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INTAKE FLOW FIELDS FOR A ZOOPLANKTON
PUMP SAMPLING SYSTEM

by

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ABSTRACT

The flow fields entering intake forms oriented into a steady flume flow has been observed and quantified. This data is applied to a model of zooplankton sampler performance, to predict the fraction of the sampled fluid from which no animals will escape under conditions similar to those of the tests. Flume flow speeds (≈ 5 cm/s) and intake pumping rate (≈ 33 gal/min) are scaled by a factor of 20 in the model, while test form dimensions (4 and 7 inch throats and 12 inch outside diameters) are considered to be full-size for the prototype pump samplers. The data presented can be applied to other flow and geometrical scales.

The 'lethal cone' and critical fluid deformation rate envelopes are evaluated for eleven intake forms: pointed, bullet-shaped, funnel-shaped, rounded and square-ended. The sharply-pointed intake performed best, for tow speed ≈ 100 cm/s, swimming speed = 30 cm/s and $D_c = 1.0$ sec⁻¹. 'Sure capture' is predicted in 83% of the sampled water. The four funnel-shaped forms follow consecutively in a rank ordering, with efficiencies of 77% to 68%.

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List of Symbols and Notation

A_s	area of a spherical shell of radius s
A'_s	area of a spherical shell less that of a cylindrical hole
$\dot{D}$	fluid deformation rate
$\dot{D}_c$	critical $\dot{D}$
$\dot{D}_m$	mean $\dot{D}$
$\dot{D}_N$	normal component of $\dot{D}$
$\dot{D}_s$	shear component of $\dot{D}$
$\dot{D}_{s,0}$	initial shear deformation rate
$\dot{D}_{RR}$	radial fluid particle contraction/expansion rate
$\dot{D}_{xx}$	axial fluid particle contraction/expansion rate
F_G	geometrical scaling factor
F_Q	flow rate scaling factor
l	liter; as a subscript, lower half-plane
n	normally-oriented unit vector
P	prototype (subscript)
Q	volume flow rate
r	radial distance variable (normal to axis of symmetry)
R	radial coordinate value
R_b	radius of a cylindrical body
R_c	radius of the 'capture cylinder'

R_e	radial coordinate of the 'lethal cone'/ $\dot{D}_c$ contour intersection point
R_m	radius of sampler's mouth
R_s	radius of a spherical shell
	Reynolds number
s	second
T	test (subscript)
u	velocity component parallel to axis of symmetry; as a subscript, upper
u_c	corrected u
u_o	initial u
$\overline{u_o}$	mean value of u_o
u_R	relative u
U	vectorial velocity
U_e	animal's maximum escape velocity
$\overline{U_m}$	mean velocity in sampler's mouth
U_o	approach velocity of uniform streaming motion; tow velocity
U_o^*	the value of $U_o = Q / \pi R_b^2$
U_s	the point directed velocity on a spherical shell = $Q / 4\pi R_s^2$
U_t	the uniform velocity across a cylindrical throat section
v	velocity component normal to axis of symmetry
v_c	corrected v

v_o	initial v
v_R	relative v
x	axial distance variable
x	axial coordinate value
$\hat{x}_e$	axial coordinate of the 'lethal cone'/ $\dot{D}_c$ contour intersection point, relative to the entrance plane
$\hat{x}_L$	apex of the 'lethal cone', relative to the entrance plane
α	lethal cone's half-angle
θ	angle from axis of symmetry
θ_b	angle from axis of symmetry to body's surface
ν	kinematic viscosity of water
ψ	streamline identification number (stream function in potential flow)

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1. INTRODUCTION

1.1 STUDY OVERVIEW

This study is a theoretical and experimental approach which provides the basic concepts and data needed to develop an efficient pumping system for sampling zooplankton. Many zooplankters have the ability to sense sampling gear and avoid capture. This results in their being undersampled; density calculations are thus inaccurate. This bias is inherent to varying degree in all traditional zooplankton sampling gear. Its severity is also a function of the kind of species and developmental stage.

Avoidance has been thought to be more pronounced for pumps than for nets, particularly for the larger zooplankton. This is due to the combination of the pumps' much smaller sampling rates with intake designs and sampling strategies which cause an early forewarning of their presense. Thus the fundamental goal of a zooplankton pump design study is to minimize bias due to avoidance by assessing the influence of pump capacity, intake geometry (form and dimensions), and deployment on sampling performance.

This report presents the hydrodynamic and biological principles which govern zooplankton pump performance and experimental results of intake flow field observations. The flow fields surrounding twelve intake forms (throat diameters of 4 and 7 inches and outside diameter of 12

inches - see Figure 1) and two intake pipes were obtained in a flume. The pumping rate of ≈ 33 gal/min was not varied. The intake forms were oriented into the flow and observed through the flume's side glass wall (Figures 2 and 3). Flow visualization was accomplished by pulsed hydrogen bubbles generated on the vertical centerline plane, 6 to 10 inches in front of the intakes' entrance (Figure 4). The flow patterns were photographed and subsequently redrawn at 3:2 scale. Coordinates of the intersection points of the observed stream lines and the leading and trailing edges of the pulsed bubble 'slugs' were found, allowing the determination of velocity and fluid deformation rate components by finite differences. These values are scaled up to apply to other combinations of pumping rates, intake sizes and relative velocities.

The test conditions were chosen to duplicate the pump sampling strategy most likely to minimize avoidance: the superposition of a uniform streaming flow field with an intake whose axis of symmetry is aligned with the flow. This analysis represents both a fixed intake that is oriented into an oncoming flow and a forward-looking intake being pulled through a stationary body of water (such as an intake in the nose of a tow fish).

The other modes of intake operation, which were not experimentally studied, are: (1) the non-aligned superposition of a uniform flow with an intake; and (2) the

flow from a stationary field into a stationary intake, either free standing or bounded by a surface interface or additional structure. The former category includes such sampling strategies as a vertical intake in a horizontal flow (due to current and/or ship drift), and the towing of an intake oriented other than into the flow. In each of these cases one is confronted with either a lack of symmetry, thus presenting great difficulty in analysis and observation, or the practical difficulties arising from the nature of sink flows, i.e. very small velocities from great distances converge into a small area with large velocities. Their recurrent application in pump sampling studies justifies their inclusion in this analysis.

The technical literature review encompassed other intake systems: fish pumps, cooling water intakes, dredges, wells, aircraft engine nacelles and ducted propellers. Additional searching of the hydrodynamics and applied mathematics literature confirmed the difficulty in analyzing three-dimensional and stationary sink flows and the absence of directly applicable results. This effort has led, however, to: the formulation of intake flow principles; several relevant theoretical results (the simple two-dimensional intake, the point sink, and solutions for flows in axisymmetric contractions); and disclosure of the prior experimental evaluation of the flow field entering a simple stationary pipe intake (by Nikonerev, 1975). This

material is presented in Section 2 and Appendices A and B.

The experimental portion of this study is described in Section 3: intake designs, system operation, flow visualization, flow field data reduction, and results.

The most pertinent avoidance studies are briefly discussed in Section 4. Included is the 'Woods Hole Calanus Experiment' of Haury, Kenyon and Brooks (WHOI Contribution #4195, 1978), in which the common copepod C. finmarchicus was subjected to a simple (analytically describable) flow field and its escape reaction observed. A model of sampler performance, based on Barkley's 'lethal cone' (1964), follows. It is applied to the intake flow fields for comparative evaluations. It also provides the basis for a qualitative discussion of existing plankton pumps.

1.2 SCIENTIFIC JUSTIFICATION

Well-designed pumping systems are effective tools for ecological research in specialized applications. The sampling rate of even a large pump is much smaller than that of a small net towed at a moderate speed. Therefore, pumps are not very useful in waters of low zooplankton density, where long tows with large nets are required to get samples adequate for statistical analysis. Pumps are particularly suited, however, to neritic and coastal waters, where plankton densities and distributional heterogeneity (patchiness) are high. Because a pumping system can provide an essentially unlimited number of sequential samples on deck, small-scale distribution patterns can be resolved and visually observed nearly 'on-line'. The ability to fish the same system horizontally, vertically, obliquely or in the stationary mode further enhances this capability. The maneuverability and relatively small sampling rate is particularly useful in confined areas such as estuaries, near-shore waters, close to irregular topography, and in enclosures. An advantage of major significance to aquatic ecologists is a pump's capability of simultaneously sampling macro- and micro-zooplankton, phytoplankton and chemical constituents. Large pumping systems are also able to successfully catch larval fish (Leithiser, Erlich and Thum, 1979).

Pumps are not subject to clogging, a problem which reduces net filtration efficiency and possibly flow meter accuracy while increasing the net's forward disturbance. Filtration units used on deck to concentrate pump samples can be designed for large filtration areas and small velocities to minimize the possibility of extruding smaller forms through the meshes. Passage through the pump does not usually damage most forms.

The plankton pump literature presents little information on their design criteria, system details, mode of operation, or performance analysis. The correlation of experimentally-derived avoidance data with flow field characteristics has not been attempted for either pump or net sampling. Several studies (Barkley, 1972; Fleminger and Clutter, 1965; McGowan and Fraundorf, 1966; Murphy and Clutter, 1965) have compared experimental and inferred evidence of avoidance for different nets but without recourse to quantified fluid mechanics.

There are several factors which account for the absence of this particular analytical methodology. Historically, the development of new sampler designs is a combination of experience, intuition, and trial-and-error. Ultimately, many new samplers are compared with the existing 'standards' to evaluate their mechanical and biological performance. Sometimes the inclusion and satisfactory behavior of a desirable feature will overshadow the critical analysis of

another important component. Consequently, the system as a whole may be sub-optimal but accepted. Once accepted, its use is self-perpetuating as a matter of familiarity of operation and for the continuity and intercomparison of sampling program data. Often, if comparisons with a 'standard' are not obviously and systematically skewed, then avoidance is assumed to be negligible, when in fact the standard might inherently contain a significant bias. Such is the case for the Isaacs-Kidd Midwater Trawl. When catches of anchovy larvae by this large (10 ft. mouth) net towed at 75 cm/s were compared with a large (350 m³) plankton purse seine, the analysis suggested that 75 % or more of the larvae avoided the trawl (Barkley, 1972). However, the larvae's acute vision and maximum swimming speed far exceed that of zooplankton, so this sampler bias is probably much higher than that present in most plankton tows. A more detailed discussion of avoidance is deferred to Section 4.

The following is a brief overview of the major problems associated with zooplankton sampling and gear calibration, to further illuminate this study's advantages and limitations.

The most characteristic feature of zooplankton ecology is complexity. This term aptly describes the wide variety of physical characteristics, behavioral patterns, spatial and temporal distributions, and roles in ecological

relationships. In regards to sampling one should consider the large differences in sensory and swimming capabilities, characteristic avoidance maneuvers, and the possibility that group interactions affect avoidance. These parameters are not only species-specific, they are age-specific and also influenced by physiological and environmental conditions. Sampling gear performance is qualitatively evaluated by ability to catch the more motile forms. The different species of copepods (usually the numerically dominant group) vary in size and swimming capabilities, but as a group they are efficient avoiders. Sample counts of copepods are often the basis for gear intercomparison.

The greatest difficulty in assessing sampling efficiency is the pervasive existence of patchiness. This variability is particularly pronounced in in-shore and neritic regions. Large numbers of samples are needed to statistically characterize the biota and increase one's confidence in any subsequent conclusions. Even paired tows may be subject to substantial variance, masking the component of bias that is due to differences in sampler efficiency. Zooplankters which aggregate in dense swarms will be subject to even greater small-scale variability. Distributional heterogeneity is even more pronounced on the vertical scale.

In light of these difficulties and uncertainties, what can this study contribute to improving sampler performance?

The development of a comprehensive model of sampler performance is unlikely and unwarranted, owing to the wide variety of avoidance characteristics and interactions with environmental conditions. Quantitative information about avoidance behavior and the hydrodynamic characteristics of samplers is scarce and difficult to obtain. Statistical predictions of avoidance bias, even for a single species, must contain substantial allowance for variance and thus are of limited usefulness. Experimental verification would be a major project. Acknowledging these constraints, this study predicts the comparative efficiencies of various intake forms as zooplankton samplers, based on performance in a simple model.

The approach of this study is to apply a deterministic model of avoidance to the experimentally-quantified intake flow fields. The model incorporates a 'critical' fluid deformation rate ($\dot{D}_c$) envelope (to predict the location at which an animal will instigate an escape reaction as the tow fish/intake approaches) with a 'lethal cone' envelope (to predict the minimum volume from which any attempted escape will be unsuccessful). The radius at which the two envelopes intersect (R_e) can be thought of as an 'effective' mouth dimension. Figure 5 shows the geometry. The model predicts that there will be no avoidance from the volume with R_e . The degree of avoidance from sampled water outside of R_e is not predicted.

The proposed stimulus required to initiate the escape reaction (a mean fluid deformation rate ($\dot{D}_m$) of 1.0 sec^{-1}) is taken from the Calanus experiment of Haury, Kenyon and Brooks (1978). $\dot{D}_m$ is computed from the two fundamental fluid deformation rate components, shear ($\dot{D}_s = \frac{\partial u}{\partial r} + \frac{\partial v}{\partial x}$) and normal ($\dot{D}_n = \frac{\partial u}{\partial x} = \frac{1}{r} \frac{\partial}{\partial r}(vr)$) by:

$$\dot{D}_m = \sqrt{\dot{D}_n^2 + \dot{D}_s^2}.$$

The 'lethal cone' is due to Barkley (1964). See Section 4.2 for further details of the avoidance model.

1.3 LITERATURE REVIEW

The use of pumps to sample zooplankton has not been extensive. This review will chronicle the reports which identify major design features, sampling strategies and/or results of comparisons with nets. A critical analysis, within the context of design philosophy and avoidance, is forthcoming in Section 4.3. All comparative catch results represent sample counts normalized to the same volume sampled.

Gibbons and Fraser (1937) presented the first comparisons with nets. Given the uncertainty of predicting the net's actual filtration coefficient (in that day) and the pump's apparently equal ability to catch most species, they felt that the pump was a superior tool for quantitative sampling of the more abundant forms, including copepods. The 2 inch, 60 gal/min pump caught most macro-zooplankton forms in sufficient quantity and without damage.

The capabilities of a large pump was examined by Aron (1958). A 3 inch, 400 gal/min pump was compared to a half-meter net in fifty paired tows. The sample counts for fish eggs, copepods and other motile organisms were often quite varied, not only between stations but between the two samplers at the same station. This strongly suggests the existence of substantial patchiness on scales less than 7 meters, the net and intake separation distance. The pump outfished the net for copepods but many of the smaller

species may have been extruded through the towed net (due to large mesh and high tow speed). Twice as many Calanus were caught by the net.

O'Connell and Leong's (1963) design placed the pump and motor inside of a high-speed tow fish with a 3/4 inch orifice in the nose. The 24 gal/min system was not directly compared with a net, but they reported that copepods (including adult Calanus), euphausiids and chaetognaths were caught in sufficient numbers for precise density estimates. Counts of fragile organisms were biased by damage within the pump and hose, which had internal cables and fittings.

Beers, Stewart and Strickland (1967) also used a submersible pump. Flow rates of 40 gal/min were achieved from a depth of 100 m. The two inch horizontal intake was fin-stabilized and swivelled so that it would orient forward while under tow. In the collection unit water flowed through a series of three filters with decreasing mesh size (363- μ , 202- μ , and 103- μ) for size selection. This system was compared to two half-meter nets mounted adjacent to each other and having 103- μ and 363- μ mesh, respectively. Vertical tows from 100 m were inconclusive: in two sets of trials there was no consistent trend among the different groups and overall catches were similar; in a third set the pump caught about twice as many as the nets overall. The pump samples were characterized by the absence of

soft-bodied organisms and mutilation of other delicate forms, due to passing through the six-stage pump.

Lenz (1972) used a vacuum pump in order to minimize the risk of damage to delicate organisms. The typical pumping rate was only about 13 gal/min, producing a velocity of about 100 cm/sec in the 3.2 cm intake hose. The results of a simple suction experiment on Cyclops and Daphnia, along with the observation that highly motile forms such as euphausiids, mysids, chaetognaths and fish larvae were frequently caught by the pump, led him to conclude that an applied suction speed of about 100 cm/sec at the mouth of the hose is sufficient to sample at least copepods quantitatively.

Icanberry and Richardson (1973) were concerned with obtaining quantitative samples with minimized sampling mortality from cooling water intakes and discharges. Their solution was to place the filter upstream of the pump. Three 10-minute paired tows were conducted with a 30.5 cm net: the pump fished equally well for copepods and other motile organisms.

Following a set of comparisons with a net, an extensive pump sampling program was carried out within large plastic enclosures in the Controlled Ecosystem Pollution Experiment (CEPEX). Grice, et al. (1977) describes the pumping system and its tests. The system employed a 53 gal/min diaphragm pump. A 2-inch hose was lowered from the surface at the

rate of 3.2 m/min. Its output was filtered through 80- μ and 35- μ mesh nets. Vertical tows with a 20 cm modified Bongo net (202-) provided the comparisons. Small copepods were caught in roughly equal numbers, but the pump was less efficient than the net in catching Calanus.

The largest capacity pumping system to date (650 gal/min), was developed for collecting fish larvae within a cooling water intake (Leithiser, Ehrlich and Thum, 1979). Pump-collected samples were compared with ones obtained simultaneously with 1.0 m and 0.5 m nets fixed in the intake current of about 30 cm/sec. The data suggest that the pump and net sampled small larvae equally well, but larger larvae (over 5 mm) were more successful at avoiding the nets than the pump intake. The 1.0 m net consistently sampled more efficiently than did the smaller net. The condition of pump-caught larvae (all sizes) was similar to that of larvae in net samples, even though they passed through the pump prior to straining.

This literature shows that pumping systems have demonstrated their applicability and benefits as zooplankton samplers; but there has not yet been a study of the influence of design parameters on sampling efficiency. The literature also usually fails to provide complete information on their design, deployment and testing, necessitating considerable speculation in trying to account for differences in performance.

2. INTAKE FLOW FIELD THEORY

2.1 INTRODUCTION

The technical literature was investigated for mathematical models and solution techniques that could describe the flow field surrounding an intake. This problem is amenable to potential theory analysis, but comprehensive solutions have not been obtained (Apgar and Basco, 1973; Joynt, 1971; Levine, 1957; Muscat, 1937 pp. 429-436; Streeter, 1949; and Wheetman and Cromack, 1972). Potential flow principles are applied to three generic modes of intake operation (sampling strategies):

1. Stationary Intake/Stationary Field Mode (Figure 6), limited to the free-standing category (i.e. not a wall inlet or otherwise confined by surfaces).

2. Superimposed Uniform Streaming Motion Mode (Figure 7), considers the intake either fixed in a constant velocity uniform stream or translating through a stationary field. This designation is restricted to flows which are not aligned with the intake's axis of symmetry.

3. Tow Fish Mode (Figure 8), the special case of Mode 2: when the intake is oriented directly into a uniform stream or when a forward-looking intake is towed through a stationary field.

Intake forms considered in this analysis are limited to axisymmetric geometries (with the exception of the simple planar intake, for which an analytical solution is presented

in Appendix A). The most basic axisymmetric intake is a thin-walled and square-ended 'simple' pipe, hose or tube. It is desirable to investigate flows into thick-walled intake forms. These structures can be designed with a variety of internal and external contours, exemplified by the experimental forms pictures in Figure 1. Intakes are characterized by three geometrical parameters (Figure 9): the 'mouth' pertains to the entrance plane, having radius R_m to the leading edge; the 'throat' is the cylindrical core (radius R_t) of the annular intake 'body' (radius R_b). This analysis will consider the bodies to be semi-infinitely long cylinders.

Flow fields in Mode 2 intake operations are three-dimensional, but those in Modes 1 and 3 are axisymmetric, thus considerably more amenable to mathematical analysis. The tow fish mode of operation is emphasized in this section, in keeping with the experimental and sampling efficiency studies. An original model of this mode's 'far-field' flow characteristics is presented in Section 2.2.3. The 'near-field' preceeding a tow fish intake is modeled as an axisymmetric contraction, joining the 'sample cylinder' to the smaller cylindrical throat. Finite-difference potential flow solutions of this near-field zone were obtained for two purposes: (1) to evaluate the effects of the experimental intake's internal contraction on the entrance plane flow profile; and (2) to

provide an idealized model of two of the experimental flows (for intakes 7PT and 4Fl), for comparison. Figure 10 shows the geometries considered in these three cases. The contraction model is presented in Appendix B. The results are applied in the discussion of the experimental flow fields, in Section 3.4.

Mode 1 intake operation is represented by its most basic model, the point sink. This is qualitatively compared (in Section 2.2.1) to the simple pipe intake flow field, reproduced from Nikonerev (1975) as Figure 11. The simple planar intake (Figure 12) is also a Mode 1 flow.

This section concludes with an analysis of scaling parameters. These principles allow the experimental results to be applied to other specific combinations of intake size, pump flow rate and tow speed (or speed of approach) for geometrically-similar forms.

2.2 INTAKE FLOW PRINCIPLES

Flow is induced into an intake (at rate Q) by the existence of a relative low pressure at its mouth, due to the mechanical activity of a downstream pump or the gravitational potential of a siphon. The velocity profile at the mouth is invariably non-uniform; it can be characterized by a mean velocity $\overline{U}_m$, given by:

$$\overline{U}_m = Q/\pi R_M^2.$$

The flow field surrounding an intake can be thought of as differentiated into a 'near-field' and a 'far-field' region. Flow patterns in the near-field are strongly dependent on intake geometry, but the nature of the far-field flow is independent of geometry, as established by potential theory. Prior to discussing characteristics of the three modes, it is appropriate to discuss the applicability of potential theory and the phenomenon of separated flow, which is an undesirable trait for pump samplers.

Potential theory applies to flows which are inviscid, incompressible and irrotational. For the intake sizes and velocities considered, the Reynolds Number is very much greater than one (see calculations in Section 2.3). Therefore, inertia forces substantially dominate viscous forces in the main body of the fluid and the flow is essentially inviscid. The compressibility of water is negligible for the flow conditions considered in this study.

Satisfaction of the irrotationality criteria follows from application of Stokes' and Kelvin's Theorems. In idealized flow conditions the fluid particles are irrotational at great distance from the intake, and so they remain as they approach the sampler. In actual flow conditions small-scale turbulence (eddies) might exist, locally altering the steady flow pattern predicted by potential analysis.

The separation of the boundary layer from the wall contour invalidates the potential flow solution downstream from the point of separation. It will occur if the wall has a sudden change in contour or if there is an increasing pressure along the wall in the direction of the flow, associated with a decreasing free-stream velocity (deceleration). On the other hand, an accelerating flow stabilizes the boundary layer, provided that body contours do not radically change.

Separation is of significant concern for intakes that are used as samplers. Fluid in the separated flow region is not strongly or quickly interchanged with the free-stream flow, causing substantial smear of a sample (the time-delayed arrival at the receiving station of sample constituents originating in the same parcel of water). Separation may also cause wall pressure fluctuations, leading to structural vibration, and thus possibly alert mobile organisms of the sampler's presence prior to their capture.

The most likely separation point is obviously near the leading edge but the likelihood varies with sampling strategy for any particular design. Thick annular intakes with well-rounded mouths certainly minimize the possibility in all modes, but they may increase avoidance due to greater fluid deformations. Sharp-edged openings will cause separation in the stationary intake/stationary field strategy, but they can minimize pre-entrance fluid deformation in the tow fish mode. Non-aligned superimposed streaming motion strategies are likely to produce separation along some portion of the leading edge and certainly so downstream of the withdrawal structure or pipe, if proper streamlining is neglected.

2.2.1 Stationary Intake/Stationary Field Mode

This is the fundamental mode of operation, from which others are constructed by superposition of a uniform streaming motion. The far-field flow is that due to a point sink (Batchelor, p. 177). For the point sink singularity flow is radially directed to a point, with velocity U_s equally distributed on a spherical shell of radius R_s from the hypothetical points at which it is annihilated. The shell has a surface area $A_s = 4\pi R_s^2$, so continuity requires $U_s = Q/4\pi R_s^2$. To apply this far-field model to an actual intake one must consider that the withdrawal pipe penetrates this imaginary far-field shell, and thus slightly

reduces its mouth area (to A_s') while slightly increasing its velocity (to U_s'). This geometry is illustrated in Figure 6. Analogously, the simple planar intake's analytical solution is based on planar source flow in the far-field.

The near-field flow diverges from the point sink's radial symmetry. Figure 11 shows the exterior field for a simple pipe intake. The existence of a 'vena contracta' inside of a sharp-edged intake is well known. The separated flow region occupies one-half of the cross-sectional area at its maximum thickness. This separation causes the external flow streamlines to bunch into the core region, with corresponding higher velocities and fluid deformation rates in this region.

Hamilton (1929) studied the flow into inlets flush in a wall of a tank. He concluded that separation will be avoided if the inlet's radius of curvature is at least 0.14 that of the withdrawal pipe's diameter. Free-standing intakes probably require a larger internal radius to avoid separation, but no values were found in the literature.

2.2.2 Superimposed Uniform Streaming Motion Mode

The additional presence of a uniform streaming motion (U_0) in the external field, either aligned or unaligned with the intake's axis of symmetry, distinctly changes the flow field's character. The resulting field velocities are

the vectorial sum of U_0 and that due to an intake in still fluid. No longer does the 'sample zone' (the volume which ultimately enters the intake) incorporate the entire spherical domain; it now originates in the direction of the streaming flow as a cylinder of radius $R_c = (Q/\pi U_0)^{1/2}$, as determined by continuity and the potential flow 'half body' due to a point source in a uniform stream. The bounding streamlines of this 'sample cylinder' enclose all of water which ultimately will enter the intake. Fluid particles outside of the sample zone are deflected and deformed by the intake's presence, but they are eventually convected downstream. Figure 7 illustrates these sample zone properties.

The sample zone's near-field geometry is three-dimensional because the intake is not aligned with the flow. A bounding streamline is normal to the intake's surface at the point of contact (stagnation point). The flow immediately inside the bounding streamline (called 'peripheral fluid') is typically characterized by low velocities, long residence times and large deformations, particularly near the stagnation points.

2.2.3 Tow Fish Mode

Potential theory predicts that the far-field disturbance due to a steadily translating solid body is that of a doublet (Batchelor, p. 116). Fluid would be pushed away

from the forebody and drawn in towards the aftbody as it passes by a stationary observer. This model assumes that the flow around the body does not separate. In practice separation usually does occur near the point of maximum thickness, leaving a broad wake of back-flow, eddies and turbulence.

Batchelor proposed an alternative model to account for the wake's existence (p. 350). The time-averaged velocity profile across the wake shows a velocity defect (i.e. velocities less than U_0) and nearly parallel streamlines. Relative to the moving body, the wake appears as an influx from a cylindrical region centered on the body's axis. This influx is balanced by a 'source-like' flow, appearing (to a far-field observer) as if it originates within the body.

I have modeled tow fish intake behavior from the far-field perspective by combining Batchelor's 'wake/source' model with the point sink from Mode 1 analysis.

Figure 6 shows the geometrical relationships referenced to in this analysis. The spherical shell forming the outer boundary (at distance R_s) is penetrated by the semi-infinitely long annular intake body, of external radius R_b . The shell/body intersection point occurs at angle θ_b to the central axis. Since the shell is much larger than the body, θ_b is small and can be approximated by: $\theta_b \approx \sin \theta_b = R_b / R_s$.

The proper velocity representation on this outer 'boundary' is the vector sum of U_0 (parallel to the axis) and a radially-oriented velocity U_r , of different magnitude than the sink velocity U_s in the Mode 1 analysis (when $U_0 = 0$). Inward-directed velocities and fluxes will be designated as positive values.

Continuity requires that the influx through the closed boundary equal the outflux: $\oint U \cdot n \, dS = 0$. There is no flux through the body's walls. The flux through its interior is $-Q = \pi R_t^2 U_t$. The flux through the shell, which has surface area A_s' , is given by:

$$\begin{aligned} Q &= \int_{\theta_b}^{\pi} (U_r - U_0 \cos \theta) 2\pi R_s^2 \sin \theta \, d\theta \\ &= 2\pi R_s^2 \left[U_r \int_{\theta_b}^{\pi} \sin \theta \, d\theta - U_0 \int_{\theta_b}^{\pi} \cos \theta \sin \theta \, d\theta \right] \\ &= 2\pi R_s^2 \left[U_r (1 + \cos \theta_b) + U_0 \left(\frac{1}{2} \right) (\sin^2 \theta_b) \right] \\ &= A_s' U_r + \pi R_b^2 U_0 \end{aligned}$$

where $A_s' = 2\pi R_s^2 (1 + \cos \theta_b) \approx 2\pi R_s^2 (1 + \sqrt{1 - (R_b^2/R_s^2)})$

Thus the boundary flux relationship is:

$$A_s' U_r + \pi R_b^2 U_0 = \pi R_t^2 U_t = Q$$

This equation applies to the entire range of tow fish intake operations. When the intake is stationary ($U_0 = 0$) it predicts the corrected point sink flow $U_s' = Q/A_s'$, as before. As U_0 is increased from zero to the value

$U_o = U_o^* = Q/\pi R_b^2$, the sink flow decreases from Q/A_s' to zero. For the special case of $U_o = U_o^*$, the intake withdraws all of the fluid that a solid body's motion would otherwise displace; as a result, there is no far-field effect. For values of U_o which exceed U_o^* , U_r is negative, representing a net source-like contribution from the combined withdrawal and motion. When U_o is either less or greater than U_o^* the resulting sink/source strength is proportional to $|U_o - U_o^*|$.

Sample zone geometry also systematically changes as a function of U_o . The far-field's sample cylinder radius (R_c) can be compared with the mouth opening (R_m) by the continuity relationship $Q = \pi R_c^2 U_o = \pi R_m^2 \bar{U}_m$. When U_o is of similar value to $\bar{U}_m$, then the sample zone acquires the near-field form of a contoured transition section (contraction of diffuser) between the upstream pipe-like sample cylinder and the downstream throat section. Such flows have non-uniform velocity profiles in the transition section and extending for some distance in both directions. For the case in which U_o is much smaller than $\bar{U}_m$, the radial velocity components are relatively much stronger, and the near-field assumes more of a sink-like character. The sample cylinder incorporates a larger area than the mouth. On the other hand, when U_o exceeds $\bar{U}_m$, then some fluid in the tow fish's path is

rejected ($R_c < R_m$). (Such is the case with a simple plankton net.)

In a strict interpretation, the far-field sample zone is never truly of cylindrical shape because the sink's influence extends to infinity, but for all practical purposes U_r is very small with respect to U_o at great distances from the intake. It must be considered in continuity arguments, however, because the surface area over which this small velocity acts is very large, thus their product is not negligible.

Nikonerev's drawing of the simple pipe intake flow field was used to establish the near-field geometry of the sample zone's bounding streamline for two cases in which U_o was much smaller than $\bar{U}_m$ (114 cm/s):

Case I: $U_o = 10$ cm/s (Figure 11b), for which $R_c = 5.1$ cm, 3.4 times larger than $R_m (= 1.5$ cm).

Case II: $U_o = 20$ cm/s (Figure 11c), for which $R_c = 3.6$ cm = $2.4 R_m$.

The bounding streamline was graphically constructed by establishing its initial far-field position at R_c , and then vectorially adding U_o and the velocity due to the intake in a stationary field, to establish the direction of tangency for the bounding streamline as it approaches the intake. By assuming a slight curvature over a short distance, another point on the streamline is established, and the vectorial addition procedure is repeated. The

streamline path can be constructed with reasonable accuracy by this step-wise procedure, given the poor resolution of Nikonerev's drawing. In both cases the path conformed to expectation, confirming the validity of the superposition technique and the sample zone analysis previously described.

2.3 SCALING ANALYSIS

Pump intake flows are amenable to a simple scaling relationship for comparing the empirical flow fields to those for other values of Q , U_o and intake size.

Attention is restricted to the Tow Fish Mode.

The appropriate scaling relationship is that of geometrical similarity. For a given set of values $[U_o, Q]$ and intake form characterized by R_b, R_m and R_t , there exist other sets of $[U_o, Q, R_b, R_m, R_t]_2$ for geometrically-similar intake forms such that the flow field in set 2 conditions can be predicted from set 1 values for geometrically-similar locations. Other flow field parameters of interest are: $R_c = \sqrt{Q/\pi U_o}$; $\bar{U}_m = Q/\pi R_m^2$ and $U_t = Q/\pi R_t^2$. Geometrical similarities are illustrated by reference to the photographic reduction technique. When the negatives are projected at any geometrical scale (F_G) all dimensions and points increase proportionally ($L_2 = F_G L_1$) while retaining the same relative size and position. Velocities represented by lengths increase by the same linear factor ($U_2 = F_G U_1$), while the pumping rate increases by F_G^3 : $Q_2 = \pi (R_c^2)_2 (U_o)_2 = F_G^3 Q_1$. Deformation rates scale as U/L , so when $U_2 = F_G U_1$, and $L_2 = F_G L_1$: $D_2 \propto U_2/L_2 = U_1/L_1$.

A different scale factor (F_Q) can be applied to the velocity field (and thus the pumping rate also) for invariant intake sizes. The proper scaling relationship for

this condition is:

$$\left(\frac{U_o}{U_t}\right)_1 = \left(\frac{U_o}{U_t}\right)_2 \quad \text{OR,} \quad \frac{(U_o)_1}{(U_o)_2} = \frac{(U_t)_1}{(U_t)_2}$$

U_o must increase to $(U_o)_2 = F_Q(U_o)_1$ if U_t is increased to $(U_t)_2 = F_Q(U_t)_1$ (due to an increase in pumping rate $Q_2 = F_Q Q_1$), in order to maintain the same flow field relationships (i.e. sample zone geometry). The velocity at every point in the field is multiplied by F_Q . Deformation rates are also multiplied by F_Q , since the spatial scale is unchanged.

Flow rate scaling of $F_Q = 20$ was done for the experimental intakes, following reinstatement of the observed flow conditions (division of the computed values by 1.5, to account for the scale of the projected photographic negative). As a result of the scaling, the mean flume flow speed ($\bar{u}_o$) is increased from ≈ 5.0 to ≈ 100.0 cm/s; Q is increased from 33 gal/min to 660 gal/min; and all computed deformation rates are multiplied by 20: specifically, $\dot{D}_m = .05 \text{ sec}^{-1}$ becomes $= 1.0 \text{ sec}^{-1}$. It is possible to apply other scaling factors to the flow field computations so as to study other tow speeds/pumping rates (the two cannot be separated with this scaling). For example, if $F_Q = 10$: $\bar{u}_o \approx 50$ cm/s; $Q = 330$ gal/min and $\dot{D}_m = .10 \text{ sec}^{-1}$ becomes $\dot{D}_c = 1.0 \text{ sec}^{-1}$.

The third type of geometric scaling incorporates the other two. It allows different scale factors to be applied

to the intake and flow field geometry (F_G) than is applied to the tow speed/pumping rate (F_Q). The overall effect on the flow field velocities is the product ($F_G F_Q$), while deformation rates are scaled by F_Q . This formally states the process by which the photographs were analyzed. The drawings are reduced in scale to full-size by $F_G=2/3$, then $F_Q=20$ is applied to velocities, deformation rates and flow rate. This composite scaling method can be applied to the computed data to determine flow conditions for other values of U_0 and intake size than was studied. For instance, the flow into a half-scale model of one of the intakes at $\bar{U}_0 \approx 50$ cm/s would require $F_G=1/3$ and $F_Q=20$ for application to the flow field computer print-outs.

Model testing of fully-submerged forms typically is based on the requirement that the Reynolds number ($Re = UL/\nu$) of the test conditions equal that in for the prototype's. In this case Re can be characterized by the flow through the form's throat: $Re = (2U_t R_t / \nu) = (2Q / \pi R_t \nu)$.

It is desirable to scale the pumping rates by a factor of 20 from what was achieved in the test: $Q_p = 20 Q_t$.

If $Re_p = Re_T$ is to be achieved, then $(R_t)_T$ must equal $.05 (R_t)_P$. This requirement cannot practically be met. For instance if the prototype's throat is to be 7 inches in diameter and $Q_p=660$ gal/min, then exact Reynolds number scaling would require that $(R_t)_T=0.44$ cm while

$(U_t)_T = 3423$ cm/s. For employment of the test pump having $Q_T = 33$ gal/min such values are clearly impractical.

Scaling on the principle of geometrical similarity of flow field velocities and dimensions (i.e. by F_G and F_Q) has led to an inequality of Reynolds numbers, such that:

$$(Re)_T = 3.34 \times 10^4$$

$$(Re)_P = 6.68 \times 10^5$$

For the 7 in. forms, or $(Re)_P = 20(Re)_T$. I contend that this difference will not prohibit application of the test results to the full-scale prototype. In both cases the main body of the fluid is essentially inviscid. The boundary layer formed at the intake's surface may have a very slightly different character (under idealized conditions), but this does not affect the 'upstream' observations. The same conclusion would apply to other choices of scaling factors F_G and F_Q which might practically be considered.

3. EXPERIMENTAL STUDY

The flow into 12 intake forms oriented into a uniform streamline motion (tow fish mode) has been observed and quantified. Section 3.1 summarizes this study, while further discussion of the experimental and data reduction methods is presented in Sections 3.2 and 3.3, respectively. The flow field results are discussed in Section 3.4. The complete computer-generated results are presented in Appendix C.

3.1 METHODS SUMMARY

The experimentally-derived flow field descriptions are clearly the most significant aspect of this study. Such results are not available elsewhere, to the best of my knowledge. Although the empirical values are subject to some uncertainty and inaccuracy, the successful integration of the experimental forms with the flume's characteristics, flow visualization technique and data reduction methodology establishes the foundation for accepting the basic validity of these results. In a few cases the lack of such coordination strongly suggests that application of the analysis technique would be inappropriate, and so it was not attempted. In particular, where the fluid deformation is severe or the flow very slow, the bubbles lose their identity with a given parcel of water. Additionally, curved paths are misrepresented by linear differences of end point

values. Thus no quantitative evaluation was attempted for flow into some of the intakes.

The hydrogen bubble technique was chosen to provide a whole-field visual representation of fluid deformation that could be accurately quantified and provide fine spatial resolution. Streamlines were identified by alternating 2 cm insulated with 1 cm non-insulated lengths of the platinum wire from which the bubbles are formed. Switching the electrical current on and off identified timelines in the streaming flow. The result is a spatial 'array' of rectangular bubble 'slugs' (Figure 4). The location of their corners establishes the velocity field. Adequate optical density and contrast were attained without recourse to the high voltages which produce large, fast-rising bubbles.

The flume's speed (≈ 5 cm/s) and size (4 ft x 4 ft cross-section), coupled with the flow rate of the borrowed centrifugal 'test' pump (≈ 33 gal/min,) suggested intake forms on the order of 1 ft diameter in order to achieve $\bar{U}_m \approx U_o$. At this scale the forms are large enough to give the desired spatial resolution of the flow field. This size intake can also serve as a full-scale prototype for an actual sampler. Indeed, the experimentally-determined mean deformation rate of $\dot{D}_m = 0.05 \text{ sec}^{-1}$ is multiplied by 20 to establish the critical deformation rate contour of

1.0 sec^{-1} for a system in which $U_o \approx 100 \text{ cm/s}$ and $Q \approx 660 \text{ gal/min} \approx 40 \text{ l/s}$.

Wood forms were turned to 12 inches in outside diameter and either 4 or 7 inches in internal (throat) diameter. A variety of thick-walled shapes were created in order to establish a variety of flow field characteristics. The forms are categorized as pointed (7PT); fully rounded (4R and 7R); having a tow fish nose-shaped exterior contour (4N, 7N1 and 7N2); having a funnel-shaped internal geometry (4F1, 4F2, 7F1 and 7F2); and having a square-ended face (4S and 7S). The designations 1 and 2 refer to the radii of curvature of 1 and 1/2 inch, respectively, for the mouth of the nose-shaped forms and the external shoulder of the funnel-shaped forms. Pipe intakes of 4 and 1-1/2 inch diameter were also tested. The entire group of experimental forms is shown in Figure 1.

The flume was employed over the periods of June 6-11 and July 17 to August 18, 1978. Flow steadiness in the flume, water clarity and conductance, bubble quality, lighting, and photographic technique all required considerable manipulation and coordination to achieve good results. Figure 4 is one of the better examples of the results achieved with the hydrogen bubble technique. The features which affect the interpretation of the photographs are evident in Figure 4. These are the bubbles' buoyancy and gradual dissolution into the water, poor bubble visibility

far away from the lights, and the flume's properties of local unsteadiness and a higher velocity near the top than that near the bottom (the 'flume shear').

During the course of the experiments the pumping rate and bubble generator's period were unchanged. Small changes in the flume speed resulted from slightly different water levels, since the water was changed or partially replaced many times in attempts to improve the flow and observation conditions. For this same reason each intake form was photographed on two or more occasions.

The negatives were mounted as slides and projected onto posterboard, with magnification giving 4.5 cm spacing of the insulated sections of the bubble generator wire (3:2 scale). Based on this scaling, all computed velocities are 150% of the observed value (pulsing cycle time is unchanged), while the deformation rates are equivalent to the unscaled values. The edges of the bubble 'slugs' of the best 3 to 6 photographs for each form were copied onto the posterboard with colored pencils. Velum was overlayed and a composite picture drawn from my judgement of the colored lines' validity in a particular area of the field. Flume unsteadiness often 'contaminated' portions of the observed flow field. Intermediate streamlines bisecting the 2 cm wide bubbles were drawn to provide approximately square slugs, for improved spatial resolution.

The coordinates of the intersections of the streamlines ($I = 1$ on top to NI on bottom) with the time-markers ($J = 1$ closest to the wire, increasing to a final value of $\leq NJ$) were obtained with a Bendix Digitizer. Initial velocity computations showed that subtle discrepancies in timeline and streamline position for adjacent and near-by points substantially reduced the degree of internal consistency, even with the application of an averaging formula. The deformation rate calculations with the 'raw' data were completely inconsistent and usually unrealistic. A fine-scale readjustment of isolated anomalous coordinate values was done manually, in two iterations, for all drawings: for timelines .010 inch typical, .030 max; for streamlines .005 inch typical, .010 max. A timeline readjustment of .010 inch is equivalent to a velocity alteration of about .13 cm/s. The rise rate and flume shear characteristics prevent an exact readjustment that would satisfy the conditions of continuity and irrotationality.

3.2 EXPERIMENTAL METHOD

Arrangement of the experiment system is shown in Figures 2 and 3. The intake forms were connected to the 1-1/4 inch pump intake hose by an assembly with two other wood forms. The base section is a contraction from 4 inches to the hose fitting. There are two interchangeable intermediate sections, one having a straight 4 inch bore, and the other flaring to a 7 inch internal diameter before achieving a cylindrical section. This bolted assembly was supported by a cross-bar connected to a hoist assembly. Pitch was controlled by a rear support rod. The test pump, located alongside the flume, discharged into the flume's rear well. Hydrogen bubbles were formed on the vertical centerline plane from 6 to 10 inches in front of the intake. The platinum wire and a larger cathode wire were mounted to a movable wood framework. The leads were connected to a 0-300 V.D.C. power supply through the pulsing and polarity-reversing circuit. The bubbles were illuminated from above by a shuttered flood lamp and a small strobe, and photographed against a black backdrop through the flume's glass side walls.

The hydrogen bubble technique employed the pulsing and polarity-reversing circuit described by Schraub, et al. (1965). The relay's electronic activation/timing circuit is original to this project. The complete electrical circuit is diagrammed in Figure 13.

The timing circuit consists of two RCA 4047 integrated circuits (multivibrators) which produce a square-wave output signal in which both the period and duty cycle are adjustable, by varying R_1 and R_2 , respectively. The period was maintained at 0.40 sec throughout the experiments but the duty cycle was varied from 40 to 50% for the 'on' time.

This signal is amplified to 20 ma to activate the coil of the Potter and Brumfield mercury-wetted contact relay (#JMI-112-11). The power supply charges C_3 as the relay connection is made, preventing a transient current 'spike' and thus large bubbles at the leading edge of the time line. Current flows through the water (a weak electrolyte) between the two electrode wires, electrolyzing it into its elemental constituents: H_2 at the anode and O_2 at the cathode. At the removal of the signal the relay disconnects the power supply and C_3 discharges through the water and R_4 . Typical component and operating values were:

$$R_3 = 35\Omega; R_4 = 20\Omega; C_3 = 20 \text{ uf}$$

$$V_s = 130V \text{ (set)}; I_s = .30A \text{ (measured)}.$$

In normal operation the .002 inch platinum wire was the anode and an equal length (32 to 38 cm) of Solder Wick served as the cathode. Solder Wick was chosen for its large surface area (to prevent the shedding of O_2 bubbles) and its angular shape, which was oriented edgewise to the flow to minimize the downstream flow disturbance, i.e. vortex

shedding. In order to minimize the voltage required to produce a given current (and bubble generation rate), the two electrodes were separated by only 3 inches at the top and 2-1/2 inches at the bottom. This tapering promoted equal bubble production rates along the entire length of the wire. The polarity-reversing switch allowed electrically-deposited impurities to be removed periodically.

The slenderness of the long platinum wire necessitated constant attention to its integrity. A folding cardboard mask was made with 1 cm apertures every 2 cm, to allow careful application of a thin coat of enamel nail polish for insulation. The connection with the lead wire was soldered and coated with Liquid Tape and carefully taped in place to the top bar of the wire support framework. The other end was bonded to a short thread loop that engaged a stiff hooked wire, capable of extending 1/4 inch by turning a thumbwheel. This allowed wire tension to be adjusted.

The overall quality of the experimental procedure depended on the factors of bubble quality, photographic quality and conformance of the observed flow to steady state and axisymmetric conditions. Bubble and photographic quality parameters included wire preparation, circuit tuning, optical density (edge visibility), water clarity, illumination, photographic distortion (parallax), and negative contrast and density. Flow parameters are flume

steadiness, flume shear, bubble buoyancy, and wire/intake/flume alignment.

Water quality was a persistent concern, influencing many of the above parameters. The town water supply in summer contained substantial density of particulate matter, reducing its clarity and partially clogging the screens placed at the front and rear of the flume. This increased the scale of eddies (and thus their persistence) and contributed to the higher velocity near the top. The addition of CuSO_4 or HCl after several refillings (to increase water conductivity for small bubble production) caused white deposits (carbonates) to form on the screens. Good experimental conditions required: (1) the particulates to have settled on the flume's bottom; (2) clean screens; and (3) operation of the flume's pump for more than several hours to establish as uniform a flow as the flume design allows.

In the beginning of the flow stabilization period the intake/crossbar assembly was pulled down to mid-depth and the test pump primed and started. The crossbar hoisting lines and rear control rod were used to align the intake directly into the flow. The platinum wire was aligned to the vertical centerline plane by shimming and clamping its support framework to the rails.

Proper horizontal and vertical alignment was established by sightings against two reference systems: a wire grid on

the black backdrop, and a wire on the flume bottom that was vertically aligned with one above the flume, oriented parallel to the flume's axis. Transit sightings through the glass wall established horizontal alignment, while the vertical centerline plane was found by aligning a plumb bob suspended from the upper wire with the floor wire.

The bubble pattern was photographed on both Plus-X and Tri-X film using a 35-mm SLR camera with 50 mm and 100 mm lenses. The shutter cable release also triggered a strobe to supplement a 250-W studio lamp. The light from both sources was focused with shutters on the plane of bubbles, from opposite sides of the centerline plane. Occasionally a smaller light was projected through the glass wall, to better illuminate the lower bubbles. All incident surfaces were sprayed flat black to eliminate reflected light. Photographs were taken at several values of power supply voltage and shutter speeds ($1/30$ th and $1/60$ th sec). The focusing distance was ≈ 3 feet with the 50 mm lens and ≈ 6 feet with the 2x teleconverter attached. Several shots were usually made of both non-pulsed streamlines and streamlines broken by only a few timelines. Usually a 20 exposure roll was shot for each intake.

The procedure for obtaining the photographs was as follows: once proper alignment and fully-developed flow was established, the bubble production was alternated between the normal and reverse polarity modes for 2-3 minutes each.

After the platinum wire had just been cleaned the bubbles were barely visible. In about a minute they were still small ('wispy') but much more dense. Within another minute the bubbles were increasing in size (and rise rate), obscuring delineation of the streamlines and timelines. Soon thereafter the polarity would be reversed. During the 30-90 second 'window' the flow was observed for the presence of transient conditions in the bubble pattern. The advection of small eddies through the field would take about 5 seconds, while the larger scale irregularities would persist for about 10-15 seconds. If the flow was steady at the same time that bubble quality was good, a photograph would be taken. Such conditions occurred about 10% of the cycle time.

3.3 DATA REDUCTION METHOD

The main features of the picture-to-number translation process were described in Section 4.1. This section will present the numerical methods that result in the velocity and deformation rate computations presented in Appendix C.

The on-off period was set at 0.40 sec, but the duty cycle was computed from the drawings (for the first two cycles of the central streamlines). The odd-numbered timelines represent the trailing edge of the bubbles in all drawings, and Δt_{on} is always less than Δt_{off} . Since $\bar{U}_0 \approx 5$ cm/s, the timelines were roughly 1 cm apart near the wire.

Velocities are computed by forward differencing:

$$u(I,J) = [X(I,J+1) - X(I,J)] / \Delta t_{on,off}$$

$$v(I,J) = [R(I,J+1) - R(I,J)] / \Delta t_{on,off}$$

Note that streamlines are designated as 'I's' (dictated by the computer's format for entering matrices from consecutive points along streamlines), whereas for the contraction study the streamlines are 'J' numbered (Broadway's notation).

Since these basic velocity component computations are subject to small-scale uncertainties in the timeline placement, it is appropriate to apply an averaging formula based on the values of the eight nearest neighbors: on streamlines (I-1), I and (I+1) and timelines (J-1), J and (J+1). Based on an evaluation of computations from five

perspective 5- and 9-point equations for the near-entrance core region points of intake 7N1, it was determined that the following equation for the 'corrected' velocities (u_c and v_c) gave the most consistent and reasonable values:

$$u_c(I,J) = 1/14 \left[4u(I,J) + 2u(I,J-1) + 2u(I,J+1) \right. \\ \left. + u(I-1,J-1) + u(I-1,J) + u(I-1,J+1) \right. \\ \left. + u(I+1,J-1) + u(I+1,J) + u(I+1,J+1) \right]$$

Observe that the corrected value is center-weighted, favors its streamline neighbors, and also considers values from the six upper and lower streamline points as a moderating influence. The corresponding equation for v_c is obvious.

Four other velocity components are computed: the undisturbed flume speed $u_o(I)$, the initial rise rate $v_o(I)$ and the 'relative' velocities (u_R and v_R), defined as:

$$u_R(I,J) = u_c(I,J) - u_o(I)$$

$$v_R(I,J) = v_c(I,J) - v_o(I)$$

Subtraction of u_o and v_o gives the axial and radial components, respectively, due to the intake's influence. Unfortunately, when v_o is subtracted from points along the observed streamlines these points no longer can be considered to be on the same actual streamline, and construction of the exact streamlines is not possible from the vectorial velocities $U_R(I,J)$.

The careful evaluation of photographs and use of dividers, a sharp pencil, and judgement based on

consideration of simple flow principles generally prevented serious large-scale discrepancies, such as diverging streamlines in an accelerating region, or an apparent acceleration followed by a deceleration in order to make up for the previous (unwarranted) large timeline spacings. The fine-scale coordinate adjustments and employment of the velocity correction equation were necessary to achieve a fine sensitivity and internal consistency in the deformation rate evaluations. This goal is particularly compelling at moderate distances from the intake, where the $\dot{D}_m = 0.05 \text{ sec}^{-1}$ contour is to be found. Such a deformation rate value represents an approximate spatial difference in velocities of only .05 cm/s per cm.

As with the contraction study calculations, the photo-reduced deformation rate components are found by centered differences:

$$\dot{D}_{xx}(I,J) = 1/2 \left\{ \left[u_c(I,J+1) - u_c(I,J) \right] / \left[X(I,J+1) - X(I,J) \right] + \left[u_c(I,J) - u_c(I,J-1) \right] / \left[X(I,J) - X(I,J-1) \right] \right\}$$

$$\dot{D}_{RR}(I,J) = 1/(2R(I,J)) \left\{ \left[R(I-1,J)v_R(I-1,J) - R(I,J)v_R(I,J) \right] / \left[R(I-1,J) - R(I,J) \right] + \left[R(I,J)v_R(I+1,J) - R(I+1,J)v_R(I+1,J) \right] / \left[R(I,J) - R(I+1,J) \right] \right\}$$

$$\begin{aligned} \dot{D}_S(I,J) = 1/2 \{ & [v_C(I,J+1) - v_C(I,J)] / [X(I,J+1) - X(I,J)] \\ & + [v_C(I,J) - v_C(I,J-1)] / [X(I,J) - X(I,J-1)] \\ & + [u_C(I-1,J) - u_C(I,J)] / [R(I-1,J) - R(I,J)] \\ & + [u_C(I,J) - u_C(I+1,J)] / [R(I,J) - R(I+1,J)] \\ & - \dot{D}_{S,O}(I) \end{aligned}$$

The use of v_R is required in the product differences $\Delta(rv)$ for $\dot{D}_{RR}$. In the shear rate calculations the existence of flume shear is accounted for by subtracting its value from $(\Delta u_C / \Delta R + \Delta v_C / \Delta X)$ for all points along a streamline.

The same results are achieved by calculating $(\Delta u_R / \Delta R + \Delta v_R / \Delta X)$. This procedure assumes that the flume shear remains constant throughout the test section. Observations suggest that in some cases it may have increased for the uppermost streamlines, as discussed in the following section.

3.4 EXPERIMENTAL FLOW FIELDS DISCUSSION

This section presents observations regarding the computer-generated flow field calculations. Following an introduction to basic features and limitations of the data sets, the outstanding features of each are briefly stated, with an emphasis on possible discrepancies with actual flow patterns. My judgement of the $\dot{D}_m = .05 \text{ sec}^{-1}$ contour's accuracy is withheld until Section 4.4. Those fields least amenable to quantification, because of extreme deformation rates, were not digitized: Form 4S and both pipe intakes (Figures 25, 26 and 27).

The development of computer-generated flow field calculations from the photographs was a time-consuming process. The adjustment of grid point coordinates, in order to eliminate anomalous velocity values, was not carried out to the point where all of the computed velocities form smooth gradients. Generally, the adjustment effort was confined to the slight shifting of a point or a timeline segment, to moderate a high value with an adjacent low value. Those adjustments requiring the simultaneous shifting of several timelines, to moderate separated extremes, were not usually performed. The fraction of points that were adjusted ranged from about one-tenth to one-quarter for the X -coordinates but only about one-fiftieth to one-tenth of the R 's.

The flow field data should conform to the requirements of potential flow at every point: satisfying irrotationality ($\frac{\partial u}{\partial r} = \frac{\partial v}{\partial x}$) and continuity ($\dot{D}_{xx} = -\dot{D}_{RR}$). The degree of conformance (if the flume shear and bubble rise rate effects are properly accounted for) is a measure of the local accuracy of the coordinate placement. While the calculations presented in Appendix C assume that $u_o(I)$, $v_o(I)$ and $\dot{D}_{s,o}(I)$ remain constant throughout the field, some portion of an inequality in the magnitudes of $\dot{D}_{xx}$ and $\dot{D}_{RR}$ may be due to changes in flume flow conditions and/or rise rates throughout the field. Such inequalities cannot be resolved by repositioning the grid points. Extreme values of $\dot{D}_{RR}$ are usually calculated for points very near the centerline, due to the $(1/R)$ multiplicative factor. Another impediment to accurate reproduction of a potential field is the possibility of optical distortion caused by photographic and projection equipment, particularly along the perimeter.

Prior to discussing the individual flow fields, it is pertinent to consider the possibility that the observed external flow fields are influenced by the internal contraction of the base and middle sections. The contraction model was employed, with the upstream geometry designated as a straight 7 inch bore. These results (Appendix B) show that the velocity profile has become practically uniform ($\Delta u/U_o = .16$) by the transition between

the middle and end sections, at $I=38$. The large velocity for the centerline streamline ($1.15 U_o$) is probably an artifact, due to an inappropriate placement of streamline $J=2$. Significant adjustment to the end condition at $(60,2)$ does not occur until just several centimeters away. It is expected that $(38,2)$ would be closer to the centerline if further iterations had been made.

In the following evaluations, the values of u_o , v_o , and $\dot{D}_{s,o}$ are given for the upper and lower capture streamlines, as well as for the centerline streamline. The computed velocities are divided by 1.5 to correspond with the actual experimental conditions.

FORM 7F1 (Figure 14)		30 x 20	$R_m=5.0$ in
	u_o	v_o	$\dot{D}_{s,o}$
$I = 7$	5.03	.36	.010
$I = 17$	4.91	.21	.007
$I = 29$	4.97	.14	-.012

The flume flow has a minimum u_o at $I=18$ and a maximum $\dot{D}_{s,o}=.018$ at $I=15$. The u_o profile cannot be attributed to a consistent flume shear pattern, since there are three extrema. The v_o profile is probably the result of a combination of effects: intake effects, oblique projection and poor judgement. The upper half-plane contains many more inconsistencies than below the centerline, but the field's representation by $\dot{D}_m$ presents a relatively smooth and credible picture throughout the whole field.

FORM 7F2 (Figure 15)

36 x 24

 $R_m = 5.5$ in

	u_o	v_o	$\dot{D}_{s,o}$
I = 9	5.25	.18	.039
I = 19-1/2	5.09	.16	.013
I = 32	4.99	.14	-.004

The approach flow has a minimum u_o at I=32. The profile clearly shows a flume shear pattern of high velocities on both the top and bottom. The outward displacement of peripheral fluid ($R_c < R_m$) is even more pronounced than with 7F1, but the core region is again being accelerated: maximum value = $1.12 u_o$, versus $1.15 u_o$ for 7F1. The deformation rates and relative velocities generally are internally consistent, although at the top there is evidence of increasing velocities (due to flume shear), from the wire to timelines 7-9.

FORM 7N1 (Figure 16)

30 x 20

 $R_m = 4.5$ in

	u_o	v_o	$D_{s,o}$
I = 6-1/2	4.85	.25	.007
I = 16-1/2	4.82	.24	.007
I = 28	4.78	.19	.001

Flume shear was practically non-existent for the 7N1 test. The slight bulge in u_o near the centerline is due to the intake. Rise rate values are fairly consistent along the wire, with no significant trend. Axial velocities on the top and bottom show a gradual acceleration from the wire to J=6, then deceleration. Most likely the actual flow was

uniform in its initial approach, followed by a more moderate deceleration than is represented by the drawing. The core region is monotonically increasing, to a maximum value of $1.32 u_o$. $\dot{D}_m$ values form a consistent and realistic pattern.

<u>FORM 7N2</u> (Figure 17)		33 x 20	$R_m=4.0$ in.
	u_o	v_o	$\dot{D}_{s,o}$
I = 7	5.39	.18	.009
I = 17	5.31	.22	-.012
I = 28	5.28	.20	-.002

This data set exhibits a number of inconsistencies. $\dot{D}_{s,o}$ is largest in the core region (.025 at ψ_{20} and ψ_{21}), but it is flanked by negative values. The internal points are not well-adjusted: on both the top and bottom there are timeline placements which cause discontinuous velocities. The deformation rate calculations reflect this error by producing out-of-order values in several places. The maximum velocity at the mouth is $1.25 u_o$. There is an increasing flume shear on the uppermost streamlines, to timeline J=9.

<u>FORM 7PT</u> (Figure 18)		33 x 18	$R_m=4.75$ in.
	u_o	v_o	$\dot{D}_{s,o}$
I = 7-1/2	5.12	.27	.045
I = 18-1/2	5.00	.20	-.004
I = 30-1/2	5.03	.17	-.004

The flow field is only slightly disturbed by this intake but there is a strong and consistent shear region above Ψ_{11} . The largest rate of flume shear is .054, at Ψ_8 . u_o is a minimum at Ψ_{13} ($=4.96$). Below this streamline $\dot{D}_{s,o}$ is small.

The calculated velocities show the difficulties inherent in this data reduction method: along a streamline, values of u_c for adjacent points often have subtle discrepancies, but consistent trends are found over larger spacial scales. Another general observation to be made is that the point adjustment procedure has established consistently varying u_c values along any particular timeline.

The observed flow field (as calculated in Appendix C) can be compared to that predicted by the potential flow contraction model (in Appendix B). The model's outer boundary is an idealized representation of a stagnation streamline which meets the intake's pointed edge without any prior change in radial position from $R_c = R_m$. The predicted entrance plane velocity profile is more severe in the core region than that observed: $u_c = 1.27 U_o$ vs. $1.05 u_o$ (at points (50,1) and (18,6), respectively), but the peripheral flow has a close correspondence: $u(50,21) = .88 U_o$ vs. $u(8,17) = .87 u_o(8)$ or $u(30,17) = .87 u_o(30)$. The model predicts $u=U_o$ at $R=.71 R_m$, while this equality was observed at $R = .49 R_m$ or $.50 R_m$ (at (13,15) and

(25,15), respectively. By comparison: $u_o(11,15) = .96$
 $u_o(11)$ for $R(11,15) = .67 R_m$. While the model's high
 velocity core was not confirmed in the flume, this region is
 of secondary interest to that further away from the
 centerline. Comparison of deformation rates in the
 peripheral flow region is forthcoming in Section 4.4.

FORM 7R (Figure 19) 33 x 22 $R_m = 4.75$ in.

	u_o	v_o	$\dot{D}_{s,o}$
I = 7	4.65	.09	.005
I = 18	4.60	.09	-.002
I = 29	4.58	.12	-.001

Flume shear is almost non-existent in this flow field
 (.013 max., at $\frac{1}{3}$) and bubble rise rates are low. Most of
 the velocity values are well-ordered and symmetrical about
 the centerline. The maximum velocity achieved is $1.22 u_o$,
 while near the perimeter the flow is decelerated and
 deflected outwards slightly prior to engaging the intake's
 surface (as observed).

FORM 7S (Figure 20) 33 x 20 $R_m = 4.0$ cm

	u_o	v_o	$\dot{D}_{s,o}$
I = 8	5.32	.24	.041
I = 18-1/2	4.97	.26	.019
I = 30	4.93	.27	-.007

Very large deformation rates are encountered near the
 broad, blunt leading edge. The velocity profile at the
 entrance plane is even more exaggerated than that of 7R.

The maximum velocity in front of the mouth is $1.41 u_o$, while streamlines near the shoulders are substantially decelerated. The flume shear rate profile undergoes a 'break' at Ψ_{19} . Above this streamline there is a shear of up to $.042 \text{ sec}^{-1}$ (at Ψ_9 and Ψ_{10}), but below it no shear rate exceeds $.007 \text{ sec}^{-1}$.

FORM 4F1 (Figure 21) 33 x 22 $R_m=5.0 \text{ in.}$

	u_o	v_o	$\dot{D}_{s,o}$
I = 7	5.17	.18	.003
I = 17	5.07	.18	.015
I = 29	4.97	.15	.001

This form has a mouth radius exceeding R_c , and is therefore displacing peripheral fluid outwards. Note that the core fluid is accelerated (up to $1.35 u_o$), although this high-speed core does not represent a large percentage of the sample zone. The flume shear profile is suspect due to its irregularity, alternating high (up to $.019 \text{ sec}^{-1}$ at Ψ_{24} and Ψ_{25}) and low values several times over the wire's length. $\dot{D}_{xx}$ and $\dot{D}_{RR}$ values in the uppermost streamlines support the existence of this shear, but the pattern is not so apparent for lower streamlines.

The flow into form 4F1 was studied with the contraction model for a simplified stagnation streamline geometry. In the model, the form's diverging cone intersects a cylindrical sample zone at a sharp point, as seen in Figure 10a. The computed velocity profile at 1 cm in front of this

idealized entrance (at $I=42$) gives a peak value of $1.62 U_o$ on the centerline, decreasing to $u=U_o$ at $R=.70R_m$. Flow in the outer half of the sample zone is decelerated. The velocity on the bounding streamline is $.55 U_o$ at this breakpoint. Although details would differ for a realistic specification of the wall contour/stagnation streamline in the model, the basic features of an accelerated core and a decelerated periphery would be retained.

FORM 4F2 (Figure 22)

36 x 22

$R_m=5.5$ in

	u_o	v_o	$\dot{D}_{s,o}$
$I = 7$	5.15	.21	.048
$I = 18$	4.96	.18	.020
$I = 30$	4.79	.15	.011

Flume shear is a dominate characteristic of this flow field. It appears to increase over the top of the intake form. From a high value of .059 at the top, it decreases regularly to $-.006$ at $\dot{t}_{14}$ and $\dot{t}_{15}$. A second peak occurs at $\dot{t}_{20}$ and $\dot{t}_{21}$ (.025). $\dot{D}_{s,o}$ is rather small for the lower half-plane. The high velocities observed near the centerline are not due to flume shear - they are caused by the nozzle's influence. In this case the mechanically-applied correction procedure is actually a source of error. This data set, as is, produces discontinuous velocities and thus larger deformation rates than if all velocity gradients were smooth.

