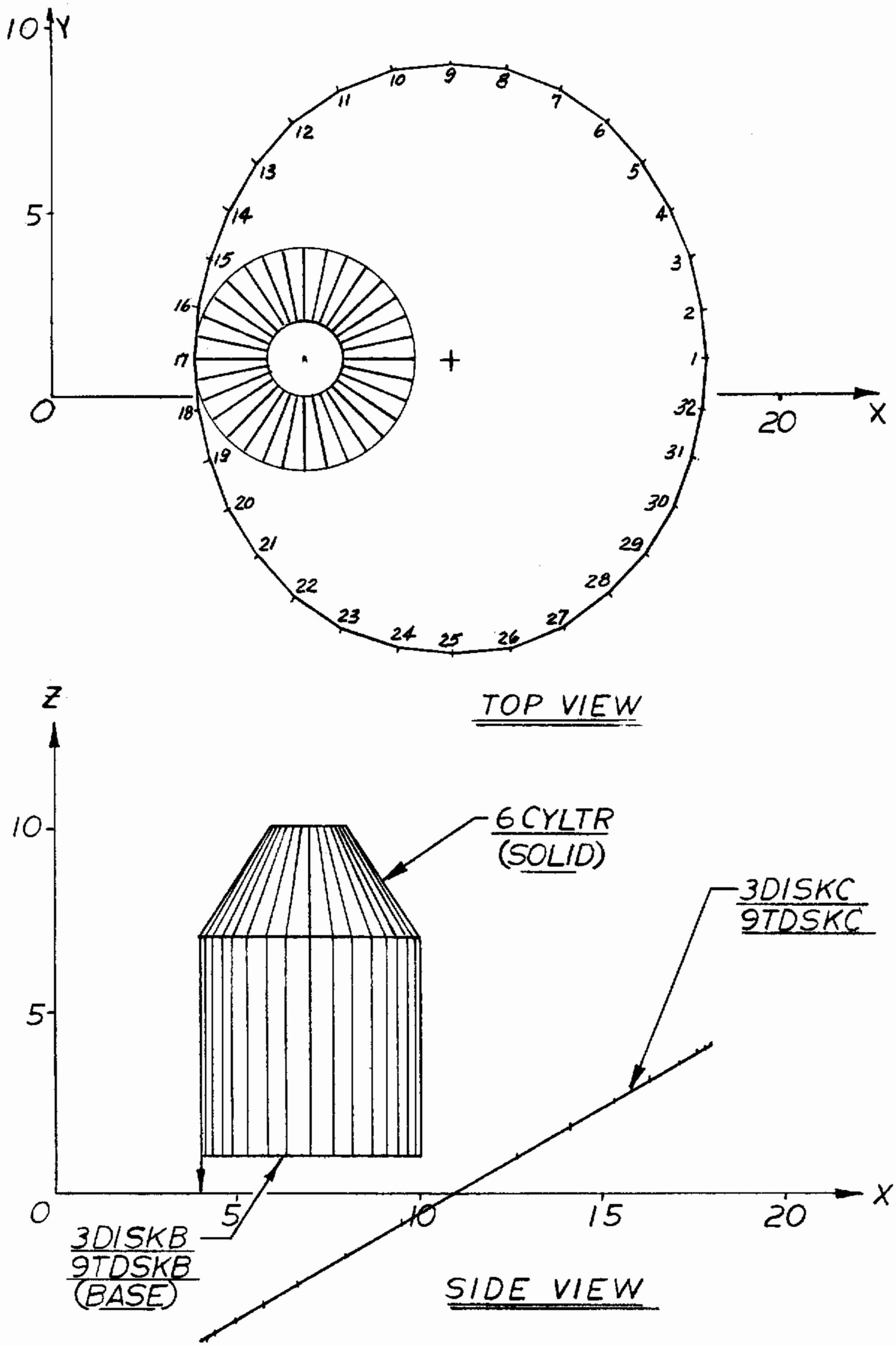

FIGURE 27. GROUP D SAMPLE PROBLEMS GEOMETRY

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 18 of 36 JOB NO. 2929-30

Col.		NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	T	N A A C Ø N F A C		
13	I	I R E P Ø R T Ø A		
25	M	P L E P R Ø B L E M		
37	Ø	F R Ø M F I G .		
49		(D) - K . A . T Ø U	73 80	
61	P	Ø , 1 1 / 1 / 6 3	D 0 1 0	
1	3	D I Ø K C		
13				
25	F	U N I T R A D I U		
37	Ø	D I Ø K		
49			73 80	
61			D 0 2 0	
1	3	2 . 0		
13	0	. 0		
25	0	. 0		
37	0	. 0		
49	8	. 0	73 80	
61	8	. 0	D 0 3 0	
1	6	C Y L T R		
13	3	U N I T R A D I U		
25	Ø	C Y L I N D E R W		
37	I	T H T R U N C A T E		
49	D	C Ø N E Ø N T Ø	73 80	
61	P		D 0 4 0	

FORM 114-C-17 REV. 7-59 - VELLUM

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 19 of 36 JOB NO. 2929-30

Col.		NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	3	2 . 0		
13	3	. 0		
25	7	. 0		
37	1	. 0		
49	1	. 0	73 80	
61	3	. 0	D 0 5 0	
1	3	. 0		
13	7	. 0		
25	3	. 0		
37	3	. 0		
49	1	0 . 0	73 80	
61	1	. 0	D 0 6 0	
1	1	. 0		
13				
25				
37				
49			73 80	
61			D 0 7 0	
1	3	D I Ø K B		
13	B	A Ø E Ø F 6 C Y L		
25	T	R - C R E A T E D W		
37	I	T H A C T I V E Ø		
49	I	D E T Ø W A R D +	73 80	
61	Z	A X I Ø	D 0 8 0	

FORM 114-C-17 REV. 7-59 - VELLUM

FIGURE 28. Group D Sample Problems Input Data Code Sheets

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 20 of 36 JOB NO. 2929-30

		NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	3	2 . 0		
13	0	. 0		
25	0	. 0		
37	0	. 0		
49	3	. 0		
61	3	. 0	D 0 9 0	
1	9	T D ∅ K C		
13	M	∅ V E ∅ 3 D I ∅ K C		
25		T ∅ ∅ K E W E D P		
37	∅	∅ I T I ∅ N ∅ N X		
49	-	A X I ∅		
61			D 1 0 0	
1	1	. 0		
13	1	7 . 9 2 8		
25	1	. 0		
37	4	. 0		
49	9	. 0		
61	1	1 . 0	D 1 1 0	
1	9	. 0		
13	0	. 0		
25	2	5 . 0		
37	1	1 . 0		
49	-	7 . 0		
61	0	. 0	D 1 2 0	

FORM 114-C-17 REV. 7-58-VELLUM

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 21 of 36 JOB NO. 2929-30

		NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	9	T D ∅ K B		
13	F	L I P ∅ 3 D I ∅ K B		
25		A R ∅ U N D ∅ ∅ T		
37	H	A T A C T I V E ∅		
49	I	D E ∅ E E ∅ 3 D I		
61	S	K C 9 T D ∅ K C	D 1 3 0	
1	1	. 0		
13	4	. 0		
25	1	. 0		
37	1	. 0		
49	9	. 0		
61	7	. 0	D 1 4 0	
1	4	. 0		
13	1	. 0		
25	2	5 . 0		
37	7	. 0		
49	-	2 . 0		
61	1	. 0	D 1 5 0	
1	3	D I ∅ K C 6 C Y L T R		
13	9	T D ∅ K C		
25	D	1 1		
37	3	D I ∅ K C 3 D I ∅ K B		
49	9	T D ∅ K C 9 T D ∅ K B		
61		1 1	D 1 6 0	

FORM 114-C-17 REV. 7-58-VELLUM

FIGURE 28. Group D Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

Contrails

```
                    NAA SPACE AND INFORMATION SYSTEMS DIVISION
            T+A PROJECT RADIANT-INTERCHANGE CONFIGURATION FACTOR PROGRAM

                                C O N F A C   I I

        NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (D)-K.A.TOUPS,11/1/63

                                I N P U T   D A T A

***** DATA NAME- *3DISKC      *              8 UNIT RADIUS DISK

SURFACE SPECIFICATIONS-

NO OF X-SECTIONS =  1          NO OF X-SECTION BOUNDARY DIVISIONS = 32

LOCATION OF VERTICAL CENTERLINE, X= 0.            , Y= 0.

X-SECTION NO.     X-AXIS RADIUS      Y-AXIS RADIUS      ELEVATION ABOVE XY PLANE
     1            0.8000000E 01      0.8000000E 01      0.

THE FOLLOWING INTERNALLY GENERATED SURFACE DATA RESULTED FROM THE ABOVE SPECIFICATIONS-

POINT        X               Y              Z             POINT        X               Y               Z
        0.8000000E 01  0.              0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1    0.8000000E 01  0.              0.                    2   0.7846282E 01  0.1560723E 01  0.
   3    0.7391036E 01  0.3061467E 01   0.                    4   0.6651757E 01  0.4444562E 01  0.
   5    0.5656854E 01  0.5656854E 01   0.                    6   0.4444561E 01  0.6651756E 01  0.
   7    0.3061467E 01  0.7391035E 01   0.                    8   0.1560722E 01  0.7846281E 01  0.
   9    0.2980232E-07  0.7999999E 01   0.                   10  -0.1560722E 01  0.7846281E 01  0.
  11   -0.3061467E 01  0.7391035E 01   0.                   12  -0.4444561E 01  0.6651756E 01  0.
  13   -0.5656853E 01  0.5656853E 01   0.                   14  -0.6651755E 01  0.4444561E 01  0.
  15   -0.7391035E 01  0.3061467E 01   0.                   16  -0.7846280E 01  0.1560722E 01  0.
  17   -0.7999998E 01  0.4470348E-07   0.                   18  -0.7846280E 01 -0.1560722E 01  0.
  19   -0.7391034E 01 -0.3061466E 01   0.                   20  -0.6651755E 01 -0.4444560E 01  0.
  21   -0.5656852E 01 -0.5656852E 01   0.                   22  -0.4444560E 01 -0.6651755E 01  0.
  23   -0.3061466E 01 -0.7391034E 01   0.                   24  -0.1560722E 01 -0.7846279E 01  0.
  25   -0.7450581E-07 -0.7999997E 01   0.                   26   0.1560722E 01 -0.7846279E 01  0.
  27    0.3061466E 01 -0.7391033E 01   0.                   28   0.4444560E 01 -0.6651754E 01  0.
  29    0.5656851E 01 -0.5656852E 01   0.                   30   0.6651754E 01 -0.4444560E 01  0.
  31    0.7391032E 01 -0.3061466E 01   0.                   32   0.7846278E 01 -0.1560722E 01  0.
```

FIGURE 29. Group D Sample Problems Program Results
(14 pages)

Approved for Public Release

***** DATA NAME- *6CYLTR   * 3 UNIT RADIUS CYLINDER WITH TRUNCATED CONE ON TOP

SURFACE SPECIFICATIONS-

NO OF X-SECTIONS = 3   NO OF X-SECTION BOUNDARY DIVISIONS = 32

LOCATION OF VERTICAL CENTERLINE, X= 0.7000000E 01, Y= 0.1000000E 01

X-SECTION NO.	X-AXIS RADIUS	Y-AXIS RADIUS	ELEVATION ABOVE XY PLANE
1	0.3000000E 01	0.3000000E 01	0.1000000E 01
2	0.3000000E 01	0.3000000E 01	0.7000000E 01
3	0.1000000E 01	0.1000000E 01	0.1000000E 02

THE FOLLOWING INTERNALLY GENERATED SURFACE DATA RESULTED FROM THE ABOVE SPECIFICATIONS-

POINT	X	Y	Z	POINT	X	Y	Z
1	0.1000000E 02	0.1000000E 01	0.1000000E 01	2	0.1000000E 02	0.1000000E 01	0.7000000E 01
3	0.8000000E 01	0.1000000E 01	0.1000000E 02	4	0.9942356E 01	0.1585271E 01	0.1000000E 01
5	0.9942356E 01	0.1585271E 01	0.7000000E 01	6	0.7980785E 01	0.1195090E 01	0.1000000E 02
7	0.9771638E 01	0.2148050E 01	0.1000000E 01	8	0.9771638E 01	0.2148050E 01	0.7000000E 01
9	0.7923879E 01	0.1382683E 01	0.1000000E 02	10	0.9494409E 01	0.2666711E 01	0.1000000E 01
11	0.9494409E 01	0.2666711E 01	0.7000000E 01	12	0.7831469E 01	0.1555570E 01	0.1000000E 02
13	0.9121320E 01	0.3121320E 01	0.1000000E 01	14	0.9121320E 01	0.3121320E 01	0.7000000E 01
15	0.7707107E 01	0.1707107E 01	0.1000000E 02	16	0.8666710E 01	0.3494409E 01	0.1000000E 01
17	0.8666710E 01	0.3494409E 01	0.7000000E 01	18	0.7555570E 01	0.1831470E 01	0.1000000E 02
19	0.8148050E 01	0.3771638E 01	0.1000000E 01	20	0.8148050E 01	0.3771638E 01	0.7000000E 01
21	0.7382683E 01	0.1923879E 01	0.1000000E 02	22	0.7585271E 01	0.3942355E 01	0.1000000E 01
23	0.7585271E 01	0.3942355E 01	0.7000000E 01	24	0.7195090E 01	0.1980785E 01	0.1000000E 02
25	0.7000000E 01	0.4000000E 01	0.1000000E 01	26	0.7000000E 01	0.4000000E 01	0.7000000E 01
27	0.7000000E 01	0.2000000E 01	0.1000000E 02	28	0.6414729E 01	0.3942355E 01	0.1000000E 01
29	0.6414729E 01	0.3942355E 01	0.7000000E 01	30	0.6804910E 01	0.1980785E 01	0.1000000E 02
31	0.5851950E 01	0.3771638E 01	0.1000000E 01	32	0.5851950E 01	0.3771638E 01	0.7000000E 01
33	0.6617317E 01	0.1923879E 01	0.1000000E 02	34	0.5333290E 01	0.3494408E 01	0.1000000E 01
35	0.5333290E 01	0.3494408E 01	0.7000000E 01	36	0.6444430E 01	0.1831469E 01	0.1000000E 02
37	0.4878680E 01	0.3121320E 01	0.1000000E 01	38	0.4878680E 01	0.3121320E 01	0.7000000E 01
39	0.6292893E 01	0.1707107E 01	0.1000000E 02	40	0.4505592E 01	0.2666710E 01	0.1000000E 01
41	0.4505592E 01	0.2666710E 01	0.7000000E 01	42	0.6168530E 01	0.1555570E 01	0.1000000E 02
43	0.4228362E 01	0.2148050E 01	0.1000000E 01	44	0.4228362E 01	0.2148050E 01	0.7000000E 01
45	0.6076121E 01	0.1382683E 01	0.1000000E 02	46	0.4057645E 01	0.1585271E 01	0.1000000E 01
47	0.4057645E 01	0.1585271E 01	0.7000000E 01	48	0.6019215E 01	0.1195090E 01	0.1000000E 02
49	0.4000001E 01	0.1000000E 01	0.1000000E 01	50	0.4000001E 01	0.1000000E 01	0.7000000E 01
51	0.6000000E 01	0.1000000E 01	0.1000000E 02	52	0.4057645E 01	0.4147292E-00	0.1000000E 01
53	0.4057645E 01	0.4147292E-00	0.7000000E 01	54	0.6019215E 01	0.8049097E 00	0.1000000E 02

FIGURE 29. Group D Sample Problems Program Results (continued)

Approved for Public Release

Contrails

Contrails

55	0.4228362E 01	-0.1480499E-00	0.1000000E 01	56	0.4228362E 01	-0.1480499E-00	0.7000000E 01
57	0.6076121E 01	0.6173167E 00	0.1000000E 02	58	0.4505592E 01	-0.6667102E 00	0.1000000E 01
59	0.4505592E 01	-0.6667102E 00	0.7000000E 01	60	0.6168531E 01	0.4444299E-00	0.1000000E 02
61	0.4878680E 01	-0.1121320E 01	0.1000000E 01	62	0.4878680E 01	-0.1121320E 01	0.7000000E 01
63	0.6292893E 01	0.2928935E-00	0.1000000E 02	64	0.5333290E 01	-0.1494408E 01	0.1000000E 01
65	0.5333290E 01	-0.1494408E 01	0.7000000E 01	66	0.6444430E 01	0.1685307E-00	0.1000000E 02
67	0.5851950E 01	-0.1771638E 01	0.1000000E 01	68	0.5851950E 01	-0.1771638E 01	0.7000000E 01
69	0.6617317E 01	0.7612080E-01	0.1000000E 02	70	0.6414729E 01	-0.1942355E 01	0.1000000E 01
71	0.6414729E 01	-0.1942355E 01	0.7000000E 01	72	0.6804910E 01	0.1921508E-01	0.1000000E 02
73	0.7000000E 01	-0.1999999E 01	0.1000000E 01	74	0.7000000E 01	-0.1999999E 01	0.7000000E 01
75	0.7000000E 01	0.3874302E-06	0.1000000E 02	76	0.7585271E 01	-0.1942355E 01	0.1000000E 01
77	0.7585271E 01	-0.1942355E 01	0.7000000E 01	78	0.7195090E 01	0.1921511E-01	0.1000000E 02
79	0.8148050E 01	-0.1771637E 01	0.1000000E 01	80	0.8148050E 01	-0.1771637E 01	0.7000000E 01
81	0.7382683E 01	0.7612085E-01	0.1000000E 02	82	0.8666710E 01	-0.1494408E 01	0.1000000E 01
83	0.8666710E 01	-0.1494408E 01	0.7000000E 01	84	0.7555570E 01	0.1685307E-00	0.1000000E 02
85	0.9121319E 01	-0.1121319E 01	0.1000000E 01	86	0.9121319E 01	-0.1121319E 01	0.7000000E 01
87	0.7707106E 01	0.2928935E-00	0.1000000E 02	88	0.9494407E 01	-0.6667099E 00	0.1000000E 01
89	0.9494407E 01	-0.6667099E 00	0.7000000E 01	90	0.7831469E 01	0.4444300E-00	0.1000000E 02
91	0.9771637E 01	-0.1480497E-00	0.1000000E 01	92	0.9771637E 01	-0.1480497E-00	0.7000000E 01
93	0.7923879E 01	0.6173167E 00	0.1000000E 02	94	0.9942354E 01	0.4147293E-00	0.1000000E 01
95	0.9942354E 01	0.4147293E-00	0.7000000E 01	96	0.7980785E 01	0.8049098E 00	0.1000000E 02

POINT	CONNECTING POINTS	POINT	CONNECTING POINTS	POINT	CONNECTING POINTS	POINT	CONNECTING POINTS
1	4, 2, 94, 0	2	5, 3, 95, 1	3	6, 0, 96, 2	4	7, 5, 1, 0
5	8, 6, 2, 4	6	9, 0, 3, 5	7	10, 8, 4, 0	8	11, 9, 5, 7
9	12, 0, 6, 8	10	13, 11, 7, 0	11	14, 12, 8, 10	12	15, 0, 9, 11
13	16, 14, 10, 0	14	17, 15, 11, 13	15	18, 0, 12, 14	16	19, 17, 13, 0
17	20, 18, 14, 16	18	21, 0, 15, 17	19	22, 20, 16, 0	20	23, 21, 17, 19
21	24, 0, 18, 20	22	25, 23, 19, 0	23	26, 24, 20, 22	24	27, 0, 21, 23
25	28, 26, 22, 0	26	29, 27, 23, 25	27	30, 0, 24, 26	28	31, 29, 25, 0
29	32, 30, 26, 28	30	33, 0, 27, 29	31	34, 32, 28, 0	32	35, 33, 29, 31
33	36, 0, 30, 32	34	37, 35, 31, 0	35	38, 36, 32, 34	36	39, 0, 33, 35
37	40, 38, 34, 0	38	41, 39, 35, 37	39	42, 0, 36, 38	40	43, 41, 37, 0
41	44, 42, 38, 40	42	45, 0, 39, 41	43	46, 44, 40, 0	44	47, 45, 41, 43
45	48, 0, 42, 44	46	49, 47, 43, 0	47	50, 48, 44, 46	48	51, 0, 45, 47
49	52, 50, 46, 0	50	53, 51, 47, 49	51	54, 0, 48, 50	52	55, 53, 49, 0
53	56, 54, 50, 52	54	57, 0, 51, 53	55	58, 56, 52, 0	56	59, 57, 53, 55
57	60, 0, 54, 56	58	61, 59, 55, 0	59	62, 60, 56, 58	60	63, 0, 57, 59
61	64, 62, 58, 0	62	65, 63, 59, 61	63	66, 0, 60, 62	64	67, 65, 61, 0
65	68, 66, 62, 64	66	69, 0, 63, 65	67	70, 68, 64, 0	68	71, 69, 65, 67
69	72, 0, 66, 68	70	73, 71, 67, 0	71	74, 72, 68, 70	72	75, 0, 69, 71
73	76, 74, 70, 0	74	77, 75, 71, 73	75	78, 0, 72, 74	76	79, 77, 73, 0
77	80, 78, 74, 76	78	81, 0, 75, 77	79	82, 80, 76, 0	80	83, 81, 77, 79

FIGURE 29. Group D Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
 81     84,  0, 78, 80     82     85, 83, 79,  0     83     86, 84, 80, 82     84     87,  0, 81, 83
 85     88, 86, 82,  0     86     89, 87, 83, 85     87     90,  0, 84, 86     88     91, 89, 85,  0
 89     92, 90, 86, 88     90     93,  0, 87, 89     91     94, 92, 88,  0     92     95, 93, 89, 91
 93     96,  0, 90, 92     94      1, 95, 91,  0     95      2, 96, 92, 94     96      3,  0, 93, 95


***** DATA NAME- *3DISKB        * BASE OF 6CYLTR-CREATED WITH ACTIVE SIDE TOWARD +Z AXIS

SURFACE SPECIFICATIONS-

NO OF X-SECTIONS =  1          NO OF X-SECTION BOUNDARY DIVISIONS = 32

LOCATION OF VERTICAL CENTERLINE, X= 0.           , Y= 0.

X-SECTION NO.      X-AXIS RADIUS      Y-AXIS RADIUS      ELEVATION ABOVE XY PLANE
     1             0.3000000E 01      0.3000000E 01      0.

THE FOLLOWING INTERNALLY GENERATED SURFACE DATA RESULTED FROM THE ABOVE SPECIFICATIONS-

POINT         X               Y                Z              POINT       X              Y                Z
      0.3000000E 01  0.                   0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
  1   0.3000000E 01  0.                   0.                   2   0.2942356E 01  0.5852710E 00  0.
  3   0.2771638E 01  0.1148050E 01        0.                   4   0.2494409E 01  0.1666711E 01  0.
  5   0.2121320E 01  0.2121320E 01        0.                   6   0.1666711E 01  0.2494409E 01  0.
  7   0.1148050E 01  0.2771638E 01        0.                   8   0.5852709E 00  0.2942355E 01  0.
  9   0.1117587E-07  0.3000000E 01        0.                  10  -0.5852709E 00  0.2942355E 01  0.
 11  -0.1148050E 01  0.2771638E 01        0.                  12  -0.1666710E 01  0.2494408E 01  0.
 13  -0.2121320E 01  0.2121320E 01        0.                  14  -0.2494408E 01  0.1666710E 01  0.
 15  -0.2771638E 01  0.1148050E 01        0.                  16  -0.2942355E 01  0.5852708E 00  0.
 17  -0.2999999E 01  0.1676381E-07        0.                  18  -0.2942355E 01 -0.5852708E 00  0.
 19  -0.2771638E 01 -0.1148050E 01        0.                  20  -0.2494408E 01 -0.1666710E 01  0.
 21  -0.2121320E 01 -0.2121320E 01        0.                  22  -0.1666710E 01 -0.2494408E 01  0.
 23  -0.1148050E 01 -0.2771638E 01        0.                  24  -0.5852708E 00 -0.2942355E 01  0.
 25  -0.2793968E-07 -0.2999999E 01        0.                  26   0.5852707E 00 -0.2942355E 01  0.
 27   0.1148050E 01 -0.2771637E 01        0.                  28   0.1666710E 01 -0.2494408E 01  0.
 29   0.2121319E 01 -0.2121319E 01        0.                  30   0.2494408E 01 -0.1666710E 01  0.
 31   0.2771637E 01 -0.1148050E 01        0.                  32   0.2942354E 01 -0.5852707E 00  0.


***** DATA NAME- *9TDSKC        * MOVES 3DISKC TO SKEWED POSITION ON X-AXIS

TRANSFORMATION DATA-
```

FIGURE 29. Group D Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
POINT       X               Y               Z              POINT       X               Y               Z
  1    0.1792800E 02  0.1000000E 01  0.4000000E 01            9   0.1100000E 02  0.9000000E 01  0.
 25    0.1100000E 02 -0.7000000E 01  0.

***** DATA NAME- *9TDSKB      * FLIPS 3DISKB AROUND SO THAT ACTIVE SIDE SEES 3DISKC9TDSKC

TRANSFORMATION DATA-

POINT       X               Y               Z              POINT       X               Y               Z
  1    0.4000000E 01  0.1000000E 01  0.1000000E 01            9   0.7000000E 01  0.4000000E 01  0.1000000E 01
 25    0.7000000E 01 -0.2000000E 01  0.1000000E 01
```

FIGURE 29. Group D Sample Problems Program Results
(continued)

Approved for Public Release

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (D)-K.A.TOUPS,11/1/63

RUN NO.   1   DATA USED FOR THIS RUN- *3DISKC*6CYLTR*
                                      *9TDSKC*      *
                                      *D    1*     1*

MAPPING    SURFACE 2 SILHOUETTE COMPUTED FROM MAPPING POINT SHOWN
LINE PT
 1   1      6  9 12 15 18 21 20 23 22 19 16 13 10  7  4  1 94 91 88 85 82 79 76 77
           80 81 84 87 90 93 96  3  6
 1   2      6  9 12 15 18 21 20 23 22 19 16 13 10  7  4  1 94 91 88 85 82 79 80 83
           84 87 90 93 96  3  6
 1   3      6  9 12 15 18 21 20 23 22 19 16 13 10  7  4  1 94 91 88 85 82 79 80 83
           84 87 90 93 96  3  6
 1   4      6  9 12 15 18 21 20 23 22 19 16 13 10  7  4  1 94 91 88 85 82 79 80 83
           84 87 90 93 96  3  6
 1   5      6  9 12 15 18 21 20 23 22 19 16 13 10  7  4  1 94 91 88 85 82 79 80 83
           84 87 90 93 96  3  6
 1   6      6  9 12 15 18 21 20 23 22 19 16 13 10  7  4  1 94 91 88 85 82 79 80 83
           84 87 90 93 96  3  6
 1   7      6  9 12 15 18 21 20 23 22 19 16 13 10  7  4  1 94 91 88 85 82 79 80 83
           84 87 90 93 96  3  6
 2   1      6  9  8 11 14 13 10  7  4  1 94 91 88 85 82 79 76 73 70 71 74 75 78 81
           84 87 90 93 96  3  6
 2   2      6  9 12 11 14 17 16 13 10  7  4  1 94 91 88 85 82 79 76 73 74 77 78 81
           84 87 90 93 96  3  6
 2   3      6  9 12 15 14 17 16 13 10  7  4  1 94 91 88 85 82 79 76 77 80 83 84 87
           90 93 96  3  6
 2   4      6  9 12 15 14 17 20 23 22 19 16 13 10  7  4  1 94 91 88 85 82 79 80 83
           86 87 90 93 96  3  6
 2   5      6  9 12 15 18 21 20 23 26 25 22 19 16 13 10  7  4  1 94 91 88 85 82 83
           86 89 90 93 96  3  6
 2   6      6  9 12 15 18 21 24 23 26 29 28 25 22 19 16 13 10  7  4  1 94 91 88 85
           86 89 92 93 96  3  6
 2   7      6  9 12 15 18 21 24 27 26 29 32 31 28 25 22 19 16 13 10  7  4  1 94 91
           88 89 92 95 96  3  6
 3   1      5  8  7  4  1 94 91 88 85 82 79 76 73 70 67 64 65 68 71 74 75 78 81 84
           87 90 93 96  3  2  5
 3   2      5  8 11 10  7  4  1 94 91 88 85 82 79 76 73 70 71 74 77 80 81 84 87 90
           93 96  3  2  5
 3   3      5  8 11 14 13 10  7  4  1 94 91 88 85 82 79 76 77 80 83 86 89 90 93 96
            3  2  5
```

FIGURE 29. Group D Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

Contrails

3	4	5	8	11	14	17	20	19	16	13	10	7	4	1	94	91	88	85	82	83	86	89	92	95	2
		5																							
3	5	5	8	11	14	17	20	23	26	25	22	19	16	13	10	7	4	1	94	91	88	89	92	95	2
		5																							
3	6	5	6	9	12	15	18	21	20	23	26	29	32	31	28	25	22	19	16	13	10	7	4	1	94
		91	92	95	2	5																			
3	7	5	6	9	12	15	18	21	24	27	30	29	32	35	34	37	40	43	46	49	52	55	58	61	64
		67	70	73	76	79	82	85	88	91	92	95	2	5											
4	1	2	5	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	62	65
		68	71	72	75	78	81	84	87	90	93	92	95	2											
4	2	2	5	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67
		68	71	74	77	80	83	86	89	92	95	2													
4	3	2	5	8	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67
		70	73	74	77	80	83	86	89	92	95	2													
4	4	2	5	8	11	14	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67
		70	73	76	79	82	85	86	89	92	95	2													
4	5	2	5	8	11	14	17	20	23	26	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67
		70	73	76	79	82	85	88	91	94	95	2													
4	6	2	5	8	11	14	17	20	23	26	29	32	31	34	37	40	43	46	49	52	55	58	61	64	67
		70	73	76	79	82	85	88	91	94	95	2													
4	7	2	5	8	11	14	15	18	21	24	27	26	29	32	35	38	37	40	43	46	49	52	55	58	61
		64	67	70	73	76	79	82	85	88	91	94	1	2											
5	1	1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	59	62	65	68
		71	74	77	80	83	86	89	92	95	2	1													
5	2	1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	65	68
		71	74	77	80	83	86	89	92	95	94	1													
5	3	1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70
		73	76	77	80	83	86	89	92	91	94	1													
5	4	1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70
		73	76	79	82	85	88	91	94	1															
5	5	1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70
		73	76	79	82	85	88	91	94	1															
5	6	1	4	7	8	11	14	17	20	23	26	29	32	35	34	37	40	43	46	49	52	55	58	61	64
		67	70	73	76	79	82	85	88	91	94	1													
5	7	1	4	5	8	11	14	17	20	23	26	29	32	35	38	41	40	43	46	49	52	55	58	61	64
		67	70	73	76	79	82	85	88	91	94	1													
6	1	1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	56	59	62	65	68
		71	74	77	80	83	86	89	88	91	94	1													
6	2	1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	59	62	65	68
		71	74	77	80	83	86	85	88	91	94	1													
6	3	1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70
		73	76	79	82	85	88	91	94	1															
6	4	1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70
		73	76	79	82	85	88	91	94	1															

FIGURE 29. Group D Sample Problems Program Results (continued)

Approved for Public Release

Contrails

```
 6   5     1   4   7  10  13  16  19  22  25  28  31  34  37  40  43  46  49  52  55  58  61  64  67  70
          73  76  79  82  85  88  91  94   1
 6   6     1   4   7  10  13  16  19  20  23  26  29  32  35  38  37  40  43  46  49  52  55  58  61  64
          67  70  73  76  79  82  85  88  91  94   1
 6   7     1   4   7  10  13  14  17  20  23  26  29  32  35  38  41  44  43  46  49  52  55  58  61  64
          67  70  73  76  79  82  85  88  91  94   1
 7   1     1   4   7  10  13  16  19  22  25  28  31  34  37  40  43  46  49  52  53  56  59  62  61  64
          67  70  73  76  79  82  85  88  91  94   1
 7   2     1   4   7  10  13  16  19  22  25  28  31  34  37  40  43  46  49  52  53  56  59  62  61  64
          67  70  73  76  79  82  85  88  91  94   1
 7   3     1   4   7  10  13  16  19  22  25  28  31  34  37  40  43  46  49  52  53  56  59  58  61  64
          67  70  73  76  79  82  85  88  91  94   1
 7   4     1   4   7  10  13  16  19  22  25  28  31  34  37  40  43  46  49  52  55  58  61  64  67  70
          73  76  79  82  85  88  91  94   1
 7   5     1   4   7  10  13  16  19  22  25  28  31  34  37  40  43  46  49  52  55  58  61  64  67  70
          73  76  79  82  85  88  91  94   1
 7   6     1   4   7  10  13  16  19  22  25  28  31  34  37  40  43  46  49  52  55  58  61  64  67  70
          73  76  79  82  85  88  91  94   1
 7   7     1   4   7  10  13  16  19  22  25  28  31  34  37  40  43  46  49  52  55  58  61  64  67  70
          73  76  79  82  85  88  91  94   1

TOTAL TIME IN SILFAC =     9.837 SECONDS.

THE FORM FACTOR FROM SURFACE *3DISKC9TDSKC* TO SURFACE *6CYLTR      * = 0.18946

THE EXCHANGE COEFFICIENT (FA)=   0.37849E 02 SQ UNITS

                  THE MAPPING AREA = 0.1894044E 03 SQ UNITS

THE AREA OF SURFACE *3DISKC9TDSKC* = 0.1997725E 03 SQ UNITS.

THE AREA OF SURFACE *6CYLTR      * = 0.1892992E 03 SQ UNITS.

WARNING-WARNING
THE MAPPING AREA IS MORE THAN 1 PERCENT DIFFERENT FROM THE AREA IN SURFACE *3DISKC9TDSKC* SEEN BY
SURFACE *6CYLTR      *. THIS MAY BE CAUSED BY WRONG SURFACE DATA ENTRY (THE SURFACE BOUNDARY
CROSSES A MAPPING LINE IN MORE THAN TWO PLACES), OR TOO COARSE INCREMENTS.  THE FACTOR MAY BE INCORRECT.


THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *3DISKC9TDSKC*
```

FIGURE 29. Group D Sample Problems Program Results

(continued)

Approved for Public Release

POINT	X	Y	Z	POINT	X	Y	Z
	0.	-0.	0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)				
1	-0.	-0.	-0.	2	0.1568275E 01	-0.	0.
3	0.3106415E 01	0.3059554E-00	0.	4	0.4555312E 01	0.9061081E 00	0.
5	0.5859285E 01	0.1777395E 01	0.	6	0.6968222E 01	0.2886333E 01	0.
7	0.7839509E 01	0.4190306E 01	0.	8	0.8439662E 01	0.5639203E 01	0.
9	0.8745612E 01	0.7177298E 01	0.	10	0.8745617E 01	0.8745619E 01	0.
11	0.8439662E 01	0.1028376E 02	0.	12	0.7839509E 01	0.1173266E 02	0.
13	0.6968223E 01	0.1303663E 02	0.	14	0.5859285E 01	0.1414557E 02	0.
15	0.4555313E 01	0.1501685E 02	0.	16	0.3106417E 01	0.1561701E 02	0.
17	0.1568276E 01	0.1592296E 02	0.	18	0.	0.1592296E 02	0.
19	-0.1538138E 01	0.1561701E 02	0.	20	-0.2987034E 01	0.1501685E 02	0.
21	-0.4291007E 01	0.1414557E 02	0.	22	-0.5399944E 01	0.1303663E 02	0.
23	-0.6271230E 01	0.1173266E 02	0.	24	-0.6871383E 01	0.1028376E 02	0.
25	-0.7177343E 01	0.8745575E 01	0.	26	-0.7177338E 01	0.7177346E 01	0.
27	-0.6871383E 01	0.5639205E 01	0.	28	-0.6271231E 01	0.4190308E 01	0.
29	-0.5399945E 01	0.2886336E 01	0.	30	-0.4291007E 01	0.1777399E 01	0.
31	-0.2987036E 01	0.9061122E 00	0.	32	-0.1538139E 01	0.3059595E-00	0.

***** DATA NAME- *6CYLTR *

POINT	X	Y	Z	POINT	X	Y	Z
1	0.8199959E 00	0.8325549E 01	0.1366034E 01	2	0.5259376E 00	0.5339926E 01	0.6562148E 01
3	0.5486780E 00	0.5570813E 01	0.1016023E 02	4	0.1407342E 01	0.8317863E 01	0.1394856E 01
5	0.1113283E 01	0.5332240E 01	0.6590970E 01	6	0.7444599E 00	0.5568251E 01	0.1016983E 02
7	0.1981902E 01	0.8409833E 01	0.1480217E 01	8	0.1687844E 01	0.5424211E 01	0.6676331E 01
9	0.9359802E 00	0.5593908E 01	0.1019829E 02	10	0.2521598E 01	0.8597926E 01	0.1618835E 01
11	0.2227539E 01	0.5612303E 01	0.6814949E 01	12	0.1115879E 01	0.5661605E 01	0.1024449E 02
13	0.3005688E 01	0.8874912E 01	0.1805383E 01	14	0.2711630E 01	0.5889290E 01	0.7001497E 01
15	0.1277242E 01	0.5753934E 01	0.1030668E 02	16	0.3415569E 01	0.9230148E 01	0.2032693E 01
17	0.3121511E 01	0.6244525E 01	0.7228807E 01	18	0.1413869E 01	0.5872346E 01	0.1038245E 02
19	0.3735490E 01	0.9649981E 01	0.2292029E 01	20	0.3441432E 01	0.6664359E 01	0.7488144E 01
21	0.1520509E 01	0.6012290E 01	0.1046889E 02	22	0.3953157E 01	0.1011828E 02	0.2573426E 01
23	0.3659099E 01	0.7132656E 01	0.7769540E 01	24	0.1593065E 01	0.6168390E 01	0.1056269E 02
25	0.4060204E 01	0.1061704E 02	0.2866068E 01	26	0.3766146E 01	0.7631421E 01	0.8062182E 01
27	0.1628747E 01	0.6334644E 01	0.1066024E 02	28	0.4052518E 01	0.1112711E 02	0.3158710E 01
29	0.3758460E 01	0.8141486E 01	0.8354824E 01	30	0.1626185E 01	0.6504666E 01	0.1075779E 02
31	0.3930394E 01	0.1162887E 02	0.3440106E 01	32	0.3636336E 01	0.8643250E 01	0.8636220E 01
33	0.1585477E 01	0.6671921E 01	0.1085158E 02	34	0.3698526E 01	0.1210305E 02	0.3699442E 01
35	0.3404467E 01	0.9117431E 01	0.8895556E 01	36	0.1508188E 01	0.6829981E 01	0.1093803E 02
37	0.3365823E 01	0.1253143E 02	0.3926752E 01	38	0.3071765E 01	0.9545804E 01	0.9122866E 01

FIGURE 29. Group D Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

39	0.1397287E 01	0.6972772E 01	0.1101380E 02	40	0.2945072E 01	0.1289753E 02	0.4113300E 01
41	0.2651014E 01	0.9911910E 01	0.9309414E 01	42	0.1257037E 01	0.7094807E 01	0.1107598E 02
43	0.2452442E 01	0.1318730E 02	0.4251918E 01	44	0.2158384E 01	0.1020168E 02	0.9448033E 01
45	0.1092827E 01	0.7191397E 01	0.1112219E 02	46	0.1906864E 01	0.1338959E 02	0.4337279E 01
47	0.1612806E 01	0.1040397E 02	0.9533393E 01	48	0.9109674E 00	0.7258828E 01	0.1115064E 02
49	0.1329305E 01	0.1349664E 02	0.4366102E 01	50	0.1035246E 01	0.1051102E 02	0.9562216E 01
51	0.7184476E 00	0.7294511E 01	0.1116025E 02	52	0.7419590E 00	0.1350433E 02	0.4337279E 01
53	0.4479007E-00	0.1051871E 02	0.9533393E 01	54	0.5226657E 00	0.7297072E 01	0.1115064E 02
55	0.1673985E-00	0.1341236E 02	0.4251919E 01	56	-0.1266598E-00	0.1042673E 02	0.9448033E 01
57	0.3311455E-00	0.7266416E 01	0.1112219E 02	58	-0.3722969E-00	0.1322426E 02	0.4113301E 01
59	-0.6663552E 00	0.1023864E 02	0.9309415E 01	60	0.1512471E-00	0.7203718E 01	0.1107598E 02
61	-0.8563868E 00	0.1294728E 02	0.3926752E 01	62	-0.1150445E 01	0.9961656E 01	0.9122866E 01
63	-0.1011620E-01	0.7111389E 01	0.1101380E 02	64	-0.1266268E 01	0.1259204E 02	0.3699442E 01
65	-0.1560326E 01	0.9606420E 01	0.8895556E 01	66	-0.1467433E-00	0.6992978E 01	0.1093803E 02
67	-0.1586189E 01	0.1217221E 02	0.3440106E 01	68	-0.1880247E 01	0.9186587E 01	0.8636220E 01
69	-0.2533836E-00	0.6853033E 01	0.1085159E 02	70	-0.1803856E 01	0.1170391E 02	0.3158710E 01
71	-0.2097914E 01	0.8718290E 01	0.8354824E 01	72	-0.3259391E-00	0.6696934E 01	0.1075779E 02
73	-0.1910903E 01	0.1120515E 02	0.2866068E 01	74	-0.2204961E 01	0.8219525E 01	0.8062182E 01
75	-0.3616215E-00	0.6530679E 01	0.1066024E 02	76	-0.1903217E 01	0.1069508E 02	0.2573426E 01
77	-0.2197275E 01	0.7709460E 01	0.7769540E 01	78	-0.3590595E-00	0.6360657E 01	0.1056269E 02
79	-0.1781093E 01	0.1019332E 02	0.2292030E 01	80	-0.2075151E 01	0.7207696E 01	0.7488144E 01
81	-0.3183516E-00	0.6193403E 01	0.1046889E 02	82	-0.1549224E 01	0.9719139E 01	0.2032694E 01
83	-0.1843283E 01	0.6733516E 01	0.7228808E 01	84	-0.2410621E-00	0.6035343E 01	0.1038245E 02
85	-0.1216522E 01	0.9290765E 01	0.1805384E 01	86	-0.1510580E 01	0.6305142E 01	0.7001498E 01
87	-0.1301613E-00	0.5892552E 01	0.1030668E 02	88	-0.7957713E 00	0.8924660E 01	0.1618836E 01
89	-0.1089830E 01	0.5939037E 01	0.6814950E 01	90	0.1008898E-01	0.5770516E 01	0.1024449E 02
91	-0.3031411E-00	0.8634892E 01	0.1480218E 01	92	-0.5971995E 00	0.5649269E 01	0.6676332E 01
93	0.1742990E-00	0.5673927E 01	0.1019829E 02	94	0.2424367E-00	0.8432598E 01	0.1394857E 01
95	-0.5162164E-01	0.5446975E 01	0.6590971E 01	96	0.3561585E-00	0.5606496E 01	0.1016984E 02

COORDINATES OF POINTS ON BOUNDARY OF SURF *3DISKC9TDSKC* FOR EACH Y INTERVAL

X-LEFT	X-RIGHT	Y	X-LEFT	X-RIGHT	Y
-0.	0.1568275E 01	-0.	-0.5167435E 01	0.6735716E 01	0.2653827E 01
-0.6734050E 01	0.8302329E 01	0.5307654E 01	-0.7177340E 01	0.8745615E 01	0.7961481E 01
-0.6734052E 01	0.8302330E 01	0.1061531E 02	-0.5167439E 01	0.6735717E 01	0.1326913E 02
0.	0.1568276E 01	0.1592296E 02			

NO. OF HORIZONTAL INCREMENTS= 6 NO. OF VERTICAL INCREMENTS= 6

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN

FIGURE 29. Group D Sample Problems Program Results

(continued)

Approved for Public Release

Contrails

LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.7089328E-01	0.7123186E-01	C.7153844E-01	0.7168752E-01	0.7167785E-01	0.7150958E-01
0.7118435E-01					
0.7330744E-01	0.9580904E-01	0.1160715E-00	0.1247633E-00	0.1170098E-00	0.9716405E-01
0.7425752E-01					
0.7488481E-01	0.1211815E-00	0.1816447E-00	0.2177063E-00	0.1844452E-00	0.1226295E-00
0.7561006E-01					
0.7790010E-01	0.1438289E-00	0.2610136E-00	0.3633965E-00	0.2776150E-00	0.1528916E-00
0.8151928E-01					
0.8439138E-01	0.1556327E-00	0.3057494E-00	0.5323031E 00	0.3692074E-00	0.1679985E-00
0.8973241E-01					
0.9451812E-01	0.1430074E-00	0.2374699E-00	0.3190749E-00	0.2706811E-00	0.1554582E-00
0.9966540E-01					
0.1122914E-00	0.1140692E-00	0.1155315E-00	0.1166523E-00	0.1171805E-00	0.1169966E-00
0.1161085E-00					

FIGURE 29. Group D Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (D)-K.A.TOUPS,11/1/63


RUN NO.    2    DATA USED FOR THIS RUN- *3DISKC*3DISKB*
                                        *9TDSKC*9TDSKB*
                                        *D     1*     1*

THE FORM FACTOR FROM SURFACE *3DISKC9TDSKC* TO SURFACE *3DISKB9TDSKB* = 0.09955

THE EXCHANGE COEFFICIENT (FA)=   0.19888E 02 SQ UNITS

                    THE MAPPING AREA = 0.1230458E 03 SQ UNITS


ONLY A PART OF SURFACE *3DISKC9TDSKC*, COMPRISING AN AREA OF  0.1314548E 03  SQ UNITS,
SEES SURFACE *3DISKB9TDSKB*

THE AREA OF SURFACE *3DISKC9TDSKC* = 0.1997725E 03 SQ UNITS.

THE AREA OF SURFACE *3DISKB9TDSKB* = 0.2809301E 02 SQ UNITS.

WARNING-WARNING
THE MAPPING AREA IS MORE THAN 1 PERCENT DIFFERENT FROM THE AREA IN SURFACE *3DISKC9TDSKC* SEEN BY
SURFACE *3DISKB9TDSKB*. THIS MAY BE CAUSED BY WRONG SURFACE DATA ENTRY (THE SURFACE BOUNDARY
CROSSES A MAPPING LINE IN MORE THAN TWO PLACES), OR TOO COARSE INCREMENTS.  THE FACTOR MAY BE INCORRECT.


THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *3DISKC9TDSKC*

POINT       X                Y                Z            POINT       X                Y               Z
        0.               0.               0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   -0.              -0.              -0.                   2    0.4591866E-00 -0.             0.
   3    0.1997284E 01   0.3059421E-00   0.                     4    0.3446224E 01  0.9061083E 00  0.
   5    0.4750197E 01   0.1777395E 01   0.                     6    0.5859134E 01  0.2886332E 01  0.
   7    0.6730421E 01   0.4190305E 01   0.                     8    0.7330573E 01  0.5639202E 01  0.
   9    0.7636528E 01   0.7177342E 01   0.                    10    0.7636528E 01  0.8745617E 01  0.
  11    0.7330573E 01   0.1028376E 02   0.                    12    0.6730421E 01  0.1173265E 02  0.
  13    0.5859134E 01   0.1303663E 02   0.                    14    0.4750197E 01  0.1414556E 02  0.
  15    0.3446224E 01   0.1501685E 02   0.                    16    0.1997328E 01  0.1561700E 02  0.
  17    0.4591879E-00   0.1592296E 02   0.                    18   -0.1109086E 01  0.1592296E 02  0.
```

FIGURE 29. Group D Sample Problems Program Results

(continued)

Approved for Public Release

```
 19  -0.2647270E 01  0.1561699E 02  0.              20  -0.4096123E 01  0.1501685E 02  0.
 21  -0.4477923E 01  0.1476174E 02  0.


***** DATA NAME- *3DISKB9TDSKB*

POINT       X              Y              Z              POINT     X              Y              Z
          0.5475978E 01  0.9721171E 01  0.3500083E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1      0.4997497E 01  0.9576025E 01  0.4366102E 01      2    0.5119621E 01  0.9001464E 01  0.4337279E 01
   3      0.5141509E 01  0.8420001E 01  0.4251918E 01      4    0.5062319E 01  0.7853981E 01  0.4113300E 01
   5      0.4885097E 01  0.7325155E 01  0.3926751E 01      6    0.4616650E 01  0.6853846E 01  0.3699441E 01
   7      0.4267297E 01  0.6458167E 01  0.3440105E 01      8    0.3850463E 01  0.6153322E 01  0.3158709E 01
   9      0.3382165E 01  0.5951028E 01  0.2866067E 01     10    0.2880401E 01  0.5859057E 01  0.2573425E 01
  11      0.2364453E 01  0.5880946E 01  0.2292029E 01     12    0.1854149E 01  0.6015851E 01  0.2032693E 01
  13      0.1369099E 01  0.6258589E 01  0.1805383E 01     14    0.9279441E 00  0.6599832E 01  0.1618834E 01
  15      0.5476367E 00  0.7026466E 01  0.1480216E 01     16    0.2427922E-00  0.7522096E 01  0.1394856E 01
  17      0.2512592E-01  0.8067674E 01  0.1366033E 01     18   -0.9699804E-01  0.8642235E 01  0.1394856E 01
  19     -0.1188859E-00  0.9223698E 01  0.1480217E 01     20   -0.3969675E-01  0.9789718E 01  0.1618835E 01
  21      0.1375262E-00  0.1031854E 02  0.1805384E 01     22    0.4059722E-00  0.1078985E 02  0.2032694E 01
  23      0.7553254E 00  0.1118553E 02  0.2292030E 01     24    0.1172160E 01  0.1149038E 02  0.2573426E 01
  25      0.1640457E 01  0.1169267E 02  0.2866068E 01     26    0.2142221E 01  0.1178464E 02  0.3158710E 01
  27      0.2658169E 01  0.1176275E 02  0.3440106E 01     28    0.3168473E 01  0.1162785E 02  0.3699442E 01
  29      0.3653523E 01  0.1138511E 02  0.3926752E 01     30    0.4094678E 01  0.1104387E 02  0.4113300E 01
  31      0.4474985E 01  0.1061723E 02  0.4251918E 01     32    0.4779829E 01  0.1012160E 02  0.4337278E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF    *3DISKC9TDSKC* FOR EACH Y INTERVAL

     X-LEFT          X-RIGHT          Y                     X-LEFT         X-RIGHT          Y

 -0.              0.4591866E-00 -0.                   -0.8050292E 00  0.5626628E 01  0.2653826E 01
 -0.1610058E 01   0.7193241E 01  0.5307652E 01        -0.2415088E 01  0.7636528E 01  0.7961479E 01
 -0.3220117E 01   0.7193242E 01  0.1061530E 02        -0.4025146E 01  0.5626629E 01  0.1326913E 02
 -0.1109086E 01   0.4591879E-00  0.1592296E 02

NO. OF HORIZONTAL INCREMENTS=  6  NO. OF VERTICAL INCREMENTS=  6

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

  0.4372625E-08   0.1230607E-03   0.2484966E-03   0.3762521E-03   0.5062687E-03   0.6384831E-03
```

FIGURE 29. Group D Sample Problems Program Results (continued)

Contrails

Approved for Public Release

Contrails

0.7728304E-03					
0.8819363E-08	0.6225217E-02	0.1501604E-01	0.2430970E-01	0.3101249E-01	0.3331677E-01
0.3168645E-01					
0.2201135E-07	0.3716788E-01	0.1266211E-00	0.1871291E-00	0.1659108E-00	0.1149264E-00
0.7174238E-01					
0.3764905E-07	0.1054514E-00	0.4651275E-00	0.5049026E 00	0.3690750E-00	0.2116433E-00
0.1064407E-00					
0.2193724E-07	0.4496273E-01	0.2592147E-00	0.4122213E-00	0.3477328E-00	0.2200246E-00
0.1171483E-00					
0.9041700E-08	0.9052752E-02	0.3587903E-01	0.8732407E-01	0.1281249E-00	0.1242457E-00
0.9358395E-01					
0.1067694E-01	0.1210962E-01	0.1363263E-01	0.1523643E-01	0.1690811E-01	0.1863135E-01
0.2038665E-01					

FIGURE 29. Group D Sample Problems Program Results (continued)

Approved for Public Release

Contrails

SAMPLE PROBLEM GROUP E

The capability of obtaining form factors to spheres in any position relative to Surface 1 is demonstrated, Figure 30. Closed form configuration factor solutions are utilized, enabling very rapid computations. The data sheets are presented in Figure 31 and the results in Figure 32.

