

NO. 486



THE IMPACTION FORCE OF AIRBORNE PARTICLES ON SPHERES AND CYLINDERS (U)

by

Stanley B. Mellsen

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### THE IMPACTION FORCE OF AIRBORNE PARTICLES ON SPHERES AND CYLINDERS (U)

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ABSTRACT

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The effect of dust on aerodynamic drag of spheres and cylinders was calculated by using a mathematical model developed for this purpose. The results were compared to experiments previously done by other workers. The calculated and experimental results agree favourably, showing that the mathematical model is satisfactory. Impaction efficiencies and drag coefficients due to dust alone were then obtained using the model for a wide range of the inertia parameter and the results are presented graphically. The model can also be used for calculating velocity distributions and points of impact for a stream of airborne particles flowing over a sphere or cylinder.

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### NOTATION

Α	frontal area of target, cm <sup>2</sup>
A <sub>d</sub>	far upstream cross sectional area of the envelope of particles which eventually hit the sphere or cylinder, cm <sup>2</sup>
a	tube radius, cm
с <sub>р</sub>	dimensionless drag coefficient for spheres or cylinders in air
C <sub>DC</sub> or C <sub>DS</sub>	drag coefficient of cylinder or sphere due to stream of particles alone
C <sub>De</sub>	total effective drag coefficient for spheres or cylinders due to particles and air together
с <sub>DL</sub>	drag coefficient for spheres in tubes adjusted to a sphere in free space by the Landenburg correction
с <sub>DpU</sub>	drag coefficient for particles alone adjusted from v <sub>rms</sub> to U
d	particle diameter, cm
Em	impaction efficiency of particles on a target
F	force exerted on a target by the air and total stream of particles hitting it, dynes
Fa	force exerted on a target by the air alone, dynes
F <sub>s</sub> or F <sub>c</sub>	force exerted on the sphere or cylinder by the total stream of particles which hit it, dynes
Fp	force exerted on a target by the particles alone travelling in air, dynes
L	cylinder or sphere radius, cm
m'	total mass of particles which had its momentum changed in unit time, g $\mathrm{s}^{-1}$
p <sub>s</sub> or p <sub>c</sub>	drag pressure on sphere or $c_{\rm M}$ inder due to stream of particles alone, dynes $cm^{-2}$
r	distance from any point to the origin, cm
t	time, seconds
U	free-stream velocity, cm s <sup>-1</sup>
u	local fluid velocity, cm s <sup>-1</sup>

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- radial component of fluid velocity, cm  $s^{-1}$
- circumferential component of fluid velocity, cm  $s^{-1}$
- v local particle velocity, cm s<sup>-1</sup>

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- v<sub>rms</sub> root-mean-square free stream particle speed upstream near target position, cm s<sup>-1</sup>
- v<sub>x</sub> component of particle velocity parallel to free field flow direction immediately before impact, cm s<sup>-1</sup>
- $v_x'$  component of particle velocity parallel to flow direction immediately after impact and reflection, cm s<sup>-1</sup>
- $v_{vo}$  far upstream particle velocity, cm s<sup>-1</sup>
- $v_y$  component of particle velocity perpendicular to free field flow direction immediately before impact, cm s<sup>-1</sup>
- $\Delta v_x$  change in the component of particle velocity parallel to the free stream flow direction caused by reflection from the sphere or cylinder, cm s<sup>-1</sup>
- x co-ordinate (origin at centre of sphere or cylinder) of particle position parallel to free stream flow direction, cm
- y transverse co-ordinate of particle position, cm
- y' off-axis distance of a particle at point of impact with the sphere or cylinder, cm
- y<sub>c</sub> far upstream transverse co-ordinate of the envelope of particles which eventually hit the sphere or cylinder, cm
- a angle of incidence of a particle against the sphere or cylinder, radians
- β angle between particle direction and free field flow direction just before the particle hits the sphere or cylinder, radians
- Y total angle change of a particle from its far upstream direction to its direction after reflection from the cylinder or sphere, radians
- o polar angle between x axis and <u>radius vector</u> to particle position, radians
- absolute velocity of fluid, poise
- ρ fluid density, g cm<sup>-3</sup>

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 $\rho^*$  total mass of particles and air per unit volume of space, g cm<sup>-3</sup>

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 $P_p$  uniform particle density per unit volume of air far upstream, g cm<sup>-3</sup> particle density, g  $cm^{-3}$ 

### The following were dimensionless:

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f(ÿ)	change in component of particle velocity due to reflection from sphere or cylinder as a function of off-axis distance far upstream
к	particle inertia parameter
Re	spherical particle Reynolds number in flow influenced by presence of sphere or cylinder
Reo	spherical particle Reynolds number in free stream
ŕ	$\frac{r}{L}$ , distance from any point to the origin
т	time <u>tU</u>
ū	local fluid velocity $\frac{u}{U}$ , $\overline{u}_x$ and $\overline{u}_y$ are x and y components
v	local particle velocity $rac{v}{U}$ , $ar{v}_{\chi}$ and $ar{v}_{y}$ are x and y components
⊽ <sub>x</sub>	$\frac{d\bar{x}}{dT}$ , parallel component of particle velocity
⊽ <sub>y</sub>	$\frac{dar{y}}{dT}$ , transverse component of particle velocity
x	parallel co-ordinate X
Ŷ	transverse co-ordinate <u>y</u>
۶ <sup>d</sup>	far upstream transverse co-ordinate of the envelope of particles which eventually hit the cylinder
ў <sub>і</sub>	co-ordinate of particle used in discretization for integration; y <sub>i</sub> increases with i from y <sub>i</sub> = o to y <sub>n</sub> = y <sub>d</sub>
φ	dimensionless group independent of drop size formed by combining Re <sub>n</sub> and K

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Stanley B. Mellsen

### 1. INTRODUCTION

Extensive studies have been made of the drag exerted on spheres and transverse cylinders by moving air (Schlicting, 1960) and attempts have been made to determine the effect of introducing dust into the air stream (Gillespie and Gunter, 1957; 1959). Also, the trajectories of water drops moving in the neighborhood of a circular cylinder placed in a uniform stream of air have been calculated by numerical solution of the equations of motion (Glauert, 1940) and with a mechanical analog (Brun et al., 1953). The latter method has been used in conjunction with flight instruments used to study droplet size and distribution in icing clouds (Brun and Mergler, 1953). Measurements of aerodyn\_mic drag on circular cylinders due to the blast wave from large TNT bursts have been done at DRES (Mellsen, 1974). The results of these tests have been used to provide blast loading input for structural analysis of lattice type masts also tested in the trials. On some of the trials there have been visible quantities of dust associated with the blast wave. In general the measured

strains in the masts have agreed favorably in an individual field trial with the ones predicted from theoretical analysis based upon the blast loading input from the drag data averaged over several blast trials (Laidlaw, 1977). The influence of dust is difficult to determine and generally considered negligible.

Another area of interest in connection with moving particles in an air stream is the impingement of liquid drops on protective clothing and military equipment. The impaction efficiency and force, and the droplet distribution are all of interest. The study of these effects on transverse cylinders and spheres is useful in this application.

The purpose of this report is to describe numerical solutions to the equations of motion of particles in a moving air stream, with possible applications to both the effect on aerodynamic drag from the point of view of blast loading of structures and the interaction of droplets with spheres and cylinders from a chemical defence point of view. The mathematical techniques along with their associated computer programs are described herein. Also, the results are compared with experiments done at DRES (Gillespie and Gunter, 1957).

### 2. DEFINITION OF THE PROBLEM

A spherical particle flowing at free stream velocity far upstream of a spherical or transverse cylindrical solid target will not necessarily follow a streamline in the vicinity of the target where the radial and axial velocity components of the fluid may be changing markedly. A particle that just impinges on the outer circumference of the target was considered. All particles of the same diameter within an envelope generated by this limiting particle trajectory would hit the target, assuming that no particles collide with other particles reflected from the target.

All particles in the steady flow field far upstream were assumed to be travelling at the velocity of the fluid but the velocities of the particles will differ from the fluid velocity as the particles approach the target. This is due to inertial effects of the particles in

the flow field near the object. The velocity of a particle immediately before contact, and also the point of contact with the target, depend upon the position of the particle within the limiting envelope far upstream from which it travels to the target. These particles all have their momentum changed when they collide with the target and in the case of solid particles are deflected in a new direction. The total change in momentum is balanced by the drag force exerted by the particles on the target.

The basic problem was, therefore, to determine the envelope of particles hitting the target and the change in particle motion due to the presence of the target in the flow. Then the drag coefficient due to particles alone could be obtained.

### 3. EQUATIONS OF MOTION

The motion of an individual spherical particle has been shown (Batchelor, 1967) to be determined by the following ordinary differential equations:

$$\frac{d\bar{v}_y}{dT} = \frac{C_D Re(\bar{u}_y - \bar{v}_y)}{24K}$$
(Eq. 1)

$$\frac{d\bar{v}_{x}}{dT} = \frac{C_{D}Re(\bar{u}_{x} - \bar{v}_{x})}{24K}$$
(Eq. 2)

where

$$Re_{0} = \frac{Ud\rho}{\mu}$$
 free stream Reynolds number (Eq. 5)

The symbols are defined in the notation section near the front of this report and the basic geometry of the flow system is illustrated in Fig. 1.

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Several assumptions were inherent in the development of Eq. 1 and Eq. 2 for calculating impaction efficiency and force due to a stream of particles, including,

- (a) uniform particle distribution,
- (b) no gravitational or electrostatic forces of consequence,
- (c) monodisperse spherical particles with diameter very small in relation to the target sphere or cylinder diameter, and
- (d) free stream flow that was steady, incompressible and irrotational.

The drag coefficient is a function of Rey olds number and was available in the form of definitive empirical equations (Davies, 1945). These equations are stated as follows:

$$Re = \frac{C_D Re^2}{24} - 2.3363 \times 10^{-4} (C_D Re^2)^2 + 2.0154 \times 10^{-6} (C_D Re^2)^3 - 6.9105 \times 10^{-9} (C_D Re^2)^4$$
 (Eq. 6)

for Re < 4 or  $C_{\rm D} {\rm Re}^2$  < 140

 $\log_{10}\text{Re} = -1.29536 + 9.86 \times 10^{-1} (\log_{10}\text{C}_{D}\text{Re}^2) - 4.6677 \times 10^{-2} (\log_{10}\text{C}_{D}\text{Re}^2)^3 +$ 

 $1.1235 \times 10^{-3} (\log_{10}C_n \text{Re}^2)^3$ 

for 3 < Re <  $10^4$  or  $100 < C_{\rm D} {\rm Re}^2 < 4.5 \times 10^7$ 

### 4. AIR FLOW FIELD

The assumption was made that the air flow in front of the cylinder or sphere is given by classical hydrodynamics theory.

a) Cylinder

The equations of fluid velocity were derived from the stream function for ideal flow around a cylinder (Milne-Thomson, 1960). These were normalized to the free stream velocity and cylinder diameter and written as follows:

$$\bar{u}_{\chi} = 1 - \frac{\bar{\chi}^2 - \bar{y}^2}{\bar{r}^4}$$
 (Eq. 8)

$$\bar{u}_{y} = 1 - \frac{\bar{x} \cdot \bar{y}}{\bar{r}^{4}}$$
 (Eq. 9)

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(Eq. 7)

b) Sphere

For purposes of comparison of the results of the theoretical work reported herein to existing experimental data the flow field about a sphere on the axis of a circular tube was applied. The flow about a sphere in the absence of the tube was then readily available from this as a limiting case.

The flow velocity was derived (Mellsen et al., 1966) from the vector potential (Smythe, 1964). The velocity components are given in terms of a series solution. For a sphere diameter of 0.8 cm and tube diameter of 2.54 cm used in the experiments (Gillespie and Gunter, 1957) sufficient accuracy (Mellsen et al., 1966) was obtained by retaining three terms of the series.

The equations were

$$\frac{u_{r}}{J} = -\cos \Theta \left[ 1 - \frac{2C_{0}}{3} - \frac{C}{r}^{3} - \frac{2A_{0}}{a} + \cdots \right]$$
(Eq. 10)  
$$\frac{u_{0}}{J} = \sin \Theta \left[ 1 + \frac{C_{0}}{3} - \frac{C}{r}^{3} - \frac{2A_{0}}{a} + \cdots \right]$$
(Eq. 11)

The constants  $C_0$ , C and  $A_0$  which are dependent upon the sphere and tube diameters (Smythe, 1964) are given as follows:

$$C_{o} = 1.5401075$$
  
 $C = 1.0$  (normalized sphere radius)  
 $A_{o} = -C \left(\frac{C}{a}\right)^{2} \frac{I(2)C_{o}}{9\pi}$ ,  $I(2) = 7.5098907$   
 $a = \frac{2.54}{0.8} C$  (normalized tube radius)

 $\boldsymbol{u}_{\text{A}}$  and  $\boldsymbol{u}_{\text{r}}$  are shown in Fig. 2.

Converting to rectangular co-ordinates gives

$$\bar{u}_{x} = -\frac{u_{r}}{U}\cos \Theta + \frac{u_{\theta}}{U}\sin \Theta \qquad (Eq. 12)$$

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$$\bar{u}_{y} = \frac{u_{r}}{U} \sin \Theta + \frac{u_{\theta}}{U} \cos \Theta \qquad (Eq. 13)$$

The equation for flow around a sphere in the absence of the tube is given by letting the value of "a" approach infinity.

For 
$$a \rightarrow \infty$$
,  $C_0 \rightarrow 1.5$  (Smythe, 1964)  
Eq. 10 becomes  $\frac{u_r}{U} = -\cos \Theta \left[1 - \left(\frac{L}{r}\right)^3\right]$  (Eq. 14)

Eq. 11 becomes 
$$\frac{u_{\theta}}{U} = \sin \Theta \left[1 + \frac{1}{2} \left(\frac{L}{r}\right)^3\right]$$
 (Eq. 15)

Eqs. 14 and 15 are well known in ideal flow theory (Batchelor, 1967) and therefore serve as a partial check on the correctness of Eqs. 10 and 11.

### 5. VELOCITY CHANGE OF AN INDIVIDUAL PARTICLE

 $\gamma = \left(\frac{\pi}{2} - \Theta\right) + \alpha$ 

To calculate the drag force due to airborne particles, the velocity change of an individual particle due to the presence of the cylinder or sphere in the flow was first considered. The velocity change determined applied to both the cylindrical and spherical targets because the same geometry could be used for both (Fig. 3).

The motion considered concerned a spherical particle which starts far upstream within the envelope of particles which travel to the target, eventually hit it and are reflected by it in a new direction. The total change in direction of a particle which comes from a far upstream offaxis position y, and hits the target at a point defined by y' (Fig. 3), is represented by  $\gamma$ . For a spherical particle the angle of incidence,  $\alpha$ , is equal to the angle of reflection. Then

where

$$0 = \sin^{-1}\left(\frac{y'}{L}\right) = \tan^{-1}\left(\frac{y'}{\sqrt{L^2 - (y')^2}}\right) \quad (Eq. 17)$$

(Eq. 16)

and 
$$\alpha + \beta = \frac{\pi}{2} - \Theta$$
 (Eq. 18)  
where  $\beta = \tan^{-1} \left( \frac{v_y}{v_x} \right)$  (Eq. 19)

and  $v_x$  and  $v_y$  are the components of particle velocity just before impact with the target. Substituting the value of  $\alpha$  obtained from Eq. 18 into Eq. 16 gives

$$\gamma = \pi - 2\Theta - \beta \qquad (Eq. 20)$$

Substituting Eqs. 17 and 19 into Eq. 20 gives an equation of  $\gamma$  suitable for computation. Thus:

$$\gamma = \pi - 2 \tan^{-1} \left( \frac{y'}{\sqrt{1 - y'^2}} \right) - \tan^{-1} \left( \frac{v_y}{v_x} \right) \quad (Eq. 21)$$

or in non-dimensional terms

$$\gamma = \pi - 2 \tan^{-1} \left( \frac{\tilde{y}'}{\sqrt{1 - \tilde{y}'^2}} \right) - \tan^{-1} \left( \frac{\tilde{v}_y}{\tilde{v}_x} \right) \quad (Eq. 21a)$$

The component of velocity in the direction of free field flow immediately after particle reflection is

$$v_{\nu}' = v \cos \gamma$$
 (Eq. 22)

where

and

$$v = \sqrt{v_x^2 + v_y^2}$$
 (Eq. 23)  
non-dimensional terms  $\bar{v}_{,,}' = \bar{v} \cos \gamma$  (Eq. 22a)

or in nor

 $\vec{v} = \sqrt{\vec{v}_x^2 + \vec{v}_y^2}$  (Eq. 23a)

The total change of the component of velocity in the direction of free stream flow due to reflection from the target is then given by the following relationship:

 $\Delta v_{x} = v_{x} - v \cos \gamma \qquad (Eq. 24)$ 

### 6. THE DRAG FORCE DUE TO PARTICLES ALONE

The force  $F_p$  of a stream of particles hitting a cylinder or sphere is related to the change in momentum which in general is given by the following relationship:

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 $F_{D} = m' \Delta v_{x}$ 

(Eq. 25)

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where m' is the total mass of particles having its momentum changed per unit time and  $\Delta v_x$  is its change of velocity in the free stream flow direction.

The quantity m' can be calculated using the following equation:  $m' = \rho_{D} A_{d} v_{x0}$  (Eq. 26)

where  $\rho_p$  is the uniform particle density per unit volume of air far upstream,  $A_d$  is the far upstream cross sectional area of the envelope of particles which eventually hits the sphere or cylinder, and  $v_{\chi 0}$  is the far upstream particle velocity which is assumed equal to the fluid velocity. Combining Eqs. 25 and 26 gives

$$F = \rho_{p} A_{d} v_{x0} \Delta v_{x}$$
 (Eq. 27)

 $\Delta v_{\chi}$  was not constant but was shown in the previous section to be a function of the off-axis, upstream starting location of an individual particle. This can be accounted for by integrating the velocity change over the range of starting locations across the particle envelope. Then the equation of force becomes  $A_d$ 

$$F = \rho_{p} v_{xo} \int_{0}^{u} \Delta v_{x} dA \qquad (Eq. 28)$$

where dA is an element of cross sectional area at location y.

Assuming that the particles do not interact with each other, the equation of drag force due to particles alone is then obtained in usable form by substituting Eq. 24 into Eq. 28 which gives the following equation:

$$F_{p} = \rho_{p} v_{x0} \int_{0}^{A} (v_{x} - v \cos \gamma) dA \qquad (Eq. 29)$$

7. THE DRAG COEFFICIENT

(a) Cylinder

For a transverse cylinder of unit length, Eq. 29 becomes

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$$F_{s} = 2\rho_{p}v_{x0}\int_{0}^{y_{c}} (v_{x} - v \cos \gamma) dy \qquad (Eq. 30)$$

In non-dimensional terms this is written

$$\frac{\overline{y}_{d}}{\frac{F_{s}}{\rho_{p}U^{2}L}} = 2\overline{v}_{xo}\int_{O}^{\overline{y}_{d}} (\overline{v}_{x} - \overline{v}\cos\gamma)d\overline{y} \qquad (Eq. 31)$$

The drag coefficient is defined as follows:

$$C_{D} = \frac{p}{\lambda_{so_{D}}U^{2}}$$
 (Eq. 32)

where p is the average drag pressure (Schlicting, 1960).

The average drag pressure for a cylinder of unit length is given by the following equation:

$$P_{c} = \frac{F}{2L}$$
 (Eq. 33)

Substituting Eq. 33 into Eq. 32 and the resulting equation into Eq. 32 gives  $\overline{v}$ .

$$C_{DC} = 2\bar{v}_{xo} \int_{0}^{y} (\bar{v}_{x} - \bar{v} \cos \gamma) d\bar{y} \qquad (Eq. 34)$$

b) Sphere

For a sphere Eq. 29 becomes

$$F_{s} = 2\pi\rho_{0}v_{x0}\int_{0}^{y_{c}} (v_{x} - v \cos \gamma)y \, dy \qquad (Eq. 35)$$

In non-dimensional terms this is written

$$\frac{\bar{y}_{d}}{F_{p}U^{2}L^{2}} = 2\pi \bar{v}_{xo} \int_{O} (\bar{v}_{x} - \bar{v} \cos \gamma) \bar{y} d\bar{y} \qquad (Eq. 36)$$

The drag pressure on the sphere is given by

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$$p_{s} = \frac{F_{s}}{\pi L^{2}}$$
 (Eq. 37)

Substituting Eq. 36 into Eq. 37 and the resulting equation into Eq. 32 gives the drag coefficient for a sphere as follows:

$$C_{\text{Ds}} = 4\bar{v}_{\text{xo}} \int_{0}^{y} (\bar{v}_{\text{x}} - \bar{v}' \cos \gamma)\bar{y} \, d\bar{y} \qquad (\text{Eq. 38})^{2}$$

### 8. INTEGRATION METHOD FOR THE DRAG COEFFICIENT EQUATIONS

a) Cylinder

Let 
$$f(\bar{y}) = \bar{v}_{\chi} - \bar{v} \cos \gamma$$
 (Eq. 39)

Then Eq. 33 can be written

$$C_{D} = 2\bar{v}_{xo} \int_{0}^{\bar{y}_{d}} f(\bar{y}) \, d\bar{y} \qquad (Eq. 40)$$

$$\bar{y}_{d} \int_{0}^{\bar{y}_{d}} f(\bar{y}) \, d\bar{y} \text{ was integrated numerically by dividing the upstream}$$

cross sectional area into strips of equal width  $\Delta y$ , and calculating the contribution from each strip. These contributions were then summed as follows:

$$\int_{0}^{\bar{y}_{d}} f(\bar{y}) \, d\bar{y} = \frac{f(\bar{y}_{1}) + f(\bar{y}_{n})}{2} + \sum_{i=2}^{i=n-1} f(\bar{y}_{1}) \Delta \bar{y} \quad (Eq. 41)$$

where  $y_i$  increases with i from  $\bar{y}' = 0$  to  $\bar{y}_n = \bar{y}_d$ .

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b) Sphere

Using Eq. 39 in Eq. 38 gives the following equation for the drag coefficient of a sphere

$$C_{\text{Ds}} = 4\bar{v}_{\text{xo}} \int_{O}^{O} f(\bar{y}) \, \bar{y} \, d\bar{y} \qquad (\text{Eq. 42})$$

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 $f(\bar{y})$   $\bar{y}$  d $\bar{y}$  was integrated numerically by dividing the upstream  $\delta$ 

cross sectional area into concentric annuli of equal width  $\Delta \bar{y}$  and calculating the contribution from each ring. These contributions were then summed as follows:

$$\int_{0}^{\overline{y}_{d}} f(\overline{y}) \ d\overline{y} = \sum_{i=1}^{n} i \ f(\overline{y}_{i}) \ \overline{y}_{i} \ \Delta \overline{y}$$
 (Eq. 43)

where  $y_i$  increases with i from  $\bar{y}_i = \Delta \bar{y}$  to  $\bar{y}_n = \bar{y}_d$ 

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### 9. SOLUTION OF THE DRAG COEFFICIENT EQUATIONS

To solve Eq. 34 or Eq. 38 for the drag coefficient it was necessary to know the values of  $\vec{v}_x$ ,  $\vec{v}'$  and  $\gamma$  in the range  $0 \le \vec{y} \le \vec{y}_d$ .

The first step was to find the value of  $\bar{\mathbf{y}}_d$  which was the upper limit of the integral. This was done by an iterative procedure called the half interval method (Carnahan et al., 1969). The value of  $\bar{\mathbf{y}}$  for the critical particle was estimated far upstream and the path followed to the target. The difference between the ordinate of the target path and the ordinate of the point on the actual path parallel to the tangent path was the miss criterion used. The direction of the tangent path was not known a priori but was assumed parallel to the actual path. The half interval method previously mentioned was applied to determine a better initial estimate. Then the path was followed to the target again for another calculation of miss distance. This process was repeated several times until sufficient accuracy was achieved. The plane of initial position of particles which was perpendicular to the flow direction was located far enough from the target so that free stream conditions prevailed. A distance of five target radii upstream of the target centre was considered adequate (Batchelor, 1967).