FORM 4N (Figure 23)

36 x 24

 $R_m = 3.0$ in.

	u_o	v_o	$\dot{D}_{s,o}$
I = 10	5.40	.045	.004
I = 20	5.45	.098	.006
I = 31	5.16	.084	.007

The profile of $\dot{D}_{s,o}$ does not conform to the pattern observed for the other intakes. In these data, the upper half-plane has very little shear, whereas the lower half-plane has a substantial shear, with rates up to $.034 \text{ sec}^{-1}$ (for τ_{26}). The approximate symmetry and consistency of $\dot{D}_s(I,J)$ values suggests that this shear is truly superimposed on the nozzle's effect. The explanation offered is that this intake, having a small mouth and thus high velocities in the core, influenced the upstream flow profile by nullifying the expected upper half-plane shear and by establishing a positive shear in the lower half-plane.

The data set is also characterized by numerous inconsistencies in timeline spacing. The high degree of smoothness achieved in the corrected velocity field indicates that the averaging equation that was employed is proper and necessary in these circumstances.

The uppermost capture streamline is judged to be τ_{10} , although the drawing shows an upward deflection near the mouth. This is probably the consequence of the bubbles not following the water when it undergoes a sharp downward turn at low velocities. The maximum velocity achieved in this flow is $1.79 u_o$.

FORM 4R

(Figure 24)

27 x 24

 $R_m = 4.0$ in.

	u_o	v_o	$\dot{D}_{S,o}$
I = 2	4.86	.006	.004
I = 12	4.90	.057	.003
I = 23	4.84	.054	.000

The flume flow profile ($u_o(I)$) shows a maximum value on the centerline, just slightly greater than that on the stagnation streamlines. The fluid behavior near the rounded shoulder is subject to considerable speculation, particularly concerning placement of the intermediate streamlines $\bar{I}_2$ and $\bar{I}_{23}$. On the centerline the velocity reaches $1.91 u_o$. The irregular profile of v_o is due to improper judgement and construction technique. Moreover, many radial velocity values are suspect. This conclusion is based on the lack of correspondence of $-\dot{D}_{RR}$ with $\dot{D}_{xx}$ for most grid points at considerable distance from the entrance.

Pumping Rate Determination

The pumping rate was not directly measured under the experimental conditions. An earlier test had shown it to be about 40 gal/min, but hose lengths and both suction and discharge heads were smaller then. The pump's arrangement in the experiments also included several additional constricting fittings and lengths of pipe.

The pumping rate attained in the experiments can be calculated from the continuity relationship:

$Q = \pi R_c^2 \bar{u}_0$. Flume shear and bubble buoyancy causes a lack of symmetry and a degree of uncertainty in the observed flow field. Since streamlines are 1 cm apart at the wire: $R_{c,est.} = (I_{upper} - I_{lower})/2$ [cm] for the data previously presented, assuming that these streamlines actually represent the outermost boundaries of the capture cylinder. If the velocity profile is moderately uniform a mean value of $u_0(I)$ can be readily estimated. Estimated values of Q are calculated from some of the data sets:

Intake form	$R_{c,est.}$ (cm)	$\bar{u}_0$ (cm/s)	$Q_{est.}$ (cm ³ /s)	Q_{est} (gal/min)	$R_{c,calc.}$ (cm)
7F1	11.00	4.96	1885	29.9	11.56
7N1	10.75	4.80	1743	27.6	11.75
7N2	10.50	5.32	1843	29.2	11.13
7PT	11.50	5.04	2094	33.2	11.47
7R	11.00	4.62	1756	27.8	11.98

The exact value cannot be resolved by this method, but $Q=33$ gal/min (2082 cm³/s) is a reasonable estimate, based on 7PT's minimal uncertainty. The smaller estimates are for flows into thick-shouldered forms, often associated with large radial velocities in the periphery and/or large decelerations near the mouth. Both effects contribute to measurement uncertainties. Observe that $R_{c,calc.}$ exceeds $R_{c,est.}$ by .56 cm to 1.00 cm for these other forms.

4. SAMPLER AVOIDANCE

4.1 EXPERIMENTAL AVOIDANCE STUDIES

Sampling efficiency is the ultimate criteria by which a quantitative sampler should be judged. Unfortunately, direct measurement is not feasible, leaving the question to comparative catch studies or inferences from laboratory experiments. Few studies have attempted to quantify avoidance, however. The most comprehensive of these are the works of Fleminger and Clutter (1965) and Singarajah (1969 and 1975). Avoidance is not readily amenable to modeling and the available data is too sparse to justify the application of definitive bias correction factors to actual sample counts. These studies and several others serve to identify avoidance capabilities and/or relative sampling efficiencies. The Woods Hole Calanus experiment's novel approach was to determine the stimulus required to provoke the escape reaction.

Fleminger and Clutter (1965) towed three nets (22, 32, and 45 cm diameter, having mouth areas of 400, 800 and 1600 cm², respectively) through a large, enclosed seawater pool under different light conditions and population densities. Catches of mysids and six species of copepods were counted for 108 samples. The nets were preceded by bridles and obliquely towed at the relatively low speed of 30 cm/s.

For mysids, but not for copepods, avoidance was greater in light than in darkness. For both mysids and copepods the adjusted catch was significantly lower for the smaller nets. The relative degree of avoidance differed among species. The ratio of catches of the smaller nets to the 45 cm net determines the width of the 'apparent minimum peripheral escape zone'. Fleminger and Clutter assumed that the 'effective' sampling areas of the smaller nets are proportional to their catches. This analysis does not account for the absolute avoidance bias of the large net, so their calculated values are most probably conservative. The values range from 1.6 cm for Calanus helgolandicus to 7.2 cm for Paracalanus parvus, averaging catches from both nets and both sampling dates.

It is instructive to look at the calculated values for both nets and populations separately, comparing the adjusted mean catch ratios (C_s/C_l), equivalent to the relative sampling efficiency. Table I presents this data. The catch counts are adjusted by multiplying the mean value for 6 replicate hauls by 2 and 4 for the 32 and 22 cm nets, respectively, to correspond to the number of individuals per 0.8 m^3 of water strained by the 45 cm net.

TABLE 4-1 MEAN ADJUSTED CATCHES,
FLEMINGER AND CLUTTER (1965)

July 5-6 Population

Copepod	C45	C32	C22	C32/C45	C32/C45
A. clausi	192.8	122.2	38.2	.63	.20
A. tonsa	76.1	48.0	17.6	.63	.20
C. helgolandicus	21.87	15.43	7.80	.71	.36
Corycaeus	3.07	1.37	0.23	.45	.07
Oithona	12.80	8.47	2.87	.66	.22
Paracalanus	26.70	8.67	2.00	.32	.07

July 13-14 Population

Copepod	C45	C32	C22	C32/C45	C32/C45
A. clausi	281.6	135.8	85.6	.48	.30
A. tonsa	967.4	595.7	665.5	.62	.69
C. helgolandicus	4.40	4.57	4.67	1.04	1.06
Corycaeus	99.8	35.0	16.2	.35	.16
Oithona	151.8	84.0	114.9	.55	.76
Paracalanus	67.0	44.6	36.9	.67	.55

Some of the species listed were not represented by enough individuals to warrant strong confidence in the sampling accuracy. In four cases the actual mean catches were less than one per haul, while in another ten categories the mean catch was less than 10 animals/haul. While some of the comparisons might not accurately describe the true nature of avoidance behavior, the overall picture presented is that copepods can be grossly undersampled by small bridled nets towed slowly. It is believed that the bridle causes early forewarning and is a more significant cause of avoidance than the disturbance caused by the net and its attachment ring.

Calanus is the largest of the 6 species of copepods enumerated, yet it exhibited the least differential avoidance between the large and small nets. It is possible that this animal was more successful at avoiding the 45 cm net than the others, so that the observed variation with net size was not so dramatic.

Singarajah (1969) presented evidence that Calanus is more effective at avoiding a pursuing siphon tube than Acartia and other small copepods, and that copepod avoidance capabilities exceeded those of all other groups tested. In this study he positioned the tube's mouth at a distance of 2 to 3 mm from the animal selected for capture. As soon as one individual was caught another was pursued. Any animal which reacted violently, by long darts or jumps, was soon abandoned and attention was transferred to the nearest more quiescent individual. The numbers of animals caught per minute was recorded. He estimated that the current speed at a distance of 2.4 mm from the mouth was about 20% of the tube velocity for the 2 mm tube and 40% of the tube velocity for the 4 mm tube, roughly corresponding with Nikonerev's findings.

These catch data exhibit a consistent increase of percentage caught with increasing tube velocity, showing the individualistic nature of avoidance capabilities, yet the conformity to an overall pattern for each species. A statistical evaluation is not possible due to absense of

data on the ratio of successful to unsuccessful capture attempts. Another shortcoming of the study is the failure to identify the maximum attainable escape speed. For some species it could possibly be inferred, but tube velocities were too low to approach this speed for the copepods.

No Calanus were caught with a tube velocity as high as 9.25 cm/s, and only 2 of 30 (6.7%) were caught at the field velocity of 10.6 cm/s (with the 4 mm tube). At this higher speed, 8 of 30 (26.7%) Acartia clausi were caught and intermediate numbers for 4 other copepods (none of which were also studied by Fleminger and Clutter). Copepodites (stage VI) of both Acartia and Calanus were tested. At the field current of about 14 cm/s, 68.6% of the Acartia but only 25.7% of the Calanus were captured in one minute. For conditions roughly comparable to the 4 mm experiment with adult forms, the two catch percentages were 14 and 40 for the copepodids, compared to 6.7 and 26.7 for the adults.

Singarajah's 1975 study found avoidance to be reduced when the experimental vessel was shaken and/or in darkness. The intake was provided with five openings and only moved about slowly, rather than in pursuit of individual animals. One experiment, with illumination and no turbulence, can be compared with the 1969 experiment to assess the combined influence of the altered intake and the withdrawal technique. For the same tube size and velocity the two catch rates were comparable, although the current in each

opening of the 1975 study was one-fifth of that of the earlier work. This suggests that the multiple intake did not alarm the animals as readily, thus compensating for the smaller intake velocity. The improvement in catch rate with turbulence suggests that turbulence masked the intake's signal and inhibited detection and/or localization of the intake. Once again Acartia was caught most readily of all the copepod species in the 1975 experiments.

The Woods Hole Calanus experiment of Haury, Kenyon and Brooks subjected CIV or V copepodites to a simple mechanical disturbance. The flow distortion caused by a cylindrical obstruction rigidly held in a rotating cylinder of fluid was used as the disturbance. It is our hypothesis that either fluid deformation or deformation rate is the relevant fluid dynamical property for mechano-sensory response. For obstacles with diameters of 6 and 10 mm, the mean values for fluid deformation were .12 and .24 mm/min, respectively; fluid deformation rate mean values were 0.8 and 1.0 sec^{-1} . Avoidance speeds averaged 16 cm/sec, with maximum speeds of about 30 cm/s. The distance of avoidance flights averaged 15 mm, but it is believed that they would extend much further if sufficiently stimulated. Marshall and Orr (1972, p. 164) reported occasional zigzag flights of about 30 cm when escaping from fish. Our data suggests that Calanus can localize the source of the disturbance and that

there is a preferred direction of avoidance, one which probably optimizes their chances of escape.

The avoidance data reviewed above provides one justification of the choice of Calanus as an indicator species for this study's sampling efficiency evaluations. Additionally, C. finmarchicus and its sibling species are widely distributed and commonly found in sufficient density for quantitative estimates. Its avoidance characteristics should be similar to those of many moderately-sized copepods. The 3.5 mm Labidocera is likely to be an adept avoider since it can maintain the speed of 80 cm/s for over 15 cm (Smith, unpublished data, in Clutter and Anraku, 1968, p. 72). The upper limit for copepods is probably represented by the large mesopelagic copepod Euchirella, for which Smith (same ref.) reported flights of 150 cm at 100 cm/s. Because avoidance abilities probably are a function of both size and physiological state, it is to be expected that Calanus' capabilities exceed those of much smaller copepods, and the juvenile, egg-carrying, weak and aged members of larger species.

4.2 SAMPLER PERFORMANCE THEORY

The theory of sampling gear performance presented in this thesis owes its philosophical basis to Nikonerov (1975), whose interest concerned commercial fishing gear. While sampling gear should accurately assess the biota, harvesting gear design and deployment strategies strive to induce dense concentrations for capture. The basic concept of Nikonerov's performance analysis is the interaction of the 'zone of action' with the 'zone of sure capture.' His goal is to further extend the (favorable) 'action'. The 'action' provided by sampling gear, however, potentially induces avoidance and is to be minimized. In this study Nikonerov's concepts will be quantitatively applied to the towed intake (via Barkley's 'lethal cone' avoidance model), but only qualitatively applied to the stationary and non-aligned intakes.

The water in the cylindrical volume that eventually enters an intake undergoes continuous deformation due to acceleration (or deceleration), shear, and streamline curvature. Other possible disturbances include the influence of a towing bridle, the noise projected from a solid surface, and cues allowing visual detection. These disturbances may forewarn an animal of the sampler's presence and stimulate an escape reaction. The location at which the reaction begins will determine the attempt's success, for a given flow field and escape behavior. Within

a 'zone of sure capture' any escape attempt at speed U_e or less will be futile. It should be the designer's goal to minimize the 'zone of action' while maximizing the fraction of the sample cylinder that includes the 'zone of sure capture' and other portions of the sampled volume characterized by a low probability of successful avoidance.

Neither the zone of action or the zone of sure capture is easily determined, although the latter is potentially more amenable to quantitative evaluation if one has detailed knowledge of the flow field. For a stationary intake the zone of sure capture is merely the volume enclosed by the isovel $U = U_e$. With the superposition of a uniform flow its geometry is not so directly recognizable. Besides the volume within the U_e isovel, one must also consider regions of the flow field from which an animal will ultimately be overtaken by the sampler (or drawn into it), even when swimming at speed U_e in an optimal direction. This consideration leads to Barkley's 'lethal cone' for the towed net and forward-looking intake.

This study's attempt to evaluate the extent of the zone of action uses a simple model that directly correlates the threshold for escape reaction stimulation with a quantifiable property of the flow field; it ignores the possibility of an earlier response due to noise, light or bridle-induced cues. The parameter selected for evaluating the intake flow field data is a 'critical' fluid deformation

rate ($\dot{D}_c$). It is too simplistic to presume that this single-valued stimulus would predict behavior under actual field conditions, but it allows different designs to be compared by the same criteria.

Barkley's 1964 paper proposed a model for predicting the capture or escape of animals in the path of a towed net. It is applicable to a pumping system intake oriented into a relative flow. Figure 5 shows the relevant geometry and notation. The model assumes that an animal, in the presence of a sampler that is approaching at speed U_o , will swim at speed U_e in a direction which will optimize its chances for escape, until it has either passed beyond the mouth (of radius R_m) or is overtaken. There is, therefore, a cone-shaped space ahead of the net which assures certain capture once it encloses the animal. The distance in front of the net mouth (the apex) of this "lethal cone" is given by:

$$\hat{X}_L = R_m \sqrt{\left(\frac{U_o}{U_e}\right)^2 - 1}$$

Barkley's model predicts the consequences of an optimal avoidance attempt without any regard to what stimulates that attempt. This study's extension is to determine the intersection point ($\hat{X}_e, R_e$) of the cone's surface with the critical deformation rate contour, comparing the relative area (R_e^2/R_m^2) for the various test forms,

given the set of parameters $U_e = 30 \text{ cm/s}$; $U_o \approx 100 \text{ cm/s}$ and $\dot{D}_c = 1.0 \text{ sec}^{-1}$.

It is also useful to reference R_e to the sample cylinder's radius by (R_e^2/R_c^2) . Barkley implicitly assumes that $R_m = R_c$, but the intake form experiments did not conform to this simple relationship. (R_e^2/R_c^2) is a better indicator of sampling efficiency than is (R_e^2/R_m^2) . R_e may be thought of as an 'effective' sampling radius.

Closer examination reveals that Barkley's model, based on the strictly geometrical relationship of the independent motion of points in space, is simplistic. In reality the flow field produced by the sampler will modify the animal's speed and trajectory. The rejection of peripheral water ($R_c < R_m$, i.e. less than 100% filtration efficiency for a net), contributes to the animal's escape efforts, but the flow of peripheral water in towards an intake ($R_c > R_m$) makes escape more difficult than Barkley predicts. In terms of the lethal cone geometry, the cone's side would bulge inwards near the base for the former case and outward for the latter case. When the sample cylinder radius is approximately the same as the mouth radius this effect is negligible, but as the differences increase Barkley's model (as given) becomes increasingly less accurate, particularly in light of the r^2 significance of peripheral flow to total volume filtered or pumped. For this reason Barkley's

uncorrected model is more applicable to the 7 inch throat designs than to most of the 4 inch throat designs.

The simplicity of Barkley's model also fails to account for the animal's limited capacity to sustain escape reaction speeds for extended distances. This characteristic contributes to the better performance of larger samplers: a greater percentage of the sample cylinder area encloses a central core of sure capture, based on an animal's maximum possible flight distance. I suggest that this effect was operative in the Acartia catches of Fleminger and Clutter's experiment, while the greater stamina of Calanus allowed it a better possibility of escape from the core of the larger net's sample cylinder. The existence of a 'lethal core' may also influence the evaluation of pump catches (or expected catches), even though my intakes are much smaller than all but the smallest nets. It is expected that Calanus could cross the sample cylinder from the centerline in an escape attempt but there is no certainty that the smaller forms could do likewise.

4.3 PLANKTON PUMP PERFORMANCE EVALUATION

The credibility and usefulness of the proposed sampler performance model is tested by how well it explains the performance data reported for various plankton pumps. This discussion will be primarily speculative and descriptive, by necessity. The systems will be considered in chronological order to facilitate easy referral to the discussion of Section 1.3.

Aron (1958) stated that no difference in catches could be detected between forward and rearward directed intakes while under tow at 170 cm/sec. For the former strategy $R_c = 6.9$ cm and $R_c = 7.9$ cm for the latter one, compared to $R_m = 3.8$ cm. Patchiness may have obscured sampling efficiency, and/or the moderately fast tow speed and high pumping rate may have minimized the negative effects of flow noise and large deformation rates in the rearward mode. His observation that the half meter net outfished the pump for Calanus shows the value of increasing R_m so as to create (or enlarge) a 'lethal core', countering the possible effect of the net's towing bridle. The net had less peripheral deformation and therefore a greater (R_e^2/R_c^2) ratio than did the pump.

O'Connell and Leong's (1963) design complied with the criteria suggested in this study: a forward-looking and contoured intake and the tow speed that nearly matches $\bar{U}_m$. With such a small orifice (3/4 inch) it was prudent

that they had a slight peripheral inflow ($R_c = .40$ inch), to make escape attempts (of even very small darts) less likely to succeed.

Beers, Stewart and Strickland (1967) inappropriately tested their horizontal intake system by raising it at 2 m/min, subjecting the animals in the sample volume to the radiated noise of the submersible pump. The nets were raised at about 12 m/min. The inconclusive test results probably reflect the fact that neither strategy was conducive to high efficiency.

Icanberry and Richardson's (1973) pump results probably are the averages of larger catches when the intake was forward-looking (at the start of the tests) with smaller catches after it became turned towards the rear. The net sampled 80 times more water than this small (22 gal/min) pump, so that the absolute numbers caught in 10 minutes of pumping were quite small and probably statistically inconclusive.

The CEPEX sampling tests (Grice, et al., 1977) show that Calanus was more adept at avoiding the intake than the net. The slow hose lowering rate causes the sample cylinder to be much larger than the intake ($R_c = 25.2$ cm vs $R_m = 5.1$ cm), causing large deformations in the periphery while suction velocities are quite low. Avoidance would be very likely for much of the sample cylinder under these

conditions. However, the high intake velocity ($\bar{U}_m = 165$ cm/sec) and sampling strategy would create a large cone-like zone of sure capture for poor swimmers.

Results of Lenz's (1972) suction experiment and Nikonorev's study suggest a scale for the zone of sure capture for the CEPEX experiments. Neither Cyclops nor Daphnia could escape when within a distance of 2 to 3 cm from a 1 cm tube having $\bar{U}_m = 85$ cm/sec. By assuming geometrical similiarity ($\hat{x}_e/R_m = 4$ to 6) and roughly accounting for the effect of the 2:1 tube velocity difference, it is expected that the zone of sure capture for these animals in CEPEX pumping conditions would be about 6 to 8 inches. At these distances the velocity would be roughly $0.1 \bar{U}_m$.

The high volume pump of Leithiser, Ehrlich and Thum (1979) outfished the half-meter net by 4 to 1 and the one meter net by 2 to 1 for large fish larvae. Both samplers were suspended in a 30 cm/sec flow; no intake description or deployment mode was mentioned. It is likely that the larvae's swimming capabilities exceed Calanus', and so they should be able to dodge the nets more easily than the accelerating flow into the intake.

Coughlan and Flemming (1978) consider the existence of a suction field surrounding the intake to be essential for optimal sampling efficiency, but their reasoning is neither consistent nor comprehensive. They attempt to justify their

strategy of suspending a downward-looking intake in a horizontally-moving flow by stating that it "should minimize the pressure gradients upstream of the orifice" (p. 135). I contend that pressure cues are not of primary significance. For their sampling strategy, deformation of the peripheral water of the sample cylinder will be substantially greater than that of the core region. Its uppermost bounding streamline is deflected downward and along the pipe while the lowest one ultimately undergoes a change in direction of up to 270° while subjected to velocities U_o . Certainly the intake flow must be U_e (as they point out), but the pre-entrance history (path, deformation, acceleration) of the sampled water is a more significant criteria for judging sampling performance than pressure.

These published reports support my contentions, with the exceptions of Aron's and Icanberry and Richardson's backwards/forwards results. The importance of an integrated design philosophy and sampling strategy is emphasized by comparing the apparently superior performance of O'Connell and Leong's tow fish with the sink-like CEPEx sampling. The general trend of improvement in performance with increasing mouth velocity (e.g. Coughlan and Flemming, 1978) can be explained within this theory's scope. As intake velocity (pumping rate) increases, the zone of sure capture expands, incorporating a greater volume of the field. The greater the distance from the intake, the further the streamlines

are spaced out and the smaller are the spatial gradients in velocity (i.e. shear) prior to encountering the zone of sure capture. This effect is likely to overcompensate for the higher velocity experienced at this point due to increased pumping rate, since the rate of increase of radial velocity is small at large distances. By increasing the pumping rate, the zone of sure capture increases faster than does the zone of action.

4.4 EXPERIMENTAL INTAKE PERFORMANCE EVALUATION

The eleven intake data sets have been subjected to a standard procedure to determine the points of intersection, $(\hat{X}_e, R_e)_u$ and $(\hat{X}_e, R_e)_l$ (above and below the centerline, respectively) of the critical deformation rate contour (1.0 sec^{-1}) with the lethal cone (for $U_e = 30 \text{ cm/s}$ and $U_o = 20\bar{u}_o$). Values of R_e are compared to R_m and R_c by the ratio of enclosed areas: (R_e^2/R_m^2) and (R_e^2/R_c^2) . These relative area values predict the portion of the mouth and sample zone areas, respectively, from which no animals will escape.

The procedure to be followed is as follows:

1. Plot the $\dot{D}_m = 0.05 \text{ sec}^{-1}$ contour on a photocopy of the flow field drawing, interpolating values that were calculated at the grid points.
2. Determine $\bar{u}_o$, either separately for the upper and lower half-planes if the field is significantly non-symmetrical, or for the whole field.
3. Calculate $U_o = 20 \bar{u}_o$, $\hat{X}_L/R_m = \sqrt{(\frac{U_o}{U_e})^2 - 1}$ and the cone angle $\alpha = \tan^{-1}(R_m/\hat{X}_L)$.
4. Draw the cone's surface: a straight line from the mouth, at angle α from the axis (see Figure 5).
5. Determine $(\hat{X}_e, R_e)_u$ and $(\hat{X}_e, R_e)_l$.
6. Calculate $R_c = \sqrt{Q/\pi\bar{u}_o}$, for $Q=2082 \text{ cm}^3/\text{s}$ (33 gal/min.).

7. Calculate R_e^2/R_m^2 and R_e^2/R_c^2 .

Judgement plays a significant role in this evaluation. The mean approach speed ($\overline{u_0}$) is estimated from the $u_0(I)$ profile across the capture cylinder. In addition, the lack of axial symmetry in the D_c contour requires the selection of either the upper or lower cone intersection point as the most accurate. The simultaneous observation of flow both above and below the centerline provides a necessary check for quantified results and a back-up when one 'set' is contaminated with irregularities, uncertainties or inaccuracies. Although the two are referred to as the upper and lower 'half-planes', the observed flow should be representative of any wedge-shaped segment having its apex on the axis of symmetry. Obviously, bubble buoyancy and flume shear have no correspondence with axial symmetry; they act in the vertical plane throughout the flume's cross-section. Careful alignment was required to restrict the observed flow to the vertical plane only.

FORM 7F1 (Figure 28)

 $R_m = 5.0$ in.

$$\begin{aligned} \overline{u_o} &\approx 4.96 \text{ cm/s } \hat{X}_L/R_m = 3.15; \quad \alpha = 17.6^\circ \quad R_c = 11.56 \text{ cm} = 4.55 \text{ in} \\ (\hat{X}_e, R_e)_u &= (3.5, 4.0); \quad (\hat{X}_e, R_e)_l = (3.7, -3.9) \\ (R_e^2/R_m^2)_u &= .64 \quad (R_e^2/R_c^2)_u = .77 \end{aligned}$$

The symmetry between the upper and lower intersection points is remarkable, particularly in light of the ambiguity in the lower half-plane, due to out-of-order values.

FORM 7F2 (Figure 29)

 $R_m = 5.5$ in.

$$\begin{aligned} \overline{u_{o,u}} &\approx 5.16 \text{ cm/s } (\hat{X}_L/R_m)_u = 3.29 \quad (\hat{X}_e, R_e)_u = (5.6, 3.9) \\ \overline{u_{o,l}} &\approx 5.04 \text{ cm/s } (\hat{X}_L/R_m)_l = 3.21 \quad \alpha = 17.3^\circ \end{aligned}$$

For the lower half-plane:

$$\begin{aligned} (\hat{X}_e, R_e) &= (6.1, 3.7) \quad R_c = 11.47 \text{ cm} = 4.51 \text{ in.} \\ (R_e^2/R_m^2) &= .45 \quad (R_e^2/R_c^2) = .68 \end{aligned}$$

The large gradient in $u_o(I)$ in the upper half-plane is not conducive to accurate determination of $\overline{u_{o,u}}$ (and therefore $(\hat{X}_e, R_e)_u$), but this point's coordinates correspond well with $(\hat{X}_e, R_e)_l$ nevertheless. Both half-planes show deformation rates that are steadily increasing with radial distance, due to far-reaching deceleration of the fluid in the sample zone's periphery and that which is rejected.

FORM 7N1 (Figure 30)

 $R_m = 4.5$ in.

$$\begin{aligned} \bar{u}_O &\approx 4.80 \text{ cm/s} \quad (\dot{X}_L/R_m) = 3.06 \quad \alpha = 18.1^\circ \quad R_C = 11.71 \text{ cm} = 4.61 \text{ in.} \\ (\dot{X}_e, R_e)_u &= (4.5, 3.1) \quad (\dot{X}_e, R_e)_l = (4.1, -3.3) \\ \text{for } \bar{R}_e &= 3.2 \text{ in.: } (R_e^2/R_m^2) = .51; (R_e^2/R_C^2) = .48 \end{aligned}$$

The $\dot{D}_C$ profile has symmetrical features, although slightly skewed in magnitude. It bulges outward at the junction with the cone, but sample zone fluid further away is subjected to lower deformation rates.

FORM 7N2 (Figure 31)

 $R_m = 4.0$ in.

For the upper half-plane:

$$\begin{aligned} \bar{u}_O &\approx 5.35 \text{ cm/s} \quad (\dot{X}_L/R_m) = 3.42 \quad \alpha = 16.3^\circ \quad R_C = 11.13 \text{ cm} = 4.38 \text{ in.} \\ (\dot{X}_e, R_e) &= (4.9, 2.7) \quad (R_e^2/R_m^2) = .46 \quad (R_e^2/R_C^2) = .38 \end{aligned}$$

Computations from this data set are not very reliable. The large meanders in the $\dot{D}_C$ contour and its lack of axial symmetry are a case in point. $\dot{D}_m$ values smaller than .05 (further away from the intake) are inconsistent. In this case it appears that the .05 value is within that portion of the field where data reduction inaccuracies dominate the true fluid behavior's weak 'signal', as evident by erratically-varying values.

FORM 7PT (Figure 32)

 $R_m = 4.75$ in.

$$\begin{aligned} \bar{u}_o &\approx 5.04 \text{ cm/s} \quad (\hat{X}_L/R_m) = 3.21 \alpha = 17.3 \quad R_c = 11.47 \text{ cm} = 4.51 \text{ in} \\ (\hat{X}_e, R_e)_u &= (2.9, 3.9); (\hat{X}_e, R_e)_l = (2.2, -4.1) \\ (R_e^2/R_m^2)_l &= .75 \quad (R_e^2/R_c^2)_l = .83 \end{aligned}$$

The lower half-plane was not subject to the superimposed flume shear and these flow field calculations are slightly more consistent as a whole. The subtlety of this intake's influence is graphically illustrated by the nearness of the $\dot{D}_c$ contour to the intake.

The 7PT contraction model verifies the quantified observation. Discounting the core region (within $\bar{\Psi}_4$), the $\dot{D}_m = .05$ contour falls on the X_{55} section until $J=12$, at $R = .74 R_m$. At this point it slowly turns inward. Near the wall it is found between X_{53} and X_{54} . Figure 10 shows $\dot{D}_c$ to intersect the lethal cone on $\bar{\Psi}_{16}$ halfway between X_{54} and X_{55} . At this point $\hat{X}_e = 5.5 \text{ cm} = 2.17 \text{ in.}$ and $R_e = .86 R_m$ for the 12.2 cm (4.80 in.) capture cylinder. This intersection point is exactly at the same radial distance as computed from the data set:
 $(R_e = 10.5 \text{ cm} = 4.3 \text{ in.})$ The model predicts $(R_e^2/R_m^2) = .74$.

FORM 7R (Figure 33)

 $R_m = 4.75$ in.

$$\begin{aligned} \bar{u}_o &\approx 4.62 \text{ cm/s } (X_L/R_m) = 3.08; \quad \alpha = 18.0^\circ; \quad R_c = 11.93 \text{ cm} = 4.72 \text{ in} \\ (\hat{X}_e, R_e)_u &= (3.9, 3.6) \quad (\hat{X}_e, R_e)_l = (3.7, -3.7) \\ (R_e^2/R_m^2)_l &= .61 \quad (R_e^2/R_c^2)_l = .61 \end{aligned}$$

General features of the $\dot{D}_c$ profile are symmetrical, but the lower half-plane position is probably more accurate. The contour line's vertical alignment between $I=11$ to 17 correlates with corrected axial velocities along $J=7$ that are substantially lower than their neighbors. Peripheral sample zone flow on both the top and bottom is subject to lower $\dot{D}$ than is the core flow, because velocities on these streamlines do not significantly deviate from their initial values for a relatively long period.

FORM 7S (Figure 34)

 $R_m = 4.0$ in.

For the lower half-plane:

$$\begin{aligned} \bar{u}_o &\approx 4.96 \text{ cm/s } (\hat{X}_L/R_m) = 3.15 \quad \alpha = 17.6^\circ \quad R_c = 11.56 \text{ cm} = 4.55 \text{ in.} \\ (\hat{X}_e, R_e) &= (4.5, -2.5) \quad (R_e^2/R_m^2) = .39 \quad (R_e^2/R_c^2) = .30 \end{aligned}$$

The $\dot{D}_c$ profile is smooth, due to consistently varying velocities in this region.

FORM 4F1 (Figure 35)

 $R_m = 5.0 \text{ in.} = 12.70 \text{ cm}$

$$\begin{aligned} \bar{u}_0 &\approx 5.07 \text{ cm/s} \quad (\hat{X}_L/R_m) = 3.23 \quad \alpha = 17.2^\circ \quad R_c = 11.43 \text{ cm} = 4.50 \text{ in} \\ (\hat{X}_e, R_e)_u &= (3.6, 3.9) \quad (R_e^2/R_m^2)_u = .61 \quad (R_e^2/R_c^2)_u = .75 \\ (\hat{X}_e, R_e)_l &= (4.0, -3.75) \quad (R_e^2/R_m^2)_l = .56 \quad (R_e^2/R_c^2)_l = .69 \end{aligned}$$

Despite irregular velocities and uncertainties due to out-of-order deformation rates, the $\dot{D}_c$ contour is generally smooth and symmetric. The contraction model predicts an outward-bulging profile (Figure 10), with $(\hat{X}_e, R_e)$ located at $(8.5, 9.5) [\text{cm}] = (3.3, 3.7) [\text{in.}]$. The geometries are not exactly the same (different R_m and α), but the relative area calculations (R_e^2/R_c^2) and (R_e^2/R_m^2) offer a proper basis of comparison. The modeled flow field predicts: $(R_e^2/R_c^2) = (R_e^2/R_m^2) = .61$, the same value as for $(R_e^2/R_m^2)_u$ in the experimental flow. This result is perhaps coincidental: neighboring $\dot{D}_m$ values of both the upper and lower intersection points are inconsistent, consequently the contour's placement is subject to my possible misinterpretation. Additionally, the model's simplified mouth/stagnation streamline geometry would be expected to produce a slightly different flow than was observed.

FORM 4F2 (Figure 36)

 $R_m = 5.5$ in.

For the upper half-plane:

$$\begin{aligned} \bar{u}_o &\approx 5.05 \text{ cm/s} \quad (\hat{x}_L/R_m) = 3.21 \quad \alpha = 17.3^\circ \quad R_C = 11.46 \text{ cm} = 4.51 \text{ in.} \\ (\hat{x}_e, R_e) &= (5.5, 4.0) \quad (R_e^2/R_m^2) = .53 \quad (R_e^2/R_C^2) = .79 \end{aligned}$$

No evaluation was possible for the lower half-plane, due to incessant irregularities in $\dot{D}_m$ values near .05. The upper half-plane profile appears to be valid. Note that the largest peripheral $\dot{D}_m$ values occur outside of the sample zone, in the rejected fluid.

FORM 4N (Figure 37)

 $R_m = 3.0$ in.

$$\begin{aligned} \bar{u}_o &\approx 5.40 \text{ cm/s} \quad (\hat{x}_L/R_m) = 3.46 \quad \alpha = 16.1^\circ \quad R_C = 11.08 \text{ cm/s} = 4.36 \text{ in.} \\ (\hat{x}_e, R_e)_u &= (6.8, 1.17) \quad (\hat{x}_e, R_e)_l = (7.6, -.94) \\ (R_e^2/R_m^2)_l &= .10 \quad (R_e^2/R_C^2)_l = .05 \end{aligned}$$

It is assumed that the inwards bulge in $\dot{D}_m$ (from $\bar{x}16$ to $\bar{x}20$) is an artifact. The profile is nearly uniform across the entire sample zone.

FORM 4R (Figure 38)

 $R_m = 4.0$ in.

$$\begin{aligned} \overline{u}_o &\approx 4.86 \text{ cm/s} \quad (\hat{X}_L/R_m) = 3.08 \quad \alpha = 18.0^\circ \quad R_c = 11.68 \text{ cm} = 4.60 \text{ in.} \\ (\hat{X}_e, R_e)_u &= (5.7, 2.3) \quad (\hat{X}_e, R_e)_l = (7.0, -2.0) \\ (R_e^2/R_m^2)_l &= .25 \quad (R_e^2/R_c^2)_l = .19 \end{aligned}$$

The ragged $\dot{D}_m$ profile in the central region reflects small-scale data irregularities. The sharp decrease in $\dot{D}_m$ with increasing R favors efficient sampling from the peripheral water.

DISCUSSION

Most of the significant irregularities, inaccuracies and uncertainties regarding the experimental flow data sets have been identified in this section and in 3.4. Lest one conclude that the patterns established in the computer print-outs are of dubious validity, it should be recalled that the two intakes for which a numerical/theoretical model was attempted proved to have good agreement. Therefore, it is suggested that the performance evaluation procedure may proceed with confidence in quantitative comparisons. The performance predictions are specific to these test conditions.

TABLE 4-2. RANK ORDERINGS OF INTAKES

BY R_e^2/R_m^2	BY R_e^2/R_c^2	BY $\hat{X}_e$	BY $ (R_c/R_m)-1 $
1. 7PT .75	1. 7PT .83	1. 7PT 2.2	1. 7R .99
2. 7F1 .64	2. 7F1 .77	2. 7F1 3.6	2. 7N1 1.02
3. 4F1 .61	3. 4F1 .75	3. 7R 3.7	3. 7PT .95
3. 7R .61	4. 4F2 .71	4. 4F1 4.0	4. 7F1 .91
4. 4F2 .53	5. 7F2 .68	5. 7N1 4.3	5. 7N2 1.09
5. 7N1 .51	6. 7R .61	6. 7S 4.5	6. 4F1 .90
6. 7N2 .46	7. 7N1 .48	7. 7N2 4.9	7. 7S 1.14
7. 7F2 .45	8. 7N2 .38	8. 4F2 5.5	8. 4R 1.15
8. 7S .39	9. 7S .30	9. 7F2 6.1	9. 7F2 .82
9. 4R .25	10. 4R .19	10. 4R 7.0	10. 4F2 .82
10. 4N .10	11. 4N .05	11. 4N 7.6	11. 4N 1.45

This presentation of results shows the superiority of 7PT in these tests. The experimental conditions were nearly ideal for its desired deployment and the applicability of the 'lethal cone' analysis. On the other end of the scale, 4N is the poorest performer, characterized by a relatively large sample cylinder ($R_c=1.45 R_m=2.18 R_t$) that has a far-reaching high velocity core.

The successive rankings and large efficiencies of the four funnel-shaped forms (second through fifth for $(R_e^2/R_c^2)=.77$ to $.68$) merits acknowledgement. Their order is the same for both $|(R_c/R_m)-1|$ and $\hat{X}_e$. These results suggest that the width of the shoulder presented to the flow is of secondary concern to that of obtaining $R_c \approx R_m$. The $\dot{D}_c$ profiles of 7F1 and 4F1 both have an inwards bulge at the sample zone's periphery. This feature was also observed (calculated) for forms 7R and 7N1. It contributes to the good performance of 7R (in

conjunction with $R_c = .99 R_m$), but for 7N1 the peripheral bulge occurs outside of the lethal cone.

Another outstanding feature of this data is the consistent ordering of the geometrically-related forms (7F1 and 7F2), (7N1 and 7N2), and (4F1 and 4F2): in each case (R_e^2/R_c^2) is larger with the one inch radius form. This pattern correlates with both the $|(R_c/R_m)-1|$ and the $\hat{X}_e$ orderings of each pair. It is particularly striking that 4F2 and 7F2, with the largest mouths (5.5 in.) and thus divergences of (R_c/R_m) from unity, rank 4th and 5th in (R_e^2/R_c^2) . Although some approaching fluid is being rejected, the model does not account for this. The actual sampling efficiency would be less than predicted, because the peripheral fluid's radial velocity component would assist an animal's escape attempt.

The existence of a peripheral inwards bulge in the $\dot{D}_c$ profile is a particularly attractive feature because most of the sample zone volume comes from the periphery. A design/sampling strategy (Q and U_o) combination which produces an outward bulge in the $\dot{D}_c$ profile in the core in order to create an inwards bulge in the periphery would be preferred for consideration of the proportionate area affected. 4F1 is an example of such a $\dot{D}_c$ profile.

A direct manipulation of these data to exploit a desirable feature can be achieved by applying the scaling relationships, discussed in Section 2.3. Conversely,

undesirable features can be avoided in differently-sized systems by consulting these data prior to final design selection. It is hoped that this study has provided the rational basis for the design, deployment and evaluation of effective zooplankton pump sampling systems.

Figure 1a. Intake forms - 7 inch throat

Figure 1b. Intake forms - 4 inch throat

Figure 2. Flume test arrangement - upstream viewpoint.

Figure 3. Flume test pump and bubble generator

Figure 4. Hydrogen bubble photograph, Form 7N1

Figure 5. Lethal cone and critical deformation rate envelopes

Figure 6. Stationary intake/stationary field
pumping mode

Figure 7. Superimposed uniform streaming motion
pumping mode (non-aligned)

Figure 8. Tow fish pumping mode ,illustrating
extremes in sample zone geometries

Figure 9. Intake geometry notation .

Figure 10. Axisymmetric contraction model geometries

$$R_m = 1.5 \text{ cm}$$

$$Q = 804.8 \text{ cm}^3/\text{s}$$

$$\bar{U}_m = 114 \text{ cm/s}$$

Figure 11a. Simple pipe intake flow field (isovels),
from Nikonerev (1975)

Figure 11b. Superimposed $U_0 = 10 \text{ cm/s}$ with
pipe intake flow

Figure 11c. Superimposed $U_0 = 20 \text{ cm/s}$ with pipe intake flow

Figure 12. Simple planar intake

Figure 13. Hydrogen bubble generator circuit

FORM 7F1

Figure 14

110

FORM 7F2

Figure 15

FORM 7N1

Figure 16

FORM 7N2

Figure 17

FORM 7PT

Figure 18

FORM 7R

Figure 19

FORM 7S

Figure 20

FORM 4F1

Figure 21

FORM 4F2

Figure 22

FORM 4N

Figure 23

FORM 4R

Figure 24

FORM 4S

Figure 25

4 IN. PIPE

Figure 26

1 1/2 IN. PIPE

Figure 27

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FORM 7N2

FORM 7PT

FORM 7R

FORM 7S

FORM 4F1

FORM 4F2

FORM 4N

FORM 4R

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APPENDIX A

SIMPLE PLANAR INTAKE

Development of the complete analytical solution

APPENDIX A: SIMPLE PLANAR INTAKE

The simple planar intake model is a theoretical construction of the flow from an infinite and stationary field into a thin-walled channel. The walls of the channel (intake) are of undefined depth and parallel, with separation distance H (see Figure 12). This flow is also known as that into a 'Borda's mouthpiece'. The analytical solution, from the hodographic method of conformal transformations, assumes that the wall streamline remains attached on entrance and that an infinite velocity is achieved at the sharp-edged lip. A real fluid will separate at the lip and form the 'vena contracta' downstream of the lip, but Robinson contends that "before the flow reaches the mouthpiece the flow pattern appears as in the unseparated case, although naturally there is some difference in detail near the mouthpiece" (p. 436).

The mathematical solution is generated by assuming the far-field velocity distribution is that of a planar sink and that a uniform velocity is achieved inside the channel (U_c). In the transformed, hodographic plane this is a source-sink pair, but in the physical plane the governing equation is

$$\zeta = (u - iv)^{-1} = -1 - e^{(\phi - i\psi)}$$

In Lamb's notation, for the special case of $U_c = -1.0$ and $H = 2\pi$. (Note that Lamb defines $u = -\frac{\partial \phi}{\partial x}$ and $v = -\frac{\partial \phi}{\partial y}$.)

Inversion gives the complex velocity:

$$u - iv = -1 / (1 + e^{\phi} \cos \psi + i e^{\phi} \sin \psi)$$

or, in the form $(a+ib)$:

$$u - iv = \frac{-1 - e^{\phi} \cos \psi}{1 + 2e^{\phi} \cos \psi + e^{2\phi}} + i \frac{e^{\phi} \sin \psi}{1 + 2e^{\phi} \cos \psi + e^{2\phi}}$$

This establishes the velocity components corresponding to coordinates (x, y) given by:

$$\begin{aligned} x &= \phi + e^{\phi} \cos \psi \\ y &= \psi + e^{\phi} \sin \psi \end{aligned}$$

The normal and shear deformation rate components $\frac{\partial u}{\partial x} = -\frac{\partial v}{\partial y}$ and $\frac{\partial u}{\partial y} = \frac{\partial v}{\partial x}$, respectively, can be obtained by the chain rule of differentiation.

$$\begin{aligned} \frac{\partial u}{\partial x} &= \left\{ [1 + 2e^{\phi} \cos \psi + e^{2\phi}] [u e^{\phi} \cos \psi + v \sin \psi e^{\phi}] \right. \\ &\quad \left. + [1 + e^{\phi} \cos \psi] [-2u e^{\phi} \cos \psi - 2v e^{\phi} \sin \psi - 2u e^{2\phi}] \right\} / A^2 \end{aligned}$$

$$\begin{aligned} \frac{\partial v}{\partial x} &= \left\{ [1 + 2e^{\phi} \cos \psi + e^{2\phi}] [u e^{\phi} \sin \psi - v e^{\phi} \cos \psi] \right. \\ &\quad \left. + [e^{\phi} \sin \psi] [-2u e^{\phi} \cos \psi - 2e^{\phi} v \sin \psi - 2u e^{2\phi}] \right\} / A^2 \end{aligned}$$

where $A = 1 + 2e^{\phi} \cos \psi + e^{2\phi}$

The equations have been modified to accommodate an arbitrary channel velocity U_c (a negative value) and width H . The relative position of the coordinate origin is retained, so the entrance plane is located at $x_E = -H/2$. The wall streamline now has the value $\psi_w = -U_c H/2$,

while ψ_a remains = 0. To simplify the expressions, define $K = -\frac{2\pi}{U_c H}$

$$x = -\frac{\phi}{U_c} + \frac{H}{2\pi} e^{K\phi} \cos K\psi$$

$$y = -\frac{\psi}{U_c} + \frac{H}{2\pi} e^{K\phi} \sin K\psi$$

$$u = U_c [1 + e^{K\phi} \cos K\psi] / [1 + 2e^{K\phi} \cos K\psi + e^{2K\phi}]$$

$$v = U_c e^{K\phi} \sin K\psi / [1 + 2e^{K\phi} \cos K\psi + e^{2K\phi}]$$

$$\frac{\partial u}{\partial x} = \left\{ [1 + 2e^{K\phi} \cos K\psi + e^{2K\phi}] [U_c K e^{K\phi} (-u \cos K\psi - v \sin K\psi)] \right. \\ \left. - [U_c (1 + e^{K\phi} \cos K\psi)] [2K e^{K\phi} (-u \cos K\psi - v \sin K\psi - u e^{K\phi})] \right\} / B^2$$

$$\frac{\partial v}{\partial x} = \left\{ [1 + 2e^{K\phi} \cos K\psi + e^{2K\phi}] [U_c K e^{K\phi} (v \cos K\psi - u \sin K\psi)] \right. \\ \left. - [U_c e^{K\phi} \sin K\psi] [2K e^{K\phi} (-u \cos K\psi - v \sin K\psi - u e^{K\phi})] \right\} / B^2$$

$$\text{WHERE } B = 1 + 2e^{K\phi} \cos K\psi + e^{2K\phi}$$

It is interesting to note the effects of changes in the parameters. For this example assume that the velocity is increased by a factor of 10, and that the channel width is decreased by a factor of 2, thus increasing the flux by a factor of 5. With the re-establishment of the y-axis

(x_E) , at geometrically-similar points the velocity is increased $\times 10$ and the deformation rate components are increased $\times 20$ ($= 10/(1/2)$).

This linear scaling relationship can be formally stated by considering normalized values for ϕ and ψ . All scale transformations require placement of the origin such that $x_E = -H/2\pi$. The following normalization factors have been determined to be appropriate:

$$\phi_N = \frac{-2\pi}{U_c H} \phi = K \phi$$

$$\psi_N = \frac{-2}{U_c H} \psi = \frac{K}{\pi} \psi$$

These values apply to the geometrically-similar points

$$(x_N, y_N) = \left(\frac{2\pi}{H} x, \frac{2\pi}{H} y \right). \text{ It can be shown the}$$

velocities scale as $u_N = u/U_c$ and $v_N = v/U_c$, while

deformation rates scale as $\frac{\partial(u,v)}{\partial(x,y)}_N = \frac{-H}{2\pi U_c} \frac{\partial(u,v)}{\partial(x,y)}$. In this

scaling, ψ_N varies from 0 on the centerline to 1.0 on the

wall for arbitrary values of U_c and H . The value of ψ_w is

prescribed by the flux through this half-plane: $\psi_w = -U_c H/2$.

All other values follow from this relationship. There is no

intrinsic importance to the equipotential line $\phi_N = 1.0$

(or any other value), but when the values of U_c and H are

those of the original derivation ($U_c = -1.0$ and $H = 2\pi$),

then $\phi_N = \phi$.

The flow field values were computed for selected

(ϕ_N, ψ_N) points, with $U_c = -100.0$ and $H = \pi$. The

computer program and results for ϕ_N from 4.0 to -1.5 by 0.5 increments on each of the 6 streamlines follows this discussion. Detailed computations for the planar intake is not warranted in this study.

The primary purpose of the planar intake computations is to illustrate the nature of velocity and deformation rate increases in the near-field. The centerline streamline is $\psi_N(1) = 0$ and the wall streamline $\psi_N(6) = 1.0$. Selected values for intermediate streamlines .1, .5 and .9 are compared in Table A-1. For these calculations $R = (x^2 + y^2)^{1/2}$; $\dot{D}_m = \left[\left(\frac{\partial u}{\partial x} \right)^2 + \left(\frac{\partial v}{\partial x} \right)^2 \right]^{1/2}$; and the relative changes in velocity and deformation rate are found by differencing the values from $\phi_N \pm 0.2$ and dividing by the value at ϕ_N .

The most notable features of the planar intake solution are briefly mentioned. The far-field flow begins to approach the symmetry of the two-dimensional sink beyond distances of about $9H$. As a particle is drawn closer to the intake, the deformation rate's relative increase exceeds that of the velocity, with the highest values towards the rear. In this rearward area the ratio $(\dot{D}_m/U)$ is also the largest, further contributing to the possibility of poor sampling efficiency for motile organisms that respond to large values of $\dot{D}$ by an escape reaction from this sector.

Table A-1. SIMPLE PLANAR INTAKE

 $U_c = -100.0$; $H = \pi$; $x_E = -.5$

ψ_N	ϕ_N	χ	y	R	u	v	U	$\frac{\partial u}{\partial x}$	$-\frac{\partial v}{\partial x}$	$\dot{D}_m$	$ \frac{\Delta u}{u} $	$ \frac{\Delta \dot{D}}{\dot{D}} $	$ \frac{\Delta \dot{D}/\dot{D}}{\Delta u/u} $
.1	4.0	28.0	8.6	79.2	-1.7	-5.5	1.8	.052	.037	.064	-	-	-
.1	3.0	11.0	3.3	11.5	-4.5	-1.4	4.7	.36	.24	.43	.38	.76	1.98
.1	2.0	4.5	1.3	4.7	-11.5	-3.3	2.0	2.2	1.3	2.5	.35	.67	1.89
.1	1.0	1.8	.58	1.88	-26.4	-6.2	22.2	10.1	4.0	10.9	.29	.48	1.64
.1	0.0	-.33	.21	.57	-50.0	-7.9	50.6	25.6	4.1	25.9	-	-	-
.5	4.0	2.0	28.1	28.2	-.03	-1.8	1.8	-0.67	.004	.07	-	-	-
.5	3.0	1.5	10.8	10.9	-.25	-5.0	5.0	-.49	.07	.49	.40	.82	2.04
.5	2.0	1.0	4.5	4.6	-1.8	-13.3	13.4	-3.3	1.4	3.6	.39	.80	2.02
.5	1.0	0.5	2.15	2.20	-11.9	-32.4	34.5	-11.0	19.5	22.4	.35	.66	1.87
.5	0.0	0.0	1.29	1.29	-50.0	-50.0	70.7	50.0	50.0	70.7	-	-	-
.9	4.0	-24.0	9.8	25.9	1.8	-.6	1.9	.056	-.043	.07	-	-	-
.9	3.0	-8.1	4.5	9.2	4.9	-1.7	5.2	.45	-.36	.57	.42	.89	2.10
.9	2.0	-2.5	2.6	3.6	14.5	-5.5	15.5	4.0	-3.9	5.5	.46	1.03	2.21
.9	1.0	-0.8	1.8	2.00	49.3	-26.1	55.7	38.7	-85.9	94.2	.62	1.58	2.56
.9	0.0	-.48	1.57	1.64	50.0	-31.6	32.0	-	-	-	-	-	-

