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Effects of Hole Length, Supply Plenum Geometry, and Freestream Turbulence on Film Cooling Performance

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NOMENCLATURE

a	Pipe inner radius of hot-wire qualification facility (1.9 cm)
a_0, a_1, a_2	Coefficients in ΔP-SVFR Relation
A	Total cross-sectional area of film cooling holes
A_0, A_1, A_2, A_3	Curve fit coefficients for meter calibrations
AFVR	Actual volumetric flow rate through flow meter
$AVFR_{hole}$	Actual volumetric flow rate supplied to film cooling holes
B_1, B_2	Coefficients in governing relationship for hot-wire anemometry
C_1, C_2	Hot-wire calibration constants
C_d	Discharge coefficient
$C_{d,o}$	Discharge coefficient measured without freestream
C_f	Skin friction coefficient
c_p	Specific heat of air
CMM	Cubic meters per minute
D	Diameter of the film cooling holes (1.9 cm)
DC	Total density correction
DR	Ratio of coolant density to freestream density
E	Anemometer bridge voltage
$E(\kappa)$	Wave number based power spectral density
E(f)	Frequency based power spectral density
E_Λ	Power level used for computing integral scale
f	Frequency
FSTI	Freestream turbulence intensity ($\sqrt{\overline{u'^2}}/U_o$)
h	Delivery channel height (3.8 cm)
I	Coolant-to-freestream momentum flux ratio ($DR \cdot VR^2$)
IGDC	Ideal gas density correction
k	Turbulence kinetic energy
K_w	Correction factor for near-wall measurements
L	Length of the film cooling delivery tube
L_u	Energy or dissipation turbulent length scale

LWD	Long width dimension for expanded metal
$\dot{m}_a$	Actual mass flow rate through film cooling holes
$\dot{m}_i$	Ideal mass flow rate through film cooling holes
M	Coolant-to-freestream blowing ratio ($DR \circ VR$)
M_{air}	Molecular weight of dry air (28.97 kg/kmol)
n	Power in hot-wire relation
P	Frequency-weighted spectra, $E(f) \times f/(u')^2$
P_∞	Ambient or fluid thermodynamic pressure, in bars
P_{sat}	Saturation pressure of water vapor at temperature (bars)
P_{sat}^{∞}	Saturation pressure of water vapor at temperature (atm)
p_c^+	Coolant supply total pressure
p_s	Freestream static pressure
R	Anemometer control resistance
R^+	Near-wall spatial coordinate
Re	Reynolds number based on bulk velocity and pipe inside diameter
Re_D	Reynolds number based on mean film cooling hole velocity and hole diameter
Re_{pipe}	Pipe Reynolds number based on center-line velocity and pipe inside diameter
R_s	Sensor resistance
Re_θ	Reynolds number based on mean streamwise velocity and momentum thickness
RHDC	Relative humidity density correction
RHVC	Relative humidity viscosity correction
r	Radial distance from pipe wall in hot-wire qualification facility
r_w	Hot-wire sensor radius
SCFM	Cubic feet per minute at standard conditions
SCMM	Cubic meters per minute at standard conditions
SVFR	Standard volumetric flow rate through flow meter
SWD	Short width dimension for expanded metal
t	Expanded metal thickness
T	Ambient or fluid temperature, in K
T_{aw}	Adiabatic wall temperature
T_c	Calibration air flow temperature

T_{hole}	Temperature of coolant supply at film cooling holes
T_f	Air flow temperature at measurement
T_j	Coolant bulk mean temperature
T_{rec}	Recovery temperature
T_s	Sensor operating temperature
T_{static}	Air static temperature
T_∞	Freestream temperature
TI	Local turbulence intensity normalized with local mean streamwise velocity ($\sqrt{\overline{u'^2}}/U$)
TPI	Threads per inch
TVC	Temperature viscosity correction
U	Time average local streamwise velocity
U_B	Bulk velocity
U_c	Corrected near-wall velocity in turbulent boundary layer
U_{cl}	Centerline (maximum) velocity
U_e	Effective cooling velocity to hot-wire sensor (calibration)
U_{eff}	Effective cooling velocity to hot-wire sensor (hole-exit)
U_R	Recorded velocity via bridge output and calibration
U_W	Corrected near-wall velocity in laminar boundary layer
U_τ	Friction velocity
U^+	Velocity in wall coordinates
U_o	Time-average freestream velocity
u'	Instantaneous values of streamwise velocity fluctuations
u_{rms}	Time-averaged rms streamwise velocity fluctuations ($\sqrt{\overline{u'^2}}$)
V	Time-averaged wall-normal velocity
VC	Viscosity correction
VR	Ratio of coolant bulk mean hole velocity to freestream velocity
v'	Instantaneous values of wall-normal velocity fluctuations
W	Time-averaged spanwise/lateral velocity
WDC	Water density correction for temperature
w'	Instantaneous values of lateral velocity fluctuations
x	Streamwise distance from center of the hole

y	Distance normal to the test wall
z	Lateral/spanwise distance from center of the middle hole

Greek:

δ	Boundary layer thickness (99%)
δ^*	Displacement thickness
δ_{in}	Inlet additive loss coefficient
δ_{out}	Outlet additive loss coefficient
ε	Dissipation rate
λ	Recovery factor
η	Adiabatic effectiveness
η_{av}	Laterally-averaged effectiveness
$\Delta \dot{m}$	Mass flow uncertainty (95% confidence)
η_m	Kolmogorov or microscale of turbulence
κ	Wave number
Λ	Integral length scale
Ω_m	Collision integral
ΔP	Meter pressure drop at standard conditions
ΔP_m	Meter pressure drop at measurement conditions
ϕ	Relative humidity (expressed as decimal)
ψ	Non-dimensional temperature ratio
ρ	Air density at measurement
ρ_{dry}	Dry air density at temperature T and pressure P
ρ_{std}	Dry air density at standard conditions
ρ_{wet}	Moist air density
σ	Collision diameter for air = 3.617×10^{-10} m
τ	Wall shear stress
ΔT	Uncertainty in temperature
θ	Momentum boundary layer thickness
φ	Circumferential coordinate for pipe flow measurements
μ_{std}	Dry air viscosity at standard conditions
μ_T	Dry air viscosity at temperature T
μ_{wet}	Moist air viscosity at temperature T
υ	Kinematic viscosity of air

ζ	Distance from wall/solid boundary
x	Axial coordinate for pipe flow measurements

Subscripts:

A, B	Flow meter designation
m	Momentum

Superscripts:

$-$	Time-averaged

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CHAPTER 1: INTRODUCTION

1.1 Motivation

Over the past fifty years, aircraft and power generation gas turbine designers have endeavored to increase the combustor exit and high-pressure turbine stage inlet temperatures. With higher combustor exit temperatures, improved efficiency and reduced fuel consumption can be achieved. Similarly, in aircraft applications, these higher temperatures lead to increased thrust. Unfortunately, these higher temperatures have jeopardized the integrity of the high-pressure turbine components and specifically the turbine blades. Modern turbine stage inlet temperatures exceed the melting point temperatures of turbine blade materials. To combat and prevent failure of turbine blades in gas turbine engines resulting from these excessive operating temperatures, film cooling has been incorporated into blade designs. In film cooling, cool air is bled from the compressor stage, ducted to the internal chambers of the turbine blades, and discharged through small holes in the blade walls. This air provides a thin, cool, insulating blanket along the external surface of the turbine blade.

In addition to the high temperatures, recent measurements in actual gas turbine engines have shown the flow exiting the combustor to be highly turbulent. Thus, in modeling designs with film cooling, matching engine-representative freestream turbulence levels has become imperative. Also, over the years, many parameters have been shown to influence film cooling phenomena. The effect of several important parameters, including the film cooling hole and coolant delivery plenum geometries, however, have not been thoroughly studied. In modern airfoils, coolant is delivered to the holes through channels that are internal to the blades and then through short holes.

1.2 Relevant Film Cooling Literature

Film cooling literature is extensive. It concentrates primarily on surface and flowfield measurements. Surface measurements include film cooling effectiveness values and heat transfer coefficients whereas flowfield measurements include velocity and turbulence intensity distributions and turbulent shear stresses. Such measurements directly support cooling design parameter choices and also support the development of computational design models.

The following sections describe some of the literature that is most relevant to the objectives of the present research. The focus of this study is the investigation of film cooling phenomena under engine-representative design conditions. As a result, the most important aspects to the present study are modeling film cooling with high freestream turbulence, short film cooling holes, and representative supply plenum geometries. Unfortunately, these aspects have only received attention in the recent past and the corresponding literature is limited. Thus, in presenting literature relevant to this study, a summary of past research will first be discussed to emphasize the evolution of film cooling. This literature, to date, primarily concentrates on low-turbulence freestream studies and long film cooling holes.

1.2.1 Evolution of Film Cooling Studies

Research on film cooling dates back to the early 1960's. These studies have primarily focused on modeling film cooling phenomena under low-turbulence freestream conditions with long film cooling hole lengths. A representative segment of these studies are now presented.

Surface and flowfield measurement data in the literature exist for slot, transpiration, and single- or multiple-row injection configurations. Examples of surface measurements in the literature include the undertakings of Goldstein et al. (1968), Pedersen et al. (1977), Foster and Lampard (1980), and Forth and Jones (1988). These investigations and others cover a wide range of density and blowing ratios. Similarly, flowfield measurements also exist for a variety of film cooling configurations. Pitot probe mapping of mean velocity profile development was reported by LeBrocq et al. (1973), who emphasized hole geometry and density ratio effects for multiple rows of staggered holes, and Foster and Lampard (1980), who investigated several inclination angles. Crabb et al. (1981) studied the hydrodynamics of a normal jet in crossflow using a cross-wire, hot-wire probe in the far field and laser Doppler velocimetry in the near field. This study utilized an L/D=30 and showed velocity profiles to be distorted at the jet exit. Andreopoulos and Rodi (1984) performed a detailed investigation of the turbulence field for a normal jet in crossflow with L/D=12, DR=1.0, and VR=0.5. They documented (1) blockage in the upstream portion of the jet exit area resulting in a velocity profile that was skewed towards the downstream edge of the hole exit and (2) the disturbed flow created by the jet-crossflow interaction upstream of the hole exit and within the jet supply length. Inclined jets with varying film cooling parameters were investigated by Launder and York (1974), Kadotani and Goldstein (1979), Yoshida and Goldstein (1984), and Jubran and Brown (1985). Lee et al. (1992) presented three-dimensional mean velocity and vorticity distributions, accompanied by flow visualization, for streamwise injection at 35∞ with an L/D=50 and freestream turbulence of 0.2%. These results showed that, as with normal injection, a pair of bound vortices reside in a complex three-dimensional flow downstream of the jet exit. The strength and range of the bound vortices are strongly dependent on the velocity ratio. Further, with inclined injection, this structure persists far downstream. A common feature of all these studies was their use of large length-to-diameter ratios (ranging from 10 to 62), atypical of gas turbines. The benefit of a long L/D was that a fully-developed, turbulent velocity profile was achieved. Another common feature of these studies is that the vast majority incorporate sub-1% freestream turbulence intensities.

1.2.2 High-Freestream Turbulence

Since measurements of combustor exit flows by Goebel et al. (1993) indicate turbulence levels of 8-12%, elevated freestream turbulence is considered to be an important factor. As discussed, a majority of film cooling studies in the literature have been conducted with freestream turbulence intensity (FSTI) less than 1%. Several researchers, however, have sought to address this issue. Launder and York (1974) found no influence to 4% FSTI. Brown and Saluja (1979) and Brown and Minty (1975) found losses in cooling effectiveness for FSTI ranging from 2 to 8%. Jumper et al. (1991), investigating the influence of high (14-17% versus 0.5%) freestream turbulence on film cooling effectiveness, found a faster decay in film cooling effectiveness with elevated FSTI than observed with low FSTI. Bons et al. (1994) documented film cooling effectiveness with FSTI=0.9%, 6.5%, 11.5%, and 17.5%, several velocity ratios, and L/D=3.5. High FSTI enhanced mixing, reduced film cooling effectiveness (by up to 70%) in the region directly downstream of the injection hole, and increased film cooling effectiveness values 50 to 100% in the near-hole regions between holes. Schmidt and Bogard (1996), however, found changes in effectiveness to depend on the coolant-to-freestream momentum flux ratio when FSTI is increased. Elevated FSTI reduced effectiveness downstream from the hole for film cooling with low momentum flux ratios but increased values when momentum flux ratios were large. Flowfield measurements were presented by MacMullin et al. (1989) for FSTI in the range of 7 to 18%. Gogineni et al. (1996) used two-color particle image velocimetry to investigate velocity and vorticity fields with 35°-inclined, single-row injection and FSTI values of 1 to 17%. Wang et al. (1996) used three-wire anemometry to document the flowfield just downstream of injection for two FSTI levels, 0.5% and 12%. Computed from the data were the eddy viscosity values in the lateral direction, $\varepsilon_{m,z}$, and wall-normal direction,

$\varepsilon_{m,y}$, and the ratio of the two. This ratio documents the anisotropy of turbulent momentum transport.

1.2.3 Short Delivery Length

Historically, film cooling studies have incorporated long-hole delivery. In recent years, researchers have elected to use shorter length-to-diameter ratios which are more representative of turbines. With a very short L/D of 1.75, Sinha et al. (1991) studied film cooling effectiveness downstream of holes with variable DR, 35°-streamwise injection, and low FSTI. Schmidt et al. (1994) investigated film cooling performance with L/D=4.0 to note the differences in adiabatic effectiveness that exist between round streamwise injection and compound-angle injection with round and shaped holes. Their studies were performed at DR=1.6 and M=0.5-2.5. Kohli and Bogard (1995) expanded L/D to 2.8 and 3.5 to investigate 35°- and 55°- streamwise injection with DR=1.6. Similarly, L/D=3.5 was used by Bons et al. (1994) and Pietrzyk et al. (1989, 1990) for studies of 35°-streamwise injection.

Differences between short- and long-hole injection have been numerically investigated as well. Leylek and Zerkle (1994) performed three-dimensional, Navier-Stokes computation and compared their results to the experiments of Pietrzyk et al. (1989, 1990) and Sinha et al. (1991). They found that film cooling exit flow contains counter-rotating vortices and displays local jetting effects. They suggested that film cooling experiments with long L/D may be misleading for engine applications. In a numerical study, Berhe and Patankar (1996) computed the influence of hole L/D and reported that L/D significantly influences the hole-exit velocity profiles and the manner by which the coolant and freestream flows interact.

1.2.4 Coolant Approach Flow Variations

Recently, strides have been made to model the film cooling delivery flow with geometries that are also more representative of the geometries in actual blade designs. Byerley et al. (1988, 1992) and Gillespie et al. (1994) studied the heat transfer near the entrance to film cooling holes. These studies incorporated different angles of inclination with the flow directed to the holes through a two-dimensional channel of height-to-diameter ratio (h/D) equal to 2.27. They found significant heat transfer enhancement over that found in an analogous duct flow but without film cooling holes. Thole et al. (1996b) and Wittig et al. (1996) also used a channel-flow delivery to study the effects of hole shapes, including those with expanded exits, on flowfield and surface quantities. Using the same facility, Thole et al. (1996a) investigated the influence of the coolant supply channel velocity on the flowfield at the jet exit and in the freestream. This investigation revealed significant influences of the channel velocity on the hole-exit and downstream flowfield velocities. In these studies, the flow was supplied to the holes parallel to and in the same direction as the freestream through a channel with h/D=2.0. Berhe and Patankar (1996) computed the role of supply plenum height and flow direction on film cooling performance. They found that the plenum flow direction has an effect on film cooling performance for h/D≤2.0.

1.2.5 Spectral Measurements

To date, measurement of spectral distributions and length scales in film cooling studies has primarily focused on the freestream. It is common, for instance, to see film cooling studies which document the integral length scales calculated from spectral measurements taken in the freestream. Though the precise influence that freestream scales have on film cooling performance has not been discerned, such documentation has been considered necessary for complete documentation and for proper starting of computational studies. The effect of length scales on cooling performance can only be inferred from data taken in film cooling studies performed at different turbulence levels which were generated by a variety of means.

To complete the documentation and the boundary conditions for computation, details of the scales, energy distribution, and dissipation rates in the coolant flow are needed. Early studies in the literature were primarily with long-hole delivery and, thus, the turbulence was that of fully-developed turbulent pipe flow. As we realize the importance of the hole L/D and investigate with shorter holes, we raise the need for documenting the influence of the hole and supply plenum geometries on coolant flow velocity distributions, turbulence levels, and scales.

Spectral measurements have been documented in considerable detail for fully-developed turbulent pipe flow over the years, including the studies of Laufer (1953), Lawn (1971), Bremhorst and Walker (1973), and Berman and Dunning (1973). In general, fully-developed pipe flow studies have documented low energy content at low frequencies, a universal -5/3 equilibrium range in the high frequencies, and a majority of the energy containing eddies in a mid-frequency range. Depending upon radial location, integral length scales of 25-75% of the pipe diameter have been determined. The larger scales are measured along the hole centerline while the smaller scales are found in the near-wall region. Peak energies were found to exist at $0.3<St_D<1.2$. Spectra in developing pipe flows have been documented by Azad et al. (1978).

Cylinders in cross flows might exhibit some similarities to certain aspects of film cooling flows. Like a cylinder in cross flow, the coolant jet is subjected to a freestream crossflow and sheds vortices in its wake. For flow past a solid cylinder, the Strouhal number for $300<Re<100{,}000$ is nearly constant and equal to 0.21.

Spectral measurements of the flow exiting film cooling holes have received limited attention in the literature. Coherent frequencies in deflected jets are in the range $St_D=0.08\text{-}0.085$ (McMahon et al., 1971). For an $L/D=4.0$, Kohli and Bogard (1997) documented the spectra of temperature fluctuations behind the hole centerline at different streamwise locations and one hole diameter from the film-cooled surface. The characteristic length scale was found to be the hole diameter.

1.2.6 Discharge Coefficients

Discharge coefficients are a measure of the flow losses through the coolant supply plenum, hole, and the coolant-freestream interaction zone. They are used to determine film cooling flow, given supply plenum total pressure and freestream static pressure. Values depend on the geometry as well as the supply plenum and freestream flow conditions.

Hay and Lampard (1996) published a review of data on discharge coefficients acknowledging measurements of Hay et al. (1983, 1992, 1994) and Hay and Lampard (1995). Discharge coefficients have been shown to scale best on the coolant-total-to-mainstream-static pressure ratio, p_c^+/p_s. These studies also document strong dependence on the internal plenum and freestream flow conditions. Gritsch et al. (1997) noted decreased discharge coefficients at high external crossflow velocities.

The geometry of the holes is also important. Haller and Camus (1983) noted that holes with a spanwise flare angle of 25° offer significant improvements in film cooling effectiveness without any additional loss penalty. Hay and Lampard (1995) reported that discharge coefficients for flared holes are higher than for cylindrical holes. Gritsch et al. (1997) documented higher discharge coefficients for fanshaped and laidback-fanshaped holes compared to those of cylindrical holes and detailed some effects of changes in approach flow conditions. Byerley (1989) looked at approach flow effects with the coolant flow delivered at acute and obtuse angles to the hole axes. Higher C_d values were observed with acute angles. Hay et al. (1992) documented discharge coefficients for cylindrical, compound-angled, lateral, and radiused-entry injection. Hay and Spencer (1992) investigated the effect of radiused and chamfered inlets of short holes (L/D=0.25-2.0). Both have increased discharge coefficients over sharp-edged holes. Hay et al. (1994) noted that vast increases in discharge coefficients could be attained with proper radiusing.

External crossflows have been observed to change the pressure drop needed to drive a given mass flow rate through a film cooling hole. Experiments (Abramovich,1963) and computations (Walters and Leylek,1997) have shown that the jets are deflected as they emerge, due to the stagnation pressure exerted by the freestream. Mixing and shearing with the freestream along the coolant jet periphery cause the flow in the outer regions of the jet to lose momentum and, thus, deflect. Keffer and Baines (1963) found that, for a normal jet, jet-to-freestream momentum significantly alters the position and size of the mixing region and jet core. This suggests that jet momentum normal to the freestream is important. Coolant-to-freestream momentum flux ratios influence jet penetration, trajectory, and the static pressure distribution (Burd et al., 1999 ; Jordinson, 1956; Walters and Leylek, 1997).

Correlating changes in pressure due to crossflow interactions, Sasaki et al. (1976) defined additive loss coefficients at the hole entrance, δ_{in}, and exit, δ_{out}. For external crossflows, they found δ_{out} to correlate well with I; high at low I and decreasing monotonically to near zero for I>1. Their data, however, show significant variability in δ_{out} for I<1.0, with differences in δ_{out} between cases approaching 200-300% for the same I, in some instances. Tillman and Jen (1984) and Hay et al. (1994) adopted Sasaki's definition in investigating discharge coefficients for other geometries. The limited number of cases with outlet additive loss evaluation and the scatter in the data prevent discussing how additive losses vary with film cooling hole geometry (Hay and Lampard, 1996). Similarly, CFD predictions of losses by Khaldi (1987) show significant mismatch with correlations deduced from the data of Sasaki et al. and Tillman and Jen.

1.3 The Present Study

Over the years, researchers have restricted their test cases to a limited number of film cooling parameters. Although each has contributed to general understanding, differences in test and flow configurations make comparing results of one with another difficult. Specifically, few direct comparisons of the roles of L/D and coolant supply plenum geometry can be clearly made for they were often conducted in separate facilities and under different conditions. The present study details the effects of these parameters, using a common facility. Data are presented in two sections. The first highlights the effect of the hole length on the film cooling process. The second documents the influence of the coolant plenum geometry. A total of six different film cooling geometries or configurations is studied. The configurations are film cooling with (1) a large, open coolant delivery plenum and a hole length-to-diameter ratio of 2.3, (2) a large, open coolant delivery plenum and a hole length-to-diameter ratio of 4.6, (3) a large, open coolant delivery plenum and a hole length-to-diameter ratio of 6.6, (4) a large, open plenum and a hole length-to-diameter ratio of 7.0, (5) a restricted plenum with flow co-current to the freestream flow and L/D=2.3, and (6) a restricted plenum with flow counter-current to the freestream flow and L/D=2.3. For all of these situations, one row of 35°-streamwise oriented film cooling holes is used. In addition, two coolant-to-freestream velocity ratios, 0.5 and 1.0, with a coolant-to-freestream density ratio of 0.96 to 1.0 are studied.

For studies of the effects of hole length-to-diameter ratio, experimental hot-wire anemometry and surface adiabatic effectiveness data are presented for the four configurations with a large, open coolant delivery plenum. The configurations vary in their respective hole length-to-diameter ratios. Hot-wire data, primarily local mean velocities and turbulence intensity, are taken at the exit-plane of the film cooling holes and in the flowfield downstream of the film cooling holes at x/D=2.5 and 5.0. Surface adiabatic effectiveness measurements are taken along the film-cooled surface downstream from the film cooling holes for $1.25 \leq x/D \leq 10$ and $-1.5 \leq z/D \leq 1.5$. Spectral (over the hole exit plane) and discharge (and loss) coefficient measurements are also presented. Although high-freestream turbulence is the primary concentration of this study, data for two FSTI levels, 0.5% and 12%, are presented for these configurations.

When holes are short, concern arises about the effect of the geometry of the plenum which supplies the film coolant to these holes. Thus, to capture the sensitivity of film cooling to the coolant delivery plenum geometry, two film cooling configurations with differing coolant delivery approach flows are introduced. For these cases, similar data are presented. Data from these cases are compared to the data for film cooling with a large, open coolant delivery plenum and a hole length-to-diameter ratio of 2.3 to quantify effects. Data are given at FSTI=12% only.

CHAPTER 2: EXPERIMENTAL TEST FACILITY

The function of the film cooling facility is to simulate a film cooling flow configuration and to permit flow and heat transfer measurements to be taken within this configuration under an assortment of flow and geometric parameter variations. The experimental test facility consists of a wind tunnel, test and metering sections, and a traversing mechanism. These components are described in the proceeding sections.

2.1 Film Cooling Geometries

Six different film cooling geometries are documented in this study. Four of these are shown in Fig. 2.1. These configurations vary in either their film cooling hole length or the means by which the coolant flow is delivered to the holes.

Four of these configurations incorporate large, unrestricted plenums and deliver the coolant as a "sink" flow to the film cooling holes. These two cases differ in their respective hole lengths and include short-hole injection (L/D=2.3), long-hole injection (L/D=7.0), and two intermediate hole-lengths (L/D=4.6 and 6.6). The latter two are not shown in Fig. 2.1. In actual blades, however, the coolant is supplied to the cooling holes through channels that are internal to the blade. The geometries of these channels influence this flow. To model the sensitivity of the film cooling flow to the direction of the coolant delivery, two additional geometries with L/D=2.3 are investigated. Counter-flow delivery forces the film coolant to approach the film cooling hole counter-current (parallel to, but in the opposite direction) to the freestream. Co-flow delivery, forces the coolant to approach the hole co-current (parallel to, and in the same direction) to the freestream. These are only two of many delivery possibilities that would be found in cooled airfoil designs. Other possibilities could include delivery of flow to the holes crossflow to the freestream. The channel height-to-hole-diameter ratio is 2.0, which is on the short side of the range for current blade designs (2.0 to 10.0). The choice concurs with h/D values used by other researchers (Thole et al., 1996a/1996b; Wittig et al., 1996).

2.2 Wind Tunnels

The freestream flow is supplied by either a high-turbulence facility or a low-turbulence facility. These two facilities are shown in Figs. 2.2 and 2.3. The freestream velocity from these facilities is nominally maintained at U_o=10.8 m/s. The flows are inherently different, however, as documented in Fig. 2.4. The approach flow measurements are taken four diameters upstream of the hole centerlines (x/D=-4). The characteristic parameters defined by these flows are given detailed in Table 2.1 below. Projected to the hole centerline, the Re_θ values are 1075 and 750, respectively.

Table 2.1: Approach Flow Conditions

Parameter	Low Turbulence Facility	High Turbulence Facility
FSTI	0.5%	12%
θ/D	0.050	0.073
δ/D	0.52	1.10
δ^*/D	0.073	0.094
Re_θ	655	960

2.2.1 Low-Turbulence Facility

The low turbulence facility (Fig. 2.2) is an open-loop wind tunnel. This is a standard configuration with a fan, screens, a setting chamber, a 6.4:1 area-reduction nozzle of exit area 68.6 cm x 12.7 cm, and the film cooling test section. The test section is that used in the high-turbulence facility. Measured turbulence intensity is 0.5%. The mean velocity was uniform to within 2% over the core of the nozzle exit flow. Uniformity measurements are presented by Tsang (1996). Figure 2.4 shows the velocity and velocity fluctuation profiles at x/D=-4.0 for the low-turbulence facility. Table 2.1 lists additional characteristics for this flow.

2.2.2 High Turbulence Facility

The high-turbulence test facility (Fig. 2.3) is a small, open-loop wind tunnel having four fans, a jet-interaction zone, a nozzle, and a film cooling test section. The main air flow, supplied by two fans through a settling chamber, is separated into two nearly equal parts. One part is distributed across the back panel and the other is ducted into the first row of jets in the side panels. These two flows combine to create a recirculation zone inside the turbulence generator. This flow interacts with flow through downstream air jets in the side panels. A 2.76:1 contraction (exit is 68.6 cm x 12.7 cm) is then used to improve the uniformity of the flow to the film cooling test section. Measured power spectra of the three components of velocity (u', v', w'), show that the flow approaching the film cooling test section is isotropic (Tsang, 1996). The integral length scale calculated from the u' power spectrum is approximately 3.3 cm. The measured turbulence intensity is 12%, a level characteristic of flow exiting the combustor stage in actual gas turbine engines. Surveys of turbulence intensity and mean velocity show that each is uniform to within 2% of its mean value. The uniformity of the velocity and turbulence intensity of the nozzle is documented by Wang (1996). The essential features of this facility were taken from the works of Ames (1994), but the facility was designed by Wang (1996). The approach flow from this facility is shown in Fig. 2.4 and documented in Table 2.1.

2.3 Test Section

The test section (Figs. 2.5, 2.6, and 2.7) consists of an upstream plate (25.4 cm x 68.6 cm), the test plate (15.2 cm x 68.6 cm), a downstream plate (91 cm x 68.6 cm), and the film cooling supply system. There is a single column of eleven film cooling holes distributed uniformly across the test plate. The film cooling flow is injected at an angle of 35° in the streamwise direction and 0° in the lateral direction. The film cooling holes are machined to a diameter of 1.9 cm (0.75 inch) and positioned three diameters apart, center to center. As described in section 2.1, the film cooling delivery tubes have length-to-diameter ratios of 7, 6.6, 4.6, and 2.3. The largest is sufficient to establish fully-developed flow within the delivery tube and is within the range used by Goldstein, Eckert, and Burggraf (1974). The smallest, at the low end of many film cooling designs in modern blades, will exhibit the greatest flow sensitivity. A rectangular polycarbonate strip (1.6 mm thick x 13 mm wide x 68.6 cm long and fabricated with sharp and straight leading and trailing edges), attached to the upstream plate, serves as a boundary layer trip. Its downstream edge is positioned 19.8 cm upstream of the hole centers. Film cooling flow is supplied by a fan through a metering section and a supply plenum which was designed for uniform distribution of flow to the holes. The coolant has Re_D=13,000 to achieve a velocity ratio of 1.0 and Re_D=6,500 to achieve a velocity ratio of 0.5. The coolant-to-freestream density ratio is in the range 0.96 to 1.0. The 0.96 value was in effect during measurements of adiabatic effectiveness. A density ratio of unity was maintained for flowfield measurements.

2.3.1 Upstream Plate

The upstream test plate (Fig. 2.8) is constructed of 9.5 mm (0.375 inch) thick clear cast acrylic sheet. The dimensions of the upstream test plate are 25.4 cm (10 inch) by 77.5 cm (30.5 inch). The upstream plate has five holes machined at both the top and bottom to permit attachment to the test wall frame support.

Attached to the upstream test plate is a side-wall channel section. The side-wall channel consists of three walls and an attachment flange. The three side walls coupled with the first 12.7 cm (5.0 inch) of the upstream plate form a box-like channel for the flow exiting the wind tunnels. Two of the three side walls are positioned normal to the upstream plate to form the top and bottom of the channel. The third side wall is positioned parallel to the upstream plate, such that it and the upstream plate form the sides of the channel. The side walls are all fabricated out of 12.7 cm (0.5 inch) thick acrylic sheet. The top and bottom side walls are 12.7 cm (5.0 inch) long by 14 cm (5.5 inch) wide. The third side wall section is inserted between the top and bottom sections and is 12.7 cm long by 68.6 cm in height. The three side wall sections are fabricated with sharp trailing edges to minimize entrainment of flow from the surroundings. These side walls are 12.7 mm thick at the upstream end of the channel and are machined to a tip at the downstream end of the channel. The machining operation is only performed on the exterior surfaces of the channel sections such that the inside surfaces of the channel remain parallel to the streamwise direction of the exiting flow and normal to one another and the upstream test plate. The attachment flange is fabricated of 12.7 mm (0.5 inch) thick acrylic. The flange is attached to upstream ends on the upstream test plate and the side wall sections. The outside dimensions of the flange are 22.9 cm (9.0 inch) by 78.7 cm (31.0 inch). The inside dimensions are 12.7 cm (5.0 inches) by 68.6 cm (27.0 inches). The dimensions of the flange are equal to the dimensions of the flanges existing at the exit of both the high-turbulence and low-turbulence tunnels thus permitting easy attachment of the test wall to either wind tunnel. The flange also permits a smooth transition of flow from the wind tunnel into the side wall channel section and assists with proper alignment of the test wall with the tunnels.

Two supports are attached to the back side of the upstream test plate. The first of these supports is used to attach the film cooling delivery plenum to the back side of the upstream test plate. This plenum support is fabricated of 2.54 cm by 3.81 cm rectangular cast acrylic with threaded holes along its length. The second of the supports is an alignment support that is used to attach the test plate to the upstream test plate. It is similar in geometry to the plenum support and is described in more detail in section 2.3.2. These supports span the internal vertical height of the supply plenum as shown in Fig. 2.12. The supports are secured to the upstream test plate using ethylene dichloride. Ethylene dichloride is a clear chemical solution that, when applied to two contacting acrylic surfaces, causes a chemical reaction which bonds the two pieces of acrylic to one another. An advantage of using ethylene dichloride versus many two-part epoxy resins is that ethylene dichloride is easily applied, fills voids, seals between materials, and forms a bond with good strength and minimal discoloration.

In addition, a planar insert (Fig. 2.12) was attached to the back side of the upstream plate between the two supports. The planar insert consists of a 1.6 mm thick piece of acrylic that is attached to two long acrylic spacers. The insert and spacers are the same length as the two supports and are necessary to form a smooth, flat surface along the back side of the test wall. For the counter-flow and co-flow delivery configurations in Fig. 2.1, this surface is needed to have a smooth flow channel to the holes.

2.3.2 Test Plate

The major characteristics of the film cooling test plate are shown in Fig. 2.9. A total of eleven film cooling holes are machined in the test plate. The holes are 19 mm (0.75 inch) in diameter and spaced three diameters apart, center-to-center. The holes are inclined at an angle of 35° and are streamwise oriented. This inclination and orientation provide a streamwise film cooling injection configuration when the test plate is secured in place. The inclination angle, hole diameter, and plate thickness together result in a hole length-to-diameter ratio of 2.3. The test plate is constructed of 2.54 cm (1.0 inch) thick phenolic laminate plate material with dimensions of 15.2 cm in width by 77.5 cm in height. Phenolic laminate is characterized by low thermal conductivity ($k \sim 0.25$ W/m•K) and is resistant to exposure to a temperature that is continually in excess of 250°C. Though somewhat abrasive, phenolic laminate was found to have good machinability and strength.

The plate is fabricated with three holes at both its top and bottom to permit attachment to the test wall support frame. The test plate is also attached to the frame along its vertical lengths via alignment supports. The alignment supports are located on the back sides of the upstream and downstream plates. The alignment supports are made of 25.4 mm by 15.9 mm cast acrylic rectangular stock with nine slots, rectangular with rounded ends, drilled through each. The alignment supports span the internal vertical height of the film cooling delivery plenum, running parallel with the sides of the test plate. Nine threaded holes are drilled in the sides of the test plate to permit the plate to be attached to these supports with machine screws and washers. The slot design permits the test plate to be secured such that its exposed surface is flush with the exposed surfaces of the adjacent plates. This is essential to maintaining a smooth, flat test surface during experimentation. The alignment supports and location with respect to the test plate can be seen in Fig. 2.12.

On the back of the test plate is a series of threaded holes. These holes are drilled to permit attachments to be placed on the back side of the test plate. The holes do not obstruct nor perturb the delivery flow to the film cooling holes. The attachments that are used include an attachment for creating long holes and, thus, fully-developed delivery, and a baffle geometry that is used to create counter-flow or co-flow delivery. These attachments are described in more detail in sections 2.3.2.2 and 2.3.2.3.

2.3.2.1 Basis for Test Plate Attachments

A focus of this research is to investigate film cooling performance with different flow delivery configurations. The base case configuration studied is one with the test plate in place with a large, open plenum behind the plate. The configuration creates a film cooling flow with no delivery directionality and a film cooling hole length-to-diameter ratio of 2.3. The flow in this configuration is delivered to the film cooling hole as a sink flow. Two test plate attachments, however, are incorporated to modify the manner in which the flow is delivered to the film cooling holes. The attachments are a long delivery tube attachment plate and baffle geometries that direct the flow entering the short holes.

2.3.2.2 Long-Hole Delivery

The long-hole delivery attachment plate (Fig. 2.10) is used to create a longer film cooling hole lengths. This attachment secures on to the back of the test plate and, combined with the thickness of the test plate, creates hole L/D's of 4.6, 6.6, and 7.0. The hole extension tubes, which are made of linen phenolic tube stock, have an inside diameter equal to the film cooling hole diameter (19 mm inside diameter and 25.4 mm outer diameter). When the attachment plate is secured to the test plate, the flow enters the extension tube from the open plenum and then travels through the hole in the test plate. Careful machining and placement of the extension tubes ensures a smooth transition from the extension tube to the test plate hole. The extension tubes used to create the L/D=4.6 and 6.6 geometries are machined so the entrance plane is parallel to the exit plane. The extension tubes for the L/D=7.0 geometry are machined with the entrance plane normal to the tube (hole) axis.

2.3.2.3 Baffle Geometry

One baffle geometry (Fig. 2.11) is used to direct the delivery flow to the film cooling holes either (1) parallel to, and in the same direction as, the freestream flow or (2) parallel to, but in the opposite direction of, the freestream flow. These two configurations correspond to the co-flow and counter-flow delivery configurations. Figure 2.1 shows the baffle positioned to achieve these flow configurations. The baffle is placed behind the test plate and forms a channel through which the delivery flow to the film cooling holes is directed. The channel height is two hole diameters (h/D=2). The baffle extends 22.9 cm in the streamwise and 66 cm in the lateral direction. The entrance to the delivery channel is 10.8 cm upstream of the leading edge of the film cooling hole. The baffle forms a closed channel ensuring that flow which enters the channel has only one exit path, through the film cooling holes. The goal herein is to investigate some delivery flow geometry effects, but not to capture all geometric features of actual airfoils, such as diffusion holes or exit rounding.

2.3.3 Downstream Plate

The downstream test plate is also fabricated from 9.5 mm thick clear cast acrylic sheet. The downstream test plate is 91.4 cm in length by 77.5 cm in height. The plate is fabricated with eight holes at both its top and bottom to permit attachment to the test wall support frame. The length of the plate permits measurements up to 40 diameters in the streamwise direction, flow conditions permitting. For the research described herein, a streamwise distance range of $x/D \leq 10$ will be considered. An alignment support for the test plate, identical to that on upstream plate, is attached to the downstream plate (Fig. 2.12).

2.3.4 Test Wall Support Structure

The test wall support structure consists of a wooden table and a Unistrut frame. The wooden table forms the foundation for the test wall. The Unistrut frame forms the actual support structure onto which the test wall and the film cooling delivery plenum are attached. Desirable qualities of the Unistrut material are its strength, rigidity, and versatile design. Each Unistrut section is constructed of steel with evenly spaced holes facilitating attachment of the various plates to the frame. Unistrut 41 mm (1.625 inch) x 41 mm (1.625 inch) pierced channel (Model# P1000 H3) is used as the horizontal and vertical support beams for the frame. To secure the channel sections to one another, 12.7 mm (0.5 inch)-13 screws, channel nuts, and flat plate fittings (Unistrut P1028, P1031, and P1036) are used. The support frame is also visible in Figs. 2.6 and 2.7. The cantilevered portion of the structure is necessary for clearance over the secondary fan which is part of the high-turbulence facility. The wooden table legs and cross-beams are made with 8.9 cm x 8.9 cm (standard 4 by 4) and 3.8 cm x 9.8 cm (standard 2 by 4) lumber. The top section is fabricated of 1.27 cm (0.5 inch) thick plywood sheet.

2.3.5 Metering Section

The film cooling metering section provides the supply flow for the film cooling holes. It consists of the coolant blower, header section, two parallel flow meters, and the supply plenum. The arrangement of these components is shown in Fig. 2.7. The components are described in detail in the following sections.

2.3.5.1 Film Cooling Supply Plenum

The film cooling supply plenum (Fig. 2.12) is located directly behind the test plate, the downstream end of the upstream test plate, and the upstream end of the downstream plate. The film cooling supply plenum consists of a "box-like" plenum and a manifold. The plenum is fabricated of 12.7 mm thick clear cast acrylic. Four pieces form the two sides, top, and bottom of the section. The top and bottom are 40 cm (15.75 inch) long by 38.1 cm (15 inch) wide. The side pieces are 66 cm (26 inch) high by 38.1 cm (15 inch) wide. When positioned behind the test wall, the plenum spans a streamwise length of 40 cm (15.75 inches) and a vertical height of 68.6 cm (27 inches). The use of clear cast acrylic permits observation and flow visualization.

Connected to the plenum is the manifold section (Fig. 2.12), fabricated of 1.27 cm thick plywood. The manifold section has a streamwise-decreasing flow area to assist with flow distribution into the film cooling delivery plenum. It has two locations through which the coolant flow is received. A 30.0 x 36.0 cm access panel (not shown in Fig. 2.12) is in the manifold.

Between the manifold and the plenum is a flow resistance element whose purpose is to assist with distributing the flow evenly into the plenum chamber. This element is 40 cm (15.75 inch) by 68.6 cm (27 inch) expanded metal plate material. The expanded metal is a standard "diamond" configuration (SWD=1.4 cm, LWD=3.18 cm, and t=1.75 mm) with approximately 58% open area. The expanded metal with 42% blockage created a pressure drop which was substantial enough to cause the desired distribution of coolant flow without noticeable deformation.

With machine screws, the plenum is affixed to the test wall. The plenum is fastened to a vertical support attached to the upstream plate and to the Unistrut support frame. A support stand, consisting of a platform and four adjustable legs, is also positioned directly underneath the manifold body to hold the delivery plenum in place. The platform is a bilayer of 12.7 mm-thick plywood sheet and the adjustable legs are 12.7 mm (0.5 inch)-13 TPI diameter threaded cylindrical bar stock. Once fastened, sealant (General Electric RTV) is applied to prevent undesired leakage of flow from the plenum.

2.3.5.2 Flow Meters

In determining an appropriate flow meter design for the film cooling facility, a series of preliminary calculations was performed to determine the operating parameters. First, the flow requirements were investigated. The film cooling test facility was designed to supply a range of velocity ratios, based on a freestream velocity of 11 m/s, from 0 to 2.0, with primary interest in the velocity ratio range of 0.5 to 1.0. Similarly, the facility was also designed with the capacity of supplying as many as twenty-one, 19 mm film cooling holes at once, should staggered rows of holes become of interest. Using these parameters, the flow requirements were determined. It was determined that the flow metering system have a volumetric air flow capacity of 0.13 m^3/s (275 CFM), a value which exceeds the capacity of most moderately-priced, commercially available air flow meters. This capacity is based upon a mean hole velocity of 22 m/s, should a VR=2.0 be desired. The calculated pressure head required at this flow rate was approximately 100 mm water.

Due to the limited number of moderately-priced, commercial grade flow meters that meet these flow capacity requirements, it was decided that a flow meter be fabricated in the Heat Transfer Laboratory at the University of Minnesota. In order to properly monitor the flow that is to be blown through a series of film cooling holes, a simple but accurate flow meter design was considered essential. Since a laminar flow meter exhibits an easily interpreted linear relationship between mass flow rate and pressure drop across the laminar flow element, a design that operates on essentially the same principles as a laminar flow meter was desired. In addition, given available pressure measuring equipment in the laboratory, a pressure drop across the meter on the order of 50 mm water (2 inches of water) at the maximum flow rate was desired.

Further design calculations were performed to determine which materials, dimensions, and other considerations would best satisfy the outlined requirements. First, the body for the flow meter was selected. Schedule 80 polyvinyl-chloride piping, 10.2 cm (4 inch) nominal diameter, was chosen as the housing. This material was chosen because it was readily available, easy to machine, and is a common commercial material that is adaptable to a variety of connections. With the PVC pipe, the geometric framework was established; thus, limiting the scope of design possibilities. A honeycomb configuration was selected as the meter flow element. The hydraulic diameter of each honeycomb module, however, had to be small enough to ensure that laminar flow would propagate through each module. Similarly, in conjunction with the hydraulic diameter, the length of each module must be such that the desired pressure drop is attained. Unfortunately, most commercially available honeycomb material did not satisfy both of these requirements. As a result, honeycombs were fabricated using approximately 500 plastic tubes, 3 mm diameter by 13.3 cm long, that were secured to one another with an epoxy spray. The honeycomb was then secured in the PVC pipe with a combination of the epoxy spray coupled with the friction and compressive forces applied to the honeycomb by the rigid inside walls of the PVC piping. In each flow meter, two honeycomb banks are used and placed in series. Two are used to increase the pressure drop in the meter length. Two meters were fabricated such that the flow metering system consists of two parallel flow sections with a single flow meter in each. The two meters are denoted by the labels Meter A and Meter B. The flow meters are 51 cm (20.0 inch) in length. Static pressure taps are drilled 9.5 cm from the two ends of the meter length. The two honeycomb banks are placed centrally in the meter length, with a 19 mm gap between the two banks. As a result, the pressure taps are located 2.5 cm upstream and downstream from the entrance to and exit from the banks, respectively. The 19 mm gap between the honeycomb sections was a design selection made to simplify assembly. It also provides a smooth transition from one bank to the next, eliminating some induced swirl and flow losses. The gap is probably the cause of other "non-laminar" pressure losses, however. A schematic of the flow meters is given in Fig. 2.13. Additional information regarding the calibration and use of the flow meters is provided in section 3.2.

2.3.5.3 Film Cooling Supply Fan

The coolant flow is supplied by the film cooling supply fan. The fan is a 2 hp, 230 VAC Cincinnati High Pressure Blower, Model HPB, with 35.6 cm (14.0 inch) diameter wheel and 12.7 cm (5.0 inch) inlet diameter. The performance curve for the blower is given in Fig. 2.14. Design flows exceed the requirements for testing, so a motor frequency controller drive is used to reduce the rotational speed of, and flow supplied by, the blower. A MagneTek GPD333 3.0 horsepower Motor Controller Drive, Model DS024, is used for the film cooling supply flow control. The drive is also adjusted to tune the blower to the rotational speed necessary to yield the velocity ratios under which testing takes place.

2.3.5.4 Header

The header (Fig. 2.26) section is a conventional decreasing-area configuration that is used to distribute the flow to the two metering sections. The flow enters the bottom of the header section and then travels to the reducing-area section where the flow is gradually forced to make a perpendicular bend and enter one of the two metering sections.

2.3.5.5 Developing Section

A 56 cm long developing length is placed between the header section and the flow meters. The developing section allows the flow from the header to the individual meters to develop modestly, but not necessarily to achieve a fully-developed condition. The desire of this section is primarily to dampen any irregular flow distributions or separation regions that result when the flow enters from the header. Screens are placed at the entrance and exit of the developing section to assist with flow uniformity and swirl reduction. Both the flow meters and the developing sections have the same inside diameters. The flow through these sections is turbulent with Reynolds numbers ranging from 6,500 to nearly 30,000 when both meters are receiving flows corresponding to velocity ratios of 0.5 to 2.0. The developing sections are connected to the meters using standard PVC socket flanges. Neoprene gaskets are placed between the socket flanges to prevent leakage.

2.4 Modifications to Test Section for Heat Transfer Studies

Both fluid mechanics and heat transfer studies are performed using the test section. The discussion to this point has only outlined the test section design as it applies to the fluid mechanics studies. For heat transfer studies, however, the facility as described is inadequate. To facilitate heat transfer measurements, including those of temperatures and surface adiabatic effectiveness, several modifications to the facility had to be made. These modifications are now described.

2.4.1 Heater for Injection Flow

For adiabatic effectiveness and temperature profile measurements, a means of either heating or cooling the injection or freestream flows is needed. Heating of the film cooling (injection) flow was selected as the means to generate the temperature difference needed between the injectant and freestream. To heat the injectant, a heater assembly (Fig. 2.15) was place downstream of the film cooling supply fan. The primary component of the heater assembly was a Milwaukee/Wagner Spray Tech Corporation heat gun Model 1220HS. The handle and outer casing were removed while the hollow cylindrical shaft in which the coil resistance heater is housed as well as the blower for the heat gun was kept intact. This assembly is placed between the exit of the film cooling supply blower and the entrance to the header section. Most of the film cooling supply flow is forced through the assembly and is heated by the coil resistance element. Some of the supply, however, is permitted to bypass the assembly and convectively cools the outside of the assembly. The assembly and bypass flows combine at the entrance to the header section. A mixing chamber is placed in the header to diffuse any thermal non-uniformities in the flow exiting the heater assembly. During experimentation, flows to the meter sections were found to be nearly uniform. Heating was controlled via the use of a Powerstat 0-120V Variable Autotransformer.

2.4.2 Adiabatic Test Surface

Temperature and adiabatic effectiveness measurements are taken in the coolant-freestream interaction region and along the test wall surface downstream of the film cooling holes. When the injection flow is heated, it enters the plenum and then exits through the holes. Unfortunately, a heated plenum is capable of heat transfer with the surroundings via conduction through the walls of the plenum, including the test wall.

To minimize conduction losses through the walls of the plenum chamber and manifold, fiberglass insulation was wrapped around their exteriors. To prevent conduction losses through the test wall, the following measures were taken. First, in designing the test section, materials with relatively low thermal conductivity were selected. Cast acrylic and phenolic laminate material both have low thermal conductivity values, in the range 0.2 to 0.3 W/m•K. Materials with lower thermal conductivity values were considered, but the machinability and material strength requirements negated their selection. The other step taken was that polystyrene insulation was placed behind the portions of the upstream and downstream plates that were in communication with the plenum. Unfortunately, the film cooling geometries being studied did not permit insulation of the entire test wall. The alignment supports and the test plate itself, remained exposed to the plenum. If these surfaces were insulated, flow would have been affected. Further discussion concerning the adiabatic test wall condition are provided in section 3.4.

2.5 Traversing System

An automated, two-dimensional traversing system (Fig. 2.16) was used to attain high-spatial-resolution measurements. Movements in the wall-normal and spanwise directions were performed using computer-controlled stepper motors. The slider assemblies are capable of travel distances of 30.5 cm and 45.7 cm in the wall-normal (y) and spanwise (z) directions, respectively. Movements as small as 0.025 mm (0.001 inch) can be made with this system. Movement in the streamwise (x) direction was accomplished by two means (1) manual movement of the entire assembly along a track which ran parallel to the test wall and (2) manual traverse with a micrometer gauge with the support assembly fixed. The second enables a streamwise traverse distance of 10 cm (4 inch).

The automated traverses are linked to the computer (section 3.2.4) via a Velmex NF90-3 series programmable motor controller drive in series with an IO- Tech IEEE Serial Converter. The converter is connected to the computer via an IEEE-488 interface. The traverses are each comprised of a slider assembly linked to a stepper motor. The traverse with 30.5 cm travel consists of a Velmex MB2515JK1-S3.0 Unislide slider and a Superior Electric Slo-Syn synchronous stepper motor model M062-LS09. The traverse with 45.7 cm travel consists of a Velmex MB4024JK1-S6.0 Unislide slider and a Superior Electric Model M091-FD09E stepper motor.

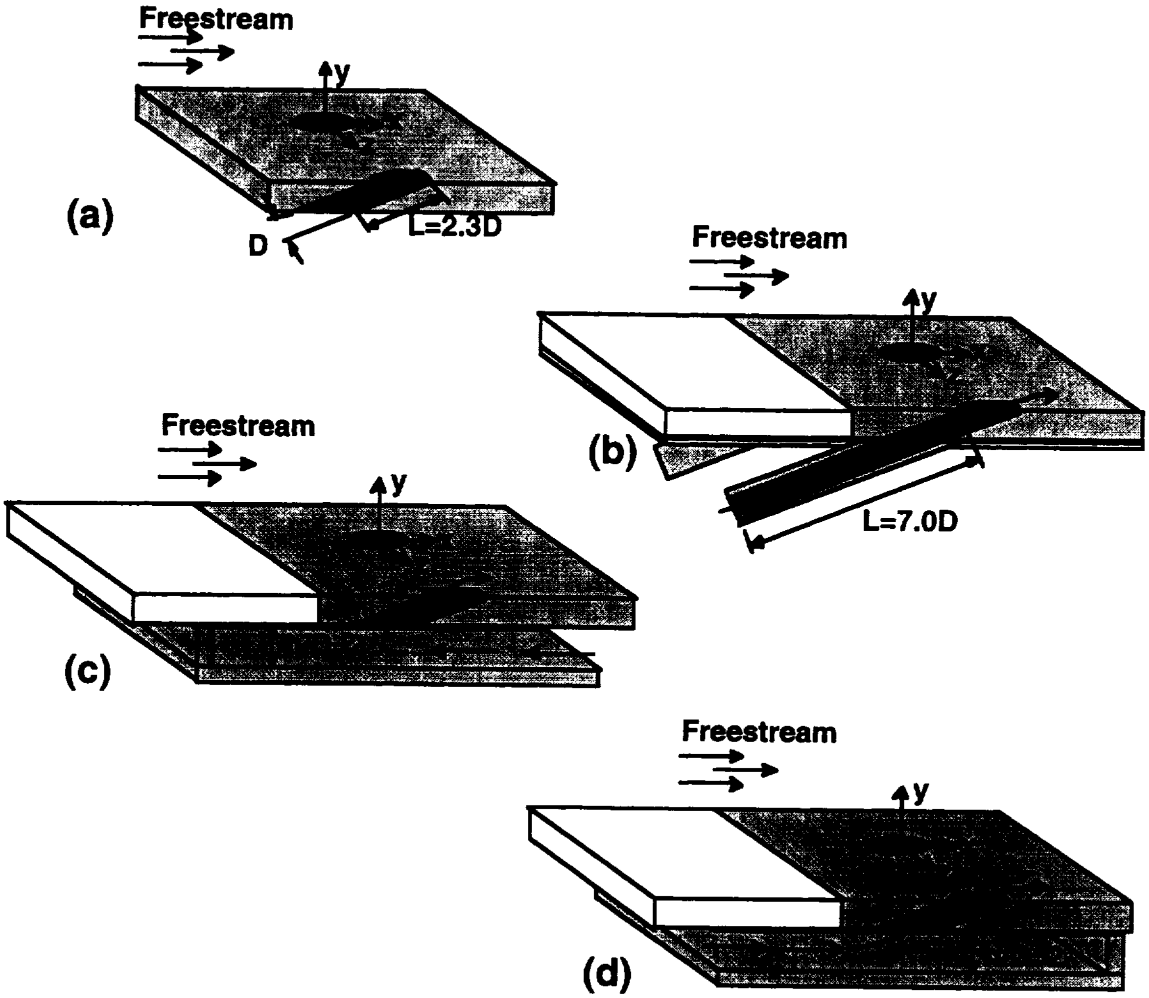


Figure 2.1: Film Cooling Geometries Studied
(a) Short-Hole, (b) Long-Hole, (c) Counter-Flow, and (d) Co-Flow

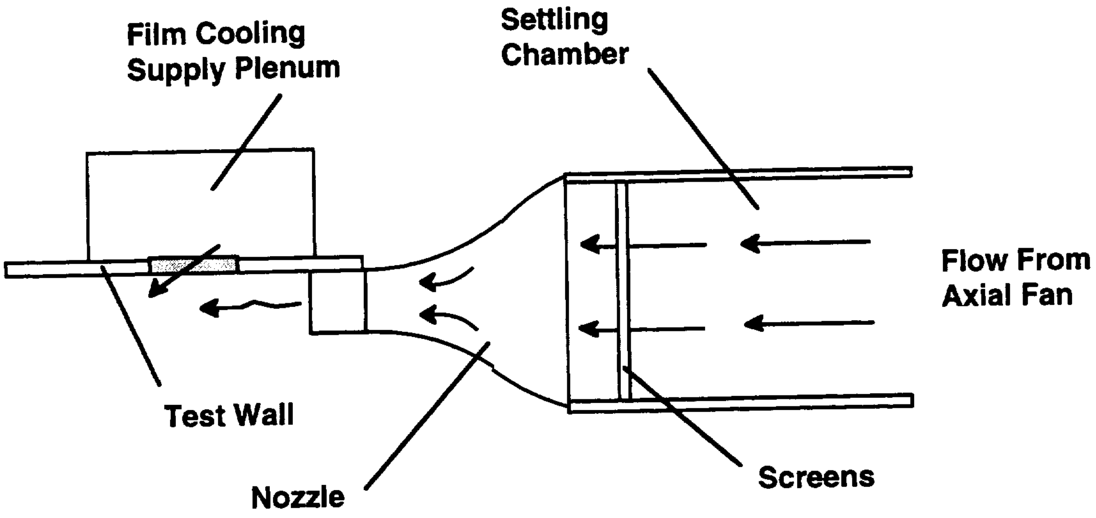


Figure 2.2: Low Turbulence Facility

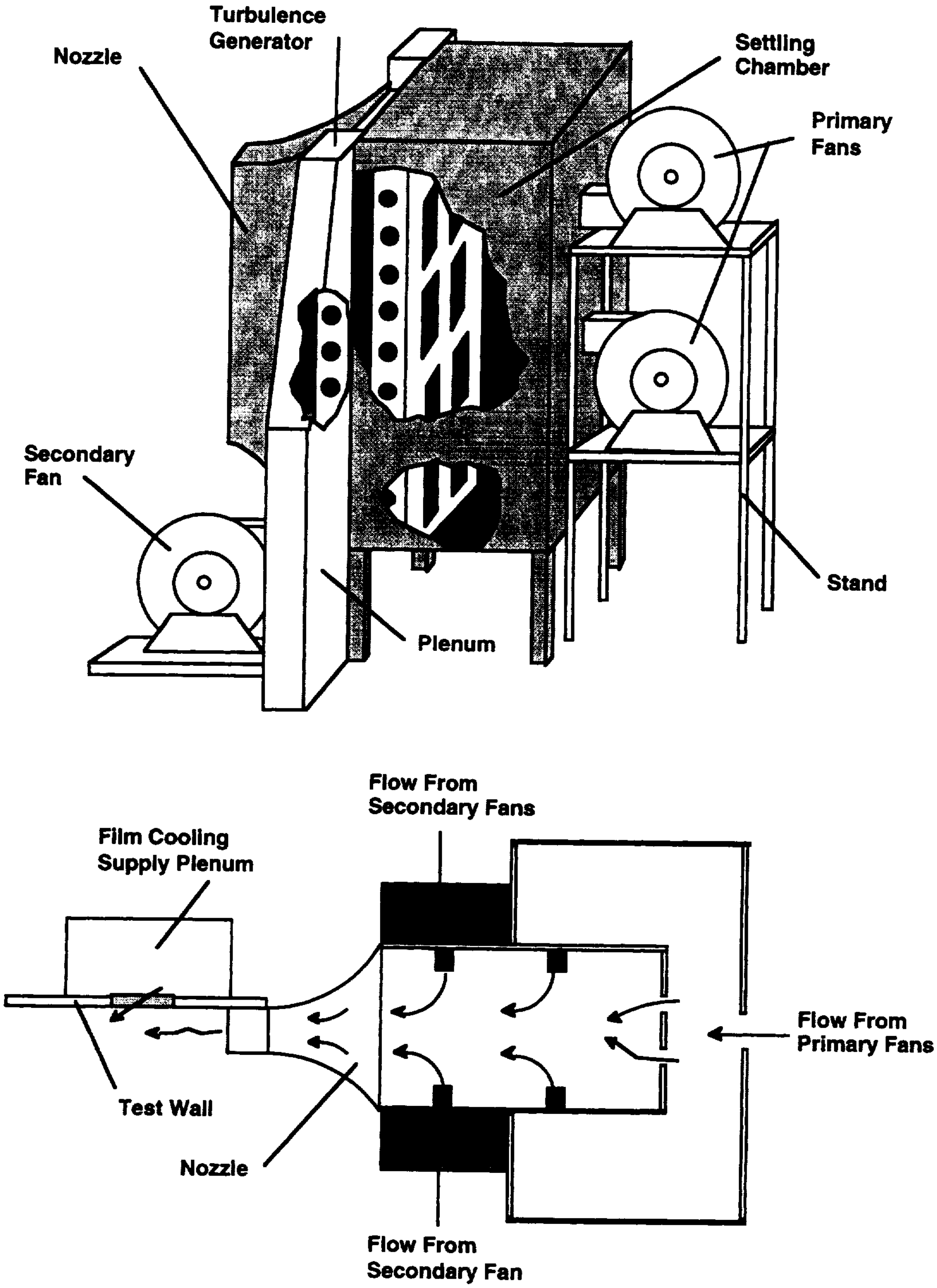


Figure 2.3: High Turbulence Facility

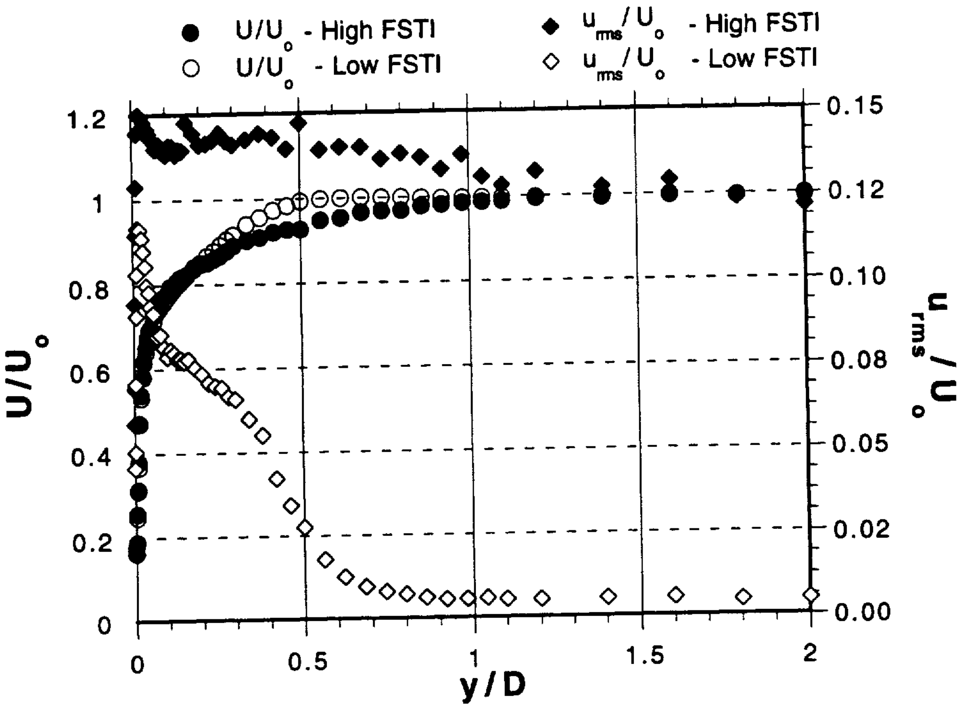


Figure 2.4: Approach Flows Characteristics

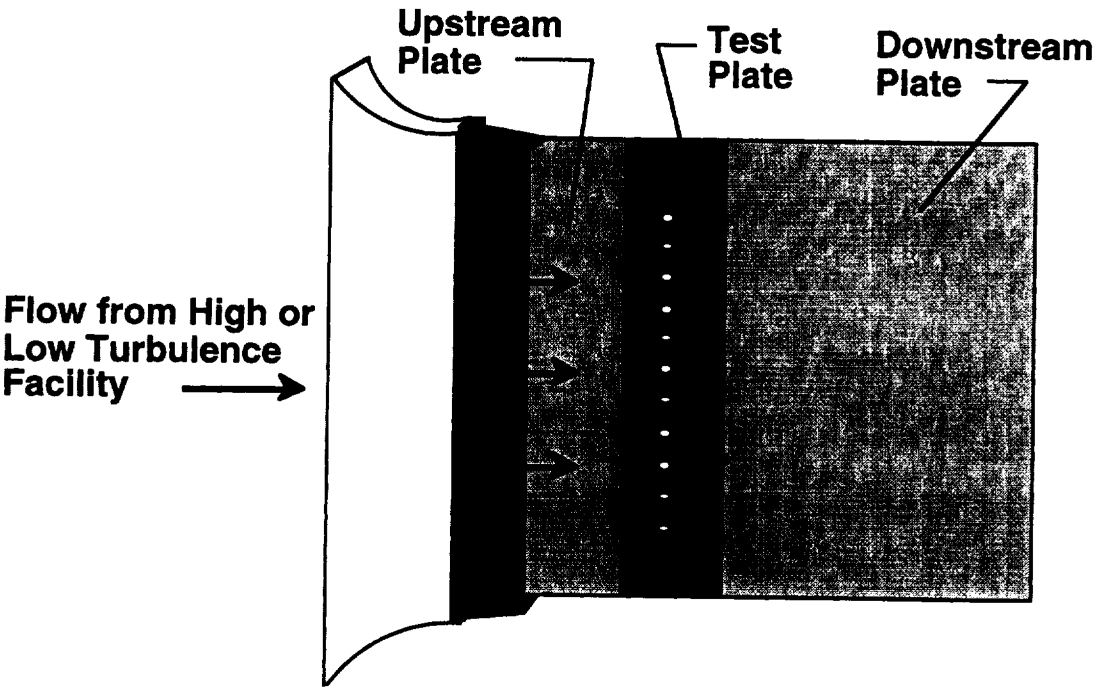


Figure 2.5: Test Section

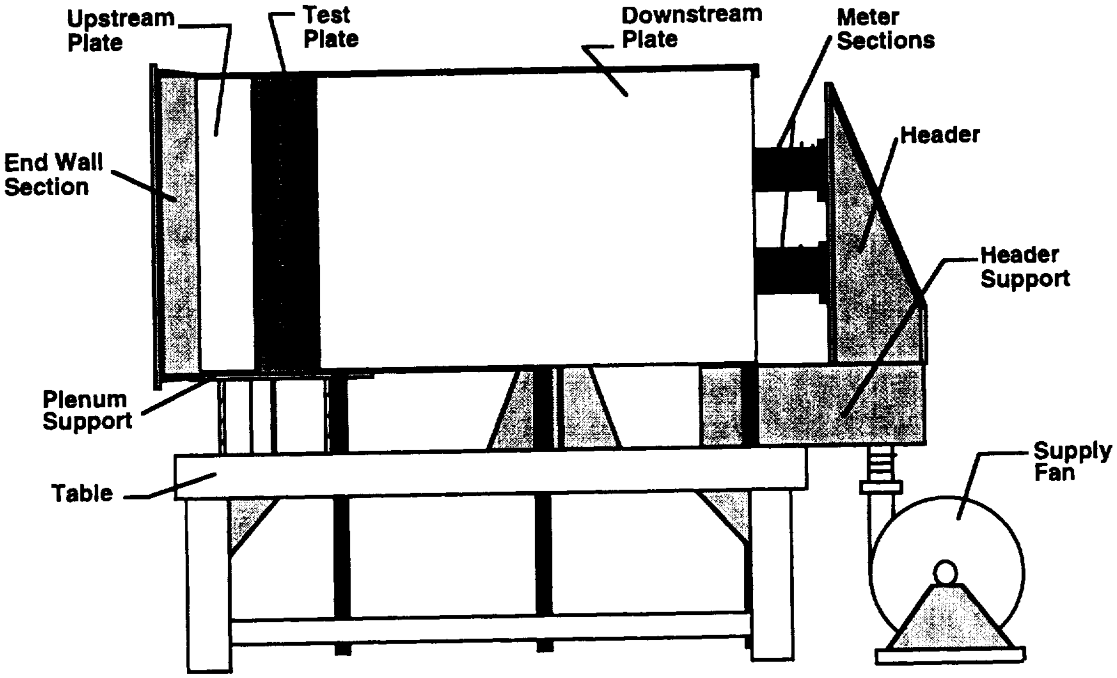


Figure 2.6: Test Section - Freestream Side

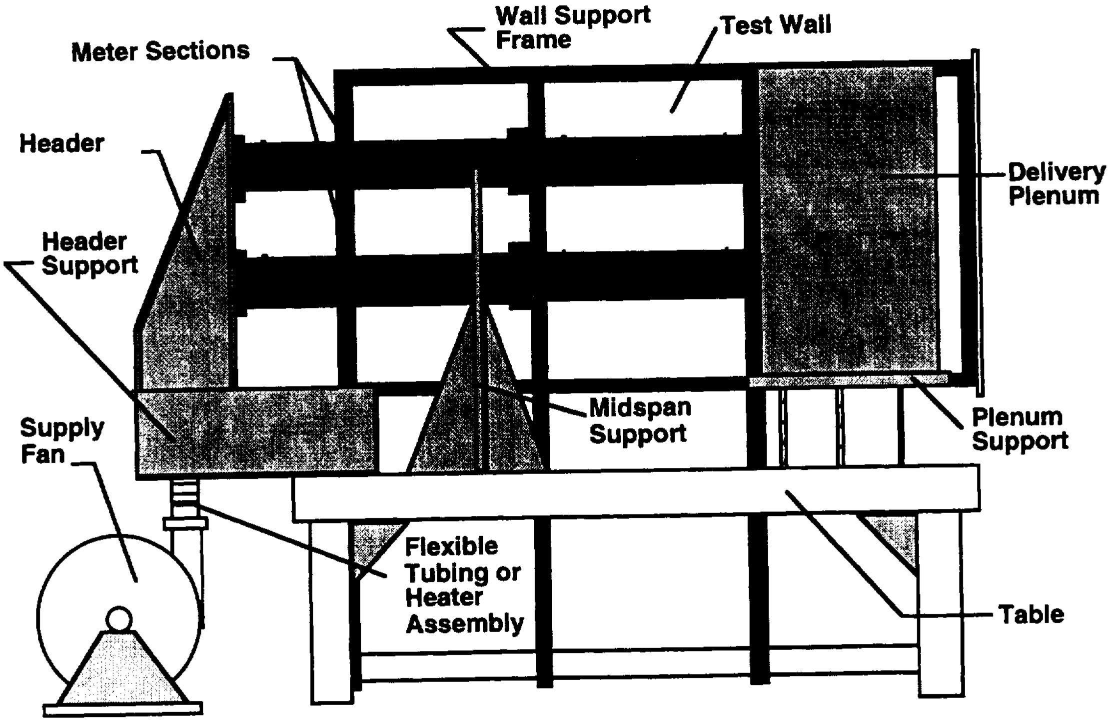


Figure 2.7: Test Section - Meter Side

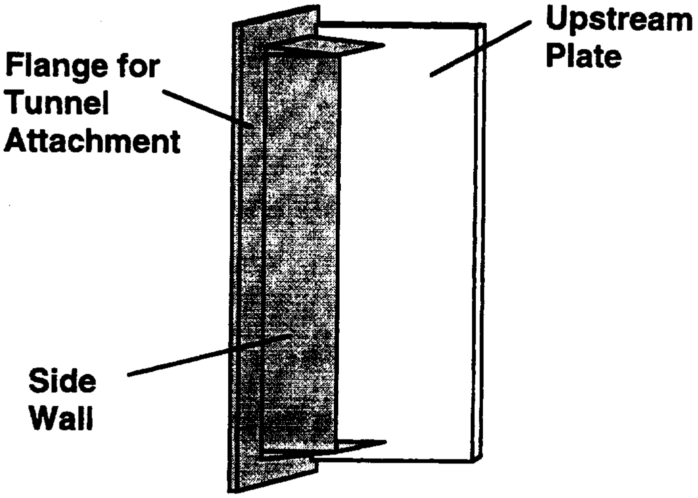


Figure 2.8: Upstream Plate and Side Wall

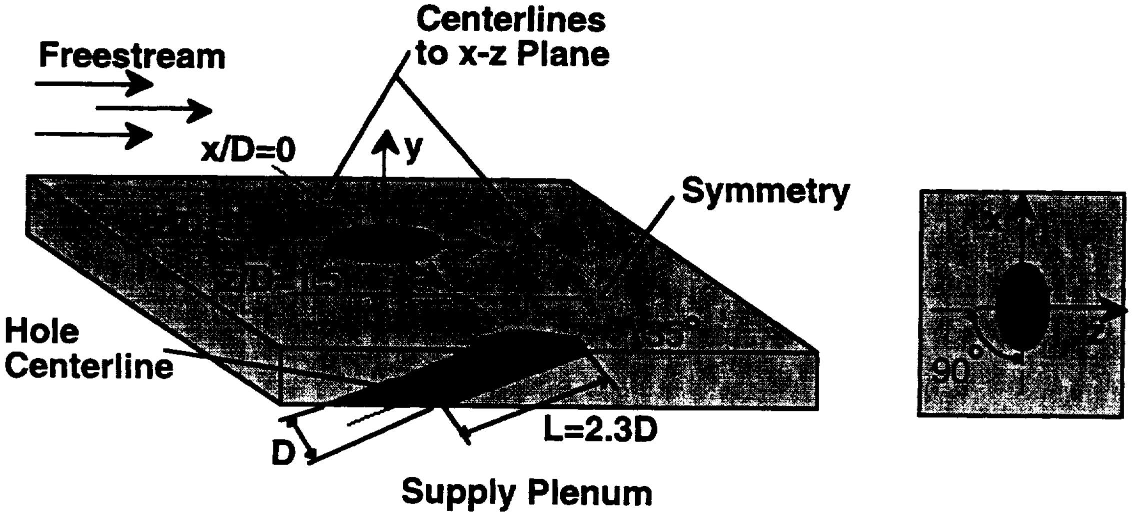


Figure 2.9: Test Plate

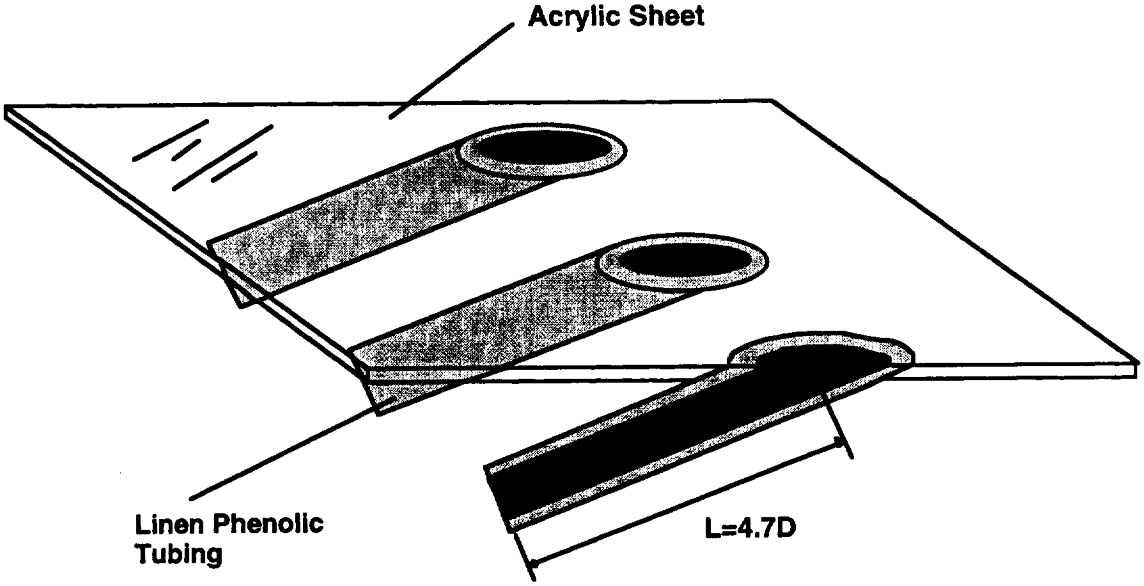


Figure 2.10: Long-Hole Attachment Plate

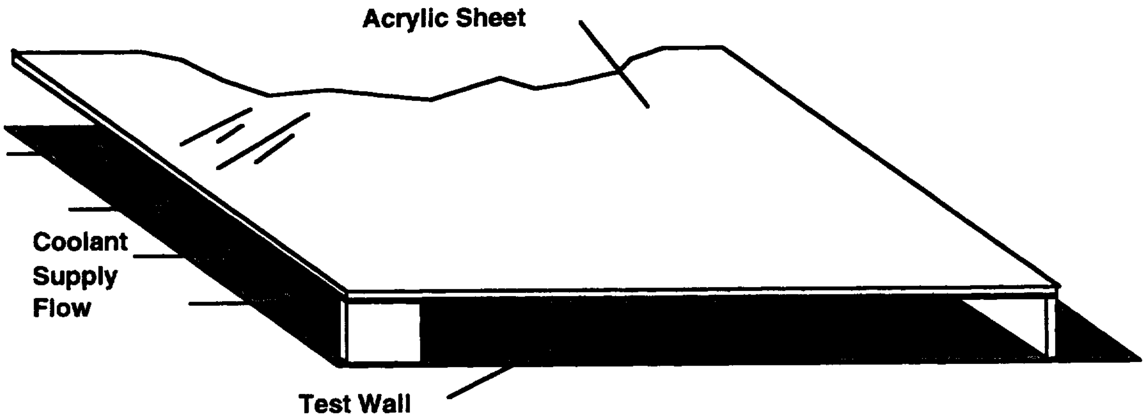


Figure 2.11: Baffle for Modified Flow Delivery Geometries

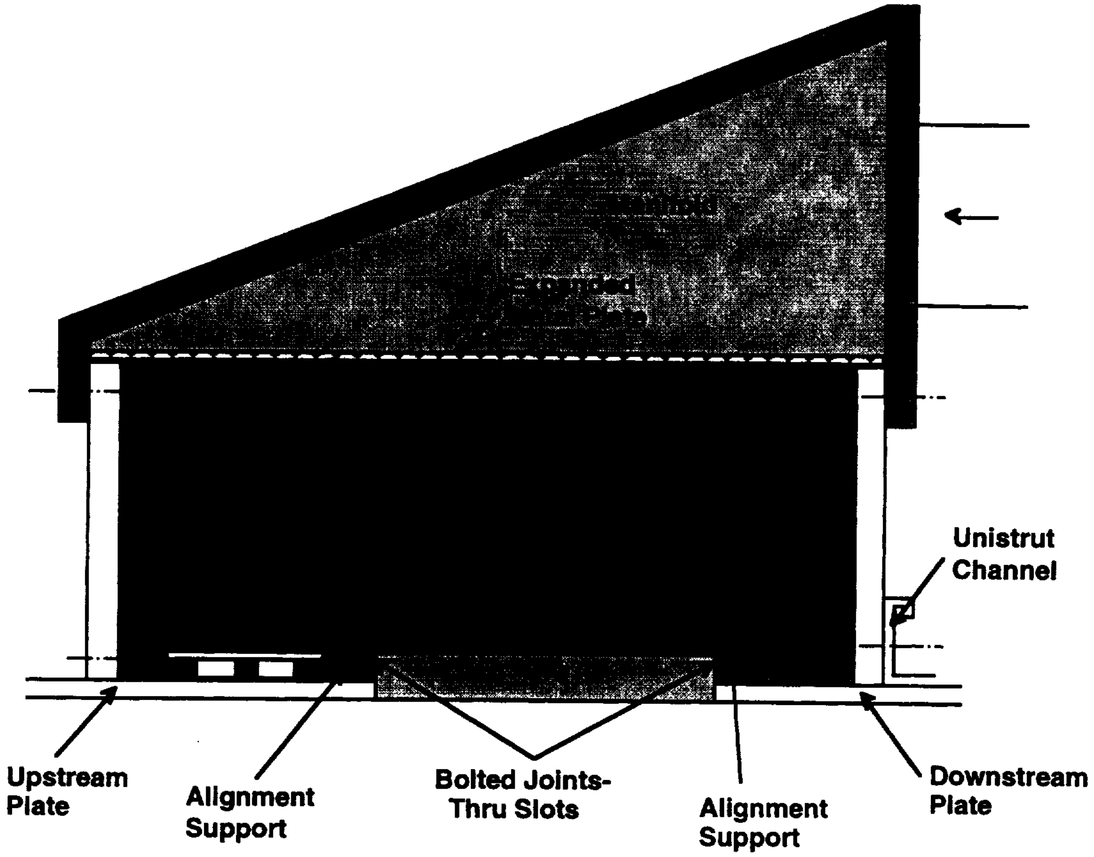


Figure 2.12: Plenum Section

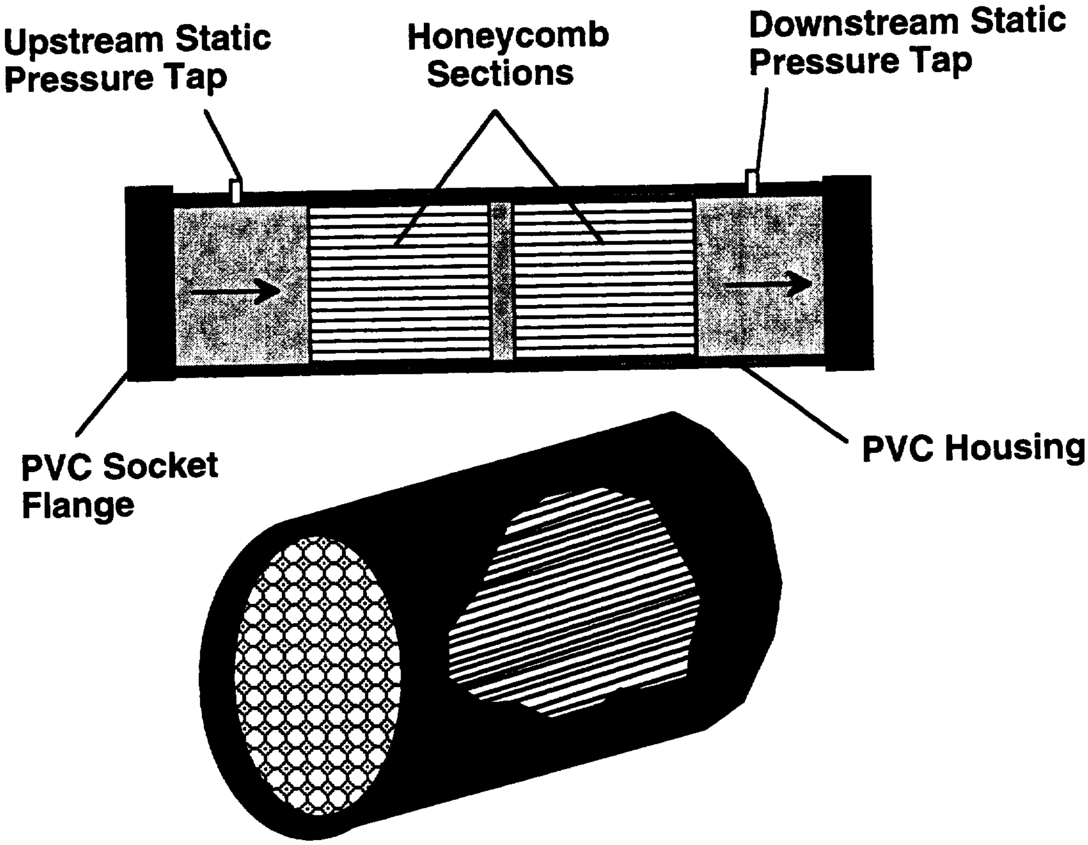


Figure 2.13: Flow Meters

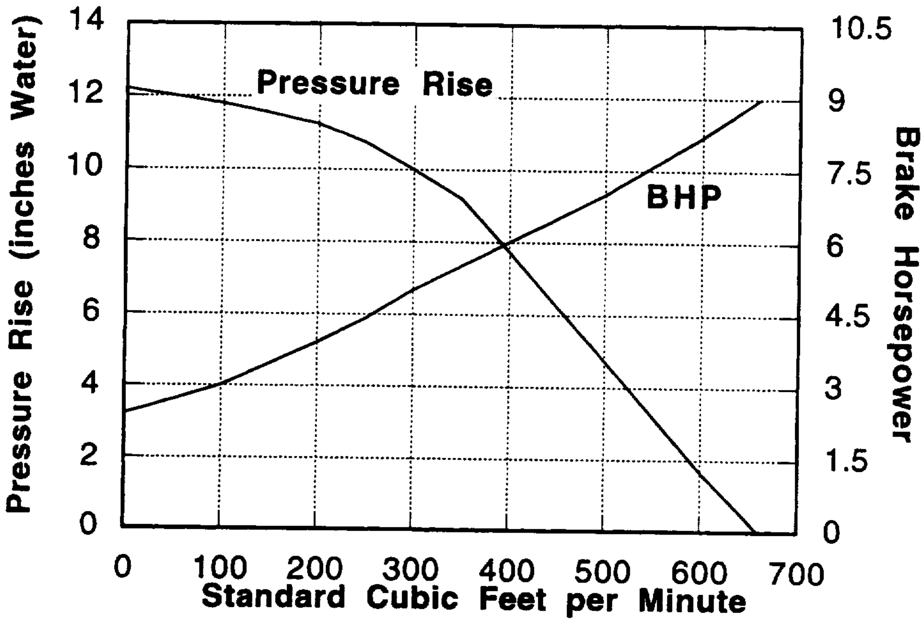


Figure 2.14: Film Cooling Supply Fan Performance Curve
(Cincinnati Blower Model HPB with 35.6 cm DIA Wheel)