The path of an individual particle was determined step by step by applying a fourth order Runge-Kutta method (Carnahan et al., 1969) to

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the equations of motion (Eqs. 1 and 2). The values of Re and K in these equations were easily determined for each new step by direct substitution of previously determined values into Eqs. 3, 4 and 5, but the value of  $C_D$ Re in Eqs. 1 and 2 had to be calculated in each step by numerical solution of the definitive empirical equations (Eqs. 6 and 7). This was done using Newton's Method (Carnahan et al., 1969) for finding the zeros of a function. The values of  $\bar{u}_x$  and  $\bar{v}_y$  in Eqs. 1, 2 and 3 were calculated from Eqs. 8 and 9 for a cylindrical target and Eqs. 10, 11, 12 and 13 for a spherical target.

Once the value of  $\bar{y}_d$  had been determined the integration procedures described in Section 8 of this report were applied. The values of  $f(\bar{y}_i)$  used in Eqs. 41 and 43 were obtained from Eq. 39. The quantities  $\bar{v}$  and  $\gamma$  used in the latter equation were calculated from Eqs. 23a and 21a respectively. The values of  $\bar{v}_x$ ,  $\bar{v}_y$  and  $\bar{y}'$  used in the latter two equations were calculated by following a particle from its initial position to the cylindrical or spherical target using the previously described step by step procedure applied in determining the value of  $\bar{y}_d$ .

### 10. IMPACTION EFFICIENCY

The impaction efficiency was defined as the ratio of the cross sectional area of the far upstream envelope of particles which eventually hit the target to the cross sectional area of the target itself. For a transverse cylindrical target this is simply given by the value of  $\bar{y}_d$ . For a spherical target it is given by  $\bar{y}_d^2$ .

### 11. COMPUTER PROGRAMS

Computer programs were written in Fortran IV for the DRES IBM 1130 computer to obtain solutions to the drag coefficient equations by the method described in Section 9 of this report. The complete programs, together with one set of results for each, are shown in Appendix A for the cylinder in free space and in Appendix B for the sphere in a tube or in free space (Appendix B). These programs are annotated so that the

functions of their various parts can be understood without further description. The application of the method described in Section 9, which was used in the programs, is straight forward with the exception of the step by step integration procedure near the target sphere or cylinder. This procedure is therefore explained as follows.

The particle motion was calculated in time steps,  $\Delta T$ , until the particle was just one time step away from the target. Then the time increment size was decreased by a factor of ten and step by step integration continued until the particle was one new time step away from the target. At this point the time increment size was decreased by another factor of ten and the integration allowed to proceed until the target was reached. This method ensured that the position of the target and particle coincided within a maximum error given by the distance travelled during one percent of the original time step size, while allowing the particle to reach the proximity of the target in an adequate but small number of steps.

### 12. <u>RESULTS</u>

Drag coefficients and impaction efficiencies were calculated by means of the computer programs (Appendix A and B) from two main points of view. First, they were calculated using the particle sizes, fluid velocities and target configurations used in experiments done at Suffield many years ago (Gillespie and Gunter, 1957; 1959). This was done so that a comparison of the results from the theoretical calculation of drag due to particles in air could be made with existing information obtained from experiments. The results were obtained for a narrow range of particle sizes and fluid velocities and, correspondingly, a narrow range of inertia parameters and free stream particle Reynolds numbers. Next, calculations of impaction efficiencies and drag coefficients were done for a wide range of inertia parameters. The impaction efficiencies were compared with the results of other workers (Friedlander, 1977) but no results were available for comparison to the calculated drag coefficients over this

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wide range of the inertia parameter. All the results previously mentioned are shown in Tables 1 and 2 and Fig. 4 - Fig. 9, along with plots of the calculated distribution of forces due to elastic reflection of particles from a cylinder (Fig. 10) and a sphere (Fig. 11). The latter two figures were plotted from the sample computer results shown with their corresponding programs in Appendix A and B. Further details explaining the significance of the tables and figures are described as follows.

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The calculated results for the various particle sizes and fluid velocities used in the experiments done at Suffield (Gillespie and Gunter, 1957; 1959) are shown for a cylinder (Table 1) and for a sphere (Table 2). The sizes of these two targets also correspond to those in the experiments. The calculations were done for a 0.2 centimetre diameter cylinder in free space and a 0.8 centimetre sphere in a 2.54 centimetre tube. The tube which was used in all the experiments was included for the sphere since the velocity potential was readily available (Smythe, 1964). However, the effect of the presence of the tube on the potential flow and the final theoretical results was found to be negligible. Similarily, the effect of not including the tube in the potential flow for the cylinder is expected to be negligible.

A reason for tabulating the calculated results is to show clearly that the effect of particle size on the calculated drag coefficient for the sizes used in the experiments was negligibly small. This conclusion was also drawn from the experiments reported by Gillespie and Gunter (1957; 1959). The drag coefficients due to the middle size particles alone were plotted against target Reynolds number for the cylinder (Fig. 4) and for the sphere (Fig. 5). Also shown for the purpose of comparison of experiment to theory, described in the following section, are the drag coefficients due to air alone.

The impaction efficiencies for a wide range of the inertia parameter were plotted for cylinders (Fig. 6) and for spheres (Fig. 8). The cylinder results were plotted for  $\phi = 1000$ . The definition of  $\phi$ 

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and the reason for its value choice are described as follows. The collection efficiency and also the drag coefficient are a function of two dimensionless groups, the inertial parameter, K, and the free stream particle Reynolds number, Re<sub>o</sub>. A new dimensionless group

$$\phi = \frac{\operatorname{Re}_{o}^{2}}{K}$$
 (Eq. 44)

independent of particle size was introduced. According to the rules of dimensionless analysis this is permissible, but the efficiency is still determined by two groups which for convenience were chosen to be K and  $\phi$ . The collection efficiencies were calculated by means of a mechanical analog and plotted for values of  $\phi$  by other workers (Brun et al., 1953). The results for the middle value of  $\phi$  from this work are also shown (Fig. 6) for comparison. The sphere results were plotted (Fig. 8) for an Reo value of 128. Again this choice was made for convenience of comparison to other work. The choice was the middle value of seven for which curves calculated from inviscid flow theory by Dorsch, Saper and Kadow are shown (Friedlander, 1977). The curve is also shown in Fig. 8.

The calculated drag coefficient due to particles alone were plotted for a wide range of inertia parameters for cylinders (Fig. 7) and for spheres (Fig. 9). In these two figures each curve was fitted by eye through several data points obtained by applying the computer programs (Appendix A and B) to various particle diameters for the cylinder case and various target diameters for the sphere case.

### 10. COMPARISON OF THEORETICAL RESULTS TO EXPERIMENTAL DATA

 $\rho^* = \rho + \rho_p$ 

The experimental work previously done at Suffield (Gillespie and Gunter, 1957; 1959) indicated that the drag force of a sphere or cylinder is given by the following equation:

$$F = 1/2\rho * U^2 C_{D_e}^A$$
 (Eq. 45)

(Eq. 46)

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and generally  $\rho$  and  $\rho_p$  are unequal. For Eq. 45 to be true, the drag coefficients due to particles alone carried by air and due to air alone must be equal. This is shown as follows. The total drag force consisted of two parts expressed by the following equation:

 $F_p + F_a = 1/2\rho_p U^2 A C_{Dp} + 1/2\rho U^2 A C_D$  (Eq. 47)

Comparison of Eq. 45 and 46 to Eq. 47 shows that

 $(\rho + \rho_{\rm p})C_{\rm De} = \rho_{\rm p}C_{\rm Dp} + \rho C_{\rm D} \qquad (Eq. 48)$ 

 $\rm C_{Dp}$  and  $\rm C_{D}$  must be equal for Eq. 48 to be true.

The results obtained herein (Tables 1 and 2) and illustrated in Fig. 4 and 5 show that the calculated drag coefficients due to particles carried by air are considerably greater than the established drag coefficients due to air alone (Schlicting, 1960). The discrepancies between the experimental and calculated drag coefficients were accounted for by showing that the velocity of the particles in the experiments were considerably lower than the mean air velocity.

The particles which were introduced by Gillespie and Gunter into the air stream with zero velocity in the direction of air flow were accelerated along a horizontal section of 2.54 cm tube, 17 cm long, and a vertical section, 78 cm long, giving a total tube length of 95 cm between the starting point and the test section. Calculations of velocity as a function of distance for particles accelerated from rest were done to simulate Gillespie's experiments (Mellsen, in draft). The results for a travelled distance of 95 cm for the various mean air velocities and number median diameter used in the experiments are shown in Table 3. Also, the curves of velocity versus distance for the three diameters and one air velocity are illustrated in Fig. 14.

The particle velocities were difficult to calculate because the behavior of the particles travelling in the air stream around the corner in the tube was very complex. The velocity of the air in a straight cross section of the tube was zero at the walls and increased to the centre to 1.22 to 1.25 times the mean velocity (Prandtl and Tietjens,

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1957). Therefore, the particle velocities were affected by the location of the particles in the tube cross section. This could not be accounted for because the time history of the location of the particles was not known. As a simplifying approximation, the mean air velocity was assumed to act on the particles over their length of travel in the tube which was also assumed vertical over its entire length. The experimental results indicate that the variation in velocities was less than this method of calculation shows. A mean value of drag force due to the presence of all particle sizes was used to offset this.

The drag coefficients which were calculated for particles with a free stream velocity equal to the mean air velocity (Table 1 and 2) were then adjusted to simulate the special conditions of the experiments as follows. The drag coefficients in the experiments were based on the mean air velocities as measured by a rotameter. The drag coefficients due to the particles travelling at lower velocities were adjusted to the mean air velocity by the following relationship for flow over the cylinder.

$$C_{\text{DpU}} = C_{\text{Dc}} \left(\frac{v_{\text{rms}}}{U}\right)^2$$
 (Eq. 49)

This method was justified because, for the purpose of comparison, the calculated drag coefficients over the range of velocities and particle sizes used were sufficiently near a constant value (Table 1). All three particle sizes were assumed present in equal quantities in the air flow. Then, since the drag forces vary as the square of the velocity, the root mean square particle velocity,  $v_{rms}$ , was calculated for each mean fluid velocity (Table 3) and used in Eq. 49 to obtain a value for the drag coefficient due to dust alone at each mean air velocity (Table 4). The overall drag coefficients due to air and particles were then calculated for the dust concentrations used in the experiments, namely 2 and 5 kilograms per cubic metre of space. This was done by solving Eq. 48 for  $C_{De}$ . That is

$$C_{De} = \frac{\rho_p C_{Dc} + \rho C_D}{\rho + \rho_p}$$
(Eq. 50)

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The results are shown for each mean air velocity (Table 4) and plotted along with the drag coefficient for air alone (Fig. 12) as was done for the experiments of Gillespie and Gunter (1957; 1959).

A similar method was used to obtain the overall drag coefficients for the sphere with the exception that, as for the experimental results, they were corrected for the presence of the tube walls by the Landenburg correction (Gillespie and Gunter, 1957). That is, the drag coefficients due to particles alone were divided by the factor 1 + 2.4L/a to obtain the corrected drag coefficient,  $C_{\rm DL}$ . For the sphere and tube radii used, the factor is 1.756. Then, the overall drag coefficient for the sphere was obtained from

$$C_{De} = \frac{\rho_p C_{DL} + \rho C_D}{\rho + \rho_p}$$
(Eq. 51)

The results are shown for each mean air velocity in Table 4, and plotted along with the drag coefficient for air alone in Fig. 13.

### 14. DISCUSSION

The equations of motion (Eq. 1 and 2) have never been proven experimentally (Friedlander, 1977) although they have been used to calculate deposition efficiencies for cylinders (Glauert, 1940). The mathematical model described herein used these equations to calculate collection efficiencies for cylinders which compare favorably (Fig. 6) with the results obtained using a differential analyzer (Brun et al., 1953). Also, the impaction efficiencies for spheres (Fig. 8) agree with solutions to the equations obtained by other workers (Friedlander, 1977).

In the work reported herein, the mathematical model for calculating impaction efficiency was extended to obtain the impaction forces due to particles in air flowing over spheres and cylinders. These results agree favorably with experiments previously done at Suffield (Gillespie and Gunter, 1957) when adjusted to the special conditions of the experiment. The experiments do support the theory, but the theoretical results

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show that the results of the experiments are not applicable to the free field case of drag due to dusty air flowing over a cylinder or sphere.

The model could also be extended to blast loading problems. Since the effect of compressibility becomes important in these problems it would have to be accounted for. This could be done in the mathematical model by changing the air flow field equations to include it. The model could also be used to calculate the actual distributions of impaction velocities on cylinders (Fig. 10) and spheres (Fig. 11) in special cases which may have applications in chemical and nuclear defence.

### 15. CONCLUSIONS

A mathematical model was developed for calculating the impaction forces due to airborne particles on spheres and cylinders. The model can also be used for calculating impaction efficiences, velocity distributions, and points of impact for a stream of airborne particles flowing over a sphere or cylinder. Hence, the drag coefficient for the particles on the sphere or cylinder can be determined.

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TABLE 1

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(1) Second State

# COEFFICIENT OF DRAG ON A 0.2 CM CYLINDER FOR VARIOUS PARTICLE SIZES

		ARTICLE SI	ZE	AIR VELOCITY	٩
	470µm	155µm	55µm	cm sec-1	Re <sub>0</sub> <sup>2</sup> /K
Coefficient	2.367	2.362	2.333	700	3.99
of Drag due	2.367	2.361	2.327	560	3.19
to Particles	2.367	2.360	2.318	435	2.48
alone, C <sub>D</sub> c	2.367	2.357	2.300	294	1.67

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TABLE 2

## COEFFICIENT OF DRAG ON A 0.8 cm SPHERE IN A 2.54 cm TUBE

FOR VARIOUS PARTICLE SIZES USING POTENTIAL FLOM

l UNCL		PA	RTICLE SIZ	Щ	AIR VELOCITY	Reo
ASSIFI		470µm	155µm	55µm	cm sec <sup>-1</sup>	For 155µm
l ED	Coefficient	2.048	2.036	1.970	700	73.6
	of Drag due	2.047	2.033	1.955	560	58.9
	to Particles	2.047	2.030	1.934	426	44.8
	alone, C <sub>Ds</sub>	2.046	2.023	1.887	272	28.6

### TABLE 3

### VELOCITY OF PARTICLES AT TARGET POSITION

ACCELERATED VERTICALLY UPWARD IN A TUBE FROM REST

### 95 cm UPSTREAM

PARTICLE	MEAN AIR	PARTICLE VELOCITY	RMS PARTICLE
DIAMETER	VELOCITY IN	AT TARGET	VELOCITY AT TARGET
Cin	TUBE cm sec-1	POSITION cm sec-1	POSITION cm sec <sup>-1</sup>
0.0470	700	299	
0.0155	700	572	534
0.0055	700	664*	
0.0470	560	191	
0.0155	560	445	398
0.0055	560	527*	
0.0470	435	75*	
0.0155	435	325*	302
0.0055	435	405*	
0.0470	426	66	
0.0155	426	317 295	
0.0055	426	396*	
0.0470	294	-	
0.0155	294	187* 188	
0.0055	294	267*	
0.0470	272		
0.0155	272	166*	171
0.0055	272	245*	

\* Upward terminal velocity reached

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### DRAG COEFFICIENT OF A 0.2 CM CYLINDER IN A 2.54 Cm TUBE DUE TO AIR CONTAINING EQUAL MASSES OF 0.0476, 0.0155 AND 0.0055 CM PARTICLES

DEFICIENCY	
E VELOCITY	
FOR PARTICL	
CORRECTED	

Re		646	759	590	399
r + dust	5 kg m <sup>-3</sup> Dust	1.30	1.16	1.14	10.1
C <sub>De</sub> AII	2 kg m <sup>-3</sup> Dust	1.23	1.14	1.14	1.07
C <sub>DPU</sub>		1.369	1.188	1.132	0.957
U THIS		534	398	302	188
م.		1.00	1.05	1.15	1.25
گى		2.354	2.352	2.348	2.341
5	CIII Sec <sup>-1</sup>	700	560	435	294

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## DRAG COEFFICIENT OF A 0.8 cm SPHERE IN A 2.54 cm TUBE DUE TO AIR CONTAINING EQUAL MASSES OF 0.0470, 0.155 AND 0.055 CM PARTICLES CORRECTED FOR

NETCICK	UEFILLENUS	
UCI ANTTV		
IN DADTTCI E		
VEI OCITY A		
 REAL FLUID		

Re	1	3796	3076	2310	1475
c <sub>be</sub> Air + DUST	5 kg m <sup>-3</sup> Dust	0.615	0.543	0.519	0.444
	2 kg m <sup>-3</sup> Dust	0.564	0.510	0.494	0.442
کر		0.669	0.579	0.547	0.447
Dan Copu		1.174	1.016	0.961	0.785
U Mensional Mens		534	398	295	171
പ്		162.0	0.396	0.406	0.433
ػۜ		2.018	2.012	2.004	1.985
U Cm sec <sup>-1</sup>		700	560	426	272

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### APPENDIX A

### COMPUTER PROGRAM FOR A CYLINDER

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AF FINE       AF AF FINE       AF AF FINE       AF A	
HIS SURPORTINE CALCULATES PARTICLE MOTION DURING THE FIMAL       INSTRUCT OF TAU       DIPENSION G(4)-bSG(4)       DIPENSION G(4)-bSG(4)       DIPENSION G(4)-bSG(4)       DIPENSION G(4)-bSG(4)       CALL ON RUNGE KUTA SUBROUTHE       A CMUTUE       CALL ON RUNGE KUTA       CONTRUE       CALL ON RUNGE KUTA       CONTRUCTORE (C1):##2+#0.5       CONTRUCTORE (C1):##2+#0.5       CONTRUE       CONTRUE <td>EAR 15 20RD [NTFGERS 151 All 151 All</td>	EAR 15 20RD [NTFGERS 151 All 151 All
C DIVENSION GLAL-DSGLAL A CALL CN RUNGE KUTTA SUBROUTINE C CLL CN RUNGE KUTTA SUBROUTINE A CALL SN221(2):45:005 (TAU-DTAK-) RUNGSN1 A CATTINE C CLL SN221(2):45:005 (TAU-DTAK-) RUNGSN1 C CALL SN221(2):45:005 (TAU-DTAK-) RUNGSN2 C CALL SN221(2):45:005 (TAU-DTAK-) RUNCSN2 C CALL S	THIS SUBROUTIRE CALCULATES PARTICLE MOTION DURING THE FINAL INCREMENT OF TAU
C CALL CM RUMGE KUTTA SURROUTIME C CALL CM RUMGE KUTTA SURROUTIME A COMTINUE ALL SHATS (ALL SHATS (ALL SHATS) (ALL SHATS) (ALCULATE FUUED VELOCITY AIT PARTICLE POSITION (ALCULATE FUUED VELOCITY AIT PARTICLE POSITION (ALT SHATS) (ALCULATE FUUED VELOCITY AIT PARTICLE POSITION (ALT SHATS) (ALT SHATS) (ALCULATE FUUED VELOCITY AIT PARTICLE POSITION (ALT SHATS) (ALT SHATS) (A	D14FMSION 6(4)*D6(4) 4=0
R CMTTNUE         R CMTTNUE           R = 1         R = 1	CALL CM RUNGE KUTTA SUBROUTINE
Cut, Saw22(44/64)GerTuu-DTAK+TRUNG+M1           FFEREWS-1110-5910           FFEREWS-1110-5910           FFEREWS-1110-5910           FCUREF(12)           F	A CONTINUE MANALE
9       FFEREXELUTO: 9:10         7       FFEREXELUTO: 9:10         7       FEREXELUTO: 1:10         7       FEREXELITO: 1:10         8:050:05       FEREXELITO: 1:10<	CALL SPH22(4+6+DC+TAV+DTAK+IRUNG+M)
NCORE-CORE (124.0ex(1)+LUX-6(1))         NG(1)=L(CORE/(124.0ex(1)+LUX-6(1)))         SG(1)=L(CORE/(124.0ex(1)+LUX-6(1)))         SG(1)=L(CORE/(124.0ex(1)+LUX-6(1)))         SG(1)=L(CORE/(124.0ex(1)+LUX-6(1)))         SG(1)=L(CORE/(124.0ex(1)+LUX-6(1)))         SG(1)=L(CORE/(124.0ex(1)+LUX-6(1)))         SG(1)=L(CORE)         SG(1)=L(CORE)         SGSG=L(G(1)+EX-2)/RSGSG         SGSG=L(G(1)+EX-2)/RSGSG         SGSG=L(G(1)+EX-2)/RSGSG         SGSG=L(G(1)+EX-2)/RSGSG         SGSG=L(G(1)+EX-2)/RSGSG         SGSG=L(G(1)+EX-2)/RSGSG         SGSG=L(G(1)+1)-LSG         SGSG=L(G(1)+1)-LSG         SGSG=L(G(1)+1)-LSG         SGSG=L(G(1)+EX-2)/RSGSG         SGSGSG=RCG(1)+EX-2)/RSGSG	IF(IRUNG=1)In+9+10 9 RF=AEZ*{(UY-G(2))**2+(UX-G(1))**2)**0.5
Drift = KCORE/(24.0=KK))=UUK=G(1)       Drift = KCORE/(24.0=KK))=UUK=G(1)       Drift = G(1)       Drift = Filon	XCDRE=CDRE(RE)
n(6(3)=6(1)           n(14)=6(12)           60 TO B           10 CONTINUE           60 TO B           60 TO B           10 CONTINUE           60 TO B           60 TO B           11 CONTINUE           60 TO B           60 TO B           60 TO B           61 TO B           62 CALCULATE FLUID VELOCITY AT PARTICLE POSITION           7           62 CALCULATE FLUID VELOCITY AT PARTICLE POSITION           7           62 CALCULATE FLUID VELOCITY AT PARTICLE POSITION           7	nG(])=(XC3RE/(24.0*XK))=(UX-6(])) DG(2)=(XCDRE/(24.0*XK))=(UY-6(2))
06 10 Hold         0.0	D6(3)=G(1)
10 CONTINUE ==C C CALCULATE FLUID VELOCITY AT PARTICLE POSITION C CALCULATE FLUID VELOCITY AT PARTICLE POSITION C CALCULATE FLUID VELOCITY AT PARTICLE POSITION C CALCULATE FLUID VELOCITY AT PARTICLE POSITION SGOSC= (6(3) + +2) + +2) + 850 (1) + 1 = 0 - (6(3) + +2) + 850 (1) + 1 = 0 - (6(3) + +2) + 850 (1) + 1 = 0 - (6(4) + -1 - 0) + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 +	D6(4)≡6(2) Go To B
M=r     M=r       C     CALCULATE FLUID VELOCITY AT PARTICLE POSITION       C     R50SG=(6(3)**2+6(4)**2)**2       1X=1.0-16(3)**2-6(4)**2)**2       1X=1.0-16(3)**2-6(4)**2)**2       1X=1.0-16(3)**6(4)**2)**2       1Y=-6(6)**1/*5050       1Y=-6(6)**2)**2       1Y=-6(6)**2)**2       1Y=-6(6)**2)**2       1Y=-6(6)**2)**2       1Y=-6(6)**2)**2       1Y=-6(6)**2)**2       1Y=-6(7)**1)*5050       1Y=-6(7)**1)*5050       1Y=10       1       0       1       10       11       10       11       10       11       10       11       11       12       13       14       15       12       13       15       14       15       16       17       18       19       11       12       13       14       14       15       16       17       18       19       19       11       12       13       14 <td>16 COMTINUE</td>	16 COMTINUE
C 75050=(6(3)**2+6(4)**2)**2 1)X=1.0=(6(3)**2-6(4)**2)**2 1)X=1.0=(6(3)**2-6(4)**2)*5050 1)Y=-(6(3)**2-6(4)**2)*5050 C 1VFGRATE ACROSS ANOTHER STEP IF REQUIRED C 1VFGRATE ACROSS ANOTHER STEP IF REQUIRED ACROSS ANOTHER ACROSS A	M=r Calculate Fluid Velocity at Particle Position
C INFEGRATE ACROSS ANOTHER STEP IF REQUIRED C IF(G(4) - 1.0)11.11.12 11 PELX = SORT(1.0 - G(4)+*2) GO TO I3 12 DELX = 0.0 13 HITS=G(3)+G(1)*1.1=DTAU+DELX 13 HITS=G(3)+G(1)*1.1=DTAU+DELX 13 HITS=G(3)+G(1)*1.1=DTAU+DELX 13 HITS=G(3)+G(1)*1.1=DTAU+DELX 14 HITS=G(3)+G(1)*1.1=DTAU+DELX 15 PELX = 0.0 17 DELX = 0.0 18 FE(HITS)R.8.1R 18 FE(HITS)R.8.1R 18 FE(HITS)R.8.1R 19 HITS=G(3)+G(1)*1.1=DTAU+DELX 19 HITS=G(3)+G(1)*1.1=DTAU+DELX 10 HITS=G(3)+G(1)*1.1=DTAU+DELX 10 HITS=G(3)+G(1)*1.1=DTAU+DELX 10 HITS=G(3)+G(1)*1.1=DTAU+DELX 11 PELX = 0.0 12 DELX = 0.0 13 HITS=G(3)+G(1)*1.1=DTAU+DELX 14 HITS=G(3)+G(1)*1.1=DTAU+DELX 15 PELX = 0.0 16 TO I3 17 DELX = 0.0 17 DELX = 0.0 18 HITS=G(3)+G(1)*1.1=DTAU+DELX 19 HITS=G(3)+G(1)*1.1=DTAU+DELX 19 HITS=G(3)+G(1)*1.1=DTAU+DELX 10 HITS=G(3)+G(1)*1.1=DTAU+DELX 11 HITS=G(3)+G(1)*1.1=DTAU+DELX 12 DELX = 0.0 13 HITS=G(3)+G(1)*1.1=DTAU+DELX 14 HITS=G(3)+G(1)*1.1=DTAU+DELX 15 HITS=G(3)+G(1)*1.1=DTAU+DELX 16 HITS=G(3)+G(1)*1.1=DTAU+DELX 17 HITS=G(3)+G(1)*1.1=DTAU+DELX 18 HITS=G(3)+G(1)*1.1=DTAU+DELX 19 HITS=G(3)+G(1)*1.1=DTAU+DELX 10 HITS=G(3)+G(1)*1.1=DTAU+DTAU+DELX 10 HITS=G(3)+G(1)*1.1=DTAU+DTAU+DTAU+DTAU+DTAU+DTAU+DTAU+DTAU+	RSOSQ=[G(3]##2+G(4]##2]##2  ]X=1.c=[G(3]##2-G(4)##2]/RSOSQ  JY=~(G[3]#6(4)]/PSOSQ
C [F(G(4) - 1.0)]1.]1.12 11 PELX = SORT(1.0 - G(4)+*2) 60 TO 13 12 BELX = 0.0 13 HIT5=5(3)+6(1)*1.]*PITAN+DELX 12 BELX = 0.0 13 HIT5=5(3)+6(1)*1.]*PITAN+DELX 14 HIT5=13+6(1)*1.]*PITAN+DELX 17 FHIT5]8.8.18 18 CONTINUE FF(HT5)8.8.18 18 CONTINUE FF(HT5)8.8.18 19 CONTINUE	INTEGRATE ACROSS ANOTHER STEP IF REQUIRED
IF(HTS)8.8.18 IF(HTS)8.8.18 I. CONTINUE RETURN FRU RETURN VARIATE ALLOCATIONS VARIATE ALLOCATIONS VARIATE ALLOCATIONS PERD INDOME DESCRIPTION MITCLD INDOME PERD INDOME	<pre>JF(G(4) - 1.0)]1.11.12 11 PELX = SORT(1.0 - G(4)==2) 60 T0 13 12 PELX = 0.0 12 DELX = 0.0 13 DETC=0.0 14 DETC=0.0 15 DETX = 0.0 16 DETX = 0.0 17 DETX = 0.0 18 DETX = 0.0 19 DETX = 0.0 10 DETX =</pre>
VARIA9LE ALLOCATIONS VARIA9LE ALLOCATIONS DELVID JEDDAE-DEDDA DETD JEDDAE DEDDAE DE	I F HITS) 8.8.18 I A CONTRUE PFTURE
	FHD 71A9LF ALLOCATIONS DG(R )=G026-0C20 RE(R )=0008 RS050(R )=000A DELX(R )=000C HITS(R )=0C0E