Problem 1E

The factor from a rectangle, 1PLAT8, to a sphere, 7SPH1, fully above the plane of 1PLAT8 (Case I) is requested as Run #1. The configuration factor solution in this case is extremely simple (see Appendix E), which, in addition to the coarse mapping of 1PLAT8, accounts for the short computational time.

Problem 2E

The factor from 1PLAT8 to 7SPH2 is requested. The sphere is the same size as 7SPH1, except part of the lower half of the sphere is below, and outside of, the surface of 1PLAT8 (Case II). The results are shown as Run #2.

Problem 3E

A larger sphere, 7SPH3, is located with part of the upper half of the sphere below the surface of 1PLAT8 (Case III). The results are shown as Run #3.

Problem 4E

The program will also compute the factor to a sphere which is embedded in Surface 1, illustrated by 7SPH2 and 1PLAT7. However, no attempt is made to determine what part of 1PLAT7 sees the sphere; when a mapping point on Surface 1 appears inside the sphere, a configuration factor of zero is returned and integrated along with the other computed factors. Therefore, in Run #4 we see no indication that 1PLAT7 is bisected by 7SPH2, although in reality it is. The problem is handled in this way because of the extreme complexity of the general determination of that part of Surface 1 not seen by the sphere.

Problem 5E

The trivial case of the sphere completely below Surface 1 is illustrated by Run #5.

Approved for Public Release

Contrails

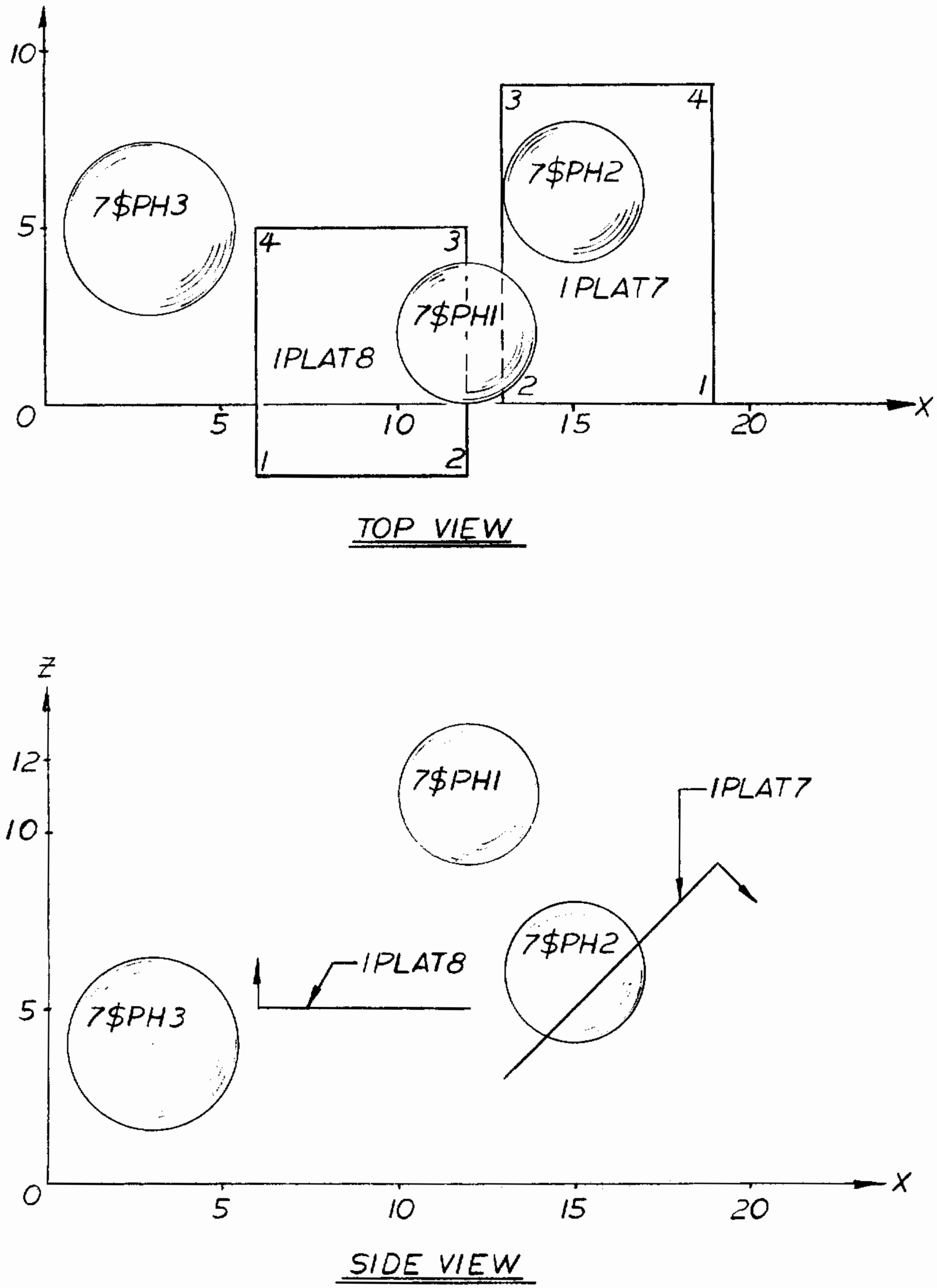

FIGURE 30. Group E Sample Problems Geometry

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 22 of 36 JOB NO. 2929-30

Col.	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	T	NAA CØNFAC		
13	I	I REPØRT ØA		
25	M	PLE PRØBLEM		
37	Ø	FRØM FIG.		
49		(E)-X.A.TØU	73 80	
61	P	Ø, 11/1/63	E010	
1	1	PLAT7		
13	Ø	KEWED RECTA		
25	N	GULAR PLATE		
37		IN 1ØT QUAD		
49	R	ANT	73 80	
61			E020	
1	4	.0		
13	1	9.0		
25	0	.0		
37	9	.0		
49	1	3.0	73 80	
61	0	.0	E030	
1	3	.0		
13	1	3.0		
25	9	.0		
37	3	.0		
49	1	9.0	73 80	
61	9	.0	E040	

FORM 114-C-17 REV. 7-56-VELLUM

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 23 of 36 JOB NO. 2929-30

Col.	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	9	.0		
13				
25				
37				
49			73 80	
61			E050	
1	1	PLAT8		
13	R	ECT PLATE P		
25	A	RALLEL TØ X		
37	Y	PLANE, 1ØT		
49		AND 4TH QUA	73 80	
61	D	RANTØ	E060	
1	4	.0		
13	6	.0		
25	-	2.0		
37	5	.0		
49	1	2.0	73 80	
61	-	2.0	E070	
1	5	.0		
13	1	2.0		
25	5	.0		
37	5	.0		
49	6	.0	73 80	
61	5	.0	E080	

FORM 114-C-17 REV. 7-56-VELLUM

FIGURE 31. Group E Sample Problems Input Data Code Sheets

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 24 of 36 JOB NO. 2929-30

Col.	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	5	. 0		
13				
25				
37				
49				
61			E 0 9 0	
1	7	$ P H 1		
13	2	U N I T R A D I O		
25	$	F U L L Y S E E N		
37		B Y 1 P L A T 8 , N		
49	Ø	T $ E E N B Y 1		
61	P	L A T 7 (C A S E I)	E 1 0 0	
1	2	. 0		
13	1	2 . 0		
25	2	. 0		
37	1	1 . 0		
49				
61			E 1 1 0	
1	7	$ P H 2		
13	2	U N I T $ P H E R		
25	E	P A R T L Y $ E E		
37	N	B Y 1 P L A T 7		
49	A	N D 1 P L A T 8 (C		
61	A	$ E I I)	E 1 2 0	

FORM 114-C-17 REV. 7-59-VELLUM

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 25 of 36 JOB NO. 2929-30

Col.	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	2	. 0		
13	1	5 . 0		
25	6	. 0		
37	6	. 0		
49				
61			E 1 3 0	
1	7	$ P H 3		
13	2	. 5 U N I T $ P H		
25	E	R E P A R T L Y $		
37	E	E N B Y 1 P L A T		
49	8	(C A $ E I I I)		
61			E 1 4 0	
1	2	. 5		
13	3	. 0		
25	5	. 0		
37	4	. 0		
49				
61			E 1 5 0	
1	1	P L A T 8 7 $ P H 1		
13				
25	D	1 1		
37	1	P L A T 8 7 $ P H 2		
49				
61	D	1 1	E 1 6 0	

FORM 114-C-17 REV. 7-59-VELLUM

FIGURE 31. Group E Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 26 of 36 JOB NO. 2929-30

Col.		NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	1	PLAT87Ø PH3		
13				
25	D	1 1		
37	1	PLAT77Ø PH2		
49			73 80	
61	D	3 3	E170	
1	1	PLAT77Ø PH1		
13				
25				
37				
49			73 80	
61			E180	
1				
13				
25				
37				
49			73 80	
61				
1				
13				
25				
37				
49			73 80	
61				

FORM 114-C-17 REV. 7-56 - VELLUM

FIGURE 31. Group E Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

Contrails

```
                    NAA SPACE AND INFORMATION SYSTEMS DIVISION
          T+A PROJECT RADIANT-INTERCHANGE CONFIGURATION FACTOR PROGRAM

                                 C O N F A C   I I

        NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.   (E)-K.A.TOUPS,11/1/63

                                 I N P U T   D A T A


***** DATA NAME- *1PLAT7        * SKEWED RECTANGULAR PLATE IN 1ST QUADRANT.

POINT        X                Y                Z             POINT        X             Y                Z
         0.1970711E 02  0.               0.8292893E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1     0.1900000E 02  0.               0.9000000E 01        2     0.1300000E 02  0.               0.3000000E 01
   3     0.1300000E 02  0.9000000E 01    0.3000000E 01        4     0.1900000E 02  0.9000000E 01    0.9000000E 0.


***** DATA NAME- *1PLAT8        * RECT PLATE PARALLEL TO XY PLANE, 1ST AND 4TH QUADRANTS.

POINT        X                Y                Z             POINT        X             Y                Z
         0.6000000E 01 -0.2000000E 01    0.6000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1     0.6000000E 01 -0.2000000E 01    0.5000000E 01        2     0.1200000E 02 -0.2000000E 01    0.5000000E 0.
   3     0.1200000E 02  0.5000000E 01    0.5000000E 01        4     0.6000000E 01  0.5000000E 01    0.5000000E 01


***** DATA NAME- *7SPH1         * 2 UNIT RADIUS FULLY SEEN BY 1PLAT8,NOT SEEN BY 1PLAT7(CASEI)

SPHERE SPECIFICATIONS-

RADIUS = 0.2000000E 01
COORDINATES OF CENTER---- X = 0.1200000E 02      Y = 0.2000000E 01      Z = 0.1100000E 02


***** DATA NAME- *7SPH2         * 2 UNIT SPHERE PARTLY SEEN BY 1PLAT7 AND 1PLAT8(CASE II)

SPHERE SPECIFICATIONS-

RADIUS = 0.2000000E 01
COORDINATES OF CENTER---- X = 0.1500000E 02      Y = 0.6000000E 01      Z = 0.6000000E 01
```

FIGURE 32. Group E Sample Problems Program Results (13 pages)

Approved for Public Release

Contrails

```
***** DATA NAME- *7SPH3        * 2.5 UNIT SPHERE PARTLY SEEN BY 1PLATB(CASE III)

SPHERE SPECIFICATIONS-

RADIUS = 0.25000000E 01
COORDINATES OF CENTER---- X = 0.30000000E 01     Y = 0.50000000E 01     Z = 0.40000000E 01
```

FIGURE 32. Group E Sample Problems Program Results
(continued)

Approved for Public Release

```
                    NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (E)-K.A.TOUPS,11/1/63

RUN NO.    1    DATA USED FOR THIS RUN- *1PLAT8*7SPH1 *
                                        *       *      *
                                        *D     1*     1*

TOTAL TIME IN SILFAC =     0.021 SECONDS.

THE FORM FACTOR FROM SURFACE *1PLAT8      * TO SURFACE *7SPH1       * = 0.06859

THE EXCHANGE COEFFICIENT (FA)=   0.28807E 01 SQ UNITS

                  THE MAPPING AREA = 0.4200000E 02 SQ UNITS

THE AREA OF SURFACE *1PLAT8       * = 0.4200000E 02 SQ UNITS.

THE AREA OF SURFACE *7SPH1        * = 0.5026548E 02 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *1PLAT8       *

POINT       X              Y                Z            POINT       X              Y              Z
       0.              -0.              0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.              -0.              0.                 2    0.6000000E 01 -0.              0.
   3   0.6000000E 01  0.7000000E 01    0.                 4    0.              0.7000000E 01  0.


***** DATA NAME- *7SPH1        *

POINT       X              Y                Z            POINT       X              Y              Z
   1   0.6000000E 01  0.4000000E 01  0.6000000E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1PLAT8      * FOR EACH Y INTERVAL

      X-LEFT          X-RIGHT          Y                      X-LEFT         X-RIGHT          Y

  0.              0.6000000E 01 -0.                      0.             0.6000000E 01  0.1166667E 01
```

FIGURE 32. Group E Sample Problems Program Results (continued)

Approved for Public Release

Contrails

```
0.              0.6000000E 01  0.2333333E 01        0.          0.6000000E 01  0.3500000E 01
0.              0.6000000E 01  0.4666667E 01        0.          0.6000000E 01  0.5833333E 01
0.              0.6000000E 01  0.7000000E 01

NO. OF HORIZONTAL INCREMENTS=  6  NO. OF VERTICAL INCREMENTS=  6

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

 0.2907282E-01   0.3552018E-01   0.4280040E-01   0.5037517E-01   0.5727027E-01   0.6220101E-01
 0.6400387E-01
 0.3352356E-01   0.4184807E-01   0.5160394E-01   0.6215214E-01   0.7210618E-01   0.7943108E-01
 0.8215256E-01
 0.3711525E-01   0.4712020E-01   0.5919767E-01   0.7267287E-01   0.8577958E-01   0.9566443E-01
 0.9938867E-01
 0.3907999E-01   0.5006706E-01   0.6354506E-01   0.7884667E-01   0.9398584E-01   0.1055655E-00
 0.1099637E-00
 0.3892276E-01   0.4982959E-01   0.6319199E-01   0.7834117E-01   0.9330887E-01   0.1047442E-00
 0.1090848E-00
 0.3668515E-01   0.4648105E-01   0.5826450E-01   0.7136197E-01   0.8405444E-01   0.9359800E-01
 0.9718746E-01
 0.3292181E-01   0.4097927E-01   0.5037517E-01   0.6048123E-01   0.6997084E-01   0.7692624E-01
 0.7950464E-01
```

FIGURE 32. Group E Sample Problems Program Results (continued)

Approved for Public Release

Contrails

Contrails

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (E)-K.A.TOUPS,11/1/63

RUN NO.    2   DATA USED FOR THIS RUN- *1PLAT8*7SPH2 *
                                       *       *      *
                                       *D     1*     1*

TOTAL TIME IN SILFAC =     0.058 SECONDS.

THE FORM FACTOR FROM SURFACE *1PLAT8       * TO SURFACE *7SPH2        * = 0.01426

THE EXCHANGE COEFFICIENT (FA)=    0.59895E 00 SQ UNITS

                  THE MAPPING AREA = 0.4200000E 02 SQ UNITS

THE AREA OF SURFACE *1PLAT8       * = 0.4200000E 02 SQ UNITS.

ONLY A PART OF SURFACE *7SPH2        *, COMPRISING AN AREA OF  0.3769911E 02  SQ UNITS,
SEES SURFACE *1PLAT8       *

THE AREA OF SURFACE *7SPH2        * = 0.5026548E 02 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

***** DATA NAME- *1PLAT8       *

POINT       X              Y              Z              POINT       X              Y              Z
       0.             -0.            0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.             -0.            0.                     2   0.6000000E 01 -0.              0.
   3   0.6000000E 01  0.7000000E 01  0.                     4   0.             0.7000000E 01   0.

***** DATA NAME- *7SPH2        *

POINT       X              Y              Z              POINT       X              Y              Z
   1   0.9000000E 01  0.8000000E 01  0.1000000E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1PLAT8      * FOR EACH Y INTERVAL
```

FIGURE 32. Group E Sample Problems Program Results
(continued)

Approved for Public Release

```
   X-LEFT           X-RIGHT            Y                          X-LEFT          X-RIGHT            Y

  0.               0.6000000E 01 -0.                             0.              0.6000000E 01  0.1166667E 01
  0.               0.6000000E 01  0.2333333E 01                  0.              0.6000000E 01  0.3500000E 01
  0.               0.6000000E 01  0.4666667E 01                  0.              0.6000000E 01  0.5833333E 01
  0.               0.6000000E 01  0.7000000E 01

 NO. OF HORIZONTAL INCREMENTS=  6  NO. OF VERTICAL INCREMENTS=  6

 THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
 LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

  0.2456234E-02   0.2950068E-02   0.3561573E-02   0.4272042E-02   0.5080212E-02   0.5951812E-02
  0.6817956E-02
  0.2968622E-02   0.3672576E-02   0.4561014E-02   0.5666165E-02   0.7002876E-02   0.8542521E-02
  0.1017746E-01
  0.3556385E-02   0.4532651E-02   0.5831172E-02   0.7555847E-02   0.9806508E-02   0.1263230E-01
  0.1592354E-01
  0.4193321E-02   0.5511498E-02   0.7372421E-02   0.1002924E-01   0.1382694E-01   0.1915586E-01
  0.2622034E-01
  0.4827291E-02   0.6535658E-02   0.9091390E-02   0.1302962E-01   0.1926402E-01   0.2928970E-01
  0.4516103E-01
  0.5374063E-02   0.7460952E-02   0.1074253E-01   0.1616383E-01   0.2564950E-01   0.4333516E-01
  0.7829274E-01
  0.5737564E-02   0.8097716E-02   0.1193474E-01   0.1858892E-01   0.3112908E-01   0.5750824E-01
  0.1219322E-00
```

FIGURE 32. Group E Sample Problems Program Results (continued)

Approved for Public Release

Contrails

Contrails

```
                    NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (E)-K.A.TOUPS,11/1/63

RUN NO.    3   DATA USED FOR THIS RUN- *1PLAT8*7SPH3 *
                                       *      *      *
                                       *D     1*     1*

TOTAL TIME IN SILFAC =     0.058 SECONDS.

THE FORM FACTOR FROM SURFACE *1PLAT8      * TO SURFACE *7SPH3      * = 0.00502

THE EXCHANGE COEFFICIENT (FA)=   0.21089E-00 SQ UNITS

                 THE MAPPING AREA = 0.4200000E 02 SQ UNITS

THE AREA OF SURFACE *1PLAT8      * = 0.4200000E 02 SQ UNITS.

ONLY A PART OF SURFACE *7SPH3       *, COMPRISING AN AREA OF  0.2356194E 02  SQ UNITS,
SEES SURFACE *1PLAT8      *

THE AREA OF SURFACE *7SPH3       * = 0.7853982E 02 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *1PLAT8       *

POINT       X              Y              Z            POINT      X              Y              Z
       0.             -0.             0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.             -0.             0.                  2   0.6000000E 01 -0.             0.
   3   0.6000000E 01  0.7000000E 01  0.                  4   0.              0.7000000E 01  0.


***** DATA NAME- *7SPH3        *

POINT       X              Y              Z            POINT      X              Y              Z
   1  -0.3000000E 01  0.7000000E 01 -0.1000000E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1PLAT8      * FOR EACH Y INTERVAL
```

FIGURE 32. Group E Sample Problems Program Results (continued)

Approved for Public Release

X-LEFT	X-RIGHT	Y
0.	0.6000000E 01	-0.
0.	0.6000000E 01	0.2333333E 01
0.	0.6000000E 01	0.4666667E 01
0.	0.6000000E 01	0.7000000E 01

X-LEFT	X-RIGHT	Y
0.	0.6000000E 01	0.1166667E 01
0.	0.6000000E 01	0.3500000E 01
0.	0.6000000E 01	0.5833333E 01

NO. OF HORIZONTAL INCREMENTS= 6 NO. OF VERTICAL INCREMENTS= 6

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.2314553E-02	0.1940820E-02	0.1589493E-02	0.1284948E-02	0.1033530E-02	0.8316651E-03
0.6718784E-03					
0.3684484E-02	0.2911745E-02	0.2252464E-02	0.1730292E-02	0.1332033E-02	0.1033080E-02
0.8094284E-03					
0.6257713E-02	0.4520665E-02	0.3233144E-02	0.2328352E-02	0.1702152E-02	0.1267144E-02
0.9610705E-03					
0.1141011E-01	0.7178652E-02	0.4622137E-02	0.3080579E-02	0.2127342E-02	0.1517988E-02
0.1115075E-02					
0.2194706E-01	0.1123993E-01	0.6367547E-02	0.3907600E-02	0.2553004E-02	0.1752717E-02
0.1252203E-02					
0.4018943E-01	0.1599525E-01	0.8025666E-02	0.4600457E-02	0.2881809E-02	0.1924313E-02
0.1348592E-02					
0.5302282E-01	0.1838423E-01	0.8745356E-02	0.4878217E-02	0.3007416E-02	0.1987817E-02
0.1383506E-02					

FIGURE 32. Group E Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (E)-K.A.TOUPS,11/1/63

RUN NO.   4   DATA USED FOR THIS RUN- *1PLAT7*7SPH2 *
                                      *      *      *
                                      *D    3*     3*

TOTAL TIME IN SILFAC =    0.393 SECONDS.

THE FORM FACTOR FROM SURFACE *1PLAT7      * TO SURFACE *7SPH2       * = 0.02446

THE EXCHANGE COEFFICIENT (FA)=   0.18682E 01 SQ UNITS

                 THE MAPPING AREA = 0.7636752E 02 SQ UNITS

THE AREA OF SURFACE *1PLAT7      * = 0.7636753E 02 SQ UNITS.

ONLY A PART OF SURFACE *7SPH2       *, COMPRISING AN AREA OF  0.1624699E 02  SQ UNITS,
SEES SURFACE *1PLAT7      *

THE AREA OF SURFACE *7SPH2       * = 0.5026548E 02 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

***** DATA NAME- *1PLAT7      *

POINT       X              Y              Z             POINT       X             Y             Z
         0.             -0.            0.9999998E 00---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1    -0.             -0.            0.                 2    0.8485281E 01 -0.              0.
   3     0.8485281E 01  0.8999999E 01  0.                 4   -0.             0.8999999E 01  0.

***** DATA NAME- *7SPH2       *
                *
POINT       X              Y              Z             POINT       X             Y             Z
   1     0.4949747E 01  0.5999999E 01 -0.7071059E 00

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1PLAT7      * FOR EACH Y INTERVAL
```

FIGURE 32. Group E Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

X-LEFT	X-RIGHT	Y	X-LEFT	X-RIGHT	Y
-0.	0.8485281E 01	-0.	-0.	0.8485281E 01	0.4999999E-00
-0.	0.8485281E 01	0.9999999E 00	-0.	0.8485281E 01	0.1500000E 01
-0.	0.8485281E 01	0.2000000E 01	-0.	0.8485281E 01	0.2500000E 01
-0.	0.8485281E 01	0.3000000E 01	-0.	0.8485281E 01	0.3500000E 01
-0.	0.8485281E 01	0.3999999E 01	-0.	0.8485281E 01	0.4499999E 01
-0.	0.8485281E 01	0.4999999E 01	-0.	0.8485281E 01	0.5499999E 01
-0.	0.8485281E 01	0.5999999E 01	-0.	0.8485281E 01	0.6499999E 01
-0.	0.8485281E 01	0.6999999E 01	-0.	0.8485281E 01	0.7499999E 01
-0.	0.8485281E 01	0.7999999E 01	-0.	0.8485281E 01	0.8499999E 01
-0.	0.8485281E 01	0.8999999E 01			

NO. OF HORIZONTAL INCREMENTS= 18 NO. OF VERTICAL INCREMENTS= 18

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.1308355E-02	0.1470404E-02	0.1647086E-02	0.1836072E-02	0.2033176E-02	0.2231959E-02
0.2423748E-02	0.2597862E-02	0.2742621E-02	0.2846771E-02	0.2901346E-02	0.2901346E-02
0.2846772E-02	0.2742615E-02	0.2597864E-02	0.2423741E-02	0.2231960E-02	0.2033179E-02
0.1836075E-02					
0.1524456E-02	0.1735840E-02	0.1971554E-02	0.2229726E-02	0.2505566E-02	0.2790641E-02
0.3072187E-02	0.3333397E-02	0.3554614E-02	0.3716081E-02	0.3801467E-02	0.3801467E-02
0.3716082E-02	0.3554617E-02	0.3333392E-02	0.3072189E-02	0.2790637E-02	0.2505567E-02
0.2229727E-02					
0.1779403E-02	0.2056375E-02	0.2373291E-02	0.2730052E-02	0.3122420E-02	0.3540086E-02
0.3964804E-02	0.4369793E-02	0.4721113E-02	0.4982401E-02	0.5122234E-02	0.5122234E-02
0.4982404E-02	0.4721113E-02	0.4369794E-02	0.3964806E-02	0.3540081E-02	0.3122423E-02
0.2730054E-02					
0.2078034E-02	0.2441828E-02	0.2870431E-02	0.3368645E-02	0.3935816E-02	0.4561811E-02
0.5222208E-02	0.5874573E-02	0.6458710E-02	0.6904292E-02	0.7146710E-02	0.7146712E-02
0.6904294E-02	0.6458712E-02	0.5874577E-02	0.5222205E-02	0.4561816E-02	0.3935819E-02
0.3368639E-02					
0.2423745E-02	0.2901350E-02	0.3482915E-02	0.4184489E-02	0.5016751E-02	0.5977219E-02
0.7038927E-02	0.8137702E-02	0.9164832E-02	0.9976504E-02	0.1042856E-01	0.1042856E-01
0.9976506E-02	0.9164833E-02	0.8137706E-02	0.7038932E-02	0.5977218E-02	0.5016749E-02
0.4184494E-02					
0.2816825E-02	0.3441045E-02	0.4229578E-02	0.5222205E-02	0.6458713E-02	0.7966446E-02
0.9736420E-02	0.1168656E-01	0.1362316E-01	0.1523465E-01	0.1616434E-01	0.1616434E-01

FIGURE 32. Group E Sample Problems Program Results
(continued)

Contrails

Approved for Public Release

0.1523465E-01	0.1362316E-01	0.1168656E-01	0.9736420E-02	0.7966444E-02	0.6458712E-02
0.5222208E-02					
0.3252088E-02	0.4060008E-02	0.5122229E-02	0.6525123E-02	0.8375808E-02	0.1079056E-01
0.1385566E-01	0.1753749E-01	0.2153340E-01	0.2513747E-01	0.2734019E-01	0.2734019E-01
0.2513747E-01	0.2153340E-01	0.1753748E-01	0.1385566E-01	0.1079056E-01	0.8375805E-02
0.6525122E-02					
0.3716081E-02	0.4744630E-02	0.6155096E-02	0.8118366E-02	0.1088436E-01	0.1480288E-01
0.2031023E-01	0.2778961E-01	0.3712062E-01	0.4680520E-01	0.5341565E-01	0.5341564E-01
0.4680519E-01	0.3712062E-01	0.2778960E-01	0.2031023E-01	0.1480287E-01	0.1088436E-01
0.8118366E-02					
0.4184495E-02	0.5461945E-02	0.7289385E-02	0.9976505E-02	0.1404648E-01	0.2040014E-01
0.3059037E-01	0.4717633E-01	0.7366529E-01	0.1116398E-00	0.1485900E-00	0.1485900E-00
0.1116397E-00	0.7366526E-01	0.4717632E-01	0.3059036E-01	0.2040013E-01	0.1404648E-01
0.9976504E-02					
0.4621429E-02	0.6155093E-02	0.8437162E-02	0.1197619E-01	0.1774963E-01	0.2778961E-01
0.4680519E-01	0.8795447E-01	0.2232282E-00	0.	0.	0.
0.	0.2232279E-00	0.8795443E-01	0.4680517E-01	0.2778959E-01	0.1774962E-01
0.1197619E-01					
0.4982398E-02	0.6745478E-02	0.9455832E-02	0.1385566E-01	0.2153339E-01	0.3638891E-01
0.7053792E-01	0.2009126E-00	0.	0.	0.	0.
0.	0.	0.2009124E-00	0.7053788E-01	0.3638890E-01	0.2153339E-01
0.1385565E-01					
0.5222204E-02	0.7146706E-02	0.1017017E-01	0.1523465E-01	0.2450979E-01	0.4400776E-01
0.9780608E-01	0.	0.	0.	0.	0.
0.	0.	0.	0.9780600E-01	0.4400774E-01	0.2450979E-01
0.1523465E-01					
0.5306457E-02	0.7289383E-02	0.1042856E-01	0.1574621E-01	0.2565938E-01	0.4717633E-01
0.1116397E-00	0.	0.	0.	0.	0.
0.	0.	0.	0.1116396E-00	0.4717630E-01	0.2565937E-01
0.1574621E-01					
0.5222204E-02	0.7146706E-02	0.1017017E-01	0.1523465E-01	0.2450979E-01	0.4400776E-01
0.9780608E-01	0.	0.	0.	0.	0.
0.	0.	0.	0.9780600E-01	0.4400774E-01	0.2450979E-01
0.1523465E-01					
0.4982398E-02	0.6745478E-02	0.9455832E-02	0.1385566E-01	0.2153339E-01	0.3638891E-01
0.7053792E-01	0.2009126E-00	0.	0.	0.	0.
0.	0.	0.2009124E-00	0.7053788E-01	0.3638890E-01	0.2153339E-01
0.1385565E-01					
0.4621429E-02	0.6155093E-02	0.8437162E-02	0.1197619E-01	0.1774963E-01	0.2778961E-01
0.4680519E-01	0.8795447E-01	0.2232282E-00	0.	0.	0.
0.	0.2232279E-00	0.8795443E-01	0.4680517E-01	0.2778959E-01	0.1774962E-01
0.1197619E-01					
0.4184495E-02	0.5461945E-02	0.7289385E-02	0.9976505E-02	0.1404648E-01	0.2040014E-01
0.3059037E-01	0.4717633E-01	0.7366529E-01	0.1116398E-00	0.1485900E-00	0.1485900E-00

FIGURE 32. Group E Sample Problems Program Results (continued)

Approved for Public Release

Contrails

0.1116397E-00	0.7366526E-01	0.4717632E-01	0.3059036E-01	0.2040013E-01	0.1404648E-01
0.9976504E-02					
0.3716081E-02	0.4744630E-02	0.6155096E-02	0.8118366E-02	0.1088436E-01	0.1480288E-01
0.2031024E-01	0.2778961E-01	0.3712063E-01	0.4680520E-01	0.5341565E-01	0.5341565E-01
0.4680519E-01	0.3712062E-01	0.2778960E-01	0.2031023E-01	0.1480287E-01	0.1088436E-01
0.8118366E-02					
0.3252088E-02	0.4060008E-02	0.5122229E-02	0.6525123E-02	0.8375808E-02	0.1079056E-01
0.1385566E-01	0.1753749E-01	0.2153340E-01	0.2513747E-01	0.2734019E-01	0.2734019E-01
0.2513747E-01	0.2153340E-01	0.1753748E-01	0.1385566E-01	0.1079056E-01	0.8375805E-02
0.6525122E-02					

Figure 32. Group E Sample Problems Program Results (continued)

Approved for Public Release

Contrails

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (E)-K.A.TOUPS,11/1/63


RUN NO.    5   DATA USED FOR THIS RUN- *1PLAT7*7SPH1 *
                                       *      *      *
                                       *      *      *


NONE OF SURFACE *1PLAT7       * IS SEEN BY SURFACE *7SPH1       *

IF THE ABOVE RESULT IS UNEXPECTED, DO NOT BECOME ALARMED- IT HAPPENS TO THE BEST OF EM. JUST CHECK YOUR
DATA-ESPECIALLY BE SURE THAT YOU ENTERED ALL POINTS IN COUNTERCLOCKWISE ORDER, AS THEY APPEAR WHEN
FACING THE ACTIVE SIDE OF THE SURFACE, AND DERIVED FROM A RIGHT-HANDED COORDINATE SYSTEM.
```

Figure 32. Group E Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

SAMPLE PROBLEM GROUP F

The capability of computing factors to surfaces which are occluded by intervening surfaces is demonstrated as shown in Figure 33. The data sheets are presented in Figure 34 and the results in Figure 35.

Problem 1F

The factor from 1PLA10 to 1PLA9 is desired with surface 1PLA11 intervening. The surface 5COPLA, representing the boundary points of 1PLA9 including connections, and the boundary points of 1PLA11 including connections is entered in data. Because the silhouette is complex, the surface 5COPLA must be reentered as 8COPLA to enable the silhouette generator to operate in the complex mode. The factor to 8COPLA from 1PLA10 is requrested as Run #1. Then, the factor from 1PLA10 to 1PLA11 is requested as Run #2. The factor from 1PLA10 to 1PLA9 is merely the difference between the two,

$$f = 0.26787 - 0.20146$$

$$f = 0.06641$$

Problem 2F

This problem also illustrates the capability of determining factors to occluded surfaces, but data is entered and handled in a different manner. The factor from 1PLA10 to 6PIPE2 is desired, taking into account the flux intercepted by 5PIPE1.

The coordinates defining 6PIPE2 are internally generated. 5PIPE1 is entered manually, and the two surfaces are combined for complex processing as 820FEM.

Notice that 5PIPE1 includes a line segment--a "bridge" line--connecting point 7 in 5PIPE1 to 6PIPE2. If this line or any other suitably oriented line serving the purpose were not present, then the silhouette generator would not include 6PIPE2 in any of the silhouettes computed from points on mapping lines 6 and 7 on 1PLA10. The line does not have to actually be in any surface--it need only appear to intersect both surfaces <u>in the silhouette</u>.

The form factor to 820FEM is 0.28139 (Run #3); to 5PIPE1 alone is 0.21556 (Run #4); therefore, the form factor to 6PIPE2 is the difference or 0.06583.

Problem 3F

This problem illustrates improper use of the program, and in particular, the silhouette generator. The factor form 1PLA12 to 5COPLA is requested as Run #5. Note that the data 5COPLA is in reality two surfaces. These surfaces when viewed from 1PLA10 or 1PLA12 present a complex silhouette, and therefore, must be processed in the complex mode. However, when a class 4, 5 or 6 surface is specified as Surface 2, the simple mode is always used. The

Approved for Public Release

Contrails

silhouette generator consequently saw only 1PLA11 sometimes and only 1PLA9 sometimes; this condition would not be relieved by use of a bridge line, because the total silhouette is complex, and must be processed as complex.

Problem 4F

When a class 8 surface is used as Surface 2, Surface 1 must be in the XY plane of the Surface 2 coordinate system, with its orientation vector pointing toward the +Z axis. The results of Run #6 show the diagnostic resulting from a request for the factor from 1PLA12 to 8COPLA.

Approved for Public Release

Contrails

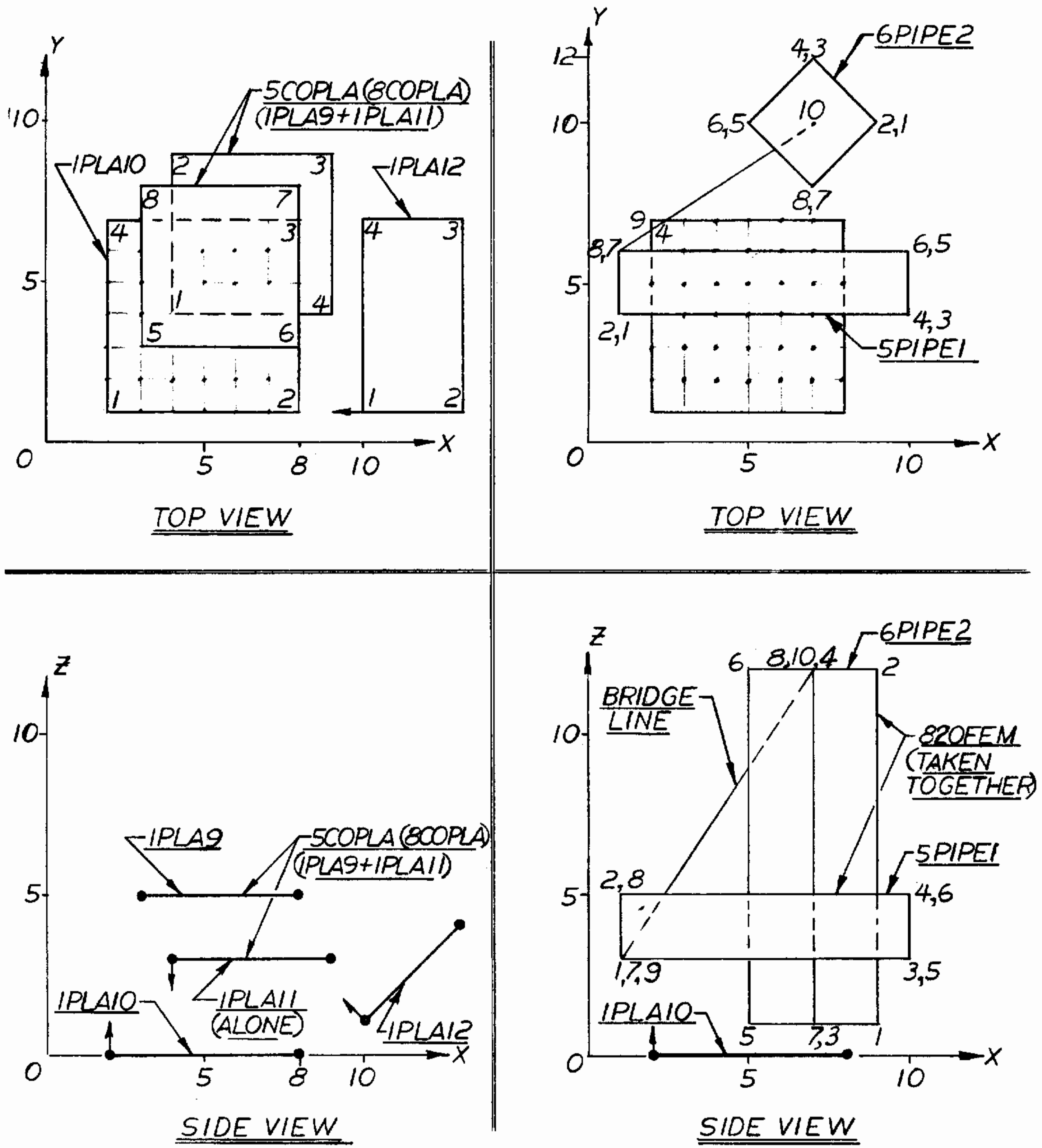

FIGURE 33. Group F Sample Problems Geometry

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 27 of 36 JOB NO. 2929-30

Col.	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	T	NAA CØNFAC		
13	I	I REPØRT ØA		
25	M	PLE PRØBLEM		
37	Ø	FRØM FIG.		
49		-K.A.TØU	73 80	
61	P	Ø, 11/1/63	F010	
1	1	PLA10		
13	6	x 6 PLATE IN		
25		XY PLANE		
37				
49			73 80	
61			F020	
1	4	.0		
13	2	.0		
25	1	.0		
37	0	.0		
49	8	.0	73 80	
61	1	.0	F030	
1	0	.0		
13	8	.0		
25	7	.0		
37	0	.0		
49	2	.0	73 80	
61	7	.0	F040	

FORM 114-C-17 REV. 7-58-VELLUM

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 28 of 36 JOB NO. 2929-30

Col.	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	0	.0		
13				
25				
37				
49			73 80	
61			F050	
1	1	PLA11		
13	5	x 5 ØQUARE, Z		
25	=	3, LØØKING A		
37	T	1PLA10		
49			73 80	
61			F060	
1	4	.0		
13	4	.0		
25	4	.0		
37	3	.0		
49	4	.0	73 80	
61	9	.0	F070	
1	3	.0		
13	9	.0		
25	9	.0		
37	3	.0		
49	9	.0	73 80	
61	4	.0	F080	

FORM 114-C-17 REV. 7-58-VELLUM

Figure 34. Group F Sample Problems Input Data Code Sheets

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 29 of 36 JOB NO. 2929-30

	NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	3 . 0		
13			
25			
37			
49		73 80	
61		F 0 9 0	
1	5 C Ø P L A		
13	1 P L A 1 1 C Ø M B I		
25	N E D W I T H 1 P L		
37	A 9		
49		73 80	
61		F 1 0 0	
1	8 . 0		
13	4 . 0		
25	4 . 0		
37	3 . 0		
49	2 4	73 80	
61	4 . 0	F 1 1 0	
1	9 . 0		
13	3 . 0		
25	1 3		
37	9 . 0		
49	9 . 0	73 80	
61	3 . 0	F 1 2 0	

FORM 114-C-17 REV. 7-59 VELLUM

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 30 of 36 JOB NO. 2929-30

	NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	2 4		
13	9 . 0		
25	4 . 0		
37	3 . 0		
49	1 3	73 80	
61	3 . 0	F 1 3 0	
1	3 . 0		
13	5 . 0		
25	6 8		
37	8 . 0		
49	3 . 0	73 80	
61	5 . 0	F 1 4 0	
1	5 7		
13	8 . 0		
25	8 . 0		
37	5 . 0		
49	6 8	73 80	
61	3 . D	F 1 5 0	
1	8 . 0		
13	5 . 0		
25	5 7		
37			
49		73 80	
61		F 1 6 0	

FORM 114-C-17 REV. 7-59 VELLUM

Figure 34. Group F Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 31 of 36 JOB NO. 2929-30

Col.	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	1	PLA12		
13	ø	KEWED RECTA		
25	N	GLE LøøKING		
37		AT 8 CøPLA		
49			73 80	
61			F170	
1	4	.0		
13	1	0..0		
25	1	.0		
37	1	.0		
49	1	3..0	73 80	
61	1	.0	F180	
1	4	.0		
13	1	3..0		
25	7	.0		
37	4	.0		
49	1	0..0	73 80	
61	7	.0	F190	
1	1	.0		
13				
25				
37				
49			73 80	
61			F200	

FORM 114-C-17 REV. 7-58-VELLUM

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 32 of 36 JOB NO. 2929-30

Col.	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	5	PIPE1		
13	H	ORIZøNTAL P		
25	A	RALLELEPIPE		
37	D	WITH LINE		
49	B	RIDGE Tø 6P	73 80	
61	I	PE2	F210	
1	1	0..0		
13	1	.0		
25	4	.0		
37	3	.0		
49		2 3 7	73 80	
61	1	.0	F220	
1	4	.0		
13	5	.0		
25		1 4 8		
37	1	0..0		
49	4	.0	73 80	
61	3	.0	F230	
1		1 4 5		
13	1	0..0		
25	4	.0		
37	5	.0		
49		2 3 6	73 80	
61	1	0..0	F240	

FORM 114-C-17 REV. 7-58-VELLUM

Figure 34. Group F Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 33 of 36 JOB NO. 2929-30

Column	NUMBER	IDENTIFICATION (73–80)	DESCRIPTION DO NOT KEY PUNCH
1	6.0		
13	3.0		
25	3 6 7		
37	10.0		
49	6.0		
61	5.0	F250	
1	4 5 9		
13	1.0		
25	6.0		
37	3.0		
49	1 5 8		
61	1.0	F260	
1	6.0		
13	5.0		
25	2 7 6		
37	1.0		
49	6.0		
61	3.0	F270	
1	10		
13	7.0		
25	10.0		
37	12.0		
49	9		
61		F280	

FORM 114-C-17 REV. 7-60 - VELLUM

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 34 of 36 JOB NO. 2929-30

Column	NUMBER	IDENTIFICATION (73–80)	DESCRIPTION DO NOT KEY PUNCH
1	6 PIPE2		
13	VERTICAL PAR		
25	ALLELEPIPED		
37			
49			
61		F290	
1	4.0		
13	2.0		
25	7.0		
37	10.0		
49	1.0		
61	2.0	F300	
1	2.0		
13	14.0		
25	2.0		
37	2.0		
49			
61		F310	
1	8 CØPLA		
13	TØ RUN 5CØPL		
25	A IN CØMPLEX		
37	MØDE IN ØIL		
49	F AC		
61		F320	

FORM 114-C-17 REV. 7-60 - VELLUM

Figure 34. Group F Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

Contrails

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 35 of 36 JOB NO. 2929-30

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	5	CØPLA		
13				
25				
37				
49				
61			F330	
1	8	2ØFEM		
13	5	PIPE1 CØMBI		
25	N	ED WITH 6PI		
37	P	E2		
49				
61			F340	
1	5	PIPE16PIPE2		
13				
25				
37				
49				
61			F350	
1	1	PLA108CØPLA		
13				
25	D	1 1		
37	1	PLA101PLA11		
49				
61	D	1 1	F360	

FORM 114-C-17 REV. 7-58-VELLUM

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. ______ PROGRAMMER ______ DATE ______ PAGE 36 of 36 JOB NO. 2929-30

	NUMBER		IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	1	PLA1082ØFEM		
13				
25	D	1 1		
37	1	PLA105PIPE1		
49				
61	D	1 1	F370	
1	1	PLA125CØPLA		
13				
25	D	1 1		
37	1	PLA128CØPLA		
49				
61	D	1 1	F380	
1				
13				
25				
37				
49				
61				
1				
13				
25				
37				
49				
61				

FORM 114-C-17 REV. 7-58-VELLUM

Figure 34. Group F Sample Problems Input Data Code Sheets (continued)

Approved for Public Release

Contrails

```
                        NAA SPACE AND INFORMATION SYSTEMS DIVISION
             T+A PROJECT RADIANT-INTERCHANGE CONFIGURATION FACTOR PROGRAM

                                   C O N F A C   I I

          NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (F)-K.A.TOUPS,11/1/63

                                   I N P U T   D A T A


***** DATA NAME- *1PLA10       * 6X6 PLATE IN XY PLANE

POINT        X              Y              Z           POINT       X              Y              Z
       0.2000000E 01  0.1000000E 01  0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.2000000E 01  0.1000000E 01  0.                  2   0.8000000E 01  0.1000000E 01  0.
   3   0.8000000E 01  0.7000000E 01  0.                  4   0.2000000E 01  0.7000000E 01  0.