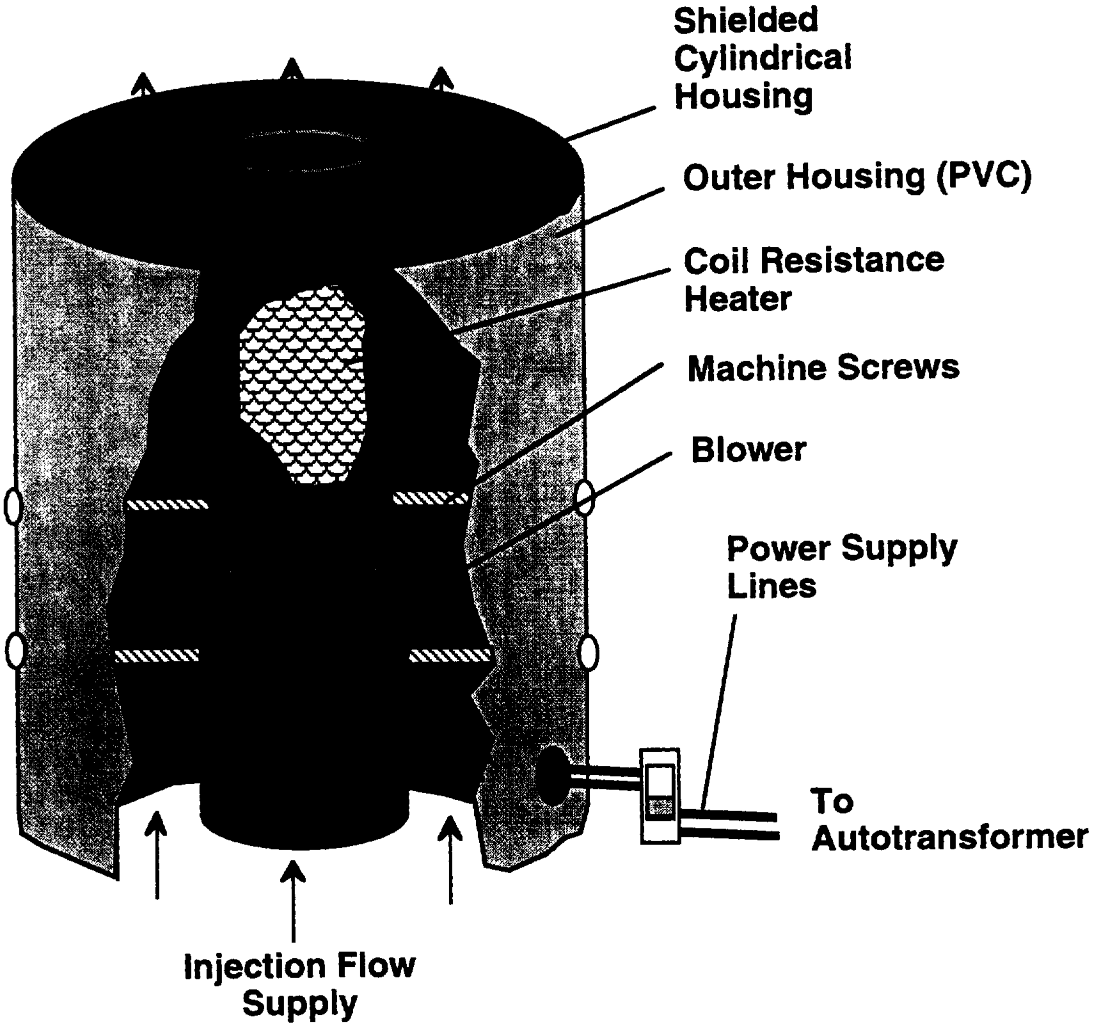


Figure 2.15: Injection Flow Heater Assembly

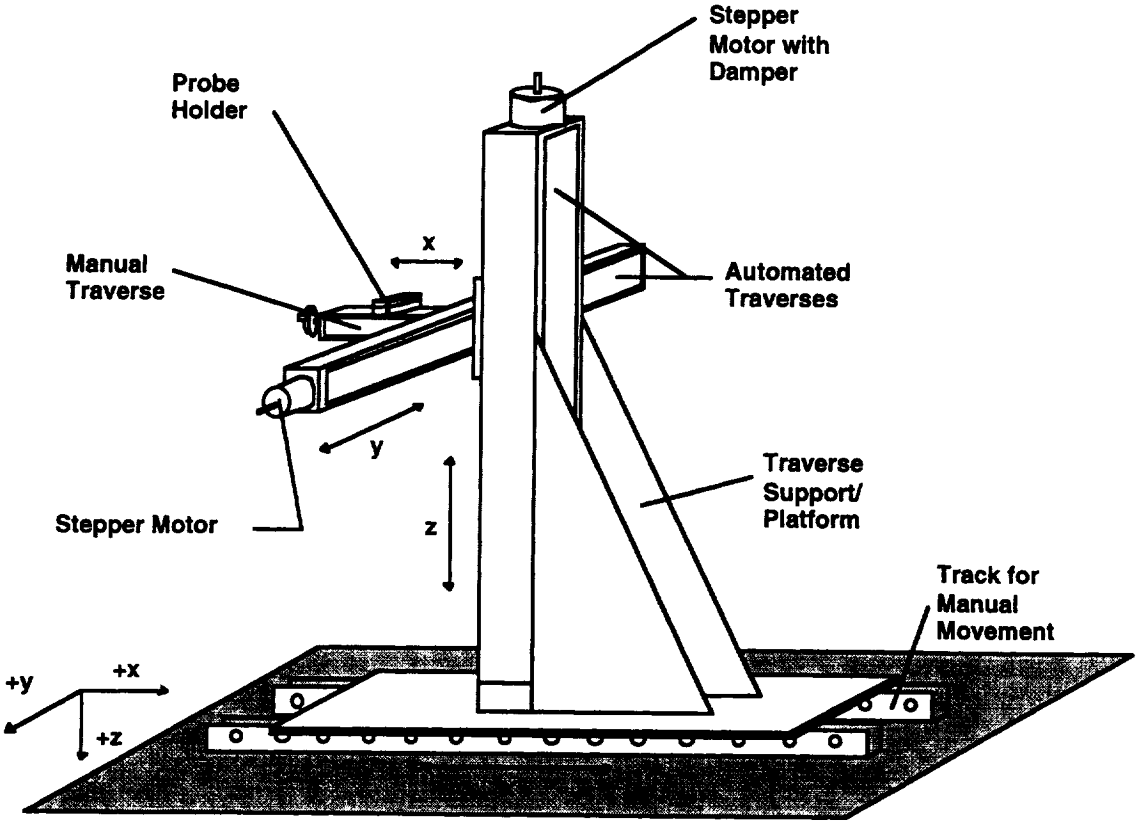


Figure 2.16: Traverse System

CHAPTER 3: EXPERIMENTAL PROCEDURE

3.1 Velocity Measurements with Hot-Wire Anemometry

Hot-wire anemometry techniques are used for measurements of velocity and velocity fluctuations in this study. The hot-wire anemometer is an extremely accommodating instrument for the measurement of mean and fluctuating velocities in an fluid stream. It utilizes small sensors, has excellent frequency response, and provides a DC electrical signal which is easily recorded. The size of the sensor allows for fine resolution measurements and measurements adjacent to a solid boundary within a sensor diameter. It also yields a continuous signal which permits processing, including spectra, octant, and wavelet analyses.

A hot-wire sensor is a small resistance element which is controlled to an elevated temperature. The amount of electrical energy dissipated is a measure of the cooling effect of the fluid flowing past the sensor. The hot-wire sensor is typically made of either platinum, tungsten, or platinum alloy in the form of a cylindrical wire. The sensor is mounted between gold-plated prongs and connected to a bridge unit via standard cables. In this study, a single-wire, boundary-layer type probe (TSI Model 1218-T1.5) was used. The probe has a 3.81 μm diameter tungsten wire sensor with a length-to-diameter ratio of 480. The active length of the wire sensor is approximately 67% of the total length.

The cooling effect of the air passing over the sensor depends on both the mass flow and temperature difference between the sensor and the fluid. The relationship between the bridge voltage and the mass flux of the air is:

$$\frac{E^2 R}{(R+R_s)^2} = \left[B_1 + B_2(\rho U_e)^{1/n}\right](T_s - T_c) \qquad (3.1)$$

Generally, n is equal to 2.0. The bridge circuit is operated in balance so that the wire operating temperature is fixed at, typically, 250°C, during experiments.

The hot-wire sensor measures the rate of heat transfer from the wire to the fluid. Thus, a calibration must be made between the bridge voltage and velocity. With a hot-wire, a near-linear relationship can be found between the bridge voltage squared and the square root of the velocity. Experimentally, one finds the power 0.435 to provide a more suitable curve fit. Thus,

$$E^2 = C_1 + C_2 U_e^{0.435} \quad (3.2)$$

A four-channel, hot-wire anemometer bridge (TSI Model IFA-100) is used. Each channel can be dedicated to a separate sensor. Data were acquired using a Norland (presently called High Techniques) Prowler digital oscilloscope and a 16-bit analog-to-digital converter (IOTECH Model #ADC 488/8SA), depending on the particular measurements. Processing and interface was performed using a Linux workstation employing C-language programming. These items are described in more detail is section 3.7.

3.1.1 Measurements

Two types of measurements are taken using the single-wire, hot-wire. First, effective velocities and velocity fluctuations are monitored over the hole-exit plane. These are used for quantifying local effective velocities, turbulence levels, and spectra of the coolant flow emerging from a given hole. Second, streamwise velocity and velocity fluctuations are measured downstream of the film cooling holes in the zone where the coolant and freestream flows interact. A single-sensor (TSI model 1218-T1.5) hot-wire probe, as shown in Fig. 3.1, is used to obtain velocity and turbulence data. It is a boundary layer type sensor, mounted to a support fashioned with a 90° bend. The bend aligns the support prongs normal to the probe centerline. This design permits measurements close to solid boundaries.

3.1.1.1 Velocity and Local Turbulence at Hole Exit

Measurements above the hole-exit plane were taken using single-wire, hot-wire anemometry. The measurements are taken by traversing the sensor parallel to the film-cooled surface and normal to the freestream flow over the exit of the film cooling hole (Fig. 3.2). The mean velocity and velocity fluctuations are, thus, expressed as effective quantities. They are, in fact, the magnitudes of velocity on the x-y plane or the vectoral sum of the wall-normal and streamwise components of velocity. The mean and rms velocities are not resolved into their wall-normal and streamwise components. Hole-exit measurements are presented for the hole-exit plane confined by $0.0 \le z/D \le 0.5$ and $-1.0 \le x/D \le 1.0$ (Fig. 3.3). The grid of measurement points in the exit-plane is made of 6 lateral by 23 streamwise stations. Additional points outside this plane were also taken but are not discussed. These additional data can be found in Appendix C. A total of

4096 data points was recorded for each measurement location over a sampling time of 40 seconds using the Norland (presently called High Techniques) Prowler digital oscilloscope.

3.1.1.2 Spectral Measurements

Effective velocity signals at the hole-exit plane were also sampled using a 16-bit analog-to-digital converter (IOTECH Model #ADC 488/8SA) in batch sizes of 262,144 (and 32,768) for spectral decomposition of the coolant flow. With these measurements, low-pass filtering was performed using a dual channel filter (Stanford Research Systems, Inc. Model SR650). Spectral distributions were measured along the streamwise hole centerline at x/D=-0.5, x/D=0.0, and x/D=0.5 of a single hole, of the eleven hole array, as shown in Fig.3.4.

After acquiring the velocity data, a fast Fourier transform was performed using Matlab software (The Math Works, Inc.) yielding the power spectral distribution (Hinze,1975).

$$E(f)=\frac{[u'(f,df)]^2}{df} \text{ and } E(f)=\frac{2\pi}{U}E(\kappa) \qquad (3.3)$$

Spectral measurements were recorded in four segments then placed together during post-processing to yield a total of 1.05 million (and 0.82 million) points for each spectral distribution. The sampling frequencies associated with these segments were 20 kHz, 2 kHz, 200 Hz, and 20 Hz. Low-pass filtering for these cases was at 10 kHz, 1 kHz, 100 Hz, and 10 Hz, respectively. This just satisfies the Nyquist sampling criterion. It was not aggressive enough to remove all alias error from the sampled data records. The use of four segments, however, produced large bands of overlap between spectra gathered at different sampling frequencies. Thus, aliases were removed by joining individual segments to produce a single continuous spectrum from the four segments, with only the highest frequency band containing a small amount of alias error. As a check, the sampling frequency was doubled and no appreciable differences were noted. Without smoothing, the spectra distributions would exhibit substantial scatter. Smoothing was employed using Hanning windowing.

3.1.1.3 Flowfield Measurements

Hot-wire measurements were also taken in the flowfield downstream from the film cooling holes. These measurements are taken at two different streamwise-normal planes, x/D=2.5 and x/D=5.0. The measurement planes, shown in Fig. 3.5, encompass the downstream coolant-freestream interaction zone given by $-0.5 \leq z/D \leq 1.67$ and $0.0 \leq y/D < 3.0$. The measurement grid has fourteen evenly spaced locations in the lateral direction. Fifty-five measurement points are distributed in the wall-normal direction with high-resolution ($y/D \sim 0.0025$) in the near-wall region and a gradual transition to coarser resolution ($y/D \sim 0.3$) in the freestream. A total of 4096 data points was recorded for each measurement location over a sampling time of 40 seconds using the Norland (presently called High Techniques) Prowler digital oscilloscope.

3.1.1.4 Additional Measurements

Hot-wire measurements were also taken at x/D=-4.0 (upstream of the film cooling holes). These measurements detail the flow approaching the film cooling holes. They permit the determination of boundary layer, momentum, and displacement thicknesses. Freestream turbulence levels are also determined using a single-wire.

3.1.2 Single-Wire Calibration

For hot-wire measurements, the density of the flow being monitored must be known. In instances where temperature variations exist, such as in the interaction region of two mixing flows of different density, hot-wire measurements may be difficult to interpret. Flowfield measurements in this study are conducted in unheated flows. Also, hot-wire measurements are unreliable in recirculating and reverse flows. To alleviate this problem, measurements are taken only in zones without recirculation, time-averaged or instantaneous. Additional effects of turbulence levels on hot-wire measurement are discussed in Section 3.1.5.

For calibration, an isothermal, low-turbulence uniform flow is used. Pitot tube measurements yield mean velocity values for calibration. Figure 3.6 shows the calibration setup using flow from a reference tunnel. The hot-wire sensor and pitot probe (United Sensor) are positioned in the same flow, with a small distance between the two. Velocities are determined via the pressure differential between the static and stagnation pressures across the pitot probe as recorded using a Dwyer Microtector micromanometer. Air density was computed from the measured temperature and barometric pressure using the ideal gas equation. When the calibration tunnel was unavailable, a calibration jet (Fig. 3.7) was used. This facility operates on the same principles as the calibration tunnel, except that velocities are deduced via the pressure drop across a nozzle. In several instances, both calibration methods were compared, showing negligible differences. A minimum of twelve velocities and their corresponding bridge voltages was recorded to yield the calibration data. The range of velocities for the calibration exceed the maximum velocity anticipated during testing to values of 2 m/s. Reliable calibration velocities below 2 m/s could not be achieved.

An example calibration is shown in Fig. 3.8. The coefficients C_1 and C_2 (Eqn. 3.1) are determined via a least squares linear curve fit. A King's Law (1914a, 1914b, 1915) type relation is approximated.

3.1.3 Measurement Correction and Compensation

3.1.3.1 Temperature Correction

For velocity measurements, best sensitivity is obtained with the largest temperature difference between the sensor and fluid. During experimentation, however, it is common for conditions to either (1) be different than calibration conditions or (2) vary during experimentation, especially during long experimental runs. There are several techniques used to account for these variations. The first-order correction is where the flow data are corrected for the temperature difference between the calibration temperature and the flow temperature. The bridge voltage is multiplied by

$$\left(\frac{T_s - T_c}{T_s - T_f}\right)^{0.5} \quad (3.4)$$

Alternatively, a standard reference condition may be incorporated to eliminate accounting for variations in calibration temperatures. For instance, all measurements could be referenced to 25°C. Therefore, during calibration and with an operating temperature of 250°C, bridge voltages would be multiplied by the proceeding correction to get a calibration referenced to 25°C.

$$\left(\frac{250 - 25}{250 - T_c}\right)^{0.5} \quad (3.5)$$

During measurements, the same correction (Eqn. 3.5) would then be used but with T_f in place of T_c, to get the corresponding velocity. Both methodologies work equally well.

During experiments, property variations may also be observed. Generally, temperature changes during a long experimental run are the dominant cause for property variations. To correct for such variations, the temperature T_f must be monitored and recorded during the run. Equation 3.4 is then corrected during the run to reflect any temperature change. This practice was implemented during the present study to eliminate bias errors that would result had no corrective measures been taken.

3.1.3.2 Pressure and Humidity Correction

Unless very pronounced, pressure and relative humidity variations tend to have minimal influence on the sensor output in comparison to temperature variations. In those instances where pressure and relative humidity variations are significant, the sensor is re-calibrated or corrective measures are taken. The most common corrective measure is to adjust the coefficients in the hot-wire calibration to reflect the change in fluid density due the pressure or humidity variation.

3.1.3.3 Near-Wall Measurements

The wall location was found by traversing the hot-wire sensor carefully against the test wall, to a location at which the probe supports are in contact with the wall. The probe was then slowly moved away from the wall in increments of 0.0025 cm. The wall location is determined by examining the anemometer bridge output as follows. When the probe is pushed against the wall, the probe supports come in contact with the wall. As the sensor of the probe moves away from the wall, the bridge output, and hence the recorded velocity, increases. When this condition is reached, the distance between the sensor and the probe depends upon the manner in which the sensor is attached to the probe. In instances where the sensor is attached to the edge of the prongs, this distance can be taken to be equal to one-half the sensor thickness. When the sensor is attached the ends of the prongs, the distance is taken to be equal to one-half the thickness of the prongs at their ends. This distance can be carefully measured with a micrometer. In the present study, both distance accounting methods were used since several different sensors were used.

3.1.3.4 Near-Wall Correction

When a hot-wire is used close to a solid boundary, errors in velocity measurements may be introduced. These errors are primarily the result of the boundary influencing the rate of heat loss from the wire. Also, when a hot-wire sensor is placed in close proximity to a solid boundary, the boundary modifies the thermal field by conduction such that additional heat is extracted from the wire. Thus, near a boundary, a false "high" velocity reading may result. Wills (1962) recognized these potential errors and, via experimentation, deduced a formulation to correct for the errors. The velocity correction, U_W, which relates the heat loss, air velocity, and distance from the wall, is given in Eqn. 3.6.

$$U_W = \left[U_R^{0.45} - K_W \left(\frac{\upsilon}{\zeta} \right)^{0.45} \right]^{1/0.45} \qquad (3.6)$$

Where the correction factor K_W is

$$K_W = 4.237\left(\frac{r_w}{\zeta} \right) - 0.000216\left(\frac{\zeta}{r_w} \right) \quad \text{for} \quad \frac{\zeta}{r_W} \le 140 \qquad (3.7)$$

This is valid only for wall distance to sensor radius ratios of 140 or less. Beyond 140, the correction is insignificant. Wills developed this correction in laminar flow. In turbulent flow, Kim (1990) found that 84% of the laminar correction best satisfied near-wall data correction in a simple, unaccelerated, fully-developed turbulent boundary layer on a flat plate. Kim's recommendation, given below, is used in this study.

$$U_c = 0.84 U_W + 0.16 U_R \qquad (3.8)$$

3.1.4 Hot-Wire Qualification

Measurements were made within a fully-developed turbulent pipe flow using the single-wire, hot-wire probe. The results were then compared to the data of Laufer (1953). The pipe, 3.75 cm (1.5 inch) inside diameter and 40 diameters long, is made of PVC plastic. Flow is supplied by a Dayton Blower Model 4C108 driven by a Dayton 1 horsepower motor (Model 5K910C). The flow exits the blower, enters a flexible ducting section, and then travels through a passive heat exchanger prior to entering the tube flow section. The passive heat exchanger is helpful as a flow resistance and straightening element upstream of the tube flow section. This facility is shown in Fig. 3.9. All the measurements were taken at the downstream end of the pipe, approximately 10 mm upstream of the pipe exit plane. The coordinates are: x, parallel to the centerline of the pipe, r, the radial direction inward from the wall, and, ϑ, the circumferential direction, perpendicular to x and r. The velocities U, V and W correspond to the velocity components in the x, r, and ϑ directions, respectively. All the results are normalized with either the flow bulk mean velocity, centerline velocity, or friction velocity. The friction velocity is calculated from the bulk and centerline velocities assuming fully-developed turbulent duct flow (Kays and Crawford, 1993).

$$U_B = 0.817 U_{cl} \qquad \textit{(3.9)}$$

$$U_\tau = U_B \sqrt{C_f / 2} = \sqrt{\tau / \rho} \qquad \textit{(3.10)}$$

$$C_f / 2 = 0.023 \mathrm{Re}^{-0.2} \qquad \textit{(3.11)}$$

The centerline velocity in the pipe is 23.8 m/s. The friction velocity is approximately 1.00 m/s. The $\mathrm{Re}_{\mathrm{pipe}}$ value is about 57,500 and Re equals 47,000. With a single-wire sensor, radial distributions of U velocity and u' velocity fluctuation profiles were taken. These measurements were then compared to similar measurements of Laufer at $\mathrm{Re}_{\mathrm{pipe}}$=50,000. All of Laufer's data are expressed in terms of $\mathrm{Re}_{\mathrm{pipe}}$.

Mean velocity and rms fluctuation data are detailed in Fig. 3.10. These data are transposed into wall coordinates in Fig. 3.11. Theoretical linear and logarithmic regions for turbulent pipe flow are superimposed in the figure. Expressions for these theoretical regions from Kays and Crawford (1993) are shown below.

$$\text{Linear: } U^+ = R^+ \qquad \textit{(3.12)}$$

$$\text{Logarithmic: } U^+ = 2.5 \ln(R^+) + 5.5 \qquad \textit{(3.13)}$$

To qualify these data, comparisons to the data of Laufer for U and u' are made in Figs. 3.12, 3.13, 3.14, and 3.15. In the figures, these data are normalized on U_{cl} or U_τ. Figure 3.12 shows a comparison plot between Laufer's and the experimental data in terms of U/U_{cl} versus r/a. The figure indicates that the experimental data agrees within 5% of Laufer's data for all data points. Laufer's data, however, extends to much smaller r/a values. This is because a 25.4 cm inside diameter pipe was used by Laufer whereas a 3.8

cm diameter pipe was used in the experimental qualification facility. Some caution, though, should be taken with the experimental data for r/a less than approximately 0.01 due to the high unsteadiness of the flow (local turbulence levels of 25-30%) and the need for a wall correction. No wall-corrected data are shown in the figure. Figure 3.13 is similar to Fig. 3.12 but shows data normalized on the friction velocity in the near-wall region. This figure highlights that the same level of agreement in the mean velocity is attained in the near-wall region.

Figure 3.14 shows normalized velocity fluctuations, u'/U_τ versus r/a. The near-wall data are expanded in Fig. 3.15. Again, there is good agreement between the data sets (less than 5% difference) for most of the radial span. In the turbulent buffer zone and the near-wall portion of the turbulent core ($0.01 \le r/a \le 0.1$), differences in the values approach 25%. The present data are less than Laufer's data. A significant portion of this error is attributable to eddy-averaging of the small near-wall turbulent scales. The ratio of the wire active length to pipe radius is approximately 0.1 for the experimental data. These influences affect a larger portion of the flow as the pipe inside diameter is reduced. Laufer's large pipe has minimal influences of this type.

3.1.5 Hot-Wire Uncertainty

Hot-wire uncertainty comes from precision and bias error. Such uncertainties, which arise during calibration and measurement, are larger at smaller velocities. They result from items such as changes in fluid properties between calibration and measurement, near-wall effects, and sensor drift. A standard propagation, as detailed by Kline and McClintock (1953), of uncertainty contributions assigned for these various effects yields a combined uncertainty of 7% (~3 m/s) to 5% (~10 m/s). Due to the large sample sizes and long sampling time associated with the hot-wire calibration and measurement, stochastic errors associated with sampling size and time fall well below the deterministic errors and are negligible in comparison. The rms velocity fluctuation and the mean velocity have the same uncertainty.

Comparisons of mean velocity and turbulence intensity to data by Laufer (1953) in a fully-developed pipe as mentioned in section 3.1.4 are used to corroborate these uncertainty values. Per these data, bias error contributions on the order of 5% of mean values are reasonable under the conditions of the bulk of the present data, so long as velocity fluctuation rms levels remain below 25% of the local measured velocity. Flow reversal over the sensor would be rectified, causing error in both fluctuation magnitude and indicated frequency. Analyses by Russ and Simon (1990) indicate that such errors become significant for turbulence intensities in excess of 25%. Our uncertainties are consistent with previous experience with such measurements and the methods outlined by Yavuzkurt (1984). Uncertainties are expressed with 95% confidence.

To corroborate the spectral data, comparisons were made to data by Laufer (1953), Lawn (1971), Bremhorst and Walker (1973), and Berman and Dunning (1973) in a fully-developed pipe flow. In general, good agreement with these data was attained.

3.2 Coolant Flow Measurements

The flow meters described in section 2.3 are used to measure the mass flow of the coolant to the film cooling holes. The methodology used for these mass flow measurements and for deducing the calibration of these meters is described in the proceeding sections.

3.2.1 Coolant Flow

Two calibration curves are generated for each flow meter, one for low flow rates and the other for high flow rates. During calibration, the flow meter was found to exhibit laminar characteristics when the flow rate was low. At higher flow rates, pressure drops in addition to the laminar contribution and proportional to the flow rate squared are observed. The forms of the calibrations and their corresponding ranges are given in Eqns. 3.14a and 3.14b. The ranges are given in terms of the pressure drop since it is the quantity being measured during experimentation. The calibrations relate a standard volumetric flow rate (SVFR) or mass flow rate at standard density to the pressure drop (ΔP) across the meter. The SVFR is referenced to dry air at 21.1 °C and 1 atm of pressure. The pressure drop is in mm of water at 4°C. The derivation of these calibration is given in section 3.2.2.

$$\mathrm{SVFR} = A_0 \circ \Delta P \quad \textbf{Where: } \Delta P < 8 \text{ mm water} \qquad \textit{(3.14a)}$$

$$\mathrm{SVFR} = A_1\sqrt{\Delta P + A_2} - A_3 \quad \textbf{Where: } 8 \le \Delta P \le 50 \text{ mm water} \qquad \textit{(3.14b)}$$

In order to properly use flow meters as accurate flow measurement devices, the test conditions must be known, including the fluid flow temperature, pressure, and relative humidity.

3.2.1.1 Standard Volumetric Flow Rate

If the temperature of the pressure measuring device is different than 4.0°C, a density correction is necessary to correlate the calibration conditions to the actual testing conditions. During experimentation, water-based micromanometers were used to measure the pressure drops across the meters. Therefore, an appropriate water density correction is needed. The following linear relationship, with T expressed in K, was deemed satisfactory as a Water Density Correction (WDC).

$$\mathrm{WDC} = 1 - 0.0003(\mathrm{T} - 277.15) \qquad (3.15)$$

For testing temperatures, water density decreases with increases in temperature. For this instance, the manometer water is at the ambient temperature. The test reading (ΔP_m) is multiplied by this factor to yield the pressure differential that would exist if the pressure-measuring instrument were referenced to 4.0°C.

$$\Delta P = \mathrm{WDC} \circ \Delta P_m \qquad (3.16)$$

3.2.1.2 Actual Volumetric Flow Rate

The actual volumetric flow rate through each hole must be determined. From this actual flow rate, the bulk mean velocity through each film cooling hole can be determined. To convert the standardized volumetric flow rate (SVFR) to the actual volumetric flow rate (AVFR), the film cooling air temperature, pressure, and relative humidity must be known. When the coolant supply heater is off, the film cooling supply system contributes a negligible amount of heat to the coolant flow. As a result, the ambient temperature is taken as the temperature of the air to the meters. This was confirmed by comparing temperatures recorded by thermocouples in the supply plenum to the ambient temperature. When the flow is heated, however, the bulk mean temperature of the coolant through the meters is determined via thermocouple surveys. Also, since the velocity head within the film cooling holes plus the pressure drops across the flow meters and through the plenum sum to an order of 0.4% or less of the ambient pressure and the film cooling flow is being discharged into the ambient, the ambient pressure can be taken to be the meter fluid pressure. Moreover, the relative humidity is assumed to be constant and equal to the ambient.

To yield an appropriate AVFR, viscosity and density corrections are needed. Air viscosity as a function of temperature (K) can be determined using the Lennard-Jones/Chapman-Enskog viscosity formulations (Bird et al. 1958):

$$\mu_T = \frac{2.6693\text{x}10^{-26}\sqrt{M_{air}T}}{\sigma^2\Omega_\mu} \quad \textit{(3.17)}$$

Where: $$\Omega_\mu = 1.3727\left(\frac{T}{97}\right)^{-0.2489}$$

Which simplifies to:

$$\mu_T = (2.5621\text{x}10^{-7})T^{0.7489} \quad \textit{(3.18)}$$

Therefore, dividing the test temperature viscosity by the viscosity at standard conditions yields the Temperature Viscosity Correction (TVC):

$$\text{TVC} = \frac{\mu_T}{\mu_{std}} = 0.014164T^{0.7489} \quad \textit{(3.19)}$$

Viscosity changes associated with relative humidity changes, as described by Mason and Monchick (1963) and Kestin and Whitelaw (1964), are incorporated into a Relative Humidity Viscosity Correction,

$$\text{RHVC} = \frac{\mu_{wet}}{\mu_T} = 1 + 0.000173\phi(T - 273.15)[1 - (0.07264(T - 273.15)] \quad \textit{(3.20)}$$

Air density changes can be determined by assuming that dry air behaves as an ideal gas. Hence, to determine density corrections, the ambient pressure (bars) and fluid temperature (K) can be compared to the standard pressure and temperature to yield an Ideal Gas Density Correction,

$$\text{IGDC} = \frac{\rho_{std}}{\rho_{dry}} = 0.003444\left(\frac{T}{P}\right) \quad \textit{(3.21)}$$

A density correction associated with changes in humidity is determined by using a standard relationship between specific humidity and relative humidity. The two quantities are related to one another via psychrometric relationships that incorporate the saturation pressure. The saturation pressure (atm), P_{sat}°, of the moist air is determined as a function of temperature. Equation 3.22 is given by Look and Sauer (1986) for the saturation pressure for water in atmospheres for the temperature range 273.15-373.15 K.

$$\begin{aligned}\log_{10}\left(P_{sat}^{\circ}\right) &= 10.79586(1-\psi) + 5.02808\log_{10}(\psi) \\ &+0.0000150474\left[1-10^{(-8.29692(1/\psi-1))}\right] \\ &+0.00042873\left[10^{(4.76955(1-\psi)}-1\right]-2.2195983 \qquad (3.22)\end{aligned}$$

Where: $\psi = \dfrac{273.15}{T}$

The saturation pressure can be expressed as bars using the formulation below.

$$P_{sat} = 1.013 P_{sat}^{\circ} \qquad (3.23)$$

With the saturation pressure of water vapor known, the correction can be resolved as:

$$RHDC = \frac{\rho_{dry}}{\rho_{wet}} = \frac{1}{1-0.378\phi\dfrac{P_{sat}}{P}} \qquad (3.24)$$

With the corrections developed, an expression for the actual volumetric flow rate being supplied to the film cooling holes can be derived. The corrections depend on the flow range under study. When flow rates are low, viscosity corrections are important. Under high flow rates, both viscosity and density corrections must be taken into account and the expression for AVFR takes on a more complex appearance. The expressions for AVFR for the low and high ranges are given in Eqns. 3.25a and 3.25b, respectively.

$$AVFR = \frac{A_0 \circ \Delta P}{VC} \qquad (3.25a)$$

$$AVFR = A_1\sqrt{\Delta P \circ DC + A_2(DC \circ VC)^2} - A_3 \circ DC \circ VC \qquad (3.25b)$$

Where:

$$DC = IGDC \circ RHDC$$
$$VC = TVC \circ RHVC$$

When the coolant is heated, there may be a slight variation in the temperature between that being supplied directly to the film cooling holes and that being recorded as the temperature of the flow through the meters. These slight variations arise from small heat transfer losses through the plenum walls. When this occurs, an additional correction is needed. This is given by multiplying the AVFR found above by the ratio of the temperatures.

$$AVFR_{hole} = AVFR\left(\frac{T_{hole}}{T}\right) \quad (3.26)$$

Measurements have shown the hole-exit flow to be uniform from hole to hole. These include hole-exit measurements and measurements taken downstream of the film cooling holes (Figs. 3.16 and 3.17). Thus, to determine the coolant bulk mean hole velocity, U_{hole}, the total AVFR is divided by the total cross-sectional area of the film cooling holes. During experimental runs, the AVFR is measured repeatedly to ensure that the chosen bulk mean film cooling hole velocity is being supplied.

3.2.2 Calibration Methodology

The flow meters have been calibrated against a Meriam Instrument laminar flow meter, model 50MC2-6. This meter is a low pressure type laminar flow meter designed for use with 15.25 cm (6.0 in) pipe or tubing. In addition, the meter is traceable to the National Institute of Standards and Technology (NIST). The specific meter used is calibrated for a range of standardized volumetric flow rates versus a corresponding range of differential pressures. The calibration data are standardized to a dry air flow rate at 21.1°C (70°F) and 1.013 bars (29.92 in Hg). The volumetric flow rate is related to the pressure differential via a calibration curve fit. Specifically, from Meriam, the Standardized volumetric flow rate in Cubic Meters per Minute (SCMM) is related to the differential pressure in millimeters of water referenced to 4.0°C. The meter has a valid calibration over the pressure differential range of 0 to 203 mm (8 in) of water at 4.0°C with a corresponding flow rate range of 0 to 28.3 SCMM (0 to 1000 SCFM).

A series type air flow configuration (Fig. 3.18) was used to calibrate the flow meters using the commercial laminar flow element. The two were attached in series with a blower (Dayton Blower Model#4C329) supplying the flow through each. The blower, located upstream of the meters supplies filtered ambient air. For reference, the performance curve for this blower is given in Fig. 3.18. The air supply first enters a small flexible tubing section then proceeds into a development section that is 66 cm (26.0 in) in length. The development section has an inside diameter equivalent to that of the flow meters and is fabricated out of 10 cm (4.0 in) nominal, schedule 80, polyvinyl chloride pipe. At the downstream end of the development is a flow screen that assists with uniformity upstream of the installed meter. A 66 cm length of PVC tubing is attached downstream of the meters. Attached to this length is a 10 cm by 15.25 cm expansion connector that joins it to a larger diameter section of stainless duct. This duct is attached directly to the laminar flow element and its length, 1.52 m (60.0 in), is chosen to satisfy the installation requirements for the laminar flow element. Honeycomb sections are placed within this duct section to ensure that the flow has developed before entering the laminar flow element. Next in series lies the commercial laminar flow element followed by an exit section of 15.25 cm diameter stainless duct.

To properly utilize the commercial laminar flow element, both the ambient environment conditions and the flow conditions at the inlet to the laminar flow element must be known. The parameters that define these conditions are then used in corrections that are necessary to yield the standardized volumetric flow rate values based upon a pressure differential referenced to 4.0°C. The corrections take into account density and viscosity variations in comparison to the referenced or standardized conditions and are essentially the same corrections described in the previous section. Pressure measurements were taken using a Microtector micromanometer and a U-tube manometer. Both use water as the manometer fluid. All absolute pressures were with a mercurial barometer. Ambient temperature was recorded with ASTM certified precision thermometers. Relative humidity was taken using a certified hygrometer and temperature indicator (Abbeon Cal, Inc. model HTAB169B).

To convert the measured pressure differentials to the 4.0°C reference, the ambient temperature to which the manometer was exposed was noted and used in the appropriate correction. Via preliminary investigations of the calibration facility, it was determined that the operating blower contributed a negligible heat input to the flow stream. Comparisons of simultaneous ambient and flow stream temperature measurements yielded temperature differences on the order of 0.1°C or less. As a result, in determining the inlet temperature to the meter, the ambient temperature was shown to be valid and was used in the corrections. The relative humidity was also assumed to remain equal to the ambient value throughout the calibration so the ambient value was incorporated into the corrections. Inlet pressures to both meters were found via static pressure taps located upstream of the respective meters.

The flow meters yield a linear relationship between volumetric flow rate (SCMM) and pressure drop (mm water) between the taps for low flow rates. This linear behavior is anticipated for a laminar flow meter. Unfortunately, at higher flow rates, the pressure drop across the meters has a "non-linear" dependence on the flow rate. A dependence of the pressure drop on the flow rate squared must be incorporated under high flow rates. Complying with the laminar flow element calibration, the volumetric flow rate is referenced to standard conditions of dry air at 1.013 bars (29.92 in Hg) and 21.1°C (70°F). Similarly, the pressure drop is referenced to standard water conditions - saturated water at 4°C. Under low flow rates, the relationship between the pressure drop and SVFR takes the form:

$$\Delta P = a_0 \circ \mathrm{SVFR} \circ \frac{\mu_{std}}{\rho_{std}} \qquad \textit{(3.27a)}$$

Under higher flow rates, the additional contribution to the pressure drop must be brought into the expression to yield

$$\Delta P = a_1 \circ \mathrm{SVFR} \circ \frac{\mu_{std}}{\rho_{std}} + a_2 \circ \mathrm{SVFR}^2 \qquad \textit{(3.27b)}$$

The function of the meters, however, is to provide SVFR values when ΔP is known. Equation 3.27a can be easily rearranged to yield an expression for SVFR as a function of ΔP. This expression is given in Eqn. 3.28a.

$$\mathrm{SVFR} = A_0 \circ \Delta P \qquad \textit{(3.28a)}$$

Via algebraic inversion, an analogous expression can be derived from Eqn. 3.27b.

$$\mathrm{SVFR} = A_1\sqrt{\Delta P + A_2} - A_3 \qquad \textit{(3.28b)}$$

The calibration curves generated for the individual meters, with ΔP in mm of water and SVFR in SCMM, are given below. The calibrations for the two meters are slight different from one another. Both calibrations encompass volumetric flows rates of 0 to 3.5 SCMM.

Meter A:

$$SVFR_A = 0.1123\Delta P \quad \text{(LOW)} \qquad \textbf{\textit{(3.29a)}}$$

$$SVFR_A = 0.7513\sqrt{\Delta P + 8.6844} - 2.2141 \quad \text{(HIGH)} \qquad \textbf{\textit{(3.29b)}}$$

Meter B:

$$SVFR_B = 0.1165\Delta P \quad \text{(LOW)} \qquad \textbf{\textit{(3.29c)}}$$

$$SVFR_B = 0.8103\sqrt{\Delta P + 9.4368} - 2.4891 \quad \text{(HIGH)} \qquad \textbf{\textit{(3.29d)}}$$

3.2.3 Flow Meter Qualification

Repeatability checks were performed to validate the calibrations of the meters. The test conditions under these repeatability checks varied from the calibration conditions. Still, repeatability test data were in excellent agreement with the calibration curves.

Hot-wire surveys and integration of the velocities at the exit of the film cooling holes were also performed without freestream flow to corroborate the velocities given by the methods in section 3.2.1. Such measurements are discussed in section 4.2.1.1.

3.2.4 Coolant Flow Uncertainties

Uncertainties for coolant flow measurements were calculated per the methods of Kline and McClintock (1953) and Moffat (1982). The major contributions of this uncertainty are precision and bias error that arise during calibration and measurement. Stochastic errors are negligible in comparison.

For the coolant flow measurements, a calibration curve, generated for each meter, was used to resolve the combined mass flow rate of the coolant through both meters. The calibrations related the pressure drop across the meters to the mass flow rate at standard dry air density (Eqns. 3.29a through 3.29d). These calibrations were performed per the methods described in section 3.2.2 and uncertainties were attained during the process. Experimental data agree to within 2.0% of the values given by the calibrations. Repeatability test data concur with this level of agreement.

During experimentation with these flow meters, additional uncertainties arise. These are primarily due to uncertainties in the temperature, pressure, and relative humidity during experimentation. These uncertainties, coupled with the calibration uncertainties, propagate via the density and viscosity corrections to yield a total uncertainty in the AVFR. With the algebraic relationships provided in section 3.2.1, the sensitivity of AVFR to each of the corrections is easily calculated. The uncertainty in AVFR was taken to be the uncertainty in the bulk mean velocity through the individual film cooling holes.

The uncertainty associated with both meters were found to be essentially the same. Uncertainty in AVFR was found to be ±2.3% when the coolant was unheated and approximately ±2.8% when the coolant supply was heated. Measurements of the pressure drops across the meters are certain to within ±0.03 mm of water for pressure measurements. Uncertainties calculated for ambient pressure and relative humidity are ±0.007 bar and ±0.005 (0.5%), respectively. Temperature uncertainties were generally on the order of ±0.3 °C or less for all measurements. All uncertainties are expressed with 95% confidence.

3.3 Discharge Coefficients

Discharge coefficients are useful for determining film cooling hole flow given the pressures of the coolant supply and freestream. A discharge coefficient is the fraction of the "ideal" mass flow rate which actually flows through the film cooling holes:

$$C_d = \frac{\dot{m}_a}{\dot{m}_i} \qquad \textit{(3.30)}$$

This ideal flow is based upon an isentropic, one-dimensional expansion of the coolant from the supply plenum total pressure, p_c^+, to the mainstream static pressure, p_s. For the present study, compressible effects can be ignored and this ideal mass flow was calculated using the Bernoulli equation:

$$\dot{m}_i = A\sqrt{2\rho\left(p_c^+ - p_s\right)} \qquad \textit{(3.31)}$$

The total pressure in the coolant supply plenum and the mainstream static pressure were measured using a pitot-static probe. For delivery from a large, open plenum (Figs. 2.1(A) and (B)), total pressure measurements were taken sufficiently far from the hole that there was no perceptible velocity head. For the counter-flow and co-flow configurations (Figs. 2.1(C) and (D)), the coolant total pressure was measured along the channel centerline at the entrance plane to the channel, 6.3D upstream from the centers of the film cooling hole inlets. Surveys indicated negligible variations in total pressure along the channel centerline at the entrance plane. Pressures are recorded using a Dwyer Microtector micromanometer. The actual mass flow to all film cooling holes was measured using laminar flow meters in the coolant supply system.

3.3.1 Outlet Additive Losses

Losses associated with the external freestream crossflow are quantified in terms of outlet additive loss coefficients. This loss, δ_{out}, relates the difference between measured pressures, with and without the external freestream, to the film cooling velocity head:

$$\delta_{out} = \frac{\left[\left(p_c^+ - p_s\right)_{U_\infty \neq 0} - \left(p_c^+ - p_s\right)_{U_\infty = 0}\right]_{U_{hole}, \rho}}{1/2\rho\left(U_{hole}\right)^2} \quad (3.32)$$

When the bulk mean velocity, density, and, thus, momentum flux of the coolant flow with and without an external freestream are matched, the net loss introduced exclusively by the external freestream flow can be quantified. This expression can be simplified in terms of discharge coefficients with, C_d, and without, $C_{d,o}$, the freestream:

$$\delta_{out} = \frac{1}{\left(C_d\right)^2} - \frac{1}{\left(C_{d,o}\right)^2} \quad (3.33)$$

3.3.2 Uncertainties in Discharge Coefficients

Uncertainties in $(p_c^+ - p_s)$ and ρ are ±1.1 Pa and ±0.004 kg/m^3, respectively. Machining tolerances result in negligible contributions to the uncertainty. The uncertainty in the mass flow is ±2.3%. Discharge coefficients have nominal uncertainties of 2.5% (2.5-8% for lowest C_d values). Uncertainties are expressed with 95% confidence.

3.4 Temperatures and Adiabatic Effectiveness

3.4.1 Thermocouple Measurements

Thermocouples were used to measure the freestream and coolant bulk temperatures. A traversing thermocouple probe, constructed by You (1986), following the design of Blackwell and Moffat (1975), was used to take temperature profiles in the freestream-coolant interaction region downstream from the holes. This probe is fabricated with the thermocouple wires slightly bowed and with a butt-welded junction that can be brought to very near the wall. All thermocouple wires, including that in the traversing probe, are 76μm diameter, type E (chromel-constantan). The small diameter was chosen to minimize conduction through the thermocouple leads. All thermocouples were referenced to the same isothermal box. The traversing and other thermocouple probes that were used are detailed in Figs. 3.20 and 3.21.

A Hewlett Packard Model 3412A Data Acquisition Unit (DAU) was used to acquire the thermocouple voltages in succession during experimental runs. A total of 100 readings of each thermocouple voltage was taken over a period of 50 seconds for the measurements of the adiabatic wall temperature, freestream temperature, and coolant jet temperature. Only mean temperatures are discussed. The delivery flow and freestream flow thermocouples, whose signals were steady, were sampled less frequently. The thermocouple voltages were converted to temperatures via calibrations for the thermocouples.

3.4.2 Temperature Measurements

3.4.2.1 Adiabatic Wall Temperature

The adiabatic wall temperature is determined by extrapolation of the near-wall fluid temperature profile to the wall. This would normally be trivial since the near-wall flow over the adiabatic wall has a zero gradient and there are several points within this isothermal zone. The measurement is more complex, however. The complexity arises because a small amount of conduction upstream of the holes was observed. This was indicated as near-wall gradients in the temperature profiles taken in the flow approaching the film cooling holes. Though a small effect throughout the flow, it was observed that this upstream heating measurably influenced the region between the film cooling holes ($z/D<-1.0$ and $z/D>1.0$) where the effectiveness tends to be small. The measurements recorded a very thin thermal boundary layer ($\delta_T/D<0.05$ for $x/D\leq10$). When measurements were taken in this region, "false-high" adiabatic wall temperature measurements were recorded. As the thermocouple probe was moved further from the wall than the thickness of this layer, an isothermal (variations ≤0.1°C) region was observed (Fig. 3.22). As the probe was moved even further from the wall, mild gradients associated with the coolant-freestream interaction were observed. The effect of this upstream heating was removed from the data by extrapolating the isothermal portion of the temperature profile to the wall, ignoring the very near-wall gradients. This is justified since the near-wall gradient has been identified to be due to conduction rather than a film cooling effect. With this extrapolation of the adiabatic zone temperature to the wall, zero values of effectiveness are recorded at locations upstream of the film cooling holes. The magnitude of this compensation varies from negligible to as high as 0.9°C at $x/D=1.25$ and $z/D=\pm1.5$. In the region downstream of the film cooling holes (about the hole centerline for $-1.0\leq z/D\leq 1.0$), however, temperature profiles indicate adiabatic behavior at the wall and no correction is needed (Fig. 3.23). It must be pointed out that this region in which no correction is needed includes the majority of the area of concern for film cooling performance assessment. Pulling the results from the two regions together, it can be seen that the temperature compensation varies from 0°C to as high as 0.9°C. An example of the compensation for one test case is shown in Fig. 3.24. Uncertainties and further discussion of measurements of the adiabatic wall temperature are given in section 3.3.6.

3.4.2.2 Coolant Supply Temperature

Thermocouples are placed in the supply plenum to monitor the bulk mean temperature of the coolant supply. The exact locations of these thermocouples depend upon the individual film cooling configuration being studied. In general, locations within the coolant delivery plenum which indicated temperatures equal to those being supplied to the film cooling hole of study were selected. The location was chosen to ensure that the presence of the thermocouple probes did not obstruct nor perturb the flow entering the film cooling holes. The temperatures from two thermocouples at slightly different locations were typically averaged to yield a single representative bulk mean coolant temperature. Two thermocouples provide redundancy.

Uniformity of temperature of the coolant flow (from hole to hole) is important. Temperature surveys were taken over the exits of the different film cooling holes using the traversing thermocouple probe. These surveys, with and without freestream flow, indicate that the temperatures of the coolant exiting the center seven film cooling holes are equal to one another to within 0.2°C.

3.4.2.3 Freestream Temperature

A thermocouple is also placed in the freestream flow. This thermocouple is upstream of the holes at a location well outside of the hydrodynamic boundary layer so that it does not influence the freestream interacting with the coolant. During testing, the temperature measured by this probe is periodically confirmed by the traversing thermocouple probe by moving the traversing probe outside of the coolant-freestream interaction region.

3.4.2.4 Reference and Other Temperatures

Thermocouples are placed at several different locations with regard to the test section. Thermocouples are placed in each of the metering lines to monitor the bulk temperature. With velocity measurements, the injection flow was not heated so the bulk temperature was determined as described in section 3.2. To assess surface adiabatic effectiveness, however, the injection flow is heated, so the temperature of the coolant is different from the ambient.

All thermocouples were referenced to an isothermal box. The box consisted of two 13 cm x 36 cm x 2.54 cm aluminum blocks which were used to sandwich the thermocouple wires. Foam strips was used to seal the edges of the blocks and the package was wrapped in fiberglass insulation. The isothermal box was referenced to an ice bath. Two thermocouples led from the isothermal box to the ice bath. The ice bath thermocouples were placed at different depths in the ice bath. When the ice bath was fresh, the voltages across the thermocouples were equal. As the ice began to melt and some temperature stratification occurred, the voltages varied. When this voltage difference exceeded 0.003 mV, the ice bath was replaced.

3.4.2.5 Temperature Conversion

To eliminate any velocity influences on the temperatures recorded, recovery temperature data were converted to static temperatures using the data from velocity measurements. In the near wall region, where velocities are on the order of 4 m/s or less, the difference between the recovery and static temperatures is negligible. The relationship between static and recovery temperatures is given below. The recovery factor, λ, is taken to be 0.88 (Kays and Crawford,1993).

$$T_{static} = T_{rec} - \frac{\lambda U^2}{2c_p} \qquad \textit{(3.34)}$$

3.4.3 Thermocouple Calibration

The thermocouples used for measurement were calibrated using a large isothermal water bath (Fig. 3.25). The water bath consists of a cylindrical glass tank with one open end. The dimensions of the tank are 40.5 cm in diameter by 31 cm in height. The wall thickness is 7 mm. The bath is either heated or cooled to achieved the desired temperatures. The bath is heated using a Polyscience Polytemp heater/stirrer assembly (Model 73). The bath is cooled using a Brinkmann Instruments Lauda IC-6 chiller unit. The stirring action of the Polytemp unit assists with creating a uniform bath. The bath is insulated using 3M Thinsulate blankets (2.5 cm thick) around the sides of the tank and 3.8 cm thick styrofoam insulation on the top and bottom. Temperatures are measured using certified precision mercury-in-glass thermometers over the temperature range of 15 to 45 °C. The thermometers are ASTM certified precision thermometers, traceable to the National Institute for Standards and Testing (NIST). The thermometers have 0.1 °C scale gradations with an advertised accuracy of 0.01 °C. The thermocouples are placed in thin-walled glass tubes filled with silicon oil. The thermocouple voltage potentials and corresponding temperatures are then recorded to deduce the calibration. The calibrations for the wires were found to be in good agreement with reference tables for type E thermocouples, provided by Powell et al. (1974). An example of the calibration curve with the associated experimental data points for one thermocouple is given in Fig. 3.26. The thermocouples, taken from the same spool, showed excellent agreement with one another as well.

Given the irregular shape of the traversing thermocouple probe and fragile nature of the butt-welded junction, calibration using the isothermal water bath was deemed inappropriate. Instead, the probe was calibrated against a platinum resistance temperature detector (Rosemount, Inc. Model 118BAK) in-situ. The traversing probe and platinum RTD were placed over the exit plane of a film cooling hole, with the injection flow heated, and the temperature recorded by the RTD was correlated to the traversing probe voltage. The calibration of the platinum RTD was performed using the isothermal water bath and was found to be within manufacturer's specifications. As an additional check, individual thermocouples were compared to the traversing probe under the same heated flow conditions. These checks show excellent agreement (±0.05°C) between the temperatures recorded with the individual thermocouples and the traversing thermocouple. The calibration of the traversing thermocouple probes with the associated calibration data points is shown in Fig 3.27.

During experimentation, the thermocouples were checked regularly against one another to eliminate biases in measured values.

3.4.4 Adiabatic Effectiveness Measurements

The performance of the film cooling scheme is given in terms of adiabatic effectiveness, η, defined as:

$$\eta = \frac{T_{aw} - T_\infty}{T_j - T_\infty} \quad (3.35)$$

During experimentation, the quantities which comprised the adiabatic effectiveness are measured independently. Laterally-averaged effectiveness values, η_{av}, are commonly used to give an averaged adiabatic effectiveness at a particular streamwise position. These values are calculated by integrating the laterally-distributed h values at a fixed streamwise position. For this study, trapezoidal integration is used.

Local surface adiabatic effectiveness values are measured at six different streamwise positions (x/D=1.25, 2.5, 3.75, 5.0, 7.5, and 10.0) and at 23 laterally-distributed locations ($-1.5 \leq z/D \leq 1.5$) about a single hole. The lateral spacing varies from $\Delta z/D=0.33$ near the symmetry region between holes to a finer resolution of $\Delta z/D=0.083$ near the hole centerline. The fine resolution is used to better capture the steep thermal gradients that exist in that region. The measurement plane is outlined in Fig. 3.28.

3.4.5 Steady-State Conditions

Prior to taking measurements, the facility was permitted to reach steady state. Generally, this "pre-test" time was on the order of 4-5 hours. All system thermocouples were monitored during this time until the temperatures indicated converged desired values. A temperature change of ±0.05°C or less in the coolant and freestream temperatures over a 15 minute time period was the implemented steady-state convergence criteria. At steady state, the coolant jet was maintained at approximately 10°C above the freestream temperature.

3.4.6 Uncertainties in Temperature and Effectiveness Measurements

Uncertainties in the fluid temperature, coolant or freestream, are approximately $\Delta T=0.15$°C (1.5% of the 10°C temperature difference). The measured adiabatic wall temperature, however, is assessed an uncertainty of $\Delta T=0.3^\circ C$. Uncertainties in η are, therefore, approximately 3.2% of the maximum obtainable value of 100%, throughout. Repeatability of η is within 2%.

It should be noted that that the identification and quantification of the conduction error is a result of measuring the adiabatic wall temperature with a traversing thermocouple probe. It would not have been identified with a thermocouple embedded in the surface. In addition, all thermocouples were calibrated using the same methodology and checked regularly against one another to eliminate biases in measured values. All thermocouples were referenced to the same ice bath reference to minimize uncertainties in temperature differences. All uncertainties are calculated via the methods of Kline and McClintock (1953) and Moffat (1982) and are expressed with 95% confidence.

3.5 Experimental Conditions

The majority of the quantities measured during in this study have been described in the previous sections. Ambient conditions, including pressure and relative humidity were not discussed in detail. Generally, during experimental runs, pressures were referenced to a precision, mercury-barometer or to a conventional wall barometer-hygrometer. The accuracy of the wall barometer was checked periodically against the mercury barometer. Relative humidity measurements were taken using a certified hygrometer and temperature indicator (Abbeon Cal, Inc. model HTAB169B). Generally, variability in relative humidity was less than 2% during any experimental run. In most cases no variability was observed.

3.6 Fluid Mechanics Quantities

A variety of different fluid mechanics quantities was used to better describe the boundary layer. These quantities include the boundary layer thickness, momentum thickness, and displacement thickness, three types of boundary-layer thicknesses that are in common use. These quantities are important in describing and modeling the flowfields. Of these, the momentum thickness is most frequently used.

3.6.1 Boundary Layer Thickness

The boundary layer thickness is defined as the normal distance from the solid wall at which the local velocity reaches 99% of the freestream value.

$$y=\delta \text{ where } U=0.99U_o \quad (3.36)$$

3.6.2 Momentum Thickness

The momentum thickness is defined as that thickness of the layer which, at zero velocity, has the same momentum defect, relative to the outer flow, as the actual boundary layer.

$$\theta = \int_0^\infty \frac{U}{U_o}\left(1 - \frac{U}{U_o}\right)dy \qquad (3.37)$$

3.6.3 Displacement Thickness

The displacement thickness is the distance which the undisturbed outer flow is displaced from the boundary by the boundary layer flow.

$$\delta^* = \int_0^\infty \left(1 - \frac{U}{U_o}\right)dy \qquad (3.38)$$

3.7 Turbulence Parameters and Scales

3.7.1 Dominant Frequency

The dominant frequencies observed in the spectra of the film cooling and freestream flows are normalized with the hole diameter to yield a Strouhal number, St.

$$St = \frac{fD}{U} \qquad (3.39)$$

3.7.2 Integral Length Scale

A common methodology for characterizing length scales in turbulent flows is the integral length scale (Hinze, 1975), a measure of the largest eddies in the flow:

$$\Lambda = E(f) \times \frac{U}{4(u')^2} = E(\kappa) \times \frac{2\pi}{4(u')^2} \quad \text{for } f \Rightarrow 0,\ \kappa \Rightarrow 0 \qquad (3.40)$$

3.7.3 Dissipation Rate

Power spectral density distributions can also be used to determine energy dissipation rates when a -5/3 equilibrium range exists (Hinze, 1975). Isotropic turbulence is assumed for this calculation. The dissipation rate are calculated by locating points, $(\kappa, E(\kappa))$, on the spectral distributions that were tangent on a $\kappa^{-5/3}$ line.

$$E(\kappa) = \frac{18}{55} \times 1.62 \times \varepsilon^{2/3} \kappa^{-5/3} \quad \textit{(3.41)}$$

3.7.4 Turbulence Kinetic Energy

The local turbulence kinetic energy is calculated using the measured rms-velocity fluctuations (Table 1). Since the local velocity fluctuation measured is a combination of the streamwise and wall-normal components of the fluctuations, a weighted formulation of k which assumes that u, v, and w are of similar magnitude (i.e. isotropic) is used.

$$k = 0.5\left(u^2 + v^2 + w^2\right) = 0.75(u')^2 \quad \textit{(3.42)}$$

3.7.5 Energy Scale

Knowledge of the turbulence kinetic energy and the dissipation rate provides a means of calculating the energy or dissipation length scale (Table 1):

$$L_u = \frac{1.5(u')^3}{\varepsilon} = \frac{2.309(k)^{3/2}}{\varepsilon} \quad \textit{(3.43)}$$

3.7.6 Microscale

A final scale that is deduced from the measurements is the Kolmogorov or microscale of turbulence (Table 1):

$$\eta = \left(\frac{\upsilon^3}{\varepsilon}\right)^{1/4} \quad \textit{(3.44)}$$

3.8 Data Acquisition

The hot-wire data acquisition system contains a hot-wire sensor probe, an anemometer, a digitizer and a personal computer. The hot-wire sensor probe used in this study is a single-sensor type (TSI 1150) into which the sensor (TSI model 1218-T1.5) is inserted. The probe is connected to the anemometer bridge unit (TSI Model IFA 100). The signal from the anemometer is transferred to the digitizer (Norland Prowler) or A-D converter (IOTECH ADC 488/8SA) then, in binary format, to the computer. The thermocouple signals are scanned by a Hewlett Packard 3412A Data Acquisition Unit and then transferred to the computer. The computer controls all the data acquisition and provides data storage. Figure 3.29 is a schematic showing the data acquisition and equipment setup. Description of these instruments and equipment is now given.

3.8.1 Anemometer

A four-channel, hot-wire anemometer (TSI Model IFA 100) is used to control the bridge voltage so that the sensor resistance and temperature are fixed. One channel is dedicated to each sensor. Each channel is fashioned with a low-pass filter and yields an analog bridge output voltage. For measurements using the filter, low-pass settings were typically set at 20-50 kHz.

3.8.2 Digitizers

Hot-wire data were acquired using Norland Prowler digital oscilloscopes, which have 12-bit resolution with variable voltage ranges from ±100mV to ±20V, and an IOTECH 16-bit analog-to-digital converter (Model #ADC 488/8SA) . The voltage range was minimized for each experiment to improve resolution of the measurements. Generally, bridge output voltages were in the range of 0.75 to 1.30V for single-wire measurements. The sample rate could be adjusted from 1 Hz to 100 kHz. The Norland oscilloscope has two-channel capabilities, with a 4096 data point buffer per channel. Four channels of data can be acquired simultaneously by linking the two oscilloscopes in a master-slave configuration with a DC power supply providing a simultaneous trigger. The IOTECH converter has eight-simultaneous channel (differential) capabilities, with 2-4 million data point buffer in a single-channel sampling operation. Data were transferred from the digitizers/converters to the Linux workstation via an IEEE bus in binary form and converted to numerical values during processing.

3.8.3 Filter

An additional filter, external to the IFA-100 unit, was used during spectral measurements using hot-wire anemometry. The filter used was a Stanford Research Systems, Inc. Model SR650, dual pass (high-low pass) filter. This filter was selected for the spectral measurements for it displayed superior filtering capability and more abrupt frequency cut-off.

3.8.4 Data Acquisition Unit

A Hewlett Packard Model 3412A Data Acquisition Unit was used to acquire thermocouple voltages. The Data Acquisition Unit consists of a mainframe, a built-in 5 1/2 digit voltmeter, a 10 kHz counter, 8-bit digital I/O capabilities, and HP-IB IEEE interface capacities. A total of 30 input channels are available on the unit. The sampling rate for voltage readings was 2 Hz. The various input channels are monitored sequentially during the course of experimentation, such that consecutive readings are taken of a given channel's voltages before the next channel in the experimental sequence is monitored. The unit does not read simultaneously.

3.8.5 Computer and Computer Interface

A 486-DX2, 90 MHZ and a Pentium-Pro, 200 Mhz LINUX-based computers were used for data acquisition and communication between devices. The computers have IEEE interface capabilities permitting command strings, instructions, and other communication to be passed between it and the various devices used. Figure 3.29 highlights the computer interface(s) and device communication links. Programs written in C and Fortran are used. These programs are also used for data processing. A listing of each program is provided in Appendix B.