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113 OCATIONS 9 = CO6A IC = COCO ORTED EGERE EGERE EGERE FAXI 5NR 5UE FAXI 5NE FAXI 5NE FAXI 5NE			11 =0104 12 =0115	•	DD FADDX FSUB FSUB	11A .1000COE 01=001C	2=0025	OGRAM 280	(HEX)		•	IT 0015					
		610	LOCATIONS 9 =C06A IC =COCO	PORTED TEGERS	OGRAMS E FSORT FAXE FAC R FAXI SNR SUF	TS 0=0318 .240000E 02=00	7ANTS 4=0023 4=0024	WENTS FOR SAWZB O VARIABLES 24 PR	RY POINT ADDRESS IS 0026	LATION	1	WS UA SBM28 DB ADDR 5F48 DB CN					

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EXERCISE EXE

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				FUICS H	ENTS			RIATE POL			40	OD ITERA1	3#X##3+A4 #A3#X##2+	ENCE	515,5.6		
		ERS	CDRE (RE)	LIUT LUN LDS KUMR NUMBER	COEFFICI	3#1.E-04 #1.E-06 5#1.E-06	36 .E-01 .7#1.E-02 *1.E-03	E APPROPI	1;2+7+7	STIMATE	1.00113.4	ITON WETH	t=1,520 12=X*=2+A *A2=X+3= PX	CONVERG	16 LX/X)-EP	4	
		4 )RD INTEG	UNCTION	IND REYNOLDS	CONSTANT	N]=1./24. N2=-2.336 13=2.0154 Ma=-6.910	20=1=0-295 21=0-86#1 22=-4=667 13=1=1235	THOOSE TH	1F(RE-4.0	INITIAL E	F (RE - 0 	rein nen	CONTINUE DO 6 ITER TEALEXAA TEXEAI+2 FLX=FX/F SELX=FX/F	THECK FOR	FS=1.E-C FF(ARS(DE TRE=X/RF		
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Edit Constraints Function Figure 11 Function Figure 12 Function Figure 12 Function Figure 12 Figure 12 F						
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NITCER CONSTANTS NITCER CONSTANTS 1 10005 1 1	•]004005-01=0042 •4342945 00=0045	+112350E 01=0044 +100006E 02=0056	•10000E-02=0046	*400000E 01=0048	•100006 03=003E •200006 01=004A	•466770E C1=0040 •30000CE 01=004C
DEC CONTRACTOR CORE L'ATIVE ENTEY POINT ADDRESS IS OGGI (HEX) M) DE COMPLIATION M) DE	NTFGER CONSTANTS 1=0052 20=00	53 2=0054	3=0055 4±0056			1
POOT OCC CARTERIAY POINT ADDRESS IS 0061 (HEX) M) OF COMPLIATION 7 Due STORE	ORE REGUIRENENENE FOR Common <u>o</u> variai	CDRE BLES 42 PROGRAU	424			
The construction To be constructed as the const A first in more as un co	FLATIVE ENTRY POINT /	ADDRESS IS 0061 (HE)	(X	• •		
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ĐTAU∍NIBP∍NSBP₀NX₀XL∍XK⊀REZ₀ CYLINDĒR	MIDP-NSD-NX		S.0.	• TAU•6(1) •6(2) •6(3) •6(4) •UX •UY •
AGF 9 AGF 9 ONE MORD INTEGERS HIST ALL THIS SUBROUTINE SBM29(G4LFT,64RIT,SIGNL,0 SUBROUTINE SBM29(G4LFT,64RIT,SIGNL,0 164ZFR) 164ZFR) DIMENSION EFICIENCY OF A CIRCULAR C DIMENSION 6(4),06(4)	WRITE(3,200) WRITE(3,201)G4LFT,64RIT,SIGML,DTAU,W HALF INTERVAL ITERATION FOR INITIAL DO 47 ITER=1,NX SET AND PRINT INITIAL COMDITIONS M=0 NSTFP=0	TAU=0.0 6(3)=XL 6(3)=XL 642FR=(64LFT+(48TT)/2.0 64.2 = 644ER 85050=(6(3)**2+6(4)**2)**2 UX=1.0-(6(3)**2-6(4)**2)/R5050 UX=1.0-(6(3)*6(14))/R5050 011=UX 6(1)=UX	REAREZ4((UY-G(2))##2+(UX-G(1))##2)# XCDRE=CDRE(RE) IP=ITER/NIRP=NIRP IF(IP-ITER)5,7,5 5 CONTINUE 1F(ITER-1)6,7,6 6 CONTINUE 1F(ITER-NX)R,7,8 7 CONTINUE	WRITE (3+203) TER+G4LFT+G4ZER+G4RIT+ WRITE(3+203) TER+G4LFT+G4ZER+G4RIT+ LXCDRF LXCDRF CALL ON RUNGE KUTTA SUBROUTINE

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**6:D6:1/W:D1/W:IRUN6:#) **6:D6:1/W:D1/W:IRUN6:#) =(12)*22*(W=6(1))*22)*0.5 =(12)*20*(1)*(W=6(1)) =(12)*(0*(1)*(1)*2)*0.5 =(12)*2)*(1)*(U=6(1)) =(12)*2)*(1)*(U=6(1)) =(12)*2)*(1)*(1)*(1)*2)*(1) =(12)*2)*(1)*(1)*(1)*2)*(1) =(12)*1)*(1)*(1)*(1)*(1)*(1)*(1)*(1)*(1)*(1)
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CHANGE INCREMENT SIZE NEAR CYLINDER AND INTEGRATE FURTHER

DTAV=DTAV/10.0 CALL SBM28(6,TAU,DTA¥,XK,REZ,UX,UY,XCDRE)

PRINT SOLUTIONS υυυ

IF(IS-ITER)21.23.21

CONTINUE 21

IF(ITER-1)22+23+22 22 CONTINUE

IF(ITER-NX)24,23,24 23 CONTINUE

WETTE(3,204)TAU.6(1),6(2),6(3),6(4),UX SUY,XCDRE CONTINUE

24

ħTAW=ĎTAW/109.0 Call Spy28(6,tAU+DTAW+XK+REZ+UX+UY+XCDRE)

PRINT SOLUTIONS υυυ

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[F(IS-ITER)31+33+31

[F(ITER-1)32,33.32 CONTINUE 1€

CONTINUE 32

[F( ITER-NX) 34, 33, 34

CONTINUE -

WELTE(3,204)TAU+6(1)+6(2)+6(3)+6(4)+UX+UY+XCDRE CONTINUE 4

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CALCULATE ORDINATE AT TAKGENT POINT OF TANGENT PATH υ υυ

OPD = G(1)/SQRT(G(1)##2 + G(2)##2)

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FIND INTERVAL HALF WITH THE SIGN CHANGE

IF ( (6(4)-ORD) = SIGNL-0=0)45=45=46 64RIT=64ZER

GO TO 47 4

46 64LFT=54ZEP

CONTINUE EM = GAZER VALTE(3,207) FM 5

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7.00. Charles in the control of EFFCIENCY OF A CIRCUME CLIMBER       7.01. Total (1) (10) 13(4)     100 (10) 13(4)     100 (10) 13(4)     100 (10) 13(4)     100 (10) 13(4)     100 (10) 13(4)       7.11. Fajo (10) 13(4)     100 (10) 13(4)     13(10) (10) 13(4)     13(10) (10) 13(4)     13(10) (10) 13(4)       7.11. Fajo (10) 13(4)     100 (10) 13(4)     13(10) (10) 13(4)     13(10) (10) 13(4)     13(10) (10) 13(4)       7.11. Fajo (10) 13(4)     13(10) (10) 13(4)     13(10) (10) 13(4)     13(10) (10) 13(4)     13(10) (10) 13(4)       7.11. Fajo (10) 13(4)     13(10) (10) 13(4)     13(10) (10) 13(4)     13(10) (10) 13(4)     13(10) (10) 13(4)       7.11. Fajo (10) 13(4)     13(10) (10) 13(4)     13(10) 13(4)     13(10) 13	
701     1     7.01     1.04 <td< th=""><th>700 FORMATE 1HD+ 35X+ 44H IMPACTION EFFICIENCY OF A CIRCULAR CYLINDER/</th></td<>	700 FORMATE 1HD+ 35X+ 44H IMPACTION EFFICIENCY OF A CIRCULAR CYLINDER/
2015       7.10	ZOI FORMAT( loHOG4LEF = %Fl0.6/ iOH G4RIT = %Fl0.6/iOH SIGM_ = % l F3.0/ iOH 9TAU = %Fl0.6/ iOH NIBP = %I3/ iOH NSRP = %I3/
1       1       100.0000       100.0000       100.0000	2 10H MX = \$13) 203 FORMAT( 10HOTTER = \$13, 10H GAUEE = \$510, 27, 10H GATEE = \$510, 201 FORMAT( 10HOTTER = \$13, 10H GAUEE = \$510, 201 FORMAT( 10HOTTER = \$13, 10H GAUEE
3       10.0 <t< td=""><td>I F10.6/ IAH GARIT = 0F10.6/ THE TAUGUT AND UNCER = 0 2 GHG(2) IDY GARIT = 0F10.6/ THE IAM 0HG(1)0 I2X0</td></t<>	I F10.6/ IAH GARIT = 0F10.6/ THE TAUGUT AND UNCER = 0 2 GHG(2) IDY GARIT = 0F10.6/ THE IAM 0HG(1)0 I2X0
2.4       FINALTO FT-4- AFLAGE 3FLAGE 1         2.7       Contrained (1++ FT-4-44)         2.75       FRANT (1++ FT-4-44)         2.77       FRANT (1++ FT-4-44)         2.77       FRANT (1-40)         750       FRANT (1-40)         751       FRANT (1-40)         751 <td>3 12X, 4HChRF /</td>	3 12X, 4HChRF /
705         FORMATT         6 worther         Monther         Mainter         Mainter <thm< td=""><td>4 IMO F7.44 4F16.65 3F16.4 ) 204 FORMAT i H - F7.44 AF16.62 3F16.4 )</td></thm<>	4 IMO F7.44 4F16.65 3F16.4 ) 204 FORMAT i H - F7.44 AF16.62 3F16.4 )
Fe0         Fe0           VALUES         Set a - could         TAUR         = could         UVER         = could         = could         UVER         = could	2n5 FORWAT ( 46411HE MOTION OF A STITICAL PARTICLE IS GIVEN BY ) 2n7 FORWAT 304NTHFT HEADTON FAITTEARY IS SELVEN BY )
Vial Rate         All Construes         Functions         Functions         Current of the second-octors         Functions         Functions <th< td=""><td></td></th<>	
RE(R)         Second         TAUR         Second	VARIARLE ALLOCATIONS
OPPIG         FUNCT         FUNCT <th< td=""><td>U(R) =CCU6+UCUP DG(R )=GODE-0008 TAU(R )=GOID RSGSO(R )=GOI2 UX(R )=0014 UY(R )=GOI6 J</td></th<>	U(R) =CCU6+UCUP DG(R )=GODE-0008 TAU(R )=GOID RSGSO(R )=GOI2 UX(R )=0014 UY(R )=GOI6 J
STATEWAY ALLOCATIONS       STATEWAY ALLOCATIONS       STATEWAY ALLOCATIONS       STATEWAY ALLOCATIONS       STATEWAY ALLOCATIONS       200	ORD(R):         ED026         ITER(I):         ED02C         MIIS(R):         E0020         DTAM(R):         E0022         IIIS(R):         E0022         IIIS(R):         E0022         IIIS(R):         E0022         IIIS(R):         E0022         IIIS(R):         E0025         IIIS(R):         E0025 <the0025< th="">         IIIS(R):         E0025</the0025<>
70n       #Cruck 201       #0068       203       #00E3       204       #00E3       207       #015       #0204       6       #0210       7       #0216       8       =0216       8       =0216       8       =0215       12       #0235       13       #0235       19       #0236       #0       #035       19       #0236       #0       #0236       #0       #0236       #0       #0236       #0236       #0       #0236       #0       #0236       #0       #0236       #0       #0236       #0       #0236       #0       #0246	STATEWERT ALLOCATIONS
c       =0.753       IC       =0.040       Z0       =0.016       5       =0.210       7       =0.216       8       =0.246         ZC       =0.015       47       =0.011       27       =0.010       20       =0.016       14       =0.016       14       =0.016       19       =0.0362       19       =0.0367       45       =0.040F         ZC       =0.015       47       =0.011       21       =0.010       23       =0.010       17       =0.0367       19       =0.0365       19       =0.0365       19       =0.0367       45       =0.040F         ZC       =0.015       47       =0.010       24       =0.030       31       =0.0365       33       =0.0367       33       =0.0367       45       =0.040F         DME <word integers<="" td="">       CALLEY SUPPORTED       0       =0.016       24       =0.0365       31       =0.0365       19       =0.0367       45       =0.040F         DME<word integers<="" td="">       CALLEY SUPPORTED       0       =0.016       5100       5101       5107       5101       5107       5101       5101       5107       5101       5107       5101       5106       5100       5101       5106</word></word>	200 ±000±0 201 ±0048 203 ±00±2 20± ±00±0 20± ±00±0 20± ±00±0
ZC         #0351         Z1         #0351         Z2         #0352         29         #0355         21         #03555         #03555         #03555         #03555         #03555         #03555         #03555         #03555         #03555         #03555         #03555         #03555         #03555         #035555         #035555         <	c ±0253 10 ±0240 11 ±0245 12 ±040 203 ±016 2 ±0160 5 ±0204 6 ±0216 8 ±0216 8 ±023£ c ±0253 10 ±0216 12 ±0300 13 ±0306 14 ±0313 15 ±0316 15 ±0216 8 ±023£
46       =0.415       47       =0.419       =0.419       =0.419       =0.415       49       =0.415       40       =0.415       40       =0.415       510       5	ZC =C36R 21 =C381 22 =C387 23 =C382 24 =C344 31 =C342 40 =U220 21 =C341 18 =C352 19 =C356
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CURL         SMALL         SMALL         FAUD         FADD         FADD         FADD         FSUBX         FMPYX         FDIV         FLD         FLDX         FSIC           FSTOX         FSTB         FDVR         FDVR         FAX         SWRT         SCORP         SIOF         SIOF         FNPYX         FLD         FLDX         FSTC           FEAL         CONSTANTS         SWRT         SCORP         SIOF         SIOF         SIOI         SUBIN         FLDX         FSTC           FEAL         CONSTANTS         SUBIN         SUBIN         SCORP         SIOF         SIOF         SIOI         SUBIN         FSTC          COD000F         00=0036         01=0036         01=0036         01=0036         01=0046          2400006         02=0036         01=0040          IIONONF         01=0042        IO0000F         02=0046          2400006         02=0036         0.00006         00=0036          2400006         02=0036         0.00006         00=0036                      <	CALLED SUPPROGRAMS
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AGE 15	<pre>If(IRUWG-1)10.9.13</pre>	96(2)={xCDRE/(24,0+xK))+(UY-G(2)) 96(3)=6(1) 96(4)=6(2) 860 T0 R 10 CONTINUE MeC	CALCULATE FLUID VELOCITY AI PARTICLE POSITION PSOSQ=[G[3]+#246[4]+#2]+#2 UX=1.0-'(G[3]+#22-6[4]+#2]/RSQSQ UY=-2.04[G[3]+66[4])/RSQSQ	<pre>IVFEGRATE ACROSS ANOTHER STEP IF REOULARED IF(6(4) = 1.0)llalla12 I1 ?ELX = SQRT(1.0 - 6(4)++2) Go TO 13</pre>	12 PFLX = 0.0 13 HITS=G(3)+G(1)*1.1*DTAU+DELX 1F(HITS)8.8.9.18 1P CONTINUE CHARGE INCREMENT SIZE NEAR CYLINDER AND INTEGRATE FURTHER	ħŦ₳₩=ħŦ₳IJ/10°C Call SPM28(G+TAU=DTAM+XK+REZ+UX+UY+XCDRE) ñtay=dtau/100°.0 Call SPM28(G+TAU=DTAM+XK+REZ+UX+UY+XCDRE)	CO-ORDIMATES, VELOCITY, AND PRESSURE DERIVATIVE AT CYLINDER VX=G(1) VY=G(2) X=G(3) Y=G(4)	V=SGRT(VX=#2+VY#=2) PI = 3=14159265358979323946264 CAWMA = PI - 2=0*ATAN(Y/SGRT(1=0-Y=+2))- ATAN(VY/VK) FY= UXZER=(VX- V=COS(GA MMA)) IF(ITEQ-1)24.25.24 24 CONTINUE

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รู้ได้มีร้าง และสมบุณหมายรูปสมบัติสอก (สมบัติการในปี) ส่วนส