***** DATA NAME- *1PLA11       * 5X5 SQUARE,Z=3,LOOKING AT 1PLA10

POINT        X              Y              Z           POINT       X              Y              Z
       0.4000000E 01  0.4000000E 01  0.2000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.4000000E 01  0.4000000E 01  0.3000000E 01       2   0.4000000E 01  0.9000000E 01  0.3000000E 01
   3   0.9000000E 01  0.9000000E 01  0.3000000E 01       4   0.9000000E 01  0.4000000E 01  0.3000000E 01


***** DATA NAME- *5COPLA       * 1PLA11 COMBINED WITH 1PLA9

POINT        X              Y              Z           POINT       X              Y              Z
   1   0.4000000E 01  0.4000000E 01  0.3000000E 01       2   0.4000000E 01  0.9000000E 01  0.3000000E 01
   3   0.9000000E 01  0.9000000E 01  0.3000000E 01       4   0.9000000E 01  0.4000000E 01  0.3000000E 01
   5   0.3000000E 01  0.3000000E 01  0.5000000E 01       6   0.8000000E 01  0.3000000E 01  0.5000000E 01
   7   0.8000000E 01  0.8000000E 01  0.5000000E 01       8   0.3000000E 01  0.8000000E 01  0.5000000E 01

POINT  CONNECTING POINTS   POINT  CONNECTING POINTS   POINT  CONNECTING POINTS   POINT  CONNECTING POINTS
   1      2,  4, -0, -0       2      1,  3, -0, -0       3      2,  4, -0, -0       4      1,  3, -0, -0
   5      6,  8, -0, -0       6      5,  7, -0, -0       7      6,  8, -0, -0       8      5,  7, -0, -0


***** DATA NAME- *1PLA12       *
```

Figure 35. Group F Sample Problems Program Results
(18 pages)

Approved for Public Release

Contrails

```
                              SKEWED RECTANGLE LOOKING AT 8COPLA

POINT       X              Y              Z          POINT       X              Y              Z
      0.9292893E 01  0.1000000E 01  0.1707107E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
  1   0.1000000E 02  0.1000000E 01  0.1000000E 01      2   0.1300000E 02  0.1000000E 01  0.4000000E 01
  3   0.1300000E 02  0.7000000E 01  0.4000000E 01      4   0.1000000E 02  0.7000000E 01  0.1000000E 01


***** DATA NAME- *5PIPE1      * HORIZONTAL PARALLELEPIPED WITH LINE BRIDGE TO 6PIPE2

POINT       X              Y              Z          POINT       X              Y              Z
  1   0.1000000E 01  0.4000000E 01  0.3000000E 01      2   0.1000000E 01  0.4000000E 01  0.5000000E 01
  3   0.1000000E 02  0.4000000E 01  0.3000000E 01      4   0.1000000E 02  0.4000000E 01  0.5000000E 01
  5   0.1000000E 02  0.6000000E 01  0.3000000E 01      6   0.1000000E 02  0.6000000E 01  0.5000000E 01
  7   0.1000000E 01  0.6000000E 01  0.3000000E 01      8   0.1000000E 01  0.6000000E 01  0.5000000E 01
  9   0.1000000E 01  0.6000000E 01  0.3000000E 01     10   0.7000000E 01  0.1000000E 02  0.1200000E 02

POINT  CONNECTING POINTS   POINT  CONNECTING POINTS   POINT  CONNECTING POINTS   POINT  CONNECTING POINTS
  1     2,  3,  7, -0        2     1,  4,  8, -0        3     1,  4,  5, -0        4     2,  3,  6, -0
  5     3,  6,  7, -0        6     4,  5,  8, -0        7     1,  5,  8, -0        8     2,  7,  6, -0
  9    10, -0, -0, -0       10     9, -0, -0, -0


***** DATA NAME- *6PIPE2      * VERTICAL PARALLELEPIPED

SURFACE SPECIFICATIONS-

NO OF X-SECTIONS =  2          NO OF X-SECTION BOUNDARY DIVISIONS =  4

LOCATION OF VERTICAL CENTERLINE, X= 0.7000000E 01, Y= 0.1000000E 02

X-SECTION NO.      X-AXIS RADIUS     Y-AXIS RADIUS      ELEVATION ABOVE XY PLANE
      1            0.2000000E 01     0.2000000E 01      0.1000000E 01
      2            0.2000000E 01     0.2000000E 01      0.1400000E 02

THE FOLLOWING INTERNALLY GENERATED SURFACE DATA RESULTED FROM THE ABOVE SPECIFICATIONS-

POINT       X              Y              Z          POINT       X              Y              Z
  1   0.9000000E 01  0.1000000E 02  0.1000000E 01      2   0.9000000E 01  0.1000000E 02  0.1400000E 02
  3   0.7000000E 01  0.1200000E 02  0.1000000E 01      4   0.7000000E 01  0.1200000E 02  0.1400000E 02
  5   0.5000000E 01  0.1000000E 02  0.1000000E 01      6   0.5000000E 01  0.1000000E 02  0.1400000E 02
  7   0.7000000E 01  0.8000000E 01  0.1000000E 01      8   0.7000000E 01  0.8000000E 01  0.1400000E 02
```

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
POINT  CONNECTING POINTS   POINT  CONNECTING POINTS   POINT  CONNECTING POINTS   POINT  CONNECTING POINTS
  1       3,  2,  7,  0      2       4,  0,  8,  1      3       5,  4,  1,  0      4       6,  0,  2,  3
  5       7,  6,  3,  0      6       8,  0,  4,  5      7       1,  8,  5,  0      8       2,  0,  6,  7

***** DATA NAME- *8COPLA     * TO RUN 5COPLA IN COMPLEX MODE IN SILFAC

MULTISURFACE DATA-

5COPLA,     ,     ,     ,     ,     ,     ,     ,     ,     ,     ,     ,

***** DATA NAME- *820FEM     * 5PIPE1 COMBINED WITH 6PIPE2

MULTISURFACE DATA-

5PIPE1,6PIPE2,     ,     ,     ,     ,     ,     ,     ,     ,     ,     ,
```

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG. (F)-K.A.TOUPS,11/1/63

```
RUN NO.   1   DATA USED FOR THIS RUN- *1PLA10*8COPLA*
                                      *     *     *
                                      *D    1*    1*
```

SURFACE 2 SILHOUETTE COMPUTED FROM MAPPING POINT SHOWN

MAPPING LINE	PT									
1	1	5	6	9	4	3	2	10	8	5
1	2	5	6	9	4	3	2	10	8	5
1	3	5	6	9	4	3	2	10	8	5
1	4	5	6	9	4	3	2	10	8	5
1	5	5	6	9	4	3	2	1	10	5
1	6	5	6	9	4	3	2	1	10	5
1	7	5	6	9	4	3	2	1	10	5
2	1	5	6	9	4	3	2	10	8	5
2	2	5	6	9	4	3	2	10	8	5
2	3	5	6	9	4	3	2	10	8	5
2	4	5	6	9	4	3	2	10	8	5
2	5	5	6	9	4	3	2	1	10	5
2	6	5	6	9	4	3	2	1	10	5
2	7	5	6	9	4	3	2	1	10	5
3	1	5	6	9	4	3	2	10	8	5
3	2	5	6	9	4	3	2	10	8	5
3	3	5	6	9	4	3	2	10	8	5
3	4	5	6	9	4	3	2	10	8	5
3	5	5	6	9	4	3	2	1	10	5
3	6	5	6	9	4	3	2	1	10	5
3	7	5	6	9	4	3	2	1	10	5
4	1	5	6	9	4	3	2	10	8	5
4	2	5	6	9	4	3	2	10	8	5
4	3	5	6	9	4	3	2	10	8	5
4	4	5	6	9	4	3	2	10	8	5
4	5	5	6	9	4	3	2	1	10	5
4	6	5	6	9	4	3	2	1	10	5
4	7	5	6	9	4	3	2	1	10	5
5	1	5	6	9	4	3	2	10	8	5
5	2	5	6	9	4	3	2	10	8	5
5	3	5	6	9	4	3	2	10	8	5
5	4	5	6	9	4	3	2	10	8	5
5	5	5	6	9	4	3	2	1	10	5
5	6	5	6	9	4	3	2	1	10	5

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
 5   7     5   6   9   4   3   2   1  10   5
 6   1     1   4   3   2   9   8   5  10   1
 6   2     1   4   3   2   9   8   5  10   1
 6   3     1   4   3   2   9   8   5  10   1
 6   4     1   4   3   2   9   8   5  10   1
 6   5     1   4   3   2   1
 6   6     1   4   3   2   1
 6   7     1   4   3   2   1
 7   1     1   4   3   2   9   8   5  10   1
 7   2     1   4   3   2   9   8   5  10   1
 7   3     1   4   3   2   9   8   5  10   1
 7   4     1   4   3   2   9   8   5  10   1
 7   5     1   4   3   2   1
 7   6     1   4   3   2   1
 7   7     1   4   3   2   1

TOTAL TIME IN SILFAC =     3.646 SECONDS.

THE FORM FACTOR FROM SURFACE *1PLA10      * TO SURFACE *8COPLA      * = 0.27337

THE EXCHANGE COEFFICIENT (FA)=    0.98413E 01 SQ UNITS

                   THE MAPPING AREA = 0.3600000E 02 SQ UNITS

THE AREA OF SURFACE *1PLA10      * = 0.3600000E 02 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *1PLA10      *

POINT        X              Y              Z            POINT       X              Y             Z
       0.2000000E 01  0.1000000E 01  0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.2000000E 01  0.1000000E 01  0.                       2   0.8000000E 01  0.1000000E 01  0.
   3   0.8000000E 01  0.7000000E 01  0.                       4   0.2000000E 01  0.7000000E 01  0.

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1PLA10      * FOR EACH Y INTERVAL

      X-LEFT          X-RIGHT            Y                    X-LEFT         X-RIGHT            Y

  0.2000000E 01  0.8000000E 01  0.1000000E 01          0.2000000E 01  0.8000000E 01  0.2000000E 01
```

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

0.2000000E 01	0.8000000E 01	0.3000000E 01	0.2000000E 01	0.8000000E 01	0.4000000E 01
0.2000000E 01	0.8000000E 01	0.5000000E 01	0.2000000E 01	0.8000000E 01	0.6000000E 01
0.2000000E 01	0.8000000E 01	0.7000000E 01			

NO. OF HORIZONTAL INCREMENTS= 6 NO. OF VERTICAL INCREMENTS= 6

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.8549479E-01	0.1053000E-00	0.1227148E-00	0.1340877E-00	0.1377212E-00	0.1318948E-00
0.1167405E-00					
0.1130059E-00	0.1428044E-00	0.1698850E-00	0.1883679E-00	0.1958413E-00	0.1882831E-00
0.1647709E-00					
0.1428044E-00	0.1848440E-00	0.2244727E-00	0.2531131E-00	0.2678413E-00	0.2602939E-00
0.2266967E-00					
0.1698850E-00	0.2244727E-00	0.2778939E-00	0.3188091E-00	0.3440795E-00	0.3393076E-00
0.2959300E-00					
0.1883679E-00	0.2531131E-00	0.3188091E-00	0.3714197E-00	0.4070679E-00	0.4058596E-00
0.3546937E-00					
0.1958413E-00	0.2678413E-00	0.3440795E-00	0.4070679E-00	0.4496363E-00	0.4496363E-00
0.3927660E-00					
0.1882831E-00	0.2602939E-00	0.3393076E-00	0.4058596E-00	0.4496363E-00	0.4496363E-00
0.3927660E-00					

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
                    NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (F)-K.A.TOUPS,11/1/63


RUN NO.   2   DATA USED FOR THIS RUN- *1PLA10*1PLA11*
                                      *      *      *
                                      *D    1*     1*

THE FORM FACTOR FROM SURFACE *1PLA10       * TO SURFACE *1PLA11       * = 0.21136

THE EXCHANGE COEFFICIENT (FA)=    0.76088E 01 SQ UNITS

                  THE MAPPING AREA = 0.3600000E 02 SQ UNITS

THE AREA OF SURFACE *1PLA10       * = 0.3600000E 02 SQ UNITS.

THE AREA OF SURFACE *1PLA11       * = 0.2500000E 02 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *1PLA10       *

POINT       X               Y               Z                  POINT       X               Y               Z
       0.2000000E 01   0.1000000E 01   0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.2000000E 01   0.1000000E 01   0.                        2    0.8000000E 01   0.1000000E 01   0.
   3   0.8000000E 01   0.7000000E 01   0.                        4    0.2000000E 01   0.7000000E 01   0.


***** DATA NAME- *1PLA11       *

POINT       X               Y               Z                  POINT       X               Y               Z
       0.4000000E 01   0.4000000E 01   0.2000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.4000000E 01   0.4000000E 01   0.3000000E 01             2    0.4000000E 01   0.9000000E 01   0.3000000E 01
   3   0.9000000E 01   0.9000000E 01   0.3000000E 01             4    0.9000000E 01   0.4000000E 01   0.3000000E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1PLA10       * FOR EACH Y INTERVAL

      X-LEFT          X-RIGHT           Y                        X-LEFT          X-RIGHT           Y

  0.2000000E 01   0.8000000E 01   0.1000000E 01             0.2000000E 01   0.8000000E 01   0.2000000E 01
  0.2000000E 01   0.8000000E 01   0.3000000E 01             0.2000000E 01   0.8000000E 01   0.4000000E 01
```

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
0.2000000E 01  0.8000000E 01  0.5000000E 01          0.2000000E 01  0.8000000E 01  0.6000000E 01
0.2000000E 01  0.8000000E 01  0.7000000E 01

NO. OF HORIZONTAL INCREMENTS=  6  NO. OF VERTICAL INCREMENTS=  6

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

 0.2571121E-01  0.3491454E-01  0.4487989E-01  0.5346227E-01  0.5840757E-01  0.5840757E-01
 0.5346227E-01
 0.3838323E-01  0.5576248E-01  0.7595849E-01  0.9394831E-01  0.1043396E-00  0.1043396E-00
 0.9394831E-01
 0.5576248E-01  0.8716592E-01  0.1264627E-00  0.1624429E-00  0.1830053E-00  0.1830053E-00
 0.1624429E-00
 0.7595850E-01  0.1264627E-00  0.1934735E-00  0.2559109E-00  0.2910528E-00  0.2910528E-00
 0.2559109E-00
 0.9394831E-01  0.1624429E-00  0.2559109E-00  0.3436941E-00  0.3927660E-00  0.3927660E-00
 0.3436941E-00
 0.1043396E-00  0.1830053E-00  0.2910528E-00  0.3927660E-00  0.4496363E-00  0.4496363E-00
 0.3927660E-00
 0.1043396E-00  0.1830053E-00  0.2910528E-00  0.3927660E-00  0.4496363E-00  0.4496363E-00
 0.3927660E-00
```

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG. (F)-K.A.TOUPS,11/1/63

RUN NO. 3 DATA USED FOR THIS RUN- *IPLA10*820FEM*
*   *   *
D   1   1*

MAPPING LINE	PT	SURFACE 2 SILHOUETTE COMPUTED FROM MAPPING POINT SHOWN														
1	1	18	19	4	3	5	20	11	13	15	21	7	1	2	22	18
1	2	18	19	4	3	5	20	11	13	15	21	7	1	2	22	18
1	3	18	19	4	3	5	20	11	13	15	21	7	1	2	22	18
1	4	18	19	4	3	5	20	11	13	15	21	7	1	2	22	18
1	5	18	19	4	3	5	20	11	13	15	21	7	1	2	22	18
1	6	18	19	4	3	5	20	11	13	15	21	7	1	2	22	18
1	7	18	19	4	3	5	20	11	13	15	21	7	1	2	22	18
2	1	2	4	3	5	19	11	13	15	20	7	1	2			
2	2	2	4	3	5	19	11	13	15	20	7	1	2			
2	3	2	4	3	5	19	11	13	15	20	7	1	2			
2	4	2	4	3	5	19	11	13	15	20	7	1	2			
2	5	2	4	3	5	19	11	13	15	20	7	1	2			
2	6	2	4	3	5	19	11	13	15	20	7	1	2			
2	7	2	4	3	5	19	11	13	15	20	7	1	2			
3	1	2	4	3	5	19	20	11	13	15	21	7	1	2		
3	2	2	4	3	5	19	11	13	15	20	7	1	2			
3	3	2	4	3	5	19	11	13	15	20	7	1	2			
3	4	2	4	3	5	19	11	13	15	20	7	1	2			
3	5	2	4	3	5	19	11	13	15	20	7	1	2			
3	6	2	4	3	5	19	11	13	15	20	7	1	2			
3	7	2	4	3	5	19	11	13	15	20	7	1	2			
4	1	1	19	20	3	5	21	17	11	13	15	22	7	1		
4	2	1	19	20	3	5	21	22	11	13	15	23	7	1		
4	3	1	19	20	3	5	21	11	13	15	22	7	1			
4	4	1	19	20	3	5	21	11	13	15	22	7	1			
4	5	1	19	20	3	5	21	11	13	15	22	7	1			
4	6	1	19	20	3	5	21	11	13	15	22	7	1			
4	7	1	19	20	3	5	21	11	13	15	22	7	1			
5	1	1	3	5	19	17	11	13	15	20	9	1				
5	2	1	3	5	19	17	11	13	15	20	9	1				
5	3	1	3	5	19	12	20	11	13	15	21	9	1			
5	4	1	3	5	19	12	11	13	15	20	9	1				
5	5	1	3	5	19	12	11	13	15	20	9	1				
5	6	1	3	5	19	12	11	13	15	20	9	1				

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
5  7     1  3  5  19  12  11  13  15  20   9   1
6  1     1  3  5  19  20   7  21  18  17  11  13  15  16  22   9   1
6  2     1  3  5  19  20   7  21  18  17  11  13  15  16  22   9   1
6  3     1  3  5  19  20   7  21  18  17  11  13  15  16   9   1
6  4     1  3  5  19  20   7  21  16  18  12  22  11  13  15  23   9   1
6  5     1  3  5  19  20   7  21  16  18  12  11  13  15  22   9   1
6  6     1  3  5  19  20   7  21  16  18  12  11  13  15  22   9   1
6  7     1  3  5  19  20   7  21  16  18  12  11  13  15  22   9   1
7  1     1  3  5   6  19  20  18  17  11  13  21  14  16  22  23   8   7   1
7  2     1  3  5   6   8   7  19  18  17  11  13  15  16  20   9   1
7  3     1  3  5   6   8   7  19  18  17  11  13  15  16  20   9   1
7  4     1  3  5   6   8   7  19  18  17  11  13  15  16  20   9   1
7  5     1  3  5   6   8   7  19  18  12  20  11  13  15  16  21   9   1
7  6     1  3  5   6   8   7  19  18  12  11  13  15  16  20   9   1
7  7     1  3  5   6   8   7  19  16  18  12  11  13  15  17  20   9   1

TOTAL TIME IN SILFAC =   15.570 SECONDS.

THE FORM FACTOR FROM SURFACE *1PLA10      * TO SURFACE *820FEM      * = 0.28258

THE EXCHANGE COEFFICIENT (FA)=   0.10173E 02 SQ UNITS

                    THE MAPPING AREA = 0.3600000E 02 SQ UNITS

THE AREA OF SURFACE *1PLA10      * = 0.3600000E 02 SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *1PLA10      *

POINT       X               Y               Z            POINT      X              Y             Z
       0.2000000E 01   0.1000000E 01   0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
  1    0.2000000E 01   0.1000000E 01   0.                 2    0.8000000E 01   0.1000000E 01  0.
  3    0.8000000E 01   0.7000000E 01   0.                 4    0.2000000E 01   0.7000000E 01  0.

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1PLA10      * FOR EACH Y INTERVAL

     X-LEFT          X-RIGHT          Y                        X-LEFT          X-RIGHT          Y

  0.2000000E 01  0.8000000E 01  0.1000000E 01           0.2000000E 01  0.8000000E 01  0.2000000E 01
```

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
0.2000000E 01  0.8000000E 01  0.3000000E 01        0.2000000E 01  0.8000000E 01  0.4000000E 01
0.2000000E 01  0.8000000E 01  0.5000000E 01        0.2000000E 01  0.8000000E 01  0.6000000E 01
0.2000000E 01  0.8000000E 01  0.7000000E 01

NO. OF HORIZONTAL INCREMENTS=  6  NO. OF VERTICAL INCREMENTS=  6

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.1145098E-00  0.1329408E-00  0.1457498E-00  0.1525982E-00  0.1535865E-00  0.1485711E-00
0.1372063E-00
0.1494541E-00  0.1758640E-00  0.1935055E-00  0.2028280E-00  0.2045044E-00  0.1982487E-00
0.1829118E-00
0.1900968E-00  0.2259356E-00  0.2489559E-00  0.2612524E-00  0.2642969E-00  0.2574969E-00
0.2384187E-00
0.2261132E-00  0.2678093E-00  0.2957793E-00  0.3115554E-00  0.3170587E-00  0.3110726E-00
0.2897589E-00
0.2824968E-00  0.3361398E-00  0.3672052E-00  0.3898299E-00  0.3995240E-00  0.3940366E-00
0.3683885E-00
0.2631508E-00  0.3146966E-00  0.3492657E-00  0.3656158E-00  0.3809775E-00  0.3787753E-00
0.3536777E-00
0.2490930E-00  0.3034336E-00  0.3501732E-00  0.3844522E-00  0.3862797E-00  0.3884276E-00
0.3604015E-00
```

Figure 35. Group F Sample Problems Program Results (continued)

Approved for Public Release

Contrails

NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG. (F)-K.A.TOUPS,11/1/63

```
RUN NO.    4    DATA USED FOR THIS RUN- *1PLA10*5PIPE1*
                                        *      *      *
                                        *D    1*     1*
```

MAPPING LINE	PT	SURFACE 2 SILHOUETTE COMPUTED FROM MAPPING POINT SHOWN						
1	1	2	4	3	5	7	1	2
1	2	2	4	3	5	7	1	2
1	3	2	4	3	5	7	1	2
1	4	2	4	3	5	7	1	2
1	5	2	4	3	5	7	1	2
1	6	2	4	3	5	7	1	2
1	7	2	4	3	5	7	1	2
2	1	2	4	3	5	7	1	2
2	2	2	4	3	5	7	1	2
2	3	2	4	3	5	7	1	2
2	4	2	4	3	5	7	1	2
2	5	2	4	3	5	7	1	2
2	6	2	4	3	5	7	1	2
2	7	2	4	3	5	7	1	2
3	1	2	4	3	5	7	1	2
3	2	2	4	3	5	7	1	2
3	3	2	4	3	5	7	1	2
3	4	2	4	3	5	7	1	2
3	5	2	4	3	5	7	1	2
3	6	2	4	3	5	7	1	2
3	7	2	4	3	5	7	1	2
4	1	1	3	5	7	1		
4	2	1	3	5	7	1		
4	3	1	3	5	7	1		
4	4	1	3	5	7	1		
4	5	1	3	5	7	1		
4	6	1	3	5	7	1		
4	7	1	3	5	7	1		
5	1	1	3	5	7	1		
5	2	1	3	5	7	1		
5	3	1	3	5	7	1		
5	4	1	3	5	7	1		
5	5	1	3	5	7	1		
5	6	1	3	5	7	1		

Figure 35. Group F Sample Problems Program Results (continued)

Approved for Public Release

Contrails

```
5   7     1   3   5   7   1
6   1     1   3   5   6   8   7   1
6   2     1   3   5   6   8   7   1
6   3     1   3   5   6   8   7   1
6   4     1   3   5   6   8   7   1
6   5     1   3   5   6   8   7   1
6   6     1   3   5   6   8   7   1
6   7     1   3   5   6   8   7   1
7   1     1   3   5   6   8   7   1
7   2     1   3   5   6   8   7   1
7   3     1   3   5   6   8   7   1
7   4     1   3   5   6   8   7   1
7   5     1   3   5   6   8   7   1
7   6     1   3   5   6   8   7   1
7   7     1   3   5   6   8   7   1

TOTAL TIME IN SILFAC =     1.484 SECONDS.

THE FORM FACTOR FROM SURFACE *1PLA10      * TO SURFACE *5PIPE1      * = 0.21472

THE EXCHANGE COEFFICIENT (FA)=    0.77299E 01 SQ UNITS

                 THE MAPPING AREA = 0.3600000E 02 SQ UNITS

THE AREA OF SURFACE *1PLA10      * = 0.3600000E 02 SQ UNITS.


THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *1PLA10      *

POINT       X               Y               Z                 POINT       X               Y            Z
       0.2000000E 01   0.1000000E 01   0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.2000000E 01   0.1000000E 01   0.                    2   0.8000000E 01   0.1000000E 01   0.
   3   0.8000000E 01   0.7000000E 01   0.                    4   0.2000000E 01   0.7000000E 01   0.


***** DATA NAME- *5PIPE1      *
```

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

POINT	X	Y	Z
1	0.1000000E 01	0.4000000E 01	0.3000000E 01
3	0.1000000E 02	0.4000000E 01	0.3000000E 01
5	0.1000000E 02	0.6000000E 01	0.3000000E 01
7	0.1000000E 01	0.6000000E 01	0.3000000E 01
9	0.1000000E 01	0.6000000E 01	0.3000000E 01

POINT	X	Y	Z
2	0.1000000E 01	0.4000000E 01	0.5000000E 01
4	0.1000000E 02	0.4000000E 01	0.5000000E 01
6	0.1000000E 02	0.6000000E 01	0.5000000E 01
8	0.1000000E 01	0.6000000E 01	0.5000000E 01
10	0.7000000E 01	0.1000000E 02	0.1200000E 02

COORDINATES OF POINTS ON BOUNDARY OF SURF •IPLA10 • FOR EACH Y INTERVAL

X-LEFT	X-RIGHT	Y
0.2000000E 01	0.8000000E 01	0.1000000E 01
0.2000000E 01	0.8000000E 01	0.3000000E 01
0.2000000E 01	0.8000000E 01	0.5000000E 01
0.2000000E 01	0.8000000E 01	0.7000000E 01

X-LEFT	X-RIGHT	Y
0.2000000E 01	0.8000000E 01	0.2000000E 01
0.2000000E 01	0.8000000E 01	0.4000000E 01
0.2000000E 01	0.8000000E 01	0.6000000E 01

NO. OF HORIZONTAL INCREMENTS= 6 NO. OF VERTICAL INCREMENTS= 6

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

0.1016997E-00	0.1182164E-00	0.1292339E-00	0.1345965E-00	0.1345965E-00	0.1292339E-00
0.1182164E-00					
0.1333196E-00	0.1567490E-00	0.1714910E-00	0.1783416E-00	0.1783416E-00	0.1714910E-00
0.1567490E-00					
0.1663359E-00	0.1971616E-00	0.2151487E-00	0.2230397E-00	0.2230397E-00	0.2151487E-00
0.1971616E-00					
0.1878273E-00	0.2236738E-00	0.2429936E-00	0.2509736E-00	0.2509736E-00	0.2429936E-00
0.2236738E-00					
0.2166066E-00	0.2581371E-00	0.2799281E-00	0.2887510E-00	0.2887510E-00	0.2799281E-00
0.2581371E-00					
0.1878273E-00	0.2236738E-00	0.2429936E-00	0.2509736E-00	0.2509736E-00	0.2429936E-00
0.2236738E-00					
0.1663359E-00	0.1971616E-00	0.2151487E-00	0.2230397E-00	0.2230397E-00	0.2151487E-00
0.1971616E-00					

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (F)-K.A.TOUPS,11/1/63

RUN NO.    5   DATA USED FOR THIS RUN- *1PLA12*5COPLA*
                                       *       *      *
                                       *D     1*     1*
```

MAPPING LINE	PT	SURFACE 2 SILHOUETTE COMPUTED FROM MAPPING POINT SHOWN				
1	1	5	6	7	8	5
1	2	5	6	7	8	5
1	3	5	6	7	8	5
1	4	5	6	7	8	5
1	5	5	6	7	8	5
1	6	5	6	7	8	5
1	7	5	6	7	8	5
2	1	5	6	7	8	5
2	2	5	6	7	8	5
2	3	5	6	7	8	5
2	4	5	6	7	8	5
2	5	5	6	7	8	5
2	6	5	6	7	8	5
2	7	5	6	7	8	5
3	1	5	6	7	8	5
3	2	5	6	7	8	5
3	3	5	6	7	8	5
3	4	5	6	7	8	5
3	5	5	6	7	8	5
3	6	5	6	7	8	5
3	7	5	6	7	8	5
4	1	6	7	8	5	6
4	2	6	7	8	5	6
4	3	6	7	8	5	6
4	4	6	7	8	5	6
4	5	6	7	8	5	6
4	6	6	7	8	5	6
4	7	6	7	8	5	6
5	1	4	3	2	1	4
5	2	4	3	2	1	4
5	3	4	3	2	1	4
5	4	4	3	2	1	4
5	5	4	1	2	3	4
5	6	4	1	2	3	4

Figure 35. Group F Sample Problems Program Results (continued)

Approved for Public Release

Contrails

```
5   7     4   1   2   3   4
6   1     4   3   2   1   4
6   2     4   3   2   1   4
6   3     4   3   2   1   4
6   4     4   3   2   1   4
6   5     4   1   2   3   4
6   6     4   1   2   3   4
6   7     4   1   2   3   4
7   1     4   3   2   1   4
7   2     4   3   2   1   4
7   3     4   3   2   1   4
7   4     4   3   2   1   4
7   5     4   1   2   3   4
7   6     4   1   2   3   4
7   7     4   1   2   3   4

TOTAL TIME IN SILFAC =     1.119 SECONDS.

THE FORM FACTOR FROM SURFACE *1PLA12      * TO SURFACE *5COPLA      * = 0.06482

THE EXCHANGE COEFFICIENT (FA)=   0.16501E 01 SQ UNITS

                  THE MAPPING AREA = 0.2545584E 02 SQ UNITS

THE AREA OF SURFACE *1PLA12      * = 0.2545584E 02 SQ UNITS.

THE AREA OF S         5                            SQ UNITS.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-


***** DATA NAME- *1PLA12      *

POINT       X              Y              Z'          POINT       X             Y               Z
        0.             0.            0.1000000E 01---(INTERNALLY GENERATED ORIENTATION VECTOR)
   1    0.             0.           -0.                 2    0.4242641E 01  0.              0.
   3    0.4242641E 01  0.6000000E 01 0.                 4    0.             0.6000000E 01 -0.


***** DATA NAME- *5COPLA      *
```

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

```
POINT       X              Y              Z              POINT       X              Y              Z
  1  -0.2828427E 01  0.3000000E 01  0.5656854E 01          2  -0.2828427E 01  0.8000000E 01  0.5656854E 01
  3   0.7071067E 00  0.8000000E 01  0.2121320E 01          4   0.7071067E 00  0.3000000E 01  0.2121320E 01
  5  -0.2121320E 01  0.2000000E 01  0.7778175E 01          6   0.1414213E 01  0.2000000E 01  0.4242641E 01
  7   0.1414213E 01  0.7000000E 01  0.4242641E 01          8  -0.2121320E 01  0.7000000E 01  0.7778175E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1PLA12     * FOR EACH Y INTERVAL

     X-LEFT          X-RIGHT          Y                   X-LEFT          X-RIGHT          Y

   0.              0.4242641E 01  0.                     0.              0.4242641E 01  0.1000000E 01
   0.              0.4242641E 01  0.2000000E 01          0.              0.4242641E 01  0.3000000E 01
   0.              0.4242641E 01  0.4000000E 01          0.              0.4242641E 01  0.5000000E 01
   0.              0.4242641E 01  0.6000000E 01

NO. OF HORIZONTAL INCREMENTS=  6  NO. OF VERTICAL INCREMENTS=  6

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

  0.6586177E-01  0.5720102E-01  0.4672842E-01  0.3566683E-01  0.2522045E-01  0.1623940E-01
  0.9095126E-02
  0.8817281E-01  0.7692802E-01  0.6270104E-01  0.4741228E-01  0.3301521E-01  0.2085200E-01
  0.1143457E-01
  0.1119025E-00  0.9807096E-01  0.7981889E-01  0.5989299E-01  0.4116668E-01  0.2557466E-01
  0.1377330E-01
  0.1321407E-00  0.1161775E-00  0.9447607E-01  0.7052859E-01  0.4804987E-01  0.2951229E-01
  0.1569413E-01
  0.2373021E-00  0.1646303E-00  0.8519655E-01  0.2931816E-01  0.             0.1271022E-01
  0.1708626E-01
  0.2708583E-00  0.1877606E-00  0.9682411E-01  0.3306940E-01  0.             0.1398839E-01
  0.1856288E-01
  0.2708583E-00  0.1877606E-00  0.9682411E-01  0.3306940E-01  0.             0.1398839E-01
  0.1856288E-01
```

Figure 35. Group F Sample Problems Program Results (continued)

Approved for Public Release

Contrails

```
                         NAA CONFAC II REPORT SAMPLE PROBLEMS FROM FIG.  (F)-K.A.TOUPS,11/1/63

RUN NO.   6   DATA USED FOR THIS RUN- *1PLA12*8COPLA*
                                      *      *      *
                                      *D    1*     1*

SURFACE 1 MUST BE IN THE XY PLANE OF ITS CS WHEN SURFACE 2 IS CLASS 8-THIS RUN ABORTED.
```

Figure 35. Group F Sample Problems Program Results
(continued)

Approved for Public Release

Contrails

APPENDIX B

PROGRAM DECK SETUP, LISTINGS, AND MAPS

The program deck arrangement shown in Figure 36 contains a main program and six subprograms which are listed in this appendix. A listing of the main program, 7J360, is shown in Figure 37 followed by a map of the core storage locations in Figure 38.

The first subprogram in the deck setup is subroutine UNIVEC which is shown in Figure 39 and the map of core storage in Figure 40. The transformation subroutine, TXFRM, is presented in Figure 41 and the map of core storage in Figure 42. The listing and map of subroutine DOICU is presented in Figures 43 and 44. The listing and map of subroutine MAP, is presented in Figure 45 and 46. The listing of the subroutine FACTOR is presented in Figure 47 and the map of core storage in Figure 48. Subroutine SILFAC listing and core storage is given in Figure 49 and 50. Figure 51 shows the variable formats used by this program.

This IBM FORTRAN II program uses two input-output statements which must be modified for computing systems other than the NAA Monitor, FIB III, system. These are

READ N, List

PRINT N, List

A convenient FAP assembled program is included which will convert the READ-PRINT statement to,

READ INPUT TAPE 5, N, List

WRITE OUTPUT TAPE 6, N, List

This assembly is listed in Figure 52. The convert to any other computing system using peripheral equipment and not using the same tape designations, the last three EQU cards are simply changed to read

MIN EQU A (Input statement tape number)

MOUT EQU B (Output statement tape number)

MPUNCH EQU C (Punch statement tape number)

For computing centers using attached printing equipment, the FAP assembly can be removed and the program will execute in that system.