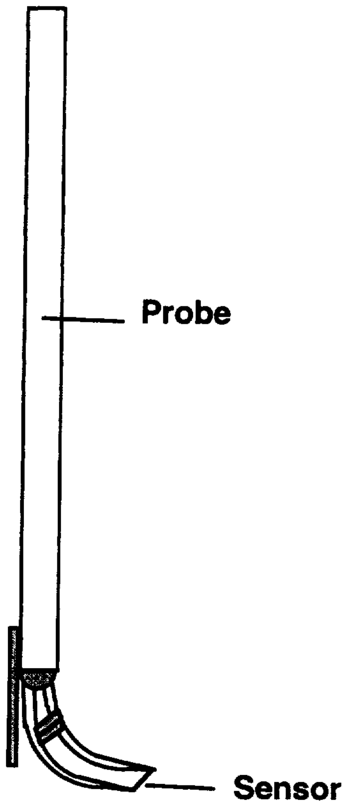


Figure 3.1: Single-Wire, Hot-Wire Boundary Layer Probe

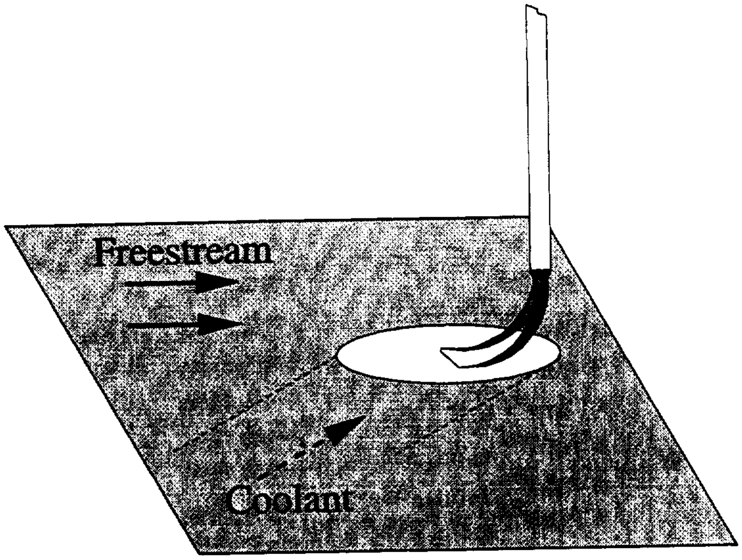


Figure 3.2: Hot-Wire Sensor Orientation For Measurements at Hole Exit Plane

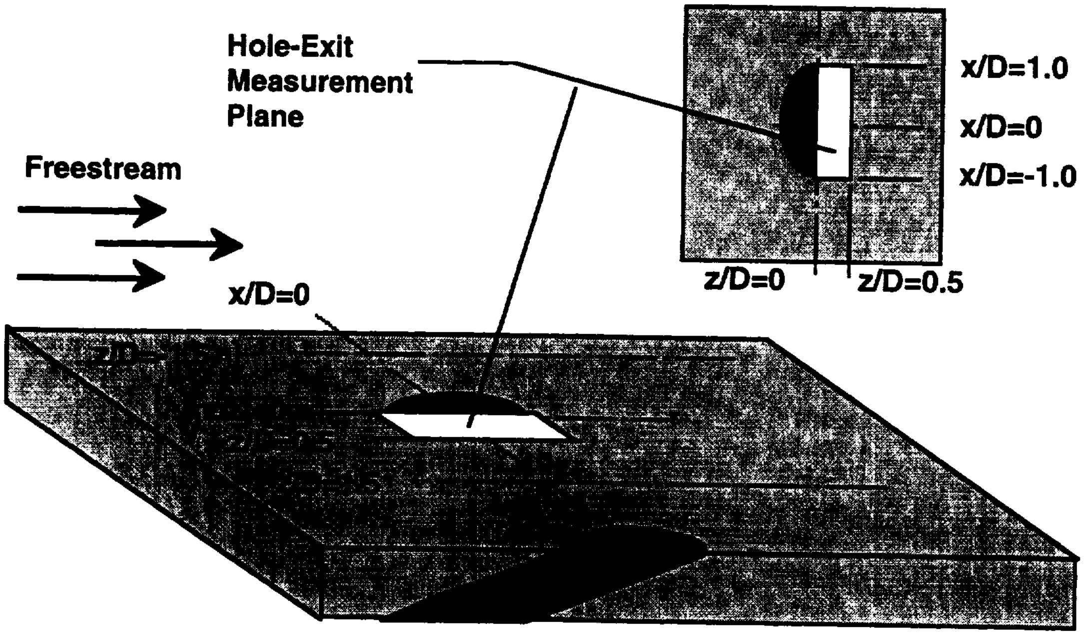


Figure 3.3: Hole-Exit Measurement Plane

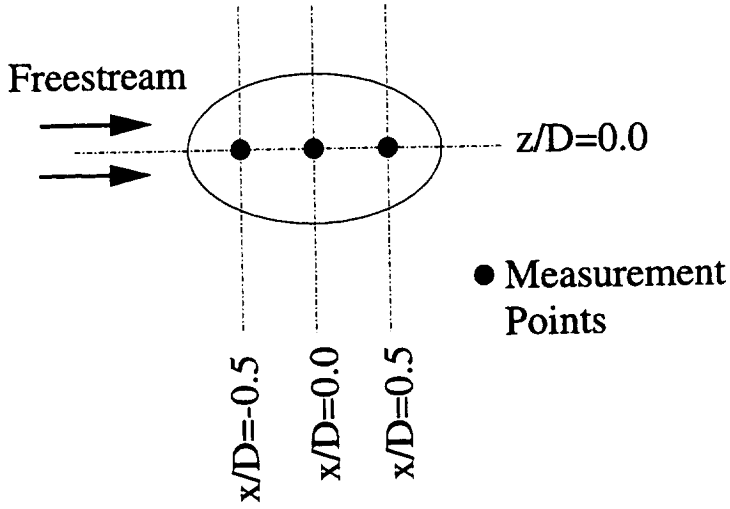


Figure 3.4: Spectral Measurement locations

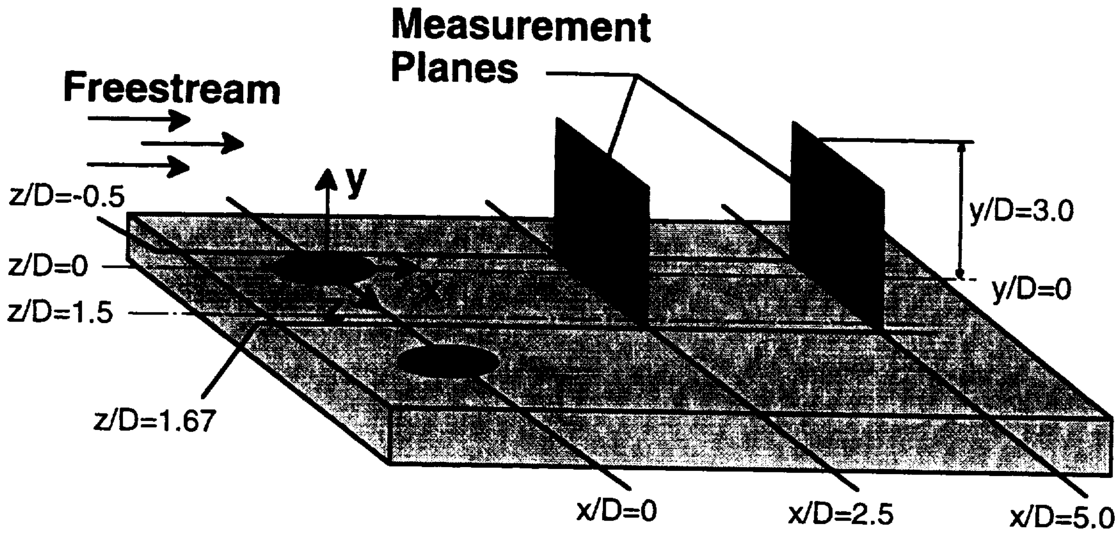


Figure 3.5 Flowfield Measurement Planes

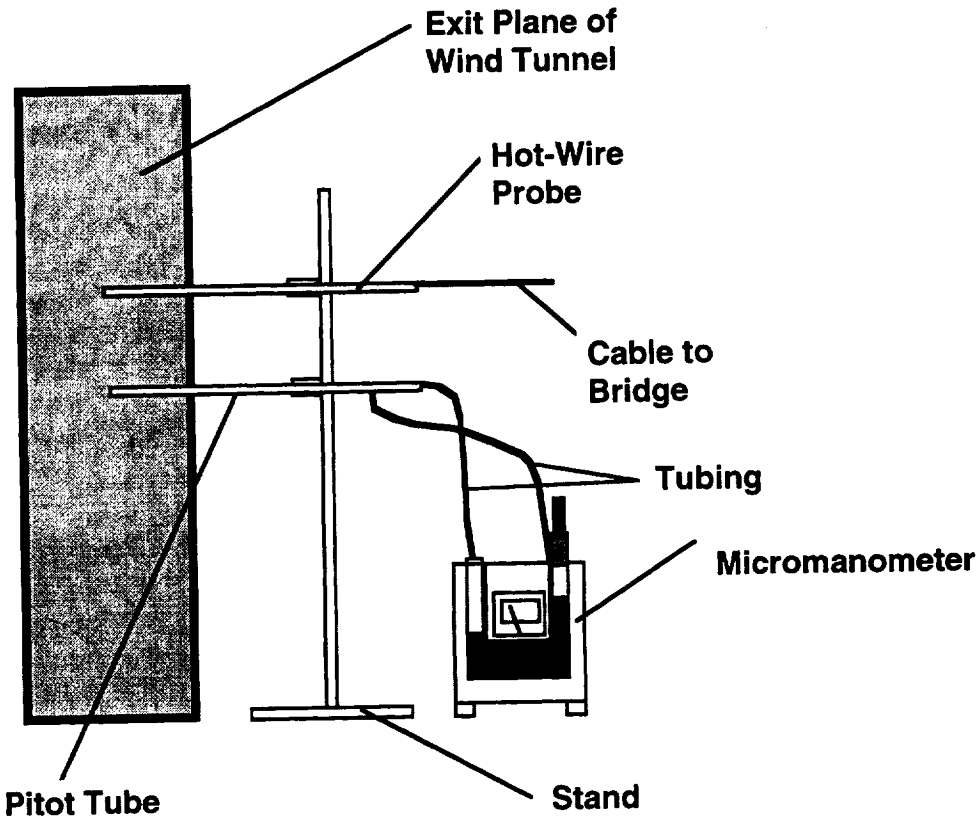


Figure 3.6: Hot-Wire Calibration Using Reference Tunnel

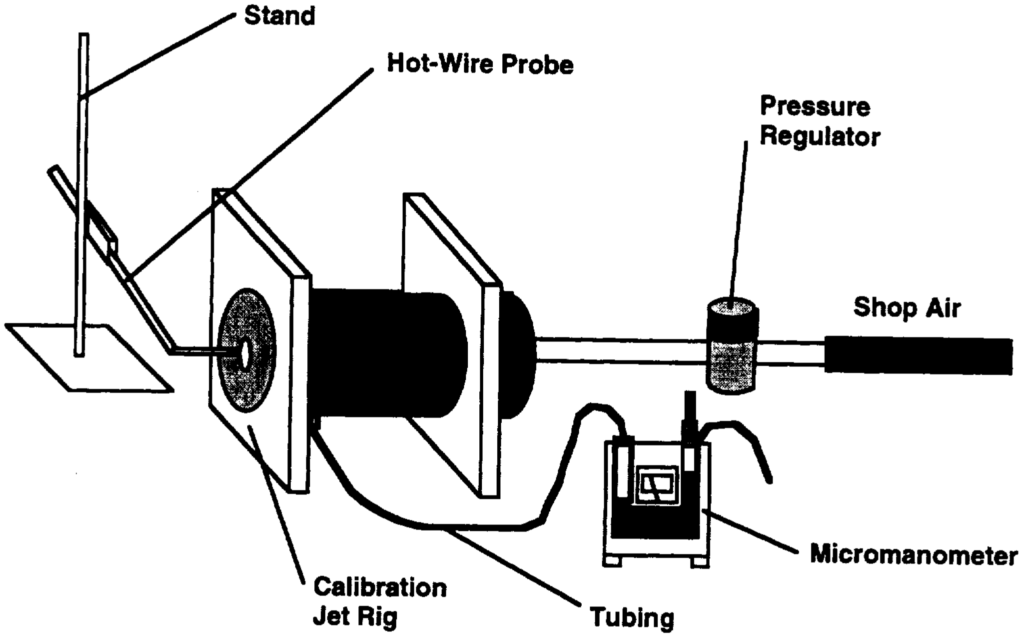


Figure 3.7: Hot-Wire Calibration Using Calibration Jet

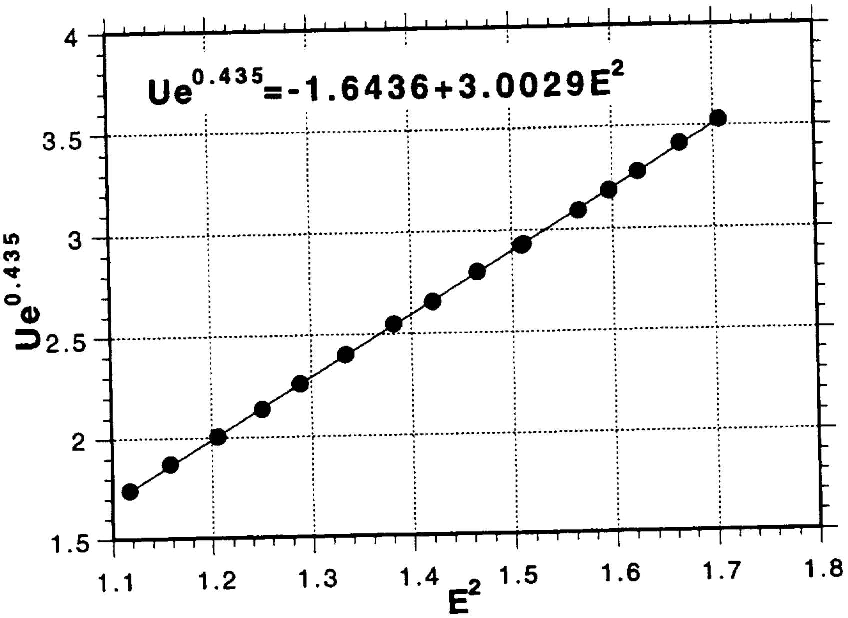


Figure 3.8: Sample Single-Wire Calibration Curve

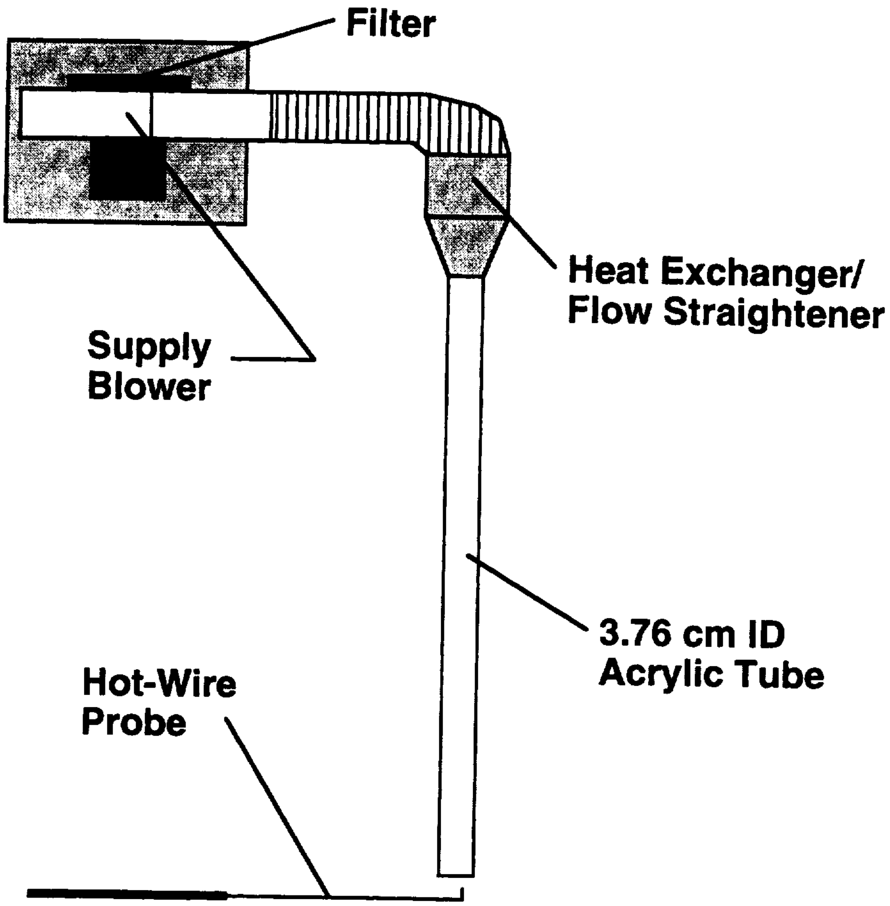


Figure 3.9: Hot-Wire Qualification Facility

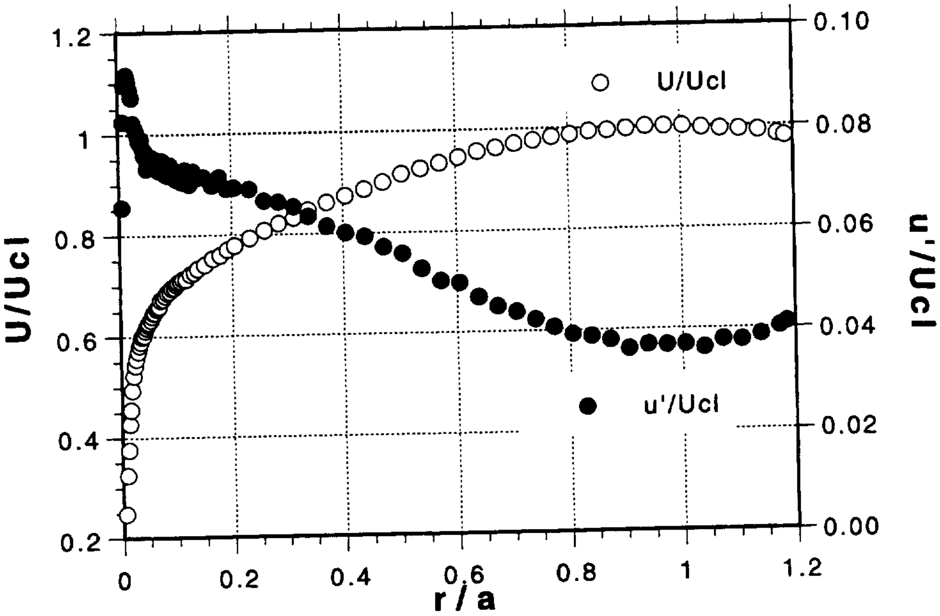


Figure 3.10: Fully-Developed Turbulent Pipe Flow Data - Mean Velocity and rms Fluctuations versus Radial Location
(r/a=0 at Pipe Inner Wall; r/a=1 at Pipe Centerline)

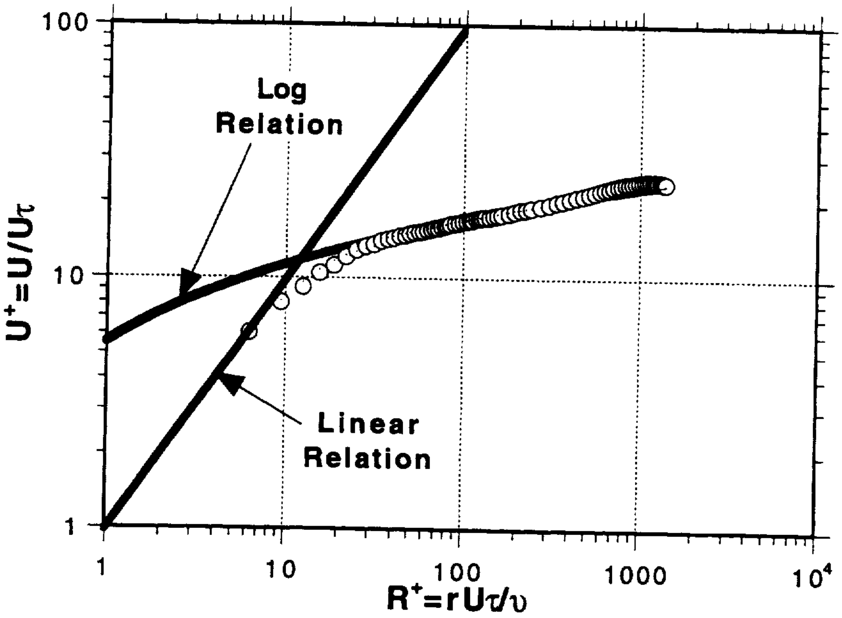


Figure 3.11: Fully-Developed Turbulent Pipe Flow Data in Wall Coordinates

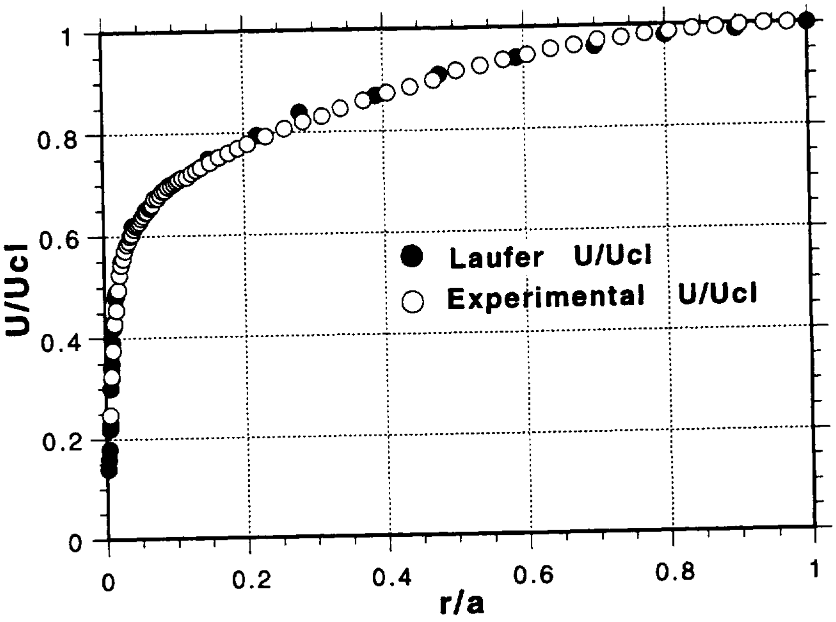


Figure 3.12: Comparison to Laufer's Data - U/Ucl versus r/a

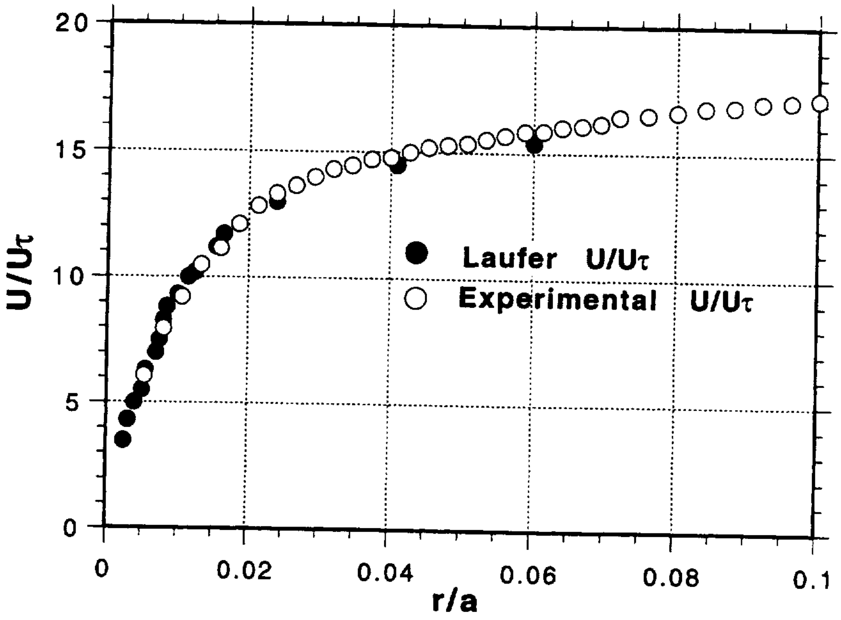


Figure 3.13: Comparison to Laufer's Data - U/Uτ versus r/a

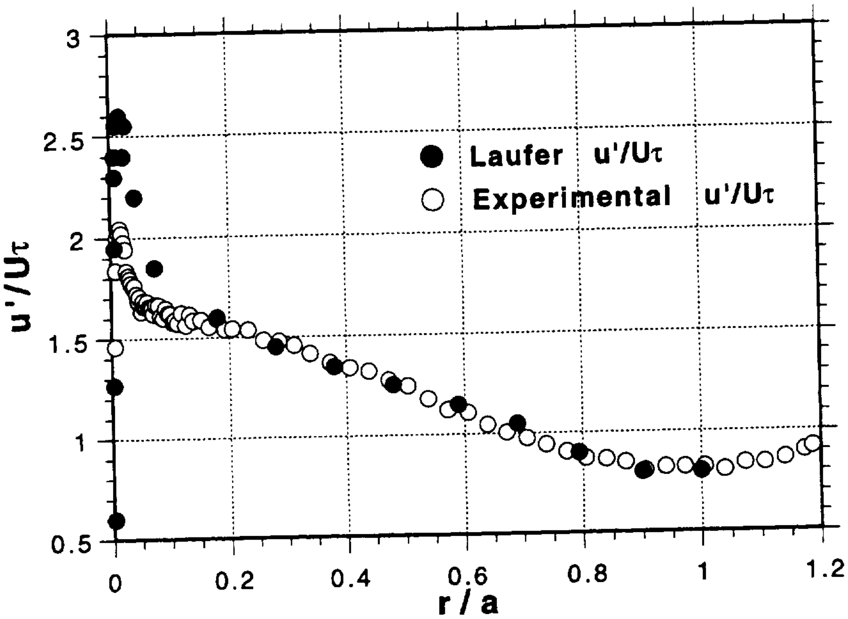


Figure 3.14: Comparison to Laufer's Data - u'/Uτ versus r/a

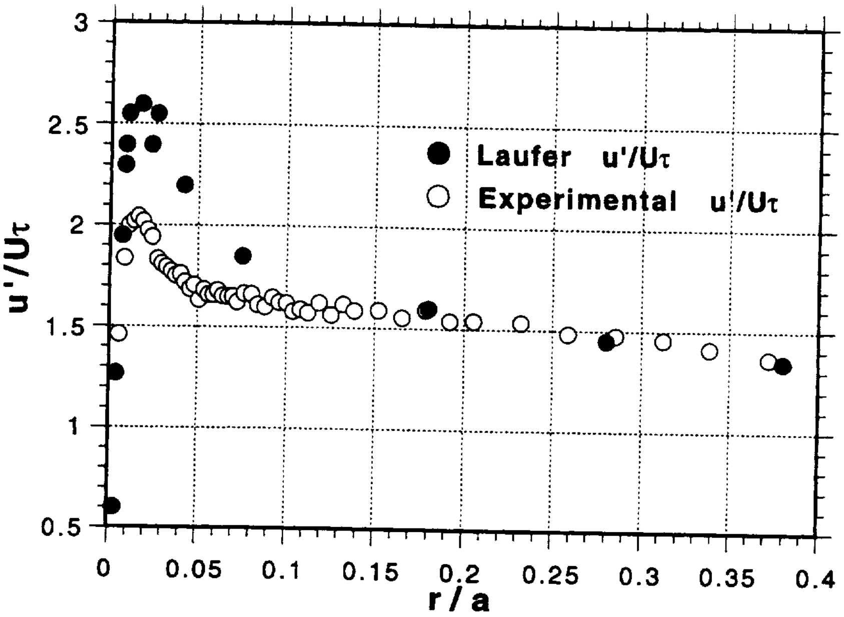
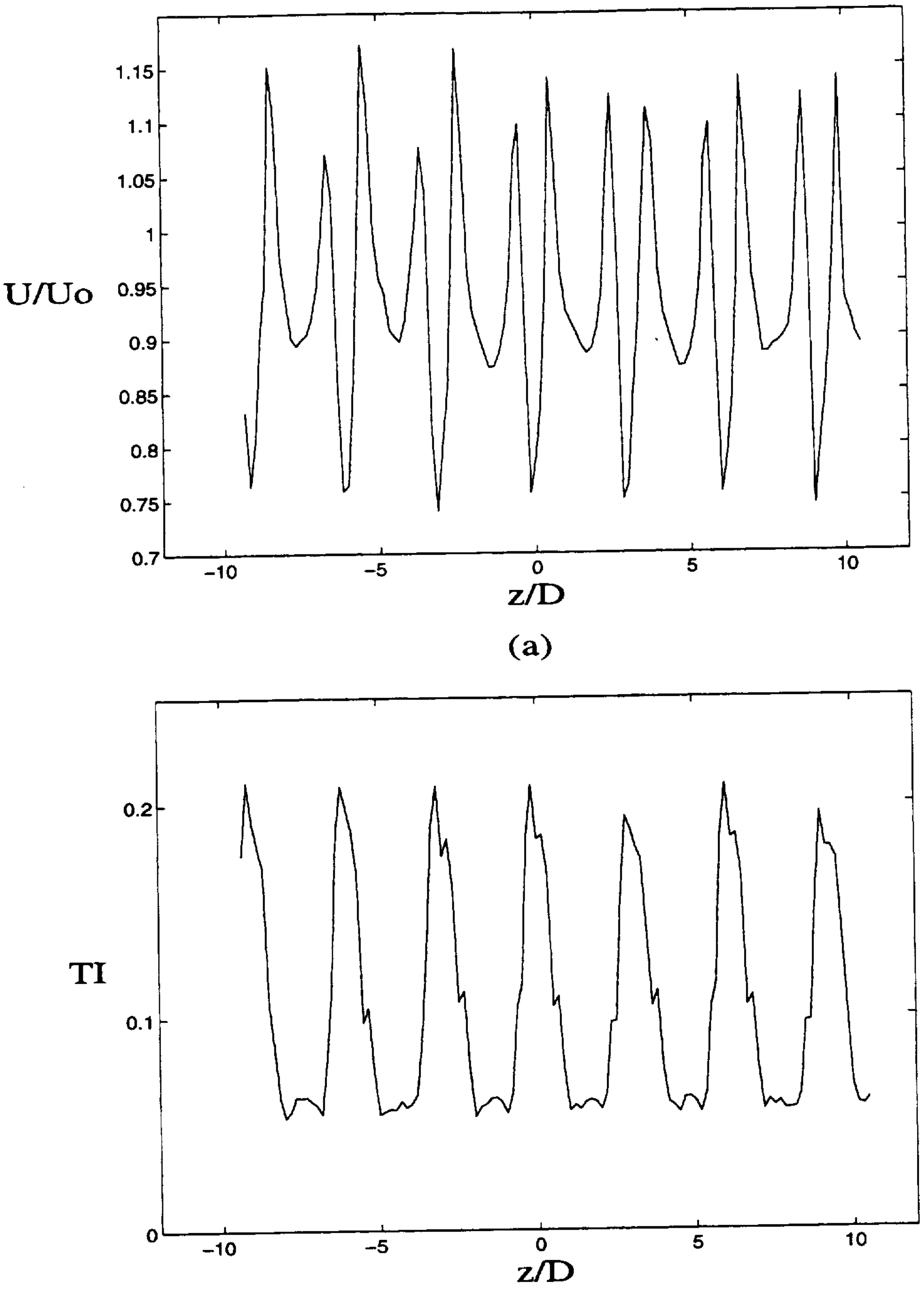


Figure 3.15: Comparison to Laufer's Data - u'/Uτ versus r/a in Near-Wall Region (r/a < 0.4)



(a)

(b)

Figure 3.16: Uniformity of Flow Distribution at VR=1.0
(a) U/U_o and (b) TI
Center Hole at z/D=0.0 with z/D=±3.0 Spacing
Measurements taken for $-10 \le z/D \le 10$, x/D=2.5, y/D=0.4

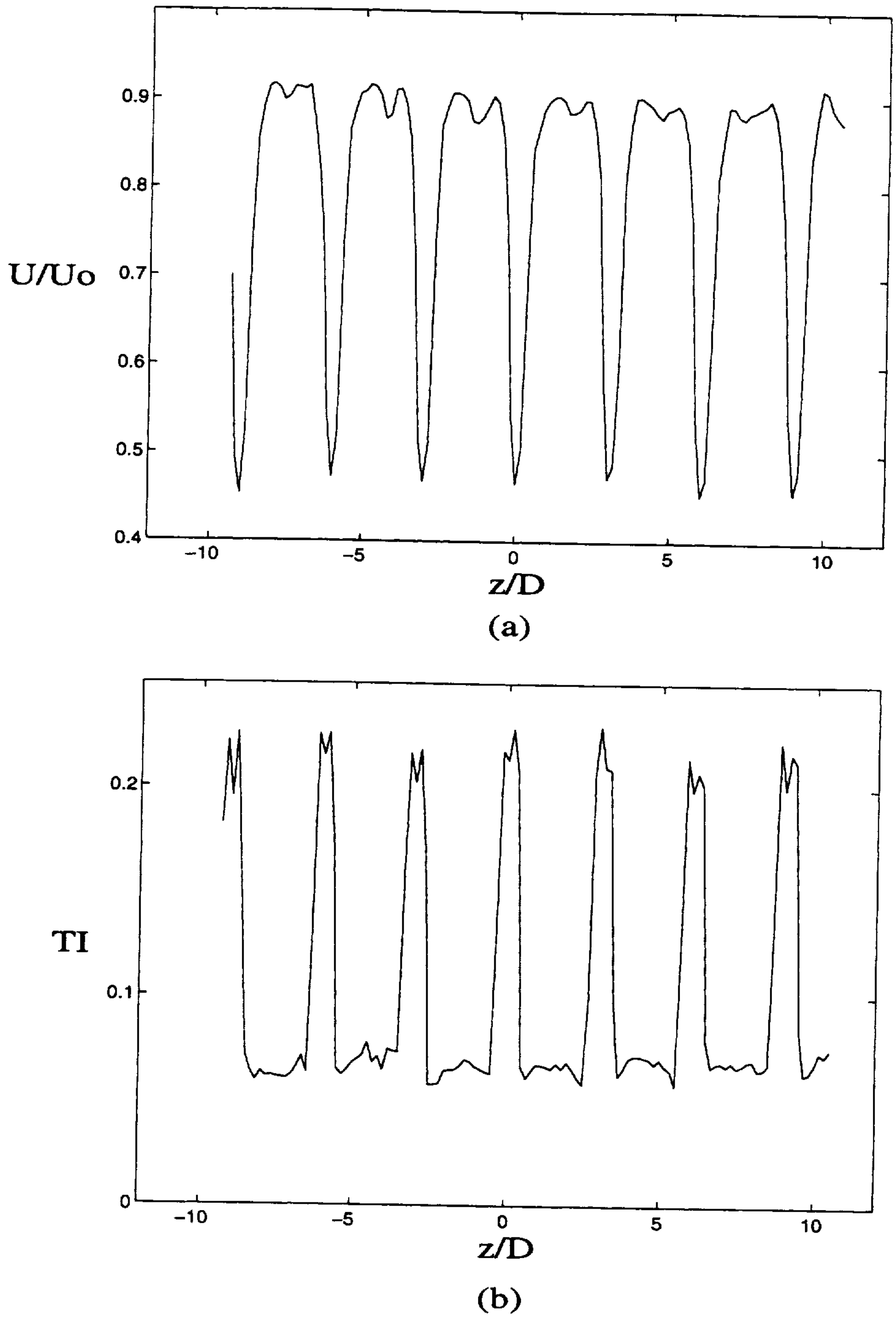


Figure 3.17: Uniformity of Flow Distribution at VR=0.5
(a) U/U_o and (b) TI
Center Hole at z/D=0.0 with z/D=±3.0 Spacing
Measurements taken for $-10 \leq z/D \leq 10$, x/D=2.5, y/D=0.4

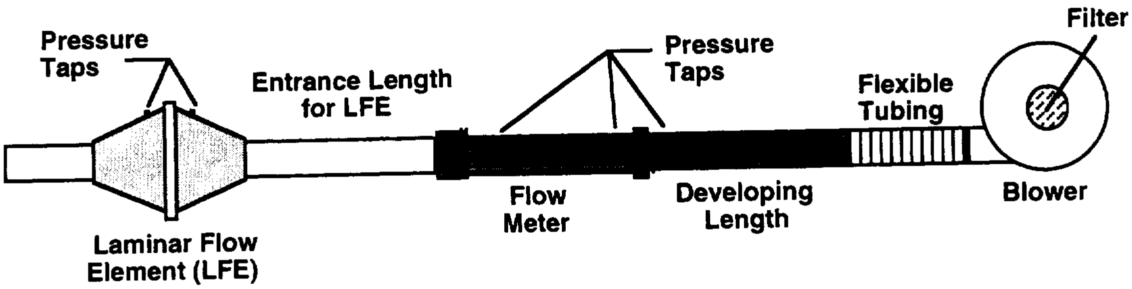


Figure 3.18: Flow Meter Calibration Setup

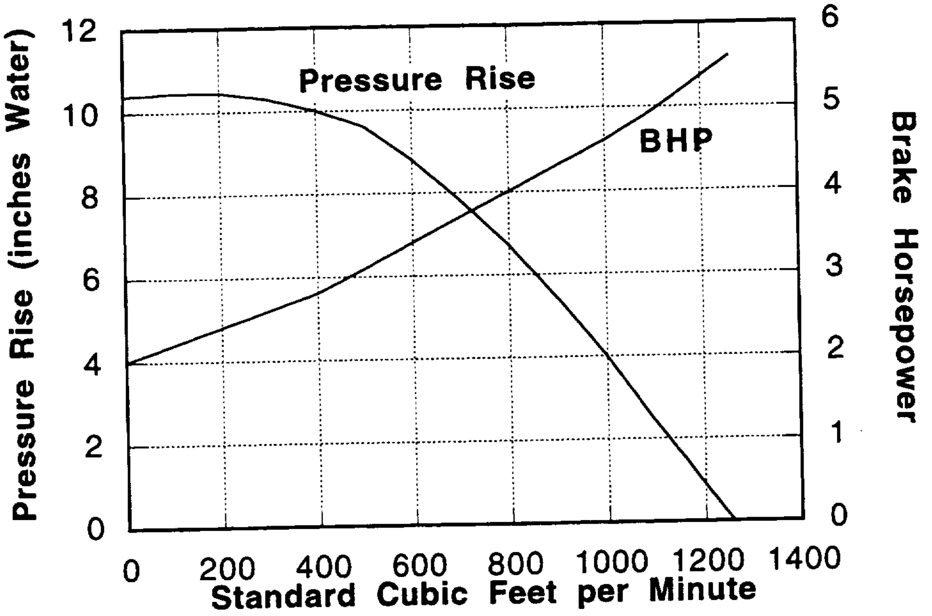


Figure 3.19: Performance Curve for Dayton Blower Model #4C329

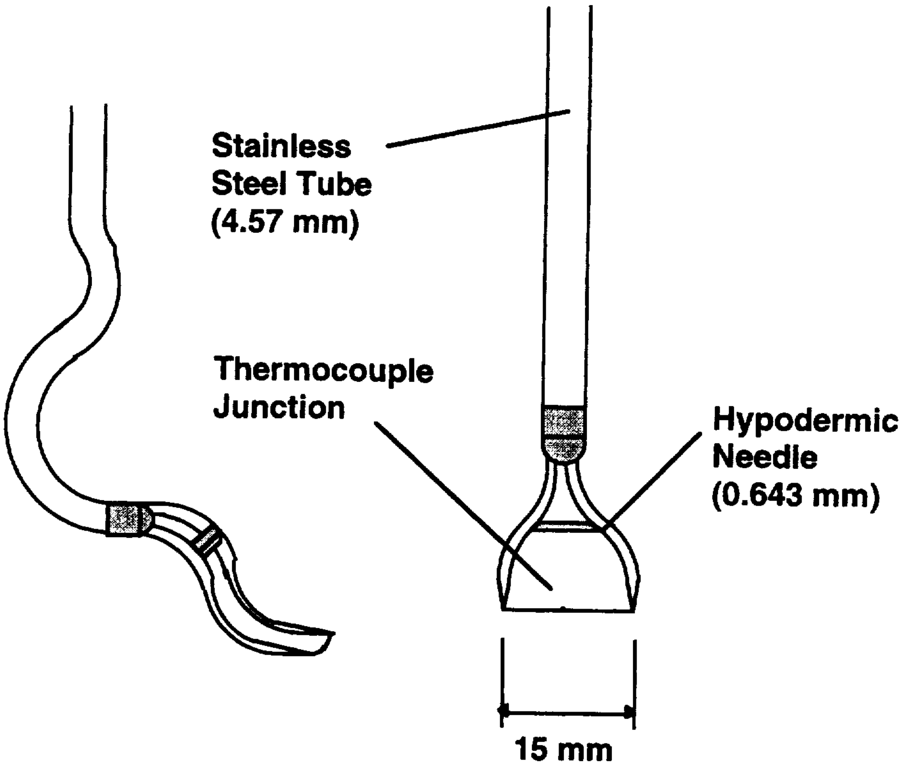


Figure 3.20: Traversing Thermocouple Probe

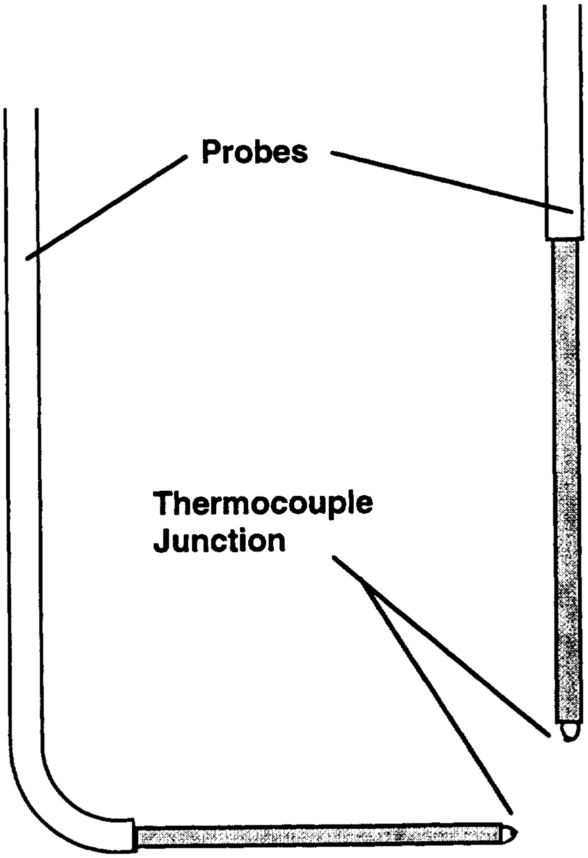


Figure 3.21: Various Thermocouple Probes Used During Experimentation

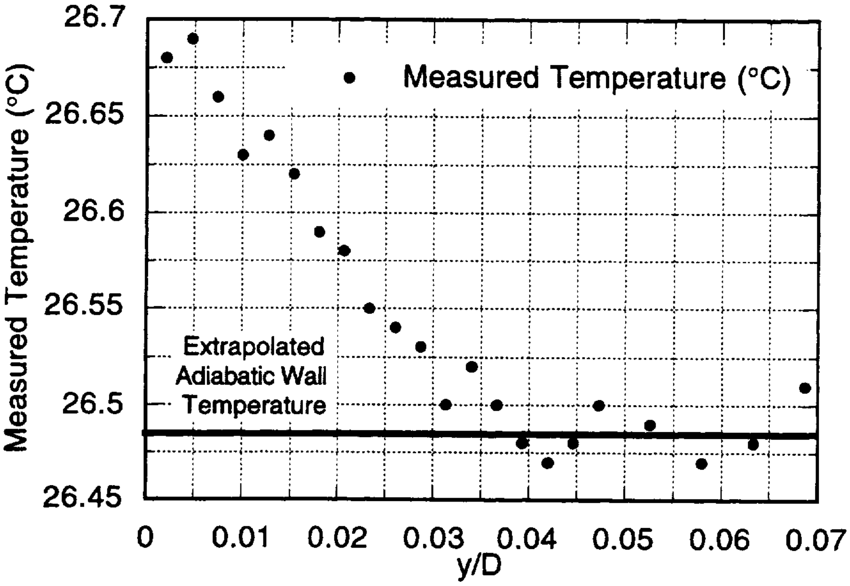


Figure 3.22: Example of a Temperature Profile Highlighting Near-Wall Conduction and Isothermal Region Distant From Wall

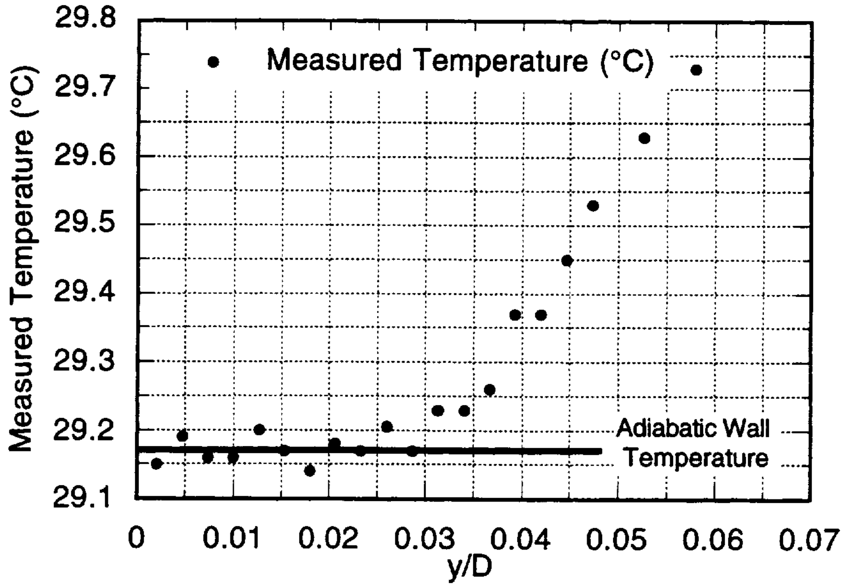


Figure 3.23: Example of Temperature Profile Highlighting Near-Wall Adiabatic Region Downstream of Film Cooling Holes

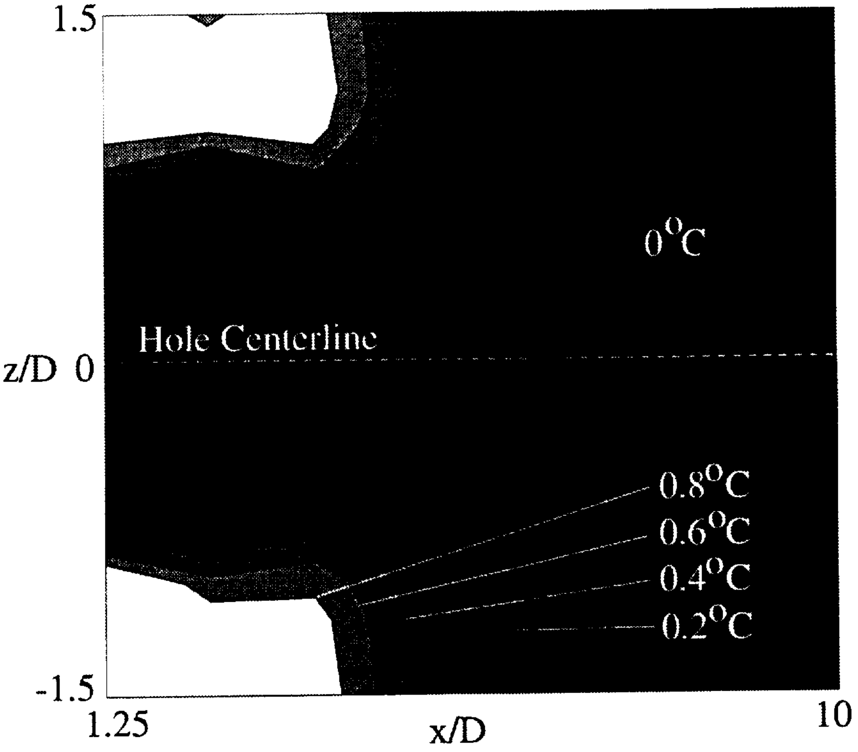


Figure 3.24: Example of Temperature Compensation Distribution

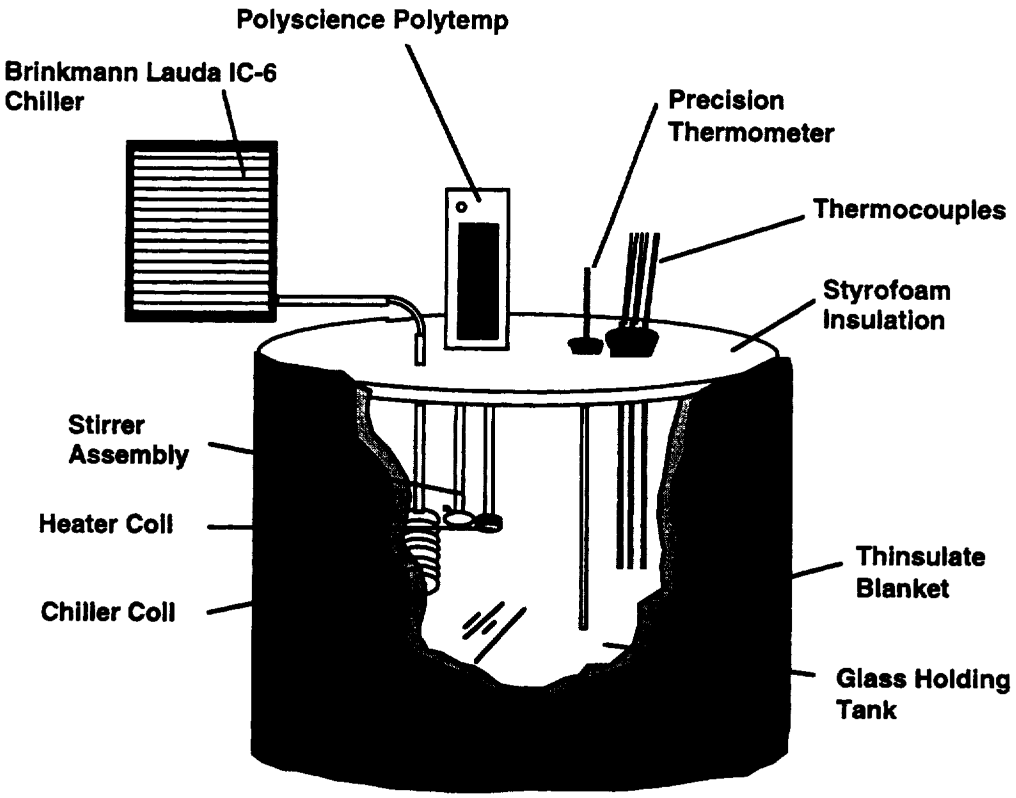


Figure 3.25: Thermocouple Calibration Facility

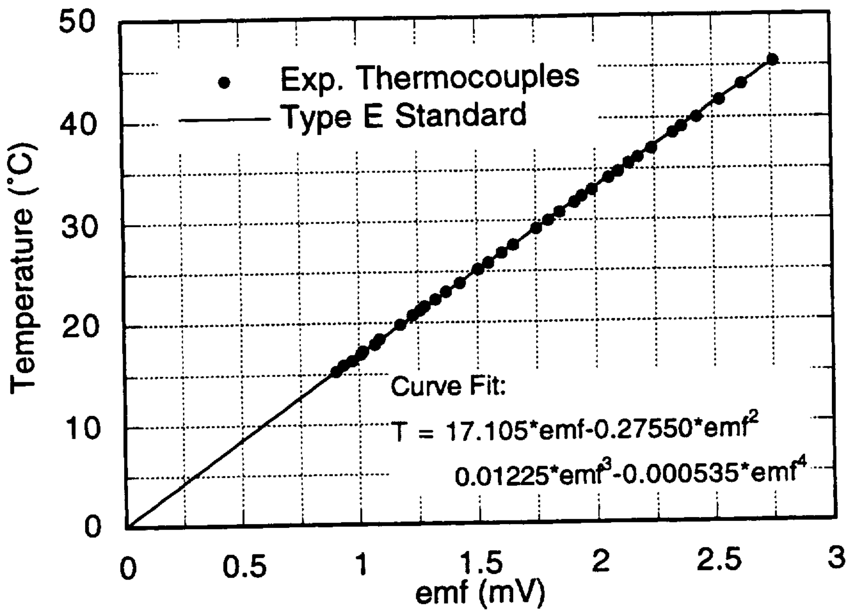


Figure 3.26: Thermocouple Calibration Example

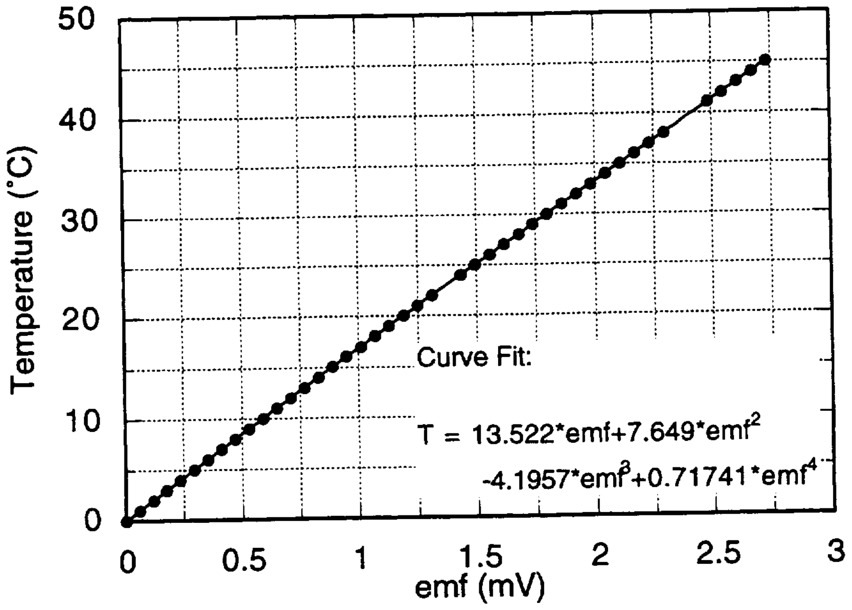


Figure 3.27: Traversing Thermocouple Calibration

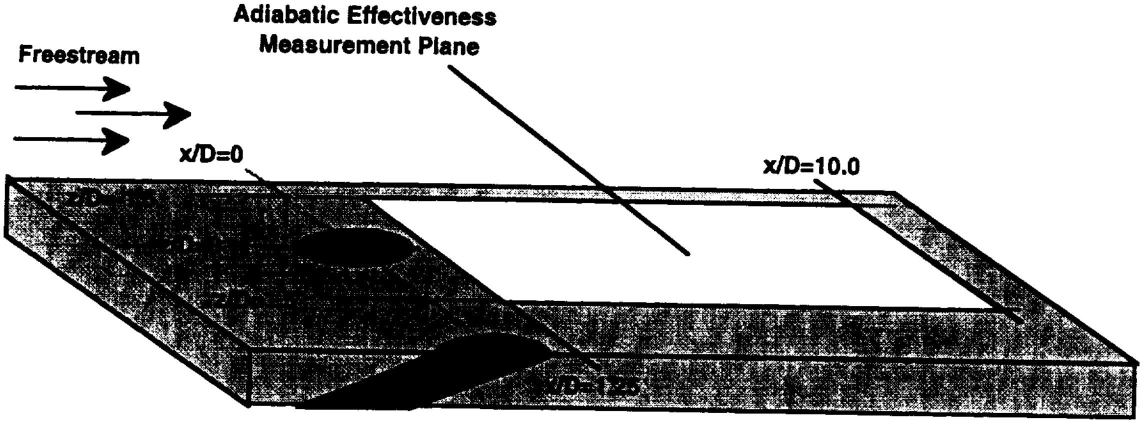


Figure 3.28: Adiabatic Effectiveness Measurement Plane

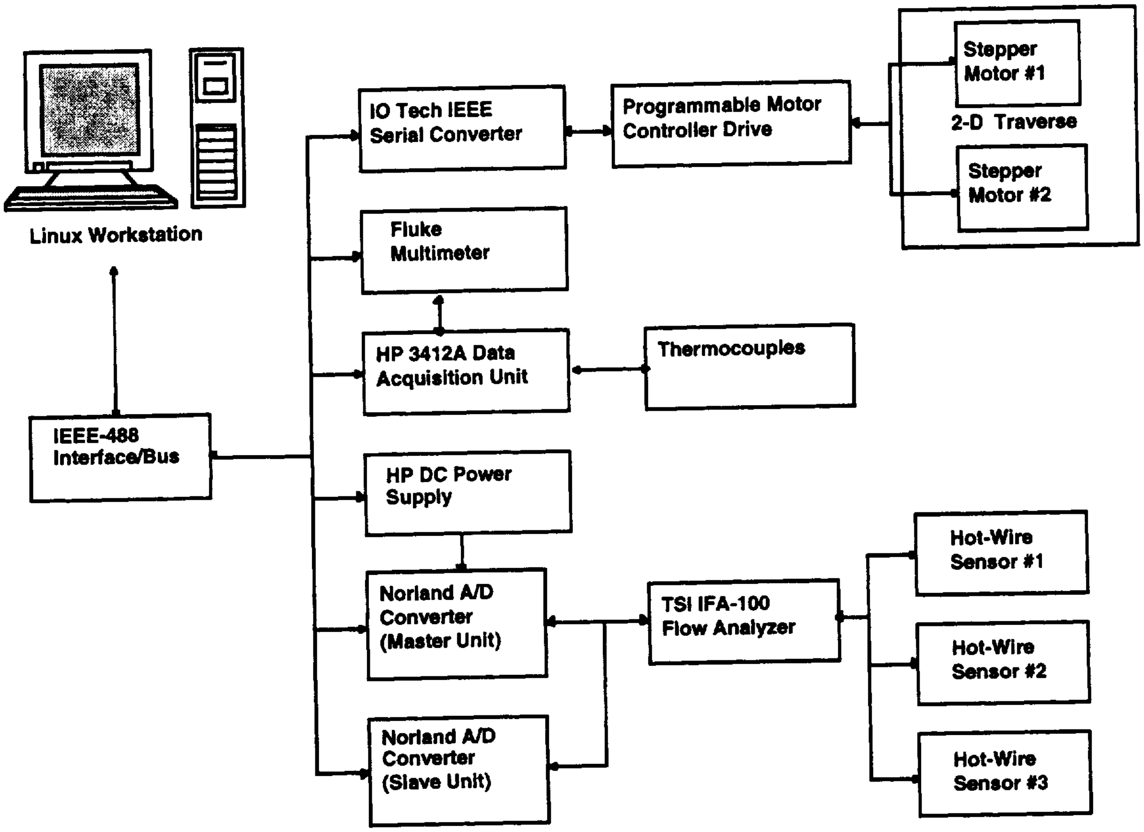


Figure 3.29: Schematic of Computer and Device Interface

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Test Cases

Flowfield, hole-exit flow and spectra, discharge coefficient and loss, and surface adiabatic effectiveness measurements are presented for the different film cooling geometries shown in Figure 2.1. These measurements are discussed in the succeeding sections. These sections will first focus on the influence of the hole L/D (and FSTI effects) on film cooling followed by discussion of the role of the coolant delivery plenum configuration and approach flow momentum on film cooling. The test cases in each of these categories are listed in Tables 4.1 through 4.7. The cases in Tables 4.1 through 4.4 focus on the role of hole L/D and include test cases with short-hole (L/D=2.3) and long-hole (L/D=7.0) injection. In several instances, intermediate hole lengths are also introduced and discussed. Data for these geometries are presented for FSTI=0.5% and 12%. The cases in Tables 4.5, 4.6, and 4.7 focus on approach flow momentum and supply plenum geometry effects and include counter-flow and co-flow delivery geometries. Short-hole injection cases are presented as a basis for comparison to these geometries and are denoted with the labels "Open Plenum" or "Sink flow." These approach flow cases are limited to FSTI=12%.

The type of measurement which corresponds to each test case is noted under the "measurement" column. Cases designated with "hole-exit" indicate hole-exit, hot-wire measurements. An "adiabatic effectiveness" designation denotes surface adiabatic effective measurements. Flowfield measurements taken at streamwise-normal planes at x/D=2.5 and x/D=5.0 are indicated with "x/D=2.5" and "x/D=5.0," respectively. The nominal coolant-to-freestream velocity ratio is given in the "VR" column. The actual values are given with the raw data in Appendix A.

4.2 Experimental Results

Many of the film cooling results in the literature, including film cooling effectiveness, are excellent for characterizing and evaluating film-cooling schemes. They describe the net results but do not have sufficient auxiliary measurements to explain these results. Such auxiliary measurements would show how the flow emerges from the holes and interacts with the freestream flow to protect the surface. Such data are now presented in order to document and rationalize the effect of hole length and plenum geometry on film cooling effectiveness.

Again, the experimental results are presented in two sections. The first section (Tables 4.1 through 4.4) documents the differences that exist between short-hole and long-hole injection. The second section (Tables 4.5 through 4.7) highlights further differences that are observed when the supply plenum is restricted. In both sections, mean effective velocity, associated turbulence distributions, and spectral measurements taken on the exit plane of the film cooling hole are presented. Also, presented are discharge and loss coefficients, adiabatic effectiveness distributions on the surface downstream of the film cooling holes, and hot-wire measurements at streamwise-normal planes 2.5 and 5.0 diameters downstream from the hole centers for the different cases. It will be shown that the coolant delivery configuration has a significant impact on the hole-exit profiles and, in turn, plays a substantial role in impacting the film cooling performance . The main effect, however, is the delivery hole length. Nevertheless, the flow delivery effect is not to be ignored.

4.2.1 Effect of Hole Length

Short-hole and long-hole injection configurations are compared for two velocity ratios in the following sections. The short-hole configuration is representative of actual film cooling designs in that the hole length-to-diameter ratio is small. This configuration will serve as a base to which the restricted plenum delivery configurations will be compared in section 4.2.2. Long-hole injection is presented to document the influence of the hole length-to-diameter ratio (L/D=7.0 vs. L/D=2.3). The results document the inherent differences between film cooling with short delivery tube lengths and those with long tube lengths. The results are all from a common facility and only the velocity ratio and FSTI levels are changed. The benefit of a single test facility is that it permits direct comparisons between the different test cases. The main focus of this study is on film cooling under high-FSTI conditions, so low-FSTI data are limited in number. Hole-exit data and surface adiabatic effectiveness, in particular, are presented only for FSTI=12%. The data will be presented using short-hole injection as the base case.

4.2.1.1 Hole-Exit Profiles

Normalized mean effective velocity and TI distributions at the hole-exit for short-hole and long-hole injection are now presented for VR=0.5 and 1.0 and FSTI=12%. High freestream turbulence, representative of actual engines, is chosen for this study. Other researchers, including Pietrzyk et al. (1989, 1990) and Leylek and Zerkle (1994), have investigated L/D effects under low FSTI.

Figure 4.1 shows the normalized mean effective velocity distributions for short-hole and long-hole injection. Figure 4.2 details the normalized mean effective velocity and local effective turbulence intensity distributions along the hole centerline for these cases.

Table 4.1: Test Cases Highlighting L/D Effects

TEST CASE	L/D	FSTI	VR	MEASUREMENT
050796	2.3	12%	1.0	Hole-Exit
051096	2.3	12%	0.5	Hole-Exit
051396	7.0	12%	1.0	Hole-Exit
051496	7.0	12%	0.5	Hole-Exit
090896a	2.3	N/A	N/A	Hole-Exit: Blowing Velocity Equivalent to 050796
090796a	2.3	N/A	N/A	Hole-Exit: Blowing Velocity Equivalent to 051096

Short-Hole Injection. Profiles with short-hole injection (Figs. 4.1 and 4.2) exhibit a prominent "jetting" of the coolant; higher velocities in the upstream portion of the flow. Jetting results from a vena contracta in the hole formed at the separation bubble in the delivery length near the tube entrance. These higher velocities are also found along the lateral edges of the holes. Downstream from this high velocity region, the effective velocity decreases, forming a depression. Downstream of this depression, the velocities increase sharply until the edge of the exit plane is reached. All in all, the exit profile is quite complex.

Integration of the normalized effective velocities over the entire exit plane yields a value greater than unity. This indicates that the freestream significantly interacts with the jet as it exits, inducing higher velocities through flow entrainment in the process. To distinguish between the influence of the freestream on the exit profile versus that attributable to the hole geometry, a hole-exit profile for short hole injection at the same blowing velocity as the VR=0.5 case but with no freestream flow is presented in Fig. 4.1(c). This hole-exit distribution is, therefore, for coolant flow without the freestream interaction. Such measurements are useful in that they present a picture of how the flow would exit the hole if it were left undisturbed by the freestream. Integration of the normalized mean effective velocities over the exit plane in this figure yields a value of unity. Comparing Fig. 4.1(a) to 4.1(c) leads one to the conclusion that jetting behavior is inherent to the short-hole geometry and is mostly separate from the freestream interaction effect, but that the freestream is able to have a significant influence primarily in the downstream portion of the exit plane.

Long-Hole Injection. This section details the hole-exit characteristics of film cooling with long-hole injection (L/D=7.0). Again, data for this configuration are given in Figs. 4.1 and 4.2. Jetting is less pronounced than with short-hole injection. At VR=0.5, a near parabolic profile is observed. Though a turbulent "pipe flow" profile might be expected, the larger momentum of the freestream forces the profile to be skewed towards the downstream edge of the exit plane. At VR=1.0 (Fig. 4.2(e)), the "pipe flow" exit profile is only slightly skewed. Comparisons of TI level traces in Fig. 4.2 indicates that TI levels in the short L/D cases are significantly higher than values with long-hole injection. In addition, the long hole injection produces a more uniform TI distribution over the film cooling hole. In both cases, the highest TI levels are in regions of low velocity. Levels for long-hole injection are consistent with those for fully-developed turbulent flows in tubes (Laufer, 1953).

Intermediate Hole Lengths. Much of the focus in this study is on comparing short (L/D=2.3) film cooling lengths to long (L/D=7.0) film cooling lengths. Several intermediate film cooling lengths, L/D=4.6 and 6.6, were also investigated to document the transition from short (L/D=2.3) to long (L/D=7.0) film cooling hole lengths. Like the short-hole and contrary to the long-hole geometry, these cases have the hole-entrance planes machined parallel to the hole exit plane. Centerline velocity profiles are presented in Fig. 4.3 for these geometries with the L/D=2.3 and L/D=7.0 profiles provided for comparison. In general, there appears to be a gradual transition in moving from short to long hole lengths. With increased length, jetting is reduced. Increased length is speculated to attenuate the effects of the separation zone at hole entrance.

4.2.1.2 Spectral Measurements

Spectral distribution are presented in two different plot formats. The first details P (the product of the power spectral density, E(f), and the local frequency, f, normalized on u'^2) versus St (e.g. Fig. 4.4(a)). This type of figure is useful for determining the proportional energy content of the flow at particular frequencies for, in this form, the area under the curve in any frequency band is proportional to the energy in that frequency band. The second type of plot details the power spectral density, E(κ), versus the wave number, κ (e.g. Fig. 4.4(b)). This plot is useful in determining the dissipation rate and scales within the coolant flow. Examples of the spectra are given in Fig. 4.4. This figure highlights spectra measured in the freestream. On Fig. 4.4(b), the various regimes of the spectra can be easily distinguished. At low frequencies, the energy is associated with the largest eddies in the flow and whatever unsteadiness may exist at those frequencies. At high frequencies, the spectra denote the inertial subrange (identified by the $\kappa^{-5/3}$ relationship) and for higher κ, the dissipation range. At mid frequencies, the spectra distribution is related to the energy-containing eddies in the flow (e.g. peak in Fig. 4.4(a)). Very low frequency (f<10Hz) spectral data are not representative of turbulence and merely highlight some low-frequency unsteadiness of the film cooling and mainstream flows.

To document the effects of hole length, four film cooling hole geometries having L/D=2.3, 4.6, 6.6, and 7.0 with a large, open plenum ("sink" flow delivery, Figs. 2.1(a) and 2.1(b)) were investigated. These geometries incorporate the short, intermediate, and long hole lengths documented in the previous.

Figures 4.5 and 4.6 show such data (P vs. St) at the hole center (x=y=z=0) for the four L/D configurations at VR=1.0 and VR=0.5, respectively. It is evident that all the coolant flows exhibit the same dominant frequency ranges, 0.5<St<0.9, suggesting turbulent scales on the order of 0.5-0.9D. The higher end of this range is similar to scales of temperature fluctuations found by Kohli and Bogard (1997). For the VR=1.0 case, Fig. 4.5, data from short holes exhibit concentration in a narrower part of that frequency range. Data from long-holes are more typical of fully-developed flows, like those given for the freestream in Fig. 4.4. Also, peak values are higher with small L/D than with large L/D, suggesting attenuation of some energy with increased hole length. Noteworthy is that the influence of the low-frequency, freestream turbulence (0.04<St<0.07) is small. Also, a low frequency unsteadiness (0.002<St<0.01) is visible in the plots, which becomes proportionately more prominent as L/D is increased.

Although not presented, these measurements were repeated but without freestream flow. In doing so, it was discovered that the spectra in the range of the dominant frequency, 0.5<St<0.9, did not change. It is speculated that this dominant frequency corresponds to the frequency of unsteady separation at the hole entrance and is not associated with any processes in the coolant-mainstream mixing zone. High energy at this dominant frequency is visible for all cases but dies off as the hole length is increased.

For VR=0.5 (Fig. 4.6), trends similar to the VR=1.0 case are observed. With the lower coolant momentum, differences with L/D are reduced. The shorter L/D's cases exhibit more peaking of energy, but not to the extent found in Fig. 4.5. Also, all the peak magnitudes are below those for the VR=1.0 flow. Finally, the VR=0.5 flow cases appear to be more influenced by the freestream, than for VR=1.0 case, since more distinct energy is visible in the 0.04<St<0.08 range.

Given the distinctly different distributions of exit velocity within the emerging jets with different L/D (Burd, et al., 1999), it is also likely that spectra may change from one position to another within the emerging jet. To document this, data at y=z=0 were also taken at x/D=-0.5 (upstream of hole center) and x/D=0.5 (downstream of hole center). Figures 4.7 and 4.8 highlight these measurements for L/D's of 2.3, 4.6, and 7.0 at VR=1.0.

Upstream, x/D=-0.5, (Fig. 4.7) there are very distinct differences for different L/D's. Dominant frequencies are visible in each of the coolant flows, but they center about St=0.6 for the short lengths and St=1.0 for L/D=7.0. With such inclined holes, L/D=2.3 and L/D=4.6 cases have substantial separation zones and associated shearing at the inlet to the delivery hole whereas the L/D=7.0 case has a smoother transition at the inlet, a smaller vena contracta, and more decay of the effect of this region over the delivery length. It is apparent from Fig. 4.7 that the peaks are more defined and larger for L/D=2.3, decreasing as L/D increases. The hole-exit velocity profiles in section 4.2.1.1 showed that shorter L/D cases are more susceptible to "jetting" or having higher velocities in the upstream portion of the hole exit plane, yielding significantly more coolant mass and turbulence energy in that region. Perhaps the most intriguing aspect of Fig. 4.7 is found in looking for frequencies that may be associated with the freestream. Both L/D=4.6 and L/D=7.0 cases show very little energy at the freestream frequencies (0.04<St<0.07) in their spectral distributions. The L/D=2.3 case has more prominent jetting towards the upstream side of the hole (See Fig. 4.3) and is expected to have more momentum exchange with the freestream in the upstream portion of hole exit plane. Indeed, more influence of the freestream is being "felt" at this upstream location with the short hole as evidenced by more energy in the 0.04<St<0.07 range (Fig. 4.7, L/D=2.3). The interaction is probably not influential, however, for the coolant-energy and freestream-induced-energy peaks remain separated and energy at the freestream-dominant frequency is relatively low.

Measurements downstream of hole center are presented in Fig. 4.8. Unlike in the upstream measurements, the distributions for all L/D's are similar; all exhibit the majority of their energy content in the same frequency band. Downstream, though, this region centers about St=1.0, suggesting a turbulence scale equal to one hole diameter. There seems to be little influence at the freestream-dominant frequencies. Along the downstream portion of the hole-exit plane, the coolant is fairly isolated from the freestream interaction, so scales would likely be more independent of the freestream. This area is best characterized in terms of the hole diameter. As in Figs. 4.5 and 4.7, the short L/D cases exhibit a more defined peak in the vicinity of St=1.0.

Thus far, with the use of a Strouhal number, normalization of the spectral distributions has been with the hole diameter. To further understanding and documentation of these flows, additional turbulence parameters and scales, including integral length scales, local disspation rates, local turbulent kinetic energy (k), and microscales of turbulence, were calculated via the spectra. These quantities are listed in Table 4.2.

Unlike freestream spectra, though, coolant spectra have two regions in which $E(\kappa)$ plateaus (Fig. 4.9). One corresponds to the low-frequency unsteadiness ($f \Rightarrow 0$) and the other is considered to correspond to the larger scales of turbulence. The latter (See E_Λ, Fig. 4.9) was used to compute the integral length scales listed in Table 4.2. For long film cooling holes, the plateau corresponding to the larger scales of turbulence resembles to that shown in Fig. 4.4(b). For short holes, this plateau is less distinct. To conservatively document the integral length scales, a range of "feasible" values are presented for each case in Table 4.2. In general, $0.1<\Lambda/D<0.5$ is common to all the flows. This is characteristic of values found for developing and near-fully-developed pipe flows.

To calculate dissipation rates, the focus turns to the inertial subrange in the spectra. In general, the inertial subrange was identified by the $\kappa^{-5/3}$ relationship in the spectra. Cases with a shorter delivery length, though, tended to not follow this relationship, having κ^{-2} or $\kappa^{-5/2}$ relationships instead. Nevertheless, best fits to the -5/3 relationship were used. Dissipation rates calculated for all the film cooling configurations are also listed in Table 4.2 with the cases in which the -5/3 relationship was less clear noted with an asterisk (*). Dissipation rates are generally observed to be smallest for (1) low VR's and (2) longer film cooling hole lengths. It was previously speculated that these cases have less interaction with the freestream. This speculation is supported by the spectra in Figs. 4.5, 4.6, 4.7, and 4.8. Also, dissipation values tend to be lowest in the region of highest coolant velocity and lowest turbulence kinetic energy. This generally corresponds to regions in coolant flows where shear is low. For most of the cases studied, uncertainty in ε is within ±10%. Values are higher for the cases denoted with an asterisk.

Turbulence kinetic energy, energy length scales, and turbulence microscales were also calculated for the cases (Table 4.2). Observations regarding turbulence kinetic energy are that (1) k magnitudes are largest for short film cooling hole lengths and decrease monotonically as L/D is increased, (2) k scales on VR, and (3) locations of highest coolant momentum tend to have lowest k values. Several trends are also apparent with regards to the dissipation (energy) and Kolmogorov scales. Energy length scales, for all cases, tend to fall into the range $0.1<L_u/D<0.3$. In general, microscales of turbulence are largest for low VR's.

Table 4.2: Turbulence Parameters and Scales

Case, Flow	VR	x/D	U/U_{hole}	k (m^2/s^2)	Λ/D	ε (m^2/s^3)	L_u/D	η/D ($x10^3$)
2.3, Sink	0.5	-0.5	1.40	0.093	0.15-0.30	12.01*	0.287	7.20
		0.0	1.47	0.517	0.17-0.27	271.8	0.166	3.30
		0.5	1.18	0.894	0.25-0.33	662.3	0.154	2.64
	1.0	-0.5	1.32	0.153	0.11-0.66	100.3*	0.072	4.15
		0.0	1.09	4.356	0.17-0.47	4451	0.248	1.61
		0.5	0.83	2.592	0.14-0.22	4710	0.107	1.59
4.6, Sink	0.5	0.0	1.24	0.606	0.24-0.45	295.9	0.193	3.15
	1.0	-0.5	1.20	1.976	0.30-0.50	1267	0.266	2.18
		0.0	1.00	2.064	0.27-0.41	1910	0.189	1.97
		0.5	1.01	1.271	0.24-0.50	1360	0.127	2.14
6.6, Sink	0.5	0.0	1.28	0.362	0.33-0.45	163.1	0.162	3.74
	1.0	0.0	1.06	1.397	0.33-0.43	969.6	0.207	2.41
7.0, Sink	0.5	-0.5	1.16	0.554	0.15-0.34	292.9	0.171	3.18
		0.0	1.33	0.209	0.16-0.25	25.37	0.456	5.85
		0.5	1.47	0.142	0.15-0.35	23.63	0.274	5.96
	1.0	-0.5	1.08	0.813	0.16-0.38	346.0	0.257	3.08
		0.0	1.11	0.701	0.18-0.27	277.2	0.256	3.25
		0.5	1.32	0.382	0.16-0.38	225.1	0.127	3.43

** -5/3 relationship is not clear*

4.2.1.3 Discharge Coefficients

The measured discharge coefficients, C_d, for cases with an unrestricted plenum and varying L/D are plotted against the ratio of the coolant total-pressure-to-freestream-static pressure ratio, p_c^+/p_s, in Fig. 4.10. Figure 4.10(a) is without an external freestream flow whereas Fig. 4.10(b) is with freestream flow. Without the freestream flow, the three shortest L/D geometries exhibit nominally the same magnitudes for all pressure ratios exceeding 1.001. All of these cases have the same inlet geometry so the only expected differences between these cases would be attributable to skin friction or experimental uncertainty. The data suggest that friction losses are negligible corroborating the findings of Lichtarowicz et al. (1965), Andrews and Mkpadi (1983), and Hay and Lampard (1996). Due to the different inlet geometry, the L/D=7.0 case has higher C_d values throughout. This is consistent with the results of Fried and Idelchik (1989). For all cases with freestream flow, discharge coefficient magnitudes increase nearly monotonically as p_c^+/p_s increases, with the C_d values asymptotically approaching a near constant level at the highest p_c^+/p_s. Although no other 35° inclination data are available in the open literature, C_d values of 0.70-0.75 are anticipated for 35° inclination at high p_c^+/p_s based on 30° and 45° data of Gritsch et al. (1997), Hay et al. (1994), and Byerley (1989).

A comparison of the curves with (Fig. 4.10(b)) and without (Fig. 4.10(a)) the external freestream shows that freestream flow causes a reduction in C_d at each pressure ratio; significant at the low p_c^+/p_s reducing to near zero at the highest p_c^+/p_s. The effect of the freestream varies with geometry. The "with" and "without" freestream curves for L/D=2.3 are relatively closer to one another than curves for the L/D=7.0 case.

Outlet additive losses are presented in Fig. 4.11 for the different L/D configurations. They increase with L/D; substantial values ($\delta_{out} > 1.00$) at low I, converging on near-zero values for large I. For $0.25 < I < 1.5$, there are considerable differences in δ_{out} between L/D cases (e.g. 0.15-0.20 higher for L/D=7.0 than for L/D=2.3 at I=0.7).

Review of Fig. 4.3 shows that with geometries for which more coolant is distributed in the upstream portion of the hole exit plane (i.e. short holes), interaction with the freestream is more aggressive, resulting in substantially higher pressures where the mainstream and coolant flows first meet. This interaction leads to a low pressure region over much of the hole exit plane as the coolant jet is turned by the interaction. This is similar to a cylinder in crossflow in which high pressures are found near the stagnation point and low pressures are found downstream in the cylinder wake. In the present instance, the void created by the blockage (jetting coolant) is filled as the coolant is turned. The low downstream pressure increases the mass flux at the downstream portion of the hole exit. The net result is a comparatively low outlet additional loss and higher velocities at the downstream portion of the hole-exit plane, for a fixed p_c^+/p_s. Configurations with more coolant distributed at the downstream portion of the hole exit (i.e. long holes) have flows which interact with the freestream more passively due to the lower momentum exchange where the mainstream and coolant flows first meet. This results in a shifting downstream of the high-pressure region, leading to a smaller low-pressure region in the downstream portion of the hole exit plane. The two combine to create a higher effective static pressure at the hole exit for these cases.

4.2.1.3 Surface Adiabatic Effectiveness

Local and centerline adiabatic effectiveness distributions are now given for short-hole and long-hole injection (Table 4.3). As with the hole-exit profiles, data are presented for only the FSTI=12%. Centerline effectiveness data are presented in Fig. 4.13. Additional data for short-hole injection are also presented in Figs. 4.12 and 4.47. Figure 4.12 is presented to highlight the resolution with which measurements were taken and to present the general shapes of the surface adiabatic effectiveness distributions downstream from the holes. Intersections of the grid lines in Fig. 4.12 correspond to the measurement locations.

Table 4.3: Test Cases Highlighting L/D Effects

TEST CASE	L/D	FSTI	VR	MEASUREMENT
092196b	2.3	12%	1.0	Adiabatic Effectiveness
092196a	2.3	12%	0.5	Adiabatic Effectiveness
092896b	7.0	12%	1.0	Adiabatic Effectiveness
092896a	7.0	12%	0.5	Adiabatic Effectiveness

The magnitudes of the effectiveness values are consistent with the literature. To demonstrate this consistency, Fig. 4.13(b) is provided. This figure shows the experimental data (from Fig. 4.13(a)) and data available in the literature on a single plot. High-FSTI data in the literature is sparse, especially in the near-hole region. Several data sets, however, have been selected for comparison. Given the different density ratios in these studies, comparisons are made for test cases in which momentum flux ratios are similar in magnitude to those in the present study. The figure shows, for instance, that the values at x/D=5.0 are within about 3% of the data presented by Bons et al. (1994) and Schmidt and Bogard (1996). Surveys of laterally-distributed values indicates the same level of agreement. The comparisons highlight the validity of the present measurement technique versus methods, primarily embedded thermocouples, used in prior studies.

Short-Hole Injection. Both Figs. 4.12 and 4.13 show the largest values of adiabatic effectiveness near the downstream edge of the hole and along the hole centerline. The values decay monotonically in both the streamwise and lateral directions, indicating no jet detachment. If jet detachment were present, the values would not decay monotonically, but would be low near the hole, increase to a peak value, and then decay monotonically. The lower velocity ratio case yields higher effectiveness in this 12% FSTI situation. The major difference with VR is a broader distribution in the lateral direction for VR=0.5 than with VR=1.0.

Long-Hole Injection. Centerline adiabatic effectiveness comparisons are made in Fig. 4.13 for long-hole injection versus short-hole injection. At VR=0.5, the two are similar. Short-hole injection exhibits slightly higher η in the very near-hole region ($x/D<2.5$). At VR=1.0, a definite detachment of the coolant jet in the near-hole region is visible with long-hole injection; the centerline value rises from $x/D=1.25$ to $x/D=2.5$. Downstream, the long-hole case has higher effectiveness relative to the short-hole case. The reduced jetting of the long-hole case has apparently allowed more of the coolant to eventually be turned streamwise with reduced mixing of the freestream, hence, a higher effectiveness at, and downstream of, reattachment.

4.2.1.4 Flowfield Measurements

Flowfield measurements are now presented for the cases in Table 4.4. The data for each of these test cases are given as contour plots of normalized streamwise velocity and local turbulence intensity in Figs. 4.14 through 4.27. To separate effects, these data are compared to one another and the results are presented in three sections as percent difference comparison plots. The first section highlights the influence of the hole length-to-diameter ratio with FSTI=0.5%. The second documents the effects of the hole length-to-diameter ratio with FSTI=12%. The third explores the effects of FSTI with a fixed geometry. It will be shown that both the hole length-to-diameter ratio and FSTI play influential roles.

In the proceeding sections, the "core" refers to the center of the region influenced by the coolant flow in which velocity gradients are small. The "mixing region" refers to the coolant jet periphery in which velocity gradients are large.

Table 4.4: Test Cases Highlighting L/D Effects

TEST CASE	L/D	FSTI	VR	MEASUREMENT
040396	7.0	0.5%	1.0	Flowfield, x/D=2.5
040896	2.3	0.5%	1.0	Flowfield, x/D=2.5
040496	7.0	0.5%	1.0	Flowfield, x/D=5.0
040796	2.3	0.5%	1.0	Flowfield, x/D=5.0
040396aa	7.0	0.5%	0.5	Flowfield, x/D=2.5
041096	2.3	0.5%	0.5	Flowfield, x/D=2.5
040596	7.0	0.5%	0.5	Flowfield, x/D=5.0
040696	2.3	0.5%	0.5	Flowfield, x/D=5.0
041296bb	7.0	12%	1.0	Flowfield, x/D=2.5
041496	2.3	12%	1.0	Flowfield, x/D=2.5
041396	7.0	12%	0.5	Flowfield, x/D=2.5
041596	2.3	12%	0.5	Flowfield, x/D=2.5
090896b	2.3	12%	1.0	Flowfield, x/D=5.0
091196	2.3	12%	0.5	Flowfield, x/D=5.0

General Features of the Flowfields. There appears to be some common features associated with the film cooling configurations studied that can be correlated to VR but are independent of the L/D and FSTI. With film cooling, the coolant exits the film cooling hole and disturbs the freestream flow and boundary layer. The particular disturbance that this coolant causes varies to some degree with VR. These features can be observed by looking at Figs. 4.14 through 4.27, the normalized mean velocity and local turbulence intensity distributions for the test cases in Table 4.4. Some of these characteristics are now discussed.

VR=1.0. At VR=1.0, the coolant forms a blockage of the freestream directly downstream from the hole. This blockage usually manifests itself as a nearly symmetric region of low velocities downstream. This region has its lowest velocities directly downstream from the hole centerline (z/D=0.0). It is centered at y/D~0.3 at x/D=2.5 and moves further from the wall downstream. Another common feature of the VR=1.0 cases is that this blockage is strong enough to force the freestream boundary layer to accelerate around it. Hence, for the VR=1.0 cases, a ring of velocities that exceed the nominal freestream velocity are visible outside of the blockage. The interface between the blockage and region of acceleration provide a qualitative outline of the coolant jet periphery.

VR=0.5. At VR=0.5, the coolant also forms a blockage of the freestream directly downstream from the hole that also tends to be symmetric. For VR=0.5, however, the coolant remains closer to the wall such that the region is centered at y/D~0.2 at x/D=2.5 and moves further from the wall downstream. The VR=0.5 situations have much reduced momentum in comparison to VR=1.0 cases and are unable to accelerate the freestream.

L/D Influence at Low FSTI. This section documents the hole L/D effect by comparing case A to case B. Pietrzyk et al. (1989, 1990) and Leylek and Zerkle (1994) recorded a strong effect of L/D, noting that short-hole injection is subject to "jetting" effects. With jetting, the jet velocity profile is not uniformly distributed across the majority of the plane at which it exits, but is skewed with substantially higher velocities upstream (Fig. 4.3). The data presented in Fig. 4.3 are for high FSTI whereas Leylek and Zerkle (1994) describe similar profiles for low FSTI.

VR=1.0. Figure 4.28(a) shows, at x/D=2.5, the percent rise in mean velocity (U/U_o) and Fig. 4.28(b) shows the rise in TI in going from L/D=7.0 to L/D=2.3. The mean velocities and TI levels for these cases are given in Figs. 4.14 and 4.15, respectively. A rise in the normalized velocity is observed over the majority of the region $0.2<y/D<0.5$ and $-0.4<z/D<0.4$ in going to the shorter delivery length. The flow emerging from the shorter hole is able to penetrate farther into the freestream flow and accelerates the freestream in that region. The film coolant ejects further in the wall-normal direction and spreads more in the spanwise direction, as evidenced by the rise in U/U_o along the hole centerline (z/D=0.0) at y/D=0.9 as well as at y/D~0.5 and z/D=±0.6. Negative velocity difference values (Fig. 4.28(a)) in the zone y/D=0.05 and z/D=±0.3 show a weaker downwash associated with a less coherent jet and a more elevated trajectory of the coolant in the short L/D case. In film cooling with long L/D, counter rotating vortex pairs are common downstream from the point of injection. The effects on the local turbulence intensity differences (Fig. 4.28(b)) are also pronounced, showing that mixing occurs further into the freestream with short-hole injection (note 5% higher values for the short hole case directly downstream of the film cooling holes (z/D=0) at y/D~0.9). In addition, higher turbulence levels extend into the region between the holes, to as far as z/D=0.7, emphasizing the jet lateral spreading. The region of negative TI differences with a change to short L/D holes (y/D~0.3, z/D~0) highlights the higher centerline momentum associated with short-hole injection.

Measurements were taken also at a downstream location, x/D=5.0, for VR=1.0 as shown in Fig. 4.29. In looking at this figure, it is apparent that the majority of the differences between the cases have decayed. The only features that remain are slightly higher velocities in the core region due to the jetting and lower velocities in the near-wall region along the centerline. The negative values in Fig. 4.29(a) highlight a potentially stronger downwash and centerline upwash associated with the L/D=7.0 case. TI differences are similar to those for x/D=2.5 but have decayed substantially. The cases compared in Fig. 4.29 are shown separately in Figs. 4.16 and 4.17.