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UF IS FREE STEAM	VELOCITY, CM/SEC
REAP.(2,101)0C_DP+RH0	•STGWA.XWU.UF
XL IS UPSTREAM START	INS POSITION FOR CALCULATING PARTICLE MOTION
REAN(2+192)XL	
REZ=RHOF:D=UF/XMU	
V_SSIG#A#OP#A#OP#A - 0 - = 0	•*XM(#DC)
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ITTE     1.00000       64.FF     0.00000       64.FF     0.00000       64.FF     0.000142       7.MU     6(1)     6(3)     6(4)     W       7.MU     6(1)     6(3)     6(4)     W       0.0000     0.461117     0.001482     -4.000100     0.96111     0.001411       0.0000     0.461117     0.001482     -4.000100     0.96111     0.001411       0.0000     0.461117     0.001482     -4.000100     0.96111     0.001411       0.0000     0.961117     0.001482     -4.001761     0.501116     0.001112       0.00000     0.961118     0.0017847     -4.001761     0.501117     0.001112       0.00001     0.961118     0.0017847     -4.001761     0.501117     0.001112       1.00001     0.961118     0.0017847     -4.001761     0.501117     0.001112       1.00001     0.961118     0.0017847     -4.001761     0.501117     0.001112       1.00001     0.961118     0.0017847     -4.0017721     0.5117867     0.00112       1.10001     0.961118     0.0017847     -5.001744     0.0017847     0.00128       1.10001     0.961118     0.0017847     -5.001744     0.01178     0.01218 <t< td=""><td></td><td>CDRE</td><td>24.0000</td><td>24.3728</td><td>25e2001</td><td>26.1397</td><td>27.1814</td><td>28-2857</td><td>3043616</td><td>31.2151</td><td>32.1351</td><td>34=0064</td><td>35.7737</td><td>37.7117</td><td>39.8650</td><td>42°2912</td><td>45°0651</td><td>46+2873</td><td>52*0961</td><td>20000</td><td>62=3423</td><td>10717 07</td><td>100 V 42</td><td>73.8589</td><td></td><td></td><td></td><td>•</td><td></td></t<>		CDRE	24.0000	24.3728	25e2001	26.1397	27.1814	28-2857	3043616	31.2151	32.1351	34=0064	35.7737	37.7117	39.8650	42°2912	45°0651	46+2873	52*0961	20000	62=3423	10717 07	100 V 42	73.8589				•	
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TITER     1       G4LER     0.000000       G4LER     0.00000       G4LER     0.00000       0.0000     0.001842       0.0000     0.001842       0.0000     0.001842       0.0000     0.001842       0.0000     0.001842       0.0000     0.001842       0.0001842     0.001842       0.0001842     0.001842       0.0001844     0.001842       0.0001844     0.001842       1.0000     0.001844       1.0000     0.001844       1.0000     0.001844       1.0000     0.001844       1.0000     0.001844       1.0000     0.001844       1.0000     0.001784       0.000184     0.01184       0.000184     0.01184       0.000184     0.01184       0.000184     0.01184       0.000184     0.011841       0.000184     0.011841       0.000184     0.011841       0.000184     0.011841       0.0001954		Ň	0.9611	0.9581	0*9546	0.9505		0.9415	0.9293	0.9216	0.9131	0.9029	8068-0	0.8765	0.8595	0.8389	0.6139	0.7836	0+7467	0• 10Z2	0.6515	0 520		0-5739					
ITFR = 1     1     6(2)     6(3)       G42EF = 0.000000     0.400000     642130     0.5001842     -5.000000       G42FF = 0.500000     0.461130     0.507842     -5.000000       0.4000     0.461177     0.607842     -5.000000       0.4000     0.461172     0.607842     -5.000000       0.4000     0.461172     0.607842     -5.000000       0.4000     0.961172     0.607844     -4.61763       0.4000     0.961172     0.607844     -4.622291       0.4000     0.961172     0.607844     -4.622791       0.4000     0.961138     0.607845     -5.679926       1.4000     0.961138     0.607845     -5.679926       1.4000     0.961138     0.607845     -5.679926       1.4000     0.961138     0.6077855     -5.679926       1.4000     0.961138     0.6077855     -5.679926       1.4000     0.961138     0.6077855     -5.679926       2.4000     0.961138     0.6077855     -5.679726       2.4000     0.9610860     0.6077855     -5.679726       2.4000     0.9610860     0.60077861     -5.679726       2.4000     0.9610860     0.6007965     -1.9467736       2.4000     0.9607865     0.6007965<		6(4)	0.50000	- 0-501568	0-503136	0=504705	0.506274	0+507844	0-5007413	0-512560	0.514136	0-515715	0+517298	0+518887	0.520483	0.522089	0.523709	0.525348	0.527014	07/974+0	0+530485	6462660	TCC+COD	0.535737				•	
ITER     1       G4LEF     0.500000       G4LIT     0.0007847       0.0000     0.961172       0.0007847     0.0007847       1.2000     0.961153       0.4001     0.961153       0.5007847     0.0007847       1.2000     0.961153       1.2000     0.961153       1.2000     0.961153       1.2000     0.961060       1.2000     0.961086       1.2000     0.961086       1.2000     0.961086       1.4000     0.961086       1.4000     0.961086       2.4000     0.9600866       2.4000     0.9600866       2.4000     0.9600866       2.4000     0.9600866       2.4000     0.9600866       2.4000     0.9600866       3.4000     0.9600866		6(3)	-5.000000	-4.807763	-4.615527	4.423291	-+-231056	-4.038823	2660+0+6-	-3.462144	-3.269928	-3.077720	-2+885521	-2.693334	-2-501165	-2.309010	-2.116882	-1.924786	-1-732731	06/0441-	- 348799	TOADCTOT-		-0.554543			• •		
$ \begin{array}{rcl} IITER & & I \\ G4LEF & 0.6000000 \\ G4ZER & & 0.500000 \\ G4ZER & & 0.961180 \\ 0.961177 \\ 0.6000 & 0.961177 \\ 0.6000 & 0.961164 \\ 1.6000 & 0.961164 \\ 1.6000 & 0.961164 \\ 1.6000 & 0.961164 \\ 1.6000 & 0.961164 \\ 1.6000 & 0.961164 \\ 1.6000 & 0.961164 \\ 1.6000 & 0.961164 \\ 1.6000 & 0.961164 \\ 1.6000 & 0.961164 \\ 2.6000 & 0.9600565 \\ 3.6000 & 0.9600565 \\ 3.6000 & 0.95600565 \\ 3.6000 & 0.95600565 \\ 3.6000 & 0.95600565 \\ 3.6000 & 0.95600565 \\ 3.6000 & 0.95600565 \\ 3.6000 & 0.95600565 \\ 3.6000 & 0.95600565 \\ 3.6000 & 0.95600565 \\ 3.6000 & 0.957707 \\ 4.3259 & 0.957707 \\ 4.3259 & 0.957707 \\ \end{array}$		6(2)	0.007842	0.007842	0.007643	0=007544	0=007847	0.007851	0-001050	0-007874	0.007887	0=007904	0.007928	0.007960	0.008002	0.008060	0.008141	0+008253	0-006415	0.008654	0.000018	0.000996		0-011594				i	
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5	0+0137	0-0154	0.0174	0-0197	0-0224	0.0256	0.0294	0•0339	0*0395	0+052	0=0545	0-0647	0+0775	1660-0	0+1142	0-1405	0.1745	0+2185	0.2752	0.3473	0-4354	0*5346-	0+6257	0.6659	0-5890	0.3453	0+0752	0.0609					:	
RΥ	0.9638	0.9612	0+9583	0.9551	0.9516	0.9476	0 <b>•</b> 9432	0.9383	0.9329	0=9268	0.9201	0*9126	0.9045	0.8958	0+8868	0.8780	0-5707	0.8668	0.8703	0.6878	0=9305	1.0152	1.1630	13876	1.6672	1.9132	1.9073	1.9924			, . ,			
Gi 4)	0.920898	0.923655	0=926411	0-929169	0.931926	0.934685	0.937446	0+9+0208	0-942973	0*945743	0-948517	0.951297	0-954086	0.956886	0+959700	0-962535	0-965395	0+968290	0+971233	0+974242	0+977341	0.980564	+56930-0	0.967560	0.991422	0=995538	0.997873	0+998192	1		. 1			
(613)	-5=000000	-4.807229	-4.614459	-4.421689	-4.228919	-4-036151	-3.843386	-3.650624	-3.457865	-3.265111	-3.072362	-2.879621	-2-686889	-2-494166	-2.301457	-2+108763	-1.916086	-1.723432	-1-530600	-1.338194	-1-145610	-0*653039	-0.760457	-0.567813	-0.375021	-0.181953	-0.075599	-0-061086		· · · · · · · · · · · · · · · · · · ·				
6(2)	0+013783	0.013783	0.013784	0.013787	167610.0	0.013798	0.013807	013810°C	0-013835	0+013857	0+013884	0.013921	0-013969	0-014033	0-014117	0.014229	0-014379	0.014583	0.014860	0+015242	015768	0.016487	0=017445	0.018646	C.019978	C-021135	0-521292	0.021300						-
6(1)	0.963851	C.963850	0.963848	0.963844	0.963837	0.963828	C.963816	0.963800	0.963780	C.963755	C.963723	0.953684	0.963637	0.963579	0+963509	0.963426	0.96332R	0+963216	0-963094	0.962971	0.962872	0.962849	0-963000	0.963486	0.964518	0.966240	0 <b>.96748</b> 9	0.967668		•				
TAU	0 • 0000	0.2000	1007°U	0.6600	0.9500	1.0000	1.2000	1.4000	I.= 5000	1.8000	2.0000	2.2000	2.44000	2.6000	2.8000	3,0000	3.2000	3.4000	3.6000	3. 8000	4.0000	4.2000	4.400	4.6000	4.800	5+0000	5.1099	5.1249		•				
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0.013192	0.011173	0-011172		G(2) 6(3)	6(4)	ΛX	5	CDRE
0.013172	0.011193	MIII P PAGE 16 BEST QUALITY PROPAGE 10 BEST QUA	φ	0+013792 -5+000600	0.921588	0+9635	C-0137	24+0000
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MILE PAGE         15 Bass 1 QUALL         0.932623         0.93264         0.93641         0.93641 <th0.9364< th="">         0.93641         0.93641</th0.9364<>	0.013800         -+.028915         0.932536         0.90256         23.01333         0.90256         23.01333         0.90256         23.01336         0.932536         0.90256         23.01336         0.93256         0.90256         23.01336         0.90256         23.01336         0.90256         23.01336         0.90256         23.01336         0.90256         23.01336         0.90256         23.01336         0.90256         23.01336         0.90256         23.01336         0.90256         23.01336         0.90256         23.01366         0.90256         23.01366         0.90256         23.01366         0.90256         23.01366         0.90256         23.01366         0.90256         23.01366         0.90256         23.01366         0.90256         23.01366         0.90256         23.01366         0.90256         23.01366         0.90256         23.01366         0.90256         23.01366         0.90256         23.01366         0.90256         0.90256         0.90256 <t< td=""><td>MIIS PAGE 16 BEST QUALITY FRACTION           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 17           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 17           MIS PAGE 17           MIS PAGE 16 DEST 0           MIS PAGE 17           MIS PAGE 17           MIS PAGE 17</td><td>6</td><td>0-013796 -4-421685</td><td>6-929863</td><td>0.9551</td><td>0-0197</td><td>26+0635</td></t<>	MIIS PAGE 16 BEST QUALITY FRACTION           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 17           MIS PAGE 16 DEST QUALITY FRACTION           MIS PAGE 17           MIS PAGE 17           MIS PAGE 17           MIS PAGE 16 DEST 0           MIS PAGE 17           MIS PAGE 17           MIS PAGE 17	6	0-013796 -4-421685	6-929863	0.9551	0-0197	26+0635
0.013801        013814         0.02586         0.02586         0.01382         0.011082         0.011082         0.011082	MILE PAGE IS BEST QUALITY PRACTION           MILE PAGE IS DEST QUALITY PRACTICAL PAGE IS DEST QUALITY PRACTION           MILE PAGE IS DEST QUALITY PRACTICAL PAGE IS DEST QUALITY PRACTICAL PAGE IS DESCRIPTION OF THE PAGE IS DESCRIPTION	Image of contract         Is BEST QUALITY:         PRACTICA #0.000           1001301	ņ	0.013800 -4.228915	0.932623	0.9516	0-0224	27-0662
0.013816       -3-453779       0-938146       0-9432       0-00294       29.1094         0.013926       -3-4550615       0-9432       0-0340       30.1785         0.013926       -3-550615       0-94264       0-93269       0.01395         0.013965       -3-550615       0-93269       0.00245       31.40572         0.013965       -3-550615       0-994644       0.02269       30.1785         0.013966       -3-506101       0-994644       0.02269       31.40572         0.013976       -3-506101       0-994644       0.02269       0.00445       31.40572         0.013976       -3-506101       0-994647       0.02269       0.00445       31.40572         0.013976       -2-694152       0-994647       0.02269       0.00445       31.40572         0.014126       -2-694152       0-994479       0.42010       0.994479       31.40572         0.014126       -2-694152       0-994479       0.42010       0.4522       51.4094         0.0140126       -2-694152       0-91465       0.41405       51.4094       51.4094         0.0140126       -1-1224112       0-925204       0-91452       0.14952       51.4094         0.0140126       -1-122411	0.0013816         -3-053379         0-093816         0-014916	Image: Second contract in the second contract	ا ج	0.013607 -4.036146	0.935384	0.9476	0=0256	28.1336
0.013928         -3-6570516         0-940217         0-9304         0-0304         0-01392         31.0267         31.0267           0.013964         -3-259105         0-9434677         0-9329         0-0462         31.0267         31.0267           0.013964         -3-259101         0-9434677         0-9229         0-0462         31.0267         31.0267           0.013976         -3-269102         0-943279         0-9221         0-94327         31.0267         31.0267           0.013976         -2-879609         0-92210         0-92210         0-9221         31.0267         31.0267           0.014126         -2-879609         0-92477         0-92210         0-92477         35.096         31.0267           0.014126         -2-879167         0-92211         0-926114         0-9222         31.0327         35.096           0.014126         -2-849127         0-91461         0-926211         0-92479         0-91461         35.096         31.032           0.014126         -2-849127         0-91461         0-925211         0-92421         0-91462         31.032         35.096         0.014126         52.096         0.014126         52.096         0.014126         52.0912         0.014126         52.09126	INTERPACTION         PAGE IS BEST QUALITY PRACTION           0:0013010	0.01384:	2	0-013816 -3.843379	0-938146	0=9432	0=0294	29.1994
0.0013044         -3-657856         0.943677         0.00395         31.0267         31.0267           0.0013076         -3-057856         0.9456775         0.9564475         0.00397         31.0267         31.0267           0.0013078         -3-0723101         0.9964475         0.9964775         0.90647         31.0267         31.0267           0.0013078         -3-072310         0.9964775         0.9964775         0.90647         35.3243         91.0267           0.0014042         -2.2.6971950         0.9957599         0.90765         0.90765         31.00267         35.3244           0.0014126         -2.301441         0.99697159         0.90647         35.3244         91.0281           0.0014276         -2.301441         0.9660114         0.9660114         0.914765         35.3244           0.001428         -1.016059         0.976905         0.91677         0.91795         51.049           0.014667         -1.250184         0.91765         0.926591         1.016195         55.244           0.014667         -1.250184         0.9260146         0.946705         0.91716         0.91716           0.011452         -1.145230180         0.916715         0.926591         1.016126         55.26906 <t< td=""><td>0:013844         -1-657856         0-943677         0-0220         <th0-0220< th=""> <th0-< td=""><td>0:001339:0        </td><td>ور</td><td>0-013828 -3-650616</td><td>016046-0</td><td>0.9384</td><td>0=0340</td><td>30+1785</td></th0-<></th0-0220<></td></t<>	0:013844         -1-657856         0-943677         0-0220 <th0-0220< th=""> <th0-< td=""><td>0:001339:0        </td><td>ور</td><td>0-013828 -3-650616</td><td>016046-0</td><td>0.9384</td><td>0=0340</td><td>30+1785</td></th0-<></th0-0220<>	0:001339:0	ور	0-013828 -3-650616	016046-0	0.9384	0=0340	30+1785
0.01386	0:001399	Design	2	0-013844 -3-457856	0-943677	0.9329	0.0395	31.0267
0.013930         -3.072351         0.959224         0.09201         23.32243           0.0013976         -2.5679609         0.99127         0.00641         35.16006         35.16006           0.0013976         -2.569306         0.9922006         0.99127         35.16006         35.16006           0.0013976         -2.569306         0.99220         0.99220         35.16006         35.16006           0.0014126         -2.5693609         0.99220         0.99220         35.16006         35.16006           0.0014126         -2.501441         0.995641         0.995641         35.16006         35.16006           0.0014126         -2.569306         0.996641         0.996641         35.1010         35.16006           0.014128         -2.51081441         0.995641         0.995641         35.16006         35.16006           0.014128         -2.51081441         0.995641         0.995641         35.1600         35.16006           0.014128         -2.51081441         0.995641         0.995641         35.1600         35.1600           0.014129         -2.51081441         0.91450         0.91450         0.91450         35.1600           0.0114650         -1.5123441         0.912600         0.91450         0.9145	0.01303       -3.072351       0.945224       0.09201       0.05645       33.3243         0.013020       -2.013720       0.00647       36.01204       33.3243         0.013020       -2.0666875       0.9954797       0.00647       36.01205         0.014042       -2.067600       0.095470       0.00647       36.01202         0.014042       -2.0494125       0.9045       0.01442       36.01202         0.014042       -2.0494125       0.00647       36.01202       36.09226         0.014042       -2.04412       0.9954797       0.00647       36.0146         0.014042       -2.044125       0.995706       0.01442       36.0146       36.0146         0.014042       -2.044125       0.095114       0.01442       36.0146       36.0146       36.0146         0.014426       -2.04712       0.01442       0.01442       0.01442       36.0146       36.016<	0.0013093       -3.072351       0.949224       0.00241       2.84125       0.00041       3.3.3243         0.0013030       -2.610300       0.0014121       Exaction       0.0014121       2.84125       0.0014121       2.84125       0.0014121       2.84125       0.0014121       2.84125       0.0014121       2.84125       0.0014121       2.84125       0.00144121       2.841121       0.0144011       2.841121       0.0144011       2.841121       0.941121       2.841121       0.941121       2.841121       0.941121       2.841121	0	0-013866 -3-265101	0=946448	0+9268	0+0462	31.8572
0.013930         -2.079609         0.9127         0.013930         -2.079609         0.9127         L.M.M.           0.013930         -2.013976         0.01423         0.01412         0.00641         0.01627         0.91647           0.011361         -2.016412         0.0014120         0.0074152         0.01627         0.01637           0.011426         -2.016412         0.0014120         0.0047         2.060677         0.01637           0.011426         -2.0164142         0.001423         0.01627         0.01637         0.01647           0.011426         -2.0167746         0.016423         0.016423         0.01647         0.01647           0.014238         -10.016497         0.050114         0.050251         0.01637         0.01637           0.014238         -10.016497         0.016473         0.016473         0.016473         0.016473           0.014238         -11.016669         0.052211         0.056701         0.02730         0.016473           0.015261         -11.016669         0.01990         0.016493         0.016493         0.016493           0.0115261         -11.016669         0.011765         0.010969         0.01969         0.01097           0.0117452         -0.016679	0:013930         -2:379609         0:922006         0:9127           0:0113976         -2:379609         0:9522006         0:9127           0:0113976         -2:301441         0:00647         10:90045           0:011317         10:90045         0:9045         0:9045           0:0114126         -2:301441         0:0950415         0:995044           0:0114126         -2:301441         0:0950415         0:9950416           0:0104126         -2:301441         0:950415         0:9950416           0:0104126         -2:301441         0:950415         0:9114           0:0104126         -2:301441         0:950415         0:9114           0:010420         -2:301441         0:920416         0:9114           0:011426         -11:21:000         0:92114         0:920416           0:0115251         -11:21:000         0:92114         0:92114           0:0115251         -11:21:00         0:92125         0:92125           0:0115251         -11:21:00         0:92125         0:92125           0:0119251         -11:21:00         0:92125         0:92125           0:011251         -11:21:00         0:92125         0:92125           0:011305         0:010135	Decision         -2-879609         0-9952006         0-995799         -2-894779         -2-8947979         -2-8947979         -2-8947979         -2-8947979         -2-8947979         -2-8947979         -2-8947979         -2-8947979         -2-8947979         -2-8947979         -2-8947979	Ģ	0*013693 -3*072351	0.949224	0.9201	C=0545	33+3243
0.0013978         -2.666677         0.9954797         0.9954797         0.9954797         0.9954797         0.9954797         0.9954797         0.9954797         0.9954797         0.9954759         0.9954752         0.9954752         0.9954752         0.9954752         0.9954752         0.9954752         0.9954752         0.9954752         0.9954752         0.9954752         0.9114/2         0.9146/2         0.9146/2         0.9146/2         0.9146/2         0.9147/2         0.9147/2         0.9147/2         0.9147/2         0.9147/2         0.9147/2         0.9147/2         0.9147/2         0.9147/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2         0.9174/2 <th0.9174 2<="" th=""> <th0.9172 2<="" th=""> <th0.9< td=""><td>Imis Page 15       IS BEST QUAL       Product of the state o</td><td>INIT &amp; PAGE 13         BEST QUALITY         PRACTICABL           30:00101         13         BEST QUALITY         PRACTICABL           30:00102         10001         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         100000         100000         100000           30:0010000         1000000         1000000         1000000           30:001000000         10000000         10000000         10000000           30:00100000000         100000000         100000000         100000000           30:001000000000000000000000000000000000</td><td>Q</td><td>0.013930 -2.879609</td><td>0=952006</td><td>0.9127</td><td>0.0647</td><td>35.1604</td></th0.9<></th0.9172></th0.9174>	Imis Page 15       IS BEST QUAL       Product of the state o	INIT & PAGE 13         BEST QUALITY         PRACTICABL           30:00101         13         BEST QUALITY         PRACTICABL           30:00102         10001         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         10000         10000         10000           30:00102         100000         100000         100000           30:0010000         1000000         1000000         1000000           30:001000000         10000000         10000000         10000000           30:00100000000         100000000         100000000         100000000           30:001000000000000000000000000000000000	Q	0.013930 -2.879609	0=952006	0.9127	0.0647	35.1604
0.014042         -2.494152         0.0957590         0.037592           0.014238         -2.301441         0.0960415         0.0960415         0.0960415           0.014238         -2.301441         0.0960415         0.0960415         0.0960415           0.014238         -2.301441         0.0960415         0.0960415         0.001423           0.014238         -2.301441         0.001423         0.010446         0.0014464           0.014238         -1.012241         0.0014695         0.011415         0.011415           0.014238         -1.012241         0.066314         0.014695         0.011415           0.014466         -1.012241         0.02600         0.014695         0.011415           0.014466         0.0114615         0.010460         0.014605         0.011415           0.014466         0.010460         0.02101         0.010460         0.011415           0.011415         -1.012245         0.010460         0.010460         0.010460           0.011415         -1.012245         0.010460         0.010460         0.010460           0.011415         -1.012241         0.02301         0.02301         0.010460           0.011415         -1.012245280         0.0101601         0.010460 </td <td>0.014042       -2.494152       0.0057599       0.0014124       LPAGE IS BELT QUALT       LPAGE IS BELT QUALT       LPAGE IS BELT QUALT       PAGE IS B</td> <td>0:014042       -2:004152       0:001402       -2:0014124       D:00014         0:014126       -2:01441       0:00014       0:01402       0:01402         0:014128       -2:01441       0:00014       0:01402       0:01402         0:014128       -2:01441       0:00014       0:01402       0:01402         0:014080       0:014080       0:01402       0:01402       0:01402         0:014080       0:01402       0:010241       0:00014       0:01402         0:0101251       -1:01229412       0:001201       0:01202       0:010201         0:011465       -1:01229412       0:001201       0:01202       0:010201         0:011465       -1:01229412       0:001201       0:01202       0:01202         0:011465       -1:01229412       0:001202       0:01202       0:01202         0:011465       -1:01229412       0:001202       0:01202       0:01202         0:011134       -0:01202       0:01202       0:01202       0:01202         0:011045       -0:0100241       1:012230       0:01202       0:01202         0:011045       -0:0100241       1:010241       1:010241       0:01002         0:011045       -0:0100241       1:0002412       0</td> <td>N</td> <td>0=013978 -2+686875</td> <td>0-954797</td> <td>0+9045</td> <td>0=0776</td> <td>36.9526</td>	0.014042       -2.494152       0.0057599       0.0014124       LPAGE IS BELT QUALT       LPAGE IS BELT QUALT       LPAGE IS BELT QUALT       PAGE IS B	0:014042       -2:004152       0:001402       -2:0014124       D:00014         0:014126       -2:01441       0:00014       0:01402       0:01402         0:014128       -2:01441       0:00014       0:01402       0:01402         0:014128       -2:01441       0:00014       0:01402       0:01402         0:014080       0:014080       0:01402       0:01402       0:01402         0:014080       0:01402       0:010241       0:00014       0:01402         0:0101251       -1:01229412       0:001201       0:01202       0:010201         0:011465       -1:01229412       0:001201       0:01202       0:010201         0:011465       -1:01229412       0:001201       0:01202       0:01202         0:011465       -1:01229412       0:001202       0:01202       0:01202         0:011465       -1:01229412       0:001202       0:01202       0:01202         0:011134       -0:01202       0:01202       0:01202       0:01202         0:011045       -0:0100241       1:012230       0:01202       0:01202         0:011045       -0:0100241       1:010241       1:010241       0:01002         0:011045       -0:0100241       1:0002412       0	N	0=013978 -2+686875	0-954797	0+9045	0=0776	36.9526