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1. DIMENSION PSIN(6)
2. REAL K
3. C
4. READ(105,10) PHINMIN, PHINMAX, PHININC, VELC, D
5. 10 FORMAT(5G)
6. C
7. PI=3.1416
8. XC=1.0*D/(2.0*PI)
9. FLUX=VELC*D
10. K=2.0*PI/(VELC*D)
11. C
12. REPEAT 25, FOR I=1,4
13. PSIN(I)=0.20*(I-1.0)
14. PI*PSIN(I)*PI/K
15. SINPSIN=SIN(PI*PSIN(I))
16. COSPSIN=COS(PI*PSIN(I))
17. PHIN=PHINMAX
18. REPEAT 20, WHILE IF(PHIN, PHINMIN) .GE. 0
19. PHIN=PHIN/K
20. EXPPHIN=EXP(PHIN)
21. XI=1.0*(PHI/VELC) + (D/(2.0*PI))*EXPPHIN*COSPSIN
22. YI=1.0*(PSI/VELC) + (D/(2.0*PI))*EXPPHIN*SINPSIN
23. BI=1.0 + 2.0*EXPPHIN*COSPSIN + EXPPHIN**2
24. VELU=VELC*(1.0 + EXPPHIN*COSPSIN)/B
25. VELV=VELC*EXPPHIN*SINPSIN/B
26. ALPHA=57.29578*ATAN(VELV/VELU)
27. VELSSORT(VELU**2 + VELV**2)
28. DVUX=(VELC*K*EXPPHIN*(1.0*B*(VELU*COSPSIN+VELV*SINPSIN)
29. 1 + 2.0*(1.0*EXPPHIN*COSPSIN)*(VELU*(COSPSIN+EXPPHIN)
30. 2 + VELV*SINPSIN))/B**2)
31. DVUX=(VELC*K*EXPPHIN*(B*(VELV*COSPSIN - VELU*SINPSIN)
32. 1 + 2.0*EXPPHIN*SINPSIN*(VELU*(COSPSIN+EXPPHIN)
33. 2 + VELV*SINPSIN))/B**2)
34. DEFRM=SQRT(DVUX**2 + DVUX**2)
35. C
36. WRITE(108,60) I, PSIN(I), PHIN, X, Y, VELU, VELV, VEL, ALPHA,
37. 1 DVUX, DVUX, DEFRM
38. C
39. 20 PHIN=PHIN-PHININC
40. 25 CONTINUE
41. C
42. WRITE(108,70) D, VELC, XC, FLUX, K
43. 70 PSYAT(77) IX,16CHANNEL WIDTH D=F6.4,5X,17CHANNEL VEL VELC=F6.2
44. 1,5X,27ENTRANCE PLANE LOCATION XC=F5.3,5X,20FLUX PER UNIT DEPTH=
45. 2,F6.3,1X,44NORMIALIZATION FACTOR K=PHIN/PHI=PSIN*PI/PSI,F5.3)
46. 60 PSYAT(1X,2H1,12,4X,PPSINI)=F3.1,2X,5HPPHIN,F4.1,4X,2HXA=F6.2,
47. 12X,2HY=F6.2,4X,5HVELU=F8.2,2X,5HVELV=F8.2,3X,5HVELS=F8.2,3X,6H
48. 2ALPHA=F6.2,2/57X,13HOU/DX=DV/DY=F6.2,3X,13HOU/DX=DV/DY=F6.2,4X,
49. 36HDEFRM=F6.2)
50. C
51. END

```

RUN	I= 1	PSIN(I)= .0	PHIN= 4.0	X= 29.30	Y= .00	VELU= -1.80	VELV= .06	VELS= .00	ALPHA= .00
						DU/DX=-DV/DY=	DV/DX=+DU/DY=	DEFM= .03	
	I= 1	PSIN(I)= .0	PHIN= 3.5	X= 18.31	Y= .00	VELU= -2.93	VELV= .17	VELS= .00	ALPHA= .00
						DU/DX=-DV/DY=	DV/DX=+DU/DY=	DEFM= .17	
	I= 1	PSIN(I)= .0	PHIN= 3.0	X= 11.54	Y= .00	VELU= -4.74	VELV= .43	VELS= .00	ALPHA= .00
						DU/DX=-DV/DY=	DV/DX=+DU/DY=	DEFM= .43	
	I= 1	PSIN(I)= .0	PHIN= 2.5	X= 7.34	Y= .00	VELU= -7.59	VELV= 1.06	VELS= .00	ALPHA= .00
						DU/DX=-DV/DY=	DV/DX=+DU/DY=	DEFM= 1.06	
	I= 1	PSIN(I)= .0	PHIN= 2.0	X= 4.69	Y= .00	VELU= -11.92	VELV= 2.60	VELS= .00	ALPHA= .00
						DU/DX=-DV/DY=	DV/DX=+DU/DY=	DEFM= 2.60	
	I= 1	PSIN(I)= .0	PHIN= 1.5	X= 2.99	Y= .00	VELU= -18.24	VELV= 5.44	VELS= .00	ALPHA= .00
						DU/DX=-DV/DY=	DV/DX=+DU/DY=	DEFM= 5.44	
	I= 1	PSIN(I)= .0	PHIN= 1.0	X= 1.86	Y= .00	VELU= -26.89	VELV= 10.58	VELS= .00	ALPHA= .00
						DU/DX=-DV/DY=	DV/DX=+DU/DY=	DEFM= 10.58	
	I= 1	PSIN(I)= .0	PHIN= .5	X= 1.07	Y= .00	VELU= -37.75	VELV= 17.74	VELS= .00	ALPHA= .00
						DU/DX=-DV/DY=	DV/DX=+DU/DY=	DEFM= 17.74	

I = 1	PSIN(I) = .0	PHIN = .5	X = 1.07	Y = .00	VELU = -37.75	VELV = 17.74	DV/DX = -DV/DY =	.03	VELS =	37.75	ALPHA =	.00	DEFIN = 17.74
I = 1	PSIN(I) = .0	PHIN = .0	X = .50	Y = .00	VELU = -50.00	VELV =	DV/DX = DV/DY =	.00	VELS =	50.00	ALPHA =	.00	DEFIN = 25.00
I = 1	PSIN(I) = .0	PHIN = -.5	X = .05	Y = .00	VELU = -62.25	VELV =	DV/DX = DV/DY =	.00	VELS =	62.25	ALPHA =	.00	DEFIN = 25.00
I = 1	PSIN(I) = .0	PHIN = -1.0	X = -.32	Y = .00	VELU = -73.11	VELV =	DV/DX = DV/DY =	.00	VELS =	73.11	ALPHA =	.00	DEFIN = 28.75
I = 1	PSIN(I) = .0	PHIN = -1.5	X = -.64	Y = .00	VELU = -81.76	VELV =	DV/DX = DV/DY =	.00	VELS =	81.76	ALPHA =	.00	DEFIN = 28.75
I = 2	PSIN(I) = .2	PHIN = 4.0	X = 24.09	Y = 16.36	VELU = -1.47	VELV =	DV/DX = DV/DY =	-1.05	VELS =	1.80	ALPHA =	35.33	DEFIN = .06
I = 2	PSIN(I) = .2	PHIN = 3.5	X = 15.15	Y = 10.05	VELU = -2.41	VELV =	DV/DX = DV/DY =	.02	VELS =	2.95	ALPHA =	35.01	DEFIN = .17
I = 2	PSIN(I) = .2	PHIN = 3.0	X = 9.62	Y = 6.22	VELU = -3.95	VELV =	DV/DX = DV/DY =	.06	VELS =	4.78	ALPHA =	34.39	DEFIN = .44
I = 2	PSIN(I) = .2	PHIN = 2.5	X = 4.13	Y = 3.89	VELU = -6.42	VELV =	DV/DX = DV/DY =	.17	VELS =	7.69	ALPHA =	33.41	DEFIN = .44
I = 2	PSIN(I) = .2	PHIN = 2.0	X = 2.56	Y = 1.63	VELU = -10.33	VELV =	DV/DX = DV/DY =	.48	VELS =	12.17	ALPHA =	31.90	DEFIN = 1.11
I = 2	PSIN(I) = .2	PHIN = 1.5	X = 1.60	Y = 1.11	VELU = -16.32	VELV =	DV/DX = DV/DY =	1.34	VELS =	20.30	ALPHA =	29.56	DEFIN = 2.56
I = 2	PSIN(I) = .2	PHIN = 1.0	X = .92	Y = .80	VELU = -25.02	VELV =	DV/DX = DV/DY =	3.58	VELS =	27.56	ALPHA =	25.54	DEFIN = 5.94
I = 2	PSIN(I) = .2	PHIN = .5	X = .40	Y = .61	VELU = -36.55	VELV =	DV/DX = DV/DY =	8.61	VELS =	39.57	ALPHA =	22.55	DEFIN = 11.89
I = 2	PSIN(I) = .2	PHIN = .0	X = .00	Y = .49	VELU = -50.00	VELV =	DV/DX = DV/DY =	17.33	VELS =	52.57	ALPHA =	18.00	DEFIN = 20.43
I = 2	PSIN(I) = .2	PHIN = -.5	X = -.00	Y = .49	VELU = -63.45	VELV =	DV/DX = DV/DY =	27.64	VELS =	65.24	ALPHA =	13.05	DEFIN = 29.06
I = 2	PSIN(I) = .2	PHIN = -1.0	X = -.35	Y = .42	VELU = -74.98	VELV =	DV/DX = DV/DY =	33.59	VELS =	76.02	ALPHA =	9.46	DEFIN = 32.32
I = 2	PSIN(I) = .2	PHIN = -1.5	X = -.66	Y = .38	VELU = -83.68	VELV =	DV/DX = DV/DY =	38.03	VELS =	84.19	ALPHA =	5.34	DEFIN = 32.32
I = 3	PSIN(I) = .4	PHIN = 4.0	X = 10.44	Y = 26.59	VELU = -.59	VELV =	DV/DX = DV/DY =	.05	VELS =	1.82	ALPHA =	71.01	DEFIN = .07
I = 3	PSIN(I) = .4	PHIN = 3.5	X = 6.87	Y = 16.38	VELU = -1.00	VELV =	DV/DX = DV/DY =	.13	VELS =	2.99	ALPHA =	70.37	DEFIN = .18
I = 3	PSIN(I) = .4	PHIN = 3.0	X = 4.60	Y = 10.18	VELU = -1.73	VELV =	DV/DX = DV/DY =	.34	VELS =	4.90	ALPHA =	69.33	DEFIN = .47
I = 3	PSIN(I) = .4	PHIN = 2.5	X = 3.13	Y = 6.42	VELU = -3.04	VELV =	DV/DX = DV/DY =	.81	VELS =	7.98	ALPHA =	67.55	DEFIN = 1.24
I = 3	PSIN(I) = .4	PHIN = 2.0	X = 2.14	Y = 4.14	VELU = -5.46	VELV =	DV/DX = DV/DY =	1.72	VELS =	12.89	ALPHA =	64.96	DEFIN = 3.17
I = 3	PSIN(I) = .4	PHIN = 1.5	X = 1.44	Y = 2.76	VELU = -10.00	VELV =	DV/DX = DV/DY =	3.50	VELS =	20.47	ALPHA =	50.77	DEFIN = 7.69
I = 3	PSIN(I) = .4	PHIN = 1.0	X = .92	Y = 1.92	VELU = -18.27	VELV =	DV/DX = DV/DY =	8.67	VELS =	31.51	ALPHA =	54.35	DEFIN = 17.01
I = 3	PSIN(I) = .4	PHIN = .5	X = .50	Y = 1.41	VELU = -31.86	VELV =	DV/DX = DV/DY =	12.87	VELS =	45.94	ALPHA =	45.09	DEFIN = 31.98
I = 3	PSIN(I) = .4	PHIN = .0	X = .15	Y = 1.10	VELU = -50.00	VELV =	DV/DX = DV/DY =	29.28	VELS =	51.80	ALPHA =	35.00	DEFIN = 52.73
I = 3	PSIN(I) = .4	PHIN = -.5	X = -.16	Y = .92	VELU = -63.14	VELV =	DV/DX = DV/DY =	38.20	VELS =	54.66	ALPHA =	17.44	DEFIN = 75.75
I = 3	PSIN(I) = .4	PHIN = -1.0	X = -.44	Y = .80	VELU = -81.73	VELV =	DV/DX = DV/DY =	43.55	VELS =	75.75	ALPHA =	25.91	DEFIN = 17.01
I = 3	PSIN(I) = .4	PHIN = -1.5	X = -.72	Y = .73	VELU = -90.00	VELV =	DV/DX = DV/DY =	52.45	VELS =	85.66	ALPHA =	11.23	DEFIN = 31.98
I = 4	PSIN(I) = .6	PHIN = 4.0	X = 6.44	Y = 26.91	VELU = .54	VELV =	DV/DX = DV/DY =	12.87	VELS =	1.84	ALPHA =	73.00	DEFIN = .07
I = 4	PSIN(I) = .6	PHIN = 3.5	X = 3.37	Y = 16.69	VELU = .86	VELV =	DV/DX = DV/DY =	27.05	VELS =	3.05	ALPHA =	73.56	DEFIN = .19

I= 4	PSIN(I)= .6	PHIN= 3.0	X= -1.60	Y= 10.49	VELU= 1.33	VELV= -4.87	VELS= 5.05	ALPHA=-74.75
I= 4	PSIN(I)= .6	PHIN= 2.5	X= -.63	Y= 6.74	VELU= 1.95	VELV= -8.17	VELS= 8.40	DEFK= .52
I= 4	PSIN(I)= .6	PHIN= 2.0	X= -.14	Y= 4.46	VELU= 2.51	VELV= -13.77	VELS= 14.00	DEFK= 1.44
I= 4	PSIN(I)= .6	PHIN= 1.5	X= .06	Y= 3.07	VELU= 3.10	VELV= -23.27	VELS= 23.37	ALPHA=-79.65
I= 4	PSIN(I)= .6	PHIN= 1.0	X= .08	Y= 2.24	VELU= 3.68	VELV= -33.63	VELS= 38.61	DEFK= 4.05
I= 4	PSIN(I)= .6	PHIN= .5	X= -.00	Y= 1.73	VELU= 4.26	VELV= -43.99	VELS= 50.00	DEFK= 11.44
I= 4	PSIN(I)= .6	PHIN= .0	X= -.15	Y= 1.42	VELU= 4.84	VELV= -54.29	VELS= 60.87	ALPHA= 86.45
I= 4	PSIN(I)= .6	PHIN= -.5	X= -.34	Y= 1.23	VELU= 5.42	VELV= -64.58	VELS= 69.92	DEFK= 31.28
I= 4	PSIN(I)= .6	PHIN= -1.0	X= -.56	Y= 1.12	VELU= 6.00	VELV= -74.87	VELS= 78.07	ALPHA= 72.63
I= 4	PSIN(I)= .6	PHIN= -1.5	X= -.78	Y= 1.05	VELU= 6.58	VELV= -85.16	VELS= 88.00	DEFK= 74.35
I= 4	PSIN(I)= .6	PHIN= -2.0	X= -1.00	Y= 1.00	VELU= 7.16	VELV= -95.45	VELS= 99.50	ALPHA= 56.00
I= 4	PSIN(I)= .6	PHIN= -2.5	X= -1.22	Y= 1.00	VELU= 7.74	VELV= -105.74	VELS= 110.00	DEFK= 123.11
I= 4	PSIN(I)= .6	PHIN= -3.0	X= -1.44	Y= 1.00	VELU= 8.32	VELV= -116.03	VELS= 120.00	ALPHA= 35.37
I= 4	PSIN(I)= .6	PHIN= -3.5	X= -1.66	Y= 1.00	VELU= 8.90	VELV= -126.32	VELS= 130.00	DEFK= 122.59
I= 4	PSIN(I)= .6	PHIN= -4.0	X= -1.88	Y= 1.00	VELU= 9.48	VELV= -136.61	VELS= 140.00	ALPHA= 21.54
I= 4	PSIN(I)= .6	PHIN= -4.5	X= -2.10	Y= 1.00	VELU= 10.06	VELV= -146.90	VELS= 150.00	DEFK= 85.04
I= 4	PSIN(I)= .6	PHIN= -5.0	X= -2.32	Y= 1.00	VELU= 10.64	VELV= -157.19	VELS= 160.00	ALPHA= 12.84
I= 5	PSIN(I)= .8	PHIN= 4.0	X= -2.00	Y= 17.30	VELU= 1.49	VELV= -1.11	VELS= 1.86	DEFK= 51.25
I= 5	PSIN(I)= .8	PHIN= 3.5	X= -1.65	Y= 10.99	VELU= 2.47	VELV= -1.85	VELS= 3.09	ALPHA= -36.63
I= 5	PSIN(I)= .8	PHIN= 3.0	X= -1.22	Y= 7.16	VELU= 3.45	VELV= -2.59	VELS= 5.19	DEFK= .07
I= 5	PSIN(I)= .8	PHIN= 2.5	X= -.78	Y= 4.84	VELU= 4.43	VELV= -3.37	VELS= 8.78	ALPHA= -37.04
I= 5	PSIN(I)= .8	PHIN= 2.0	X= -.34	Y= 3.43	VELU= 5.41	VELV= -4.15	VELS= 12.84	DEFK= .20
I= 5	PSIN(I)= .8	PHIN= 1.5	X= .10	Y= 2.57	VELU= 6.39	VELV= -4.93	VELS= 16.90	ALPHA= -37.75
I= 5	PSIN(I)= .8	PHIN= 1.0	X= .56	Y= 2.06	VELU= 7.37	VELV= -5.71	VELS= 20.96	DEFK= .56
I= 5	PSIN(I)= .8	PHIN= .5	X= 1.02	Y= 1.74	VELU= 8.35	VELV= -6.49	VELS= 25.02	ALPHA= -38.96
I= 5	PSIN(I)= .8	PHIN= .0	X= 1.48	Y= 1.55	VELU= 9.33	VELV= -7.27	VELS= 29.08	DEFK= 1.55
I= 5	PSIN(I)= .8	PHIN= -.5	X= 1.94	Y= 1.43	VELU= 10.31	VELV= -8.05	VELS= 33.14	ALPHA= -41.10
I= 5	PSIN(I)= .8	PHIN= -1.0	X= 2.40	Y= 1.36	VELU= 11.29	VELV= -8.83	VELS= 37.20	DEFK= 5.13
I= 5	PSIN(I)= .8	PHIN= -1.5	X= 2.86	Y= 1.32	VELU= 12.27	VELV= -9.61	VELS= 41.26	ALPHA= -43.03
I= 5	PSIN(I)= .8	PHIN= -2.0	X= 3.32	Y= 1.57	VELU= 13.25	VELV= -10.39	VELS= 45.32	DEFK= 17.42
I= 5	PSIN(I)= .8	PHIN= -2.5	X= 3.78	Y= 1.57	VELU= 14.23	VELV= -11.17	VELS= 49.38	ALPHA= -45.11
I= 5	PSIN(I)= .8	PHIN= -3.0	X= 4.24	Y= 1.57	VELU= 15.21	VELV= -11.95	VELS= 53.44	DEFK= 53.11
I= 5	PSIN(I)= .8	PHIN= -3.5	X= 4.70	Y= 1.57	VELU= 16.19	VELV= -12.73	VELS= 57.50	ALPHA= -47.19
I= 5	PSIN(I)= .8	PHIN= -4.0	X= 5.16	Y= 1.57	VELU= 17.17	VELV= -13.51	VELS= 61.56	ALPHA= -70.99
I= 5	PSIN(I)= .8	PHIN= -4.5	X= 5.62	Y= 1.57	VELU= 18.15	VELV= -14.29	VELS= 65.62	DEFK= 306.22
I= 5	PSIN(I)= .8	PHIN= -5.0	X= 6.08	Y= 1.57	VELU= 19.13	VELV= -15.07	VELS= 69.68	ALPHA= -72.00
I= 5	PSIN(I)= .8	PHIN= -5.5	X= 6.54	Y= 1.57	VELU= 20.11	VELV= -15.85	VELS= 73.74	DEFK= 847.23
I= 5	PSIN(I)= .8	PHIN= -6.0	X= 7.00	Y= 1.57	VELU= 21.09	VELV= -16.63	VELS= 77.80	ALPHA= 34.99
I= 5	PSIN(I)= .8	PHIN= -6.5	X= 7.46	Y= 1.57	VELU= 22.07	VELV= -17.41	VELS= 81.86	DEFK= 507.87
I= 5	PSIN(I)= .8	PHIN= -7.0	X= 7.92	Y= 1.57	VELU= 23.05	VELV= -18.19	VELS= 85.92	ALPHA= 17.11
I= 5	PSIN(I)= .8	PHIN= -7.5	X= 8.38	Y= 1.57	VELU= 24.03	VELV= -18.97	VELS= 90.00	DEFK= 155.37
I= 5	PSIN(I)= .8	PHIN= -8.0	X= 8.84	Y= 1.57	VELU= 25.01	VELV= -19.75	VELS= 94.06	ALPHA= -49.39
I= 5	PSIN(I)= .8	PHIN= -8.5	X= 9.30	Y= 1.57	VELU= 25.99	VELV= -20.53	VELS= 98.12	DEFK= 78.07
I= 5	PSIN(I)= .8	PHIN= -9.0	X= 9.76	Y= 1.57	VELU= 26.97	VELV= -21.31	VELS= 102.18	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -9.5	X= 10.22	Y= 1.57	VELU= 27.95	VELV= -22.09	VELS= 106.24	DEFK= .07
I= 5	PSIN(I)= .8	PHIN= -10.0	X= 10.68	Y= 1.57	VELU= 28.93	VELV= -22.87	VELS= 110.30	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -10.5	X= 11.14	Y= 1.57	VELU= 29.91	VELV= -23.65	VELS= 114.36	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -11.0	X= 11.60	Y= 1.57	VELU= 30.89	VELV= -24.43	VELS= 118.42	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -11.5	X= 12.06	Y= 1.57	VELU= 31.87	VELV= -25.21	VELS= 122.48	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -12.0	X= 12.52	Y= 1.57	VELU= 32.85	VELV= -25.99	VELS= 126.54	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -12.5	X= 12.98	Y= 1.57	VELU= 33.83	VELV= -26.77	VELS= 130.60	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -13.0	X= 13.44	Y= 1.57	VELU= 34.81	VELV= -27.55	VELS= 134.66	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -13.5	X= 13.90	Y= 1.57	VELU= 35.79	VELV= -28.33	VELS= 138.72	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -14.0	X= 14.36	Y= 1.57	VELU= 36.77	VELV= -29.11	VELS= 142.78	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -14.5	X= 14.82	Y= 1.57	VELU= 37.75	VELV= -29.89	VELS= 146.84	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -15.0	X= 15.28	Y= 1.57	VELU= 38.73	VELV= -30.67	VELS= 150.90	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -15.5	X= 15.74	Y= 1.57	VELU= 39.71	VELV= -31.45	VELS= 154.96	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -16.0	X= 16.20	Y= 1.57	VELU= 40.69	VELV= -32.23	VELS= 159.02	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -16.5	X= 16.66	Y= 1.57	VELU= 41.67	VELV= -33.01	VELS= 163.08	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -17.0	X= 17.12	Y= 1.57	VELU= 42.65	VELV= -33.79	VELS= 167.14	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -17.5	X= 17.58	Y= 1.57	VELU= 43.63	VELV= -34.57	VELS= 171.20	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -18.0	X= 18.04	Y= 1.57	VELU= 44.61	VELV= -35.35	VELS= 175.26	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -18.5	X= 18.50	Y= 1.57	VELU= 45.59	VELV= -36.13	VELS= 179.32	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -19.0	X= 18.96	Y= 1.57	VELU= 46.57	VELV= -36.91	VELS= 183.38	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -19.5	X= 19.42	Y= 1.57	VELU= 47.55	VELV= -37.69	VELS= 187.44	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -20.0	X= 19.88	Y= 1.57	VELU= 48.53	VELV= -38.47	VELS= 191.50	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -20.5	X= 20.34	Y= 1.57	VELU= 49.51	VELV= -39.25	VELS= 195.56	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -21.0	X= 20.80	Y= 1.57	VELU= 50.49	VELV= -40.03	VELS= 199.62	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -21.5	X= 21.26	Y= 1.57	VELU= 51.47	VELV= -40.81	VELS= 203.68	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -22.0	X= 21.72	Y= 1.57	VELU= 52.45	VELV= -41.59	VELS= 207.74	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -22.5	X= 22.18	Y= 1.57	VELU= 53.43	VELV= -42.37	VELS= 211.80	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -23.0	X= 22.64	Y= 1.57	VELU= 54.41	VELV= -43.15	VELS= 215.86	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -23.5	X= 23.10	Y= 1.57	VELU= 55.39	VELV= -43.93	VELS= 219.92	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -24.0	X= 23.56	Y= 1.57	VELU= 56.37	VELV= -44.71	VELS= 223.98	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -24.5	X= 24.02	Y= 1.57	VELU= 57.35	VELV= -45.49	VELS= 228.04	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -25.0	X= 24.48	Y= 1.57	VELU= 58.33	VELV= -46.27	VELS= 232.10	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -25.5	X= 24.94	Y= 1.57	VELU= 59.31	VELV= -47.05	VELS= 236.16	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -26.0	X= 25.40	Y= 1.57	VELU= 60.29	VELV= -47.83	VELS= 240.22	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -26.5	X= 25.86	Y= 1.57	VELU= 61.27	VELV= -48.61	VELS= 244.28	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -27.0	X= 26.32	Y= 1.57	VELU= 62.25	VELV= -49.39	VELS= 248.34	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -27.5	X= 26.78	Y= 1.57	VELU= 63.23	VELV= -50.17	VELS= 252.40	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -28.0	X= 27.24	Y= 1.57	VELU= 64.21	VELV= -50.95	VELS= 256.46	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -28.5	X= 27.70	Y= 1.57	VELU= 65.19	VELV= -51.73	VELS= 260.52	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -29.0	X= 28.16	Y= 1.57	VELU= 66.17	VELV= -52.51	VELS= 264.58	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -29.5	X= 28.62	Y= 1.57	VELU= 67.15	VELV= -53.29	VELS= 268.64	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -30.0	X= 29.08	Y= 1.57	VELU= 68.13	VELV= -54.07	VELS= 272.70	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -30.5	X= 29.54	Y= 1.57	VELU= 69.11	VELV= -54.85	VELS= 276.76	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -31.0	X= 30.00	Y= 1.57	VELU= 70.09	VELV= -55.63	VELS= 280.82	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -31.5	X= 30.46	Y= 1.57	VELU= 71.07	VELV= -56.41	VELS= 284.88	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -32.0	X= 30.92	Y= 1.57	VELU= 72.05	VELV= -57.19	VELS= 288.94	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -32.5	X= 31.38	Y= 1.57	VELU= 73.03	VELV= -57.97	VELS= 293.00	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -33.0	X= 31.84	Y= 1.57	VELU= 74.01	VELV= -58.75	VELS= 297.06	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -33.5	X= 32.30	Y= 1.57	VELU= 74.99	VELV= -59.53	VELS= 301.12	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -34.0	X= 32.76	Y= 1.57	VELU= 75.97	VELV= -60.31	VELS= 305.18	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -34.5	X= 33.22	Y= 1.57	VELU= 76.95	VELV= -61.09	VELS= 309.24	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -35.0	X= 33.68	Y= 1.57	VELU= 77.93	VELV= -61.87	VELS= 313.30	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -35.5	X= 34.14	Y= 1.57	VELU= 78.91	VELV= -62.65	VELS= 317.36	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -36.0	X= 34.60	Y= 1.57	VELU= 79.89	VELV= -63.43	VELS= 321.42	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -36.5	X= 35.06	Y= 1.57	VELU= 80.87	VELV= -64.21	VELS= 325.48	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -37.0	X= 35.52	Y= 1.57	VELU= 81.85	VELV= -64.99	VELS= 329.54	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -37.5	X= 35.98	Y= 1.57	VELU= 82.83	VELV= -65.77	VELS= 333.60	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -38.0	X= 36.44	Y= 1.57	VELU= 83.81	VELV= -66.55	VELS= 337.66	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -38.5	X= 36.90	Y= 1.57	VELU= 84.79	VELV= -67.33	VELS= 341.72	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -39.0	X= 37.36	Y= 1.57	VELU= 85.77	VELV= -68.11	VELS= 345.78	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -39.5	X= 37.82	Y= 1.57	VELU= 86.75	VELV= -68.89	VELS= 349.84	DEFK= .00
I= 5	PSIN(I)= .8	PHIN= -40.0	X= 38.28	Y= 1.57	VELU= 87.73	VELV= -69.67	VELS= 353.90	ALPHA= .00
I= 5	PSIN(I)= .8	PHIN= -40.5	X= 38.74	Y= 1.57	VELU= 88.71	VELV= -70.45	VELS= 357.96	DEFK

I= 6	PSIN(I)=1.0	PHIN= .5	X= -.57	Y= 1.57	VELU= 154.15	VELV= .00	VELS= 154.15	ALPHA= .00
					DV/DX=-DV/DY=#####	DV/DX=+DU/DY=	.05	DEFK=#####
I= 6	PSIN(I)=1.0	PHIN= .0	X= -.50	Y= 1.57	VELU= .00	VELV=#####	VELS=#####	ALPHA= 90.00
					DV/DX=-DV/DY=	.00	DV/DX=+DU/DY=#####	DEFK=#####
I= 6	PSIN(I)=1.0	PHIN= -.5	X= -.55	Y= 1.57	VELU= -254.15	VELV= .00	VELS= 254.15	ALPHA= -.00
					DV/DX=-DV/DY=#####	DV/DX=+DU/DY=	.07	DEFK=#####
I= 6	PSIN(I)=1.0	PHIN=-1.0	X= -.68	Y= 1.57	VELU= -158.20	VELV= .00	VELS= 158.20	ALPHA= -.00
					DV/DX=-DV/DY=#####	DV/DX=+DU/DY=	.00	DEFK=291.30
I= 6	PSIN(I)=1.0	PHIN=-1.5	X= -.86	Y= 1.57	VELU= -128.72	VELV= .00	VELS= 128.72	ALPHA= -.00
					DV/DX=-DV/DY=-95.18	DV/DX=+DU/DY=	.00	DEFK= 95.18
CHANNEL WIDTH 0.31416 CHANNEL VEL VELC= -100.00 ENTRANCE PLANE LOCATION XE=-.500 FLUX PER UNIT DEPTH=-314.160 NORMALIZATION FACTOR K=PHIN/PHI=PSIN*SI/PSI= .020 *STEP= 0								

APPENDIX B

AXISYMMETRIC CONTRACTION POTENTIAL FLOW SOLUTION

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APPENDIX B: AXISYMMETRIC CONTRACTION

A solution technique for the potential flow through an axisymmetric contraction has been developed, using the method of Boadway (1976). He obtained an equivalent form of the governing equation ($\nabla^2 \psi = \frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial r^2} - \frac{1}{r} \frac{\partial \psi}{\partial r} = 0$) in order to solve for the set of $R(\psi, x)$ at selected (I, J) points on a regular, rectangular grid. The 'I' ordinate is the position along the axis; the 'J' ordinate is the number of the streamline in the half-plane from centerline ($J = 1$) to the wall ($J = NJ$). Figure 10 shows the notation and geometrical conventions for this analysis.

The transformation, due to J. D. Boadway, requires the solution of a quadratic equation for $R(I, J)$ at interior points, based on values at the four neighboring grid points $R(I \pm 1, J \pm 1)$:

$$R(I, J) = (-B - \sqrt{B^2 - 4AC})/2A$$

in standard quadratic form, where:

$$A = -2(\psi_1^2 + X_1^2 + 4h_x^2)$$

$$B = X_2 \cdot \psi_1^2 + \psi_2 \cdot X_1^2 + 4\psi_2 \cdot h_x^2 - \frac{1}{2} \cdot X\psi \cdot X_1 \cdot \psi_1$$

$$C = h_x^2 \cdot \psi_1^2$$

the terms X_1 , X_2 , ψ_1 , ψ_2 and $X\psi$ are defined as:

$$X1 = R(I+1,J) - R(I-1,J)$$

$$X2 = R(I+1,J) + R(I-1,J)$$

$$\phi1 = R(I,J+1) - R(I,J-1)$$

$$\phi2 = R(I,J+1) + R(I,J-1)$$

$$X\phi = R(I+1,J+1) + R(I-1,J-1) - R(I+1,J-1) - R(I-1,J+1)$$

This equation is systematically applied to all interior points through two DO loops, based on current values at the neighboring points. Successive over-relaxation (the extrapolated Liebmann method) reduces the number of iterations required to achieve a given convergence criteria. As described by McCracken and Dorn (p. 375), one applies the relaxation parameter ($1 \leq \omega \leq 2$) to the exact computed value (now called ROOTR (I,J) and the value remaining from the previous iteration (now called HOLDR (I,J)), to obtain a new value, which is identified as simply R(I,J): $R(I,J) = \omega * \text{ROOTR}(I,J) + (1-\omega) \text{HOLDR}(I,J)$.

The value of ω which will optimize the convergence rate is empirically determined. In this case, the program was run for the 7 inch bore geometry on a 25 x 11 grid, with values of $\omega = 1.5, 1.6, 1.7$ and 1.8 . The largest relative change for any point in the grid in a single iteration ($\text{BIG} = \text{MAX} (R(I,J) - \text{HOLDR}(I,J)) / R(I,J)$) was evaluated and compared to the convergence criteria, ϵ_{max} . The final values of BIG and $\epsilon_{\text{RMS}} = \sqrt{\sum \epsilon_{i,j}^2} / (23)(9)$ are given for $\omega = 1.6$. These results are presented below in Table B-1.

Table B-1. Relaxation Parameter Study
for 7 Inch Bore Geometry, 25 x 11 Grid

22 Feb. Run: $\max = 1 \times 10^{-4}$

ω	1.5	1.6	1.7	1.8
BIG < $\epsilon_{\max}$?	yes	yes	yes	no
# iterations	19	15	23	ITMAX =25

23 Feb. Run: - 1.6

$\epsilon_{\max}$	1×10^{-4}	1×10^{-6}
# iterations	15	25
BIG	7.4×10^{-5}	7.2×10^{-7}
ϵ_{RMS}	2.2×10^{-5}	1.3×10^{-7}

Based on this trial, $\omega = 1.6$ was used for all subsequent calculations.

Finite difference solutions of non-linear equations are subject to an inherent inaccuracy, often called the discretization error. Forsythe and Wasow extensively discuss theoretical limits for this error, with respect to node spacing, approximation equation form (the number of neighbors considered), and solution method. Proceeding in the style of an engineering evaluation (rather than as a

mathematician), the magnitude of this potential inaccuracy was studied by reducing the axial grid spacing (h_x) from 2 to 1 cm and increasing the number of streamlines on the half-plane from 11 to 21. The length of the cylindrical section on each side of the contraction was also slightly lengthened to better accommodate the section change effects. Final grid size became 60 x 21. With this larger grid size the computed values were changed very little, typically about % in relative difference.

The appropriate equations for calculation of the velocity and deformation rate components may be found in the computer program print-out. Note that calculation of the radial velocity component, $v = -\frac{1}{r} \frac{\partial \psi}{\partial x}$, requires interpolation of the streamline positions to determine appropriate streamline values associated with intermediate points not on the grid. In the notation of Figure 10b, we create points A and B, evaluate ψ_A and ψ_B (by assuming a linear variation in streamtube area), and then compute:

$$v(I,J) = \frac{1}{2R(I,J)} \left[\frac{\psi_A - \psi(I,J)}{h_x} + \frac{\psi(I,J) - \psi_B}{h_x} \right]$$

The program was run for the three geometries shown in Figure 10a. The computer print-outs are reproduced in this Appendix; the results are discussed in Section 4.3. Although all of experimental flows are amenable to potential flow analysis, two impediments limited the further application of the contraction program. The method requires

specification of the stagnation streamline geometry, but:

(1) Boadway's transformed equation cannot accomodate a streamline which becomes normal to the axis (where $\frac{\partial r}{\partial x} = \infty$), such as would occur with a rounded mouth, just downstream of the stagnation point; and (2) large rise rates for bubbles in very low velocities reduce one's certainty in the position of the observed stagnation streamline near the stagnation point, as discussed in Section 3.4.

Boadway found that his program is roughly one-third of the size of the comparable finite difference program in space co-ordinates, and it can solve a given problem in about one-tenth the computer time. Given my time constraints, the effort required to verify all of the experimental flows by another method was judged to be unwarranted.

```

1. C *****
2. C PROGRAM TO COMPUTE STREAMLINE RADIAL POSITION FOR FLOW IN A
3. C CONTRACTION, BASED ON THE GAUSS-SIDEL ITERATION METHOD, USING
4. C A 9-POINT JURY, FOR A TRANSFORMED LAPLACE EQUATION.
5. C *****
6. C SOLVE FOR R(I,J), WHERE I= AXIAL LOCATION; J= STREAMLINE NUMBER.
7. C SUCCESSIVE OVERRELAXATION METHOD USED. OMEGA IS THE RELAXATION
8. C PARAMETER. EPSILON IS THE RELATIVE CHANGE FROM ONE ITERATION TO
9. C THE NEXT. BIG IS THE LARGEST EPS FOR ALL GRID POINTS IN ONE
10. C PASS. CONVERGENCE OCCURS WHEN BIG IS REDUCED TO EPSMAX.
11. C *****
12. C COORDINATES IN CENTIMETERS; REPRESENT FULL-SCALE FORMS.
13. C *****
14. C IMPLICIT DOUBLE PRECISION (A-H,O-Z)
15. C DIMENSION A(60,21), B(60,21), C(60,21), FGOTR(60,21), R(60,21)
16. C DIMENSION RSQ(44:60,21), VELU(45:60,21), VELV(45:60,21)
17. C DIMENSION DEFRX(46:59,21), DEFRY(46:59,21), DEFRN(46:59,21)
18. C DIMENSION DEFRS(46:59,21), DEFRM(46:60,21)
19. C DATA R(6,21), R(9,21), R(10,21), R(11,21)/1.8, 2.1, 2.4, 2.7/
20. C DATA R(12,21), R(13,21), R(14,21), R(15,21)/3.0, 3.3, 3.6, 3.9/
21. C DATA R(16,21), R(17,21), R(18,21), R(19,21)/4.2, 4.5, 4.8, 5.1/
22. C DATA VELU(3, PI/-5.0, 3.141592654/
23. C READ(105,10) HX,NJ,NJITMAX,EPSMAX,OMEGA, R(20,21), R(21,21),
24. C 1 R(22,21), R(23,21), R(24,21), R(25,21), R(26,21), R(27,21)
25. C 13 FORMAT(14G)
26. C READ(105,11) R(28,21), R(29,21), R(30,21), R(31,21), R(32,21),
27. C 1 R(33,21), R(34,21), R(35,21), R(36,21), R(37,21), R(38,21)
28. C 11 FORMAT(11G)
29. C READ(105,12) R(39,21), R(40,21), R(41,21), R(42,21), R(43,21),
30. C 1 R(44,21), R(45,21), R(46,21), R(47,21), R(48,21), R(49,21)
31. C 12 FORMAT(11G)
32. C READ(105,13) R(50,21), R(51,21), R(52,21), R(53,21), R(54,21),
33. C 1 R(55,21), R(56,21), R(57,21), R(58,21), R(59,21), R(60,21)
34. C 13 FORMAT(11G)
35. C
36. C NIM1=NI-1
37. C NIM2=NI-2
38. C NJM1=NJ-1
39. C NJM2=NJ-2
40. C *****
41. C GENERATION OF REMAINING BOUNDARY VALUES
42. C DO 20 I=1,N1
43. C 20 R(I,1)=0.0
44. C DO 21 I=1,7
45. C 21 R(I,21)=1.5
46. C DO 22 J=2,NJM1
47. C R(I,J)=R(I,21)*DSORT((J-1.0)/NJM1)
48. C 22 R(60,J)=R(60,21)*DSORT((J-1.0)/NJM1)
49. C *****
50. C GENERATION OF INITIAL VALUES OF INTERIOR POINTS
51. C DO 30 I=2,NIM1
52. C DO 30 J=2,NJM1
53. C 30 R(I,J)=R(I,21)*DSORT((J-1.0)/NJM1)
54. C *****
55. C ITERATION SCHEME
56. C ITER=0
57. C 40 BIG=U.0
58. C SUMEPSSO= 0.0
59. C ITER=ITER+1
60. C
61. C DO 50 I=2,NIM1
62. C DO 50 J=2,NJM1
63. C HOLDR=R(I,J)
64. C A(I,J)=2.0*(R(I,J+1)-R(I,J-1))*2 + (R(I+1,J)-R(I-1,J))*2
65. C 1 + 4.0*HX**2
66. C R(I,J)=(R(I+1,J)+R(I-1,J))+R(I,J+1)-R(I,J-1))*2
67. C 1 + 4.0*HY**2 + R(I,J+1)+R(I,J-1)+R(I+1,J)+R(I-1,J)

```