Approved for Public Release

Contrails

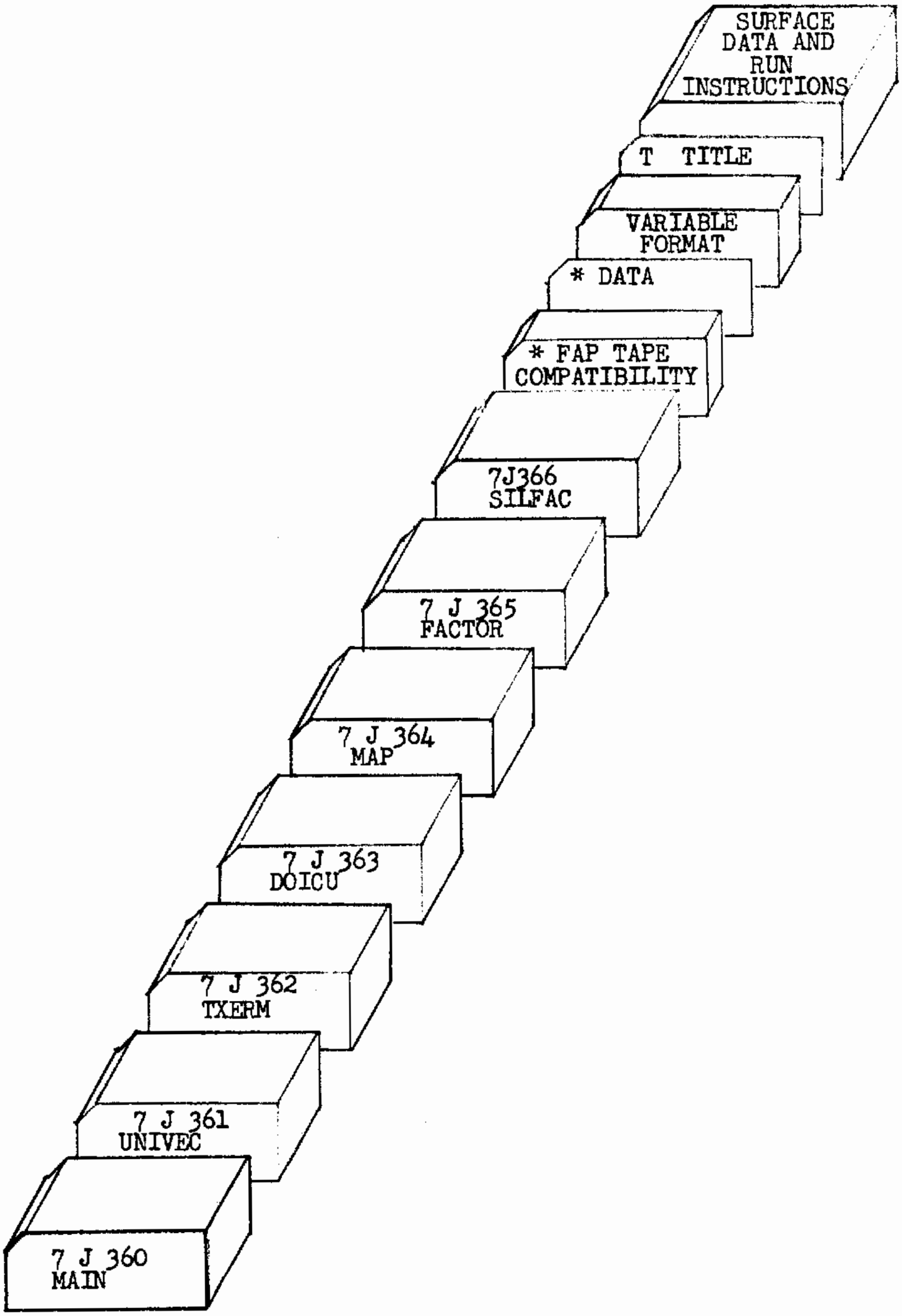

FIGURE 36. PROGRAM DECK SETUP

Approved for Public Release

Contrails


```
C CONFAC II,MAIN PROG-ANALYSIS AND PROG BY K.A.TOUPS,NAA SID, 11/1/63
C THIS MAIN PROGRAM CONTROLS THE COMPUTATION OF CONFIGURATION AND FORM
C FACTORS BETWEEN SURFACES EXCHANGING RADIANT FLUX(HEAT OR ILLUMINATION)
C FORTRAN SUBROUTINES REQD ARE UNIVEC,TXFRM,DOICU,MAP,FACTOR, AND SILFAC
C LIBRARY FUNCTIONS USED ARE SIN,COS,AND SQRT
C ALL READ AND PRINT STATEMENTS ARE ON-LINE. THESE ON-LINE STATEMENTS
C ARE CONVERTED TO TAPE READ AND WRITE BY A FAP COMPATIBILITY SUBROUTINE
C TIMING FAP SUBROUTINES COUNTV AND TIMEVARE USED IN SILFAC.
C SEE NAA SPACE AND INFORMATION SYSTEMS REPORT SID 63-1397 FOR DETAILS
C OF PROGRAM STRUCTURE AND USE.
      DIMENSION F0(12),F1(36),F2(12),F2S(12),F3(24),F4(12),F5(12),F6(12)
     1,F7(12),F8(48),F9(24),F10(24),F11(12),F12(24),F13(12),F14(12),
     2F15( 12),F16( 12),F17( 12),F18( 24),F19( 12),F20( 24),F21( 12),
     3F22( 12),F23( 12),F24( 72),F25( 12),F26( 36),F27( 24),F28( 12),
     4F29( 60),F30( 24),F31( 36),F32( 12),F33( 24),F34( 12),F35(23),
     5F36(12),F37(12),F38(12),F39(12),F40(24),F41(12),F42(12),F43(12)
      DIMENSION  NTITLE(24),NSN(56),TDN(12),NDN(12),NCLS(9 ),NSC(56),
     1AREA(56),NDL(56),NOP(34),P(3,102,34),ZS(11),RX(11),RY(11),KC(34),M
     2P(4,102,11),RA(9),SP(3,9),NMS(12,12),DK(4,10),KD(4,10),PT(3,4,10),
     3PP(3,102,34),V(3),PAF(11),CL(11),NDA(6),TDA(6),LD(6),LP(2),LI(2),
     4AREAX(2),INC(12),FHP(25,25),X1(61,2),Y1(61,2),DX(61),MSDL(12,12),
     5MSNOS(12),FH(61),FV(61),NSIL(120,25),X(120),Y(120),NDC(10),FX(1),
     6SL(4,100),VA(4,100),C1(102),C2(102),C3(102),NNN(100,2)
      EQUIVALENCE (P,PP(4)),(KD,DK),(TDN,NDN),(DT,NDT),(TNSID,NSID),(TDA
     1,NDA),(NSIL(1),PP(7345)),(NDN(3),NDC(1)),(VA(1),C1(1)),(VA(150),C2
     2(1)),(VA(300),C3(1)),(NNN(1),SL(1)),(FX,F42(3))
      COMMON NTITLE,NSN,NDN,NSC,NDL,P,PP,NOP,AREA,AREAX,RX,RY,ZS,KC,MP,
     1RA,SP,NMS,KD,PT,V,PAF,CL,NDA,NDT,LD,LP,LI,FHP,ND,KX,KP,NP,X1,Y1,
     2DX,FAP,NHI,NHL,NVI,NVL,F,DY,NCLS,NSID,AMAP,NDO,MSDL,MSNOS,NSIL,FH,
     3FV,X,Y,VA,SL,C1,C2,C3,NNN,NDC,INC,F41,F43
C READ VARIABLE FORMAT DATA
1     FORMAT(12A6)
      READ              1,NTS,NTT,NTC,NCLS,INC,F0,F1,F2,F2S,F3,F4,
     1F5,F6,F7,F8,F9,F10,F11,F12,F13,F14,F15,F16,F17,F18,F19,F20,F21,
     2F22,F23,F24,F25,F26,F27,F28,F29,F30,F31,F32,F33,F34,F35,NBLNK,F36,
     3F37,F38,F39,F40,F41,F42,F43
C LOAD HOLLERITH BLANKS INTO TITLE ARRAY-(2 CARDS(24 WORDS)MAX)
400   DO  500 M=1,24
 500  NTITLE(M)=NBLNK
```

Figure 37. Main Program Listing

Approved for Public Release

```
      GO TO 2200
C READ FIRST CARD
 1000 READ                    1,NDN
C LIFT THE FIRST CHARACTER FROM THE FIRST WORD ON THE  CARD AND STORE IN
C DT, LEFT ADJUSTED, REMAINDER FILLED WITH BLANKS.
B     DT=TDN(1)*770000000000+006060606060
C IS THIS A TITLE CARD-(THE CHARACTER T IDENTIFIES A TITLE CARD)
      IF(NDT-NTT)2500 ,1500 ,2500
C BLANK THE FIRST CHARACTER FOR LATER PRINTOUT
B1500 TDN(1)=TUN(1)*007777777777+600000000000
C LOAD INTO TITLE ARRAY
      DO 2000  M=1,12
 2000 NTITLE(M)=NDN(M)
C PRINT PROGRAM HEADING AND TITLE READ IN-
      PRINT                   F1
      PRINT                   F2,NTITLE
C INITIALIZE BAD INSTRUCTIONS COUNT
2200  NB=0
C INITIALIZE DATA COUNT VARIABLES
C TXFRM DATA COUNT
      J=0
C MULTISURFACE DATA COUNT
      KM=0
C SPHERE  DATA COUNT
      KS=0
C PLANAR AND NONPLANAR SURFACE DATA COUNT
      I=8
C         SURFACE SILHOUETTE CONNECTIONS DATA COUNT
      IC=0
C RUN NO COUNT
      NR=0
C NAME OF DATA(NSN),DATA CLASS(NSC),SURFACE AREA(AREA),XREF ARRAYS,COUNT
      IS=0
C AFTER INITIALIZING ABOVE BY PRESENCE  OF TITLE CARD, GO BACK TO READ
C NEXT CARD
      GO TO 1000
C TEST FOR A COMMENTS CARD-YES,3000-NO,4000
 2500 IF(NDT-NTC)4000 ,3000 ,4000
C IF A COMMENT CARD, LOAD INTO LAST HALF OF TITLE ARRAY TO BE PRINTED
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

Contrails


```
C ALONG WITH TITLE.                                                     36007900
C REPLACE THE FIRST CHARACTER IN FIRST WORD WITH A BLANK                36008000
B3000 TDN(1)=TDN(1)*007777777777+600000000000                           36008100
C LOAD THE COMMENT INTO THE SECOND HALF OF TITLE ARRAY                  36008200
      DO 3500  M=13,24                                                  36008300
 3500 NTITLE(M)=NDN(M-12)                                               36008400
C RETURN TO READ NEXT CARD                                              36008500
      GO TO 1000                                                        36008600
C THIS IS NOT A TITLE OR COMMENT CARD.                                  36008700
C IS THIS AN S CONTROL CARD (DETAIL SILHOUETTE DIAGNOSTIC PRINTOUT)     36008800
4000  IF(NDT-NTS)4200,4100,4200                                         36008900
4100  DO 4150  I=1,25                                                   36009000
      FV(I)=-1.                                                         36009100
4150  FH(I)=-1.                                                         36009200
      READ                F25,NV,(FV(NV)),N,(NH,(FH(NH)),M,(NK,(NSIL(N36009300
     1K,NH)),I=1,M),J=1,N)                                              36009400
      GO TO 1000                                                        36009500
C IF 1ST WORD IS BLNK,THIS IS NOT DATA-GO TO RUN INSTRUCTION TEST        36009600
4200  IF(NDN(1)-NBLNK)4250,50000,4250                                   36009700
C TEST THE SECOND WORD-IF BLANK,THIS IS A NAME CARD.IF NOT BLANK,THIS IS36009800
C THE FIRST CARD IN RUN INSTRUCTIONS                                    36009900
4250  IF(NDN(2)-NBLNK)50000,4500 ,50000                                 36010000
C DETERMINE CLASS OF DATA FROM NUMERAL IN COL 1                         36010100
 4500 DO  5000 IT=1,9                                                   36010200
      IF(NCLS(IT)-NDT) 5000,5500 , 5000                                 36010300
 5000 CONTINUE                                                          36010400
C IF FLOW TO THIS POINT, NO CLASS IS GIVEN-INTERPRET AS ERROR-PRINT     36010500
C WORD AND TERMINATE JOB                                                36010600
      PRINT                     F3,NDN(1)                               36010700
      GO TO 19600                                                       36010800
C PRINT  DATA NAME AND PROCESS ACCORDING TO CLASS                       36010900
 5500 PRINT                     F4,NDN(1),NBLNK                         36011000
C PRINT COMMENTS ON REST OF NAME CARD- WORDS 3-6                        36011100
      PRINT                F42,NDC                                      36011200
C ADVANCE COUNT FOR NAME,CLASS,AREA, AND XREF ARRAYS                    36011300
      IS=IS+1                                                           36011400
C STORE NAME OF DATA                                                    36011500
      NSN(IS)=NDN(1)                                                    36011600
C STORE CLASS OF DATA(ASSUME A NONPLANAR SURFACE INITIALLY(NEG SIGN))   36011700
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

Contrails


```
      NSC(IS)=-IT
      AREA(IS)=0.
C INITIALIZE SENSE LIGHTS
      SENSE LIGHT 0
C DATA BELOW CLASS 7 ARE SURFACE DATA TO BE STORED IN ARRAY P, AND
C IN THE CASE OF SOLIDS, CONNECTIONS ARE STORED IN MP
      IF(IT-6) 6000, 6000, 7000
C ADVANCE COUNT FOR SURFACE DATA STORAGE
 6000 I=I+1
C IF THE MAXIMUM ALLOWABLE NO OF SURFACES ARE EXCEEDED, STOP JOB
      IF(I-34)6600,6600,6500
6500  PRINT                    F38
      GO TO 19600
C ESTABLISH X-REF BETWEEN NAME SUBSCRIPT(IS) AND DATA SUBSCRIPT (I)
6600  NDL(IS)=I
C FLOW TO PROCESSING IS CONTROLLED BY CLASS NO. INDICATE BY VALUE OF IT
C IT=1, A     PLANE SURFACE, SILHOUETTE FORMED BY THE INPUT DATA.
C IT=2, A NONPLANAR SURFACE, SILHOUETTE FORMED BY THE INPUT DATA.
C IT=3, A PLANE SURFACE TO BE INTERNALLY GENERATED BY CODED INSTRUCTIONS
C GIVEN IN DATA.  THE BOUNDARY POINTS GENERATED WILL BE USED DIRECTLY
C AND THE SILHOUETTE GEN. WILL NOT BE EMPLOYED
C IT=4, A PLANE SURFACE IS GIVEN IN DATA ALONG WITH SURFACE POINT
C CONNECTIONS DATA WHICH WILL BE USED BY THE SILHOUETTE GENERATOR.
C IT=5, SAME AS 4,EXCEPT  THE SURFACE IS NONPLANAR
C IT=6, A PLANE OR SOLID SURFACE PER THE CODED INSTRUCTIONS WILL BE
C INTERNALLY GENERATED ALONG WITH CONNECTIONS DATA FOR USE BY THE
C SILHOUETTE GENERATOR(SUBROUTINE SILUET)
C IT=7, A SPHERE AS GIVEN IN DATA WILL BE USED(SURFACE 2 ONLY)
C IT=8, A GROUP OF SURFACES ARE GIVEN IN DATA(SURFACE 2 ONLY)
C IT=9, TRANSFORM DATA
 7000 GO TO(11000,12000,13000,14000,15000,16000,17000,18000,19000),IT
C SET CLASS NO. + TO INDICATE A PLANE SURFACE
11000 NSC(IS)=IT
C READ INPUT DATA FOR CLASSES 1 AND 2
12000 READ                    F5,PN     ,P(1,1,I),P(2,1,I),P(3,1,I),P(1,2,I
     1),P(2,2,I)
C IF THE MAX ALLOWABLE NO.OF SURF DATA POINTS ARE EXCEEDED, STOP JOB
      NOP(I)=PN
      IF(NOP(I)-100)12400,12400,12200
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

Contrails


```
12200 F12(10)=F11(10)                                                   36015700
C SELECT HOLLERITH FOR ERROR PRINTOUT AND TERMINATE JOB                 36015800
      GO TO 19400                                                       36015900
C READ REMAINDER OF THIS SURFACE DATA                                   36016000
12400 NP=NOP(I)                                                         36016100
      READ                    F5,P(3,2,I),((P(K,M,I),K=1,3),M=3,NP)     36016200
      GO TO 22000                                                       36016300
C READ CLASS 3 DATA-INTERNAL PLANE POLYGON-CONSTANT SILUET BOUNDARY PTS.36016400
13000 READ                    F5, SID,XB,YB,ZS(1),RX(1),RY(1)           36016500
      NSID=SID                                                          36016600
C PRINT SPECIFICATIONS                                                  36016700
      NSEC=1                                                            36016800
      GO TO 16500                                                       36016900
C READ DATA FOR A PLANE SURFACE W/CONNECTION DATA-CLASS 4               36017000
14000 NSC(IS)=IT                                                        36017100
C READ DATA FOR A NONPLANAR SURFACE W/CONNECTION DATA-CLASS 5           36017200
C ADVANCE COUNTER LOCATING CONNECTIONS DATA                             36017300
15000 IC=IC+1                                                           36017400
      IF(IC-11)14600,14600,14500                                        36017500
14500 PRINT                   F37                                       36017600
      GO TO 19600                                                       36017700
C CROSS REFERENCE SURFACE DATA LOCATION TO CONNECTIONS                  36017800
14600 KC(I)=IC                                                          36017900
      SENSE LIGHT 1                                                     36018000
C READ DATA- XYZ COORDINATES AND CONNECTIONS TO OTHER POINTS FORMING    36018100
C BOUNDARY(LIMIT 4)                                                     36018200
      READ                    F6,PN,(P(M,1,I),M=1,3),(MP(M,1,IC),M=1,4),P(36018300
     11,2,I)                                                            36018400
      NOP(I)=PN                                                         36018500
C TEST AGAINST MAX ALLOWABLE                                            36018600
      IF(NOP(I)-100 )15200,15200 ,12200                                 36018700
C READ REMAINDER OF DATA IF MAX NO. OF POINTS IS NOT EXCEEDED           36018800
15200 NP=NOP(I)                                                         36018900
      READ                    F 7,P(2,2,I),P(3,2,I),(MP(M,2,IC),M=1,4), 36019000
     1((P(M,K,I),M=1,3),(MP(M,K,IC),M=1,4),K=3,NP)                      36019100
      GO TO 22000                                                       36019200
C READ CLASS 6 DATA TO GENERATE A PLANE POLYGON OR MULTIFACETED SURFACE 36019300
C   W/CONNECTIONS DATA                                                  36019400
16000 SENSE LIGHT 1                                                     36019500
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

Contrails


```
      READ                  F5,SID,SEC,XB,YB,ZS(1),RX(1)                 36019600
      NSEC=SEC                                                           36019700
      NSID=SID                                                           36019800
      READ                  F5,RY(1),(ZS(M),RX(M),RY(M),M=2,NSEC)        36019900
16500 PRINT                 F 8,NSEC,NSID,XB,YB,(M,RX(M),RY(M),ZS(M),M=136020000
     1,NSEC)                                                             36020100
      PRINT                 F9                                           36020200
C IS A PLANE POLYGON REQUESTED-YES,20000-NO,20400                        36020300
      IF(NSEC-1)20400,20000,20400                                        36020400
C     READ  CLASS 7 DATA(SPHERE)                                         36020500
17000 KS=KS+1                                                            36020600
      IF(KS-9)17500,17500,19200                                          36020700
17500 NDL(IS)=KS                                                         36020800
      READ                  F5 ,RA(KS),(SP(M,KS),M=1,3)                  36020900
      PRINT                 F10,RA(KS),(SP(M,KS),M=1,3)                  36021000
C COMPUTE AREA OF SPHERE                                                 36021100
      AREA(IS)=12.566371*RA(KS)**2                                       36021200
      GO TO 1000                                                         36021300
C READ CLASS 8 DATA(MULTISURFACE)                                        36021400
18000 KM=KM+1                                                            36021500
      IF(KM-12)18500,18500,19200                                         36021600
18500 NDL(IS)=-KM                                                        36021700
      READ                 1,    (NMS(M,KM),M=1,12)                      36021800
      PRINT                 F11,(NMS(M,KM),M=1,12)                       36021900
      GO TO 1000                                                         36022000
C READ TXFRM DATA                                                        36022100
19000 J=J+1                                                              36022200
      NDL(IS)=J                                                          36022300
C IF MAX ALLOWABLE TXFRM DATA IS EXCEEDED, STOP JOB                      36022400
      IF(J-10 )19800,19800, 19200                                        36022500
19200 F12(10)=F11(9)                                                     36022600
19400 PRINT                 F12                                          36022700
19600 CALL EXIT                                                          36022800
      STOP                                                               36022900
19800 READ                  F 5 ,(DK(K,J),(PT(M,K,J),M=1,3)K=2,4)        36023000
      KD(2,J)=DK(2,J)                                                    36023100
      KD(3,J)=DK(3,J)                                                    36023200
      KD(4,J)=DK(4,J)                                                    36023300
C CREATE A 4TH POINT NORMAL TO THREE READ IN DATA                         36023400
```

Figure 37. Main Program Listing (continued)

Approved for Public Release

Contrails


```
      CALL UNIVEC(1,J,2,3,4)                                            36023500
      PT(1,1,J)=PT(1,3,J)+V(1)                                          36023600
      PT(2,1,J)=PT(2,3,J)+V(2)                                          36023700
      PT(3,1,J)=PT(3,3,J)+V(3)                                          36023800
      PRINT                   F13                                       36023900
      PRINT                   F14                                       36024000
      PRINT                   F15 ,(KD(M,J),PT(1,M,J),PT(2,M,J),PT(3,M,J),36024100
     1M=2,4)                                                            36024200
      GO TO 1000                                                        36024300
20000 SENSE LIGHT 2                                                     36024400
      NSC(IS)=IT                                                        36024500
C GENERATE X,Y,Z COORDINATES FOR CLASS 3 AND 6 DATA                     36024600
C IF MAX ALLOWABLE NO OF POINTS ARE EXCEEDED, STOP JOB                  36024700
20400 IF(NSEC*NSID+NSEC-102)20500,20500,12200                           36024800
C INITIALIZE PARAMETERS                                                 36024900
20500 ANG= 6.2831853/SID                                                36025000
      SINB=SINF(ANG)                                                    36025100
      COSB=COSF(ANG)                                                    36025200
      COSA=1.                                                           36025300
      SINA=0.                                                           36025400
      NP=0                                                              36025500
C ADD 1 TO NO.OF SIDES TO CLOSE SURFACE(USED IN SURFACE AREA COMP)      36025600
      NCP=NSID+1                                                        36025700
      DO 21500   K=1,NCP                                                36025800
      DO 21000   M=1,NSEC                                               36025900
      NP=NP+1                                                           36026000
      P(1,NP,I)=RX(M)*COSA+XB                                           36026100
      P(2,NP,I)=RY(M)*SINA+YB                                           36026200
21000 P(3,NP,I)=ZS(M)                                                   36026300
C COMPUTE NEW VALUES OF SINA,COSA BY (A+B) FORMULA                      36026400
      SINC= SINA*SINB                                                   36026500
      SINA= SINA*COSB+COSA*SINB                                         36026600
21500 COSA= COSA*COSB-SINC                                              36026700
C STORE NO OF POINTS GENERATED(DO NOT INCLUDE CLOSURE POINTS)           36026800
      NP=NP-NSEC                                                        36026900
      NOP(I)=NP                                                         36027000
C IF A PLANE, ERECT A UNIT VECTOR ABOVE POINT 1 AND COMPUTE AREA        36027100
C IF NONPLANAR, TRANSFER TO GENERATE CONNECTIONS DATA                   36027200
      IF(SENSE LIGHT 2)21600,30000                                      36027300
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

```
21600 PP(1,1,I)=P(1,1,I)                                                36027400
      PP(2,1,I)=P(2,1,I)                                                36027500
      PP(3,1,I)=P(3,1,I)+1.                                             36027600
      AREA(IS)=          SID *RX(1)*RY(1)*SINB/2.                       36027700
C TRANSFER TO GENERATE CONNECTIONS DATA                                  36027800
      GO TO 40000                                                       36027900
C CLOSE THE SURFACE TO FACILITATE AREA AND FACTOR COMPUTATION-CLASS 1,2 36028000
22000 K=NP+1                                                            36028100
      P(1,K,I)=P(1,1,I)                                                 36028200
      P(2,K,I)=P(2,1,I)                                                 36028300
      P(3,K,I)=P(3,1,I)                                                 36028400
22400 IF(NSC(IS))44000,44000,22500                                      36028500
C GENERATE   UNIT ORIENTATION VECTOR  DCOS FOR CLASSES 1,4              36028600
22500 CALL UNIVEC(0,I,NP,1,2)                                           36028700
      SENSE LIGHT 3                                                     36028800
      SENSE LIGHT 4                                                     36028900
      DO 26000 M=1,3                                                    36029000
      IF(SENSE  LIGHT 3)22700,23500                                     36029100
22700 IF(ABSF(V(M))-.1)23000,23000,24700                                36029200
23000 SENSE LIGHT 3                                                     36029300
23500 IF(SENSE LIGHT 4)24000,24500                                      36029400
24000 N1=M                                                              36029500
      GO TO 26000                                                       36029600
24500 N2=M                                                              36029700
      GO TO 26000                                                       36029800
C IF PTS 1,2 AND LAST FORM A TRIANGLE LYING IN THE SURFACE, THE ORIENTA-36029900
C TION VECTOR DIRECTION COSINE AND THE COMPUTED PROJECTED AREA WILL HAVE36030000
C THE SAME SIGN FOR AREAS COMPUTED ON THE ZY AND XY PLANES, AND ARE     36030100
C OPPOSITE IN SIGN ON XZ PLANE. THE SIGN OF THE DC IS THEREFORE REVERSED36030200
C TO YIELD A POSITIVE NUMBER FOR AREA.                                  36030300
24700 IF(M-2)25500,25000,25500                                          36030400
25000 DC=-V(M)                                                          36030500
      GO TO 26000                                                       36030600
25500 DC=V(M)                                                           36030700
26000 CONTINUE                                                          36030800
C PUT N1 COORDINATE OF CLOSURE POINT TEMPORARILY IN NO.1 SPOT IN ARRAY  36030900
C PP TO FACILITATE AREA COMPUTATION.                                    36031000
      PP(N1,1,I)=PP(N1,K,I)                                             36031100
C COMPUTE PROJECTED AREA ON PRINCIPAL  PLANE N1,N2                      36031200
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

Contrails


```
      DO 26500  M=2,K
26500 AREA(IS)=AREA(IS)+PP(N2,M,I)*(PP(N1,M-1,I)-PP(N1,M+1,I))
      AREA(IS)=AREA(IS)/DC/2.
C IF THE AREA IS NEGATIVE  THE ORIENTATION VECTOR MUST BE REVERSED. THE
C 1,2 AND LAST DATA POINTS FORMED THE SMALLER ANGLE OUTSIDE THE SURFACE
C PROPER WHEN THE X-PRODUCT WAS TAKEN TO CREATE THE ORIENTATION VECTOR.
      IF(AREA(IS))27000,27500,27500
27000 V(1)=-V(1)
      V(2)=-V(2)
      V(3)=-V(3)
      AREA(IS)=ABSF(AREA(IS))
C ERECT UNIT ORIENTATION VECTOR
27500 PP(1,1,I)=PP(1,2,I)+V(1)
      PP(2,1,I)=PP(2,2,I)+V(2)
      PP(3,1,I)=PP(3,2,I)+V(3)
      GO TO 44000
C DETERMINE IF X-SECTIONS ARE SIMILAR, AND IF CIRCULAR OR ELLIPTICAL
30000 SENSE LIGHT 3
      DO 33000 N=1,NSEC
      RAL=RX(N)/RY(N)
      IF(RAL)30500,33000,30500
C SL3 IS USED TO CONTROL FLOW TO INTIALIZE RAF FOR FIRST NONZERO RAL
30500 IF(SENSE LIGHT 3)31000,32000
31000 RAF=RAL
C COMPUTE TOLERANCE FOR NON-SIMILARITY
      RTOL=.005*RAF
C TEST CIRCULARITY
      IF(ABSF(RAL-1.)-.005)31500,31500,32000
C THIS XSECTION IS CIRCULAR WITHIN TOLERANCE -SL4 ON
31500 SENSE LIGHT 4
C TEST SIMILARITY TO PRIOR XSECTION
C IF SIMILAR, CONTINUE. IF NOT SIMILAR, THE AREA WILL NOT BE COMPUTED
32000 IF(ABSF(RAF-RAL)-RTOL)33000,33000,40000
33000 CONTINUE
C FLOW TO THIS POINT INDICATES X-SECTIONS ARE SIMILAR, AND IF SL4 IS ON,
C THEY ARE CIRCULAR
C THE AREA OF ONE FACET ONLY THROUGH ALL X-SECTIONS NEED BE COMPUTED
C(TIMES THE NO OF SIDES) FOR CIRCULAR X-SECTIONS. ALL MUST BE COMPUTED
C FOR ELLIPTICAL X-SECTIONS, EXCEPT FOR AN EVEN NO. OF SIDES WHEN ONLY
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

Contrails

```
7J360    CJNFAC II,MAIN PROG-ANALYSIS AND PROG BY K.A.TOUPS,NAA SID, 11/1/63      11/08/83  PAGE 10

C HALF NEED BE BECAUSE OF SIMILARITY.                                    36035200
      NS=NSID                                                            36035300
C AN EVEN NO.HAS A 0 BIT IN BINARY 17                                    36035400
B     DT=TNSID*000001000000                                              36035500
      IF(DT)34600,34500,34600                                            36035600
C 0 IN BINARY 17-TURN ON SL2                                             36035700
34500 SENSE LIGHT 2                                                      36035800
      NS=NSID/2                                                          36036000
34600 M=0                                                                36036100
C COMPUTE PROJECTED AREA OF FACETS.    FACETS FORMED BY EQUAL PARAMETRIC36036200
C ANGLES BETWEEN PARALLEL X-SECTIONS HAVE EQUAL PROJECTED AREAS,FOR EACH36036300
C PAIR OF XSECTIONS. THE 1/2 IS CANCELLED BY A 2 IN COMPUTING SLANT  H. 36036400
C THE PROJECTED AREA IS USED TO COMPUTE THE PROJECTED SLANT HEIGHT OF   36036500
C THE FACET. THE PYTHAGOREAN THEOREM IS USED TO COMPUTE THE PLANE SLANT 36036600
C HEIGHT OF THE FACET.                                                   36036700
      DO 35000   N=2,NSEC                                                36036800
35000 PAF(N) =  SINB*    (RX(N)*RY(N)-RX(N-1)*RY(N-1))                   36036900
      DO 38000 N=1,NS                                                    36037000
      SENSE LIGHT 3                                                      36037100
      DO 37000 K=1,NSEC                                                  36037200
      M=M+1                                                              36037300
      MM=M+NSEC                                                          36037400
C COMPUTE LENGTH OF CHORDS(TRAPEZOID BASES)                              36037500
      CL(K)=SQRTF(  (P(1,M,I)-P(1,MM,I))**2+(P(2,M,I)-P(2,MM,I))**2)     36037600
      IF(SENSE LIGHT 3)37000,36000                                       36037700
36000 AREA(IS)=AREA(IS)+ SQRTF( (PAF(K))**2+((ZS(K)-ZS(K-1))*(CL(K-1)+CL36037800
     1(K)))**2)                                                          36037900
37000 CONTINUE                                                           36038000
C IF SL4 ON, XSECTIONS ARE CIRCULAR                                      36038100
      IF(SENSE LIGHT 4)37500,38000                                       36038200
37500 AREA(IS)=AREA(IS)*SID/2.                                           36038300
      GO TO 39500                                                        36038400
38000 CONTINUE                                                           36038500
C IF SL2 IS NOT ON, DIVIDE BY 2 TO YIELD AREA.                           36038600
      IF(SENSE LIGHT 2)39500,39000                                       36038700
39000 AREA(IS)=AREA(IS)/2.                                               36038800
C ADD BASE AND TOP                                                       36038900
39500 AREA(IS)=AREA(IS)+(RX(1)*RY(1)+RX(NSEC)*RY(NSEC))*SID*SINB/2.      36039000
C CREATE CONNECTIONS DATA FOR INTERNALLY GENERATED SURFACES              36039100
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

Contrails


```
C INCREMENT COUNT FOR DATA STORAGE
40000 IC=IC+1
C X-REF TO SURFACE DATA IN ARRAY P
      IF(IC-11)40500,40500,14500
40500 KC(1)=IC
C LOOK AT THE POINT WITH SURFACE ORIENTED WITH +Z-AXIS UP
      DO 41000   M=1,NP
C CONNECT TO POINT ON RIGHT
      MP(1,M,IC)=M+NSEC
C CONNECT TO POINT ABOVE
      MP(2,M,IC)=M+1
C CONNECT TO POINT TO LEFT
      MP(3,M,IC)=M-NSEC
C CONNECT TO POINT BELOW
41000 MP(4,M,IC)=M-1
C ESTABLISH PROPER CONNECTIONS FOR BOUNDARY POINTS-RIGHT AND LEFT FIRST
      MM=(NSID-1)*NSEC
      DO  42000  M=1,NSEC
      K=MM+M
      MP(3,M,IC)=K
42000 MP(1,K,IC)=M
C ZERO OUT CONNECTIONS FOR LOWER AND TOPMOST POINTS
      MM=NSEC-1
      DO 43000  M=1,NP,NSEC
      K=M+MM
      MP(4,M,IC)=0
43000 MP(2,K,IC)=0
C PRINT SURFACE DATA READ IN OR GENERATED
44000 PRINT                  F14
C IF THIS IS A PLANE SURFACE, PRINT ORIENTATION VECTOR
      IF(NSC(IS))46000,46000,45000
45000 PRINT                  F16,(PP(M,1,I),M=1,3)
C PRINT SURFACE DATA
46000 PRINT                  F15,(M,P(1,M,I),P(2,M,I),P(3,M,I),M=1,NP)
C PRINT CONNECTIONS IF SL1 ON
      IF(SENSE LIGHT 1)47000,1000
47000 PRINT                  F17,( M,MP(1,M,IC),MP(2,M,IC),MP(3,M,IC),MP(
     14,M,IC),M=1,NP)
      GO TO 1000
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

Contrails

```
7J360    CONFAC II,MAIN PROG-ANALYSIS AND PROG BY K.A.TOUPS,NAA SID, 11/1/63      11/08/83  PAGE 12

C INTERPRET RUN INSTRUCTIONS-2 RUNS PER CARD                            36043100
50000 NC=0                                                              36043200
C INITIALIZE PRINTOUT FLAG- IF 0, STANDARD PRINTOUT RESULTS. IF NONZERO,36043300
C A DETAILED PRINTOUT RESULTS.                                          36043400
50500 NDO=0                                                             36043500
C LOAD SIX WORDS AT ONE TIME                                            36043600
      DO 51000 N=1,6                                                    36043700
      NS=NC+N                                                           36043800
51000 NDA(N)=NDN(NS)                                                    36043900
CIF FIRST WORD IS BLANK,ASSUME ALL ARE AND GO TO NEXT SET               36044000
      IF(NDA(1)-NBLNK)51500,81000,51500                                 36044100
C COUNT RUNS                                                             36044200
51500 NR=NR+1                                                           36044300
      SENSE LIGHT 0                                                     36044400
      DO 57000 N=1,6                                                    36044500
C COMPARE RUN DATA WITH NAMES IN DICTIONARY                              36044600
      IF(NDA(N)-NBLNK)52500,52000,52500                                 36044700
52000 IF(N-2)57050,57050,52100                                          36044800
52100 IF(N-4)52200,52200,52300                                          36044900
C IF NO TXFRM IS SPECIFIED, LOAD 0 FOR LOCATION.                         36045000
52200 LD(N)=0                                                           36045100
      GO TO 57000                                                       36045200
C IF NO INCREMENT NUMBER IS SPECIFIED, ASSUME 4                          36045300
52300 LD(N)=4                                                           36045400
      GO TO 57000                                                       36045500
52500 IF(N-4)52700,52700,5320                                           36045600
52700 DO 53000 K=1,IS                                                   36045700
      IF(NDA(N)-NSN(K))53000,56000,53000                                36045800
53000 CONTINUE                                                          36045900
C FLOW TO THIS POINT INDICATES THE WORD IS NOT IN DICTIONARY-PRINT ERROR36046000
      GO TO 57050                                                       36046100
B5320 DT=TDA(N)*777777770000+000000006060                               36046200
      IF(NDT-NBLNK)53400,5350,53400                                     36046300
53400 NDO=1                                                             36046400
B5350 DT=TDA(N)*000000007777+606060600000                               36046500
      IF(NDT-NBLNK)53600,52300,53600                                    36046600
53600 DO 54200  K=1,12                                                  36046700
54000 IF(NDT-INC(K))54200,56000,54200                                   36046800
54200 CONTINUE                                                          36046900
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

```
C FLOW TO THIS POINT INDICATES THE WORD IS NOT IN DICTIONARY-PRINT ERROR36047000
      GO TO 57050                                                      36047100
C PLACE LOCATION OF NAME IN DICTIONARY IN ARRAY LD                     36047200
56000 LD(N)=K                                                          36047300
57000 CONTINUE                                                         36047400
      N1=LD(1)                                                         36047500
      N2=LD(2)                                                         36047600
      IF(NSC(N2))57060,57040,57060                                     36047700
C COUNT SUCCESSIVE NO OF TIMES THIS HAPPENS- IF MORE THAN 10, SUPPRESS  36047800
C PRINTED OUTPUT                                                       36047900
57040 SENSE LIGHT 1                                                    36048000
57050 NB=NB+1                                                          36048100
      IF(NB-11)57100,57300,81000                                       36048200
57060 NB=0                                                             36048300
C PRINT OUTPUT GENERAL HEADING                                         36048400
57100 PRINT                      F20,NTITLE,NR,NDA                     36048500
      IF(NB)57200,57400,57200                                          36048600
57200 IF(SENSE LIGHT 1)57210,57250                                     36048700
57210 N2=NDL(N2)                                                       36048800
57220 PRINT                      F11,(NMS(M,N2),M=1,12)                36048900
57250 PRINT                      F18                                   36049000
      GO TO 81000                                                      36049100
57300 PRINT                      F19                                   36049200
      GO TO 81000                                                      36049300
C VERIFY SURFACE 1 IS CLASSED AS A PLANE                                36049400
57400 IF(NSC(N1))57500,57500,57600                                     36049500
C PRINT ERROR                                                          36049600
57500 PRINT                      F21                                   36049700
      GO TO 81000                                                      36049800
C TRANSFORM SURFACES AS INDICATED BY RUN DATA -                        36049900
57600 DO 60000 KP=1,2                                                  36050000
      SENSE LIGHT 0                                                    36050100
      KP2=KP+2                                                         36050200
C SELECT SUBSCRIPT OF DATA NAME                                        36050300
      IN=LD(KP)                                                        36050400
C LOCATE DATA SUBSCRIPT THROUGH CROSS REF ARRAY NDL                    36050500
      ND=NDL(IN)                                                       36050600
C SELECT TRANSFORMATION WORD CORRESPONDING TO SURFACE KP               36050700
C LP(KP) IS THE CURRENT LOCATION OF SURFACE KP DATA IN ARRAY P.        36050800
```

Figure 37. Main Program Listing (continued)

Contrails

Approved for Public Release

```
C TEST FOR BLANK-MEANS NO TXFRM REQD- LOAD ND IN LP(KP) FOR NO TXFRM
      IF(LD(KP2))58000,59500,58000
C IF THE WORD IN LOCATION KP+2 IS NOT BLANK, VERIFY PROPER CLASS--9.
58000 K=LD(KP2)
      IF(NSC(K)+9)58500,59000,58500
58500 PRINT                F22
      GO TO 81000
C IF THE DATA CLASS IS BELOW 6, TXFRM THE DATA. THE NEW LOCATION OF THE
C TXFRMD COORDINATES IS ESTABLISHED IN SUB TXFRM THROUGH ARRAY LP(KP)
59000 IF(XABSF(NSC(IN))-6)59300,59300,59200
59200 PRINT                F23
      GO TO 81000
C SL4 IS USED TO INDICATE A PRIMARY TXFRM
59300 SENSE LIGHT 4
      CALL TXFRM
      GO TO 60000
59500 LP(KP)=ND
C INITIALIZE BISECTION FLAGS
60000 LI(KP)=1
C IF SURFACE 2 IS A SPHERE, TRANSFER SPHERE COORDINATES TO LOC 8 IN P
      IF(NSC(N2)+7)60300,60200,60300
60200 P(1,1,8)=SP(1,ND)
      P(2,1,8)=SP(2,ND)
      P(3,1,8)=SP(3,ND)
      LP(2)=8
      NOP(8)=1
C TURN ON SL3 TO FLOW TO SILFAC,SL4 TO AUX TXFRM IN DOICU IF NECESSARY
      GO TO 61650
C SET SL2 FOR CLASS 8 IN DOICU-TO RETURN IF SURFACE 1 IS NOT IN XY PLANE
C SET SL3 FOR 5,NONPLANE 6,AND 8 FOR FLOW TO SILFAC TO COMPUTE FACTOR
C SET SL4 TO PERFORM AUX TRANSFORM ONLY TO 5 OR NONPLANE 6,AND 8 TEST
60300 IF (NSC(N2)+2)61000,62000,62000
61000 IF(NSC(N2)+8)57200,61500,61650
C VERIFY SURFACE NAMES GIVEN UNDER THE MULTISURFACE NAME,BEFORE DOICU
C ND IS INITIALLY NEGATIVE AND AFTER VERIFICATION IS MADE POSITIVE
61500 IF(ND)61510,61510,61590
61510 ND=-ND
      NDL(IN)=-NDL(IN)
      K=0
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

Contrails


```
      DO 61580 N=1,12                                                   36054800
      IF(NMS(N,ND)-NBLNK)61520,61580,61520                              36054900
61520 K=K+1                                                             36055000
C VERIFY NAME AND CLASS (4,5,6 ONLY)                                    36055100
      DO 61530 M=1,IS                                                   36055200
      IF(NMS(N,ND)-NSN(M))61530,61550,61530                             36055300
61530 CONTINUE                                                          36055400
C FLOW TO THIS POINT MEANS NAME IS NOT IN DICTIONARY                    36055500
61540 NSC(ND)=0                                                         36055600
      GO TO 57210                                                       36055700
C CONFIRM CLASS 4,5, OR 6                                               36055800
61550 IF(XABSF(NSC(M))-4)61540,61560,61560                              36055900
61560 IF(XABSF(NSC(M))-6)61570,61570,61540                              36056000
61570 MSDL(K,ND)=NDL(M)                                                 36056100
61580 CONTINUE                                                          36056200
      MSNOS(ND)=K                                                       36056300
61590 SENSE LIGHT 2                                                     36056400
61650 SENSE LIGHT 3                                                     36056500
61700 SENSE LIGHT 4                                                     36056600
C TRANSFER TO SUB DOICU TO DETERMINE IF ALL,NONE OR PART OF EACH SURFACE36056700
C SEES THE OTHER .                                                      36056800
62000 CALL DOICU                                                        36056900
C IF SURFACE 1 IS NOT IN XY PLANE FOR CLASS 8(SURF 2) , PRINT ERROR     36057000
      IF(SENSE LIGHT 4)62500,63000                                      36057100
62500 PRINT                    F35                                      36057200
      GO TO 81000                                                       36057300
C IF THE SURFACES SEE NONE OF EACH OTHER, PRINT COMMENT AND PROCEED TO  36057400
C NEXT RUN. LI(1) IS SET TO 0 IN SUB DOICU TO FLAG THIS CONDITION.      36057500
63000 IF(LI(1))67000,64000,67000                                        36057600
64000 PRINT                    F24,NDA(1),NDA(3),NDA(2),NDA(4)          36057700
      DO 66000   KP=1,2                                                 36057800
      KP2=KP+2                                                          36057900
      IF(LD(KP2))65000,66000,65000                                      36058000
65000 JP=LP(KP)                                                         36058100
      NP=NOP(JP)                                                        36058200
      PRINT                    F25,NDA(KP),NDA(KP2)                     36058300
      PRINT                    F14                                      36058400
      PRINT                    F16,(PP(M,1,JP),M=1,3)                   36058500
      PRINT                    F15,(M,P(1,M,JP),P(2,M,JP),P(3,M,JP),M=1,NP)36058600
```

Figure 37. Main Program Listing (continued)

Approved for Public Release

Contrails