VR=0.5 Figure 4.30 highlights the differences in velocity and TI in going from L/D=7.0 to L/D=2.3 with VR=0.5 at x/D=2.5. The two L/D cases compared here are shown individually in Figs. 4.18 and 4.19. At VR=0.5, the coolant serves as a blockage of the freestream but is unable to accelerate the freestream so no appreciable differences in velocities and TI are visible along the coolant jet periphery. The figures indicate that short L/D has higher velocities due to the jetting. This is given by higher velocities at 0.2<y/D<0.4 and -0.3<z/D<0.3. These higher velocities result in net lower TI levels in the same region.

For VR=0.5 at x/D=5.0 (Fig. 4.31), the differences in velocities have subsided and all but decayed away. No large regions of differences are visible, suggesting that under low FSTI and VR=0.5, the two L/D situations appear to be identical to within the measurement uncertainty. The two VR=0.5 cases at x/D=5.0 are documented individually in Figs. 4.20 and 4.21.

L/D Influence at High FSTI. This section documents the role of L/D when the FSTI is elevated to combustor exit levels (~12%). Again, different L/D cases are compared at fixed VR and x/D location.

VR=1.0 Figure 4.32 shows velocity comparisons for the two L/D cases at x/D=2.5. Figures 4.22 and 4.23 isolate the cases being compared. Per Fig. 4.32, there remains a region downstream of the hole centerline (0.2<y/D<0.5 and -0.3<z/D<0.3) where the mean velocities of the short L/D case are higher, indicating the penetration or "jetting" of the low-L/D jet further into the flow. This is similar to the low-FSTI case comparison (Fig. 4.28). Also, consistent the low-FSTI comparison, negative velocity differences in the zone y/D=0.05 and about z/D=±0.3 show a weaker downwash associated with the less coherent jet and the more elevated trajectory of the short-L/D case. Negative values of percent turbulence intensity difference (Fig. 4.32(b)) in the zone given by y/D<0.4 along the jet centerline are attributable to the higher momentum of the short hole jet and the associated reduction of shear with the mainstream flow in this region. Data are not presented at x/D=5.0, but surveys suggest that the differences decay as they did with the low-FSTI case (Fig. 4.29).

VR=0.5 Velocity and TI comparisons for L/D=7.0 and 2.3 and VR=0.5 under high FSTI are presented in Fig. 4.33. Differences similar to those with VR=1.0 are evident. Basically, the short-L/D case continues to exhibit jetting, and, thus, higher velocities in the core region (-0.4<z/D<0.4 and 0.1<y/D<0.4) and corresponding lower TI levels. Since VR=0.5 remains close to the wall and enhanced mixing is characteristic of high FSTI, near-wall differences are visible. These VR=0.5 cases are illustrated independently in Figs. 4.24 and 4.25. Measurements at x/D=5.0 are not presented but surveys indicate that differences decay as with the low-FSTI case (Fig. 4.31).

FSTI Effects. With elevated FSTI, film coolant rapidly mixes with the freestream flow. With this, the film cooling jets diffuse more rapidly, resulting in a dispersed film cooling flow with less influence distant from the wall. In the following section, comparisons at two FSTI levels for the long-hole injection cases and the short-hole cases are given. The comparisons are made between cases presented in the prior sections but with the FSTI being the variable of concern. Velocity comparisons are performed with a normalization similar to that used for the L/D comparisons (i.e. Fig. 4.28). Given the differing FSTI levels, however, TI comparisons, as found in Fig. 4.28, are not made. Instead, contour plots of the u_{rms} distributions are given in separate plots, for the two FSTI levels, and compared. Two L/D=2.3, x/D=5.0 cases at high FSTI which have not been previously introduced are added to this section for completeness (Figs. 4.26 and 4.27).

L/D=7.0 With long L/D, at VR=1.0, the normalized mean velocity distributions have significant differences. Figure 4.34 shows the change in mean velocity ratios when changing from the low-turbulence case to the high-turbulence case. First, in the region (0.3<y/D<0.5 and z/D=±0.5), the high-FSTI case has lower mean velocities. This indicates more mixing with elevated FSTI in this region. Along the centerline (z/D~0, y/D<0.5), however, the mean velocities are larger for the high-FSTI case. Deceleration along the outer portions of this region, caused by the larger shear in this region, assists with accelerating the jet core. Figure 4.34 shows u_{rms} contours for the low- and high-FSTI cases. Their turbulence structures are similar, with distinct regions detailing the core and mixing regions of the jets. The low-FSTI case shows coolant penetrating further from the wall (to y/D~1.0 along the centerline but to only y/D~0.8 for the high-FSTI case). Consistent with this is a slightly wider lateral (larger z/D) influence of the low-FSTI jet. Elevated u_{rms} levels extend to z/D~0.8 for the high-FSTI case and to z/D~1.0 for the low-FSTI case.

The VR=0.5 comparison is made in Fig. 4.35. Comparing the velocities, it is apparent that the high-FSTI case exhibits higher velocities in the core region (-0.2<z/D<0.2 and 0.1<y/D<0.3). The reason for this is that at low VR values, the coolant jet is more susceptible to FSTI influences, primarily because of its lower momentum. The high-FSTI case tends to overcome the blockage when VR is low. This results in higher velocities with high FSTI. The higher freestream and boundary layer velocities are able to interact with the coolant and accelerate the flow in the "blocked region," yielding higher velocities. The u_{rms} figure shows that, in general, the contours possess a much larger zone of influence in both the wall-normal and lateral directions.

L/D=2.3 The same comparison of different FSTI cases is made for short-L/D injection. Changes in mean velocity in going to high FSTI are noted in Fig. 4.36. Although generally the regions of difference are shared with the long-L/D case, the magnitudes are changed. The low-FSTI case maintains higher mean velocities along the outer edges of the jets (y/D~0.3-0.7 and z/D=0.6). Differences in this outer region extend to z/D~0.8, farther in the spanwise direction than those found with the long-L/D comparison case. This indicates that in the high-FSTI case, the jet is decelerating and mixing to a greater extent than in the low-FSTI case. About the hole centerline (-0.4<z/D<0.4 and y/D<0.6), mean velocities are higher for the high-FSTI case. This again shows that the high-FSTI case has enhanced jetting into the jet core region. A comparison of u_{rms} distributions shows an influence of the jets in both cases which extends to y/D~1 for high FSTI and to y/D~1.15 for low FSTI. A somewhat wider influence of the jets laterally for the low-FSTI case is also apparent. In moving downstream to x/D=5.0 (Fig. 4.37), the same trends are apparent but the regions are more pronounced.

The VR=0.5 comparisons are made in Figs. 4.38 and 4.39. These comparisons show similar results to Fig. 4.35. The high-FSTI case exhibits higher core velocities due to the interaction with the freestream and displays acceleration of the flow in the region where the injection flow blocks the freestream. Differences between the u_{rms} distributions are not distinct for these cases. In moving downstream to x/D=5.0, the same trends exist but, again, are more pronounced.

4.2.2 Effect of Coolant Plenum Geometry

Hole-exit effective velocity and TI profiles, spectral measurements, discharge and loss coefficients, and adiabatic effectiveness distributions are now presented for the cases in which flow is delivered to holes through a restricted plenum, as shown in Fig. 2.1. These cases, counter-flow and co-flow delivery, are compared to open plenum, short-hole injection to quantify the effects of each configuration. Data under high FSTI (12%) conditions only are presented. Flowfield data at x/D=2.5 and 5.0 are not presented. Given the subtle differences (≤10%) in the normalized mean velocities and TI between long-hole and short-hole injection downstream from the holes under high FSTI, it is anticipated that differences between these cases would be much smaller. Such small differences would not be captured reliably with the single-wire measurement technique. It will be shown that these cases all exhibit similar hole-exit profiles and adiabatic effectiveness distributions. This suggests that the flowfields are significantly more similar than the L/D comparison cases. As a result, the choice was made to preclude flowfield data for these cases. Results for counter-flow and co-flow delivery at VR=0.5 and 1.0 are now introduced.

4.2.2.1 Hole-Exit Profiles

As with the L/D comparison cases, normalized mean effective velocity distributions are presented in Fig. 4.40 for open plenum injection, counter-flow delivery, and co-flow delivery at VR=0.5 and 1.0. In addition, normalized centerline mean effective velocity and TI distributions for counter-flow and co-flow delivery are compared to open plenum injection in Fig. 4.41.

Counter-Flow Delivery. Looking at Figs. 4.40 and 4.41(a), it appears that, for VR=0.5, counter-flow has mean effective velocity distributions which are similar to those found with open plenum, short-hole injection. For the majority of the centerline profiles, differences between counter-flow delivery and open plenum injection are not significant, with counter-flow exhibiting only slightly higher magnitudes in the region $-0.5<x/D<0.5$.

Table 4.5: Test Cases Highlighting Influence of Coolant Plenum Geometry

TEST CASE	GEOMETRY	FSTI	VR	MEASUREMENT
050796	Open Plenum	12%	1.0	Hole-Exit
051096	Open Plenum	12%	0.5	Hole-Exit
052296	Counter-Flow	12%	1.0	Hole-Exit
052996	Counter-Flow	12%	0.5	Hole-Exit
061496	Co-Flow	12%	1.0	Hole-Exit
061796	Co-Flow	12%	0.5	Hole-Exit

Over the remainder of the exit-plane, differences in comparison to open plenum injection are negligible. With VR=1.0, though, the differences are quite substantial. Counter-flow delivery greatly enhances the jetting of the coolant in the upstream portion of the exit plane, as given by higher velocity magnitudes along the hole centerline for x/D<0.25 (Fig. 4.41(b)). These higher velocities extend to the outer edges of the hole-exit plane (Fig. 4.40) to z/D=0.4 and x/D=0.0, for instance. For x/D≥0.5, however, the velocities remain very similar to open plenum, short-hole injection.

Effective centerline TI distributions at the two VR's (Fig. 4.41) show, generally, maximum TI levels at locations of lowest velocity and minimum values in regions of the highest velocity. TI magnitudes are slightly higher than those for open plenum injection for both cases over the entire centerline profile.

Co-Flow Delivery. The general shape of the effective velocity distribution found with short-hole injection is still apparent with co-flow delivery. With VR=0.5 (Figs. 4.40 and 4.41(a)) and in comparison to short-hole injection, magnitudes of the normalized mean velocities are distinctly lower in the upstream portion of the jet exit plane with co-flow delivery. The velocities at the downstream edge of the hole (x/D>0.5) are slightly higher. Also, the depression in the velocity profile has shifted upstream to x/D=0.3 versus x/D=0.4 for the short-hole counterpart. With VR=1.0 (Fig. 4.41(b)), nearly the same effective velocity behavior is observed - lower velocities in the upstream portion and higher velocities in the downstream portion of the hole exit. For this case, though, the differences in the downstream portion of the profile are more prominent.

Turbulence intensity distributions (Figs. 4.41(a) and 4.41(b)) show comparable magnitudes to those with short-hole injection but slightly higher values at the upstream portion of the film cooling exit plane. As with short-hole injection and counter-flow delivery, TI levels are inversely related to the velocities.

4.2.2.2 Spectral Measurements

Spectral distributions were also taken for film cooling with L/D=2.3 and modified entrance flow (Figs. 2.1(c) and 1(d)). The cases with counter-flow and co-flow delivery are compared in Figs. 4.42 through 4.44. Corresponding hole-exit velocity distributions for these configurations were presented in the previos section.

Figure 4.42 highlights the spectral distributions for x/D=-0.5. There is a very pronounced energy peak at St=0.6-0.7 and a lesser peak at the dominant frequency of the freestream (0.04<St<0.07). The counter-flow case has the most prominent "jetting," or skewing of the exit velocity distribution toward the upstream, and, thus, is expected to have the highest momentum exchange with the freestream in the upstream portion of hole exit plane Figs. 4.40 and 4.41). Unlike the "sink flow" case, the energy at the freestream frequencies is substantial and is influencing a majority of the spectrum by merging with the zone of coolant peak energy. There apparently is some influence of the eddies shedding along the jet periphery and the upstream edge, as described by McMahon et al. (1971). With co-flow, the extent of jetting is reduced significantly (Burd and Simon, 1997); thus, coolant-freestream interaction is weaker. As a result, the peak is widened to 0.5<St<2.0 and the freestream influence (St<0.07) is less.

Distributions for the center (x=y=z=0) are in Fig. 4.43. All configurations still have an energy peak about 0.6<St<0.7, with the "sink flow" configuration being most pronounced. Since the significant jetting and interaction with the freestream is at the upstream portion of the hole exit, the energy at the freestream frequencies, 0.04<St<0.07, is reduced at this location. For co-flow, the distribution is quite uniform. Levels at the dominant frequency have dropped, whereas energies in the low-frequency range have risen.

At the downstream location (Fig. 4.44), distributions for the "sink flow" and counter-flow configurations are very similar to each other; both continue to have well-defined peak energies. Co-flow, however, is significantly different (and somewhat different than that found in Fig. 4.43). Co-flow has more coolant mass in the downstream portion of the hole-exit plane resulting in more interaction with the freestream at this location. Increased low-frequency energy in the spectrum would imply that this flow is more influenced by the freestream. Previously, it was shown that the co-flow case was inclined to separate on the downstream edge of the film cooling hole and reattach on the plate downstream. Apparently, freestream unsteadiness influences this process.

Turbulence turbulence parameters and scales were also calculated from the spectra for these configurations. These data are provided in Table 4.6.

Table 4.6: Turbulence Parameters and Scales

Case, Flow	VR	x/D	U/U_{hole}	k (m^2/s^2)	Λ/D	ε (m^2/s^3)	L_u/D	η/D ($x10^3$)
2.3, Sink	0.5	-0.5	1.40	0.093	0.15-0.30	12.01*	0.287	7.2
		0.0	1.47	0.517	0.17-0.27	271.8	0.166	3.3
		0.5	1.18	0.894	0.25-0.33	662.3	0.154	2.6
	1.0	-0.5	1.32	0.153	0.11-0.66	100.3*	0.072	4.1
		0.0	1.09	4.356	0.17-0.47	4451	0.248	1.6
		0.5	0.83	2.592	0.14-0.22	4710	0.107	1.5
2.3, Co-Flow	0.5	0.0	1.30	0.811	0.20-0.30	401.3	0.220	2.9
	1.0	-0.5	1.21	0.383	0.33-0.43	211.5	0.136	3.4
		0.0	1.02	5.004	0.20-0.30	3950	0.344	1.6
		0.5	0.94	2.955	0.16-0.27	3755	0.164	1.6
2.3, Counter-Flow	0.5	0.0	1.51	0.472	0.23-0.40	197.1	0.199	3.5
	1.0	-0.5	1.38	0.574	0.23-1.00	164.8*	0.320	3.6
		0.0	1.27	4.502	0.22-0.40	3760	0.308	1.6
		0.5	1.16	4.142	0.17-0.30	8732	0.117	1.3

* -5/3 relationship is not clear

Figure 4.45 details discharge coefficients measured for the counter-flow and co-flow configurations with and without freestream flow. Discharge coefficients for the L/D=2.3 case with no internal approach flow momentum are presented for comparison. Approach flow momentum, though fairly small relative to the cooling flow momentum, has a significant influence on discharge coefficient magnitudes (Fig. 4.45(a)). It is apparent that co-flow exhibits the highest discharge coefficients for all pressure ratios and counter-flow exhibits the lowest discharge coefficients. For coolant supply flow from a large, unrestricted plenum or through a channel without approach flow momentum, a separation zone is found at the downstream (relative to the mainstream) edge of the entrance to the cooling hole. With co-flow, however, the inlet separation is apparently at the upstream (relative to the mainstream) edge of the cooling hole. This results in a net reduction of entrance losses leading to higher discharge coefficients (Thole et al. 1997). The counter-flow case, however, would likely show an increase in the size of the separation zone at the downstream edge of the inlet to the film cooling hole relative to that of the "sink flow" case leading to reduction in C_d (Byerley, 1989 and Burd and Simon, 1997). As with the cases in Fig. 4.45, the presence of freestream flow causes reductions in the discharge coefficients.

For all I, δ_{out} values are greatest for the co-flow configuration and smallest for the counter-flow configuration (Fig. 4.46). For the most part, the "sink" flow supply case falls between the two, but is closer to the counter-flow case. The δ_{out} values suggest that co-flow has the highest net exit static pressures, at each I, of the three cases. In terms of hole-exit velocity distributions, it appears that the smallest outlet losses are observed for the geometry with the most coolant at the upstream portion of the hole exit plane (counter-flow) and largest for the configuration with the coolant velocity distribution most skewed toward the downstream portion of the hole exit plane (co-flow). This is consistent with the trends with L/D.

It is important to note that the sink flow and channeled-entry designs in this study do not provide high velocity approach flows to the holes. The cross-sectional area ratio between the cooling holes and the channel is 1:8, so approach velocities are on the order of 12% of film cooling velocities. That C_d and δ_{out} variations exist demonstrates the strong sensitivity. Some of this sensitivity has been documented by Burd and Simon (1997). With other film cooling designs, such as those with significant approach flow velocities, it is likely that the differences would be amplified.

4.2.2.4 Adiabatic Effectiveness

Local, laterally-averaged, and centerline adiabatic effectiveness distributions are given for open-plenum injection, counter-flow delivery, and co-flow delivery. The streamwise evolution of the adiabatic effectiveness values for all three configurations at VR=0.5 and 1.0 are given in Fig. 4.47. Centerline and laterally-averaged distributions are given in Figs. 4.48 and 4.49, respectively. Laterally-averaged effectiveness values are calculated using a trapezoidal integration of the laterally-distributed data at each streamwise position.

Counter-flow Delivery. At VR=0.5 and along the hole centerline (Fig. 4.48), counter-flow delivery is the most effective configuration in the near-hole region (x/D=1.25) but quickly loses this advantage downstream. From 2.5≤x/D≤10.0, counter-flow delivery is very similar to open-plenum injection and co-flow delivery. Although centerline values are higher in the near-hole region, the laterally-averaged effectiveness values (Fig. 4.49) are comparable to open-plenum injection at all streamwise positions.

Table 4.7: Test Cases Highlighting Influence of Coolant Plenum Geometry

TEST CASE	GEOMETRY	FSTI	VR	MEASUREMENT
092196b	Open Plenum	12%	1.0	Adiabatic Effectiveness
092196a	Open Plenum	12%	0.5	Adiabatic Effectiveness
092296a	Counter-Flow	12%	1.0	Adiabatic Effectiveness
092296b	Counter-Flow	12%	0.5	Adiabatic Effectiveness
092396b	Co-Flow	12%	1.0	Adiabatic Effectiveness
092396a	Co-Flow	12%	0.5	Adiabatic Effectiveness

For VR=1.0 and along the centerline (Fig. 4.49), counter-flow delivery exhibits the highest magnitude of effectiveness in the near hole region. At x/D=1.25, for instance, η for counter-flow delivery is 57% whereas it is only about 51% for short-hole injection. In moving downstream, counter-flow delivery continues to be more effective than short-hole injection. This higher effectiveness is again observed in the laterally-averaged data (Fig. 4.35), but to a lesser degree.

<u>**Co-flow Delivery**</u>. Co-flow injection shows little substantive differences in centerline (Fig. 4.48) and laterally-averaged (Fig. 4.49) effectiveness in comparison to open-plenum injection at VR=0.5. At most, it appears to have slightly lower centerline effectiveness values in the near-hole region. At VR=1.0, the situation is different. In the near wall region (x/D=1.25), centerline η values (Fig. 4.48) are substantially lower for co-flow delivery than they are for counter-flow delivery and open-plenum injection. Instead of there being a rapid decay in this value when moving in the streamwise direction, it decays more slowly (x/D<5). Co-flow delivery also undergoes a substantial streamwise change relative to the other delivery configurations. In the near-hole region, co-flow is least effective (x/D=1.25), increasing in relative effectiveness until it is the most effective scheme (x/D=3.75). From x/D=5.0 to 10, co-flow remains more effective than open-plenum injection but at a level nearly the same as counter-flow delivery. This behavior indicates a detachment of the film cooling jet in the near-hole region at high VR. No detachment was apparent with counter-flow and open-plenum, short-hole delivery. Co-flow delivery has a more uniform hole-exit profile with higher velocities in the downstream portion of the hole than the other cases. At a high VR, these higher velocities lead to separation and then reattachment of the coolant. While detached, the

centerline effectiveness is lower than if it had not detached. Downstream from the point of reattachment, higher centerline h values are observed as with long-hole injection. In terms of laterally-averaged effectiveness (Fig. 4.49), co-flow delivery is consistently more effective than, or equal to, short-hole injection, even in the region of jet detachment.

4.2.3 Physical Model

The present results document the influences of the plenum geometry and hole length on film cooling. Long-hole injection is visibly different than short-hole injection. In short, the two result in distinctly dissimilar hole exit qualities and performance. In comparison to open-plenum injection, coolant flow with counter-flow delivery exits with more momentum at the upstream portion of the film cooling hole causing a blockage of the freestream flow. This coolant flow, however, is rapidly redirected into the streamwise direction by the interaction with the freestream. This redirection and interaction with the freestream leads to higher effective velocities in the downstream portion of the hole exit and higher centerline effectiveness values in the near-hole region. Co-flow delivery tends to have a more uniform hole-exit profile and more momentum in the downstream portion of the hole exit in comparison to open-plenum injection. The net result of co-flow delivery, however, varies with the velocity ratio. At high VR, the higher momentum of the flow in the downstream portion of the hole leads to detachment of the jet and lower centerline effectiveness values in the near-hole region, but higher centerline effectiveness values farther downstream. Figure 4.50 provides a physical model representation of the major flow streamlines along the hole centerlines for the geometries studied.

The lateral distribution of effectiveness values in Fig. 4.47 and the laterally-averaged effectiveness values in Fig. 4.49 provide additional insight. Both short-hole injection and counter-flow delivery eject a majority of their coolant mass in the upstream portion of the exit plane, with counter-flow ejecting more mass with greater momentum. As this "jetted" coolant exits the hole and travels downstream, it interacts with the freestream dissipating some of the cooling potential along the edges of the film cooling jet. This results in laterally-distributed effectiveness distributions that are narrow and more concentrated about the centerline. With more "jetted" mass and higher momentum, counter-flow is able to sustain higher cooling potential, resulting in higher effectiveness values. Co-flow, however, has higher effective velocities across the entire exit-plane at downstream positions, not just along the centerline. Unlike short-hole and counter-flow cases, this flow need not have to travel a far distance before imposing its cooling potential. Thus, co-flow is less influenced by the freestream interaction. The higher effective values in the downstream portion of the exit-plane, thus, indicate a zone of protection that is wider in the lateral direction than with the other cases. The result is high laterally-averaged effectiveness values, even in zones of jet detachment.

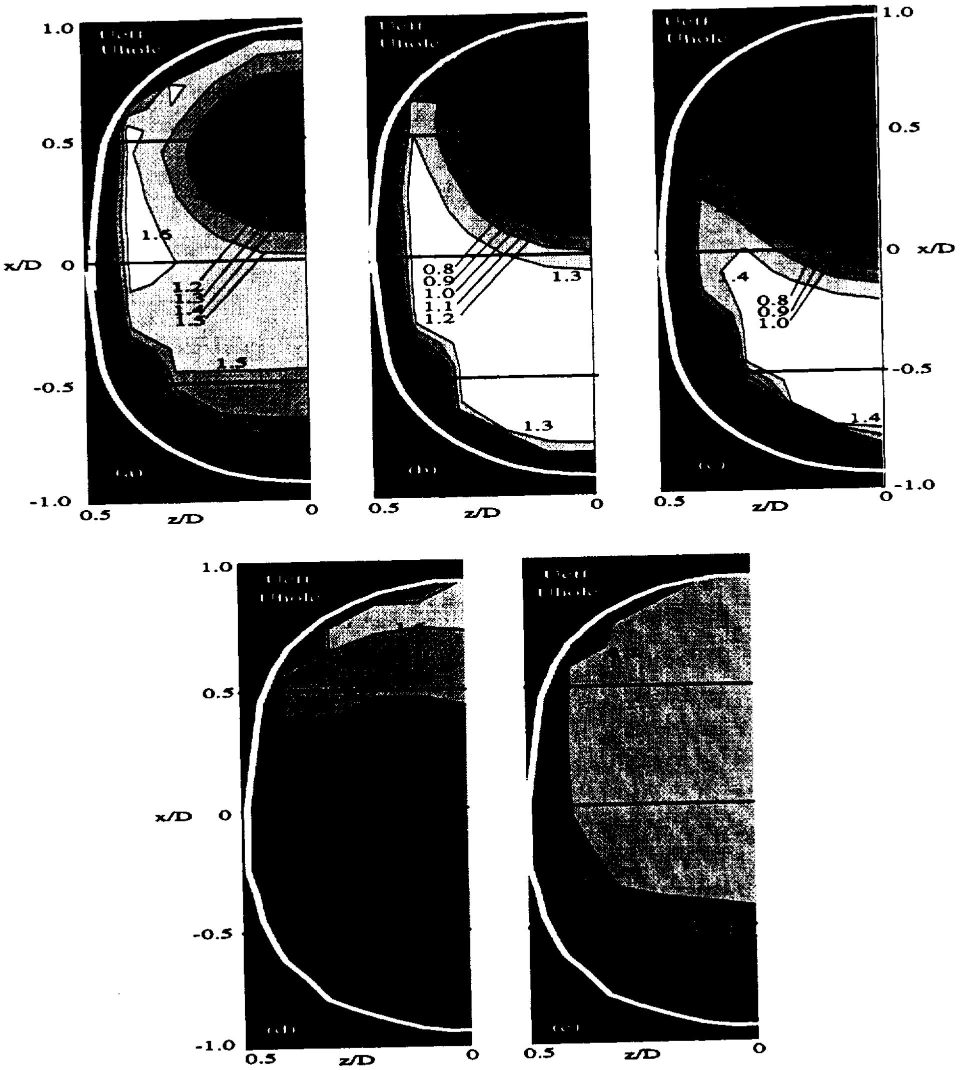
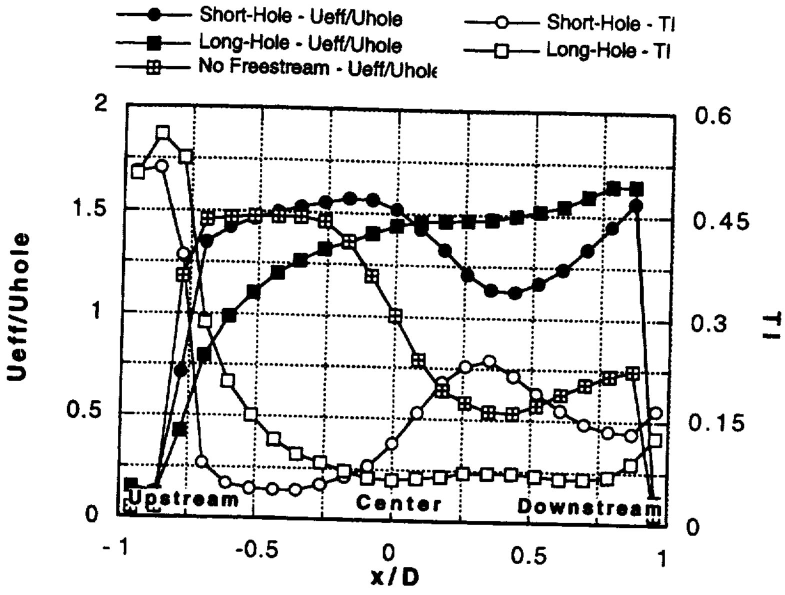
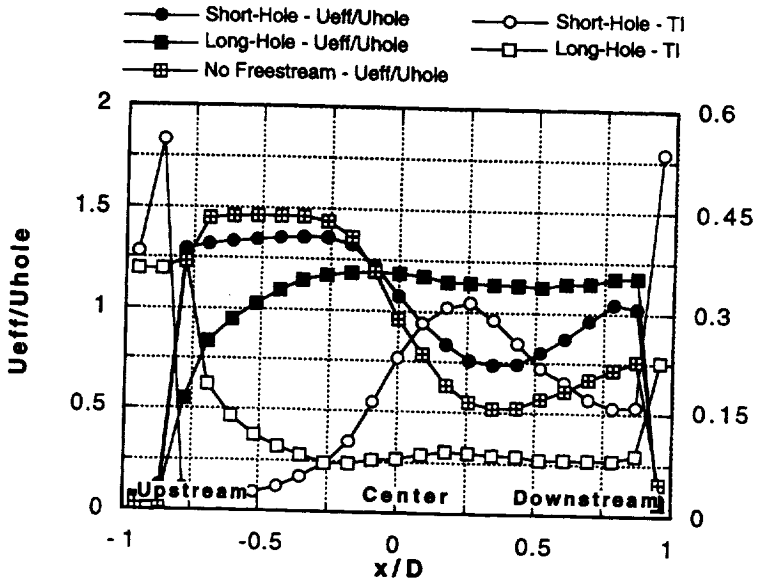


Figure 4.1: Hole-Exit Normalized Effective Velocities for Short-Hole and Long-Hole Injection - (a) Short-Hole: VR=0.5, **(b)** Short-Hole: VR=1.0, **(c)** Short-Hole: Equivalent Blowing Velocity as (a) but No Freestream, **(d)** Long-Hole Injection: VR=0.5, and **(e)** Long-Hole Injection: VR=1.0 [Note: Approximate outline of hole is given by white line. Upstream portion of exit is at the bottom of each figure; downstream portion at top of figure]



(a) VR=0.5



(b) VR=1.0

Figure 4.2: Comparisons of Short-Hole and Long-Hole Normalized Centerline Mean Effective Velocity and TI Distributions. FSTI=12%.

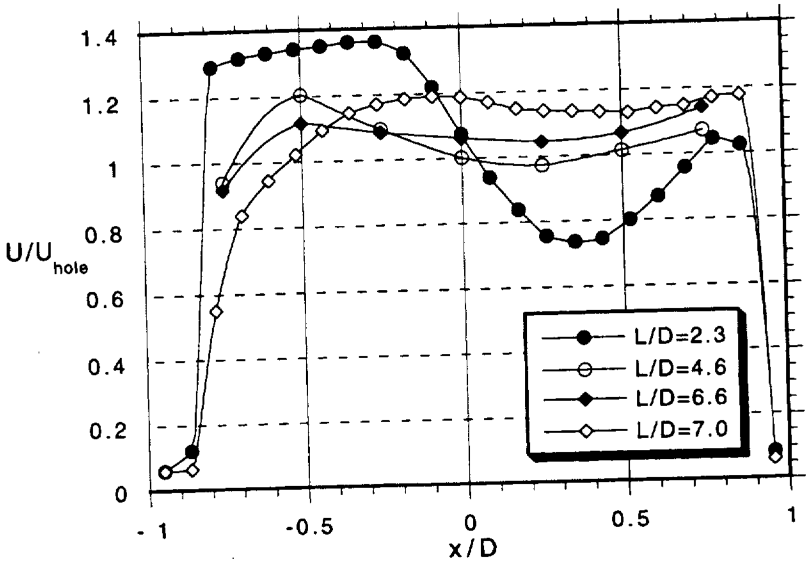


Figure 4.3: Hole-Exit Normalized Effective Velocities for Intermediate Hole Lengths (VR=1.0)

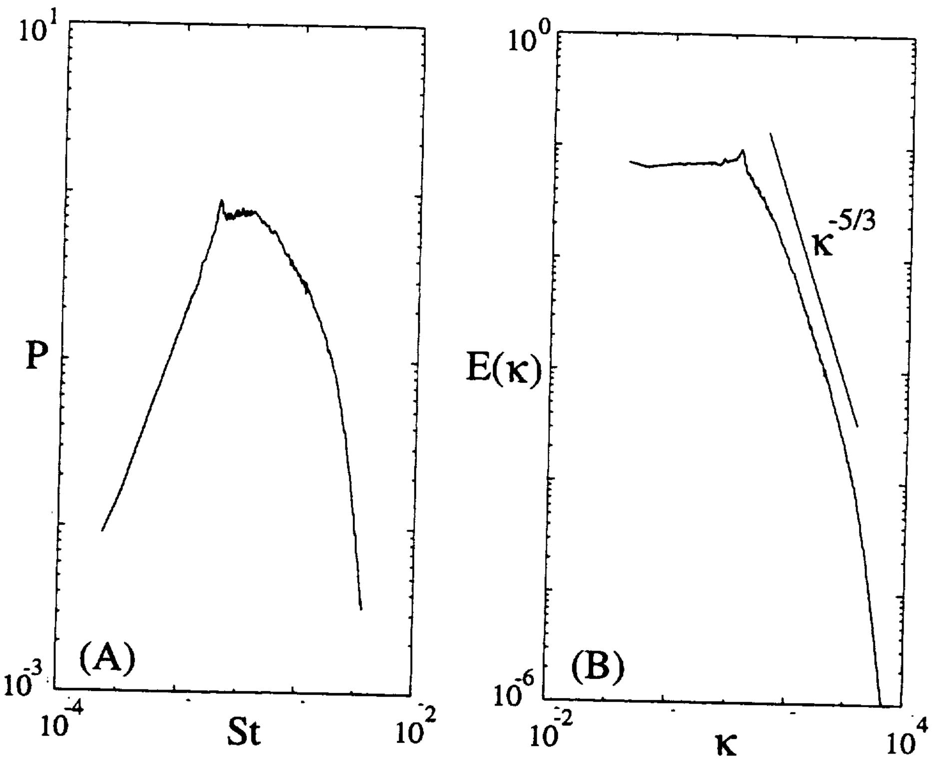


Figure 4.4: Spectra of Freestream in High-Turbulence Facility
(x/D=0.0, y/D=3.0, z/D=0.0)

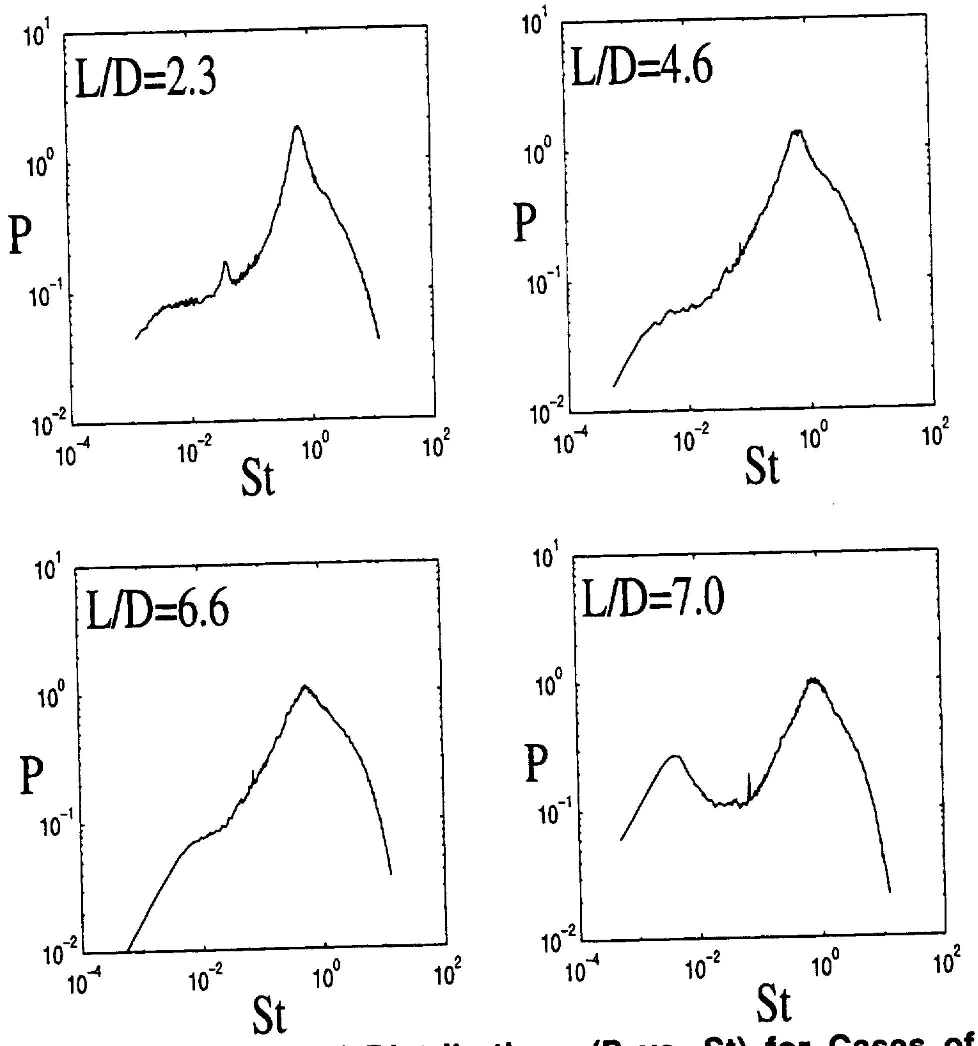


Figure 4.5: Spectral Distributions (P vs. St) for Cases of Varying L/D at x/D=0.0 and VR=1.0

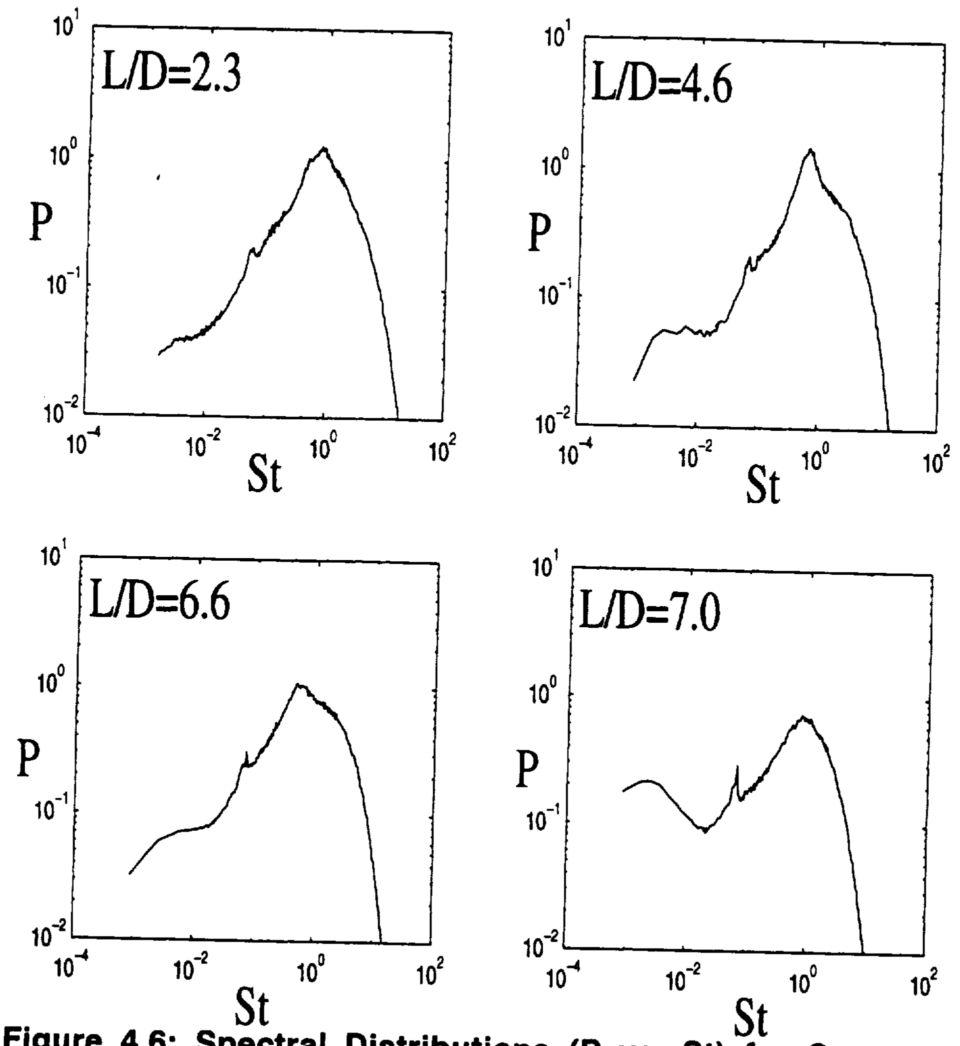


Figure 4.6: Spectral Distributions (P vs. St) for Cases of Varying L/D at x/D=0.0 and VR=0.5

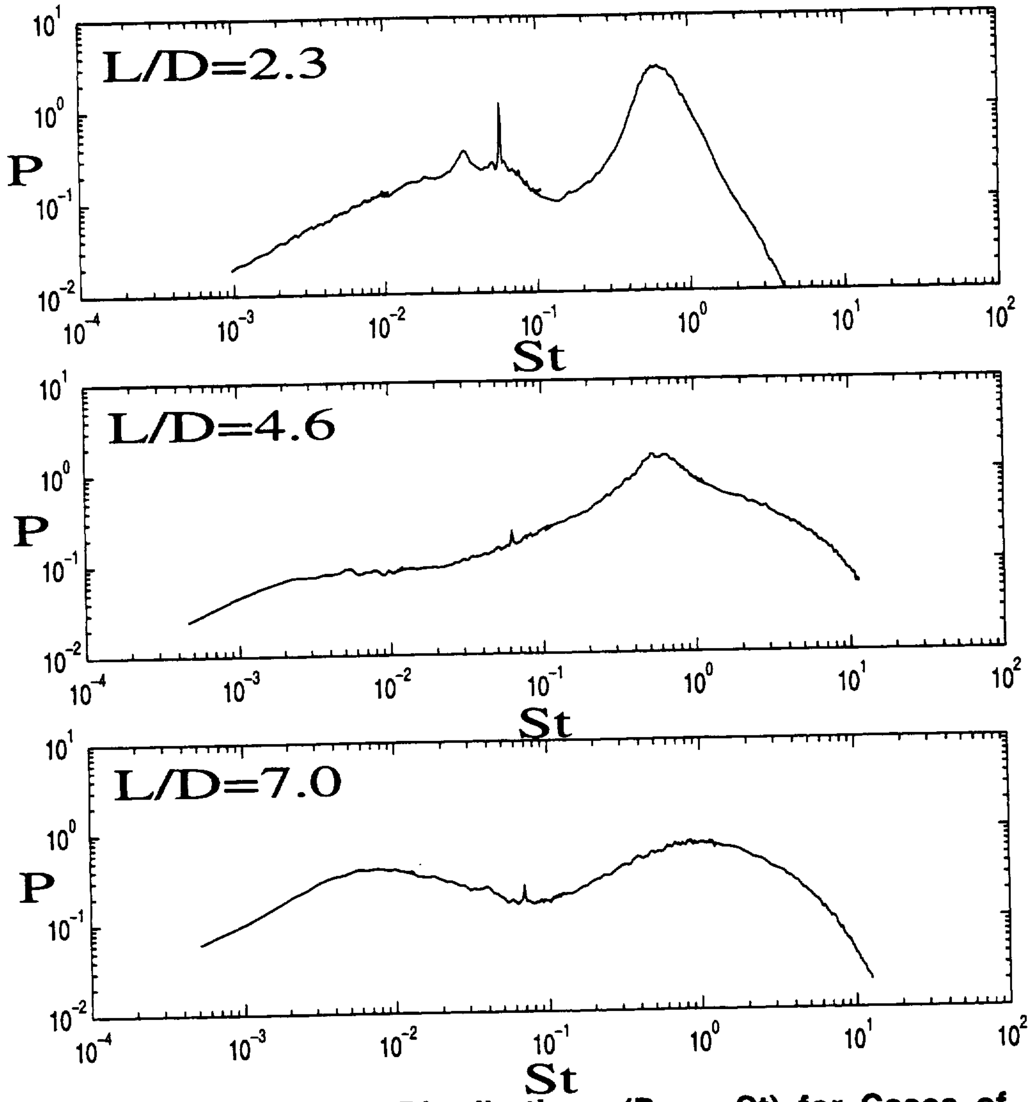


Figure 4.7: Spectral Distributions (P vs. St) for Cases of Varying L/D at x/D=-0.5 and VR=1.0

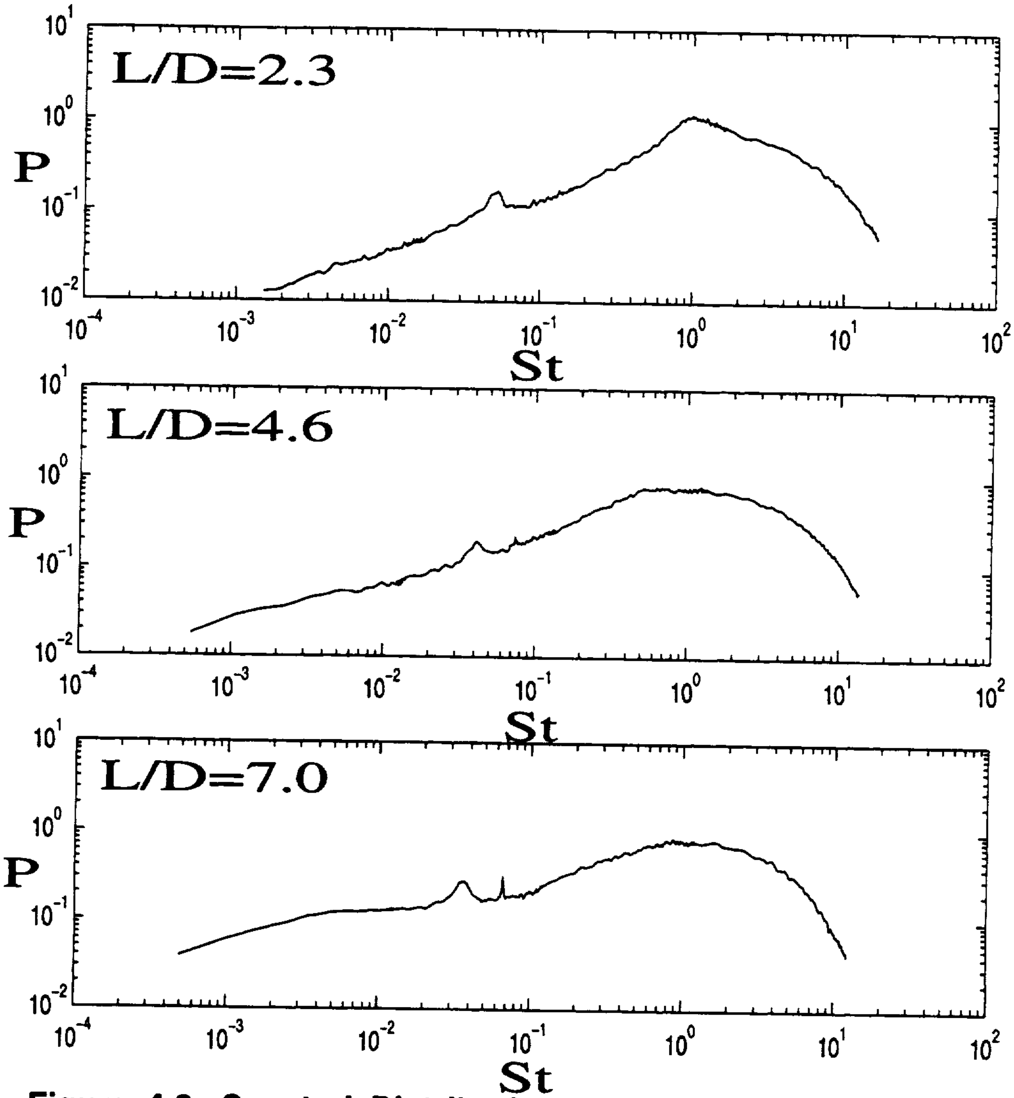


Figure 4.8: Spectral Distributions (P vs. St) for Cases of Varying L/D at x/D=0.5 and VR=1.0

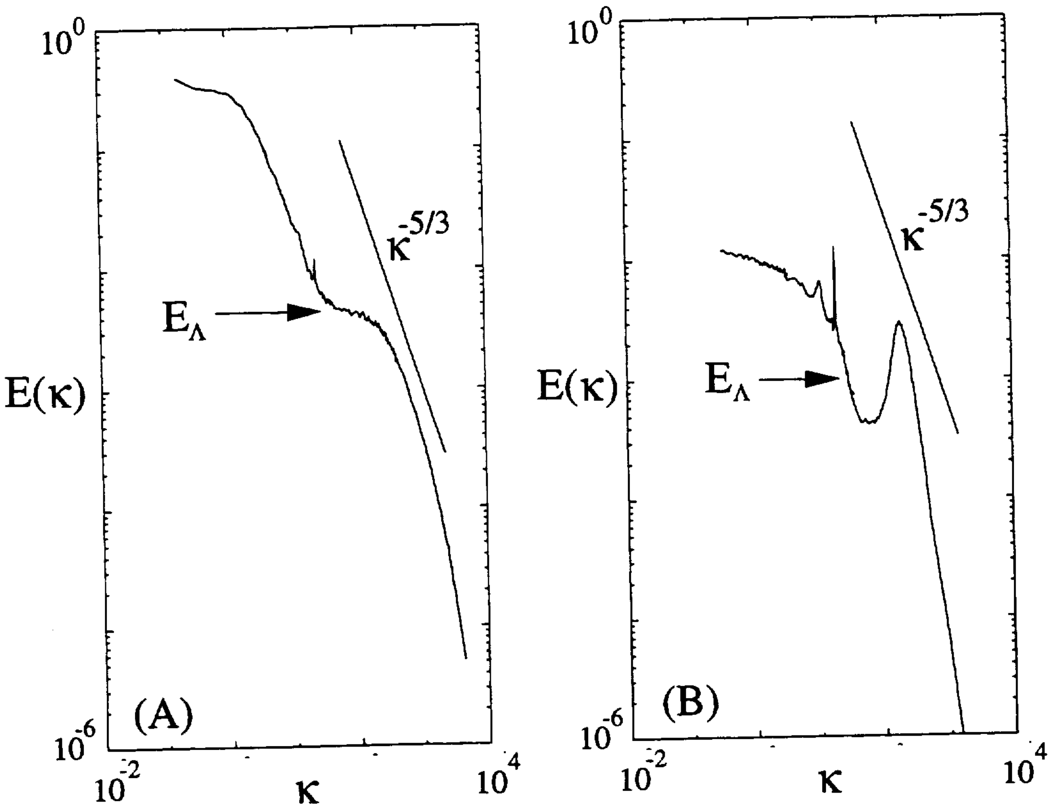
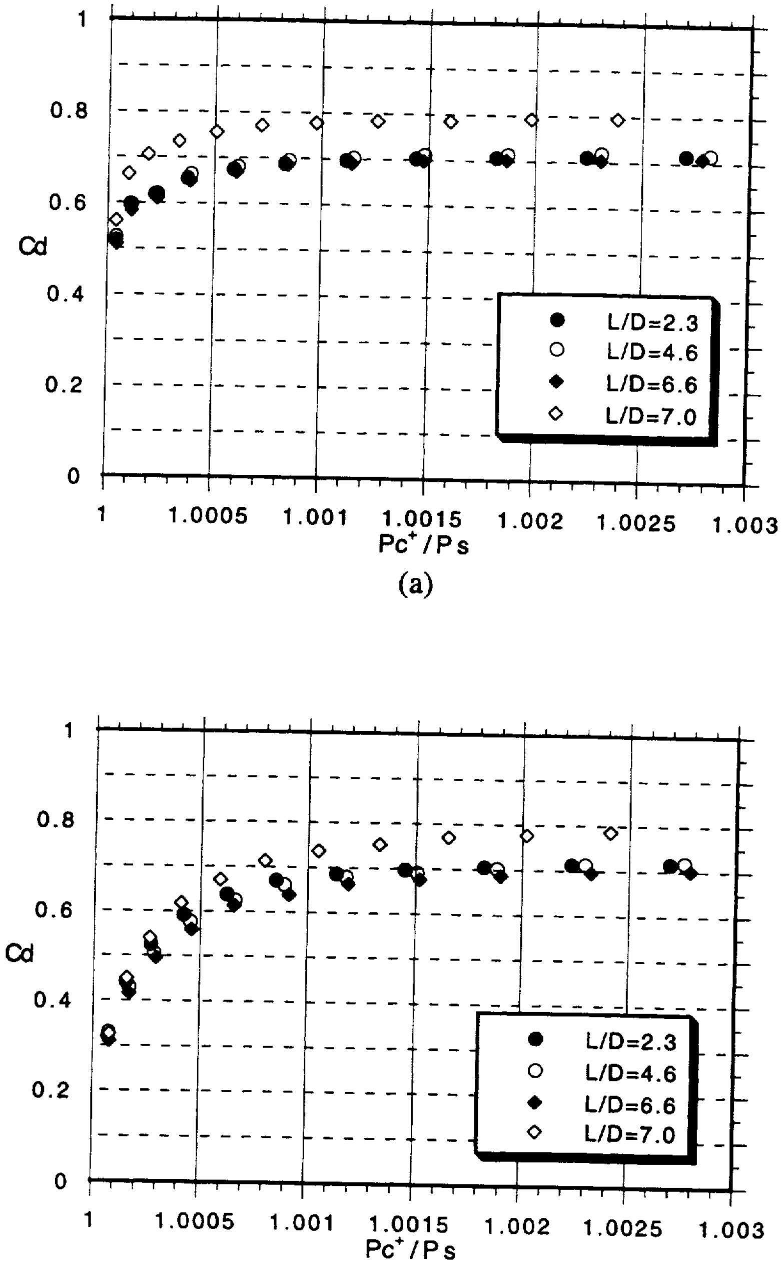


Figure 4.9: Spectral Distributions ($E(\kappa)$ vs. κ) for L/D=7.0 and L/D=2.3 at x/D=-0.5 and VR=1.0



(a)

(b)

Figure 4.10: Discharge Coefficients for Cases of Varying L/D
(a) Without Freestream
(b) With Freestream

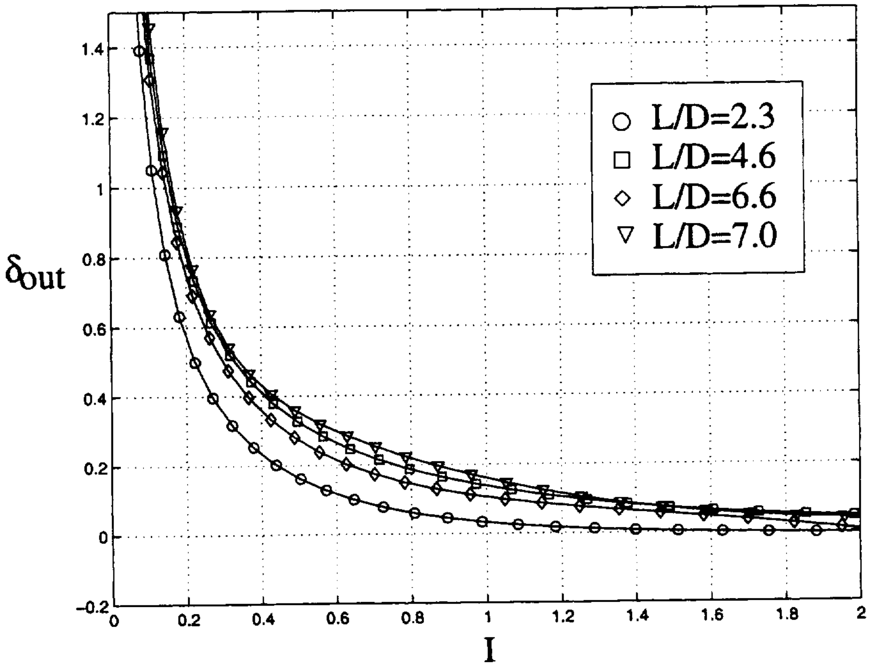
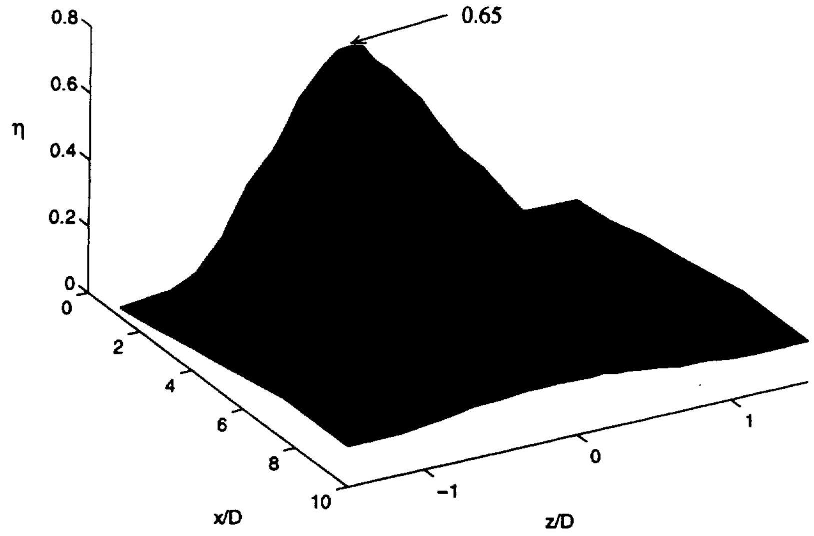
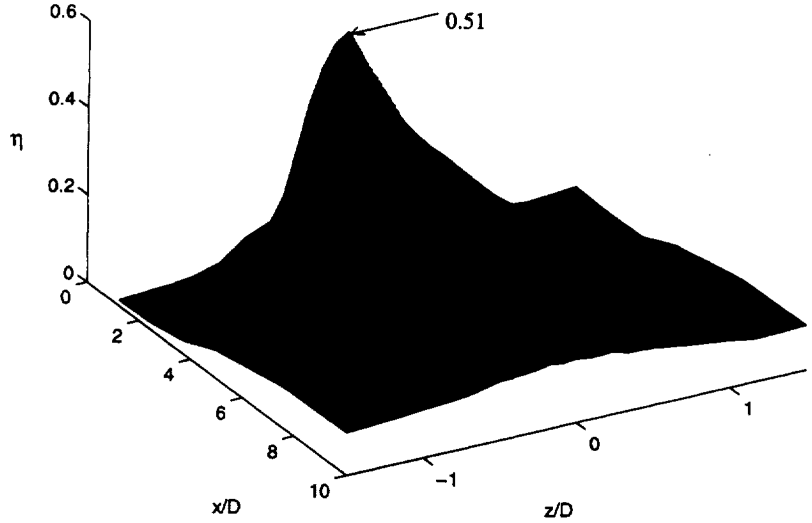


Figure 4.11: Outlet Additive Losses for Cases of Varying L/D

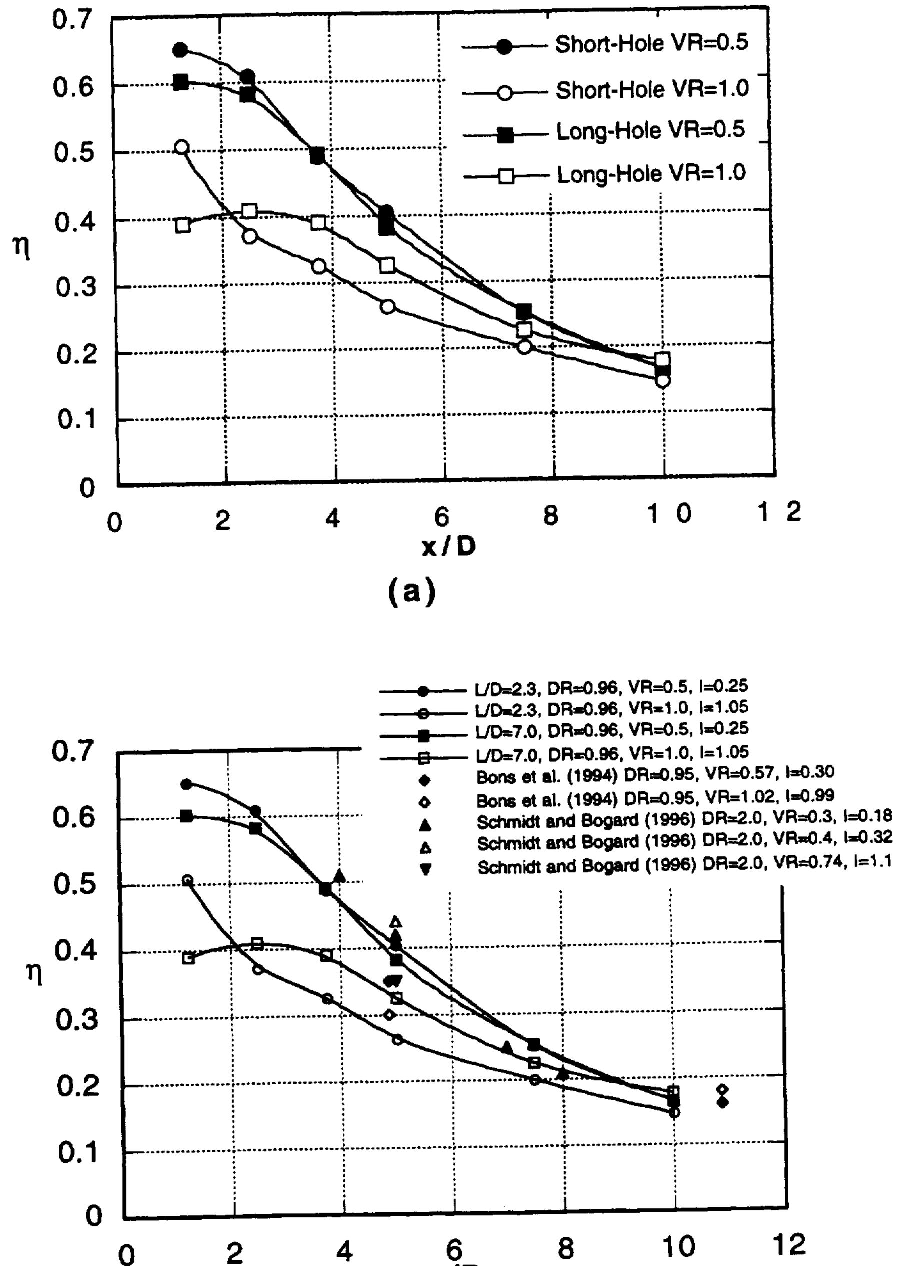


(a) VR=0.5



(b) VR=1.0

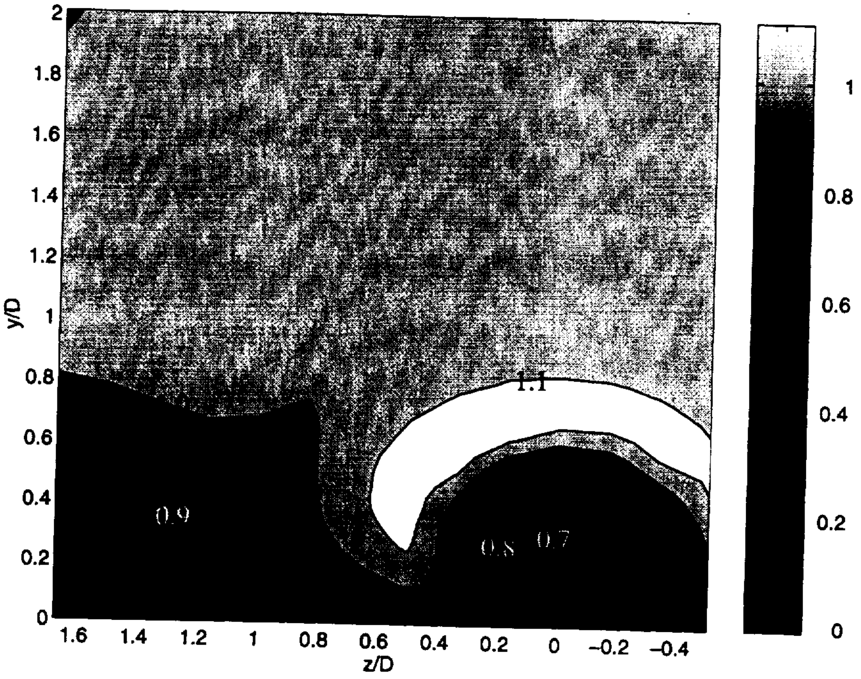
Figure 4.12: Adiabatic Effectiveness Distributions for Short-Hole Injection at Two Velocity Ratios. FSTI=12%.



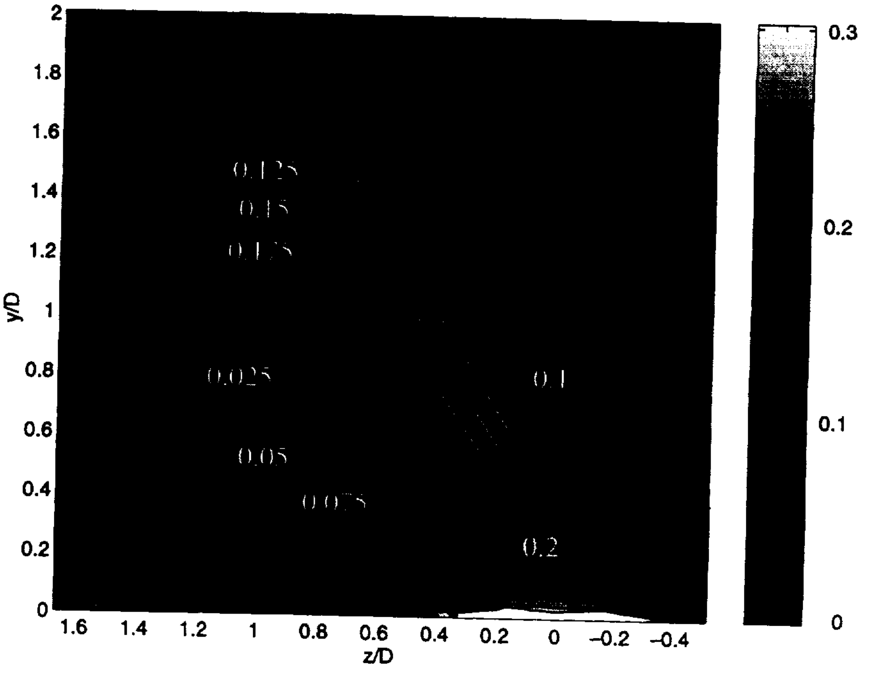
(a)

(b)

Figure 4.13: Centerline Adiabatic Effectiveness Distributions
(a) Short- and Long-Hole Experimental Data - FSTI=12%
(b) Comparison to Data in Literature
Bons et al. (1994): 35°, L/D=3.5, FSTI=11.5%
Schmidt and Bogard (1996): 30°, L/D=6.0, FSTI=10%

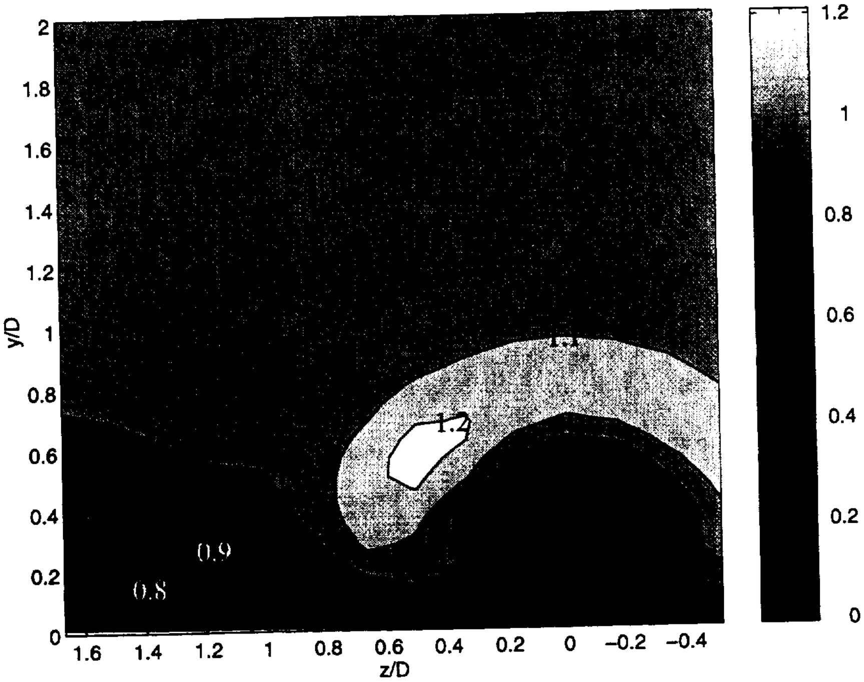


(a) U/U_o

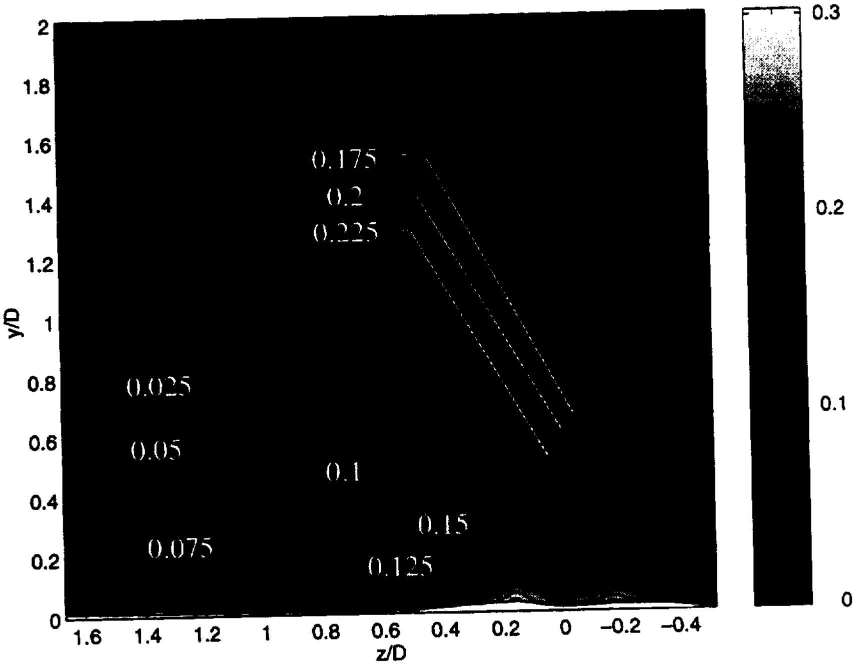


(b) TI

Figure 4.14: Normalized Velocity and Local Turbulence Intensity Contours - VR=1.0, L/D=7.0, x/D=2.5, FSTI=0.5% (Case 040396)

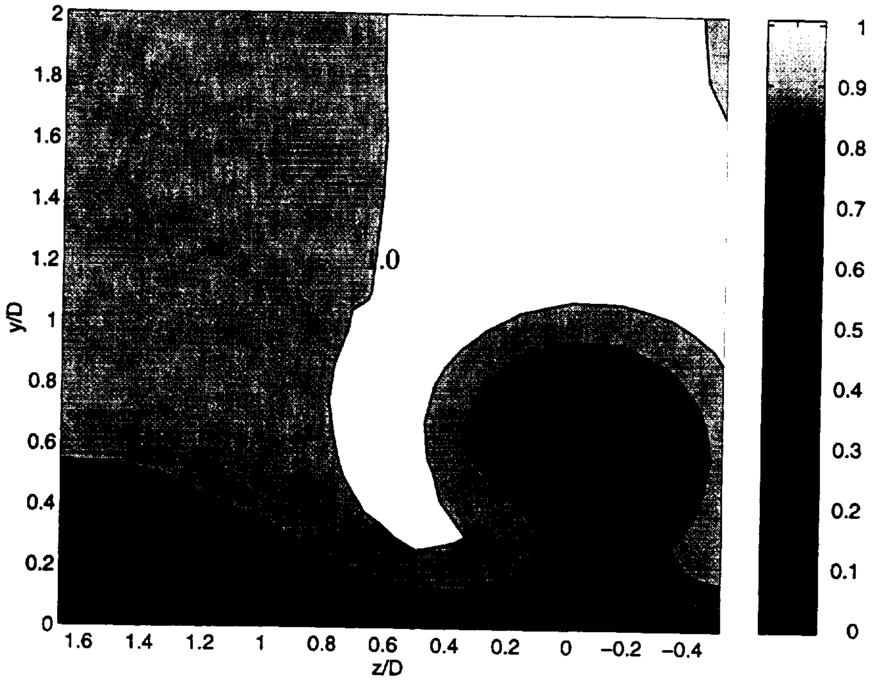


(a) U/U_o

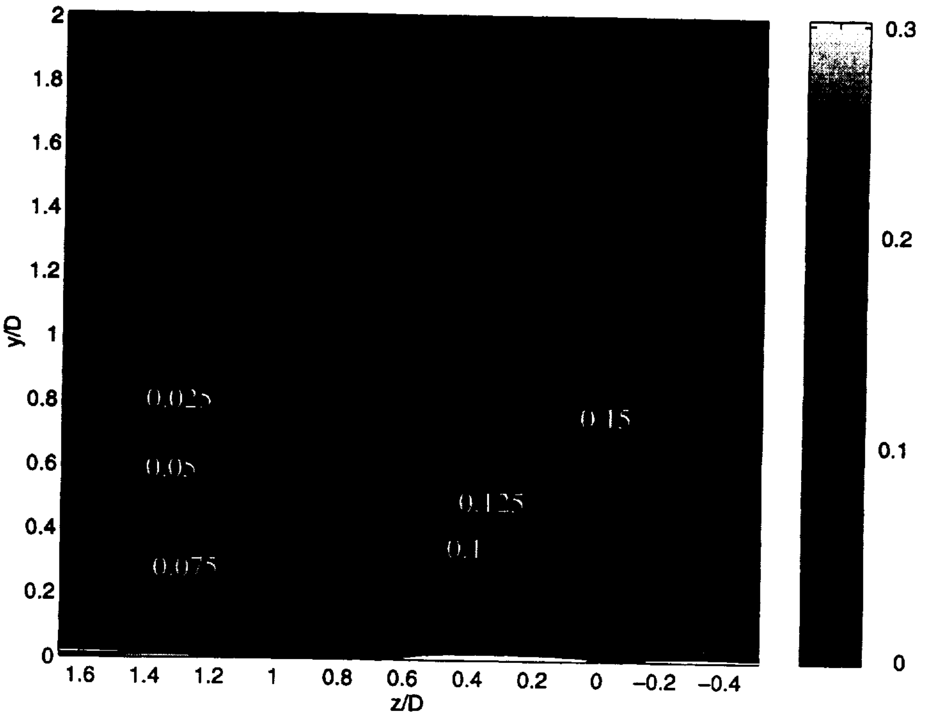


(b) TI

Figure 4.15: Normalized Velocity and Local Turbulence Intensity Contours - VR=1.0, L/D=2.3, x/D=2.5, FSTI=0.5% (Case 040896)

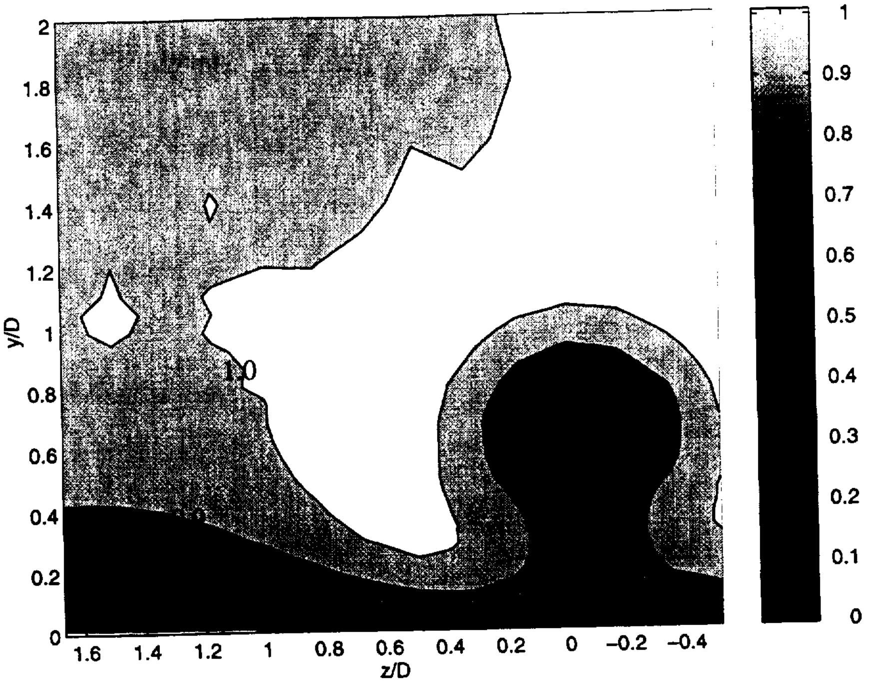


(a) U/U_o

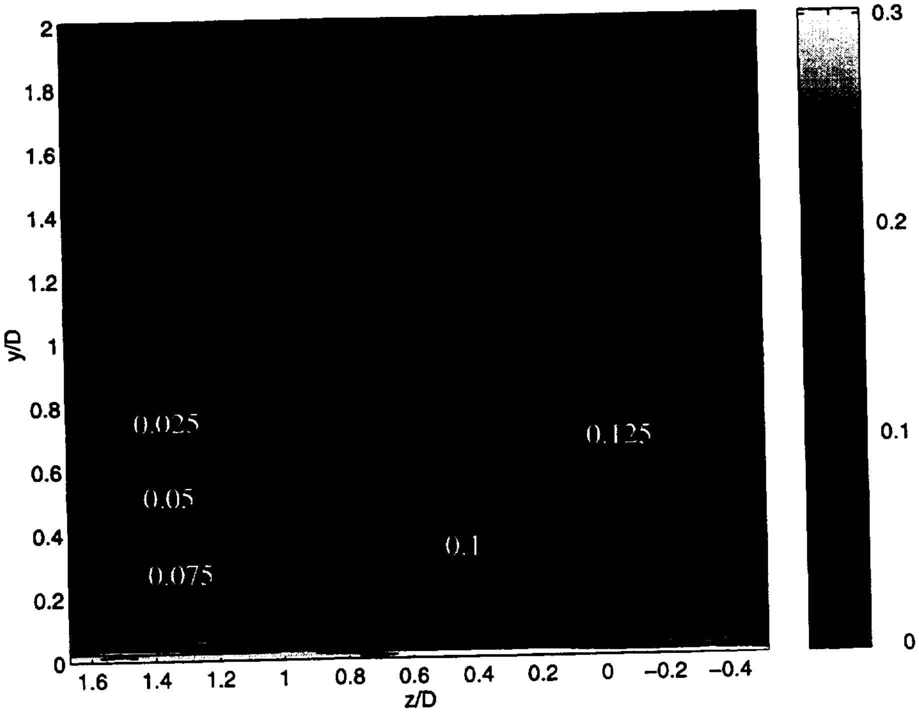


(b) TI

Figure 4.16: Normalized Velocity and Local Turbulence Intensity Contours - VR=1.0, L/D=7.0, x/D=5.0, FSTI=0.5% (Case 040496)