0.0014126         -2.301461         0.096045         0.0018186         0.001711         LUMAL           0.001428         -2.301401         10.006045         0.0018186         10.000         4969011         0.001906         490010         49690100         4969010         4969010	0.014126       -2.301441       0.0064124       0.014124       LWACTION         0.014238       -1.012421       10.0000       10.0000       10.0000         0.014592       -1.012412       10.0000       10.0000       10.0000         0.014592       -1.012412       10.0000       10.0000       10.0000         0.014592       -1.012412       0.010000       10.01200       10.01200         0.014592       -1.01200       0.011400       0.011400       10.01200         0.014667       -1.01200       0.011400       0.011400       10.01200         0.010400       -1.012000       0.011400       0.011400       10.01200         0.010400       -1.012000       0.011400       0.011400       0.011400         0.010400       -1.012000       0.011400       0.011400       0.011400         0.010400       -1.012000       0.011400       0.011400       0.011400         0.010400       -1.012000       0.011400       0.011400       0.011400         0.010400       -1.012000       0.011400       0.010000       0.011400         0.0101400       -0.010000       0.011400       0.010000       0.011400         0.0101400       -0.010000       0.011400	0.014126       -2.301441       0.960415       0.916126       -2.301441       0.960415       0.91626         0.01428       -1.1216216       0.9060114       0.9060114       0.91620       0.91620         0.01428       -1.1216216       0.906114       0.91620       0.91620       0.91620         0.014388       -1.1216216       0.91620       0.91620       0.91620       0.91620         0.014388       -1.1216210       0.91620       0.91776       1.1.5290180       0.91726         0.019381       -1.1229120       0.9969011       0.91252       0.91795       0.91726       0.91726         0.019391       -1.12530180       0.911956       0.91251       0.92706       0.91292       0.91292       0.91292         0.019776       -1.1455786       0.9971956       0.91256       0.91256       0.91256       0.91256         0.0104487       -1.1455786       0.997129       0.92567       0.92567       0.92567       0.926649       0.90104         0.0110457       -0.92567785       0.901266       0.926666       0.90106       0.926666       0.926666       0.926666       0.926666       0.926666       0.926666       0.926666       0.926666       0.9266666       0.926666       0.9266666	ŝ	0.014042 -2.494152	0-957599	0. 8958	0=0937	36.9147
0.014238       -2.108746       0.9653251       0.8706       0.91400         0.014388       -1.016069       0.9650114       0.9109       0.91406         0.014388       -1.016069       0.9650114       0.9109       0.9129         0.014869       -1.016069       0.9650114       0.9129       0.9129         0.014869       -1.016069       0.9719910       0.68706       0.912910         0.014869       -1.016069       0.9719910       0.68706       0.02752         0.015776       -1.671600       0.9719910       0.68706       0.2752         0.015776       -1.67500       0.9719910       0.68706       0.2752         0.015776       -1.67500       0.971991       0.68700       0.2752         0.017457       -1.16301       0.984495       0.01531       0.2752         0.017457       -1.16301       0.984495       0.01531       0.95449         0.017457       -1.16311       0.84705       0.955649       0.010525         0.017457       -0.55713       0.9845890       0.999290       0.999290       0.901291         0.017457       -0.0117457       0.999290       0.999290       0.901291       0.901291         0.0117457       -0.0100231	PAGE       15 BEST QUALITY       PRACTICA         00014869       01000       01000         00014869       01000       01000         00014869       01000       01000         00014869       01000       01000         00014869       01000       01000         00014869       01000       01000         00014869       01000       01000         00014869       01000       01000         00014869       010000       01000         00010100       010000       010000         00010100       010000       010000         00010100       010000       010000         00010110       010000       010000         00010110       010000       010000         00010110       000000       010000         00010110       0100000       0100000         00010110       0100000000       0100000000000000000000000000000000000	0.0014238       -2.014238       -2.014238       -2.014238       -2.0103746       0.006114       D.9653251       0.014069       0.010169       0.011111       0.011111       0.011111       0.011111       0.011111       0.011111       0.011111       0.011111       0.011111       0.011111       0.011111       0.011111       0.011111       0.011111	5	0.014126 -2.301441	0*960415	0.8569	0+11+2	41-0849
0.014368       -1.916069       0.066114       0.0.8708       0.0.1746       46.2449         0.014502       -1.723412       0.966114       0.6870       0.616492       49.3590       49.3590         0.014669       -1.723412       0.96610       0.61746       0.6269011       0.62692       52.49399         0.015251       -1.723412       0.96670       0.62189       0.62189       6.6.2449       50.0399         0.015261       -1.723412       0.96670       0.62189       0.62189       57.0580       59.3590         0.015251       -1.14556       0.631496       0.63149       0.61251       12.5693       59.6693         0.015571       -1.14556       0.631291       0.63509       0.62593       59.6693       59.6693         0.011452       -0.567785       0.991291       1.6153       0.653019       0.653019       56.5633         0.011452       -0.567785       0.998290       1.61536       0.60100       0.66499       56.6493         0.0113651       -0.656153       1.01563       1.66499       0.66499       0.66499       56.6101         0.0113651       -0.656260       0.998290       1.90920       0.90100       0.00100       56.6101       0.00100       56.6101	0.014388       -1.916069       0.966114       0.96709       0.966114       0.97109         0.0144967       -1.01667       0.914967       0.014496       0.914967       0.9309         0.0144967       -1.016495       0.914967       0.914967       0.914967       0.914967         0.0144967       -1.016495       0.015726       0.914967       0.914967       0.914967         0.015776       -1.165776       0.93109       0.914967       0.914967       0.914967         0.017452       252153       0.019204       0.914967       0.914967       0.914967         0.017452       -1.16536       0.93014       0.931291       1.01563       0.914967         0.0117452       -1.16145586       0.931291       1.01593       0.914967       0.95131         0.0117452       -1.163301       0.931291       1.01533       0.914967       0.95163         0.0117452       -1.163302       0.931291       1.916326       0.914967       0.914967         0.0117452       -1.163302       0.931291       1.916326       0.914967       0.914967         0.0117452       -0.9251123       1.916326       0.92667       0.914967       0.914967         0.01117452       -0.052113       1.	0.01438       -1-310000       0-30200       0-30200         0.01466       -1-10000       100000       0-30200       0-30200         0.01466       -1-230120       0-36200       0-36200       0-36200         0.01466       -1-230120       0-36200       0-36200       0-36200         0.01466       -1-230120       0-36200       0-36200       0-36200         0.01466       -1-230120       0-36200       0-37400       0-37400         0.010460       -1-230120       0-36200       0-37400       0-37400         0.010460       -1-24200       0-37400       0-37400       0-37400         0.010460       -1-24200       0-37400       0-37400       0-37400         0.010400       -1-24200       0-37400       0-37400       0-37400         0.010400       -1-24200       0-30400       0-30400       0-37400         0.010400       -1-24200       0-30400       0-30400       0-30400       0-30400         0.010400       -1-342000       -1-3620200       0-30400       0-30400       0-30400       0-30400         0.010400       -0-3021300       -0-303547       1-3630540       0-30400       0-30400       0-30400       0-30400       0-3040	2	0-014238 -2.108746	0-963251	0.8781	0=1406	43°2096 2
0.016592       -1.723412       0.04670       0.04670       0.02105         0.0114867       -1.7230780       0.974956       0.04670       0.02105         0.0114867       -1.1330776       0.974956       0.01005       0.02172         0.0115776       -1.1330770       0.974956       0.0015       0.02172       571.050         0.0115776       -1.1330172       0.974956       0.02172       571.050       571.050         0.0115776       -1.135117       0.021201       0.021201       0.02167       571.050         0.0115776       -1.15512       0.021201       0.021201       0.021201       0.021201         0.0115776       -1.15512       0.021201       0.021201       0.021201       0.021201         0.011111       0.011055       0.021201       0.021201       0.020103       0.001001         0.011111       0.010010       0.020241       1.0100241       1.0100241       1.0100241         0.0111110       0.01101035       1.0002241       1.09950       0.0001001       0.000100354         0.0101010       0.0100101       1.09950       0.0001001       0.0001001       0.0001001       0.0001001         0.0111110       0.0110010       0.0001001       0.0000001	0.014592       -1.123412       0.0014502       0.0014505       0.0014505         0.0014669       0.001526       0.00100       0.00100       0.00100         0.001466       0.001526       0.0010       0.00100       0.00100         0.001575       1.0001111       0.001000       0.001000       0.001000         0.001575       0.001000       0.001000       0.001000       0.001000         0.0017452       0.001000       0.001000       0.001000       0.001000         0.0017452       0.001000       0.001000       0.001000       0.001000         0.0017452       0.001000       0.001000       0.001000       0.001000         0.0017452       0.001000       0.001000       0.001000       0.0010000         0.0017452       0.001000       0.001000       0.001000       0.0010000         0.0010000       0.0010000       0.0010000       0.000000       0.0000000         0.00101000       0.000000       0.000000       0.000000       0.000000         0.00101000       0.000000       0.000000       0.000000       0.0000000         0.00101000       0.000000       0.000000       0.000000       0.0000000         0.00100000       0.00000000 <td< td=""><td>Mail       13 BEST QUALICY       PRACTICABL         0.01486       10 DD0       10 DD0         10 DD1225       10 DD0       10 DD0         10 DD1225       10 DD0       10 SESS         10 DD1255       10 DD0       10 SESS         11 S DEST QUALICAL       10 DD0         12 S DEST QUALICAL       10 DD0         13 DD0       10 SESS         14 S D1 12 O       10 DD0         15 S D1 12 O       10 DD0         16 S D1 12 O       10 SESS         17 S D1 12 O       10 SESS         18 S D1 12 O       10 SESS         19 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS</td><td>4</td><td>0=014368 -1=916069</td><td>0.966114</td><td>0.8708</td><td>0.1746</td><td>46.2449</td></td<>	Mail       13 BEST QUALICY       PRACTICABL         0.01486       10 DD0       10 DD0         10 DD1225       10 DD0       10 DD0         10 DD1225       10 DD0       10 SESS         10 DD1255       10 DD0       10 SESS         11 S DEST QUALICAL       10 DD0         12 S DEST QUALICAL       10 DD0         13 DD0       10 SESS         14 S D1 12 O       10 DD0         15 S D1 12 O       10 DD0         16 S D1 12 O       10 SESS         17 S D1 12 O       10 SESS         18 S D1 12 O       10 SESS         19 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS         10 S S10 S       10 SESS	4	0=014368 -1=916069	0.966114	0.8708	0.1746	46.2449
0.014869       -1.530780       0.971956       0.8706       0.8706       0.8706       0.8706       0.8706       0.8706       0.8706       0.8706       0.8706       0.8706       0.8706       0.8706       0.8706       0.8776       0.87677       0.87677       0.87	0.014869       -1.530780       0.971956       0.97100       0.97165	19       BIEST QUALITY       PRACTICABL         10015251       10010       1000         1101511       10000       10000         1101511       100000       100000	2	0+014592 -1+723412	0*969011	0-8670	0.2185	49.3590
0.015251       -1.0338172       0.0974966       0.0881       0.03101       0.03472       57.0582         0.015776       -1.015776       -1.01576       0.0318067       0.03508       0.0318067       0.031808         0.015776       -1.01576       0.0378067       0.03508       0.05341       0.05341       0.0582         0.011457       -0.0101457       0.053410       0.0984683       1.01533       0.05341       0.1151         0.011457       -0.0567785       0.0984583       1.01533       0.05341       0.13153       0.05149         0.011457       -0.557785       0.0388290       1.01533       0.05659       0.05619       0.05619         0.0114651       -0.557785       0.0998290       1.01533       0.05659       0.05619       0.05619         0.011136       -0.051136       0.0998290       1.9120       0.956579       0.00101       95.5589         0.010910       -0.01002541       1.9120       0.0010354       1.9120       0.0010354       0.001001         0.021308       -0.0010355       0.00010354       1.09999       0.001001       0.00100354       0.001000	0.015251       -1.338172       0.974966       0.9801       0.97492         0.015776       -1.338172       0.997696       0.99769       0.99769         0.015776       -1.145596       0.99769       0.99769       0.99269         0.011457       -0.97696       0.99301       0.99301       0.99269         0.011457       -0.5769       0.99169       0.99590       0.99269         0.011457       -0.57785       0.99269       0.99509       0.99599         0.011457       -0.5767785       0.992619       1.0150       0.95699         0.019651       -0.5767785       0.992619       1.9152       0.95699         0.0198651       -0.567785       0.999529       1.9152       0.95699         0.0198651       -0.567785       0.9995296       1.9152       0.956649         0.0198651       -0.9996219       1.999529       0.904649       0.956649         0.010134       -0.01865130       0.9995296       1.999529       0.901699         0.0221306       -0.966538       1.909529       0.90010       9.575639         0.0221306       -0.966538       1.909529       0.90100       9.575639         0.0221306       -0.966538       1.909529       0.9	S PEST QUALITY PRACTICAL         0.015276       -1.01576         0.015776       -1.0100         0.015776       0.010497         0.015776       0.010497         0.015776       0.010497         0.015776       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.011745       0.010497         0.01111       0.01041         0.011114       0.01041         0.011114       0.01041         0.011114       0.01041         0.011114       0.001041         0.011114       0.001041         0.011114       0.001041         0.010114       0.001041         0.010114       0.0010441         0.010114	þ	0=014869 -1=530780	0-971956	0.8706	0-2752	52.9328
0.015776     -1.165586     0.978067     0.9308     0.4352     61.8289       0.016495     -0.953014     0.991291     1.0156     0.4352     61.8289       0.017452     -0.953014     0.9984683     1.1633     0.6259     61.8289       0.017451     -0.657780     0.9984583     1.1633     0.6259     61.8143       0.017451     -0.6259     0.9984583     1.1633     0.6259     61.751       0.019980     -0.62591     0.9982153     1.66666     0.5879     86.7657       0.019980     -0.66673     0.9982153     1.9120     0.5879     86.7657       0.019980     -0.66673     0.9992153     1.9120     0.58779     92.2295       0.021136     -0.66673     0.999270     1.9120     0.9445     92.2295       0.0211306     -0.66663     0.999263     1.9120     0.94445     92.5295       0.0211306     -0.66643     0.001035     1.99999     0.0010     95.55894       0.0211308     -0.001035     1.99999     0.00010     95.55894       0.021308     -0.001035     1.99999     0.00010     95.55894	0.015776         -1.145586         0.9306         0.4352         61.8289         61.8289           0.015776         -1.145586         0.93014         0.9301         0.6341         61.8289         61.8289           0.017452         -0.953014         0.9361391         1.01156         0.05341         61.3143         67.3143           0.017452         -0.953014         0.9984683         1.11633         0.65549         61.8289         61.6151           0.0117452         -0.5760930         0.9984683         1.1633         0.65549         61.3143           0.0118651         -0.577815         0.9984683         1.1633         0.65549         86.1751         1.67           0.0118651         -0.534191         0.9986279         1.1633         1.65666         0.99445         92.2295         92.2293           0.011306         -0.66649         0.9992630         1.99950         0.90464         95.5844         92.2283           0.021308         -0.018531         1.99995         0.00010         95.5844         92.2180         92.2283           0.021308         -0.020103541         1.99995         0.00010         95.5844         92.5180         92.5283           0.02121308         -0.021308         0.021301	O-015776         O-015776         O-0200         O-0000         O-0010495         O-0010495         O-0010495         O-0010400         O-0	ŗ	0.015251 -1.336172	0.974966	0-681	0.3472	57.0582
0.016495       -0.953014       0.981291       1.0156       0.5341       61.3143         0.017452       -0.953014       0.9884683       1.1633       0.6250       73.5000         0.017452       -0.5760430       0.9884683       1.1633       0.6250       73.5000         0.017452       -0.576030       0.9884683       1.1633       0.6250       73.5500         0.019980       -0.57703       1.3877       0.6253       0.625399       0.60139         0.019980       -0.6449       0.9952153       1.99950       0.40649       95.3180       0.01056         0.001336       -0.001035       1.090241       1.99950       0.40010       95.5894       0.01006         0.0010337       1.000241       1.99959       0.40010       95.5894       0.01006         0.00010337       1.0000241       1.99959       0.40010       95.5894       0.00010	0.016495       -0.953014       0.9681291       1.0156       0.5341       67.3143         0.017452       -6.760430       0.9964663       1.1653       0.5341       73.500         0.0117452       -6.760430       0.9964663       1.1653       0.6556       73.500         0.0118651       -0.5567785       0.99862290       1.1653       0.6556       73.500         0.0198651       -0.57785       0.999283       1.99950       0.49464       92.2299         0.011346       -0.616538       0.999283       1.99950       0.49464       92.52894       0.6010         0.021306       -0.001035       1.000241       1.99950       0.40460       0.40461       95.5894       0.0010         0.021308       -0.001035       1.000241       1.99950       0.40461       95.5894       0.0101         0.021308       -0.001035       1.000241       1.99950       0.40461       95.5894       0.0101         0.021308       -0.001035       1.000241       1.99950       0.40464       95.5894       0.0101         0.021308       -0.001035       1.000241       1.99955       0.0010       95.5894       0.0101	0.016495       0.016495       0.010495       0.010495       0.010495         0.011452       0.010405       0.010405       0.010405       0.010405         0.011452       0.010405       0.010405       0.010405       0.010405         0.011452       0.01098       0.01005       0.010405       0.010405         0.011452       0.01098       0.01005       0.01005       0.01005         0.011986       0.01098       0.01005       0.01005       0.01005         0.011306       0.01005       0.0000       0.00005       0.0000         0.011306       0.01005       0.0000       0.0000       0.0000         0.011306       0.00000       0.00000       0.00000       0.00000         0.010055       0.00000       0.00000       0.00000       0.00000         0.010055       0.00000       0.00000       0.00000       0.00000         0.010055       0.00000       0.00000       0.00000       0.00000         0.010050       0.00000       0.00000       0.00000       0.00000         0.010050       0.00000       0.00000       0.00000       0.00000         0.010050       0.00000       0.000000       0.000000       0.000000 <td>5</td> <td>0.015776 -1.145586</td> <td>0.978067</td> <td>0-9308</td> <td>0-4352</td> <td>61.8289</td>	5	0.015776 -1.145586	0.978067	0-9308	0-4352	61.8289
0.017452       -C.760430       0.984683       1.1633       0.6250       73.5000       H         0.018651       -0.567785       0.988290       1.3877       0.6250       73.5000       H         0.018651       -0.567785       0.998290       1.3877       0.6649       86.1751       H       A         0.019980       -0.574991       0.992153       1.3877       0.65505       92.5295       A       A         0.019980       -0.374991       0.992153       1.39950       0.4445       92.5295       B       A       A         0.021306       -0.01633       0.999243       1.99950       0.40464       95.5894       B       A         0.021308       -0.0010335       1.000241       1.99955       0.40010       95.5894       B       A         0.021308       -0.0010335       1.000241       1.99955       0.40010       95.5894       B       A	0.017452       -C.760430       C.984683       1.1633       0.6250       73.5004         0.018651       -0.557785       0.9845683       1.1633       0.6649       86.1751         0.019867       -0.557785       0.9981290       1.538778       9.5509       77.500         0.019980       -0.57785       0.9992153       1.63950       0.58679       86.1751         0.019980       -0.57785       0.9992153       1.538290       0.53649       86.1751         0.01134       -0.58172       0.999263       1.99950       0.4449       95.5894       70.075130         0.021308       -0.001035       1.000241       1.99950       0.4444       95.5894       70.0010         0.021308       -0.001035       1.000241       1.99950       0.4444       95.5894       70.00101         0.021308       -0.001035       1.000241       1.99950       0.4444       95.5894       70.00101         0.021308       -0.001035       1.000241       1.99950       0.4444       95.5894       70.00101         0.021308       -0.001035       1.000241       1.99955       0.00010       95.5894       70.00101	0.017452       -C.760430       0.984683       1.11633       0.6250       7785         0.017452       -C.760430       0.988290       1.5877       0.5000       1.5877         0.0196651       0.019980       -0.567785       0.9928290       1.5807       0.5230         0.019980       -0.574991       0.5958290       0.59577       0.56579       95.7531         0.019980       -0.515192       0.9922153       1.565660       0.56538       0.5046538         0.019980       -0.01035       1.59990       0.59992       0.50466538       0.50466538         0.021308       -0.01035       1.59990       0.50466538       0.504666       0.504666         0.021308       -0.01035       1.59990       0.504666       0.504666       0.504666         0.021308       -0.001035       1.59990       0.5099264       0.5099264       0.509026         0.021308       -0.001035       0.5092643       1.59995       0.50912       0.50912       0.50912         0.021308       -0.001035       1.59995       0.50926       0.59926       0.59956       0.50010         0.02131208       -0.501035       0.59956       0.59956       0.59956       0.59956       0.59956         0.	2	0+016495 -0+953014	0-981291	1.0156	1463-0	67.3143
0.018651       -0.567785       0.998290       1.3877       0.66649       86.1751       80.1751         0.019980       -0.374991       0.992153      66666       0.58799       86.7667       97         0.019980       -0.374991       0.992153      66666       0.58799       86.7667       87         0.019980       -0.374991       0.992153      66666       0.58799       86.7667       87         0.01134       -0.01134       -0.999243       1.99950       0.04664       95.5894       87         0.021308       -0.001035       1.000241       1.99955       0.00010       95.5894       0.00010         0.921308       -0.001035       1.0002241       1.99955       0.00010       95.5894       0.00010	0.018651       -0.567785       0.988296       1.3877       0.96649       66.1751         1.000       -0.374991       0.999153      66666       0.5879       86.7667         0.019980       -0.374991       0.999263       1.9120       0.5879       86.7667         0.011306       -0.0166538       0.999563       1.99950       0.94649       95.5380         0.021308       -0.001035       1.000241       1.99950       0.00010       95.5380         0.021308       -0.001035       1.000241       1.99955       0.00010       95.5380         0.021308       -0.001035       1.000241       1.99955       0.00010       95.558180	0.018651       -0.567785       0.0088290       1.3877       0.056795         0.019980       -0.55799       0.092153      6666       0.55799         0.019980       -0.019980       0.056798       0.056798       95.0579         0.019980       -0.019980       0.05679       86.7667       95.2295         0.019980       -0.011134       -0.019980       0.0567785       92.1229         0.011134       -0.011134       0.099243       1.9120       95.5394         0.0211306       -0.010135       1.99926       0.00109       95.55834         0.0211308       -0.001035       1.99999       0.0010       95.55834         0.0211308       -0.001035       1.99999       0.0010       95.55834         0.0211308       -0.001035       1.99999       0.0010       95.55834         0.0211308       -0.0010354       1.99999       0.0010       0.0010         0.0212308       -0.0010355       0.000244       1.99996       0.0010		0.017452 -C.760430	0.954653	1.1633	0-6250	73.5000