```
66000 CONTINUE                                                        36058700
C PROCEED TO NEXT RUN                                                 36058800
      GO TO 81000                                                     36058900
67000 CALL MAP                                                        36059100
      IF(SENSE LIGHT 3)67500,67600                                    36059200
67500 IF(ND0)67520,67550,67520                                        36059300
67520 IF(I-24)67540,67540,67530                                       36059400
67530 PRINT                F38                                        36059500
      PRINT                F39                                        36059600
      GO TO 81000                                                     36059700
C IF SURFACE 2 IS A SPHERE, DO NOT PRINT DETAILED SILHOUETTE HEADING  36059710
67540 IF(NSC(N2)+7)67545,67550,67545                                  36059720
67545 PRINT                F40                                        36059800
67550 CALL SILFAC                                                     36059900
C SL1 ON MEANS 0 OR NEG Z COORD IN CLASS 8 SURFACE-PRINT DIAGNOSTIC   36060000
      IF(SENSE LIGHT 1)67590,67700                                    36060100
67590 PRINT                F36                                        36060200
      GO TO 81000                                                     36060300
67600 CALL FACTOR                                                     36060500
67700 PRINT                F26,NDA(1),NDA(3),NDA(2),NDA(4),F,FAP,AMAP 36060600
C PRINT OUTPUT INDICATING AREA OF EACH SURFACE SEEN, IF NOT ALL.      36060800
      DO 70000   KP=1,2                                               36060900
      J3=LD(KP)                                                       36061000
      IF(NSC(J3)+8)67800,70000,67800                                  36061100
67800 KP2=KP+2                                                        36061200
      IF(LI(KP))68000,64000,68400                                     36061500
68000 J1=3-KP                                                         36061600
      J2=J1+2                                                         36061700
      IF(NSC(J3)+2)68200,68100,68200                                  36061720
68100 PRINT                FX,NDA(KP),NDA(KP2),NDA(J1),NDA(J2)        36061740
      GO TO 70000                                                     36061760
68200 PRINT                F27,NDA(KP),NDA(KP2) ,AREAX(KP),NDA(J1),NDA(36061800
     1J2)                                                             36061900
68400 IF(NSC(J3))68500,70000,69000                                    36061950
68500 IF(NSC(J3)+6)69000,69000,70000                                  36061970
69000 PRINT                F28,NDA(KP),NDA(KP2),AREA(J3)              36062000
70000 CONTINUE                                                        36062100
C DETERMINE WHETHER THE MAPPING AREA IS WITHIN TOLERANCE OF THE ACTUAL 36062200
C SURFACE AREA MAPPED(SURFACE 1)                                      36062300
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

```
C IF SURFACE 1 WAS BISECTED, USE MODIFIED SURFACE-                          36062400
      IF(LI(1))72000,64000,71000                                            36062500
71000 AREAX(1)=AREA(N1)                                                     36062600
72000 IF(ABSF(AMAP-   AREAX(1))-.01*AREAX(1))73500,73500,73000              36062700
C PRINT WARNING                                                             36062800
73000 PRINT                F29,NDA(1),NDA(3),NDA(2),NDA(4)                  36062900
C IF A DETAILED OUTPUT WAS NOT REQUESTED,PROCEED TO NEXT RUN                36063000
73500 IF(NDO)74000,81000 ,74000                                             36063100
74000 PRINT                F30                                              36063200
      SENSE LIGHT 1                                                         36063300
      KP=1                                                                  36063400
75000 KP2=KP+2                                                              36063500
      IN=LD(KP)                                                             36063600
      IF(NSC(IN)+7)80000,76000,76000                                        36063700
76000 ND=LP(KP)                                                             36063800
      NP=NOP(ND)                                                            36063900
      PRINT                F4,NDA(KP),NDA(KP2)                              36064000
      PRINT                F14                                              36064100
C IF THE SURFACE IS PLANAR, PRINT ORIENTATION VECTOR.                       36064200
      IF(NSC(IN))78000,78000,77000                                          36064300
77000 PRINT                F16,(PP(M,1,ND),M=1,3)                           36064400
78000 PRINT                F15,(M,P(1,M,ND),P(2,M,ND),P(3,M,ND),M=1,NP)36064500
      KP=2                                                                  36064600
      IF(SENSE LIGHT 1)75000,80000                                          36064700
80000 PRINT                F31,NDA(1),NDA(3),(X1(M,1),X1(M,2),Y1(M),M=136064800
     1,NVL)                                                                 36064900
      PRINT                F32,NHI,NVI                                      36065000
C PRINT POINT FACTORS COMPUTED, BUT NOT TO EXCEED 625(STANDARD 24X24)       36065100
C CONTROLLED BY SUB FACTOR.                                                 36065200
      PRINT                F33                                              36065300
      IF(NHL-25)80500,80500,80400                                           36065400
80400 NHL=25                                                                36065500
80500 IF(NVL-25)80700,80700,80600                                           36065600
80600 NVL=25                                                                36065700
80700 DO 80800    N=1,NVL                                                   36065800
80800 PRINT                F34,(FHP(M,N),M=1,NHL)                           36065900
81000 IF(NC)1000 ,82000,1000                                                36066000
82000 NC=6                                                                  36066100
      GO TO 50500                                                           36066200
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

Figure 37. Main Program Listing
(continued)

Approved for Public Release

Contrails

7J360 CONFAC II,MAIN PROG-ANALYSIS AND PROG BY K.A.TOUPS,NAA SID, 11/1/63 02/06/84 PAGE 18

STORAGE NOT USED BY PROGRAM

DEC	OCT	DEC	OCT
4006	07646	14613	34425

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
AMAP	15169	35501	AREA	21067	51113	AREAX	21011	51023	CI	22094	53116
C2	21945	52671	C3	21795	52443	CL	16140	37414	DK	22154	53212
DT	22102	53126	DX	15246	35616	DY	15179	35513	F41	14637	34455
F43	14625	34441	FAP	15185	35521	FHP	16119	37367	FH	15011	35243
F	15180	35514	FV	14950	35146	INC	14649	34471	KC	20976	50760
KD	22154	53212	KP	15492	36204	KX	15493	36205	LD	16129	37401
LI	16121	37371	LP	16123	37373	MP	20942	50716	MSDL	15167	35477
MSNOS	15023	35257	NCLS	15178	35512	NDA	22100	53124	NDC	22112	53140
NDL	21157	51245	NDN	22114	53142	NDO	15168	35500	ND	15494	36206
NDT	22102	53126	NHI	15184	35520	NHL	15183	35517	NMS	16418	40042
NNN	21693	52275	NOP	21101	51155	NP	15491	36203	NSC	21213	51335
NSID	22101	53125	NSIL	25217	61201	NSN	21269	51425	NTITLE	21293	51455
NVI	15182	35516	NVL	15181	35515	PAF	16151	37427	PP	32561	77461
P	32558	77456	PT	16274	37622	RA	16454	40106	RX	21009	51021
RY	20998	51006	SL	21693	52275	SP	16445	40075	TDA	22100	53124
TDN	22114	53142	TNSID	22101	53125	VA	22094	53116	V	16154	37432
X1	15490	36202	X	14889	35051	Y1	15368	36010	Y	14769	34661
ZS	20987	50773									

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
F0	3993	07631	F10	3777	07301	F11	3753	07251	F12	3741	07235
F13	3717	07205	F14	3705	07171	F15	3693	07155	F16	3681	07141
F17	3669	07125	F18	3657	07111	F19	3633	07061	F1	3981	07615
F20	3621	07045	F21	3597	07015	F22	3585	07001	F23	3573	06765
F24	3561	06751	F25	3489	06641	F26	3477	06625	F27	3441	06561
F28	3417	06531	F29	3405	06515	F2	3945	07551	F2S	3933	07535
F30	3345	06421	F31	3321	06371	F32	3285	06325	F33	3273	06311
F34	3249	06261	F35	3237	06245	F36	3214	06216	F37	3202	06202
F38	3190	06166	F39	3178	06152	F3	3921	07521	F40	3166	06136
F42	4005	07645	F4	3897	07471	F5	3885	07455	F6	3873	07441

Figure 38. Main Program Core Storage Map

Approved for Public Release

Contrails

F7	3861	07425	F8	3849	07411	F9	3801	07331	FX	4003 07643

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
ANG	3142	06106	COSA	3141	06105	COSB	3140	06104	DC	3139	06103
IC	3138	06102	IN	3137	06101	I	3136	06100	IS	3135	06077
IT	3134	06076	J1	3133	06075	J2	3132	06074	J3	3131	06073
JP	3130	06072	J	3129	06071	KM	3128	06070	KP2	3127	06067
K	3126	06066	KS	3125	06065	MM	3124	06064	M	3123	06063
N1	3122	06062	N2	3121	06061	NBLNK	3120	06060	NB	3119	06057
NCP	3118	06056	NC	3117	06055	NH	3116	06054	NK	3115	06053
NR	3114	06052	N	3113	06051	NSEC	3112	06050	NS	3111	06047
NTC	3110	06046	NTS	3109	06045	NTT	3108	06044	NV	3107	06043
PN	3106	06042	RAF	3105	06041	RAL	3104	06040	RTOL	3103	06037
SEC	3102	06036	SID	3101	06035	SINA	3100	06034	SINB	3099	06033
SINC	3098	06032	XB	3097	06031	YB	3096	06030			

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

	EFN	LOC		EFN	LOC		EFN	LOC		EFN	LOC
8)1	1	05742									

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
1)	3043	05743	2)	2998	05666	3)	3019	05713	4)	32767	77777
6)	3036	05734	A)100	2829	05415	A)104	2842	05432	A)107	2851	05443
A)109	2860	05454	A)1G0	2873	05471	A)1G7	2882	05502	A)1G9	2891	05513
A)1GA	2906	05532	A)1GB	2921	05551	A)1GC	2934	05566	A)1GF	2953	05611
A)1GG	2968	05630	A)1GI	2983	05647	C)G0	3047	05747	C)G2	3048	05750
C)G3	3049	05751	C)G4	3050	05752	C)G5	3051	05753	C)G6	3052	05754
C)G7	3053	05755	C)G8	3054	05756	C)G9	3055	05757	C)GA	3056	05760
C)GB	3057	05761	C)GC	3058	05762	C)GD	3059	05763	C)GE	3060	05764
C)GF	3061	05765	C)GG	3062	05766	C)GH	3063	05767	C)GI	3064	05770
C)GJ	3065	05771	C)GK	3066	05772	C)GL	3067	05773	C)100	3068	05774
C)104	3069	05775	C)105	3070	05776	C)107	3071	05777	C)108	3072	06000
C)109	3073	06001	C)1G0	3074	06002	C)1G7	3075	06003	C)1G8	3076	06004
C)1G9	3077	06005	C)1GA	3078	06006	C)1GB	3079	06007	C)1GC	3080	06010
C)1GD	3081	06011	C)1GE	3082	06012	C)1GF	3083	06013	C)1GG	3084	06014

Figure 38. Main Program Core Storage Map
(continued)

Approved for Public Release

Contrails

C)1GH	3085	06015	C)1GI	3086	06016	C)201	3087	06017	C)209	3088	06020
C)20F	3089	06021	C)20G	3090	06022	C)20I	3091	06023	C)20J	3092	06024
C)20L	3093	06025	C)20M	3094	06026	C)20R	3095	06027	D)10G	335	00517
D)112	511	00777	D)11B	595	01123	D)12D	946	01662	D)12E	949	01665
D)12F	957	01675	D)12U	1183	02237	D)131	1267	02363	D)13V	1515	02753
D)146	1563	03033	D)147	1578	03052	D)14Q	1818	03432	D)14U	1847	03467
D)150	2009	03731	D)15U	2053	04005	D)17T	2598	05046	D)17U	2602	05052
D)23T	1472	02700	D)23U	1478	02706	D)24F	1724	03274	D)25L	1974	03666
D)25N	1988	03704	D)264	2112	04100	D)268	2135	04127	D)26A	2148	04144
D)26F	2217	04251	D)26L	2256	04320	D)26P	2278	04346	D)26R	2290	04362
D)26S	2293	04365	D)270	2560	05000	D)27R	2588	05034	D)282	2638	05116
D)28L	2821	05405	D)312	510	00776	D)31B	594	01122	D)32D	945	01661
D)331	1266	02362	D)33T	1471	02677	D)346	1562	03032	D)34U	1846	03466
D)350	2008	03730	D)36F	2216	04250	D)38L	2820	05404	D)403	202	00312
D)404	221	00335	D)42L	1077	02065	D)43F	1376	02540	D)440	1539	03003
D)452	1867	03513	D)453	1872	03520	D)45H	1946	03632	D)45I	1951	03637
D)45L	1977	03671	D)45P	2014	03736	D)45S	2040	03770	D)470	2314	04412
D)47J	2491	04673	D)470	2563	05003	D)47R	2586	05032	D)503	201	00311
D)512	508	00774	D)52F	956	01674	D)540	1538	03002	D)547	1577	03051
D)552	1866	03512	D)553	1871	03517	D)55H	1945	03631	D)55I	1950	03636
D)55L	1976	03670	D)55S	2039	03767	D)603	198	00306	D)604	220	00334
D)62L	1076	02064	D)64F	1723	03273	D)65P	2013	03735	D)66S	2292	04364
D)670	2313	04411	D)703	200	00310	D)71B	593	01121	D)731	1265	02361
D)74F	1722	03272	D)74U	1845	03465	D)750	2007	03727	D)76F	2215	04247
E)0	386	00602	E)34	1277	02375	E)35	1281	02401	E)37	1298	02422
E)3B	1313	02441	E)3K	1409	02601	E)3M	1418	02612	E)40	1537	03001
E)4V	1853	03475	E)56	1885	03535	E)58	1902	03556	E)59	1904	03560
E)5E	1927	03607	E)6I	2246	04306	E)77	2412	04554	E)7M	2522	04732
E)70	2562	05002	E)7P	2567	05007	E)17Q	2573	05015	E)37R	2590	05036

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
COS	10	00012	DOICU	13	00015	EXIT	7	00007	FACTOR	16	00020
MAP	14	00016	SILFAC	15	00017	SIN	9	00011	SQRT	11	00013
TXFRM	12	00014	UNIVEC	8	00010	(CSH)	1	00001	(FIL)	5	00005
(FPT)	0	00000	(RTN)	3	00003	(SLI)	2	00002	(SLO)	6	00006
(SPH)	4	00004									

Figure 38. Main Program Core Storage Map
(continued)

Approved for Public Release

Contrails

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

COS	DOICU	EXIT	FACTOR	MAP	SILFAC	SIN	SQRT
TXFRM	UNIVEC	(CSH)	(FIL)	(FPT)	(RTN)	(SLI)	(SLO)
(SPH)							

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
400	9	00300	500	10	00301	1000	12	00313	1500	16	00336
2000	18	00343	2200	22	00362	2500	31	00444	3000	32	00451
3500	34	00456	4000	36	00463	4100	37	00470	4150	39	00473
4200	56	00564	4250	57	00567	4500	58	00574	5000	60	00606
5500	64	00622	6000	74	00657	6500	76	00711	6600	78	00717
7000	79	00721	11000	80	00732	12000	81	00734	12200	85	01000
12400	87	01003	13000	98	01044	14000	103	01103	15000	104	01105
14500	106	01124	14600	108	01132	15200	121	01220	16000	138	01325
16500	149	01415	17000	157	01464	17500	159	01475	18000	174	01561
18500	176	01570	19000	188	01641	19200	191	01663	19400	192	01666
19600	193	01676	19800	195	01705	20000	219	02104	20400	221	02107
20500	222	02116	21000	234	02201	21500	237	02217	21600	241	02240
22000	246	02260	22400	250	02307	22500	251	02313	22700	257	02366
23000	258	02373	23500	259	02377	24000	260	02402	24500	262	02416
24700	264	02424	25000	265	02431	25500	267	02434	26000	268	02436
26500	271	02500	27000	274	02527	27500	278	02541	30000	282	02553
30500	286	02564	31000	287	02566	31500	290	02602	32000	291	02603
232	292	02616	1732	296	02633	1832	298	02644	2232	300	02657
3232	308	02754	4232	309	03004	4732	311	03010	5232	313	03020
6232	315	03027	6732	316	03034	7232	317	03053	7732	319	03066
8232	324	03117	9232	329	03176	10232	334	03262	11232	335	03275
12232	337	03306	13232	342	03330	14232	348	03367	17232	354	03427
17732	355	03433	18232	358	03445	18732	360	03455	19232	364	03476
19332	365	03503	19432	366	03507	19532	368	03514	19732	370	03521
19932	371	03525	20232	373	03554	5320	375	03561	20632	377	03570
5350	378	03572	20832	380	03601	21232	381	03602	21432	382	03626
23232	384	03633	24232	385	03640	24272	389	03665	24282	390.	03672
24292	392	03702	24332	393	03705	24432	396	03732	24442	397	03737
24452	398	03743	24482	403	03771	24532	405	03777	24632	407	04006
24732	408	04011	24832	410	04017	25232	416	04051	25732	418	04072

Figure 38. Main Program Core Storage Map (continued)

Approved for Public Release

Contrails

26232	420	04101	26432	421	04107	26532	423	04115	26732	426	04124
27232	427	04130	27432	429	04145	27532	435	04160	28232	436	04164
28732	437	04171	28742	438	04174	28752	443	04255	28762	446	04316
28772	447	04321	28782	449	04330	28792	450	04336	28802	451	04343
28812	452	04347	28822	454	04363	28882	455	04366	28932	456	04367
29232	457	04370	29732	459	04377	30232	461	04405	31232	462	04413
32232	467	04445	464	482	04555	1464	484	04561	1964	486	04570
1984	487	04572	1994	488	04577	2004	491	04610	2009	492	04613
2014	493	04620	2054	495	04627	2064	497	04635	2164	498	04642
2264	503	04703	2464	505	04713	2564	508	04733	2664	511	04755
2864	513	05004	2964	514	05010	3464	515	05016	4464	517	05037
5464	519	05047	6464	520	05053	7464	521	05065	7964	523	05104
8464	524	05106	9464	527	05117	10464	530	05135	11464	536	05200
12464	541	05226	14464	548	05276	14864	558	05341	14964	559	05343
15064	560	05350	15164	561	05352	15264	562	05370	15464	567	05406
16464	568	05412									

Figure 38. Main Program Core Storage Map
(continued)

Approved for Public Release

Contrails

```
7J361    UNIVEC(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63    11/07/73   PAGE 1

C UNIVEC(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63 36100100
      SUBROUTINE UNIVEC(I,K,J,M,N)                                      36100200
C THIS SUBROUTINE COMPUTES THE DIRECTION COSINES OF A VECTOR NORMAL TO  36100300
C THE POINTS J,M,N IN ARRAY P(X,Y,K) OR PT(X,Y,K), AS CONTROLLED BY I.  36100400
C THE CROSS PRODUCT YIELDS A VECTOR NORMAL TO THE SURFACE. THIS VECTOR  36100500
C IS UNITIZED. THUS YIELDING THE DIRECTION COSINES OF A UNIT VECTOR,    36100600
C WHICH ARE ALSO THE XYZ VALUES DEFINING THE UNIT VECTOR.               36100700
      DIMENSION  NTITLE(24),NSN(56),TDN(12),NDN(12),NCLS(9 ),NSC(56),   36100800
     1AREA(56),NDL(56),NOP(34),P(3,102,34),ZS(11),RX(11),RY(11),KC(34),M36100900
     2P(4,102,11),RA(9),SP(3,9),NMS(12,12),DK(4,10),KD(4,10),PT(3,4,10),36101000
     3PP(3,102,34),V(3),PAF(11),CL(11),NDA(6),TDA(6),LD(6),LP(2),LI(2), 36101100
     4AREAX(2),INC(12),FHP(25,25),X1(61,2),Y1(61,2),DX(61),MSDL(12,12), 36101200
     5MSNOS(12),FH(61),FV(61),NSIL(120,25),X(120),Y(120),NDC(10),       36101300
     6SL(4,100),VA(4,100),C1(102),C2(102),C3(102),NNN(100,2)            36101400
      EQUIVALENCE (P,PP(4)),(KD,DK),(TDN,NDN),(DT,NDT),(TNSID,NSID),(TDA36101500
     1,NDA),(NSIL(1),PP(7345)),(NDN(3),NDC(1)),(VA(1),C1(1)),(VA(150),C236101600
     2(1)),(VA(300),C3(1)),(NNN(1),SL(1))                               36101700
      COMMON NTITLE,NSN,NDN,NSC,NDL,P,PP,NOP,AREA,AREAX,RX,RY,ZS,KC,MP, 36101800
     1RA,SP,NMS,KD,PT,V,PAF,CL,NDA,NDT,LD,LP,LI,FHP,ND,KX,KP,NP,X1,Y1,  36101900
     2DX,FAP,NHI,NHL,NVI,NVL,F,DY,NCLS,NSID,AMAP,NDO,MSDL,MSNOS,NSIL,FH,36102000
     3FV,X,Y,VA,SL,C1,C2,C3,NNN,NDC,INC                                 36102100
      DIMENSION D(2,3)                                                  36102200
      I1=N                                                              36102300
   10 DO 40  I2=1,2                                                     36102400
      IF(I)30,20,30                                                     36102500
   20 DO 25  I3=1,3                                                     36102600
   25 D(I2,I3)=P(I3,I1,K)-P(I3,M,K)                                     36102700
      GO TO 40                                                          36102800
   30 DO 35 I3=1,3                                                      36102900
   35 D(I2,I3)=PT(I3,I1,K)-PT(I3,M,K)                                   36103000
   40 I1=J                                                              36103100
      V(1)=D(1,2)*D(2,3)-D(2,2)*D(1,3)                                  36103200
      V(2)=D(2,1)*D(1,3)-D(1,1)*D(2,3)                                  36103300
      V(3)=D(1,1)*D(2,2)-D(2,1)*D(1,2)                                  36103400
      VL=SQRTF(V(1)**2+V(2)**2+V(3)**2)                                 36103500
      V(1)=V(1)/VL                                                      36103600
      V(2)=V(2)/VL                                                      36103700
      V(3)=V(3)/VL                                                      36103800
      RETURN                                                            36103900
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

Figure 39. Subroutine UNIVEC Listing

Approved for Public Release

Contrails

```
7J361   UNIVEC(CONFAC II)ANALYSIS AN...   ..AMMING BY K.A.TOUPS,NAASID,11/1/63   11/07/73   PAGE 2

                              STORAGE NOT USED BY PROGRAM

        DEC   OCT              DEC   OCT
        206 00316            14637 34455

                 STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

        DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT
 AMAP 15169 35501       AREA 21067 51113       AREAX 21011 51023          C1 22094 53116
   C2 21945 52671         C3 21795 52443          CL 16140 37414          DK 22154 53212
   DT 22102 53126         DX 15246 35616          DY 15179 35513         FAP 15185 35521
  FHP 16119 37367         FH 15011 35243           F 15180 35514          FV 14950 35146
  INC 14649 34471         KC 20976 50760          KD 22154 53212          KP 15492 36204
   KX 15493 36205         LD 16129 37401          LI 16121 37371          LP 16123 37373
   MP 20942 50716       MSDL 15167 35477       MSNOS 15023 35257        NCLS 15178 35512
  NDA 22100 53124        NDC 22112 53140         NDL 21157 51245         NDN 22114 53142
  NDO 15168 35500         ND 15494 36206         NDT 22102 53126         NHI 15184 35520
  NHL 15183 35517        NMS 16418 40042         NNN 21693 52275         NOP 21101 51155
   NP 15491 36203        NSC 21213 51335        NSID 22101 53125        NSIL 25217 61201
  NSN 21269 51425     NTITLE 21293 51455         NVI 15182 35516         NVL 15181 35515
  PAF 16151 37427         PP 32561 77461           P 32558 77456          PT 16274 37622
   RA 16454 40106         RX 21009 51021          RY 20998 51006          SL 21693 52275
   SP 16445 40075        TDA 22100 53124         TDN 22114 53142       TNSID 22101 53125
   VA 22094 53116          V 16154 37432          X1 15490 36202           X 14889 35051
   Y1 15368 36010          Y 14769 34661          ZS 20987 50773

        STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

        DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT
    D   205 00315

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

        DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT
   I1   199 00307         VL   198 00306

                 LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM
```

Figure 40. Subroutine UNIVEC Core Storage Map

Approved for Public Release

Contrails

```
7J361   UNIVEC(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63   11/07/73  PAGE 3

          DEC    OCT               DEC    OCT               DEC    OCT               DEC    OCT
     1)   189  00275       2)     178  00262       6)     183  00267    C)100    193  00301
  C)1G0   194  00302    C)1G1     195  00303    C)1G2     196  00304    C)200    197  00305
  D)101    32  00040    D)103      72  00110    D)303      71  00107    D)408    123  00173
  C)703    70  00106      E)1      30  00036      E)2      37  00045

                         LOCATIONS OF NAMES IN TRANSFER VECTOR

          DEC    OCT               DEC    OCT               DEC    OCT               DEC    OCT
   SQRT     0  00000

                      ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

 SQRT

     EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

   EFN   IFN   LOC         EFN   IFN   LOC         EFN   IFN   LOC         EFN   IFN   LOC
    10     8  00032         20    10  00046         25    11  00111         30    13  00123
    35    14  00162         40    15  00174
```

Figure 40. Subroutine UNIVEC Core Storage Map
(continued)

Approved for Public Release

```
7J362    TXFRM(CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63    11/07/73   PAGE 1

C TXFRM(CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63
      SUBROUTINE TXFRM
C THIS SUBROUTINE IS DIVIDED INTO TWO PARTS- THE FIRST SECTION TRANS-
C FORMS A SURFACE SO THAT ALL Z COORDINATES ARE ZERO,I.E.,THE SURFACE
C LIES IN THE X-Y PLANE OF THE NEW CS. THE OTHER SURFACE IS THEN ALSO
C TRANSFORMED INTO THIS SYSTEM IN   ITS PROPER POSITION RELATIVE TO THE
C FIRST SURFACE. THIS IS TERMED AN AUXILIARY TRANSFORMATION
C THE SECOND SECTION TRANSFORMS THE COORDINATES OF A GIVEN SURFACE TO
C SOME POSITION SPECIFIED BY THE TRANSFORMATION DATA POINTS. THIS IS
C TERMED A PRIMARY TRANSFORMATION.
      DIMENSION  NTITLE(24),NSN(56),TDN(12),NDN(12),NCLS(9 ),NSC(56),
     1AREA(56),NDL(56),NOP(34),P(3,102,34),ZS(11),RX(11),RY(11),KC(34),M
     2P(4,102,11),RA(9),SP(3,9),NMS(12,12),DK(4,10),KD(4,10),PT(3,4,10),
     3PP(3,102,34),V(3),PAF(11),CL(11),NDA(6),TDA(6),LD(6),LP(2),LI(2),
     4AREAX(2),INC(12),FHP(25,25),X1(61,2),Y1(61,2),DX(61),MSDL(12,12),
     5MSNOS(12),FH(61),FV(61),NSIL(120,25),X(120),Y(120),NDC(10),
     6SL(4,100),VA(4,100),C1(102),C2(102),C3(102),NNN(100,2)
      EQUIVALENCE (P,PP(4)),(KD,DK),(TDN,NDN),(DT,NDT),(TNSID,NSID),(TDA
     1,NDA),(NSIL(1),PP(7345)),(NDN(3),NDC(1)),(VA(1),C1(1)),(VA(150),C2
     2(1)),(VA(300),C3(1)),(NNN(1),SL(1))
      COMMON NTITLE,NSN,NDN,NSC,NDL,P,PP,NOP,AREA,AREAX,RX,RY,ZS,KC,MP,
     1RA,SP,NMS,KD,PT,V,PAF,CL,NDA,NDT,LD,LP,LI,FHP,ND,KX,KP,NP,X1,Y1,
     2DX,FAP,NHI,NHL,NVI,NVL,F,DY,NCLS,NSID,AMAP,NDO,MSDL,MSNOS,NSIL,FH,
     3FV,X,Y,VA,SL,C1,C2,C3,NNN,NDC,INC
      DIMENSION R(4,3),COSA(3,3),      T(3),DI(3,3)
      IF (SENSE LIGHT 4)28,10
C START OF AUXILIARY TRANSFORMATION
C THE SURFACE TO WHICH THE CS WILL BE MOVED WAS SELECTED IN CALLING PROG
C THE Z AXIS OF THE NEW CS IS THE SURFACE ORIENTATION VECTOR ERECTED
C ABOVE POINT 1 IN THE SURFACE. THE X-AXIS IS ALIGNED FROM POINT 1 TO
C POINT 2. THE Y-AXIS IS OBTAINED BY THE X-PRODUCT OF THE OTHER TWO.
 10   DO 12 M=1,3
 12   DI(M,1)=P(M,2,ND)-P(M,1,ND)
      DV=SQRTF(DI(1,1)**2+DI(2,1)**2+DI(3,1)**2)
      DO 13 M=1,3
C COMPUTE DIRECTION COSINES OF NEW X-AXIS RELATIVE TO OLD X-Y-Z
      COSA(1,M)=DI(M,1)/DV
C COMPUTE DIRECTION COSINES OF NEW Z-AXIS RELATIVE TO OLD X-Y-Z
C THE HEAD END OF THE UNIT VECTOR IS STORED AS POINT 1 IN ARRAY PP.   PP
```

Figure 41. Subroutine TXFRM Listing

Approved for Public Release

Contrails


```
C AND P ARE STAGGERED 1 POINT( 3 COORDINATES) THROUGH EQUIVALENCE.
 13    COSA(3,M)=PP(M,1,ND)-PP(M,2,ND)
C COMPUTE DIRECTION COSINES OF NEW Y-AXIS RELATIVE TO OLD X-Y-Z
C USE VECTOR CROSS OF OTHER COMPONENTS.
      COSA(2,1)=COSA(3,2)*COSA(1,3)-COSA(1,2)*COSA(3,3)
      COSA(2,2)=COSA(1,1)*COSA(3,3)-COSA(3,1)*COSA(1,3)
      COSA(2,3)=COSA(3,1)*COSA(1,2)-COSA(1,1)*COSA(3,2)
C COMPUTE TRANSLATION COMPONENTS H,K,L MOVING OLD ORIGIN TO NEW ORIGIN
C AT POINT 1 IN SURFACE.
      DO 15 K=1,3
 15   T(K)=-P(1,1,ND)*COSA(K,1)-P(2,1,ND)*COSA(K,2)-P(3,1,ND)*COSA(K,3)
      KM=2
      GO TO 310
C START OF PRIMARY TRANSFORMATION SECTION
C SELECT TRANSFORMATION DATA NAME
28    NC=LD(KP+2)
C PICKUP TXFRM DATA FROM NDL
      NC=NDL(NC)
C SELECT MIDDLE POINT FOR MULTIPLE USE LATER.
      NP=KD(3,NC)
C COMPUTE A FOURTH POINT FROM THE THREE COORDINATES IN SURFACE DATA,
C NECESSARILY NOT IN THE PLANE OF THE OTHER THREE. THIS POINT CORRES-
C PONDS TO THE FOURTH POINT WHICH WAS CREATED IN LIKE MANNER USING THE
C THREE POINTS GIVEN IN TRANSFORMATION DATA(SEE MAIN  PROGRAM)
      CALL UNIVEC(O,ND,KD(2,NC),NP,KD(4,NC))
      R(1,1)=P(1,NP,ND)+V(1)
      R(1,2)=P(2,NP,ND)+V(2)
      R(1,3)=P(3,NP,ND)+V(3)
C THE FOLLOWING FUNDAMENTAL EQUATION IS SOLVED FOR THE NEW CS AXES
C DIRECTION COSINES RELATIIVE TO OLD, ALONG WITH THE TRANSLATION COMP

C X,Y,Z=XP*COS(A1,B1,G1)+YP*COS(A2,B2,G2)+ZP*COS(A3,B3,G3)+H,K,L

C THIS EQUATION IS WRITTEN FOUR TIMES  FORMING A 4X4 DETERMINANT, AND
C SOLVED FOR COS(A2,B2,G2) AND COS(A3,B3,G3) BY CRAMERS RULE. COS(A1,B1,
C G1) IS THEN DERIVED BY THE X-PRODUCT OF THE Y-Z UNIT VECTORS(DCOSINES)
C ARRAY R CONTAINS THE OLD COORDINATES,ARRAY PT CONTAINS THE NEW.
C COMPUTE DIRECTION COSINES OF NEW AXES BY MEANS OF A 4X4 DETERMINANT
C WITH 4TH COLUMN 1'S(COEFFICIENT OF TRANSLATION COMPONENT).
```

Figure 41. Subroutine TXFRM Listing
(continued)

Approved for Public Release

Contrails

```
7J362    TXFRM(CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63    11/07/73   PAGE 3

C COMPUTE Y AND Z AXIS DCOSINES BY CRAMERS RULE                               36207900
      DO 30 I=2,4                                                             36208000
      N=KD(I,NC)                                                              36208100
      DO 30 J=1,3                                                             36208200
 30   R(I,J)=P(J,N,ND)                                                        36208300
      N=0                                                                     36208400
      CD=1.                                                                   36208500
C START LOOP TO COMPUTE Y AND Z DCOSINES                                       36208600
 40   DO 200 I=2,3                                                            36208700
      DO 60  K=1,4                                                            36208800
C STORE THE ITH COLUMN OF R IN TEMPORARY C1                                   36208900
 60   C1(K)=R(K,I)                                                            36209000
      DO 150 J=1,3                                                            36209100
C ON THE FIRST PASS, COMPUTE THE COEFFICIENT DETERMINANT FROM R.              36209200
      IF(N) 80,100,80                                                         36209300
C PLACE X,Y AND Z VALUES FOR POINTS 1-4 SUCCESSIVELY FROM PK INTO R ITH       36209400
 80   DO 90 K=1,4                                                             36209500
 90   R(K,I)=PT(J,K,NC)                                                       36209600
C COMPUTE COMMON FACTOR IN EXPANDED DETERMINANT                               36209700
 100  A= R(3,3)-R(4,3)                                                        36209800
      B= R(3,2)-R(4,2)                                                        36209900
      C= R(3,2)*R(4,3)-R(4,2)*R(3,3)                                          36210000
      D= R(3,1)-R(4,1)                                                        36210100
      E= R(3,1)*R(4,3)-R(4,1)*R(3,3)                                          36210200
      F= R(3,1)*R(4,2)-R(4,1)*R(3,2)                                          36210300
C COMPUTE COEFFICIENT DETERMINANT ON FIRST PASS, AND DIRECTION COSINES         36210400
C ON SUCCESSIVE PASSES                                                        36210500
      COSA(J,I)=  (R(1,1)*(A*R(2,2)-B*R(2,3)+C)+R(1,3)*(B*R(2,1)-D*R(2,236210600
     1)+F)-R(1,2)*(A*R(2,1)-D*R(2,3)+ E)-C*R(2,1)+E*R(2,2)-F*R(2,3))/CD 36210700
      IF(N)150,120,150                                                        36210800
 120  CD=COSA(1,2)                                                            36210900
      N=1                                                                     36211000
      GO TO 40                                                                36211100
 150  CONTINUE                                                                36211200
C RESTORE ITH COLUMN OF R FROM TEMPORARY C1                                   36211300
      DO 170 K=1,4                                                            36211400
 170  R(K,I)=C1(K)                                                            36211500
 200  CONTINUE                                                                36211600
C COMPUTE THE X-AXIS DCOSINES BY THE VECTOR X-PRODUCT OF YXZ DCOSINES.        36211700
```

Figure 41. Subroutine TXFRM Listing (continued)

Approved for Public Release

Contrails

```
7J362   TXFRM(CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63   11/07/73  PAGE 4
      COSA(1,1)=COSA(2,2)*COSA(3,3)-COSA(2,3)*COSA(3,2)                 36211800
      COSA(2,1)=COSA(1,3)*COSA(3,2)-COSA(1,2)*COSA(3,3)                 36211900
      COSA(3,1)=COSA(1,2)*COSA(2,3)-COSA(1,3)*COSA(2,2)                 36212000
C COMPUTE TRANSLATION COMPONENTS H,L,K                                   36212100
      DO  300 I=1,3                                                     36212200
 300  T(I)=PT(I,2,NC)-R(2,1)*COSA(I,1)-R(2,2)*COSA(I,2)-R(2,3)*COSA(I,3)36212300
      KM=1                                                              36212400
      KX=KP+5                                                           36212500
      SENSE LIGHT 2                                                     36212600
 310  DO 500  K=1,KM                                                    36212700
      M=KX+K                                                            36212800
      IF (SENSE LIGHT 2)320,330                                         36212900
 320  LP(KP)=M                                                          36213000
      GO TO 335                                                         36213100
 330  ND=LP(K)                                                          36213200
      LP(K)=M                                                           36213300
 335  NOP(M)=NOP(ND)                                                    36213400
      J2=NOP(M)+2                                                       36213500
C TRANSFORM ALL COORDINATES TO NEW CS  AND STORE IN M                   36213600
      DO 500 I=1,J2                                                     36213700
      DO 500 J=1,3                                                      36213800
      PP(J,I,M)=PP(1,I,ND)*COSA(J,1)+PP(2,I,ND)*COSA(J,2)+PP(3,I,ND)*   36213900
     1 COSA(J,3)+T(J)                                                   36214000
      IF(PP(J,I,M))460,500,460                                          36214100
 460  IF(ABSF(PP(J,I,M))-.0001)480,480,500                              36214200
 480  PP(J,I,M)=0.                                                      36214300
 500  CONTINUE                                                          36214400
 700  RETURN                                                            36214500
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

Figure 41. Subroutine TXFRM Listing (continued)

Approved for Public Release

Contrails

STORAGE NOT USED BY PROGRAM

DEC	OCT	DEC	OCT
702	01276	14637	34455

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
AMAP	15169	35501	AREA	21067	51113	AREAX	21011	51023	C1	22094	53116
C2	21945	52671	C3	21795	52443	CL	16140	37414	DK	22154	53212
DT	22102	53126	DX	15246	35616	DY	15179	35513	FAP	15185	35521
FHP	16119	37367	FH	15011	35243	F	15180	35514	FV	14950	35146
INC	14649	34471	KC	20976	50760	KD	22154	53212	KP	15492	36204
KX	15493	36205	LD	16129	37401	LI	16121	37371	LP	16123	37373
MP	20942	50716	MSDL	15167	35477	MSNOS	15023	35257	NCLS	15178	35512
NDA	22100	53124	NDC	22112	53140	NDL	21157	51245	NDN	22114	53142
NDO	15168	35500	ND	15494	36206	NDT	22102	53126	NHI	15184	35520
NHL	15183	35517	NMS	16418	40042	NNN	21693	52275	NOP	21101	51155
NP	15491	36203	NSC	21213	51335	NSID	22101	53125	NSIL	25217	61201
NSN	21269	51425	NTITLE	21293	51455	NVI	15182	35516	NVL	15181	35515
PAF	16151	37427	PP	32561	77461	P	32558	77456	PT	16274	37622
RA	16454	40106	RX	21009	51021	RY	20998	51006	SL	21693	52275
SP	16445	40075	TDA	22100	53124	TDN	22114	53142	TNSID	22101	53125
VA	22094	53116	V	16154	37432	X1	15490	36202	X	14889	35051
Y1	15368	36010	Y	14769	34661	ZS	20987	50773			

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
COSA	686	01256	DI	677	01245	R	698	01272	T	701	01275

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
A	668	01234	B	667	01233	CD	666	01232	C	665	01231
D	664	01230	DV	663	01227	E	662	01226	I	661	01225
J2	660	01224	J	659	01223	KM	658	01222	K	657	01221
M	656	01220	NC	655	01217	N	654	01216			

Figure 42. Subroutine TXFRM Core Storage Map

Approved for Public Release

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
1)	613	01145	2)	595	01123	3)	604	01134	6)	607	01137
A)104	562	01062	A)1G1	571	01073	A)1G2	580	01104	C)G0	625	01161
C)G1	626	01162	C)G2	627	01163	C)G4	628	01164	C)G5	629	01165
C)G6	630	01166	C)G7	631	01167	C)100	632	01170	C)102	633	01171
C)103	634	01172	C)104	635	01173	C)106	636	01174	C)107	637	01175
C)108	638	01176	C)109	639	01177	C)10A	640	01200	C)10B	641	01201
C)1G0	642	01202	C)1G1	643	01203	C)1G2	644	01204	C)1G4	645	01205
C)1G5	646	01206	C)1G6	647	01207	C)1G7	648	01210	C)200	649	01211
C)201	650	01212	C)202	651	01213	C)203	652	01214	C)204	653	01215
D)109	190	00276	D)10D	221	00335	D)10E	234	00352	D)112	478	00736
D)208	122	00172	D)20F	239	00357	D)20P	375	00567	D)214	515	01003
D)406	103	00147	D)40H	260	00404	D)40U	447	00677	D)413	508	00774
D)60H	259	00403	D)614	514	01002	D)70H	258	00402	D)714	513	01001
E)E	236	00354	E)G	245	00365	E)M	357	00545	E)Q	381	00575
E)17	539	01033	E)10L	272	00420						

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
SQRT	0	00000	UNIVEC	1	00001						

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

SQRT UNIVEC

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
10	8	00030	12	9	00042	13	13	00107	15	18	00150
28	21	00173	30	32	00320	40	35	00336	60	37	00360
80	40	00407	90	41	00407	100	42	00422	120	50	00547
150	53	00561	170	55	00570	200	56	00576	300	61	00650
310	65	00700	320	68	00715	330	70	00721	335	72	00737
460	78	01023	480	79	01030	500	80	01035	700	81	01056

Figure 42. Subroutine TXFRM Core Storage Map
(continued)

Approved for Public Release

Contrails

```
7J363    DOICU(CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63    11/09/73  PAGE 1

C DOICU(CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63 36300100
      SUBROUTINE DOICU                                                  36300200
C THIS SUBROUTINE DETERMINES WHETHER THE SURFACES SEE EACH OTHER IN     36300300
C WHOLE OR IN PART, AND IF IN PART, COMPUTES THE COORDINATES AND AREA OF36300400
C THE PORTION OF EACH SURFACE WHICH IS SEEN BY THE OTHER                36300500
      DIMENSION  NTITLE(24),NSN(56),TDN(12),NDN(12),NCLS(9 ),NSC(56),   36300600
     1AREA(56),NDL(56),NOP(34),P(3,102,34),ZS(11),RX(11),RY(11),KC(34),M36300700
     2P(4,102,11),RA(9),SP(3,9),NMS(12,12),DK(4,10),KD(4,10),PT(3,4,10),36300800
     3PP(3,102,34),V(3),PAF(11),CL(11),NDA(6),TDA(6),LD(6),LP(2),LI(2), 36300900
     4AREAX(2),INC(12),FHP(25,25),X1(61,2),Y1(61,2),DX(61),MSDL(12,12), 36301000
     5MSNOS(12),FH(61),FV(61),NSIL(120,25),X(120),Y(120),NDC(10),       36301100
     6SL(4,100),VA(4,100),C1(102),C2(102),C3(102),NNN(100,2)            36301200
      EQUIVALENCE (P,PP(4)),(KD,DK),(TDN,NDN),(DT,NDT),(TNSID,NSID),(TDA36301300
     1,NDA),(NSIL(1),PP(7345)),(NDN(3),NDC(1)),(VA(1),C1(1)),(VA(150),C236301400
     2(1)),(VA(300),C3(1)),(NNN(1),SL(1))                               36301500
      COMMON NTITLE,NSN,NDN,NSC,NDL,P,PP,NOP,AREA,AREAX,RX,RY,ZS,KC,MP, 36301600
     1RA,SP,NMS,KD,PT,V,PAF,CL,NDA,NDT,LD,LP,LI,FHP,ND,KX,KP,NP,X1,Y1,  36301700
     2DX,FAP,NHI,NHL,NVI,NVL,F,DY,NCLS,NSID,AMAP,NDO,MSDL,MSNOS,NSIL,FH,36301800
     3FV,X,Y,VA,SL,C1,C2,C3,NNN,NDC,INC                                 36301900
      IF(SENSE LIGHT 4)400,450                                          36302000
400   KL=1                                                              36302100
      GO TO 34000                                                       36302200
450   KL=2                                                              36302300
      DO 10000 KP=1,2                                                   36302400
C INITIALIZE SENSE LIGHTS                                               36302500
      SENSE LIGHT 0                                                     36302600
C IF SURFACE KP IS NONPLANAR, DO NOT CHECK BISECTION OF SURFACE KL      36302700
      JP=LD(KP)                                                         36302800
      IF(NSC(JP))9000,9000,500                                          36302900
C SELECT POSITION OF SURFACE KP IN ARRAY P                              36303000
500   JP=LP(KP)                                                         36303100
C DO LIKEWISE FOR SURFACE KL                                            36303200
      JL=LP(KL)                                                         36303300
C NP= NO.OF POINTS DEFINING  SURFACE JL                                 36303400
      NP=NOP(JL)                                                        36303500
C COMPUTE COMPONENTS OF UNIT VECTOR IN SURFACE KP.                      36303600
      DXP=PP(1,1,JP)-PP(1,2,JP)                                         36303700
      DYP=PP(2,1,JP)-PP(2,2,JP)                                         36303800
      DZP=PP(3,1,JP)-PP(3,2,JP)                                         36303900
```

Figure 43. Subroutine DOICU Listing

Approved for Public Release

Contrails

```
7J363   DOICU(CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63   11/09/73  PAGE 2
      DO 6000  I=1,NP                                                   36304000
C COMPUTE COMPONENTS OF VECTOR FROM POINT 1 IN KP (UNIT VECTOR ORIGIN)  36304100
C TO POINT I IN SURFACE KL.                                             36304200
      DXL= P(1,I,JL)-P(1,1,JP)                                          36304300
      DYL= P(2,I,JL)-P(2,1,JP)                                          36304400
      DZL= P(3,I,JL)-P(3,1,JP)                                          36304500
C COMPUTE THE DOT PRODUCT RESULTING FROM UNIT VECTOR IN DP AND VECTOR   36304600
C FORMED BY THE KP UNIT VECTOR ORIGIN AND POINT I IN SURFACE KL         36304700
      CS=DXL*DXP+DYL*DYP+DZL*DZP                                        36304800
C IF THE DOT PRODUCT IS POS, GO TO SET SL1. IF 0, CONTINUE TO NEXT PT.- 36304900
C IF NEG, COMPUTE COSINE AND COMPARE WITH TOLERANCE                     36305000
      IF(CS)1000,6000,4000                                              36305100
C IF COSINE IS NEG AND GREATER THAN TOLERANCE, GO TO SET SL2            36305200
1000  IF(CS/SQRTF(DXL**2+DYL**2+DZL**2)+.0001)5000,6000,6000            36305300
C SET  SL1 IF THIS POINT IS ABOVE THE REF PLANE OF SURFACE KP.          36305400
 4000 SENSE LIGHT 1                                                     36305500
C IF SL2 IS ON, THEN SURFACE KL IS BISECTED BY SURFACE KP               36305600
      IF(SENSE LIGHT 2)8000,6000                                        36305700
C SET  SL2 IF THIS POINT IS BELOW THE REF PLANE OF SURFACE KP.          36305800
 5000 SENSE LIGHT 2                                                     36305900
C IF SL1 IS ON, THEN SURFACE KL IS BISECTED BY THE REF PLANE OF SURF KP 36306000
      IF(SENSE LIGHT 1)8000,6000                                        36306100
 6000 CONTINUE                                                          36306200
C FLOW TO THIS POINT MEANS SURFACE KL IS NOT BISECTED BY KP.            36306300
C IF SL1 IS NOT ON, NO POINT IN KL IS ABOVE SURFACE KP REF PLANE .      36306400
      IF(SENSE LIGHT 1)9000,7000                                        36306500
C NONE OF KL IS SEEN BY KP, SET FLAG TO TRIGGER DIAGNOSTICS, RETURN MP  36306600
 7000 LI(1) =0                                                          36306700
      GO TO 36000                                                       36306800
C PART OF KL IS SEEN BY KP                                              36306900
 8000 LI(KL)=-1                                                         36307000
C ALL OF KL IS SEEN BY KP (LI(KL)=1, INTIAL VALUE)                      36307100
 9000 KL=1                                                              36307200
C TEST VIEW FROM OTHER SURFACE REF PLANE                                36307300
10000 CONTINUE                                                          36307400
C IF A SURFACE IS TO BE BISECTED, ALL COORDINATES ARE TRANSFORMED TO THE36307500
C REF PLANE OF THE OTHER SURFACE. THEN, THE POINT WHERE Z-COORDINATES   36307600
C CHANGE SIGN ARE DETECTED AND A NEW POINT COMPUTED WHERE Z=0. RENUMBER-36307700
C ING OF POINTS IS PERFORMED AS THE SURFACE IS REDEFINED TO EXCLUDE ALL 36307800
```

Figure 43. Subroutine DOICU Listing (continued)

Approved for Public Release

Contrails


```
C NEG Z SURFACES.                                                           36307900
C                                                                           36308000
C START WITH THE REF PLANE IN SURFACE 2.                                     36308100
      SENSE LIGHT 0                                                         36308200
      KP=2                                                                  36308300
C THIS NUMBER CONTROLS LOCATION OF TRANSFORMED SURFACE COORD IN ARRAY P     36308400
      KX=4                                                                  36308500
      KL=1                                                                  36308600
10500 GO TO(11000,12000),KL                                                 36308700
C IF SURFACE 2 IS NOT BISECTED, NO AUXILIARY TRANSFORMATION IS REQUIRED    36308800
C FOR THAT PURPOSE. HOWEVER, SURFACE 1 MUST BE IN THE XY PLANE WITH THE    36308900
C ORIENTATION VECTOR POINTING TOWARD THE Z-AXIS, IF NOT ALREADY THERE      36309000
11000 IF(LI(KL))12000,7000,34000                                            36309200
C SELECT POSITION OF SURFACE KP IN ARRAY P                                  36309300
12000 ND=LP(KP)                                                             36309400
C PICKUP LAST POINT. POINTS 1,2 AND LAST POINT FORM REFERENCE PLANE.        36309500
      NP=NOP(ND)                                                            36309600
C IS THE REF PLANE OF SURF KP IN XY PLANE WITHIN TOLERANCE INDICATED        36309700
C FLOW TO 15000 INDICATES THE SURFACE IS NOT IN XY PLANE.                   36309730
      IF( ABSF(P(3, 1,ND))-.0001)13000,13000,15000                          36309800
13000 IF( ABSF(P(3, 2,ND))-.0001)14000,14000,15000                          36309900
14000 IF( ABSF(P(3,NP,ND))-.0001)14500,14500,15000                          36310000
C FLOW TO 15000 INDICATES ORIENTATION VECTOR IS NOT POINTING TO +Z AXIS    36310100
14500 IF(PP(3,1,ND))15000,15000,15500                                       36310150
15000 IF(SENSE LIGHT 2)15100,15200                                          36310200
15100 SENSE LIGHT 4                                                         36310300
      GO TO 36000                                                           36310400
15200 CALL TXFRM                                                            36310500
C IF SURFACE 2 IS A SPHERE, LOOK AT Z-COORDINATE FROM SURFACE 1             36310600
15500 N2=LD(2)                                                              36310700
      IF(NSC(N2)+7)15700,15600,15700                                        36310800
15600 IN=LP(2)                                                              36310900
      JP=NDL(N2)                                                            36311000
      H=P(3,1,IN)+RA(JP)                                                    36311100
15650 IF(H)7000,7000, 15655                                                 36311200
15655 IF(P(3,1,IN)-RA(JP))15660,36000,36000                                 36311300
15660 AREAX(2)=6.2831853*RA(JP)*H                                           36311400
      LI(2)=-1                                                              36311500
      GO TO 36000                                                           36311600
```

Figure 43. Subroutine DOICU Listing (continued)

Approved for Public Release

Contrails