```

58. SUMEPSSQ= 0.0
59. ITER=ITER+1

60. DO 50 I=2,NIMI
61. DO 50 J=2,NJMI
62. HOLDR=R(I,J)
63. A(I,J)=-2.*(R(I,J+1)-R(I,J-1))**2 + (R(I+1,J)-R(I-1,J))**2
64. 1 +4.*HX**2)
65. E(I,J)=(R(I+1,J)+R(I-1,J))*(R(I,J+1)-R(I,J-1))**2
66. 1 + (R(I+1,J)+R(I-1,J))*(R(I+1,J)-R(I-1,J))**2 +4.*HX**2 *(R(I,J+1)
67. 2 +R(I,J-1)) -0.5*(R(I+1,J+1)+R(I-1,J-1)-R(I+1,J-1)-R(I-1,J+1))
68. 3 *(R(I+1,J)-R(I-1,J))*(R(I,J+1)-R(I,J-1))
69. C(I,J)=(HX*(R(I,J+1)-R(I,J-1))**2
70. R(I,J)=C(I,J)-OSQRT(8(I,J))**2
71. 1 -4.*A(I,J)=C(I,J))/12.*A(I,J))
72. R(I,J)=OMEGA*ROTRI(I,J) + (1.-OMEGA)*HOLDR
73. EPS=OABS(X(I,J)-HOLDR)/R(I,J))
74. SUMEPSSQ= EPS**2 +SUMEPSSQ
75. IF (EPS .GT. BIG) BIG=EPS
76. RMSEPS= DSQRT(SUMEPSSQ/(NIM2*NJM2))
77. C
78. C
79. WRITE(108,200) ITER, BIG, RMSEPS
80. 200 FORMAT(1X,5HITER=,I3,2X,4H0IG=,E12.6,2X,7HRMSEPS=,E12.6)
81. C
82. IF (BIG .LE. EPSMAX) GO TO 60
83. IF (ITER - ITMAX) 40,80,80
84. C
85. C
86. C *****
87. C OUTPUT STATEMENTS IF CONVERGENCE IN LESS THAN ITMAX ITERATIONS
88. C *****
89. 60 WRITE(108,100) NI,NJ
90. 100 FORMAT(1X,12HMODEL OF 7PT,3X,12,1X,1HX,1X,12)
91. WRITE(108,260) BIG,ITER, (I,I=1,15)
92. 260 FORMAT(1X,10X,30HCONVERGENCE TO WITHIN EPSILON=,E12.6,1X,
93. 1 20H:HAS BEEN ACHIEVED IN,I3,1X,11HITERATIONS=,
94. 2 /10X,40HTHE STREAMLINES' RADIAL COORDINATES ARE:,//4X,2HI=,1518)
95. DO 261 J=1,NJ
96. 261 WRITE(108,262) J, (R(I,J),I=1,15)
97. 262 FORMAT(1X,2HJ=,I2,2X,15F8.4)
98. WRITE(108,263) (I,I=16,30)
99. 263 FORMAT(1X,11X,2HI=,1518)
100. DO 264 J=1,NJ
101. 264 WRITE(108,265) J, (R(I,J),I=16,30)
102. 265 FORMAT(1X,12HJ=,I2,2X,15F8.4)
103. WRITE(108,266) (I,I=31,45)
104. 266 FORMAT(1X,11X,2HI=,1518)
105. DO 267 J=1,NJ
106. 267 WRITE(108,268) J, (R(I,J),I=31,45)
107. 268 FORMAT(1X,12HJ=,I2,2X,15F8.4)
108. WRITE(108,269) (I,I=46,60)
109. 269 FORMAT(1X,11X,2HI=,1518)
110. DO 270 J=1,NJ
111. 270 WRITE(108,271) J, (R(I,J),I=46,60)
112. 271 FORMAT(1X,12HJ=,I2,2X,15F8.4)
113. C
114. C
115. C *****
116. C OUTPUT STATEMENTS IF CONVERGENCE HAS NOT OCCURED BY ITMAX
117. C *****
118. 80 WRITE(108,120) NI,NJ
119. 120 FORMAT(1X,12HMODEL OF 7PT,3X,12,1X,1HX,1X,12)
120. WRITE(108,280) ITMAX,EPSSMAX, (I,I=1,15)
121. 280 FORMAT(1X,10X,30HCONVERGENCE HAS NOT BEEN ACHIEVED BY,I3,1X,
122. 1 22HITERATIONS FOR EPSMAX=,E9.1,4X,21HTHE CURRENT VALUES OF,

```


[illegible]

ENTRANCE REGION VELOCITY AND MEAN DEFORMATION RATE VALUES

STRAIGHT 7 IN. BORE UPSTREAM

For Iteration no. 60:

BIG : 2.54E-5

42 RMSEPS : 46.79E-6

I=	34	35	36	37	38	39	40	41	42 RMSEPS	46	47	48
J= 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	-5.833	-5.796	-5.771	-5.755	-5.744	-5.737	-5.732	-5.729	-5.727	-5.725	-5.724	-5.723
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.207	0.202	0.199	0.197	0.195	0.195	0.194	0.194	0.194	0.193	0.193	0.193
J= 2	1.8425	1.8484	1.8523	1.8550	1.8568	1.8579	1.8587	1.8592	1.8595	1.8598	1.8600	1.8603
	-5.456	-5.425	-5.404	-5.390	-5.381	-5.375	-5.371	-5.369	-5.367	-5.366	-5.364	-5.363
	-0.039	-0.026	-0.018	-0.012	-0.008	-0.005	-0.003	-0.002	-0.001	-0.001	-0.001	-0.001
	0.352	0.339	0.330	0.324	0.320	0.318	0.316	0.315	0.314	0.314	0.313	0.312
J= 3	2.7006	2.7083	2.7134	2.7168	2.7191	2.7206	2.7216	2.7222	2.7227	2.7229	2.7233	2.7237
	-5.058	-5.035	-5.020	-5.010	-5.003	-4.999	-4.996	-4.994	-4.993	-4.992	-4.991	-4.990
	-0.048	-0.032	-0.022	-0.014	-0.009	-0.006	-0.004	-0.003	-0.002	-0.001	-0.001	-0.001
	0.277	0.262	0.251	0.244	0.239	0.236	0.234	0.232	0.231	0.231	0.230	0.229
J= 4	3.3503	3.3590	3.3647	3.3685	3.3711	3.3727	3.3738	3.3745	3.3750	3.3753	3.3757	3.3761
	-5.027	-5.008	-4.996	-4.988	-4.983	-4.979	-4.977	-4.976	-4.975	-4.974	-4.973	-4.973
	-0.054	-0.036	-0.024	-0.016	-0.010	-0.007	-0.004	-0.003	-0.002	-0.001	-0.001	-0.001
	0.067	0.050	0.039	0.032	0.027	0.024	0.022	0.020	0.019	0.018	0.018	0.017
J= 5	3.8951	3.9042	3.9103	3.9143	3.9165	3.9186	3.9198	3.9205	3.9210	3.9213	3.9217	3.9221
	-5.009	-4.995	-4.985	-4.975	-4.971	-4.969	-4.968	-4.967	-4.966	-4.965	-4.964	-4.963
	-0.057	-0.038	-0.025	-0.016	-0.011	-0.007	-0.005	-0.003	-0.002	-0.001	-0.001	-0.001
	0.057	0.040	0.029	0.021	0.016	0.013	0.011	0.009	0.008	0.008	0.007	0.006
J= 6	4.3739	4.3832	4.3893	4.3933	4.3959	4.3977	4.3988	4.3995	4.4000	4.4004	4.4008	4.4012
	-4.986	-4.985	-4.978	-4.974	-4.971	-4.969	-4.968	-4.967	-4.966	-4.966	-4.966	-4.966
	-0.058	-0.038	-0.025	-0.017	-0.011	-0.007	-0.005	-0.003	-0.002	-0.001	-0.001	-0.001
	0.054	0.037	0.025	0.018	0.013	0.009	0.007	0.006	0.005	0.004	0.004	0.003
J= 7	4.8062	4.8154	4.8214	4.8254	4.8276	4.8296	4.8307	4.8315	4.8320	4.8325	4.8328	4.8331
	-4.985	-4.977	-4.973	-4.970	-4.968	-4.966	-4.965	-4.964	-4.963	-4.962	-4.961	-4.960
	-0.058	-0.038	-0.025	-0.016	-0.011	-0.007	-0.005	-0.003	-0.002	-0.001	-0.001	-0.001
	0.052	0.035	0.023	0.016	0.011	0.008	0.006	0.004	0.004	0.003	0.002	0.001
J= 8	5.2035	5.2124	5.2182	5.2221	5.2245	5.2262	5.2272	5.2279	5.2284	5.2289	5.2291	5.2293
	-4.975	-4.970	-4.968	-4.967	-4.966	-4.965	-4.965	-4.965	-4.965	-4.965	-4.965	-4.964
	-0.056	-0.037	-0.024	-0.016	-0.010	-0.007	-0.004	-0.003	-0.002	-0.001	-0.001	-0.001
	0.050	0.033	0.022	0.015	0.010	0.007	0.005	0.004	0.003	0.002	0.001	0.001
J= 9	5.5732	5.5817	5.5873	5.5909	5.5932	5.5948	5.5958	5.5964	5.5969	5.5972	5.5975	5.5978
	-4.966	-4.965	-4.964	-4.964	-4.964	-4.964	-4.964	-4.964	-4.964	-4.964	-4.964	-4.964
	-0.054	-0.035	-0.023	-0.015	-0.010	-0.006	-0.004	-0.003	-0.002	-0.001	-0.001	-0.001
	0.047	0.031	0.020	0.013	0.009	0.006	0.004	0.003	0.002	0.001	0.001	0.000
J=10	5.9205	5.9285	5.9337	5.9370	5.9392	5.9406	5.9416	5.9422	5.9426	5.9431	5.9434	5.9435
	-4.958	-4.959	-4.961	-4.962	-4.962	-4.963	-4.963	-4.963	-4.964	-4.964	-4.964	-4.964
	-0.050	-0.033	-0.021	-0.014	-0.009	-0.006	-0.004	-0.003	-0.002	-0.001	-0.001	-0.001
	0.045	0.029	0.019	0.012	0.008	0.006	0.004	0.003	0.002	0.001	0.001	0.000
J=11	6.2489	6.2563	6.2611	6.2642	6.2662	6.2675	6.2684	6.2689	6.2693	6.2696	6.2697	6.2698
	-4.951	-4.955	-4.958	-4.960	-4.961	-4.962	-4.963	-4.963	-4.963	-4.963	-4.964	-4.964
	-0.047	-0.030	-0.020	-0.013	-0.008	-0.005	-0.004	-0.002	-0.002	-0.001	-0.001	-0.001
	0.042	0.027	0.017	0.011	0.006	0.005	0.003	0.002	0.002	0.001	0.001	0.000
J=12	6.5614	6.5681	6.5724	6.5752	6.5770	6.5782	6.5790	6.5795	6.5798	6.5801	6.5803	6.5806
	-4.944	-4.948	-4.951	-4.954	-4.956	-4.958	-4.959	-4.960	-4.960	-4.961	-4.961	-4.961
	-0.042	-0.027	-0.017	-0.011	-0.006	-0.005	-0.004	-0.003	-0.002	-0.001	-0.001	-0.001
	0.042	0.027	0.017	0.011	0.006	0.005	0.004	0.003	0.002	0.001	0.001	0.000

J=11	6.2489 -4.951 -.047 -.042	6.2563 -4.955 -.030 -.027	6.2611 -4.958 -.020 -.017	6.2642 -4.960 -.013 -.011	6.2662 -4.961 -.008 -.008	6.2675 -4.962 -.005 -.005	6.2684 -4.963 -.004 -.003	6.2689 -4.963 -.002 -.002	6.2693 -4.963 -.002 -.002	6.2696 -4.963 -.001 -.001	6.2697 -4.964 -.001 -.001	6.2698 -4.964 -.001 -.001	6.2699 -4.964 -.001 -.001	6.2700 -4.964 -.001 -.001	6.2702 -4.964 -.001 -.001
J=12	6.5614 -4.945 -.042 -.039	6.5724 -4.955 -.018 -.025	6.5752 -4.958 -.010 -.016	6.5770 -4.960 -.007 -.007	6.5782 -4.961 -.005 -.005	6.5790 -4.962 -.003 -.003	6.5795 -4.963 -.002 -.002	6.5798 -4.963 -.001 -.001	6.5801 -4.963 -.001 -.001	6.5802 -4.963 -.001 -.001	6.5803 -4.963 -.001 -.001	6.5804 -4.964 -.000 -.000	6.5805 -4.964 -.000 -.000	6.5806 -4.964 -.000 -.000	6.5806 -4.964 -.000 -.000
J=13	6.8599 -4.940 -.038 -.036	6.8659 -4.948 -.024 -.023	6.8698 -4.953 -.016 -.015	6.8723 -4.957 -.010 -.010	6.8739 -4.959 -.006 -.006	6.8749 -4.961 -.004 -.004	6.8756 -4.962 -.003 -.003	6.8761 -4.962 -.002 -.002	6.8764 -4.963 -.001 -.001	6.8766 -4.963 -.001 -.001	6.8767 -4.963 -.001 -.001	6.8768 -4.963 -.000 -.000	6.8769 -4.963 -.000 -.000	6.8770 -4.964 -.000 -.000	6.8770 -4.964 -.000 -.000
J=14	7.1463 -4.931 -.033 -.032	7.1515 -4.945 -.021 -.021	7.1549 -4.950 -.014 -.013	7.1571 -4.955 -.009 -.009	7.1585 -4.958 -.006 -.006	7.1594 -4.960 -.004 -.004	7.1600 -4.961 -.002 -.002	7.1604 -4.962 -.002 -.002	7.1606 -4.963 -.001 -.001	7.1608 -4.963 -.001 -.001	7.1609 -4.963 -.001 -.001	7.1610 -4.963 -.000 -.000	7.1611 -4.963 -.000 -.000	7.1612 -4.964 -.000 -.000	7.1612 -4.964 -.000 -.000
J=15	7.4219 -4.923 -.028 -.029	7.4263 -4.942 -.018 -.019	7.4292 -4.950 -.012 -.012	7.4310 -4.954 -.008 -.008	7.4322 -4.958 -.005 -.005	7.4330 -4.960 -.003 -.003	7.4335 -4.961 -.002 -.002	7.4338 -4.962 -.001 -.001	7.4341 -4.962 -.001 -.001	7.4342 -4.963 -.001 -.001	7.4343 -4.963 -.001 -.001	7.4344 -4.963 -.000 -.000	7.4344 -4.963 -.000 -.000	7.4345 -4.963 -.000 -.000	7.4346 -4.964 -.000 -.000
J=16	7.6877 -4.928 -.023 -.027	7.6914 -4.941 -.015 -.017	7.6938 -4.948 -.010 -.011	7.6953 -4.953 -.006 -.007	7.6963 -4.957 -.004 -.005	7.6969 -4.959 -.003 -.003	7.6973 -4.961 -.002 -.002	7.6976 -4.962 -.001 -.001	7.6978 -4.962 -.001 -.001	7.6979 -4.963 -.001 -.001	7.6980 -4.963 -.000 -.000	7.6980 -4.963 -.000 -.000	7.6981 -4.963 -.000 -.000	7.6982 -4.963 -.000 -.000	7.6982 -4.964 -.000 -.000
J=17	7.9448 -4.926 -.018 -.024	7.9477 -4.939 -.012 -.015	7.9496 -4.948 -.008 -.010	7.9508 -4.953 -.005 -.006	7.9516 -4.957 -.003 -.004	7.9521 -4.959 -.002 -.003	7.9524 -4.960 -.001 -.002	7.9526 -4.961 -.001 -.001	7.9528 -4.962 -.001 -.001	7.9529 -4.963 -.000 -.001	7.9529 -4.963 -.000 -.000	7.9530 -4.963 -.000 -.000	7.9530 -4.963 -.000 -.000	7.9531 -4.963 -.000 -.000	7.9531 -4.964 -.000 -.000
J=18	8.1940 -4.924 -.014 -.022	8.1961 -4.938 -.009 -.014	8.1975 -4.947 -.006 -.009	8.1984 -4.953 -.004 -.006	8.1990 -4.956 -.002 -.004	8.1993 -4.959 -.002 -.002	8.1996 -4.960 -.001 -.002	8.1997 -4.961 -.001 -.001	8.1998 -4.962 -.000 -.001	8.1999 -4.962 -.000 -.001	8.2000 -4.963 -.000 -.000	8.2000 -4.963 -.000 -.000	8.2000 -4.963 -.000 -.000	8.2001 -4.963 -.000 -.000	8.2001 -4.964 -.000 -.000
J=19	8.4358 -4.923 -.009 -.020	8.4373 -4.937 -.006 -.013	8.4382 -4.946 -.004 -.008	8.4387 -4.952 -.002 -.005	8.4391 -4.956 -.002 -.004	8.4393 -4.959 -.001 -.002	8.4395 -4.960 -.001 -.002	8.4396 -4.961 -.000 -.001	8.4397 -4.962 -.000 -.001	8.4397 -4.962 -.000 -.001	8.4398 -4.963 -.000 -.000	8.4398 -4.963 -.000 -.000	8.4398 -4.963 -.000 -.000	8.4398 -4.963 -.000 -.000	8.4398 -4.964 -.000 -.000
J=20	8.6710 -4.922 -.004 -.019	8.6717 -4.937 -.003 -.012	8.6721 -4.946 -.002 -.008	8.6724 -4.952 -.001 -.005	8.6726 -4.956 -.001 -.003	8.6727 -4.958 -.000 -.002	8.6728 -4.960 -.000 -.001	8.6729 -4.961 -.000 -.001	8.6729 -4.962 -.000 -.001	8.6729 -4.962 -.000 -.001	8.6729 -4.963 -.000 -.000	8.6729 -4.963 -.000 -.000	8.6730 -4.963 -.000 -.000	8.6730 -4.963 -.000 -.000	8.6730 -4.964 -.000 -.000
J=21	8.9000 -4.922 -.000 -.019	8.9000 -4.936 -.000 -.012	8.9000 -4.946 -.000 -.008	8.9000 -4.952 -.000 -.005	8.9000 -4.956 -.000 -.003	8.9000 -4.958 -.000 -.002	8.9000 -4.960 -.000 -.001	8.9000 -4.961 -.000 -.001	8.9000 -4.962 -.000 -.001	8.9000 -4.962 -.000 -.001	8.9000 -4.963 -.000 -.000	8.9000 -4.963 -.000 -.000	8.9000 -4.963 -.000 -.000	8.9000 -4.963 -.000 -.000	8.9000 -4.964 -.000 -.000

ENTRANCE REGION DEFORMATION RATE COMPONENTS

DEPRXII,J) (1/SEC)

DEPRRI(I,J)

DEPRRI(I,J)

DEPRRI(I,J)

I=

J= 1

J= 2

J= 3

J= 4

J= 5

J= 6

J= 7

J= 8

J= 9

J=10

J=11

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J=349

MODEL OF 7PT

For Iteration no. 60:
BIG: 2.44E-5
RMSEPS: 7.86E-6

ENTRANCE REGION VELOCITY AND MEAN DEFORMATION RATE VALUES

For Iteration no. 60: BIG: 2.44E-5 RMSEPS: 7.86E-6																
I=	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
J= 1	0.0000 -7.246 0.000 0.000 0.000	0.0000 -6.579 0.000 0.000 0.000	0.0000 -6.743 0.000 0.000 0.000	0.0000 -6.535 0.000 0.000 0.000	0.0000 -6.364 0.000 0.000 0.000	0.0000 -6.216 0.000 0.000 0.000	0.0000 -6.093 0.000 0.000 0.000	0.0000 -5.988 0.000 0.000 0.000	0.0000 -5.988 0.000 0.000 0.000	0.0000 -5.813 0.000 0.000 0.000	0.0000 -5.728 0.000 0.000 0.000	0.0000 -5.630 0.000 0.000 0.000	0.0000 -5.499 0.000 0.000 0.000	0.0000 -5.367 0.000 0.000 0.000	0.0000 -5.231 0.000 0.000 0.000	0.0000 -5.000 0.000 0.000 0.000
J= 2	2.2662 -6.765 -0.297 0.456	2.3090 -6.513 -0.270 0.433	2.3491 -6.290 -0.240 0.404	2.3856 -6.099 -0.210 0.378	2.4181 -5.937 -0.181 0.352	2.4466 -5.802 -0.154 0.326	2.4713 -5.690 -0.131 0.306	2.4928 -5.598 -0.113 0.284	2.5119 -5.520 -0.102 0.263	2.5300 -5.450 -0.100 0.239	2.5487 -5.384 -0.110 0.210	2.5709 -5.313 -0.139 0.170	2.6012 -5.231 -0.200 0.121	2.6479 -5.126 -0.318 0.240	2.7280 -5.000 -0.000 0.000	2.8126 -4.960 -0.202 0.140
J= 3	3.3251 -6.246 -0.411 0.406	3.3391 -6.006 -0.372 0.384	3.4485 -5.797 -0.325 0.361	3.5023 -5.620 -0.285 0.337	3.5497 -5.472 -0.242 0.312	3.5907 -5.353 -0.203 0.286	3.6255 -5.257 -0.169 0.261	3.6551 -5.131 -0.143 0.236	3.6805 -5.120 -0.124 0.212	3.7034 -5.070 -0.114 0.186	3.7255 -5.029 -0.115 0.156	3.7491 -4.979 -0.128 0.119	3.7770 -4.968 -0.158 0.070	3.8126 -4.960 -0.202 0.140	3.8580 -5.000 -0.000 0.000	3.9000 -5.000 -0.000 0.000
J= 4	4.1292 -6.182 -0.513 0.284	4.2093 -5.939 -0.407 0.260	4.2843 -5.729 -0.407 0.234	4.3513 -5.552 -0.390 0.207	4.4099 -5.408 -0.294 0.175	4.4598 -5.294 -0.274 0.150	4.5017 -5.205 -0.200 0.122	4.5365 -5.137 -0.165 0.096	4.5657 -5.085 -0.139 0.072	4.5912 -5.045 -0.123 0.050	4.6145 -5.015 -0.117 0.030	4.6379 -4.992 -0.121 0.019	4.6632 -4.979 -0.135 0.027	4.6921 -4.980 -0.155 0.052	4.7250 -5.000 -0.000 0.000	4.7580 -5.000 -0.000 0.000
J= 5	4.6037 -6.132 -0.601 0.292	4.6909 -5.863 -0.593 0.269	4.7693 -5.673 -0.529 0.243	4.8384 -5.498 -0.483 0.215	4.8984 -5.307 -0.443 0.185	4.9498 -5.117 -0.297 0.162	5.0000 -4.931 -0.237 0.128	5.0498 -4.765 -0.205 0.094	5.0984 -4.617 -0.188 0.072	5.1466 -4.472 -0.152 0.046	5.1941 -4.330 -0.126 0.028	5.2409 -4.199 -0.107 0.010	5.2870 -4.077 -0.088 0.003	5.3325 -3.962 -0.071 0.001	5.3775 -3.850 -0.055 0.000	5.4220 -3.740 -0.040 0.000
J= 6	5.4625 -6.084 -0.679 0.304	5.5108 -5.833 -0.603 0.282	5.5601 -5.581 -0.529 0.257	5.6094 -5.330 -0.443 0.228	5.6584 -5.079 -0.369 0.196	5.7069 -4.828 -0.297 0.162	5.7548 -4.577 -0.237 0.128	5.8020 -4.326 -0.188 0.094	5.8484 -4.075 -0.152 0.072	5.8941 -3.824 -0.126 0.046	5.9391 -3.573 -0.100 0.028	5.9834 -3.322 -0.074 0.010	6.0270 -3.071 -0.048 0.003	6.0700 -2.820 -0.022 0.001	6.1125 -2.570 0.000 0.000	6.1545 -2.320 0.000 0.000
J= 7	5.9437 -6.035 -0.752 0.317	6.0644 -5.780 -0.670 0.296	6.1748 -5.524 -0.581 0.272	6.2722 -5.330 -0.487 0.244	6.3568 -5.137 -0.396 0.210	6.4225 -4.944 -0.315 0.172	6.4765 -4.743 -0.247 0.135	6.5192 -4.542 -0.193 0.101	6.5600 -4.340 -0.152 0.072	6.5998 -4.138 -0.126 0.046	6.6384 -3.936 -0.100 0.028	6.6757 -3.735 -0.074 0.010	6.7120 -3.534 -0.048 0.003	6.7475 -3.333 -0.022 0.001	6.7825 -3.132 0.000 0.000	6.8170 -2.931 0.000 0.000
J= 8	6.4435 -5.985 -0.820 0.331	6.5760 -5.726 -0.729 0.312	6.6970 -5.507 -0.628 0.290	6.8055 -5.333 -0.522 0.262	6.9018 -5.150 -0.419 0.225	6.9864 -4.977 -0.328 0.183	7.0693 -4.804 -0.252 0.141	7.1504 -4.631 -0.194 0.104	7.2297 -4.458 -0.152 0.072	7.3072 -4.275 -0.126 0.046	7.3834 -4.092 -0.100 0.028	7.4581 -3.917 -0.074 0.010	7.5312 -3.742 -0.048 0.003	7.6025 -3.567 -0.022 0.001	7.6725 -3.392 0.000 0.000	7.7420 -3.217 0.000 0.000
J= 9	6.9110 -5.934 -0.885 0.346	7.0551 -5.661 -0.764 0.329	7.1863 -5.447 -0.671 0.310	7.3094 -5.273 -0.553 0.282	7.4247 -5.100 -0.437 0.242	7.5324 -4.927 -0.336 0.194	7.6384 -4.754 -0.254 0.147	7.7428 -4.581 -0.192 0.107	7.8457 -4.408 -0.152 0.072	7.9472 -4.235 -0.126 0.046	8.0472 -4.062 -0.100 0.028	8.1457 -3.889 -0.074 0.010	8.2427 -3.716 -0.048 0.003	8.3382 -3.543 -0.022 0.001	8.4325 -3.370 0.000 0.000	8.5255 -3.195 0.000 0.000
J=10	7.3526 -5.881 -0.946 0.360	7.5081 -5.611 -0.837 0.347	7.6493 -5.385 -0.713 0.331	7.7713 -5.211 -0.580 0.305	7.8766 -5.034 -0.451 0.260	7.9755 -4.861 -0.339 0.205	8.0683 -4.688 -0.252 0.153	8.1550 -4.515 -0.187 0.109	8.2367 -4.342 -0.142 0.075	8.3125 -4.169 -0.111 0.050	8.3834 -3.996 -0.088 0.028	8.4492 -3.823 -0.062 0.012	8.5100 -3.650 -0.040 0.005	8.5657 -3.477 -0.018 0.001	8.6170 -3.302 0.000 0.000	8.6675 -3.127 0.000 0.000
J=11	7.7720 -5.832 -0.997 0.375	7.9357 -5.561 -0.888 0.360	8.0910 -5.390 -0.764 0.347	8.2206 -5.217 -0.653 0.320	8.3242 -5.044 -0.542 0.280	8.4025 -4.871 -0.431 0.230	8.4598 -4.698 -0.320 0.180	8.5016 -4.525 -0.210 0.130	8.5323 -4.352 -0.150 0.080	8.5556 -4.179 -0.100 0.050	8.5739 -4.006 -0.070 0.020	8.5890 -3.833 -0.040 0.005	8.6024 -3.660 -0.010 0.001	8.6147 -3.487 0.000 0.000	8.6267 -3.312 0.000 0.000	8.6375 -3.137 0.000 0.000

J=11	7.7728	7.9357	8.0910	8.2306	8.3242	8.4025	8.4598	8.5016	8.5323	8.5556	8.5739	8.5890	8.6024	8.6147	8.6267
	-5.827	-5.550	-5.319	-5.144	-5.035	-4.978	-4.955	-4.948	-4.950	-4.955	-4.962	-4.970	-4.979	-4.989	-5.000
	-1.006	-888	-752	-604	-460	-338	-235	-179	-133	-103	-083	-071	-064	-061	.000
	.375	.365	.355	.331	.280	.217	.157	.110	.075	.050	.032	.021	.014	.035	.000
J=12	8.1751	8.3535	8.5150	8.6522	8.7594	8.8381	8.8941	8.9339	8.9627	8.9841	9.0008	9.0145	9.0264	9.0373	9.0478
	-5.771	-5.487	-5.249	-5.072	-4.972	-4.921	-4.921	-4.925	-4.934	-4.945	-4.956	-4.967	-4.977	-4.988	-5.000
	-1.064	-937	-790	-625	-464	-332	-235	-169	-124	-094	-075	-063	-057	-053	.000
	.389	.385	.381	.362	.303	.227	.160	.109	.073	.049	.032	.021	.015	.032	.000
J=13	8.5623	8.7522	8.9242	9.0692	9.1793	9.2572	9.3109	9.3481	9.3745	9.3940	9.4089	9.4210	9.4315	9.4410	9.4501
	-5.714	-5.423	-5.176	-4.995	-4.907	-4.883	-4.888	-4.903	-4.920	-4.936	-4.950	-4.963	-4.975	-4.988	-5.000
	-1.121	-987	-827	-643	-463	-321	-222	-156	-113	-085	-067	-056	-050	-046	.000
	.403	.405	.411	.399	.328	.237	.161	.107	.071	.047	.031	.021	.015	.029	.000
J=14	8.9364	9.1381	9.3211	9.4742	9.5862	9.6620	9.7123	9.7464	9.7701	9.7873	9.8005	9.8110	9.8200	9.8282	9.8360
	-5.655	-5.355	-5.098	-4.910	-4.838	-4.835	-4.857	-4.883	-4.907	-4.928	-4.945	-4.960	-4.974	-4.987	-5.000
	-1.177	-1.036	-864	-658	-456	-304	-204	-141	-100	-075	-058	-048	-043	-040	.000
	.416	.425	.445	.445	.355	.245	.160	.104	.068	.045	.030	.021	.016	.027	.000
J=15	9.2991	9.5130	9.7077	9.8695	9.9821	10.0542	10.1002	10.1305	10.1512	10.1661	10.1773	10.1863	10.1939	10.2007	10.2073
	-5.596	-5.286	-5.015	-4.816	-4.765	-4.788	-4.828	-4.866	-4.896	-4.921	-4.941	-4.957	-4.972	-4.986	-5.000
	-1.232	-1.088	-903	-671	-441	-281	-183	-124	-087	-064	-050	-041	-036	-033	.000
	.429	.446	.484	.502	.385	.250	.156	.098	.064	.042	.029	.021	.016	.024	.000
J=16	9.6518	9.8784	10.0859	10.2575	10.3689	10.4353	10.4758	10.5018	10.5193	10.5317	10.5410	10.5464	10.5546	10.5602	10.5655
	-5.537	-5.216	-4.926	-4.708	-4.689	-4.743	-4.802	-4.850	-4.887	-4.915	-4.937	-4.955	-4.971	-4.986	-5.000
	-1.287	-1.133	-944	-680	-417	-252	-158	-105	-073	-053	-041	-034	-029	-027	.000
	.440	.466	.528	.578	.417	.251	.149	.092	.059	.040	.028	.021	.017	.022	.000
J=17	9.9597	10.2356	10.4571	10.6404	10.7478	10.8064	10.8403	10.8614	10.8755	10.8854	10.8928	10.8986	10.9035	10.9079	10.9120
	-5.477	-5.143	-4.831	-4.581	-4.611	-4.702	-4.780	-4.837	-4.875	-4.910	-4.934	-4.953	-4.970	-4.985	-5.000
	-1.343	-1.192	-990	-685	-380	-215	-130	-085	-058	-042	-033	-027	-023	-021	.000
	.449	.485	.560	.680	.450	.246	.140	.085	.055	.037	.027	.020	.017	.020	.000
J=18	10.3317	10.5835	10.8228	11.0212	11.1200	11.1680	11.1943	11.2103	11.2209	11.2282	11.2337	11.2380	11.2416	11.2448	11.2478
	-5.418	-5.070	-4.729	-4.426	-4.533	-4.666	-4.762	-4.827	-4.873	-4.906	-4.932	-4.952	-4.969	-4.985	-5.000
	-1.399	-1.249	-1.042	-687	-326	-170	-100	-054	-043	-031	-024	-020	-017	-016	.000
	.456	.502	.640	.823	.482	.235	.128	.077	.050	.035	.026	.020	.017	.018	.000
J=19	10.6667	10.9292	11.1844	11.4035	11.4863	11.5208	11.5366	11.5493	11.5563	11.5611	11.5647	11.5675	11.5699	11.5720	11.5739
	-5.359	-4.987	-4.620	-4.225	-4.460	-4.637	-4.748	-4.820	-4.869	-4.904	-4.930	-4.951	-4.969	-4.985	-5.000
	-1.455	-1.310	-1.106	-682	-250	-119	-067	-042	-029	-021	-016	-013	-011	-010	.000
	.461	.515	.711	1.026	.510	.215	.115	.070	.047	.033	.025	.020	.017	.017	.000
J=20	10.9833	11.2571	11.5431	11.7931	11.8466	11.8648	11.8737	11.8790	11.8824	11.8848	11.8866	11.8879	11.8891	11.8901	11.8911
	-5.301	-4.924	-4.506	-4.064	-4.402	-4.619	-4.740	-4.816	-4.866	-4.902	-4.929	-4.951	-4.968	-4.985	-5.000
	-1.513	-1.376	-1.187	-669	-144	-061	-033	-021	-014	-010	-008	-006	-005	-005	.000
	.439	.491	.734	1.049	.533	.193	.105	.066	.044	.032	.024	.020	.017	.016	.000
J=21	11.3000	11.6000	11.9000	12.2000	12.2600	12.2600	12.2600	12.2600	12.2600	12.2600	12.2600	12.2600	12.2600	12.2600	12.2600
	-5.273	-4.888	-4.447	-3.812	-4.235	-4.612	-4.738	-4.814	-4.866	-4.902	-4.929	-4.950	-4.968	-4.985	-5.000
	-1.579	-1.456	-1.303	-659	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.371	.401	.509	.377	.403	.179	.101	.064	.043	.031	.024	.020	.017	.016	.000

ENTRANCE REGION DEFORMATION RATE COMPONENTS

DEPRX(I,J) (1/SEC)
 DEPRR(I,J)
 DEFRN(I,J)
 DEFRS(I,J)

I=	46	47	48	49	50	51	52	53	54	55	56	57	58	59
J= 1	.231 -.131 .206 .184 .212 .202	.251 -.117 .184 .193 .207	.220 -.102 .161 .184 .177	.190 -.088 .118 .139 .184	.161 -.075 .118 .177	.136 -.083 .169	.114 -.053 .163	.098 -.045 .157	.087 -.041 .150	.085 -.040 .144	.092 -.043 .135	.114 -.054 .123	.161 -.077 .103	.250 -.120 .185 .068
J= 2	.267 -.250 .259 .376	.237 -.222 .230 .364	.207 -.194 .200 .350	.177 -.166 .171 .336	.149 -.135 .144 .322	.123 -.116 .120 .306	.102 -.096 .289	.085 -.031 .272	.074 -.070 .253	.068 -.065 .230	.068 -.067 .199	.077 -.077 .152	.094 -.097 .074	.115 -.130 .096 .206
J= 3	.254 -.241 .248 .321 .316	.224 -.212 .213 .309	.193 -.182 .183 .309	.163 -.153 .158 .298	.134 -.126 .130 .283	.108 -.101 .105 .266	.086 -.081 .083 .247	.068 -.064 .066 .227	.055 -.051 .053 .205	.045 -.042 .044 .180	.038 -.034 .036 .152	.030 -.026 .028 .115	.017 -.011 .014 .068	.016 -.024 .020 .139
J= 4	.259 -.232 .256 .124	.227 -.221 .224 .133	.193 -.188 .190 .137	.160 -.155 .158 .134	.129 -.125 .127 .126	.101 -.099 .100 .112	.078 -.076 .077 .095	.060 -.059 .059 .076	.046 -.045 .046 .056	.035 -.035 .035 .035	.028 -.027 .027 .014	.019 -.019 .017 .000	.011 -.011 .011 -.012	.007 -.007 .008 .052
J= 5	.263 -.256 .260 .134	.229 -.222 .226 .146	.194 -.187 .190 .151	.158 -.152 .155 .149	.124 -.120 .122 .135	.095 -.092 .093 .122	.071 -.069 .070 .101	.052 -.051 .052 .079	.038 -.037 .038 .057	.028 -.027 .027 .036	.021 -.020 .021 .041	.012 -.013 .013 .023	.000 -.006 .000 -.003	.006 -.007 .007 .050
J= 6	.268 -.259 .264 .152	.232 -.223 .223 .166	.194 -.186 .190 .172	.156 -.149 .152 .170	.120 -.114 .117 .159	.088 -.084 .086 .137	.063 -.061 .062 .112	.045 -.043 .044 .087	.031 -.030 .030 .063	.021 -.020 .021 .041	.012 -.013 .013 .023	.006 -.006 .006 -.007	.000 -.000 .000 -.003	.006 -.007 .007 .050
J= 7	.273 -.262 .267 .171	.236 -.224 .230 .187	.195 -.185 .190 .195	.154 -.145 .149 .193	.114 -.107 .111 .176	.081 -.076 .078 .153	.055 -.052 .053 .124	.037 -.035 .036 .094	.024 -.023 .023 .068	.015 -.014 .015 .045	.008 -.008 .008 .027	.003 -.002 .003 .003	.002 -.002 .003 .003	.007 -.007 .007 .048
J= 8	.273 -.264 .271 .190	.239 -.225 .232 .208	.196 -.184 .190 .219	.151 -.140 .146 .218	.108 -.100 .104 .200	.072 -.067 .070 .169	.046 -.043 .044 .134	.029 -.026 .027 .101	.017 -.016 .016 .072	.009 -.009 .009 .048	.004 -.003 .004 .030	.001 -.001 .001 .016	.004 -.004 .004 .006	.007 -.007 .007 .044
J= 9	.284 -.267 .275 .209	.243 -.227 .235 .230	.193 -.183 .190 .244	.148 -.135 .142 .244	.101 -.091 .096 .222	.063 -.057 .060 .185	.037 -.033 .035 .143	.020 -.018 .019 .105	.010 -.009 .009 .074	.004 -.003 .004 .050	.000 -.001 .000 .031	.003 -.004 .004 .018	.006 -.006 .006 .008	.008 -.008 .008 .041
J=10	.289 -.270 .280 .227	.243 -.229 .233 .251	.200 -.182 .191 .270	.145 -.130 .138 .272	.093 -.082 .087 .245	.052 -.045 .049 .200	.026 -.022 .024 .151	.011 -.009 .010 .105	.003 -.002 .003 .075	.001 -.002 .002 .050	.004 -.004 .004 .032	.006 -.006 .006 .019	.008 -.008 .008 .009	.009 -.009 .009 .038

J=11 .295 .254 .203 .142 .083 .040 .015 .002 .003 .006 .008 .009 .010 .010 .010

J=11	.295	.254	.203	.142	.083	.024	.060	.015	.002	-.003	-.006	-.008	-.009	-.010	-.010	.038
	-.272	-.231	-.182	-.125	-.070	-.032	-.032	-.011	-.000	-.005	.007	.008	.009	.010	.010	
	.284	.242	.193	.133	.076	.036	.036	.013	.006	.009	.010	.010	.010	.010	.010	
	.244	.203	.157	.110	.075	.049	.031	.019	.010	.019	.031	.031	.031	.031	.031	
J=12	.302	.261	.207	.139	.071	.026	.003	.003	-.007	-.010	-.011	-.011	-.011	-.011	-.011	
	-.276	-.234	-.183	-.119	-.057	-.018	.001	.001	.009	.011	.011	.011	.011	.011	.011	
	.289	.247	.195	.129	.064	.022	.008	.008	.012	.012	.012	.012	.012	.012	.012	
	.261	.219	.168	.109	.056	.026	.016	.016	.019	.019	.019	.019	.019	.019	.019	
J=13	.309	.269	.214	.135	.056	.009	.009	-.010	-.016	-.016	-.015	-.014	-.013	-.012	-.012	
	-.279	-.239	-.185	-.112	-.040	-.001	.014	.014	.018	.017	.015	.014	.013	.012	.012	
	.294	.254	.199	.123	.048	.005	.012	.012	.017	.017	.017	.017	.017	.017	.017	
	.276	.235	.180	.106	.034	.027	.016	.016	.019	.019	.019	.019	.019	.019	.019	
J=14	.316	.279	.223	.130	.038	-.010	-.024	-.024	-.025	-.022	-.019	-.016	-.014	-.013	-.013	
	-.283	-.244	-.190	-.104	-.020	.018	.028	.028	.027	.023	.019	.016	.015	.014	.013	
	.300	.262	.206	.117	.029	.014	.026	.026	.026	.022	.019	.016	.014	.013	.013	
	.289	.235	.179	.095	.034	.024	.015	.015	.010	.006	.004	.002	.001	.008	.023	
J=15	.325	.291	.235	.125	.014	-.031	-.039	-.039	-.034	-.028	-.022	-.018	-.016	-.014	-.014	
	-.287	-.252	-.197	-.095	.006	.040	.042	.042	.035	.028	.022	.018	.016	.015	.014	
	.306	.271	.216	.110	.010	.036	.040	.040	.035	.028	.022	.018	.016	.015	.014	
	.300	.254	.193	.090	.035	.027	.015	.015	.009	.007	.006	.002	.001	.008	.020	
J=16	.333	.306	.254	.118	.056	-.056	-.053	-.042	-.032	-.032	-.025	-.020	-.017	-.015	-.014	
	-.232	-.201	-.150	-.085	.040	.064	.056	.043	.033	.033	.025	.020	.017	.015	.014	
	.313	.281	.232	.102	.025	.060	.055	.043	.030	.025	.020	.015	.012	.010	.006	
	.309	.270	.215	.095	.046	.044	.039	.031	.020	.019	.015	.012	.010	.006	.016	
J=17	.343	.323	.281	.110	.061	-.084	-.068	-.050	-.036	-.036	-.027	-.022	-.018	-.016	-.015	
	-.238	-.204	-.150	-.085	.040	.064	.056	.043	.033	.033	.025	.020	.017	.015	.014	
	.321	.294	.255	.109	.025	.060	.055	.043	.030	.025	.020	.015	.012	.010	.006	
	.314	.283	.241	.095	.046	.044	.039	.031	.020	.019	.015	.012	.010	.006	.016	
J=18	.353	.344	.322	.114	.081	-.056	-.056	-.040	-.032	-.040	-.029	-.023	-.019	-.017	-.015	
	-.235	-.209	-.156	-.082	.040	.064	.056	.043	.033	.033	.025	.020	.017	.015	.014	
	.305	.289	.256	.119	.082	.040	.036	.030	.025	.020	.015	.012	.010	.004	.009	
	.316	.289	.256	.119	.082	.040	.036	.030	.025	.020	.015	.012	.010	.004	.009	
	.316	.289	.256	.119	.082	.040	.036	.030	.025	.020	.015	.012	.010	.004	.009	
J=19	.363	.359	.384	.080	.080	-.204	-.091	-.060	-.042	-.042	-.031	-.024	-.019	-.017	-.016	
	-.311	-.287	-.230	-.037	.230	.147	.092	.060	.042	.042	.031	.024	.019	.017	.016	
	.337	.338	.342	.055	.217	.146	.092	.060	.042	.042	.031	.024	.019	.017	.016	
	.314	.289	.256	.119	.082	.040	.036	.030	.025	.020	.015	.012	.010	.004	.009	
J=20	.373	.368	.480	.052	.327	-.169	-.099	-.063	-.043	-.043	-.031	-.024	-.020	-.017	-.016	
	-.331	-.340	-.378	-.028	.339	.170	.099	.063	.043	.043	.031	.024	.020	.017	.016	
	.352	.359	.429	.040	.333	.169	.099	.063	.043	.043	.031	.024	.020	.017	.016	
	.263	.324	.596	1.048	.417	.092	.036	.018	.010	.006	.002	.001	.001	.001	.003	
J=21	.378	.413	.538	.034	.400	-.179	-.101	-.064	-.044	-.044	-.032	-.024	-.020	-.017	-.016	
	-.342	-.359	-.425	-.030	.395	.177	.100	.063	.043	.043	.031	.024	.020	.017	.016	
	.360	.366	.482	.032	.398	.178	.100	.063	.043	.043	.031	.024	.020	.017	.016	
	.030	.108	.165	.376	.066	.019	.003	.004	.003	.003	.002	.001	.001	.000	.000	

VELU60= VELOCITY AT ENTRANCE=-5.00 (CM/SEC)
Q= TOTAL FLUX THRU CONTRACTION=VELU60 * AREA CF MOUTH= 2337.97 (CM**3/SEC)

MODEL OF 4FI

For Iteration no. 50:

BIG: 1.34E-3 RMSEPS: 3.66E-5

ENTRANCE REGION VELOCITY AND MEAN DEFORMATION RATE VALUES

I=	J=										
	40	41	42	43	44	45	46	47	48	49	50
J= 1	VELU(I,J) (CM)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	VELU(I,J) (CM/SEC)	-9.611	-8.768	-8.089	-7.547	-7.118	-6.782	-6.320	-6.166	-6.048	-5.958
	VELU(I,J) (CM/SEC)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	DEPRM(I,J) (1/SEC)	0.780	0.843	0.929	0.937	0.961	0.987	1.013	1.039	1.065	1.091
J= 2	VELU(I,J) (CM)	1.9580	2.0499	2.1342	2.2096	2.2752	2.3309	2.3770	2.4145	2.4445	2.4682
	VELU(I,J) (CM/SEC)	-8.833	-8.103	-7.477	-6.981	-6.590	-6.288	-6.055	-5.877	-5.742	-5.640
	VELU(I,J) (CM/SEC)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	DEPRM(I,J) (1/SEC)	1.142	1.214	1.286	1.358	1.430	1.502	1.574	1.646	1.718	1.790
J= 3	VELU(I,J) (CM)	2.8899	3.0253	3.1498	3.2598	3.3546	3.4341	3.4990	3.5511	3.5920	3.6240
	VELU(I,J) (CM/SEC)	-8.036	-7.329	-6.766	-6.325	-5.985	-5.726	-5.531	-5.385	-5.278	-5.198
	VELU(I,J) (CM/SEC)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	DEPRM(I,J) (1/SEC)	1.059	1.131	1.203	1.275	1.347	1.419	1.491	1.563	1.635	1.707
J= 4	VELU(I,J) (CM)	3.6063	3.7762	3.9304	4.0663	4.1823	4.2784	4.3561	4.4175	4.4653	4.5022
	VELU(I,J) (CM/SEC)	-7.816	-7.127	-6.583	-6.162	-5.843	-5.604	-5.429	-5.301	-5.208	-5.141
	VELU(I,J) (CM/SEC)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	DEPRM(I,J) (1/SEC)	1.266	1.338	1.410	1.482	1.554	1.626	1.698	1.770	1.842	1.914
J= 5	VELU(I,J) (CM)	4.2167	4.4155	4.5953	4.7525	4.8854	4.9963	5.0812	5.1490	5.2012	5.2410
	VELU(I,J) (CM/SEC)	-7.020	-6.346	-5.720	-5.139	-4.603	-4.114	-3.674	-3.282	-2.938	-2.644
	VELU(I,J) (CM/SEC)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	DEPRM(I,J) (1/SEC)	1.471	1.543	1.615	1.687	1.759	1.831	1.903	1.975	2.047	2.119
J= 6	VELU(I,J) (CM)	4.7622	4.9870	5.1893	5.3649	5.5118	5.6306	5.7241	5.7961	5.8509	5.8922
	VELU(I,J) (CM/SEC)	-6.428	-5.769	-5.159	-4.594	-4.074	-3.597	-3.164	-2.774	-2.428	-2.126
	VELU(I,J) (CM/SEC)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	DEPRM(I,J) (1/SEC)	1.682	1.754	1.826	1.898	1.970	2.042	2.114	2.186	2.258	2.330
J= 7	VELU(I,J) (CM)	5.2634	5.5122	5.7351	5.9265	6.0855	6.2119	6.3098	6.3843	6.4403	6.4821
	VELU(I,J) (CM/SEC)	-5.834	-5.175	-4.565	-3.999	-3.478	-2.997	-2.564	-2.179	-1.844	-1.558
	VELU(I,J) (CM/SEC)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	DEPRM(I,J) (1/SEC)	1.893	1.965	2.037	2.109	2.181	2.253	2.325	2.397	2.469	2.541
J= 8	VELU(I,J) (CM)	5.7326	6.0041	6.2461	6.4523	6.6205	6.7524	6.8530	6.9284	6.9843	7.0257
	VELU(I,J) (CM/SEC)	-5.245	-4.586	-3.976	-3.410	-2.889	-2.408	-1.967	-1.574	-1.230	-0.936
	VELU(I,J) (CM/SEC)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	DEPRM(I,J) (1/SEC)	2.104	2.176	2.248	2.320	2.392	2.464	2.536	2.608	2.680	2.752
J= 9	VELU(I,J) (CM)	6.1778	6.4710	6.7309	6.9501	7.1260	7.2614	7.3630	7.4379	7.4928	7.5329
	VELU(I,J) (CM/SEC)	-4.657	-4.000	-3.390	-2.824	-2.303	-1.822	-1.381	-0.988	-0.644	-0.350
	VELU(I,J) (CM/SEC)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	DEPRM(I,J) (1/SEC)	2.353	2.425	2.497	2.569	2.641	2.713	2.785	2.857	2.929	3.001
J= 10	VELU(I,J) (CM)	6.6045	6.9183	7.1958	7.4265	7.6082	7.7453	7.8461	7.9192	7.9721	8.0105
	VELU(I,J) (CM/SEC)	-4.141	-3.484	-2.874	-2.308	-1.787	-1.306	-0.865	-0.472	-0.128	0.176
	VELU(I,J) (CM/SEC)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	DEPRM(I,J) (1/SEC)	2.564	2.636	2.708	2.780	2.852	2.924	3.000	3.072	3.144	3.216
J= 11	VELU(I,J) (CM)	7.0167	7.3519	7.6455	7.8863	8.0713	8.2085	8.3068	8.3770	8.4272	8.4632
	VELU(I,J) (CM/SEC)	-3.653	-3.000	-2.390	-1.824	-1.303	-0.822	-0.381	0.022	0.376	0.680
	VELU(I,J) (CM/SEC)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	DEPRM(I,J) (1/SEC)	2.775	2.847	2.919	2.991	3.063	3.135	3.207	3.279	3.351	3.423

J=12	1.090	.556	.829	.682	.526	.387	.277	.196	.138	.097	.068	.048	.033	.022	.014
	7.4173	7.7737	8.0835	8.3331	8.5202	8.6544	8.7486	8.8148	8.8614	8.8946	8.9185	8.9360	8.9460	8.9590	8.9670
	-0.266	-5.683	-5.258	-4.895	-4.599	-4.360	-4.182	-4.037	-3.914	-3.811	-3.724	-3.650	-3.585	-3.529	-3.470
	-2.473	-1.917	-1.493	-1.104	-0.783	-0.554	-0.388	-0.274	-0.195	-0.140	-0.102	-0.075	-0.057	-0.045	-0.037
	1.112	.983	.869	.711	.538	.386	.270	.188	.131	.091	.064	.045	.031	.021	.014
J=13	7.8101	8.1371	8.4131	8.6498	8.8461	9.0024	9.1186	9.1948	9.2310	9.2376	9.2291	9.2147	9.1953	9.1709	9.1423
	-0.067	-5.433	-5.074	-4.781	-4.545	-4.360	-4.215	-4.100	-4.004	-3.926	-3.864	-3.814	-3.773	-3.739	-3.709
	-2.413	-1.958	-1.504	-1.085	-0.754	-0.518	-0.358	-0.250	-0.176	-0.126	-0.091	-0.067	-0.051	-0.039	-0.032
	1.133	1.024	.915	.742	.546	.330	.260	.178	.123	.085	.059	.041	.029	.020	.013
J=14	8.1959	8.5946	8.9371	9.1990	9.3614	9.5034	9.5847	9.6338	9.6777	9.7043	9.7232	9.7369	9.7470	9.7548	9.7609
	-5.865	-5.286	-4.880	-4.597	-4.369	-4.182	-4.037	-3.914	-3.811	-3.724	-3.650	-3.585	-3.529	-3.470	-3.411
	-2.473	-1.917	-1.493	-1.085	-0.754	-0.518	-0.358	-0.250	-0.176	-0.126	-0.091	-0.067	-0.051	-0.039	-0.032
	1.155	1.063	.971	.776	.551	.370	.247	.166	.113	.078	.055	.038	.027	.019	.013
J=15	8.5770	8.9935	9.3584	9.6230	9.7978	9.9096	9.9824	10.0307	10.0635	10.0864	10.1026	10.1144	10.1230	10.1296	10.1348
	-5.660	-5.073	-4.673	-4.355	-4.096	-3.896	-3.741	-3.614	-3.511	-3.426	-3.350	-3.285	-3.229	-3.173	-3.117
	-2.522	-2.021	-1.497	-1.003	-0.645	-0.423	-0.282	-0.193	-0.134	-0.095	-0.068	-0.050	-0.038	-0.029	-0.024
	1.177	1.109	1.042	.814	.550	.355	.231	.153	.104	.072	.050	.035	.025	.018	.013
J=16	8.9552	9.4011	9.7802	10.0437	10.2065	10.3056	10.3681	10.4089	10.4364	10.4555	10.4689	10.4786	10.4858	10.4912	10.4955
	-5.452	-4.863	-4.447	-4.169	-3.933	-3.733	-3.565	-3.426	-3.311	-3.218	-3.144	-3.089	-3.043	-3.006	-2.977
	-2.566	-2.047	-1.478	-0.933	-0.575	-0.365	-0.239	-0.161	-0.112	-0.079	-0.056	-0.041	-0.031	-0.024	-0.019
	1.199	1.163	1.134	.852	.541	.335	.212	.140	.094	.065	.045	.032	.023	.017	.012
J=17	9.3320	9.8043	10.2061	10.4630	10.6080	10.6915	10.7426	10.7754	10.7975	10.8126	10.8233	10.8309	10.8366	10.8409	10.8442
	-5.239	-4.634	-4.194	-3.821	-3.524	-3.296	-3.126	-2.999	-2.904	-2.831	-2.773	-2.729	-2.690	-2.656	-2.627
	-2.603	-2.073	-1.446	-0.837	-0.487	-0.299	-0.193	-0.129	-0.089	-0.062	-0.045	-0.033	-0.024	-0.019	-0.015
	1.222	1.228	1.259	.891	.521	.308	.192	.126	.085	.059	.041	.029	.021	.016	.012
J=18	9.7031	10.2123	10.6415	10.8824	11.0027	11.0678	11.1066	11.1312	11.1476	11.1588	11.1667	11.1724	11.1766	11.1797	11.1822
	-5.021	-4.390	-3.899	-3.493	-3.177	-2.941	-2.773	-2.664	-2.591	-2.531	-2.481	-2.439	-2.404	-2.374	-2.348
	-2.645	-2.094	-1.398	-0.707	-0.383	-0.228	-0.145	-0.096	-0.066	-0.046	-0.033	-0.024	-0.018	-0.014	-0.011
	1.245	1.311	1.434	.925	.487	.270	.173	.113	.077	.054	.038	.027	.020	.015	.012
J=19	10.0881	10.6270	11.0948	11.3027	11.3933	11.4347	11.4605	11.4768	11.4876	11.4950	11.5002	11.5039	11.5066	11.5087	11.5103
	-4.795	-4.124	-3.537	-3.077	-2.718	-2.450	-2.273	-2.177	-2.111	-2.066	-2.031	-2.004	-1.981	-1.961	-1.943
	-2.632	-2.123	-1.327	-0.530	-0.265	-0.153	-0.095	-0.063	-0.043	-0.030	-0.022	-0.016	-0.012	-0.009	-0.007
	1.271	1.423	1.689	.947	.438	.248	.155	.103	.071	.049	.035	.026	.019	.015	.012
J=20	10.4709	11.0535	11.5819	11.7234	11.7698	11.7921	11.8049	11.8129	11.8182	11.8218	11.8244	11.8262	11.8275	11.8285	11.8293
	-4.560	-3.822	-3.059	-2.355	-1.717	-1.135	-0.676	-0.311	-0.021	.015	.011	.008	.006	.004	.004
	-2.720	-2.151	-1.215	-0.293	.013	.135	.248	.346	.426	.481	.511	.524	.528	.529	.529
	1.175	1.411	1.673	.946	.386	.224	.143	.096	.066	.047	.034	.025	.018	.014	.011
J=21	10.8600	11.5000	12.1400	12.1400	12.1400	12.1400	12.1400	12.1400	12.1400	12.1400	12.1400	12.1400	12.1400	12.1400	12.1400
	-4.439	-3.657	-2.783	-1.906	-1.026	-0.146	.046	.240	.426	.592	.737	.848	.920	.958	.978
	-2.828	-2.296	-1.743	-1.140	-0.500	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.726	.754	.496	.695	.355	.214	.138	.093	.065	.046	.033	.024	.018	.014	.011

ENTRANCE REGION DEFORMATION RATE COMPONENTS

DEFRRX(I,J) (1/SEC)

DEFRRY(I,J)

DEFRRZ(I,J)

DEFRRS(I,J)

I=

J= 1

40 .940 .761 .611 .486 .383 .298 .231 .177 .136 .104 .080 .063 .051 .045 .044

J= 2

41 -.431 -.349 -.280 -.222 -.175 -.137 -.106 -.082 -.063 -.048 -.037 -.029 -.021 -.021 -.021

J= 3

42 -.685 -.555 -.445 -.354 -.279 -.218 -.163 -.130 -.099 -.076 -.059 -.046 -.038 -.036 -.036

J= 4

43 .572 .324 .287 .256 .232 .212 .196 .183 .173 .165 .159 .154 .149 .146 .142

J= 5

44 -.872 .703 .561 .443 .346 .268 .205 .156 .118 .090 .068 .053 .043 .037 .034

J= 6

45 -.805 -.649 -.518 -.410 -.321 -.249 -.191 -.146 -.111 -.085 -.065 -.050 -.041 -.035 -.033

J= 7

46 .775 .683 .605 .535 .483 .434 .393 .358 .328 .304 .285 .268 .254 .241 .227

J= 8

47 .794 .635 .502 .391 .300 .227 .170 .127 .094 .070 .052 .039 .030 .025 .021

J= 9

48 -.726 -.580 -.458 -.357 -.274 -.208 -.157 -.117 -.087 -.065 -.048 -.037 -.028 -.023 -.019

J= 10

49 .760 .607 .480 .374 .287 .218 .163 .122 .090 .067 .050 .038 .029 .024 .020

J= 11

50 .754 .702 .622 .550 .485 .427 .375 .331 .294 .263 .238 .218 .201 .185 .170

J= 12

51 .776 .617 .482 .370 .279 .207 .152 .110 .080 .058 .043 .032 .024 .018 .015

J= 13

52 -.721 -.572 -.447 -.344 -.260 -.194 -.143 -.105 -.077 -.056 -.041 -.031 -.024 .018 .015

J= 14

53 .748 .594 .465 .357 .270 .200 .147 .108 .078 .057 .042 .031 .024 .018 .015

J= 15

54 .545 .488 .432 .376 .321 .267 .217 .174 .137 .106 .082 .062 .046 .032 .019

J= 16

55 .760 .600 .464 .351 .255 .187 .133 .094 .067 .047 .034 .025 .018 .014 .010

J= 17

56 -.690 -.543 .420 .318 .236 .172 .124 .088 .063 .045 .033 .024 .018 .013 .010

J= 18

57 .725 .572 .442 .334 .247 .179 .123 .091 .065 .046 .033 .024 .018 .013 .010

J= 19

58 .607 .543 .482 .419 .354 .291 .232 .182 .140 .106 .079 .057 .040 .026 .014

J= 20

59 .745 .584 .447 .331 .237 .166 .115 .078 .054 .037 .026 .018 .013 .009 .007

J= 21

60 -.659 -.515 .420 .311 .224 .157 .109 .075 .052 .036 .025 .018 .013 .009 .006

J= 22

61 .670 .601 .534 .463 .389 .316 .249 .192 .145 .108 .079 .057 .040 .025 .014

J= 23

62 .730 .569 .429 .310 .215 .145 .095 .062 .041 .027 .018 .012 .008 .006 .003

J= 24

63 -.627 -.486 .365 .263 .183 .124 .083 .055 .037 .025 .017 .012 .008 .005 .003

J= 25

64 .679 .527 .397 .287 .199 .134 .089 .059 .039 .026 .018 .012 .008 .006 .003

J= 26

65 .728 .656 .584 .506 .421 .338 .263 .199 .149 .109 .079 .056 .039 .025 .014

J= 27

66 .716 .554 .411 .288 .191 .122 .075 .046 .028 .018 .011 .007 .004 .002 .001

J= 28

67 -.597 -.458 .337 .235 .156 .100 .063 .039 .025 .016 .010 .006 .002 .001 .001

J= 29

68 .656 .506 .374 .261 .174 .111 .069 .043 .027 .017 .011 .007 .004 .002 .001

J= 30

69 .781 .700 .632 .546 .451 .356 .272 .203 .150 .109 .078 .055 .038 .025 .014

J= 31

70 .733 .540 .392 .265 .166 .098 .055 .030 .016 .009 .004 .002 .001 .000 .001

J= 32

71 -.567 -.430 .309 .205 .127 .074 .042 .023 .013 .007 .003 .002 .001 .001 .001

J= 33

72 .635 .485 .350 .235 .146 .086 .049 .027 .014 .008 .004 .002 .001 .000 .001

J= 34

73 .829 .754 .678 .584 .477 .370 .278 .204 .148 .106 .076 .053 .037 .024 .014

J= 35

74 .690 .526 .374 .240 .138 .072 .034 .014 .005 .000 .002 .002 .003 .003 .003

J= 36

75 -.538 -.403 .280 .174 .097 .048 .021 .008 .001 .002 .003 .003 .003 .003 .003

J= 37

76 .614 .465 .327 .207 .117 .060 .028 .011 .003 .001 .002 .003 .003 .003 .003

J= 38

77 .873 .803 .724 .622 .503 .380 .279 .202 .144 .102 .072 .051 .035 .023 .014

J= 39

78 .679 .514 .355 .212 .108 .045 .013 .001 .007 .008 .008 .007 .006 .005 .005

J= 40

79 -.510 -.373 .251 .141 .064 .021 .001 .008 .010 .009 .008 .007 .006 .005 .005

J= 41

80 .595 .446 .303 .176 .086 .033 .007 .004 .008 .009 .009 .008 .007 .006 .005

J=12	.913	.845	.772	.659	.519	.395	.277	.196	.138	.097	.068	.047	.032	.021	.013
	.670	.504	.335	.181	.075	.017	-.008	-.016	-.017	-.015	-.012	-.010	-.008	-.007	-.006
	-.483	-.353	-.222	-.104	-.029	.007	.020	.022	.020	.016	.013	.010	.008	.007	.006
	.577	.429	.279	.143	.052	.014	.019	.018	.018	.016	.013	.010	.008	.007	.006
	.950	.890	.823	.697	.535	.386	.270	.187	.130	.090	.063	.043	.030	.020	.012
J=13	.663	.497	.315	.147	.037	-.013	-.030	-.031	-.027	-.022	-.017	-.013	-.010	-.009	-.007
	-.459	-.330	-.192	-.064	.009	.036	.040	.036	.029	.023	.017	.014	.011	.009	.007
	.561	.414	.254	.105	.023	.025	.035	.033	.028	.022	.017	.013	.011	.009	.007
	.985	.933	.879	.735	.546	.379	.258	.175	.119	.082	.057	.039	.027	.018	.011
J=14	.658	.493	.294	.106	-.004	-.045	-.051	-.044	-.036	-.027	-.021	-.016	-.012	-.010	-.008
	-.436	-.310	-.160	-.017	.050	.065	.060	.043	.037	.028	.021	.016	.013	.010	.008
	.547	.401	.227	.062	.027	.055	.055	.046	.037	.028	.021	.016	.012	.010	.008
	1.017	.983	.944	.774	.550	.366	.241	.160	.107	.073	.050	.035	.024	.016	.010
J=15	.657	.494	.272	.056	-.051	-.077	-.071	-.057	-.043	-.032	-.024	-.018	-.014	-.011	-.009
	-.416	-.292	-.127	.037	.095	.086	.078	.060	.045	.033	.025	.018	.014	.011	.009
	.537	.393	.198	.047	.073	.086	.075	.058	.044	.034	.024	.018	.014	.011	.009
	1.048	1.037	1.023	.813	.545	.345	.219	.142	.094	.064	.043	.030	.020	.014	.009
J=16	.661	.503	.247	-.006	-.103	-.110	-.090	-.068	-.050	-.037	-.027	-.020	-.015	-.012	-.010
	-.398	-.273	-.090	.104	.143	.124	.095	.070	.051	.037	.027	.020	.015	.012	.010
	.530	.390	.169	.055	.123	.117	.092	.069	.051	.037	.027	.020	.015	.012	.010
	1.076	1.095	1.122	.850	.526	.313	.191	.121	.080	.053	.036	.025	.017	.011	.007
J=17	.670	.523	.217	-.035	-.162	-.141	-.106	-.077	-.055	-.040	-.029	-.022	-.016	-.013	-.010
	-.384	-.270	-.049	.139	.196	.152	.110	.078	.056	.040	.029	.022	.016	.013	.010
	.527	.396	.133	.079	.179	.146	.108	.078	.056	.040	.029	.022	.016	.013	.010
	1.102	1.162	1.252	.880	.489	.271	.159	.099	.064	.043	.029	.020	.014	.009	.006
J=18	.686	.561	.179	-.192	-.224	-.170	-.120	-.094	-.060	-.043	-.031	-.023	-.017	-.013	-.011
	-.373	-.270	.002	.300	.249	.176	.122	.085	.060	.043	.031	.023	.017	.013	.011
	.529	.415	.090	.246	.237	.173	.121	.085	.060	.043	.031	.023	.017	.013	.011
	1.127	1.244	1.431	.892	.425	.218	.123	.075	.048	.032	.022	.015	.010	.007	.004
J=19	.713	.629	.124	-.341	-.287	-.194	-.130	-.090	-.063	-.045	-.032	-.024	-.018	-.014	-.011
	-.366	-.279	.073	.445	.300	.196	.131	.090	.063	.045	.032	.024	.018	.014	.011
	.539	.454	.098	.393	.293	.195	.131	.090	.063	.045	.032	.024	.018	.014	.011
	1.151	1.353	1.686	.862	.326	.153	.083	.050	.032	.021	.015	.010	.007	.005	.003
J=20	.756	.753	.033	-.559	-.338	-.209	-.137	-.093	-.064	-.046	-.033	-.024	-.018	-.014	-.011
	-.449	-.391	.077	.608	.342	.210	.137	.093	.064	.046	.033	.024	.018	.014	.011
	.602	.571	.055	.584	.340	.210	.137	.093	.064	.046	.033	.024	.018	.014	.011
	1.009	1.290	1.672	.744	.183	.079	.042	.025	.016	.011	.007	.005	.004	.002	.002
J=21	.784	.823	-.024	-.690	-.360	-.215	-.139	-.094	-.065	-.046	-.033	-.024	-.018	-.014	-.011
	-.528	-.490	.035	.680	.355	.212	.137	.092	.064	.045	.033	.024	.018	.014	.011
	.656	.659	.029	.835	.357	.213	.138	.093	.065	.046	.033	.024	.018	.014	.011
	.311	.365	.495	.117	.039	.018	.010	.006	.004	.003	.002	.001	.001	.001	.001

VELU60= VELOCITY AT ENTRANCE=-5.00 (CM/SEC)
Q= TOTAL FLUX THRU CONTRACTION=VELU60 * AREA CF MOUTH= 2315.03 (CM**3/SEC)
COMPUTATIONS BASED ON NJ= 21 STREAMLINES, (THEREFORE 20 STREAMTUBES), WITH A UNIFORM DIFFERENCE IN VALUE HPSI= 18.422
ITMAX = 50
EPSMAX = 1.000000000000000E-06

APPENDIX C

EXPERIMENTAL INTAKE FLOW COMPUTER OUTPUTS

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1.  DIMENSION X(30,20), R(30,20), VELU(30,19), VELV(30,19)
2.  DIMENSION VELUC(29,18), VELVC(29,18)
3.  DIMENSION VELUO(29), VELUR(29,18), VELVR(29,18)
4.  DIMENSION VELSR(29,18), THETAR(29,18), DEFRM(28,17), DEFRSO(29)
5.  DIMENSION DEFRXX(28,17), DEFRRR(28,17), DEFRNI(28,17), DEFRS(28,17)
6.
7.  READ(105,4) NI,NJ,SFCTRL,DELTCY
8.  FORMAT(4G)
9.
10. READ(105,5) ((X(I,J),R(I,J),J=1,NJ),I=1,NI)
11. 5 FORMAT(8X,8F8.3)
12.
13. NIM1= NI-1
14. NIM2= NI-2
15. NJM1= NJ-1
16. NJM2= NJ-2
17. NJM3= NJ-3
18. NJM4= NJ-4
19. NJM5= NJ-5
20.
21. DELION= ((X(11,2)-X(11,1))/(X(11,3)-X(11,1)) + (X(12,4)-X(12,3))/
22. 1 (X(12,5)-X(12,3)) + (X(13,2)-X(13,1))/(X(13,3)-X(13,1))
23. 2 + (X(14,4)-X(14,3))/(X(14,5)-X(14,3)) + (X(15,2)-X(15,1))/
24. 3 (X(15,3)-X(15,1)) + (X(16,4)-X(16,3))/(X(16,5)-X(16,3))
25. 4 + (X(17,2)-X(17,1))/(X(17,3)-X(17,1)) + (X(18,4)-X(18,3))/
26. 5 (X(18,5)-X(18,3)) + (X(19,2)-X(19,1))/(X(19,3)-X(19,1))
27. 6 + (X(20,4)-X(20,3))/(X(20,5)-X(20,3)) + (X(21,2)-X(21,1))/
28. 7 (X(21,3)-X(21,1)) + (X(22,4)-X(22,3))/(X(22,5)-X(22,3))
29. 8 + (X(23,4)-X(23,3))/(X(23,5)-X(23,3)) + (X(24,2)-X(24,1))/
30. 9 (X(24,3)-X(24,1)) + (X(25,4)-X(25,3))/(X(25,5)-X(25,3))
31. A + (X(26,2)-X(26,1))/(X(26,3)-X(26,1))*DELTCY/16.3)
32.
33. DELTOF=DELTCY-DELTON
34.
35. DO 10 I=1,NI
36. DO 10 J=1,NJM1,2
37. VELU(I,J)=(X(I,J+1)-X(I,J))*SFCTRL/DELTON
38. VELV(I,J)=(R(I,J+1)-R(I,J))*SFCTRL/DELTON
39.
40. DO 20 I=1,NI
41. DO 20 J=2,NJM2,2
42. VELU(I,J)=(X(I,J+1)-X(I,J))*SFCTRL/DELTOF
43. VELV(I,J)=(R(I,J+1)-R(I,J))*SFCTRL/DELTOF
44.
45. DO 30 I=2,NIM1
46. DO 30 J=2,NJM2
47. VELUC(I,J)=(VELU(I-1,J-1)+VELU(I-1,J)+VELU(I-1,J+1)+VELU(I+1,J-1)
48. 1 +VELU(I+1,J)+VELU(I+1,J+1) +2.*VELU(I,J-1) +4.*VELU(I,J)
49. 2 +2.*VELU(I,J+1))/14.
50.
51. 30 VELVC(I,J)=(VELV(I-1,J-1)+VELV(I-1,J)+VELV(I-1,J+1)+VELV(I+1,J-1)
52. 1 +VELV(I+1,J)+VELV(I+1,J+1) +2.*VELV(I,J-1) +4.*VELV(I,J)
53. 2 +2.*VELV(I,J+1))/14.
54.
55. DO 40 I=2,NIM1
56. VELUG(I)=.50*(VELUC(I,2)+VELUC(I,3))
57. 40 VELVG(I)=.25*(VELVC(I,2)+VELVC(I,3)+VELVC(I,4)+VELVC(I,5))
58.
59.
60. DO 41 I=3,NIM2
61. 41 DEFRSO(I)=.5/SFCTRL*((VELUG(I-1)-VELUG(I))/R(I-1,1)-R(I,1))
62. 1 + (VELUG(I)-VELUG(I+1))/R(I,1)-R(I+1,1))
63.
64. DO 50 I=2,NJM1
65. DO 50 J=2,NJM2
66. 50 DEFRXX(I,J)=VELU(I,J)-VELU(I,J+1)
67. 50 DEFRRR(I,J)=VELU(I,J)-VELU(I,J+1)
68. 50 DEFRNI(I,J)=VELU(I,J)-VELU(I,J+1)
69. 50 DEFRS(I,J)=VELU(I,J)-VELU(I,J+1)

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57. VELUJ(I)=.50*(VELUC(I,2)+VELUC(I,3))
58. 40 VELVJ(I)=.25*(VELVC(I,2)+VELVC(I,3)+VELVC(I,4)+VELVC(I,5))
59.
60. DO 41 I=3,NIM2
61. 41 DEFRSO(I)=.5*(SFCRTL*(VELUC(I,1)-VELUC(I,1))/(R(I,1,1)-R(I,1,1))
62. 1+(VELUC(I,1)-VELUC(I,1))/(R(I,1,1)-R(I,1,1)))
63.
64. DO 50 I=2,NIM1
65. DO 50 J=2,NJM2
66. VELUR(I,J)=VELUC(I,J)-VELUC(I)
67. 50 VELVR(I,J)=VELVC(I,J)-VELVC(I)
68.
69. DO 60 I=3,NIM2
70. DO 60 J=3,NJM3
71. DEFRXX(I,J)=.5*(SFCRTL*(VELUC(I,J+1)-VELUC(I,J))/(X(I,J+1)-X(I,J))
72. 1+(VELUC(I,J)-VELUC(I,J-1))/(X(I,J)-X(I,J-1)))
73. DEFRXR(I,J)=.5*(R(I,J)*SFCRTL*(R(I,1,1)-R(I,1,1)))+(R(I,J)*VELVR(I,J)
74. 1-R(I,J)*VELVR(I,J))/(R(I,1,1)-R(I,1,1)))+(R(I,J)*VELVR(I,J)
75. 2-R(I,1,1)*VELVR(I,1,1))/(R(I,1,1)-R(I,1,1)))
76. DEFRN(I,J)=.5*(ABS(DEFRXX(I,J)))+(ABS(DEFRXR(I,J)))
77. DEFRS(I,J)=.5*(SFCRTL*(VELVC(I,J+1)-VELVC(I,J))/(X(I,J+1)-X(I,J))
78. 1+(VELVC(I,J)-VELVC(I,J-1))/(X(I,J)-X(I,J-1)))
79. 1+(VELVC(I,1)-VELVC(I,1))/(R(I,1,1)-R(I,1,1)))
80. 3+(VELUC(I,J)-VELUC(I,1))/(R(I,J)-R(I,1,1))) -DEFRSO(I)
81. 60 DEFRN(I,J)=SQRT(DEFRN(I,J)**2 +DEFRS(I,J)**2)
82.
83.
84. WRITE(I08,200) (J,J=1,NJ)
85. 200 FORMAT(/1H1,9X,16HX(I,J) (INCHES)/10X,6HR(I,J)/4X,2HJ=,2016)
86. DO 201 I=1,NI
87. 201 WRITE(I08,202) I, (X(I,J),J=1,NJ), (R(I,J),J=1,NJ)
88. 202 FORMAT(/1X,2HI=,12,1X,20F6.3/6X,20F6.3)
89.
90. WRITE(I08,300) DELTON, DELTOF
91. 300 FORMAT(/10X,7HDELTON=,F5.3,1X,5H(SEC)/10X,8HDELTOFF=,F5.3)
92.
93. WRITE(I08,203) (J,J=1,NJ)
94. 203 FORMAT(/1H1,9X,59HVELU(I,J) (CM/SEC) FORWARD DIFFERENCE VELOCITY
95. 1 COMPONENTS/10X,9HVELV(I,J)/4X,2HJ=,2016)
96. DO 204 I=1,NI
97. 204 WRITE(I08,205) I, (VELU(I,J),J=1,NJM1), (VELV(I,J),J=1,NJM1)
98. 205 FORMAT(/1X,2HI=,12,1X,19F6.3/6X,19F6.3)
99.
100. WRITE(I08,206) (J,J=1,NJ)
101. 206 FORMAT(/1H1,9X,62HVELUC(I,J) (CM/SEC) CORRECTED (SMOOTHED) VELOC
102. ITY COMPONENTS/10X,10HVELVC(I,J)/4X,2HJ=,2016)
103.
104. DO 207 I=2,NIM1
105. 207 WRITE(I08,208) I, (VELUC(I,J),J=2,NJM2), (VELVC(I,J),J=2,NJM2)
106. 208 FORMAT(/1X,2HI=,12,7X,17F6.3/12X,17F6.3)
107. WRITE(I08,227) (I,I=2,15), (VELUC(I),I=2,15), (VELV(I),I=2,15),
108. 1 (DEFRSO(I),I=2,15)
109. 227 FORMAT(/1H1,9X,42HVELUO(I) (CM/SEC) APPROACH FLOW VELOCITY
110. 1 /10X,36HVELVO(I) (CM/SEC) BUBBLE RISE RATE