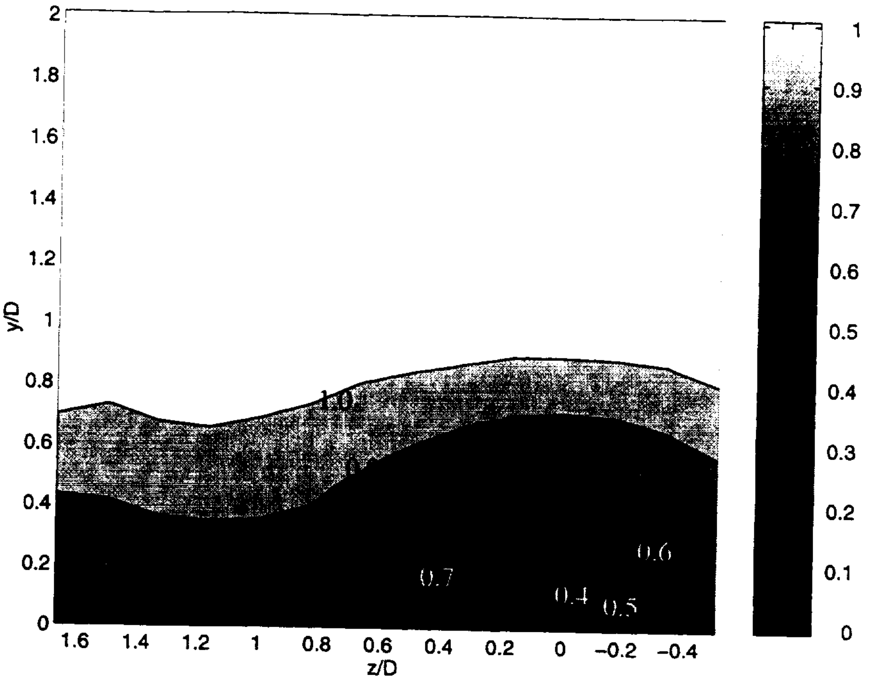


(a) U/U_o

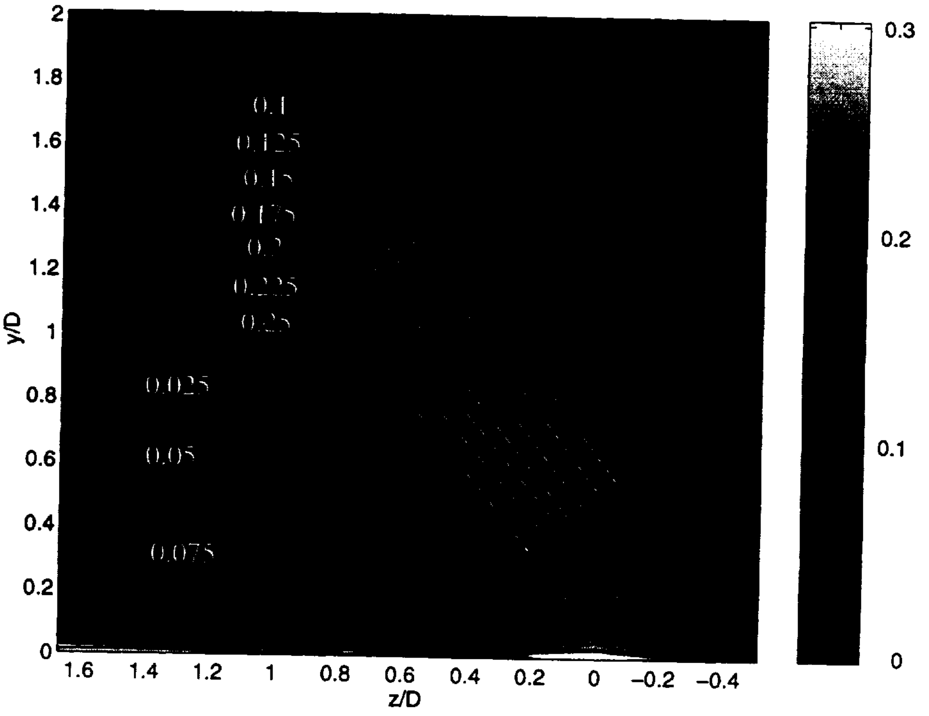


(b) TI

Figure 4.17: Normalized Velocity and Local Turbulence Intensity Contours - VR=1.0, L/D=2.3, x/D=5.0, FSTI=0.5% (Case 040796)

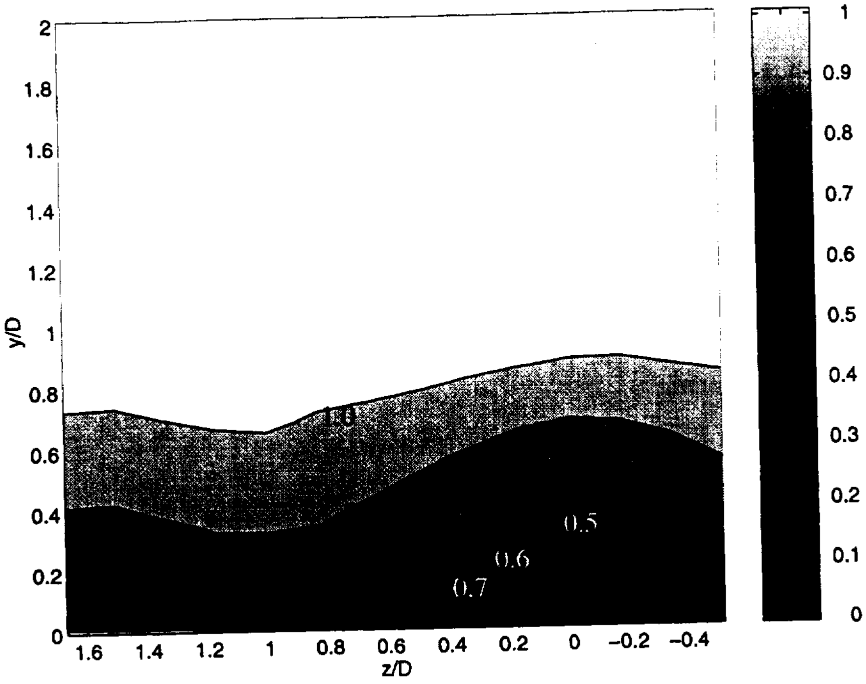


(a) U/U$_o$

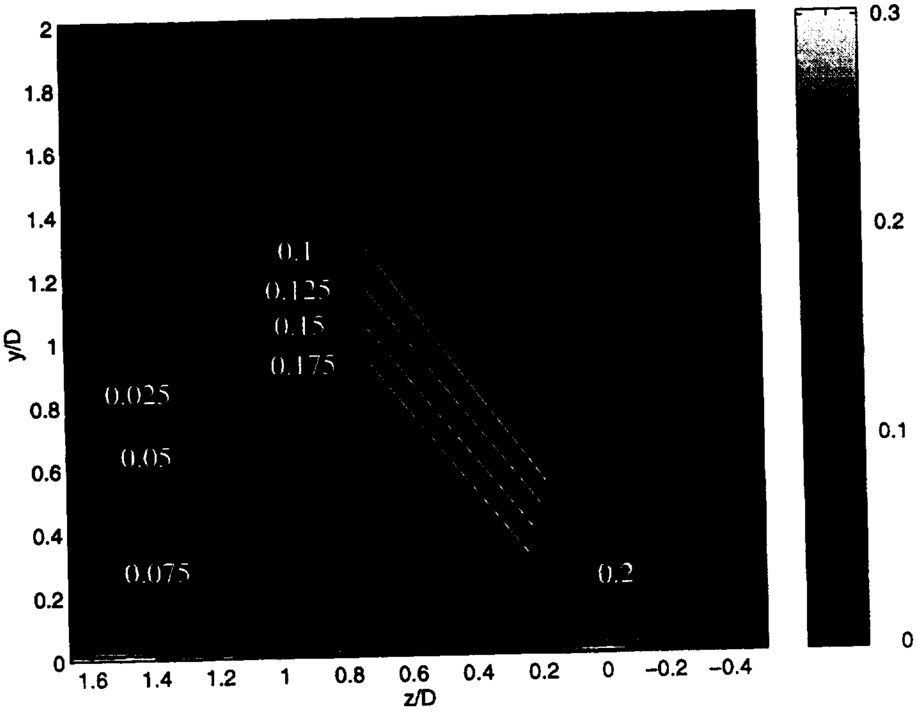


(b) TI

Figure 4.18: Normalized Velocity and Local Turbulence Intensity Contours - VR=0.5, L/D=7.0, x/D=2.5, FSTI=0.5% (Case 040396aa)

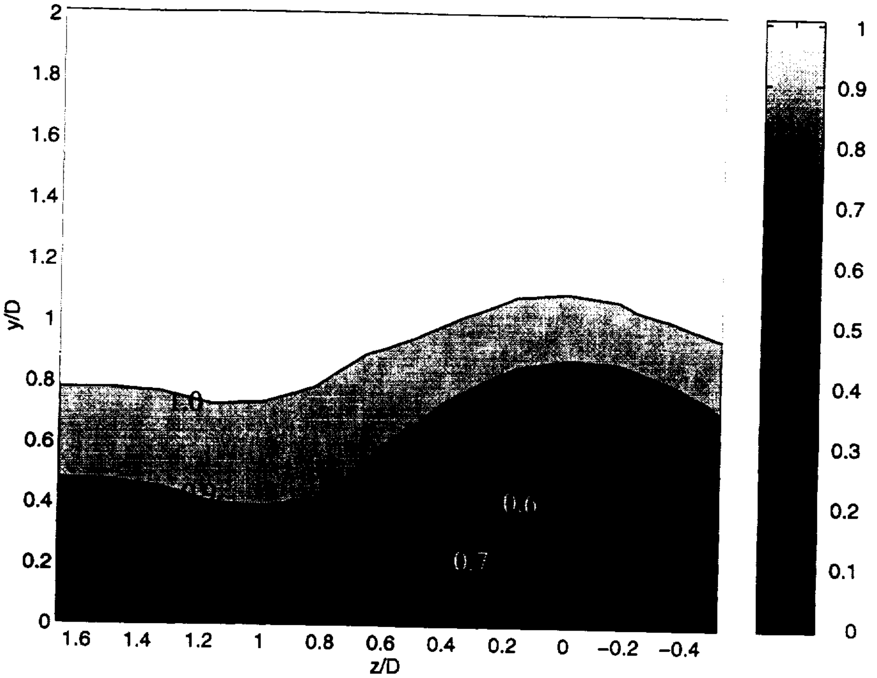


(a) U/U_o

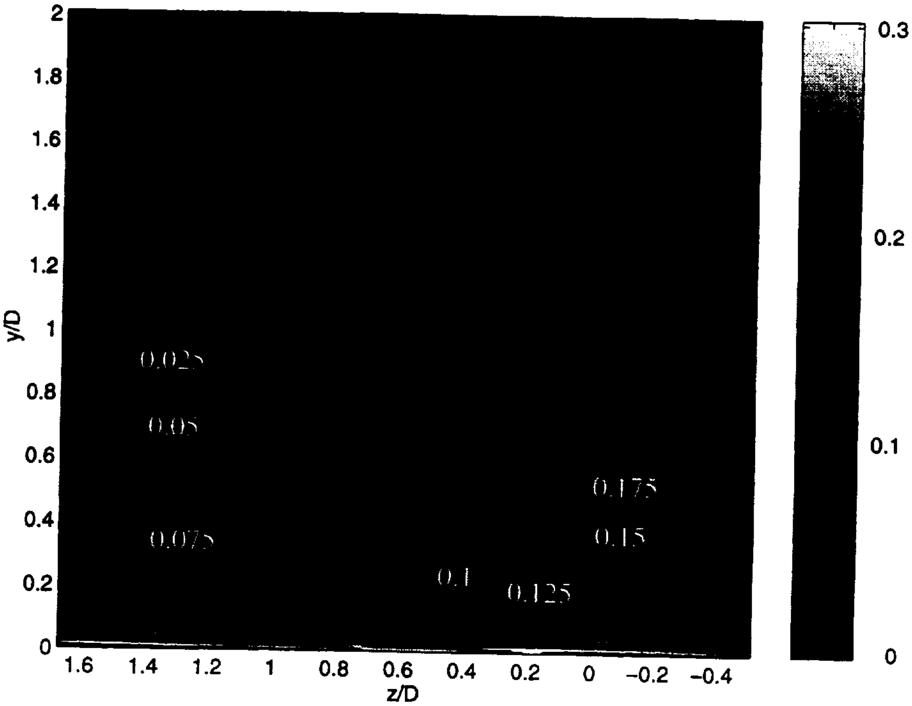


(b) TI

Figure 4.19: Normalized Velocity and Local Turbulence Intensity Contours - VR=0.5, L/D=2.3, x/D=2.5, FSTI=0.5% (Case 041096)

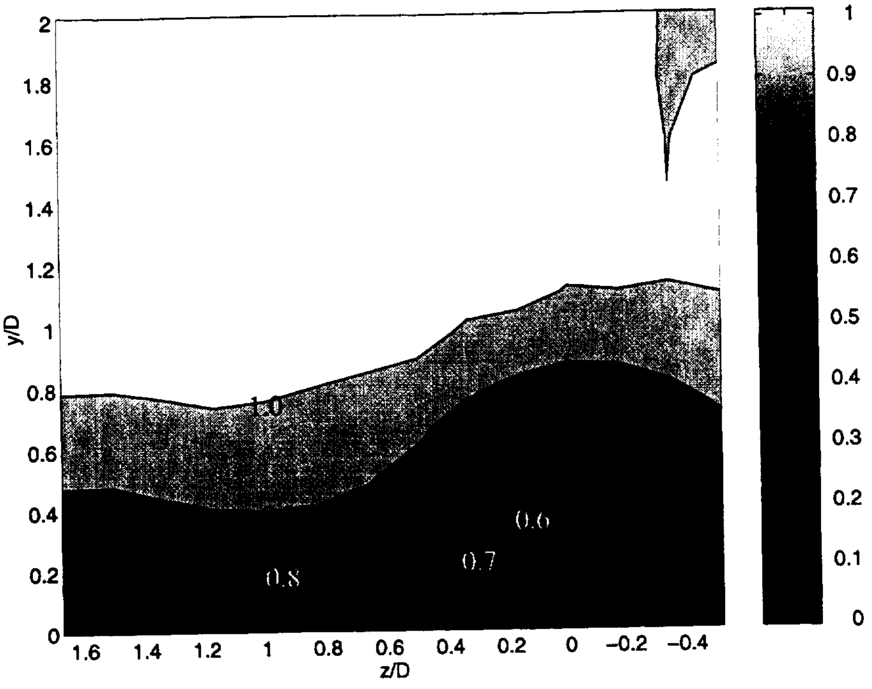


(a) U/U_o

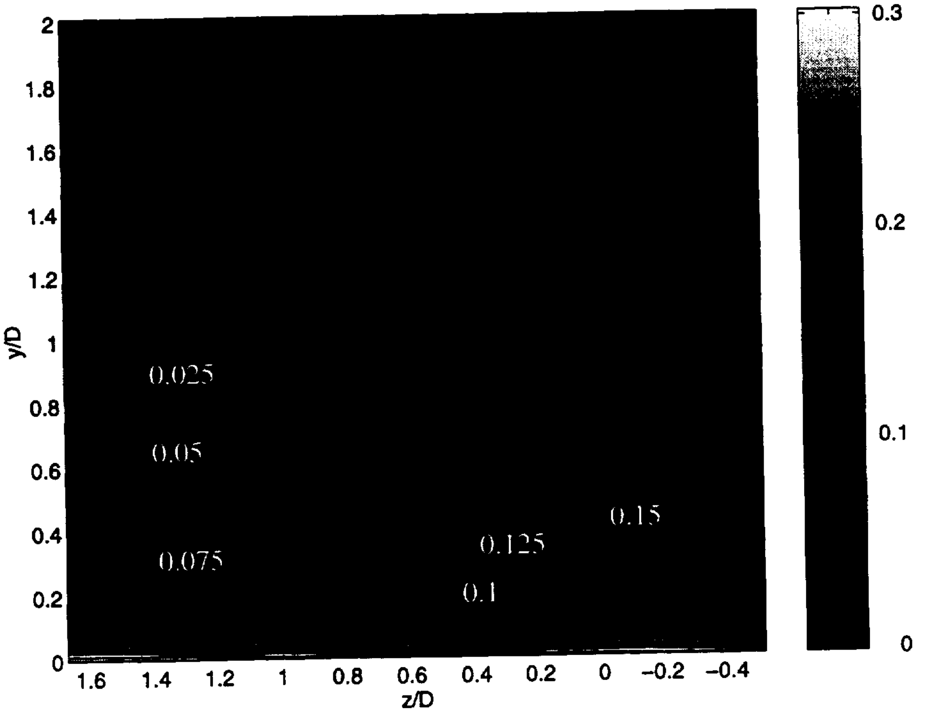


(b) TI

Figure 4.20: Normalized Velocity and Local Turbulence Intensity Contours - VR=0.5, L/D=7.0, x/D=5.0, FSTI=0.5% (Case 040596)

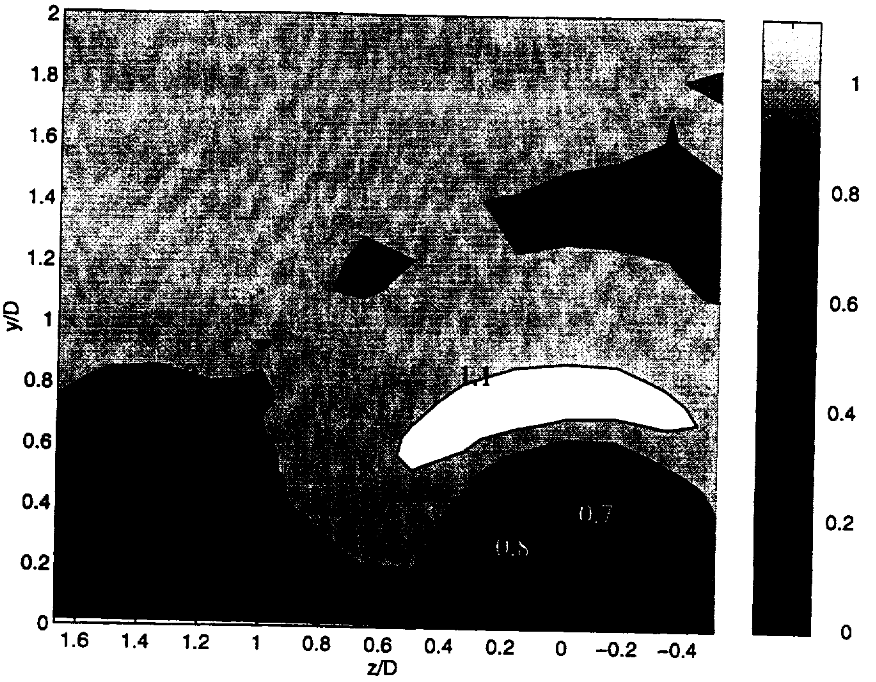


(a) U/U_o

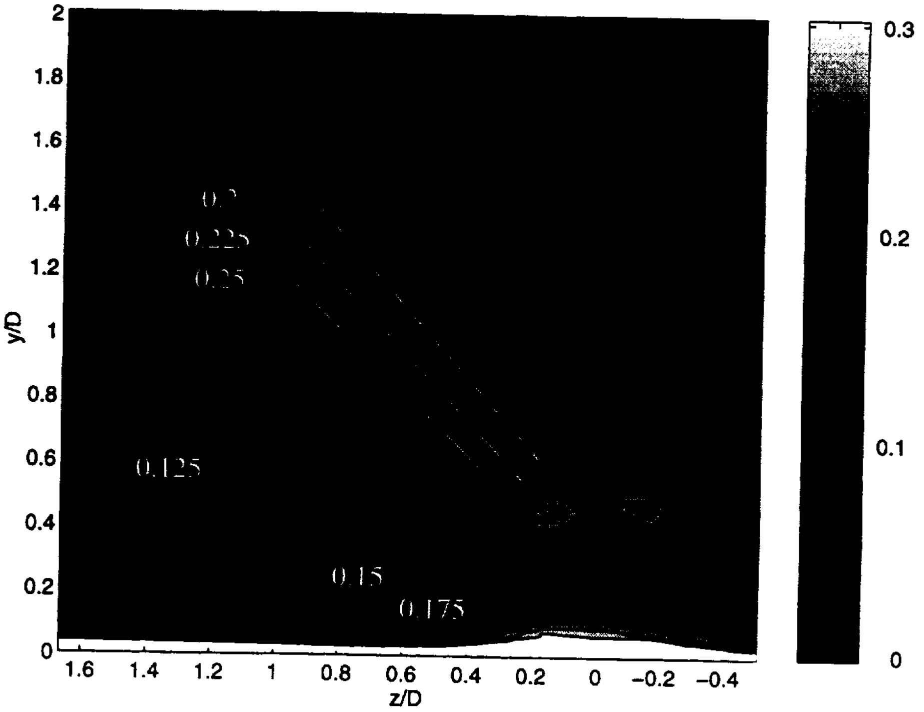


(b) TI

Figure 4.21: Normalized Velocity and Local Turbulence Intensity Contours - VR=0.5, L/D=2.3, x/D=5.0, FSTI=0.5% (Case 040696)

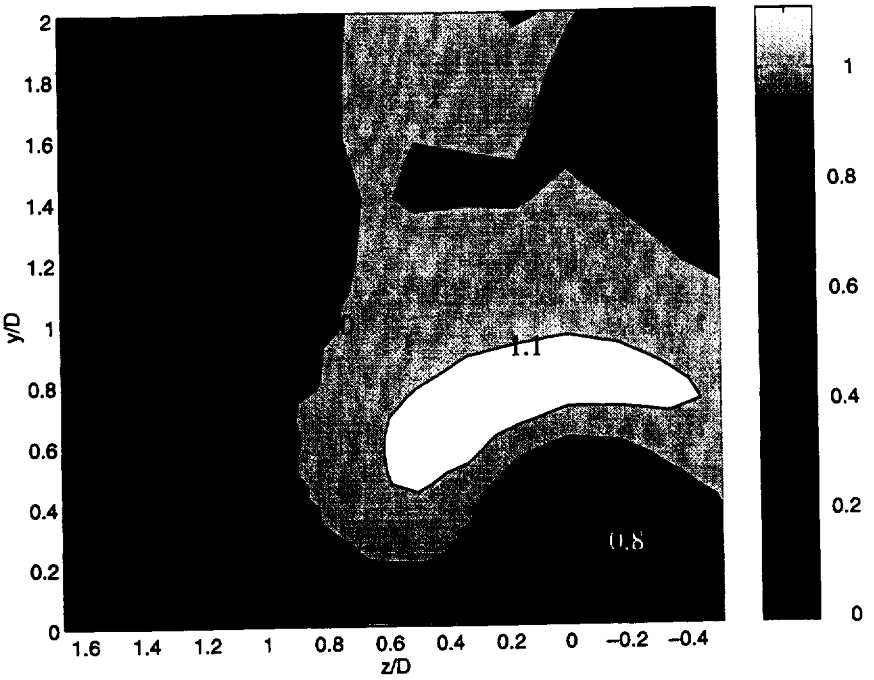


(a) U/U_o

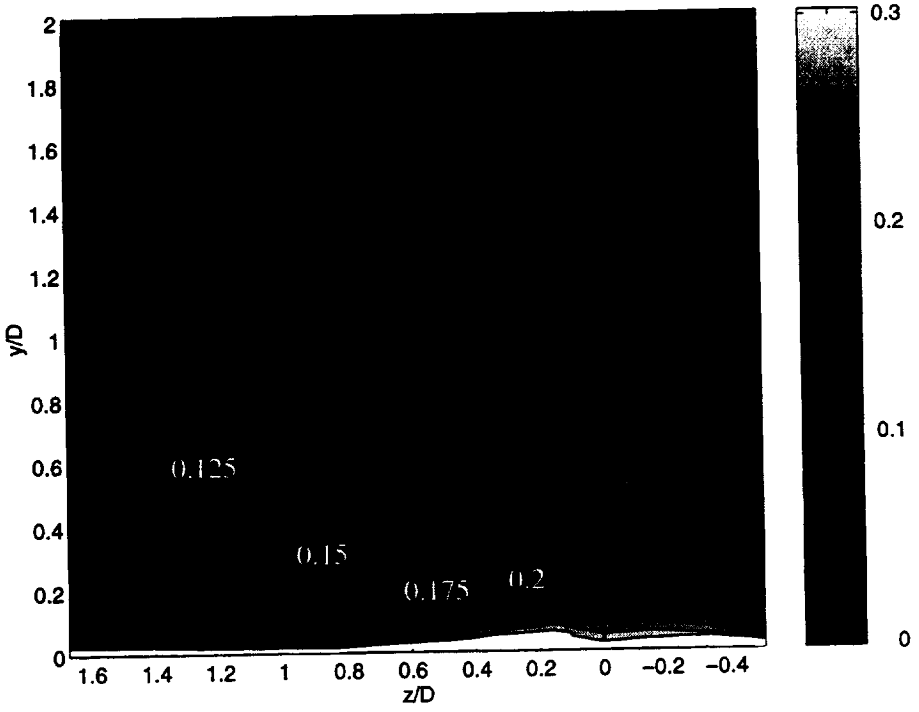


(b) TI

Figure 4.22: Normalized Velocity and Local Turbulence Intensity Contours - VR=1.0, L/D=7.0, x/D=2.5, FSTI=12.0% (Case 041296bb)

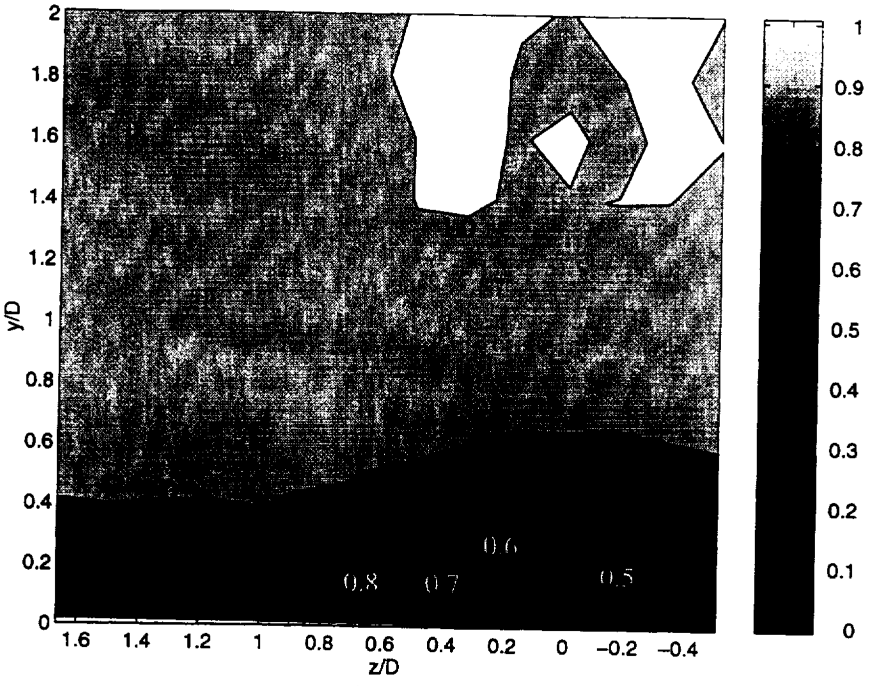


(a) U/U_o

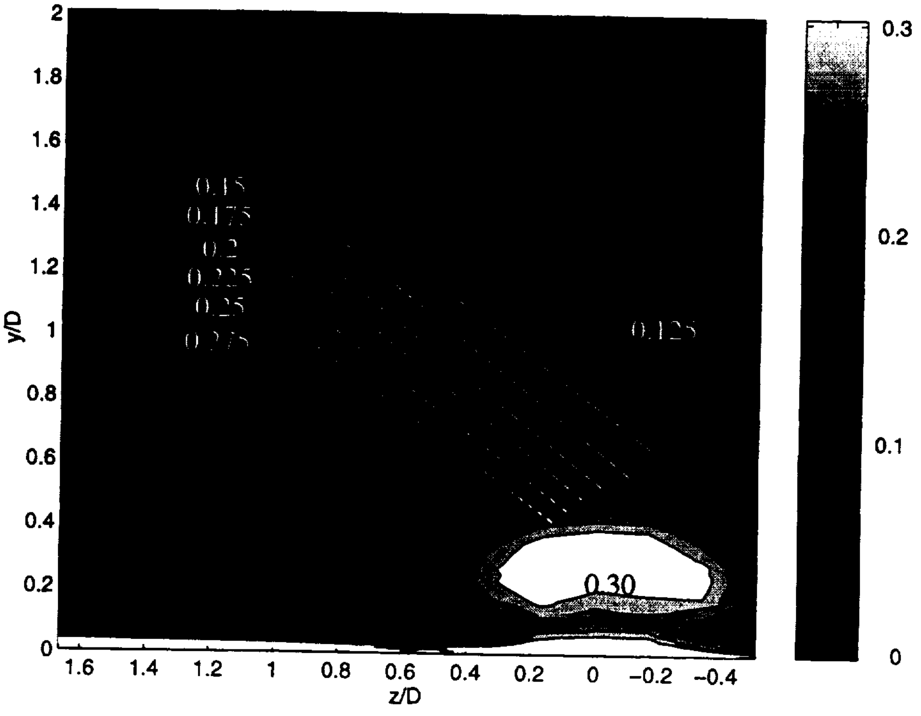


(b) TI

Figure 4.23: Normalized Velocity and Local Turbulence Intensity Contours - VR=1.0, L/D=2.3, x/D=2.5, FSTI=12.0% (Case 041496)

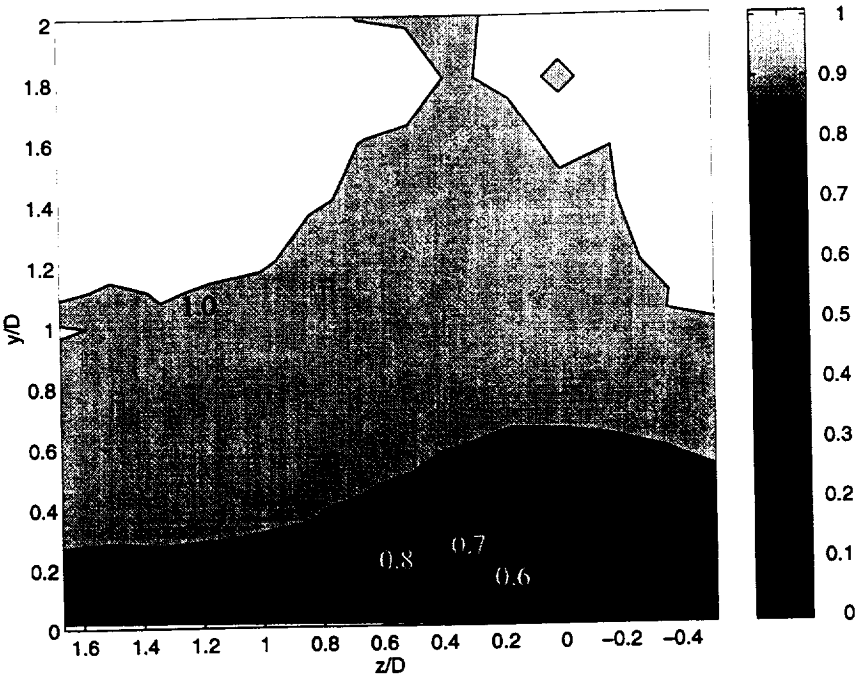


(a) U/U_o

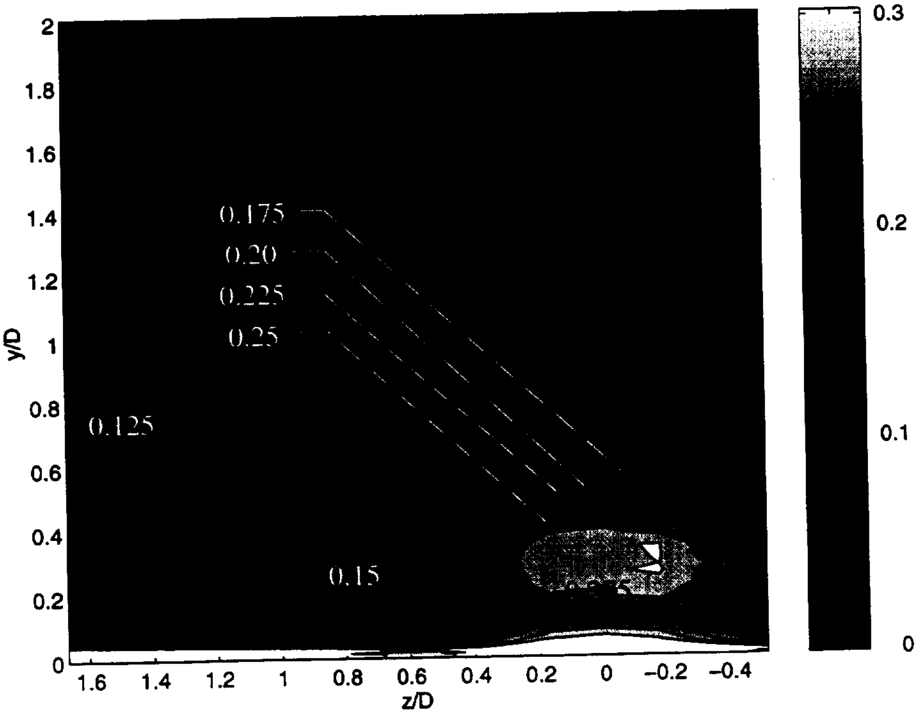


(b) TI

Figure 4.24: Normalized Velocity and Local Turbulence Intensity Contours - VR=0.5, L/D=7.0, x/D=2.5, FSTI=12.0% (Case 041396)

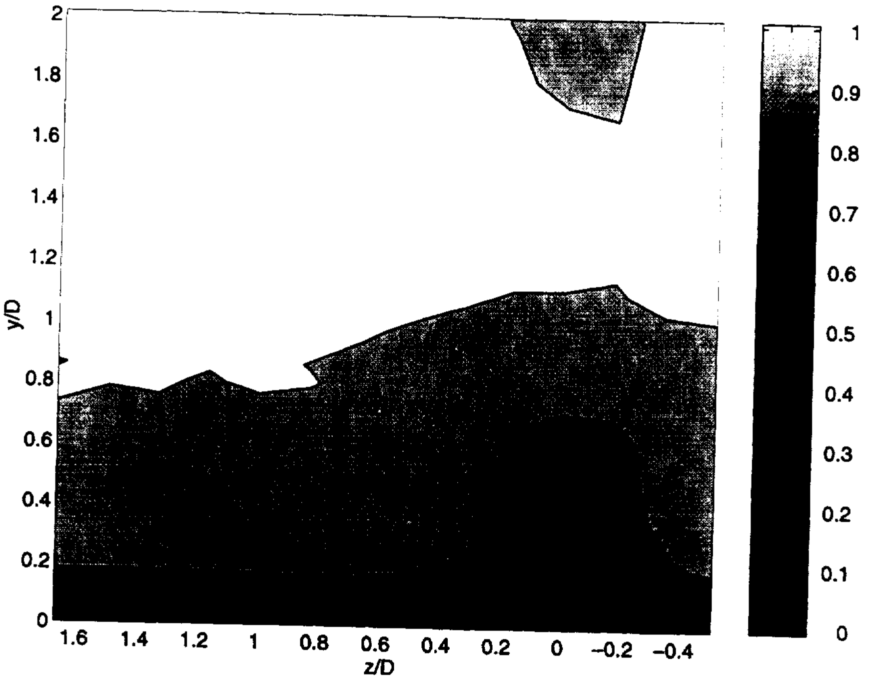


(a) U/U$_o$

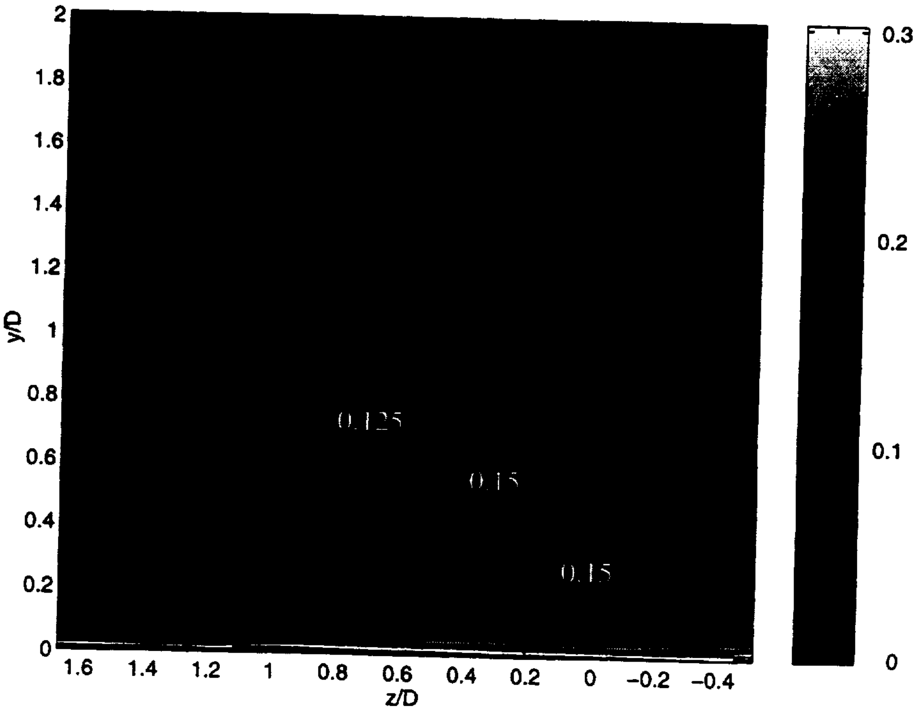


(b) TI

Figure 4.25: Normalized Velocity and Local Turbulence Intensity Contours - VR=0.5, L/D=2.3, x/D=2.5, FSTI=12.0% (Case 041596)

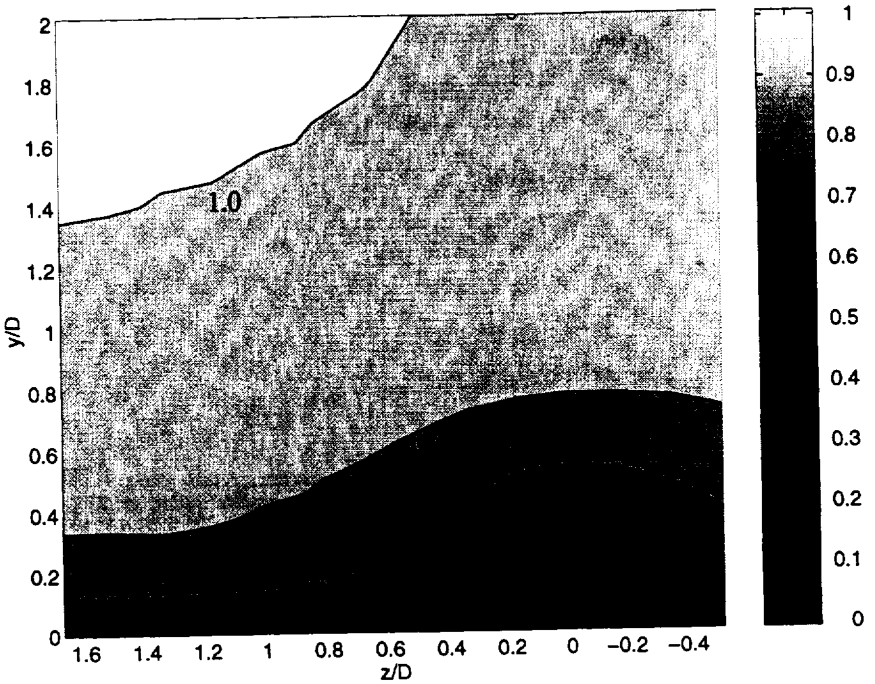


(a) U/U_o

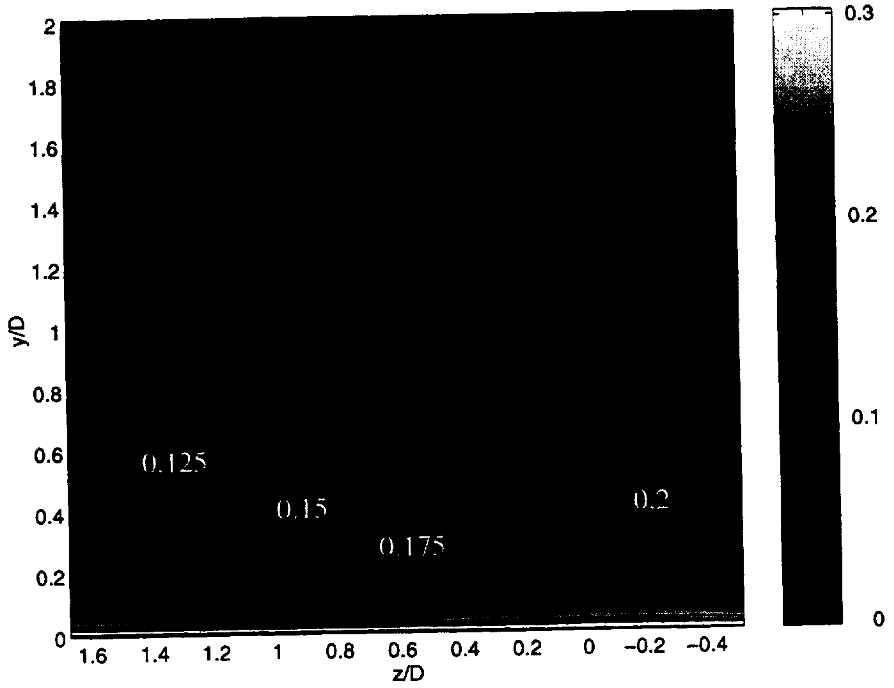


(b) TI

Figure 4.26: Normalized Velocity and Local Turbulence Intensity Contours - VR=1.0, L/D=2.3, x/D=5.0, FSTI=12.0% (Case 090896b)

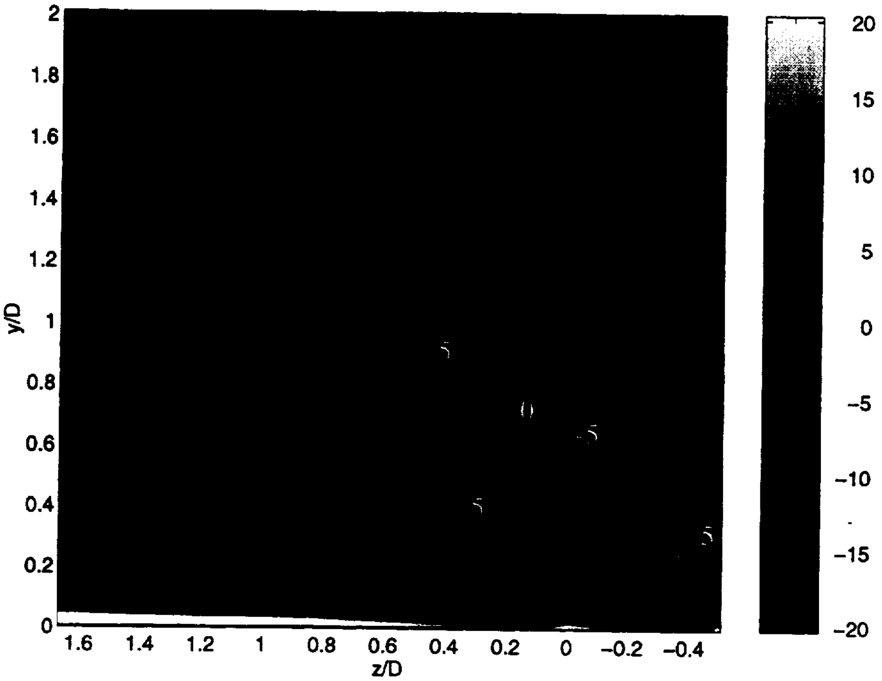


(a) U/U_o

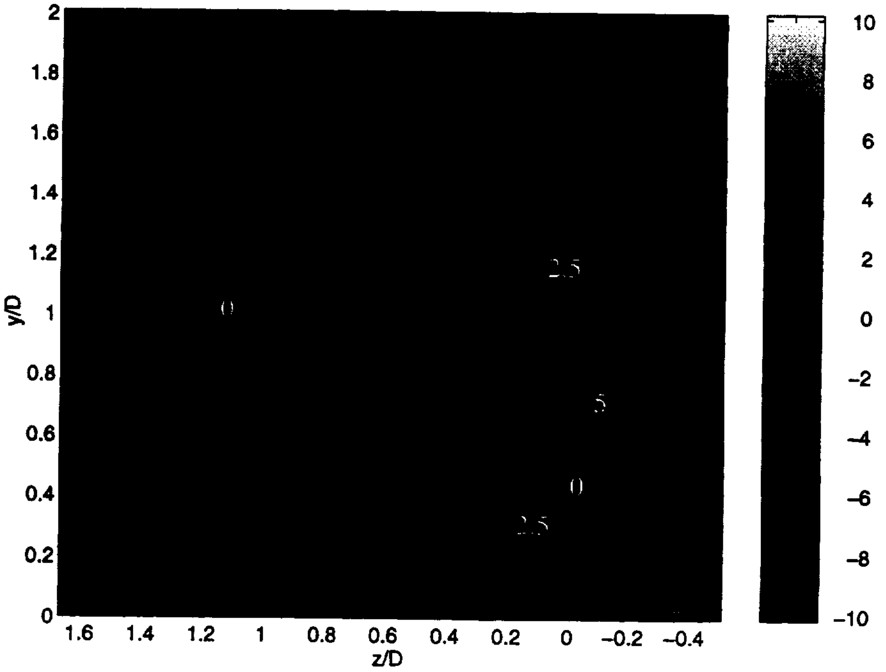


(b) TI

Figure 4.27: Normalized Velocity and Local Turbulence Intensity Contours - VR=0.5, L/D=2.3, x/D=5.0, FSTI=12.0% (Case 091196)

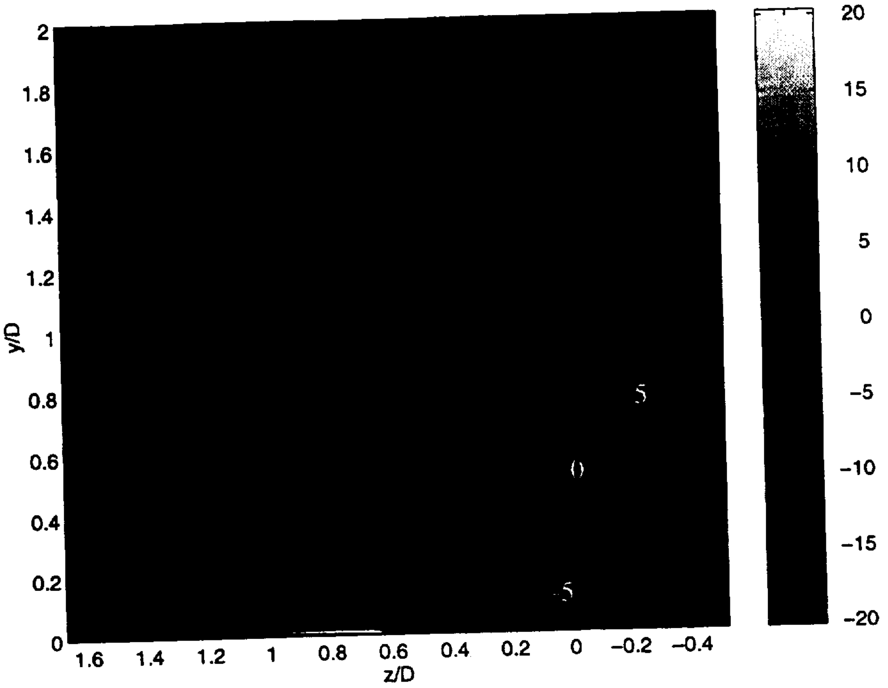


(a) $\frac{(U/U_o)_{2.3}-(U/U_o)_{7.0}}{(U/U_o)_{7.0}}\times 100$

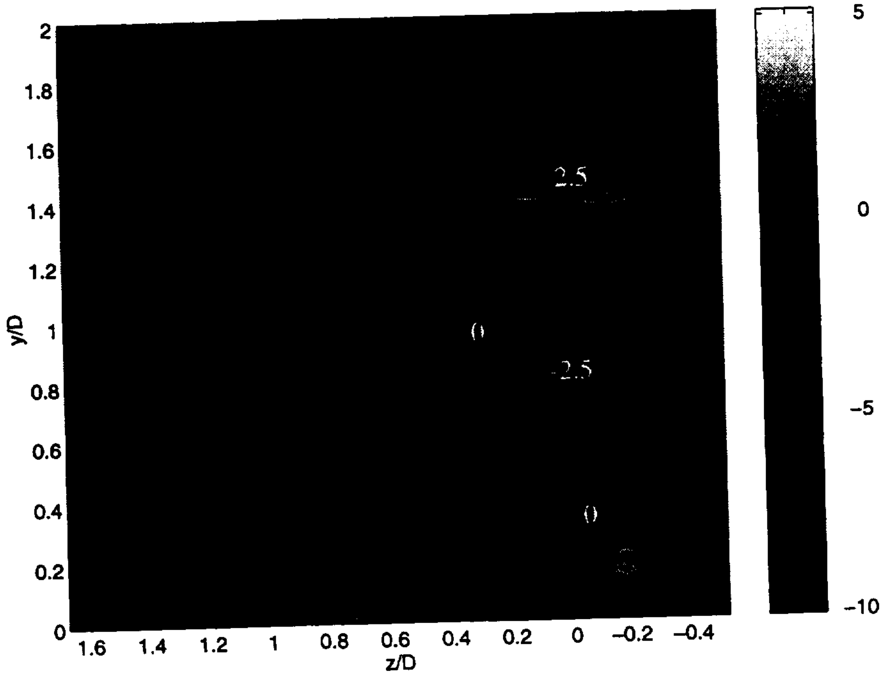


(b) $[(TI)_{2.3}-(TI)_{7.0}]\times 100$

Figure 4.28: L/D Effect at Low FSTI: VR=1.0, x/D=2.5 (Comparison of 040896 to 040396)

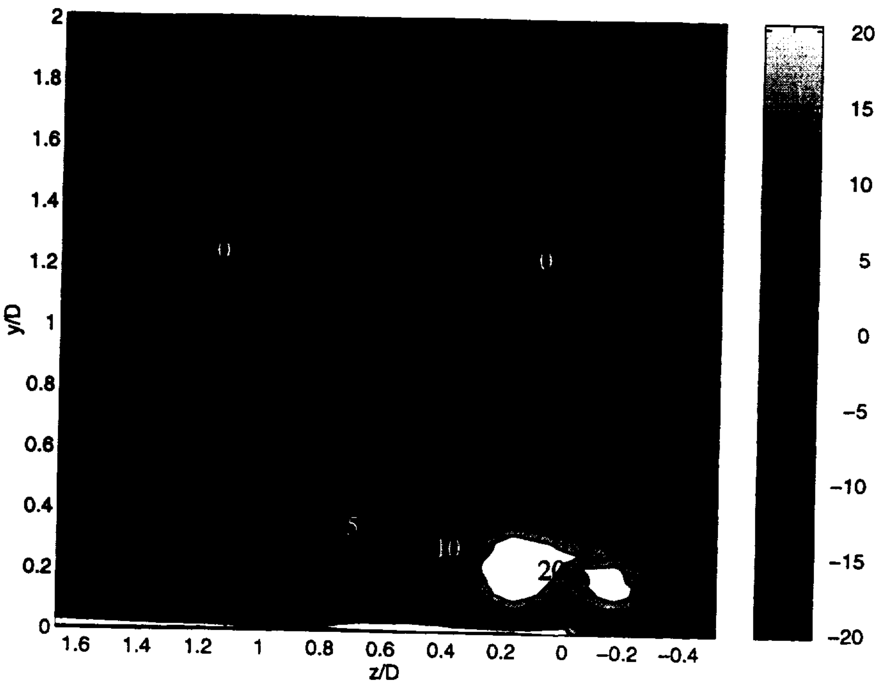


(a) $\frac{(U/U_o)_{2.3} - (U/U_o)_{7.0}}{(U/U_o)_{7.0}} \times 100$

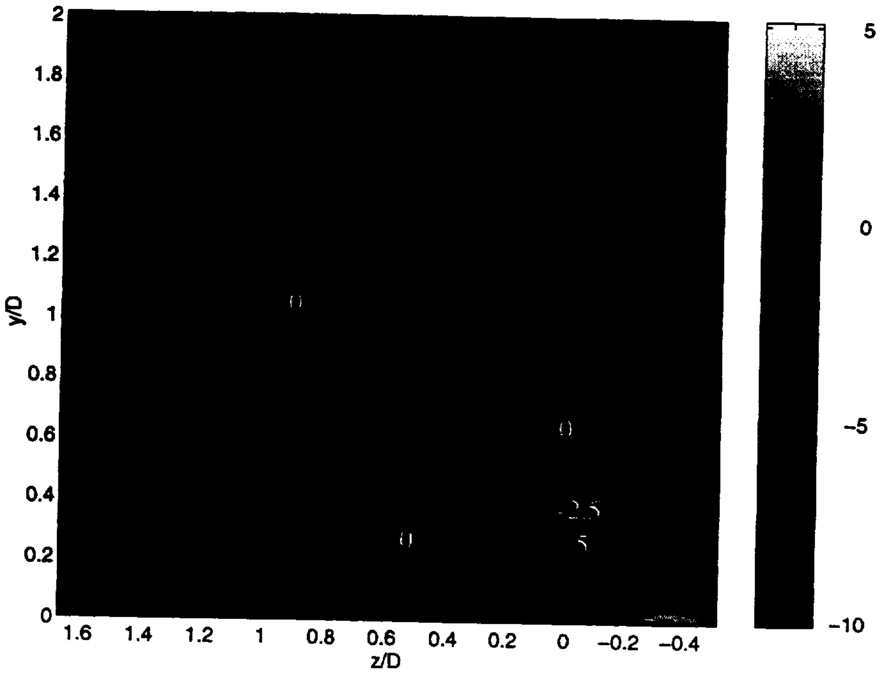


(b) $[(TI)_{2.3}-(TI)_{7.0}] \times 100$

Figure 4.29: L/D Effect at Low FSTI: VR=1.0, x/D=5.0 (Comparison of 040796 to 040496)

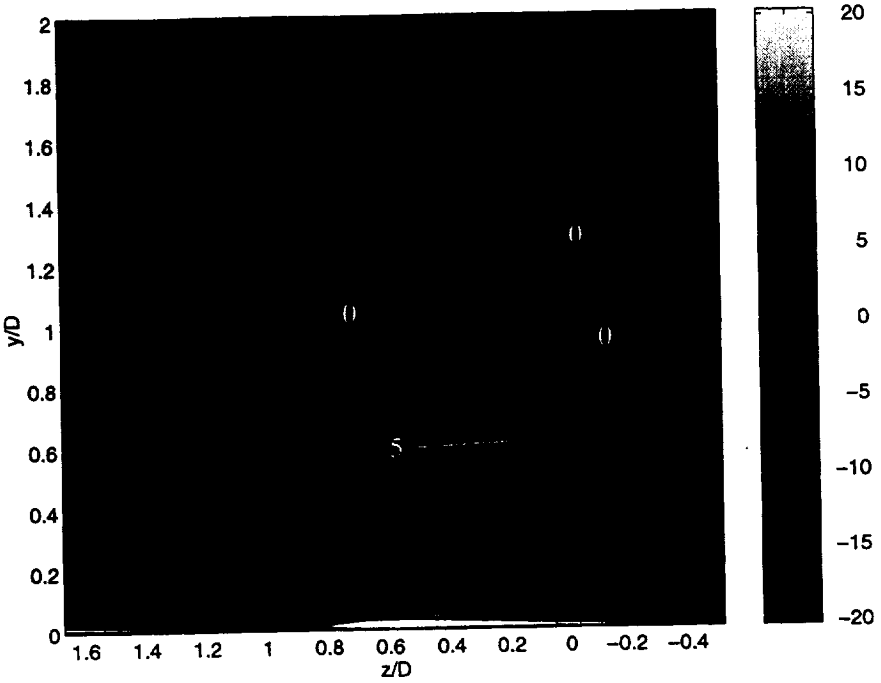


(a) $\frac{(U/U_o)_{2.3}-(U/U_o)_{7.0}}{(U/U_o)_{7.0}}\times 100$

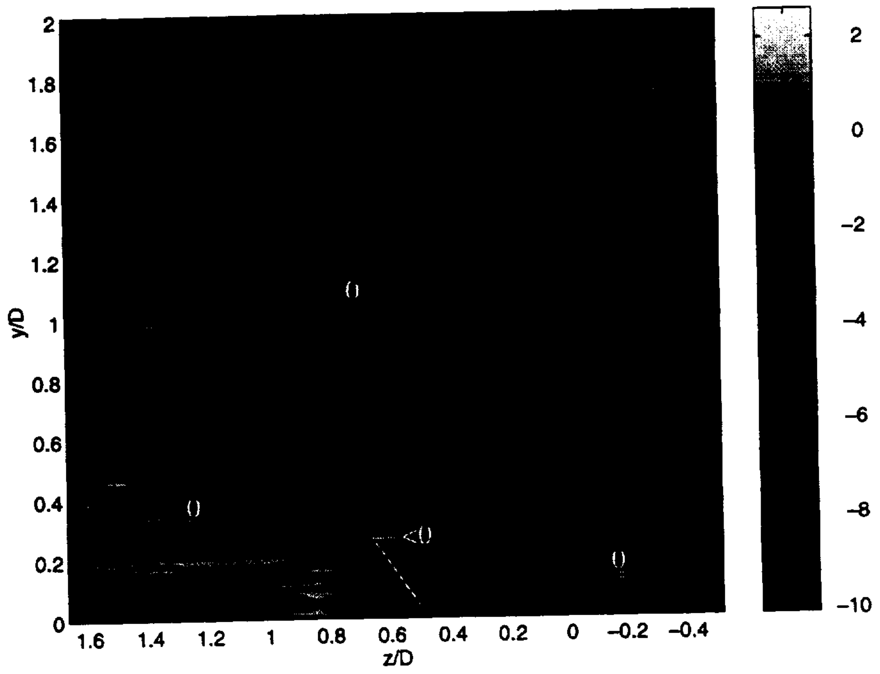


(b) $[(TI)_{2.3}-(TI)_{7.0}]\times 100$

Figure 4.30: L/D Effect at Low FSTI: VR=0.5, x/D=2.5 (Comparison of 041096 to 040396aa)

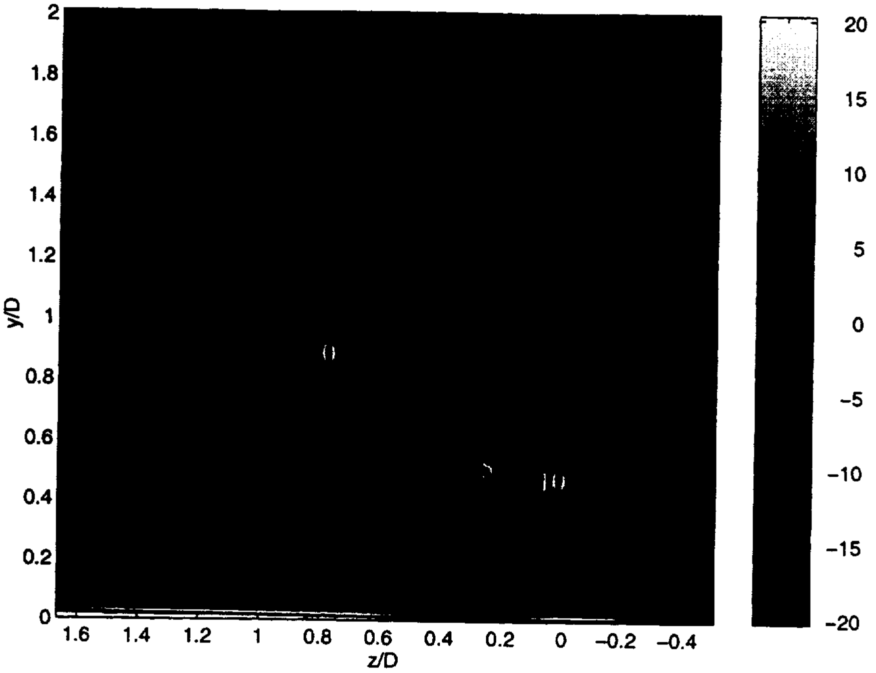


(a) $\frac{(U/U_o)_{2.3} - (U/U_o)_{7.0}}{(U/U_o)_{7.0}} \times 100$

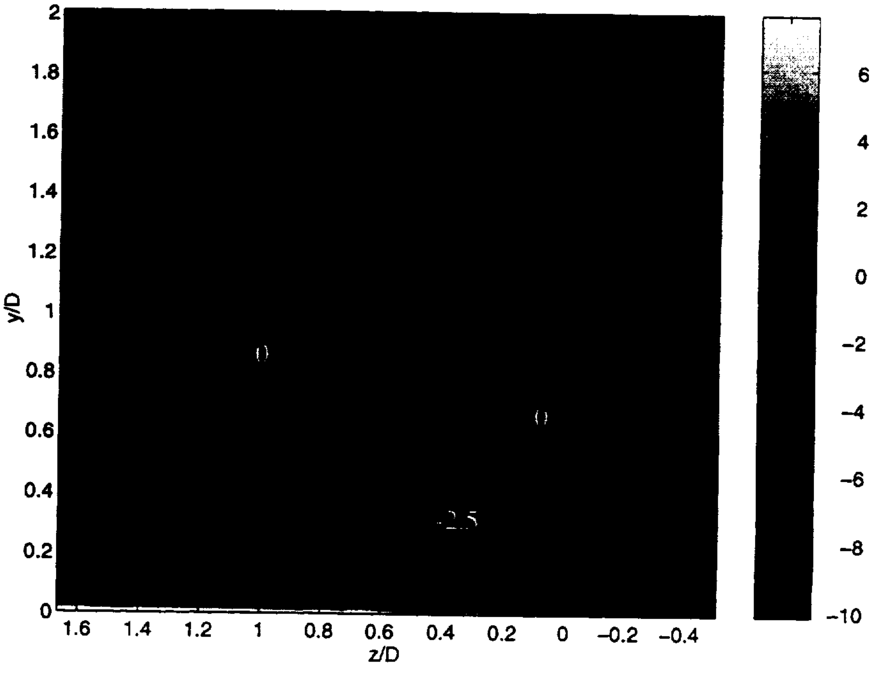


(b) $[(TI)_{2.3} - (TI)_{7.0}] \times 100$

Figure 4.31: L/D Effect at Low FSTI: VR=0.5, x/D=5.0
(Comparison of 040696 to 040596)

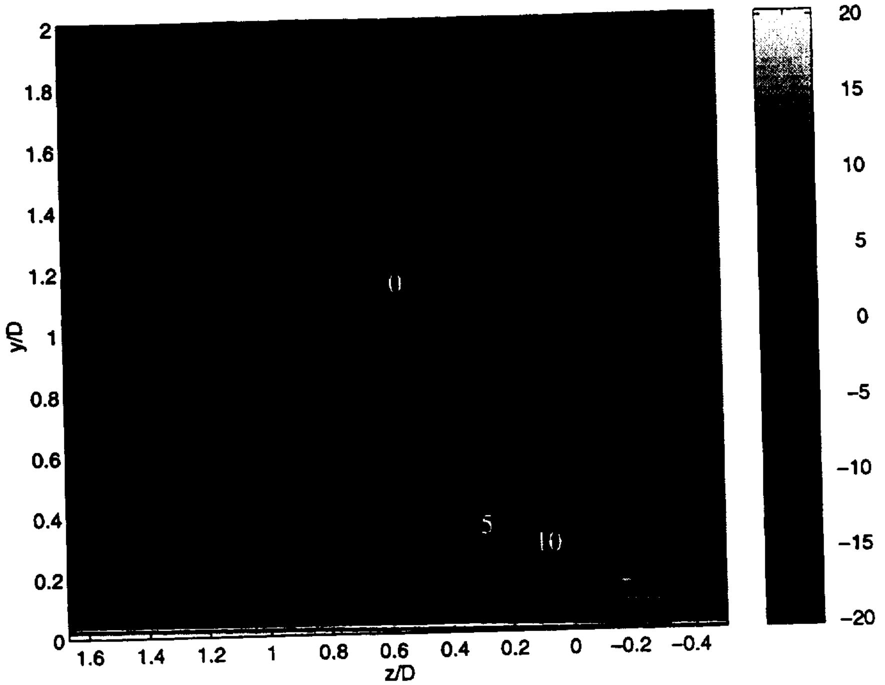


(a) $\frac{(U/U_o)_{2.3}-(U/U_o)_{7.0}}{(U/U_o)_{7.0}} \times 100$

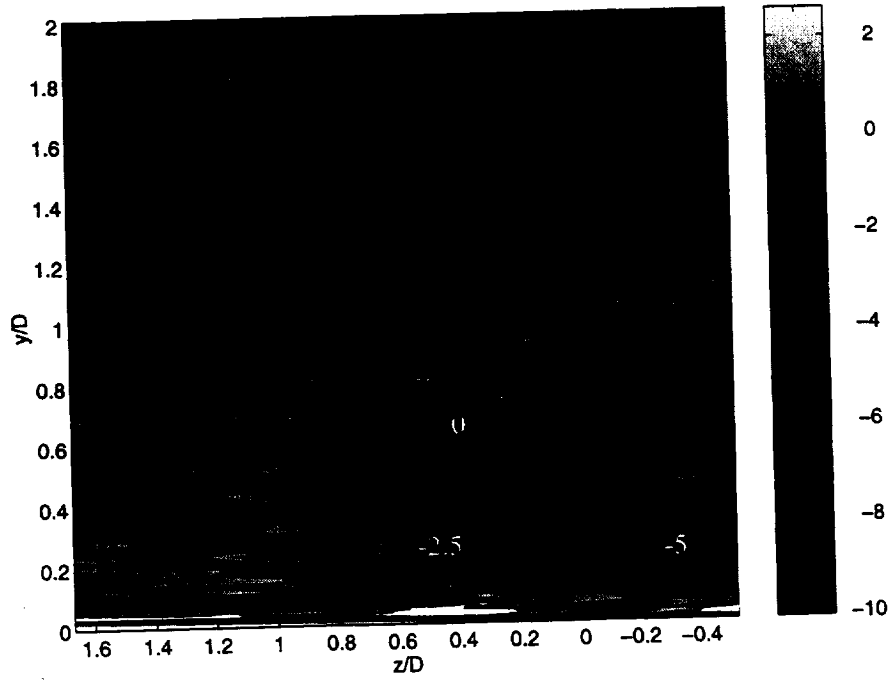


(b) $[(TI)_{2.3}-(TI)_{7.0}] \times 100$

Figure 4.32: L/D Effect at High FSTI: VR=1.0, x/D=2.5 (Comparison of 041496 to 041296bb)

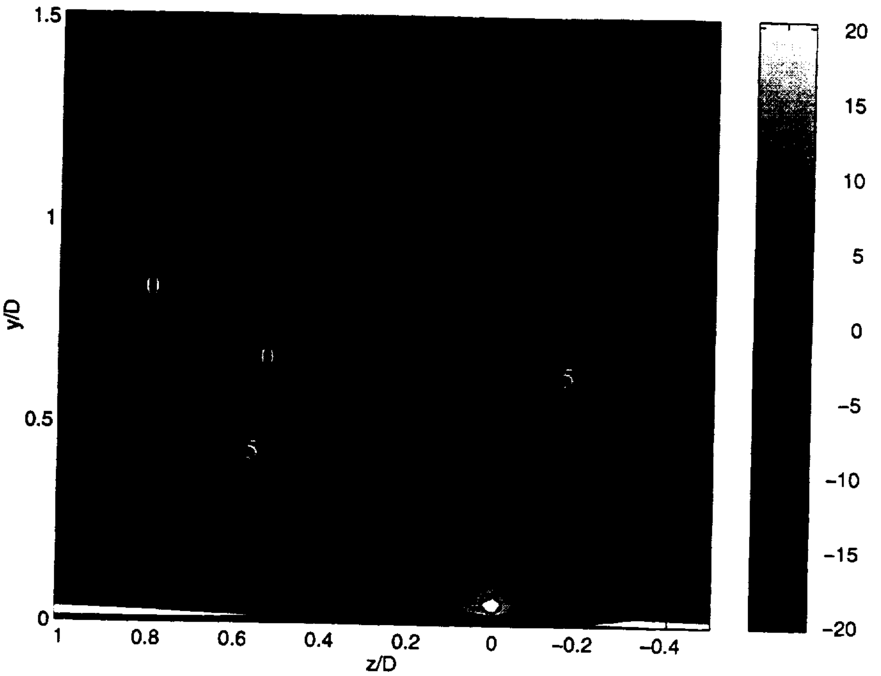


(a) $\frac{(U/U_o)_{2.3} - (U/U_o)_{7.0}}{(U/U_o)_{7.0}} \times 100$

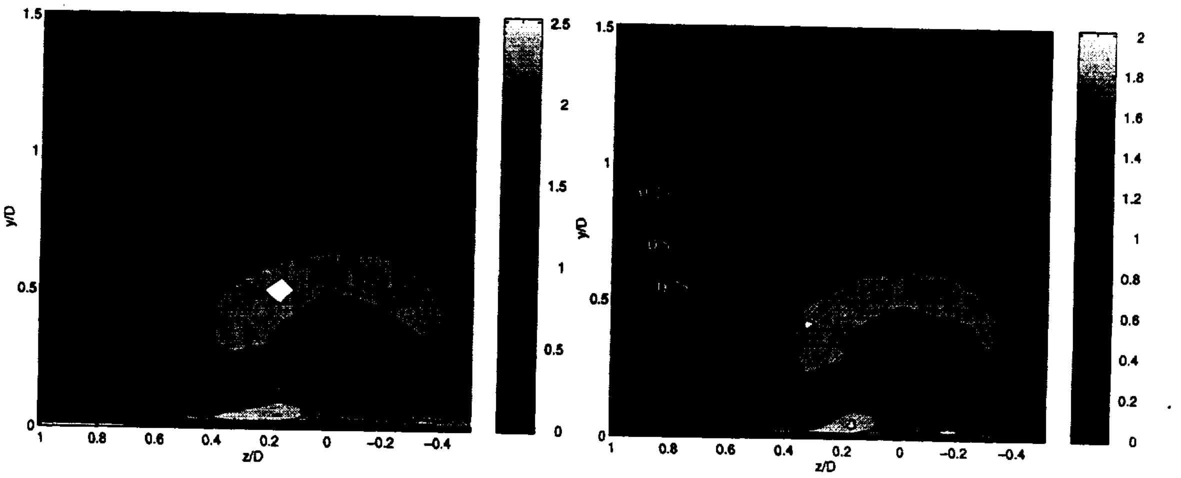


(b) $[(TI)_{2.3} - (TI)_{7.0}] \times 100$

Figure 4.33: L/D Effect at High FSTI: VR=0.5, x/D=2.5 (Comparison of 041596 to 041396)

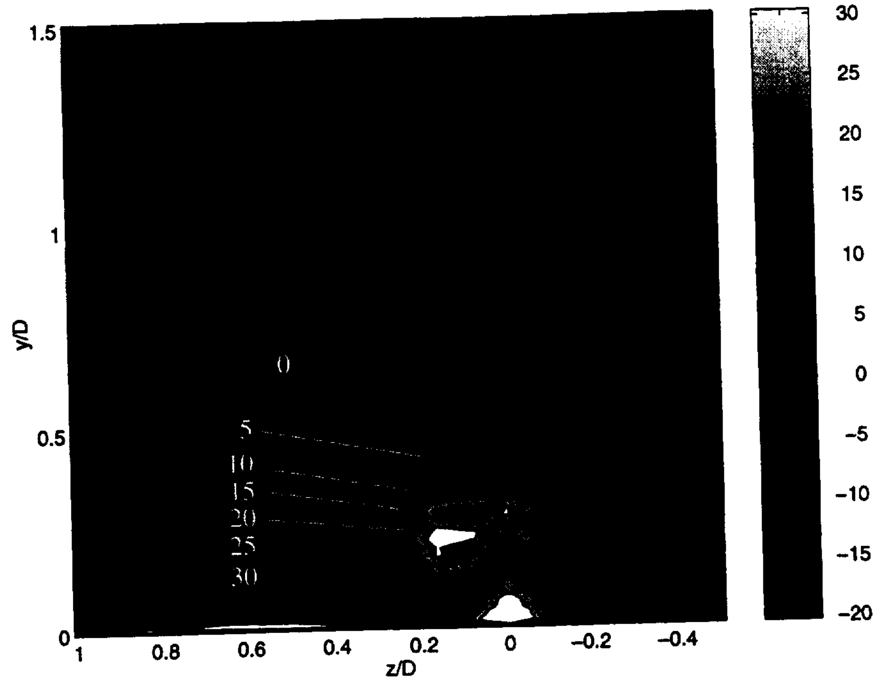


(a) $\frac{(U/U_o)_{high} - (U/U_o)_{low}}{(U/U_o)_{low}} \times 100$

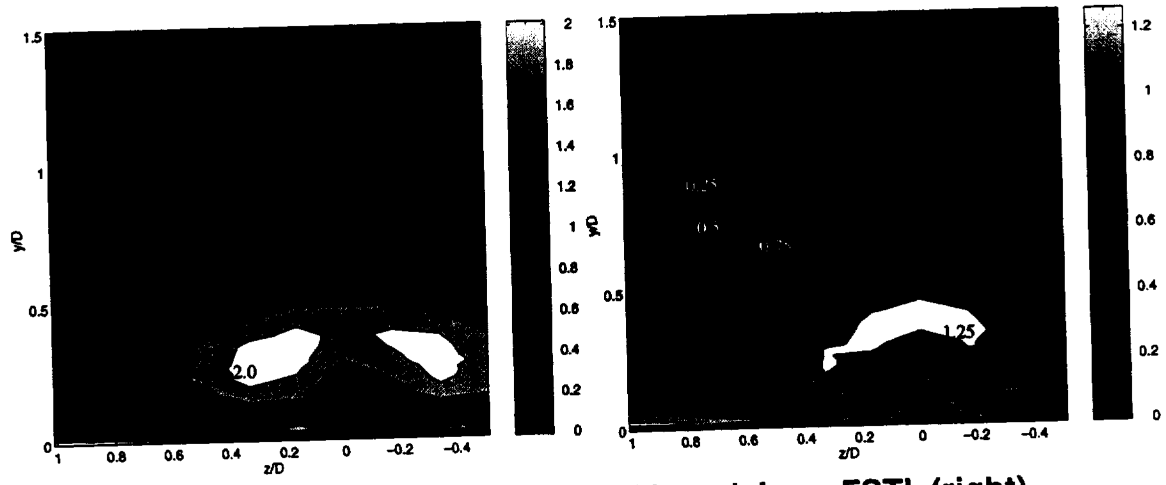


(b) u_{rms}(m/s): High FSTI (left) and Low FSTI (right)

Figure 4.34: FSTI Effect with L/D=7.0: VR=1.0, x/D=2.5 (Comparison of 041296bb to 040396)

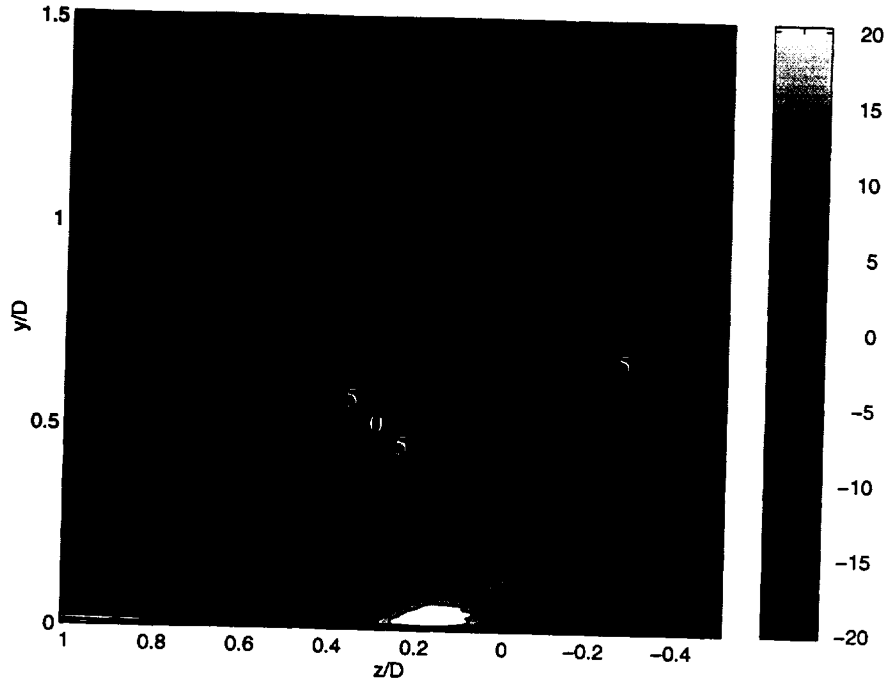


(a) $\frac{(U/U_o)_{high} - (U/U_o)_{low}}{(U/U_o)_{low}} \times 100$

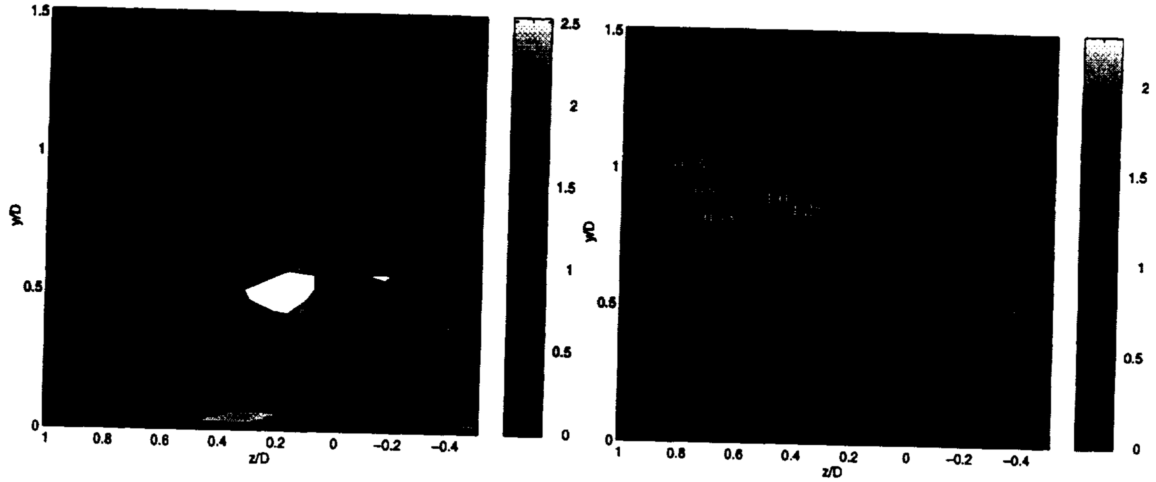


(b) u_{rms}(m/s): High FSTI (left) and Low FSTI (right)