```
C PROCEED TO BISECT SURFACE KL IF REQUIRED                                   36311700
15700 IF(LI(KL))16000,7000,34000                                             36311800
C PICKUP SUBSCRIPTS OF SURFACES IN ARRAY P                                   36311900
16000 JL=LP(KL)                                                              36312000
      NP=NOP(JL)                                                             36312100
C TEST Z-COORDINATES OF SURFACE KL, COMPUTE X,Y AT TRANSITION AND RENUM-36312200
C BER POINTS ABOVE HORIZON.                                                  36312300
      K=0                                                                    36312400
      SENSE LIGHT 0                                                          36312500
      DO 22000  M=1,NP                                                       36312600
C IF Z IS POSITIVEOR ZERO, USE THE POINT. TURN ON SL1 IF ZERO.               36312700
      IF(P(3,M,JL))17000,18000,19000                                         36312800
C IF NEXT POINT IS - OR 0,CONTINUE. IF +,GO TO COMPUTE  X,Y AT HORIZON. 36312900
17000 IF(P(3,M+1,JL))22000,22000,21000                                       36313000
18000 SENSE LIGHT 1                                                          36313100
C ADVANCE TO THE NEXT SUBSCRIPT TO NEW POSITION IN KP OF ARRAY P.           36313200
19000 K=K+1                                                                  36313300
      P(1,K,KL)=P(1,M,JL)                                                    36313400
      P(2,K,KL)=P(2,M,JL)                                                    36313500
      P(3,K,KL)=P(3,M,JL)                                                    36313600
C TEST NEXT POINT ON BOUNDARY-IF BELOW(NEG),TEST SL1-IF ZERO OR POSITIVE36313700
C GO TO CONTINUE THE LOOP TO PICKUP ON NEXT GO ROUND.                       36313800
      IF(P(3,M+1,JL))20000,22000,22000                                       36313900
C IF THE LAST POINT WAS NOT ZERO, THE VALUE OF X,Y AT THE HORIZON MUST  36314000
C BE COMPUTED.                                                               36314100
20000 IF(SENSE LIGHT 1)22000,21000                                           36314200
21000 K=K+1                                                                  36314300
C COMPUTE X,Y AT HORIZON(Z=0) FROM TRACE OF LINE SEGMENT M-M+1 ON XZ AND36314400
C YZ PLANES.                                                                 36314500
      ZC=P(3,M,JL)/(P(3,M+1,JL)-P(3,M,JL))                                   36314600
      DO 21500 I=1,2                                                         36314700
21500 P(I,K,KL)=P(I,M,JL)-ZC*(P(I,M+1,JL)-P(I,M,JL))                         36314800
      P(3,K,KL)=0.                                                           36314900
22000 CONTINUE                                                               36315000
      LP(KL)=KL                                                              36315100
      NOP(KL)=K                                                              36315200
C COMPUTE ORIENTATION UNIT VECTOR COMPONENTS FROM OLD DATA(ARRAY JL) AND36315300
C USE TO RESTORE UNIT VECTOR IN NEW ARRAY KL, AND FOR USE IN AREA COMP- 36315400
C UTATION- ADD POINT K+1 EQUAL TO POINT 1 FOR USE LATER                      36315500
```

Figure 43. Subroutine DOICU Listing
(continued)

Approved for Public Release

```
      K=K+1
      SENSE LIGHT 1
      SENSE LIGHT 2
      DO 32000   M=1,3
      V(M)=PP(M,1,JL)-PP(M,2,JL)
      PP(M,1,KL)=PP(M,2,KL)+V(M)
      P(M,K,KL)=P(M,1,KL)
      IF(SENSE LIGHT 1)26000,28000
26000 IF(ABSF(V(M))-.1)27000,27000,31000
27000 SENSE LIGHT 1
28000 IF(SENSE LIGHT 2)29000,30000
29000 N1=M
      GO TO 32000
30000 N2=M
      GO TO 32000
31000 DC=V(M)
32000 CONTINUE
C
      AREAX(KL)=0.
C SAVE POINT 1
      P1=PP(N1,1,KL)
C PUT COORDINATE OF LAST POINT IN THIS SPOT FOR AREA COMPUTATION
      PP(N1,1,KL)=PP(N1,K,KL)
C COMPUTE PROJECTED AREA ON N1,N2 PRINCIPAL PLANE
      DO   33000 M=2,K
33000 AREAX(KL)=AREAX(KL)+PP(N2,M,KL)*(PP(N1,M-1,KL)-PP(N1,M+1,KL))
C FIND PLANE AREA
      AREAX(KL)=ABSF(AREAX(KL)/DC/2.)
C RESTORE COORDINATE IN UNIT VECTOR
      PP(N1,1,KL)=P1
C GO TO SURFACE 2 BISECTION IF REQD
34000 KP=1
      KX=2
35000 IF(KL-2)35500,36000,36000
35500 KL=2
      GO TO 10500
36000 RETURN
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

Figure 43. Subroutine DOICU Listing (continued)

Approved for Public Release

STORAGE NOT USED BY PROGRAM

DEC	OCT	DEC	OCT
831	01477	14637	34455

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
AMAP	15169	35501	AREA	21067	51113	AREAX	21011	51023	C1	22094	53116
C2	21945	52671	C3	21795	52443	CL	16140	37414	DK	22154	53212
DT	22102	53126	DX	15246	35616	DY	15179	35513	FAP	15185	35521
FHP	16119	37367	FH	15011	35243	F	15180	35514	FV	14950	35146
INC	14649	34471	KC	20976	50760	KD	22154	53212	KP	15492	36204
KX	15493	36205	LD	16129	37401	LI	16121	37371	LP	16123	37373
MP	20942	50716	MSDL	15167	35477	MSNOS	15023	35257	NCLS	15178	35512
NDA	22100	53124	NDC	22112	53140	NDL	21157	51245	NDN	22114	53142
NDO	15168	35500	ND	15494	36206	NDT	22102	53126	NHI	15184	35520
NHL	15183	35517	NMS	16418	40042	NNN	21693	52275	NOP	21101	51155
NP	15491	36203	NSC	21213	51335	NSID	22101	53125	NSIL	25217	61201
NSN	21269	51425	NTITLE	21293	51455	NVI	15182	35516	NVL	15181	35515
PAF	16151	37427	PP	32561	77461	P	32558	77456	PT	16274	37622
RA	16454	40106	RX	21009	51021	RY	20998	51006	SL	21693	52275
SP	16445	40075	TDA	22100	53124	TDN	22114	53142	TNSID	22101	53125
VA	22094	53116	V	16154	37432	X1	15490	36202	X	14889	35051
Y1	15368	36010	Y	14769	34661	ZS	20987	50773			

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
CS	830	01476	DC	829	01475	DXL	828	01474	DXP	827	01473
DYL	826	01472	DYP	825	01471	DZL	824	01470	DZP	823	01467
H	822	01466	IN	821	01465	I	820	01464	JL	819	01463
JP	818	01462	KL	817	01461	K	816	01460	M	815	01457
N1	814	01456	N2	813	01455	P1	812	01454	ZC	811	01453

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

Figure 44. Subroutine DOICU Core Storage Map

Contrails

Approved for Public Release

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
1)	780	01414	2)	762	01372	3)	769	01401	6)	774	01406
A)1G0	673	01241	A)1G2	682	01252	A)1G3	691	01263	A)1G4	706	01302
A)1G6	715	01313	A)1GC	730	01332	A)1GD	743	01347	C)G0	784	01420
C)G1	785	01421	C)G2	786	01422	C)G3	787	01423	C)G5	788	01424
C)G6	789	01425	C)G7	790	01426	C)1G0	791	01427	C)1G1	792	01430
C)1G2	793	01431	C)1G3	794	01432	C)1G4	795	01433	C)1G5	796	01434
C)1G6	797	01435	C)1G7	798	01436	C)1G8	799	01437	C)1G9	800	01440
C)1GA	801	01441	C)1GB	802	01442	C)1GC	803	01443	C)1GD	804	01444
C)1GE	805	01445	C)1GF	806	01446	C)200	807	01447	C)201	808	01450
C)202	809	01451	C)203	810	01452	D)10D	178	00262	D)10H	230	00346
D)11H	566	01066	D)20F	188	00274	D)218	457	00711	D)21L	639	01177
D)30D	177	00261	D)30F	187	00273	D)30H	229	00345	D)31L	638	01176
D)410	369	00561	D)412	378	00572	D)415	402	00622	D)416	439	00667
D)41C	539	01033	D)41D	544	01040	D)41N	668	01234	D)50D	174	00256
D)512	377	00571	D)516	438	00666	D)51C	538	01032	D)51D	543	01037
D)51N	667	01233	D)610	368	00560	D)61N	664	01230	D)70D	176	00260
D)70H	228	00344	D)71N	666	01232	E)6	127	00177	E)7	152	00230
E)R	287	00437	E)V	324	00504	E)15	401	00621	E)1D	542	01036
E)1E	547	01043	E)1G	563	01063	E)1M	649	01211	E)115	404	00624
E)30D	172	00254									

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
SQRT	0	00000	TXFRM	1	00001						

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

SQRT TXFRM

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
400	7	00025	450	9	00044	500	14	00100	1000	26	00201
4000	27	00232	5000	29	00240	6000	31	00246	7000	33	00263
8000	35	00270	9000	36	00275	10000	37	00313	10500	42	00347
11000	43	00351	12000	44	00354	13000	47	00401	14000	48	00406
14500	49	00413	15000	50	00416	15100	51	00420	15200	53	00422

Figure 44. Subroutine DOICU Core Storage Map (continued)

Approved for Public Release

Contrails

```
7J363   DOICU(CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63   11/09/73  PAGE 8

15500    54 00427     15600    56 00440     15650    59 00461     15655    60 00465
15660    61 00471     15700    64 00501     16000    65 00505     17000    71 00565
18000    72 00573     19000    73 00574     20000    78 00616     21000    79 00625
21500    82 00670     22000    84 00712     26000    95 01025     27000    96 01034
28000    97 01041     29000    98 01044     30000   100 01056     31000   102 01064
32000   103 01067       232   108 01145      1232   111 01200      2232   113 01205
 2732   114 01213      3232   116 01235
```

Figure 44. Subroutine DOICU Core Storage Map
(continued)

Approved for Public Release

Contrails

```
7J364    MAP (CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63     11/07/73  PAGE 1

C MAP (CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63  36400100
      SUBROUTINE  MAP                                                    36400200
C GIVEN THE COORDINATES OF THE SURFACE FROM WHICH THE FACTOR IS DESIRED,36400300
C THIS SUBROUTINE COMPUTES THOSE POINTS ON THE SURFACE FROM WHICH THE   36400400
C PLANE POINT FACTOR TO THE RECEIVING SURFACE WILL BE COMPUTED.         36400500
      DIMENSION  NTITLE(24),NSN(56),TDN(12),NDN(12),NCLS(9 ),NSC(56),   36400600
     1AREA(56),NDL(56),NOP(34),P(3,102,34),ZS(11),RX(11),RY(11),KC(34),M36400700
     2P(4,102,11),RA(9),SP(3,9),NMS(12,12),DK(4,10),KD(4,10),PT(3,4,10),36400800
     3PP(3,102,34),V(3),PAF(11),CL(11),NDA(6),TDA(6),LD(6),LP(2),LI(2), 36400900
     4AREAX(2),INC(12),FHP(25,25),X1(61,2),Y1(61,2),DX(61),MSDL(12,12), 36401000
     5MSNOS(12),FH(61),FV(61),NSIL(120,25),X(120),Y(120),NDC(10),       36401100
     6SL(4,100),VA(4,100),C1(102),C2(102),C3(102),  N(100,2)            36401200
      EQUIVALENCE (P,PP(4)),(KD,DK),(TDN,NDN),(DT,NDT),(TNSID,NSID),(TDA36401300
     1,NDA),(NSIL(1),PP(7345)),(NDN(3),NDC(1)),(VA(1),C1(1)),(VA(150),C236401400
     2(1)),(VA(300),C3(1)),(  N(1),SL(1))                               36401500
      COMMON NTITLE,NSN,NDN,NSC,NDL,P,PP,NOP,AREA,AREAX,RX,RY,ZS,KC,MP, 36401600
     1RA,SP,NMS,KD,PT,V,PAF,CL,NDA,NDT,LD,LP,LI,FHP,ND,KX,KP,NP,X1,Y1,  36401700
     2DX,FAP,NHI,NHL,NVI,NVL,F,DY,NCLS,NSID,AMAP,NDO,MSDL,MSNOS,NSIL,FH,36401800
     3FV,X,Y,VA,SL,C1,C2,C3,N,NDC,INC                                   36401900
C SET UP HORIZONTAL AND VERTICAL INCREMENTS                              36402000
C CONVERT INCREMENT NO INTO NO OF INCREMENTS                             36402100
      IF(LD(5)-11)20,10,20                                               36402200
10    NHI=2                                                              36402300
      GO TO 30                                                           36402400
20    NHI=LD(5)*6                                                        36402500
30    NHL=NHI+1                                                          36402600
      IF(LD(6)-11)50,40,50                                               36402700
40    NVI=2                                                              36402800
      GO TO 60                                                           36402900
50    NVI=LD(6)*6                                                        36403000
60    NVL=NVI+1                                                          36403100
 90   ND=LP(1)                                                           36403200
      NP=NOP(ND)                                                         36403300
C DETERMINE THE SUBSCRIPTS OF THE COORDINATES HAVING THE MIN AND THE MAX36403400
C VALUE OF Y.                                                            36403500
      YMIN=1.E+30                                                        36403600
      YMAX=-1.E+30                                                       36403700
      DO 200 K=1,NP                                                      36403800
      IF(P(2,K,ND)-YMIN)110,110,120                                      36403900
```

Figure 45. Subroutine MAP Listing

Approved for Public Release

Contrails


```
 110   YMIN=P(2,K,ND)                                                   36404000
       MN =K                                                            36404100
 120   IF(P(2,K,ND)-YMAX)200,200,175                                    36404200
 175   YMAX=P(2,K,ND)                                                   36404300
       MX = K                                                           36404400
 200   CONTINUE                                                         36404500
       N(1,1)=MN                                                        36404600
       N(1,2)=MN                                                        36404700
C STARTING FROM YMIN, AND MOVING TOWARD YMAX CLOCKWISE, STORE SUBSCRIPTS36404800
C OF POINTS IN ARRAY P DEFINING THE SURFACE INTO THE ARRAY N(  ,1). DO  36404900
C THE SAME FOR POINTS ON THE RIGHT COUNTERCLOCKWISE ,BUT STORE IN N( ,2)36405000
 220   I1=-1                                                            36405100
 225   DO 300 I=1,2                                                     36405200
       DO 290   J=2,NP                                                  36405300
       N(J,I)=N(J-1,I)+I1                                               36405400
       IF(I1)245,260,230                                                36405500
  230  IF(N(J,I)-NP) 260,260,240                                        36405600
C IF THE LAST POINT IS ENCOUNTERED BEFORE YMAX, 1 IS THE NEXT POINT     36405700
 240   N(J,I)=1                                                         36405800
       GO TO 260                                                        36405900
 245   IF(N(J,I))260,250,260                                            36406000
C IF POINT 1 IS ENCOUNTERED PRIOR TO YMAX, THE LAST POINT IS THE NEXT   36406100
C POINT                                                                 36406200
  250 N (J,I)=NP                                                        36406300
C GO TO THE OTHER SIDE IF YMAX IS ENCOUNTERED                           36406400
  260 IF(N(J,I)-MX)290,295,290                                          36406500
  290 CONTINUE                                                          36406600
 295   I1=1                                                             36406700
C THE FOLLOWING MANEUVER PREVENTS DIFFICULTIES IN MAPPING THE TOPMOST   36406800
C LINES OF THE SURFACE.                                                 36406900
       N(J+1,I)=MX                                                      36407000
       N(J+2,I)=MX                                                      36407100
  300 CONTINUE                                                          36407200
C THE FOLLOWING INSTRUCTIONS COMPUTE THE POINTS OF INTERSECTION OF EACH 36407300
C HORIZONTAL GRID LINE AND THE LINE SEGMENTS FORMING THE SURF BOUNDARY  36407400
C COMPUTE THE VERTICAL INCREMENT                                        36407500
 390   DY=(YMAX-YMIN)/FLOATF(NVI)                                       36407600
       Y1(1)=YMIN                                                       36407700
C COMPUTE THE HORIZONTAL GRID LINES                                     36407800
```

Figure 45. Subroutine MAP Listing (continued)

Approved for Public Release

Contrails

```
7J364   MAP (CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63    11/07/73  PAGE 3
      Y1(NVL)=YMAX                                                        36407900
      DO 400  I=2,NVI                                                     36408000
  400 Y1(I)=Y1(I-1)+DY                                                    36408100
C COMPUTE VALUE OF TOLERANCE FOR USE IN MAPPING SURFACE 1.                36408200
      DT=.01*DY                                                           36408300
C STARTING WITH THE LEFT BOUNDARY, COMPUTE THE INTERSECTION OF HORZ       36408400
C GRID LINES AND LINE SEGMENTS FORMING BOUNDARY OF SURFACE 1.             36408500
      DO 700 I=1,2                                                        36408600
C SET MAPPING LINE COUNTER                                                36408700
      K=1                                                                 36408800
C SET UP LOOP TO DETERMINE INTERSECTION OF MAPPING LINE WITH BOUNDARY     36408900
C LINE SEGMENT J1-J2                                                      36409000
      DO 690 J=1,NP                                                       36409100
      J1=N(J,I)                                                           36409200
      J2=N(J+1,I)                                                         36409300
      J3=N(J+2,I)                                                         36409400
C IS THE POINT J2 NEAR THE MAPPING LINE WITHIN THE TOLERANCE DT-YES,460-36409500
C NO,560                                                                  36409600
 440  PD=Y1(K)-P(2,J2,ND)                                                 36409700
      IF(ABSF(PD)-DT)460,460,560                                          36409800
C IF THE MAPPING LINE IS BELOW THE POINT J2, COMPUTE THE VALUE OF X AT    36409900
C THE INTERSECTION OF LINE J1-J2 AND THE MAPPING LINE(600)                36410000
C IF THE MAPPING LINE IS ABOVE THE POINT J2, CONTINUE J-LOOP TO SELECT    36410000
C NEXT LINE SEGMENT BUT DO NOT SELECT A NEW MAPPING LINE(690)             36411000
 560  IF(PD)600,460,690                                                   36411100
C COMPUTE X , GO TO NEXT MAPPING LINE BUT USE SAME BOUNDARY LINE SEGMENT36411200
600   X1(K,I)=P(1,J1,ND)+(Y1(K)-P(2,J1,ND))*(P(1,J2,ND)-P(1,J1,ND))/(P(236411300
     1,J2,ND)-P(2,J1,ND))                                                 36411400
      K=K+1                                                               36411500
      GO TO 440                                                           36411600
C IS THE NEXT POINT (J3) ALSO NEAR THE MAPPING LINE -YES,480-NO,540       36411700
 460  IF(ABSF(Y1(K)-P(2,J3,ND))-DT)480,480,540                            36411800
C IF J3 IS NOT THE OUTERMOST POINT, CONTINUE J-LOOP WITH SAME MAP LINE. 36411900
C IF J3 IS THE OUTERMOST POINT, USE POINT AND SELECT NEXT MAPPING LINE. 36412000
C IF THE X-VALUES ARE EQUAL, USE J2 AND SELECT NEXT MAPPING LINE IF ANY.36412100
 480  IF(P(1,J2,ND)-P(1,J3,ND))500,540,520                                36412200
 500  GO TO(540,690),I                                                    36412300
 520  GO TO(690,540),I                                                    36412400
 540  X1(K,I)=P(1,J2,ND)                                                  36412500
```

Figure 45. Subroutine MAP Listing (continued)

Approved for Public Release

Contrails

```
7J364    MAP (CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63     11/07/73  PAGE 4
      IF(K-NVL)680,700,700                                            36412600
C GO TO NEXT MAPPING LINE AND NEXT BOUNDARY LINE SEGMENT               36412700
 680  K=K+1                                                           36412800
 690  CONTINUE                                                        36412900
 700  CONTINUE                                                        36413000
 800  HNI=NHI                                                         36413100
      AR=0.                                                           36413200
C COMPUTE THE MAPPING AREA                                             36413300
      DO 840 K=1,NVL                                                  36413400
      DXL=X1(K,2)-X1(K,1)                                             36413500
      AR=AR+DXL                                                       36413600
 840  DX(K)=DXL/HNI                                                   36413700
      AMAP   =(AR -(DXL +X1(1,2)-X1(1,1))/2.)*DY                      36413800
      RETURN                                                          36413900
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

Figure 45. Subroutine MAP Listing
(continued)

Approved for Public Release

Contrails

STORAGE NOT USED BY PROGRAM

DEC	OCT	DEC	OCT
510	00776	14637	34455

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
AMAP	15169	35501	AREA	21067	51113	AREAX	21011	51023	C1	22094	53116
C2	21945	52671	C3	21795	52443	CL	16140	37414	DK	22154	53212
DT	22102	53126	DX	15246	35616	DY	15179	35513	FAP	15185	35521
FHP	16119	37367	FH	15011	35243	F	15180	35514	FV	14950	35146
INC	14649	34471	KC	20976	50760	KD	22154	53212	KP	15492	36204
KX	15493	36205	LD	16129	37401	LI	16121	37371	LP	16123	37373
MP	20942	50716	MSDL	15167	35477	MSNOS	15023	35257	NCLS	15178	35512
NDA	22100	53124	NDC	22112	53140	NDL	21157	51245	NDN	22114	53142
NDO	15168	35500	ND	15494	36206	NDT	22102	53126	NHI	15184	35520
NHL	15183	35517	NMS	16418	40042	NOP	21101	51155	NP	15491	36203
N	21693	52275	NSC	21213	51335	NSID	22101	53125	NSIL	25217	61201
NSN	21269	51425	NTITLE	21293	51455	NVI	15182	35516	NVL	15181	35515
PAF	16151	37427	PP	32561	77461	P	32558	77456	PT	16274	37622
RA	16454	40106	RX	21009	51021	RY	20998	51006	SL	21693	52275
SP	16445	40075	TDA	22100	53124	TDN	22114	53142	TNSID	22101	53125
VA	22094	53116	V	16154	37432	X1	15490	36202	X	14889	35051
Y1	15368	36010	Y	14769	34661	ZS	20987	50773			

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
AR	509	00775	DXL	508	00774	HNI	507	00773	I1	506	00772
I	505	00771	J1	504	00770	J2	503	00767	J3	502	00766
J	501	00765	K	500	00764	MN	499	00763	MX	498	00762
PD	497	00761	YMAX	496	00760	YMIN	495	00757			

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
1)	479	00737	2)	462	00716	3)	469	00725	6)	473	00731
A)102	404	00624	A)1G1	417	00641	A)1G2	432	00660	A)1G3	447	00677
C)G1	483	00743	C)G2	484	00744	C)G3	485	00745	C)G4	486	00746

Figure 46. Subroutine MAP Core Storage Listing

Approved for Public Release

Contrails

```
7J364    MAP (CONFAC II) ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63    11/07/73  PAGE 6

C)101    487 00747       C)102    488 00750       C)1G1    489 00751       C)1G2    490 00752
C)1G3    491 00753       C)201    492 00754       C)202    493 00755       C)203    494 00756
D)113    307 00463       D)11A    359 00547       D)20D    124 00174       D)20R    221 00335
D)20T    253 00375       D)31A    358 00546       D)40N    173 00255       D)410    292 00444
D)412    303 00457       D)414    311 00467       D)415    320 00500       D)416    329 00511
D)418    347 00533       D)510    291 00443       D)60N    172 00254       D)71A    357 00545
  E)1     25 00031         E)4     41 00051         E)D    122 00172         E)G    140 00214
  E)H    145 00221       E)10R    219 00333

    EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

 EFN   IFN   LOC          EFN   IFN   LOC          EFN   IFN   LOC          EFN   IFN   LOC
  10     7 00032           20     9 00035           30    10 00041           40    12 00052
  50    14 00055           60    15 00061           90    16 00066          110    22 00133
 120    24 00137          175    25 00144          200    27 00150          220    30 00160
 225    31 00162          230    35 00207          240    36 00216          245    38 00223
 250    39 00227          260    40 00231          290    41 00247          295    42 00256
 300    45 00264          390    46 00267          400    50 00310          440    58 00376
 560    60 00407          600    61 00412          460    64 00445          480    65 00453
 500    66 00460          520    67 00464          540    68 00470          680    70 00523
 690    71 00534          700    72 00550          800    73 00557          840    78 00600
```

Figure 46. Subroutine MAP Core Storage Listing
(continued)

Approved for Public Release

Contrails

```
7J365    FACTOR(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63    11/07/73   PAGE 1

C FACTOR(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63 36500100
      SUBROUTINE FACTOR                                                 36500200
C THIS SUBROUTINE COMPUTES CONFIGURATION FACTORS FROM POINTS ON SURF 1  36500300
C TO SURFACE 2 BY A METHOD USING THE UNIT SPHERE. THE FORM FACTOR FROM  36500400
C SURFACE 1 TO 2 IS COMPUTED BY INTEGRATION OF ALL CONFIGURATION FACTORS36500500
C TO YIELD THE AREA-WEIGHTED MEAN.  TRAPEZOIDAL INTEGRATION IS USED.    36500600
      DIMENSION  NTITLE(24),NSN(56),TDN(12),NDN(12),NCLS(9 ),NSC(56),   36500700
     1AREA(56),NDL(56),NOP(34),P(3,102,34),ZS(11),RX(11),RY(11),KC(34),M36500800
     2P(4,102,11),RA(9),SP(3,9),NMS(12,12),DK(4,10),KD(4,10),PT(3,4,10),36500900
     3PP(3,102,34),V(3),PAF(11),CL(11),NDA(6),TDA(6),LD(6),LP(2),LI(2), 36501000
     4AREAX(2),INC(12),FHP(25,25),X1(61,2),Y1(61,2),DX(61),MSDL(12,12), 36501100
     5MSNOS(12),FH(61),FV(61),NSIL(120,25),XP(120),YP(120),NDC(10),     36501200
     6SL(4,100),VA(4,100),C1(102),C2(102),C3(102),NNN(103,2)            36501300
      EQUIVALENCE (P,PP(4)),(KD,DK),(TDN,NDN),(DT,NDT),(TNSID,NSID),(TDA36501400
     1,NDA),(NSIL(1),PP(7345)),(NDN(3),NDC(1)),(VA(1),C1(1)),(VA(150),C236501500
     2(1)),(VA(300),C3(1)),(NNN(1),SL(1))                               36501600
      COMMON NTITLE,NSN,NDN,NSC,NDL,P,PP,NOP,AREA,AREAX,RX,RY,ZS,KC,MP, 36501700
     1RA,SP,NMS,KD,PT,V,PAF,CL,NDA,NDT,LD,LP,LI,FHP,ND,KX,KP,NP,X1,Y1,  36501800
     2DX,FAP,NHI,NHL,NVI,NVL,F,DY,NCLS,NSID,AMAP,NDO,MSDL,MSNOS,NSIL,FH,36501900
     3FV,XP,YP,VA,SL,C1,C2,C3,NNN,NDC,INC                               36502000
      F=0.                                                              36502100
      J1 =LD(1)                                                         36502200
C LOCATE THE ARRAY CONTAINING THE FINAL COORDINATES OF SURFACE 2.       36502300
      J2=LP(2)                                                          36502400
C NP=NO. OF POINTS DEFINING SURFACE 2                                   36502500
      NP=NOP(J2)                                                        36502600
      ML=NP+1                                                           36502700
C COMPUTE A CONSTANT IN Z OF SURFACE 2  FOR LATER COMPUTATION OF VECTOR 36502800
C DOT PRODUCT                                                           36502900
      DO 860 J=1,NP                                                     36503000
  860 C1(J)=P(3,J,J2)*P(3,J+1,J2)                                       36503100
C START WITH LOWEST HORIZONTAL GRID LINE, MOVING UP TO YMAX             36503200
      DO 1000 K=1,NVL                                                   36503300
      FV(K)=0.                                                          36503400
C LOCATE THE POINTSFROM WHICH THE PLANE POINT FACTOR WILL BE COMPUTED-  36503500
      DO 890 J=1,ML                                                     36503600
C START AT LEFT BOUNDARY OF SURFACE1 AND MOVE TO RIGHT(CONSTANT Y)      36503700
      XP(J)=P(1,J,J2)-X1(K,1)                                           36503800
      YP(J)=P(2,J,J2)-Y1(K)                                             36503900
```

Figure 47. Subroutine FACTOR Listing

Approved for Public Release

Contrails


```
C ZERO OUT COMPUTATIONAL ERROR
      IF(ABSF(XP(J))-1.E-6)865,865,870
 865  XP(J)=0.
 870  IF(ABSF(YP(J))-1.E-6)875,875,890
 875  YP(J)=0.
 890  CONTINUE
C COMPUTE THE PART OF THE VECTOR CROSS  PRODUCT INVARIANT FOR EACH HORZ
C GRID LINE (CONSTANT Y AND Z)
      DO 900 J=1,NP
C COMPUTE FUNCTION OF SINE OF ANGLE FORMED BY J,J+1 IN SURFACE 2.
      C2(J)=(YP(J)*P(3,J+1,J2)- YP(J+1)*P(3,J,J2))**2
 900  C3(J)= YP(J)*YP(J+1)
C COMPUTE PLANE POINT FACTOR FUNCTION FOR EACH INCREMENT OF X ALONG GRID
      DO 987 I=1,NHL
  930 FH(I)=0.
      DO 980 J=1,NP
      ANG=0.
      FS1= C2(J)+(XP(J)*P(3,J+1,J2)-XP(J+1)*P(3,J,J2))**2
C THIS X-PRODUCT IN X,Y REVEALS THE PROJECTED AREA OF THE TRIANGLE
C ORIGIN,J,J+1 ON THE X-Y PLANE
      FS2= XP(J)*YP(J+1)-XP(J+1)*YP(J)
C IF THE PROJECTED AREA IS NOT ZERO, PROCEED TO COMPUTE THE PROJECTED
C AREA FUNCTION OF THE CIRCULAR SECTOR FORMED BY THE TRIANGLE AND UNIT
C SPHERE
      IF(FS2)950,910,950
C IF Z-S ARE ZERO, THE ORIGIN LIES ALONG THE EXTENDED LINE OR WITHIN THE
C LINE SEGMENT (A BOUNDARY OF SURFACE 2 LIES ON SURFACE 1)
C IS THE ORIGIN ON THE LINE SEGMENT ENDS,SOMEWHERE BETWEEN,OR ON AN
C EXTENSION
 910  IF(P(3,J,J2)+P(3,J+1,J2))980,936,980
 936  IF(XP(J)*XP(J+1))945,937,980
 937  IF(YP(J)*YP(J+1))945,940,980
C IF PRECISELY ON THE END OF THE LINE SEGMENT, ADD PI/2  SO THAT THE
C FINAL RESULT WILL REFLECT THE VALUE APPROACHING THE END, RATHER THAN
C ZERO
 940  FH(I)=FH(I)+1.5707963
      GO TO 980
C IF SOMEWHERE BETWEEN THE ENDS, ADD PI   SO THAT THE FINAL RESULT WILL
C BE THE FACTOR APPROACHING THE BOUNDARY
```

Figure 47. Subroutine FACTOR Listing (continued)

Approved for Public Release

Contrails

```
7J365   FACTOR(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS.NAASID,11/1/63   11/07/73  PAGE 3

 945  FH(I)=FH(I)+3.1415927                                                36507900
      GO TO 980                                                            36508000
C COMPUTE THE CROSS PRODUCT OF VECTORS TO POINTS DEFINING LINE SEGMENT     36508100
 950  FS3=SQRTF(FS1+FS2**2)                                                36508200
C COMPUTE THE COSINE OF ANGLE BETWEEN THE CIRCULAR SECTOR AND X-Y PLANE    36508300
C (K-COMPONENT OF X-PRODUCT )                                              36508400
      CSG=FS2/FS3                                                          36508500
C COMPUTE THE DOT PRODUCT SAME VECTORS                                     36508600
      FCS = XP(J)*XP(J+1)+C3(J)+ C1(J)                                     36508700
C COMPUTE THE ANGLE BETWEEN VECTOR IN RADIANS                              36508800
      IF(FCS)960,965,970                                                   36508900
 960  ANG=3.1415927                                                        36509000
      GO TO 970                                                            36509100
 965  FH(I)=FH(I)-1.5707963*CSG                                            36509200
      GO TO 980                                                            36509300
 970  FH(I)=FH(I)-(A   TANF(FS3/FCS)+ANG)*CSG                              36509400
  980 CONTINUE                                                             36509500
C A NEG AREA RESULTS WHEN THE ORDER OF COMPUTATION REVERSES(THE BACKSIDE36509600
C OF SURFACE 2 IS VIEWED). THIS MAY BE DELIBERATED INDUCED FROM THE        36509700
C RECONSTRUCTION OF A BISECTED NONPLANAR SURFACE,TXFRM ROUNDOFF, OR BY A36509800
C SURFACE WHICH SHOULD BE BUT IS NOT QUITE PLANAR                          36509900
      IF(FH(I))903,986,986                                                 36510000
903   IF(FH(I)+.0001)904,985,985                                           36510100
904   FH(I)=FH(I)+6.2831853                                                36510200
      GO TO 986                                                            36510300
985   FH(I)=0.                                                             36510400
C IF A DETAILED PRINTOUT WAS REQUESTED, COMPUTE THE POINT FACTOR           36510500
 986  IF(NDO)971,984,971                                                   36510600
 971  IF(I-25)500,500,984                                                  36510700
 500  IF(K-25)520,520,984                                                  36510800
 520  FHP(I,K)=FH(I)/6.2831853                                             36510900
C IF THE LAST POINT ON THE LINE IS REACHED, USE THE MAP BOUNDARY VALUE     36511000
C FOR THE POINT TO AVOID ERROR BUILDUP IN X                                36511100
 984  IF(I-NH1)972,973,988                                                 36511200
 973  DO 974 J=1,ML                                                        36511300
      XP(J)=P(1,J,J2)-X1(K,2)                                              36511400
C MAKE NEAR ZERO VALUES ZERO                                               36511500
      IF(ABSF(XP(J))-1.E-6)964,964,974                                     36511600
 964  XP(J)=0.                                                             36511700
```

Figure 47. Subroutine FACTOR Listing
(continued)

Approved for Public Release

Contrails

```
7J365    FACTOR(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63    11/07/73  PAGE 4
 974  CONTINUE                                                            36511800
      GO TO 987                                                           36511900
C MOVE THE ORIGIN(THE POSITION OF THE POINT RELATIVE TO SURFACE 2) TO     36512000
C THE RIGHT AN INCREMENT AND CONTINUE                                     36512100
 972  DO 975 J=1,ML                                                       36512200
  975 XP(J)=XP(J)-DX(K)                                                   36512300
 987  CONTINUE                                                            36512400
C INTEGRATE THE FUNCTION FH ALONG THE HORIZONTAL GRID                     36512500
 988  DO 990 I=2,NHI                                                      36512600
 990  FV(K)= FV(K)+FH(I)                                                  36512700
      FV(K)=(FV(K)+(FH(1)+FH(NHL))/2.)*DX(K)                              36512800
 1000 CONTINUE                                                            36512900
C INTEGRATE THE FUNCTION FV ALONG THE VERTICAL. DIVIDE BY 2 TO CONVERT    36513000
C FH TO AREA, BY PI TO CONVERT THIS TO A CONFIGURATION FACTOR, AND BY     36513100
C THE MAPPING AREA TO YIELD THE FORM FACTOR.                              36513200
      DO 1050 K=2,NVI                                                     36513300
 1050 F=F+FV(K)                                                           36513400
      F=ABSF(F+(FV(1)+FV(NVL))/2.)*DY/ AMAP   /6.2831853                  36513500
C IF A PART OF SURFACE 1 IS SHADOWED, THE FACTOR MUST BE REDUCED TO       36513600
C REFLECT THIS.                                                           36513700
      IF(LI(1) )1060,1500,1500                                            36513800
 1060 F =F * AREAX(1)/AREA(J1 )                                           36513900
C COMPUTE THE FACTOR X AREA PRODUCT                                       36514000
1500  FAP=F*AREA(J1 )                                                     36514100
 2000 RETURN                                                              36514200
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

Figure 47. Subroutine FACTOR Listing (continued)

Approved for Public Release

Contrails

STORAGE NOT USED BY PROGRAM

DEC	OCT	DEC	OCT
459	00713	14637	34455

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
AMAP	15169	35501	AREA	21067	51113	AREAX	21011	51023	C1	22094	53116
C2	21945	52671	C3	21795	52443	CL	16140	37414	DK	22154	53212
DT	22102	53126	DX	15246	35616	DY	15179	35513	FAP	15185	35521
FHP	16119	37367	FH	15011	35243	F	15180	35514	FV	14950	35146
INC	14649	34471	KC	20976	50760	KD	22154	53212	KP	15492	36204
KX	15493	36205	LD	16129	37401	LI	16121	37371	LP	16123	37373
MP	20942	50716	MSDL	15167	35477	MSNOS	15023	35257	NCLS	15178	35512
NDA	22100	53124	NDC	22112	53140	NDL	21157	51245	NDN	22114	53142
NDO	15168	35500	ND	15494	36206	NDT	22102	53126	NHI	15184	35520
NHL	15183	35517	NMS	16418	40042	NNN	21693	52275	NOP	21101	51155
NP	15491	36203	NSC	21213	51335	NSID	22101	53125	NSIL	25217	61201
NSN	21269	51425	NTITLE	21293	51455	NVI	15182	35516	NVL	15181	35515
PAF	16151	37427	PP	32561	77461	P	32558	77456	PT	16274	37622
RA	16454	40106	RX	21009	51021	RY	20998	51006	SL	21693	52275
SP	16445	40075	TDA	22100	53124	TON	22114	53142	TNSID	22101	53125
VA	22094	53116	V	16154	37432	X1	15490	36202	XP	14889	35051
Y1	15368	36010	YP	14769	34661	ZS	20987	50773			

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
ANG	458	00712	CSG	457	00711	FCS	456	00710	FS1	455	00707
FS2	454	00706	FS3	453	00705	I	452	00704	J1	451	00703
J2	450	00702	K	449	00701	ML	448	00700			

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
1)	434	00662	2)	416	00640	3)	421	00645	6)	428	00654
C)G1	438	00666	C)G2	439	00667	C)G3	440	00670	C)G4	441	00671
C)G5	442	00672	C)G6	443	00673	C)G7	444	00674	C)100	445	00675
C)101	446	00676	C)1G0	447	00677	D)104	76	00114	D)113	314	00472

Figure 48. Subroutine FACTOR Core Storage Map

Approved for Public Release

Contrails

```
7J365    FACTOR(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63    11/07/73   PAGE 6

D)210    287 00437       D)218    332 00514       D)21A    340 00524       D)21C    350 00536
D)313    313 00471       D)31A    339 00523       D)40D    152 00230       D)41D    354 00542
D)41J    408 00630       D)60D    151 00227       D)713    312 00470         E)G    187 00273
  E)P    260 00404        E)10    286 00436        E)12    297 00451       E)110    286 00436
E)20N    251 00373       E)210    286 00436       E)40N    248 00370

                          LOCATIONS OF NAMES IN TRANSFER VECTOR

       DEC   OCT               DEC   OCT               DEC   OCT               DEC   OCT
A  TAN    1 00001         SQRT    0 00000

                          ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

A  TAN      SQRT

          EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

  EFN   IFN   LOC         EFN   IFN   LOC         EFN   IFN   LOC         EFN   IFN   LOC
  860    12 00052         865    19 00132         870    20 00134         875    21 00141
  890    22 00143         900    25 00174         930    27 00207         910    33 00261
  936    34 00266         937    35 00276         940    36 00303         945    38 00307
  950    40 00313         960    44 00337         965    46 00342         970    48 00350
  980    49 00376         903    51 00405         904    52 00411         985    54 00415
  986    55 00417         971    56 00421         500    57 00425         520    58 00431
  984    59 00440         973    60 00452         964    63 00503         974    64 00505
  972    66 00511         975    67 00515         987    68 00525         988    69 00537
  990    70 00543        1000    72 00562        1050    74 00576        1060    77 00622
 1500    78 00631        2000    79 00634
```

Figure 48. Subroutine FACTOR Core Storage Map
(continued)

Approved for Public Release

```
C SILFAC(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63 36600100
      SUBROUTINE SILFAC                                                 36600200
C THI¸ SUBROUTINE DETERMINES THE SILHOUETTE OF SURFACE 2 FROM SELECTED  36600300
C POINTS ON SURFACE 1, COMPUTES A CONFIGURATION FACTOR FOR EACH POINT   36600400
C AND FINALLY THE FORM FACTOR FROM SURFACE 1 TO SURFACE 2.              36600500
      DIMENSION  NTITLE(24),NSN(56),TDN(12),NDN(12),NCLS(9 ),NSC(56),   36600600
     1AREA(56),NDL(56),NOM(34),P(3,102,34),ZS(11),RX(11),RY(11),KC(34),M36600700
     2C(4,102,11),RA(9),SP(3,9),NMS(12,12),DK(4,10),KD(4,10),PT(3,4,10),36600800
     3PP(3,102,34),V(3),PAF(11),CL(11),NDA(6),TDA(6),LD(6),LP(2),LI(2), 36600900
     4AREAX(2),INC(12),FHP(25,25),XK(61,2),YK(61,2),DX(61),MSDL(12,12), 36601000
     5MSNOS(12),FH(61),FV(61),NSIL(120,25),X(120),Y(120),NDC(10),       36601100
     6SL(4,100),VA(4,100),C1(102),C2(102),C3(102),NNN(100,2)            36601200
      DIMENSION MN(100),NST(25),NJM(20),NS(120),YI(4,100),NI(100),NJ(10036601300
     1),XV(2),YV(2),DXI(100),MP(4,100),F41(12),F43(12)                  36601400
      EQUIVALENCE (P,PP(4)),(KD,DK),(TDN,NDN),(DT,NDT),(TNSID,NSID),(TDA36601500
     1,NDA),(NSIL(1),PP(7345)),(NDN(3),NDC(1)),(VA(1),C1(1)),(VA(150),C236601600
     2(1)),(VA(300),C3(1)),(NNN(1),SL(1))                               36601700
      COMMON NTITLE,NSN,NDN,NSC,NDL,P,PP,NOM,AREA,AREAX,RX,RY,ZS,KC,MC, 36601800
     1RA,SP,NMS,KD,PT,V,PAF,CL,NDA,NOT,LD,LP,LI,FHP,ND,KX,KP,NP,XK,YK,  36601900
     2DX,FAP,NHI,NHL,NVI,NVL,F,DY,NCLS,NSID,AMAP,NDO,MSDL,MSNOS,NSIL,FH,36602000
     3FV,X,Y,VA,SL,C1,C2,C3,NNN,NDC,INC,F41,F43                         36602100
      CALL COUNTV                                                       36602200
      F=ú.                                                              36602300
C PICKUP LOCATION OF SURFACE 1 AREA                                      36602400
      J1 =LD(í)                                                         36602500
C PICKUP LOCATION OF SURFACE 2 NAME                                     36602600
      N2=LD(2)                                                          36602700
C PICKUP ORIGINAL LOCATION OF SURFACE 2 SURFACE DATA IN ARRAY P AND PP  36602800
      ND=NDL(N2)                                                        36602900
C PICKUP FINAL POSITION(TRANSFORMED OR NOT) OF SURFACE 2-CLASSES 4,5,6,736603000
      IN=LP(2)                                                          36603100
      IF(NSC(N2)+7)29800,29000,29800                                    36603200
29000 N=1                                                               36603300
      NX=-1                                                             36603400
      FD=1.                                                             36603500
      IF(P(3,1,IN)-RA(ND))29050,29200,29200                             36603600
29050 IF(P(3,1,IN))29100,29100,29150                                    36603700
29100 NX=-3                                                             36603800
      GO TO 29160                                                       36603900
```

Figure 49. Subroutine SILFAC Listing

Approved for Public Release

Contrails

```
29150 NX=-2
29160 FD=3.14159265
29200 ZSQ=P(3,1,IN)**2
      RSQ=RA(ND)**2
      RSQZ=RSQ*P(3,1,IN)
      RSMZS=ABSF(RSQ-ZSQ)
      GO TO 31000
29800 FD=6.28318531
C INTIALIZE FLAG TO CONTROL CONNECTIONS DATA SETUP
      KK=0
C IF SURFACE 2 IS MULTISURFACE, DETERMINE NO OF SURFACES NX FROM MSNOS.
C IF NOT, SET NX=0-DO 12000 LOOP WILL EXECUTE ONCE. ZERO IS USED INSTEAD
C OF 1 FOR EFFICIENT FLOW CONTROL IN LOOP
      IF(NSC(N2)+8) 30000,30500,30000
30000 NX=0
C PICKUP POSITION OF CONNECTIONS DATA
      ID=KC(ND)
      GO TO 31000
C PICKUP NO. OF SURFACES INCLUDED UNDER MULTISURFACE NAME(CLASS 8 ONLY)
30500 NX=MSNOS(ND)
C START WITH LOWEST MAPPING LINE OF SURFACE 1.
31000 DO 1000 NV=1,NVL
      IF(FV(NV))1017,31550,31500
31500 FV(NV)=0.
31550 IF(NX)29250,29900,29900
C COMPUTE SPHERE Y-CONSTANT
29250 YSPZS=(P(2,1,IN)-YK(NV))**2+ZSQ
      X=P(1,1,IN)-XK(NV,1)
      DXI=DX(NV)
      GO TO 12100
C INITIALIZE POINT COUNT FOR NEW COMPOSITE SURFACE
29900 N=0
C INTIALIZE YMIN FOR SELECTION OF LOWEST POINT IN COMPOSITE SURFACE
C LOOP TO CREATE COMPOSITE SURFACE-ASSEMBLE ALL POINTS IN ONE ARRAY FOR
C RAPID PROCESSING BY SIL LOGIC.
      YMIN=1.E+38
      XYMIN=1.E+38
      DO 12000 L=1,NX
C SET CONNECTIONS COUNTER
```

Figure 49. Subroutine SILFAC Listing (continued)

Approved for Public Release

Contrails


```
      NC=N
      IF(NX)2100,2200,2100
C IF NX IS NOT 0, PICKUP SUBSCRIPT IN ARRAY P FROM MULTIPLE SURFACE DATA
C LOCATION ARRAY MSDL FOR EACH SURFACE L,AND THE CONNECTIONS DATA FOR
C SURFACE L FROM  KC
2100  IN=MSDL(L,ND)
      ID=KC(IN)
C PICKUP NO OF POINTS DEFINING SURFACE  L
2200  NP=NOM(IN)
C SET UP LOOP TO TRANSFORM EACH X,Y,Z TO X,Y ON Z=1 PLANE.
      DO 12000 J=1,NP
C UPDATE POINT NO COUNTER
      N=N+1
C TRANSFORM X-COORD OF SURFACE POINT TO THE Z=1 PLANE, WITH THE ORIGIN
C AT THE BEGINNING(X-LEFT)OF MAPPING LINE NV.
      IF(P(3,J,IN))6900,6900,7000
6900  SENSE LIGHT 1
      GO TO 2300
7000  X(N)=(P(1,J,IN)-XK(NV,1))/P(3,J,IN)
C COMPUTE HORIZONTAL INCREMENT IN Z=1 PLANE
      DXI(N)=DX(NV)/P(3,J,IN)
C TRANSFORM Y-COORDINATE TO Z=1 PLANE TO SAME CS AS X-COORDINATE
      Y(N)=(P(2,J,IN)-YK(NV))/P(3,J,IN)
      YDI=Y(N)-YMIN
      IF(ABSF(YDI)-1.E-6)10100,10100,8000
8000  IF(YDI)10000,10100,11000
C SELECT ALL YMIN
10000 JM=1
      YMIN=Y(N)
      GO TO 10200
10100 JM=JM+1
10200 NJM(JM)=N
C IF KK=0,CONTINUE TO ASSEMBLE CONNECTIONS DATA FROM EACH SURFACE INTO
C ONE CONTINUOUS COMPOSITE ARRAY MP
11000 IF(KK)12000,11500,12000
C RESET CONNECTIONS COUNTER-NO OF CONNECTIONS TO THE POINT
11500 K2=0
C LOOP TO LOAD CONNECTIONS DATA FROM INDIVIDUAL SURFACE CONNECTIONS DATA
C ARRAY MC TO COMPOSITE ARRAY MP
```