111. 2 /10X,36HDEFRSO(I) (1/SEC) FLUME SHEAR RATE
112. 3 //1X,14HSTREAMLINE NO.,14I6/15X,14F6.3/15X,14F6.3)
113. WRITE(I08,228) (I,I=16,29), (VELUC(I),I=16,29), (VELV(I),I=16,29)
114. 1 (DEFRSO(I),I=16,29)
115. 228 FORMAT(/1X,14HSTREAMLINE NO.,14I6/15X,14F6.3/15X,14F6.
116. 13)
117.
118. WRITE(I08,229) (J,J=1,NJ)
119. 229 FORMAT(/10X,50HVELUR(I,J) (CM/SEC) RELATIVE VELOCITY COMPONENT

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HEX			DEC			HEX			DEC								
NAME	TYPE	CLASS	LOC	WORDS		NAME	TYPE	CLASS	LOC	WORDS		NAME	TYPE	CLASS	LOC	WORDS	
ABS	R	SPOG	INTRIN			DEFRR	R	ARRAY	0159A	V	476	DEFRR	R	ARRAY	01849	V	476
DEFRRR	R	ARRAY	0196F	V	476	DEFRR	R	ARRAY	01D27	V	476	DEFRR	R	ARRAY	01776	V	29
DEFRRX	R	ARRAY	01793	V	476	DELTCY	R	SCALR	01F06	V	1	DELTCY	R	SCALR	01F11	V	1

VELUO(I) (CM/SEC) APPROACH FLOW VELOCITY
VELVGT(I) (CM/SEC) BUBBLE RISE RATE
DEFRSC(I) (1/SEC) FLUME SHEAR RATE

STREAMLINE NO. 2 3 4 5 6 7 8 9 10 11 12 13 14 15
7.606 7.582 7.575 7.575 7.561 7.541 7.534 7.531 7.521 7.502 7.481 7.465 7.442 7.415
-579 -579 -573 -580 -572 -545 -550 -546 -542 -505 -462 -425 -378 -334
-000 -011 -002 -004 -012 -010 -003 -004 -009 -013 -013 -013 -017 -018

STREAMLINE NO. 16 17 18 19 20 21 22 23 24 25 26 27 28 29
7.388 7.369 7.367 7.371 7.371 7.389 7.407 7.411 7.410 7.414 7.422 7.412 7.422 7.450
-325 -320 -313 -327 -331 -322 -308 -331 -324 -290 -291 -255 -206
-015 -007 -000 -001 -006 -012 -007 -001 -001 -004 -001 -000 -012 -000

VELUR(I,J) (CM/SEC) RELATIVE VELOCITY COMPONENTS

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I= 2	-007	007	019	041	101	077	015	013	-042	-166	-236	-047	140	411	837	1517	2218			
	-009	-008	005	012	011	013	030	064	151	393	890	1632	2464	3112	2979	2328	1670			
I= 3	-013	013	033	002	-008	-015	-056	-110	-267	-480	-586	-455	-302	030	239	804	2067			
	-018	-015	007	026	021	002	-010	017	109	298	626	1177	2000	3060	3499	3143	2529			
I= 4	-013	013	018	-034	-050	-086	-133	-232	-436	-698	-951	-877	-857	-678	-667	-279	756			
	-010	-006	-003	020	017	-001	-012	015	087	197	383	760	1345	2378	3424	3975	3436			
I= 5	-014	014	-007	-066	-124	-146	-237	-333	-518	-851	-1238	-1241	-1392	-1480	-1854	-1957	1610			
	-001	-003	005	-001	-008	-009	010	043	063	059	093	265	575	1309	2148	3149	3803			
I= 6	-012	012	-007	-080	-138	-176	-272	-365	-538	-886	-1355	-1417	-1620	-1914	-2381	-2843	3415			
	008	-003	-011	005	-003	-024	-029	008	024	036	032	065	095	326	640	1252	1645			
I= 7	-010	010	-008	-108	-163	-171	-250	-341	-515	-857	-1263	-1374	-1578	-1838	-2088	-2355	3050			
	022	019	-014	-028	-002	015	001	001	012	022	027	000	-048	-097	-147	-161	-175			
I= 8	-005	005	-039	-165	-169	-144	-204	-336	-502	-728	-1069	-1212	-1387	-1501	-1688	-1559	1997			
	006	019	-001	-024	-018	-003	000	006	-027	-054	-106	-182	-310	-458	-651	-820	-931			
I= 9	-001	001	-063	-189	-168	-131	-177	-350	-473	-565	-792	-1010	-1152	-1172	-964	-812	-1174			
	024	010	-013	-020	-009	012	011	013	-065	-117	-199	-363	-559	-803	-1039	-1252	-1401			
I=10	-006	006	-064	-194	-169	-122	-155	-318	-391	-408	-540	-774	-946	-851	-522	-269	-632			
	028	009	-010	-027	-010	012	026	001	053	-167	-311	-493	-697	-914	-1172	-1397	-1473			
I=11	-004	004	-058	-186	-155	-123	-125	-254	-303	-279	-296	-533	-730	-563	-071	151	-276			
	004	-007	-007	010	003	-002	-005	-030	-067	-193	-386	-577	-726	-881	-1033	-1126	-1144			
I=12	-007	007	-045	-159	-156	-119	-093	-214	-251	-185	-119	-301	-491	-293	302	567	156			
	014	-005	000	-009	-013	004	024	030	-030	-133	-241	-386	-542	-661	-770	-881	-908			
I=13	-011	011	-043	-139	-148	-127	-037	-191	-183	-134	-014	-119	-216	-017	561	714	183			
	-014	003	018	-007	-012	013	050	-016	-123	-250	-353	-462	-570	-673	-740	-728	-736			
I=14	-015	015	-028	-111	-119	-122	-095	-125	-116	-088	-039	052	052	236	783	476	-548			
	-030	-019	021	027	010	034	043	001	-106	-214	-297	-403	-510	-593	-625	-584	-586			

I=15 006 -006 -008 -062 -079 -101 -083 -103 -037 -046 -099 -160 -274 -488 -940 -328 -795
-011 -006 -011 -005 -013 -021 -041 -014 -067 -125 -218 -295 -399 -481 -505 -449 -420
I=16 006 -006 -018 -034 -050 -063 -057 -053 -005 -002 -117 -217 -470 -650 -1068 -494 -450
-002 -002 -006 -002 -006 -007 -036 -034 -026 -113 -162 -222 -263 -305 -321 -301 -291

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	DEFXX(I,J)	(1/SEC)	AXIAL COMPONENT,	DEF. RATE																
	DEFRR(I,J)	(1/SEC)	RADIAL COMPONENT,	DEF. RATE																
I=3	-.015	-.003	-.013	-.006	-.017	-.031	-.073	-.124	-.108	-.005	-.102	-.164	-.182	-.235	-.608					
I=4	-.001	-.003	-.002	-.001	.005	.015	.018	.027	.081	.201	.341	.440	.347	.013	-.352					
I=5	.010	-.014	-.036	-.018	-.047	-.106	-.183	-.160	-.183	-.070	.035	.069	.066	.121	.535					
I=6	-.005	.001	.009	.010	.004	-.006	-.007	.020	.091	.198	.333	.500	.590	.450	.089					
I=7	-.002	-.026	-.039	-.027	-.040	-.063	-.100	-.178	-.261	-.154	-.065	-.096	-.217	-.224	.172					
I=8	-.001	.002	.005	.007	.007	.005	.003	.024	.060	.125	.239	.412	.641	.812	.702					
I=9	.001	-.030	-.043	-.032	-.047	-.064	-.096	-.179	-.298	-.210	-.115	-.198	-.358	-.446	-.578					
I=10	-.007	.006	.009	-.002	-.008	.003	.015	.019	.014	.025	.095	.220	.475	.732	.935					
I=11	.000	-.038	-.051	-.022	-.031	-.058	-.095	-.176	-.274	-.206	-.132	-.187	-.223	-.242	-.440					
I=12	-.007	-.003	.010	.004	-.009	-.011	.005	.016	.028	.041	.074	.120	.243	.406	.624					
I=13	-.012	-.055	-.041	.007	-.013	-.064	-.104	-.137	-.208	-.185	-.128	-.117	-.027	-.020	-.216					
I=14	.004	-.001	-.004	.002	.002	-.003	.004	.023	.041	.085	.100	.134	.174	.207	.237					
I=15	-.022	-.062	-.033	.020	-.004	-.072	-.101	-.077	-.116	-.160	-.135	-.067	.082	.145	-.078					
I=16	.005	.002	-.001	-.004	-.004	-.007	-.003	.005	.028	.051	.073	.083	.085	.081	.075					
I=17	-.020	-.066	-.033	.024	.004	-.064	-.079	-.032	-.054	-.127	-.147	-.034	.166	.219	-.039					
I=18	.006	-.003	-.010	-.004	.005	.005	.003	.006	.011	.035	.026	-.003	.048	-.089	-.140					
I=19	-.019	-.063	-.030	.022	.010	-.043	-.060	-.010	.002	-.083	-.151	-.014	.250	.260	-.070					
I=20	.005	-.004	-.007	-.000	.004	.003	.008	.016	.002	-.013	-.039	-.081	-.131	-.194	-.289					
I=21	-.018	-.050	-.036	.013	.022	-.030	-.052	.009	.046	-.035	-.127	.002	.293	.303	-.048					
I=22	-.004	-.008	.006	.004	-.004	-.015	-.008	.006	.009	-.056	-.101	-.130	.164	-.207	-.249					
I=23	-.020	-.042	-.033	.004	.021	-.020	-.031	.019	.059	.009	-.068	.034	.275	.252	-.116					
I=24	.003	-.005	-.010	-.008	-.007	-.001	-.013	-.027	-.042	-.080	-.116	-.137	-.160	-.198	-.223					
I=25	-.014	-.031	-.029	-.004	.008	-.000	-.007	.012	.054	.049	.004	.060	.250	.101	-.424					
I=26	.003	.005	-.004	-.008	.001	.012	-.010	-.041	-.077	-.099	-.126	-.150	-.175	-.199	-.207					
I=27	-.004	-.018	-.023	-.013	-.001	-.000	.017	.021	.049	.071	.058	.108	.217	-.030	-.512					
I=28	-.009	.010	.014	.006	.015	.014	-.005	-.045	-.079	-.109	-.147	-.191	-.226	-.242	-.229					
I=29	.005	-.008	-.022	-.010	-.002	.004	.018	.018	.044	.075	.117	.155	.187	-.050	-.445					
I=30	-.004	.007	.004	.009	.013	.024	.007	-.026	-.066	-.115	-.159	-.215	-.259	-.273	-.242					
I=31	.013	-.001	-.024	-.009	.005	.002	.016	.018	.020	.076	.172	.174	.157	-.059	-.421					
I=32	-.096	1.077	-.242	-.099	.009	.111	.071	-.049	-.177	-.224	-.279	-.320	-.376	-.409	-.394					
I=33	.009	.002	-.014	-.008	-.004	-.004	.008	.007	.023	.087	.184	.137	.116	-.085	-.482					
I=34	-.003	.014	.011	-.011	-.022	-.028	-.029	-.040	-.031	-.027	-.033	-.036	-.025	.004	.021					
I=35	.007	.002	-.011	-.010	-.005	-.004	-.009	-.005	.018	.074	.180	.155	.078	-.044	-.263					
I=36	.007	-.001	-.016	-.019	-.022	-.023	-.032	-.038	-.049	-.064	-.075	-.091	-.090	-.106	-.123					
I=37	.008	.009	-.010	-.018	-.010	-.009	-.016	-.008	.004	.046	.172	.145	.030	.008	-.053					
I=38	.005	-.014	-.010	-.007	-.024	-.032	-.036	-.044	-.048	-.065	-.085	-.098	-.095	-.097	-.109					
I=39	-.005	.005	-.001	-.018	-.028	-.028	-.018	-.000	-.003	.020	.142	.122	.005	-.040	-.075					
I=40	-.001	-.001	-.007	-.014	-.028	-.043	-.055	-.054	-.051	-.059	-.079	-.116	-.120	-.115	-.100					
I=41	-.010	.003	.002	-.021	-.040	-.045	-.025	.000	-.011	-.002	.118	.105	-.007	-.041	-.080					
I=42	-.001	.006	-.002	-.006	.000	.005	-.023	-.027	-.022	-.018	-.039	-.085	-.108	-.127	-.115					
I=43	-.008	.006	.001	-.023	-.051	-.063	-.036	-.012	-.035	-.009	-.107	.059	-.045	-.010	-.019					
I=44	.006	.002	-.008	-.004	.010	.015	.008	-.007	-.004	-.007	-.019	-.031	-.057	-.097	-.134					

I=21	-.005	.005	.001	-.018	-.028	-.028	-.018	-.000	-.003	.020	.142	.122	.005	-.040	-.075
	-.001	-.001	-.007	-.014	-.028	-.043	-.055	-.054	-.051	-.059	-.079	-.116	-.120	-.115	-.100
I=22	-.010	.003	.002	-.021	-.040	-.045	-.025	.000	-.011	-.002	.118	.105	-.007	-.041	-.080
	-.001	.006	-.002	-.006	.000	.005	-.023	-.027	-.022	-.018	-.039	-.085	-.108	.127	-.115
I=23	-.008	.006	.001	-.023	-.031	-.063	-.036	-.012	-.035	-.009	.107	.059	-.045	-.010	-.019
	.006	.002	-.008	-.004	.010	.015	.008	-.007	-.004	-.007	-.019	-.031	-.057	-.097	-.134
I=24	-.003	.012	.007	-.027	-.065	-.073	-.049	-.035	-.060	-.029	.084	.034	-.073	-.041	-.033
	.000	.008	.000	-.008	-.007	-.006	-.007	-.008	-.003	.002	-.000	-.014	-.018	-.015	-.050
I=25	-.008	.015	.004	-.030	-.066	-.076	-.053	-.054	-.111	-.089	.048	.036	-.108	.162	-.140
	-.006	-.000	.012	.006	-.002	.003	.006	.008	.018	.029	.024	.028	.035	.057	.062
I=26	.011	.023	.001	-.044	-.062	-.062	-.049	-.075	-.158	-.144	-.016	-.025	-.173	.245	-.180
	.002	-.010	-.003	.008	.025	.034	.042	.041	.046	.048	.059	.084	.091	.088	.093
I=27	.026	.041	-.007	-.063	-.056	-.042	-.048	-.089	-.172	-.181	-.107	-.108	-.242	-.302	-.211
	.003	.003	-.007	-.003	.013	.023	.034	.060	.064	.068	.093	.104	.111	.102	.100
I=28	.038	.049	-.010	-.076	-.055	-.024	-.045	-.087	-.178	-.230	-.163	-.147	-.284	-.365	-.358
	-.005	.005	.011	.005	-.000	.009	.039	.072	.091	.100	.107	.118	.128	.139	.149

I=16
-004 -008 -013 -007 -006 -044 -013 -022 -022 -022 -010 -013 -016 -056 -077
-002 -015 -021 -011 -046 -009 -067 -031 -061 -133 -061 -151 -228 -251 -171 -352
-005 -017 -024 -015 -010 -018 -048 -072 -086 -100 -151 -228 -251 -171 -352

I=17
-055 -539 -133 -054 -007 -057 -044 -034 -099 -150 -225 -247 -266 -234 -408
-000 -008 -018 -005 -001 -008 -019 -030 -029 -001 -015 -060 -023 -023 -017
-055 -539 -134 -055 -007 -057 -048 -045 -103 -150 -226 -254 -267 -235 -408

I=18
-006 -008 -012 -009 -013 -016 -019 -023 -027 -057 -108 -097 -070 -045 -251
-017 -012 -005 -001 -012 -006 -006 -014 -021 -037 -034 -012 -028 -091 -005
-018 -014 -013 -009 -017 -017 -020 -027 -035 -068 -114 -097 -076 -101 -251

I=19
-007 -002 -013 -014 -013 -014 -020 -021 -033 -069 -127 -123 -084 -075 -193
-016 -006 -007 -011 -011 -004 -016 -030 -024 -048 -146 -141 -118 -173 -198
-018 -007 -015 -018 -017 -015 -026 -037 -041 -084 -146 -141 -118 -173 -198

I=20
-006 -011 -010 -013 -017 -021 -026 -026 -026 -026 -055 -128 -121 -063 -053 -081
-003 -020 -010 -005 -013 -027 -035 -039 -065 -095 -185 -124 -185 -124 -185
-007 -023 -014 -014 -021 -034 -044 -044 -044 -044 -086 -160 -156 -135 -192 -148

I=21
-003 -003 -004 -016 -028 -035 -036 -027 -027 -040 -110 -119 -063 -078 -088
-020 -024 -008 -021 -033 -044 -058 -055 -053 -086 -113 -123 -127 -164 -205
-021 -025 -009 -026 -043 -056 -068 -061 -060 -095 -157 -171 -142 -182 -223

I=22
-006 -004 -002 -014 -020 -025 -024 -013 -017 -010 -079 -095 -057 -084 -097
-010 -013 -016 -023 -031 -049 -051 -042 -062 -103 -134 -142 -140 -151 -127
-011 -014 -016 -026 -037 -055 -056 -044 -064 -104 -155 -171 -152 -173 -160

I=23
-007 -004 -004 -014 -030 -039 -022 -010 -020 -008 -063 -045 -051 -054 -076
-003 -001 -001 -002 -008 -038 -046 -041 -056 -110 -152 -173 -177 -151 -170
-008 -004 -005 -014 -032 -054 -051 -042 -059 -110 -164 -177 -181 -195 -170

I=24
-002 -010 -004 -018 -036 -040 -028 -022 -032 -016 -042 -024 -046 -028 -042
-000 -008 -004 -014 -003 -020 -035 -029 -055 -123 -184 -202 -198 -258 -306
-002 -013 -005 -023 -036 -045 -045 -036 -064 -124 -189 -203 -203 -260 -309

I=25
-007 -008 -008 -018 -034 -040 -029 -031 -065 -059 -036 -032 -071 -110 -101
-013 -005 -008 -008 -012 -012 -014 -003 -026 -106 -207 -235 -159 -272 -392
-015 -009 -011 -020 -036 -041 -033 -031 -070 -122 -210 -237 -211 -293 -405

I=26
-007 -016 -002 -026 -044 -048 -046 -058 -102 -096 -038 -055 -132 -166 -136
-001 -016 -016 -004 -013 -008 -006 -021 -005 -057 -133 -185 -198 -248 -309
-007 -023 -016 -027 -045 -049 -046 -062 -102 -112 -138 -193 -238 -299 -338

I=27
-015 -022 -007 -033 -035 -032 -041 -075 -118 -125 -100 -106 -176 -202 -156
-010 -014 -026 -029 -011 -021 -021 -025 -033 -002 -074 -124 -157 -201 -242
-016 -026 -027 -044 -037 -039 -046 -079 -123 -125 -125 -163 -236 -286 -288

I=28
-021 -027 -010 -041 -028 -016 -042 -080 -134 -165 -135 -133 -206 -252 -253
-008 -004 -004 -014 -032 -032 -064 -068 -039 -006 -048 -081 -100 -120 -173
-023 -028 -011 -043 -031 -036 -076 -105 -140 -165 -143 -155 -229 -279 -307

STOP 0

VELUO(I) (CM/SEC) APPROACH FLOW VELOCITY
 VELVO(I) (CM/SEC) BUBBLE RISE RATE
 DEFRSO(I) (1/SEC) FLUME SHEAR RATE

STREAMLINE NO.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
8.308	8.252	8.178	8.120	8.075	8.012	7.946	7.882	7.830	7.788	7.740	7.712	7.692	7.674	7.671	7.668	7.658	
.168	.173	.196	.234	.272	.263	.246	.264	.269	.252	.241	.232	.245	.257	.257	.264	.254	
.000	.044	.045	.034	.035	.044	.044	.039	.032	.029	.025	.016	.013	.007	.002	.004	.008	

STREAMLINE NO.	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
7.643	7.617	7.604	7.596	7.587	7.574	7.569	7.550	7.523	7.505	7.505	7.498	7.494	7.488	7.507	7.543	7.600	
.244	.238	.230	.241	.247	.235	.222	.208	.210	.211	.213	.223	.226	.206	.206	.187	.187	
.014	.013	.007	.006	.007	.006	.008	.015	.015	.006	.002	.004	.004	.004	.004	.018	.030	.000

VELUR(I,J) (CM/SEC) RELATIVE VELOCITY COMPONENTS

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I= 2	-.043	.043	.071	.145	.190	.213	.214	.237	.237	.247	.212	.140	.116	.186	.308	.439	.394	.316
	-.013	-.000	.006	.008	.035	.063	.118	.227	.227	.373	.517	.731	1.051	1.497	1.949	2.323	2.420	2.289
I= 3	-.033	.033	.028	.098	.162	.153	.157	.143	.135	.074	.074	.012	-.013	-.022	.036	.085	.005	-.052
	-.016	-.008	.004	.020	.037	.071	.130	.201	.324	.491	.491	.732	1.086	1.449	1.826	2.148	2.355	2.366
I= 4	-.019	.019	.032	.094	.128	.138	.120	.118	.054	-.027	-.027	-.062	-.128	-.185	-.180	-.229	-.315	-.328
	.001	-.001	-.005	.005	.029	.083	.131	.202	.292	.448	.448	.700	1.017	1.361	1.710	2.012	2.256	2.400
I= 5	-.015	.015	.014	.054	.097	.107	.115	.094	.010	-.176	-.176	-.223	-.278	-.352	-.404	-.502	-.621	-.706
	-.019	.001	-.004	.014	.055	.106	.159	.206	.302	.433	.433	.599	.863	1.187	1.512	1.823	2.083	2.236
I= 6	-.001	.001	-.003	.039	.055	.081	.143	.183	.233	.304	.401	.554	.755	1.007	1.266	1.492	1.716	1.984
	-.028	-.009	.005	.032	.081	.143	.183	.233	.304	.401	.554	.755	1.007	1.266	1.492	1.716	1.984	
I= 7	.016	-.016	-.008	.028	.022	.084	.150	.215	.292	.356	.431	.558	.720	.922	1.140	1.341	1.491	1.643
	-.041	-.013	.012	.042	.084	.150	.215	.292	.356	.431	.558	.720	.922	1.140	1.341	1.491	1.643	
I= 8	.018	-.018	-.014	.048	.011	.051	.101	.171	.226	.271	.361	.446	.545	.667	.845	.999	1.171	1.308
	-.045	-.020	.014	.051	.101	.171	.226	.271	.361	.446	.545	.667	.845	.999	1.171	1.308	1.491	1.643
I= 9	.021	-.021	-.003	.041	.002	.075	.130	.167	.226	.271	.361	.446	.545	.667	.845	.999	1.171	1.308
	-.033	-.017	.009	.041	.075	.130	.167	.226	.271	.361	.446	.545	.667	.845	.999	1.171	1.308	1.491
I=10	.021	-.021	-.018	.028	.013	.060	.096	.146	.186	.228	.292	.348	.406	.466	.511	.595	.665	.716
	-.047	-.003	.020	.030	.060	.096	.146	.186	.228	.292	.348	.406	.466	.511	.595	.665	.716	
I=11	.008	-.008	-.024	.006	.017	.026	.037	.062	.120	.170	.204	.235	.277	.336	.418	.489	.525	.502
	-.028	-.013	.013	.029	.052	.095	.110	.120	.170	.204	.235	.277	.336	.418	.489	.525	.502	
I=12	.019	-.019	-.017	.014	.011	.014	.014	.014	.025	.092	.246	.406	.481	.495	.527	.527	.747	-.904
	-.017	-.002	.006	.013	.051	.078	.088	.106	.146	.169	.169	.156	.154	.184	.254	.299	.332	.356
I=13	.019	-.019	-.036	.001	.006	.009	.005	.012	.055	.216	.216	.365	.372	.398	.420	.532	.677	-.947
	-.008	-.015	-.000	.024	.001	.054	.075	.096	.109	.115	.115	.097	.056	.073	.118	.131	.141	.139
I=14	.013	-.013	-.038	-.013	.003	.003	.000	.018	.023	.029	.188	.328	.291	.290	.253	.324	.410	-.609
	.002	-.012	-.003	.013	.018	.020	.026	.022	.016	.018	.018	.027	.028	.027	.012	.006	.025	-.048

I=15	.007	-.007	-.018	-.008	.007	-.001	.012	.023	-.004	-.142	-.277	-.239	-.169	-.076	-.127	-.150	-.241
I=16	.007	.004	-.000	-.011	-.016	-.012	-.017	-.043	-.073	-.083	-.091	-.106	-.111	-.102	-.114	-.143	-.158
I=17	.003	-.003	-.023	-.019	-.009	-.000	.009	.018	.010	-.133	-.247	-.212	-.103	.039	.044	.070	.021
I=17	.002	.005	.004	-.011	-.018	-.023	-.042	-.068	-.071	-.070	-.101	-.112	-.141	-.152	-.171	-.178	-.223
I=17	-.005	.005	-.022	-.033	-.006	-.015	.003	.021	.020	-.114	-.222	-.192	-.036	.140	.141	.218	.201
I=18	.000	-.000	.004	-.003	-.015	-.021	-.045	-.058	-.076	-.083	-.100	-.122	-.144	-.158	-.175	-.194	-.220
I=18	-.001	.001	-.020	-.027	-.023	-.050	-.014	.017	.026	-.103	-.204	-.147	.028	.197	.195	.314	.364
I=18	.003	.005	-.007	-.001	-.004	-.007	-.006	-.018	-.044	-.063	-.091	-.102	-.122	-.132	-.145	-.144	-.172
I=19	-.004	.004	-.013	-.018	-.016	-.064	-.055	-.002	.008	-.093	-.180	-.102	.060	.229	.219	.378	.488
I=19	.006	.002	-.001	-.007	-.012	-.009	-.004	-.009	-.035	-.048	-.053	-.050	-.077	-.091	-.097	-.110	-.111
I=20	.007	-.007	-.002	.011	-.009	-.079	-.078	.021	.009	-.055	-.129	-.068	.053	.214	.255	.427	.547
I=20	-.000	.004	.000	-.003	-.014	-.001	-.007	.015	-.034	-.019	-.022	-.022	-.036	-.008	-.014	-.015	-.023
I=21	.013	-.013	-.003	.013	-.017	-.089	-.090	-.055	-.011	-.036	-.123	-.075	.009	.191	.219	.395	.497
I=21	-.010	-.003	.003	.010	.006	.019	.027	.004	-.001	.037	.022	-.003	.014	.039	.043	.042	.048
I=22	.006	-.006	.005	-.004	-.022	-.098	-.105	-.055	-.018	-.073	-.134	-.110	-.088	.093	.135	.287	.345
I=22	-.020	-.002	.015	.007	.004	.017	.015	.006	-.002	.015	.009	.010	.015	.035	.032	.045	.027
I=23	.001	-.001	.009	-.016	-.037	-.112	-.072	-.043	-.028	-.090	-.162	-.185	-.226	-.054	-.010	.127	.157
I=23	-.012	.000	.004	.008	.002	.002	.001	.010	.016	.012	-.013	-.001	.013	.028	.040	.021	.013
I=24	-.005	.005	.033	-.022	-.054	-.113	.061	-.051	-.014	-.082	-.201	-.295	-.355	-.200	-.166	-.048	-.079
I=24	-.003	.005	.003	-.005	.003	.034	.034	.023	.014	.012	.001	.000	.003	.027	.035	.035	.020
I=25	-.006	.006	.049	-.035	-.067	-.123	-.060	-.069	-.031	-.128	-.263	-.365	-.456	-.339	.348	.267	.384
I=25	-.005	-.003	.001	.007	.027	.045	.048	.028	-.003	-.009	-.008	.000	-.021	.005	.002	.007	.018
I=26	.006	-.006	.067	-.019	-.045	-.109	.037	.079	-.062	-.177	-.292	.412	.513	-.473	-.524	.493	.657
I=26	-.004	-.000	-.003	.007	.020	.029	.034	.025	.004	.008	-.001	-.008	-.027	-.035	-.041	-.042	-.047
I=27	.010	-.010	.081	.028	.001	-.087	-.039	-.088	-.077	-.188	-.316	-.433	-.572	-.589	-.708	.732	.934
I=27	.019	.000	-.006	-.013	-.015	.002	.017	.031	.017	.015	-.008	-.060	-.104	-.112	-.132	-.143	-.148
I=28	.014	-.014	.084	.031	.021	-.070	-.048	-.097	-.090	-.222	-.334	-.484	-.667	-.741	-.872	-.961	-1.209
I=28	.032	.025	-.021	-.036	-.008	.006	.006	-.002	-.020	-.042	-.089	-.143	-.189	-.204	-.217	-.232	-.260
I=29	.020	-.020	.055	.022	.002	-.095	-.038	-.081	-.110	-.275	-.405	-.559	-.766	-.894	-.1.097	-1.161	-1.427
I=29	.023	.014	-.010	-.027	-.020	-.002	-.006	-.043	-.104	-.135	-.169	-.216	-.262	-.289	-.324	-.353	-.397
I=30	.021	-.021	.045	.026	.002	-.076	-.015	-.061	-.116	-.296	-.461	-.637	-.843	-.1.023	-.1.277	-1.381	-1.613
I=30	.019	.016	-.005	-.031	-.052	-.053	-.067	-.137	-.205	-.241	-.268	-.308	-.364	-.403	-.425	-.484	-.524
I=31	.017	-.017	.032	.031	.038	-.049	-.013	-.038	-.116	-.326	-.514	-.710	-.925	-.1.049	-.1.394	-1.596	-1.832
I=31	.011	.011	.002	-.023	-.055	-.079	-.121	-.193	-.283	-.325	-.356	-.420	-.485	-.511	-.551	-.606	-.641
I=32	.024	-.024	.032	.054	.077	.002	.046	.000	-.119	-.342	-.570	-.778	-.962	-.1.071	-1.442	-1.698	-1.973
I=32	.014	.014	-.001	-.027	-.041	-.074	-.130	-.225	-.294	-.358	-.394	-.460	-.547	-.621	-.656	-.712	-.778
I=33	.024	-.024	.022	.053	.085	.004	.062	.004	-.122	-.393	-.640	-.835	-.1.010	-.1.079	-1.426	-1.718	-1.980
I=33	.029	.013	-.011	-.030	-.046	-.065	-.130	-.216	-.283	-.323	-.407	-.515	-.632	-.734	-.787	-.875	-.972
I=34	.025	-.025	.022	.036	.069	.001	.045	-.020	-.156	-.420	-.692	-.892	-.1.037	-.1.075	-1.339	-1.615	-1.885
I=34	.013	.024	.000	-.037	-.052	-.087	-.118	-.183	-.265	-.356	-.432	-.582	-.748	-.875	-.963	-1.051	-1.177
I=35	.016	-.016	.002	-.003	.049	-.036	.020	-.071	-.208	-.482	-.745	-.938	-1.055	-1.014	-1.193	-1.441	-1.697
I=35	.019	.021	.001	-.041	-.062	-.076	-.107	-.160	-.260	-.359	-.490	-.615	-.786	-.939	-1.070	-1.213	-1.355

I=34	.025	-.025	.022	-.036	.069	.001	.045	-.020	-.156	-.420	-.692	-.892	-1.037	-1.075	-1.339	-1.615	-1.888	
	.013	.024	.000	-.037	-.052	-.087	-.118	-.183	-.265	-.356	-.432	-.582	-.748	-.875	-.963	-1.051	-1.177	
I=35	.016	-.016	.002	-.003	.049	-.006	.020	-.071	-.208	-.482	-.745	-.938	-1.055	-1.014	-1.193	-1.441	-1.697	
	.019	.021	.001	-.041	-.062	-.076	-.107	-.160	-.260	-.359	-.490	-.615	-.786	-.939	-1.070	-1.213	-1.355	
J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DEFRRX(I,J)	(1/SEC)	AXIAL COMPONENT,	DEF. RATE															
DEFRRY(I,J)	(1/SEC)	RADIAL COMPONENT,	DEF. RATE															
I= 3	.016	.017	.041	.020	-.001	-.002	-.001	-.002	-.006	-.018	-.038	-.028	-.010	.012	.033	-.003	-.041	-.081
	.000	.004	.002	.003	-.004	.001	.017	.041	.043	.039	.054	.103	.153	.188	.142	.049		
I= 4	.015	.021	.028	.014	-.004	-.007	-.004	-.022	-.044	-.034	-.030	-.038	-.019	-.016	-.041	-.028	-.049	
	-.003	.003	.003	.003	-.004	-.009	-.004	.007	.021	.040	.076	.121	.146	.177	.191	.179	.132	
I= 5	.008	.011	.026	.018	.005	-.003	.035	-.079	-.067	-.033	-.042	-.042	-.052	-.070	-.068	-.097		
	.002	-.003	-.003	-.016	-.016	-.011	-.001	.009	.036	.081	.133	.177	.216	.249	.253	.218		
I= 6	-.001	.010	.017	.005	.001	.001	-.050	-.109	-.093	-.042	-.035	-.062	-.080	-.108	-.145	-.145		
	.004	-.005	-.008	-.006	-.009	-.010	-.017	.002	.022	.042	.087	.141	.186	.232	.265	.269		
I= 7	-.006	.013	.008	.001	.003	-.003	-.058	-.116	-.115	-.064	-.021	-.039	-.105	-.157	-.237	-.245		
	.003	-.002	-.004	-.002	-.001	-.001	.001	.002	.007	.031	.065	.099	.142	.167	.214	.286		
I= 8	-.008	.019	.004	-.017	-.007	-.008	-.059	-.119	-.122	-.071	-.009	-.032	-.129	-.202	-.312	-.334		
	.001	.002	.003	.008	.015	.027	.037	.033	.033	.048	.083	.125	.156	.195	.217	.253		
I= 9	-.005	.019	-.002	-.021	-.012	-.010	-.053	-.114	-.119	-.063	-.004	-.040	-.155	-.214	-.307	-.343		
	-.007	-.001	.010	.019	.034	.038	.043	.063	.074	.092	.116	.148	.174	.209	.223	.228		
I=10	-.010	.014	-.003	-.017	-.012	-.015	-.039	-.098	-.118	-.068	-.015	-.044	-.157	-.208	-.260	-.273		
	-.002	-.001	.006	.012	.019	.028	.047	.063	.084	.110	.122	.137	.160	.170	.182	.192		
I=11	-.011	.002	-.000	-.011	-.006	-.011	-.037	-.080	-.111	-.087	-.030	-.030	-.130	-.173	-.203	-.215		
	-.000	.006	.007	.007	.012	.028	.037	.040	.056	.079	.099	.126	.132	.142	.141	.139		
I=12	-.010	.009	-.001	-.010	-.001	-.001	-.028	-.069	-.106	-.084	-.028	-.016	-.098	-.137	-.176	-.186		
	-.000	.005	.004	.008	.020	.020	.017	.032	.043	.058	.085	.100	.115	.135	.141	.132		
I=13	-.017	.004	.008	-.004	.004	.024	.035	.051	.104	-.059	-.012	-.017	-.053	-.089	-.158	-.139		
	.003	.003	.001	.014	.024	.026	.035	.051	.059	.066	.065	.075	.089	.109	.124	.135		
I=14	-.017	-.002	.011	.005	.008	.008	-.018	-.065	-.100	-.043	.011	.011	-.018	-.053	-.106	-.075		
	-.007	-.000	.013	.021	.025	.034	.050	.063	.067	.062	.049	.056	.070	.077	.087	.089		
I=15	-.008	-.001	.008	.003	.003	.003	-.004	-.049	-.093	-.040	.039	.054	.007	-.026	-.043	-.007		
	-.006	-.002	.009	.012	.015	.022	.027	.026	.026	.016	.018	.026	.044	.041	.034	.037		
I=16	-.009	-.007	.012	.008	-.001	.008	-.000	-.044	-.085	-.033	.053	.083	.042	.009	-.012	.013		
	.002	-.001	-.004	-.003	.000	.004	-.004	.012	.014	-.013	-.014	-.010	-.003	-.003	-.011	-.010		
I=17	-.007	-.013	.007	.008	.004	.004	.005	-.039	-.079	-.031	.069	.111	.051	.021	.015	.038		
	.001	.003	-.005	-.007	-.009	-.017	-.026	.022	.018	-.025	-.027	-.036	-.038	-.044	-.047	-.060		
I=18	-.007	-.010	-.001	-.006	.006	.006	.012	-.034	-.075	-.021	.085	.116	.047	.032	.052	.080		
	-.000	.002	-.001	-.006	-.009	-.022	-.028	-.033	-.035	-.042	-.053	-.060	-.064	-.071	-.078	-.091		
I=19	-.004	-.008	-.001	-.013	-.010	.019	.019	-.025	-.062	-.010	.086	.110	.044	.040	.086	.129		
	.005	-.006	-.001	-.005	-.006	-.005	-.014	-.033	-.044	-.064	-.070	-.083	-.087	-.096	-.095	-.113		

I=20	-.002	.006	-.004	-.028	-.020	.017	.028	-.007	-.046	-.011	.065	.093	.061	.062	.092	.149
	.003	-.004	-.010	.004	-.026	-.054	.007	.091	.014	.122	.505	1.730	-.976	-.443	-.314	-.242
I=21	-.004	.008	-.006	-.032	-.022	.010	.028	.010	-.040	-.019	.047	.084	.062	.058	.086	.134
	.002	-.009	-.004	-.003	-.010	-.009	.005	.000	-.010	-.006	-.007	-.010	-.025	-.024	-.033	-.020
I=22	.001	.002	-.009	-.029	-.025	.012	.029	-.001	-.040	-.017	.016	.061	.069	.057	.064	.110
	-.001	-.002	-.002	.000	.004	.004	.004	-.008	.001	.010	-.000	-.004	-.009	-.014	-.005	.000
I=23	.003	-.004	-.015	-.030	-.007	.024	.014	-.012	-.046	-.034	-.023	.034	.069	.055	.049	.032
	-.003	.002	.004	-.000	-.011	-.012	.009	-.007	-.002	.001	.002	.002	-.005	-.009	-.006	-.003
I=24	.013	-.006	-.028	-.030	.002	.023	.017	-.006	-.065	-.073	-.053	.022	.061	.046	.020	.045
	.001	.001	-.001	-.011	-.019	-.020	.009	.005	.007	.000	-.000	.012	.005	.009	.008	-.004
I=25	.020	-.008	-.037	-.029	.007	.022	.012	-.014	-.080	-.083	-.068	-.001	.032	.019	-.027	-.018
	.002	.002	-.004	-.007	-.002	-.005	.004	.003	.001	.001	.003	.012	.021	.026	.026	.024
I=26	.024	.002	-.035	-.029	.008	.014	.006	-.028	-.079	-.081	-.078	-.029	-.010	-.013	-.063	.063
	-.001	.003	.007	.013	.011	.007	.004	-.007	-.008	.001	.023	.034	.044	.050	.051	.059
I=27	.028	.018	-.025	-.037	-.009	.003	.010	-.029	-.083	-.086	-.093	-.062	-.057	-.059	-.099	-.085
	-.009	.007	.015	.008	.005	.007	.008	.009	.018	.033	.051	.062	.064	.067	.072	.080
I=28	.029	.022	-.019	-.031	-.019	-.007	.012	-.037	-.083	-.090	-.121	-.099	-.082	-.086	-.145	-.116
	-.005	.002	.006	.003	.002	.007	.026	.045	.055	.060	.062	.066	.073	.080	.086	.100
I=29	.017	.019	-.017	-.037	-.007	.009	.024	-.061	-.101	-.100	-.134	-.127	-.134	-.113	-.149	-.149
	.001	-.005	.001	.017	.022	.027	.051	.070	.076	.072	.070	.077	.086	.089	.105	.110
I=30	.013	.020	-.015	-.032	.000	.010	.035	-.076	-.120	-.121	.143	-.145	-.178	-.155	-.153	.140
	.000	-.004	.001	.015	.029	.043	.058	.072	.077	.078	.086	.095	.095	.099	.108	.106
I=31	.009	.019	.002	-.023	-.002	.009	.045	-.094	-.138	-.136	.155	-.133	-.201	-.228	-.197	.146
	-.000	-.001	.001	-.001	.011	.027	.040	.044	.056	.060	.072	.085	.098	.103	.104	.114
I=32	.007	.028	.015	-.013	-.006	.003	.058	-.113	-.159	-.157	.147	-.117	-.210	-.261	-.240	.171
	-.001	.005	.004	-.000	-.001	.010	.019	.015	.017	.038	.056	.078	.105	.110	.123	.144
I=33	.004	.027	.021	-.012	-.002	.005	.064	-.128	-.182	-.163	.140	-.101	-.185	-.261	-.243	.147
	-.004	-.000	.005	.006	.008	.002	.003	.005	.017	.033	.067	.098	.118	.137	.147	.168
I=34	.004	.022	.016	-.008	-.003	-.003	.070	-.130	-.190	-.174	.129	-.078	-.135	-.215	-.232	.115
	-.003	-.004	.005	.008	.007	-.002	-.009	.005	.028	.048	.059	.083	.103	.131	.151	.167

DEFRN(I,J) (1/SEC) NORMAL COMPONENT, DEF. RATE
 DEFRS(I,J) (1/SEC) SHEAR COMPONENT, DEF. RATE
 DEFRM(I,J) (1/SEC) ROOT-MEAN-SQUARED VALUE, DEF. RATE

J=

I= 3

I=17	.004	-.003	.006	-.007	.006	-.015	.016	.031	-.049	-.028	-.048	-.073	-.045	-.033	-.031	-.049
	.000	-.002	-.004	.004	.005	-.005	-.010	-.014	-.018	-.027	-.036	-.055	-.063	-.061	-.081	-.134
	.004	.008	.007	.009	.008	.016	.019	.034	.052	.039	.061	.092	.077	.069	.100	.143
I=18	.004	.006	.001	.006	.008	.022	.020	.033	.055	.032	.069	.088	.056	.052	.055	.086
	-.003	-.006	-.005	.001	.016	-.016	-.006	-.011	-.023	-.028	-.041	-.043	-.037	-.031	-.064	-.111
	.005	-.009	.005	.006	.017	.028	.021	.035	.060	.042	.080	.098	.067	.060	.091	.140
I=19	.004	.007	.001	.009	.008	.012	.017	.029	.053	.037	.078	.097	.065	.068	.090	.121
	.000	-.009	-.017	-.006	.013	.022	.001	-.008	-.022	-.026	-.035	-.023	-.012	-.026	-.042	-.060
	.004	.011	.017	.011	.015	.025	.017	.030	.058	.045	.086	.099	.067	.073	.100	.136
I=20	.003	.005	.007	.016	.023	.036	.017	.049	.030	.066	.285	.911	.518	.252	.203	.196
	.005	-.006	-.015	-.000	.009	.007	.008	.003	-.016	-.020	-.014	.020	.019	-.002	-.009	-.037
	.006	.007	.017	.016	.025	.036	.019	.049	.034	.069	.285	.912	.519	.252	.203	.196
I=21	.003	.009	.005	.018	.016	.009	.016	.005	.025	.013	.027	.047	.044	.041	.050	.077
	.004	.002	.006	.007	.014	.005	.003	.018	.012	-.011	.014	.063	.052	.044	.051	.066
	.005	.009	.008	.019	.021	.011	.016	.019	.028	.017	.031	.079	.068	.060	.079	.101
I=22	.001	.002	.006	.015	.015	.008	.016	.005	.020	.014	.008	.033	.039	.036	.034	.055
	.008	.000	.006	.010	.011	-.009	-.010	.007	.021	.011	.039	.087	.088	.079	.087	.101
	.008	.002	.008	.018	.018	.012	.019	.009	.029	.018	.040	.093	.096	.087	.094	.116
I=23	.003	.003	.010	.015	.009	.018	.012	.010	.024	.018	.013	.018	.037	.032	.028	.042
	.001	-.007	.005	.008	.005	-.011	.004	-.000	-.008	.016	.070	.098	.105	.098	.102	.133
	.003	.007	.011	.017	.010	.021	.012	.010	.025	.024	.071	.100	.111	.103	.106	.140
I=24	.007	.003	.015	.020	.011	.021	.013	.006	.036	.037	.027	.017	.033	.028	.014	.025
	-.001	-.017	.007	.022	.013	-.008	.002	-.003	.009	.030	.061	.085	.106	.116	.124	.172
	.007	.017	.016	.030	.017	.023	.013	.006	.037	.040	.066	.087	.111	.119	.125	.174
I=25	.011	.005	.021	.018	.005	.013	.008	.008	.040	.042	.036	.007	.027	.022	.026	.021
	.006	-.009	.008	.010	.005	-.013	-.008	.002	.030	.034	.033	.052	.098	.115	.154	.201
	.012	.010	.022	.021	.007	.019	.011	.009	.050	.054	.049	.053	.101	.117	.156	.202
I=26	.013	.003	.021	.021	.010	.011	.005	.017	.043	.041	.051	.032	.027	.032	.057	.051
	.005	-.003	-.012	.015	.007	-.008	-.005	.008	.017	.012	.012	.027	.075	.113	.144	.176
	.014	.009	.024	.026	.012	.013	.007	.019	.047	.043	.052	.042	.080	.117	.154	.186
I=27	.019	.013	.020	.022	.007	.005	.009	.019	.050	.059	.072	.062	.061	.063	.085	.082
	-.005	-.010	-.018	-.017	.002	.013	.005	.003	.005	-.011	-.011	.028	.072	.096	.137	.164
	.020	.016	.028	.028	.007	.014	.011	.019	.051	.060	.072	.068	.094	.115	.161	.183
I=28	.017	.012	.013	.017	.010	.007	.019	.041	.069	.075	.092	.083	.078	.083	.115	.109
	-.016	-.013	.008	.015	.007	-.003	.012	-.002	.004	-.006	.005	.039	.087	.112	.115	.132
	.023	.018	.015	.023	.012	.008	.022	.041	.069	.075	.092	.091	.116	.140	.163	.171
I=29	.009	.012	.009	.027	.015	.018	.037	.066	.089	.086	.102	.102	.110	.101	.127	.129
	-.010	-.001	-.001	.014	.006	-.024	-.047	-.024	.002	.014	.016	.029	.066	.103	.100	.094
	.013	.012	.009	.031	.016	.030	.060	.070	.089	.087	.103	.106	.128	.144	.162	.160
I=30	.006	.012	.008	.023	.014	.026	.046	.074	.098	.099	.115	.120	.137	.127	.130	.123
	-.010	-.003	-.019	-.020	.021	-.044	-.061	-.035	-.005	.012	.011	.014	.025	.061	.091	.102
	.012	.014	.020	.031	.026	.051	.077	.082	.099	.100	.115	.121	.139	.141	.159	.160
I=31	.005	.010	.001	.012	.006	.018	.042	.069	.097	.098	.113	.109	.150	.166	.154	.130
	-.003	-.007	-.029	-.044	-.049	-.058	-.075	-.045	-.010	.002	-.004	.001	-.013	.013	.057	.080
	.005	.012	.029	.046	.050	.061	.086	.083	.098	.098	.113	.109	.150	.166	.161	.153
I=32	-.004	.016	.010	.007	.003	.006	.038	.064	.088	.097	.102	.097	.158	.186	.181	.157

I=31
 .005 -.010 .001 .012 .006 .018 .042 .069 .097 .098 .113 .109 .150 .166 .151 .130
 -.003 -.007 .029 .044 .049 .058 .075 .045 .010 .002 .004 .001 .013 .013 .057 .080
 .005 .012 .029 .046 .050 .061 .086 .083 .098 .098 .113 .109 .150 .166 .161 .153

I=32
 .004 .016 .010 .007 .003 .006 .038 .064 .088 .097 .102 .097 .158 .186 .181 .157
 -.004 .010 .020 .030 .049 .066 .088 .043 .012 .006 .019 .035 .031 .026 .018 .022
 .006 .019 .022 .031 .049 .066 .078 .077 .089 .097 .104 .104 .161 .187 .182 .159

I=33
 .004 .014 .013 .009 .005 .004 .034 .067 .100 .098 .103 .100 .152 .199 .195 .157
 -.014 .012 .006 .009 .030 .050 .044 .025 .021 .028 .049 .061 .056 .086 .107 .131
 .014 .018 .014 .012 .030 .050 .036 .071 .102 .102 .114 .117 .162 .217 .222 .235

I=34
 .003 .013 .011 .008 .005 .002 .040 .068 .109 .111 .094 .080 .119 .173 .191 .141
 -.008 .013 .002 .004 .019 .017 .026 .030 .029 .044 .088 .101 .103 .142 .177 .215
 .009 .018 .011 .009 .019 .017 .047 .074 .113 .120 .129 .129 .157 .224 .261 .257

VELUG(I) (CM/SEC) APPROACH FLOW VELOCITY
 VELVG(I) (CM/SEC) BUBBLE RISE RATE
 VELVSO(I) (1/SEC) FLUME SHEAR RATE

STREAMLINE NO. 2 3 4 5 6 7 8 9 10 11 12 13 14 15
 7.308 7.298 7.293 7.284 7.280 7.265 7.254 7.255 7.250 7.243 7.243 7.253 7.253 7.256
 .375 .379 .387 .352 .390 .406 .425 .411 .406 .407 .423 .408 .369
 .000 .005 .004 .004 .006 .009 .003 .000 .002 .004 .001 .004 .003 .004

STREAMLINE NO. 16 17 18 19 20 21 22 23 24 25 26 27 28 29
 7.242 7.229 7.228 7.238 7.220 7.203 7.189 7.183 7.184 7.183 7.176 7.170 7.166 7.169
 .367 .358 .342 .354 .351 .344 .341 .313 .319 .361 .365 .327 .290 .280
 .009 .005 .003 .003 .012 .011 .007 .002 .000 .003 .004 .003 .001 .000

VELUR(I,J) (CM/SEC) RELATIVE VELOCITY COMPONENTS

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I= 2	.010	-.010	.009	.063	.152	.106	.116	.076	-.137	-.241	-.255	-.123	-.252	-.201	-.062	.209	.300			
	-.017	-.004	.001	.021	.068	.110	.165	.263	.354	.480	.692	1.072	1.434	1.839	2.201	2.480	2.583			
I= 3	.004	-.004	.026	.077	.149	.096	.060	-.019	-.236	-.306	-.306	-.212	-.409	-.413	-.349	-.176	-.195			
	-.001	-.016	-.003	.019	.021	.060	.109	.179	.258	.431	.640	.937	1.241	1.608	2.042	2.432	2.607			
I= 4	-.014	.014	-.042	.084	.142	.081	.015	.091	-.266	-.347	-.387	-.332	-.580	-.690	-.812	-.785	-.833			
	.012	-.011	-.013	.012	.015	.003	.054	.105	.171	.317	.526	.789	1.059	1.471	1.883	2.332	2.561			
I= 5	-.021	.021	.058	.082	.136	.097	.011	-.107	-.254	-.345	-.434	-.420	-.754	-1.060	-1.552	-1.675	-1.561			
	.015	-.002	-.013	-.000	.010	-.002	.001	.026	.065	.183	.307	.509	.781	1.169	1.564	2.133	2.791			
I= 6	-.027	.027	.057	.077	.136	.100	.025	-.080	-.201	-.298	-.374	-.460	-.857	-1.382	-2.101	-2.377	-2.382			
	.020	.004	-.010	-.014	-.007	-.012	-.005	-.011	.001	.043	.083	.164	.326	.593	.850	1.281	2.102			
I= 7	-.033	.033	.085	.097	.135	.118	.059	-.044	-.104	-.163	-.229	-.304	-.685	-1.256	-1.924	-2.162	-2.369			
	.000	-.007	-.004	.010	.010	-.010	-.049	-.084	-.074	-.084	-.120	-.131	-.120	-.140	-.215	-.214	-.104			
I= 8	-.040	.040	.115	.122	.151	.132	.070	.023	-.008	-.026	.010	.027	.132	.457	.881	1.395	2.274			
	-.012	-.007	.006	.012	.003	-.061	.130	-.173	-.203	-.254	-.349	-.463	-.592	-.724	-.860	-.938	-.948			
I= 9	-.038	.038	.111	.130	.174	.153	.109	.077	.079	.093	.280	.472	.592	.668	.462	-.755	-2.501			
	-.023	.004	.006	.013	.019	-.109	-.236	-.347	-.408	-.457	-.545	-.689	-.932	-1.238	-1.441	-1.421	-1.122			
I=10	-.030	.030	.087	.123	.201	.204	.184	.178	.206	.285	.538	.856	1.152	1.486	.906	-.756	-2.628			
	-.013	.005	.013	-.005	-.039	-.132	-.261	-.366	-.423	-.458	-.547	-.737	-1.054	-1.480	-1.802	-1.675	-1.382			
I=11	-.028	.028	.076	.128	.212	.246	.268	.321	.388	.504	.820	1.182	1.513	1.749	.615	-1.417	-2.894			
	-.010	-.034	.014	-.000	-.059	-.153	-.278	-.358	-.401	-.455	-.550	-.767	-1.103	-1.503	-1.669	-1.627	-1.308			
I=12	-.029	.029	.090	.127	.238	.281	.334	.428	.547	.709	1.069	1.472	1.747	1.804	.165	-1.808	-3.088			
	-.016	.003	.015	-.002	-.036	-.127	-.245	-.329	-.391	-.473	-.606	-.831	-1.122	-1.364	-1.499	-1.404	-1.255			
I=13	-.037	.037	.099	.148	.237	.303	.381	.486	.634	.821	1.255	1.715	1.887	1.874	.133	-2.129	-3.111			
	.003	.003	.007	-.013	-.050	-.111	-.202	-.298	-.366	-.444	-.570	-.810	-1.028	-1.172	-1.258	-1.303	-1.124			
I=14	-.036	.036	.098	.137	.245	.298	.418	.546	.678	.861	1.370	1.865	2.026	1.971	.214	-1.827	-3.210			
	.000	.007	.009	-.017	-.052	-.101	-.159	-.239	-.310	-.383	-.518	-.708	-.885	-.963	-1.053	-1.159	-1.077			

I=15	-.030	.030	.103	.149	.235	.295	.439	.559	.699	.884	1.432	1.965	2.140	2.108	.084	-2.381	-3.544
	-.006	.001	.008	-.003	-.019	-.044	-.076	-.146	-.224	-.306	-.417	-.581	-.682	-.703	-.796	-.876	-.852
I=16	-.026	.026	.114	.170	.240	.274	.440	.574	.708	.895	1.439	2.018	2.239	2.224	.008	-2.465	-3.461
	.010	.008	.002	-.020	-.022	-.035	-.064	-.120	-.177	-.243	-.299	-.354	-.422	-.454	-.562	-.688	-.649
I=17	-.016	.016	.111	.172	.234	.273	.437	.558	.660	.801	1.367	1.990	2.287	2.317	.067	-2.383	-3.202
	.014	.006	-.007	-.012	-.009	-.035	-.076	-.108	-.130	-.141	-.146	-.164	-.180	-.226	-.308	-.341	-.340
I=18	-.016	.016	.109	.149	.214	.266	.403	.478	.541	.695	1.224	1.868	2.253	2.328	.250	-2.232	-3.312
	.028	-.005	-.016	-.007	-.003	.012	.010	.010	.010	-.026	-.027	-.019	-.020	-.005	-.082	-.214	-.216
I=19	-.020	.020	.092	.133	.199	.245	.318	.334	.388	.554	1.053	1.677	2.112	2.278	.487	-1.643	-2.893
	-.010	-.000	.007	.004	.026	.045	.049	.050	.069	.065	.071	.099	.145	.153	.045	-.206	-.316
I=20	-.017	.017	.097	.125	.208	.242	.250	.223	.263	.422	.834	1.415	1.946	2.183	.753	-1.217	-2.477
	-.028	-.004	.017	.014	.031	.045	.038	.045	.088	.131	.171	.238	.322	.326	.165	-.123	-.240
I=21	-.011	.011	.085	.133	.203	.221	.201	.140	.155	.280	.575	1.132	1.693	1.910	1.031	-.785	-2.112
	-.002	-.007	.008	.001	-.004	.008	.029	.036	.095	.147	.222	.324	.478	.585	.406	.193	.067
I=22	-.011	.011	.101	.137	.168	.178	.162	.061	.076	.167	.379	.850	1.272	1.451	1.210	-.470	-2.734
	-.005	.001	.003	.002	-.014	-.012	.007	.037	.086	.160	.252	.411	.591	.677	.642	.519	.326
I=23	-.008	.008	.098	.125	.141	.151	.109	-.032	-.056	.027	.185	.478	.793	.923	.985	-.202	-1.939
	.000	-.012	-.000	.012	.021	.025	.041	.060	.087	.153	.259	.431	.596	.692	.683	.596	.420
I=24	-.031	.031	.077	.100	.115	.100	.061	-.111	-.175	-.145	-.052	.143	.273	.331	.462	.173	-.614
	.001	-.011	-.001	.011	.002	.017	.032	.050	.069	.123	.195	.316	.486	.613	.675	.654	.578
I=25	-.035	.035	.061	.080	.089	.042	.010	-.131	-.235	-.326	-.317	.249	-.212	-.245	-.157	-.118	-.344
	-.000	-.001	-.004	.006	-.014	-.016	.004	.022	.042	.067	.095	.154	.279	.425	.546	.577	.494
I=26	.001	-.031	.058	.079	.060	.004	-.034	-.127	-.278	-.459	-.565	-.611	-.706	-.882	-.932	-1.040	-1.020
	-.017	-.000	.009	.008	-.009	-.021	-.013	.020	.020	.036	.064	.112	.173	.221	.237	.235	.331
I=27	.002	-.002	.051	.062	.038	-.029	-.051	-.155	-.340	-.545	-.734	-.885	-1.149	-1.417	-1.673	-1.953	-1.957
	-.001	.001	-.003	.003	-.010	-.011	-.001	.030	.046	.038	.040	.064	.104	.110	.079	.081	.180
I=28	.006	-.006	.019	.027	.004	-.026	-.061	-.144	-.393	-.593	-.802	-1.066	-1.463	-1.750	-2.042	-2.329	-2.530
	.009	.003	-.003	-.010	-.009	-.006	-.016	-.027	-.044	-.051	-.082	-.097	-.099	-.104	-.132	-.145	-.133
I=29	.012	-.012	.005	-.015	-.035	-.041	-.053	-.131	-.353	-.562	-.827	-1.085	-1.581	-1.867	-2.107	-2.452	-2.780
	.007	-.005	-.005	.003	.001	-.025	-.077	-.115	-.180	-.288	-.375	-.423	-.455	-.491	-.533	-.544	-.532

DEFXX(I,J) (1/SEC) AXIAL COMPONENT, DEF. RATE
 DEFA(I,J) (1/SEC) RADIAL COMPONENT, DEF. RATE

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	DEFRRX(I,J)	(1/SEC)	AXIAL COMPONENT, DEF. RATE	DEFRRR(I,J)	(1/SEC)	RADIAL COMPONENT, DEF. RATE														
I=3	.038	.028	.043	.009	-.030	-.039	-.104	-.101	-.023	.029	-.049	-.080	.026	.084	.050					
	.002	.004	.004	.020	.038	.042	.061	.072	.072	.082	.133	.176	.187	.187	.150					
I=4	.019	.024	.035	.002	-.043	-.058	-.099	-.091	-.043	.002	-.082	-.136	-.090	-.045	-.011					
	-.005	.003	.007	.011	.023	.039	.056	.071	.095	.129	.167	.189	.196	.223	.192					
I=5	.027	.021	.027	.007	-.043	-.069	-.093	-.085	-.065	-.030	-.129	-.236	-.333	-.277	.016					
	-.005	-.002	.009	.008	.005	.021	.040	.059	.097	.154	.213	.291	.337	.342	.342					
I=6	.028	.017	.028	.010	-.038	-.061	-.079	-.077	-.062	-.058	-.189	-.342	-.539	-.476	-.122					
	.001	-.004	-.003	.001	.015	.028	.036	.046	.092	.146	.216	.302	.424	.543	.629					
I=7	.041	.023	.018	.008	-.027	-.054	-.055	-.042	-.044	-.050	-.172	-.346	-.514	-.423	-.229					
	.003	-.005	-.009	.002	.015	.039	.048	.062	.092	.135	.194	.282	.398	.492	.572					
I=8	.054	.030	.013	.005	-.028	-.037	-.027	-.017	.007	.019	-.053	-.165	-.276	-.367	-.579					
	-.004	-.003	-.000	.002	.015	.040	.072	.091	.098	.108	.138	.197	.252	.256	.239					
I=9	.052	.033	.022	.010	-.022	-.026	-.010	.005	.074	.129	.101	.064	-.047	-.409	-.978					
	-.004	-.002	.006	.010	.016	.028	.042	.045	.033	.021	.031	.068	.129	.153	.074					
I=10	.040	.033	.040	.029	-.006	-.009	.008	.035	.116	.187	.193	.191	-.078	-.597	-1.179					
	.002	-.002	.005	.009	.001	.012	.031	-.042	-.045	-.052	-.046	-.044	-.050	-.084	-.106					
I=11	.036	.034	.047	.041	.018	.024	.040	.059	.147	.216	.209	.168	-.269	-.846	-1.476					
	.001	.001	-.001	.005	-.017	-.035	-.053	-.058	-.049	-.047	-.060	-.105	-.206	-.301	-.284					
I=12	.041	.034	.053	.054	.032	.049	.071	.089	.172	.237	.197	.099	-.466	-1.010	-1.435					
	-.002	.004	.003	.011	-.033	-.060	-.067	-.066	.067	-.072	-.098	-.181	-.315	-.372	-.348					
I=13	.047	.038	.048	.053	.048	.060	.084	.107	.201	.274	.178	.047	-.515	-1.091	-1.819					
	-.000	.004	.004	.003	-.029	-.065	-.080	-.088	-.105	-.128	-.176	-.260	-.357	-.403	-.342					
I=14	.046	.035	.052	.056	.059	.082	.084	.099	.224	.306	.182	.032	-.535	-1.032	-1.404					
	.002	.002	.005	.018	-.041	-.075	-.103	-.117	-.135	-.168	-.242	-.322	-.393	-.423	-.442					
I=15	.046	.041	.045	.050	.069	.083	.084	.103	.237	.329	.196	.040	-.599	-1.196	-2.544					
	.003	.005	-.006	-.025	-.048	-.074	-.107	-.134	-.161	-.223	-.315	-.406	-.457	-.503	-.555					
I=16	.049	.050	.043	.035	.070	.101	.086	.101	.233	.338	.223	.058	-.649	-1.236	-2.550					
	.002	.006	-.005	.017	-.040	-.067	-.118	-.172	-.226	-.304	-.423	-.499	-.528	-.608	-.680					
I=17	.045	.055	.042	.034	.071	.096	.072	.077	.233	.365	.258	.090	-.632	-1.232	-2.019					
	.002	.017	.019	.018	.011	.048	.159	.277	.468	.680	1.066	1.711	3.060	6.866	14.619					
I=18	.045	.047	.036	.040	.065	.072	.045	.069	.227	.363	.293	.128	-.566	-1.185	-2.175					
	.001	-.005	-.003	.016	-.029	-.035	-.038	-.051	-.050	-.055	-.074	-.108	-.117	-.041	-.154					
I=19	.039	.040	.037	.038	.040	.031	.024	.070	.225	.352	.306	.169	-.460	-1.025	-1.482					
	.001	-.011	-.008	.015	-.020	-.017	-.025	-.048	-.072	-.093	-.123	-.177	-.182	-.110	-.034					
I=20	.041	.039	.039	.041	.014	.006	.006	.064	.196	.316	.335	.225	-.342	-.890	-1.355					
	.003	-.002	.001	.008	.007	-.001	-.004	-.022	-.050	-.083	-.123	-.186	-.238	-.187	-.146					
I=21	.035	.043	.041	.031	-.032	-.027	-.014	.046	.146	.278	.354	.238	-.199	-.727	-1.060					
	-.001	.004	.003	.014	.017	.007	-.004	-.013	-.034	-.062	-.114	-.171	-.211	-.247	-.281					

I=22	.040	.045	.023	.014	-.003	-.038	-.026	.035	.106	.225	.289	.189	-.027	-.534	-1.165
	.033	.002	-.004	-.009	-.007	-.008	-.014	-.012	-.022	-.045	-.088	-.116	-.130	-.178	-.209
I=23	.039	.042	.015	.009	-.012	-.060	-.054	.019	.086	.152	.207	.150	.058	-.315	-.894
	.004	.001	-.004	-.004	-.010	-.010	-.009	-.003	-.003	-.006	-.010	-.028	-.056	-.089	-.113
I=24	.029	.036	.013	.000	-.019	-.070	-.080	-.014	.045	.100	.112	.065	.066	-.040	-.353
	-.003	.002	.001	.012	.014	.011	.010	.010	.019	.040	.067	.065	.033	-.016	-.052
I=25	.024	.027	.009	-.012	-.027	-.058	-.085	-.070	-.028	.027	.038	.003	.023	.047	-.867
	-.003	-.004	.000	.004	.013	.015	.008	.013	.024	.036	.054	.080	.094	.101	.088
I=26	.022	.029	.000	-.026	-.032	-.045	-.087	-.118	-.104	-.059	-.055	-.102	-.085	-.063	-.033
	-.001	-.000	.001	-.001	-.001	.002	-.005	-.004	.006	.013	.022	.043	.082	.124	.125
I=27	.018	.024	-.005	-.031	-.030	-.042	-.105	-.140	-.147	-.133	-.167	-.218	-.223	-.244	-.128
	-.001	.004	.006	.000	-.004	.002	.015	.021	.027	.046	.064	.081	.094	.106	.107
I=28	.005	.012	-.006	-.018	-.023	-.041	-.122	-.162	-.158	-.182	-.274	-.299	-.265	-.280	-.241
	.002	.001	-.000	-.003	.006	.027	.050	.077	.110	.137	.154	.170	.176	.175	.173

DEFN(I,J) (1/SFC) NORMAL COMPONENT, DEF. RATE
 DEFN(I,J) (1/SFC) TANGENTIAL COMPONENT, DEF. RATE

DEFRM(I,J)		NORMAL COMPONENT, DEF. RATE																		
DEFRS(I,J)		SHEAR COMPONENT, DEF. RATE																		
DEFRM(I,J)		ROOT-MEAN-SQUARED VALUE, DEF. RATE																		
J =	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I = 3			.005	.016	.023	.015	.034	.040	.082	.087	.047	.056	.091	.128	.106	.136	.100			
			.008	.001	.001	.016	.038	.073	.106	.127	.175	.220	.281	.341	.447	.536	.490			
			.010	.016	.023	.022	.051	.084	.134	.154	.182	.227	.295	.365	.459	.553	.500			
I = 4			.012	.013	.021	.006	.033	.049	.077	.081	.069	.066	.124	.162	.143	.134	.101			
			.017	.003	.007	.002	.014	.051	.070	.079	.145	.210	.258	.347	.505	.675	.670			
			.021	.014	.022	.006	.036	.071	.104	.113	.160	.220	.287	.383	.525	.688	.678			
I = 5			.016	.011	.018	.007	.024	.045	.067	.072	.081	.092	.171	.242	.312	.307	.179			
			.014	.005	.003	.001	.003	.066	.019	.033	.072	.113	.215	.318	.503	.735	.970			
			.022	.012	.018	.007	.024	.045	.069	.079	.109	.146	.274	.399	.592	.796	.986			
I = 6			.015	.010	.016	.005	.027	.044	.057	.061	.077	.102	.203	.322	.482	.509	.376			
			.014	.015	.004	.002	.006	.016	.019	.032	.032	.026	.051	.128	.262	.394	.866			
			.020	.019	.016	.006	.027	.047	.060	.069	.083	.105	.209	.346	.548	.644	.944			
I = 7			.022	.014	.013	.005	.021	.047	.052	.052	.068	.092	.183	.314	.456	.458	.401			
			.005	.014	.018	.024	.035	.028	.031	.065	.108	.144	.155	.224	.303	.360	.186			
			.023	.020	.022	.025	.041	.054	.060	.083	.128	.171	.240	.386	.547	.582	.442			
I = 8			.029	.016	.006	.003	.021	.039	.049	.054	.053	.063	.095	.181	.264	.312	.409			
			.035	.002	.015	.037	.055	.056	.065	.087	.134	.230	.317	.463	.633	.708	.386			
			.029	.016	.016	.037	.059	.068	.082	.103	.144	.239	.331	.497	.685	.773	.562			
I = 9			.028	.017	.014	.010	.019	.027	.026	.025	.054	.075	.066	.066	.088	.281	.526			
			.013	.013	.010	.057	.098	.119	.109	.108	.150	.246	.389	.573	.748	.561	.041			
			.031	.021	.017	.058	.100	.123	.112	.111	.159	.257	.395	.577	.753	.627	.528			
I = 10			.021	.017	.022	.019	.004	.010	.019	.039	.081	.120	.119	.117	.064	.341	.642			
			.012	.009	.018	.054	.106	.131	.134	.133	.178	.268	.398	.532	.574	.115	.381			
			.025	.019	.029	.058	.106	.132	.135	.138	.196	.294	.416	.545	.578	.360	.747			
I = 11			.018	.018	.024	.023	.018	.030	.046	.058	.098	.131	.135	.136	.238	.573	.880			
			.009	.001	.027	.064	.099	.119	.124	.145	.192	.273	.372	.409	.259	.203	.577			
			.020	.018	.036	.068	.101	.123	.132	.157	.215	.303	.395	.431	.351	.608	1.053			
I = 12			.022	.019	.028	.032	.033	.054	.069	.078	.119	.154	.148	.140	.390	.691	.892			
			.007	.009	.025	.049	.089	.107	.105	.132	.181	.261	.359	.281	.147	.146	.401			
			.023	.021	.037	.059	.095	.120	.126	.153	.217	.303	.370	.314	.417	.706	.978			
I = 13			.024	.021	.026	.028	.039	.062	.082	.098	.153	.201	.177	.153	.436	.747	1.080			
			.001	.008	.023	.035	.057	.050	.093	.092	.119	.215	.270	.199	.123	.052	.249			
			.024	.023	.034	.045	.069	.109	.124	.134	.194	.294	.323	.251	.453	.749	1.108			
I = 14			.024	.018	.029	.037	.050	.078	.094	.108	.180	.237	.212	.177	.464	.728	.923			
			.005	.009	.021	.027	.033	.064	.073	.067	.088	.157	.188	.156	.127	.035	.125			
			.024	.020	.036	.046	.060	.101	.119	.127	.200	.284	.283	.236	.481	.728	.931			
I = 15			.025	.023	.026	.037	.059	.081	.095	.118	.199	.276	.255	.223	.528	.849	1.550			
			.009	.006	.021	.012	.011	.040	.057	.060	.072	.105	.126	.108	.124	.031	.264			
			.026	.024	.033	.039	.060	.090	.111	.133	.212	.295	.285	.248	.543	.850	1.572			
I = 16			.026	.028	.024	.026	.055	.084	.102	.137	.230	.321	.323	.278	.588	.921	1.615			
			.002	.011	.016	.005	.007	.027	.036	.026	.011	.012	.042	.079	.116	.051	.053			
			.026	.030	.028	.027	.056	.083	.109	.139	.230	.321	.325	.289	.600	.922	1.615			

I=17	.024	.036	.031	.026	.041	.072	.115	.177	.350	.522	.662	.900	1.846	4.049	8.311
	-.034	-.005	.007	.001	-.020	-.012	.014	.045	.062	.057	.063	.020	-.071	-.121	-.095