Figure 4.35: FSTI Effect with L/D=7.0: VR=0.5, x/D=2.5 (Comparison of 041396 to 040396aa)

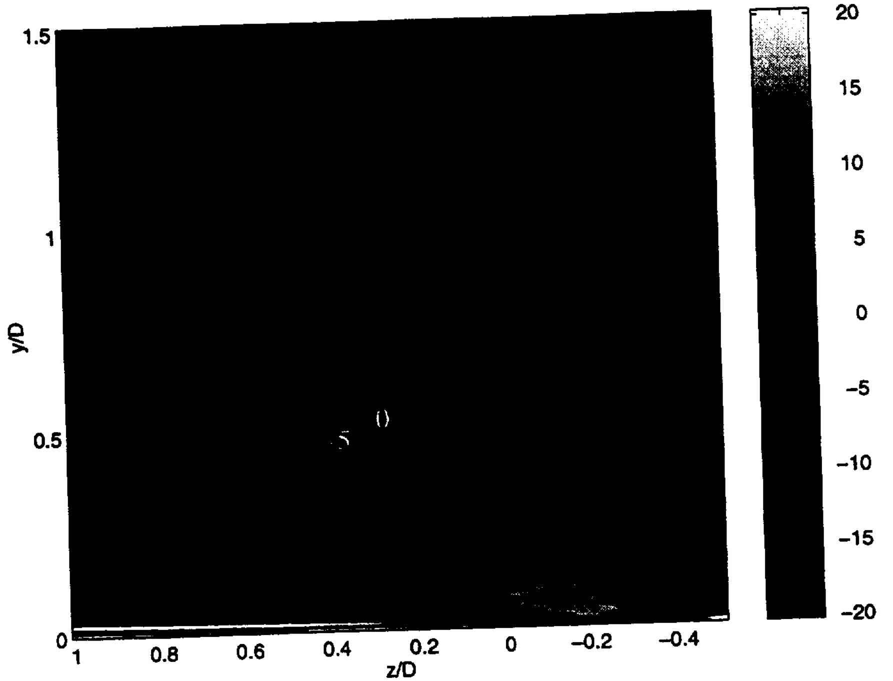


(a) $\frac{(U/U_o)_{high} - (U/U_o)_{low}}{(U/U_o)_{low}} \times 100$

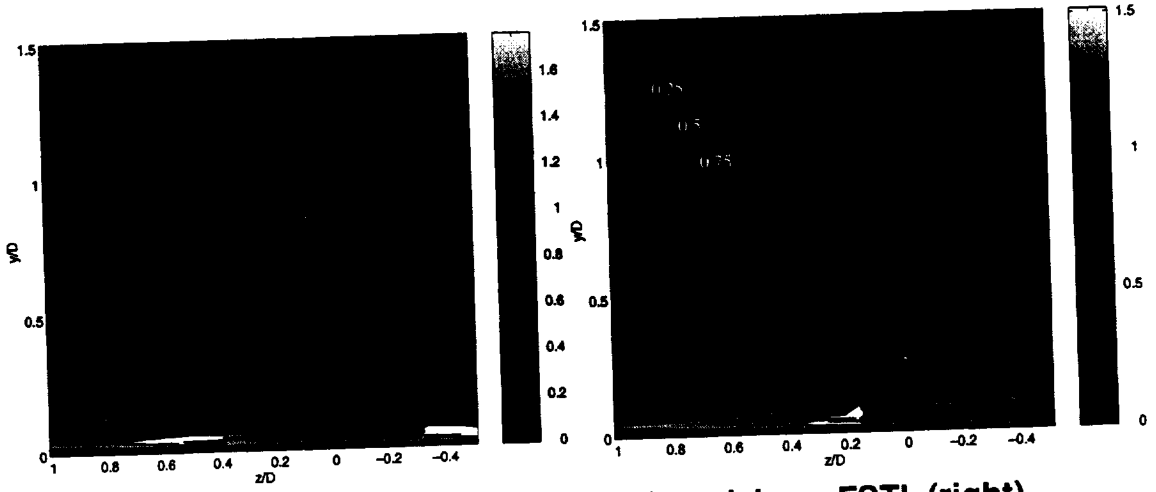


(b) u_{rms}(m/s): High FSTI (left) and Low FSTI (right)

Figure 4.36: FSTI Effect with L/D=2.3: VR=1.0, x/D=2.5 (Comparison of 041496 to 040896)

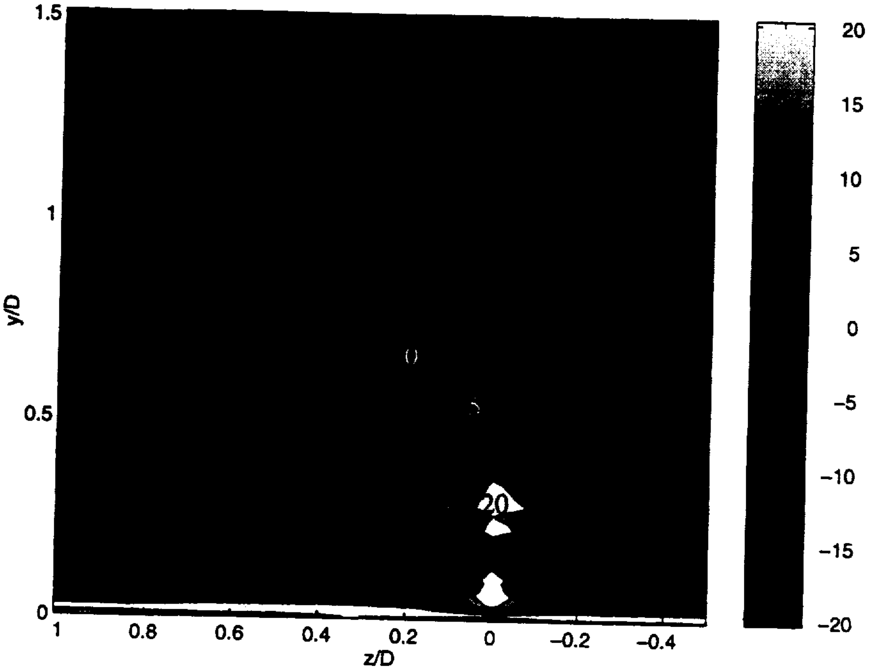


(a) $\frac{(U/U_o)_{high} - (U/U_o)_{low}}{(U/U_o)_{low}} \times 100$

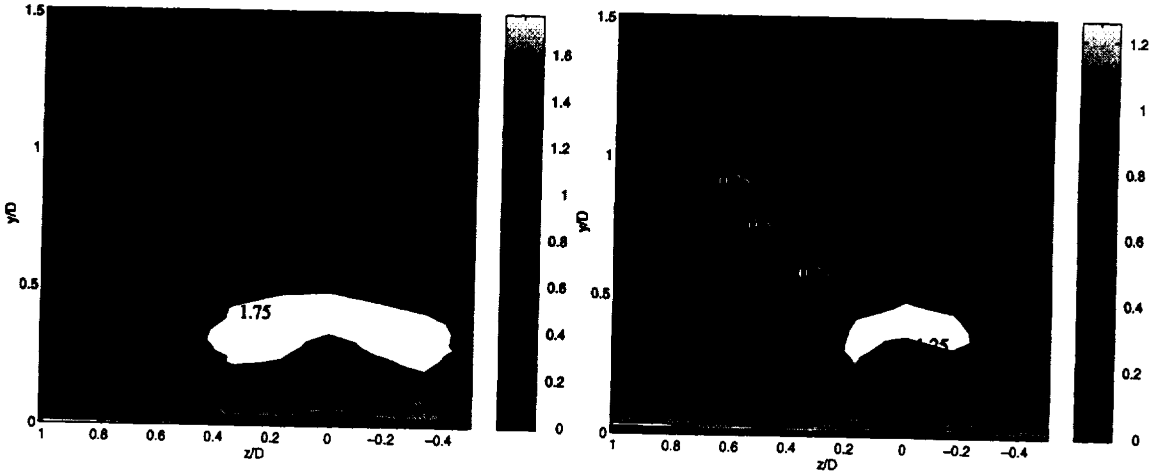


(b) u_{rms}(m/s): High FSTI (left) and Low FSTI (right)

Figure 4.37: FSTI Effect with L/D=2.3: VR=1.0, x/D=5.0 (Comparison of 090896b to 040796)

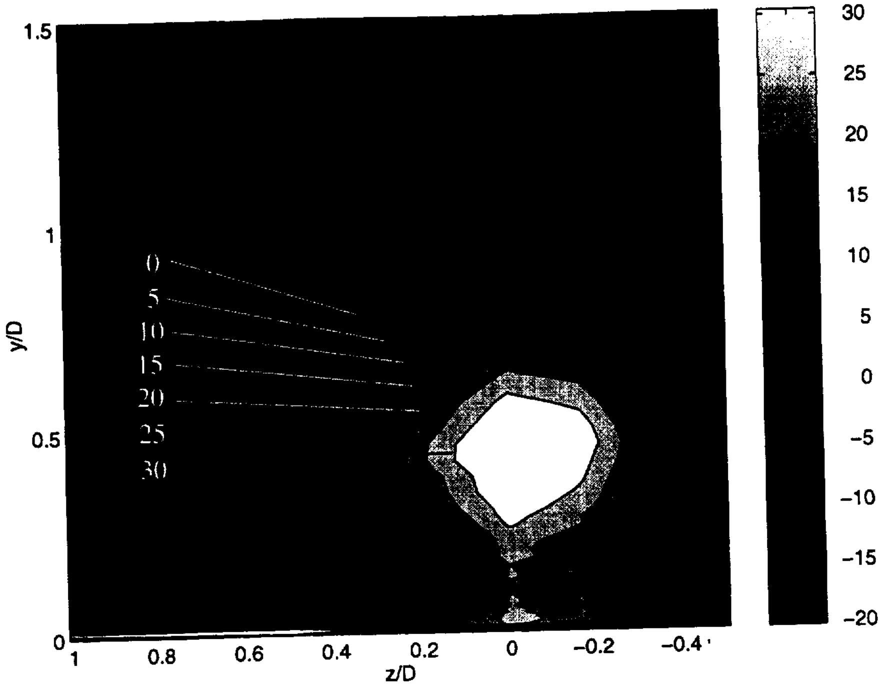


(a) $\frac{(U/U_o)_{high} - (U/U_o)_{low}}{(U/U_o)_{low}} \times 100$

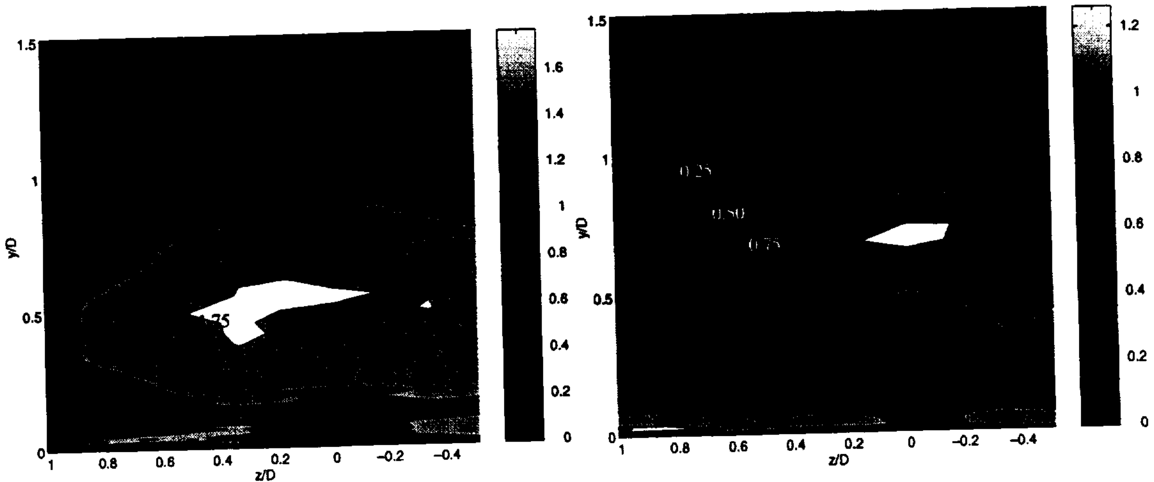


(b) u_{rms}(m/s): High FSTI (left) and Low FSTI (right)

Figure 4.38: FSTI Effect with L/D=2.3: VR=0.5, x/D=2.5 (Comparison of 041596 to 041096)



(a) $\frac{(U/U_o)_{high} - (U/U_o)_{low}}{(U/U_o)_{low}} \times 100$



(b) u_{rms}(m/s): High FSTI (left) and Low FSTI (right)

Figure 4.39: FSTI Effect with L/D=2.3: VR=0.5, x/D=5.0
(Comparison of 091196 to 040696)

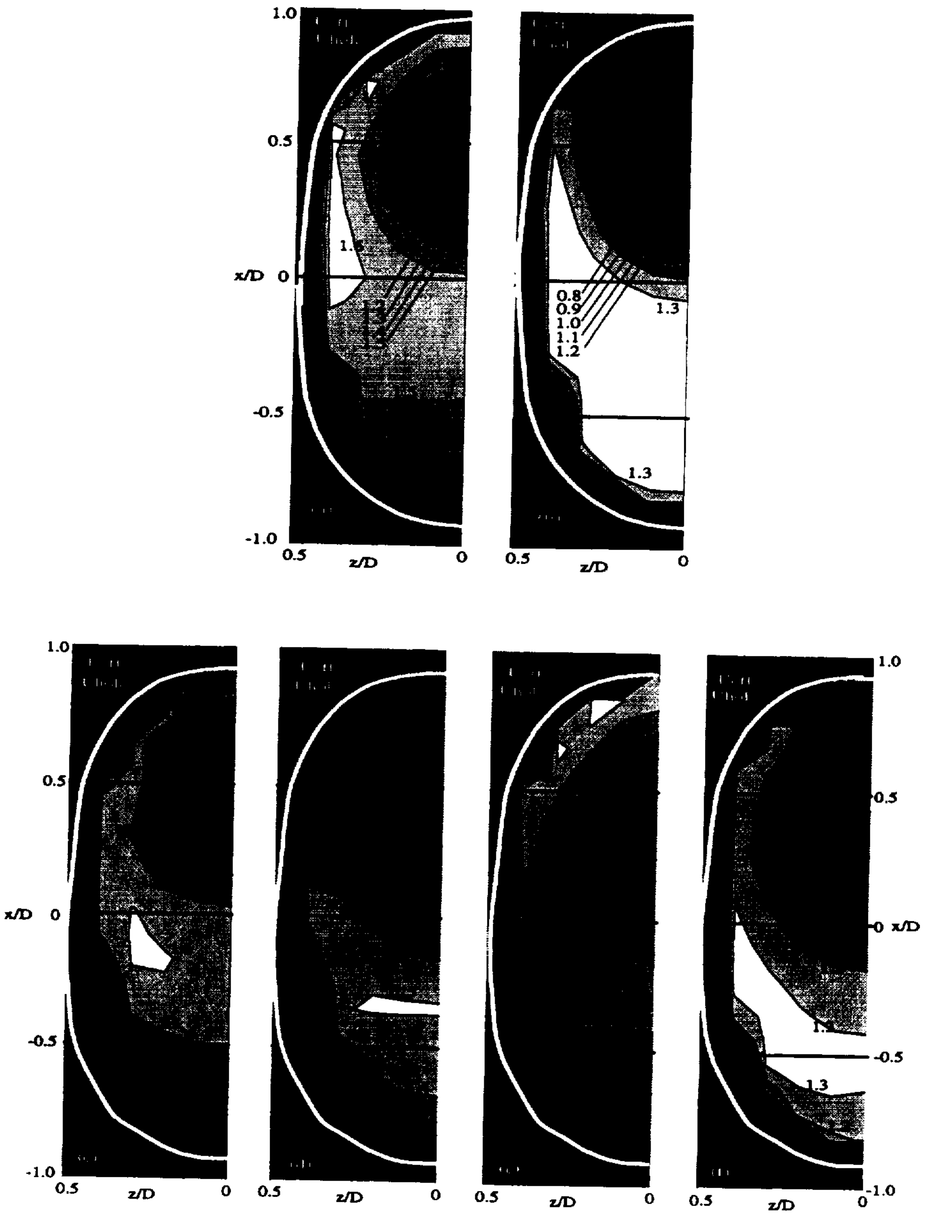
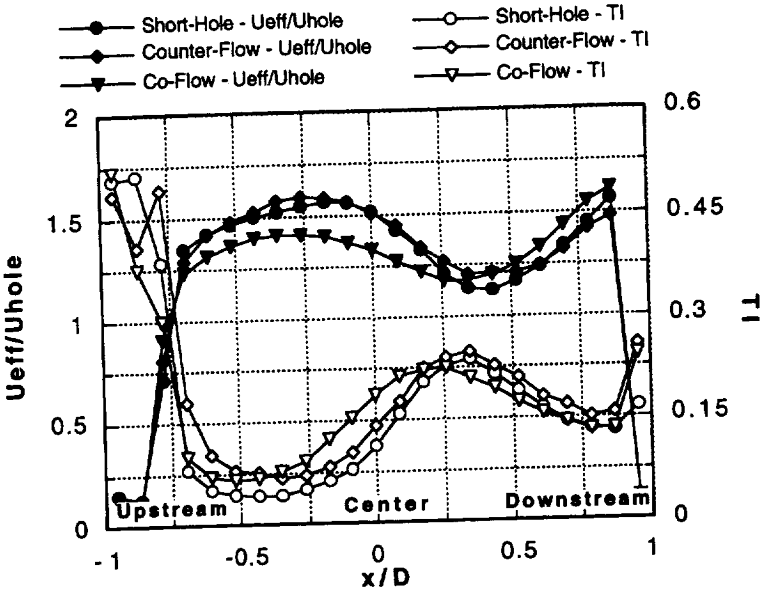
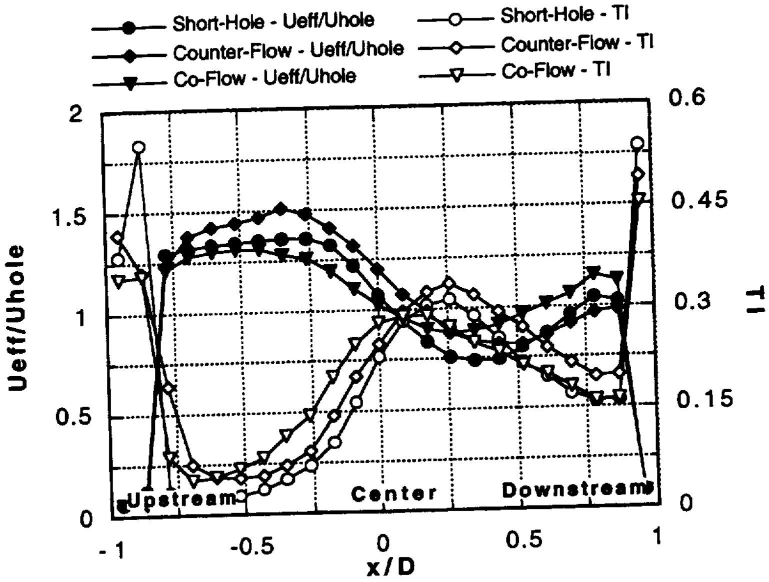


Figure 4.40: Hole-Exit Profiles for Different Plenum Geometries (**a**) Short-Hole/Open Plenum: VR=0.5, (**b**) Short-Hole/Open Plenum: VR=1.0, (**c**) Counter-Flow: VR=0.5, (**d**) Counter-Flow: VR=1.0, (**e**) Co-Flow: VR=0.5, and (**f**) Co-Flow: VR=1.0

[Note: Approximate outline of hole is given by white line. Upstream portion of exit is at the bottom of each figure; downstream portion at top of figure.]



(a) VR=0.5



(b) VR=1.0

Figure 4.41: Comparisons of Normalized Centerline Mean Effective Velocity and TI Distributions for Short-Hole/Open Plenum Injection, Counter-Flow Delivery, and Co-Flow Delivery. FSTI=12%.

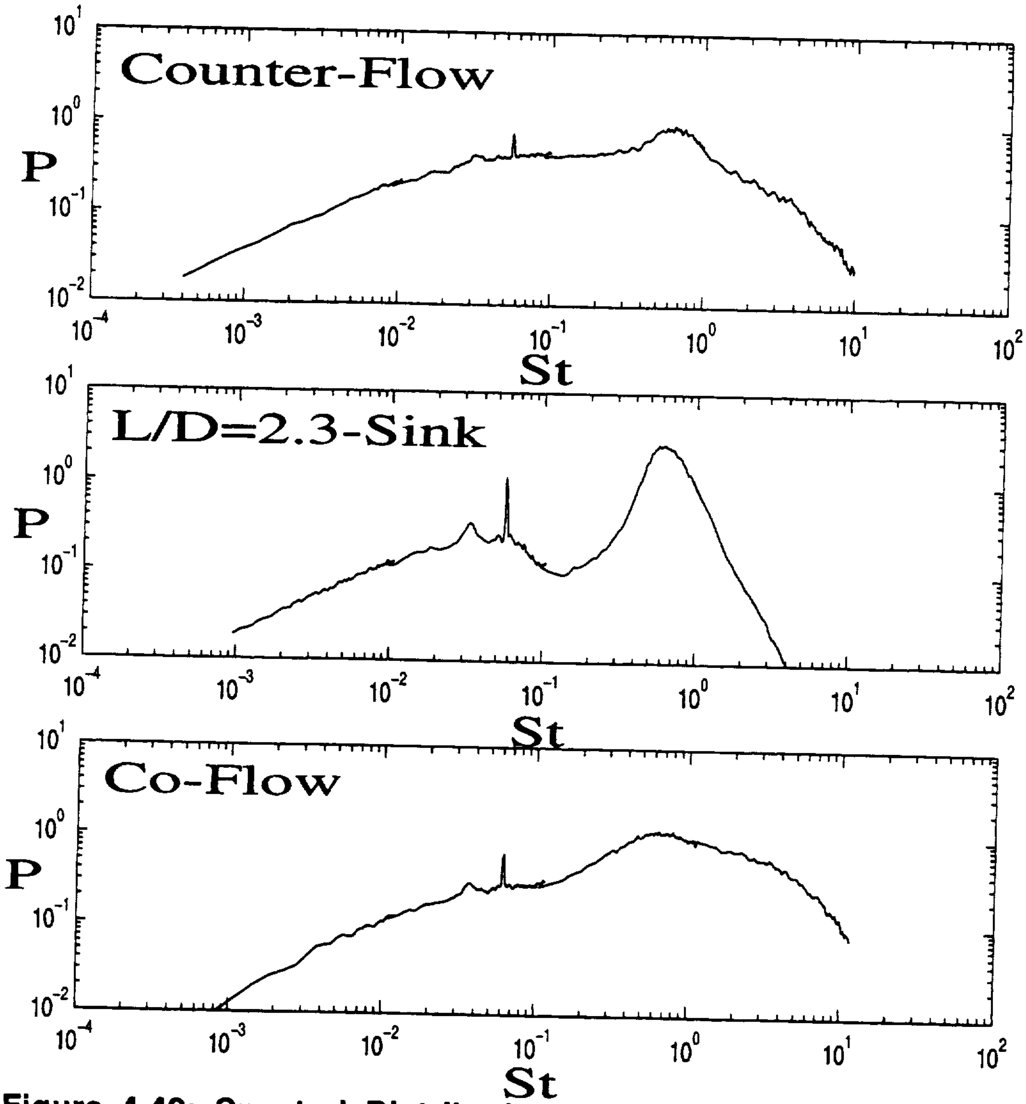


Figure 4.42: Spectral Distributions (P vs. St) for Cases with Approach Flow Momentum at x/D=-0.5 and VR=1.0

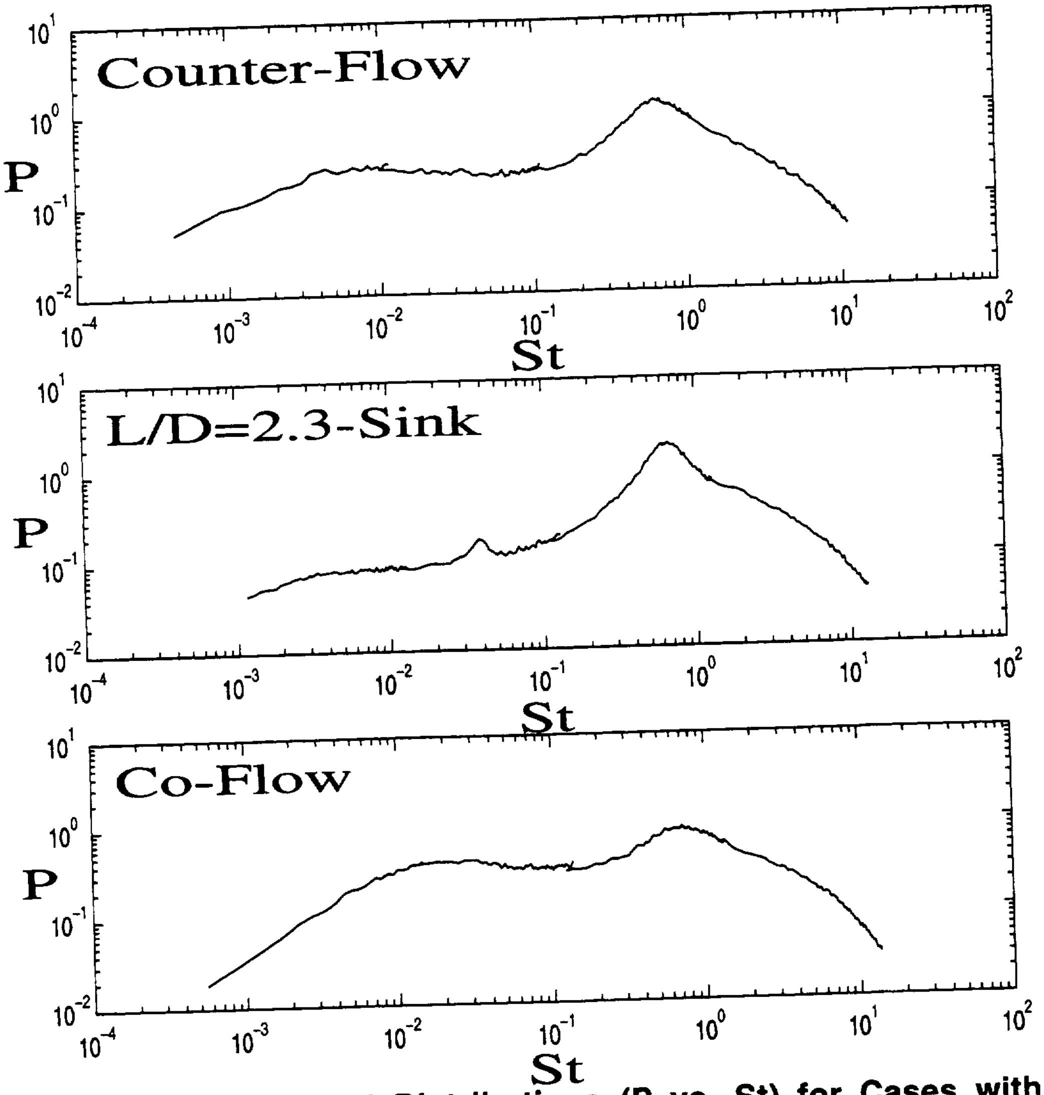


Figure 4.43: Spectral Distributions (P vs. St) for Cases with Approach Flow Momentum at x/D=0.0 and VR=1.0

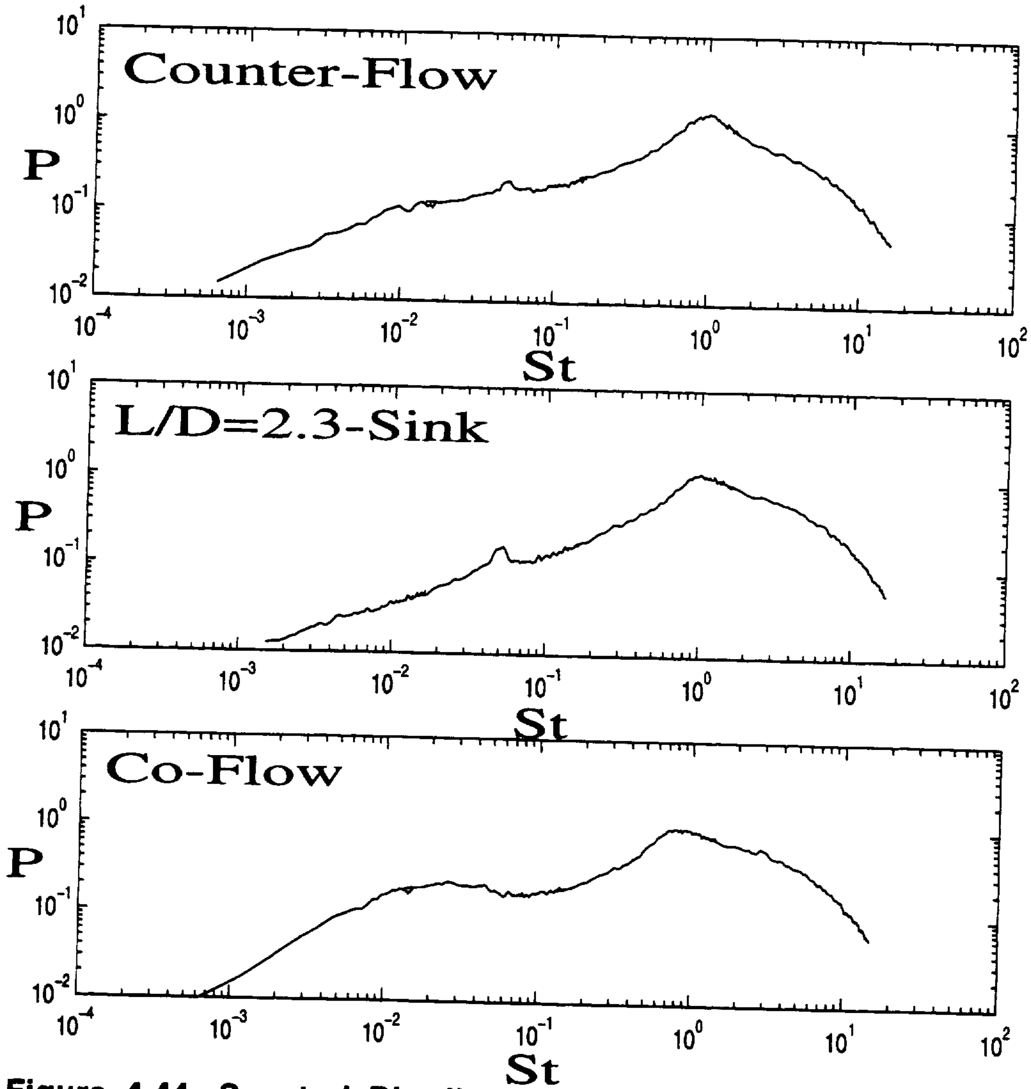
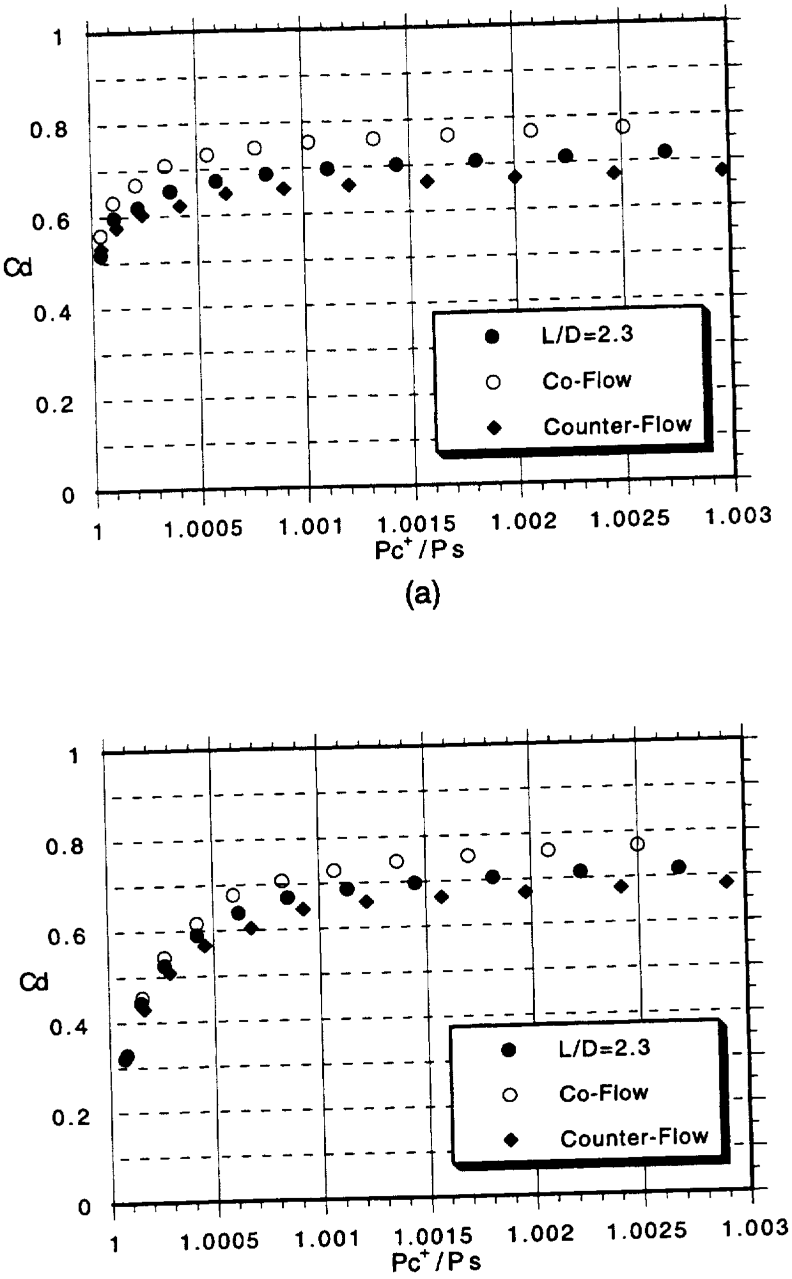


Figure 4.44: Spectral Distributions (P vs. St) for Cases with Approach Flow Momentum at x/D=-0.5 and VR=1.0



(a)

(b)

Figure 4.45: Discharge Coefficients for Cases with Approach Flow Momentum
(a) Without Freestream
(b) With Freestream

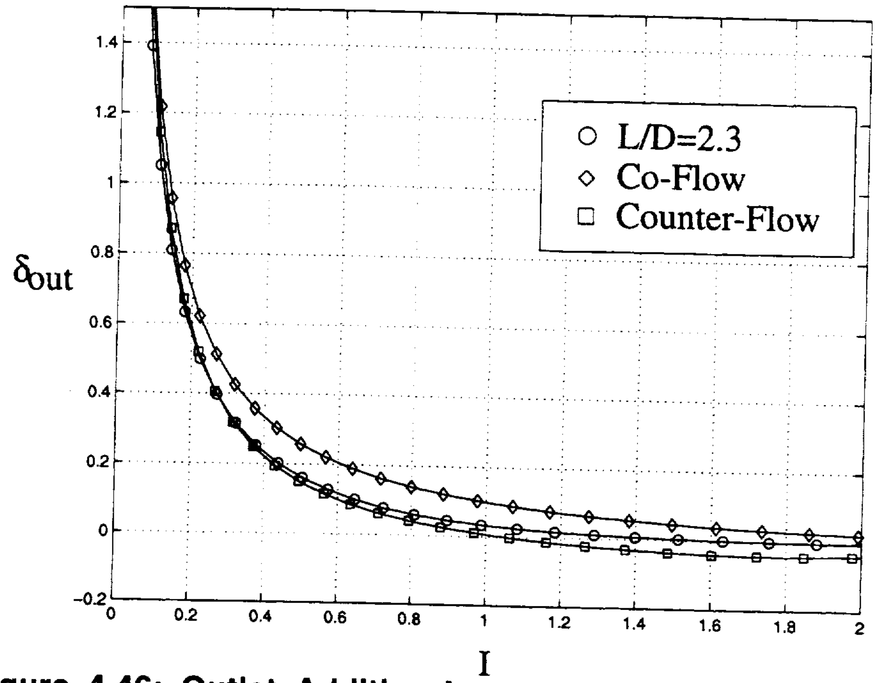
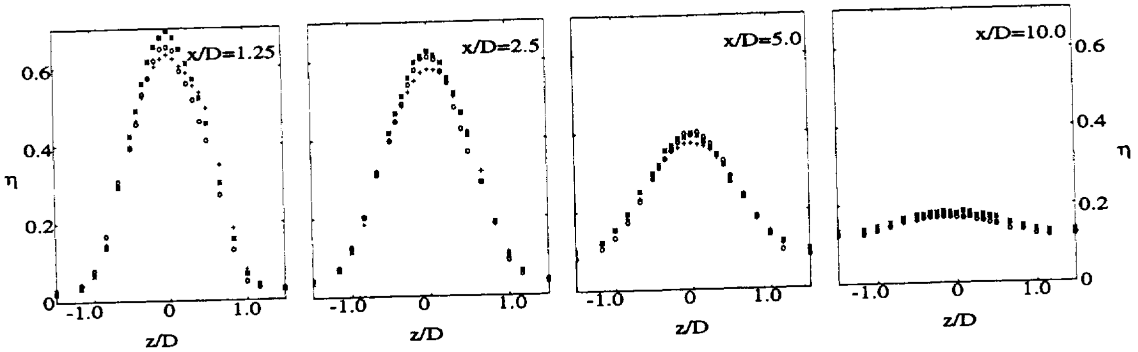
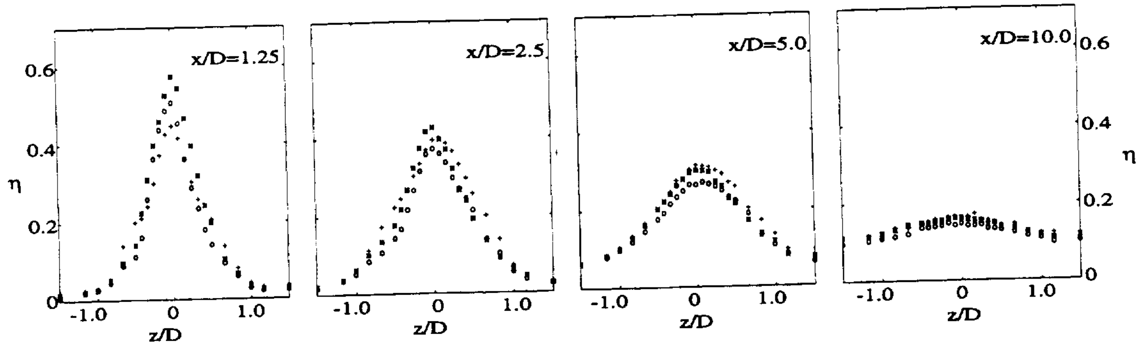


Figure 4.46: Outlet Additive Losses for Cases with Approach Flow Momentum



(a) VR=0.5



(b) VR=1.0

Figure 4.47: Streamwise Evolution of Local Adiabatic Effectiveness at (a) VR=0.5 and (b) VR=1.0. FTSI=12%. [*=Counter-Flow, o=Short-Hole/Open Plenum, and +=Co-Flow]

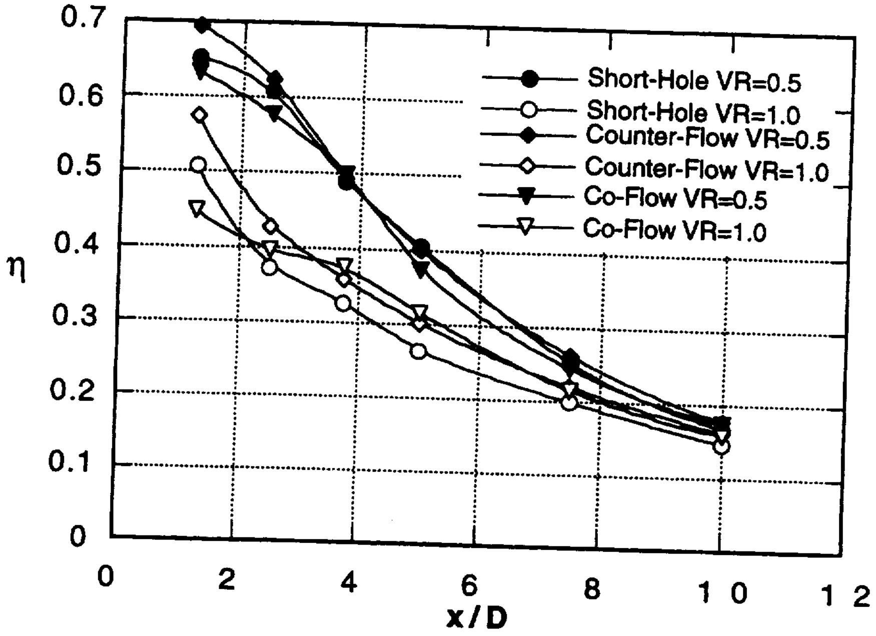


Figure 4.48: Centerline Adiabatic Effectiveness Distributions at VR=0.5 and VR=1.0. FSTI=12%.

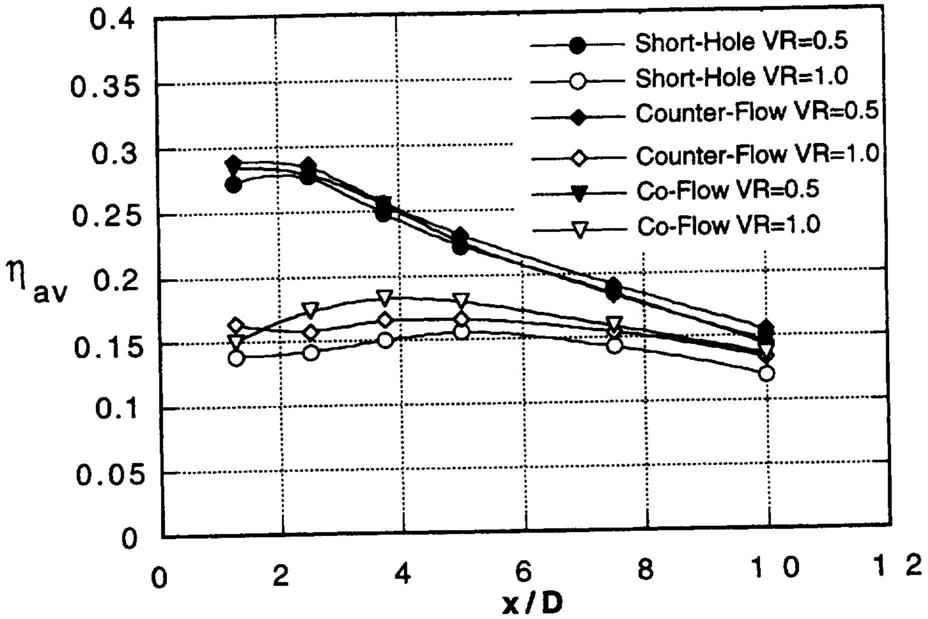


Figure 4.49: Laterally-Averaged Adiabatic Effectiveness Distributions at VR=0.5 and VR=1.0. FSTI=12%.

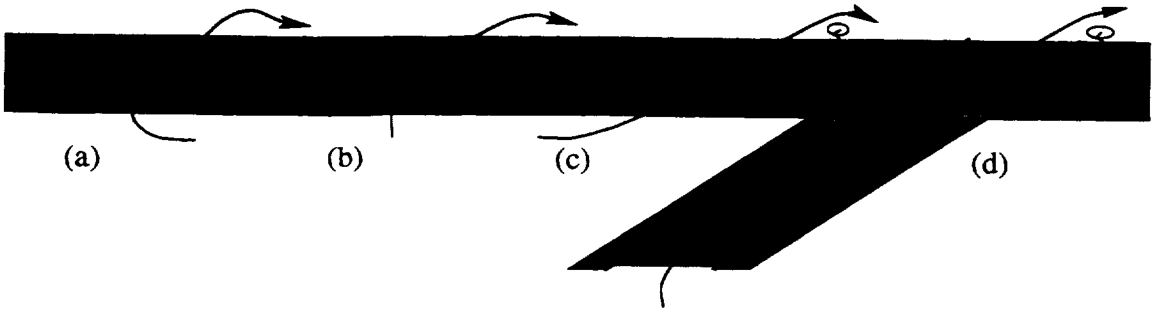


Figure 4.50: Physical Model Depiction of Major Centerline Flow Streamlines for Different Geometries Studied:
(a) Counter-Flow Delivery, **(b)** Short-Hole/Open Plenum Injection, **(c)** Co-Flow Delivery, and **(d)** Long-Hole Injection

CHAPTER 5: CONCLUSIONS

5.1 General Significance and Applicability of Results

The results presented highlight some important effects and aspects related to film cooling. A summary of the findings attained via the different measurements as they relate to the area of film cooling research is now given.

5.1.1 Hole-Exit Measurements

To the designer and other researchers, this information highlights the fundamental differences that exist between the delivery geometries. The measurements, in detail, that (1) the flow physics are strongly dependent on hole and delivery geometry and that, (2) in experiment settings, realistic models are needed if representative simulations are to be attained. The measurements may also be used to assess the value of experimental data in the existing literature. To a researcher in the computational field, knowledge of the velocity and local turbulence distributions of the flow emerging from film cooling holes is useful for developing accurate models and validating computations. Knowledge of the exiting flowfield may have two major implications. It may (1) eliminate the need to model the internal plenum geometry, thus simplifying the boundary conditions, grid generation scheme, and overall geometry or (2) alternatively, emphasize the need for more realistic models of the plenum geometries.

5.1.2 Spectral Measurements

The spectral measurements presented in this study establish a precedent in the area of film cooling. To date and to the authors' knowledge, no measurements of this type have appeared in the open literature. In short, these spectral measurements are extremely useful for they provide additional insight into the flow physics of film cooling flows. Documentation regarding coolant jet dissipation, scales, and freestream-coolant momentum interactions are of particular interest. These data are also valuable contributions to computation model development, especially those employing k-ε turbulence modeling or large-eddy simulation (LES).

5.1.3 Discharge Coefficients

Though discharge coefficient documentation is plentiful in the open literature, correlating discharge coefficients to film cooling hole and supply plenum geometry have eluded researchers. The most significant observation is that geometries and the resulting variations in momentum distributions of the emerging coolant flow do play a distinct, and potentially significant, role in establishing mass flow rates through and impacting losses experienced film cooling flows.

5.1.4 Surface Adiabatic Effectiveness and Flowfield Measurements

The influence of the exit flow downstream from the film cooling holes is the primary concern of most designers. Most designers are interested in the manner in which this coolant flow interacts with the freestream flow and then influences the heat transfer along the surface being protected. The surface adiabatic effectiveness and flowfield measurements present snapshots of the performance of the various film cooling configurations and highlight the evolution of the film cooling phenomena in moving from one configuration to the next. Such performance data can be incorporated into design choices. The data presented also serve as bases to which other experimental studies and computations can be compared.

5.2 Specific Conclusions

5.2.1 Hole-Exit Measurements

Hole-exit measurements have been documented for cases with long-hole and short-hole injection with an open plenum, counter-flow delivery, and co-flow delivery. The measurements show that these are influenced by the cooling hole length and delivery plenum geometry. The latter three geometries, all with L/D=2.3, exhibit similar hole-exit profiles and are characterized by jetting of the coolant in the upstream portion of the hole exit. The extent of the jetting and the precise profiles, however, are a function of the particular delivery geometry. Comparisons of long-hole and short-hole injection demonstrate that long-hole injection results in profiles that have features similar to "fully-developed" turbulent tube flow, in contrast to the other three configurations, whether VR=0.5 and 1.0.

5.2.2 Spectral Measurements

Spectral distributions have been measured for a variety of film cooling configurations of differing film cooling hole lengths and coolant supply flow orientations. The results highlight some of the fundamental differences. Where possible, physical explanations of the trends were given. The distributions of turbulence energy were dependent on the film cooling design and the measurement location over the exit plane.

In general, coolant flows through long and short holes exhibit nominally the same peak-energy frequencies. The range of dominant frequencies is $0.5<St<0.9$ for measurements over the upstream portion and center of the hole exit-plane. Slightly larger peak frequencies are evident for flows over the downstream portion of the hole-exit plane ($0.8<St<1.0$). Such dominant frequencies suggest dominant turbulence scales of 0.5-1.0D for coolant flows.

Documentation of additional turbulence parameters, including dissipation rates, and integral, energy, and Kolmogorov length scales, is also presented. In general, these data highlight that short holes have higher dissipation values. Length scales for all geometries tend to be nominally of the same order of magnitude.

Useful for CFD and turbulence modeling is the fact that, though energy at the freestream turbulence length scales is visible in the spectra (some spectra show it to be more prominent than others), it never seems to dominate the spectra. This implies that computation of the coolant flow and the freestream-mixing zone could be separated so long as the appropriate velocity distribution of the coolant flow were imposed.

5.2.3 Discharge Coefficients

Discharge coefficients for a variety of film cooling geometries have been presented. The trends documented in this study provide insight into the influence that hole length and coolant supply orientation, coupled with the presence of an external freestream, have on discharge coefficients. In general, long film cooling lengths are most susceptible to higher outlet losses due to the interaction with freestream flow. The skewing of coolant velocity distributions over the hole exit plane towards the upstream, with short holes, imposes a net effect of reducing static pressures over the hole exit plane. This, in turn, leads to higher discharge coefficients with freestream flow. Though, streamwise and lateral injection cases exhibit similar discharge coefficients over a wide range of pressure ratios, the manner in which the coolant interacts with the freestream to modify the static pressure distribution over the hole exit plane for the two is fundamentally different.

The results highlight that scaling of δ_{out} on I still appears to be satisfactory, although since all measurements were taken with a density ratio of 1.0, the robustness of this scaling was not put to a very rigorous test. In previous work, hole inclination angle and position were tested. This study suggests that hole geometry also has a significant impact on δ_{out} values.

5.2.4 Surface Adiabatic Effectiveness Measurements

A very useful technique for measuring adiabatic effectiveness of film cooling with a traversing thermocouple in the flow has been implemented. The technique is attractive in its simplicity and in that it provides temperature profile information over the point where the effectiveness is measured.

The effect of the flow delivery configuration, hole L/D, and velocity ratio on the film cooling performance have been detailed. It is noted, however, that long- versus short-hole injection is a more important distinction than the various means of delivery of the flow to the holes. The plenum geometry does have an effect on the film cooling performance, with the differences between cases amplified at the higher velocity ratio. Comparisons of centerline, laterally-averaged, and laterally-distributed effectiveness values, however, suggest that the overall manner in which the coolant interacts with the freestream and then protects the surface is fundamentally different with each of the cases.

5.2.5 Flowfield Measurements

The flowfield comparisons emphasize that L/D, FSTI, and VR play influential roles in film cooling. A cross-correlation is observed of these two effects which makes interpretation of one in isolation of the other incomplete. Changing the L/D from 7.0 to 2.3 has more influence under low-FSTI than under high FSTI. With low FSTI, differences tend to encompass a much larger portion of the region downstream from the holes. With high-FSTI, the regions of differences tend to be isolated to a smaller zone downstream from the holes. Comparing like geometries under different FSTI levels highlights the fact that enhanced turbulence significantly alters the flowfield downstream from the holes. Specific conclusions are given below.

Under low-FSTI conditions, the short-hole injection flow is prone to jetting. At VR=1.0, this jetting permits the coolant to penetrate further from the wall and influence a greater extent of the region downstream from the hole. Most significant are higher velocities in the jet core region and pronounced acceleration along the coolant jet periphery. At VR=0.5, the jetting associated with short-hole injection only leads to higher velocities in the core region.

With high FSTI, similar differences are observed for both VR=1.0 and 0.5. Both VR cases exhibit jetting effects and higher jet core velocities with short-L/D injection. No differences are observed along the jet periphery, however, even with the VR=1.0 situation.

Comparing like geometries under differing FSTI conditions yields turbulence structures that are generally similar but shows signs of significant differences in mixing and penetration. With high FSTI, increased mixing along the coolant jet periphery and more acceleration of the core flow of the emerging jet is observed.

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APPENDIX A: ORIGINAL DATA

Run ID: 040396

VR=0.995
Uo=10.95 m/s
x/D=2.5 FSTI=0.5%
L/D=7.0

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	2.71771	0.65952
0.0018	-0.375	3.51405	0.84870
0.0037	-0.375	4.47853	1.06129
0.0056	-0.375	5.2432	1.17454
0.0075	-0.375	6.05833	1.19145
0.0112	-0.375	7.14115	1.26732
0.015	-0.375	7.87707	1.24115
0.0187	-0.375	8.3301	1.20973
0.0225	-0.375	8.64801	1.15374
0.0262	-0.375	8.8752	1.08557
0.03	-0.375	9.06642	1.07
0.0337	-0.375	9.22768	1.06588
0.0375	-0.375	9.33194	1.02103
0.045	-0.375	9.52562	0.99799
0.0525	-0.375	9.68691	1.00903
0.06	-0.375	9.77242	1.0231
0.0675	-0.375	9.9172	1.00154
0.075	-0.375	10.011	1.05367
0.0825	-0.375	10.0469	1.06451
0.09	-0.375	10.137	1.08167
0.0975	-0.375	10.1516	1.07934
0.105	-0.375	10.259	1.09093
0.1125	-0.375	10.2582	1.12044
0.12	-0.375	10.3385	1.12766
0.135	-0.375	10.3786	1.13536
0.15	-0.375	10.4906	1.20802
0.165	-0.375	10.5824	1.2433
0.18	-0.375	10.6678	1.23852
0.195	-0.375	10.8743	1.23189
0.21	-0.375	10.8957	1.26926
0.225	-0.375	11.0931	1.28697
0.255	-0.375	11.3232	1.21061
0.285	-0.375	11.6789	1.18518
0.315	-0.375	11.8701	1.12368
0.345	-0.375	12.071	1.09878
0.375	-0.375	12.2162	1.05635
0.42	-0.375	12.22	1.08527
0.465	-0.375	12.1024	1.15896
0.51	-0.375	11.9514	1.13755
0.555	-0.375	11.696	1.05374
0.6	-0.375	11.373	0.90414
0.645	-0.375	11.1843	0.75885
0.69	-0.375	11.1144	0.61038
0.735	-0.375	11.1247	0.46141
0.78	-0.375	11.1207	0.37228
0.825	-0.375	11.1864	0.23100
0.9	-0.375	11.1853	0.14945
1.05	-0.375	11.1396	0.09880
1.2	-0.375	11.096	0.08917
1.35	-0.375	11.0596	0.08339
1.5	-0.375	11.0482	0.08097
1.65	-0.375	11.0336	0.08777
1.8	-0.375	11.0077	0.09377
2.025	-0.375	10.9626	0.10237
2.25	-0.375	10.9349	0.11481
0	-0.25	2.19338	0.61784
0.0018	-0.25	2.70149	0.86265
0.0037	-0.25	3.5302	1.16218
0.0056	-0.25	4.29659	1.30663
0.0075	-0.25	5.10017	1.46523
0.0112	-0.25	6.29274	1.57756
0.015	-0.25	7.23529	1.54369
0.0187	-0.25	7.81541	1.5073
0.0225	-0.25	8.29791	1.37256
0.0262	-0.25	8.63282	1.31706
0.03	-0.25	8.87812	1.2569
0.0337	-0.25	8.99498	1.20909
0.0375	-0.25	9.11866	1.1992
0.045	-0.25	9.29187	1.17826
0.0525	-0.25	9.35526	1.15638
0.06	-0.25	9.4105	1.16615
0.0675	-0.25	9.37484	1.16981
0.075	-0.25	9.37702	1.18718
0.0825	-0.25	9.35672	1.17701
0.09	-0.25	9.35298	1.26258
0.0975	-0.25	9.28775	1.30487
0.105	-0.25	9.19335	1.33314
0.1125	-0.25	9.17933	1.35231
0.12	-0.25	9.08454	1.41375
0.135	-0.25	8.95051	1.44352
0.15	-0.25	8.84497	1.50711
0.165	-0.25	8.76474	1.53664
0.18	-0.25	8.58537	1.58171
0.195	-0.25	8.71008	1.63429
0.21	-0.25	8.75951	1.67612
0.225	-0.25	8.76693	1.66773
0.255	-0.25	9.16305	1.82375
0.285	-0.25	9.42659	1.8615
0.315	-0.25	10.0109	1.84728
0.345	-0.25	10.5594	1.83762
0.375	-0.25	11.1885	1.73538
0.42	-0.25	12.074	1.39922
0.465	-0.25	12.4215	1.21669
0.51	-0.25	12.4287	1.20841
0.555	-0.25	12.1694	1.21781
0.6	-0.25	11.8455	1.13018
0.645	-0.25	11.4828	0.98526
0.69	-0.25	11.2788	0.85891
0.735	-0.25	11.1689	0.61577
0.78	-0.25	11.1685	0.46886
0.825	-0.25	11.2045	0.30645
0.9	-0.25	11.2297	0.16996
1.05	-0.25	11.1912	0.10267
1.2	-0.25	11.141	0.09409
1.35	-0.25	11.1158	0.09053
1.5	-0.25	11.0925	0.09266
1.65	-0.25	11.0483	0.08743
1.8	-0.25	11.0346	0.09620
2.025	-0.25	10.9906	0.10145
2.25	-0.25	10.9499	0.11293
0	-0.125	1.79431	0.68512
0.0018	-0.125	1.77836	0.67018
0.0037	-0.125	2.19008	0.89134
0.0056	-0.125	2.58895	1.09226
0.0075	-0.125	3.0258	1.29604
0.0112	-0.125	3.91095	1.58964
0.015	-0.125	4.72131	1.73385
0.0187	-0.125	5.4629	1.81008
0.0225	-0.125	6.00194	1.84279
0.0262	-0.125	6.44533	1.86716
0.03	-0.125	6.82465	1.82655
0.0337	-0.125	7.23819	1.72793
0.0375	-0.125	7.50624	1.67844
0.045	-0.125	7.89384	1.61112
0.0525	-0.125	8.1829	1.49355
0.06	-0.125	8.20132	1.44037
0.0675	-0.125	8.27642	1.37846
0.075	-0.125	8.26231	1.38632
0.0825	-0.125	8.19389	1.35754
0.09	-0.125	8.15735	1.37574
0.0975	-0.125	8.08453	1.39304
0.105	-0.125	7.93414	1.45052
0.1125	-0.125	7.89764	1.47386
0.12	-0.125	7.73631	1.50179
0.135	-0.125	7.58128	1.55115
0.15	-0.125	7.31201	1.5833
0.165	-0.125	7.24832	1.55631
0.18	-0.125	7.12414	1.5921
0.195	-0.125	7.00825	1.58514
0.21	-0.125	7.00359	1.58565
0.225	-0.125	6.99746	1.59041
0.255	-0.125	7.14407	1.59248
0.285	-0.125	7.34302	1.60783
0.315	-0.125	7.70335	1.67833
0.345	-0.125	8.35345	1.83156
0.375	-0.125	9.00311	1.97143

0.42	-0.125	10.3774	1.94202
0.465	-0.125	11.6867	1.64237
0.51	-0.125	12.3962	1.26904
0.555	-0.125	12.4155	1.2297
0.6	-0.125	12.165	1.21472
0.645	-0.125	11.7196	1.12079
0.69	-0.125	11.3668	0.91970
0.735	-0.125	11.1695	0.72921
0.78	-0.125	11.1001	0.52294
0.825	-0.125	11.1387	0.39473
0.9	-0.125	11.1871	0.21041
1.05	-0.125	11.1646	0.10925
1.2	-0.125	11.1298	0.09384
1.35	-0.125	11.0879	0.08736
1.5	-0.125	11.0658	0.08405
1.65	-0.125	11.0396	0.08763
1.8	-0.125	11.0121	0.09104
2.025	-0.125	10.9684	0.09911
2.25	-0.125	10.9299	0.11535
0	0	2.00286	0.78006
0.0018	0	1.99291	0.79302
0.0037	0	2.11481	0.85953
0.0056	0	2.53779	1.05337
0.0075	0	2.90191	1.13832
0.0112	0	3.56276	1.28868
0.015	0	3.99697	1.33066
0.0187	0	4.35722	1.29348
0.0225	0	4.62651	1.32913
0.0262	0	4.8427	1.36543
0.03	0	5.0016	1.37752
0.0337	0	5.19564	1.37637
0.0375	0	5.35234	1.3926
0.045	0	5.68904	1.49091
0.0525	0	6.01088	1.49703
0.06	0	6.25455	1.56468
0.0675	0	6.48335	1.60337
0.075	0	6.74807	1.62005
0.0825	0	6.9927	1.6156
0.09	0	7.10621	1.57249
0.0975	0	7.34596	1.53492
0.105	0	7.51057	1.50972
0.1125	0	7.58487	1.50054
0.12	0	7.59077	1.44094
0.135	0	7.70386	1.51849
0.15	0	7.69803	1.49662
0.165	0	7.87441	1.5228
0.18	0	7.76208	1.54863
0.195	0	7.79448	1.57795
0.21	0	7.80403	1.6041
0.225	0	7.71287	1.67963
0.255	0	7.49266	1.65006
0.285	0	7.45167	1.65055
0.315	0	7.45793	1.61681
0.345	0	7.68677	1.67255
0.375	0	8.24032	1.78386
0.42	0	9.72012	1.97968
0.465	0	11.4238	1.77441
0.51	0	12.4023	1.39047
0.555	0	12.623	1.26516
0.6	0	12.2735	1.26174
0.645	0	11.7837	1.15099
0.69	0	11.4365	0.99652
0.735	0	11.202	0.73533
0.78	0	11.1277	0.56715
0.825	0	11.1401	0.42384
0.9	0	11.2132	0.23610
1.05	0	11.1901	0.11024
1.2	0	11.1448	0.09662
1.35	0	11.1143	0.09303
1.5	0	11.0873	0.08886
1.65	0	11.0591	0.08645
1.8	0	11.031	0.09228
2.025	0	10.99	0.10396
2.25	0	10.9518	0.11297
0	0.125	2.27997	0.91248
0.0018	0.125	2.3035	0.91064
0.0037	0.125	2.27442	0.90951
0.0056	0.1256	2.43836	0.96195
0.0075	0.125	2.98989	1.22518
0.0112	0.125	3.9465	1.54352
0.015	0.125	4.73273	1.70246
0.0187	0.125	5.50427	1.82852
0.0225	0.125	6.05823	1.89359
0.0262	0.125	6.44466	1.99072
0.03	0.125	6.86467	2.00385
0.0337	0.125	7.21607	2.03669
0.0375	0.125	7.4213	2.04898
0.045	0.125	7.98673	2.02184
0.0525	0.125	8.27373	2.02469
0.06	0.125	8.55909	1.9028
0.0675	0.125	8.73162	1.85759
0.075	0.125	8.75224	1.76183
0.0825	0.125	8.83701	1.71686
0.09	0.125	8.9484	1.671
0.0975	0.125	8.86256	1.62771
0.105	0.125	8.88896	1.63058
0.1125	0.125	8.78294	1.63144
0.12	0.125	8.7745	1.61831
0.135	0.125	8.61265	1.62556
0.15	0.125	8.4894	1.63689
0.165	0.125	8.43734	1.60962
0.18	0.125	8.37225	1.65439
0.195	0.125	8.26931	1.7108
0.21	0.125	8.23166	1.71033
0.225	0.125	8.11543	1.72891
0.255	0.125	8.02392	1.66451
0.285	0.125	7.93245	1.69764
0.315	0.125	8.06275	1.78437
0.345	0.125	8.41022	1.85744
0.375	0.125	9.15484	1.93409
0.42	0.125	10.823	1.91847
0.465	0.125	12.1713	1.54634
0.51	0.125	12.7235	1.23435
0.555	0.125	12.6105	1.27942
0.6	0.125	12.1649	1.19083
0.645	0.125	11.7798	1.1618
0.69	0.125	11.3861	0.96459
0.735	0.125	11.1639	0.71754
0.78	0.125	11.1186	0.53416
0.825	0.125	11.1483	0.40424
0.9	0.125	11.1947	0.21202
1.05	0.125	11.1733	0.10507
1.2	0.125	11.1382	0.09730
1.35	0.125	11.0925	0.09041
1.5	0.125	11.0683	0.09043
1.65	0.125	11.0357	0.09037
1.8	0.125	11.012	0.09316
2.025	0.125	10.9759	0.10257
2.25	0.125	10.9464	0.10780
0	0.25	2.62336	0.77622
0.0018	0.25	2.57657	0.77508
0.0037	0.25	2.48363	0.74198
0.0056	0.25	2.5059	0.73534
0.0075	0.25	2.83161	0.85908
0.0112	0.25	4.51135	1.38399
0.015	0.25	6.09579	1.67075
0.0187	0.25	7.201	1.80198
0.0225	0.25	8.06135	1.76809
0.0262	0.25	8.69015	1.70378
0.03	0.25	9.06593	1.64425
0.0337	0.25	9.40851	1.59394
0.0375	0.25	9.65045	1.54155
0.045	0.25	10.0756	1.43397
0.0525	0.25	10.2616	1.36956
0.06	0.25	10.4555	1.32149
0.0675	0.25	10.5269	1.29789
0.075	0.25	10.5705	1.3351
0.0825	0.25	10.591	1.38888
0.09	0.25	10.5606	1.36611
0.0975	0.25	10.6048	1.37911
0.105	0.25	10.5215	1.46717
0.1125	0.25	10.5529	1.43235
0.12	0.25	10.4308	1.54286
0.135	0.25	10.4659	1.62371
0.15	0.25	10.2798	1.69417
0.165	0.25	10.1638	1.67274

0.18	0.25	10.2364	1.76251
0.195	0.25	10.0604	1.77068
0.21	0.25	9.9866	1.84542
0.225	0.25	10.0371	1.91387
0.255	0.25	10.0601	1.9517
0.285	0.25	10.4394	1.9613
0.315	0.25	10.8072	2.05049
0.345	0.25	11.4086	1.93736
0.375	0.25	11.9771	1.71625
0.42	0.25	12.6288	1.31843
0.465	0.25	12.9116	1.19966
0.51	0.25	12.674	1.22947
0.555	0.25	12.2801	1.2325
0.6	0.25	11.7856	1.14814
0.645	0.25	11.4835	0.96181
0.69	0.25	11.2403	0.79346
0.735	0.25	11.1235	0.57247
0.78	0.25	11.1453	0.42794
0.825	0.25	11.164	0.32998
0.9	0.25	11.216	0.16211
1.05	0.25	11.1738	0.10838
1.2	0.25	11.1306	0.09164
1.35	0.25	11.0865	0.08805
1.5	0.25	11.06	0.08329
1.65	0.25	11.0492	0.08515
1.8	0.25	11.0244	0.08992
2.025	0.25	10.9796	0.10239
2.25	0.25	10.9532	0.11379
0	0.375	2.76945	0.64442
0.0018	0.375	2.74762	0.67782
0.0037	0.375	2.69953	0.65155
0.0056	0.375	2.6154	0.62564
0.0075	0.375	2.56871	0.60703
0.0112	0.375	3.9243	1.02144
0.015	0.375	5.68282	1.26884
0.0187	0.375	6.97121	1.40518
0.0225	0.375	7.88233	1.3626
0.0262	0.375	8.41312	1.34228
0.03	0.375	8.92133	1.343
0.0337	0.375	9.17723	1.29394
0.0375	0.375	9.40641	1.29455
0.045	0.375	9.77136	1.23346
0.0525	0.375	10.0804	1.21513
0.06	0.375	10.2999	1.20476
0.0675	0.375	10.4752	1.17697
0.075	0.375	10.6826	1.20036
0.0825	0.375	10.8173	1.20429
0.09	0.375	10.9153	1.16569
0.0975	0.375	11.1144	1.20012
0.105	0.375	11.2095	1.23855
0.1125	0.375	11.3384	1.21328
0.12	0.375	11.4182	1.17287
0.135	0.375	11.5614	1.23332
0.15	0.375	11.7469	1.16855
0.165	0.375	11.9173	1.16127
0.18	0.375	12.0433	1.20657
0.195	0.375	12.2127	1.0991
0.21	0.375	12.3264	1.1484
0.225	0.375	12.3984	1.13232
0.255	0.375	12.5718	1.09008
0.285	0.375	12.7361	1.04559
0.315	0.375	12.7665	1.04098
0.345	0.375	12.8253	1.07548
0.375	0.375	12.8034	1.10796
0.42	0.375	12.657	1.16735
0.465	0.375	12.304	1.19892
0.51	0.375	12.0091	1.18306
0.555	0.375	11.5781	1.06285
0.6	0.375	11.3999	0.93252
0.645	0.375	11.162	0.74785
0.69	0.375	11.0998	0.57485
0.735	0.375	11.1132	0.43454
0.78	0.375	11.148	0.32293
0.825	0.375	11.193	0.22490
0.9	0.375	11.1885	0.14446
1.05	0.375	11.1632	0.09971
1.2	0.375	11.1209	0.09505
1.35	0.375	11.0874	0.08503
1.5	0.375	11.0613	0.08651
1.65	0.375	11.0315	0.08513
1.8	0.375	11.0041	0.09510
2.025	0.375	10.9737	0.09940
2.25	0.375	10.942	0.11215
0	0.5	2.56809	0.55802
0.0018	0.5	2.51872	0.54217
0.0037	0.5	2.4798	0.55573
0.0056	0.5	2.46206	0.54577
0.0075	0.5	2.3946	0.50999
0.0112	0.5	2.86405	0.69929
0.015	0.5	4.53623	1.04447
0.0187	0.5	5.92618	1.20098
0.0225	0.5	6.91147	1.23352
0.0262	0.5	7.62352	1.20604
0.03	0.5	8.07292	1.17366
0.0337	0.5	8.37558	1.17976
0.0375	0.5	8.66812	1.14736
0.045	0.5	9.0128	1.09133
0.0525	0.5	9.28998	0.99729
0.06	0.5	9.48312	0.99404
0.0675	0.5	9.66736	0.95795
0.075	0.5	9.79469	0.96404
0.0825	0.5	9.9164	0.95892
0.09	0.5	10.0594	1.00057
0.0975	0.5	10.2403	1.00976
0.105	0.5	10.3369	1.01444
0.1125	0.5	10.4332	1.02752
0.12	0.5	10.5596	1.03813
0.135	0.5	10.7915	1.06756
0.15	0.5	10.936	1.05629
0.165	0.5	11.0657	1.07227
0.18	0.5	11.2569	1.14887
0.195	0.5	11.3319	1.12206
0.21	0.5	11.4335	1.08475
0.225	0.5	11.5612	1.12071
0.255	0.5	11.6803	1.12525
0.285	0.5	11.7799	1.13867
0.315	0.5	11.8041	1.10282
0.345	0.5	11.7283	1.12501
0.375	0.5	11.717	1.1083
0.42	0.5	11.5689	1.06394
0.465	0.5	11.3642	0.96977
0.51	0.5	11.2231	0.85088
0.555	0.5	11.07	0.71336
0.6	0.5	11.041	0.60124
0.645	0.5	11.0369	0.50857
0.69	0.5	11.1217	0.39302
0.735	0.5	11.1485	0.30369
0.78	0.5	11.1764	0.19983
0.825	0.5	11.1612	0.15829
0.9	0.5	11.1654	0.11615
1.05	0.5	11.1278	0.09614
1.2	0.5	11.1043	0.08943
1.35	0.5	11.0827	0.08038
1.5	0.5	11.0522	0.08173
1.65	0.5	11.0244	0.08687
1.8	0.5	11.008	0.09656
2.025	0.5	10.979	0.09816
2.25	0.5	10.9202	0.11691
0	0.625	2.60667	0.58023
0.0018	0.625	2.57382	0.57807
0.0037	0.625	2.53788	0.54894
0.0056	0.625	2.50337	0.55391
0.0075	0.625	2.49199	0.55264
0.0112	0.625	2.14281	0.44645
0.015	0.625	3.41632	0.83287
0.0187	0.625	4.7648	1.07606
0.0225	0.625	5.8601	1.20003
0.0262	0.625	6.61792	1.20616
0.03	0.625	7.17453	1.17841
0.0337	0.625	7.56678	1.12842
0.0375	0.625	7.87661	1.09552
0.045	0.625	8.30664	1.0278
0.0525	0.625	8.57093	0.95199
0.06	0.625	8.77986	0.86917
0.0675	0.625	8.91595	0.85648
0.075	0.625	9.06714	0.80206

0.0825	0.625	9.18934	0.79021
0.09	0.625	9.25832	0.77827
0.0975	0.625	9.37066	0.76581
0.105	0.625	9.44222	0.75624
0.1125	0.625	9.538	0.75051
0.12	0.625	9.64034	0.76327
0.135	0.625	9.79551	0.74779
0.15	0.625	9.96454	0.75641
0.165	0.625	10.0344	0.73863
0.18	0.625	10.2003	0.76902
0.195	0.625	10.2618	0.75501
0.21	0.625	10.3801	0.77053
0.225	0.625	10.4303	0.75958
0.255	0.625	10.6015	0.75646
0.285	0.625	10.6564	0.76202
0.315	0.625	10.7197	0.75654
0.345	0.625	10.7696	0.71329
0.375	0.625	10.7879	0.72045
0.42	0.625	10.8	0.64382
0.465	0.625	10.8506	0.60615
0.51	0.625	10.8905	0.55730
0.555	0.625	10.9492	0.47260
0.6	0.625	11.0085	0.43891
0.645	0.625	11.1132	0.32765
0.69	0.625	11.142	0.27086
0.735	0.625	11.1824	0.20819
0.78	0.625	11.1966	0.16529
0.825	0.625	11.1902	0.12789
0.9	0.625	11.1942	0.10375
1.05	0.625	11.1457	0.09487
1.2	0.625	11.1232	0.09040
1.35	0.625	11.0833	0.08728
1.5	0.625	11.0736	0.08452
1.65	0.625	11.037	0.09132
1.8	0.625	11.0258	0.08896
2.025	0.625	10.9869	0.10120
2.25	0.625	10.9445	0.11405
0	0.75	2.26671	0.51495
0.0018	0.75	2.22562	0.50474
0.0037	0.75	2.20114	0.48888
0.0056	0.75	2.16017	0.47182
0.0075	0.75	2.12424	0.47303
0.0112	0.75	2.0728	0.44019
0.015	0.75	2.69097	0.66913
0.0187	0.75	4.04626	1.01777
0.0225	0.75	5.2499	1.21305
0.0262	0.75	6.05241	1.25108
0.03	0.75	6.75498	1.21392
0.0337	0.75	7.12374	1.19126
0.0375	0.75	7.48922	1.13245
0.045	0.75	7.92126	1.04892
0.0525	0.75	8.23166	0.95819

0.06	0.75	8.44333	0.89635
0.0675	0.75	8.59966	0.81301
0.075	0.75	8.6964	0.78978
0.0825	0.75	8.84529	0.76110
0.09	0.75	8.94827	0.74621
0.0975	0.75	9.01481	0.71011
0.105	0.75	9.09631	0.72002
0.1125	0.75	9.16387	0.72052
0.12	0.75	9.22915	0.69570
0.135	0.75	9.38758	0.67409
0.15	0.75	9.47875	0.67646
0.165	0.75	9.6575	0.67174
0.18	0.75	9.73787	0.66313
0.195	0.75	9.82115	0.63477
0.21	0.75	9.9429	0.62435
0.225	0.75	9.99422	0.63813
0.255	0.75	10.1637	0.61477
0.285	0.75	10.2515	0.60215
0.315	0.75	10.4132	0.57885
0.345	0.75	10.491	0.57163
0.375	0.75	10.61	0.55657
0.42	0.75	10.7167	0.51440
0.465	0.75	10.8341	0.47802
0.51	0.75	10.9541	0.41969
0.555	0.75	11.0521	0.36497
0.6	0.75	11.109	0.32538
0.645	0.75	11.1577	0.24397
0.69	0.75	11.1796	0.19270
0.735	0.75	11.1991	0.14255
0.78	0.75	11.1957	0.13022
0.825	0.75	11.1914	0.11143
0.9	0.75	11.1813	0.10288
1.05	0.75	11.1495	0.09591
1.2	0.75	11.1263	0.09207
1.35	0.75	11.0994	0.08558
1.5	0.75	11.0501	0.08196
1.65	0.75	11.0377	0.08499
1.8	0.75	11.0098	0.09006
2.025	0.75	10.9829	0.09875
2.25	0.75	10.9449	0.11314
0	0.875	2.2285	0.52574
0.0018	0.875	2.19157	0.51248
0.0037	0.875	2.15873	0.49869
0.0056	0.875	2.13232	0.48265
0.0075	0.875	2.10389	0.47513
0.0112	0.875	2.02529	0.45220
0.015	0.875	2.14198	0.50704
0.0187	0.875	3.4222	0.92181
0.0225	0.875	4.70736	1.16045
0.0262	0.875	5.6892	1.23758
0.03	0.875	6.46796	1.25975
0.0337	0.875	6.92539	1.23347