Figure 49. Subroutine SILFAC Listing (continued)

Approved for Public Release

```
      DO 11700 K=1,4                                                    36611800
C PICKUP CONNECTING POINT K1 TO POINT J IN SURFACE ID                    36611900
C IF K1 IS ZERO, NO DATA IN THIS SPOT- CONTINUE                          36612000
      IF(MC(K,J,ID))11600,11700,11600                                   36612100
C UPDATE NO OF CONNECTIONS COUNTER                                       36612200
11600 K2=K2+1                                                           36612300
C ADD CONNECTING POINT NO TO TOTAL OF POINTS DEFINING COMPOSITE SURFACE 36612400
C UP TO THIS SURFACE TO CREATE NEW CONNECTING POINTS CONSISTENT         36612500
C WITH NEW COMPOSITE SURFACE POINT NUMBER N.                            36612600
      MP(K2,N)=NO+MC(K,J,ID)                                            36612700
11700 CONTINUE                                                          36612800
C LOAD TOTAL NO OF POINTS CONNECTING TO NEW POINT NO N.                  36612900
      MN(N)=K2                                                          36613000
12000 CONTINUE                                                          36613100
C SET CONNECTIONS PROCESSING FLAG TO NONZERO(ONLY ONE ENTRY REQD)        36613200
      KK=1                                                              36613300
C START LOOP TO DETERMINE SILHOUETTE FROM LINE SEGMENTS PROJECTED ON Z=136613400
C PLANE AND COMPUTE PLANE POINT FACTOR FROM THIS SILHOUETTE.             36613500
12100 DO 987  NH=1,NHL                                                  36613600
      IF(FH(NH))903,12150,12150                                         36613700
12150 IF(NX)12200,12800,12800                                           36613800
12200 DSQ=X**2+YSPZS                                                    36613900
      D=SQRTF(DSQ)                                                      36614000
      F1=RSQZ/(DSQ*D)                                                   36614100
      FH(NH)=F1                                                         36614200
      IF(NX+1)12300,986,12300                                           36614300
12300 ALPHA =DSQ-RSQ                                                    36614400
      IF(ALPHA)903,903,12350                                            36614500
12350 BETA=SQRTF(RSMZS/ALPHA)                                           36614600
      FH(NH)=A  TANF(BETA)-F1*A  TANF(BETA*D/P(3,1,IN))-ALPHA*BETA/DSQ  36614700
      IF(NX+2)986,12400,986                                             36614800
12400 FH(NH)=FH(NH)+F1*3.1459265                                        36614900
      GO TO 986                                                         36615000
C COMPUTE VECTOR SLOPES,ANGLES AND Y-INTERCEPTS                          36615100
12800 NLS=N-1                                                           36615200
      SENSE LIGHT 0                                                     36615300
      DO 400 I=1,NLS                                                    36615400
C PICKUP NO OF POINTS CONNECTING TO POINT I.                             36615500
      NP=MN(I)                                                          36615600
```

Figure 49. Subroutine SILFAC Listing (continued)

Approved for Public Release

Contrails


```
      DO 400 J=1,NP                                                     36615700
C PICKUP JTH POINT CONNECTING TO I.                                     36615800
      NPP=MP(J,I)                                                       36615900
C THE SLOPE OF LINE SEGMENT FROM I TO J IS THE SAME AS J TO I. IF THE   36616000
C CONNECTING POINT IS NUMERICALLY LESS THAN POINT, THE SLOPE AND       36616100
C Y-INTERCEPT HAVE ALREADY BEEN COMPUTED.                               36616200
C IF NPP IS GREATER THAN I, GO TO COMPUTE LINE SEGMENT PARAMETERS.      36616300
      IF(I-NPP)225,400,400                                              36616400
C SEARCH FOR POINT I FROM CONNECTIONS TO NPP.                           36616500
225   DO 240 K=1,4                                                      36616600
 227  IF(MP(K,NPP)-I)240,260,240                                        36616700
 240  CONTINUE                                                          36616800
C COMPUTE SLOPES,Y-INTERCEPTS AND VECTOR QUASI ANGLES                   36616900
 260  DYY=Y(NPP)-Y(I)                                                   36617000
      DXX=X(NPP)-X(I)                                                   36617100
      SL(J,I)=DYY/DXX                                                   36617200
      IF(ABSF(SL(J,I))-1.)270,300,300                                   36617300
270   IF(DXX)280,295,290                                                36617400
280   VA(J,I)=SL(J,I)+4.                                                36617500
      GO TO 325                                                         36617600
290   VA(J,I)=SL(J,I) + 8.                                              36617700
      GO TO 315                                                         36617800
295   IF(X(I))297,296,297                                               36617900
296   SENSE LIGHT 1                                                     36618000
      YI(J,I)=0.                                                        36618100
297   SL(J,I)=1.E+30                                                    36618200
300   IF(DYY)310,330,320                                                36618300
310   VA(J,I)=6.-1./SL(J,I)                                             36618400
315   VA(K,NPP)=VA(J,I)-4.                                              36618500
      GO TO 370                                                         36618600
320   VA(J,I)=2.-1./SL(J,I)                                             36618700
325   VA(K,NPP)=VA(J,I)+4.                                              36618800
      GO TO 370                                                         36618900
330   SL(J,I)=0.                                                        36619000
      VA(J,I)=-10.                                                      36619100
      VA(K,NPP)=-10.                                                    36619200
      YI(J,I)=1.E+38                                                    36619300
      IF(SENSE LIGHT 1)13600,13600                                      36619400
C IF NOT CLASS B SURFACE, THE FOLLOWING LINE ELEMENTS ARE NOT NEEDED    36619500
```

Figure 49. Subroutine SILFAC Listing (continued)

Approved for Public Release

Contrails


```
370    IF(NX)375,400,375                                                  36619600
C COMPUTE YINTERCEPT BASED ON MINY TO INCREASE COMPUTATIONAL ACCURACY     36619700
375    IF(SENSE LIGHT 1)13600,12900                                       36619800
12900 IF(ABSF(Y(I))-ABSF(Y(NPP)))13000,13000,13500                        36619900
13000 YI(J,I)=Y(I)-X(I)*SL(J,I)                                           36620000
      GO TO 13600                                                         36620100
13500 YI(J,I)=Y(NPP)-X(NPP)*SL(J,I)                                       36620200
13600 YI(K,NPP)=YI(J,I)                                                   36620300
      SL(K,NPP)=SL(J,I)                                                   36620400
 400  CONTINUE                                                            36620500
C SELECT YMIN HAVING XMIN AS FIRST POINT ON SILHOUETTE                     36620600
      DO 11400 J=1,JM                                                     36620700
      I=NJM(J)                                                            36620800
      IF(X(I)-XYMIN)11300,11400,11400                                     36620900
11300 NS(1)=I                                                             36621000
      XYMIN=X(I)                                                          36621100
11400 CONTINUE                                                            36621200
C NL=SUBSCRIPT OF POSITION OF COMPUTED X,Y OF POINT ON SILHOUETTE         36621300
C OBTAINED BY INTERSECTION OF LINE ELEMENTS                               36621400
      NL=N                                                                36621500
C NS(1) IS THE FIRST POINT OF SILHOUETTE                                  36621600
      L=NS(1)                                                             36621700
C NPP IS BASE POINT OF VECTOR FORMING  SILHOUETTE.                        36621800
      NPP=N+1                                                             36621900
C JR IS SUBSCRIPT OF CONNECTING POINT  FORMING SIL VECTOR,AS (JR,NPP)     36622000
      JR=1                                                                36622100
      VA(JR,NPP)=5.                                                       36622200
      IF(NX)649,105,649                                                   36622300
105   LX=L                                                                36622400
      M=1                                                                 36622500
      NLP=L                                                               36622600
      GO TO 115                                                           36622700
100   M=M+1                                                               36622800
      IF(M-120)2700,2700,2600                                             36622820
2600  PRINT                    F43                                        36622840
      GO TO 2000                                                          36622860
2700  NS(M)=NPP                                                           36622900
      IF(NPP-L)104,995,104                                                36623000
104   IF(NPP-LX)110,995,110                                               36623100
```

Figure 49. Subroutine SILFAC Listing
(continued)

Approved for Public Release

Contrails

```
7J366    SILFAC(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63    11/08/83   PAGE 7
110    NLP=NPP                                                              36623200
115    SENSE LIGHT 0                                                        36623300
       SENSE LIGHT 2                                                        36623400
       MX=0                                                                 36623500
140    NP=MN(NLP)                                                           36623600
       DO 190 J=1,NP                                                        36623700
       IF(VA(J,NLP))160,180,180                                             36623800
160    IF(SENSE LIGHT 2)170,190                                             36623900
170    SENSE LIGHT 3                                                        36624000
       JX=J                                                                 36624100
       IF(M-1)190,175,190                                                   36624200
175    LX=MP(JX,NLP)                                                        36624300
       GO TO 190                                                            36624400
180    MX=MX+1                                                              36624500
       NI(MX)=NLP                                                           36624600
       NJ(MX)=J                                                             36624700
190    CONTINUE                                                             36624800
       IF(SENSE LIGHT 3)195,835                                             36624900
195    NLP=MP(JX,NLP)                                                       36625000
       GO TO 140                                                            36625100
649    SL(JR,NPP)=1.                                                        36625200
       YI(JR,NPP)=YMIN-X(L)                                                 36625300
       X(NPP)=X(L)                                                          36625400
       Y(NPP)=YMIN                                                          36625500
C M=NO. OF POINTS DEFINING SILHOUETTE                                       36625600
       M=0                                                                  36625700
C X1= X-VALUE OF HEAD OF DEPARTURE VECTOR                                   36625800
       X1=X(L)-1.                                                           36625900
C X2= X-VALUE OF BASE OF DEPARTURE VECTOR                                   36626000
       X2=X(L)                                                              36626100
 660   XMIN=1.E+30                                                          36626200
       SLR=0.                                                               36626300
       IF(1.    -ABSF(SL(JR,NPP)))402,403,403                               36626400
402    SLR=1.                                                               36626500
C INITIALIZE COUNT OF VECTORS TO BE CONSIDERED IN FINAL SELECTION OF        36626600
C SILHOUETTE PATH.                                                          36626700
403    MX=0                                                                 36626800
       IF(NSIL(M+1,NH))404,662,662                                          36626900
404    XM=7777777.                                                          36627000
```

Figure 49. Subroutine SILFAC Listing (continued)

Approved for Public Release

```
      YM=XM                                                             36627100
      PRINT 5000,NS(M),M,NL,NPP,NLP,MP(JR,NPP),SL(JR,NPP),YI(JR,NPP),VA(36627200
     1JR,NPP),X(NPP),Y(NPP),X(NLP),Y(NLP),X1,X2                         36627300
 5000 FORMAT(1H-,6X6HNS(M)=I4/10X2HM=I4/9X3HNL=I4/8X4HNPP=I4/8X4HNLP=I4/36627400
     1/12H MP(JR,NPP)= I3  /12H SL(JR,NPP)=E14.7/12H YI(JR,NPP)=E14.7/1236627500
     2H VA(JR,NPP)=E14.7/5X7HX(NPP)=E14.7/5X7HY(NPP)=E14.7/5X7HX(NLP)=E136627600
     34.7/5X7HY(NLP)=E14.7/9X3HX1=E14.7/9X3HX2=E14.7)                   36627700
C ENTER LOOP TO DETERMINE WHICH VECTORSTOUCH THE REFERENCE OR DEPARTURE 36627800
C VECTOR (JR,NPP)                                                       36627900
 662  DO 804 I=1,N                                                      36628000
      NOP=MN(I)                                                         36628100
C SELECT VECTOR (J,I)-                                                  36628200
 663  DO 804 J=1,NOP                                                    36628300
      IF(NSIL(M+1,NH))651,664,664                                       36628400
 651  XA=7777777.                                                       36628500
      YA=XA                                                             36628600
      XC=XA                                                             36628700
      XD=XA                                                             36628800
      XE=XA                                                             36628900
      XF=XA                                                             36629000
      XG=XA                                                             36629100
C SELECT HEAD END OF TEST VECTOR(J,I)                                   36629200
      NPC=MP(J,I)                                                       36629300
 664  SENSE LIGHT 0                                                     36629400
C COMPUTE COEFFICIENT DETERMINANT WITH REF VECTOR                        36629500
      CD=SL(JR,NPP)-SL(J,I)                                             36629600
C IF CD=0,OR NEAR ZERO, TEST VECTOR(J,I) AND REFERENCE VECTOR(JR,NPP)   36629700
C OF ALL VECTORS PARALLEL TO REF VECTOR, SELECT ONLY THOSE TOUCHING AND 36629800
C EXTENDING BEYOND THE REF VECTOR IN THE OPPOSITE  DIRECTION.           36629900
 665  IF(ABSF(CD)-1.E-6)667,667,670                                     36630000
C EXCLUDE ALL VECTORS HAVING SAME DIRECTION AS REF VECTOR               36630100
 667  IF(ABSF(VA(JR,NPP)-VA(J,I))-.0001)800,800,668                     36630200
C EXCLUDE ALL NOT IN SAME LINE(NONCONCURRENT)                           36630300
 668  IF(ABSF(YI(JR,NPP))-1.)669,669,671                                36630400
 669  TOL=1.E-5                                                         36630500
      GO TO 672                                                         36630600
 671  TOL=ABSF(1.E-5*YI(JR,NPP))                                        36630700
 672  IF(ABSF(YI(JR,NPP)-YI(J,I))-TOL)673,673,800                       36630800
C QUASI-ANGLES OF 9 UNITS ARE THE SAME AS 1 UNIT(1ST QUAD,45DEG VECTOR) 36630900
```

Figure 49. Subroutine SILFAC Listing
(continued)

Contrails

Approved for Public Release

Contrails

```
7J366   SILFAC(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63   11/08/83  PAGE 9
673   IF(ABSF(VA(JR,NPP)-VA(J,I))-7.9999)674,800,800            36631000
 674  XA=X(NPP)                                                 36631100
      YA=Y(NPP)                                                 36631200
      GO TO 679                                                 36631300
670   XA=(YI(J,I)-YI(JR,NPP))/CD                                36631400
      IF(ABSF(XA)-1.E-8)2400,2400,2500                          36631500
2400  XA=0.                                                     36631600
2500  IF(ABSF(SL(JR,NPP))-ABSF(SL(J,I)))677,677,678             36631700
 677  YA=SL(JR,NPP)*XA+YI(JR,NPP)                               36631800
      GO TO 679                                                 36631900
 678  YA=SL(J,I)*XA+YI(J,I)                                     36632000
679   IF(ABSF(XA)-1.)4000,4000,4100                             36632100
4000  TOLX=1.E-5                                                36632200
      GO TO 4200                                                36632300
4100  TOLX=1.E-5*ABSF(XA)                                       36632400
4200  IF(ABSF(YA)-1.)4300,4300,4400                             36632500
4300  TOLY=1.E-5                                                36632600
      GO TO 4500                                                36632700
4400  TOLY=1.E-5*ABSF(YA)                                       36632800
4500  IF(SLR)410,420,410                                        36632900
410   XB=YA-Y(LT)                                               36633000
      TOL1=TOLY                                                 36633100
      GO TO 430                                                 36633200
420   XB=XA-X1                                                  36633300
      TOL1=TOLX                                                 36633400
430   XC=ABSF(XB)                                               36633500
      IF(XC-TOL1 ) 800,800,435                                  36633600
435   IF(SLR)440,450,440                                        36633700
440   XD=YA-Y(NPP)                                              36633800
      GO TO 460                                                 36633900
450   XD=XA-X2                                                  36634000
460   IF(ABSF(XD)-TOL1 )695,695,675                             36634100
  675 IF(XB)690,800,680                                         36634200
  680 IF(XD)695,800,800                                         36634300
  690 IF(XD)800,800,695                                         36634400
695   NPC=MP(J,I)                                               36634500
      IF(ABSF(SL(J,I))-1.    )697,696,696                       36634600
696   SENSE LIGHT 2                                             36634700
      XF=YA-Y(NPC)                                              36634800
```

Figure 49. Subroutine SILFAC Listing (continued)

Approved for Public Release

Contrails


```
      TOL2=TOLY                                                         36634900
      GO TO 700                                                         36635000
697   XF=XA-X(NPC)                                                      36635100
      TOL2=TOLX                                                         36635200
700   IF(ABSF(XF)-TOL2 )800,800,704                                     36635300
704   IF(SENSE LIGHT 2)705,706                                          36635400
705   XE=YA-Y(I)                                                        36635500
      GO TO 708                                                         36635600
706   XE=XA-X(I)                                                        36635700
708   IF(ABSF(XE)-TOL2 )735,735,710                                     36635800
 710  IF(XE)720,740,730                                                 36636000
 720  IF(XF)800,800,735                                                 36636100
 730  IF(XF)735,800,800                                                 36636200
 735  XG=XC-XMIN                                                        36636300
 740  IF(ABSF(XG)-TOL1 )760,760,745                                     36636400
 745  IF(XG)755,760,800                                                 36636500
 755  XM=XA                                                             36636600
      YM=YA                                                             36636700
      TOL3=TOLX                                                         36636800
      TOL4=TOLY                                                         36636900
      XMIN=XC                                                           36637000
      MX=1                                                              36637100
      GO TO 770                                                         36637200
 760  MX=MX+1                                                           36637300
 770  NI(MX)=I                                                          36637400
      NJ(MX)=J                                                          36637500
800   IF(NSIL(M+1,NH))801,804,804                                       36637600
801   PRINT 5010,NV,NH,I,NPC,J,SL(JR,NPP),YI(J,I),VA(J,I),SL(J,I),YI(JR,36637700
     1NPP),CD,XA,YA,MX,X1,Y(NLP),XM,X2,Y(NPP),YM,X(I),Y(I),NI(MX),X(NPC)36637800
     2,Y(NPC),NJ(MX),XB,XMIN,XD,TOLX,TOLY,XE,TOL1,TOL2,XF,TOL3,TOL4     36637900
5010  FORMAT(4HONV=I3,4H NH=I3,3H I=I3,5H NPC=I3,3H J=I3/6H SLRF=E14.7,536638000
     1X 8HYI(J,I)=E14.7,10H  VA(J,I)=E14.7/4X8HSL(J,I)=14.7,13H  YI(JR,N36638100
     2PP)=E14.7/9X3HCD=E14.7/9X3HXA=E14.7,10X3HYA=E14.7,7X3HMX=I3/9X3HX136638200
     3=E14.7,6X7HY(NLP)=E14.7,7X3HXM=E14.7/9X3HX2=E14.7,6X7HY(NPP)=E14.736638300
     4,7X3HYM=E14.7/7X5HX(I)=E14.7,8X5HY(I)=E14.7,10H   NI(MX)=I3/5X7HX(36638400
     5NPC)=E14.7,6X7HY(NPC)=E14.7,10H   NJ(MX)=I3/9X3HXB=E14.7,56X5HXMIN36638500
     6=E14.7/9X3HXD=E14.7,8X5HTOLX=E14.7,5X5HTOLY=E14.7/9X3HXE=E14.7,8X536638600
     7HTOL1=E14.7,5X5HTOL2=E14.7/9X3HXF=E14.7,8X5HTOL3=E14.7,5X5HTOL4=E136638700
     84.7)                                                              36638800
```

Figure 49. Subroutine SILFAC Listing (continued)

Approved for Public Release

Contrails


```
804    CONTINUE                                                    36638900
802    IF(M)805,803,805                                            36639000
803    M=1                                                         36639100
       GO TO 835                                                   36639200
 805   M=M+1                                                       36639300
       IF(MX)4560,4550,4560                                        36639400
4550   XM=X(NPP)                                                   36639500
       YM=Y(NPP)                                                   36639600
4560   IF(M-120)810,810,2600                                       36639700
810    IF(ABSF(XM-X(NPP))-TOL3 )540,540,830                        36639800
 540   IF(ABSF(YM-Y(NPP))-TOL4 )820,820,830                        36639900
 820   IF(ABSF(XM-X(L))-TOL3 )821,821,823                          36640000
 821   IF(ABSF(YM-Y(L))-TOL4 )822,822,823                          36640100
 822   NS(M)=L                                                     36640200
       GO TO 995                                                   36640300
 830   MX=MX+1                                                     36640400
       NI(MX)=NLP                                                  36640500
       NJ(MX)=NXJ                                                  36640600
 834   NL=NL+1                                                     36640700
2800   IF(NL-120)824,824,2600                                      36640800
824    X(NL)=XM                                                    36640900
       Y(NL)=YM                                                    36641000
       NS(M)=NL                                                    36641100
       NERR=NERR+1                                                 36641200
       IF(NERR-6) 835  ,832,832                                    36641300
832    SENSE LIGHT 4                                               36641400
       GO TO 1015                                                  36641500
 823   NS(M)=NPP                                                   36641600
       IF(MX)4580,4570,4580                                        36641700
4570   NLP=NPP                                                     36641800
       NXJ=JR                                                      36641900
       GO TO 4590                                                  36642000
4580   NERR=0                                                      36642100
 835   VAMIN=10.                                                   36642200
       SENSE LIGHT 1                                               36642300
840    DO  940 K=1,MX                                              36642400
       I=NI(K)                                                     36642500
       J=NJ(K)                                                     36642600
       IF(VA(JR,NPP)-VA(J,I))850,940,870                           36642700
```

Figure 49. Subroutine SILFAC Listing (continued)

Approved for Public Release

Contrails


```
 850  IF(SENSE LIGHT 1)860,890                                                 36642800
 860  VAMIN=10.                                                                36642900
      GO TO 890                                                                36643000
 870  IF(SENSE LIGHT 1)880,940                                                 36643100
 880  SENSE LIGHT 1                                                            36643200
 890  IF(VA(J,I)-VAMIN)910,905,940                                             36643300
 905  NLP=NI(NK)                                                               36643400
      NXJ=NJ(NK)                                                               36643500
      NPX=MP(NXJ,NLP)                                                          36643600
      NPC=MP(J,I)                                                              36643700
      IF(SQRTF((X(NPC)-XM)**2+(Y(NPC)-YM)**2)-SQRTF((X(NPX)-XM)**2+(Y(NP36643800
     1X)-YM)**2))940,940,920                                                   36643900
 910  VAMIN=VA(J,I)                                                            36644000
 920  NK=K                                                                     36644100
 940  CONTINUE                                                                 36644200
 945  NLP=NI(NK)                                                               36644300
      NXJ=NJ(NK)                                                               36644400
4590  NPP=MP(NXJ,NLP)                                                          36644500
 610  DO 650 JR=1,4                                                            36644600
 615  IF(MP(JR,NPP)-NLP)650,656,650                                            36644700
 650  CONTINUE                                                                 36644800
 656  IF(NX)657,100,657                                                        36644900
 657  LT=NS(M)                                                                 36645000
      X1=X(LT)                                                                 36645100
      X2=X(NPP)                                                                36645200
      GO TO 660                                                                36645300
 995  NP=M-1                                                                   36645400
C INITIALIZE FACTOR FUNCTION FH.                                                36645500
      IF(NDO)996,998,996                                                       36645600
 996  IF(NH-25)1600,1600,998                                                   36645700
1600  NST(NH)=M                                                                36645800
      DO 997 I=1,M                                                             36645900
 997  NSIL(I,NH)=NS(I)                                                         36646000
 998  FH(NH)=0.                                                                36646100
      DO 980 I=1,NP                                                            36646200
      J=NS(I)                                                                  36646300
      K=NS(I+1)                                                                36646400
      ANG=0.                                                                   36646500
      FS2=X(J)*Y(K)-X(K)*Y(J)                                                  36646600
```

Figure 49. Subroutine SILFAC Listing (continued)

Approved for Public Release

Contrails


```
C IF THE PROJECTED AREA IS NOT ZERO, PROCEED TO COMPUTE THE PROJECTED   36646700
C AREA FUNCTION OF THE CIRCULAR SECTOR FORMED BY THE TRIANGLE AND UNIT  36646800
C SPHERE                                                                36646900
      IF(FS2)950,980,950                                                36647000
C COMPUTE THE CROSS PRODUCT OF VECTORS TO POINTS DEFINING LINE SEGMENT  36647100
950   FS3=SQRTF((Y(J)-Y(K))**2+(X(J)-X(K))**2+FS2**2)                   36647200
C COMPUTE THE COSINE OF ANGLE BETWEEN THE CIRCULAR SECTOR AND X-Y PLANE 36647300
C (K-COMPONENT OF X-PRODUCT )                                           36647400
      CSG=FS2/FS3                                                       36647500
C COMPUTE THE DOT PRODUCT SAME VECTORS                                  36647600
      FCS=X(J)*X(K)+Y(J)*Y(K)+1.                                        36647700
C COMPUTE THE ANGLE BETWEEN VECTOR IN RADIANS                           36647800
      IF(FCS)960,965,970                                                36647900
 960  ANG=3.1415927                                                     36648000
      GO TO 970                                                         36648100
965   FH(NH)=FH(NH)+1.5707963*CSG                                       36648200
      GO TO 980                                                         36648300
970   FH(NH)=FH(NH)+(ATANF(FS3/FCS)+ANG)*CSG                            36648400
  980 CONTINUE                                                          36648500
C IF THE PROJECTED AREA IS VERY SMALL, SET TO 0 (FH IS DOUBLE THIS AREA)36648600
      IF(FH(NH)-1.E-6)903,903,986                                       36648700
903   FH(NH)=0.                                                         36648800
C IF A DETAILED PRINTOUT WAS REQUESTED, COMPUTE THE POINT FACTOR        36648900
 986  IF(NDO)971,984,971                                                36649000
971   IF(NH-25)500,500,984                                              36649100
500   IF(NV-25)520,520,984                                              36649200
520   FHP(NH,NV)=FH(NH)/FD                                              36649300
984   IF(NH-NHI)972,972,988                                             36649400
C MOVE THE ORIGIN(THE POSITION OF THE POINT RELATIVE TO SURFACE 2) TO    36649500
C THE RIGHT AN INCREMENT AND CONTINUE                                   36649600
972   DO 975 J=1,N                                                      36649700
975   X(J)=X(J)-DXI(J)                                                  36649800
 987  CONTINUE                                                          36649900
C INTEGRATE THE FUNCTION FH ALONG THE HORIZONTAL GRID                   36650000
 988  DO 990 I=2,NHI                                                    36650100
990   FV(NV)=FV(NV)+FH(I)                                               36650200
      FV(NV)=(FV(NV)+(FH(1)+FH(NVL))/2.)*DX(NV)                         36650300
      IF(NDO)1015,1000,1015                                             36650400
1015  IF(NX)1000,999,999                                                36650500
```

Figure 49. Subroutine SILFAC Listing (continued)

Approved for Public Release

Contrails


```
999    IF(NH-25)1700,1700,1000                                            36650600
1700   DO 1020 I=1,NH                                                     36650700
       NP=NST(I)                                                          36650800
1020   PRINT                    F41,NV,I,(NSIL(J,I),J=1,NP)               36650900
       IF(SENSE LIGHT 4)1016,1000                                         36651000
1016   CALL DUMP                                                          36651100
1017   FV(NV)=0.                                                          36651200
 1000 CONTINUE                                                            36651300
C INTEGRATE THE FUNCTION FV ALONG THE VERTICAL. DIVIDE BY 2 TO CONVERT    36651400
C FH TO AREA, BY PI TO CONVERT THIS TO A CONFIGURATION FACTOR, AND BY     36651500
C THE MAPPING AREA TO YIELD THE FORM FACTOR.                              36651600
       DO 1050 K=2,NVI                                                    36651700
 1050 F=F+FV(K)                                                           36651800
       F=ABSF(F+(FV(1)+FV(NVL))/2.)*DY/ AMAP    /FD                       36651900
C IF A PART OF SURFACE 1 IS SHADOWED, THE FACTOR MUST BE REDUCED TO       36652000
C REFLECT THIS.                                                           36652100
       IF(LI(1) )1060,1500,1500                                           36652200
 1060 F =F * AREAX(1)/AREA(J1 )                                           36652300
C COMPUTE THE FACTOR X AREA PRODUCT                                       36652400
1500   FAP=F*AREA(J1 )                                                    36652500
       CALL TIMEV(END)                                                    36652600
       PRINT 1999,END                                                     36652700
1999   FORMAT(23H-TOTAL TIME IN SILFAC =F9.3,9H SECONDS.)                 36652800
2000   SENSE LIGHT 0                                                      36652900
2300   RETURN                                                             36653000
       END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

Figure 49. Subroutine SILFAC Listing (continued)

Approved for Public Release

Contrails

STORAGE NOT USED BY PROGRAM

DEC	OCT	DEC	OCT
3725	07215	14613	34425

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
AMAP	15169	35501	AREA	21067	51113	AREAX	21011	51023	C1	22094	53116
C2	21945	52671	C3	21795	52443	CL	16140	37414	DK	22154	53212
DT	22102	53126	DX	15246	35616	DY	15179	35513	F41	14637	34455
F43	14625	34441	FAP	15185	35521	FHP	16119	37367	FH	15011	35243
F	15180	35514	FV	14950	35146	INC	14649	34471	KC	20976	50760
KD	22154	53212	KP	15492	36204	KX	15493	36205	LD	16129	37401
LI	16121	37371	LP	16123	37373	MC	20942	50716	MSDL	15167	35477
MSNOS	15023	35257	NCLS	15178	35512	NDA	22100	53124	NDC	22112	53140
NDL	21157	51245	NDN	22114	53142	NDO	15168	35500	ND	15494	36206
NDT	22102	53126	NHI	15184	35520	NHL	15183	35517	NMS	16418	40042
NNN	21693	52275	NOM	21101	51155	NP	15491	36203	NSC	21213	51335
NSID	22101	53125	NSIL	25217	61201	NSN	21269	51425	NTITLE	21293	51455
NVI	15182	35516	NVL	15181	35515	PAF	16151	37427	PP	32561	77461
P	32558	77456	PT	16274	37622	RA	16454	40106	RX	21009	51021
RY	20998	51006	SL	21693	52275	SP	16445	40075	TDA	22100	53124
TDN	22114	53142	TNSID	22101	53125	VA	22094	53116	V	16154	37432
XK	15490	36202	X	14889	35051	YK	15368	36010	Y	14769	34661
ZS	20987	50773									

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
DXI	3255	06267	MN	3724	07214	MP	2755	05303	NI	3459	06603
NJM	3599	07017	NJ	3359	06437	NS	3579	06773	NST	3624	07050
XV	3259	06273	YI	3155	06123	YV	3257	06271			

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
ALPHA	2355	04463	ANG	2354	04462	BETA	2353	04461	CD	2352	04460
CSG	2351	04457	D	2350	04456	DSQ	2349	04455	DXX	2348	04454
DYY	2347	04453	END	2346	04452	F1	2345	04451	FCS	2344	04450

Figure 50. Subroutine SILFAC Core Storage Map

Approved for Public Release

FD	2343	04447	FS2	2342	04446	FS3	2341	04445	ID	2340	04444
IN	2339	04443	I	2338	04442	J1	2337	04441	JM	2336	04440
JR	2335	04437	J	2334	04436	JX	2333	04435	K2	2332	04434
KK	2331	04433	K	2330	04432	L	2329	04431	LT	2328	04430
LX	2327	04427	M	2326	04426	MX	2325	04425	NO	2324	04424
N2	2323	04423	NERR	2322	04422	NH	2321	04421	NK	2320	04420
NLP	2319	04417	NL	2318	04416	NLS	2317	04415	NOP	2316	04414
NPC	2315	04413	NPP	2314	04412	NPX	2313	04411	N	2312	04410
NV	2311	04407	NXJ	2310	04406	NX	2309	04405	RSMZS	2308	04404
RSC	2307	04403	RSQZ	2306	04402	SLR	2305	04401	TOL1	2304	04400
TOL2	2303	04377	TOL3	2302	04376	TOL4	2301	04375	TOL	2300	04374
TOLX	2299	04373	TOLY	2298	04372	VAMIN	2297	04371	X1	2296	04370
X2	2295	04367	XA	2294	04366	XB	2293	04365	XC	2292	04364
XD	2291	04363	XE	2290	04362	XF	2289	04361	XG	2288	04360
XMIN	2287	04357	XM	2286	04356	XYMIN	2285	04355	YA	2284	04354
YDI	2283	04353	YMIN	2282	04352	YM	2281	04351	YSPZS	2280	04350
ZSC	2279	04347									

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

	EFN	LOC		EFN	LOC		EFN	LOC		EFN	LOC
8)1UF	1999	04066	8)458	5000	04266	8)4SI	5010	04216			

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
1)	2231	04267	2)	2055	04007	3)	2068	04024	6)	2089	04051
A)102	1955	03643	A)103	1968	03660	A)104	1981	03675	A)105	1994	03712
A)107	2007	03727	A)108	2020	03744	A)109	2033	03761	A)1G0	2046	03776
C)G1	2235	04273	C)G2	2236	04274	C)G3	2237	04275	C)G4	2238	04276
C)G5	2239	04277	C)G6	2240	04300	C)G7	2241	04301	C)G8	2242	04302
C)G9	2243	04303	C)GA	2244	04304	C)GB	2245	04305	C)GC	2246	04306
C)GD	2247	04307	C)GE	2248	04310	C)GF	2249	04311	C)GG	2250	04312
C)GH	2251	04313	C)GI	2252	04314	C)GJ	2253	04315	C)GK	2254	04316
C)GL	2255	04317	C)GM	2256	04320	C)100	2257	04321	C)101	2258	04322
C)102	2259	04323	C)103	2260	04324	C)104	2261	04325	C)105	2262	04326
C)106	2263	04327	C)107	2264	04330	C)108	2265	04331	C)109	2266	04332
C)10B	2267	04333	C)1G0	2268	04334	C)1G1	2269	04335	C)1G2	2270	04336
C)201	2271	04337	C)202	2272	04340	C)203	2273	04341	C)204	2274	04342
C)205	2275	04343	C)206	2276	04344	C)207	2277	04345	C)208	2278	04346

Figure 50. Subroutine SILFAC Core Storage Map (continued)

Approved for Public Release

Contrails

Contrails

7J366 SILFAC(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63 11/08/83 PAGE 17

D)1CS	303	00457	D)114	351	00537	D)12E	712	01310	D)12I	738	01342
D)12K	768	01400	D)12P	801	01441	D)14K	1208	02270	D)158	1441	02641
D)159	1451	02653	D)15H	1553	03021	D)15K	1583	03057	D)166	1751	03327
D)16P	1853	03475	D)16U	1890	03542	D)175	1946	03632	D)176	1950	03636
D)20C	289	00441	D)21C	462	00716	D)21I	505	00771	D)21M	533	01025
D)21P	543	01037	D)223	601	01131	D)224	609	01141	D)225	618	01152
D)22R	808	01450	D)23C	999	01747	D)23I	1035	02013	D)23R	1078	02066
D)23V	1097	02111	D)243	1116	02134	D)24K	1210	02272	D)24M	1301	02425
D)262	1691	03233	D)268	1761	03341	D)269	1766	03346	D)26D	1782	03366
D)26M	1838	03456	D)26V	1896	03550	D)274	1931	03613	D)30S	302	00456
D)31C	461	00715	D)325	617	01151	D)32K	767	01377	D)362	1690	03232
D)368	1760	03340	D)369	1765	03345	D)36M	1837	03455	D)36U	1889	03541
D)375	1945	03631	D)376	1949	03635	D)40E	130	00202	D)40G	172	00254
D)40I	189	00275	D)40P	285	00435	D)410	325	00505	D)424	611	01143
D)42J	747	01353	D)42T	844	01514	D)431	907	01613	D)433	933	01645
D)44R	1335	02467	D)45F	1485	02715	D)45I	1560	03030	D)45P	1616	03120
D)45G	1619	03123	D)45R	1630	03136	D)46J	1815	03427	D)510	324	00504
D)55I	1559	03027	D)55R	1629	03135	D)56J	1814	03426	D)60G	171	00253
D)60P	284	00434	D)624	608	01140	D)62J	746	01352	D)62T	843	01513
D)633	932	01644	D)65P	1615	03117	D)66V	1895	03547	D)70S	301	00455
D)725	616	01150	D)72K	766	01376	D)76U	1888	03540	D)76V	1894	03546
D)775	1944	03630	D)776	1948	03634	E)C	118	00166	E)K	227	00343
E)M	267	00413	E)R	294	00446	E)15	356	00544	E)1D	478	00736
E)1F	495	00757	E)2A	642	01202	E)2B	645	01205	E)2L	772	01404
E)35	956	01674	E)37	974	01716	E)3D	1005	01755	E)4L	1214	02276
E)5M	1607	03107	E)6A	1769	03351	E)10D	124	00174			

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
A TAN	2	00002	COUNTV	0	00000	DUMP	5	00005	SQRT	1	00001
TIMEV	6	00006	(FIL)	4	00004	(SPH)	3	00003			

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

A TAN   COUNTV   DUMP   SQRT   TIMEV   (FIL)   (SPH)

Figure 50. Subroutine SILFAC Core Storage Map
(continued)

Approved for Public Release

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
29000	17	00062	29050	21	00103	29100	22	00106	29150	24	00111
29160	25	00113	29200	26	00115	29800	31	00133	30000	34	00142
30500	37	00147	31000	38	00151	31500	40	00171	31550	41	00177
29250	42	00203	29900	46	00220	2100	52	00261	2200	54	00276
6900	58	00344	7000	60	00365	8000	65	00414	10000	66	00417
10100	69	00426	10200	70	00436	11000	71	00442	11500	72	00447
11600	75	00462	11700	77	00474	12000	79	00506	12100	81	00527
12150	83	00545	12200	84	00550	12300	89	00576	12350	91	00605
12400	94	00656	12800	96	00663	225	103	00740	227	104	00752
240	105	00766	260	106	00772	270	110	01012	280	111	01015
290	113	01021	295	115	01026	296	116	01032	297	118	01035
300	119	01040	310	120	01043	315	121	01051	320	123	01056
325	124	01064	330	126	01071	370	131	01105	375	132	01107
12900	133	01112	13000	134	01123	13500	136	01132	13600	137	01144
400	139	01153	11300	143	01175	11400	145	01203	105	152	01245
100	156	01272	2600	158	01311	2700	160	01320	104	162	01325
110	163	01330	115	164	01343	140	167	01354	160	170	01406
170	171	01410	175	174	01424	180	176	01427	190	179	01442
195	181	01451	649	183	01464	660	190	01515	402	193	01527
403	194	01531	404	196	01541	662	200	01614	663	202	01624
651	204	01651	664	212	01675	665	214	01702	667	215	01707
668	216	01717	669	217	01724	671	219	01727	672	220	01733
673	221	01741	674	222	01750	670	225	01756	2400	227	01767
2500	228	01771	677	229	02001	678	231	02006	679	232	02014
4000	233	02021	4100	235	02024	4200	236	02032	4300	237	02037
4400	239	02042	4500	240	02050	410	241	02052	420	244	02061
430	246	02067	435	248	02077	440	249	02101	450	251	02106
460	252	02112	675	253	02120	680	254	02124	690	255	02130
695	256	02135	696	258	02147	697	262	02156	700	264	02163
704	265	02171	705	266	02173	706	268	02200	708	269	02204
710	270	02212	720	271	02215	730	272	02221	735	273	02224
740	274	02227	745	275	02235	755	276	02240	760	283	02257
770	284	02264	800	286	02273	801	287	02277	804	289	02426
802	290	02441	803	291	02445	805	293	02454	4550	295	02470
4560	297	02474	810	298	02500	540	299	02507	820	300	02515
821	301	02524	822	302	02532	830	304	02535	834	307	02546
2800	308	02553	824	309	02557	832	314	02575	823	316	02606

Figure 50. Subroutine SILFAC Core Storage Map (continued)

Approved for Public Release

Contrails

Contrails

```
7J366    SILFAC(CONFAC II)ANALYSIS AND PROGRAMMING BY K.A.TOUPS,NAASID,11/1/63    11/08/83  PAGE 19

 4570   318 02614        4580   321 02637         835   322 02642         840   324 02645
  850   328 02700         860   329 02702         870   331 02705         880   332 02707
  890   333 02710         905   334 02716         910   339 03016         920   340 03022
  940   341 03031         945   342 03036        4590   344 03060         610   345 03070
  615   346 03102         650   347 03114         656   348 03121         657   349 03124
  995   353 03137         996   355 03144        1600   356 03150         997   358 03167
  998   359 03174         950   366 03234         960   370 03300         965   372 03303
  970   374 03310         980   375 03330         903   377 03342         986   378 03347
  971   379 03352         500   380 03356         520   381 03362         984   382 03367
  972   383 03403         975   384 03406         987   385 03413         988   386 03430
  990   387 03433        1015   390 03457         999   391 03463        1700   392 03467
 1020   394 03500        1016   401 03535        1017   402 03543        1000   403 03551
 1050   405 03561        1060   408 03605        1500   409 03614        2000   414 03633
 2300   415 03637
```

Figure 50. Subroutine SILFAC Core Storage Map
(continued)

Approved for Public Release

Contrails

```
                                                                  2/14/74     PAGE 1

                          * 7090 FORTRAN INPUT-OUTPUT COMPATIBILITY ROUTINE CAUSES              00000003
                          *      'READ N, LIST' TO BE EXECUTED AS 'READ INPUT TAPE              00000004
                          *      M1, N, LIST', 'PRINT N, LIST' TO BE EXECUTED AS                00000005
                          *      'WRITE OUTPUT TAPE M2, N, LIST', AND 'PUNCH N, LIST'           00000006
                          *      TO BE EXECUTED AS 'WRITE OUTPUT TAPE M3, N, LIST'              00000007
                          *      WHERE N IS THE STATEMENT NUMBER OF A FORMAT AND                00000008
                          *      M1, M2, AND M3 ARE THE LOGICAL TAPE NUMBERS                    00000009
                          *      FOR PERIPHERAL INPUT, OUTPUT AND PUNCHING RESPECTIVELY.        00000010
                          *                                                                     00000011
                          *      WRITTEN BY O. M. GEORGE, NORTH AMERICAN AVIATION, INC.         00000012
                          *              SPACE AND INFORMATION SYSTEMS DIVISION, DOWNEY, CALIF. 00000013
                          *                                                                     00000014
                00002            ENTRY    (CSH)                                                 00000015
                00004            ENTRY    (SPH)                                                 00000016
                00006            ENTRY    (SCH)                                                 00000017

     TRANSFER VECTOR
   00000  746362303460    (TSH)
   00001  746263303460    (STH)

   00002 -0500 00 0 00010  (CSH) CAL     M1                                                     00000018
   00003  0020 00 0 00000        TRA     $(TSH)                                                 00000019
   00004 -0500 00 0 00011  (SPH) CAL     M2                                                     00000020
   00005  0020 00 0 00001        TRA     $(STH)                                                 00000021
   00006 -0500 00 0 00012  (SCH) CAL     M3                                                     00000022
   00007  0020 00 0 00001        TRA     $(STH)                                                 00000023
   00010  0 00005 0 00000  M1    PZE     0,0,MIN                                                00000024
   00011  0 00006 0 00000  M2    PZE     0,0,MOUT                                               00000025
   00012  0 00016 0 00000  M3    PZE     0,0,MPUNCH                                             00000026
                00005      MIN   EQU     5                 LOGICAL INPUT TAPE NUMBER            00000027
                00006      MOUT  EQU     6                 LOGICAL OUTPUT TAPE NUMBER           00000028
                00016      MPUNCH EQU    14                LOGICAL PUNCH TAPE NUMBER            00000029
                                 END                                                            00000030
```

Figure 51. FAP Input-Output Compatibility Subroutine Listing

Approved for Public Release

Contrails

```
                                                        2/14/74     PAGE 1
                     POST PROCESSOR ASSEMBLY DATA

          13 IS THE FIRST LOCATION NOT USED BY THIS PROGRAM

REFERENCES TO DEFINED SYMBOLS
          10      M1      2
          11      M2      4
          12      M3      6
           5     MIN     10,    13
           6    MOUT     11,    13
           2   (CSH)
           6   (SCH)
           4   (SPH)
           1   (STH)      5,     7
           0   (TSH)      3
          16 MPUNCH      12,    13

NO ERROR IN ABOVE ASSEMBLY.
```

Figure 51. FAP Input-Output Compatibility Subroutine Listing (Continued)

Approved for Public Release

Contrails