	.024	.036	.031	.026	.046	.073	.116	.183	.356	.527	.663	.901	1.847	4.050	8.319
I=18	.023	.026	.020	.028	.047	.053	.041	.060	.138	.209	.184	.118	.341	.613	1.165
	-.016	.005	.017	.018	.013	.033	.068	.089	.084	.114	.116	.068	-.003	-.217	-.341
	.028	.026	.026	.033	.049	.063	.079	.107	.162	.238	.217	.136	.341	.650	1.214
I=19	.020	.025	.023	.027	.030	.024	.024	.059	.148	.223	.217	.173	.321	.568	.758
	.006	.006	.015	.016	.015	.054	.093	.100	.094	.145	.181	.126	.025	-.283	-.548
	.021	.026	.027	.031	.034	.059	.096	.116	.176	.266	.282	.214	.322	.634	.936
I=20	.022	.020	.020	.025	.010	.004	.005	.043	.123	.199	.229	.205	.290	.538	.750
	.018	.009	.005	.009	.010	.029	.083	.106	.119	.192	.228	.169	.081	-.313	-.466
	.028	.022	.020	.026	.014	.039	.083	.115	.171	.277	.334	.266	.301	.622	.883
I=21	.018	.023	.022	.022	.009	.017	.009	.029	.090	.170	.234	.204	.205	.437	.670
	.006	.002	-.008	.016	.033	.039	.075	.101	.133	.212	.274	.311	.237	.272	-.393
	.019	.023	.024	.028	.035	.043	.076	.106	.161	.272	.360	.372	.314	.558	.777
I=22	.022	.024	.014	.011	.005	.023	.020	.023	.064	.135	.189	.152	.079	.356	.687
	.004	-.004	-.003	.015	.031	.047	.085	.111	.141	.212	.326	.382	.347	.039	-.296
	.022	.024	.014	.019	.031	.052	.087	.114	.154	.252	.376	.411	.356	.358	.748
I=23	.022	.022	.009	.007	.011	.035	.032	.011	.045	.079	.109	.089	.057	.202	.504
	.033	.016	.019	.022	.032	.045	.072	.113	.161	.231	.339	.400	.372	.204	-.278
	.022	.027	.021	.022	.034	.057	.078	.114	.167	.245	.356	.410	.376	.287	.575
I=24	.016	.019	.007	.006	.016	.040	.045	.012	.032	.070	.090	.065	.049	.028	-.202
	.031	.020	.016	.019	.047	.045	.046	.085	.167	.240	.360	.436	.438	.383	-.049
	.016	.028	.017	.020	.050	.060	.064	.086	.170	.250	.361	.441	.441	.384	.208
I=25	.014	.015	.005	.008	.020	.036	.047	.042	.026	.031	.046	.042	.059	.074	.078
	-.031	.009	.003	.011	.040	.046	.019	.052	.129	.209	.328	.430	.498	.508	.352
	.014	.018	.006	.013	.045	.058	.051	.067	.131	.211	.331	.432	.501	.513	.360
I=26	.011	.015	.000	.013	.017	.023	.046	.061	.055	.036	.038	.073	.084	.094	.079
	.011	.007	-.001	.007	.023	.034	.019	.040	.089	.165	.251	.349	.406	.487	.602
	.016	.016	.001	.015	.028	.041	.050	.073	.105	.169	.254	.356	.414	.496	.607
I=27	.010	.014	.005	.016	.017	.022	.060	.080	.087	.089	.116	.149	.159	.175	.113
	.031	.013	.015	.014	.013	.023	.022	.040	.042	.086	.171	.256	.257	.326	.444
	.010	.019	.016	.021	.021	.032	.064	.090	.097	.124	.206	.296	.302	.370	.459
I=28	.034	.006	.003	.025	.011	.034	.086	.120	.134	.159	.214	.235	.220	.227	.207
	-.031	.014	.024	.025	.001	-.007	-.018	-.005	-.011	.010	.054	.123	.111	.100	.133
	.034	.015	.024	.028	.015	.035	.088	.120	.135	.160	.221	.265	.247	.249	.246

VELUO(I) (CM/SEC) APPROACH FLOW VELOCITY
VELVO(I) (CM/SEC) BUBBLE RISE RATE
DEFSO(I) (1/SEC) FLUME SHEAR RATE

STREAMLINE NO. 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
8.130 8.125 8.114 8.103 8.093 8.073 8.067 8.047 8.022 8.018 8.019 8.021 8.014 7.978 7.957
.282 .284 .259 .266 .281 .272 .266 .305 .320 .313 .317 .326 .337
.000 .005 .007 .007 .010 .009 .009 .015 .010 .001 .001 .002 .014 .019 .002

STREAMLINE NO. 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
7.970 7.993 7.974 7.936 7.897 7.862 7.861 7.872 7.885 7.902 7.914 7.924 7.920 7.931 7.946 7.956
.331 .290 .217 .192 .195 .218 .240 .242 .267 .289 .284 .303 .312 .304 .296 .254
-.012 -.001 .019 .025 .025 .012 -.003 -.008 -.010 -.010 -.007 -.002 -.002 -.008 -.008 .000

VELUR(I,J) (CM/SEC) RELATIVE VELOCITY COMPONENTS
VELVR(I,J)

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I= 2	-.091	.091	.142	.242	.336	.475	.514	.649	.461	.348	.098	.164	.094	.357	.481	.546	.310			
	.007	.013	.000	-.021	-.026	-.009	.014	.075	.147	.222	.305	.446	.578	.749	1.000	1.322	1.601			
I= 3	-.086	.086	.120	.221	.302	.439	.459	.555	.341	.169	-.039	.049	.005	.251	.338	.419	.157			
	.018	.016	-.008	-.027	-.029	-.025	.008	.060	.108	.152	.204	.362	.504	.682	.923	1.231	1.529			
I= 4	-.080	.080	.102	.196	.264	.386	.432	.487	.277	.086	-.135	-.055	-.068	.108	.115	.192	.058			
	.034	-.000	-.018	-.016	.015	.049	.066	.079	.086	.083	.127	.242	.416	.619	.822	1.121	1.453			
I= 5	-.078	.078	.101	.168	.217	.365	.427	.436	.226	.050	-.182	-.140	-.122	-.014	-.050	.111	-.092			
	.025	.007	-.008	-.024	-.015	-.006	.024	.021	.018	-.006	.013	.080	.240	.440	.643	.930	1.258			
I= 6	-.069	.069	.101	.166	.202	.319	.419	.407	.198	.045	-.222	-.139	-.071	-.011	-.025	.150	-.141			
	.010	.018	.006	-.033	-.064	-.080	-.080	-.074	-.085	-.096	-.104	-.070	.026	.142	.272	.448	.681			
I= 7	-.064	.064	.122	.192	.215	.316	.411	.403	.178	.102	-.193	-.034	.090	.145	.128	.272	.090			
	.014	.019	-.003	-.031	-.039	-.085	.122	-.162	-.159	-.176	-.177	-.202	-.190	-.240	-.309	-.413	-.472			
I= 8	-.066	.066	.135	.176	.213	.307	.414	.381	.190	.091	-.140	.090	.296	.329	.312	.584	.558			
	.011	-.001	-.007	-.003	-.018	-.044	-.104	-.163	-.185	-.203	-.239	-.285	-.359	-.464	-.610	-.801	-1.001			
I= 9	-.079	.079	.179	.193	.222	.318	.423	.371	.248	.024	.000	.246	.462	.526	.603	.941	1.022			
	.017	.002	.020	-.000	-.046	-.101	-.134	-.172	-.202	.232	-.276	-.376	-.513	-.658	-.804	-.989	-1.206			
I=10	-.083	.063	.199	.210	.235	.323	.430	.408	.342	.163	.192	.412	.627	.745	.941	1.332	1.293			
	.014	-.007	.011	.010	-.020	-.067	-.115	-.163	-.187	-.227	-.305	-.458	-.612	-.744	-.856	-.990	-1.188			
I=11	-.086	.086	.183	.193	.208	.265	.388	.433	.433	.282	.353	.611	.811	.970	1.164	1.641	1.685			
	.005	-.004	.003	-.004	-.012	-.069	-.123	-.175	-.202	-.254	-.333	-.481	-.662	-.783	-.851	-.892	-.993			
I=12	-.091	.091	.168	.157	.180	.254	.358	.401	.458	.407	.523	.807	1.036	1.143	1.288	1.826	2.011			
	.003	.011	.016	-.024	-.029	-.049	-.119	-.196	-.264	-.331	-.383	-.493	-.638	-.756	-.787	-.817	-.846			
I=13	-.085	.085	.118	.114	.174	.275	.351	.371	.444	.475	.673	1.004	1.212	1.253	1.375	1.902	2.161			
	.006	.008	.007	-.009	-.011	-.011	-.036	-.117	-.204	-.288	-.383	-.483	-.563	-.628	-.703	-.752	-.770			
I=14	-.081	.081	.100	.113	.161	.269	.331	.375	.452	.526	.764	1.113	1.298	1.371	1.448	1.926	2.291			
	.003	.013	.002	-.012	-.003	-.002	-.024	-.065	-.136	-.222	-.302	-.386	-.459	-.542	-.593	-.650	-.713			

I=15	-.059	.059	.111	.163	.186	.263	.323	.406	.474	.609	.822	1.136	1.324	1.460	1.536	1.961	2.409
	.002	.003	.004	-.009	-.008	-.005	-.030	-.079	.131	-.186	-.244	-.290	-.340	-.400	-.455	-.491	-.513
I=16	-.055	.055	.101	.172	.179	.271	.328	.397	.443	.632	.846	1.100	1.257	1.467	1.577	1.962	2.434
	-.003	.009	-.007	.002	.006	.006	-.021	-.059	-.113	-.164	-.208	-.260	-.283	-.305	-.318	-.341	-.359
I=17	-.055	.055	.090	.127	.131	.240	.314	.401	.386	.546	.764	1.028	1.126	1.367	1.544	1.935	2.381
	-.010	-.000	.004	.006	.019	.011	-.019	-.051	-.093	-.138	-.168	-.172	-.159	-.137	-.135	-.147	-.158
I=18	-.058	.058	.056	.059	.072	.186	.267	.373	.357	.483	.667	.898	.974	1.232	1.421	1.830	2.284
	-.021	-.004	.004	.021	.023	.023	.047	.023	.029	.004	-.028	-.044	-.021	.021	.086	.123	.129
I=19	-.048	.048	.059	.030	.057	.193	.252	.357	.377	.476	.589	.796	.872	1.085	1.272	1.691	2.164
	-.019	.009	.009	.000	.008	.063	.110	.165	.178	.188	.164	.147	.170	.217	.274	.367	.457
I=20	-.041	.041	.058	.047	.101	.226	.260	.335	.375	.449	.544	.659	.677	.935	1.154	1.554	1.938
	-.009	.000	.009	.000	.004	.031	.119	.181	.216	.213	.231	.243	.267	.305	.401	.507	.605
I=21	-.041	.041	.062	.097	.149	.244	.278	.364	.370	.429	.468	.483	.511	.802	1.003	1.343	1.610
	-.014	-.005	-.000	.019	.011	.053	.108	.154	.199	.224	.232	.284	.327	.388	.456	.572	.649
I=22	-.037	.037	.096	.124	.160	.247	.323	.382	.372	.373	.343	.314	.402	.681	.810	1.123	1.268
	-.014	-.004	.016	.003	.025	.050	.065	.101	.149	.193	.248	.297	.351	.445	.534	.591	.658
I=23	-.037	.037	.093	.130	.143	.228	.279	.303	.302	.285	.197	.140	.255	.511	.549	.801	.902
	-.013	.003	-.001	.012	.017	.022	.044	.069	.116	.178	.229	.278	.328	.419	.512	.669	.741
I=24	-.033	.033	.084	.117	.132	.175	.207	.217	.210	.148	.045	-.016	.072	.265	.293	.487	.626
	-.016	-.013	.011	.019	.029	.049	.095	.145	.192	.193	.212	.237	.262	.353	.518	.735	.927
I=25	-.027	.027	.061	.088	.096	.104	.119	.151	.141	.013	-.099	-.156	-.120	.005	.108	.347	.412
	-.017	-.013	-.000	.031	.044	.056	.077	.132	.201	.240	.220	.217	.266	.347	.489	.704	.885
I=26	-.026	.026	.027	.051	.056	.033	.031	.076	.072	-.104	-.250	-.345	-.329	-.200	-.042	.167	.237
	-.021	-.004	.006	.019	.035	.046	.054	.079	.167	.221	.235	.237	.273	.344	.441	.617	.820
I=27	-.023	.023	.009	.015	.016	-.018	-.005	.020	.002	-.207	-.401	-.527	-.518	-.350	-.136	.031	-.040
	-.022	-.007	.012	.017	.027	.047	.066	.101	.138	.180	.213	.225	.278	.385	.489	.612	.754
I=28	-.027	.027	-.003	-.021	-.046	-.063	-.034	-.008	-.039	-.255	-.486	-.666	-.635	-.447	-.254	-.103	-.295
	-.011	.001	.001	.009	.011	.002	.022	.050	.081	.105	.113	.140	.214	.324	.400	.477	.572
I=29	-.029	.029	.008	-.035	-.101	-.136	-.064	-.001	-.018	-.242	-.482	-.677	-.671	-.490	-.367	-.280	-.458
	-.006	-.004	-.002	.012	.002	-.009	-.018	.001	.020	.007	-.017	-.002	.064	.104	.127	.113	.014
I=30	-.030	.030	.003	.065	-.135	-.167	-.110	-.042	-.013	-.179	-.416	-.594	-.636	-.444	-.422	-.339	-.436
	.011	.007	.002	-.020	-.014	-.037	-.032	-.024	-.012	-.039	-.090	-.093	-.082	-.082	-.137	-.251	-.433
I=31	-.036	.036	-.010	-.125	-.164	.151	-.116	-.070	.005	-.099	-.301	-.465	-.498	-.367	-.347	-.286	-.302
	-.005	.034	-.001	-.028	-.023	-.035	-.038	-.023	-.027	-.055	-.080	-.096	-.120	-.180	-.266	-.401	-.616
I=32	-.030	.030	-.018	-.155	-.189	-.153	-.068	.032	.091	-.006	-.191	-.277	-.335	-.239	-.210	-.071	-.015
	.001	.009	.009	-.019	-.001	-.006	-.011	-.021	-.011	-.022	-.040	-.059	-.117	-.212	-.301	-.441	-.663

DEFRR(I,J) (1/SEC) AXIAL COMPONENT, DEF. RATE
 DEFRR(I,J) (1/SEC) RADIAL COMPONENT, DEF. RATE

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)	DEFRRX(I,J)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I=3	.057	.038	.057	.064	.040	.030	.056	.119	.125	.064	.003	.042	.094	.053	.077	.098	.118			
I=4	.049	.032	.050	.056	.047	.030	.065	.123	.135	.069	.015	.038	.046	.021	.035	.123	.140			
I=5	.048	.026	.036	.055	.060	.026	.075	.121	.134	.079	.018	.034	.012	.026	.041	.188	.230			
I=6	.048	.029	.030	.043	.067	.035	.080	.138	.130	.048	.050	.043	.009	.038	.070	.285	.371			
I=7	.056	.037	.028	.038	.061	.034	.085	.153	.107	.006	.091	.063	.007	.029	.036	.250	.329			
I=8	.061	.037	.024	.037	.064	.033	.078	.142	.090	.044	.142	.087	.001	.060	.057	.117	.128			
I=9	.080	.042	.015	.035	.064	.027	.059	.103	.066	.058	.147	.096	.045	.108	.109	.021	.015			
I=10	.089	.047	.012	.032	.062	.035	.030	.070	.035	.069	.138	.107	.102	.160	.073	.122				
I=11	.083	.040	.008	.020	.062	.058	.011	.037	.012	.093	.139	.108	.108	.174	.118	.160				
I=12	.078	.027	.006	.027	.059	.051	.032	.009	.029	.114	.153	.104	.076	.168	.178	.162				
I=13	.058	.012	.023	.049	.054	.034	.032	.035	.079	.153	.154	.080	.053	.156	.198	.185				
I=14	.050	.011	.022	.046	.051	.035	.040	.047	.105	.171	.148	.079	.043	.128	.223	.232				
I=15	.051	.034	.022	.028	.043	.044	.046	.059	.111	.153	.140	.094	.056	.116	.239	.266				
I=16	.047	.036	.021	.026	.045	.039	.035	.065	.125	.137	.115	.101	.084	.119	.239	.304				
I=17	.043	.023	.011	.029	.057	.050	.015	.034	.122	.144	.097	.088	.116	.144	.230	.407				
I=18	.030	.000	.006	.034	.061	.058	.020	.025	.101	.124	.082	.086	.126	.153	.240	.321				
I=19	.030	.003	.004	.045	.058	.049	.034	.032	.067	.093	.077	.076	.117	.158	.254	.272				
I=20	.029	.004	.019	.053	.045	.032	.034	.034	.055	.064	.035	.069	.143	.167	.221	.195				
I=21	.030	.017	.030	.045	.037	.035	.024	.017	.030	.018	.014	.083	.147	.150	.173	.134				

I=22	-.044	.031	.022	.036	.052	.045	.011	-.003	-.011	-.019	.027	.104	.118	.120	.126
	-.003	.001	.001	-.004	.006	.012	.014	.007	-.012	-.031	-.038	-.047	-.070	-.091	-.128
I=23	.042	.032	.015	.027	.042	.026	.005	-.005	-.038	-.048	.031	.111	.079	.075	.100
	.004	.001	-.007	-.004	-.005	-.019	-.028	.034	-.022	-.014	-.011	-.006	-.017	-.058	-.129
I=24	.038	.029	.015	.017	.024	.015	-.000	-.019	-.056	-.056	.019	.086	.061	.058	.105
	.006	-.000	-.008	-.012	.015	-.016	-.031	.044	-.041	-.019	-.004	-.008	-.015	-.043	-.082
I=25	.028	.021	.010	.005	.008	.014	.005	-.037	-.077	-.060	-.001	.048	.075	.102	.086
	-.003	.001	-.001	-.004	-.003	.008	.013	.007	-.027	-.027	-.021	-.027	-.027	-.015	-.020
I=26	.014	.007	.008	-.004	-.007	.011	.010	-.047	-.104	-.084	-.019	.042	.101	.120	.082
	-.001	-.005	.003	.003	-.000	-.001	.002	.009	.094	-.014	-.020	-.025	-.041	-.038	-.021
I=27	.006	-.004	.002	-.009	-.004	.012	-.000	-.063	-.133	-.113	-.032	.052	.138	.134	.015
	-.002	.001	.002	.007	.013	.008	.005	.020	.027	.028	.018	.002	-.018	-.017	.005
I=28	.002	-.017	-.015	-.014	.007	.019	-.005	-.070	-.151	-.144	-.038	.067	.137	.123	-.038
	-.001	.004	.001	.007	.017	.027	.030	.034	.052	.069	.066	.057	.073	.091	.124
I=29	.007	-.020	-.038	-.036	.020	.046	.010	-.066	-.156	-.152	-.053	.054	.106	.077	-.056
	-.002	-.000	.010	.008	.013	.018	.024	.029	.046	.065	.073	.088	.117	.151	.200
I=30	.005	-.028	-.046	-.037	.015	.041	.030	-.033	-.138	-.144	-.068	.037	.065	.031	-.022
	-.013	-.000	.013	.009	.010	.008	.008	.015	.021	.022	.032	.058	.088	.121	.155
I=31	.001	-.048	-.046	-.013	.017	.026	.042	.003	-.107	-.125	-.059	.022	.044	.024	.009
	-.000	-.003	.001	-.004	-.009	-.006	.000	.000	-.004	-.013	-.007	.016	.048	.062	.075

DEFRN(I,J) (1/SEC) NORMAL COMPONENT, DEF. RATE
 CFRS(I,J) (1/SEC) SHEAR COMPONENT, DEF. RATE

		DEFN(I,J) (1/SEC) NORMAL COMPONENT, DEF. RATE																		
		DEFRS(I,J) (1/SEC) SHEAR COMPONENT, DEF. RATE																		
		DEFRM(I,J) (1/SEC) ROOT-MEAN-SQUARED VALUE, DEF. RATE																		
J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I= 3			.031	.022	.029	.039	.029	.023	.029	.073	.090	.066	.043	.059	.083	.076	.097			
			-.006	-.001	.010	.024	.043	.052	.085	.090	.119	.136	.168	.154	.217	.284	.292			
			.031	.022	.031	.046	.052	.057	.090	.116	.149	.152	.174	.165	.233	.294	.308			
I= 4			.026	.016	.026	.031	.027	.018	.039	.078	.095	.068	.058	.069	.073	.072	.087			
			-.013	-.000	.030	.049	.039	.020	.045	.040	.057	.094	.161	.161	.212	.272	.298			
			.029	.016	.040	.057	.048	.027	.060	.087	.111	.116	.171	.175	.224	.281	.310			
I= 5			.027	.017	.020	.040	.051	.036	.062	.088	.095	.076	.059	.082	.086	.107	.135			
			-.007	-.010	.010	.026	.035	.015	.024	.018	.042	.051	.109	.116	.167	.194	.213			
			.028	.019	.022	.048	.062	.039	.067	.090	.104	.092	.124	.142	.188	.222	.252			
I= 6			.025	.015	.015	.025	.045	.040	.068	.095	.090	.052	.067	.088	.109	.161	.220			
			.002	-.022	.026	.016	.012	.007	.008	.009	.042	.009	.014	.001	.032	.045	.091			
			.025	.026	.030	.029	.047	.041	.068	.096	.099	.052	.068	.088	.114	.167	.238			
I= 7			.031	.021	.019	.028	.038	.018	.054	.089	.066	.019	.074	.087	.091	.139	.182			
			-.006	-.027	.014	.019	.021	.022	.000	.001	.010	.034	.076	.126	.146	.156	.178			
			.032	.034	.024	.034	.044	.029	.054	.089	.067	.039	.107	.153	.172	.209	.255			
I= 8			.034	.022	.018	.019	.032	.019	.044	.071	.047	.030	.090	.085	.053	.089	.093			
			-.011	-.021	.009	.015	.031	.041	.012	.037	.063	.093	.136	.178	.207	.258	.333			
			.036	.031	.020	.024	.044	.046	.045	.080	.078	.098	.163	.197	.214	.273	.346			
I= 9			.041	.024	.009	.018	.034	.016	.036	.059	.038	.029	.089	.072	.045	.065	.062			
			.006	-.018	-.034	.039	.032	.027	.029	.072	.113	.159	.191	.200	.231	.309	.369			
			.041	.030	.035	.043	.047	.032	.047	.093	.119	.162	.210	.212	.236	.316	.374			
I=10			.044	.027	.007	.023	.041	.025	.023	.044	.025	.039	.071	.056	.064	.112	.097			
			.006	.005	-.012	.019	.012	.019	.041	.081	.126	.188	.220	.204	.219	.257	.327			
			.045	.027	.014	.030	.043	.031	.047	.092	.129	.192	.231	.212	.228	.280	.341			
I=11			.044	.020	.009	.010	.037	.035	.010	.019	.008	.053	.090	.084	.094	.145	.139			
			-.002	.011	.013	.001	.012	.010	.020	.061	.123	.176	.231	.226	.182	.146	.204			
			.044	.023	.016	.010	.039	.036	.022	.064	.123	.184	.248	.241	.205	.206	.247			
I=12			.041	.014	.003	.015	.042	.045	.035	.017	.027	.073	.108	.110	.112	.162	.170			
			.006	.013	.014	.004	.035	.033	.023	.046	.101	.156	.212	.212	.133	.090	.107			
			.041	.019	.015	.005	.054	.056	.042	.049	.104	.172	.238	.238	.174	.185	.201			
I=13			.030	.009	.015	.030	.037	.038	.049	.056	.080	.118	.132	.117	.118	.171	.192			
			.007	.018	.010	.005	.014	.020	.044	.051	.096	.143	.160	.133	.123	.095	.053			
			.030	.020	.018	.031	.040	.043	.066	.076	.125	.186	.207	.177	.171	.195	.199			
I=14			.026	.007	.012	.025	.027	.022	.037	.054	.095	.142	.147	.125	.116	.171	.227			
			.005	-.005	-.016	.000	.004	.009	.049	.058	.095	.100	.092	.083	.109	.087	.053			
			.028	.008	.020	.025	.028	.024	.061	.079	.134	.174	.174	.150	.159	.192	.234			
I=15			.028	.018	.014	.015	.022	.026	.034	.053	.095	.132	.141	.134	.134	.176	.253			
			.009	.004	-.022	.005	.010	.020	.039	.030	.069	.059	.023	.015	.064	.071	.027			
			.030	.018	.027	.016	.024	.033	.052	.061	.118	.145	.143	.135	.149	.190	.254			
I=16			.025	.020	.014	.015	.024	.030	.042	.072	.117	.140	.141	.151	.162	.198	.272			
			-.002	.003	.017	.020	.003	.016	.028	.003	.007	.009	.017	.056	.024	.012	.001			
			.025	.020	.022	.025	.025	.034	.050	.072	.117	.140	.142	.161	.164	.198	.272			

I=17	.024	.014	.064	.136	.384	.052	.078	.149	.249	.319	.340	.319	.304	.284	.319
	.003	.018	.044	.040	.015	.061	.015	.002	.028	.050	.075	.109	.090	.055	.043
	.025	.023	.078	.142	.385	.092	.079	.149	.251	.322	.348	.337	.317	.289	.321
I=18	.018	.003	.003	.020	.052	.066	.066	.073	.114	.117	.090	.102	.146	.187	.280
	.010	.018	.037	.031	.022	.015	.010	.001	.005	.043	.084	.106	.132	.128	.098
	.020	.018	.038	.037	.056	.068	.067	.073	.115	.124	.123	.148	.156	.226	.297
I=19	.015	.003	.004	.024	.032	.049	.058	.067	.085	.106	.104	.110	.139	.184	.263
	.013	.003	.004	.007	.019	.033	.030	.001	.004	.026	.081	.116	.131	.131	.147
	.020	.005	.005	.025	.037	.050	.065	.067	.085	.109	.132	.160	.191	.226	.301
I=20	.017	.003	.013	.028	.027	.028	.033	.042	.057	.066	.066	.091	.138	.161	.208
	.008	.000	.023	.022	.024	.041	.026	.015	.021	.050	.114	.137	.139	.149	.176
	.018	.003	.027	.036	.036	.050	.042	.044	.061	.083	.132	.164	.196	.219	.272
I=21	.016	.011	.015	.027	.025	.019	.014	.013	.029	.033	.040	.083	.132	.142	.154
	.006	.006	.008	.012	.026	.012	.013	.024	.035	.084	.146	.124	.128	.171	.209
	.017	.012	.028	.030	.036	.023	.019	.027	.045	.090	.151	.150	.184	.222	.260
I=22	.023	.016	.011	.020	.029	.028	.013	.005	.012	.025	.032	.076	.094	.106	.127
	.012	.005	.006	.018	.018	.014	.049	.053	.081	.125	.150	.132	.157	.203	.227
	.026	.017	.012	.027	.034	.032	.050	.053	.082	.127	.154	.152	.183	.229	.260
I=23	.023	.016	.011	.016	.023	.022	.017	.019	.030	.031	.021	.058	.048	.066	.114
	.004	.006	.008	.013	.034	.053	.080	.089	.112	.134	.144	.155	.197	.244	.274
	.023	.017	.013	.020	.041	.058	.082	.091	.116	.137	.146	.166	.202	.253	.297
I=24	.022	.015	.011	.015	.019	.016	.016	.031	.049	.038	.012	.047	.038	.051	.093
	.013	.022	.020	.025	.064	.084	.082	.072	.100	.116	.118	.162	.261	.267	.284
	.026	.027	.023	.029	.067	.086	.083	.079	.111	.122	.119	.169	.264	.271	.299
I=25	.015	.011	.006	.005	.005	.011	.009	.022	.052	.044	.011	.038	.051	.059	.053
	.005	.032	.035	.034	.060	.083	.089	.083	.088	.092	.133	.180	.243	.230	.238
	.017	.034	.036	.035	.060	.083	.089	.086	.102	.102	.133	.184	.248	.237	.243
I=26	.008	.006	.006	.004	.003	.006	.006	.028	.054	.049	.020	.034	.071	.079	.052
	.010	.025	.035	.037	.048	.053	.086	.096	.096	.109	.143	.171	.182	.170	.237
	.012	.026	.035	.037	.048	.053	.086	.100	.110	.120	.144	.174	.195	.188	.242
I=27	.004	.003	.002	.008	.008	.010	.003	.041	.080	.071	.025	.027	.078	.076	.010
	.011	.019	.030	.044	.045	.039	.052	.063	.075	.095	.132	.154	.155	.145	.179
	.012	.019	.030	.044	.046	.040	.052	.075	.110	.119	.134	.156	.174	.164	.179
I=28	.001	.011	.008	.011	.012	.023	.018	.052	.101	.107	.052	.062	.105	.107	.081
	.001	.002	.020	.037	.045	.035	.026	.025	.021	.037	.088	.112	.108	.125	.152
	.002	.011	.021	.039	.047	.042	.032	.058	.103	.113	.102	.128	.151	.164	.172
I=29	.004	.010	.024	.022	.017	.032	.017	.047	.101	.109	.063	.071	.111	.114	.128
	.001	.002	.014	.023	.026	.026	.024	.005	.037	.027	.011	.041	.022	.057	.021
	.004	.010	.028	.032	.032	.042	.029	.048	.107	.112	.064	.082	.113	.128	.129
I=30	.009	.014	.030	.023	.012	.024	.019	.024	.079	.083	.050	.048	.076	.076	.088
	.005	.002	.025	.017	.001	.021	.021	.029	.009	.072	.062	.049	.061	.061	.111
	.010	.014	.039	.028	.012	.032	.034	.025	.107	.114	.080	.069	.098	.097	.142
I=31	.001	.025	.023	.008	.013	.016	.021	.001	.056	.069	.033	.019	.046	.043	.042
	.003	.014	.024	.016	.008	.011	.022	.043	.072	.085	.116	.123	.118	.138	.213
	.003	.029	.033	.018	.015	.019	.031	.043	.091	.109	.120	.124	.127	.145	.217

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I= 2	VELVR(1,J)	-.008 .016	.008 .010	-.050 -.007	-.145 -.019	-.159 .009	-.186 .055	-.210 .105	-.289 .179	-.268 .278	-.317 .396	-.268 .561	-.310 .708	-.240 .919	-.291 1.091	-.214 1.250		
I= 3		-.007 .019	.007 .001	-.053 -.012	-.146 -.009	-.151 .027	-.166 .075	-.197 .123	-.271 .185	-.279 .285	-.349 .408	-.349 .551	-.422 .684	-.380 .875	-.444 1.070	-.370 1.250		
I= 4		-.006 .028	-.006 .004	-.054 -.024	-.155 -.008	-.128 .037	-.161 .067	-.192 .134	-.258 .224	-.251 .315	-.400 .415	-.410 .567	-.488 .689	-.468 .850	-.580 1.014	-.513 1.206		
I= 5		-.011 .019	-.011 -.009	-.058 -.011	-.150 .002	-.118 .026	-.158 .034	-.210 .090	-.249 .181	-.233 .289	-.377 .395	-.413 .538	-.521 .667	-.584 .785	-.734 .924	-.580 1.134		
I= 6		-.020 -.000	-.020 -.014	-.053 -.001	-.133 .013	-.108 .009	-.183 .005	-.226 .050	-.245 .141	-.197 .257	-.345 .338	-.380 .492	-.554 .613	-.694 .711	-.852 .834	-.646 1.040		
I= 7		-.014 -.009	-.014 -.008	-.022 .018	-.060 -.001	-.067 .003	-.190 .003	-.214 .051	-.186 .128	-.139 .225	-.279 .305	-.348 .410	-.520 .532	-.727 .646	-.864 .735	-.653 .903		
I= 8		-.018 -.000	-.018 -.001	-.001 -.004	-.012 .004	-.013 .011	-.133 .010	-.181 .028	-.148 .085	-.115 .173	-.228 .235	-.302 .318	-.486 .393	-.659 .461	-.751 .553	-.698 .688		
I= 9		-.013 .020	-.013 -.002	-.017 -.017	.045 -.000	.028 .023	-.096 .008	-.150 .016	-.129 .052	-.069 .117	-.143 .154	-.212 .192	-.358 .224	-.506 .256	-.659 .302	-.677 1.400		
I=10		-.011 .019	-.011 -.005	-.060 -.015	.103 .001	.054 .007	-.079 -.000	-.122 .000	-.074 .007	-.012 .052	-.024 .081	-.077 .076	-.213 .071	-.328 .105	-.487 .155	-.613 .248		
I=11		-.017 .005	-.017 .003	-.074 -.000	.154 -.008	.092 -.002	-.016 -.016	-.033 .019	-.002 -.007	.065 .007	.055 .002	.039 .014	-.067 .017	-.144 .053	-.324 .108	-.487 .154		
I=12		-.017 -.003	-.017 .001	-.081 .002	.155 .000	.098 .007	.026 .004	.049 .004	.080 .002	.103 .005	.085 .011	.102 .031	.036 .039	-.006 .032	-.160 .036	-.288 .063		
I=13		-.017 .002	-.017 -.009	-.084 .005	.148 .002	.099 .006	.047 -.001	.080 .004	.110 .007	.082 .016	.124 .019	.124 .012	.104 .020	.057 .034	.004 .011	-.101 .013		
I=14		-.018 -.013	-.018 -.005	-.071 .010	.142 .008	.095 -.008	.043 -.018	.086 -.014	.112 -.021	.106 .013	.069 .001	.143 -.007	.159 -.003	.172 .014	.122 .027	.070 -.012		

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I=15	.023	-.023	.056	.107	.073	.023	.093	.111	.110	.067	.142	.197	.255	.189	.157			
	-.016	-.009	.016	.009	.004	.008	-.006	-.007	.002	-.002	-.012	-.009	.005	-.002	-.017			
I=16	.027	-.027	.045	.075	.029	.014	.094	.122	.111	.043	.137	.231	.280	.222	.242			
	-.009	.004	.005	-.000	.009	.004	.008	.003	-.009	-.003	.005	.001	-.004	-.005	-.015			
I=17	.026	-.026	.017	.041	.006	-.001	.068	.088	.092	.030	.119	.230	.276	.245	.288			
	-.004	-.005	.001	.008	.001	-.006	-.010	-.016	-.026	-.016	-.013	-.009	.002	.006	.009			
I=18	.013	-.013	-.001	.013	-.000	-.024	.050	.076	.082	.010	.102	.227	.313	.283	.336			
	-.000	.011	.003	-.014	-.018	-.027	-.025	-.020	-.014	-.029	-.021	-.003	.003	.004	.007			
I=19	.016	-.016	-.026	.005	-.011	-.025	-.032	.035	.082	.075	-.001	.085	.347	.312	.321			
	.002	.004	.005	-.011	-.025	-.030	-.020	-.002	-.005	-.030	-.027	-.009	-.011	-.007	-.000			
I=20	.022	-.022	-.035	-.025	-.038	-.038	.055	.090	.071	-.003	.089	.201	.319	.302	.298			
	-.012	-.011	.009	.015	.019	.005	-.000	.001	.005	-.004	-.009	-.006	-.000	-.000	-.000			
I=21	.024	-.024	-.030	-.026	-.046	-.046	.061	.102	.082	.005	.083	.174	.284	.263	.309			
	.003	-.004	-.007	.008	.019	.016	.012	.005	.008	-.001	.002	.002	.009	.015	.016			
I=22	.019	-.019	-.022	-.023	-.039	-.048	.050	.103	.085	.019	.060	.138	.241	.240	.252			
	.020	-.004	-.011	-.004	-.003	.005	.008	-.004	-.017	-.005	.006	.023	.012	.017	.031			
I=23	.016	-.016	-.009	-.010	-.026	-.031	.040	.085	.080	.040	.064	.115	.202	.189	.175			
	.006	.004	-.011	.002	.007	.006	.006	-.000	-.015	-.015	.013	.018	.019	.025	.041			
I=24	.013	-.013	-.030	-.033	-.033	-.036	.031	.048	.036	.028	.057	.085	.132	.081	.029			
	-.003	-.011	.006	.008	.008	.008	.005	.002	-.010	-.018	-.018	-.002	.010	.014	.001			
I=25	.014	-.014	-.040	-.059	-.037	-.029	.024	.034	.018	.029	.044	.055	.064	-.035	-.154			
	.004	-.015	-.003	.014	-.004	-.009	-.012	-.014	-.009	-.020	-.031	-.019	-.009	-.038	-.076			
I=26	.023	-.023	-.055	-.067	-.044	-.038	.014	.014	.016	.015	.022	.029	.018	-.174	-.349			
	.006	-.001	-.002	.002	.018	.009	.007	.012	.011	.002	-.011	-.019	-.054	-.115	-.205			
I=27	.012	-.012	-.032	-.065	-.030	-.037	-.002	.018	.028	.029	.027	.015	-.106	-.307	-.502			
	.004	-.002	-.004	.002	.007	.013	.017	.005	-.021	-.042	-.051	-.079	-.143	-.229	-.308			
I=28	.009	-.009	-.027	-.069	-.043	-.048	-.004	.006	.034	.035	.025	.020	-.194	-.471	-.667			
	-.006	-.003	-.001	.009	.010	.012	.008	-.015	-.031	-.034	-.129	-.193	-.258	-.324	-.391			
I=29	.001	-.001	-.022	-.088	-.058	-.052	.002	.011	.023	-.001	.016	.042	.270	.605	-.835			
	-.006	-.002	.004	.003	.004	.001	.003	-.008	-.037	-.160	-.175	-.246	-.321	-.397	-.427			
I=30	.003	.003	.021	-.095	-.067	-.044	.016	.024	-.010	-.049	-.035	.063	.323	.703	-.954			
	-.010	.009	.007	-.007	-.010	-.013	-.028	-.073	.137	.221	.256	.323	-.392	-.488	-.563			
I=31	.005	.005	-.008	-.084	-.049	-.007	.062	.047	-.005	-.073	-.033	.044	-.395	-.780	-.940			
	.001	-.000	.003	-.004	.008	.005	-.040	-.138	-.241	-.362	-.365	-.444	-.538	-.660	-.814			
I=32	.009	.009	-.013	-.075	-.046	.009	.080	.067	.002	-.063	-.040	.084	-.438	-.820	-.891			
	-.007	-.006	.005	.009	.022	.043	-.006	-.114	-.215	-.299	-.390	-.528	-.649	-.772	-.898			

DSEFRXX(I,J) (1/SEC) AXIAL COMPONENT, DEF. RATE
 DEFRRR(I,J) (1/SEC) RADIAL COMPONENT, DEF. RATE

J=

I= 3

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	DEFRRR(I,J)	(1/SEC)	RADIAL COMPONENT,	DEF. RATE														
I= 3	-.014	-.047	-.031	-.007	-.015	-.033	-.026	-.025	-.022	-.024	-.011	-.009	-.001	-.009	-.001			
I= 4	-.002	-.005	-.004	-.008	-.001	-.004	-.006	-.000	-.011	-.021	-.035	-.059	-.069	-.069	-.069			
I= 5	-.019	-.047	-.023	-.002	-.021	-.031	-.019	-.045	-.051	-.030	-.020	-.032	-.017	-.032	-.017			
I= 6	-.003	-.000	-.004	-.001	-.016	-.016	-.009	-.011	-.022	-.028	-.035	-.066	-.091	-.066	-.091			
I= 7	-.022	-.044	-.019	-.003	-.030	-.029	-.008	-.041	-.058	-.049	-.057	-.074	-.001	-.074	-.001			
I= 8	-.006	-.009	-.007	-.010	-.022	-.032	-.036	-.033	-.043	-.050	-.055	-.081	-.100	-.081	-.100			
I= 9	-.023	-.036	-.018	-.017	-.038	-.020	-.009	-.032	-.059	-.071	-.105	-.104	-.014	-.104	-.014			
I= 10	-.001	-.010	-.001	-.010	-.011	-.016	-.026	-.036	-.049	-.069	-.077	-.083	-.106	-.083	-.106			
I= 11	-.012	-.015	-.015	-.043	-.048	-.002	-.025	-.030	-.068	-.083	-.128	-.119	-.025	-.119	-.025			
I= 12	-.005	-.001	-.004	-.000	-.001	-.009	-.025	-.041	-.051	-.082	-.101	-.113	-.128	-.101	-.113			
I= 13	-.005	-.002	-.000	-.039	-.055	-.005	-.022	-.026	-.062	-.088	-.122	-.093	-.015	-.122	-.093			
I= 14	-.002	-.012	-.000	-.008	-.001	-.014	-.031	-.046	-.064	-.089	-.121	-.149	-.162	-.121	-.149			
I= 15	-.002	-.019	-.003	-.046	-.058	-.011	-.027	-.004	-.047	-.072	-.100	-.105	-.061	-.100	-.105			
I= 16	-.002	-.003	-.001	-.003	-.004	-.011	-.032	-.052	-.065	-.098	-.126	-.136	-.151	-.126	-.136			
I= 17	-.016	-.038	-.002	-.059	-.058	-.002	-.037	-.017	-.021	-.063	-.085	-.094	-.099	-.085	-.094			
I= 18	-.002	-.007	-.002	-.010	-.008	-.012	-.024	-.044	-.058	-.070	-.081	-.081	-.080	-.081	-.081			
I= 19	-.020	-.057	-.006	-.055	-.041	-.005	-.033	-.019	-.009	-.041	-.061	-.087	-.118	-.061	-.087			
I= 20	-.002	-.006	-.000	-.001	-.001	-.001	-.002	-.018	-.026	-.019	-.014	-.028	-.045	-.019	-.028			
I= 21	-.023	-.058	-.005	-.042	-.016	-.018	-.018	-.002	-.000	-.016	-.036	-.066	-.096	-.036	-.066			
I= 22	-.004	-.002	-.004	-.001	-.006	-.008	-.005	-.002	-.005	-.002	-.001	-.010	-.037	-.001	-.010			
I= 23	-.023	-.056	-.005	-.033	-.006	-.021	-.013	-.009	-.002	-.007	-.009	-.034	-.066	-.009	-.034			
I= 24	-.002	-.002	-.002	-.005	-.006	-.005	-.006	-.005	-.004	-.014	-.016	-.009	-.007	-.016	-.009			
I= 25	-.018	-.054	-.008	-.033	-.003	-.023	-.007	-.014	-.012	-.030	-.009	-.013	-.033	-.009	-.013			
I= 26	-.001	-.002	-.002	-.003	-.003	-.003	-.005	-.006	-.008	-.008	-.010	-.012	-.005	-.010	-.012			
I= 27	-.012	-.044	-.006	-.028	-.007	-.030	-.006	-.015	-.010	-.043	-.037	-.007	-.031	-.037	-.007			
I= 28	-.003	-.003	-.004	-.006	-.009	-.008	-.010	-.003	-.001	-.004	-.002	-.002	-.012	-.002	-.012			
I= 29	-.007	-.034	-.005	-.020	-.022	-.036	-.006	-.026	-.009	-.063	-.047	-.003	-.012	-.003	-.012			
I= 30	-.003	-.007	-.003	-.002	-.005	-.001	-.000	-.007	-.003	-.003	-.002	-.002	-.002	-.002	-.002			
I= 31	-.002	-.023	-.004	-.014	-.021	-.030	-.008	-.019	-.009	-.067	-.052	-.004	-.004	-.004	-.004			
I= 32	-.001	-.002	-.002	-.007	-.006	-.007	-.005	-.003	-.003	-.006	-.001	-.003	-.003	-.003	-.003			
I= 33	-.004	-.008	-.000	-.012	-.017	-.034	-.010	-.022	-.007	-.072	-.069	-.018	-.008	-.069	-.018			
I= 34	-.004	-.003	-.005	-.004	-.010	-.011	-.013	-.021	-.014	-.011	-.007	-.001	-.004	-.007	-.001			
I= 35	-.014	-.001	-.002	-.007	-.018	-.038	-.013	-.027	-.003	-.075	-.086	-.028	-.008	-.086	-.028			
I= 36	-.007	-.011	-.010	-.013	-.013	-.020	-.017	-.008	-.034	-.066	-.028	-.012	-.033	-.066	-.012			
I= 37	-.019	-.001	-.001	-.004	-.031	-.043	-.005	-.031	-.006	-.068	-.075	-.032	-.007	-.068	-.032			
I= 38	-.002	-.005	-.005	-.012	-.012	-.009	-.003	-.005	-.001	-.002	-.002	-.006	-.010	-.002	-.006			
I= 39	-.018	-.000	-.005	-.007	-.036	-.050	-.007	-.032	-.006	-.057	-.073	-.029	-.008	-.057	-.029			
I= 40	-.000	-.007	-.005	-.005	-.001	-.004	-.002	-.009	-.002	-.004	-.012	-.006	-.003	-.004	-.006			
I= 41	-.014	-.001	-.006	-.008	-.030	-.051	-.012	-.028	-.008	-.040	-.060	-.033	-.004	-.040	-.033			
I= 42	-.002	-.003	-.001	-.002	-.001	-.000	-.001	-.008	-.006	-.005	-.008	-.006	-.008	-.005	-.008			

I=23	-.008	-.002	-.005	-.007	-.022	-.039	.013	-.015	-.005	-.025	.046	.025	-.009
	.003	-.005	-.004	-.004	.001	-.000	-.002	-.000	.006	.009	.007	-.001	-.001
I=24	-.014	-.007	-.001	-.001	-.022	-.029	-.002	-.007	.007	.019	.025	-.001	-.034
	.007	-.002	-.005	-.004	.005	.006	.006	-.000	.004	.016	.012	.009	.022
I=25	-.018	-.015	.001	.010	.021	.021	-.002	-.002	.009	.009	.007	-.029	-.072
	-.003	.003	.003	-.005	-.003	-.001	-.004	-.007	-.006	-.001	.007	.024	.048
I=26	-.026	-.014	.003	.009	.020	.018	.001	.000	.002	.005	-.014	-.067	-.111
	-.003	.001	.003	-.004	-.007	-.010	-.006	.005	.010	.010	.024	.051	.074
I=27	-.015	-.018	.001	.009	.009	.018	.010	.003	-.000	-.005	-.045	-.107	-.135
	.001	-.000	-.004	.002	-.002	-.001	.009	.022	.032	.045	.065	.078	.084
I=28	-.012	-.020	-.005	.007	.013	.018	.013	.009	-.003	-.018	-.074	-.151	-.163
	-.000	-.003	-.000	.001	.003	.004	.005	.008	.025	.050	.067	.074	.077
I=29	-.008	-.029	-.012	.012	.020	.021	.007	-.004	-.013	-.014	-.086	-.188	-.198
	-.004	-.003	.005	.006	.008	.012	.022	.034	.054	.053	.058	.064	.079
I=30	-.006	-.032	-.016	.017	.028	.023	-.008	-.024	-.008	-.005	-.097	-.214	-.222
	-.000	.000	.002	-.002	-.002	.016	.050	.079	.079	.079	.086	.097	.116
I=31	-.001	-.030	-.014	.026	.037	.018	-.022	-.040	-.009	.010	-.119	-.247	-.194
	.005	.001	-.005	-.011	-.020	-.006	.021	.039	.042	.064	.094	.115	.128

DEFN(I,J) (1/SEC) NORMAL COMPONENT, DEF. RATE
 DEFS(I,J) (1/SEC) SHEAR COMPONENT, DEF. RATE

7PT

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I= 3			.008	.026	.017	.007	.008	.019	.016	.013	.017	.023	.023	.034	.035			
			-.005	-.002	.015	.015	.022	.028	.041	.065	.113	.137	.163	.202	.219			
			.009	.026	.023	.017	.023	.034	.044	.067	.114	.139	.165	.205	.222			
I= 4			.011	.024	.013	.002	.018	.023	.014	.028	.036	.029	.028	.049	.054			
			-.010	-.002	.020	.013	.028	.054	.051	.046	.092	.113	.126	.175	.214			
			.015	.024	.024	.013	.033	.059	.053	.054	.099	.117	.129	.182	.220			
I= 5			.014	.026	.013	.007	.026	.031	.022	.037	.051	.049	.056	.077	.050			
			-.005	.003	.005	.004	.028	.059	.061	.052	.063	.081	.102	.158	.204			
			.015	.027	.014	.008	.038	.067	.065	.063	.081	.095	.117	.176	.210			
I= 6			.012	.023	.010	.013	.025	.018	.018	.034	.054	.070	.091	.093	.060			
			.001	-.004	-.029	-.020	.024	.046	.047	.032	.044	.071	.072	.124	.158			
			.012	.023	.030	.024	.034	.050	.050	.047	.070	.100	.116	.155	.169			
I= 7			.008	.008	.009	.021	.025	.005	.025	.035	.060	.082	.114	.116	.076			
			.007	-.016	-.048	.030	.002	.027	.025	.030	.021	.051	.057	.061	.064			
			.011	.018	.049	.037	.025	.028	.035	.046	.063	.097	.128	.131	.100			
I= 8			.004	.007	.002	.024	.028	.009	.027	.036	.063	.088	.122	.121	.089			
			-.002	-.012	.030	.029	.025	.004	.030	.026	.030	.008	.005	.015	.017			
			.004	.014	.030	.037	.038	.010	.040	.044	.063	.089	.122	.122	.090			
I= 9			.002	.011	.002	.024	.031	.011	.030	.028	.056	.085	.113	.121	.106			
			-.015	-.022	.025	.022	.022	.008	.005	.005	.050	.059	.076	.088	.040			
			.015	.025	.025	.033	.038	.014	.030	.028	.075	.103	.136	.149	.113			
I=10			.009	.022	.002	.035	.033	.007	.030	.031	.040	.067	.083	.087	.090			
			-.011	.020	.033	.024	.031	.039	.029	.024	.064	.093	.092	.095	.064			
			.014	.030	.033	.042	.045	.039	.042	.039	.075	.114	.124	.129	.110			
I=11			.011	.032	.003	.028	.021	.003	.017	.018	.017	.030	.038	.058	.081			
			-.000	-.012	.018	.018	.041	.054	.043	.035	.034	.054	.068	.073	.070			
			.011	.034	.019	.033	.046	.054	.046	.040	.038	.061	.078	.093	.107			
I=12			.013	.030	.004	.022	.011	.013	.011	.002	.002	.009	.019	.038	.066			
			.002	.004	.003	.002	.023	.039	.038	.016	.001	.020	.057	.081	.098			
			.013	.030	.006	.022	.026	.041	.039	.016	.003	.022	.060	.089	.119			
I=13			.013	.029	.003	.019	.006	.013	.010	.007	.003	.011	.012	.021	.036			
			.002	.007	.001	.000	.002	.010	.007	.003	.004	.013	.034	.062	.101			
			.013	.030	.003	.019	.007	.016	.012	.008	.005	.017	.036	.065	.107			
I=14			.010	.028	.005	.018	.003	.013	.006	.010	.010	.019	.010	.012	.019			
			.010	.014	.008	.000	.006	.005	.000	.010	.007	.007	.024	.042	.069			
			.014	.031	.009	.018	.007	.014	.006	.014	.012	.020	.026	.044	.072			
I=15			.007	.024	.005	.017	.008	.019	.008	.009	.006	.024	.019	.005	.022			
			.014	.015	.019	.022	.006	.006	.000	.000	.004	.000	.018	.034	.041			
			.016	.028	.019	.028	.010	.020	.008	.009	.007	.024	.027	.034	.047			
I=16			.005	.021	.004	.011	.013	.019	.003	.016	.006	.033	.025	.002	.007			
			.005	.012	.023	.024	.007	.008	.002	.004	.017	.009	.014	.009	.022			
			.008	.024	.024	.026	.015	.020	.003	.017	.018	.034	.028	.009	.023			

I=17	.002	.012	.003	.011	.013	.019	.006	.011	.006	.036	.026	.004	.004
	.003	.020	.021	.005	.009	.011	.010	.015	.015	.039	.006	.007	.018
	.003	.023	.021	.012	.016	.022	.012	.015	.016	.039	.027	.008	.018
I=18	.004	.006	.002	.008	.014	.022	.012	.021	.011	.042	.038	.010	.036
	.002	.006	.011	.004	.008	.014	.006	.003	.008	.020	.010	.022	.022
	.005	.008	.011	.009	.016	.026	.013	.021	.013	.046	.039	.024	.022
I=19	.011	.006	.006	.010	.015	.029	.015	.017	.029	.071	.057	.020	.021
	.004	.007	.003	.006	.006	.008	.001	.006	.003	.012	.014	.002	.003
	.011	.009	.007	.011	.017	.030	.015	.018	.029	.072	.059	.020	.021
I=20	.011	.003	.003	.008	.021	.026	.004	.018	.003	.035	.039	.019	.008
	.010	.010	.008	.005	.002	.010	.005	.004	.007	.006	.020	.023	.016
	.014	.010	.008	.010	.021	.027	.006	.018	.008	.036	.043	.030	.018
I=21	.009	.004	.005	.006	.019	.027	.005	.021	.004	.030	.043	.017	.008
	.004	.000	.007	.003	.001	.002	.006	.007	.009	.011	.023	.030	.023
	.010	.004	.009	.007	.019	.027	.007	.022	.010	.032	.048	.035	.024
I=22	.008	.002	.004	.005	.016	.025	.007	.018	.007	.022	.034	.020	.006
	.013	.007	.002	.004	.001	.004	.003	.000	.004	.009	.022	.025	.031
	.015	.007	.004	.006	.016	.026	.007	.018	.008	.024	.040	.032	.031
I=23	.006	.004	.005	.005	.012	.020	.007	.008	.006	.017	.026	.013	.005
	.008	.002	.010	.001	.002	.004	.011	.012	.007	.012	.019	.038	.060
	.010	.004	.011	.006	.012	.020	.013	.014	.009	.021	.032	.040	.060
I=24	.011	.004	.003	.002	.013	.017	.004	.004	.006	.017	.019	.005	.028
	.003	.017	.017	.001	.002	.006	.012	.014	.001	.012	.029	.051	.071
	.011	.017	.018	.003	.014	.018	.013	.014	.006	.021	.035	.051	.076
I=25	.010	.009	.002	.007	.012	.011	.003	.005	.007	.005	.007	.026	.060
	.001	.018	.011	.004	.002	.004	.012	.005	.003	.012	.026	.044	.063
	.001	.020	.011	.008	.012	.012	.013	.005	.008	.013	.027	.052	.087
I=26	.015	.008	.003	.007	.014	.014	.003	.003	.006	.007	.019	.059	.092
	.003	.003	.009	.001	.001	.010	.007	.006	.007	.002	.001	.024	.037
	.015	.008	.009	.007	.014	.017	.008	.007	.009	.008	.019	.064	.100
I=27	.008	.009	.002	.005	.006	.010	.010	.013	.016	.025	.055	.092	.109
	.007	.008	.004	.003	.007	.003	.003	.022	.017	.013	.015	.007	.037
	.011	.012	.005	.006	.009	.010	.014	.025	.023	.028	.057	.093	.115
I=28	.006	.011	.003	.004	.008	.011	.009	.009	.014	.034	.070	.112	.120
	.002	.001	.011	.010	.005	.010	.017	.021	.016	.021	.024	.010	.049
	.006	.011	.012	.011	.009	.015	.019	.023	.021	.040	.074	.113	.129
I=29	.006	.016	.009	.009	.014	.017	.015	.019	.033	.033	.072	.126	.138
	.000	.001	.008	.007	.002	.010	.019	.016	.019	.029	.034	.009	.038
	.006	.016	.012	.012	.014	.019	.024	.025	.038	.044	.080	.127	.143
I=30	.003	.016	.009	.010	.015	.019	.029	.051	.044	.042	.091	.156	.169
	.004	.010	.007	.005	.022	.042	.049	.040	.015	.028	.045	.015	.004
	.005	.019	.012	.011	.027	.046	.057	.065	.046	.051	.102	.156	.169
I=31	.003	.015	.009	.019	.028	.012	.021	.039	.025	.037	.106	.181	.161
	.002	.004	.005	.004	.035	.070	.081	.058	.036	.046	.050	.033	.063
	.003	.016	.011	.019	.045	.071	.084	.070	.044	.059	.117	.184	.173

VELUO(I) (CM/SEC) APPROACH FLOW VELOCITY
VELVG(I) (CM/SEC) BUBBLE RISE RATE
DEFSOI(I) (1/SEC) FLUME SHEAR RATE

STREAMLINE NO.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	31	32
17	7.039	7.025	6.999	6.998	6.997	6.979	6.981	6.979	6.966	6.943	6.927	6.924	6.919	6.903	6.901		
18	.114	.120	.116	.126	.135	.134	.140	.132	.111	.118	.104	.107	.106	.106	.117		
19	.000	.013	.009	.001	.006	.005	.000	.005	.012	.013	.006	.003	.007	.006	.000		

STREAMLINE NO.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
6.902	6.894	6.909	6.921	6.914	6.901	6.877	6.883	6.886	6.888	6.874	6.863	6.862	6.846	6.847		
.134	.139	.144	.138	.133	.142	.151	.162	.157	.142	.143	.149	.149	.149	.149		
.003	.002	.009	.002	.007	.013	.006	.003	.002	.004	.005	.003	.001	.006	.005	.000	

VELUR(I,J) (CM/SEC) RELATIVE VELOCITY COMPONENTS

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I=2	-.001	-.001	-.010	-.049	-.061	-.017	.084	.179	.234	.234	.261	.221	.121	-.057	-.165	.290	.609	.992
I=3	-.004	-.004	-.005	-.032	-.002	.008	.038	.114	.200	.248	.326	.481	.727	1.041	1.392	1.908	2.519	3.239
I=4	-.004	-.005	-.004	.005	.024	.039	.072	.116	.189	.308	.463	.658	.870	1.135	1.554	2.081	2.855	
I=5	.000	-.000	.010	.004	.001	-.052	-.040	.023	.048	-.010	-.200	-.411	-.651	-.829	-.968	-1.063	-.922	
I=6	-.002	-.002	-.008	-.007	-.007	-.064	-.081	-.019	.021	-.073	-.261	-.487	-.709	-.893	-1.105	-1.355	-1.525	
I=7	.013	-.013	-.016	-.006	.013	-.068	-.090	-.035	.023	-.107	-.300	-.466	-.587	-.747	-.984	-1.351	-1.657	
I=8	.029	-.029	-.049	-.013	.004	-.051	-.033	-.072	-.001	-.133	-.279	-.402	-.375	-.495	-.685	-1.098	-1.361	
I=9	.036	-.036	-.054	-.032	-.003	-.041	-.073	-.085	.004	-.102	-.173	-.254	-.107	-.173	-.314	-.635	-.757	
I=10	.038	-.038	-.040	-.013	-.002	-.039	-.057	-.079	.050	-.001	.003	-.051	.195	.106	.039	-.163	-.052	
I=11	.034	-.034	-.007	.022	.021	-.045	-.016	-.008	.128	.103	.198	.178	.454	.367	.352	.223	.441	
I=12	.026	-.026	.015	.045	.029	-.022	.043	.072	.218	.215	.390	.401	.673	.586	.619	.505	.816	
I=13	.023	-.023	.019	.052	.055	-.007	.089	.119	.289	.324	.527	.561	.864	.763	.869	.800	1.091	
I=14	.027	-.027	.016	.058	.073	.016	.110	.173	.376	.411	.638	.684	1.021	.945	1.095	1.048	1.400	
I=15	.025	-.025	.034	.076	.099	.028	.149	.227	.469	.513	.741	.786	1.148	1.135	1.320	1.254	1.712	
I=16	.025	-.025	.038	.072	.092	.047	.176	.255	.509	.556	.798	.837	1.244	1.274	1.479	1.407	1.795	
I=17	.004	-.004	-.001	.014	.014	.007	.033	.089	.126	.157	.173	.182	-.203	-.247	-.268	-.294	-.327	

I=15	.023	-.025	.034	.076	.099	.028	.149	.227	.469	.513	.741	.786	1.148	1.135	1.320	1.254	1.712
	.004	.003	-.003	-.004	-.007	-.021	-.063	-.120	-.164	-.163	-.165	-.173	-.216	-.238	-.292	-.350	-.365
I=16	.025	-.025	.038	.072	.092	.047	.176	.255	.509	.556	.758	.837	1.244	1.274	1.479	1.407	1.795
	.004	.001	-.004	-.001	.014	.007	-.033	-.089	-.126	-.157	-.173	-.182	-.203	-.247	-.268	-.254	-.327
I=17	.021	-.021	.035	.060	.090	.068	.193	.256	.519	.560	.792	.850	1.280	1.340	1.557	1.505	1.803
	-.004	-.001	-.003	.007	.020	.021	-.006	-.052	-.105	-.125	-.147	-.158	-.167	-.182	-.206	-.220	-.221
I=18	.012	-.012	.055	.059	.111	.104	.222	.256	.524	.537	.738	.818	1.247	1.344	1.594	1.547	1.879
	-.003	.003	-.000	-.000	.004	.012	.006	-.028	-.048	-.050	-.060	-.076	-.087	-.104	-.095	-.097	-.110
I=19	.013	-.013	.032	.039	.103	.104	.212	.251	.493	.471	.630	.693	1.120	1.248	1.530	1.525	1.890
	-.010	-.001	.003	.008	.011	.015	.011	.001	.002	.004	.002	-.018	-.033	-.027	-.010	.025	.014
I=20	.013	-.013	.025	.013	.097	.098	.200	.227	.443	.384	.512	.552	.955	1.109	1.423	1.408	1.754
	-.009	-.003	.002	.010	.014	.026	.023	.014	.015	.008	.002	.007	.041	.050	.096	.138	.155
I=21	.005	-.005	.039	.023	.088	.093	.202	.215	.388	.303	.423	.420	.783	.966	1.284	1.238	1.556
	-.004	.000	.001	.003	.011	.012	.017	.016	.017	.049	.058	.038	.083	.142	.174	.194	.220
I=22	.014	.014	.046	.017	.098	.107	.214	.205	.328	.229	.317	.279	.606	.776	1.083	.976	1.306
	-.011	-.005	.007	.009	-.002	-.008	-.019	-.027	.027	.068	.089	.097	.136	.158	.189	.226	.257
I=23	.015	.015	.067	.043	.116	.124	.220	.185	.275	.137	.178	.140	.439	.574	.799	.680	1.026
	-.007	-.003	.007	.004	-.003	-.006	-.014	-.007	.022	.046	.072	.092	.138	.162	.204	.242	.290
I=24	.024	.024	.057	.020	.079	.102	.189	.143	.201	.033	.029	-.064	.184	.325	.465	.290	.608
	-.002	.002	-.000	.000	.002	.000	.001	-.007	.019	.052	.053	.066	.094	.124	.178	.220	.263
I=25	.018	.018	.038	.001	.048	.057	.157	.104	.133	-.040	-.091	-.247	-.101	.022	.128	-.063	.032
	-.003	.001	.006	-.004	.001	.011	.011	.003	-.004	-.002	.008	.035	.070	.113	.151	.195	.249
I=26	.006	.006	.016	-.008	.029	.026	.106	.060	.092	-.056	-.181	-.425	-.377	-.256	-.186	-.420	-.557
	-.005	-.007	.000	.012	.011	.008	.013	.010	.011	.014	.020	.040	.076	.121	.160	.196	.239
I=27	.010	.010	.014	.018	.045	.023	.073	.029	.069	-.055	-.201	-.518	-.595	-.511	-.468	-.707	-.988
	-.002	-.001	.002	.001	.007	-.010	-.018	-.010	-.007	.011	.045	.067	.067	.101	.133	.166	.192
I=28	.021	.021	.029	.022	.052	.022	.048	.016	.063	-.024	-.176	-.533	-.744	-.769	-.765	-.974	1.317
	.005	.001	-.003	-.003	-.002	-.006	-.006	-.010	-.020	-.022	-.004	-.003	-.010	-.012	-.011	-.017	-.004
I=29	.018	.018	.014	.000	.012	.020	.051	.015	.064	.015	-.143	-.544	-.790	-.928	1.006	1.158	1.499
	.008	.001	-.005	-.004	.006	.002	.003	-.011	-.011	-.019	.033	-.064	-.108	-.169	-.250	-.365	-.492
I=30	.024	.024	.018	.018	.011	.013	.053	.030	.112	.070	-.093	-.478	-.708	-.896	1.046	1.246	1.476
	-.003	.002	.001	.000	.005	.006	-.005	-.013	-.005	-.022	-.071	-.139	-.224	-.352	-.526	-.773	1.099
I=31	.023	.023	.026	-.002	-.006	.018	.064	.066	.183	.184	.053	.332	-.537	-.685	-.861	1.074	1.325
	-.001	-.004	-.002	.007	.004	-.006	-.011	-.016	-.033	-.063	-.128	-.226	-.407	-.639	-.875	1.174	1.564
I=32	.016	.016	.021	-.016	-.013	.018	.076	.105	.258	.273	.209	.154	-.331	-.464	-.507	-.729	1.088
	-.003	-.006	.002	.007	.001	-.020	-.028	-.023	-.042	-.068	-.147	-.310	-.589	-.899	1.222	1.555	1.880

I=22	.022	.004	.024	.036	.045	.039	.045	.016	.002	.021	.110	.178	.161	.074	.081	-.244
	.001	-.003	-.001	.004	.006	.010	.007	-.005	-.007	-.015	-.029	-.038	-.032	-.042	-.054	-.068
I=23	.031	.014	.022	.033	.040	.026	.023	-.010	-.029	.003	.102	.159	.125	.044	.087	-.151
	-.002	.002	.002	-.001	-.002	-.005	-.005	-.000	-.002	-.001	.000	-.000	-.007	-.021	-.028	-.037
I=24	.029	.002	.012	.032	.042	.019	.007	-.032	-.056	-.033	.068	.147	.099	-.004	.068	-.025
	-.001	-.001	.003	-.001	-.006	-.008	-.003	.008	.014	.017	.012	.012	.001	-.002	-.009	-.017
I=25	.020	-.004	.008	.022	.043	.022	.006	-.046	-.078	-.074	.007	.103	.084	-.021	.023	.028
	.003	-.000	-.004	-.003	-.003	-.005	-.006	.002	.010	.010	.004	-.002	-.011	-.010	-.012	-.017
I=26	.008	-.004	.008	.014	.031	.017	-.003	-.037	-.099	-.133	-.063	.064	.072	-.049	.138	-.026
	.000	.001	-.001	-.002	.007	.010	.004	.002	-.005	-.014	-.015	-.005	-.005	-.006	-.005	.001
I=27	.008	.003	.012	.004	.013	.005	.001	-.025	-.101	-.166	-.142	-.004	.050	-.062	-.211	-.149
	-.002	.001	.005	.004	.005	.006	.006	.011	.012	.007	.012	.025	.038	.048	.059	.085
I=28	.017	.001	.010	.003	.001	-.001	.008	-.010	-.091	-.181	-.214	-.104	-.007	-.073	-.242	-.218
	-.001	.003	.002	.000	-.004	-.007	.001	.002	.010	.026	.043	.059	.090	.127	.172	.216
I=29	.010	-.006	.000	.007	.015	.001	.008	.003	-.080	-.196	-.244	-.163	-.089	-.096	-.226	-.251
	-.000	-.001	-.001	-.003	-.004	-.000	.002	-.004	.001	.025	.050	.078	.123	.183	.260	.362
I=30	.013	-.011	-.010	.008	.025	.009	.026	.020	-.074	-.193	-.233	-.172	-.141	-.148	.199	-.210
	.002	-.001	-.004	.000	.002	.005	.002	.069	.017	.035	.061	.110	.170	.222	.282	.364
I=31	.016	-.007	-.011	.006	.027	.020	.048	.048	-.050	-.179	-.215	-.143	-.133	-.158	-.208	-.221
	.003	-.001	-.002	.001	.009	.009	.004	.013	.017	.030	.067	.139	.203	.254	.283	.289

DEFN(I,J) (1/SEC) NORMAL COMPONENT, DEF. RATE
 DEFRS(I,J) (1/SEC) SHEAR COMPONENT, DEF. RATE
 DEFRM(I,J) (1/SEC) ROOT-MEAN-SQUARED VALUE, DEF. RATE

J=

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I= 3	.003	-.007	.011	.005	.021	.031	.025	.024	.037	.069	.095	.112	.123	.225	.299	.278		
	-.002	-.007	-.017	-.006	.046	.079	.081	.092	.152	.240	.339	.378	.466	.708	.818	.679		
	.003	.010	.020	.008	.051	.085	.085	.095	.156	.250	.353	.394	.482	.743	.871	.734		
I= 4	.005	.003	.006	.012	.005	.032	.037	.024	.061	.100	.132	.156	.146	.166	.297	.373		
	.000	.001	-.001	-.006	.025	.054	.075	.091	.155	.203	.258	.304	.424	.616	.842	.965		
	.005	.003	.007	.013	.026	.063	.084	.094	.167	.226	.289	.342	.448	.638	.892	1.034		
I= 5	.002	.001	.003	.010	.020	.022	.021	.021	.084	.133	.175	.194	.193	.211	.211	.301		
	.002	.017	.018	.006	.018	.049	.067	.069	.107	.131	.167	.217	.321	.465	.672	.883		
	.003	.017	.018	.012	.021	.053	.071	.072	.137	.187	.242	.292	.374	.510	.704	.933		
I= 6	.003	.002	.000	.012	.017	.013	.028	.019	.079	.118	.146	.164	.188	.241	.283	.344		
	.004	.015	.018	-.002	.008	.045	.046	.023	.048	.055	.069	.067	.131	.224	.384	.578		
	.005	.015	.018	.012	.019	.047	.054	.030	.092	.130	.161	.177	.229	.329	.477	.673		
I= 7	.006	.003	.009	.015	.019	.012	.038	.030	.085	.097	.092	.103	.154	.233	.304	.370		
	.005	.021	.009	-.005	-.002	.016	.019	.042	.087	.097	.094	.129	.163	.237	.307	.385		
	.008	.021	.012	.016	.019	.017	.059	.042	.087	.097	.094	.129	.163	.237	.307	.385		
I= 8	.015	.003	.011	.008	.018	.011	.028	.030	.078	.080	.051	.057	.118	.197	.251	.255		
	.009	.012	.009	.008	.010	.008	.015	.004	-.004	-.049	-.064	-.137	-.177	-.213	-.252	-.317		
	.017	.012	.015	.011	.021	.014	.032	.031	.078	.094	.081	.148	.213	.290	.356	.406		