0.0375	0.875	7.24738	1.17687
0.045	0.875	7.77193	1.05479
0.0525	0.875	8.06076	0.98452
0.06	0.875	8.28115	0.89308
0.0675	0.875	8.49199	0.82260
0.075	0.875	8.63492	0.80113
0.0825	0.875	8.71339	0.77354
0.09	0.875	8.83041	0.75732
0.0975	0.875	8.89817	0.72454
0.105	0.875	8.99586	0.74570
0.1125	0.875	9.05287	0.71204
0.12	0.875	9.134	0.71814
0.135	0.875	9.232	0.67283
0.15	0.875	9.34463	0.68792
0.165	0.875	9.47335	0.66667
0.18	0.875	9.57827	0.66187
0.195	0.875	9.66181	0.64502
0.21	0.875	9.77315	0.64688
0.225	0.875	9.86483	0.65052
0.255	0.875	10.0289	0.61434
0.285	0.875	10.1541	0.59985
0.315	0.875	10.2818	0.56071
0.345	0.875	10.4215	0.54985
0.375	0.875	10.5591	0.52454
0.42	0.875	10.7055	0.49578
0.465	0.875	10.8583	0.43814
0.51	0.875	10.9691	0.39638
0.555	0.875	11.065	0.32501
0.6	0.875	11.1379	0.25346
0.645	0.875	11.1487	0.20658
0.69	0.875	11.1544	0.16131
0.735	0.875	11.1559	0.14080
0.78	0.875	11.1806	0.12348
0.825	0.875	11.1649	0.10807
0.9	0.875	11.1527	0.09934
1.05	0.875	11.1185	0.08900
1.2	0.875	11.0844	0.08199
1.35	0.875	11.0658	0.08026
1.5	0.875	11.0406	0.08271
1.65	0.875	11.0094	0.08957
1.8	0.875	10.9773	0.09534
2.025	0.875	10.9555	0.10098
2.25	0.875	10.9176	0.11448
0	1	2.23888	0.55492
0.0018	1	2.19555	0.52769
0.0037	1	2.21335	0.52475
0.0056	1	2.32343	0.54503
0.0075	1	2.30089	0.55537
0.0112	1	2.15077	0.49301
0.015	1	2.01131	0.46445
0.0187	1	2.81074	0.75741
0.0225	1	4.07186	1.09726

0.0262	1	5.19854	1.24985
0.03	1	5.99801	1.23085
0.0337	1	6.51601	1.27441
0.0375	1	6.95078	1.19654
0.045	1	7.53587	1.08114
0.0525	1	7.83731	0.98713
0.06	1	8.08117	0.90942
0.0675	1	8.27159	0.86119
0.075	1	8.46016	0.80204
0.0825	1	8.53344	0.77285
0.09	1	8.59648	0.76633
0.0975	1	8.69597	0.73132
0.105	1	8.78727	0.70793
0.1125	1	8.84872	0.72475
0.12	1	8.90954	0.69495
0.135	1	9.03346	0.67877
0.15	1	9.12018	0.67184
0.165	1	9.24807	0.68887
0.18	1	9.36949	0.65308
0.195	1	9.47462	0.65819
0.21	1	9.54301	0.67351
0.225	1	9.63818	0.63785
0.255	1	9.79449	0.63133
0.285	1	9.94718	0.62216
0.315	1	10.0838	0.59294
0.345	1	10.2368	0.56971
0.375	1	10.3588	0.56446
0.42	1	10.5413	0.52677
0.465	1	10.6849	0.48793
0.51	1	10.8491	0.43664
0.555	1	10.9866	0.35396
0.6	1	11.0601	0.29780
0.645	1	11.1432	0.21398
0.69	1	11.1729	0.17333
0.735	1	11.1724	0.13742
0.78	1	11.1571	0.12134
0.825	1	11.1578	0.10370
0.9	1	11.1322	0.09205
1.05	1	11.0912	0.08776
1.2	1	11.0718	0.07991
1.35	1	11.0384	0.08124
1.5	1	11.0262	0.08780
1.65	1	11.0111	0.08913
1.8	1	10.9708	0.09356
2.025	1	10.9424	0.10207
2.25	1	10.8996	0.11442
0	1.125	2.13272	0.52946
0.0018	1.125	2.08194	0.53419
0.0037	1.125	2.06696	0.50172
0.0056	1.125	2.03459	0.49299
0.0075	1.125	2.00303	0.47619
0.0112	1.125	1.9384	0.47150
0.015	1.125	1.8694	0.43961
0.0187	1.125	2.0744	0.53973
0.0225	1.125	3.2959	0.93531
0.0262	1.125	4.48052	1.18524
0.03	1.125	5.338	1.23368
0.0337	1.125	6.06291	1.27049
0.0375	1.125	6.46171	1.20998
0.045	1.125	7.12353	1.09806
0.0525	1.125	7.51502	1.0182
0.06	1.125	7.7227	0.93178
0.0675	1.125	7.96332	0.86877
0.075	1.125	8.11316	0.79751
0.0825	1.125	8.23566	0.76503
0.09	1.125	8.3286	0.74699
0.0975	1.125	8.43914	0.73635
0.105	1.125	8.49029	0.71225
0.1125	1.125	8.57924	0.70443
0.12	1.125	8.65878	0.69680
0.135	1.125	8.78808	0.68707
0.15	1.125	8.91739	0.64874
0.165	1.125	9.01986	0.67344
0.18	1.125	9.13048	0.67693
0.195	1.125	9.19017	0.66162
0.21	1.125	9.28848	0.66759
0.225	1.125	9.41708	0.66359
0.255	1.125	9.55369	0.66620
0.285	1.125	9.71801	0.63546
0.315	1.125	9.88268	0.62370
0.345	1.125	10.022	0.60113
0.375	1.125	10.195	0.58359
0.42	1.125	10.3512	0.56944
0.465	1.125	10.5679	0.52964
0.51	1.125	10.7373	0.46128
0.555	1.125	10.8543	0.43487
0.6	1.125	10.9881	0.31464
0.645	1.125	11.0636	0.26485
0.69	1.125	11.1246	0.20508
0.735	1.125	11.1526	0.16395
0.78	1.125	11.1505	0.12035
0.825	1.125	11.1394	0.10139
0.9	1.125	11.1033	0.09457
1.05	1.125	11.0832	0.07961
1.2	1.125	11.0612	0.07567
1.35	1.125	11.0259	0.07480
1.5	1.125	10.9818	0.08621
1.65	1.125	10.9587	0.09864
1.8	1.125	10.9248	0.10391
2.025	1.125	10.8809	0.11146
2.25	1.125	10.8326	0.12068
0	1.25	2.11646	0.53965
0.0018	1.25	2.07024	0.50549
0.0037	1.25	2.01213	0.50858
0.0056	1.25	1.94979	0.47915
0.0075	1.25	1.9195	0.47390
0.0112	1.25	1.86824	0.46310
0.015	1.25	1.81241	0.41973
0.0187	1.25	1.86142	0.44068
0.0225	1.25	2.8926	0.81528
0.0262	1.25	4.09322	1.12019
0.03	1.25	5.04186	1.24982
0.0337	1.25	5.79974	1.27877
0.0375	1.25	6.28606	1.2026
0.045	1.25	6.97046	1.12095
0.0525	1.25	7.37751	1.02415
0.06	1.25	7.66318	0.95299
0.0675	1.25	7.8546	0.84990
0.075	1.25	8.00839	0.80849
0.0825	1.25	8.13398	0.75951
0.09	1.25	8.22652	0.74943
0.0975	1.25	8.32329	0.73594
0.105	1.25	8.41067	0.70792
0.1125	1.25	8.48732	0.67619
0.12	1.25	8.53964	0.69684
0.135	1.25	8.67824	0.66409
0.15	1.25	8.78779	0.65820
0.165	1.25	8.88648	0.66522
0.18	1.25	8.98133	0.65478
0.195	1.25	9.08286	0.67589
0.21	1.25	9.20452	0.67721
0.225	1.25	9.30226	0.64420
0.255	1.25	9.48984	0.65449
0.285	1.25	9.65364	0.62259
0.315	1.25	9.78506	0.62320
0.345	1.25	9.95355	0.61341
0.375	1.25	10.1143	0.59867
0.42	1.25	10.3443	0.56286
0.465	1.25	10.5143	0.53685
0.51	1.25	10.694	0.48033
0.555	1.25	10.8202	0.42029
0.6	1.25	10.9219	0.35111
0.645	1.25	11.0329	0.25877
0.69	1.25	11.0556	0.19922
0.735	1.25	11.0869	0.14440
0.78	1.25	11.0788	0.12249
0.825	1.25	11.0761	0.10389
0.9	1.25	11.0657	0.09022
1.05	1.25	11.0589	0.07775
1.2	1.25	11.0269	0.08184
1.35	1.25	10.9794	0.08590
1.5	1.25	10.9406	0.10272
1.65	1.25	10.9237	0.10273
1.8	1.25	10.9012	0.10353
2.025	1.25	10.8639	0.10978
2.25	1.25	10.8322	0.11043

Run ID: 040396aa

VR=0.498
Uo=10.77 m/s
x/D=2.5 FSTI=0.5%
L/D=7.0

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.73788	0.38228
0.00187	-0.375	2.2405	0.53344
0.00375	-0.375	2.92923	0.71632
0.00562	-0.375	3.65466	0.87484
0.0075	-0.375	4.29571	0.93886
0.01125	-0.375	5.44397	1.04658
0.015	-0.375	6.34995	0.99405
0.01875	-0.375	6.87532	0.98172
0.0225	-0.375	7.26956	0.88637
0.02625	-0.375	7.50263	0.87123
0.03	-0.375	7.66567	0.81347
0.03375	-0.375	7.75237	0.78069
0.0375	-0.375	7.8175	0.74193
0.045	-0.375	7.89131	0.70560
0.0525	-0.375	7.93863	0.68193
0.06	-0.375	7.92883	0.67583
0.0675	-0.375	7.96082	0.68180
0.075	-0.375	7.95566	0.6763
0.0825	-0.375	7.97179	0.66489
0.09	-0.375	7.94269	0.66108
0.0975	-0.375	7.93155	0.65715
0.105	-0.375	7.96029	0.66370
0.1125	-0.375	7.97201	0.66386
0.12	-0.375	8.01954	0.66566
0.135	-0.375	8.07156	0.68663
0.15	-0.375	8.13585	0.69475
0.165	-0.375	8.17101	0.71878
0.18	-0.375	8.24268	0.70319
0.195	-0.375	8.3255	0.70738
0.21	-0.375	8.41357	0.72292
0.225	-0.375	8.44116	0.70354
0.255	-0.375	8.63735	0.70071
0.285	-0.375	8.80991	0.73641
0.315	-0.375	8.99321	0.76350
0.345	-0.375	9.14719	0.78003
0.375	-0.375	9.42398	0.80226
0.42	-0.375	9.64594	0.81561
0.465	-0.375	10.0033	0.76670
0.51	-0.375	10.3191	0.68774
0.555	-0.375	10.5206	0.62033
0.6	-0.375	10.7531	0.48778
0.645	-0.375	10.9216	0.35126
0.69	-0.375	10.991	0.28687
0.735	-0.375	11.0109	0.19616
0.78	-0.375	11.027	0.16093
0.825	-0.375	11.0302	0.12641
0.9	-0.375	11.0055	0.10032
1.05	-0.375	10.9656	0.08296
1.2	-0.375	10.9371	0.07707
1.35	-0.375	10.9091	0.08866
1.5	-0.375	10.886	0.08904
1.65	-0.375	10.8672	0.09210
1.8	-0.375	10.8283	0.1001
2.025	-0.375	10.8002	0.10308
2.25	-0.375	10.7656	0.11342
0	-0.25	1.61651	0.39176
0.00187	-0.25	1.68623	0.43088
0.00375	-0.25	2.18675	0.57819
0.00562	-0.25	2.83031	0.75603
0.0075	-0.25	3.47762	0.86427
0.01125	-0.25	4.71433	0.95157
0.015	-0.25	5.58701	0.93477
0.01875	-0.25	6.15882	0.93749
0.0225	-0.25	6.53226	0.93588
0.02625	-0.25	6.81608	0.88928
0.03	-0.25	6.93355	0.87668
0.03375	-0.25	7.00246	0.87682
0.0375	-0.25	7.04265	0.85141
0.045	-0.25	7.0565	0.85500
0.0525	-0.25	6.98162	0.87089
0.06	-0.25	6.9	0.88279
0.0675	-0.25	6.74676	0.89845
0.075	-0.25	6.74715	0.92941
0.0825	-0.25	6.6853	0.97888
0.09	-0.25	6.55033	1.03268
0.0975	-0.25	6.57211	1.00763
0.105	-0.25	6.52145	1.0735
0.1125	-0.25	6.50408	1.07952
0.12	-0.25	6.46995	1.10459
0.135	-0.25	6.52858	1.10263
0.15	-0.25	6.55918	1.18893
0.165	-0.25	6.64967	1.2231
0.18	-0.25	6.73786	1.22385
0.195	-0.25	6.90238	1.23226
0.21	-0.25	7.08823	1.17693
0.225	-0.25	7.31125	1.10589
0.255	-0.25	7.61781	1.04901
0.285	-0.25	7.96522	0.91926
0.315	-0.25	8.31044	0.86413
0.345	-0.25	8.5897	0.78950
0.375	-0.25	8.80803	0.78248
0.42	-0.25	9.15978	0.79194
0.465	-0.25	9.50707	0.83671
0.51	-0.25	9.85906	0.78517
0.555	-0.25	10.2076	0.71365
0.6	-0.25	10.5037	0.60915
0.645	-0.25	10.7487	0.45446
0.69	-0.25	10.8928	0.33531
0.735	-0.25	10.9604	0.22684
0.78	-0.25	10.9743	0.17819
0.825	-0.25	10.9864	0.13762
0.9	-0.25	10.9772	0.10188
1.05	-0.25	10.928	0.08581
1.2	-0.25	10.9085	0.08081
1.35	-0.25	10.876	0.08161
1.5	-0.25	10.8568	0.08793
1.65	-0.25	10.8117	0.10144
1.8	-0.25	10.7721	0.10067
2.025	-0.25	10.7825	0.09621
2.25	-0.25	10.7942	0.09882
0	-0.125	1.33378	0.37955
0.00187	-0.125	1.60676	0.52119
0.00375	-0.125	2.07838	0.68518
0.00562	-0.125	2.51877	0.79125
0.0075	-0.125	2.94405	0.89578
0.01125	-0.125	3.74601	1.00438
0.015	-0.125	4.36664	1.02715
0.01875	-0.125	4.79071	1.06064
0.0225	-0.125	5.08457	1.06251
0.02625	-0.125	5.27959	1.03197
0.03	-0.125	5.39775	1.03966
0.03375	-0.125	5.47424	1.0705
0.0375	-0.125	5.52693	1.04256
0.045	-0.125	5.45758	1.04181
0.0525	-0.125	5.31525	1.05034
0.06	-0.125	5.20452	1.06731
0.0675	-0.125	5.0164	1.01945
0.075	-0.125	4.90175	1.0579
0.0825	-0.125	4.81501	1.0661
0.09	-0.125	4.64803	1.05041
0.0975	-0.125	4.49224	1.05397
0.105	-0.125	4.44168	1.02691
0.1125	-0.125	4.35848	1.05152
0.12	-0.125	4.31396	1.05197
0.135	-0.125	4.2757	1.08523
0.15	-0.125	4.23793	1.08422
0.165	-0.125	4.24822	1.11496
0.18	-0.125	4.3861	1.1484
0.195	-0.125	4.55604	1.19059
0.21	-0.125	4.69348	1.26113
0.225	-0.125	4.9416	1.27731
0.255	-0.125	5.57181	1.38218
0.285	-0.125	6.26723	1.33514
0.315	-0.125	7.02801	1.23419
0.345	-0.125	7.71262	1.07196
0.375	-0.125	8.22703	0.94651

0.42	-0.125	8.76819	0.79431
0.465	-0.125	9.18626	0.79341
0.51	-0.125	9.5542	0.82319
0.555	-0.125	10.0117	0.79777
0.6	-0.125	10.352	0.71881
0.645	-0.125	10.681	0.53065
0.69	-0.125	10.8682	0.37037
0.735	-0.125	10.9659	0.26532
0.78	-0.125	10.9848	0.18368
0.825	-0.125	10.9937	0.14216
0.9	-0.125	10.9888	0.11262
1.05	-0.125	10.9601	0.08308
1.2	-0.125	10.935	0.08412
1.35	-0.125	10.9169	0.08363
1.5	-0.125	10.8806	0.08605
1.65	-0.125	10.8547	0.09166
1.8	-0.125	10.8329	0.10186
2.025	-0.125	10.7879	0.10772
2.25	-0.125	10.754	0.11747
0	0	0.88037	0.28495
0.00187	0	0.90949	0.32267
0.00375	0	1.06651	0.43234
0.00562	0	1.30075	0.53305
0.0075	0	1.55244	0.62912
0.01125	0	1.94657	0.71131
0.015	0	2.30844	0.75821
0.01875	0	2.60137	0.79005
0.0225	0	2.89387	0.80823
0.02625	0	3.09647	0.83850
0.03	0	3.26824	0.88679
0.03375	0	3.48585	0.89365
0.0375	0	3.59088	0.89914
0.045	0	3.84083	0.91116
0.0525	0	3.9862	0.94158
0.06	0	4.07604	0.91575
0.0675	0	4.19298	0.90896
0.075	0	4.22228	0.91988
0.0825	0	4.17705	0.91323
0.09	0	4.20272	0.93738
0.0975	0	4.20439	0.93553
0.105	0	4.1865	0.95283
0.1125	0	4.12473	0.97306
0.12	0	4.11856	1.01644
0.135	0	4.02612	0.95807
0.15	0	3.95622	0.99347
0.165	0	3.88059	0.98812
0.18	0	3.86286	0.97432
0.195	0	3.86748	0.98434
0.21	0	3.96836	1.0316
0.225	0	4.12253	1.10083
0.255	0	4.6921	1.24278
0.285	0	5.48169	1.3725
0.315	0	6.38408	1.35629
0.345	0	7.23964	1.24475
0.375	0	7.97382	0.98974
0.42	0	8.60169	0.80836
0.465	0	9.03228	0.79199
0.51	0	9.45513	0.80397
0.555	0	9.89674	0.80040
0.6	0	10.3038	0.68647
0.645	0	10.6356	0.55795
0.69	0	10.8633	0.41467
0.735	0	10.9673	0.27807
0.78	0	11.0247	0.18723
0.825	0	11.028	0.14901
0.9	0	11.0176	0.11431
1.05	0	10.9848	0.08772
1.2	0	10.9548	0.08746
1.35	0	10.928	0.08920
1.5	0	10.9082	0.08328
1.65	0	10.8782	0.09350
1.8	0	10.842	0.09388
2.025	0	10.819	0.10966
2.25	0	10.772	0.11561
0	0.125	1.38615	0.45019
0.00187	0.125	1.36538	0.42971
0.00375	0.125	1.49273	0.48399
0.00562	0.125	1.92035	0.67429
0.0075	0.125	2.38548	0.80098
0.01125	0.125	3.35675	1.06354
0.015	0.125	4.12723	1.19172
0.01875	0.125	4.74962	1.2296
0.0225	0.125	5.19465	1.24446
0.02625	0.125	5.50538	1.21712
0.03	0.125	5.68306	1.23814
0.03375	0.125	5.81481	1.18135
0.0375	0.125	5.84913	1.16708
0.045	0.125	5.84852	1.11135
0.0525	0.125	5.67919	1.09947
0.06	0.125	5.50272	1.0935
0.0675	0.125	5.37467	1.12267
0.075	0.125	5.22252	1.16167
0.0825	0.125	5.04723	1.12188
0.09	0.125	4.87875	1.11037
0.0975	0.125	4.70764	1.1006
0.105	0.125	4.64244	1.10801
0.1125	0.125	4.56839	1.11266
0.12	0.125	4.49374	1.11505
0.135	0.125	4.40522	1.14893
0.15	0.125	4.33603	1.15771
0.165	0.125	4.29372	1.12917
0.18	0.125	4.37391	1.17702
0.195	0.125	4.5102	1.21676
0.21	0.125	4.65167	1.27983
0.225	0.125	4.84487	1.31278
0.255	0.125	5.51287	1.39703
0.285	0.125	6.37892	1.37401
0.315	0.125	7.16258	1.22474
0.345	0.125	7.85106	1.03573
0.375	0.125	8.34225	0.81301
0.42	0.125	8.81801	0.71566
0.465	0.125	9.15234	0.77324
0.51	0.125	9.53367	0.77461
0.555	0.125	9.95127	0.78657
0.6	0.125	10.3578	0.66729
0.645	0.125	10.6322	0.55496
0.69	0.125	10.8596	0.39127
0.735	0.125	10.964	0.24868
0.78	0.125	10.9842	0.18169
0.825	0.125	10.9875	0.13455
0.9	0.125	10.9753	0.10781
1.05	0.125	10.9408	0.08730
1.2	0.125	10.9118	0.08610
1.35	0.125	10.8911	0.08203
1.5	0.125	10.8744	0.08720
1.65	0.125	10.8314	0.09601
1.8	0.125	10.791	0.10416
2.025	0.125	10.7733	0.10892
2.25	0.125	10.7307	0.12132
0	0.25	1.76312	0.42439
0.00187	0.25	1.72608	0.38548
0.00375	0.25	1.70325	0.40777
0.00562	0.25	1.91004	0.46239
0.0075	0.25	2.54477	0.61772
0.01125	0.25	4.03636	0.91785
0.015	0.25	5.32803	0.98173
0.01875	0.25	6.13498	0.92395
0.0225	0.25	6.71307	0.86011
0.02625	0.25	7.0433	0.80579
0.03	0.25	7.21215	0.76026
0.03375	0.25	7.29444	0.76351
0.0375	0.25	7.36116	0.72827
0.045	0.25	7.32512	0.77359
0.0525	0.25	7.33272	0.77012
0.06	0.25	7.25844	0.80438
0.0675	0.25	7.21522	0.86655
0.075	0.25	7.14536	0.88846
0.0825	0.25	7.04525	0.92351
0.09	0.25	6.98546	1.00358
0.0975	0.25	6.93052	1.02894
0.105	0.25	6.90148	1.05748
0.1125	0.25	6.84631	1.09036
0.12	0.25	6.76251	1.1654
0.135	0.25	6.74423	1.19589
0.15	0.25	6.72763	1.25863
0.165	0.25	6.7886	1.29153

0.18	0.25	6.93905	1.28094
0.195	0.25	7.09274	1.25811
0.21	0.25	7.20375	1.27537
0.225	0.25	7.35366	1.19732
0.255	0.25	7.76396	1.01236
0.285	0.25	8.08909	0.87298
0.315	0.25	8.44233	0.69756
0.345	0.25	8.6544	0.66745
0.375	0.25	8.80088	0.66817
0.42	0.25	9.1092	0.74406
0.465	0.25	9.43434	0.77952
0.51	0.25	9.77751	0.79585
0.555	0.25	10.1603	0.72985
0.6	0.25	10.5269	0.59910
0.645	0.25	10.746	0.47093
0.69	0.25	10.8921	0.32679
0.735	0.25	10.9409	0.23304
0.78	0.25	10.9598	0.17416
0.825	0.25	10.9495	0.12570
0.9	0.25	10.9342	0.10262
1.05	0.25	10.903	0.08466
1.2	0.25	10.8808	0.08545
1.35	0.25	10.8631	0.08606
1.5	0.25	10.843	0.09168
1.65	0.25	10.7997	0.10465
1.8	0.25	10.7652	0.10494
2.025	0.25	10.7361	0.11081
2.25	0.25	10.7022	0.12682
0	0.375	1.65279	0.34351
0.00187	0.375	1.60488	0.33029
0.00375	0.375	1.58958	0.33161
0.00562	0.375	1.52969	0.31032
0.0075	0.375	1.7118	0.39214
0.01125	0.375	2.92197	0.67485
0.015	0.375	4.26115	0.92833
0.01875	0.375	5.43462	0.97220
0.0225	0.375	6.27282	0.96104
0.02625	0.375	6.82356	0.88027
0.03	0.375	7.19814	0.80187
0.03375	0.375	7.46901	0.73936
0.0375	0.375	7.62494	0.67067
0.045	0.375	7.81718	0.62146
0.0525	0.375	7.88545	0.55953
0.06	0.375	7.90271	0.55086
0.0675	0.375	7.8826	0.53761
0.075	0.375	7.93513	0.52313
0.0825	0.375	7.9555	0.52411
0.09	0.375	7.98662	0.53047
0.0975	0.375	7.97624	0.54495
0.105	0.375	8.01498	0.54955
0.1125	0.375	8.04163	0.52897
0.12	0.375	8.07986	0.56899
0.135	0.375	8.11024	0.54604
0.15	0.375	8.14606	0.56424
0.165	0.375	8.18942	0.55930
0.18	0.375	8.29154	0.55280
0.195	0.375	8.31616	0.55498
0.21	0.375	8.38414	0.55688
0.225	0.375	8.46162	0.57158
0.255	0.375	8.58139	0.58141
0.285	0.375	8.72668	0.59305
0.315	0.375	8.86014	0.65334
0.345	0.375	9.03836	0.67902
0.375	0.375	9.19037	0.73209
0.42	0.375	9.46472	0.76331
0.465	0.375	9.7986	0.76928
0.51	0.375	10.1093	0.72053
0.555	0.375	10.4308	0.63190
0.6	0.375	10.6577	0.51320
0.645	0.375	10.8206	0.37581
0.69	0.375	10.8809	0.28198
0.735	0.375	10.9077	0.19296
0.78	0.375	10.9155	0.15267
0.825	0.375	10.9705	0.12312
0.9	0.375	10.9708	0.10064
1.05	0.375	10.9047	0.08618
1.2	0.375	10.8772	0.08738
1.35	0.375	10.8734	0.08531
1.5	0.375	10.8554	0.09412
1.65	0.375	10.8235	0.09705
1.8	0.375	10.7813	0.10078
2.025	0.375	10.7496	0.10124
2.25	0.375	10.7412	0.12380
0	0.5	1.79255	0.40331
0.00187	0.5	1.76176	0.41198
0.00375	0.5	1.74288	0.38781
0.00562	0.5	1.73496	0.40064
0.0075	0.5	1.71276	0.37412
0.01125	0.5	2.76359	0.69943
0.015	0.5	4.21784	1.00764
0.01875	0.5	5.416	1.09222
0.0225	0.5	6.32395	1.11075
0.02625	0.5	6.91157	1.05277
0.03	0.5	7.32093	0.96068
0.03375	0.5	7.60188	0.93210
0.0375	0.5	7.77392	0.84751
0.045	0.5	8.04107	0.73460
0.0525	0.5	8.19554	0.70590
0.06	0.5	8.2129	0.67356
0.0675	0.5	8.3205	0.62501
0.075	0.5	8.33413	0.59503
0.0825	0.5	8.36379	0.60755
0.09	0.5	8.41227	0.61182
0.0975	0.5	8.41509	0.59179
0.105	0.5	8.45421	0.58783
0.1125	0.5	8.47083	0.60743
0.12	0.5	8.51838	0.61284
0.135	0.5	8.58714	0.63443
0.15	0.5	8.59223	0.62489
0.165	0.5	8.67242	0.63714
0.18	0.5	8.7215	0.64973
0.195	0.5	8.7817	0.64840
0.21	0.5	8.82184	0.67646
0.225	0.5	8.90283	0.67986
0.255	0.5	9.01028	0.67549
0.285	0.5	9.1483	0.70429
0.315	0.5	9.32797	0.73394
0.345	0.5	9.46477	0.75540
0.375	0.5	9.63497	0.74951
0.42	0.5	9.89661	0.74235
0.465	0.5	10.1506	0.68595
0.51	0.5	10.3807	0.64159
0.555	0.5	10.5756	0.54134
0.6	0.5	10.7623	0.43147
0.645	0.5	10.8722	0.32667
0.69	0.5	10.9548	0.25098
0.735	0.5	11.0162	0.18761
0.78	0.5	11.0313	0.15220
0.825	0.5	11.0123	0.12146
0.9	0.5	11.0057	0.09919
1.05	0.5	10.9802	0.08403
1.2	0.5	10.9288	0.07286
1.35	0.5	10.9118	0.08324
1.5	0.5	10.9075	0.08696
1.65	0.5	10.902	0.09196
1.8	0.5	10.8963	0.09363
2.025	0.5	10.857	0.10167
2.25	0.5	10.8224	0.10552
0	0.625	1.72593	0.44614
0.00187	0.625	1.70691	0.44884
0.00375	0.625	2.15279	0.62651
0.00562	0.625	2.84218	0.84163
0.0075	0.625	3.43627	1.00031
0.01125	0.625	4.63522	1.19509
0.015	0.625	5.55806	1.28948
0.01875	0.625	6.14555	1.27719
0.0225	0.625	6.66334	1.23348
0.02625	0.625	7.02478	1.21127
0.03	0.625	7.31948	1.11692
0.03375	0.625	7.48832	1.09617
0.0375	0.625	7.6512	1.03162
0.045	0.625	7.9866	0.91987
0.0525	0.625	8.13957	0.84397
0.06	0.625	8.28223	0.81734
0.0675	0.625	8.3378	0.75090
0.075	0.625	8.45592	0.73773

0.0825	0.625	8.4829	0.71072
0.09	0.625	8.59426	0.69419
0.0975	0.625	8.60628	0.69735
0.105	0.625	8.68632	0.67082
0.1125	0.625	8.72318	0.69446
0.12	0.625	8.76085	0.69564
0.135	0.625	8.89163	0.68152
0.15	0.625	8.99716	0.69525
0.165	0.625	9.06558	0.68260
0.18	0.625	9.08753	0.71289
0.195	0.625	9.17833	0.68739
0.21	0.625	9.23128	0.70041
0.225	0.625	9.33311	0.70084
0.255	0.625	9.4655	0.70707
0.285	0.625	9.60911	0.69269
0.315	0.625	9.77575	0.71463
0.345	0.625	9.88776	0.69574
0.375	0.625	9.99251	0.67231
0.42	0.625	10.2096	0.63829
0.465	0.625	10.4087	0.57607
0.51	0.625	10.6071	0.5081
0.555	0.625	10.7901	0.44021
0.6	0.625	10.872	0.38086
0.645	0.625	10.9757	0.28084
0.69	0.625	11.0184	0.21736
0.735	0.625	11.0627	0.17319
0.78	0.625	11.0682	0.13264
0.825	0.625	11.0533	0.11601
0.9	0.625	11.0509	0.10401
1.05	0.625	11.0268	0.08812
1.2	0.625	10.9726	0.08236
1.35	0.625	10.9358	0.08033
1.5	0.625	10.9272	0.08620
1.65	0.625	10.9357	0.08342
1.8	0.625	10.8837	0.09488
2.025	0.625	10.8839	0.09903
2.25	0.625	10.8763	0.11155
0	0.75	1.62488	0.46615
0.00187	0.75	1.59528	0.44817
0.00375	0.75	1.62469	0.48687
0.00562	0.75	2.13999	0.68684
0.0075	0.75	2.74086	0.87019
0.01125	0.75	3.89867	1.17389
0.015	0.75	4.89869	1.28242
0.01875	0.75	5.57398	1.28315
0.0225	0.75	6.07224	1.27505
0.02625	0.75	6.52016	1.21583
0.03	0.75	6.70651	1.16573
0.03375	0.75	6.99317	1.12343
0.0375	0.75	7.21559	1.09099
0.045	0.75	7.52223	1.02406
0.0525	0.75	7.72826	0.95235
0.06	0.75	7.92205	0.91249
0.0675	0.75	8.03552	0.88955
0.075	0.75	8.15583	0.82745
0.0825	0.75	8.23909	0.81260
0.09	0.75	8.36836	0.79603
0.0975	0.75	8.39883	0.78226
0.105	0.75	8.51039	0.77595
0.1125	0.75	8.59736	0.76557
0.12	0.75	8.63701	0.76151
0.135	0.75	8.79957	0.75317
0.15	0.75	8.87845	0.75738
0.165	0.75	9.01059	0.75910
0.18	0.75	9.14035	0.75244
0.195	0.75	9.23987	0.75452
0.21	0.75	9.36463	0.73378
0.225	0.75	9.43276	0.73370
0.255	0.75	9.63819	0.71465
0.285	0.75	9.82154	0.71772
0.315	0.75	9.94912	0.68960
0.345	0.75	10.1042	0.65112
0.375	0.75	10.2373	0.61414
0.42	0.75	10.4307	0.57523
0.465	0.75	10.6281	0.52577
0.51	0.75	10.7526	0.46004
0.555	0.75	10.9032	0.37510
0.6	0.75	10.9394	0.33403
0.645	0.75	11.0302	0.25070
0.69	0.75	11.1084	0.19971
0.735	0.75	11.1134	0.15934
0.78	0.75	11.1139	0.12721
0.825	0.75	11.0888	0.11002
0.9	0.75	11.0536	0.09999
1.05	0.75	11.0359	0.09259
1.2	0.75	10.9962	0.08761
1.35	0.75	10.9471	0.08283
1.5	0.75	10.9489	0.08224
1.65	0.75	10.9209	0.08771
1.8	0.75	10.889	0.09677
2.025	0.75	10.8349	0.10471
2.25	0.75	10.8076	0.11135
0	0.875	1.72989	0.49159
0.00187	0.875	1.7054	0.48840
0.00375	0.875	1.64366	0.44682
0.00562	0.875	1.71372	0.48427
0.0075	0.875	2.20354	0.67344
0.01125	0.875	3.50812	1.09488
0.015	0.875	4.55722	1.2817
0.01875	0.875	5.43044	1.30359
0.0225	0.875	6.09493	1.27402
0.02625	0.875	6.48156	1.2559
0.03	0.875	6.72461	1.19883
0.03375	0.875	7.06384	1.13081
0.0375	0.875	7.26534	1.08333
0.045	0.875	7.54949	0.98680
0.0525	0.875	7.70972	0.92954
0.06	0.875	7.9308	0.88479
0.0675	0.875	8.09834	0.85740
0.075	0.875	8.19255	0.80084
0.0825	0.875	8.25337	0.79920
0.09	0.875	8.36218	0.82099
0.0975	0.875	8.48303	0.80823
0.105	0.875	8.55293	0.76187
0.1125	0.875	8.62543	0.75884
0.12	0.875	8.64879	0.76594
0.135	0.875	8.80228	0.76875
0.15	0.875	8.94081	0.75656
0.165	0.875	9.07003	0.75287
0.18	0.875	9.15238	0.72724
0.195	0.875	9.26354	0.72040
0.21	0.875	9.35341	0.73168
0.225	0.875	9.49127	0.70146
0.255	0.875	9.65997	0.70486
0.285	0.875	9.85417	0.66899
0.315	0.875	10.0015	0.63734
0.345	0.875	10.1675	0.64227
0.375	0.875	10.2821	0.59709
0.42	0.875	10.5257	0.55277
0.465	0.875	10.675	0.52066
0.51	0.875	10.8399	0.44135
0.555	0.875	10.9705	0.39358
0.6	0.875	11.0602	0.28908
0.645	0.875	11.1283	0.23596
0.69	0.875	11.1816	0.18904
0.735	0.875	11.204	0.15537
0.78	0.875	11.1682	0.12200
0.825	0.875	11.1613	0.11660
0.9	0.875	11.1151	0.10171
1.05	0.875	11.0705	0.09438
1.2	0.875	11.0592	0.09239
1.35	0.875	11.0271	0.09239
1.5	0.875	11.0196	0.09292
1.65	0.875	10.9718	0.09331
1.8	0.875	10.9414	0.09015
2.025	0.875	10.9087	0.09700
2.25	0.875	10.9051	0.10441
0	1	1.68394	0.48717
0.00187	1	1.63623	0.46695
0.00375	1	1.60378	0.44879
0.00562	1	1.64046	0.46284
0.0075	1	1.81792	0.53231
0.01125	1	3.06236	0.97668
0.015	1	4.30173	1.24012
0.01875	1	5.22265	1.33441
0.0225	1	5.84352	1.29234

0.02625	1	6.34085	1.24066
0.03	1	6.67594	1.22981
0.03375	1	6.9776	1.16313
0.0375	1	7.173	1.08987
0.045	1	7.47194	1.01868
0.0525	1	7.69412	0.93694
0.06	1	7.86438	0.90008
0.0675	1	8.02258	0.86846
0.075	1	8.17292	0.82461
0.0825	1	8.29079	0.80019
0.09	1	8.37127	0.80355
0.0975	1	8.49072	0.78019
0.105	1	8.51842	0.76786
0.1125	1	8.59147	0.75649
0.12	1	8.65068	0.76039
0.135	1	8.78917	0.74928
0.15	1	8.91181	0.74249
0.165	1	9.00945	0.73522
0.18	1	9.15044	0.74658
0.195	1	9.24055	0.74299
0.21	1	9.34564	0.73579
0.225	1	9.42411	0.71069
0.255	1	9.61288	0.70003
0.285	1	9.76271	0.68359
0.315	1	9.87475	0.68190
0.345	1	10.0293	0.64975
0.375	1	10.1906	0.64026
0.42	1	10.4164	0.58535
0.465	1	10.6038	0.55760
0.51	1	10.7896	0.47580
0.555	1	10.9051	0.41852
0.6	1	11.0149	0.33170
0.645	1	11.0646	0.25141
0.69	1	11.1001	0.20612
0.735	1	11.1066	0.14750
0.78	1	11.1156	0.12335
0.825	1	11.114	0.11422
0.9	1	11.1222	0.10616
1.05	1	11.1299	0.09320
1.2	1	11.085	0.09671
1.35	1	11.0592	0.09882
1.5	1	11.0309	0.09234
1.65	1	10.9959	0.09067
1.8	1	10.9604	0.09258
2.025	1	10.9243	0.09965
2.25	1	10.8897	0.10929
0	1.125	1.68389	0.48108
0.00187	1.125	1.65589	0.47820
0.00375	1.125	1.61088	0.45052
0.00562	1.125	1.58523	0.44112
0.0075	1.125	1.55495	0.42971
0.01125	1.125	2.3748	0.74941
0.015	1.125	3.5977	1.12204
0.01875	1.125	4.6655	1.2706
0.0225	1.125	5.38393	1.2981
0.02625	1.125	5.89822	1.28551
0.03	1.125	6.30435	1.2504
0.03375	1.125	6.61522	1.13816
0.0375	1.125	6.86069	1.12252
0.045	1.125	7.28263	1.02844
0.0525	1.125	7.48004	0.94911
0.06	1.125	7.61829	0.88497
0.0675	1.125	7.79084	0.84164
0.075	1.125	7.91638	0.82823
0.0825	1.125	8.02158	0.78399
0.09	1.125	8.1495	0.76522
0.0975	1.125	8.23235	0.75877
0.105	1.125	8.25847	0.76275
0.1125	1.125	8.34753	0.74004
0.12	1.125	8.45572	0.75326
0.135	1.125	8.59125	0.72674
0.15	1.125	8.64157	0.72103
0.165	1.125	8.75554	0.71925
0.18	1.125	8.8564	0.74358
0.195	1.125	9.02087	0.73064
0.21	1.125	9.08716	0.71609
0.225	1.125	9.21432	0.72507
0.255	1.125	9.37486	0.71509
0.285	1.125	9.55503	0.68988
0.315	1.125	9.70932	0.69182
0.345	1.125	9.87015	0.68696
0.375	1.125	10.0034	0.66055
0.42	1.125	10.2236	0.63001
0.465	1.125	10.409	0.61083
0.51	1.125	10.6288	0.53630
0.555	1.125	10.8006	0.45081
0.6	1.125	10.9494	0.37142
0.645	1.125	11.0529	0.27769
0.69	1.125	11.1164	0.22552
0.735	1.125	11.1554	0.16717
0.78	1.125	11.1705	0.14680
0.825	1.125	11.1628	0.11954
0.9	1.125	11.1465	0.10427
1.05	1.125	11.1165	0.09173
1.2	1.125	11.0909	0.09857
1.35	1.125	11.0645	0.09524
1.5	1.125	11.0628	0.10007
1.65	1.125	11.0436	0.09942
1.8	1.125	11.0233	0.09909
2.025	1.125	10.9948	0.10333
2.25	1.125	10.9598	0.10439
0	1.25	1.63179	0.46031
0.00187	1.25	1.60012	0.47018
0.00375	1.25	1.5677	0.44963
0.00562	1.25	1.54521	0.42475
0.0075	1.25	1.5182	0.42132
0.01125	1.25	1.82655	0.58040
0.015	1.25	3.02455	0.96357
0.01875	1.25	4.07462	1.1953
0.0225	1.25	4.99453	1.26724
0.02625	1.25	5.59419	1.25668
0.03	1.25	6.08388	1.19245
0.03375	1.25	6.42837	1.15761
0.0375	1.25	6.70647	1.12506
0.045	1.25	7.07106	1.02854
0.0525	1.25	7.33908	0.96319
0.06	1.25	7.53801	0.87427
0.0675	1.25	7.68355	0.81988
0.075	1.25	7.80774	0.79573
0.0825	1.25	7.91538	0.80625
0.09	1.25	7.9879	0.75914
0.0975	1.25	8.09043	0.76906
0.105	1.25	8.16071	0.73978
0.1125	1.25	8.22923	0.74994
0.12	1.25	8.2861	0.73958
0.135	1.25	8.42178	0.74102
0.15	1.25	8.54048	0.71927
0.165	1.25	8.64488	0.72816
0.18	1.25	8.7416	0.73814
0.195	1.25	8.90295	0.72483
0.21	1.25	8.98948	0.72841
0.225	1.25	9.05724	0.74566
0.255	1.25	9.29091	0.71281
0.285	1.25	9.47108	0.69447
0.315	1.25	9.62793	0.70025
0.345	1.25	9.82818	0.69378
0.375	1.25	10.1386	0.68361
0.42	1.25	10.3642	0.59135
0.465	1.25	10.5118	0.54864
0.51	1.25	10.7233	0.48108
0.555	1.25	10.9021	0.42778
0.6	1.25	11.0153	0.32789
0.645	1.25	11.0444	0.25400
0.69	1.25	11.0923	0.21778
0.735	1.25	11.1033	0.14550
0.78	1.25	11.1067	0.12522
0.825	1.25	11.1122	0.11266
0.9	1.25	11.1201	0.10512
1.05	1.25	11.1265	0.09555
1.2	1.25	11.0754	0.09704
1.35	1.25	11.0542	0.09888
1.5	1.25	11.0309	0.09432
1.65	1.25	10.9897	0.09075
1.8	1.25	10.9426	0.09222
2.025	1.25	10.8799	0.09931
2.25	1.25	10.8079	0.10952

Run ID: 040496

VR=1.001
Uo=11.26 m/s
x/D=5.0 FSTI=0.5%
L/D=7.0

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.97644	0.61074
0.00187	-0.375	2.59404	0.86273
0.00375	-0.375	3.25617	1.01742
0.00562	-0.375	3.97004	1.2361
0.0075	-0.375	4.58796	1.34474
0.01125	-0.375	5.50482	1.45879
0.015	-0.375	6.20917	1.43626
0.01875	-0.375	6.68584	1.45405
0.0225	-0.375	7.20152	1.39004
0.02625	-0.375	7.47012	1.41267
0.03	-0.375	7.82902	1.3931
0.03375	-0.375	8.03229	1.37994
0.0375	-0.375	8.25017	1.36347
0.045	-0.375	8.5935	1.26313
0.0525	-0.375	8.87026	1.24426
0.06	-0.375	9.18807	1.1718
0.0675	-0.375	9.41029	1.12318
0.075	-0.375	9.49109	1.09413
0.0825	-0.375	9.68895	1.05178
0.09	-0.375	9.83524	1.03607
0.0975	-0.375	9.93972	0.96308
0.105	-0.375	10.0543	0.96173
0.1125	-0.375	10.1045	0.92846
0.12	-0.375	10.2304	0.91636
0.135	-0.375	10.3296	0.91794
0.15	-0.375	10.4256	0.89755
0.165	-0.375	10.5103	0.88501
0.18	-0.375	10.5648	0.89856
0.195	-0.375	10.5986	0.95234
0.21	-0.375	10.6918	0.98312
0.225	-0.375	10.6502	1.0039
0.255	-0.375	10.7429	1.04524
0.285	-0.375	10.6459	1.13355
0.315	-0.375	10.5914	1.17211
0.345	-0.375	10.563	1.23534
0.375	-0.375	10.5542	1.28367
0.42	-0.375	10.4678	1.34082
0.465	-0.375	10.5061	1.39396
0.51	-0.375	10.6083	1.39129
0.555	-0.375	10.8148	1.33706
0.6	-0.375	10.9778	1.29787
0.645	-0.375	11.233	1.16046
0.69	-0.375	11.3855	1.04329
0.735	-0.375	11.5255	0.93554
0.78	-0.375	11.4774	0.80550
0.825	-0.375	11.4947	0.76154
0.9	-0.375	11.4043	0.56658
1.05	-0.375	11.2849	0.25025
1.2	-0.375	11.2798	0.15464
1.35	-0.375	11.2469	0.14197
1.5	-0.375	11.2294	0.14666
1.65	-0.375	11.213	0.14518
1.8	-0.375	11.195	0.15265
2.025	-0.375	11.1672	0.15447
2.25	-0.375	11.1587	0.17061
0	-0.25	1.9496	0.63978
0.00187	-0.25	2.19365	0.75712
0.00375	-0.25	2.834	0.96728
0.00562	-0.25	3.51115	1.21873
0.0075	-0.25	4.1125	1.2858
0.01125	-0.25	5.05815	1.45457
0.015	-0.25	5.65355	1.43882
0.01875	-0.25	6.10711	1.45956
0.0225	-0.25	6.55355	1.47045
0.02625	-0.25	6.80446	1.51879
0.03	-0.25	7.12385	1.4778
0.03375	-0.25	7.37886	1.47358
0.0375	-0.25	7.67521	1.4593
0.045	-0.25	8.06863	1.43904
0.0525	-0.25	8.35982	1.40984
0.06	-0.25	8.64432	1.38264
0.0675	-0.25	8.97922	1.3103
0.075	-0.25	9.09564	1.29586
0.0825	-0.25	9.29277	1.21426
0.09	-0.25	9.45391	1.1879
0.0975	-0.25	9.63577	1.14759
0.105	-0.25	9.73997	1.15737
0.1125	-0.25	9.86997	1.07962
0.12	-0.25	9.90921	1.05266
0.135	-0.25	9.999	1.05352
0.15	-0.25	10.0272	1.02107
0.165	-0.25	10.0394	1.01534
0.18	-0.25	10.0949	1.02861
0.195	-0.25	10.147	1.10197
0.21	-0.25	10.121	1.08417
0.225	-0.25	10.0107	1.16116
0.255	-0.25	9.83859	1.17513
0.285	-0.25	9.64147	1.22308
0.315	-0.25	9.54734	1.31062
0.345	-0.25	9.38177	1.3692
0.375	-0.25	9.25657	1.3608
0.42	-0.25	9.03556	1.36648
0.465	-0.25	9.15318	1.42685
0.51	-0.25	9.24678	1.47132
0.555	-0.25	9.40518	1.50815
0.6	-0.25	9.84814	1.4969
0.645	-0.25	10.2174	1.47073
0.69	-0.25	10.7357	1.36555
0.735	-0.25	11.117	1.20685
0.78	-0.25	11.3583	1.0436
0.825	-0.25	11.502	0.91217
0.9	-0.25	11.4726	0.69285
1.05	-0.25	11.3398	0.30975
1.2	-0.25	11.3223	0.16453
1.35	-0.25	11.3034	0.14545
1.5	-0.25	11.3102	0.14036
1.65	-0.25	11.306	0.14828
1.8	-0.25	11.2734	0.15720
2.025	-0.25	11.2457	0.16077
2.25	-0.25	11.2059	0.17158
0	-0.125	2.05443	0.64279
0.00187	-0.125	2.0105	0.60535
0.00375	-0.125	2.52703	0.80898
0.00562	-0.125	3.2394	1.01892
0.0075	-0.125	3.79702	1.13786
0.01125	-0.125	4.75315	1.23023
0.015	-0.125	5.45024	1.29619
0.01875	-0.125	5.85558	1.27027
0.0225	-0.125	6.19756	1.22723
0.02625	-0.125	6.40146	1.21757
0.03	-0.125	6.5868	1.2137
0.03375	-0.125	6.76625	1.22167
0.0375	-0.125	6.98865	1.23903
0.045	-0.125	7.26515	1.27163
0.0525	-0.125	7.48419	1.26346
0.06	-0.125	7.76877	1.24201
0.0675	-0.125	7.93889	1.28904
0.075	-0.125	8.18683	1.25213
0.0825	-0.125	8.3263	1.25979
0.09	-0.125	8.47804	1.24778
0.0975	-0.125	8.53926	1.25633
0.105	-0.125	8.7233	1.22183
0.1125	-0.125	8.89169	1.21834
0.12	-0.125	8.94281	1.19381
0.135	-0.125	9.05526	1.1553
0.15	-0.125	9.192	1.1177
0.165	-0.125	9.28776	1.11973
0.18	-0.125	9.30494	1.13119
0.195	-0.125	9.36177	1.09605
0.21	-0.125	9.39031	1.1265
0.225	-0.125	9.43157	1.12422
0.255	-0.125	9.31501	1.10977
0.285	-0.125	9.27339	1.18832
0.315	-0.125	9.11632	1.18586
0.345	-0.125	9.02557	1.21058
0.375	-0.125	8.89668	1.24721

0.42	-0.125	8.76471	1.25577
0.465	-0.125	8.62731	1.23541
0.51	-0.125	8.60981	1.30944
0.555	-0.125	8.71073	1.32903
0.6	-0.125	8.94874	1.4408
0.645	-0.125	9.39882	1.52995
0.69	-0.125	9.98018	1.49307
0.735	-0.125	10.6156	1.41147
0.78	-0.125	11.1221	1.25552
0.825	-0.125	11.4341	1.06328
0.9	-0.125	11.5798	0.81404
1.05	-0.125	11.3778	0.34713
1.2	-0.125	11.3345	0.16732
1.35	-0.125	11.3261	0.14605
1.5	-0.125	11.3196	0.14297
1.65	-0.125	11.3132	0.14229
1.8	-0.125	11.2902	0.15204
2.025	-0.125	11.2791	0.15835
2.25	-0.125	11.2598	0.17536
0	0	2.20711	0.65744
0.00187	0	2.15278	0.62722
0.00375	0	2.21573	0.67530
0.00562	0	2.97085	0.92716
0.0075	0	3.5921	1.07017
0.01125	0	4.7565	1.27908
0.015	0	5.53569	1.25694
0.01875	0	6.00246	1.23405
0.0225	0	6.34202	1.23294
0.02625	0	6.61896	1.22641
0.03	0	6.75509	1.25194
0.03375	0	6.97006	1.18967
0.0375	0	7.12308	1.19703
0.045	0	7.35535	1.25684
0.0525	0	7.56363	1.26868
0.06	0	7.74927	1.21978
0.0675	0	7.95588	1.30886
0.075	0	8.10538	1.29139
0.0825	0	8.22564	1.32504
0.09	0	8.35878	1.31454
0.0975	0	8.44241	1.29897
0.105	0	8.57641	1.31733
0.1125	0	8.71245	1.33615
0.12	0	8.76926	1.31371
0.135	0	8.91037	1.3089
0.15	0	9.08241	1.31466
0.165	0	9.25536	1.35584
0.18	0	9.30637	1.31619
0.195	0	9.40287	1.28337
0.21	0	9.4247	1.30325
0.225	0	9.49349	1.24086
0.255	0	9.5074	1.24614
0.285	0	9.51406	1.28254
0.315	0	9.43704	1.25934
0.345	0	9.40205	1.25189
0.375	0	9.28647	1.24793
0.42	0	9.0589	1.26024
0.465	0	8.84564	1.22145
0.51	0	8.6461	1.24274
0.555	0	8.6544	1.29709
0.6	0	8.79991	1.35175
0.645	0	9.23368	1.43841
0.69	0	9.91031	1.51715
0.735	0	10.4503	1.46113
0.78	0	11.0284	1.23171
0.825	0	11.4509	1.10815
0.9	0	11.6026	0.79968
1.05	0	11.4311	0.37511
1.2	0	11.384	0.17355
1.35	0	11.3672	0.13728
1.5	0	11.3771	0.14242
1.65	0	11.3427	0.14286
1.8	0	11.3308	0.15180
2.025	0	11.2862	0.15928
2.25	0	11.2669	0.17478
0	0.125	2.26899	0.78165
0.00187	0.125	2.2434	0.76109
0.00375	0.125	2.22305	0.72888
0.00562	0.125	2.43078	0.84585
0.0075	0.125	3.16979	1.08193
0.01125	0.125	4.40113	1.38359
0.015	0.125	5.35864	1.52586
0.01875	0.125	6.01094	1.48664
0.0225	0.125	6.42913	1.53002
0.02625	0.125	6.76593	1.46982
0.03	0.125	7.06358	1.55656
0.03375	0.125	7.29169	1.5019
0.0375	0.125	7.45955	1.5092
0.045	0.125	7.83664	1.5562
0.0525	0.125	8.19729	1.58221
0.06	0.125	8.43675	1.5523
0.0675	0.125	8.70917	1.5593
0.075	0.125	8.89326	1.56595
0.0825	0.125	9.06061	1.53777
0.09	0.125	9.28246	1.5076
0.0975	0.125	9.47341	1.53755
0.105	0.125	9.66375	1.50122
0.1125	0.125	9.78817	1.45429
0.12	0.125	9.8979	1.43656
0.135	0.125	10.1677	1.40655
0.15	0.125	10.2306	1.40332
0.165	0.125	10.4398	1.33102
0.18	0.125	10.49	1.32476
0.195	0.125	10.5331	1.25444
0.21	0.125	10.4462	1.28693
0.225	0.125	10.4833	1.26768
0.255	0.125	10.4253	1.30433
0.285	0.125	10.2382	1.36361
0.315	0.125	10.0515	1.40338
0.345	0.125	9.69512	1.44204
0.375	0.125	9.61416	1.41342
0.42	0.125	9.28845	1.37578
0.465	0.125	9.01475	1.34804
0.51	0.125	8.94179	1.34422
0.555	0.125	9.08145	1.37548
0.6	0.125	9.32414	1.48657
0.645	0.125	9.75548	1.50063
0.69	0.125	10.3012	1.47271
0.735	0.125	10.8669	1.39066
0.78	0.125	11.2902	1.20608
0.825	0.125	11.5364	1.01781
0.9	0.125	11.5837	0.74439
1.05	0.125	11.4271	0.33294
1.2	0.125	11.3779	0.15533
1.35	0.125	11.3812	0.14333
1.5	0.125	11.3744	0.14049
1.65	0.125	11.3692	0.14636
1.8	0.125	11.3368	0.15137
2.025	0.125	11.2922	0.15972
2.25	0.125	11.2641	0.17803
0	0.25	2.25078	0.74696
0.00187	0.25	2.23823	0.76418
0.00375	0.25	2.21152	0.74792
0.00562	0.25	2.17561	0.73320
0.0075	0.25	2.49409	0.87692
0.01125	0.25	4.06415	1.31126
0.015	0.25	5.20967	1.56859
0.01875	0.25	6.01645	1.5873
0.0225	0.25	6.54655	1.56323
0.02625	0.25	7.09227	1.60425
0.03	0.25	7.46016	1.57398
0.03375	0.25	7.71947	1.57474
0.0375	0.25	7.91431	1.56941
0.045	0.25	8.48633	1.49117
0.0525	0.25	8.85095	1.49521
0.06	0.25	9.11192	1.45893
0.0675	0.25	9.4463	1.44234
0.075	0.25	9.64426	1.39274
0.0825	0.25	9.86981	1.32502
0.09	0.25	10.0402	1.27304
0.0975	0.25	10.1584	1.28187
0.105	0.25	10.3132	1.247
0.1125	0.25	10.4825	1.2455
0.12	0.25	10.6262	1.20994
0.135	0.25	10.7813	1.15749
0.15	0.25	10.9139	1.14973
0.165	0.25	11.0525	1.1192

0.18	0.25	11.1349	1.10463
0.195	0.25	11.1677	1.13029
0.21	0.25	11.2204	1.15824
0.225	0.25	11.2604	1.12962
0.255	0.25	11.1886	1.25256
0.285	0.25	11.0433	1.38871
0.315	0.25	10.794	1.4355
0.345	0.25	10.6567	1.46929
0.375	0.25	10.485	1.55495
0.42	0.25	10.1979	1.53074
0.465	0.25	10.0228	1.5735
0.51	0.25	10.0733	1.58705
0.555	0.25	10.2551	1.58273
0.6	0.25	10.4453	1.57284
0.645	0.25	10.9081	1.41508
0.69	0.25	11.2014	1.30177
0.735	0.25	11.4797	1.1574
0.78	0.25	11.6213	0.96982
0.825	0.25	11.6755	0.87657
0.9	0.25	11.6094	0.65365
1.05	0.25	11.4658	0.27531
1.2	0.25	11.4247	0.14988
1.35	0.25	11.4171	0.13619
1.5	0.25	11.4044	0.13533
1.65	0.25	11.3968	0.13850
1.8	0.25	11.377	0.15024
2.025	0.25	11.3361	0.16496
2.25	0.25	11.2957	0.17436
0	0.375	2.24439	0.69170
0.00187	0.375	2.19586	0.69684
0.00375	0.375	2.14906	0.67603
0.00562	0.375	2.13676	0.65756
0.0075	0.375	2.09369	0.66437
0.01125	0.375	3.44722	1.09545
0.015	0.375	4.86951	1.3995
0.01875	0.375	5.83894	1.46847
0.0225	0.375	6.55623	1.4854
0.02625	0.375	7.0938	1.51609
0.03	0.375	7.46885	1.50521
0.03375	0.375	7.81295	1.46022
0.0375	0.375	8.04764	1.44264
0.045	0.375	8.49497	1.42069
0.0525	0.375	8.89622	1.35696
0.06	0.375	9.19107	1.30011
0.0675	0.375	9.47766	1.253
0.075	0.375	9.65985	1.2001
0.0825	0.375	9.8505	1.17171
0.09	0.375	9.95539	1.16009
0.0975	0.375	10.1245	1.16758
0.105	0.375	10.2661	1.13373
0.1125	0.375	10.3538	1.10099
0.12	0.375	10.5054	1.09483
0.135	0.375	10.6872	1.10221
0.15	0.375	10.8581	1.05205
0.165	0.375	11.0645	1.0435
0.18	0.375	11.2043	1.05572
0.195	0.375	11.2912	1.04753
0.21	0.375	11.4069	1.03246
0.225	0.375	11.5074	1.00952
0.255	0.375	11.5805	1.06425
0.285	0.375	11.6507	1.07685
0.315	0.375	11.6549	1.12587
0.345	0.375	11.6712	1.17351
0.375	0.375	11.6668	1.24121
0.42	0.375	11.5357	1.27954
0.465	0.375	11.5126	1.33826
0.51	0.375	11.4673	1.31556
0.555	0.375	11.5773	1.26343
0.6	0.375	11.6662	1.14187
0.645	0.375	11.6996	1.02951
0.69	0.375	11.7176	0.96153
0.735	0.375	11.7123	0.84747
0.78	0.375	11.6581	0.76009
0.825	0.375	11.6137	0.62491
0.9	0.375	11.5087	0.45758
1.05	0.375	11.464	0.19168
1.2	0.375	11.4567	0.13619
1.35	0.375	11.4458	0.12987
1.5	0.375	11.4516	0.13474
1.65	0.375	11.4205	0.13864
1.8	0.375	11.4066	0.14788
2.025	0.375	11.3624	0.16346
2.25	0.375	11.3281	0.15589
0	0.5	1.92895	0.56660
0.00187	0.5	2.25508	0.71156
0.00375	0.5	3.03502	0.96753
0.00562	0.5	3.7015	1.12067
0.0075	0.5	4.30796	1.21256
0.01125	0.5	5.44793	1.33265
0.015	0.5	6.08151	1.39831
0.01875	0.5	6.61046	1.4015
0.0225	0.5	7.0018	1.3334
0.02625	0.5	7.37223	1.35326
0.03	0.5	7.60523	1.34054
0.03375	0.5	7.83517	1.33824
0.0375	0.5	8.05114	1.30854
0.045	0.5	8.38234	1.25336
0.0525	0.5	8.64039	1.20295
0.06	0.5	8.92128	1.18621
0.0675	0.5	9.04133	1.10767
0.075	0.5	9.23921	1.06212
0.0825	0.5	9.37333	1.04828
0.09	0.5	9.54918	1.03235
0.0975	0.5	9.63856	1.04539
0.105	0.5	9.76627	1.00137
0.1125	0.5	9.87207	0.97450
0.12	0.5	9.98121	0.97960
0.135	0.5	10.1325	0.95089
0.15	0.5	10.2802	0.91315
0.165	0.5	10.4625	0.94197
0.18	0.5	10.609	0.95026
0.195	0.5	10.7259	0.92380
0.21	0.5	10.8488	0.93008
0.225	0.5	10.9769	0.94806
0.255	0.5	11.1222	0.94562
0.285	0.5	11.2797	0.95907
0.315	0.5	11.3671	0.94321
0.345	0.5	11.4406	0.95227
0.375	0.5	11.5396	0.95109
0.42	0.5	11.543	0.91172
0.465	0.5	11.5713	0.92092
0.51	0.5	11.5527	0.90192
0.555	0.5	11.5737	0.87958
0.6	0.5	11.4786	0.80308
0.645	0.5	11.4507	0.78385
0.69	0.5	11.3881	0.67952
0.735	0.5	11.3315	0.58912
0.78	0.5	11.3014	0.50107
0.825	0.5	11.2409	0.39577
0.9	0.5	11.2276	0.29602
1.05	0.5	11.1948	0.15768
1.2	0.5	11.172	0.13933
1.35	0.5	11.1922	0.13220
1.5	0.5	11.1931	0.13242
1.65	0.5	11.1719	0.14272
1.8	0.5	11.1285	0.14234
2.025	0.5	11.0928	0.14945
2.25	0.5	11.0767	0.15160
0	0.625	1.83631	0.53430
0.00187	0.625	1.78489	0.51154
0.00375	0.625	2.14801	0.65244
0.00562	0.625	2.82264	0.88445
0.0075	0.625	3.48762	1.04927
0.01125	0.625	4.74791	1.28605
0.015	0.625	5.5175	1.32536
0.01875	0.625	6.17732	1.33521
0.0225	0.625	6.54819	1.32836
0.02625	0.625	6.87197	1.35149
0.03	0.625	7.14198	1.28498
0.03375	0.625	7.3655	1.22588
0.0375	0.625	7.60353	1.25853
0.045	0.625	7.8896	1.1563
0.0525	0.625	8.17528	1.14051
0.06	0.625	8.38305	1.09783
0.0675	0.625	8.54225	1.03283
0.075	0.625	8.70342	1.02604

0.0825	0.625	8.85483	0.97717
0.09	0.625	8.99307	0.94373
0.0975	0.625	9.12475	0.89770
0.105	0.625	9.23539	0.90763
0.1125	0.625	9.33043	0.88076
0.12	0.625	9.45062	0.82686
0.135	0.625	9.6251	0.80528
0.15	0.625	9.79313	0.80283
0.165	0.625	9.88907	0.81219
0.18	0.625	10.0349	0.80069
0.195	0.625	10.1595	0.74857
0.21	0.625	10.2466	0.75529
0.225	0.625	10.3606	0.76023
0.255	0.625	10.5239	0.72365
0.285	0.625	10.6617	0.73306
0.315	0.625	10.781	0.70377
0.345	0.625	10.8896	0.70998
0.375	0.625	10.9381	0.72037
0.42	0.625	11.0388	0.70035
0.465	0.625	11.0899	0.65593
0.51	0.625	11.1341	0.64027
0.555	0.625	11.1539	0.59835
0.6	0.625	11.1738	0.56378
0.645	0.625	11.1655	0.45792
0.69	0.625	11.1506	0.43136
0.735	0.625	11.1607	0.35562
0.78	0.625	11.1928	0.32726
0.825	0.625	11.1786	0.24272
0.9	0.625	11.1744	0.17645
1.05	0.625	11.157	0.14072
1.2	0.625	11.1647	0.12499
1.35	0.625	11.1555	0.12681
1.5	0.625	11.1327	0.13286
1.65	0.625	11.1139	0.13587
1.8	0.625	11.1099	0.13949
2.025	0.625	11.0825	0.15011
2.25	0.625	11.0558	0.15588
0	0.75	1.76474	0.49443
0.00187	0.75	1.72953	0.50146
0.00375	0.75	1.70013	0.46254
0.00562	0.75	2.1696	0.67844
0.0075	0.75	2.8655	0.88745
0.01125	0.75	4.04535	1.15341
0.015	0.75	4.99309	1.24973
0.01875	0.75	5.65389	1.29006
0.0225	0.75	6.14129	1.28361
0.02625	0.75	6.53355	1.27582
0.03	0.75	6.78916	1.27679
0.03375	0.75	7.03572	1.25171
0.0375	0.75	7.23021	1.21866
0.045	0.75	7.56714	1.16678
0.0525	0.75	7.8755	1.08305
0.06	0.75	8.06024	1.03151
0.0675	0.75	8.22552	0.99738
0.075	0.75	8.40492	0.95339
0.0825	0.75	8.51398	0.94690
0.09	0.75	8.66548	0.87001
0.0975	0.75	8.76497	0.89772
0.105	0.75	8.84287	0.86494
0.1125	0.75	8.93193	0.84580
0.12	0.75	9.04853	0.80935
0.135	0.75	9.17243	0.76448
0.15	0.75	9.36714	0.73723
0.165	0.75	9.52628	0.70281
0.18	0.75	9.59271	0.70736
0.195	0.75	9.72138	0.68227
0.21	0.75	9.81349	0.67757
0.225	0.75	9.91836	0.66420
0.255	0.75	10.0806	0.63211
0.285	0.75	10.2656	0.58919
0.315	0.75	10.371	0.56497
0.345	0.75	10.5218	0.53783
0.375	0.75	10.6204	0.52443
0.42	0.75	10.7078	0.48944
0.465	0.75	10.8345	0.46715
0.51	0.75	10.9392	0.42733
0.555	0.75	11.0256	0.40099
0.6	0.75	11.0785	0.32817
0.645	0.75	11.1011	0.31404
0.69	0.75	11.1631	0.24927
0.735	0.75	11.1727	0.22018
0.78	0.75	11.1868	0.18286
0.825	0.75	11.235	0.16658
0.9	0.75	11.2377	0.14826
1.05	0.75	11.2054	0.13796
1.2	0.75	11.188	0.12763
1.35	0.75	11.1864	0.13452
1.5	0.75	11.1624	0.13450
1.65	0.75	11.1429	0.13941
1.8	0.75	11.1179	0.13721
2.025	0.75	11.0701	0.13813
2.25	0.75	11.0469	0.15253
0	0.875	1.72238	0.49099
0.00187	0.875	1.69944	0.50120
0.00375	0.875	1.67892	0.48276
0.00562	0.875	1.68692	0.49528
0.0075	0.875	2.21902	0.69564
0.01125	0.875	3.55409	1.05615
0.015	0.875	4.54298	1.22616
0.01875	0.875	5.30963	1.28723
0.0225	0.875	5.73892	1.25405
0.02625	0.875	6.17293	1.25895
0.03	0.875	6.48421	1.26061
0.03375	0.875	6.75142	1.2207
0.0375	0.875	6.92059	1.18723
0.045	0.875	7.27149	1.17834
0.0525	0.875	7.53396	1.12642
0.06	0.875	7.8011	1.04115
0.0675	0.875	7.93434	1.03236
0.075	0.875	8.11233	0.95993
0.0825	0.875	8.23894	0.93134
0.09	0.875	8.3912	0.894
0.0975	0.875	8.48644	0.90504
0.105	0.875	8.61969	0.83671
0.1125	0.875	8.69644	0.85986
0.12	0.875	8.78965	0.82263
0.135	0.875	8.93218	0.76058
0.15	0.875	9.03533	0.73264
0.165	0.875	9.18307	0.72286
0.18	0.875	9.31028	0.72649
0.195	0.875	9.40028	0.68220
0.21	0.875	9.54827	0.66592
0.225	0.875	9.65767	0.65368
0.255	0.875	9.81333	0.62010
0.285	0.875	9.9784	0.61808
0.315	0.875	10.1321	0.58643
0.345	0.875	10.2858	0.55066
0.375	0.875	10.3906	0.51180
0.42	0.875	10.5625	0.50709
0.465	0.875	10.7086	0.44718
0.51	0.875	10.8622	0.39065
0.555	0.875	10.943	0.33028
0.6	0.875	11.0041	0.27499
0.645	0.875	11.0585	0.22984
0.69	0.875	11.0944	0.18992
0.735	0.875	11.1003	0.17341
0.78	0.875	11.1196	0.14161
0.825	0.875	11.1127	0.13672
0.9	0.875	11.1231	0.12420
1.05	0.875	11.1144	0.12502
1.2	0.875	11.0972	0.12307
1.35	0.875	11.0952	0.12653
1.5	0.875	11.0874	0.12874
1.65	0.875	11.0684	0.13253
1.8	0.875	11.0484	0.13929
2.025	0.875	11.0132	0.14372
2.25	0.875	10.9987	0.14697
0	1	1.6675	0.49479
0.00187	1	1.60719	0.45498
0.00375	1	1.6133	0.45422
0.00562	1	1.59567	0.46427
0.0075	1	1.64261	0.47630
0.01125	1	2.82771	0.88174
0.015	1	3.90286	1.13182
0.01875	1	4.74661	1.25853
0.0225	1	5.31626	1.27836

0.02625	1	5.75543	1.27278
0.03	1	6.09676	1.22042
0.03375	1	6.3295	1.22411
0.0375	1	6.59103	1.19372
0.045	1	6.91397	1.15809
0.0525	1	7.20237	1.10305
0.06	1	7.37992	1.06718
0.0675	1	7.57645	1.02641
0.075	1	7.73453	0.98063
0.0825	1	7.88625	0.94533
0.09	1	8.01136	0.90722
0.0975	1	8.10548	0.87030
0.105	1	8.1998	0.86154
0.1125	1	8.30577	0.83991
0.12	1	8.39613	0.82241
0.135	1	8.58563	0.80063
0.15	1	8.73494	0.77522
0.165	1	8.83156	0.75154
0.18	1	8.96533	0.70781
0.195	1	9.06379	0.70868
0.21	1	9.17441	0.68689
0.225	1	9.28179	0.67891
0.255	1	9.47865	0.65452
0.285	1	9.66821	0.63967
0.315	1	9.82317	0.61157
0.345	1	9.98784	0.61131
0.375	1	10.1333	0.57124
0.42	1	10.3033	0.54451
0.465	1	10.5096	0.48554
0.51	1	10.6921	0.42857
0.555	1	10.8326	0.36922
0.6	1	10.9235	0.30084
0.645	1	10.9855	0.23278
0.69	1	10.9886	0.19465
0.735	1	11.0256	0.15483
0.78	1	11.0349	0.13172
0.825	1	11.0705	0.13083
0.9	1	11.056	0.12205
1.05	1	11.0697	0.11722
1.2	1	11.0555	0.11804
1.35	1	11.0306	0.11826
1.5	1	10.9933	0.11987
1.65	1	10.9957	0.12476
1.8	1	10.9855	0.12728
2.025	1	10.9436	0.13984
2.25	1	10.9284	0.14333
0	1.125	1.60912	0.47463
0.00187	1.125	1.56425	0.46914
0.00375	1.125	1.56281	0.47763
0.00562	1.125	1.52556	0.44024
0.0075	1.125	1.51105	0.44952
0.01125	1.125	2.24538	0.71387
0.015	1.125	3.35638	1.01043
0.01875	1.125	4.23231	1.21009
0.0225	1.125	4.90081	1.23765
0.02625	1.125	5.39206	1.27401
0.03	1.125	5.76275	1.23144
0.03375	1.125	6.02917	1.2141
0.0375	1.125	6.27441	1.22199
0.045	1.125	6.60148	1.16081
0.0525	1.125	6.89855	1.09259
0.06	1.125	7.09321	1.0655
0.0675	1.125	7.29992	1.03309
0.075	1.125	7.50873	0.97805
0.0825	1.125	7.61355	0.92553
0.09	1.125	7.73141	0.91956
0.0975	1.125	7.88655	0.87802
0.105	1.125	7.97842	0.85814
0.1125	1.125	8.093	0.85920
0.12	1.125	8.19493	0.82958
0.135	1.125	8.36528	0.78140
0.15	1.125	8.47225	0.77129
0.165	1.125	8.67226	0.75795
0.18	1.125	8.77894	0.72375
0.195	1.125	8.90273	0.7119
0.21	1.125	9.02705	0.72517
0.225	1.125	9.13324	0.68739
0.255	1.125	9.3324	0.66221
0.285	1.125	9.50323	0.64300
0.315	1.125	9.69111	0.63498
0.345	1.125	9.84749	0.60817
0.375	1.125	9.99717	0.58191
0.42	1.125	10.2229	0.53816
0.465	1.125	10.4373	0.49911
0.51	1.125	10.5899	0.45667
0.555	1.125	10.7317	0.40080
0.6	1.125	10.8413	0.30827
0.645	1.125	10.9197	0.25145
0.69	1.125	10.9477	0.19937
0.735	1.125	10.9761	0.16422
0.78	1.125	11.0135	0.15369
0.825	1.125	10.9966	0.13017
0.9	1.125	11.0001	0.11113
1.05	1.125	11.0134	0.11236
1.2	1.125	11.0018	0.11250
1.35	1.125	10.9919	0.11242
1.5	1.125	10.9777	0.11579
1.65	1.125	10.966	0.12368
1.8	1.125	10.9389	0.12181
2.025	1.125	10.916	0.12829
2.25	1.125	10.908	0.14442
0	1.25	1.605	0.48188
0.00187	1.25	1.56728	0.47364
0.00375	1.25	1.54555	0.46174
0.00562	1.25	1.52507	0.44740
0.0075	1.25	1.53082	0.44775
0.01125	1.25	1.7472	0.54888
0.015	1.25	2.90442	0.92110
0.01875	1.25	3.91683	1.13214
0.0225	1.25	4.67966	1.2293
0.02625	1.25	5.18156	1.2235
0.03	1.25	5.56347	1.22599
0.03375	1.25	5.90014	1.23014
0.0375	1.25	6.12549	1.20113
0.045	1.25	6.55305	1.18392
0.0525	1.25	6.79804	1.12802
0.06	1.25	7.04009	1.09257
0.0675	1.25	7.30434	1.03407
0.075	1.25	7.4256	0.97812
0.0825	1.25	7.57822	0.93489
0.09	1.25	7.691	0.92319
0.0975	1.25	7.76978	0.90078
0.105	1.25	7.93048	0.88331
0.1125	1.25	8.02488	0.83292
0.12	1.25	8.12363	0.84760
0.135	1.25	8.29299	0.79218
0.15	1.25	8.4538	0.77111
0.165	1.25	8.61142	0.76
0.18	1.25	8.73437	0.71424
0.195	1.25	8.84438	0.71198
0.21	1.25	8.98646	0.71841
0.225	1.25	9.08465	0.68974
0.255	1.25	9.29059	0.68947
0.285	1.25	9.48353	0.64873
0.315	1.25	9.68021	0.62758
0.345	1.25	9.84179	0.62034
0.375	1.25	9.97751	0.59509
0.42	1.25	10.2049	0.55099
0.465	1.25	10.3977	0.50399
0.51	1.25	10.5881	0.43278
0.555	1.25	10.7229	0.38523
0.6	1.25	10.8406	0.31882
0.645	1.25	10.9072	0.23230
0.69	1.25	10.9381	0.20184
0.735	1.25	10.9715	0.16106
0.78	1.25	10.9966	0.13431
0.825	1.25	11.0063	0.12679
0.9	1.25	10.9782	0.10891
1.05	1.25	10.9825	0.10811
1.2	1.25	10.9732	0.11210
1.35	1.25	10.9941	0.11650
1.5	1.25	10.9682	0.11881
1.65	1.25	10.9195	0.12253
1.8	1.25	10.8889	0.12346
2.025	1.25	10.8821	0.13565
2.25	1.25	10.8747	0.14368