```
*     DATA                                                                  36700000
S     T     C     1     2     3     4     5     6     7     8     9        36700100
      1     2     3     4     5     6     7     8     9     10    11     1236700200
       (1H1/(1H 12A6))                                                     36700300
(  1H133X42HNAA SPACE AND INFORMATION SYSTEMS DIVISION/25X60HT+A PROJECT36700400
 RADIANT-INTERCHANGE CONFIGURATION FACTOR PROGRAM/1H045X16HC O N F A C  36700500
I I)                                                                       36700600
(   1H018X12A6/19X12A6/1H045X18HI N P U T  D A T A)                        36700700
(36I2)                                                                     36700800
( 13HODATA NAME- *1A6,1H*/ 78HONO CLASS NO.GIVEN IN COL.1 OF DATA NAME C36700900
ARD--YOUR JOB CANNOT BE CONTINUED.  )                                      36701000
(1H0/19HO***** DATA NAME- *2A6,1H*)                                        36701100
(6F12.0)                                                                   36701200
(4F12.0,4I3,1F12.0)                                                        36701300
(2F12.0,4I3,3F12.0/4I3,3F12.0,4I3,F12.0)                                   36701400
(24HOSURFACE SPECIFICATIONS-/ 19HONO OF X-SECTIONS =I3,10X36HNO OF X-SEC36701500
TION BOUNDARY DIVISIONS =I3/36HOLOCATION OF VERTICAL CENTERLINE, X=E14.736701600
,4H, Y=E14.7/14HOX-SECTION NO.5X13HX-AXIS RADIUS6X13HY-AXIS RADIUS6X24HE36701700
LEVATION ABOVE XY PLANE/(I7,6X3E19.7))                                     36701800
( 88HOTHE FOLLOWING INTERNALLY GENERATED SURFACE DATA RESULTED FROM THE 36701900
ABOVE SPECIFICATIONS-)                                                     36702000
(23HOSPHERE SPECIFICATIONS-/ 9HORADIUS =E14.7/30H COORDINATES OF CENTER-36702100
--- X =E14.7,5X3HY =E14.7,5X3HZ =E14.7)                                    36702200
(19HOMULTISURFACE DATA-/1HO12(1A6,1H,))          ENTRIE POINT              36702300
(102HOYOU HAVE EXCEEDED THE MAX ALLOWABLE NO OF DATA  ENTRIES IN THE CLA36702400
SS IN WHICH THE ABOVE NAME APPEARS./ 30H YOUR JOB CANNOT BE CONTINUED.) 36702500
( 21HOTRANSFORMATION DATA-)                                                36702600
(1HO2(5HPOINT7X1HX14X1HY14X1HZ11X))                                        36702700
(2(I5,1X3E15.7,3X))                                                        36702800
(    6X3E15.7,44H---(INTERNALLY GENERATED ORIENTATION VECTOR))             36702900
(1H0/4(27H POINT  CONNECTING POINTS  ) /4(I5,I7,1H,I3,1H,I3,1H,I3,3X))  36703000
(75H-ONE OR MORE OF ABOVE NAMES OR INSTRUCTIONS IS INCORRECT. THIS RUN A36703100
BORTED.)                                                                   36703200
( 48H- HI-I HOPE YOU ARE GLAD I STOPPED THIS- K.TOUPS)                     36703300
(1H118X12A6/19X12A6/8H-RUN NO.I4,28H   DATA USED FOR THIS RUN- *1A6,1H*136703400
A6,1H*/2(39X,1H*1A6,1H*1A6,1H*/))                                          36703500
( 66H-A NONPLANAR SURFACE CANNOT BE USED AS SURFACE 1-THIS RUN ABORTED.)36703600
( 61H-TXFRM DATA MUST BE IN CLASS 9. THIS RUN CANNOT BE CONTINUED.)     36703700
( 63H-SURFACE DATA ABOVE CLASS 6 CANNOT BE TRANSFORMED. RUN ABORTED.)   36703800
(18H-NONE OF SURFACE *2A6,22H* IS SEEN BY SURFACE *2A6,1H*//104H IF THE 36703900
ABOVE RESULT IS UNEXPECTED, DO NOT BECOME ALARMED- IT HAPPENS TO THE BES36704000
T OF EM. JUST CHECK YOUR/ 99H DATA-ESPECIALLY BE SURE THAT YOU ENTERED A36704100
LL POINTS IN COUNTERCLOCKWISE ORDER, AS THEY APPEAR WHEN/ 90H FACING THE36704200
 ACTIVE SIDE OF THE SURFACE, AND DERIVED FROM A RIGHT-HANDED COORDINATE 36704300
```

Figure 52. Variable Format

Approved for Public Release

Contrails

```
SYSTEM.)                                                                36704400
(10HOSURFACE *1A6,22H* WAS TRANSFORMED BY *1A6,19H* TO THE FOLLOWING-)  36704500
(31HOTHE FORM FACTOR FROM SURFACE *2A6,14H* TO SURFACE *2A6,3H* =F8.5/  36704600
 31HOTHE EXCHANGE COEFFICIENT (FA)=E14.5,9H SQ UNITS/1H018X18HTHE MAPPIN36704700
G AREA =E14.7,9H SQ UNITS)                                              36704800
(25H-ONLY A PART OF SURFACE *2A6,25H*, COMPRISING AN AREA OF E14.7, 11H 36704900
 SQ UNITS,/15H SEES SURFACE *2A6,1H*)                                   36705000
(22HOTHE AREA OF SURFACE *2A6,3H* =  E14.7,10H SQ UNITS.)               36705100
( 16HOWARNING-WARNING/  77H THE MAPPING AREA IS MORE THAN 1 PERCENT DIFF36705200
ERENT FROM THE AREA IN SURFACE *2A6,  9H* SEEN BY/10H SURFACE *2A6, 71H*36705300
. THIS MAY BE CAUSED BY WRONG SURFACE DATA ENTRY (THE SURFACE BOUNDARY/ 36705400
105H CROSSES A MAPPING LINE IN MORE THAN TWO PLACES), OR TOO COARSE INCR36705500
EMENTS.  THE FACTOR MAY BE INCORRECT.)                                  36705600
( 83H-THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FAC36705700
TOR COMPUTATION-)                                                       36705800
( 47HOCOORDINATES OF POINTS ON BOUNDARY OF SURF    *2A6,21H* FOR EACH Y 36705900
INTERVAL     /1H06X,6HX-LEFT9X,7HX-RIGHT10X,1HY22X,6HX-LEFT9X,7HX-RIGHT136706000
0X,1HY// (1X,3E15.7,10X,3E15.7))                                        36706100
(3CH-NO. OF HORIZONTAL INCREMENTS=I3,29H  NO. OF VERTICAL INCREMENTS=I3)36706200
(74H-THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR TH36706300
IS RUN/48H LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.///)          36706400
(6E16.7)                                                                36706500
( 88HOSURFACE 1 MUST BE IN THE XY PLANE OF ITS CS WHEN SURFACE 2 IS CLAS36706600
S 8-THIS RUN ABORTED.)                                                  36706700
(60H-SURF 2 HAS A 0 OR - Z-COORD REL TO SURF 1-THIS RUN ABORTED.)       36706800
(63H-THE ALLOWABLE GRAND TOTAL OF CLASS 4,5,6 SURFACES IS EXCEEDED.)    36706900
(67H-YOU HAVE EXCEEDED THE MAX. GRAND TOTAL OF ALL SURFACE DATA ENTRIES)36707000
(66H ALLOWED WHEN A DETAILED SILHOUETTE GENERATOR OUTPUT IS REQUESTED.) 36707100
(66H-MAPPING     SURFACE 2 SILHOUETTE COMPUTED FROM MAPPING POINT SHOWN/ 36707200
 8H LINE PT)                                                            36707300
(1H I3,I4,3X,24I4/(11X,24I4))                                           36707400
(1H+32X10A6)(25H-ONLY A PART OF SURFACE *2A6,16H* SEES SURFACE *2A6,1H*)36707500
(53H-TROUBLE IN SILFAC-THIS SILHOUETTE DOES NOT CONVERGE.)              36707600
```

Figure 52. Variable Format

Approved for Public Release

Contrails

APPENDIX C

COORDINATE TRANSFORMATION

PRIMARY TRANSFORMATION

As indicated in Section II, the surface coordinate transformation technique employed by the program does not require transformation parameters such as direction cosines, Euler angles and translation terms to be entered as input data to the program for transformation purposes. Instead, the x, y and z coordinates of three points, not in a line, are given from the new origin, or to the new position of the surface. These data are then used to derive the rotational and translation terms required to transform the remaining surface data to the new origin or surface position.

The classical equations for transformation of rectangular coordinates in space are employed for both primary and auxiliary transformation. The new x, y and z coordinates in terms of the old coordinates are:

$$x = x'\cos\alpha_1 + y'\cos\alpha_2 + z'\cos\alpha_3 + H \qquad (1)$$

$$y = x'\cos\beta_1 + y'\cos\beta_2 + z'\cos\beta_3 + L \qquad (2)$$

$$z = x'\cos\gamma_1 + y'\cos\gamma_2 + z'\cos\gamma_3 + K \qquad (3)$$

Note that there are 9 unknown direction cosines and 3 translation terms, or a total of 12 unknowns. It is clear that the coordinates of four points from the new origin are required if these equations are to be used directly to determine the unknown parameters.

It can be shown, however, that the coordinates of three points (not in a line) are sufficient and necessary to fix the position of a surface in any rectangular coordinate system. It appears, therefore, that another point must be made available for solution of the above equations, or another technique developed which directly requires only three points. Investigation of the latter yielded a complex, difficult to program, solution. On the other hand, solution of the classical equations is straightforward, but requires the extra point (not in the plane of the other three). Rather than require the user to supply the extra point in data, it was decided to generate the point as a unit normal vector above the second point given in transformation data. This extra point must, of course, be generated in both old and new coordinate systems.

Figure 53 depicts a primary transformation of Surface A from the old (primed) to the new (unprimed) coordinate system. Note that the primary transformation shown affects only one surface, whereas both surfaces are involved in the auxiliary transformation, which will be discussed in more

Approved for Public Release

Contrails

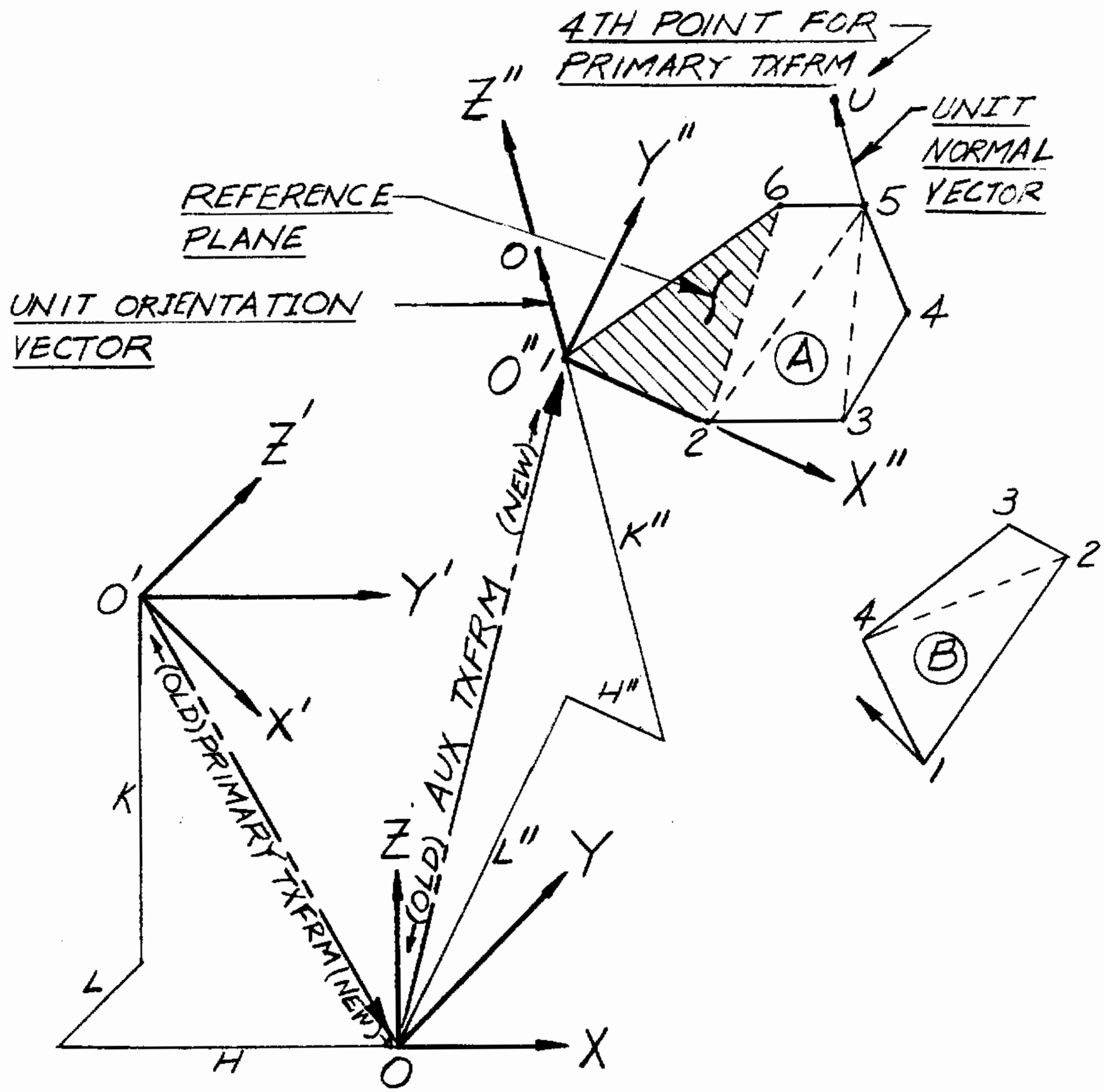

Figure 53. Coordinate Transformation

Approved for Public Release

Contrails

detail later in this Appendix. The angles (α, β and γ) shown in Equations 1, 2 and 3 are related in the following manner with the primed and unprimed coordinate axes shown in Figure 53:

$$\alpha_1 = \angle O'X'OX,\ \alpha_2 = \angle O'Y'OX,\ \alpha_3 = \angle O'Z'OX$$

$$\beta_1 = \angle O'X'OY,\ \beta_2 = \angle O'Y'OY,\ \beta_3 = \angle O'Z'OY$$

$$\gamma_1 = \angle O'X'OZ,\ \gamma_2 = \angle O'Y'OZ,\ \gamma_3 = \angle O'Z'OZ$$

Given the coordinates of points 2, 5 and 6 in Surface A, and the generated point U, from <u>both</u> the old and new coordinate systems, we may write four independent equations similar to Equation 1. Using Equation 1, the resulting set of equations in x is:

$$x_2 = x_2' \cos \alpha_1 + y_2' \cos \alpha_2 + z_2' \cos \alpha_3 + H \tag{4}$$

$$x_5 = x_5' \cos \alpha_1 + y_5' \cos \alpha_2 + z_5' \cos \alpha_3 + H \tag{5}$$

$$x_6 = x_6' \cos \alpha_1 + y_6' \cos \alpha_2 + z_6' \cos \alpha_3 + H \tag{6}$$

$$x_U = x_U' \cos \alpha_1 + y_U' \cos \alpha_2 + z_U' \cos \alpha_3 + H \tag{7}$$

We may similarly write two more sets of equations in y and z similar to Equations 2 and 3, for a total of twelve independent equations. Each set of four simultaneous equations is solved by Cramer's Rule (Reference 2) for the unknown direction cosines relating the old y' and z' axes to the new x, y and z axes.

For example, using the set developed above for Equation 1 (Equations 4, 5, 6 and 7), the coefficient determinant D is

$$D = \begin{vmatrix} x_2' & y_2' & z_2' & 1 \\ x_5' & y_5' & z_5' & 1 \\ x_6' & y_6' & z_6' & 1 \\ x_U' & y_U' & z_U' & 1 \end{vmatrix} \tag{8}$$

By Cramer's Rule, we successively replace the elements in each column of the set with the respective element on the left of each equation in the set. For example, the solution for $\cos \alpha_2$ is:

Approved for Public Release

Contrails

$$\cos \alpha_2 = \frac{\begin{vmatrix} x'_2 & x_2 & z'_2 & 1 \\ x'_5 & x_5 & z'_5 & 1 \\ x'_6 & x_6 & z'_6 & 1 \\ x'_U & x_U & z'_U & 1 \end{vmatrix}}{D} \qquad (9)$$

and similarly,

$$\cos \alpha_3 = \frac{\begin{vmatrix} x'_2 & y'_2 & x_2 & 1 \\ x'_5 & y'_5 & x_5 & 1 \\ x'_6 & y'_6 & x_6 & 1 \\ x'_U & y'_U & x_U & 1 \end{vmatrix}}{D} \qquad (10)$$

The above process is repeated for the solution of $\cos \beta_2$, $\cos \beta_3$, $\cos \gamma_2$, and $\cos \gamma_3$, using the sets developed for y and z. The coefficient determinant is the same for all sets, because the coefficients of the unknowns in all sets are identical.

To increase computational efficiency, repeated factors in the expanded determinants are computed only once for each set. Also, considerable economy results in computing the unknown direction cosines $\cos \alpha_1$, $\cos \beta_1$, $\cos \gamma_1$, as the cross product of the corresponding direction cosines of the other (y and z) axes:

$$\cos \alpha_1 = \cos \beta_2 \cos \gamma_3 - \cos \gamma_2 \cos \beta_3 \qquad (11)$$

$$\cos \beta_1 = \cos \gamma_2 \cos \alpha_3 - \cos \alpha_2 \cos \gamma_3 \qquad (12)$$

$$\cos \gamma_1 = \cos \alpha_2 \cos \beta_3 - \cos \beta_2 \cos \alpha_3 \qquad (13)$$

The translation components H, L and K are computed by substituting the coordinates of the point below point U in the surface to be transformed into Equations 1, 2 and 3, along with the known values of direction cosines. For the Surface A shown in Figure 53, using point 5,

$$H = x_5 - x'_5 \cos \alpha_1 - y'_5 \cos \alpha_2 - z'_5 \cos \alpha_3 \qquad (14)$$

$$L = y_5 - x'_5 \cos \beta_1 - y'_5 \cos \beta_2 - z'_5 \cos \beta_3 \qquad (15)$$

$$K = z_5 - x'_5 \cos \gamma_1 - y'_5 \cos \gamma_2 - z'_5 \cos \gamma_3 \qquad (16)$$

Approved for Public Release

Contrails

The program now transforms all point coordinates in Surface A from the old to the new system by direct substitution in Equations 1, 2 and 3.

The method outlined above will always perform the transformation desired, providing the three points selected are (1) sufficiently separated in space, (2) accurately computed, and (3) do not form a straight line in space. Because the fourth point U is always computed outside the plane of the other three, the coefficient determinant D can never be 0. Hence, by Cramer's Rule, a unique solution must always exist.

AUXILIARY TRANSFORMATION

An auxiliary transformation transforms the coordinates of both surfaces into the reference plane of a specified surface--the "Control" surface. In Figure 53, Surface A is the control surface; the auxiliary transformation depicted transforms both Surface A and B from the unprimed (old) system to the double-primed (new) system. In general, the origin O" in the control surface is always point 1 in the control surface coordinate array. It may not always be the first point entered in input surface data; if a bisection of the surface occurs, and the original point 1 is not seen by the other surface (assumed planar), then a new point 1 will be computed. The new point will be used as the origin O". The same processing occurs for internally generated surfaces. Only surfaces classed as plane surfaces may be control surfaces, i.e., Classes 1, 3, 4 and planar 6. For example, if both Surface A and B in Figure 53 are plane and bisect each other, two auxiliary transformations would occur to facilitate surface reconstruction. Actually, if Surface A were entered as Surface 1, the first auxiliary transformation to occur would be to point 1 in Surface B, rather than Surface A. This would not occur, however, if Surface A were not bisected by Surface B. In any case, the last transformation always is to point 1 in Surface 1, so that mapping and factor computation may proceed forthwith.

The processing of an auxiliary transformation differs from the primary transformation because unknowns may be more readily computed from available data. Equations 1, 2 and 3 are rewritten for the auxiliary old and new coordinate systems,

$$x'' = x \cos \alpha_1 + y \cos \alpha_2 + z \cos \alpha_3 + H'' \qquad (17)$$

$$y'' = x \cos \beta_1 + y \cos \beta_2 + z \cos \beta_3 + L'' \qquad (18)$$

$$z'' = x \cos \gamma_1 + y \cos \gamma_2 + z \cos \gamma_3 + K'' \qquad (19)$$

The angles are defined as follows, referring to Figure 53:

$$\alpha_1 = \angle OXO''X'',\ \alpha_2 = \angle OYO''X'',\ \alpha_3 = \angle OZO''X''$$

$$\beta_1 = \angle OXO''Y'',\ \beta_2 = \angle OYO''Y'',\ \beta_3 = \angle OZO''Y''$$

$$\gamma_1 = \angle OXO''Z'',\ \gamma_2 = \angle OYO''Z'',\ \gamma_3 = \angle OZO''Z''$$

Approved for Public Release

Contrails

Because the O"X" axis in the new system is directed along the line segment formed by the first and second point in the control surface, the direction cosines related to that axis are readily computed.

The length of line $\overline{12}$ in Surface A is

$$LS_{12} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2},$$

and the direction cosines relating the new O"X" axis to the old OX, OY and OZ axes are:

$$\cos \alpha_1 = (x_2 - x_1)/LS_{12} \tag{20}$$

$$\cos \alpha_2 = (y_2 - y_1)/LS_{12} \tag{21}$$

$$\cos \alpha_3 = (z_2 - z_1)/LS_{12} \tag{22}$$

Because the new O"Z" axis is directed along the surface unit orientation vector (point 0 above Surface A) the cosines relating that axis to the old OX, OY and OZ axes are

$$\cos \gamma_1 = x_0 - x_1 \tag{23}$$

$$\cos \gamma_2 = y_0 - y_1 \tag{24}$$

$$\cos \gamma_3 = z_0 - z_1 \tag{25}$$

The remaining direction cosines are computed by cross products of the X" and Z" axis unit base vectors (direction cosines).

$$\cos \beta_1 = \cos \gamma_2 \cos \alpha_3 - \cos \alpha_2 \cos \gamma_3 \tag{26}$$

$$\cos \beta_2 = \cos \alpha_1 \cos \gamma_3 - \cos \gamma_1 \cos \alpha_3 \tag{27}$$

$$\cos \beta_3 = \cos \gamma_1 \cos \alpha_2 - \cos \alpha_1 \cos \gamma_2 \tag{28}$$

The unknown translation terms are determined from Equations 17, 18 and 19 for point 1 in Surface A ($x_1'' = 0$, $y_1'' = 0$, $z_1'' = 0$).

$$H'' = - x_1 \cos \alpha_1 - y_1 \cos \alpha_2 - z_1 \cos \alpha_3 \tag{29}$$

$$L'' = - x_1 \cos \beta_1 - y_1 \cos \beta_2 - z_1 \cos \beta_3 \tag{30}$$

$$K'' = - x_1 \cos \gamma_1 - y_1 \cos \gamma_2 - z_1 \cos \gamma_3 \tag{31}$$

The program now transforms all coordinates in Surface A <u>and</u> Surface B to the new system by using Equations 17, 18 and 19.

Approved for Public Release

Contrails

APPENDIX D

COMPUTATION OF SURFACE AREA OF INTERNALLY GENERATED SURFACES

In Figure 54, View J-J shows a view of the surface of a right elliptical cone between the two arbitrary cross-sections indicated in the isometric sketch of the cone. Because the program internal surface generator uses the elliptical cross-section as the basic generating element, elemental surface areas such as Area ABCD in Figure 54 are trapezoids having, in general, unequal nonparallel sides. Also, because each elemental surface is developed by equal elliptical parametric angles, one need compute the area of only one elemental surface for each pair of cross-sections (providing, of course, the cross-sections are similar).

The plane area of trapezoid ABCD is

$$A_T = \tfrac{1}{2} h \, (L_1 + L_2). \qquad (1)$$

L_1 and L_2 are readily computed from the X, Y coordinates of points A, B, C and D;

$$L_1 = \sqrt{(X_C - X_A)^2 + (Y_C - Y_A)^2} \qquad (2)$$

$$L_2 = \sqrt{(X_D - X_B)^2 + (Y_D - Y_B)^2} \qquad (3)$$

The trapezoid height h is computed indirectly from the projected area A_p of the trapezoid on the XY plane in the following manner:

$$h = \sqrt{h_p^{\,2} + Z^2} \qquad (4)$$

where h_p is the projected length of trapezoid height h, and Z is the distance between cross-sections.

The projected area of ABCD is:

$$A_p = \tfrac{1}{2} h_p \, (L_1 + L_2). \qquad (5)$$

Solving for h_p in Equation 5:

$$h_p = \frac{2 \, A_p}{(L_1 + L_2)} \qquad (6)$$

The area A_p is computed from the trapezoid (X,Y) coordinates in the following manner:

Approved for Public Release

Contrails

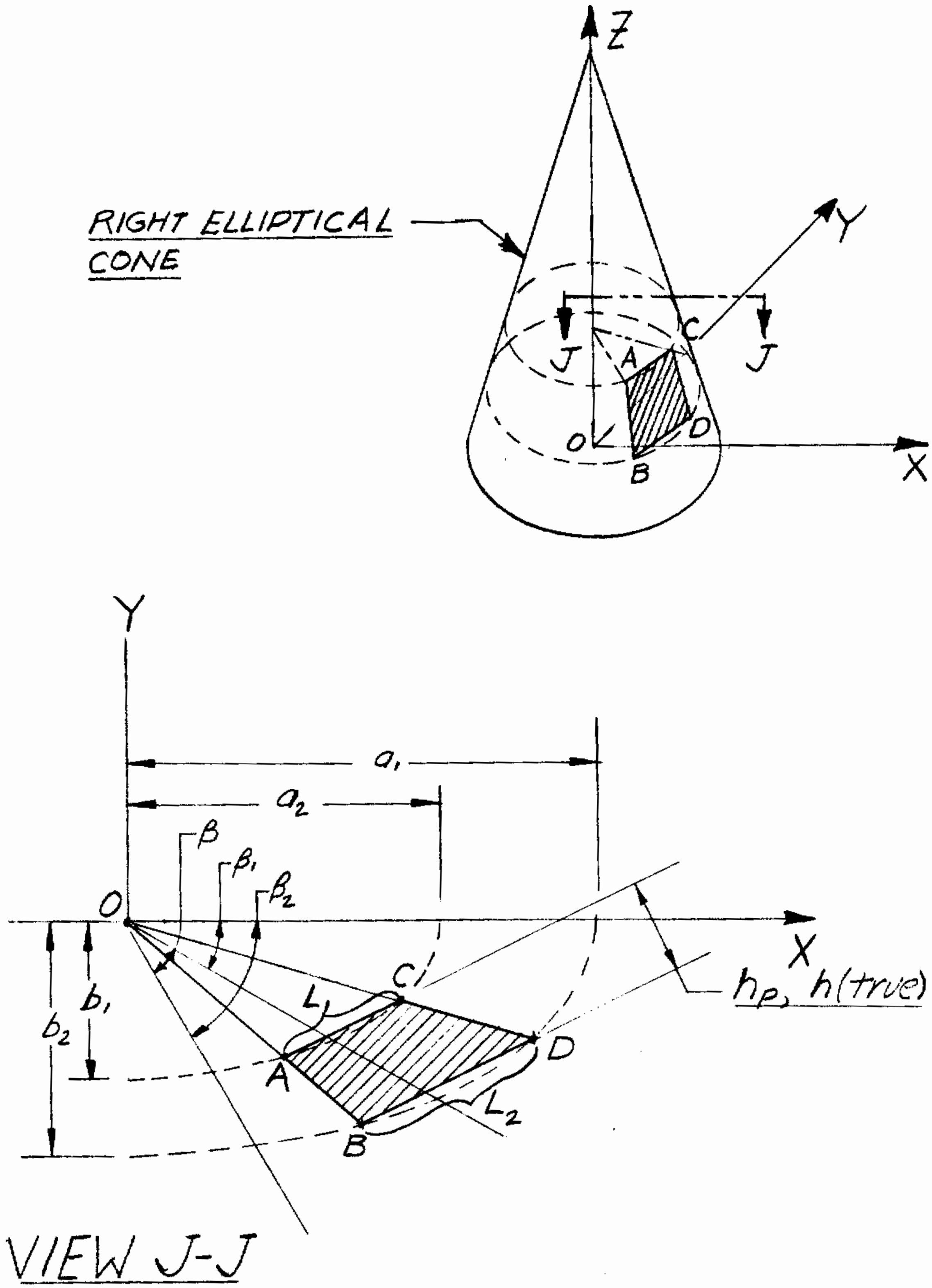

Figure 54. Surface Area Geometry of Internally Generated Polyhedra

Approved for Public Release

Contrails

Noting triangles BOD and AOC

$$A_p = \text{Area } \Delta BOD - \text{Area } \Delta AOC \tag{7}$$

It is desirable for computational efficiency to compute A_p using known parameters. In this case, sin β is known and is used. The parametric equations of the ellipse are:

$$x = a \cos \theta \tag{8}$$

$$y = b \sin \theta \tag{9}$$

where a is the semi-major axis, b is the semi-minor axis and θ is the parametric angle. In Figure 54, angle β_1 defines points A and B and angle β_2 defines points C and D. Angle $\beta = \beta_2 - \beta_1$.

The area of triangle AOC can be computed by vector cross products,

$$A_{AOC} = \tfrac{1}{2} (X_A Y_C - X_C Y_A) \tag{10}$$

From Equations 8 and 9 for the parametric angles β_1 and β_2 defining points A and C,

$$X_A = a_1 \cos \beta_1, \; Y_A = b_1 \sin \beta_1 \tag{11}$$

$$X_C = a_1 \cos \beta_2, \; Y_C = b_1 \sin \beta_2 \tag{12}$$

Substituting Equations 11 and 12 in Equation 10,

$$A_{AOC} = \tfrac{1}{2} a_1 b_1 (\cos \beta_1 \sin \beta_2 - \cos \beta_2 \sin \beta_1)$$

$$A_{AOC} = \tfrac{1}{2} a_1 b_1 \sin (\beta_2 - \beta_1)$$

$$A_{AOC} = \tfrac{1}{2} a_1 b_1 \sin \beta \tag{13}$$

A similar derivation is developed to obtain the area of triangle BOD.

$$A_{BOD} = \tfrac{1}{2} a_2 b_2 \sin \beta \tag{14}$$

Substituting Equations 13 and 14 in Equation 7,

$$A_p = \tfrac{1}{2} \sin \beta \, (a_2 b_2 - a_1 b_1) \tag{15}$$

Substituting Equation 15 into Equation 6,

$$h_p = \frac{2\left[\tfrac{1}{2} \sin \beta \, (a_2 b_2 - a_1 b_1)\right]}{L_1 + L_2} \tag{16}$$

Approved for Public Release

Contrails

Substituting Equation 16 into Equation 4,

$$h = \sqrt{\left[\frac{\sin\beta\,(a_2b_2 - a_1b_1)}{L_1 + L_2}\right]^2 + Z^2} \qquad (17)$$

Finally, substituting Equation 17 into Equation 1,

$$A_T = \frac{L_1 + L_2}{2}\sqrt{\left[\frac{\sin\beta\,(a_2b_2 - a_1b_1)}{L_1 + L_2}\right]^2 + Z^2}$$

Rearranging terms,

$$A_T = \tfrac{1}{2}\sqrt{\left[\sin\beta\,(a_2b_2 - a_1b_1)\right]^2 + \left[Z\,(L_1 + L_2)\right]^2} \qquad (18)$$

The total surface area is computed by repeated evaluation of Equation 18 for the particular surface generated.

Approved for Public Release

Contrails

APPENDIX E

DERIVATION OF CONFIGURATION FACTOR TO A SPHERE

The analytic solution of the configuration factor to a sphere depends upon the position of the sphere relative to the plane of Surface 1. This is clearly demonstrated geometrically by using the Nusselt unit sphere projection as shown in Figure 55. Three unique solutions are apparent from the five different sphere positions; Ib and IIIa represent "limit" values in each case. The unit sphere projections (crosshatched areas) shown in the lower part of Figure 55 correspond respectively to sphere positions (not to scale) depicted in the upper half. Case I results when the sphere is above (Ia) and/or touching (Ib) the plane of Surface 1. The locus on the Nusselt hemisphere base is an ellipse, and varies from a circle (when the sphere is vertically over the point O) to the single tangency position shown in Ib. When the sphere goes below the plane of Surface 1, the Case II locus appears, and is formed by the ellipse boundary on the left and the unit circle boundary on the right.

The locus projected on the unit sphere surface is a circle, in every case. The radius, b, of the circle becomes the semi-major axis of the projected ellipse. By similar triangles,

$$\frac{b}{1} = \frac{R}{D}$$

$$b = \frac{R}{D} \tag{1}$$

where D = distance from center of sphere to origin of unit sphere and R is the sphere radius. The semi-minor axis, a, of the ellipse is the projection on the unit circle of b; again by similar triangles,

$$\frac{Z}{D} = \frac{a}{b}$$

or

$$a = b\,\frac{Z}{D} = \frac{RZ}{D^2} \tag{2}$$

The area of the ellipse is

$$A = \pi ab = \pi\,\frac{R^2Z}{D^3} \tag{3}$$

The configuration factor for Case I is the area of the ellipse divided by the area of the unit radius circle,

Approved for Public Release

Contrails

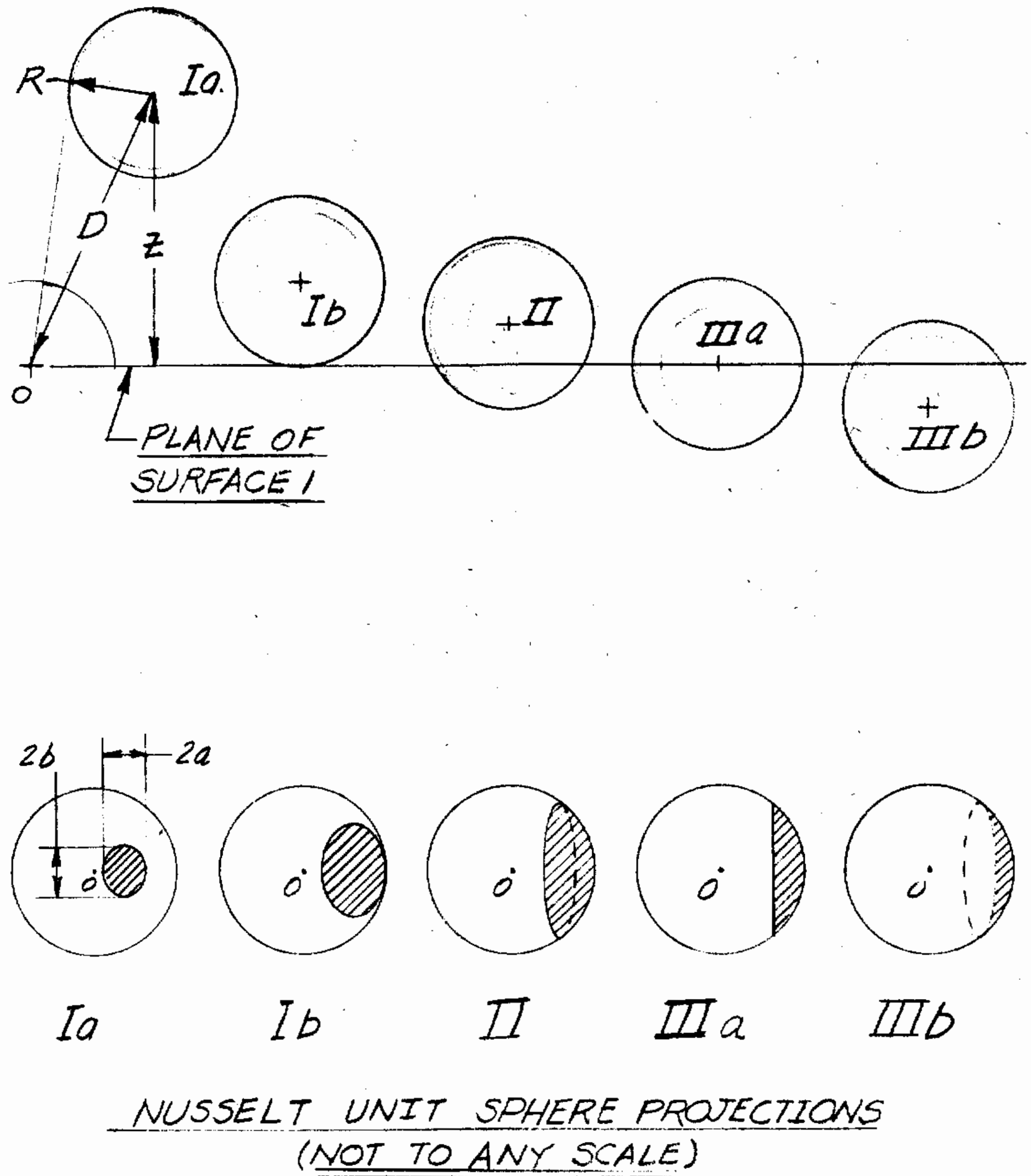

Figure 55. Areas Involved in Configuration Factor to Spheres

Approved for Public Release

Contrails

$$e_I = \frac{\pi \frac{R^2 Z}{D^3}}{\pi}$$

$$e_I = \frac{R^2 Z}{D^3}, \quad Z \geq R \tag{4}$$

The computation of Case III proceeds as follows. Referring to Figure 56, a detailed drawing of the upper half of the Case III b locus, the area to be determined is Area ACB.

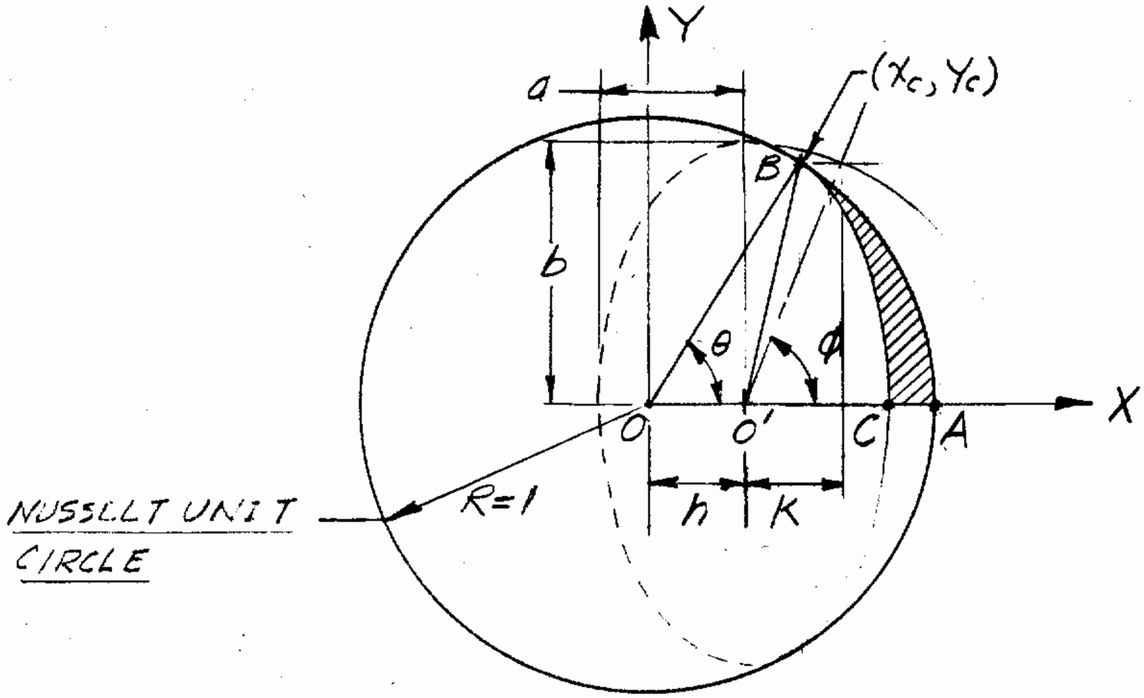

Figure 56, Case IIIb Detail Geometry

By inspection,

$$A_{ACB} = A_{AOB} - A_{O'OB} - A_{CO'B} \tag{5}$$

Area AOB is a sector of the unit circle, R = 1,

$$A_{AOB} = \tfrac{1}{2} R^2 \theta = \tfrac{1}{2} \theta \tag{6}$$

Given h, the distance between centers O and O', and Y_C, the value of y at the tangency point between the ellipse and the circle, the area of the triangle O'OB is

$$A_{O'OB} = \tfrac{1}{2} h \, y_c \tag{7}$$

Approved for Public Release

Contrails

The area CO'B is an elliptical sector defined by the parametric angle ϕ at (x_c, y_c) the point of tangency,

$$A_{CO'B} = \frac{ab}{2} \phi \tag{8}$$

Inserting Equations 6, 7 and 8 into Equation 5,

$$A_{ACB} = \frac{1}{2} \left(\theta - hy_c - ab\phi \right) \tag{9}$$

The unknowns θ, h, y_c and ϕ must be evaluated in terms of R, Z and D. The tangency point x_c, y_c, is determined as follows. The equation of the ellipse when translated a distance h in the x direction from the origin 0 is

$$\frac{(x - h)^2}{a^2} + \frac{y^2}{b^2} = 1 \tag{10}$$

The equation of the unit circle is

$$x^2 + y^2 = 1 \tag{11}$$

At the intersection point the slopes are equal. Taking the first derivative of Equation 10,

$$\frac{2}{a^2} (x-h)\, dx + \frac{2y}{b^2} dy = 0$$

Rearranging,

$$\frac{dy}{dx} = \frac{b^2}{2y} \left[\frac{2}{a^2} (h-x) \right] = \frac{b^2}{a^2} \frac{(h-x)}{y} \tag{12}$$

The slope at any point x, y on the circle is:

$$\frac{dy}{dx} = - \frac{x}{y} \tag{13}$$

Equating Equations 12 and 13,

$$\frac{b^2}{a^2} \frac{(h-x)}{y} = - \frac{x}{y}$$

Solving for h, at $x = x_c$ and $y = y_c$,

$$h = x_c \frac{(b^2 - a^2)}{b^2} \tag{14}$$

Substituting Equation 14 into Equation 10,

Approved for Public Release

Contrails

$$\frac{\left[x_c - x_c \dfrac{(b^2 - a^2)}{b^2}\right]^2}{a^2} + \frac{y_c^{\,2}}{b^2} = 1$$

Reducing and rearranging terms, and solving simultaneously with Equation 11:

$$\left(\frac{a}{b}\right)^2 x_c^{\,2} + y_c^{\,2} = b^2 \qquad (15)$$

$$x_c^{\,2} + y_c^{\,2} = 1$$

Subtracting Equation 11 from Equation 15,

$$x_c^{\,2}\left[\left(\frac{a}{b}\right)^2 - 1\right] = b^2 - 1$$

Solving for x_c,

$$x_c^{\,2} = \frac{b^2 - 1}{\left(\frac{a}{b}\right)^2 - 1} \qquad (16)$$

$$x_c = b\sqrt{\frac{1 - b^2}{b^2 - a^2}} \qquad (17)$$

Solving for y_c in Equation 11,

$$y_c = \sqrt{1 - x_c^{\,2}} \qquad (18)$$

Substituting Equation 1 and 2 into Equation 17,

$$x_c = \sqrt{\frac{R^2 - D^2}{Z^2 - D^2}} \qquad (19)$$

Substituting Equation 1, 2 and 16 into Equation 18,

$$y_c = \sqrt{\frac{Z^2 - R^2}{Z^2 - D^2}} \qquad (20)$$

The angle ϕ may be defined as

$$\phi = \tan^{-1}\frac{y_c}{K} = \tan^{-1}\frac{y_c\, b}{a\sqrt{b^2 - y_c^{\,2}}} \qquad (21)$$

$K = (x_c - h)$

$x_c - h = \frac{a}{b}\sqrt{b^2 - y_c^2}$

Substituting Equation 1 and 20 into Equation 21,

$$\phi = \tan^{-1}\left[\frac{D}{|Z|} \cdot \sqrt{\frac{Z^2 - R^2}{R^2 - D^2}}\right] \qquad (22)$$

Approved for Public Release

Contrails

The angle θ may be defined as

$$\theta = \tan^{-1} \frac{y_c}{x_c} \tag{23}$$

Substituting Equations 19 and 20 into Equation 23,

$$\theta = \tan^{-1}\sqrt{\frac{Z^2 - R^2}{R^2 - D^2}} \tag{24}$$

Substituting Equations 1, 2 and 19 into Equation 14,

$$h = \frac{D^2 - Z^2}{D^2}\sqrt{\frac{R^2 - D^2}{Z^2 - D^2}} \tag{25}$$

The parameter hy_c in Equation 9 is evaluated by multiplying Equations 20 and 25,

$$hy_c = \left[\frac{D^2 - Z^2}{D^2}\sqrt{\frac{R^2 - D^2}{Z^2 - D^2}}\right] \cdot \frac{Z^2 - R^2}{Z^2 - D^2}$$

$$hy_c = \frac{\sqrt{D^2 - R^2} \cdot \sqrt{R^2 - Z^2}}{D^2}$$

$$hy_c = \left(\frac{D^2 - R^2}{D^2}\right)\sqrt{\frac{R^2 - Z^2}{D^2 - R^2}} \tag{26}$$

Let $$\alpha = D^2 - R^2 \tag{27}$$

and $$\beta = \sqrt{\frac{R^2 - Z^2}{\alpha}} \tag{28}$$

Substituting Equations 27 and 28 into Equations 22, 24 and 26, respectively,

$$\phi = \tan^{-1}\left[\frac{D}{|Z|}\,\beta\right] \tag{29}$$

$$\theta = \tan^{-1}\,\beta \tag{30}$$

and $$hy_c = \frac{\alpha\,\beta}{D^2} \tag{31}$$

Finally, substitute Equations 29, 30 and 31 into 9; the actual area projected on the hemisphere base is twice Area ACB and is divided by the base area to yield the configuration factor.

Approved for Public Release

Contrails

$$\mathcal{C}_{III} = \frac{1}{\pi}\left[\left(\tan^{-1}\beta\right) - \frac{R^2|Z|}{D^3}\left(\tan^{-1}\frac{\beta D}{|Z|}\right) - \frac{\alpha\beta}{D^2}\right] \tag{32}$$

where $\alpha = D^2 - R^2$

$$\beta = \sqrt{\frac{R^2 - Z^2}{\alpha}}, \quad Z \leqq 0 \text{ and } Z^2 \leqq R^2$$

By inspection of Figure 55, the projected area for Case II is the sum of the ellipse evaluated by the Case I formula and the crescent shaped area determined by the Case III formula,

$$\mathcal{C}_{II} = \mathcal{C}_I + \mathcal{C}_{III}, \quad 0 < Z < R \tag{33}$$

In summary, referring to Figure 55,

$$\mathcal{C}_I = \frac{R^2 Z}{D^3}, \quad Z \geqq R$$

$$\mathcal{C}_{III} = \frac{1}{\pi}\left[\left(\tan^{-1}\beta\right) - \frac{R^2|Z|}{D^3}\left(\tan^{-1}\frac{\beta D}{|Z|}\right) - \frac{\alpha\beta}{D^2}\right]$$

where $\alpha = D^2 - R^2, \quad \beta = \sqrt{\frac{R^2 - Z^2}{\alpha}},$

$$Z \leqq 0, \quad Z^2 \leqq R^2$$

$$\mathcal{C}_{II} = \mathcal{C}_I + \mathcal{C}_{III}, \quad 0 < Z < R$$

Approved for Public Release

Contrails

Approved for Public Release