0.019980       -0.374991       0.992153      6666       0.5879       86.7667       1         0.019980       -0.8151922       0.995270       1.9120       0.5879       86.7667       1         0.021134       -0.181922       0.996270       1.9120       0.9445       92.5295       0         0.021136       -0.001035       0.999243       1.99950       0.00464       95.5894       0         0.0211308       -0.001035       1.000241       1.99950       0.00010       95.5894       0         0.021308       -0.001035       1.0002241       1.99995       0.00010       95.5894       0	0.019980       -0.374991       0.992153       1.6666       0.5679       86.767       1.71         C.021134       -0.181922       0.996270       1.9120       0.5449       95.3180       92.2255       0.11         C.021134       -0.181922       0.999243       1.9120       0.94445       92.3180       0.10         C.021308       -0.001035       1.000241       1.99995       0.0010       95.5894       0.01         C.0221308       -0.001035       1.000241       1.99995       0.0010       95.5894       0.0010	0-0119980 -0-374991 0-9921536666 0-5879 86.7667 051134 -0.181922 0-996270 1-9120 0-9445 92.2295 011 C-021134 -0.181922 0-996270 1-9120 0-9445 92.2295 011 0-021306 -0-001035 1-09924 1-9995 0-0010 95.5894 05 0-021308 -0-001035 1-000241 1-9995 0-0010 95.5894 05 0-0010 0 0-92155 00 0-0010 0 0-00010 0 0-0000 0 0-00010 0 0-0000	ŝ	0+018651 -0+567785	0.988290	1.3877	0-6649	80.1751
C.021134     -0.181922     0.996270     1.9120     0.9445     92.2295     0.1       C.021306     -0.0046538     0.999243     1.99950     0.0466     95.5894     0.1       C.021308     -0.001035     1.000241     1.9995     0.0010     95.5894     0.1	C-021134 -0.181922 D-996270 1-9120 0-9445 92.2295 0 F 0.021306 -0.046538 D.999243 1-9950 D-0464 95.3180 E 0.021308 -0.001035 1.000241 1.9995 D-0464 95.5894 D 0.021308 -0.001035 1.000241 1.9995 0.0010 95.5894 D 0.9215E 00 0.0215 0 0.001035 0.001035 0.00100 0.000000 0.0000000 0.0000000 0.000000	C-021134 -0.181922 0.996270 1.9120 0.9445 92.2295 071 0.021306 -0.001035 1.099243 1.9995 0.0464 95.3180 04 0.021308 -0.001035 1.000241 1.9995 0.0010 95.5894 071 0.021308 0.992241 1.9995 0.0010 95.5894 0.010 0.021308 0.001035 1.000241 1.9995 0.0010 95.5894 0.010	9	0*019980 -0*374991	0.992153		0+5879	86.7667
0.021306     -0.001035     0.099243     1.9950     0.0464     95.3180     213       0.021308     -0.001035     1.000241     1.9995     0.40010     95.5894     0.4	0.021306     -0.0046538     0.099243     1.9950     0.0464     95.3180     0.10       0.021308     -0.001035     1.000241     1.99995     0.0010     95.5894     0.10       0.9215E     00     0.021308     -0.001035     1.000241     1.99995     0.0010     95.5894     0.10	C-021306 -0-0046538 0-099243 1-09950 0-00464 45-001035 0-001035 1-9995 0-0-001035 0-001035 1-9995 0-0-001035 0-0-0001035 0-0-001035 0-0-001035 0-0-001035 0-0-001035 0-0-001035 0-0-001035 0-0-001035 0-0-001035 0-0-001035 0-0-001035 0-0-00010000000 0-0-000000000000000000	ý	C+021134 -0+181922	0-996270	1-9120	0+3445	92.2295
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0.0         0.019333         0.119438         0.01933         0.119438         0.01495         1.179221           -0.999577         0.151292         0.01495         0.11957         0.11955         1.179221           -0.9995676         0.246067         0.2151004         0.013517         0.013529         0.11955           -0.9996676         0.215004         0.20349         0.013517         0.17256         0.1295           -0.999676         0.231061         0.23617         1.07225         0.256167         1.07225           -0.999676         0.23714         0.23617         0.236167         0.23616         1.17221           -0.999675         0.23757         0.23617         0.23617         1.257616         1.257616           -0.9917768         0.23847         0.23847         0.23867         1.25765         1.25765           -0.9917778         0.2450197         0.238167         0.238161         1.25765           -0.9917779         0.2450197         0.238167         0.238168         1.217201           -0.9917779         0.245019         0.245019         0.238167         1.217205           -0.9850178         0.2553943         0.2553943         0.24575         1.24677         0.245618 <t< td=""></t<>	
-0.9885/7         0.151292         0.04559         0.1495         1.17221           -0.997566         0.15507         0.04599         0.2674         1.77265           -0.997566         0.256067         0.25674         1.77253           -0.997566         0.2310616         0.01557         0.2674         1.67253           -0.977566         0.215006         0.25674         1.77265         1.77265           -0.97566         0.2310616         0.2310615         0.25674         1.65153           -0.97148         0.2310616         0.23467         1.65153         1.65153           -0.97148         0.310615         0.23467         1.651563         1.651566           -0.97148         0.31477         0.23467         1.651566         1.651663           -0.97148         0.332945         0.4720         0.4720         1.651663           -0.865068         0.501995         0.532947         0.51961         1.651663           -0.865068         0.501995         0.64929         0.64897         1.617665           -0.865068         0.551964         0.51467         0.122565         1.648913           -0.865049         0.551905         0.548929         0.548929         1.617661      <	
-0.993570         0.183147         0.0679         0.1779         0.1771           -0.997564         0.276730         0.276731         0.276731         0.1557         0.1575         0.1516         0.1775         0.1575         0.1575         0.1575         0.1575         0.15766         0.1576         0.1576         <	
-0.977564       0.215004       0.00939       0.2004       1.07251         -0.950676       0.216667       0.21226       0.23388       1.672231         -0.950676       0.278733       0.21226       0.23388       1.672231         -0.950676       0.231657       0.23347       1.675783       0.23467       1.672531         -0.950676       0.2310516       0.23467       0.23467       1.655693         -0.950676       0.3702       0.3702       1.556693         -0.991748       0.450166       0.3702       1.556693         -0.91779       0.450165       0.450165       0.45016       1.462596         -0.917648       0.4770077       0.450165       0.45016       1.462596         -0.865068       0.470077       0.45027       0.45017       1.25769         -0.865068       0.470077       0.45027       0.45027       1.46184         -0.8657965       0.470077       0.45027       0.45093       1.104411         -0.8657969       0.470077       0.45027       0.45097       1.1455961         -0.8657964       0.470077       0.45027       0.45077       1.25769         -0.8127470       0.45023       0.45027       0.45077       0.45677	
0.0       0.02763       0.01255       0.027673       1.07231         -0.959714       0.031637       0.01557       0.1557       1.69153         -0.950676       0.314373       0.01557       0.3467       1.65693         -0.950676       0.314379       0.0342495       0.03467       1.65661         -0.950676       0.314379       0.342495       0.470077       1.57661         -0.914779       0.470077       0.4307       1.57661       1.55661         -0.950676       0.470077       0.43397       1.45912       1.57661         -0.985068       0.470077       0.4607       0.4784       1.155084       1.155084         -0.865068       0.470077       0.4607       0.4667       1.26562       1.26563         -0.865068       0.5533943       0.67100       0.4667       1.26566       1.265664         -0.865068       0.5533943       0.671202       0.569387       1.265710       1.26568       1.265664         -0.717568       0.6523960       0.669383       0.7142       0.46677       0.266488       1.017688         -0.720228       0.6523890       0.67832       1.26777       0.46837       1.027695       0.266410       0.266486       0.266486	
-0.960640         0.278733         0.1557         0.2674         1.69153           -0.999676         0.374378         0.374378         0.374378         0.45661         1.656693           -0.9297748         0.374378         0.374378         0.33467         1.656693         1.656693           -0.914779         0.374378         0.33467         0.33467         1.656693         1.656693           -0.914779         0.470077         0.33467         0.33467         1.656693         1.656693           -0.914779         0.470077         0.33467         0.33467         1.657661         1.656693           -0.899855         0.470077         0.45018         0.47145         1.655908         1.48131           -0.865068         0.470077         0.4503         0.47593         1.35967         1.48131           -0.865068         0.470077         0.4503         0.47593         1.165398         1.35967           -0.865068         0.550390         0.5703         0.47593         1.355967         1.359687           -0.777681         0.5653903         0.5703         0.45657         0.49887         0.26653           -0.779939         0.5703         0.45677         0.49887         0.266939         0.4677     <	
0.0.939714         0.0.310616         0.1931         0.2347         0.2342495         0.2342495         0.2342495         0.2342495         0.2342495         0.2342495         0.2342495         0.2342495         0.2342495         0.23467         1.556693         0.23467         1.557661	
-0.973714         0.234245         0.22447         0.631664         1.61864           -0.9277448         0.3467         1.57661         1.57661           -0.917779         0.470077         0.470077         1.57661           -0.914779         0.470077         0.470077         1.57661           -0.914779         0.470077         0.470077         1.57661           -0.914779         0.470077         0.470077         1.57661           -0.914779         0.470077         0.470077         0.4145         1.48131           -0.865068         0.470077         0.470077         0.4145         1.48131           -0.866172         0.450195         0.450195         0.4145         1.245561           -0.866172         0.553943         0.503995         0.45677         0.54581           -0.866172         0.553943         0.6400         0.4568         0.45681           -0.77568         0.553943         0.672997         0.46883         1.106418           -0.777668         0.552960         0.652983         0.46877         0.46878         0.176693           -0.775681         0.775997         0.6872441         1.14890         0.17693         0.166438           -0.552960         0.7	
-0.927748         0.374378         0.2807         0.3467         1.57661         1.57661           -0.914779         0.470077         0.470077         0.47027         1.55084           -0.999855         0.470077         0.470077         0.47027         1.55084           -0.9859664         0.470077         0.470077         0.47027         1.48131           -0.865968         0.501995         0.470077         0.4506         1.48131           -0.865964         0.470077         0.4506         0.4506         1.35967           -0.865968         0.5501995         0.5700         0.4508         1.35967           -0.865968         0.5501995         0.5700         0.4508         1.35967           -0.865968         0.553943         0.5700         0.4508         1.135967           -0.865968         0.553943         0.5700         0.4598         1.135967           -0.777568         0.5599303         0.5700         0.46977         0.49987           -0.7775681         0.655990         0.6529803         0.665894         0.755957           -0.7775681         0.6553944         0.552993         0.665894         0.25612         0.25693           -0.513944         0.725957         1.26	
-0.914779       0.430165       0.3307       0.3702       1.55084         -0.802964       0.430165       0.3843       0.3929       1.48131         -0.865964       0.430165       0.430165       0.3929       1.48131         -0.865964       0.430165       0.501995       0.5199       1.48131         -0.865964       0.470077       0.50399       0.496172       1.4501         -0.865968       0.501995       0.50399       0.4508       1.309616         -0.865968       0.553943       0.5700       0.4508       1.309616         -0.865968       0.553943       0.5700       0.4508       1.101641         -0.865968       0.55992       0.59793       0.59783       1.02789       1.02789         -0.777668       0.650867       0.7420       0.4693       1.017653       1.0275957       1.055084       0.04987       0.056888         -0.7770228       0.0651867       0.7420       0.66939       0.66400       0.4677       0.956888       0.64610       0.4677       0.26699       0.1665888       0.1665888       0.1665888       0.1665888       0.1665888       0.1665888       0.1665888       0.1665888       0.1665888       0.1665888       0.1665888       0.1665888       0	
-0.899855       0.438165       0.3843       0.3929       1.48131         -0.887964       0.470077       0.4420       0.4420       0.4420         -0.887964       0.4601995       0.5039       0.4508       1.3529195         -0.887964       0.501995       0.5039       0.4420       0.4420         -0.887964       0.501995       0.5039       0.4508       1.35291         -0.887905       0.553943       0.5039       0.4558       1.352949         -0.887905       0.597853       0.57420       0.4559       1.35294         -0.87710       0.597853       0.57420       0.4667       1.1017663         -0.777568       0.661867       0.7142       0.4998       1.0177663         -0.7170508       0.661867       0.7142       0.4993       0.10528         -0.652960       0.725957       1.12477       0.4993       0.16643         -0.613464       0.725957       1.2477       0.4993       0.16643         -0.6522960       0.725957       1.2477       0.4993       0.213695         -0.613464       0.72595441       1.2573       0.4993       0.213555         -0.613464       0.725957       1.2477       0.4993       0.213555	
-0.882964       0.470077       0.4420       0.4400       1.4200         -0.882964       0.501995       0.50399       0.4501       1.33091         -0.865068       0.558943       0.55039       0.4501       1.31095         -0.865305       0.558943       0.55039       0.4501       1.24505         -0.865305       0.558943       0.57142       0.4508       1.13066         -0.862305       0.558943       0.57142       0.4508       1.24505         -0.862305       0.558932       0.57142       0.4958       1.13066         -0.802470       0.5677       0.57883       1.110657       1.24505         -0.770528       0.5693903       0.5677       0.4995       0.58883       1.0177663         -0.710528       0.5693903       0.5677       0.4995       0.58883       1.017663         -0.0513661       0.776925       0.4995       0.4995       0.058883       0.266599         -0.051361       0.770528       0.5693903       0.64777       0.4995       0.216699         -0.0513661       0.770925       0.259023       0.21461       0.4995       0.216699         -0.051361       0.641844       0.649167       0.649169       0.409435       0.	
-0.865068       0.501995       0.5039       0.4339       1.37096         -0.865068       0.55890       0.5700       0.4339       1.31096         -0.865172       0.55890       0.5700       0.4508       1.33066         -0.865172       0.55890       0.5700       0.4568       1.33066         -0.865172       0.55890       0.56400       0.4571       1.23667         -0.865196       0.55783       0.7142       0.4583       1.110667         -0.77568       0.55890       0.57142       0.4583       1.110617         -0.77758       0.55737       0.54939       0.5738       0.5738       1.10573         -0.71422       0.865344       0.7142       0.4939       0.77586       1.10573         -0.77505       0.5653960       0.725937       1.05627       0.49397       0.64939       0.77586         -0.6653944       0.77561       1.3559       0.4435       0.4677       0.27663       0.17663         -0.6553960       0.755937       1.25477       0.49397       0.64939       0.664475       0.24695         -0.6553964       0.75233       0.4677       0.2952867       0.4677       0.213555       0.46491         -0.5519841       0	
-0.8%6172       0.533943       0.5700       0.4508       1.35361         -0.8856172       0.55890       0.55890       0.4567       1.11653         -0.8825305       0.55890       0.56400       0.4657       1.117653         -0.8825305       0.55890       0.56400       0.4657       1.117653         -0.8825305       0.558932       0.7142       0.4657       1.117653         -0.8759       0.661867       0.8757       0.4958       1.02771         -0.714939       0.661867       0.8757       0.4958       1.02771         -0.714939       0.661867       0.8757       0.4958       1.02771         -0.714939       0.661867       0.8757       0.4958       1.02771         -0.7170228       0.653960       0.725997       0.49399       0.077584         -0.0513464       0.7259957       1.05228       0.49399       0.058878         -0.0513464       0.7259957       1.1480       0.49399       0.058878         -0.0513464       0.867174       1.2573       0.4677       0.26693         -0.0513464       0.867174       1.5733       0.46575       0.216693         -0.0513464       0.987174       1.5733       0.24012       0.25602	
-0.825305       0.565890       0.66400       0.4657       1.24505         -0.8022470       0.597853       0.7142       0.4784       1.17663         -0.777668       0.659832       0.7925       0.4784       1.17663         -0.777939       0.651867       0.7925       0.4784       1.17663         -0.777939       0.651867       0.7925       0.4983       1.117663         -0.77939       0.651867       0.7925       0.7926       0.59874         -0.720228       0.659867       0.725957       0.698394       0.7711         -0.613464       0.725957       1.0528       0.4987       0.096710         -0.6513464       0.775023       0.64939       0.64637       0.64641         -0.6513464       0.7790235       1.12447       0.4939       0.64641         -0.6513464       0.779636       0.64647       0.64647       0.776643         -0.6513464       0.79235       1.25733       0.4094       0.766438         -0.6513464       0.872441       1.25733       0.26653       0.164438         -0.6513464       0.872456       0.94937       0.49395       0.164438         -0.6513464       0.872456       0.876457       0.256667       0	
-0.802470       0.597853       0.7142       0.4784       1.17663         -0.777568       0.659832       0.77925       0.4784       1.17663         -0.770228       0.661867       0.8757       0.4958       1.07271         -0.720228       0.661867       0.8757       0.4958       1.07271         -0.720228       0.6693903       0.9657       0.4958       1.07271         -0.720228       0.659303       0.9677       0.4987       0.077784         -0.720228       0.659303       0.9677       0.4987       0.077784         -0.655360       0.775957       1.0528       0.4987       0.77584         -0.6513941       0.775954       1.2477       0.4939       0.77584         -0.6513941       0.77580       0.49367       0.4838       0.77584         -0.6513941       0.77580       0.49367       0.4838       0.21699         -0.6513941       0.87776       1.65906       0.4938       0.21699         -0.6513941       0.87776       1.65906       0.49887       0.21699         -0.6513441       1.65906       0.49887       0.21699       0.21699         -0.651344       0.64184       0.87776       0.21699       0.21699 </td	
-0.777668       0.629832       0.7925       0.4683       1.10441         -0.777668       0.661867       0.7925       0.4958       1.02771         -0.770228       0.661867       0.695303       0.69793       1.02771         -0.775954       0.6589544       0.755957       0.94792       0.94792         -0.6589545       0.775957       0.95627       0.94793       0.054712         -0.6589545       0.775957       0.49979       0.077594       0.054412         -0.6513464       0.7755957       1.0528       0.49399       0.058431         -0.613464       0.775544       1.05528       0.44878       0.77584         -0.6513941       0.775544       1.3523       0.4677       0.68431         -0.6513941       0.875754       1.3523       0.44359       0.68431         -0.519341       0.8773       1.3523       0.4677       0.38473         -0.519341       0.87174       1.8135       0.44359       0.48878         -0.2393145       0.919774       1.8135       0.36422       0.126499       0.126499         -0.2393145       0.9919774       1.8135       0.25665       0.126499       0.126499       0.126499       0.126499       0.126499	
-0.749939     0.661867     0.8757     0.4958     1.02771       -0.77228     0.6661867     0.9627     0.4995     0.94782       -0.77228     0.666544     0.75957     1.0528     0.94795     0.94782       -0.666544     0.775957     1.0528     0.49995     0.94687     0.94782       -0.652960     0.755957     1.05528     0.49999     0.54641     0.94782       -0.6519441     0.7758082     1.1477     0.49399     0.668431     64       -0.519441     0.790235     1.2477     0.4435     0.668431     64       -0.519341     0.854754     1.3523     0.4435     0.66878     64       -0.519341     0.854754     1.3523     0.4435     0.66878     67       -0.519341     0.854754     1.3573     0.4435     0.66878     67       -0.519341     0.854754     1.5733     0.4435     0.66878     67       -0.393145     0.86702     1.65906     0.62659     0.616478     67       -0.305038     0.952602     1.61335     0.62659     0.616498     67       -0.277681     0.87602     1.61359     0.62659     0.13555     67       -0.277681     0.956991     1.68454     0.62665     0.13555     67	
-0.720228     0.693903     0.9627     0.94782     0.94782       -0.6689344     0.725957     1.0228     0.94782     0.94782       -0.6681344     0.725957     1.0228     0.4993     0.77594       -0.66823960     0.725957     1.0228     0.4933     0.77594       -0.6652960     0.7758082     1.1480     0.68431     0.68431       -0.661364     0.790235     1.15477     0.4839     0.61754       -0.6519841     0.854754     1.82473     0.68431     0.68431       -0.6519841     0.854754     1.85459     0.46878     0.68431       -0.6519841     0.854754     1.84595     0.4435     0.68878       -0.6519841     0.854754     1.85733     0.4677     0.58882       -0.6519841     0.854754     1.85906     0.46878     0.68878       -0.6519845     0.897174     1.8733     0.4677     0.88773       -0.2392145     0.995602     1.8135     0.2002     0.16438       -0.277681     0.995602     1.8135     0.25665     0.156438       -0.277681     0.9955602     1.84554     0.84555     0.156555       10     1.84554     0.25665     0.135555       10     1.84554     0.25665     0.135555	
-0.6685544         0.725957         1.0528         0.4987         0.86410         6           -0.6552960         0.7758082         1.1480         0.4939         0.77584         00           -0.6552960         0.7585082         1.1480         0.4939         0.77584         00           -0.6552960         0.7585082         1.1480         0.6677         0.68431         X           -0.6552964         0.6822441         1.25477         0.4639         0.68431         X           -0.6513941         0.822441         1.25733         0.4677         0.58882         X           -0.6513945         0.887174         1.4595         0.4435         0.58478         X           -0.6513845         0.6417         0.887174         1.5733         0.4435         0.38473         X           -0.65138         0.9919734         1.65905         0.4435         0.221699         X         X           -0.2393145         0.9919734         1.65905         0.63667         0.16438         X           -0.2393145         0.99060991         1.8454         0.25665         0.115459         X           -0.277681         0.9906091         1.8454         0.26655         0.115555         X	
-0.652960     0.77504 20     0.77504 20       -0.6613464     0.77502 1.1480     0.4939     0.77504 20       -0.613464     0.790235     1.2477     0.4839     0.64631       -0.613464     0.790235     1.3523     0.4639     0.58882       -0.651941     0.6854754     1.3523     0.4435     0.58843       -0.651941     0.6854754     1.4573     0.4435     0.48878       -0.651941     0.6854754     1.45733     0.4435     0.48878       -0.461844     0.887174     1.45733     0.4435     0.48878       -0.393145     0.9919734     1.45733     0.4034     0.38473       -0.305038     0.995602     1.68135     0.25022     0.16438       -0.277681     0.9960891     1.88454     0.22665     0.13555       10 <the is<="" of="" particles="" reflection="" td="">     2.3435     0.23435     0.13555</the>	
-0.613464     0.790235     1.2477     0.4839     0.68431     No.68431       -0.559994     0.822441     1.3523     0.4677     0.58882       -0.519841     0.8254754     1.4595     0.4637     0.58882       -0.519841     0.8254754     1.4595     0.4637     0.58882       -0.519841     0.8254754     1.4595     0.4637     0.58882       -0.461844     0.887174     1.4595     0.4435     0.48878       -0.461844     0.887174     1.4595     0.4639     0.48878       -0.461844     0.891734     1.4599     0.4094     0.38473       -0.2393145     0.9919734     1.65906     0.25612     0.16438       -0.2393145     0.9952602     1.8135     0.22612     0.16438       -0.277681     0.952602     1.8135     0.25665     0.16438       -0.277681     0.960891     1.8454     0.26665     0.154558       70 <th of="" particles<="" reflection="" td="">     1.8435     0.26655     0.155558</th>	1.8435     0.26655     0.155558
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## APPENDIX B