I= 9	.016	.001	.011	.003	.018	.018	.029	.015	.048	.046	.036	.053	.084	.137	.144	.130		
	.002	.001	-.000	-.003	-.012	-.016	-.009	-.031	-.058	-.105	-.133	-.203	-.222	-.291	-.366	-.452		
	.016	.001	.011	.004	.021	.024	.031	.034	.075	.114	.138	.210	.237	.322	.393	.471		
I=10	.014	.005	.008	.005	.012	.013	.033	.030	.018	.017	.048	.049	.049	.064	.014	.061		
	.003	-.022	-.023	-.013	-.017	-.044	-.041	-.052	-.080	-.141	-.184	-.236	-.273	-.349	-.429	-.434		
	.014	.023	.025	.014	.021	.046	.052	.060	.082	.142	.190	.241	.235	.281	.349	.434		
I=11	.007	.010	.008	.015	.010	.013	.032	.024	.017	.020	.054	.040	.026	.038	.041	.133		
	.002	-.023	-.025	-.020	-.025	-.063	-.081	-.078	-.085	-.148	-.203	-.232	-.219	-.245	-.285	-.329		
	.007	.025	.026	.025	.027	.064	.087	.082	.087	.150	.210	.235	.220	.248	.287	.355		
I=12	.001	.014	.002	.014	.009	.021	.037	.037	.046	.044	.058	.054	.037	.046	.076	.208		
	.002	.005	.007	.012	.034	.070	.077	.084	.099	.138	.162	.170	.175	.224	.242	.220		
	.002	.015	.008	.019	.035	.073	.086	.092	.109	.145	.172	.178	.179	.229	.254	.303		
I=13	.003	.015	.008	.014	.015	.027	.040	.045	.062	.066	.085	.070	.039	.053	.096	.264		
	.005	-.006	.001	.015	-.041	-.066	-.058	-.053	-.079	-.119	-.136	-.152	-.158	-.200	-.202	-.178		
	.006	.016	.008	.021	.044	.071	.070	.070	.100	.136	.160	.167	.163	.207	.224	.318		
I=14	.001	.017	.011	.008	.010	.036	.063	.055	.057	.068	.099	.090	.063	.077	.115	.269		
	.003	.009	.016	.027	.038	-.064	-.063	-.053	-.062	-.101	-.110	-.121	-.159	-.188	-.173	-.203		
	.003	.019	.015	.028	.039	.074	.089	.076	.084	.122	.148	.151	.171	.203	.208	.337		
I=15	.005	.019	.013	.013	.024	.055	.087	.078	.063	.066	.103	.101	.072	.076	.127	.246		
	.004	-.011	-.006	-.012	-.032	-.058	-.063	-.062	-.051	-.058	-.070	-.099	-.139	-.170	-.149	-.130		
	.006	.022	.015	.018	.040	.080	.107	.100	.081	.088	.125	.141	.157	.186	.196	.278		
I=16	.006	.019	.011	.007	.026	.055	.088	.090	.063	.081	.109	.118	.085	.084	.128	.299		
	.004	-.002	.012	.007	-.032	-.049	-.042	-.041	-.033	-.027	-.033	-.066	-.092	-.097	-.107	-.027		
	.007	.019	.017	.009	.041	.074	.098	.099	.089	.085	.114	.136	.125	.128	.167	.301		
I=17	.006	.017	.010	.008	.025	.047	.094	.104	.107	.115	.152	.161	.138	.131	.155	.362		
	.004	-.003	.013	-.001	-.029	-.041	-.036	-.032	-.008	-.009	-.000	-.008	-.036	-.052	-.054	-.028		
	.007	.018	.016	.008	.038	.063	.100	.108	.107	.116	.152	.161	.142	.141	.164	.363		
I=18	.011	.016	.022	.033	.053	.037	.106	.159	.173	.234	.340	.417	.431	.440	.429	.703		

I=17	.006	.017	.010	.008	.025	.047	.094	.104	.107	.115	.152	.161	.138	.131	.155	.362
	-.004	-.003	.013	-.001	-.029	-.041	-.036	-.032	-.008	.009	.000	-.008	-.036	-.052	-.054	-.028
	.007	.018	.016	.008	.038	.063	.100	.108	.107	.116	.152	.161	.142	.141	.164	.363
I=18	.011	.016	.022	.033	.053	.037	.106	.159	.173	.234	.340	.417	.431	.440	.429	.703
	-.002	-.001	.008	.000	-.012	-.020	-.017	.000	.026	.047	.046	.048	.030	.012	-.013	-.037
	.011	.016	.024	.033	.054	.042	.107	.159	.174	.238	.344	.420	.432	.440	.429	.704
I=19	.006	.011	.017	.017	.029	.035	.058	.049	.029	.041	.088	.108	.083	.076	.106	.268
	.005	.013	.018	.007	.002	.003	.006	.028	.051	.068	.077	.094	.073	.087	.053	.032
	.008	.017	.025	.018	.029	.035	.058	.056	.058	.080	.118	.143	.120	.107	.118	.270
I=20	.004	.006	.015	.019	.021	.028	.050	.036	.026	.044	.089	.118	.113	.094	.101	.257
	.001	.002	.010	.010	.006	-.001	.009	.033	.050	.067	.103	.125	.111	.105	.115	.109
	.004	.007	.018	.021	.028	.028	.050	.049	.057	.080	.137	.172	.158	.144	.153	.279
I=21	.008	.008	.011	.016	.027	.031	.043	.024	.023	.042	.087	.121	.111	.078	.081	.210
	-.008	-.006	.003	.003	-.001	-.003	.007	.049	.065	.062	.103	.154	.144	.135	.165	.156
	.011	.010	.012	.016	.027	.031	.044	.054	.069	.075	.134	.196	.182	.156	.184	.262
I=22	.012	.003	.012	.020	.025	.025	.026	.010	.004	.018	.070	.108	.096	.058	.067	.156
	.000	-.003	-.011	-.016	-.017	-.013	.028	.072	.077	.093	.111	.139	.152	.187	.212	.187
	.012	.004	.016	.026	.030	.028	.038	.073	.077	.095	.132	.176	.180	.196	.223	.243
I=23	.017	.008	.012	.017	.021	.016	.014	.005	.016	.002	.051	.080	.066	.033	.057	.094
	.002	-.000	-.005	.003	-.002	.007	.034	.062	.084	.115	.142	.170	.176	.236	.262	.252
	.017	.008	.013	.017	.021	.017	.037	.062	.085	.115	.151	.188	.188	.238	.268	.269
I=24	.015	.001	.008	.016	.024	.014	.005	.020	.035	.025	.040	.079	.050	.003	.039	.021
	-.001	.009	.015	.023	.023	.019	.035	.069	.076	.097	.144	.203	.216	.258	.278	.355
	.015	.009	.017	.028	.033	.023	.036	.072	.084	.100	.149	.218	.221	.258	.281	.355
I=25	.011	.002	.006	.013	.023	.014	.006	.024	.044	.042	.005	.053	.047	.015	.018	.023
	.010	.013	.008	.022	.029	.024	.022	.035	.035	.083	.142	.212	.219	.240	.267	.414
	.015	.013	.010	.026	.037	.028	.023	.042	.056	.093	.142	.218	.224	.241	.257	.415
I=26	.004	.002	.005	.008	.019	.013	.004	.019	.052	.074	.039	.035	.039	.027	.072	.013
	.005	.014	-.003	-.000	.012	.029	.024	.022	.008	.045	.111	.195	.209	.225	.244	.380
	.007	.015	.005	.008	.023	.032	.024	.029	.052	.086	.118	.198	.212	.227	.254	.381
I=27	.005	.002	.009	.004	.009	.006	.004	.018	.056	.087	.077	.014	.044	.055	.135	.107
	-.003	-.003	-.008	-.010	-.008	.019	.018	.017	.009	.019	.043	.133	.193	.212	.201	.275
	.006	.004	.012	.011	.012	.020	.019	.025	.057	.089	.088	.134	.198	.219	.242	.295
I=28	.009	.002	.006	.001	.002	.004	.005	.006	.050	.103	.129	.082	.049	.100	.207	.217
	.005	-.002	.006	.010	-.000	.006	-.001	-.003	.017	.012	.006	.059	.133	.169	.143	.165
	.010	.003	.009	.011	.002	.007	.005	.007	.053	.104	.129	.101	.142	.197	.252	.273
I=29	.005	.004	.001	.005	.010	.000	.005	.004	.041	.110	.147	.121	.106	.140	.243	.366
	-.006	.001	.015	.024	.002	-.006	-.009	.019	.040	-.047	-.049	-.055	-.019	.005	-.021	-.103
	.008	.004	.015	.025	.010	.006	.011	.019	.057	.120	.155	.133	.108	.140	.244	.323
I=30	.008	.006	.007	.004	.014	.007	.014	.014	.046	.114	.147	.141	.155	.185	.240	.287
	-.001	-.005	.003	.008	-.004	-.011	-.016	-.041	-.081	-.106	-.128	-.166	-.205	-.220	-.289	-.389
	.008	.008	.007	.009	.014	.013	.022	.044	.093	.156	.195	.218	.257	.287	.376	.483
I=31	.010	.004	.006	.004	.018	.014	.026	.031	.034	.104	.141	.141	.168	.206	.246	.255
	.003	.003	.003	-.004	-.007	-.011	-.033	-.064	-.101	-.152	-.215	-.286	-.327	-.382	-.462	-.476
	.010	.005	.007	.005	.019	.018	.042	.071	.107	.185	.257	.319	.367	.434	.523	.540

VELU(I) (CM/SEC) APPROACH FLOW VELOCITY
VELV(I) (CM/SEC) BUBBLE RISE RATE
DEFRSC(I) (1/SEC) FLUME SHEAR RATE

STREAMLINE NO. 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
8.259 8.201 8.158 8.115 8.075 8.038 7.978 7.915 7.854 7.791 7.741 7.710 7.671 7.627 7.569
-375 -369 -363 -357 -351 -345 -339 -333 -327 -321 -315 -309 -303 -297 -291
-000 -034 -029 -026 -025 -034 -041 -042 -042 -038 -028 -024 -027 -035 -039

STREAMLINE NO. 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
7.513 7.467 7.439 7.424 7.430 7.428 7.426 7.417 7.414 7.403 7.394 7.394 7.389 7.397 7.408 7.405
-363 -377 -390 -409 -421 -394 -364 -357 -370 -385 -388 -392 -406 -403 -406 -405
-034 -025 -014 -003 -001 -001 -004 -004 -004 -007 -002 -002 -000 -007 -003 -000

VELUR(I,J) (CM/SEC) RELATIVE VELOCITY COMPONENTS

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I= 2	-040	040	020	-004	-097	-121	-138	-144	-122	-125	-176	-291	-284	-218	022	270	386			
I= 3	-003	-001	-002	-006	-007	-033	-008	116	432	966	1752	2565	3288	3629	3631	3405	3085			
I= 4	-031	031	008	-010	-107	-131	-153	-187	-309	-369	-449	-523	-513	-472	-307	-146	128			
I= 5	-008	-002	-006	-001	-014	-043	-043	072	370	873	1542	2286	3086	3554	3697	3447	3139			
I= 6	-022	022	-011	-044	-127	-108	-175	-285	-505	-661	-724	-750	-720	-685	-672	-643	-084			
I= 7	-001	-004	-001	005	006	-006	007	104	359	775	1392	2094	2854	3547	3823	3573	3377			
I= 8	-019	019	-031	-067	-116	-100	-206	-383	-682	-929	-1031	-1021	-919	-921	-1096	-1196	-651			
I= 9	-012	-010	005	017	030	052	097	190	367	649	1121	1757	2627	3366	3718	3668	3615			
I= 10	-016	016	-070	-102	-118	-102	-225	-461	-820	-1131	-1294	-1278	-1173	-1284	-1577	-1811	-1547			
I= 11	005	031	002	-007	009	033	083	193	377	605	935	1460	2201	2914	3443	3685	3712			
I= 12	-018	018	-087	-135	-117	-097	-230	-498	-909	-1268	-1413	-1442	-1436	-1700	-2183	-2556	-2586			
I= 13	013	010	-007	-016	008	012	038	132	349	562	781	1052	1519	2013	2369	2654	2788			
I= 14	-019	019	-076	-123	-090	-066	-214	-529	-946	-1282	-1410	-1463	-1507	-1900	-2534	-3051	-3186			
I= 15	002	002	-001	-003	-001	-024	-032	025	145	253	308	330	412	428	371	263	172			
I= 16	-019	019	-061	-093	-064	-061	-200	-531	-892	-1130	-1216	-1253	-1307	-1670	-2122	-2450	-2553			
I= 17	-008	-032	006	004	005	-030	-045	-044	-049	-075	-108	-192	-370	-631	-945	-1289	-1618			
I= 18	-012	012	-044	-064	-024	-040	-171	-449	-755	-905	-868	-874	-937	-1184	-1449	-1600	-1662			
I= 19	003	001	-003	-002	-001	-041	-081	-114	-163	-250	-348	-496	-718	-1014	-1350	-1707	-2037			
I= 20	-014	014	-024	-034	021	-006	-109	-346	-575	-626	-531	-434	-439	-618	-749	-868	-942			
I= 21	003	012	-000	-016	-057	-108	-145	-173	-212	-291	-419	-610	-867	-1148	-1456	-1756	-1991			
I= 22	-013	013	-020	-034	024	038	-035	-256	-402	-364	-164	-053	007	007	-027	-139	-339			
I= 23	011	006	001	-018	-048	-127	-198	-244	-261	-317	-443	-637	-902	-1186	-1469	-1773	-1958			
I= 24	-021	021	-024	-064	008	034	025	-155	-253	-129	152	327	391	575	684	426	-070			
I= 25	006	005	003	-014	-032	-072	-153	-225	-278	-339	-436	-598	-857	-1171	-1496	-1724	-1727			
I= 26	-031	031	001	-056	002	054	079	-051	-083	096	500	690	813	1117	1330	730	-295			
I= 27	014	004	-007	-012	-034	-079	-143	-233	-307	-384	-468	-613	-838	-1128	-1371	-1433	-1289			
I= 28	-034	034	015	-031	045	081	113	050	125	353	748	1028	1159	1615	1928	1099	-128			
I= 29	-004	001	007	-012	-032	-088	-170	-240	-316	-398	-488	-507	-776	-989	-1157	-1130	-1033			
I= 30	-030	030	041	025	114	121	149	175	331	554	968	1283	1464	2029	2437	1502	412			
I= 31	002	002	002	-005	-030	-080	-132	-191	-268	-345	-424	-521	-632	-787	-895	-935	-871			

I=15	-.034	.034	.015	-.031	.045	.081	.113	.050	.125	.353	.748	1.028	1.169	1.615	1.928	1.099	-.128
	.004	.001	.007	-.012	-.032	-.088	-.170	-.240	-.316	-.398	-.488	-.607	-.776	-.989	-1.157	-1.130	-1.033
I=16	-.030	.030	.041	.025	.114	.121	.149	.175	.331	.554	.968	1.283	1.464	2.029	2.437	1.502	.412
	.002	.002	.002	-.005	-.030	-.080	-.132	-.191	-.268	-.345	-.424	-.521	-.632	-.787	-.895	-.935	-.871
I=17	-.020	.020	.055	.087	.177	.165	.196	.278	.482	.755	1.139	1.441	1.691	2.394	2.776	1.785	.525
	-.000	-.000	.007	-.007	-.046	-.093	-.131	-.153	-.183	-.239	-.281	-.342	-.444	-.553	-.613	-.630	-.634
I=18	-.014	.014	.075	.129	.211	.192	.222	.352	.575	.873	1.258	1.546	1.862	2.690	3.299	2.343	1.238
	-.010	.005	.008	-.003	-.025	-.059	-.085	-.096	-.119	-.144	-.153	-.183	-.236	-.313	-.357	-.404	-.422
I=19	-.015	.015	.079	.161	.212	.166	.210	.370	.593	.918	1.325	1.580	1.974	2.966	3.662	2.560	1.170
	-.019	.001	.011	.007	-.002	-.011	-.020	.033	.042	-.058	-.064	-.071	-.066	-.071	-.078	-.115	-.144
I=20	-.009	.009	.070	.164	.207	.152	.173	.334	.542	.867	1.317	1.573	2.028	3.062	3.795	2.504	1.323
	-.003	-.014	-.000	.017	.021	.013	.006	-.001	.020	.057	.079	.086	.154	.227	.259	.184	.195
I=21	-.001	-.001	.013	.132	.189	.131	.107	.274	.466	.758	1.199	1.457	1.950	3.036	3.824	2.447	1.251
	-.028	-.021	.004	.045	.073	.066	.047	.050	.084	.136	.190	.255	.399	.581	.678	.570	.487
I=22	.010	-.010	-.018	.099	.168	.127	.073	.201	.369	.648	1.068	1.272	1.816	2.932	3.687	2.407	1.023
	-.036	-.034	.008	.062	.107	.130	.138	.140	.163	.223	.342	.455	.546	.931	1.148	1.036	.805
I=23	.002	-.002	-.035	.073	.144	.113	.059	.170	.254	.451	.860	1.075	1.650	2.752	3.450	2.119	.814
	-.003	-.007	-.004	.014	.035	.067	.122	.201	.249	.335	.481	.654	.892	1.238	1.503	1.377	1.147
I=24	.010	-.010	-.035	.059	.129	.107	.060	.146	.166	.261	.599	.827	1.468	2.481	3.175	2.308	.987
	.003	-.009	-.007	.013	.032	.050	.093	.170	.271	.389	.565	.720	1.051	1.461	1.727	1.641	1.594
I=25	.002	-.002	-.035	.047	.120	.103	.021	.092	.099	.102	.355	.604	1.186	1.973	2.742	2.288	1.634
	-.005	-.005	.000	.013	.026	.067	.106	.160	.235	.369	.562	.771	1.087	1.482	1.862	1.912	1.859
I=26	.008	-.008	-.034	.046	.126	.099	.016	.035	.032	-.031	.181	.397	.834	1.418	2.088	2.032	1.619
	-.010	.003	.001	.006	.017	.046	.101	.179	.266	.323	.489	.730	1.077	1.442	1.871	2.039	2.005
I=27	.011	-.011	-.031	.049	.110	.085	.004	.008	-.039	-.127	.026	.170	.419	.770	1.384	1.523	1.629
	-.005	-.006	-.004	.015	.029	.046	.081	.161	.210	.264	.442	.678	1.018	1.328	1.838	2.211	2.330
I=28	.009	-.009	-.030	.038	.079	.040	-.026	-.031	-.092	-.220	-.158	-.120	-.036	.065	.609	.828	.789
	.003	.004	-.005	-.002	.013	.027	.042	.055	.091	.178	.366	.592	.886	1.243	1.760	2.225	2.394
I=29	.009	-.009	-.022	.042	.055	.018	-.035	-.062	-.131	-.276	-.308	-.394	-.516	-.551	-.209	-.218	-.582
	.008	.013	-.012	-.009	-.020	-.016	-.020	-.000	.042	.109	.249	.442	.699	.992	1.480	1.887	2.032
I=30	.003	-.003	-.025	.010	.013	-.015	-.068	-.088	-.156	-.292	-.412	-.615	-.882	-1.091	-1.036	-1.311	-1.806
	.006	.008	-.005	-.008	-.011	-.015	-.004	.028	.062	.087	.160	.297	.458	.632	.976	1.307	1.540
I=31	.000	-.000	-.038	.013	-.029	-.064	-.113	-.125	-.167	-.262	-.443	-.725	-.985	-1.365	-1.685	-2.190	-2.678
	.012	.018	-.011	-.019	-.011	-.004	-.003	.010	.000	-.013	.003	.080	.173	.225	.349	.551	.707
I=32	.004	-.004	-.032	.019	-.061	-.095	-.139	-.122	-.129	-.202	-.339	-.539	-.795	-1.340	-1.960	-2.577	-2.983
	.009	.011	-.010	-.010	.001	-.003	-.032	-.078	-.136	-.216	-.306	-.384	-.452	-.498	-.507	-.493	-.488

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	DEFRRX(I,J)	(1/SEC)	AXIAL COMPONENT, DEF. RATE	DEFRRR(I,J)	(1/SEC)	RADIAL COMPONENT, DEF. RATE														
I=3	.009	-.013	-.039	-.041	-.014	-.017	-.053	-.060	-.046	-.050	-.018	.016	.073	.107	.141	.141	.073	.073	.073	.073
I=4	.000	-.020	-.039	-.025	-.019	-.054	-.111	-.125	-.059	-.032	.004	.022	.016	.014	.221	.221	.014	.014	.014	.014
I=5	.002	-.004	-.005	-.014	-.031	-.046	-.034	.018	.112	.202	.261	.261	.201	.140	.068	.068	.201	.201	.201	.201
I=6	.007	-.027	-.028	-.013	-.034	-.087	-.161	-.185	-.114	-.038	.044	.040	-.067	-.099	.198	.198	-.067	-.067	-.067	-.067
I=7	.002	-.001	.004	-.000	-.012	-.023	-.023	.012	.091	.208	.285	.315	.328	.263	.121	.121	.328	.328	.328	.328
I=8	.022	-.039	-.015	-.001	-.040	-.110	-.202	-.230	-.162	-.062	.049	.007	-.155	-.199	.044	.044	-.155	-.155	-.155	-.155
I=9	.007	.004	.011	.008	.015	.023	.028	.025	.060	.162	.308	.467	.547	.542	.414	.414	.547	.547	.547	.547
I=10	.027	-.050	-.007	.012	-.043	-.124	-.230	-.267	-.174	-.072	.007	-.089	-.299	-.353	-.161	.161	-.299	-.299	-.299	-.299
I=11	.000	.001	-.002	.003	.019	.039	.061	.089	.132	.224	.383	.571	.707	.779	.724	.724	.707	.707	.707	.707
I=12	.023	-.047	-.001	.019	-.046	-.142	-.249	-.266	-.162	-.074	-.038	-.158	-.423	-.519	.324	.324	-.423	-.423	-.423	-.423
I=13	.004	-.004	-.007	.001	.013	.027	.060	.140	.218	.290	.376	.533	.662	.727	.735	.735	.662	.662	.662	.662
I=14	.018	-.038	.001	.012	-.049	-.144	-.235	-.217	-.112	-.049	-.035	-.147	-.321	-.331	.186	.186	-.321	-.321	-.321	-.321
I=15	.000	.001	-.000	.000	.003	.013	.045	.104	.168	.210	.249	.325	.380	.408	.408	.408	.380	.380	.380	.380
I=16	.013	-.026	.009	.010	-.052	-.127	-.197	-.165	-.032	.013	-.027	-.107	-.190	-.165	-.083	.083	-.190	-.190	-.190	-.190
I=17	.004	.002	.006	.019	.020	.026	.034	.044	.058	.081	.101	.104	.084	.053	.009	.009	.084	.084	.084	.084
I=18	.006	-.017	.017	.012	-.045	-.106	-.155	-.103	.022	.068	.028	-.055	-.106	-.091	-.068	.068	-.106	-.106	-.106	-.106
I=19	.001	-.001	.005	.013	.021	.026	.027	.013	-.003	-.004	-.005	-.013	-.044	-.090	-.138	.138	-.044	-.044	-.044	-.044
I=20	.005	-.016	.017	.026	-.022	-.090	-.119	-.043	.089	.109	.054	.022	-.012	-.045	-.106	.106	.022	.022	.022	.022
I=21	.004	.001	-.002	.013	-.021	-.012	-.003	-.002	-.015	-.037	-.066	-.092	-.112	-.139	-.197	.197	-.092	-.092	-.092	-.092
I=22	.005	-.028	.015	.034	.004	-.055	-.088	.002	.144	.155	.072	.074	.089	-.029	-.237	.237	.072	.072	.072	.072
I=23	.001	.002	-.004	-.010	-.029	-.039	-.032	-.018	-.019	-.045	-.082	-.124	-.157	-.203	-.314	.314	-.124	-.124	-.124	-.124
I=24	.007	-.028	.005	.037	.024	-.029	-.049	.043	.204	.200	.093	.121	.150	-.071	-.476	.476	.093	.093	.093	.093
I=25	.002	-.000	-.002	-.004	-.006	-.018	-.028	-.030	-.033	-.049	-.083	-.144	-.217	-.311	-.421	.421	-.083	-.083	-.083	-.083
I=26	.013	-.020	.015	.039	.022	-.007	.009	.095	.207	.214	.120	.159	.214	-.081	-.561	.561	.159	.159	.159	.159
I=27	.001	-.003	-.004	-.007	-.015	-.030	-.054	-.067	-.081	-.099	-.138	-.209	-.302	-.390	-.420	.420	-.099	-.099	-.099	-.099
I=28	.022	-.001	.029	.035	.012	.018	.064	.120	.210	.229	.140	.197	.268	.061	-.513	.513	.197	.197	.197	.197
I=29	.000	.002	-.004	-.006	-.021	-.051	-.079	-.106	-.132	-.166	-.210	-.272	-.356	-.435	-.436	.436	-.272	-.272	-.272	-.272
I=30	.025	.023	.043	.030	.008	.036	.098	.150	.209	.210	.156	.250	.285	-.084	-.585	.585	.250	.250	.250	.250
I=31	.001	.000	-.003	-.013	-.036	-.060	-.089	-.126	-.162	-.204	-.253	-.308	-.390	-.452	-.484	.484	-.308	-.308	-.308	-.308
I=32	.031	.039	.047	.025	.005	.049	.119	.163	.216	.206	.172	.300	.379	-.002	-.483	.483	.379	.379	.379	.379
I=33	.000	.011	-.005	-.043	-.082	-.113	-.129	-.151	-.191	-.220	-.262	-.335	-.418	-.468	-.493	.493	-.262	-.262	-.262	-.262
I=34	.033	.049	.044	.006	.003	.064	.128	.171	.231	.204	.187	.369	.436	-.016	-.571	.571	.369	.369	.369	.369
I=35	.012	-.003	-.018	-.012	.026	.071	.129	.165	.214	.303	1.168	2.820	.771	.623	.810	.810	1.168	1.168	1.168	1.168
I=36	.029	.052	.044	.000	-.008	.055	.124	.167	.248	.221	.205	.399	.456	-.043	-.554	.554	.399	.399	.399	.399
I=37	.012	-.001	-.025	-.042	-.040	-.030	-.033	-.056	-.091	-.130	-.183	-.258	-.363	-.463	-.544	.544	-.258	-.258	-.258	-.258
I=38	.005	.041	.058	.005	.026	.041	.121	.153	.238	.223	.219	.432	.490	-.043	-.575	.575	.432	.432	.432	.432
I=39	.013	-.004	-.026	-.046	-.059	-.065	-.069	-.078	-.103	-.163	-.226	-.326	-.491	-.648	-.659	.659	-.326	-.326	-.326	-.326
I=40	.009	.032	.062	.015	-.033	.017	.102	.143	.229	.203	.225	.468	.497	-.041	-.607	.607	.468	.468	.468	.468
I=41	.002	.003	.006	.003	-.014	-.042	-.076	-.089	-.118	-.172	-.241	-.328	-.468	-.603	-.623	.623	-.328	-.328	-.328	-.328
I=42	.014	.020	.060	.018	-.030	.012	.065	.088	.209	.210	.241	.488	.490	-.075	-.645	.645	.488	.488	.488	.488
I=43	.005	.005	.011	.015	.012	-.003	-.033	-.069	-.104	-.149	-.189	-.289	-.409	-.495	-.521	.521	-.289	-.289	-.289	-.289

I=22	-.009	.032	.062	.015	-.033	.017	.102	.143	.229	.203	.225	.468	.497	-.041	-.607
	-.002	.003	.006	.003	-.014	-.042	-.076	-.089	-.118	-.172	-.241	-.328	-.468	-.603	-.623
I=23	-.014	.020	.060	.018	-.030	.012	.065	.088	.209	.210	.241	.488	.490	-.075	-.645
	-.005	.005	.011	.015	.012	-.003	-.033	-.069	-.104	-.149	-.189	-.289	-.409	-.495	-.521
I=24	-.016	.019	.056	.021	-.025	.007	.033	.035	.157	.193	.276	.496	.468	.006	-.528
	.001	-.001	-.001	.000	-.008	-.009	-.009	-.026	-.058	-.097	-.138	-.207	-.286	-.390	-.469
I=25	-.014	.012	.053	.024	-.036	-.010	.024	.004	.099	.171	.270	.420	.445	.124	-.281
	-.004	-.003	.002	.002	-.004	-.013	-.022	-.027	-.017	-.033	-.086	-.134	-.170	-.277	-.384
I=26	-.015	.014	.055	.023	-.039	-.026	.005	-.020	.065	.149	.216	.323	.377	.192	-.131
	-.000	.001	-.002	-.004	.002	-.000	-.015	-.012	.006	-.008	-.040	-.082	-.092	-.190	-.329
I=27	-.015	.016	.048	.016	-.038	-.030	-.017	-.045	.034	.105	.133	.196	.313	.242	.068
	-.001	.002	.003	.000	.004	.014	.033	.045	.027	.005	-.011	-.023	-.055	-.131	-.263
I=28	-.013	.012	.036	.005	-.037	-.027	-.025	-.062	-.014	.037	.044	.063	.240	.271	.050
	-.007	.003	.008	.016	.019	.031	.049	.047	.036	.036	.032	.033	.012	-.027	-.077
I=29	-.010	.014	.024	-.006	-.031	-.029	-.035	-.071	-.057	-.040	-.076	-.060	.131	.139	-.136
	-.002	.001	.002	.008	-.013	.013	.006	.004	.021	.050	.066	.091	.126	.137	.133
I=30	-.010	.002	.012	-.007	-.029	-.027	-.033	-.068	-.090	-.114	-.174	.183	-.049	-.073	-.314
	-.003	.000	.004	-.002	-.004	-.005	-.003	.014	.040	.077	.107	.149	.212	.297	.309
I=31	-.015	-.007	.001	-.016	-.030	-.023	-.020	-.046	-.101	-.162	-.203	-.245	-.282	-.354	-.461
	-.002	.002	.001	-.004	-.004	.010	.037	.068	.102	.153	.211	.269	.315	.395	.433

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	DEFN(I,J)	11/SEC)	NORMAL COMPONENT,	DEF. RATE																
	DEFRS(I,J)	11/SEC)	SHEAR COMPONENT,	DEF. RATE																
	DEFRM(I,J)	11/SEC)	ROOT-MEAN-SQUARED VALUE,	DEF. RATE																
I=3	.005	.007	.020	.023	.012	.011	.030	.050	.073	.117	.132	.139	.119	.095	.107	.109	.153			
	.002	.011	.010	.003	.012	.044	.185	.375	.562	.636	.652	.571	.332	.187	.109	.153				
	.005	.013	.022	.023	.017	.045	.187	.378	.567	.647	.665	.587	.352	.210	.153					
I=4	.031	.012	.022	.019	.025	.050	.072	.072	.090	.117	.132	.142	.108	.077	.145	.175	.227			
	.004	.015	.020	.000	.009	.049	.187	.343	.533	.645	.629	.450	.266	.175						
	.005	.019	.030	.019	.027	.070	.201	.350	.560	.656	.674	.645	.463	.277	.227					
I=5	.004	.014	.016	.007	.023	.055	.092	.098	.103	.123	.164	.178	.198	.181	.159	.274	.317			
	.007	.028	.027	.008	.020	.058	.151	.256	.434	.582	.715	.716	.537	.367	.274					
	.009	.031	.031	.010	.030	.080	.177	.274	.446	.595	.734	.737	.573	.409	.317					
I=6	.014	.022	.013	.005	.027	.067	.115	.128	.111	.112	.179	.237	.351	.370	.229	.452	.507			
	.000	.017	.026	.013	.024	.057	.138	.213	.318	.440	.624	.708	.680	.605	.452					
	.014	.027	.029	.013	.036	.087	.179	.248	.337	.454	.649	.746	.765	.710	.507					
I=7	.014	.026	.004	.008	.031	.081	.145	.178	.153	.148	.195	.330	.503	.566	.443	.440	.490	.440		
	.008	.007	.013	.001	.001	.032	.129	.188	.209	.223	.351	.470	.575	.702	.755	.624				
	.015	.026	.014	.008	.031	.088	.195	.259	.259	.268	.401	.575	.702	.755	.624					
I=8	.014	.026	.004	.010	.030	.085	.155	.203	.190	.182	.207	.346	.543	.623	.530	.187	.562			
	.001	.010	.014	.023	.021	.063	.072	.073	.010	.035	.021	.008	.052	.129	.187	.562				
	.014	.028	.014	.025	.037	.085	.171	.216	.190	.185	.208	.346	.545	.636	.562					
I=9	.009	.019	.001	.006	.026	.079	.140	.161	.140	.129	.142	.236	.350	.369	.297	.686	.747			
	.007	.009	.020	.032	.024	.019	.029	.075	.149	.220	.291	.340	.437	.579	.686	.747				
	.011	.021	.020	.032	.036	.081	.143	.177	.204	.255	.324	.414	.560	.686	.747					
I=10	.009	.014	.007	.014	.036	.077	.116	.104	.045	.047	.064	.105	.137	.109	.046	.734	.736			
	.000	.014	.019	.040	.044	.054	.090	.151	.233	.309	.398	.458	.555	.676	.734	.736				
	.009	.020	.021	.042	.057	.094	.147	.184	.237	.313	.403	.470	.572	.685	.736					
I=11	.004	.009	.011	.013	.033	.066	.091	.058	.013	.036	.016	.034	.075	.090	.103	.653				
	.002	.017	.030	.046	.054	.068	.087	.155	.251	.337	.420	.483	.579	.660	.645	.653				
	.004	.019	.032	.048	.064	.095	.126	.165	.251	.339	.421	.484	.584	.666	.653					
I=12	.004	.009	.010	.019	.022	.051	.061	.023	.052	.073	.060	.057	.062	.092	.151	.587				
	.006	.008	.006	.029	.062	.085	.085	.133	.234	.335	.411	.459	.586	.676	.587	.606				
	.007	.012	.012	.035	.066	.099	.105	.135	.240	.343	.415	.463	.590	.682	.606					
I=13	.003	.015	.010	.022	.016	.047	.060	.010	.081	.100	.077	.099	.123	.116	.275	.357	.451			
	.007	.012	.004	.011	.047	.089	.110	.147	.212	.306	.388	.451	.578	.637	.357	.451				
	.008	.019	.011	.025	.049	.100	.126	.147	.227	.322	.396	.462	.591	.648	.451					
I=14	.004	.014	.004	.021	.015	.023	.039	.036	.119	.125	.088	.132	.184	.191	.449	.490	.551			
	.011	.018	.020	.033	.051	.078	.120	.174	.212	.263	.343	.404	.494	.505	.194	.251	.551			
	.012	.023	.020	.039	.054	.081	.126	.177	.243	.291	.354	.425	.527	.540	.489	.490	.551			
I=15	.007	.012	.010	.023	.018	.018	.031	.081	.144	.156	.129	.184	.258	.235	.490	.474	.551			
	.001	.017	.042	.063	.069	.075	.126	.193	.212	.224	.285	.332	.426	.443	.251	.551				
	.007	.021	.043	.067	.071	.077	.130	.210	.256	.273	.317	.380	.498	.501	.551	.474	.551			
I=16	.011	.001	.017	.020	.017	.035	.071	.113	.171	.197	.175	.234	.312	.248	.474	.260	.260			
	.005	.016	.052	.069	.063	.045	.124	.174	.190	.191	.207	.262	.360	.362	.260	.439	.541			
	.012	.016	.055	.072	.065	.074	.143	.208	.255	.275	.271	.351	.476	.439	.541					
I=17	.013	.011	.023	.021	.022	.048	.094	.138	.186	.207	.205	.279	.338	.268	.535	.349	.638			
	.008	.013	.053	.060	.051	.045	.076	.108	.138	.129	.138	.201	.291	.357	.349	.638				
	.015	.017	.058	.064	.055	.065	.121	.175	.231	.244	.247	.344	.446	.447	.638					
I=18	.016	.025	.026	.034	.044	.081	.124	.157	.203	.213	.217	.317	.358	.235	.488					

I=17	.013	.011	.023	.021	.022	.048	.094	.138	.186	.207	.205	.279	.338	.268	.535
	.008	.013	-.053	-.060	-.051	-.045	-.076	-.108	-.138	-.129	-.138	-.201	-.291	-.357	-.349
	.015	.017	.058	.064	.055	.065	.121	.175	.231	.244	.247	.344	.446	.447	.638
I=18	.016	.025	.026	.034	.044	.081	.124	.157	.203	.213	.217	.317	.398	.235	.488
	.007	.010	-.036	-.030	-.019	-.017	-.043	-.053	-.067	.077	-.073	.139	.252	-.376	-.338
	.017	.027	.045	.045	.048	.083	.131	.166	.214	.226	.229	.347	.471	.443	.594
I=19	.023	.026	.031	.009	.015	.067	.129	.168	.223	.254	.677	1.594	.603	.319	.690
	.012	.004	-.017	-.004	.008	.010	-.001	.004	-.005	-.025	-.009	-.061	-.146	-.207	-.079
	.025	.026	.035	.010	.017	.068	.129	.168	.223	.255	.677	1.595	.621	.381	.695
I=20	.020	.026	.034	.021	.024	.043	.078	.111	.170	.176	.194	.348	.459	.313	.549
	.007	.032	.016	.007	.007	.030	.038	.061	.074	.054	.067	.048	-.000	-.071	.040
	.021	.042	.038	.022	.025	.052	.087	.127	.185	.184	.205	.352	.459	.321	.550
I=21	.009	.023	.042	.026	.043	.053	.095	.115	.171	.193	.222	.379	.491	.345	.617
	.018	.050	.044	.021	-.001	.027	.059	.086	.109	.122	.167	.167	.120	.046	-.001
	.020	.055	.061	.033	.043	.059	.112	.144	.202	.228	.278	.414	.505	.348	.617
I=22	.006	.018	.034	.009	.023	.029	.089	.116	.173	.188	.233	.398	.482	.322	.615
	.017	.049	.053	.039	.015	.019	.043	.094	.159	.184	.218	.240	.234	.174	.045
	.018	.052	.063	.040	.028	.035	.099	.150	.235	.263	.319	.465	.536	.366	.616
I=23	.010	.013	.036	.017	.021	.007	.049	.079	.156	.180	.215	.389	.449	.285	.583
	.000	.012	.027	.030	.037	.048	.059	.108	.206	.256	.272	.290	.323	.232	-.052
	.010	.018	.045	.035	.043	.049	.077	.134	.258	.312	.347	.485	.553	.367	.585
I=24	.009	.010	.028	.011	.016	.008	.021	.031	.107	.145	.207	.351	.377	.198	.498
	-.003	.007	.022	.020	.025	.052	.088	.125	.219	.280	.313	.383	.453	.301	-.094
	.009	.012	.036	.023	.030	.053	.090	.128	.244	.316	.375	.520	.589	.360	.507
I=25	.009	.007	.027	.013	.020	.011	.023	.015	.058	.102	.178	.277	.308	.201	.333
	.001	.007	.013	.018	.030	.046	.082	.113	.212	.277	.312	.432	.580	.486	.088
	.005	.010	.030	.022	.036	.047	.085	.114	.220	.295	.355	.513	.657	.526	.344
I=26	.007	.008	.028	.013	.021	.013	.010	.016	.035	.078	.128	.202	.235	.191	.230
	.006	-.000	.005	.016	.036	.050	.085	.097	.161	.250	.335	.483	.642	.619	.277
	.010	.008	.029	.021	.041	.052	.086	.099	.164	.262	.362	.523	.683	.648	.360
I=27	.008	.009	.025	.008	.021	.022	.025	.045	.031	.055	.072	.110	.184	.187	.165
	.001	.005	.014	.027	.039	.052	.066	.077	.150	.255	.364	.500	.702	.740	.511
	.008	.011	.029	.028	.044	.057	.071	.089	.153	.261	.371	.512	.726	.763	.537
I=28	.010	.008	.022	.010	.028	.029	.037	.054	.025	.037	.038	.048	.126	.149	.063
	-.004	-.006	.009	.029	.033	.023	.041	.070	.150	.253	.361	.514	.714	.811	.703
	.011	.010	.024	.031	.043	.037	.055	.089	.152	.256	.363	.516	.725	.824	.706
I=29	.006	.007	.013	.007	.022	.021	.020	.038	.039	.045	.071	.075	.128	.138	.134
	-.010	-.011	.006	.019	.018	.018	.041	.058	.100	.201	.323	.466	.661	.820	.790
	.012	.013	.014	.020	.028	.028	.046	.069	.107	.206	.331	.472	.674	.831	.802
I=30	.007	.001	.008	.005	.016	.016	.018	.041	.065	.096	.141	.166	.130	.185	.312
	-.007	-.000	.017	.026	.031	.041	.045	.033	.032	.120	.223	.283	.483	.736	.739
	.010	.001	.019	.027	.035	.044	.048	.053	.072	.153	.263	.368	.501	.759	.848
I=31	.008	.005	.001	.010	.017	.017	.028	.057	.101	.157	.207	.257	.298	.375	.447
	-.009	-.011	.011	.031	.030	.029	.012	-.016	-.027	.010	.049	.041	.161	.416	.511
	.012	.012	.011	.032	.034	.033	.031	.059	.105	.158	.213	.260	.339	.560	.679

VELUO(I) (CM/SEC) APPROACH FLOW VELOCITY
VELVD(I) (CM/SEC) BUBBLE RISE RATE
DEFSO(I) (1/SEC) FLOW SHEAR RATE

STREAMLINE NO.

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
17	7.823	7.807	7.788	7.764	7.750	7.749	7.741	7.724	7.710	7.697	7.678	7.664	7.652	7.633	
18	.277	.286	.282	.287	.271	.277	.275	.271	.266	.266	.246	.247	.247	.258	
19	.000	.012	.014	.013	.005	.003	.008	.010	.009	.005	.006	.011	.009	.010	.016

STREAMLINE NO.

	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	7.605	7.588	7.576	7.571	7.573	7.570	7.566	7.550	7.510	7.491	7.470	7.459	7.462	7.455	7.450	7.447
2	.268	.250	.233	.245	.267	.278	.269	.254	.249	.242	.233	.235	.232	.231	.242	.238
3	.015	.010	.006	.001	.000	.002	.007	.019	.019	.014	.011	.002	.001	.004	.003	.000

VELUR(I,J) (CM/SEC) RELATIVE VELOCITY COMPONENTS
VELVR(I,J)

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I=2	.004	-.004	.010	.036	.135	.179	.216	.300	.254	.286	.256	.644	.786	.758	.377	.410	.461	.461
	-.014	-.015	.003	.021	.021	.012	.008	.028	.043	.077	.163	.469	1.021	1.812	2.572	3.184	3.429	
I=3	.000	-.000	-.008	.006	.101	.162	.184	.229	.176	.193	.160	.462	.480	.455	.019	-.103	-.142	
	-.022	.002	.008	.012	.019	.009	.008	.017	.043	.094	.189	.431	.803	1.477	2.248	2.934	3.257	
I=4	.012	-.012	-.038	-.002	.065	.138	.131	.173	.093	.122	.076	.278	.237	.185	-.342	-.599	-.860	
	-.010	-.013	.006	.017	.031	.042	.025	.025	.056	.125	.203	.387	.672	1.180	1.700	2.337	2.835	
I=5	.020	-.020	-.043	-.007	.056	.125	.126	.135	.023	.053	.030	.163	.019	-.047	-.553	-.962	-1.480	
	-.008	-.008	.001	.015	.033	.035	.042	.049	.053	.086	.181	.320	.502	.865	1.256	1.735	2.211	
I=6	.018	-.018	-.044	-.000	.048	.118	.106	.104	-.025	-.011	-.030	.046	-.143	-.197	-.652	-1.138	-1.880	
	-.007	-.005	.005	.007	.015	.016	.013	.011	.039	.079	.146	.266	.405	.593	.819	1.098	1.308	
I=7	.017	-.017	-.056	-.031	.038	.090	.090	.069	-.073	-.080	-.081	-.061	-.283	-.298	-.614	-1.058	-1.819	
	-.003	-.001	.002	.002	.002	.011	.013	.011	.049	.095	.123	.159	.206	.325	.435	.505	.564	
I=8	.014	-.014	-.040	-.029	.017	.092	.088	.037	-.110	-.111	-.097	-.121	-.376	-.332	-.454	-.742	-1.331	
	.003	.009	-.001	-.011	-.009	-.010	-.006	.003	.013	.021	.048	.043	.037	.060	.066	.040	.008	
I=9	.008	-.008	-.007	-.006	.025	.075	.052	.041	-.062	-.091	-.147	-.397	-.298	-.231	-.363	-.699		
	.015	.006	-.008	-.013	-.004	-.006	-.012	-.023	-.010	-.003	-.012	-.016	-.024	-.082	-.149	-.209	-.292	
I=10	.007	-.007	-.001	.029	.031	.036	.018	.036	-.021	-.022	-.060	-.164	-.344	-.196	-.069	-.003	-.089	
	.013	.014	-.005	-.022	-.016	-.010	-.008	.002	.011	.017	-.019	-.059	-.082	-.130	-.241	-.374	-.493	
I=11	.010	-.010	-.001	.025	.035	.038	.007	.024	.015	.047	.014	-.127	-.255	-.071	.096	.277	.450	
	.003	.001	.004	-.008	-.015	-.019	-.018	-.013	.001	-.021	-.062	-.118	-.165	-.192	-.259	-.375	-.494	
I=12	.004	-.004	-.014	.014	.024	.039	.009	.009	.043	.139	.113	-.049	-.163	.048	.267	.542	.910	
	.001	-.006	-.003	.008	.014	.004	-.020	-.026	-.034	-.044	-.080	-.126	-.165	-.196	-.236	-.322	-.410	
I=13	.006	-.006	-.002	.019	.024	.046	.026	.034	.100	.237	.248	.051	-.044	.192	.459	.799	1.308	
	.001	-.004	-.007	.011	.024	.011	-.014	-.019	-.002	-.004	-.041	-.086	-.129	-.182	-.227	-.290	-.341	
I=14	.006	-.006	-.010	-.000	.015	.047	.051	.065	.155	.306	.365	.200	.104	.331	.600	.989	1.573	
	.002	.002	-.002	-.002	.001	-.005	-.011	-.015	-.015	-.026	-.030	-.055	-.079	-.121	-.192	-.251	-.289	
I=15	.010	-.010	-.035	-.021	-.010	.042	.078	.106	.181	.365	.470	.343	.283	.440	.668	1.133	1.761	
	.002	.001	-.002	-.000	-.016	-.022	-.022	-.031	-.056	-.066	-.065	-.061	-.055	-.081	-.128	-.175	-.194	
I=16	.013	-.013	-.040	-.023	-.033	.030	.099	.130	.221	.405	.540	.467	.408	.511	.702	1.206	1.877	
	.007	.003	.001	-.012	-.023	-.019	-.028	-.046	-.062	-.063	-.056	-.047	-.025	-.031	-.067	-.122	-.160	

I=15	.010	-.010	-.035	-.021	-.010	.042	.078	.106	.181	.365	.470	.343	.283	.440	.668	1.133	1.761
	.002	.001	-.002	-.000	-.016	-.022	-.022	-.031	-.056	-.066	-.065	-.061	-.055	-.081	-.128	-.175	-.194
I=16	.013	-.013	-.040	-.023	-.033	.030	.099	.130	.221	.405	.540	.467	.408	.511	.702	1.206	1.877
	.007	.003	.001	-.012	-.023	-.019	-.028	-.046	-.062	-.063	-.056	-.047	-.025	-.031	-.067	-.122	-.160
I=17	.016	-.016	-.028	.000	-.032	.016	.089	.160	.238	.447	.578	.521	.481	.551	.696	1.218	1.884
	.000	.003	.001	-.005	-.029	-.037	-.027	-.021	-.031	-.030	-.019	.003	.009	.001	-.035	-.072	-.125
I=18	.008	-.008	-.019	.017	-.032	-.018	.057	.125	.210	.421	.563	.538	.520	.535	.666	1.154	1.780
	-.000	.005	-.002	-.003	-.018	-.005	.015	.015	.017	.037	.047	.056	.055	.052	.039	.006	-.019
I=19	.009	-.009	-.008	.024	-.036	-.036	.008	.082	.159	.348	.498	.516	.509	.498	.613	1.048	1.592
	.018	.004	-.003	-.018	-.015	.014	.034	.033	.041	.066	.100	.114	.129	.133	.120	.114	.097
I=20	.011	-.011	-.018	.009	-.043	-.071	-.036	.032	.111	.270	.398	.401	.432	.424	.531	.880	1.338
	.010	.009	-.005	-.014	-.014	.003	.025	.040	.051	.074	.087	.114	.135	.153	.123	.122	.130
I=21	.014	-.014	-.049	-.041	-.065	-.105	-.089	.001	.061	.180	.264	.277	.314	.293	.392	.684	1.032
	.003	.007	-.000	-.015	-.012	-.003	.027	.046	.059	.041	.042	.047	.071	.103	.090	.089	.126
I=22	.018	-.018	-.087	-.111	-.124	-.123	-.121	-.087	.003	.089	.139	.148	.177	.137	.235	.447	.675
	.014	.009	-.011	-.013	-.026	-.008	.009	.017	.009	.028	.029	.027	.041	.054	.048	.072	.100
I=23	.022	-.022	-.108	-.154	-.151	-.139	-.154	-.121	.075	.023	.020	-.017	.028	.007	.067	.179	.291
	.008	.003	.003	-.014	-.027	-.016	.010	.014	.005	.013	.021	.014	.011	.020	.044	.056	.058
I=24	.031	-.031	-.111	-.154	-.161	-.156	-.167	-.138	-.082	-.021	-.090	.152	.123	.102	.063	.104	.090
	.002	.008	-.003	-.007	-.016	-.005	.000	.011	.018	.035	.022	-.011	-.020	.015	.022	.001	-.006
I=25	.036	-.036	-.072	-.106	-.134	-.148	-.162	-.125	.073	.049	.164	.242	.228	.210	.174	.295	.416
	.008	.012	-.010	-.010	.002	.005	.007	.013	.016	.008	-.001	-.015	-.023	.013	.007	-.049	-.095
I=26	.034	-.034	-.057	-.081	-.121	-.151	-.152	-.119	.085	.088	.235	.351	.356	.331	.306	.456	.635
	.007	-.000	.001	-.008	.003	.014	-.001	.010	-.000	-.013	-.032	.037	.035	.031	.054	.092	.134
I=27	.049	-.049	-.046	-.046	-.089	-.135	-.120	.093	.078	.133	.287	.392	.438	.468	.433	.555	.816
	.012	-.000	-.010	-.002	-.005	-.008	.034	.031	.029	-.021	-.051	-.071	.068	.070	.095	.136	.155
I=28	.044	-.044	-.031	-.033	-.069	-.118	.097	.101	.081	.153	.309	.427	.487	.579	.542	.637	.967
	.016	-.004	-.002	-.009	-.022	-.020	.017	.021	.025	-.035	.063	.088	.118	.146	.198	.238	.247
I=29	.039	-.039	-.030	-.031	-.063	-.112	.105	.119	.072	.143	.326	.452	.522	.626	.622	.745	1.121
	.001	.014	.001	-.017	-.028	.002	.001	.001	.016	-.027	-.040	.065	.120	.193	.290	.410	.480
I=30	.036	-.036	-.009	-.027	-.046	-.096	.078	.116	.059	.111	.290	.478	.511	.610	.652	.854	1.215
	.009	.006	-.003	-.011	-.011	.001	.009	.020	.039	-.031	.045	.067	.130	.199	.292	.473	.742
I=31	.033	-.033	.008	-.013	-.019	-.045	.036	.095	.055	.083	.262	.444	.496	.574	.661	.923	1.234
	.008	-.000	-.002	-.006	-.007	.002	.007	.021	.046	-.035	.036	.095	.160	.223	.385	.671	.982
I=32	.025	-.025	.038	.009	-.003	-.026	.007	.047	.037	.084	.205	.416	.451	.564	.644	.924	1.219
	.000	-.006	-.000	.006	.002	-.001	.007	.001	.015	-.008	-.017	.064	.160	.284	.495	.809	1.170

DEFRRX(I,J) (1/SEC) AXIAL COMPONENT, DEF. RATE
 DEFRRR(I,J) (1/SEC) RADIAL COMPONENT, DEF. RATE

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I= 3		-.003	-.001	.001	.040	.053	.017	.019	-.002	-.015	-.008	.066	.085	.001	-.172	-.197	-.048	.044
		-.001	.001	.001	.002	-.002	-.009	-.005	.002	-.002	-.011	-.005	.047	.159	.278	.377	.369	.297
I= 4		-.017	.001	.003	.036	.045	.017	.009	-.019	-.023	-.010	.035	.038	-.029	-.219	-.276	-.189	-.087
		.003	.003	-.000	-.000	-.003	-.008	-.010	-.009	-.001	.008	.012	.056	.133	.256	.401	.461	.415
I= 5		-.020	.002	.002	.034	.043	.019	.003	-.040	-.034	-.001	.027	-.020	-.073	-.224	-.319	-.364	-.309
		-.003	.001	.004	.007	.007	.011	.005	.006	.008	.021	.029	.058	.118	.241	.347	.461	.542
I= 6		-.020	.003	.031	.038	.038	.015	-.005	-.050	-.045	-.004	.013	-.053	-.088	-.203	-.324	-.504	-.534
		-.003	-.000	.005	.011	.011	.010	.011	.015	.005	.003	.028	.067	.117	.207	.306	.424	.536
I= 7		-.024	-.008	.030	.040	.040	.017	-.006	-.060	-.056	-.003	.005	-.082	-.091	-.137	-.256	-.489	-.569
		-.004	.002	.006	.008	.008	.009	.006	.005	.010	.023	.038	.082	.132	.184	.253	.334	.389
I= 8		-.018	-.007	.021	.039	.039	.019	-.015	-.071	-.057	.006	-.001	-.106	-.087	-.039	-.130	-.343	-.402
		-.002	.003	.004	.062	.062	.006	.009	.011	.021	.036	.048	.062	.080	.137	.190	.217	.250
I= 9		-.004	.001	.012	.026	.026	.005	-.012	-.042	-.048	-.008	-.015	-.112	-.067	.049	-.011	-.173	-.199
		-.001	.001	.002	.001	.001	-.001	.000	-.002	.002	.003	.023	.033	.037	.059	.092	.118	.136
I=10		-.002	.011	.009	.002	.002	-.006	-.002	-.017	-.022	-.015	-.044	-.099	-.026	.095	.069	-.017	-.025
		.002	-.004	-.003	.003	.003	.003	.001	-.005	-.004	.005	.013	.028	.039	.024	.018	.029	.029
I=11		-.002	.011	.011	.035	.035	-.011	-.007	.001	.006	-.004	-.052	-.089	.005	.120	.114	.116	.106
		.007	-.001	-.011	-.010	-.010	-.005	.003	.008	.014	.019	.015	.012	.014	.004	-.027	-.054	-.075
I=12		-.006	.004	.012	.008	-.008	-.007	-.011	.013	.040	.017	-.054	-.088	.019	.147	.156	.212	.180
		.002	.003	-.006	-.012	-.012	-.010	-.004	-.000	.001	-.007	-.014	-.024	-.031	-.027	-.041	-.070	-.104
I=13		-.002	.008	.008	.008	.008	-.001	-.006	.028	.064	.042	-.049	-.089	.033	.170	.188	.274	.248
		-.003	-.001	.004	.006	.006	.003	-.005	-.007	-.010	-.012	-.025	-.038	-.048	-.050	-.046	-.068	-.096
I=14		-.005	.001	.009	.015	.015	.011	.006	.039	.077	.064	-.023	-.080	.030	.165	.198	.309	.284
		-.002	-.003	.005	.014	.014	.010	-.001	-.002	.012	.013	-.003	-.024	-.043	-.060	-.068	-.086	-.103
I=15		-.015	-.006	.008	.019	.022	.029	.022	.036	.080	.090	.005	-.055	.022	.127	.202	.341	.313
		.000	-.001	.001	.004	.004	.001	-.001	.001	.003	-.002	-.005	-.018	-.034	-.053	-.080	-.099	-.110
I=16		-.018	-.006	.001	.014	.045	.035	.043	.086	.086	.101	.030	-.040	.007	.097	.199	.365	.368
		.000	-.002	-.000	-.010	-.014	-.013	-.019	-.034	-.034	-.040	-.039	-.038	-.035	-.050	-.075	-.098	-.104
I=17		-.014	.003	-.005	.001	.042	.049	.049	.088	.088	.106	.032	-.030	.004	.071	.189	.369	.410
		.032	.005	.320	-.757	-.151	-.074	-.109	-.132	-.132	-.081	-.049	-.023	.008	-.006	-.062	-.143	-.192
I=18		-.009	.006	-.009	-.016	.034	.049	.052	.092	.092	.111	.045	-.013	-.003	.051	.177	.348	.381
		-.002	.002	.012	.010	-.009	-.022	-.023	-.028	-.028	-.047	-.074	-.090	-.106	-.112	-.098	-.039	-.061
I=19		-.005	.009	-.014	-.023	.017	.039	.051	.083	.083	.109	.061	.002	-.006	.039	.161	.306	.313
		-.003	.002	.006	.004	-.002	-.010	-.018	-.023	-.023	-.032	-.038	-.052	-.064	-.075	-.063	-.068	-.076
I=20		-.009	.005	-.012	-.028	.006	.033	.050	.076	.076	.094	.049	.012	.009	.036	.136	.256	.245
		-.002	-.001	.003	.002	.004	-.005	-.013	-.018	-.018	-.004	.003	.004	-.005	-.020	-.017	-.018	-.040
I=21		-.022	-.011	-.007	-.021	-.005	.033	.049	.057	.057	.066	.036	.017	.008	.030	.120	.205	.145
		-.002	.003	.002	.007	.004	.004	.003	.003	.009	.007	.010	.017	.016	.014	.009	-.002	-.012

I=22	-.037	-.034	-.012	-.005	.001	.011	.046	.061	.044	.022	.014	.000	-.026	.098	-.143	.060
I=23	.001	-.001	.002	.008	.006	.003	.007	.014	.006	.003	.008	.012	.018	.006	-.000	.008
I=24	-.046	-.047	-.012	.005	-.002	.004	.028	.046	.028	.012	.008	.012	.017	.057	.074	.000
I=25	-.001	-.002	-.001	-.001	-.000	.002	.000	-.004	-.006	-.001	.012	.019	.009	.004	.018	.028

I=22	-.037	-.034	-.012	-.005	-.001	.011	.046	.061	.044	.022	.014	.000	.026	.098	.143	.060
	.001	-.001	.002	.008	.006	.003	.007	.014	.006	.003	.006	.014	.018	.006	-.000	.008
I=23	-.046	-.047	-.012	-.005	-.002	.004	.028	.046	.028	-.012	.008	.012	.017	.057	.074	.000
	-.001	-.002	-.001	-.001	-.000	.002	.000	-.004	-.006	-.001	.012	.019	.009	.004	.018	.028
I=24	-.049	-.044	-.016	-.002	-.003	.004	.031	.040	-.009	-.045	-.006	.018	.021	.003	-.007	-.035
	-.004	.005	-.000	-.009	-.006	.006	-.001	-.004	.001	.006	.010	.012	.010	.015	.034	.051
I=25	-.035	-.025	-.021	-.015	-.010	.005	.032	.028	-.039	-.069	-.017	.011	.020	-.022	-.084	-.085
	.002	-.001	.001	-.006	-.007	.000	.007	.005	.015	.019	.010	.007	.016	.026	.034	.048
I=26	-.029	-.016	-.023	-.025	-.009	.010	.024	.013	-.060	-.093	-.036	.005	.017	-.036	-.117	-.153
	.004	.001	-.002	.002	.004	.010	.015	.015	.010	.018	.022	.018	.022	.032	.035	.029
I=27	-.027	.001	-.017	-.031	-.007	.014	.014	-.010	-.078	-.094	-.051	-.029	.006	-.023	-.145	-.250
	.001	.001	.001	.009	.012	.006	.005	.009	.009	.013	.021	.032	.043	.055	.057	.049
I=28	-.020	.005	-.015	-.029	-.006	.007	.007	-.013	-.083	-.098	-.062	-.054	-.012	-.014	-.166	-.336
	.005	-.004	.006	.009	-.003	-.010	-.010	-.003	.003	-.001	.002	.023	.049	.077	.107	.125
I=29	-.019	.003	-.013	-.027	-.012	-.001	.015	-.002	-.093	-.111	-.069	-.062	-.030	-.038	-.197	-.376
	-.003	.000	.001	-.003	-.006	-.002	.001	.006	.001	-.003	-.003	.011	.028	.046	.099	.194
I=30	-.010	.006	-.013	-.022	-.008	-.004	.012	.008	-.085	-.128	-.072	-.045	-.049	-.083	-.220	-.355
	.004	.001	-.003	-.006	-.000	.003	.008	.012	.004	.001	.014	.021	.021	.049	.114	.203
I=31	-.003	.010	-.008	-.010	-.004	-.014	-.001	.008	-.078	-.126	-.077	-.046	-.061	-.122	-.221	-.300
	.004	-.001	-.005	-.004	.000	-.005	-.006	-.007	-.007	-.008	.002	.017	.041	.088	.142	.183

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I=3	DEFRN(I,J)	(1/SEC)	NORMAL COMPONENT, DEF. RATE	DEFRN(I,J)	(1/SEC)	SHEAR COMPONENT, DEF. RATE	DEFRN(I,J)	(1/SEC)	ROOT-MEAN-SQUARED VALUE, DEF. RATE	DEFRN(I,J)	(1/SEC)	ROOT-MEAN-SQUARED VALUE, DEF. RATE	DEFRN(I,J)	(1/SEC)	ROOT-MEAN-SQUARED VALUE, DEF. RATE	DEFRN(I,J)	(1/SEC)	ROOT-MEAN-SQUARED VALUE, DEF. RATE
I=4	.002	.001	.021	.027	.013	.012	.002	.009	.010	.035	.066	.080	.225	.287	.209	.170		
I=5	.012	.020	.027	.036	.017	.033	.035	.077	.105	.161	.328	.493	.646	.702	.611	.545		
I=6	.010	.002	.016	.024	.009	.009	.014	.012	.009	.024	.047	.081	.238	.339	.325	.251		
I=7	.013	.022	.013	.023	.009	.006	.043	.081	.096	.123	.260	.393	.494	.560	.648	.697		
I=8	.017	.022	.022	.034	.015	.011	.046	.082	.097	.125	.264	.401	.548	.654	.725	.741		
I=9	.012	.001	.019	.025	.015	.004	.023	.021	.011	.028	.039	.096	.232	.333	.412	.425		
I=10	.005	.009	.010	.013	.010	.013	.027	.051	.091	.110	.185	.293	.381	.523	.666	.790		
I=11	.013	.009	.022	.028	.018	.013	.035	.055	.092	.113	.189	.309	.446	.512	.666	.790		
I=12	.011	.001	.018	.024	.012	.008	.032	.025	.003	.021	.060	.103	.205	.315	.464	.535		
I=13	.003	.008	.012	.012	.010	.010	.032	.053	.081	.096	.160	.204	.226	.193	.213	.308		
I=14	.012	.008	.021	.027	.016	.013	.045	.059	.081	.098	.171	.228	.306	.369	.511	.617		
I=15	.014	.005	.018	.024	.013	.006	.032	.033	.013	.022	.082	.112	.160	.255	.412	.479		
I=16	.000	.000	.010	.013	.012	.006	.035	.055	.056	.043	.082	.126	.121	.006	.065	.095		
I=17	.014	.005	.020	.027	.018	.009	.048	.064	.058	.048	.116	.169	.201	.255	.417	.488		
I=18	.010	.005	.013	.020	.013	.012	.041	.039	.021	.024	.084	.083	.088	.160	.280	.326		
I=19	.005	.023	.010	.002	.006	.015	.016	.005	.017	.012	.024	.040	.009	.118	.227	.345		
I=20	.011	.023	.016	.020	.014	.019	.044	.039	.027	.027	.087	.092	.088	.198	.361	.474		
I=21	.003	.001	.007	.014	.003	.006	.022	.025	.005	.019	.073	.052	.054	.051	.145	.168		
I=22	.010	.020	.017	.002	.015	.018	.002	.023	.032	.017	.032	.061	.106	.170	.287	.454		
I=23	.006	.014	.001	.001	.015	.019	.012	.021	.060	.067	.069	.078	.147	.195	.293	.453		
I=24	.007	.016	.014	.003	.016	.019	.016	.025	.061	.067	.069	.078	.147	.195	.293	.453		
I=25	.005	.006	.011	.007	.008	.005	.005	.010	.012	.033	.051	.010	.062	.070	.085	.090		
I=26	.001	.002	.001	.002	.002	.002	.002	.022	.075	.088	.071	.085	.113	.165	.253	.400		
I=27	.005	.006	.011	.007	.008	.007	.007	.024	.076	.094	.087	.086	.129	.180	.267	.410		
I=28	.004	.004	.009	.010	.009	.007	.007	.020	.012	.034	.056	.025	.087	.099	.141	.142		
I=29	.002	.005	.007	.003	.015	.017	.008	.034	.078	.104	.087	.094	.112	.158	.228	.331		
I=30	.004	.006	.011	.010	.010	.017	.019	.040	.079	.109	.103	.057	.142	.186	.268	.360		
I=31	.002	.004	.006	.007	.002	.005	.017	.037	.027	.037	.064	.041	.110	.118	.171	.172		
I=32	.002	.003	.015	.005	.016	.025	.025	.031	.069	.109	.111	.121	.127	.168	.252	.309		
I=33	.003	.005	.016	.008	.016	.026	.022	.048	.075	.116	.128	.127	.168	.187	.252	.309		
I=34	.004	.002	.007	.015	.010	.003	.020	.044	.038	.013	.052	.037	.112	.133	.197	.194		
I=35	.000	.010	.015	.011	.003	.020	.025	.030	.046	.081	.111	.127	.119	.110	.140	.176		
I=36	.004	.010	.016	.018	.011	.021	.032	.053	.060	.082	.122	.133	.164	.173	.242	.262		
I=37	.008	.003	.005	.012	.015	.011	.018	.042	.046	.005	.037	.028	.090	.141	.220	.211		
I=38	.001	.009	.002	.008	.004	.018	.034	.035	.035	.057	.086	.106	.084	.063	.092	.114		
I=39	.008	.010	.005	.014	.015	.021	.038	.054	.058	.057	.093	.109	.123	.155	.238	.240		
I=40	.009	.004	.001	.012	.029	.024	.031	.060	.070	.035	.039	.021	.074	.137	.232	.236		
I=41	.000	.007	.015	.004	.006	.012	.029	.026	.025	.032	.051	.061	.052	.036	.057	.062		
I=42	.009	.003	.015	.013	.030	.027	.043	.065	.075	.047	.064	.065	.090	.142	.239	.244		
I=43	.005	.004	.011	.013	.022	.022	.036	.037	.060	.079	.060	.052	.054	.082	.138	.218		
I=44	.023	.004	.162	.359	.097	.061	.079	.110	.093	.041	.026	.006	.039	.126	.256	.301		
I=45	.001	.010	.025	.012	.018	.019	.008	.000	.001	.002	.016	.038	.023	.005	.010	.011		
I=46	.023	.011	.164	.399	.098	.064	.079	.110	.093	.002	.031	.039	.045	.126	.256	.301		
I=47	.005	.004	.011	.013	.022	.022	.036	.037	.060	.079	.060	.052	.054	.082	.138	.218		

I=17	.023	.004	.162	.359	.097	.061	.079	.110	.093	.041	.026	.006	.039	.126	.256	.301
	-.001	-.010	-.025	-.012	.018	.019	-.001	.000	-.001	.002	-.016	-.038	-.023	-.009	-.010	.011
	.023	.011	.164	.359	.098	.064	.079	.110	.093	.041	.031	.039	.045	.126	.256	.301
I=18	.005	.004	.011	.013	.022	.036	.037	.060	.079	.060	.032	.054	.082	.138	.218	.221
	-.003	-.010	-.014	-.001	.029	.035	.026	.032	.042	.032	.003	-.011	.013	.015	.041	.098
	.007	.011	.018	.013	.036	.050	.046	.068	.089	.068	.052	.055	.083	.138	.222	.242
I=19	.004	.006	.010	.014	.010	.024	.034	.053	.071	.050	.027	.035	.057	.112	.187	.195
	-.006	-.007	-.000	.013	.034	.039	.034	.043	.070	.071	.035	.036	.034	.040	.087	.155
	.007	.009	.010	.019	.035	.046	.048	.068	.099	.087	.062	.050	.067	.119	.206	.249
I=20	.006	.003	.008	.015	.005	.019	.032	.047	.049	.026	.008	.007	.028	.077	.137	.143
	-.004	.006	.019	.014	.036	.046	.036	.044	.069	.092	.097	.079	.063	.063	.125	.200
	.007	.006	.020	.021	.037	.050	.048	.064	.085	.096	.097	.079	.069	.099	.185	.245
I=21	.012	.007	.005	.014	.005	.018	.026	.033	.037	.023	.017	.012	.022	.065	.103	.079
	-.001	.016	.037	.031	.032	.046	.051	.037	.057	.090	.096	.104	.101	.094	.157	.237
	.012	.018	.037	.034	.033	.050	.057	.049	.067	.092	.098	.105	.103	.114	.188	.250
I=22	.019	.018	.007	.006	.003	.007	.026	.037	.025	.012	.010	.007	.022	.052	.072	.034
	-.007	.011	.032	.029	.024	.030	.040	.048	.058	.081	.102	.103	.096	.111	.181	.250
	.020	.021	.033	.030	.024	.031	.048	.060	.063	.081	.102	.103	.098	.122	.195	.252
I=23	.023	.024	.006	.003	.001	.003	.014	.025	.017	.006	.010	.015	.013	.030	.046	.014
	.003	.002	.004	.010	.025	.027	.014	.026	.041	.076	.094	.099	.088	.108	.180	.240
	.023	.024	.007	.011	.025	.027	.020	.036	.045	.076	.095	.100	.089	.112	.186	.240
I=24	.026	.024	.008	.005	.005	.005	.016	.022	.005	.026	.008	.015	.016	.009	.020	.043
	.002	-.017	-.020	-.006	.008	.008	.007	.007	.024	.046	.060	.090	.084	.075	.144	.219
	.026	.030	.022	.008	.009	.009	.018	.023	.024	.053	.061	.092	.085	.075	.146	.223
I=25	.019	.013	.011	.010	.008	.003	.019	.017	.027	.044	.014	.009	.018	.024	.059	.066
	-.007	-.027	-.019	-.008	-.006	-.004	.001	-.000	.016	.040	.058	.076	.081	.069	.084	.149
	.020	.030	.022	.013	.010	.005	.019	.017	.031	.059	.059	.076	.083	.073	.103	.163