COMPUTER PROGRAM FOR A SPHERE IN A

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TRANSPORT NUMBER

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n!wewslow 6(4)         1F(11UBE)1.1.2         1R30 = 5(1)1820**2.5         UX = 1.0.150**1.5 + 1.5*6(4)**2.5         UX = 1.0.150**1.5 + 1.0.150**2.5         UX = 1.1.0.150**1.5 + 1.0.150**2.5         UX = 1.2.0001*         COST = -6(13)/R         SIMT = 6(14)/R         DC = 0.8         COST = -6(13)/R         DC = 0.4         COST = -6(13)/R         DC = 0.4         COST = -6(13)/R         DC = 0.4         DC = 0.4         DC = 0.4         DC = 1.0         A = 12.54/DOT5         DT = 2.54/DOT5         DT = 2.0*CCER0*C**3/(13.*R**3)         FR1 = 2.0*CCER0*C**3/(13.*R**3)         FR2 = FT2         UM = -005*F(1.0-FR1_FR2)
<pre>     Ff(ITUME[)1.1.2     If (ITUME[)1.1.2     UX = 10 - 1.0/RSQM=1.5 + 1.5%G(4)**2/RSQM=2.5     UX = 1.0 - 1.0/RSQM=1.5 + 1.5%G(4)**2/RSQM=2.5     UX = 10 - 1.0/RSQM=2.5     SQMT(G(13)**2 + G(4)**2)     COT = -G(13)/R     COT = -G(13)/R</pre>
UX = 1.0-1.0.K20=1.5 + 1.5546(4)==2/R50=2.5 UY ==1.576(3)=6(4)/R50=2.5 C TO 3 Z R = SORT(6(3)=2 + 6(4)==2) C S ==-6(3)/R SIMT = 6(4)/R SIMT = 6(4)/R D C = 0.8 C = 1.54/DC1=C S2 = 7.54/DC1=C S2 = 7.54/DC1=C
UV ==1.54/6(1)*650#22.5 CO TO 3 CO TO
<pre>CG T0 3 2 R = SQRT(G(3)+#2) CG = 0.8 5INT = G(4)/R 5INT = G(4)/R 0C = 0.8 C = 1.0 C = 1.54/D014 A = (2.54/D014 C = 1.5509001 CZER0 = 1.55000001 CZER0 = 1.55000001 CZER0 = 1.5500000000000000000000000000000000000</pre>
2 R = SQRT(G(3)**2 + G(4)**2) COST ==6(3)/R SIMT = 6(4)/R DC = 0.8 C = 1.0 A = (2.64/DC)*C C = 1.0 A = (2.64/DC)*C S2 = 7.5098907 C = 1.54/DC)*C S2 = 7.5098907 C = 1.5401075 A = (2.64/DC)*C S2 = 7.5098907 C = 1.5401075 PT = 2.0422ER0/(9.04PI) FT1 = C2ER0*C+3/(3.*R**3) FT2 = C2ER0*C+3/(3.*R**3) FT2 = C2 UR=-COST*(1.0-FR1-FR2) UX = -UR*COST + UT*SIMT UX = -UR*COST + UT*SIMT UX = -UR*COST + UT*SIMT UX = -UR*COST + UT*SIMT
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Ass 1     2 Puwes       2 Puwes     ertoss       2 Puwes     ertoss       2 Puwes     900 25 - 13 N       3 Puwes     900 25 - 13 N       3 Puwes     900 25 - 13 N       2 Puwes     910 25 - 13 N       3 Puwes     910 25 - 13 N       3 Puwes     910 20 - 13 N       1 Puwes     910 20 - 13 N       1 Puwes     1 Puwes       1 Puwes     Pumes       1 Pumes     Pumes <t< td=""><td>C PAS 1 C PUNCE1 C PUNCE1 C PASS 2 SAV 21 == VA SAV 2</td><td>C AAS 1 7 PUWGE 7 PUWGE 6 PLSS 2 1 PUWGE 8 PLSS 2 1 PUWGE 8 PLSS 2 1 PLSS 2 2 PLSS 2 2 PLSS 2 2 PLSS 2 2 PLSS 2 1 PLSS 2 1 PLSS 2 2 PLSS 2 2 PLSS 2 2 PLSS 2 1 PLSS 2 2</td><td>GO TO (2+3+4+5+6)+M</td><td></td><td></td></t<>	C PAS 1 C PUNCE1 C PUNCE1 C PASS 2 SAV 21 == VA SAV 2	C AAS 1 7 PUWGE 7 PUWGE 6 PLSS 2 1 PUWGE 8 PLSS 2 1 PUWGE 8 PLSS 2 1 PLSS 2 2 PLSS 2 2 PLSS 2 2 PLSS 2 2 PLSS 2 1 PLSS 2 1 PLSS 2 2 PLSS 2 2 PLSS 2 2 PLSS 2 1 PLSS 2 2	GO TO (2+3+4+5+6)+M		
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1       1	x=x+0.5+H         x=uvc=1         x=ruvc=1         x=ruvc=1         x=ruvc=1         x=ruvc=1         y=1(1)=PH1(1)+2.0Ff(1)         y=1(1)=PH(1)+2.0Ff(1)         x=ruvc=1         refute         c       pot 44 J=1.N         A       Y(1)=SAVY(1)+HF(1)         x=x+0.5+H         x=x+0.5+H         x=ruvc=1         x=ruv	x=x+0.5+H         x=x+0.5+H         x=ubdest         x=rubdest         rubdest	PH[(J)=F(J) 22 Y(J)=S&V(J)+0.5*H#F[J]		
A       PHI (J) = PHI (J) = PHI (J) = PHI (J) = PHI (J) = PHI (J) = SHVE (J) = SH	C PASS 3 A D 3 J 1.01=PHT(J)+2.0FF(J) PH1(J)=PHT(J)+2.0FF(J) PH1(J)=SAVV(J)+0.53HHF(L) REVIGET REVIGET C PASS 4 C PASS 4 C PASS 4 A V1(J)=SAVV(J)+F(J) A V1(J)=SAVV(J) + (PH1(J) + F(J))3H/6.0 FRUGEZ C PASS 5 J 1.0 C PASS 6 C PASS 7 C PASS	C PASS 3 C DO SS 3 Prilid Plane Prilid Plane Prilid Plane Prilid Plane Prilid Plane Prilid Plane Prilid Plane Prilid Plane C Prilid Plane C Prilid Plane Prilid Plane	X=X+0.654H		
C PASS 3 PHI (1) = PHI (1	C D0 33 31.0 PHI (1) =PHI (1)+2.0 FF (J) PHI (1) =PHI (J)+2.0 FF (J) RFUNG=1 RFUNG=1 RFUNG=1 RFUNG=1 RFUNG=1 RFUNG=1 RFUNG=1 RFUNG=1 RFUNG=2 R	C P ASS 5 P ASS 5 P AL (J)=PHT(J)+20+F(J) 1 Y(J)=SHYT(J)+20+F(J) 1 X(J)=SHYT(J)+20+F(J) 1 R HGE-1 R FTURN C P ASS 4 C P ASS 6 C P ASS 6 C P ASS 4 C P ASS 6 C P ASS 6 C P ASS 6 C P ASS 4 C P ASS 6 C P ASS 7 C P ASS		1	
Pir (1):=Pir (1):	Pril (J) = PHI (J) + 2.00F (J)         33 Y(J) = SAVY(J) + 2.00F (J)         1 RENGE=1         REUGE=1         REUGE=2         G 00 55 J=1.0N         FRUNC         RETURN         C         DASS J=1.0N         RETURN         C         BS Y(L)1 + (PHI(J) + F(L)1)*H/6.0         RETURN         C         END	PHI (J) = PHI (J) = PHI (J) = PHI (J) = 20 F (J)         33 Y (J) = SAVY (J) + 0.5 = H = [U]         RETURG         RETURG         RETURG         A J = 3 M         PHI (J) = SAVY (J) + 10 M         A Y(J) = SAVY (J) + 10 M         A FURM         C PASS 4         B PHI (J) = SAVY (J) + 10 M         A Y U = SAVY (J) + 10 M         A Y U = SAVY (J) + 10 M         C PASS 1         B PHI (J) = SAVY (J) + 10 M	C PASS 3 4 DO 73 Jajak		
33 Y(JJ = SAVY(J)+0.5+H#F(J) FRUGE1 FRUGE2	33 Y(J)=SAVY(J)+0.5#H#F(L) RUGG=1 RUGG=1 RUGG=1 RUGG=1 A Y(J)=SAVY(J)+H#F(J) A Y(J)=SAVY(J)+H#F(J) A Y(J)=SAVY(J)+H#F(J) A Y(J)=SAVY(J)+H#F(J) A Y(J)=SAVY(J)+F(J)]+H/6.0 C PASS 5 C PASS 5 C PASS 5 C PASS 5 C PASS 5 C PASS 5 C PASS 6 C PASS 7 C PASS	33 Y(J) = SAVY(J) +0.5****F(L) RETURG RETURG C SS 4 C SO 44 J=1.M PHI(J) = PHI(J) + 2.0*F(L) RTUNG=1 RTU	PHI(J)=PHI(J)+2_0#F(J)		1.5
RETURN         PMS 4         5 00 44 J=1.N         PHI(J)=PHI(J)+2.0*F(J)         44 Y(J)=SAVY(J)+4+F(J)         45 Y(J)=SAVY(J)+4+F(J)         18006=1         18006=1         6 50 55 J=1.N         18006=2         87(J) = SAVY(J) + (PHI(J) + F(J))*H/6.0         18006=2         810         18006=2         6 50 55 J=1.N         18006=2         18006=2         6 100         18006=2         6 101         18006=2         18006=2         6 100         18006=2         18006=2         18006=2         18006=2	RETURN C PASS 4 50 44 J=1.N PHI(J)=PHI(J)+2.00F(J) 4 Y(J)=SAVY(J)+HF(J) 4 Y(J)=SAVY(J)+HF(J) 7 X=X+0.65H 1 RUMG=1 RUMG=2 F(J) = SAVY(J) + (PHI(J) + F(J))#H/6.0 1 RUMG=2 RETURN C END C END	RFTURN           C         9.45.4           FHI(J)=SAVY(J)+++F(J)           44         Y(J)=SAVY(J)+++F(J)           45         Y(J)=SAVY(J)+++F(J)           47         Y(J)=SAVY(J)+++F(J)           47         Y(J)=SAVY(J)+++F(J)           47         Y(J)=SAVY(J)+++F(J)           47         Y(J)=SAVY(J)+++F(J)           6         PO           55         J=1+N           6         PO           6         PO           7(J)=SAVY(J)++F(J))++F(J))++/6=0           1         FULN=           6         PO           6         PO           7         FULN=           6         FULN           6         FULN=	33 Y(J)=SAVY(J)+0°55#H#F(U) [RUNG#]		
C PASS 4 5 70 44 J=1.N PHI(J)=PHI(J)+2.04F(J) 44 Y(J)=SAVY(J)+H+F(J) X=X+0.55H X=X+0.55H RETUGE RETURN 6 70 55 J=1.N F(J) = SAVY(J) + (PHI(J) + F(J))*H/6.0 FUNG=2 RETURN C PASS 2 RETURN C PASS 2 RETURN C PASS 2 RETURN	C Pass 4 5 00 44 J=1.M PHI(J)=PHI(J)+2.0#F(J) 44 Y(J)=SAVY(J)+H+F(J) 44 Y(J)=SAVY(J)+H+F(J) 45 Y(J)=SAVY(J) + (PHI(J) + F(J))#H/6.0 FETURN C Pass 5 6 D0 55 J=1.M C Pass 5 1 Y(J) = SAVY(J) + (PHI(J) + F(J))#H/6.0 FETURN C END C END	C PASS 4 5 D0 44 J=1.M PHI(U)=SAVY(J)+X=0#F(J) 4 X(J)=SAVY(J)+X=(J) 4 X(J)=SAVY(J)+F(J) 7 X=X=0.5 1 RUMG=1 RUMG=2 RTURN C END C END	RETURN		100
PHI(J)=PHI(J)+2.04F(J) 44 Y(J)=SAVY(J)+H+F(J) X=X+0.55+H REUMG=1 REUMG=1 REUMG=2 REUMG=	PHI(J)=PHI(J)+2.04F(J) 44 Y(J)=SAVY(J)+H+F(J) 44 Y(J)=SAVY(J)+H+F(J) 1840G=1 8ETUGE1 8ETUGE1 6 D0 55 J=1.0N 1840G=2 18	PHI(J)=PHI(J)+2.0%F(J) 4. Y(J)=SAVY(J)+H+F(J) X=X+0.5*H RETURG=1 RETURG=1 RETURG=2 6 D0 55 J=1.4N 6 D0 55 J=1.4N 17UMG=2 RETURN C END C END	C PASS 4 6 DD 44 i=1.N		<u>DD</u> Q
44 Y(J)=SAVY(J)+H+F(J) X=X+0.55H X=X+0.55H RETURG RETURA 6 50 55 J=1.4N 1 RUMG=2 RETURA C END C END	44 Y(J)=SAVY(J)+H+F(J) X=X+0.55H 18UNG=1 RETUG=1 6 D0 55 J=1.N 5 Y(J) + (PHI(J) + F(J))#H/6.0 18UNG=2 RETURN C END	44 Y(J)=SAVY(J)+H+F(J) X=X+0.5#H X=X+0.5#H RETURN C PASS 5 6 D0 55 J=1.N 5 Y(J) + (PHI(J) + F(J))#H/6.0 C END C END	PH[(J)=PH[(J)+2_04F(J)		
Reumder1         RETURN         C       Pass 5         6       55 J=1.N         55 Y(J) = SAVY(J) + F(J))#H/6.0         18UMG=2         RETURN         C         END	IRUNG=1         RETURN         C       PASS 5         6 700 55 J=1.4N         5 7 (1) = SAVY(J) + (PHI(J) + F(J))#H/6.0         19UVG=2         RETURN         C         END	IRUNGET RETURM 6 70 55 J=1.N 5 8 7(J) + (PHI(J) + F(J))#H/6.0 1 7(U)G = SAVY(J) + (PHI(J) + F(J))#H/6.0 6 FUURN C END	¢¢ Υ(J)=SAVY(J)+H#F(J) X±X+D_55#H		
C PASS 5 6 DO 55 5 J=1.N 55 Y(J) = SAVY(J) + F(J))#H/6.0 1RUNG=2 REUNG=2 C END C END	C PASS 5 6 PASS 5 6 VO 55 J=1.N 7 V(J) + (PHI(J) + F(J))#H/6.0 1 REVNG=2 RETURN C END	C PASS 5 6 70 55 J=1.N 5 7(J) + (PHI(J) + F(J))*H/6.0 19UNG=2 RFTURN C END			
6 70 55 J=1.4N 55 Y(J) = (PHI(J) + F(J))#H/6.0 Iquage2 ReTurn C END	6 PO 55 J=1.N 55 Y(J) = {PHI(J) + F(J)}#H/6.0 IRUNG=2 RETURN C END	6 70 55 J=1.N 55 Y(J) = {PHI(J) + F(J))#H/6.0 IRUNG=2 RETURN C END	RETURN DAGG 5		
C END	C END	C END	6 70 55 J=1.eN 55 Y(J) = SAVY(J) + (PHI(J) + F(J))#H/6=0		
END	END O	END -	[QU4Ge2 DE71:34		
END	END	END			
			END		

	B 392	VARIABLE ALLOCATIONS PHIR J=0062=0009 SAVYIR J=00C6-0064 JII ]=00C8 2 =0105 3 =0108 22	FEATURES SUPPORTED ONE WORD INTEGERS CALLED SUPPORTED FADD FMDY FWPYX FD:V FLD FLDX FSTO FSTO FADD FADDX FWPY FUPYX FD:V FLD FLDX FSTO FSTOX	INTEGER CONSTANTS -200000E 01=COCC •60000CE 01=00CE SUBSC SUBIN 1=00D3 Z=n3D1 CORE REQUIREVENTS FOR SBM22 COMMON 0 VARIABLES 202 DOCENTION	FELATIVE ENTRY POINT ADDRESS IS 00D2 (HEX) 250 END OF COMPILATION	-STORE US UN SAN22 CART ID 0305 DH ADDR 5A47 DB CNT OCI2 // EJECT	ILSHIND TO DOQ	PRACTICABLE		
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PAGE 10	STATEMENT ALLOCATIONS 8 #On50 9 #0065 10 FEATURES SUPPORTED ONE WORD INTEGERS CALLED SURPROGRAWS SOM22 CORE SOM3A FSC FDVR FAL. SUBIN FSC REAL CONSTANTS	INTEGER CONSTANTS INTEGER CONSTANTS 0=0022 ]=0023 CORE REOUTREMENTS FOR SAM92 COMMON 0 VARIABLES RELATIVE FNTRY POINT ADDRESS END OF COMPILATION	*STORE WS UN SBM32 CART ID 0305 DB ADDR 5A59 // FJECT																
	• crcw. ottol.ht00.WC00.WX×XI.xK×057.*		THE IPHERE	shL•DTAU•NIBP•NSBP=NX	RINITIAL G4 VALUE		TIONS				r11114621460.5				ER+G4RIT+TAU+6(1)+6(2)+6(3)+6(4)+UX+UY+		TINE		•[RUNGsM}
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PAGE 11	// FOR #ORD INTEGERS #LIST ALL	SURROUTINE SBM30 (GALFT + GARI	C THIS SUBROUTINE CALCULATES C IMPACTION EFFICIENCY OF A S	C DIMENSION G(4)+DG(4) WRITE(3+200) WRITE(3+201)64LF1-64RIT+516	C HALF INTERVAL ITERATION FOR	C DO 31 ITER=1.NX	C SET AND PRINT INITIAL CONDI	A =0 NSTEP=0 Tation_0	6(3)=XL 642ER=(64LFT+64RIT)/2.0	G(4)=G4ZER Call Š8M34 (G∘UX∘UY∘ITUBE) Cii = IIX		RE=REZ*1(UT=G(Z));**Z+10A=G XCDRE=CDRE3RE) to-1t5/MtRD=MtRD	15(1P=1TER)5,7,5 5 1F(1TER=1)6,7,5	6 IF(ITER-MX)8.7.0 7 CONTINIE	WRITE (3,205) WRITE(3,203)ITER.G4LFT,6642)	IXCDRE	C CALL ON RUNGE KUTTA SUBROU	C B CONTINUE	CALL_SRM22(4,5,006,TAU.0TAU IF(IRUNG-1)10,9410 9 ?==RFZ=([UY-6(2))#=2+(UX-5

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 PAGE 13	22 IF(ITER-wx)24,23,24 23 COMTINUE WRITE(1,204)TAU-G(1),G(2),G(4),UX,UY,XCDR2 24 CONTINUE	71 A PLAN 100.0 CALL SBM52 (G+TAU+DTAM+XK+REZ+UX+UY+XCDRE) C PRIMT SOLUTIONS C IF(IS-ITER) 25+27+25	25 IF(ITER-1)26,27,26 26 IF(ITER-WX)28,27,28 27 CONTINUE WRITE(3,204)TAU,6(1),6(2),6(3),6(4),UX,UY,XCDRE 28 COMTINUE C	C CALCULATE ORDINATE AT TANGENT POINT OF TANGENT PAI C DRD = G(1)/SQRT(G(1)##2 + G(2)##2) C FIMD INTERVAL HALF WITH THE SIGN CHANGE C	IF1(6(4)-ORD)#SIGNL=0.0)29,29,30 29 GARIT=64ZER 60 TD 31 30 G4LFT=64ZER 31 COMTINUF EM = G4ZER##2	WRITE(3,207) EM C RETURN C FORMATS FOR OUTPUT STATEVENTS C	700 FORWATT 140, 41X, 33HFWPACTION EFFICIENCY OF A SPH 1 140 1 201 FORMATT 1040G4LEF = \$F10.6/ 104 G4R1T = \$F10.6/ 1 F3.0/ 104 DTAU = \$F10.6/ 104 NIBP = \$13/ 10 2 104 NL = \$13 1 2 104 NL = \$13 104 G4RT = \$F10.6/ 740 TAU. 11X, 446 2 44G(2) 12X, 44G(3) 12X, 44G(4), 14X, 24UX, 14 3 12X, 44CDRE / 2 024 F004AT 140 CF2 4 516.60 3F16.4 1 2 04 05 740 CF2 4 516.60 3F16.4 1 2 04 CF2 4 516.60 3F16.4 1 2 04 CF2 4 100 CF2 4 10 CF2 4	205 FORMAT ( 46411HE MOTION OF A CRITICAL PARTICLE IS

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0.+0000         0.9928910         0.002153         +++60239         0.998195         0.99910         0.00223         24-40423           0.60000         0.992865         0.001154         -++0622849         0.998091         0.99910         0.00233         24-40423         24-4033         24-4033         24-4033         0.991054         0.991054         0.991054         24-4033         0.991054         0.991054         0.991054         24-4033         0.991054         0.991054         0.991054         24-4033         0.991054         0.991054         0.991054         24-4033         0.991054         0.991054         0.991054         24-4033         0.991054         0.991054         0.991054         24-4033         0.991054         0.991054         0.991054         24-4033         0.991054         0.991054         0.991054         24-4033         0.991054         0.991054         0.991054         24-4033         0.991054         0.991054         0.991054         24-4033         0.991054         0.991054         0.99116         24-4033         24-4034         0.992164         0.9991245         0.99116         24-4035         24-4034         24-4034         24-4034         24-4044         24-40454         0.9991245         0.99116         24-4054         24-4044         24-40454         0.	4000         0.992870         0.002153         4.60249           6000         0.992869         0.002155         4.602701           8000         0.992865         0.002155         4.602701           8000         0.992859         0.002155         4.602701           8000         0.992859         0.002161         -3.60982           8000         0.992859         0.002161         -3.60982           8000         0.992859         0.002169         -3.611412           8000         0.992854         0.002169         -3.611412           8000         0.992854         0.002169         -3.611412           8000         0.992851         0.002169         -3.212843           8000         0.992811         0.002169         -3.611712           8000         0.992813         0.002193         -2.617151           8000         0.992792         0.002214         -2.2.21004           8000         0.992793         0.002214         -2.2.4189595           8000         0.992792         0.002216         -1.628443           8000         0.992793         0.002216         -1.628965           8000         0.992571         0.002230         -1.628965 <tr< td=""><td>0.988165 0.988165 0.9889596 0.9989458 0.9989889 0.998889 0.991187 0.992158 0.992058 0.992058</td><td>0.9910 0.9899 0.9885 0.9885 0.9870 0.9829 0.9829 0.9829 0.9666 0.9629 0.9529</td><td>0=0029 0=0034 0=0041 0=0041 0=0041 0=0041 0=0041 0=0041 0=0111 0=0116 0=0116 0=0116</td><td>24.24219 24.66219 24.9539 25.25.3495 25.3495 25.8227</td></tr<>	0.988165 0.988165 0.9889596 0.9989458 0.9989889 0.998889 0.991187 0.992158 0.992058 0.992058	0.9910 0.9899 0.9885 0.9885 0.9870 0.9829 0.9829 0.9829 0.9666 0.9629 0.9529	0=0029 0=0034 0=0041 0=0041 0=0041 0=0041 0=0041 0=0041 0=0111 0=0116 0=0116 0=0116	24.24219 24.66219 24.9539 25.25.3495 25.3495 25.8227
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	6000         0.992869         0.002155         -4.404275           .80001         0.992865         0.002155         -4.404275           .80000         0.992865         0.002155         -4.404275           .80001         0.992854         0.002156         -3.808554           .80001         0.992854         0.002161         -3.611412           .80001         0.992854         0.002161         -3.611412           .80001         0.992854         0.002164         -3.611412           .80001         0.992856         0.002164         -3.611412           .80011         0.992811         0.002164         -3.611412           .80011         0.992814         0.002164         -3.617151           .80011         0.992811         0.002198         -2.61895           .80011         0.992814         0.002198         -2.617151           .80011         0.992815         0.002218         -2.617151           .80011         0.992816         0.002238         -2.617151           .80011         0.992818         0.002238         -1.822965           .80011         0.992818         0.002238         -1.822965           .80011         0.992818         0.002238 <t< td=""><td>0.988596 0.989458 0.989458 0.9989899 0.990321 0.990354 0.991187 0.992058 0.992698</td><td>0.9899 0.9885 0.9885 0.9870 0.9870 0.9829 0.9802 0.9732 0.9732 0.9732 0.97629 0.95629</td><td>0=0034 0=0041 0=0041 0=0049 0=0072 0=0139 0=0111 0=0139 0=0126</td><td>24.6219 24.9539 25.<b>3</b>495 25.<b>3</b>495 25.8227</td></t<>	0.988596 0.989458 0.989458 0.9989899 0.990321 0.990354 0.991187 0.992058 0.992698	0.9899 0.9885 0.9885 0.9870 0.9870 0.9829 0.9802 0.9732 0.9732 0.9732 0.97629 0.95629	0=0034 0=0041 0=0041 0=0049 0=0072 0=0139 0=0111 0=0139 0=0126	24.6219 24.9539 25. <b>3</b> 495 25. <b>3</b> 495 25.8227
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	#000         0.992866         0.002155         -4.205701           0.0000         0.992865         0.002156         -4.205701           0.0000         0.992865         0.002161         -3.609855           0.002161         -3.600982         -3.600982           6000         0.992864         0.002161         -3.611412           6000         0.992814         0.002161         -3.611412           6000         0.992812         0.002169         -3.611412           6000         0.992812         0.002169         -3.611412           6000         0.992812         0.002169         -3.611412           6000         0.992812         0.002196         -3.617151           6000         0.992812         0.002198         -2.617151           6000         0.992792         0.002219         -2.617151           6000         0.992792         0.002219         -2.617151           6000         0.992792         0.002219         -2.617151           6000         0.992644         0.002202         -1.622965           6000         0.992644         0.0022302         -1.622965           6000         0.992644         0.0022302         -1.622965 <t< td=""><td>0.989027 0.989458 0.9899889 0.9990321 0.990754 0.991187 0.99187 0.99182496</td><td>0.9885 0.9870 0.9870 0.9821 0.9823 0.9802 0.9732 0.9732 0.9732 0.97629 0.95629</td><td>0+0041 0+0049 0+0059 0+0072 0+0111 0+0111 0+0113 0+0116 0+0116</td><td>24.9539 25.3495 25.8227</td></t<>	0.989027 0.989458 0.9899889 0.9990321 0.990754 0.991187 0.99187 0.99182496	0.9885 0.9870 0.9870 0.9821 0.9823 0.9802 0.9732 0.9732 0.9732 0.97629 0.95629	0+0041 0+0049 0+0059 0+0072 0+0111 0+0111 0+0113 0+0116 0+0116	24.9539 25.3495 25.8227
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	0000         0.992863         0.002156         -4.007127           2000         0.992859         0.002161         -3.808554           6000         0.992864         0.002161         -3.808554           6000         0.992864         0.002161         -3.60982           6000         0.992864         0.002161         -3.601451           6000         0.992864         0.002161         -3.611512           6001         0.992816         0.002195         -2.611512           6001         0.992811         0.002196         -3.212843           6001         0.992812         0.002196         -3.611512           70001         0.992812         0.002196         -2.611512           70001         0.992737         0.002218         -2.6115112           70001         0.992737         0.002214         -2.61150           70001         0.992737         0.002214         -2.61150           70001         0.992644         0.0022324         -2.611505           70001         0.992644         0.0022314         -2.6215004           70001         0.9922495         0.0022314         -1.622443           60001         0.9922495         0.0022500         -1.6224435	0.989458 0.999689 0.990321 0.991187 0.991187 0.991622 0.992058 0.992058	0.9870 0.9851 0.9852 0.98029 0.9802 0.98020 0.9606 0.9626 0.9629 0.9629	0+0049 0+0059 0+00489 0+00489 0+0111 0+0111 0+0116 0+0126	25.3495 25.8227
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	2000         0.992859         0.002168         -3.60955           6000         0.992854         0.002161         -3.60982           6000         0.992854         0.002161         -3.60982           6000         0.992854         0.002161         -3.60982           6000         0.992854         0.002165         -3.60982           6000         0.992856         0.002165         -3.611412           7000         0.992816         0.002185         -2.617115           6000         0.992875         0.002198         -2.617115           6000         0.992767         0.002198         -2.617115           6000         0.992767         0.002198         -2.617115           6000         0.992767         0.002218         -2.617115           6000         0.992767         0.002218         -2.617115           6000         0.992696         0.002218         -2.617190           6000         0.992696         0.002218         -2.617190           6000         0.992695         0.002218         -2.6221909           6000         0.992695         0.002230         -1.622695           6000         0.992270         0.0022812         -1.622895 <tr< td=""><td>0.989889 0.990754 0.990754 0.991187 0.991622 0.992058 0.992058</td><td>0.9851 0.9829 0.9802 0.9771 0.9771 0.9629 0.9561 0.9561</td><td>0=0059 0=0072 0=0089 0=0111 0=0111 0=0116 0=0126</td><td>25.8227</td></tr<>	0.989889 0.990754 0.990754 0.991187 0.991622 0.992058 0.992058	0.9851 0.9829 0.9802 0.9771 0.9771 0.9629 0.9561 0.9561	0=0059 0=0072 0=0089 0=0111 0=0111 0=0116 0=0126	25.8227
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	4000         0.992854         0.002161         -3.60982           6000         0.992847         0.002164         -3.411412           7001         0.992816         0.002164         -3.411412           7100         0.992816         0.002164         -3.411412           7100         0.992816         0.002195         -3.615712           7100         0.992816         0.002198         -2.617151           7100         0.992737         0.002214         -2.617151           7100         0.992767         0.002214         -2.617151           7151         0.002214         -2.617151         -2.617151           7151         0.002216         0.002214         -2.617151           7151         0.002214         -2.617151         -2.617151           7151         0.002214         -2.617151         -2.617151           7151         0.002214         -2.617151         -2.617151           7151         0.002214         -2.617151         -2.617150           7151         0.002238         -1.628443         -2.6121604           71600         0.992547         0.002238         -1.628443           71000         0.992271         0.002290         -1.628443 </td <td>0.990321 0.991187 0.991187 0.992058 0.992058</td> <td>0.9829 0.9802 0.9811 0.9771 0.9613 0.9629 0.95629 0.95629</td> <td>0+0072 0+0089 0+0111 0+0139 0+0176 0+0226</td> <td></td>	0.990321 0.991187 0.991187 0.992058 0.992058	0.9829 0.9802 0.9811 0.9771 0.9613 0.9629 0.95629 0.95629	0+0072 0+0089 0+0111 0+0139 0+0176 0+0226	
1.600         0.992647         0.6012164         -3-411412         0.990754         0.990174         0.9002         0.0089         27.0009         27.0009         27.0009         27.0009         27.0009         27.0009         27.0009         27.0009         27.0009         27.0009         27.00011         27.0006         27.00011         27.00011         27.00011         27.00011         27.00011         27.00011         27.00011         27.00011         27.0011         27.00011         27.0011 <td>600         0.992847         0.602164         -3.411412           1000         0.992838         0.002176         -3.411412           1000         0.992812         0.002176         -3.411412           1000         0.992812         0.002176         -3.411412           1000         0.992811         0.002198         -3.411412           4000         0.992792         0.002198         -2.617151           4000         0.992767         0.002214         -2.617151           4000         0.992767         0.002216         -2.617151           4000         0.992767         0.002216         -2.617151           4000         0.992644         0.002216         -2.617151           4000         0.992644         0.002218         -2.622969           4000         0.992644         0.002202         -1.622469           4000         0.992644         0.002202         -1.622469           4000         0.992649         0.002202         -1.622469           4000         0.992649         0.002202         -1.222447           4000         0.992271         0.002202         -1.6223695           4000         0.992271         0.002202         -1.222466</td> <td>0.990754 0.991187 0.991622 0.992058 0.992496</td> <td>0.9802 0.9771 0.9732 0.9686 0.9629 0.9529</td> <td>0=0089 0=0111 0=0139 0=0176 0=0226</td> <td>26.3884</td>	600         0.992847         0.602164         -3.411412           1000         0.992838         0.002176         -3.411412           1000         0.992812         0.002176         -3.411412           1000         0.992812         0.002176         -3.411412           1000         0.992811         0.002198         -3.411412           4000         0.992792         0.002198         -2.617151           4000         0.992767         0.002214         -2.617151           4000         0.992767         0.002216         -2.617151           4000         0.992767         0.002216         -2.617151           4000         0.992644         0.002216         -2.617151           4000         0.992644         0.002218         -2.622969           4000         0.992644         0.002202         -1.622469           4000         0.992644         0.002202         -1.622469           4000         0.992649         0.002202         -1.622469           4000         0.992649         0.002202         -1.222447           4000         0.992271         0.002202         -1.6223695           4000         0.992271         0.002202         -1.222466	0.990754 0.991187 0.991622 0.992058 0.992496	0.9802 0.9771 0.9732 0.9686 0.9629 0.9529	0=0089 0=0111 0=0139 0=0176 0=0226	26.3884
1-6000         0.992293         0.90111         21.3449         0.91111         21.3449           2.0000         0.992216         0.00214         -3.014276         0.992162         0.90126         29.4111           2.0000         0.992216         0.00219         -3.014276         0.992496         0.90224         24.413           2.0000         0.992216         0.992219         0.992496         0.90219         29.4114           2.4000         0.992175         0.992317         0.992317         0.992496         0.00224         24.4139           2.4000         0.992714         0.002214         -2.418715         0.993332         0.99449         0.00224         24.4139           2.4000         0.992714         0.002214         -2.418715         0.993476         0.09261         24.7517           3.0000         0.992571         0.992572         0.99267         0.99267         0.99267         91.45196           3.4000         0.992211         0.002201         -1.422939         0.999576         0.99267         0.91959         41.6611           3.4000         0.992216         0.002201         -1.422939         0.999566         0.92165         0.40169         41.6614           3.4000         0.9922	6000         0.992838         0.002169         -3.212872           0.002176         0.992826         0.002176         -3.01477           0.9928795         0.002195         -3.01477           1.2000         0.992816         0.002195         -3.01471           1.2001         0.9928792         0.002195         -3.01477           1.2001         0.992816         0.002219         -2.61719           1.2001         0.992677         0.002238         -2.61719           1.2002         0.992696         0.002232         -2.6220044           1.8000         0.992696         0.002232         -2.6220044           1.8000         0.992696         0.002232         -2.6220044           1.8000         0.992696         0.002232         -1.622464           1.8000         0.992697         0.0023303         -0.622190           1.8000         0.9922492         0.002203         -1.622943           1.8000         0.9922493         0.0002303         -1.6229503           1.8000         0.9922493         0.0002303         -1.6229503           1.8000         0.9922129         0.0003203         -1.6229503           1.8000         0.9922129         0.0003203         -0.0353	0.991187 0.991622 0.992058 0.992496	0.9771 0.9732 0.9666 0.9629 0.9561	0•0111 0•0139 0•0176 0•0226	27.0605
Z         000C         0.992826         0.002176         -9.014276         0.991622         0.99329         0.00139         28-6714           Z         4000         0.9972811         0.002195         -2.617171         0.992395         0.99239         0.992391         0.00216         23-66714         23-67717         0-00224         -2-617151         0-993392         0-99367         0-00244         23-67717         0-02244         23-67714         0-99367         0-99367         0-95199         23-1766         31-7664         31-7664         31-7664         31-7664         31-7664         31-7664         31-7664         31-7664         31-7664         31-6764         31-6764         31-6764         31-6764         31-6764         31-6764         31-6764         31-6764         31-6764         31-6764         31-6764         31-6764         31-6764         31-6764         31-6764         31-67	000C         0.992826         0.002176         -3.014276           200C         0.992811         -0.002185         -2.617121           4.000         0.992737         0.002185         -2.617151           4.000         0.992737         0.002185         -2.617151           4.000         0.992737         0.002218         -2.617151           4.000         0.992737         0.002231         -2.61750           4.000         0.992737         0.002232         -2.61750           4.000         0.992696         0.002232         -2.021500           2.0000         0.992697         0.0022320         -1.6224055           2.0001         0.992697         0.002500         -1.622405           2.0001         0.9922492         0.0025500         -1.622405           2.0001         0.9922492         0.0025500         -1.622495           2.0001         0.9922495         0.002260         -1.622495           2.0001         0.9922495         0.002260         -1.622495           2.0001         0.992268         0.002561         -1.6226951           2.0001         0.992268         0.003283         -0.632109           2.0001         0.992268         0.003264         <	0.991622 0.992058 0.992496	0.9732 0.9686 0.9629 0.9561	0=0139 0=0176 0=0226	27.8458
2.200C         0.992811         0.002185         -2.615712         0.9922058         0.90216         23.6114           2.6000         0.997792         0.002219         -2.611571         0.992397         0.99561         0.02246         30.5895           2.6000         0.997797         0.09219         -2.611895         0.99511         0.02246         31.4721           2.6000         0.997797         0.09219         -2.611895         0.99517         0.02246         31.4721           3.6000         0.997797         0.99519         0.995495         0.997492         0.49749         31.4721           3.2001         0.99277         0.992497         0.997492         0.997493         0.49759         0.49749         32.7664           3.2001         0.992577         0.997493         0.997493         0.49759         0.49759         0.41349         40.4096           3.7600         0.992577         0.9995267         0.997567         0.99756         0.4136         41.4096           3.6001         0.9922169         0.002219         -1.227447         0.9995267         0.99756         0.49756         0.4186         41.4092           4.6001         0.9922169         0.002212         -1.622961         0.9995676	2000         0.992811         0.002185         -2.815112           4.000         0.992792         0.002198         -2.617151           4.000         0.992767         0.002198         -2.617151           6.000         0.992767         0.002198         -2.617151           6.000         0.992767         0.002214         -2.617151           6.000         0.992696         0.002212         -2.617150           6.000         0.992696         0.002212         -2.6221600           6.000         0.992644         0.0022320         -1.822965           6.000         0.992644         0.0022500         -1.622495           6.000         0.9926492         0.002500         -1.622495           6.000         0.992268         0.002218         -1.622695           6.000         0.992268         0.0022813         -0.632109           7.000         0.992268         0.003283         -0.6330537           6.000         0.992268         0.003283         -0.6330537           6.000         0.992268         0.003283         -0.6330537           6.000         0.992368         0.003283         -0.633109           6.000         0.992268         0.003283         -0.63	0.992496 0.992496	0.9686 0.9629 0.9561	0-0176 0-0226	28.7317
2.400         0.992792         0.002198         -2.617151         0.992496         0.9629         0.00226         31.4721           2.400         0.99777         0.002214         -2.41895         0.993332         0.99761         0.09234         31.4721           2.4000         0.99777         0.002214         -2.41895         0.993332         0.99761         0.09534         31.4721           3.0000         0.992777         0.002272         -2.418956         0.993332         0.99767         0.09567         35.1754           3.0000         0.992777         0.002272         -2.021900         0.993452         0.994452         0.994567         9.099466         40.9056           3.0000         0.992771         0.002250         -1.622935         0.994452         0.994567         0.91398         43.57175           3.6000         0.992771         0.002250         -1.622935         0.995767         0.99056         40.9056           4.0000         0.992711         0.002218         -1.622935         0.99536         0.99056         43.5906           4.0000         0.992716         0.002218         0.995367         0.99556         0.99056         40.905           4.0000         0.992716         0.0022107	4.000         0.992792         0.002198         -2.617151           0.0021         0.992737         0.002214         -2.611895           0.0022         0.992737         0.002214         -2.611805           0.0022         0.992696         0.002214         -2.611805           0.0022         0.992674         0.002214         -2.611805           0.0022         0.992677         0.002230         -1.622965           0.002230         0.992677         0.002292         -1.6224443           0.002200         0.992677         0.002290         -1.622447           0.0000         0.992677         0.002290         -1.622447           0.0000         0.992677         0.002290         -1.622447           0.0000         0.992271         0.002290         -1.622447           0.0000         0.992271         0.002212         -1.622447           0.0001         0.992268         0.003283         -0.633195           0.0001         0.992268         0.003343         -0.633186           0.0001         0.992366         0.003343         -0.633186           0.0001         0.993434         0.0005142         -0.235186           0.0003547         0.0005541         -0.00063564<	0.992496	0.9629 0.9561	0-0226	29-6714
2.6,000         0.9927167         0.002214         -2.4,18,95         0.992397         0.99561         0.00224         31.4721           7.6000         0.992646         0.002218         -2.4220044         0.999392         0.9939392         0.993169         0.6019         35.1350           3.2000         0.992646         0.002210         -2.6220044         0.9994793         0.99267         0.60139         35.1350           3.2000         0.992644         0.002200         -1.622965         0.9994763         0.99267         0.60139         37.6513           3.4000         0.992241         0.9995252         0.9994763         0.99266         40.3006         49.5593         0.99266         40.3096         40.3066         40.3766         40.6014         40.601         49.992381         0.9995254         0.9995254         0.99956         40.39956         47.4906         40.3765         51.8936         47.4906         44.4006         49.2953         0.9995254         0.99956         49.29536         49.29566         49.29536         49.29566         49.29536         49.29566         49.29566         49.29566         49.29566         49.29566         49.29566         49.29566         49.29566         49.29566         49.295666         49.29566         49.2956	6000         0.992767         0.002214         -2.418595           20005         0.992737         0.002238         -2.2021900           20005         0.992696         0.002232         -2.021500           20005         0.992696         0.002232         -1.822965           20000         0.992677         0.0022320         -1.822965           20000         0.992677         0.0022300         -1.822965           20000         0.992492         0.002500         -1.622443           2000         0.9922492         0.002500         -1.6229595           3000         0.9922492         0.002500         -1.6229595           3000         0.9922492         0.002500         -1.622945           3000         0.9922492         0.002501         -1.622945           3000         0.9922129         0.0023283         -0.633109           2000         0.9922129         0.0034474         -0.633109           4000         0.992268         0.0014474         -0.633109           4000         0.992268         0.0014474         -0.633109           4000         0.993494         0.0014474         -0.633109           9000         0.993434         0.0005570         -0.036		0.9561		30.5895
Z. 8000         C. 992737         D. 0002238         -Z. 22004         O. 993983         O. 6448         Q. 0386         J. 32, 156           3. 000C         0. 992666         0. 0002272         -J. 002230         0. 99483         0. 99363         0. 97366         3. 3517           3. 4000         0. 992697         0. 992697         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99267         0. 99767         0. 99757         0. 99757         0. 99757         0. 99757         0. 99757         0. 99757         0. 99757         0. 99757         0. 99757         0. 99757         0. 99757         0. 99757         0. 99757         0. 99758         0. 99758         0. 99758         0. 996581         1. 0046         0. 47. 4096         51. 8056           4. 6000         0. 9972187         0. 997587         0. 997647         0. 997647         0. 997647         0. 997647         0. 994676         1. 0. 04248         65. 8702           4. 6000         0. 997647         0. 996676         1. 0. 09767         0. 9976476	8000         C.992737         D.002238         -2.220044           00000         0.992696         0.002320         -1.822965           22000         0.992644         0.002320         -1.822965           20000         0.992644         0.0022320         -1.822965           20000         0.992645         0.0022900         -1.822965           4000         0.992492         0.002590         -1.624443           4000         0.9922492         0.002590         -1.622443           4000         0.9922492         0.002590         -1.622443           2000         0.9922492         0.002590         -1.6229595           4000         0.9922129         0.002383         -0.633109           20001         0.9922129         0.003283         -0.633109           20001         0.9922129         0.003409         -0.633180           20001         0.9922129         0.003464         -0.633180           20001         0.9922129         0.003409         -0.633180           20001         0.993444         0.005570         -0.035566           20001         0.993444         0.0005570         -0.000603           20359         0.0005570         -0.000603         0.00	126266+0		0+0294	31.4721
3.000C       0.992696       0.002272       -2.021500       0.99463       0.9369       0.00519       35.1390         3.000C       0.992647       0.002392       -1.622493       0.994763       0.9267       0.00704       37.5175         3.4000       0.992497       0.002392       -1.622493       0.994763       0.994567       0.00704       37.5175         3.4000       0.992497       0.002392       -1.622443       0.995767       0.99456       40.5004       97.5936         3.4000       0.992398       0.002500       -1.425935       0.995767       0.9975       0.1336       40.59564         3.4000       0.992268       0.002303       -1.6224981       0.9956324       0.997567       0.1336       47.4905         4.0000       0.9922179       0.002303       -0.6330537       0.9956324       0.99756       0.4116       61.6017         4.4000       0.9922168       0.0023142       -0.6330537       0.9996491       0.99756       0.4116       61.6017         4.4000       0.9922168       0.0033163       -0.6330537       0.9996491       0.99756       0.4116       61.6017         4.4000       0.9922168       0.0033163       -0.233563       0.09996491       0.99756 <td< td=""><td>000C         0.992696         0.002272         -2.021500           .2000         0.992644         0.002320         -1.622443           .2000         0.992577         0.002320         -1.622955           .4000         0.992547         0.002260         -1.622955           .6001         0.992388         0.002261         -1.622955           .6001         0.992245         0.002263         -1.622955           .6001         0.9922165         0.002263         -1.622955           .6001         0.9922165         0.002363         -0.632109           .6001         0.992268         0.003283         -0.632109           .6001         0.9922165         0.003563         -0.632109           .6001         0.992268         0.005561         -0.632109           .6001         0.992268         0.005561         -0.632109           .6001         0.993434         0.005561         -0.0355656           .0001         0.993467         0.005570         -0.0006764           .0299         0.05571         -0.000803         -0.0006764</td><td>0.993362</td><td>0.9478</td><td>0=0388</td><td>32.7664</td></td<>	000C         0.992696         0.002272         -2.021500           .2000         0.992644         0.002320         -1.622443           .2000         0.992577         0.002320         -1.622955           .4000         0.992547         0.002260         -1.622955           .6001         0.992388         0.002261         -1.622955           .6001         0.992245         0.002263         -1.622955           .6001         0.9922165         0.002263         -1.622955           .6001         0.9922165         0.002363         -0.632109           .6001         0.992268         0.003283         -0.632109           .6001         0.9922165         0.003563         -0.632109           .6001         0.992268         0.005561         -0.632109           .6001         0.992268         0.005561         -0.632109           .6001         0.993434         0.005561         -0.0355656           .0001         0.993467         0.005570         -0.0006764           .0299         0.05571         -0.000803         -0.0006764	0.993362	0.9478	0=0388	32.7664
3.200 $0.992644$ $0.002320$ $-1.822965$ $0.994763$ $0.9267$ $0.0704$ $31.5175$ $3.4000$ $0.992517$ $0.992517$ $0.992517$ $0.992552$ $0.99266$ $40.20866$ $40.20866$ $3.4000$ $0.9922492$ $0.992517$ $0.992552$ $0.992552$ $0.99266$ $47.4095$ $0.1338$ $3.6000$ $0.99224165$ $0.002500$ $-1.2729595$ $0.995757$ $0.997567$ $0.91455$ $0.01386$ $4.0000$ $0.9922165$ $0.002263$ $-1.2226961$ $0.995661$ $0.9766$ $0.3376$ $55.66614$ $4.2000$ $0.9922165$ $0.003283$ $-0.6330537$ $0.9956324$ $0.99665$ $0.4116$ $61.66017$ $4.2000$ $0.9922169$ $0.002261$ $-1.02269817$ $0.99957649$ $1.0426$ $0.4116$ $61.66017$ $4.8000$ $0.9922169$ $0.003283$ $-0.6330537$ $0.999597649$ $1.0426$ $0.42166$ $61.66017$ $4.8000$ $0.9922168$ $0.003281$ $-0.6331672$ $0.999597649$ $1.0426$ $0.42166$ $61.66017$ $4.8000$ $0.9927068$ $0.003261$ $-0.6336772$ $0.99957649$ $1.0426$ $0.97276$ $0.92716$ $4.8000$ $0.9927068$ $0.09270661$ $1.002916$ $1.002661$ $1.6426$ $0.937976$ $0.93376$ $5.0290$ $0.99777268$ $0.00376561$ $-0.0336569$ $1.000661$ $1.64962$ $0.99136767$ $0.99136767$ $5.0299$ $0.999577266$ $0.9995769$ $1.000661$ $1.69957726667676767676676676676$	2000         0.992644         0.002320         -1.822965           4000         0.992577         0.002500         -1.62443           4000         0.9925492         0.002500         -1.62443           4000         0.992388         0.002500         -1.425955           4000         0.9922492         0.002500         -1.425955           4000         0.992268         0.0022912         -1.425951           4000         0.992268         0.003283         -0.633109           4000         0.992169         0.003283         -0.633109           4000         0.992268         0.003283         -0.633109           4000         0.992268         0.003283         -0.633109           4000         0.992368         0.003283         -0.633109           4000         0.992368         0.003283         -0.633109           4000         0.993494         0.003561         -0.03555180           4000         0.993494         0.005571         -0.0006764           4000         0.993560         0.005571         -0.000603	EE96660	0.9380	0+0519	35.1330
3.4000       0.992577       0.902597       0.994763       0.994763       0.99466       40.306         3.6000       0.992388       0.99564       -1.425935       0.995757       0.993767       0.9155       40.306       40.306         3.6000       0.992318       0.002500       -1.422935       0.995767       0.995767       0.1933       4.4095       0.1133       4.3.5895         4.2000       0.9923165       0.0025012       -1.022891       0.995677       0.99566       0.1133       4.3.5895         4.2000       0.9923165       0.0023283       -0.6830537       0.995674       0.99475       0.1975       56.6614         4.4000       0.992129       0.004474       -0.6330672       0.999476       1.2030       0.44116       61.6017         4.4000       0.992129       0.004474       -0.633672       0.999476       1.2030       0.44116       61.6017         4.4000       0.992129       0.005142       -0.633672       0.999476       1.2030       0.44116       61.6017         4.4000       0.992129       0.003561       -0.633672       0.999476       1.2030       0.44126       65.8702         4.6000       0.992129       0.905561       -0.035569       0.099576	+4000         0.992577         0.002392         -1.624443           .4000         0.992492         0.002500         -1.42595           .4000         0.992492         0.002500         -1.42595           .4000         0.992271         0.002500         -1.42595           .4000         0.992165         0.002312         -1.425951           .2000         0.992165         0.003283         -0.63319           .2000         0.992165         0.003283         -0.63319           .2000         0.992165         0.003283         -0.63319           .2000         0.992129         0.003283         -0.63319           .2000         0.992166         0.003283         -0.63319           .2000         0.993268         0.004474         -0.235180           .0001         0.993434         0.005510         -0.0436569           .0001         0.993434         0.005570         -0.006764           .02999         0.05570         -0.000603         -0.000603	0°994292	0.9267	0-0704	37.5175
3.6000       0.9952472       0.003500       -1.425935       0.9952457       0.01338       43.5836         3.8000       0.992383       0.003264       -1.627935       0.9952467       0.01336       47.4095         4.0000       0.997265       0.002564       -1.625937       0.995324       0.99565       0.1336       47.4095         4.0000       0.997265       0.0023283       -0.6530537       0.995644       0.03376       56.6614         4.0000       0.992267       0.093278       0.995476       0.10425       0.3376       56.6614         4.0000       0.992268       0.000474       -0.633057       0.998476       1.0426       0.41607       61.6072         4.6000       0.992268       0.004474       -0.633180       0.998476       1.0426       0.41607       61.6072         4.6000       0.992268       0.004474       -0.633180       0.999479       1.0426       0.416072       61.6072         4.86000       0.993571       0.999497       1.0426       0.416072       61.6072       61.6072         5.0000       0.993577       0.999497       1.0426       0.416072       61.6072       63.5492         5.0000       0.993577       0.0035561       -0.635569	(600         0.992492         0.002500         -1.425935           (700)         0.992388         0.002664         -1.227447           (700)         0.992388         0.002501         -1.227447           (700)         0.992215         0.002383         -0.632537           (700)         0.9922165         0.003283         -0.6330537           (700)         0.9922165         0.003283         -0.633109           (400)         0.9922169         0.003489         -0.633109           (400)         0.9922129         0.004444         -0.633109           (400)         0.992268         0.004444         -0.6335180           (400)         0.992268         0.005561         -0.0355180           (400)         0.993444         0.005570         -0.235180           (5000         0.993572         0.005570         -0.036564           (2000         0.993572         0.005570         -0.006303           (7000         0.993560         0.005571         -0.000803	0+994763	0.9145	0•0966	40-3086
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4.000r       0.992271       0.002912       -1.026961       0.9965324       0.99666       0.23576       51.8058         4.2000       0.992185       0.003809       -0.633109       0.995377       0.99475       0.03376       56.6614         4.6000       0.992185       0.003809       -0.633109       0.997649       1.00426       0.44116       61.6017         4.6000       0.992187       0.003809       -0.633109       0.998476       1.2030       0.44116       61.6017         4.6000       0.992268       0.003809       -0.6336180       0.998476       1.2030       0.44116       61.6017         4.6000       0.992268       0.005142       -0.643672       0.999439       1.3892       0.4268       65.5349         5.0300       0.993434       0.005561       -0.235569       1.000514       1.4962       0.60545       68.5349         5.0399       0.993570       0.035550       1.000514       1.69027       0.60557       69.63549         5.0399       0.993560       1.000514       1.6006681       1.5377       0.0012       71.65809         5.0399       0.9993600       0.9993600       0.600571       -0.000603       1.00014       1.53379       0.0012       71.65809	000r         0.992271         0.002912         -1.026981           2000         0.992165         0.003283         -0.633037           2000         0.992165         0.003409         -0.633109           4000         0.992168         0.003409         -0.633109           6001         0.992268         0.004474         -0.433672           6001         0.993464         0.003561         -0.033589           7000         0.993434         0.005561         -0.035569           0299         0.993572         0.005570         -0.006764           03559         0.005570         -0.006764	0+995767	0.875	0-1656	47.4096
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Fig. 3: Velocity Charge of a Particle due to Interaction with a Sphere or Cylinder

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Fig. 4: Variation of Drag Coefficient for Cylinders.

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Fig. 5: Variation of Drag Coefficient for a Spherical Target.



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Fig. 7: Calculated Drag Coefficient for Cylinders due to Particles alone in an Inviscid Flow.



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