I=26	.016	.008	.013	.014	.007	.010	.019	.014	.035	.056	.029	.012	.020	.034	.076	.091
	.003	-.011	-.018	-.007	-.007	-.023	-.010	.002	.016	.031	.048	.070	.074	.061	.054	.099
	.016	.014	.022	.015	.010	.025	.022	.014	.038	.064	.056	.071	.077	.070	.094	.134
I=27	.014	.001	.009	.020	.009	.010	.009	.010	.043	.053	.036	.030	.025	.039	.101	.149
	-.004	-.010	-.015	-.019	-.023	-.028	-.004	.002	.011	.005	.020	.043	.068	.051	.036	.090
	.015	.010	.017	.028	.024	.030	.010	.010	.045	.054	.041	.052	.072	.064	.108	.174
I=28	.013	.004	.010	.019	.005	.009	.008	.008	.043	.050	.032	.038	.030	.046	.137	.230
	-.008	-.006	-.012	.013	.005	-.004	.006	-.006	-.011	-.006	-.000	.007	.021	.027	.046	.093
	.015	.008	.016	.023	.007	.010	.010	.010	.045	.050	.032	.039	.037	.053	.144	.248
I=29	.011	.002	.007	.015	.009	.002	.008	.004	.047	.057	.036	.036	.029	.042	.148	.285
	-.004	-.017	-.012	-.003	.001	-.007	-.002	-.017	-.022	-.019	-.014	-.037	-.054	-.043	.005	.026
	.012	.017	.014	.015	.009	.007	.008	.018	.052	.060	.038	.052	.061	.061	.148	.286
I=30	.007	.003	.008	.014	.004	.003	.010	.010	.045	.064	.043	.033	.035	.066	.167	.279
	-.007	.019	.008	.012	.022	.029	.019	.011	.023	.034	-.037	.057	.079	.086	.116	.159
	.010	.019	.011	.018	.023	.030	.021	.015	.050	.072	.057	.066	.086	.109	.203	.321
I=31	.003	.005	.007	.007	.002	.010	.003	.007	.042	.067	.040	.032	.051	.105	.182	.241
	-.007	.017	.013	.012	.024	.035	-.037	.014	.006	-.046	.066	.068	.103	.164	.206	.258
	.008	.018	.015	.014	.024	.037	.037	.016	.043	.081	.077	.075	.115	.195	.275	.354

VELUD(I) (CM/SEC) APPROACH FLOW VELOCITY
 VELVO(I) (CM/SEC) BUBBLE RISE RATE
 DEFRSO(I) (1/SEC) FLUME SHEAR RATE

STREAMLINE NO. 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
 8.138 8.047 7.963 7.882 7.801 7.727 7.656 7.589 7.534 7.501 7.472 7.463 7.467 7.482 7.484 7.473 7.441
 .274 .285 .308 .293 .317 .344 .333 .315 .286 .273 .277 .279 .280 .285 .279 .277
 .000 .059 .056 .054 .052 .048 .046 .041 .029 .021 .013 .001 .006 .006 .003 .014 .020

STREAMLINE NO.

19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
 7.413 7.380 7.339 7.305 7.276 7.239 7.210 7.207 7.208 7.211 7.205 7.187 7.172 7.179 7.187 7.189 7.201
 .284 .271 .267 .271 .244 .253 .273 .236 .213 .217 .216 .221 .233 .245 .251 .229 .206
 .021 .025 .025 .021 .022 .022 .010 .001 .001 .001 .008 .011 .003 .005 .003 .005 .000

VELUR(I,J) (CM/SEC) RELATIVE VELOCITY COMPONENTS

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I= 2	-.039	-.039	-.039	-.121	.148	.101	.174	.143	.183	.008	.006	-.096	.175	.244	.415	.478	1.293	2.482
	-.005	-.006	-.007	-.007	.018	.130	.255	.337	.431	.591	.777	.961	1.347	1.834	2.339	2.641	2.868	2.830
I= 3	-.032	-.032	-.032	.095	.144	.114	.179	.114	.149	-.073	-.140	-.222	.081	.129	.265	.131	.876	2.115
	-.026	-.015	-.002	.039	.104	.104	.204	.300	.430	.586	.771	.979	1.368	1.790	2.244	2.549	2.943	3.089
I= 4	-.032	-.032	-.032	.088	.138	.111	.169	.082	.105	-.154	-.204	-.276	.007	.031	.088	.187	.311	1.295
	-.024	-.033	-.009	.048	.116	.116	.186	.275	.405	.567	.774	1.039	1.383	1.709	2.087	2.386	2.898	3.175
I= 5	-.037	-.037	-.037	.093	.137	.065	.107	.040	.061	-.208	-.254	-.322	-.094	-.094	-.070	-.470	-.612	-.479
	-.030	-.016	.009	.037	.079	.079	.151	.230	.367	.536	.739	.951	1.246	1.543	1.911	2.186	2.575	2.878
I= 6	-.019	.019	.066	.066	.088	.013	.064	.016	.051	-.229	-.301	-.365	-.197	-.232	-.217	-.696	-1.310	-1.353
	-.012	-.011	.006	.017	.072	.072	.144	.204	.332	.497	.668	.829	1.058	1.331	1.669	1.890	2.084	2.315
I= 7	-.002	.002	.024	.024	.025	-.033	.043	.022	.037	-.237	-.302	-.390	-.274	-.365	-.406	-.833	-1.466	-2.293
	-.010	-.010	-.002	.023	.023	.081	.156	.213	.285	.392	.549	.684	.844	1.009	1.228	1.351	1.473	1.526
I= 8	-.003	-.003	.021	.006	.007	-.029	.004	-.029	-.019	-.234	-.287	-.359	-.325	-.475	-.534	-.845	-1.292	-2.015
	-.030	-.001	.006	.025	.025	.064	.133	.187	.251	.316	.399	.473	.554	.627	.741	.894	.978	.973
I= 9	-.003	.003	.030	.007	.012	-.029	-.018	-.084	-.061	-.200	-.246	-.332	-.374	-.532	-.574	-.793	-1.093	-1.635
	-.024	-.003	.007	.034	.034	.086	.106	.144	.219	.260	.278	.285	.310	.340	.421	.493	.581	.600
I=10	-.010	-.010	.001	-.014	-.014	-.018	-.012	-.080	-.081	-.186	-.236	-.344	-.403	-.530	-.533	-.741	-.960	-1.337
	-.027	-.008	.006	.030	.030	.060	.086	.120	.166	.167	.187	.193	.202	.209	.243	.273	.294	.335
I=11	.007	-.007	-.037	.006	.022	.031	.027	-.031	.067	.087	.114	.138	.158	.155	.148	.143	.158	.177
	-.024	-.003	.006	.022	.031	.031	.027	-.031	.067	.087	.114	.138	.158	.155	.148	.143	.158	.177
I=12	.015	-.015	-.030	.004	.006	-.003	.031	-.032	-.033	-.187	-.334	-.490	-.457	-.479	-.515	-.654	-.700	-.818
	-.011	.002	.004	.006	.022	.031	.027	-.031	.067	.087	.114	.138	.158	.155	.148	.143	.158	.177
I=13	.007	-.007	-.041	.006	.006	-.005	.033	-.002	.013	-.171	-.400	-.577	-.516	-.463	-.458	-.571	-.586	-.556
	-.003	.008	.005	.010	.028	-.028	-.037	-.034	-.031	-.059	-.078	-.076	-.051	-.031	-.028	-.019	-.008	-.002
I=14	-.003	.003	.009	.002	.018	.015	.031	-.010	.060	-.124	-.403	-.632	-.550	-.451	-.387	-.448	-.434	-.360
	-.006	.003	.002	.001	-.011	-.011	-.029	-.038	-.051	-.069	-.080	-.079	-.073	-.085	-.092	-.084	-.081	-.095

I=20	.040	.019	-.030	-.023	.022	.040	.001	-.043	-.040	-.030	-.048	-.058	.019	-.050	.154	.180
	.009	-.003	-.007	-.007	.010	.013	.015	.012	.012	.013	.013	.016	.032	.039	.036	.034
I=21	.031	.013	-.025	-.008	.032	.032	-.008	-.042	-.053	-.032	-.043	-.079	-.021	.077	.148	.138
	-.005	.004	.011	.018	.017	.010	.012	.009	.013	.008	.009	.022	.036	.035	.032	.032
I=22	.025	.010	-.024	-.006	.013	.007	-.006	-.021	-.053	-.054	-.058	-.083	-.052	.019	.124	.128
	-.010	.012	.021	.016	.005	.008	.006	.009	.018	.020	.024	.039	.048	.050	.047	.058
I=23	.024	.005	-.017	-.016	-.023	-.015	.011	-.001	-.056	-.065	-.062	-.065	-.088	-.033	.056	.046
	-.010	.007	.023	.025	.026	.030	.027	.029	.036	.048	.055	.053	.001	.067	.076	.092
I=24	.018	.001	-.011	-.017	-.041	-.021	.027	.004	-.074	-.073	-.051	-.071	-.089	-.064	-.036	-.038
	-.010	-.005	.009	.040	.054	.048	.054	.063	.064	.066	.062	.058	.059	.070	.092	.105
I=25	.012	-.002	-.012	-.019	-.045	-.033	.031	.024	-.083	-.099	-.031	-.032	-.095	-.092	-.093	-.102
	.005	-.010	-.006	.020	.038	.046	.049	.055	.051	.043	.042	.044	.045	.063	.078	.080
I=26	.001	-.008	-.016	-.021	-.040	-.044	.022	.039	-.064	-.105	-.055	-.025	-.076	-.117	.132	-.099
	.003	-.002	-.001	.008	.015	.025	.023	.026	.030	.042	.052	.063	.068	.070	.066	.072
I=27	-.007	-.015	-.015	-.023	-.035	-.033	.018	.041	-.046	-.105	-.077	-.034	-.096	-.157	.143	.102
	-.006	.006	.013	.008	.007	.012	.016	.035	.061	.088	.102	.116	.125	.107	.097	.101
I=28	-.011	-.019	-.016	-.023	-.022	-.017	.016	.025	-.044	-.085	-.068	-.041	-.138	-.198	.176	.151
	-.010	.015	.020	.016	.031	.045	.054	.072	.105	.118	.128	.140	.150	.142	.128	.113
I=29	-.007	-.021	-.013	-.013	-.008	-.007	.005	.007	-.036	-.051	-.047	-.060	-.198	-.226	.213	.213
	-.003	.010	.011	.016	.039	.075	.102	.106	.117	.136	.146	.145	.147	.163	.174	.170
I=30	.000	-.007	-.006	-.011	.002	.006	-.013	-.014	-.003	-.006	-.050	-.084	-.201	-.250	-.241	.241
	.005	-.008	-.005	-.001	.013	.044	.088	.106	.115	.130	.153	.172	.209	.259	.304	.343
I=31	.009	.012	.004	-.006	.004	-.001	-.020	-.005	.025	.024	-.055	-.098	-.158	-.193	.252	.252
	-.006	.003	.006	.003	.008	.020	.051	.078	.099	.111	.141	.192	.285	.332	.366	.406
I=32	.019	.012	.004	.009	.004	-.011	-.013	.014	.041	.033	-.054	-.093	-.114	-.135	.161	.175
	-.007	.016	.016	.012	.016	.029	.040	.055	.074	.104	.134	.171	.227	.278	.307	.320
I=33	.030	.011	-.003	.017	.013	.009	-.002	.034	.043	.029	-.044	-.081	-.082	-.078	-.075	.122
	-.000	-.000	-.000	.004	.006	.021	.028	.032	.046	.074	.098	.106	.114	.138	.202	.255
I=34	.040	.022	-.003	.007	.011	.000	.014	.053	.056	.036	-.045	-.068	-.051	-.012	.022	-.080
	-.001	-.006	.000	.012	.021	.030	.032	.037	.048	.060	.059	.052	.042	.034	.075	.142

[illegible]

I=17	.028	.013	.022	.024	.005	.023	.014	.050	.075	.057	.033	.023	.074	.097	.077	.078
	-.002	-.014	-.015	-.019	-.032	-.027	-.023	-.041	-.074	-.101	-.089	-.068	-.079	-.081	-.076	-.136
	.028	.019	.027	.030	.032	.035	.027	.065	.105	.116	.095	.072	.108	.126	.108	.157
I=18	.039	.021	.021	.024	.022	.061	.054	.071	.085	.078	.062	.040	.092	.108	.112	.136
	.004	.000	-.016	-.019	.021	-.027	-.019	-.014	-.052	-.079	-.076	-.071	-.059	-.024	-.004	-.086
	.039	.021	.026	.030	.030	.066	.057	.073	.100	.110	.098	.082	.109	.110	.112	.160
I=19	.028	.019	.022	.024	.008	.034	.029	.044	.057	.066	.063	.053	.075	.106	.160	.203
	.006	.005	.013	.007	-.013	-.025	-.009	-.001	-.023	-.047	-.044	-.026	.010	.082	.026	.000
	.028	.020	.026	.025	.015	.042	.030	.044	.061	.081	.077	.059	.076	.114	.162	.203
I=20	.024	.011	.018	.015	.016	.027	.008	.027	.026	.021	.031	.037	.025	.065	.095	.107
	.018	.020	.030	.013	-.014	-.025	.007	.006	.008	.010	-.001	.011	.049	.070	.051	.082
	.030	.022	.035	.020	.021	.037	.011	.028	.027	.024	.031	.038	.056	.095	.108	.135
I=21	.018	.008	.020	.013	.024	.021	.010	.025	.033	.020	.026	.051	.028	.056	.090	.085
	.015	.018	.021	-.003	-.008	.009	.043	.031	.019	.033	.041	.036	.053	.103	.137	.152
	.023	.020	.029	.013	.026	.023	.044	.040	.039	.039	.048	.062	.060	.117	.164	.174
I=22	.017	.011	.023	.011	.009	.008	.006	.015	.036	.037	.041	.061	.050	.035	.085	.093
	-.005	-.004	-.001	-.010	.022	.044	.064	.037	.027	.039	.050	.037	.054	.106	.163	.193
	.018	.012	.023	.015	.024	.044	.065	.040	.045	.053	.065	.071	.074	.111	.184	.214
I=23	.017	.006	.020	.021	.024	.022	.019	.015	.046	.057	.058	.069	.075	.050	.066	.069
	-.026	-.016	.010	.004	.024	.043	.050	.015	.024	.030	.030	.008	.021	.057	.099	.163
	.031	.017	.022	.021	.034	.048	.054	.021	.052	.066	.066	.070	.078	.076	.119	.177
I=24	.014	.003	.010	.029	.047	.035	.040	.033	.069	.070	.057	.065	.074	.067	.064	.071
	-.023	-.027	-.006	-.001	.015	.023	.035	.005	-.003	.018	.034	-.006	-.020	-.010	.029	.095
	.027	.027	.012	.029	.050	.041	.054	.034	.069	.072	.066	.065	.076	.068	.070	.119
I=25	.008	.006	.009	.019	.042	.040	.040	.039	.067	.071	.036	.038	.065	.077	.085	.091
	-.009	-.020	-.031	-.021	.037	.011	.024	.007	-.004	.009	.031	.005	-.030	.030	.040	.048
	.012	.021	.032	.029	.042	.041	.047	.040	.067	.072	.048	.038	.072	.083	.085	.103
I=26	.002	.005	.008	.014	.027	.035	.023	.033	.047	.073	.054	.044	.072	.054	.099	.085
	.003	.000	-.033	-.031	-.011	-.007	.010	.011	-.002	-.016	.003	.011	-.031	-.018	.024	.040
	.004	.005	.034	.034	.029	.035	.025	.034	.047	.075	.054	.045	.078	.095	.102	.094
I=27	.006	.011	.014	.016	.021	.022	.017	.038	.054	.096	.090	.075	.110	.132	.120	.101
	-.006	-.011	-.033	-.033	-.012	-.016	-.025	-.021	-.024	-.044	-.044	-.037	-.031	.013	.023	.022
	.009	.015	.036	.037	.024	.028	.031	.044	.059	.105	.100	.083	.115	.132	.122	.104
I=28	.011	.017	.018	.020	.027	.031	.035	.048	.075	.102	.098	.091	.144	.170	.152	.132
	-.021	-.028	-.034	-.031	-.033	-.043	.061	-.065	-.052	-.065	-.088	-.069	-.040	.016	-.001	.032
	.024	.033	.038	.037	.043	.053	.071	.081	.091	.121	.131	.127	.150	.171	.152	.136
I=29	.005	.015	.012	.015	.024	.041	.053	.057	.077	.094	.096	.102	.168	.194	.193	.192
	-.048	-.057	-.050	-.062	-.073	.074	.083	.081	-.076	-.093	-.127	-.118	-.064	-.017	.003	.015
	.048	.059	.051	.063	.077	.085	.099	.099	.108	.132	.160	.156	.180	.195	.193	.192
I=30	.003	.007	.005	.006	.008	.025	.050	.060	.059	.068	.101	.128	.205	.255	.272	.292
	-.039	-.053	.066	.082	.117	.123	.095	.079	-.112	-.144	-.139	-.106	-.106	-.128	-.110	.103
	.039	.053	.082	.082	.117	.126	.108	.099	.126	.159	.172	.166	.231	.285	.294	.310
I=31	.008	.008	.005	.005	.006	.011	.036	.042	.062	.068	.098	.145	.212	.262	.309	.329
	-.023	-.043	-.054	-.075	-.123	.128	.112	.110	-.131	-.147	-.169	-.167	-.207	-.259	-.288	-.377
	.024	.044	.054	.075	.123	.129	.118	.118	.145	.161	.195	.221	.296	.368	.423	.501

I=32

.013 .014 .010 .010 .010 .020 .027 .034 .057 .068 .094 .132 .170 .207 .234 .245

I=31

.008	.008	.005	.005	.006	.011	.036	.042	.062	.068	.098	.145	.212	.262	.309	.329
-.023	-.043	-.054	-.075	-.123	-.128	-.112	-.110	-.131	-.147	-.169	-.167	-.207	-.259	-.288	-.377
.024	.044	.054	.075	.123	.129	.118	.118	.145	.161	.195	.221	.296	.368	.423	.501

I=32

.013	.014	.010	.010	.010	.020	.027	.034	.057	.068	.094	.132	.170	.207	.234	.248
-.049	-.060	-.036	-.050	-.116	-.126	-.128	-.133	-.163	-.160	-.192	-.225	-.283	-.366	-.331	-.445
.050	.061	.038	.051	.116	.128	.130	.138	.173	.174	.214	.261	.331	.369	.405	.509

I=33

.015	.006	.002	.011	.011	.015	.015	.033	.044	.052	.071	.094	.098	.108	.138	.188
-.067	-.064	-.042	-.052	-.107	-.124	-.132	-.145	-.186	-.190	-.215	-.249	-.330	-.345	-.398	-.445
.068	.065	.042	.053	.108	.125	.132	.149	.191	.197	.226	.266	.344	.362	.421	.483

I=34

.020	.014	.002	.010	.016	.015	.023	.045	.052	.048	.052	.060	.047	.023	.048	.111
-.042	-.053	-.052	-.066	-.105	-.120	-.122	-.136	-.188	-.201	-.200	-.226	-.339	-.390	-.483	-.456
.046	.055	.052	.067	.106	.121	.124	.143	.195	.207	.206	.234	.342	.391	.485	.470

VELUO(I) (CM/SEC) APPROACH FLOW VELOCITY
 VELVO(I) (CM/SEC) BUBBLE RISE RATE
 DEFERO(I) (1/SEC) FLUME SHEAR RATE

STREAMLINE NO. 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
 8.146 8.140 8.134 8.125 8.119 8.113 8.100 8.107 8.100 8.088 8.098 8.132 8.159 8.164 8.178 8.175 8.165
 -.081 -.066 -.062 -.060 -.059 -.059 -.056 -.061 -.067 -.074 -.069 -.061 -.057 -.074 -.070 -.077 -.098
 -.000 -.004 -.005 -.005 -.004 -.006 -.002 -.000 -.006 -.001 -.015 -.020 -.011 -.006 -.004 -.005 -.002

STREAMLINE NO. 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
 8.171 8.173 8.144 8.110 8.075 8.020 7.976 7.928 7.876 7.832 7.790 7.758 7.739 7.726 7.693 7.664 7.630
 -.118 -.148 -.169 -.187 -.199 -.176 -.156 -.142 -.136 -.149 -.138 -.139 -.126 -.100 -.102 -.112 -.110
 -.003 -.009 -.021 -.023 -.030 -.033 -.031 -.034 -.032 -.029 -.024 -.017 -.011 -.015 -.021 -.021 -.000

VELUR(I,J) (CM/SEC) RELATIVE VELOCITY COMPONENTS

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I= 2	-.033	-.033	-.022	-.035	-.041	-.138	-.104	-.061	-.019	-.017	-.019	-.053	-.089	-.103	-.125	-.065	-.112	-.184
I= 3	-.040	-.040	-.023	-.037	-.035	-.097	-.039	-.010	-.001	-.009	-.046	-.083	-.102	-.137	-.171	-.137	-.220	-.216
I= 4	-.039	-.039	-.020	-.036	-.012	-.023	-.009	-.016	-.047	-.025	-.080	-.115	-.134	-.160	-.218	-.222	-.333	-.124
I= 5	-.042	-.042	-.014	-.029	-.008	-.020	-.064	-.049	-.076	-.041	-.093	-.120	-.159	-.188	-.272	-.331	-.454	-.042
I= 6	-.047	-.047	-.006	-.020	-.024	-.062	-.112	-.078	-.087	-.044	-.077	-.108	-.174	-.222	-.332	-.445	-.593	-.230
I= 7	-.045	-.045	-.001	-.009	-.044	-.100	-.134	-.068	-.079	-.019	-.032	-.031	-.163	-.255	-.367	-.502	-.736	-.460
I= 8	-.037	-.037	-.001	-.008	-.048	-.097	-.131	-.052	-.032	-.003	-.033	-.077	-.076	-.201	-.349	-.514	-.781	-.767
I= 9	-.036	-.036	-.027	-.050	-.065	-.081	-.111	-.023	-.018	-.041	-.085	-.192	-.078	-.056	-.255	-.451	-.688	-.977
I=10	-.034	-.034	-.002	-.036	-.034	-.059	-.071	-.036	-.107	-.145	-.166	-.326	-.313	-.237	-.023	-.177	-.313	-.295
I=11	-.034	-.034	-.037	-.047	-.022	-.007	-.073	-.092	-.198	-.240	-.260	-.467	-.556	-.531	-.310	-.292	-.488	-.488
I=12	-.014	-.014	-.007	-.033	-.019	-.043	-.070	-.028	-.067	-.180	-.268	-.366	-.641	-.771	-.801	-.736	-.890	1.070
I=13	-.014	-.014	-.019	-.031	-.041	-.064	-.130	-.254	-.317	-.365	-.494	-.810	-.983	1.079	1.137	1.557	1.996	1.810
I=14	-.021	-.021	-.032	-.045	-.089	-.112	-.180	-.283	-.358	-.418	-.629	-.986	1.194	1.341	1.517	2.164	3.068	1.946

I=15	-.039	-.039	.071	.082	.140	.202	.277	.335	.369	.475	.757	1.165	1.416	1.584	1.908	2.832	4.140
	-.016	-.002	.009	.010	-.011	-.071	-.128	-.182	-.252	-.364	-.485	-.602	-.720	-.898	-1.165	-1.557	-2.026
I=16	-.048	.048	.095	.106	.174	.243	.333	.372	.390	.516	.858	1.271	1.596	1.837	2.272	3.407	5.096
	-.013	-.010	.002	.020	.007	-.026	-.080	-.113	-.161	-.253	-.369	-.461	-.587	-.802	-1.096	-1.485	-1.936
I=17	-.052	-.052	.127	.159	.208	.273	.379	.444	.444	.562	.932	1.376	1.769	2.105	2.634	3.870	5.859
	-.004	-.011	.003	.012	.018	-.011	-.036	-.058	-.110	-.200	-.289	-.375	-.484	-.655	-.931	-1.264	-1.614
I=18	-.048	.048	.146	.190	.237	.272	.409	.494	.552	.661	1.003	1.412	1.867	2.281	2.952	4.286	6.486
	-.000	-.008	-.003	.012	.002	-.019	-.049	-.078	-.106	-.142	-.186	-.251	-.344	-.478	-.644	-.882	-1.211
I=19	-.043	.043	.142	.179	.222	.272	.424	.513	.626	.738	.990	1.331	1.836	2.360	3.170	4.538	6.737
	.004	.001	-.005	-.000	.008	-.011	-.039	-.063	-.072	-.070	-.085	-.132	-.189	-.248	-.315	-.427	-.562
I=20	-.046	.046	.128	.135	.182	.258	.425	.506	.646	.729	.905	1.155	1.709	2.298	3.182	4.537	6.537
	-.002	-.006	.000	.008	.019	.013	-.004	-.007	-.007	-.004	-.011	-.024	-.021	-.019	-.004	.014	.009
I=21	-.023	.023	.119	.096	.149	.247	.420	.495	.644	.697	.797	.981	1.556	2.166	2.962	4.181	6.075
	-.014	.001	.005	.009	.025	.038	.043	.056	.075	.080	.080	.099	.158	.238	.297	.352	.468
I=22	-.016	.016	.105	.075	.108	.223	.384	.441	.576	.627	.641	.792	1.369	1.971	2.649	3.618	5.377
	.001	.003	-.001	-.002	.026	.066	.089	.121	.142	.152	.169	.231	.337	.417	.511	.629	.846
I=23	-.014	.014	.092	.019	.040	.177	.338	.363	.457	.473	.488	.590	1.136	1.648	2.223	2.933	4.429
	-.002	.006	-.002	-.001	.042	.102	.149	.179	.216	.226	.249	.310	.391	.477	.607	.818	1.132
I=24	-.010	.010	.094	-.002	-.008	.109	.274	.311	.326	.316	.335	.469	.900	1.327	1.779	2.251	3.473
	-.021	-.009	-.003	.033	.103	.180	.202	.238	.279	.324	.366	.431	.505	.594	.734	.942	1.331
I=25	-.011	.011	.064	-.023	-.042	.039	.196	.219	.212	.152	.201	.321	.655	.972	1.339	1.623	2.593
	-.021	-.012	.001	.032	.059	.167	.226	.266	.308	.371	.472	.560	.641	.734	.877	1.072	1.432
I=26	-.004	.004	.032	-.064	-.078	.145	.217	.157	.097	.054	.102	.203	.422	.661	.955	1.140	1.838
	-.014	-.012	-.002	.027	.075	.145	.217	.290	.344	.423	.527	.659	.761	.890	1.049	1.191	1.481
I=27	.003	-.003	.001	-.096	-.117	-.038	.100	.096	.020	-.038	.051	.136	.242	.374	.622	.755	1.214
	-.007	-.009	-.008	.024	.074	.120	.182	.268	.352	.446	.564	.687	.806	.935	1.122	1.287	1.498
I=28	.010	-.010	-.012	-.102	-.141	-.125	.034	.044	-.035	-.102	.016	.100	.085	.121	.307	.417	.644
	-.017	.001	-.002	.017	.067	.115	.172	.241	.338	.446	.550	.635	.733	.864	1.037	1.197	1.406
I=29	.013	-.013	.006	-.067	-.158	-.184	-.006	.015	-.065	-.132	-.011	.052	.002	-.063	.040	.084	.205
	-.015	-.006	.003	.018	.053	.109	.184	.270	.367	.470	.553	.623	.707	.796	.942	1.096	1.262
I=30	.020	-.020	.018	-.050	-.147	-.215	-.038	-.008	-.069	-.166	-.046	.029	-.051	-.182	-.178	-.168	-.125
	-.017	.002	.007	.008	.021	.067	.148	.232	.313	.399	.509	.596	.672	.776	.909	1.013	1.153
I=31	.019	-.019	.037	-.067	-.162	-.259	-.096	-.048	-.061	-.163	-.080	-.040	-.116	-.255	-.324	-.364	-.356
	-.012	-.004	-.001	.017	.036	.074	.129	.187	.253	.331	.437	.532	.628	.734	.848	.953	1.059
I=32	.014	-.014	.049	-.085	-.176	-.304	-.126	-.087	-.055	-.133	-.125	-.156	-.171	-.268	-.337	-.495	-.491
	-.003	-.006	.002	.008	.037	.069	.119	.195	.258	.312	.393	.503	.620	.701	.750	.878	.988
I=33	.014	-.014	.067	-.085	-.185	-.256	-.097	-.076	-.044	-.108	-.137	-.200	-.200	-.221	-.372	-.513	-.434
	.006	.007	-.009	-.004	.021	.054	.116	.182	.222	.252	.314	.412	.528	.646	.730	.836	.985
I=34	-.004	.004	.083	-.109	-.158	-.251	-.109	-.085	-.027	-.088	-.129	-.198	-.178	-.170	-.270	-.418	-.356
	.004	.002	.004	-.010	-.012	.013	.069	.123	.158	.183	.243	.330	.454	.581	.720	.837	.963
I=35	.006	-.006	.113	-.039	-.131	-.237	-.145	-.106	-.017	-.057	-.101	-.138	-.094	-.092	-.116	-.275	-.288
	-.014	-.003	.018	-.002	.018	.003	.052	.080	.100	.125	.184	.268	.394	.540	.704	.816	.954

I=34	DEFRRR(I,J) (1/SEC) AXIAL COMPONENT, DEF. RATE																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
	.006	.007	-.009	-.004	-.004	.021	.024	.110	.085	-.027	-.088	-.129	-.198	-.178	-.170	-.270	-.418	-.356	
	-.004	.004	.083	-.109	-.158	-.251	-.109	-.109	-.085	-.027	-.158	.183	.243	.330	.454	.581	.720	.837	
	.004	.002	.004	-.010	-.012	.013	.069	.123	.123	.158	.183	.243	.330	.454	.581	.720	.837	.963	
I=35	.006	-.006	.113	-.039	-.131	-.257	-.145	-.106	-.106	-.017	-.057	-.101	-.138	-.094	-.092	-.116	-.279	-.288	
	-.014	-.003	.018	-.002	-.018	.003	.052	.080	.080	.100	.125	.184	.268	.394	.540	.704	.816	.954	
J=																			
I=3	.014	-.003	.003	.003	.015	-.007	-.029	-.012	-.012	-.002	-.019	-.031	-.017	-.016	-.022	-.004	-.024	-.073	
	.003	.003	.006	-.001	.001	.005	.006	.004	.004	-.001	-.007	-.011	-.009	-.007	.000	.001	.000	.028	
I=4	.012	-.003	.003	.005	-.007	-.010	-.014	-.014	-.014	-.006	-.016	-.030	-.016	-.014	-.030	-.024	-.045	-.082	
	-.001	.003	.003	.003	.004	.000	.001	.007	.007	-.001	-.011	-.012	-.008	-.005	.007	.015	.036	.088	
I=5	.011	-.007	-.011	-.011	-.017	-.020	-.014	-.007	-.007	-.001	-.011	-.027	-.022	-.023	-.041	-.049	-.065	-.088	
	-.001	-.002	.000	.000	.001	.005	.000	.002	.002	-.008	-.011	-.005	.008	.021	.032	.054	.081	.110	
I=6	.008	-.012	-.014	-.014	-.026	-.029	-.011	.005	.008	-.008	-.002	-.021	-.034	-.039	-.056	-.074	-.091	-.103	
	-.001	.002	.001	.001	.007	-.000	-.000	-.006	.000	.000	.007	.018	.036	.061	.079	.085	.104	.115	
I=7	.006	-.015	-.018	-.018	-.035	-.028	.004	.013	.011	.011	.010	-.005	-.052	-.076	-.069	-.082	-.131	-.139	
	.000	.002	-.000	-.000	-.004	-.001	-.001	.001	.013	.013	.035	.044	.061	.084	.099	.105	.118	.132	
I=8	.004	-.017	-.017	-.017	-.028	-.026	.007	.029	.029	.017	.021	.023	-.049	-.091	-.092	-.104	-.154	-.158	
	-.000	.003	.001	.001	-.006	-.013	.002	.023	.023	.037	.055	.077	.085	.088	.095	.104	.096	.108	
I=9	.006	-.030	-.012	-.010	-.016	.011	.021	.039	.039	.022	.023	.044	-.017	-.077	-.114	-.131	-.150	-.153	
	-.002	-.003	.003	.006	.006	.011	.021	.046	.046	.062	.066	.078	.087	.080	.073	.062	.046	.062	
I=10	.003	-.022	-.008	-.006	-.011	.027	.036	.055	.055	.037	.045	.048	.035	-.023	-.118	-.138	-.094	-.090	
	-.000	.002	.004	.011	.027	.036	.055	.037	.037	.041	.045	.043	.040	.036	.015	.006	.022	.058	
I=11	.019	-.004	-.007	-.017	-.014	.024	.024	.071	.051	.051	.018	.059	.085	.028	-.088	-.037	-.003	-.010	
	-.002	.002	.005	.007	.007	.010	.009	.009	.001	.001	.002	.003	-.007	-.013	-.033	-.038	-.008	.006	
I=12	.015	.013	.002	-.008	.010	.004	.004	.062	.044	.044	.031	.088	.115	.055	-.017	.011	.100	.098	
	.000	-.001	.001	.004	.004	.004	.004	.008	-.008	-.014	-.021	-.039	-.058	-.082	-.103	-.095	-.079	-.056	
I=13	.009	.005	.007	.010	.031	.057	.057	.055	.055	.035	.060	.124	.137	.083	.041	.113	.238	.257	
	.003	-.002	-.008	-.005	-.002	-.006	-.006	-.015	-.015	-.036	-.061	-.068	-.098	-.143	-.172	-.167	-.143	-.094	
I=14	.015	.008	.020	.023	.032	.032	.037	.054	.054	.042	.092	.163	.156	.103	.091	.197	.426	.384	
	-.000	-.004	-.006	-.011	-.022	-.037	-.037	-.052	-.052	-.070	-.086	-.091	-.115	-.154	-.189	-.184	-.172	-.177	
I=15	.032	.015	.025	.038	.044	.044	.042	.027	.027	.039	.129	.199	.179	.119	.142	.258	.576	.363	
	.002	.001	-.005	-.013	-.027	-.045	-.045	-.066	-.066	-.085	-.096	-.123	-.156	-.182	-.197	-.201	-.239	-.324	
I=16	.042	.021	.029	.043	.050	.043	.043	.016	.016	.037	.156	.219	.202	.159	.187	.369	.697	.332	
	.002	.003	.001	-.009	-.027	-.045	-.045	-.063	-.063	-.080	-.106	-.137	-.168	-.194	-.231	-.284	-.389	-.534	
I=17	.055	.037	.026	.034	.055	.055	.055	.016	.016	.029	.166	.237	.230	.200	.229	.405	.775	.327	
	-.003	.002	.007	.007	.008	-.026	-.026	-.035	-.035	-.051	-.085	-.129	-.160	-.201	-.279	-.392	-.559	-.749	
I=18	.062	.049	.029	.027	.059	.072	.041	.041	.041	.047	.149	.215	.241	.235	.285	.458	.818	.298	
	-.006	.003	.006	.009	.004	-.013	-.013	-.020	-.020	-.046	-.094	-.138	-.180	-.231	-.322	-.475	-.684	-.921	
I=19	.060	.047	.025	.028	.068	.078	.062	.062	.062	.067	.114	.166	.244	.275	.347	.496	.803	.237	
	-.007	-.002	.009	.003	-.014	-.036	-.036	-.058	-.058	-.078	-.105	-.137	-.187	-.257	-.367	-.506	-.727	-.1053	

I=20	.055	.033	.019	.037	.080	.081	.069	.070	.080	.119	.244	.311	.386	.515	.745	.185
	-.003	-.002	-.017	-.063	-.074	-.037	-.023	-.062	-.094	-.033	.169	.228	.295	-1.113	-1.314	-1.086
I=21	.049	.031	.014	.045	.089	.082	.072	.066	.048	.078	.241	.331	.369	.472	.724	.184
	-.002	.001	.002	-.015	-.041	-.057	-.079	-.094	-.104	-.118	-.166	-.247	-.319	-.410	-.546	-.777
I=22	.043	.027	.005	.043	.089	.073	.063	.062	.017	.041	.240	.338	.337	.395	.665	.260
	-.003	.002	.002	-.016	-.044	-.067	-.081	-.097	-.104	-.117	-.149	-.186	-.229	-.302	-.437	-.640
I=23	.037	.011	-.011	.044	.096	.066	.041	.039	.009	.030	.225	.318	.296	.328	.571	.398
	.004	.001	-.015	-.039	-.064	-.070	-.080	-.094	-.114	-.131	-.150	-.163	-.191	-.242	-.328	-.492
I=24	.038	.008	-.027	.029	.094	.072	.015	.003	.005	.041	.192	.261	.247	.249	.469	.456
	.006	-.001	-.013	-.029	-.043	-.056	-.066	-.075	-.099	-.137	-.162	-.179	-.203	-.237	-.280	-.375
I=25	.026	-.002	-.030	.014	.082	.066	.003	-.018	.004	.050	.157	.204	.203	.191	.377	.406
	.002	.000	-.002	-.002	-.009	-.032	-.052	-.063	-.084	-.114	-.153	-.177	-.211	-.244	-.255	-.280
I=26	.013	-.014	-.031	.015	.081	.061	-.021	-.034	.007	.045	.111	.145	.166	.150	.281	.327
	-.000	.003	-.000	-.001	-.000	-.008	-.030	-.051	-.071	-.089	-.115	-.141	-.170	-.208	-.227	-.217
I=27	.000	-.024	-.034	.013	.076	.053	-.030	-.045	.020	.058	.063	.075	.129	.128	.197	.229
	-.004	.000	.001	-.004	-.002	-.003	-.009	-.030	-.049	-.059	-.055	-.065	-.082	-.105	-.132	-.137
I=28	.006	-.025	-.040	-.012	.069	.067	-.028	-.049	.030	.070	.017	.004	.084	.103	.112	.136
	-.000	-.004	.000	.002	-.006	-.015	-.022	-.035	-.046	-.044	-.035	-.033	-.031	-.034	-.049	-.056
I=29	.001	-.012	-.055	-.043	.066	.079	-.026	-.050	.031	.067	-.003	-.037	.025	.054	.059	.061
	-.000	-.003	.002	.012	.010	-.003	-.014	-.016	-.017	-.027	-.034	-.035	-.035	-.036	-.031	-.025
I=30	.005	-.004	-.056	-.057	.053	.081	-.016	-.051	.023	.070	-.011	-.067	-.034	.004	.020	.033
	-.000	.001	-.001	.003	.006	.008	.012	.017	.018	.004	-.010	-.021	-.034	-.034	-.029	-.021
I=31	.012	-.006	-.066	-.065	.039	.080	.008	-.033	.006	.045	-.019	-.069	.067	-.040	-.008	.005
	.003	.001	-.000	-.007	-.005	.001	-.000	.001	.007	.010	-.004	-.023	-.023	-.017	-.019	-.019
I=32	.017	-.012	-.073	-.073	.037	.085	.024	-.009	-.018	-.005	-.015	-.033	-.081	-.082	-.026	.008
	-.004	.003	.007	.003	.003	-.002	-.008	-.003	.010	.020	.012	-.000	-.011	-.008	-.015	-.037
I=33	.025	-.010	-.081	-.060	.043	.070	.019	-.005	-.029	-.029	-.018	-.006	-.068	-.102	-.004	.038
	-.003	-.001	.006	.016	.017	.012	.016	-.023	.030	.033	.034	.026	.005	-.018	-.033	-.044
I=34	.033	-.023	-.073	-.047	.030	.065	.030	.007	-.033	-.036	-.011	.010	-.039	-.083	-.015	.018
	.003	-.009	-.001	.013	.016	.018	.028	.033	.032	.030	.030	.021	.005	-.027	-.034	-.038

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I= 3	DEFRN(I,J) (1/SEC)	DEFRS(I,J) (1/SEC)	DEFRM(I,J) (1/SEC)	NORMAL COMPONENT, DEF. RATE ROOT-MEAN-SQUARED VALUE	DEF. RATE	DEF. RATE	DEF. RATE	DEF. RATE	DEF. RATE	DEF. RATE	DEF. RATE	DEF. RATE	DEF. RATE	DEF. RATE	DEF. RATE	DEF. RATE	DEF. RATE	DEF. RATE
I= 4	.008	.005	.002	.008	.006	.018	.008	.002	.013	.021	.013	.021	.013	.012	.011	.003	.012	.050
I= 5	.003	.006	.001	.034	.007	.034	.007	.023	.013	.010	.037	.021	.010	.002	.014	.035	.0157	.232
I= 6	.009	.008	.002	.011	.035	.041	.024	.013	.016	.030	.017	.020	.017	.012	.018	.055	.0157	.238
I= 7	.007	.003	.004	.006	.005	.008	.009	.004	.013	.021	.020	.020	.012	.010	.018	.020	.040	.085
I= 8	.003	.006	.003	.009	.036	.034	.017	.021	.020	.024	.024	.029	.004	.004	.006	.037	.0134	.183
I= 9	.007	.007	.005	.011	.036	.035	.019	.021	.024	.024	.024	.029	.013	.010	.019	.060	.0140	.202
I= 10	.006	.005	.006	.009	.013	.007	.005	.005	.011	.016	.015	.015	.015	.022	.037	.051	.073	.099
I= 11	.004	.006	.005	.010	.025	.029	.021	.018	.012	.001	.022	.022	.022	.020	.007	.035	.107	.153
I= 12	.007	.008	.008	.008	.013	.028	.030	.022	.016	.016	.026	.026	.026	.030	.037	.082	.129	.182
I= 13	.004	.007	.008	.014	.018	.006	.006	.004	.004	.019	.035	.035	.035	.050	.088	.080	.098	.109
I= 14	.000	.008	.004	.010	.022	.019	.011	.005	.009	.034	.067	.051	.029	.051	.029	.004	.069	.138
I= 15	.004	.010	.009	.017	.029	.020	.012	.007	.010	.039	.076	.076	.076	.071	.074	.080	.119	.176
I= 16	.003	.008	.009	.020	.014	.002	.007	.012	.022	.024	.056	.080	.080	.080	.084	.094	.124	.136
I= 17	.000	.004	.008	.002	.012	.014	.011	.026	.029	.066	.130	.130	.130	.119	.066	.028	.023	.102
I= 18	.003	.009	.013	.020	.019	.015	.013	.028	.037	.071	.141	.141	.141	.143	.107	.098	.127	.169
I= 19	.002	.010	.009	.017	.020	.015	.026	.027	.038	.050	.067	.067	.067	.089	.093	.104	.125	.133
I= 20	.001	.013	.024	.007	.015	.015	.026	.059	.053	.081	.160	.160	.160	.182	.149	.095	.039	.007
I= 21	.003	.016	.025	.019	.024	.015	.036	.065	.065	.096	.173	.173	.173	.203	.176	.140	.131	.133
I= 22	.004	.016	.008	.008	.013	.016	.042	.042	.045	.061	.052	.052	.052	.079	.094	.097	.098	.108
I= 23	.003	.003	.015	.001	.026	.047	.066	.086	.105	.115	.172	.172	.172	.232	.221	.145	.109	.131
I= 24	.005	.017	.017	.068	.029	.049	.078	.096	.114	.130	.179	.179	.179	.245	.240	.174	.146	.170
I= 25	.002	.012	.006	.008	.019	.030	.046	.039	.031	.045	.038	.038	.038	.029	.067	.072	.058	.074
I= 26	.002	.021	.037	.037	.052	.070	.093	.102	.123	.132	.196	.196	.196	.263	.285	.220	.275	.369
I= 27	.003	.024	.037	.038	.055	.078	.104	.123	.127	.139	.200	.200	.200	.265	.273	.232	.281	.376
I= 28	.010	.003	.006	.012	.012	.016	.036	.026	.010	.031	.046	.046	.046	.020	.061	.062	.006	.008
I= 29	.002	.014	.035	.047	.070	.094	.108	.115	.130	.156	.222	.222	.222	.270	.265	.308	.431	.540
I= 30	.011	.014	.036	.049	.071	.094	.108	.118	.130	.156	.222	.222	.222	.270	.265	.308	.431	.540
I= 31	.008	.007	.002	.006	.007	.022	.035	.029	.026	.064	.086	.086	.086	.068	.060	.053	.089	.077
I= 32	.001	.002	.004	.021	.059	.095	.115	.113	.117	.164	.233	.233	.233	.258	.264	.349	.513	.672
I= 33	.008	.007	.005	.022	.059	.098	.120	.116	.120	.175	.248	.248	.248	.267	.271	.353	.520	.677
I= 34	.006	.004	.007	.008	.017	.031	.035	.035	.060	.096	.118	.118	.118	.113	.107	.140	.190	.175
I= 35	.008	.001	.008	.043	.075	.085	.088	.093	.099	.156	.210	.210	.210	.247	.287	.379	.601	.882
I= 36	.010	.004	.011	.043	.077	.091	.094	.099	.116	.183	.241	.241	.241	.271	.306	.404	.631	.899
I= 37	.007	.006	.013	.017	.027	.044	.053	.056	.089	.127	.135	.135	.135	.129	.140	.191	.299	.281
I= 38	.005	.016	.028	.058	.090	.107	.075	.067	.110	.176	.204	.204	.204	.236	.283	.414	.683	.1.004
I= 39	.009	.017	.031	.061	.094	.107	.092	.088	.142	.217	.245	.245	.245	.269	.316	.456	.745	1.042
I= 40	.017	.008	.015	.025	.036	.043	.046	.062	.113	.161	.168	.168	.168	.151	.169	.249	.408	.343
I= 41	.001	.017	.028	.051	.080	.086	.069	.064	.106	.152	.168	.168	.168	.222	.309	.451	.686	.924
I= 42	.017	.018	.031	.057	.088	.096	.083	.089	.155	.221	.237	.237	.237	.269	.352	.515	.798	.986
I= 43	.022	.012	.015	.026	.039	.044	.039	.059	.131	.178	.185	.185	.185	.177	.209	.327	.543	.433
I= 44	.001	.009	.026	.036	.052	.062	.063	.065	.095	.125	.138	.138	.138	.215	.328	.441	.595	.769
I= 45	.022	.015	.030	.044	.065	.076	.074	.088	.162	.218	.231	.231	.231	.278	.389	.549	.805	.882

I=17	.029	.019	.016	.019	.031	.040	.025	.040	.125	.183	.195	.200	.254	.399	.667	.538
	.004	.010	.024	.026	.026	.040	.066	.096	.104	.102	.105	.168	.218	.401	.499	.638
	.029	.021	.029	.032	.041	.057	.070	.104	.163	.209	.221	.261	.317	.565	.833	.834
I=18	.034	.026	.017	.018	.032	.042	.031	.047	.121	.177	.210	.233	.304	.467	.751	.609
	.003	.001	.007	.014	.016	.034	.041	.080	.084	.050	.029	.082	.172	.299	.401	.453
	.034	.026	.019	.022	.036	.054	.051	.093	.148	.184	.212	.247	.349	.554	.852	.759
I=19	.034	.025	.017	.016	.041	.057	.060	.072	.109	.152	.215	.266	.357	.501	.765	.645
	.003	.005	.022	.017	.010	.022	.013	.035	.028	.019	.063	.027	.038	.129	.157	.044
	.034	.025	.028	.023	.042	.061	.061	.080	.113	.153	.224	.267	.359	.517	.781	.647
I=20	.029	.018	.018	.050	.077	.059	.046	.066	.087	.076	.207	.270	.341	.814	1.029	.636
	.008	.012	.034	.037	.001	.005	.006	.005	.013	.064	.127	.107	.080	.157	.291	.291
	.030	.021	.038	.057	.077	.059	.046	.066	.088	.099	.243	.250	.350	.819	1.041	.699
I=21	.025	.016	.008	.030	.065	.069	.076	.080	.076	.098	.203	.289	.344	.441	.635	.481
	.016	.010	.028	.035	.017	.020	.033	.033	.038	.100	.158	.166	.165	.245	.435	.539
	.030	.019	.029	.046	.067	.072	.082	.087	.085	.140	.258	.333	.382	.505	.769	.722
I=22	.023	.014	.003	.029	.067	.070	.072	.079	.061	.079	.194	.262	.283	.349	.551	.450
	.002	.007	.037	.039	.043	.045	.062	.076	.090	.134	.196	.213	.244	.337	.573	.723
	.023	.016	.037	.056	.079	.083	.095	.110	.108	.155	.276	.337	.374	.485	.795	.851
I=23	.021	.006	.013	.042	.080	.088	.060	.067	.062	.081	.188	.241	.244	.285	.450	.445
	.001	.001	.042	.071	.072	.062	.066	.103	.120	.132	.163	.220	.295	.404	.642	.824
	.021	.006	.044	.082	.108	.092	.089	.122	.135	.155	.248	.326	.383	.455	.783	.936
I=24	.022	.005	.020	.029	.068	.064	.040	.039	.052	.089	.177	.220	.225	.243	.375	.415
	.006	.021	.049	.073	.074	.084	.072	.107	.133	.127	.135	.215	.305	.406	.642	.842
	.023	.021	.053	.079	.100	.090	.082	.114	.143	.155	.223	.307	.319	.473	.743	.939
I=25	.014	.001	.016	.008	.046	.049	.028	.041	.044	.082	.155	.190	.207	.217	.316	.343
	.009	.034	.055	.067	.078	.072	.076	.107	.141	.138	.142	.216	.302	.383	.562	.781
	.017	.034	.057	.068	.090	.087	.081	.114	.148	.161	.210	.288	.366	.440	.645	.853
I=26	.007	.009	.016	.008	.040	.035	.026	.043	.039	.067	.113	.143	.168	.179	.254	.272
	.009	.032	.050	.063	.072	.079	.079	.103	.123	.124	.135	.210	.293	.339	.441	.665
	.011	.033	.053	.063	.083	.086	.083	.112	.129	.141	.176	.254	.338	.383	.509	.718
I=27	.002	.012	.018	.008	.039	.028	.019	.037	.035	.059	.059	.070	.105	.116	.164	.183
	.004	.024	.041	.054	.079	.087	.093	.102	.124	.108	.113	.192	.284	.327	.355	.525
	.005	.026	.045	.055	.088	.091	.095	.108	.128	.123	.128	.204	.303	.347	.391	.556
I=28	.003	.014	.020	.007	.037	.041	.025	.042	.038	.057	.026	.018	.057	.068	.081	.096
	.007	.003	.016	.047	.085	.077	.083	.096	.104	.086	.089	.153	.247	.299	.331	.443
	.008	.014	.026	.047	.093	.087	.087	.104	.110	.104	.093	.154	.254	.307	.341	.454
I=29	.001	.008	.029	.028	.038	.041	.020	.033	.024	.047	.019	.036	.030	.045	.045	.053
	.009	.002	.001	.031	.075	.077	.077	.077	.082	.072	.074	.101	.181	.256	.291	.362
	.009	.008	.029	.042	.084	.087	.080	.083	.086	.086	.076	.107	.183	.260	.294	.366
I=30	.003	.002	.028	.030	.029	.044	.014	.034	.021	.037	.011	.044	.034	.019	.025	.027
	.009	.008	.005	.019	.071	.086	.076	.054	.078	.091	.082	.095	.143	.197	.226	.265
	.010	.009	.029	.036	.077	.097	.077	.064	.081	.098	.083	.104	.147	.198	.227	.266
I=31	.008	.004	.033	.036	.022	.041	.004	.017	.006	.028	.011	.046	.045	.028	.013	.012
	.002	.004	.023	.028	.063	.068	.068	.043	.055	.095	.122	.104	.103	.145	.175	.183
	.008	.005	.041	.046	.066	.079	.068	.046	.055	.099	.123	.114	.112	.147	.175	.183
I=32	.010	.007	.040	.038	.020	.044	.016	.006	.014	.012	.014	.017	.046	.045	.021	.022
	.007	.005	.019	.038	.022	.042	.055	.035	.030	.081	.129	.139	.139	.139	.139	.139

I=31	.010	.009	.029	.036	.077	.091	.071	.004	.001	.070	.003	.001	.046	.013	.012
	.008	.004	.033	.036	.022	.041	.004	.017	.006	.028	.011	.046	.028	.013	.012
	.002	-.004	.023	.028	.063	.068	.068	.043	.055	.095	.122	.104	.145	.175	.183
	.008	.005	.041	.046	.086	.079	.068	.046	.055	.099	.123	.114	.147	.175	.183
I=32	.010	.007	.040	.038	.020	.044	.016	.006	.014	.012	.014	.017	.045	.021	.022
	.001	-.005	.019	.028	.029	.042	.055	.035	.030	.081	.129	.097	.076	.119	.100
	.011	.009	.044	.047	.035	.060	.058	.035	.033	.082	.130	.098	.089	.121	.103
I=33	.014	.005	.043	.038	.030	.041	.017	.014	.030	.031	.026	.016	.060	.019	.041
	-.012	-.016	.019	.013	.017	.038	.034	.015	.019	.054	.089	.083	.023	.072	.027
	.018	.017	.048	.040	.034	.056	.038	.020	.035	.062	.092	.085	.064	.074	.049
I=34	.018	.016	.037	.030	.023	.041	.029	.020	.033	.033	.021	.016	.055	.025	.028
	-.003	-.019	-.020	-.011	.030	.054	.039	.012	.015	.037	.056	.053	.031	.008	.011
	.018	.024	.042	.032	.038	.068	.049	.023	.036	.049	.059	.055	.056	.028	.030

VELUD(I) (CM/SEC) APPROACH FLOW VELOCITY
 VELV(I) (CM/SEC) BUBBLE RISE RATE
 DEFSD(I) (1/SEC) FLUME SHEAR RATE

STREAMLINE NO. 2 3 4 5 6 7 8 9 10 11 12 13 14
 7.296 7.285 7.275 7.274 7.282 7.306 7.318 7.335 7.350 7.351 7.345 7.338 7.331
 .009 .028 .033 .029 .021 .036 .044 .064 .079 .087 .085 .090 .081
 .000 .007 .003 .002 .010 .012 .010 .011 .005 .002 .004 .005 .008

STREAMLINE NO. 15 16 17 18 19 20 21 22 23 24 25 26
 7.313 7.301 7.282 7.272 7.275 7.265 7.254 7.258 7.267 7.258 7.250 7.252
 .096 .110 .110 .114 .112 .109 .118 .105 .081 .075 .076 .078
 .010 .010 .010 .002 .002 .007 .002 .004 .000 .006 .002 .000

VELUR(I,J) (CM/SEC) RELATIVE VELOCITY COMPONENTS

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I= 2	.038	-.038	-.023	.005	.086	.144	.179	.194	.186	.130	.081	.081	.046	.069	.176	.288	.168	-.074
	-.001	.001	.001	-.000	-.000	.001	.005	.014	.030	.038	.041	.024	-.012	-.090	-.190	-.254	-.317	-.359
I= 3	.051	-.031	.000	.019	.099	.161	.209	.245	.239	.201	.159	.129	.184	.184	.306	.339	.174	-.005
	.000	-.001	-.001	.002	.003	.013	.026	.028	.028	.018	.018	-.013	-.097	-.182	-.249	-.348	-.479	-.607
I= 4	.014	-.014	.044	.057	.109	.184	.233	.279	.303	.267	.257	.266	.320	.320	.391	.411	.261	.160
	.010	.000	-.004	-.007	.009	.016	.001	.003	.006	.012	.012	-.062	-.142	-.142	-.257	-.375	-.522	-.711
I= 5	-.004	.004	.085	.075	.141	.206	.239	.287	.350	.359	.383	.402	.424	.424	.494	.499	.421	.457
	.006	-.004	-.004	.003	.004	-.004	-.012	-.024	-.008	.013	.021	.004	-.095	-.095	-.253	-.422	-.592	-.807
I= 6	-.011	.011	.078	.085	.170	.224	.229	.276	.384	.464	.511	.557	.580	.580	.576	.575	.620	.792
	.012	-.002	-.001	-.008	-.004	.011	.010	.009	.005	.019	.031	.006	-.099	-.099	-.289	-.484	-.679	-.890
I= 7	-.015	.015	.081	.091	.171	.211	.212	.274	.409	.523	.610	.668	.696	.696	.668	.677	.850	1.146
	.026	.000	-.015	-.010	-.007	-.003	.013	.015	.017	.015	.011	-.036	-.167	-.167	-.351	-.544	-.738	-.894
I= 8	-.014	.014	.078	.098	.182	.215	.239	.341	.464	.575	.667	.761	.747	.747	.755	.775	1.076	1.460
	.021	.001	-.016	-.007	.011	.009	.010	.019	.016	.007	-.012	-.075	-.215	-.215	-.388	-.543	-.652	-.761
I= 9	-.017	.017	.078	.096	.178	.225	.275	.394	.512	.618	.692	.789	.785	.785	.758	.850	1.250	1.800
	.006	-.006	-.005	.005	.003	.000	.006	.005	.012	-.003	-.047	-.141	-.274	-.274	-.395	-.477	-.566	-.673
I=10	-.014	.014	.091	.127	.182	.237	.309	.411	.527	.651	.709	.753	.747	.747	.829	.924	1.427	2.070
	-.006	.002	.007	-.003	-.002	-.005	-.006	-.002	.001	-.012	-.057	-.126	-.201	-.201	-.299	-.398	-.474	-.513
I=11	-.012	.012	.100	.147	.205	.245	.309	.430	.535	.656	.712	.746	.755	.755	.857	1.026	1.588	2.216
	-.002	.007	.003	-.007	-.007	-.008	-.002	-.003	.001	-.009	-.040	-.079	-.127	-.127	-.170	-.226	-.261	-.278
I=12	-.004	.004	.104	.186	.235	.242	.283	.388	.494	.601	.702	.789	.812	.812	.895	1.063	1.677	2.314
	.002	.002	.003	-.007	-.003	-.002	.006	.009	.017	.013	.009	-.009	-.008	-.008	-.007	-.005	-.010	-.013
I=13	-.006	.006	.115	.199	.241	.239	.257	.323	.404	.512	.645	.803	.855	.855	.929	1.069	1.724	2.362
	.006	-.000	-.004	-.002	.006	.007	.017	.016	.026	.026	.048	.083	.141	.141	.205	.259	.303	.348
I=14	-.005	.005	.102	.196	.229	.205	.210	.256	.297	.385	.562	.775	.826	.826	.962	1.118	1.724	2.308
	.008	-.001	-.005	-.002	.019	.026	.022	.021	.019	.018	.061	.127	.255	.255	.364	.468	.642	.813

I=15 -.008 -.008 -.100 -.189 .215 .144 .121 .178 .225 .301 .491 .727 .784 .937 1.111 1.678 2.155

J=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	DEPRXX(I,J)	DEPRXX(I,J)	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE	AXIAL COMPONENT, DEF. RATE
I=3	-.005	.019	.039	.051	.037	.030	.008	-.013	-.013	.012	-.028	-.026	.014	.058	-.048	-.033	-.118	-.101
I=4	.016	.028	.025	.043	.042	.033	.023	-.000	-.014	.003	-.014	-.002	.024	.042	.028	-.033	-.083	-.021
I=5	.001	.001	-.000	-.000	.006	.014	.017	.013	.003	.003	.003	-.011	-.038	-.041	-.020	-.008	-.008	.007
I=6	.028	.028	.030	.046	.032	.027	.039	.028	.012	.001	-.001	-.013	.014	.028	.022	-.019	-.007	.051
I=7	.034	.030	.037	.050	.018	.015	.058	.066	.040	.001	.001	.005	.022	.008	-.001	.012	.080	.162
I=8	.036	.030	.036	.044	.012	.018	.073	.086	.065	.006	.006	.016	.026	.003	-.004	.050	.158	.218
I=9	.035	.032	.040	.044	.019	.039	.078	.079	.066	.007	.007	.016	.020	-.002	-.050	-.111	-.174	-.218
I=10	.035	.030	.039	.047	.033	.053	.080	.075	.057	.006	.006	.007	.024	-.008	.029	.139	.305	.412
I=11	.040	.042	.032	.038	.044	.057	.075	.079	.055	.000	.000	.034	.009	.019	.057	.164	.363	.475
I=12	.043	.050	.037	.035	.037	.037	.059	.073	.053	.008	.008	.030	.012	.030	.090	.205	.365	.493
I=13	.044	.055	.043	.021	.018	.046	.072	.071	.068	.002	.002	.062	.031	.031	.084	.216	.361	.512
I=14	.049	.070	.041	.016	.007	.026	.051	.062	.081	.002	.002	.094	.061	.038	.071	.218	.392	.517
I=15	.043	.067	.040	.006	.005	.015	.030	.041	.096	.005	.005	.129	.076	.054	.094	.206	.359	.504
I=16	.043	.060	.017	.033	.040	.008	.042	.040	.088	.009	.009	.144	.101	.056	.082	.191	.317	.413
I=17	.049	.061	.004	.049	.052	.004	.038	.042	.091	.002	.002	.142	.094	.048	.078	.178	.282	.349
I=18	.049	.056	.003	.050	.066	.025	.035	.050	.077	.011	.011	.101	.082	.061	.080	.160	.231	.257
I=19	.038	.042	.003	.041	.062	.000	.019	.040	.033	.004	.004	.047	.084	.089	.070	.112	.176	.163
I=20	.033	.037	.005	.039	.059	.041	.001	.000	.007	.000	.000	.003	.003	.077	.036	.068	.122	.073
I=21	.023	.029	.001	.005	.004	.003	.002	.004	.002	.002	.002	.004	.005	.002	.029	.066	.120	.163
	.002	.004	.007	.003	.002	.006	.004	.004	.002	.002	.002	.004	.013	.075	.043	.004	.025	.004

DEFN(I,J) (1/SEC) NORMAL COMPONENT, DEF. RATE
DEFS(I,J) (1/SEC) SHEAR COMPONENT, DEF. RATE
DEFR(I,J) (1/SEC) ROOT-MEAN-SQUARED VALUE, DEF. RATE

J=

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I= 3			.003	.010	.020	.027	.020	.017	.009	.013	.020	.019	.014	.033	.027	.025	.077	.088
			-.009	-.022	-.016	-.004	-.005	-.012	-.029	-.043	-.062	-.097	-.134	-.139	-.131	-.117	-.120	-.183
			.009	.024	.026	.027	.021	.021	.030	.045	.065	.099	.134	.143	.134	.120	.143	.203
I= 4			.009	.014	.013	.022	.024	.023	.020	.006	.009	.006	.031	.041	.024	.021	.045	.014
			-.017	-.024	-.013	-.006	-.019	-.016	-.012	-.034	-.060	-.098	-.138	-.146	-.144	-.141	-.201	.305
			.019	.028	.018	.022	.031	.028	.024	.035	.061	.098	.141	.152	.146	.143	.206	.305
I= 5			.014	.014	.015	.025	.018	.014	.020	.014	.007	.014	.019	.027	.019	.013	.007	.041
			-.011	-.009	-.007	-.022	-.019	-.006	.004	-.015	-.056	-.086	-.140	-.170	-.172	-.166	-.252	.364
			.018	.017	.017	.034	.026	.016	.021	.021	.057	.087	.141	.172	.173	.166	.252	.366
I= 6			.018	.016	.020	.027	.009	.012	.036	.037	.021	.018	.017	.009	.002	.013	.054	.117
			-.008	-.007	-.006	-.004	.002	.008	.002	-.018	-.047	-.079	-.137	-.184	-.185	-.187	-.277	.366
			.020	.018	.021	.027	.009	.015	.036	.041	.052	.081	.138	.184	.185	.187	.283	.384
I= 7			.019	.017	.015	.024	.007	.010	.037	.044	.035	.033	.024	.011	.009	.051	.130	.190
			-.015	-.005	-.001	-.002	.011	.004	-.021	-.027	-.040	-.067	-.132	-.156	-.182	-.193	-.262	.315
			.024	.017	.019	.025	.013	.010	.043	.052	.054	.075	.134	.156	.182	.199	.293	.366
I= 8			.018	.019	.023	.024	.010	.021	.042	.042	.036	.039	.020	.003	.030	.099	.198	.261
			-.013	-.004	.008	.005	-.005	-.018	-.040	-.039	-.042	-.052	-.110	-.128	-.134	-.144	-.202	.301
			.023	.019	.024	.024	.011	.028	.058	.057	.056	.065	.112	.128	.137	.175	.283	.398
I= 9			.018	.019	.021	.026	.019	.030	.045	.041	.032	.031	.015	.031	.071	.151	.253	.329
			-.003	-.001	-.008	-.002	-.006	-.006	-.022	-.021	-.047	-.056	-.072	-.081	-.090	-.107	-.186	.281
			.018	.019	.022	.026	.020	.037	.050	.047	.057	.064	.073	.086	.114	.185	.314	.433
I=10			.022	.022	.018	.020	.023	.030	.039	.043	.028	.026	.034	.070	.117	.189	.313	.400
			.006	-.008	-.020	-.010	-.008	-.011	-.010	-.010	-.034	-.042	-.032	-.044	-.057	-.119	-.157	.179
			.023	.024	.027	.022	.024	.032	.040	.044	.043	.049	.047	.083	.152	.223	.350	.439
I=11			.022	.027	.020	.018	.020	.031	.038	.037	.031	.035	.050	.086	.150	.244	.357	.439
			.004	-.009	-.023	-.018	.001	.011	.009	.010	.002	-.020	-.040	-.052	-.055	-.078	-.106	.109
			.023	.029	.030	.026	.020	.033	.039	.039	.031	.040	.064	.100	.160	.257	.372	.453
I=12			.028	.035	.032	.012	.011	.049	.062	.094	.080	.068	.060	.122	.312	.417	.812	1.362
			.002	-.007	-.019	-.010	.005	.022	.041	.047	.047	.017	-.024	-.034	-.045	-.053	-.053	.056
			.028	.036	.038	.016	.012	.054	.074	.105	.093	.070	.064	.127	.313	.417	.813	1.363
I=13			.025	.037	.021	.014	.011	.020	.032	.037	.047	.067	.073	.106	.163	.279	.442	.583
			-.004	-.000	.000	.005	.016	.028	.048	.070	.081	.064	.034	.032	.014	.013	.008	.030
			.025	.037	.021	.015	.020	.034	.058	.079	.093	.093	.081	.111	.164	.279	.442	.584
I=14			.024	.035	.023	.004	.005	.011	.020	.024	.051	.070	.062	.074	.120	.221	.381	.547
			-.005	.004	.013	.019	.032	.043	.046	.057	.085	.085	.090	.099	.064	.067	.120	.158
			.024	.035	.026	.019	.032	.044	.051	.062	.099	.110	.109	.124	.136	.231	.399	.569
I=15			.022	.034	.019	.007	.019	.010	.023	.021	.050	.071	.048	.047	.081	.161	.295	.459
			.003	.007	.004	.016	.042	.053	.052	.050	.070	.081	.104	.104	.140	.193	.258	.286
			.023	.035	.019	.018	.047	.054	.056	.054	.086	.120	.114	.115	.162	.251	.392	.540
I=16			.023	.030	.010	.017	.023	.008	.023	.023	.048	.073	.056	.032	.051	.128	.240	.361
			.005	-.003	.002	.021	.033	.045	.061	.056	.059	.081	.112	.120	.173	.257	.375	.418
			.024	.030	.010	.028	.040	.045	.065	.061	.076	.109	.125	.124	.180	.287	.446	.552

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I=16	.023	.030	.019	.018	.047	.024	.020	.024	.008	.073	.056	.032	.051	.128	.240	.361
	.005	.003	.002	.021	.033	.045	.061	.056	.059	.081	.112	.120	.173	.257	.375	.418
	.024	.030	.010	.028	.040	.045	.065	.061	.076	.109	.125	.124	.180	.287	.446	.552
I=17	.025	.031	.003	.025	.031	.006	.019	.022	.046	.073	.056	.038	.040	.110	.196	.281
	.001	.006	.008	.021	.023	.035	.056	.058	.046	.066	.131	.152	.213	.281	.447	.542
	.025	.031	.008	.033	.039	.035	.059	.062	.065	.099	.143	.156	.217	.302	.488	.610
I=18	.025	.029	.003	.027	.033	.013	.021	.030	.044	.055	.047	.041	.045	.087	.136	.173
	.003	.004	.019	.025	.007	.014	.045	.049	.052	.096	.164	.176	.237	.326	.509	.608
	.025	.030	.020	.037	.034	.019	.049	.058	.058	.110	.171	.181	.242	.338	.527	.632
I=19	.020	.021	.004	.023	.031	.023	.010	.023	.018	.025	.043	.048	.047	.072	.112	.121
	.009	.016	.018	.016	.003	.002	.015	.039	.075	.120	.151	.164	.247	.340	.515	.602
	.022	.027	.019	.028	.031	.023	.018	.045	.077	.122	.157	.171	.252	.347	.527	.615
I=20	.018	.019	.005	.021	.031	.022	.001	.002	.004	.019	.049	.039	.033	.067	.121	.118
	.008	.014	.016	.011	.005	.002	.002	.024	.071	.100	.099	.124	.223	.309	.438	.519
	.019	.024	.016	.024	.031	.022	.002	.024	.071	.101	.110	.130	.226	.317	.455	.533
I=21	.013	.016	.004	.018	.031	.025	.006	.009	.017	.008	.043	.028	.013	.035	.076	.047
	.003	.018	.024	.012	.007	.005	.006	.016	.041	.058	.072	.105	.170	.231	.354	.431
	.013	.024	.025	.022	.032	.026	.008	.018	.044	.058	.084	.108	.171	.233	.362	.434
I=22	.004	.006	.005	.003	.028	.030	.011	.015	.023	.003	.025	.007	.019	.011	.029	.049
	.005	.015	.039	.027	.004	.010	.002	.017	.021	.021	.046	.083	.127	.183	.298	.357
	.007	.016	.039	.027	.028	.032	.011	.022	.032	.021	.052	.084	.128	.183	.300	.360
I=23	.004	.005	.005	.003	.019	.022	.016	.022	.024	.007	.009	.007	.024	.037	.035	.095
	.007	.004	.018	.017	.003	.015	.009	.006	.005	.012	.031	.050	.067	.104	.202	.251
	.008	.007	.019	.017	.019	.026	.019	.023	.025	.014	.032	.050	.071	.111	.205	.269
I=24	.001	.003	.003	.003	.014	.018	.020	.030	.030	.011	.012	.003	.038	.071	.074	.113
	.005	.008	.001	.002	.010	.016	.020	.001	.009	.012	.010	.015	.006	.041	.096	.118
	.005	.008	.004	.004	.017	.024	.028	.030	.032	.016	.016	.016	.039	.082	.121	.163
I=25	.001	.002	.004	.009	.013	.019	.025	.038	.034	.007	.017	.004	.050	.090	.069	.035
	.002	.005	.011	.004	.011	.015	.024	.009	.014	.017	.002	.000	.009	.008	.036	.048
	.003	.006	.012	.010	.018	.024	.034	.039	.037	.019	.017	.004	.050	.090	.078	.037