Run ID: 040596

VR=0.500
Uo=10.76 m/s
x/D=5.0 FSTI=0.5%
L/D=7.0

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.48731	0.41696
0.00187	-0.375	1.59399	0.47334
0.00375	-0.375	2.1904	0.68490
0.00562	-0.375	2.74283	0.8516
0.0075	-0.375	3.29015	0.96854
0.01125	-0.375	4.26207	1.11831
0.015	-0.375	4.92121	1.16002
0.01875	-0.375	5.39772	1.15192
0.0225	-0.375	5.73314	1.13802
0.02625	-0.375	6.13509	1.1227
0.03	-0.375	6.37444	1.12542
0.03375	-0.375	6.5378	1.10205
0.0375	-0.375	6.69052	1.0885
0.045	-0.375	7.0078	1.05394
0.0525	-0.375	7.2535	0.95145
0.06	-0.375	7.44001	0.93976
0.0675	-0.375	7.49934	0.92382
0.075	-0.375	7.61394	0.87343
0.0825	-0.375	7.68943	0.85017
0.09	-0.375	7.75645	0.82627
0.0975	-0.375	7.80367	0.83065
0.105	-0.375	7.82256	0.83276
0.1125	-0.375	7.88534	0.82019
0.12	-0.375	7.90249	0.80935
0.135	-0.375	7.95959	0.79571
0.15	-0.375	7.91254	0.84537
0.165	-0.375	7.91571	0.86931
0.18	-0.375	7.95371	0.88547
0.195	-0.375	7.9743	0.91130
0.21	-0.375	7.91952	0.95017
0.225	-0.375	8.04455	0.95603
0.255	-0.375	8.05182	1.02773
0.285	-0.375	8.09639	1.06138
0.315	-0.375	8.21033	1.06759
0.345	-0.375	8.37319	1.09182
0.375	-0.375	8.46595	1.11946
0.42	-0.375	8.81606	1.0517
0.465	-0.375	9.08157	1.04868
0.51	-0.375	9.4133	0.95822
0.555	-0.375	9.75783	0.86281
0.6	-0.375	10.0963	0.73601
0.645	-0.375	10.3202	0.63219
0.69	-0.375	10.5352	0.51155
0.735	-0.375	10.733	0.38639
0.78	-0.375	10.7985	0.29178
0.825	-0.375	10.8503	0.22382
0.9	-0.375	10.8654	0.15877
1.05	-0.375	10.8608	0.11572
1.2	-0.375	10.8399	0.11748
1.35	-0.375	10.8303	0.11642
1.5	-0.375	10.8483	0.12167
1.65	-0.375	10.8367	0.12419
1.8	-0.375	10.8241	0.13524
2.025	-0.375	10.7967	0.13902
2.25	-0.375	10.7755	0.15730
0	-0.25	1.38323	0.39670
0.00187	-0.25	1.36938	0.38954
0.00375	-0.25	1.66684	0.54721
0.00562	-0.25	2.15922	0.70820
0.0075	-0.25	2.66796	0.84295
0.01125	-0.25	3.5542	1.03114
0.015	-0.25	4.24618	1.08851
0.01875	-0.25	4.71475	1.10357
0.0225	-0.25	5.05917	1.08894
0.02625	-0.25	5.35383	1.08483
0.03	-0.25	5.53349	1.05838
0.03375	-0.25	5.74247	1.05508
0.0375	-0.25	5.90759	1.06916
0.045	-0.25	6.19322	1.04451
0.0525	-0.25	6.39893	0.99126
0.06	-0.25	6.60542	0.95159
0.0675	-0.25	6.79688	0.94677
0.075	-0.25	6.82342	0.93493
0.0825	-0.25	7.0026	0.89666
0.09	-0.25	7.04019	0.89177
0.0975	-0.25	7.03579	0.88800
0.105	-0.25	7.07697	0.89435
0.1125	-0.25	7.089	0.88120
0.12	-0.25	7.13538	0.86845
0.135	-0.25	7.11866	0.92858
0.15	-0.25	7.07754	0.88316
0.165	-0.25	7.0434	0.94507
0.18	-0.25	6.97919	0.97615
0.195	-0.25	6.89345	0.97741
0.21	-0.25	6.8937	1.0341
0.225	-0.25	6.90454	1.00119
0.255	-0.25	6.82452	1.04515
0.285	-0.25	6.78662	1.07979
0.315	-0.25	6.90798	1.13646
0.345	-0.25	6.98895	1.18647
0.375	-0.25	7.1864	1.24576
0.42	-0.25	7.47498	1.29224
0.465	-0.25	7.98091	1.2948
0.51	-0.25	8.51211	1.22331
0.555	-0.25	8.96679	1.181
0.6	-0.25	9.5305	1.02369
0.645	-0.25	9.98979	0.82310
0.69	-0.25	10.3224	0.66097
0.735	-0.25	10.5427	0.51150
0.78	-0.25	10.7238	0.37195
0.825	-0.25	10.8128	0.28091
0.9	-0.25	10.8647	0.17892
1.05	-0.25	10.872	0.11982
1.2	-0.25	10.8704	0.11035
1.35	-0.25	10.8403	0.11016
1.5	-0.25	10.8097	0.12284
1.65	-0.25	10.7936	0.12400
1.8	-0.25	10.8041	0.13673
2.025	-0.25	10.7768	0.14666
2.25	-0.25	10.7621	0.15613
0	-0.125	1.18186	0.33338
0.00187	-0.125	1.15974	0.33304
0.00375	-0.125	1.19644	0.35138
0.00562	-0.125	1.52633	0.49969
0.0075	-0.125	1.95304	0.67364
0.01125	-0.125	2.70779	0.86306
0.015	-0.125	3.31132	0.94757
0.01875	-0.125	3.74817	0.96219
0.0225	-0.125	4.08244	0.94692
0.02625	-0.125	4.34943	0.97783
0.03	-0.125	4.54095	0.95863
0.03375	-0.125	4.72641	0.96679
0.0375	-0.125	4.88523	0.96455
0.045	-0.125	5.16361	0.94343
0.0525	-0.125	5.27886	0.97002
0.06	-0.125	5.45173	0.95120
0.0675	-0.125	5.56898	0.92953
0.075	-0.125	5.75837	0.92300
0.0825	-0.125	5.81792	0.92223
0.09	-0.125	5.90535	0.91327
0.0975	-0.125	5.91119	0.88874
0.105	-0.125	6.00592	0.88045
0.1125	-0.125	6.03195	0.89089
0.12	-0.125	6.08947	0.84161
0.135	-0.125	6.10812	0.88387
0.15	-0.125	6.0695	0.85548
0.165	-0.125	6.04967	0.87380
0.18	-0.125	5.97419	0.86158
0.195	-0.125	5.95736	0.86362
0.21	-0.125	5.92579	0.84572
0.225	-0.125	5.8774	0.87573
0.255	-0.125	5.79949	0.85165
0.285	-0.125	5.78998	0.90472
0.315	-0.125	5.84214	0.94049
0.345	-0.125	5.95433	0.97583
0.375	-0.125	6.10971	1.06019

0.42	-0.125	6.39655	1.18197
0.465	-0.125	6.95599	1.27832
0.51	-0.125	7.58187	1.35493
0.555	-0.125	8.28239	1.2948
0.6	-0.125	8.95104	1.20077
0.645	-0.125	9.50903	1.02757
0.69	-0.125	10.0458	0.77409
0.735	-0.125	10.3829	0.60576
0.78	-0.125	10.5878	0.43512
0.825	-0.125	10.6771	0.34892
0.9	-0.125	10.7706	0.19822
1.05	-0.125	10.7863	0.13107
1.2	-0.125	10.7758	0.11812
1.35	-0.125	10.7671	0.11812
1.5	-0.125	10.7859	0.12658
1.65	-0.125	10.7766	0.12972
1.8	-0.125	10.74	0.13592
2.025	-0.125	10.7215	0.14851
2.25	-0.125	10.7152	0.16023
0	0	1.09818	0.31620
0.00187	0	1.08364	0.30683
0.00375	0	1.06341	0.29668
0.00562	0	1.15223	0.36170
0.0075	0	1.52298	0.49747
0.01125	0	2.25448	0.71944
0.015	0	2.91772	0.85530
0.01875	0	3.35372	0.8829
0.0225	0	3.75057	0.9336
0.02625	0	4.00376	0.91248
0.03	0	4.24082	0.89254
0.03375	0	4.38262	0.90179
0.0375	0	4.5106	0.90813
0.045	0	4.78193	0.89630
0.0525	0	4.95462	0.90575
0.06	0	5.17598	0.92550
0.0675	0	5.29418	0.89747
0.075	0	5.43821	0.86874
0.0825	0	5.50424	0.86609
0.09	0	5.59355	0.83842
0.0975	0	5.66775	0.86347
0.105	0	5.70132	0.84519
0.1125	0	5.7171	0.82809
0.12	0	5.78154	0.82143
0.135	0	5.79871	0.82581
0.15	0	5.8258	0.79811
0.165	0	5.83896	0.81147
0.18	0	5.83053	0.81118
0.195	0	5.78965	0.78766
0.21	0	5.69305	0.78879
0.225	0	5.71437	0.79467
0.255	0	5.65707	0.80114
0.285	0	5.63251	0.81734

0.315	0	5.66677	0.89070
0.345	0	5.6995	0.92386
0.375	0	5.85258	1.00009
0.42	0	6.18629	1.12577
0.465	0	6.72591	1.24753
0.51	0	7.36387	1.32781
0.555	0	8.02702	1.352
0.6	0	8.67454	1.24204
0.645	0	9.40513	1.07113
0.69	0	9.92273	0.83779
0.735	0	10.2456	0.65024
0.78	0	10.5138	0.48030
0.825	0	10.6425	0.33386
0.9	0	10.7444	0.20396
1.05	0	10.7416	0.13644
1.2	0	10.7577	0.12036
1.35	0	10.7412	0.12021
1.5	0	10.7233	0.12607
1.65	0	10.689	0.13080
1.8	0	10.6617	0.14608
2.025	0	10.6383	0.15429
2.25	0	10.6387	0.15866
0	0.125	1.3331	0.40435
0.00187	0.125	1.30458	0.39369
0.00375	0.125	1.29353	0.39448
0.00562	0.125	1.27503	0.38602
0.0075	0.125	1.48977	0.48409
0.01125	0.125	2.44534	0.80669
0.015	0.125	3.26777	0.98651
0.01875	0.125	3.91842	1.04292
0.0225	0.125	4.34524	1.035
0.02625	0.125	4.69434	1.05808
0.03	0.125	4.9221	1.06299
0.03375	0.125	5.16581	1.08091
0.0375	0.125	5.34982	1.06124
0.045	0.125	5.68992	1.03283
0.0525	0.125	5.9454	1.02962
0.06	0.125	6.16934	1.00469
0.0675	0.125	6.32703	0.99790
0.075	0.125	6.48406	0.96191
0.0825	0.125	6.59844	0.95268
0.09	0.125	6.67691	0.91034
0.0975	0.125	6.66893	0.88878
0.105	0.125	6.72909	0.88361
0.1125	0.125	6.78107	0.90745
0.12	0.125	6.72462	0.88258
0.135	0.125	6.73305	0.90397
0.15	0.125	6.74059	0.90412
0.165	0.125	6.65577	0.93325
0.18	0.125	6.58498	0.91619
0.195	0.125	6.56343	0.9275
0.21	0.125	6.48706	0.96711

0.225	0.125	6.4104	0.95211
0.255	0.125	6.32987	1.00302
0.285	0.125	6.3057	1.02535
0.315	0.125	6.31929	1.07214
0.345	0.125	6.36093	1.10664
0.375	0.125	6.52225	1.17437
0.42	0.125	6.86983	1.25759
0.465	0.125	7.28486	1.2865
0.51	0.125	7.93616	1.26985
0.555	0.125	8.53893	1.26221
0.6	0.125	9.09049	1.11956
0.645	0.125	9.63136	0.90889
0.69	0.125	10.0671	0.73045
0.735	0.125	10.3678	0.57090
0.78	0.125	10.5627	0.40474
0.825	0.125	10.6598	0.29308
0.9	0.125	10.7308	0.20052
1.05	0.125	10.7425	0.13211
1.2	0.125	10.7244	0.12600
1.35	0.125	10.7316	0.12592
1.5	0.125	10.7333	0.13061
1.65	0.125	10.7327	0.13013
1.8	0.125	10.7319	0.13649
2.025	0.125	10.7127	0.15559
2.25	0.125	10.6764	0.16568
0	0.25	1.44261	0.44226
0.00187	0.25	1.40783	0.41522
0.00375	0.25	1.38253	0.41872
0.00562	0.25	1.37756	0.40901
0.0075	0.25	1.38785	0.42062
0.01125	0.25	2.32667	0.73847
0.015	0.25	3.35911	0.99532
0.01875	0.25	4.08823	1.10906
0.0225	0.25	4.72487	1.11797
0.02625	0.25	5.19089	1.10438
0.03	0.25	5.47816	1.16652
0.03375	0.25	5.80788	1.13736
0.0375	0.25	5.99133	1.12932
0.045	0.25	6.41254	1.08239
0.0525	0.25	6.77019	1.03339
0.06	0.25	7.00179	0.92599
0.0675	0.25	7.15981	0.91572
0.075	0.25	7.28224	0.8966
0.0825	0.25	7.3799	0.84204
0.09	0.25	7.44024	0.77290
0.0975	0.25	7.50698	0.81809
0.105	0.25	7.51167	0.80901
0.1125	0.25	7.56937	0.79000
0.12	0.25	7.61612	0.78883
0.135	0.25	7.59167	0.81651
0.15	0.25	7.58633	0.80842
0.165	0.25	7.54571	0.87626

0.18	0.25	7.54193	0.89726
0.195	0.25	7.48982	0.95129
0.21	0.25	7.52248	0.92580
0.225	0.25	7.50593	1.00356
0.255	0.25	7.4467	1.01219
0.285	0.25	7.48207	1.10298
0.315	0.25	7.52358	1.12933
0.345	0.25	7.66827	1.15847
0.375	0.25	7.80362	1.18842
0.42	0.25	8.1163	1.20747
0.465	0.25	8.5193	1.13346
0.51	0.25	8.96916	1.07083
0.555	0.25	9.32818	1.01523
0.6	0.25	9.73032	0.85114
0.645	0.25	10.0649	0.69729
0.69	0.25	10.3165	0.59849
0.735	0.25	10.5513	0.46869
0.78	0.25	10.6721	0.35225
0.825	0.25	10.7423	0.2454
0.9	0.25	10.7908	0.16849
1.05	0.25	10.8046	0.11627
1.2	0.25	10.8017	0.11912
1.35	0.25	10.7942	0.11679
1.5	0.25	10.7837	0.12006
1.65	0.25	10.7722	0.12148
1.8	0.25	10.7552	0.13685
2.025	0.25	10.7309	0.14765
2.25	0.25	10.714	0.15961
0	0.375	1.52114	0.43454
0.00187	0.375	1.4979	0.42917
0.00375	0.375	1.46629	0.42087
0.00562	0.375	1.44987	0.41636
0.0075	0.375	1.42984	0.39967
0.01125	0.375	2.18532	0.67646
0.015	0.375	3.30699	0.95773
0.01875	0.375	4.20629	1.13332
0.0225	0.375	4.90107	1.16425
0.02625	0.375	5.44496	1.20314
0.03	0.375	5.89383	1.1584
0.03375	0.375	6.18104	1.1689
0.0375	0.375	6.42484	1.11417
0.045	0.375	6.8966	1.10334
0.0525	0.375	7.1763	1.009
0.06	0.375	7.4259	0.93291
0.0675	0.375	7.57708	0.89562
0.075	0.375	7.71162	0.83635
0.0825	0.375	7.82145	0.80711
0.09	0.375	7.91454	0.76351
0.0975	0.375	7.99685	0.73594
0.105	0.375	8.03334	0.71165
0.1125	0.375	8.11812	0.69448
0.12	0.375	8.13494	0.71480
0.135	0.375	8.18842	0.69462
0.15	0.375	8.23603	0.70410
0.165	0.375	8.22888	0.70856
0.18	0.375	8.27575	0.73772
0.195	0.375	8.36432	0.74375
0.21	0.375	8.34066	0.75482
0.225	0.375	8.41175	0.75009
0.255	0.375	8.47319	0.79763
0.285	0.375	8.54705	0.83487
0.315	0.375	8.67016	0.85457
0.345	0.375	8.80046	0.83442
0.375	0.375	8.92223	0.87382
0.42	0.375	9.1407	0.85275
0.465	0.375	9.37348	0.86527
0.51	0.375	9.66785	0.79476
0.555	0.375	9.89769	0.72438
0.6	0.375	10.1802	0.65782
0.645	0.375	10.3907	0.55950
0.69	0.375	10.5844	0.45896
0.735	0.375	10.6971	0.34899
0.78	0.375	10.779	0.26944
0.825	0.375	10.8339	0.20769
0.9	0.375	10.8645	0.15037
1.05	0.375	10.8637	0.11011
1.2	0.375	10.8414	0.10977
1.35	0.375	10.8368	0.12063
1.5	0.375	10.8269	0.11385
1.65	0.375	10.8343	0.12237
1.8	0.375	10.833	0.12451
2.025	0.375	10.7945	0.13825
2.25	0.375	10.7732	0.15198
0	0.5	1.62895	0.47621
0.00187	0.5	1.56113	0.45757
0.00375	0.5	1.5611	0.44695
0.00562	0.5	1.54036	0.43629
0.0075	0.5	1.54079	0.44839
0.01125	0.5	1.85977	0.57932
0.015	0.5	3.08207	0.92317
0.01875	0.5	4.15092	1.13999
0.0225	0.5	4.91118	1.18428
0.02625	0.5	5.49384	1.22057
0.03	0.5	5.89579	1.20363
0.03375	0.5	6.23234	1.18707
0.0375	0.5	6.5593	1.14375
0.045	0.5	6.93843	1.11036
0.0525	0.5	7.22837	1.04255
0.06	0.5	7.45554	0.99496
0.0675	0.5	7.64171	0.93026
0.075	0.5	7.78634	0.90513
0.0825	0.5	7.94752	0.81538
0.09	0.5	8.06777	0.79302
0.0975	0.5	8.12624	0.77953
0.105	0.5	8.21065	0.73768
0.1125	0.5	8.25206	0.72005
0.12	0.5	8.3511	0.68440
0.135	0.5	8.45392	0.68325
0.15	0.5	8.54082	0.68523
0.165	0.5	8.62557	0.65611
0.18	0.5	8.70037	0.65881
0.195	0.5	8.75969	0.64987
0.21	0.5	8.84458	0.65088
0.225	0.5	8.85985	0.67665
0.255	0.5	8.99604	0.65739
0.285	0.5	9.10191	0.67213
0.315	0.5	9.22138	0.68270
0.345	0.5	9.31346	0.68474
0.375	0.5	9.47423	0.68632
0.42	0.5	9.64918	0.67848
0.465	0.5	9.83934	0.67125
0.51	0.5	10.0445	0.63881
0.555	0.5	10.2099	0.58689
0.6	0.5	10.4289	0.52072
0.645	0.5	10.5713	0.45491
0.69	0.5	10.697	0.37621
0.735	0.5	10.7953	0.31112
0.78	0.5	10.8597	0.22358
0.825	0.5	10.8741	0.18262
0.9	0.5	10.9022	0.13567
1.05	0.5	10.9009	0.11000
1.2	0.5	10.8961	0.10740
1.35	0.5	10.8944	0.11189
1.5	0.5	10.8863	0.10907
1.65	0.5	10.87	0.11580
1.8	0.5	10.8648	0.12394
2.025	0.5	10.8305	0.14363
2.25	0.5	10.8416	0.15713
0	0.625	1.56114	0.44665
0.00187	0.625	1.77183	0.56197
0.00375	0.625	2.37368	0.75760
0.00562	0.625	2.93488	0.94275
0.0075	0.625	3.50067	1.06636
0.01125	0.625	4.46736	1.19336
0.015	0.625	5.07727	1.24633
0.01875	0.625	5.51666	1.25606
0.0225	0.625	5.90213	1.22451
0.02625	0.625	6.20068	1.24402
0.03	0.625	6.40564	1.16922
0.03375	0.625	6.57859	1.20481
0.0375	0.625	6.79981	1.17267
0.045	0.625	7.08135	1.09474
0.0525	0.625	7.37193	1.01807
0.06	0.625	7.53574	0.99192
0.0675	0.625	7.70382	0.93688
0.075	0.625	7.80445	0.97531

0.0825	0.625	7.95317	0.85511
0.09	0.625	8.05422	0.85831
0.0975	0.625	8.153	0.84356
0.105	0.625	8.23212	0.79094
0.1125	0.625	8.33625	0.77983
0.12	0.625	8.4238	0.74462
0.135	0.625	8.54182	0.72603
0.15	0.625	8.65451	0.70912
0.165	0.625	8.7664	0.69671
0.18	0.625	8.89843	0.68090
0.195	0.625	9.04013	0.67348
0.21	0.625	9.0954	0.66907
0.225	0.625	9.1694	0.66398
0.255	0.625	9.32133	0.66442
0.285	0.625	9.46894	0.65045
0.315	0.625	9.58545	0.66374
0.345	0.625	9.72516	0.63192
0.375	0.625	9.84805	0.63662
0.42	0.625	10.0126	0.62363
0.465	0.625	10.2063	0.57886
0.51	0.625	10.3798	0.53032
0.555	0.625	10.5411	0.48929
0.6	0.625	10.6726	0.43050
0.645	0.625	10.7979	0.36739
0.69	0.625	10.8835	0.29987
0.735	0.625	10.9379	0.22734
0.78	0.625	10.9745	0.19421
0.825	0.625	10.9998	0.15293
0.9	0.625	10.9999	0.12704
1.05	0.625	11.0078	0.10953
1.2	0.625	11.0027	0.11033
1.35	0.625	10.9842	0.11507
1.5	0.625	10.9667	0.11901
1.65	0.625	10.9731	0.12051
1.8	0.625	10.9667	0.12480
2.025	0.625	10.9544	0.13613
2.25	0.625	10.9404	0.14571
0	0.75	1.60535	0.47977
0.00187	0.75	1.54391	0.45948
0.00375	0.75	1.90841	0.61197
0.00562	0.75	2.5266	0.84006
0.0075	0.75	3.08135	0.98359
0.01125	0.75	4.07306	1.18069
0.015	0.75	4.77598	1.246
0.01875	0.75	5.28954	1.26003
0.0225	0.75	5.64554	1.26298
0.02625	0.75	5.96693	1.23418
0.03	0.75	6.21867	1.18462
0.03375	0.75	6.39911	1.15477
0.0375	0.75	6.56106	1.16359
0.045	0.75	6.8706	1.12658
0.0525	0.75	7.05881	1.1008

0.06	0.75	7.30778	1.05033
0.0675	0.75	7.46889	0.97354
0.075	0.75	7.65944	0.94362
0.0825	0.75	7.75539	0.91509
0.09	0.75	7.90431	0.88384
0.0975	0.75	8.0347	0.85663
0.105	0.75	8.13963	0.86190
0.1125	0.75	8.22595	0.82334
0.12	0.75	8.30386	0.81153
0.135	0.75	8.46762	0.78600
0.15	0.75	8.63599	0.73702
0.165	0.75	8.71772	0.75264
0.18	0.75	8.86152	0.71934
0.195	0.75	8.94822	0.71545
0.21	0.75	9.05654	0.68689
0.225	0.75	9.16019	0.70008
0.255	0.75	9.3607	0.67649
0.285	0.75	9.54134	0.66816
0.315	0.75	9.68419	0.63559
0.345	0.75	9.84128	0.63239
0.375	0.75	9.95831	0.62448
0.42	0.75	10.1492	0.58424
0.465	0.75	10.3142	0.54470
0.51	0.75	10.5081	0.49746
0.555	0.75	10.6515	0.45210
0.6	0.75	10.7885	0.37925
0.645	0.75	10.8983	0.29786
0.69	0.75	10.9471	0.25361
0.735	0.75	10.9833	0.21338
0.78	0.75	11.0164	0.17186
0.825	0.75	11.0376	0.14675
0.9	0.75	11.0328	0.12461
1.05	0.75	11.028	0.11742
1.2	0.75	11.0191	0.11579
1.35	0.75	10.9899	0.11472
1.5	0.75	10.9942	0.11991
1.65	0.75	10.9896	0.12181
1.8	0.75	10.9709	0.12006
2.025	0.75	10.9667	0.13387
2.25	0.75	10.9487	0.14922
0	0.875	1.61261	0.48403
0.00187	0.875	1.54702	0.44557
0.00375	0.875	1.58413	0.45883
0.00562	0.875	2.11308	0.67255
0.0075	0.875	2.67239	0.84025
0.01125	0.875	3.75564	1.12644
0.015	0.875	4.61946	1.20722
0.01875	0.875	5.17632	1.27945
0.0225	0.875	5.56799	1.22562
0.02625	0.875	5.91761	1.20795
0.03	0.875	6.15515	1.18845
0.03375	0.875	6.37314	1.20155

0.0375	0.875	6.54779	1.13302
0.045	0.875	6.85822	1.1093
0.0525	0.875	7.1088	1.0549
0.06	0.875	7.21516	1.00073
0.0675	0.875	7.47474	0.97225
0.075	0.875	7.60689	0.94009
0.0825	0.875	7.72392	0.89461
0.09	0.875	7.82111	0.91798
0.0975	0.875	7.94086	0.87029
0.105	0.875	8.03849	0.85734
0.1125	0.875	8.13722	0.85430
0.12	0.875	8.19933	0.83058
0.135	0.875	8.40022	0.78521
0.15	0.875	8.54385	0.76246
0.165	0.875	8.6788	0.74360
0.18	0.875	8.77293	0.73421
0.195	0.875	8.88851	0.71594
0.21	0.875	8.98993	0.71312
0.225	0.875	9.12107	0.69886
0.255	0.875	9.30926	0.68112
0.285	0.875	9.49583	0.66083
0.315	0.875	9.63304	0.65343
0.345	0.875	9.80555	0.61671
0.375	0.875	9.94499	0.59934
0.42	0.875	10.157	0.59576
0.465	0.875	10.3277	0.54159
0.51	0.875	10.5006	0.49872
0.555	0.875	10.6762	0.43131
0.6	0.875	10.8045	0.38191
0.645	0.875	10.8965	0.30443
0.69	0.875	10.9501	0.23739
0.735	0.875	11.0001	0.18504
0.78	0.875	11.0288	0.15251
0.825	0.875	11.0388	0.13550
0.9	0.875	11.0534	0.12226
1.05	0.875	11.0465	0.11603
1.2	0.875	11.0175	0.11431
1.35	0.875	11.0067	0.11678
1.5	0.875	11.0001	0.11873
1.65	0.875	10.9836	0.12797
1.8	0.875	10.9618	0.12868
2.025	0.875	10.946	0.13784
2.25	0.875	10.9343	0.15116
0	1	1.56183	0.45201
0.00187	1	1.52942	0.45334
0.00375	1	1.53901	0.46059
0.00562	1	1.63483	0.49995
0.0075	1	2.20289	0.69863
0.01125	1	3.32499	1.03499
0.015	1	4.231	1.19254
0.01875	1	4.88122	1.25737
0.0225	1	5.34038	1.21508

0.02625	1	5.64179	1.23486
0.03	1	5.94405	1.18717
0.03375	1	6.20872	1.16823
0.0375	1	6.3789	1.1317
0.045	1	6.67925	1.12816
0.0525	1	6.8898	1.06348
0.06	1	7.07785	1.0066
0.0675	1	7.26731	0.97584
0.075	1	7.4165	0.93761
0.0825	1	7.5202	0.91508
0.09	1	7.68018	0.91008
0.0975	1	7.75481	0.86934
0.105	1	7.8389	0.8497
0.1125	1	7.99153	0.81904
0.12	1	8.06865	0.79871
0.135	1	8.22171	0.77687
0.15	1	8.32431	0.77229
0.165	1	8.45513	0.75730
0.18	1	8.57947	0.72727
0.195	1	8.71017	0.72298
0.21	1	8.82614	0.71402
0.225	1	8.9044	0.70430
0.255	1	9.08499	0.67641
0.285	1	9.28811	0.68711
0.315	1	9.45055	0.66805
0.345	1	9.60306	0.64281
0.375	1	9.74451	0.61853
0.42	1	9.94963	0.60290
0.465	1	10.1704	0.59157
0.51	1	10.3758	0.52449
0.555	1	10.5576	0.47370
0.6	1	10.7347	0.40483
0.645	1	10.8328	0.35333
0.69	1	10.93	0.26801
0.735	1	10.9632	0.19281
0.78	1	10.9802	0.16941
0.825	1	11.0149	0.14516
0.9	1	11.012	0.12439
1.05	1	11.0127	0.11410
1.2	1	11.0091	0.11357
1.35	1	10.9941	0.11287
1.5	1	10.9886	0.11707
1.65	1	10.9712	0.11923
1.8	1	10.9579	0.12838
2.025	1	10.9414	0.13638
2.25	1	10.9221	0.14643
0	1.125	1.50719	0.45104
0.00187	1.125	1.47067	0.42039
0.00375	1.125	1.45016	0.43741
0.00562	1.125	1.4187	0.41474
0.0075	1.125	1.69841	0.55508
0.01125	1.125	2.79138	0.92035
0.015	1.125	3.74164	1.12852
0.01875	1.125	4.45939	1.18326
0.0225	1.125	5.02868	1.23425
0.02625	1.125	5.35276	1.20269
0.03	1.125	5.60518	1.20155
0.03375	1.125	5.84581	1.16472
0.0375	1.125	6.03071	1.14369
0.045	1.125	6.3734	1.10349
0.0525	1.125	6.62648	1.04385
0.06	1.125	6.81418	1.02017
0.0675	1.125	7.0126	1.00527
0.075	1.125	7.12914	0.92829
0.0825	1.125	7.32347	0.89901
0.09	1.125	7.42448	0.86727
0.0975	1.125	7.53499	0.86235
0.105	1.125	7.66711	0.86811
0.1125	1.125	7.72784	0.82754
0.12	1.125	7.81471	0.81095
0.135	1.125	8.01484	0.77741
0.15	1.125	8.16903	0.75688
0.165	1.125	8.24929	0.73629
0.18	1.125	8.41813	0.73924
0.195	1.125	8.52756	0.72161
0.21	1.125	8.61247	0.70181
0.225	1.125	8.74332	0.72281
0.255	1.125	8.95753	0.70069
0.285	1.125	9.12312	0.69029
0.315	1.125	9.31332	0.67583
0.345	1.125	9.51429	0.67256
0.375	1.125	9.67776	0.64623
0.42	1.125	9.87526	0.61328
0.465	1.125	10.1224	0.58979
0.51	1.125	10.3213	0.56058
0.555	1.125	10.5267	0.53200
0.6	1.125	10.6964	0.45396
0.645	1.125	10.8135	0.38981
0.69	1.125	10.9174	0.30294
0.735	1.125	11.0357	0.23598
0.78	1.125	11.0503	0.18331
0.825	1.125	11.058	0.15584
0.9	1.125	11.0691	0.12672
1.05	1.125	11.053	0.11246
1.2	1.125	11.0512	0.10896
1.35	1.125	11.0364	0.11892
1.5	1.125	11.0175	0.11691
1.65	1.125	11.0104	0.1274
1.8	1.125	11.0034	0.12779
2.025	1.125	10.9983	0.13748
2.25	1.125	10.9792	0.15635
0	1.25	1.53704	0.47070
0.00187	1.25	1.51386	0.45160
0.00375	1.25	1.47151	0.44981
0.00562	1.25	1.46956	0.42690
0.0075	1.25	1.48111	0.42993
0.01125	1.25	2.46451	0.78715
0.015	1.25	3.51926	1.07976
0.01875	1.25	4.29254	1.2057
0.0225	1.25	4.79578	1.1938
0.02625	1.25	5.29464	1.22702
0.03	1.25	5.57069	1.19701
0.03375	1.25	5.79001	1.15306
0.0375	1.25	5.98321	1.15088
0.045	1.25	6.35399	1.11076
0.0525	1.25	6.60294	1.05199
0.06	1.25	6.82631	1.00672
0.0675	1.25	6.99457	0.96892
0.075	1.25	7.14772	0.97682
0.0825	1.25	7.28545	0.91883
0.09	1.25	7.40819	0.87553
0.0975	1.25	7.56303	0.88569
0.105	1.25	7.63909	0.85808
0.1125	1.25	7.74056	0.82362
0.12	1.25	7.83215	0.82832
0.135	1.25	7.97022	0.79930
0.15	1.25	8.13808	0.77756
0.165	1.25	8.27396	0.75555
0.18	1.25	8.41658	0.76178
0.195	1.25	8.49539	0.72701
0.21	1.25	8.65811	0.73717
0.225	1.25	8.7195	0.73000
0.255	1.25	8.90248	0.70651
0.285	1.25	9.10849	0.6784
0.315	1.25	9.32909	0.67538
0.345	1.25	9.4826	0.64887
0.375	1.25	9.66404	0.66010
0.42	1.25	9.8902	0.6313
0.465	1.25	10.0967	0.60916
0.51	1.25	10.3272	0.55900
0.555	1.25	10.5207	0.51584
0.6	1.25	10.7008	0.44792
0.645	1.25	10.8452	0.37465
0.69	1.25	10.9342	0.30968
0.735	1.25	11.0067	0.23003
0.78	1.25	11.0513	0.18246
0.825	1.25	11.0797	0.15506
0.9	1.25	11.0844	0.13151
1.05	1.25	11.0716	0.11467
1.2	1.25	11.0539	0.12145
1.35	1.25	11.0522	0.12554
1.5	1.25	11.0381	0.12579
1.65	1.25	11.0297	0.12742
1.8	1.25	11.0292	0.12432
2.025	1.25	11.0288	0.13988
2.25	1.25	10.9982	0.14107

Run ID: 040696

VR=0.497
Uo=10.86 m/s
x/D=5.0 FSTI=0.5%
L/D=2.3

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.5908	0.43005
0.00187	-0.375	1.86332	0.54912
0.00375	-0.375	2.51185	0.74894
0.00562	-0.375	3.09674	0.89817
0.0075	-0.375	3.70111	1.03455
0.01125	-0.375	4.72842	1.13203
0.015	-0.375	5.34971	1.19735
0.01875	-0.375	5.8458	1.16498
0.0225	-0.375	6.23439	1.17192
0.02625	-0.375	6.53807	1.1721
0.03	-0.375	6.8266	1.09655
0.03375	-0.375	7.02467	1.08784
0.0375	-0.375	7.23428	1.03702
0.045	-0.375	7.45223	1.01154
0.0525	-0.375	7.60005	0.97880
0.06	-0.375	7.81858	0.88241
0.0675	-0.375	7.88033	0.86498
0.075	-0.375	7.99431	0.81220
0.0825	-0.375	8.08762	0.78375
0.09	-0.375	8.08041	0.78407
0.0975	-0.375	8.16684	0.77364
0.105	-0.375	8.14589	0.77101
0.1125	-0.375	8.18195	0.75884
0.12	-0.375	8.20617	0.76012
0.135	-0.375	8.19474	0.80350
0.15	-0.375	8.21033	0.77080
0.165	-0.375	8.22836	0.81470
0.18	-0.375	8.21821	0.84992
0.195	-0.375	8.2238	0.86552
0.21	-0.375	8.24735	0.88464
0.225	-0.375	8.26265	0.89504
0.255	-0.375	8.32124	0.91596
0.285	-0.375	8.36846	0.96722
0.315	-0.375	8.45932	1.00925
0.345	-0.375	8.61269	0.97390
0.375	-0.375	8.72997	1.00107
0.42	-0.375	8.97761	0.96994
0.465	-0.375	9.31855	0.94501
0.51	-0.375	9.60863	0.84939
0.555	-0.375	9.9209	0.78864
0.6	-0.375	10.2086	0.67081
0.645	-0.375	10.4408	0.57449
0.69	-0.375	10.6417	0.44228
0.735	-0.375	10.7649	0.33618
0.78	-0.375	10.8404	0.23285
0.825	-0.375	10.865	0.19221
0.9	-0.375	10.9037	0.14665
1.05	-0.375	10.8847	0.11431
1.2	-0.375	10.8816	0.11682
1.35	-0.375	10.8717	0.10565
1.5	-0.375	10.8346	0.11815
1.65	-0.375	10.827	0.12083
1.8	-0.375	10.8284	0.12827
2.025	-0.375	10.8097	0.13710
2.25	-0.375	10.7861	0.1489
0.0007	-0.25	1.4647	0.41571
0.00257	-0.25	1.62237	0.51453
0.00445	-0.25	2.15983	0.70808
0.00632	-0.25	2.73816	0.85515
0.0082	-0.25	3.21163	0.98385
0.01195	-0.25	4.09211	1.0979
0.0157	-0.25	4.66402	1.13845
0.01945	-0.25	5.13212	1.17251
0.0232	-0.25	5.43786	1.1706
0.02695	-0.25	5.75359	1.16231
0.0307	-0.25	5.96681	1.12155
0.03445	-0.25	6.20525	1.11901
0.0382	-0.25	6.33728	1.088
0.0457	-0.25	6.60767	1.07624
0.0532	-0.25	6.79907	1.03189
0.0607	-0.25	6.99499	0.97309
0.0682	-0.25	7.14812	0.95015
0.0757	-0.25	7.22927	0.93964
0.0832	-0.25	7.28397	0.88737
0.0907	-0.25	7.3345	0.86501
0.0982	-0.25	7.36837	0.89260
0.1057	-0.25	7.4399	0.89523
0.1132	-0.25	7.42688	0.87825
0.1207	-0.25	7.46969	0.88584
0.1357	-0.25	7.37926	0.86484
0.1507	-0.25	7.36687	0.87691
0.1657	-0.25	7.39651	0.89574
0.1807	-0.25	7.26983	0.93387
0.1957	-0.25	7.27866	0.94686
0.2107	-0.25	7.22752	0.95424
0.2257	-0.25	7.22112	0.9485
0.2557	-0.25	7.16968	0.99168
0.2857	-0.25	7.16751	1.03973
0.3157	-0.25	7.16084	1.08964
0.3457	-0.25	7.31264	1.13388
0.3757	-0.25	7.4803	1.17491
0.4207	-0.25	7.85683	1.17896
0.4657	-0.25	8.22082	1.23054
0.5107	-0.25	8.72603	1.1472
0.5557	-0.25	9.21435	1.07394
0.6007	-0.25	9.68818	0.94921
0.6457	-0.25	10.0582	0.79880
0.6907	-0.25	10.381	0.62941
0.7357	-0.25	10.6151	0.44166
0.7807	-0.25	10.7607	0.33493
0.8257	-0.25	10.8462	0.24390
0.9007	-0.25	10.9002	0.16473
1.0507	-0.25	10.865	0.11646
1.2007	-0.25	10.8632	0.11213
1.3507	-0.25	10.8559	0.11389
1.5007	-0.25	10.8576	0.12016
1.6507	-0.25	10.8472	0.12582
1.8007	-0.25	10.8102	0.13090
2.0257	-0.25	10.7892	0.14300
2.2507	-0.25	10.7782	0.14730
0.0014	-0.125	1.19289	0.34784
0.00327	-0.125	1.25581	0.38139
0.00515	-0.125	1.65172	0.55846
0.00702	-0.125	2.05729	0.67771
0.0089	-0.125	2.47261	0.79490
0.01265	-0.125	3.19745	0.94073
0.0164	-0.125	3.69104	0.98182
0.02015	-0.125	4.04769	0.99179
0.0239	-0.125	4.34645	0.96561
0.02765	-0.125	4.60289	0.98800
0.0314	-0.125	4.76866	0.99733
0.03515	-0.125	4.89368	0.98808
0.0389	-0.125	5.05063	0.99280
0.0464	-0.125	5.32157	0.97560
0.0539	-0.125	5.45373	0.94191
0.0614	-0.125	5.64797	0.94925
0.0689	-0.125	5.8402	0.97301
0.0764	-0.125	5.91481	0.95489
0.0839	-0.125	6.01866	0.94810
0.0914	-0.125	6.10474	0.95598
0.0989	-0.125	6.14116	0.92206
0.1064	-0.125	6.17182	0.92892
0.1139	-0.125	6.2408	0.89568
0.1214	-0.125	6.24979	0.87427
0.1364	-0.125	6.28603	0.87767
0.1514	-0.125	6.36778	0.89458
0.1664	-0.125	6.29152	0.87192
0.1814	-0.125	6.24957	0.85055
0.1964	-0.125	6.21955	0.84908
0.2114	-0.125	6.25346	0.85348
0.2264	-0.125	6.16537	0.84500
0.2564	-0.125	6.14798	0.85286
0.2864	-0.125	6.13563	0.89783
0.3164	-0.125	6.2164	0.96439
0.3464	-0.125	6.30384	1.0076
0.3764	-0.125	6.48832	1.0455

0.4214	-0.125	6.83517	1.11808
0.4664	-0.125	7.36249	1.23536
0.5114	-0.125	7.95058	1.24096
0.5564	-0.125	8.56671	1.24947
0.6014	-0.125	9.20581	1.12358
0.6464	-0.125	9.74697	0.993
0.6914	-0.125	10.236	0.77083
0.7364	-0.125	10.5583	0.54486
0.7814	-0.125	10.7571	0.39469
0.8264	-0.125	10.86	0.28871
0.9014	-0.125	10.923	0.18030
1.0514	-0.125	10.9213	0.11973
1.2014	-0.125	10.9075	0.10961
1.3514	-0.125	10.9041	0.11240
1.5014	-0.125	10.9077	0.10665
1.6514	-0.125	10.8871	0.11843
1.8014	-0.125	10.8689	0.12542
2.0264	-0.125	10.8525	0.13548
2.2514	-0.125	10.8411	0.14636
0.0021	0	1.12692	0.30633
0.00397	0	1.10718	0.30275
0.00585	0	1.42179	0.46577
0.00772	0	1.81195	0.59453
0.0096	0	2.21745	0.70894
0.01335	0	2.88031	0.84803
0.0171	0	3.39042	0.91150
0.02085	0	3.75467	0.90925
0.0246	0	4.03363	0.91083
0.02835	0	4.28551	0.91543
0.0321	0	4.46336	0.90512
0.03585	0	4.63802	0.92166
0.0396	0	4.75232	0.91021
0.0471	0	5.01369	0.89748
0.0546	0	5.18661	0.89029
0.0621	0	5.31843	0.86610
0.0696	0	5.47141	0.85319
0.0771	0	5.59731	0.85640
0.0846	0	5.61645	0.84644
0.0921	0	5.71973	0.81569
0.0996	0	5.76716	0.82210
0.1071	0	5.8218	0.79990
0.1146	0	5.87811	0.79370
0.1221	0	5.90637	0.79511
0.1371	0	5.878	0.78702
0.1521	0	5.93488	0.77609
0.1671	0	5.94277	0.77112
0.1821	0	5.94022	0.76557
0.1971	0	5.92498	0.76599
0.2121	0	5.93158	0.78166
0.2271	0	5.89752	0.77743
0.2571	0	5.8617	0.76611
0.2871	0	5.91283	0.79162
0.3171	0	5.9718	0.87873
0.3471	0	6.0565	0.92467
0.3771	0	6.24987	1.0141
0.4221	0	6.65086	1.16993
0.4671	0	7.17072	1.20794
0.5121	0	7.77217	1.28067
0.5571	0	8.38842	1.25487
0.6021	0	9.08727	1.18018
0.6471	0	9.68122	1.00053
0.6921	0	10.2166	0.78247
0.7371	0	10.523	0.59689
0.7821	0	10.7575	0.40057
0.8271	0	10.8485	0.29494
0.9021	0	10.9269	0.17422
1.0521	0	10.9453	0.11959
1.2021	0	10.9318	0.10963
1.3521	0	10.9392	0.10879
1.5021	0	10.9369	0.11671
1.6521	0	10.9319	0.12114
1.8021	0	10.8997	0.12333
2.0271	0	10.8805	0.13561
2.2521	0	10.8645	0.14840
0.0028	0.125	1.38665	0.39746
0.00467	0.125	1.35949	0.37222
0.00655	0.125	1.61287	0.50934
0.00842	0.125	2.13472	0.66868
0.0103	0.125	2.60902	0.80403
0.01405	0.125	3.48155	1.01601
0.0178	0.125	4.14498	1.08934
0.02155	0.125	4.653	1.11065
0.0253	0.125	4.99409	1.08902
0.02905	0.125	5.25717	1.0582
0.0328	0.125	5.52824	1.06359
0.03655	0.125	5.74859	1.07205
0.0403	0.125	5.86971	1.04383
0.0478	0.125	6.11833	1.00498
0.0553	0.125	6.35145	0.99062
0.0628	0.125	6.50978	0.95299
0.0703	0.125	6.68546	0.94071
0.0778	0.125	6.71888	0.90329
0.0853	0.125	6.8373	0.95055
0.0928	0.125	6.90422	0.89362
0.1003	0.125	6.95142	0.88637
0.1078	0.125	6.95916	0.87283
0.1153	0.125	6.944	0.89239
0.1228	0.125	6.94481	0.86612
0.1378	0.125	6.92599	0.88922
0.1528	0.125	6.90448	0.88530
0.1678	0.125	6.82948	0.90992
0.1828	0.125	6.81455	0.90285
0.1978	0.125	6.71561	0.92738
0.2128	0.125	6.66143	0.93810
0.2278	0.125	6.59616	0.93652
0.2578	0.125	6.57014	0.96065
0.2878	0.125	6.59862	0.96600
0.3178	0.125	6.62137	1.04114
0.3478	0.125	6.75409	1.08206
0.3778	0.125	6.97006	1.15661
0.4228	0.125	7.31621	1.21587
0.4678	0.125	7.86555	1.25075
0.5128	0.125	8.39567	1.2493
0.5578	0.125	8.94213	1.20781
0.6028	0.125	9.53357	1.05689
0.6478	0.125	10.0663	0.87377
0.6928	0.125	10.4458	0.68555
0.7378	0.125	10.696	0.50359
0.7828	0.125	10.863	0.37478
0.8278	0.125	10.9516	0.25845
0.9028	0.125	10.9755	0.16879
1.0528	0.125	10.9647	0.12062
1.2028	0.125	10.9617	0.11523
1.3528	0.125	10.9507	0.11724
1.5028	0.125	10.9508	0.11375
1.6528	0.125	10.945	0.11702
1.8028	0.125	10.933	0.12795
2.0278	0.125	10.9104	0.13592
2.2528	0.125	10.886	0.14623
0.0035	0.25	1.53875	0.44474
0.00537	0.25	1.48447	0.41490
0.00725	0.25	1.68411	0.50594
0.00912	0.25	2.3152	0.72785
0.011	0.25	2.89419	0.88602
0.01475	0.25	3.89927	1.06529
0.0185	0.25	4.64451	1.13469
0.02225	0.25	5.24434	1.17632
0.026	0.25	5.64922	1.14155
0.02975	0.25	6.01024	1.14116
0.0335	0.25	6.30811	1.08501
0.03725	0.25	6.50751	1.08525
0.041	0.25	6.70478	1.05485
0.0485	0.25	7.01356	1.04043
0.056	0.25	7.28197	0.98325
0.0635	0.25	7.46085	0.91211
0.071	0.25	7.60288	0.85625
0.0785	0.25	7.66662	0.84545
0.086	0.25	7.7279	0.81917
0.0935	0.25	7.83505	0.81076
0.101	0.25	7.84925	0.81677
0.1085	0.25	7.85424	0.80676
0.116	0.25	7.90907	0.80270
0.1235	0.25	7.8761	0.78968
0.1385	0.25	7.91995	0.82576
0.1535	0.25	7.90973	0.8422
0.1685	0.25	7.85472	0.86985

0.1835	0.25	7.8292	0.91533
0.1985	0.25	7.81295	0.92533
0.2135	0.25	7.75326	0.95925
0.2285	0.25	7.78125	0.99310
0.2585	0.25	7.76366	1.01863
0.2885	0.25	7.83834	1.08436
0.3185	0.25	7.89778	1.08403
0.3485	0.25	8.0596	1.10954
0.3785	0.25	8.19775	1.1296
0.4235	0.25	8.55744	1.13157
0.4685	0.25	8.89816	1.12305
0.5135	0.25	9.31797	1.04031
0.5585	0.25	9.70731	0.95466
0.6035	0.25	10.1023	0.80749
0.6485	0.25	10.391	0.68243
0.6935	0.25	10.6491	0.51012
0.7385	0.25	10.8143	0.39904
0.7835	0.25	10.9121	0.30739
0.8285	0.25	10.9658	0.22499
0.9035	0.25	10.9842	0.14736
1.0535	0.25	10.9833	0.11356
1.2035	0.25	10.9819	0.11240
1.3535	0.25	10.9659	0.11963
1.5035	0.25	10.9677	0.11786
1.6535	0.25	10.9619	0.12115
1.8035	0.25	10.9414	0.12669
2.0285	0.25	10.9184	0.13925
2.2535	0.25	10.9158	0.14679
0	0.375	1.58791	0.42977
0.00187	0.375	1.80217	0.55398
0.00375	0.375	2.46019	0.74655
0.00562	0.375	3.02753	0.88672
0.0075	0.375	3.65394	1.02717
0.01125	0.375	4.6114	1.18897
0.015	0.375	5.34554	1.2041
0.01875	0.375	5.82669	1.20122
0.0225	0.375	6.31791	1.17492
0.02625	0.375	6.62858	1.15355
0.03	0.375	6.89318	1.14426
0.03375	0.375	7.09788	1.09595
0.0375	0.375	7.29017	1.07883
0.045	0.375	7.61971	0.98913
0.0525	0.375	7.85523	0.92603
0.06	0.375	8.02351	0.88822
0.0675	0.375	8.13318	0.84251
0.075	0.375	8.24038	0.80704
0.0825	0.375	8.31805	0.75474
0.09	0.375	8.36371	0.76039
0.0975	0.375	8.47315	0.71035
0.105	0.375	8.51802	0.72201
0.1125	0.375	8.53139	0.68078
0.12	0.375	8.54383	0.71309
0.135	0.375	8.62744	0.69188
0.15	0.375	8.66682	0.72205
0.165	0.375	8.68594	0.74038
0.18	0.375	8.72583	0.73617
0.195	0.375	8.73328	0.75072
0.21	0.375	8.79292	0.77015
0.225	0.375	8.80639	0.77164
0.255	0.375	8.88343	0.81220
0.285	0.375	9.03315	0.80865
0.315	0.375	9.12922	0.83992
0.345	0.375	9.24706	0.87966
0.375	0.375	9.38729	0.84378
0.42	0.375	9.6257	0.80606
0.465	0.375	9.83157	0.80342
0.51	0.375	10.079	0.74249
0.555	0.375	10.3388	0.68007
0.6	0.375	10.5843	0.57942
0.645	0.375	10.7837	0.48658
0.69	0.375	10.9445	0.38927
0.735	0.375	11.0406	0.30383
0.78	0.375	11.096	0.24046
0.825	0.375	11.1168	0.19059
0.9	0.375	11.1212	0.15622
1.05	0.375	11.1236	0.12598
1.2	0.375	11.1193	0.12007
1.35	0.375	11.1159	0.12528
1.5	0.375	11.1049	0.12871
1.65	0.375	11.0842	0.13020
1.8	0.375	11.0775	0.13652
2.025	0.375	11.0398	0.13736
2.25	0.375	11.0293	0.14775
0.0007	0.5	1.65082	0.45699
0.00257	0.5	1.70616	0.50509
0.00445	0.5	2.28991	0.71446
0.00632	0.5	2.97878	0.91140
0.0082	0.5	3.56314	1.04173
0.01195	0.5	4.51679	1.18716
0.0157	0.5	5.33108	1.25716
0.01945	0.5	5.84921	1.24345
0.0232	0.5	6.28886	1.21002
0.02695	0.5	6.57003	1.20117
0.0307	0.5	6.81062	1.21793
0.03445	0.5	7.05712	1.15962
0.0382	0.5	7.22434	1.14386
0.0457	0.5	7.54311	1.07281
0.0532	0.5	7.76539	0.98833
0.0607	0.5	7.96723	0.90889
0.0682	0.5	8.12897	0.91045
0.0757	0.5	8.27374	0.86575
0.0832	0.5	8.3644	0.78409
0.0907	0.5	8.42285	0.77936
0.0982	0.5	8.5565	0.74602
0.1057	0.5	8.64047	0.73155
0.1132	0.5	8.69926	0.67459
0.1207	0.5	8.74969	0.70086
0.1357	0.5	8.85953	0.65893
0.1507	0.5	8.9215	0.65543
0.1657	0.5	9.02388	0.64892
0.1807	0.5	9.11727	0.61808
0.1957	0.5	9.16199	0.62332
0.2107	0.5	9.20281	0.61454
0.2257	0.5	9.28212	0.61329
0.2557	0.5	9.39243	0.63770
0.2857	0.5	9.50909	0.63187
0.3157	0.5	9.59988	0.64163
0.3457	0.5	9.72602	0.64011
0.3757	0.5	9.85627	0.64683
0.4207	0.5	10.0314	0.63388
0.4657	0.5	10.2161	0.61331
0.5107	0.5	10.3745	0.59516
0.5557	0.5	10.5922	0.54061
0.6007	0.5	10.7466	0.47474
0.6457	0.5	10.9038	0.39412
0.6907	0.5	11.0025	0.33102
0.7357	0.5	11.0739	0.25493
0.7807	0.5	11.1197	0.21318
0.8257	0.5	11.1126	0.18852
0.9007	0.5	11.1264	0.14182
1.0507	0.5	11.134	0.12363
1.2007	0.5	11.1254	0.12665
1.3507	0.5	11.1007	0.12168
1.5007	0.5	11.0886	0.12018
1.6507	0.5	11.0861	0.13591
1.8007	0.5	11.0642	0.13262
2.0257	0.5	11.0384	0.14183
2.2507	0.5	11.0152	0.15708
0.0014	0.625	1.66222	0.47989
0.00327	0.625	1.63531	0.46816
0.00515	0.625	2.06964	0.66091
0.00702	0.625	2.725	0.86185
0.0089	0.625	3.2901	1.04922
0.01265	0.625	4.35842	1.19676
0.0164	0.625	5.01858	1.26587
0.02015	0.625	5.54042	1.27292
0.0239	0.625	5.95701	1.26117
0.02765	0.625	6.24524	1.24449
0.0314	0.625	6.50885	1.19352
0.03515	0.625	6.69954	1.17443
0.0389	0.625	6.87176	1.18095
0.0464	0.625	7.25188	1.12066
0.0539	0.625	7.43187	1.04321
0.0614	0.625	7.64052	1.05031
0.0689	0.625	7.81238	0.97950
0.0764	0.625	7.9555	0.93211

0.0839	0.625	8.12588	0.88142
0.0914	0.625	8.17626	0.87445
0.0989	0.625	8.34627	0.85925
0.1064	0.625	8.44833	0.79354
0.1139	0.625	8.51671	0.79694
0.1214	0.625	8.60876	0.77764
0.1364	0.625	8.7437	0.73172
0.1514	0.625	8.86057	0.71486
0.1664	0.625	8.97968	0.69341
0.1814	0.625	9.10989	0.68495
0.1964	0.625	9.20128	0.65631
0.2114	0.625	9.30561	0.63840
0.2264	0.625	9.38576	0.63036
0.2564	0.625	9.56546	0.61551
0.2864	0.625	9.67752	0.60036
0.3164	0.625	9.80525	0.59285
0.3464	0.625	9.92131	0.60383
0.3764	0.625	10.0615	0.58386
0.4214	0.625	10.2402	0.57804
0.4664	0.625	10.3649	0.56849
0.5114	0.625	10.5506	0.52849
0.5564	0.625	10.7229	0.46545
0.6014	0.625	10.865	0.41915
0.6464	0.625	10.9895	0.34776
0.6914	0.625	11.0504	0.28691
0.7364	0.625	11.1166	0.22018
0.7814	0.625	11.1316	0.19441
0.8264	0.625	11.1528	0.15848
0.9014	0.625	11.1612	0.14029
1.0514	0.625	11.1391	0.12322
1.2014	0.625	11.1159	0.11973
1.3514	0.625	11.1225	0.13163
1.5014	0.625	11.1106	0.12707
1.6514	0.625	11.089	0.13056
1.8014	0.625	11.0837	0.13215
2.0264	0.625	11.05	0.14406
2.2514	0.625	11.0408	0.15261
0.0021	0.75	1.65245	0.48506
0.00397	0.75	1.59416	0.46274
0.00585	0.75	1.87549	0.58611
0.00772	0.75	2.52041	0.78896
0.0096	0.75	3.09492	0.97470
0.01335	0.75	4.16883	1.24337
0.0171	0.75	4.94026	1.30029
0.02085	0.75	5.4203	1.24338
0.0246	0.75	5.82576	1.26136
0.02835	0.75	6.15346	1.2253
0.0321	0.75	6.32517	1.22337
0.03585	0.75	6.58464	1.20878
0.0396	0.75	6.72636	1.15264
0.0471	0.75	7.08722	1.09868
0.0546	0.75	7.30543	1.08409
0.0621	0.75	7.51059	1.01523
0.0696	0.75	7.66656	0.98928
0.0771	0.75	7.8488	0.96362
0.0846	0.75	7.97419	0.95171
0.0921	0.75	8.11152	0.88546
0.0996	0.75	8.20663	0.87611
0.1071	0.75	8.32893	0.85464
0.1146	0.75	8.43088	0.82886
0.1221	0.75	8.4785	0.80627
0.1371	0.75	8.67187	0.80104
0.1521	0.75	8.8136	0.77096
0.1671	0.75	8.95033	0.74691
0.1821	0.75	9.05768	0.72724
0.1971	0.75	9.19634	0.71989
0.2121	0.75	9.27329	0.70226
0.2271	0.75	9.36928	0.67536
0.2571	0.75	9.55991	0.66356
0.2871	0.75	9.72498	0.64263
0.3171	0.75	9.87564	0.62350
0.3471	0.75	10.0279	0.61572
0.3771	0.75	10.1566	0.59016
0.4221	0.75	10.356	0.56172
0.4671	0.75	10.5271	0.52550
0.5121	0.75	10.681	0.49217
0.5571	0.75	10.8329	0.43589
0.6021	0.75	10.9721	0.36103
0.6471	0.75	11.0443	0.30569
0.6921	0.75	11.1196	0.26330
0.7371	0.75	11.1707	0.19919
0.7821	0.75	11.194	0.17314
0.8271	0.75	11.2042	0.15528
0.9021	0.75	11.2057	0.13942
1.0521	0.75	11.1815	0.12571
1.2021	0.75	11.1627	0.12205
1.3521	0.75	11.1483	0.12365
1.5021	0.75	11.1505	0.13059
1.6521	0.75	11.1328	0.13167
1.8021	0.75	11.1227	0.14057
2.0271	0.75	11.1017	0.15067
2.2521	0.75	11.0659	0.16184
0.0028	0.875	1.65394	0.47642
0.00467	0.875	1.63859	0.48643
0.00655	0.875	1.73357	0.51664
0.00842	0.875	2.34946	0.72083
0.0103	0.875	2.97067	0.93608
0.01405	0.875	3.97728	1.15605
0.0178	0.875	4.86251	1.27492
0.02155	0.875	5.39651	1.2723
0.0253	0.875	5.7809	1.23502
0.02905	0.875	6.18278	1.2693
0.0328	0.875	6.32408	1.22222
0.03655	0.875	6.56838	1.21231
0.0403	0.875	6.7925	1.17308
0.0478	0.875	7.06215	1.09402
0.0553	0.875	7.28537	1.05307
0.0628	0.875	7.4562	1.02466
0.0703	0.875	7.65163	0.97791
0.0778	0.875	7.85293	0.94878
0.0853	0.875	7.91404	0.93260
0.0928	0.875	8.0506	0.90288
0.1003	0.875	8.18197	0.87173
0.1078	0.875	8.29349	0.86084
0.1153	0.875	8.3781	0.83124
0.1228	0.875	8.47078	0.80586
0.1378	0.875	8.60224	0.81137
0.1528	0.875	8.75562	0.78286
0.1678	0.875	8.91215	0.75514
0.1828	0.875	9.01784	0.71803
0.1978	0.875	9.12901	0.72444
0.2128	0.875	9.25811	0.68315
0.2278	0.875	9.32714	0.70128
0.2578	0.875	9.49618	0.69253
0.2878	0.875	9.70288	0.66553
0.3178	0.875	9.85274	0.63349
0.3478	0.875	10.0024	0.62648
0.3778	0.875	10.1687	0.60202
0.4228	0.875	10.3487	0.56784
0.4678	0.875	10.567	0.50251
0.5128	0.875	10.7171	0.49018
0.5578	0.875	10.8832	0.43577
0.6028	0.875	11.0186	0.34407
0.6478	0.875	11.1092	0.29771
0.6928	0.875	11.1635	0.25394
0.7378	0.875	11.2026	0.20128
0.7828	0.875	11.2232	0.17337
0.8278	0.875	11.23	0.15112
0.9028	0.875	11.2287	0.12877
1.0528	0.875	11.2163	0.12562
1.2028	0.875	11.2124	0.12891
1.3528	0.875	11.2072	0.13408
1.5028	0.875	11.1902	0.13602
1.6528	0.875	11.1818	0.13851
1.8028	0.875	11.1612	0.14838
2.0278	0.875	11.1331	0.15478
2.2528	0.875	11.1063	0.1581
0.0035	1	1.64045	0.47222
0.00537	1	1.58708	0.45628
0.00725	1	1.62004	0.46851
0.00912	1	2.17192	0.66665
0.011	1	2.73214	0.87756
0.01475	1	3.9117	1.17033
0.0185	1	4.6246	1.25034
0.02225	1	5.30328	1.27169
0.026	1	5.64011	1.23107

0.02975	1	5.99659	1.21838
0.0335	1	6.24224	1.22928
0.03725	1	6.44823	1.19643
0.041	1	6.61636	1.15238
0.0485	1	6.86598	1.11971
0.056	1	7.13709	1.06793
0.0635	1	7.35618	1.03262
0.071	1	7.53163	0.96323
0.0785	1	7.67681	0.95691
0.086	1	7.80498	0.91872
0.0935	1	7.91754	0.89353
0.101	1	8.02046	0.86484
0.1085	1	8.11509	0.86427
0.116	1	8.21171	0.81642
0.1235	1	8.29978	0.83273
0.1385	1	8.48842	0.79924
0.1535	1	8.56231	0.79650
0.1685	1	8.74638	0.74017
0.1835	1	8.85817	0.74091
0.1985	1	8.98939	0.73619
0.2135	1	9.06865	0.71638
0.2285	1	9.19362	0.72342
0.2585	1	9.35792	0.71028
0.2885	1	9.55997	0.66638
0.3185	1	9.72382	0.67898
0.3485	1	9.89749	0.65509
0.3785	1	10.0214	0.60959
0.4235	1	10.2626	0.59571
0.4685	1	10.4642	0.56687
0.5135	1	10.6515	0.49671
0.5585	1	10.8122	0.47074
0.6035	1	10.9591	0.3999
0.6485	1	11.0752	0.32833
0.6935	1	11.1494	0.26532
0.7385	1	11.2103	0.20182
0.7835	1	11.2381	0.16710
0.8285	1	11.2499	0.14965
0.9035	1	11.2383	0.13562
1.0535	1	11.2343	0.12689
1.2035	1	11.217	0.12685
1.3535	1	11.2164	0.13301
1.5035	1	11.2011	0.12959
1.6535	1	11.2052	0.13915
1.8035	1	11.1931	0.14610
2.0285	1	11.1529	0.14746
2.2535	1	11.1336	0.16333
0.0042	1.125	1.56671	0.45132
0.00607	1.125	1.5251	0.44158
0.00795	1.125	1.5082	0.44466
0.00982	1.125	1.84392	0.57782
0.0117	1.125	2.45783	0.78949
0.01545	1.125	3.50586	1.09961

0.0192	1.125	4.30322	1.21869
0.02295	1.125	4.91581	1.24178
0.0267	1.125	5.39463	1.21677
0.03045	1.125	5.73846	1.21462
0.0342	1.125	6.00465	1.20889
0.03795	1.125	6.17435	1.19451
0.0417	1.125	6.32355	1.15843
0.0492	1.125	6.65303	1.13576
0.0567	1.125	6.87467	1.04647
0.0642	1.125	7.07784	1.01599
0.0717	1.125	7.34543	0.99598
0.0792	1.125	7.40518	0.96203
0.0867	1.125	7.55898	0.93473
0.0942	1.125	7.71785	0.89289
0.1017	1.125	7.79381	0.86841
0.1092	1.125	7.89295	0.86032
0.1167	1.125	7.99881	0.84484
0.1242	1.125	8.09802	0.83581
0.1392	1.125	8.24846	0.80566
0.1542	1.125	8.33514	0.78131
0.1692	1.125	8.5295	0.76351
0.1842	1.125	8.58315	0.74796
0.1992	1.125	8.74789	0.74077
0.2142	1.125	8.86479	0.72093
0.2292	1.125	8.98331	0.72061
0.2592	1.125	9.19905	0.7122
0.2892	1.125	9.35972	0.68849
0.3192	1.125	9.54724	0.67433
0.3492	1.125	9.72419	0.69406
0.3792	1.125	9.88843	0.63503
0.4242	1.125	10.1386	0.61713
0.4692	1.125	10.372	0.59295
0.5142	1.125	10.5735	0.54314
0.5592	1.125	10.7586	0.48711
0.6042	1.125	10.9043	0.42083
0.6492	1.125	11.0645	0.35296
0.6942	1.125	11.1471	0.28869
0.7392	1.125	11.2195	0.23680
0.7842	1.125	11.2441	0.18146
0.8292	1.125	11.2743	0.15503
0.9042	1.125	11.2556	0.14166
1.0542	1.125	11.2382	0.12585
1.2042	1.125	11.2342	0.13036
1.3542	1.125	11.2359	0.13552
1.5042	1.125	11.2086	0.13659
1.6542	1.125	11.2134	0.14351
1.8042	1.125	11.1901	0.14440
2.0292	1.125	11.1689	0.15354
2.2542	1.125	11.1434	0.16321
0.0049	1.25	1.55253	0.45516
0.00677	1.25	1.53359	0.45151
0.00865	1.25	1.51619	0.43445

0.01052	1.25	1.70922	0.54612
0.0124	1.25	2.30455	0.73104
0.01615	1.25	3.35035	1.04778
0.0199	1.25	4.25872	1.21012
0.02365	1.25	4.85204	1.25295
0.0274	1.25	5.33975	1.25091
0.03115	1.25	5.64828	1.20595
0.0349	1.25	5.89225	1.17132
0.03865	1.25	6.10326	1.17174
0.0424	1.25	6.29632	1.15433
0.0499	1.25	6.63206	1.12015
0.0574	1.25	6.88694	1.06294
0.0649	1.25	7.03345	1.04706
0.0724	1.25	7.2779	1.01065
0.0799	1.25	7.39748	0.94675
0.0874	1.25	7.49718	0.92228
0.0949	1.25	7.69612	0.90094
0.1024	1.25	7.7558	0.86291
0.1099	1.25	7.85477	0.88338
0.1174	1.25	7.97099	0.85745
0.1249	1.25	8.03644	0.83359
0.1399	1.25	8.23014	0.81851
0.1549	1.25	8.38266	0.79275
0.1699	1.25	8.51388	0.76662
0.1849	1.25	8.63912	0.76629
0.1999	1.25	8.72795	0.74959
0.2149	1.25	8.85969	0.74183
0.2299	1.25	8.94996	0.73566
0.2599	1.25	9.18551	0.70618
0.2899	1.25	9.34449	0.71709
0.3199	1.25	9.52393	0.70146
0.3499	1.25	9.74966	0.66466
0.3799	1.25	9.90301	0.65974
0.4249	1.25	10.1249	0.63347
0.4699	1.25	10.3722	0.59999
0.5149	1.25	10.5831	0.56269
0.5599	1.25	10.7452	0.50128
0.6049	1.25	10.9313	0.43474
0.6499	1.25	11.0554	0.38468
0.6949	1.25	11.1543	0.30434
0.7399	1.25	11.2267	0.25387
0.7849	1.25	11.2654	0.19703
0.8299	1.25	11.2907	0.15767
0.9049	1.25	11.291	0.14718
1.0549	1.25	11.2892	0.13059
1.2049	1.25	11.2727	0.13206
1.3549	1.25	11.2603	0.12996
1.5049	1.25	11.2316	0.14230
1.6549	1.25	11.2209	0.13965
1.8049	1.25	11.2248	0.14886
2.0299	1.25	11.1917	0.15570
2.2549	1.25	11.1612	0.16338

Run ID: 040796

VR=0.998
Uo=10.96 m/s
x/D=5.0 FSTI=0.5%
L/D=2.3

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.83246	0.59613
0.00187	-0.375	2.05584	0.70308
0.00375	-0.375	2.67138	0.91254
0.00562	-0.375	3.37737	1.12024
0.0075	-0.375	3.9754	1.25129
0.01125	-0.375	5.00149	1.37713
0.015	-0.375	5.6683	1.43605
0.01875	-0.375	6.27338	1.43837
0.0225	-0.375	6.62133	1.42448
0.02625	-0.375	7.03479	1.37996
0.03	-0.375	7.36849	1.37525
0.03375	-0.375	7.634	1.36874
0.0375	-0.375	7.82724	1.35224
0.045	-0.375	8.21943	1.24791
0.0525	-0.375	8.53509	1.22122
0.06	-0.375	8.7793	1.23463
0.0675	-0.375	9.01284	1.1288
0.075	-0.375	9.18201	1.13629
0.0825	-0.375	9.3827	1.08968
0.09	-0.375	9.53524	1.04768
0.0975	-0.375	9.70646	1.03634
0.105	-0.375	9.82291	1.00306
0.1125	-0.375	9.94788	1.02811
0.12	-0.375	10.0205	0.96711
0.135	-0.375	10.2446	1.00673
0.15	-0.375	10.4066	0.92986
0.165	-0.375	10.5501	0.95211
0.18	-0.375	10.7105	0.93820
0.195	-0.375	10.8027	0.96367
0.21	-0.375	10.9073	0.97691
0.225	-0.375	10.9103	0.96578
0.255	-0.375	11.0594	1.00967
0.285	-0.375	11.0767	1.07255
0.315	-0.375	11.0342	1.11001
0.345	-0.375	11.0311	1.17837
0.375	-0.375	10.9338	1.21838
0.42	-0.375	10.9125	1.25598
0.465	-0.375	10.8386	1.32017
0.51	-0.375	10.9369	1.31546
0.555	-0.375	11.0685	1.29026
0.6	-0.375	11.1902	1.26817
0.645	-0.375	11.3873	1.23426
0.69	-0.375	11.5971	1.16217
0.735	-0.375	11.7149	1.08625
0.78	-0.375	11.7171	0.99222
0.825	-0.375	11.6645	0.94023
0.9	-0.375	11.4404	0.76940
1.05	-0.375	11.1409	0.42610
1.2	-0.375	11.0782	0.20673
1.35	-0.375	11.0643	0.14193
1.5	-0.375	11.0642	0.12614
1.65	-0.375	11.0495	0.13145
1.8	-0.375	11.0419	0.13896
2.025	-0.375	11.0189	0.14214
2.25	-0.375	11.0053	0.15355
0.0007	-0.25	1.86409	0.64139
0.00257	-0.25	1.86666	0.64227
0.00445	-0.25	2.37906	0.83718
0.00632	-0.25	2.99082	1.08594
0.0082	-0.25	3.59371	1.25338
0.01195	-0.25	4.54432	1.3773
0.0157	-0.25	5.20143	1.41541
0.01945	-0.25	5.69521	1.46242
0.0232	-0.25	6.07451	1.43436
0.02695	-0.25	6.34132	1.46073
0.0307	-0.25	6.64879	1.468
0.03445	-0.25	6.85394	1.45522
0.0382	-0.25	7.13917	1.44979
0.0457	-0.25	7.51661	1.47041
0.0532	-0.25	7.91594	1.47296
0.0607	-0.25	8.18021	1.44035
0.0682	-0.25	8.45859	1.35124
0.0757	-0.25	8.73343	1.30924
0.0832	-0.25	8.92127	1.3076
0.0907	-0.25	9.10667	1.25084
0.0982	-0.25	9.23562	1.23959
0.1057	-0.25	9.41609	1.18579
0.1132	-0.25	9.56067	1.17455
0.1207	-0.25	9.6351	1.12041
0.1357	-0.25	9.88345	1.10094
0.1507	-0.25	10.0341	1.04376
0.1657	-0.25	10.149	1.05729
0.1807	-0.25	10.3028	1.02401
0.1957	-0.25	10.3245	1.03857
0.2107	-0.25	10.343	1.07151
0.2257	-0.25	10.4557	1.04864
0.2557	-0.25	10.427	1.08874
0.2857	-0.25	10.339	1.10761
0.3157	-0.25	10.2148	1.14425
0.3457	-0.25	10.1037	1.18903
0.3757	-0.25	9.89039	1.21596
0.4207	-0.25	9.66234	1.24011
0.4657	-0.25	9.60436	1.25584
0.5107	-0.25	9.56721	1.27689
0.5557	-0.25	9.67441	1.31591
0.6007	-0.25	9.91113	1.32748
0.6457	-0.25	10.3325	1.39876
0.6907	-0.25	10.7209	1.33061
0.7357	-0.25	11.1101	1.31141
0.7807	-0.25	11.4586	1.15951
0.8257	-0.25	11.619	1.11572
0.9007	-0.25	11.6115	0.94414
1.0507	-0.25	11.2003	0.57213
1.2007	-0.25	11.0494	0.24891
1.3507	-0.25	11.0432	0.14601
1.5007	-0.25	11.0176	0.12656
1.6507	-0.25	11.001	0.12195
1.8007	-0.25	11	0.13364
2.0257	-0.25	11.0155	0.14765
2.2507	-0.25	10.9832	0.14740
0.0014	-0.125	1.78828	0.56485
0.00327	-0.125	1.76776	0.55344
0.00515	-0.125	2.08205	0.71462
0.00702	-0.125	2.67793	0.89222
0.0089	-0.125	3.2506	1.0509
0.01265	-0.125	4.1377	1.18148
0.0164	-0.125	4.71371	1.2061
0.02015	-0.125	5.21649	1.25651
0.0239	-0.125	5.50051	1.18483
0.02765	-0.125	5.66886	1.20475
0.0314	-0.125	5.9542	1.18589
0.03515	-0.125	6.08919	1.17791
0.0389	-0.125	6.30728	1.2519
0.0464	-0.125	6.52625	1.20355
0.0539	-0.125	6.78706	1.24687
0.0614	-0.125	7.01108	1.26542
0.0689	-0.125	7.17561	1.26533
0.0764	-0.125	7.377	1.28308
0.0839	-0.125	7.57206	1.28824
0.0914	-0.125	7.69666	1.32986
0.0989	-0.125	7.8046	1.33849
0.1064	-0.125	8.05414	1.34308
0.1139	-0.125	8.14789	1.35121
0.1214	-0.125	8.28899	1.3454
0.1364	-0.125	8.49784	1.32028
0.1514	-0.125	8.67889	1.28438
0.1664	-0.125	8.82496	1.33154
0.1814	-0.125	8.96271	1.29043
0.1964	-0.125	9.09117	1.28928
0.2114	-0.125	9.16248	1.21368
0.2264	-0.125	9.21874	1.2391
0.2564	-0.125	9.33839	1.18544
0.2864	-0.125	9.30427	1.16235
0.3164	-0.125	9.3004	1.15502
0.3464	-0.125	9.21162	1.12212
0.3764	-0.125	9.12318	1.13653

0.4214	-0.125	9.04813	1.08876
0.4664	-0.125	8.89519	1.10665
0.5114	-0.125	8.83886	1.12196
0.5564	-0.125	8.97744	1.14792
0.6014	-0.125	9.08784	1.21799
0.6464	-0.125	9.50368	1.30762
0.6914	-0.125	9.95304	1.34746
0.7364	-0.125	10.4551	1.3559
0.7814	-0.125	10.9407	1.30921
0.8264	-0.125	11.3362	1.1686
0.9014	-0.125	11.674	1.0433
1.0514	-0.125	11.2508	0.63562
1.2014	-0.125	11.0664	0.27399
1.3514	-0.125	11.047	0.16017
1.5014	-0.125	11.0485	0.12908
1.6514	-0.125	11.0424	0.13200
1.8014	-0.125	11.0162	0.14025
2.0264	-0.125	10.9896	0.14032
2.2514	-0.125	10.9688	0.14921
0.0021	0.	1.89785	0.60576
0.00397	0.	1.86893	0.57821
0.00585	0.	1.98832	0.64588
0.00772	0.	2.68735	0.86875
0.0096	0.	3.2278	1.04511
0.01335	0.	4.24066	1.172
0.0171	0.	4.89942	1.20654
0.02085	0.	5.34368	1.18818
0.0246	0.	5.6417	1.19863
0.02835	0.	5.88039	1.16164
0.0321	0.	6.11951	1.18222
0.03585	0.	6.27729	1.18052
0.0396	0.	6.37823	1.20088
0.0471	0.	6.68382	1.22373
0.0546	0.	6.86169	1.24921
0.0621	0.	7.01158	1.19141
0.0696	0.	7.19522	1.24836
0.0771	0.	7.30879	1.27582
0.0846	0.	7.46906	1.3282
0.0921	0.	7.60247	1.29871
0.0996	0.	7.7558	1.3167
0.1071	0.	7.77678	1.30903
0.1146	0.	7.98721	1.34729
0.1221	0.	7.97788	1.30756
0.1371	0.	8.20585	1.32205
0.1521	0.	8.34967	1.29419
0.1671	0.	8.4833	1.30142
0.1821	0.	8.59029	1.23918
0.1971	0.	8.70333	1.26677
0.2121	0.	8.75531	1.21849
0.2271	0.	8.84872	1.20518
0.2571	0.	8.92869	1.19032
0.2871	0.	8.97523	1.1367

0.3171	0.	8.90266	1.09795
0.3471	0.	8.88325	1.05462
0.3771	0.	8.90092	1.08339
0.4221	0.	8.84352	1.02948
0.4671	0.	8.73645	1.02081
0.5121	0.	8.69226	1.06012
0.5571	0.	8.75603	1.11635
0.6021	0.	8.97696	1.14878
0.6471	0.	9.32229	1.27531
0.6921	0.	9.7516	1.30925
0.7371	0.	10.3425	1.39255
0.7821	0.	10.8377	1.33199
0.8271	0.	11.2361	1.24075
0.9021	0.	11.5573	0.98732
1.0521	0.	11.1945	0.66210
1.2021	0.	11.0106	0.31302
1.3521	0.	11.0048	0.15342
1.5021	0.	10.994	0.12210
1.6521	0.	10.9813	0.13041
1.8021	0.	10.9732	0.12601
2.0271	0.	10.9681	0.13608
2.2521	0.	10.967	0.15007
0.0028	0.125	2.11692	0.69352
0.00467	0.125	2.12843	0.75198
0.00655	0.125	2.14288	0.76725
0.00842	0.125	2.7016	0.98726
0.0103	0.125	3.38312	1.20679
0.01405	0.125	4.56693	1.45482
0.0178	0.125	5.31851	1.49517
0.02155	0.125	5.88615	1.54879
0.0253	0.125	6.25469	1.53553
0.02905	0.125	6.54833	1.4906
0.0328	0.125	6.90245	1.549
0.03655	0.125	7.08052	1.50249
0.0403	0.125	7.31613	1.52417
0.0478	0.125	7.64307	1.53268
0.0553	0.125	8.03372	1.52914
0.0628	0.125	8.19765	1.51409
0.0703	0.125	8.52979	1.50721
0.0778	0.125	8.82271	1.49412
0.0853	0.125	9.0301	1.45576
0.0928	0.125	9.14701	1.43432
0.1003	0.125	9.2921	1.43132
0.1078	0.125	9.44966	1.39681
0.1153	0.125	9.57478	1.32716
0.1228	0.125	9.77034	1.30541
0.1378	0.125	9.86951	1.25734
0.1528	0.125	10.048	1.26501
0.1678	0.125	10.1022	1.21643
0.1828	0.125	10.1901	1.1179
0.1978	0.125	10.1528	1.16651
0.2128	0.125	10.1703	1.15149

0.2278	0.125	10.1435	1.16143
0.2578	0.125	10.0667	1.16952
0.2878	0.125	9.93032	1.16334
0.3178	0.125	9.78003	1.17924
0.3478	0.125	9.66766	1.16412
0.3778	0.125	9.45481	1.17601
0.4228	0.125	9.22447	1.18657
0.4678	0.125	9.16771	1.18175
0.5128	0.125	9.14163	1.23817
0.5578	0.125	9.23647	1.27544
0.6028	0.125	9.49266	1.32447
0.6478	0.125	9.83517	1.34851
0.6928	0.125	10.2442	1.37883
0.7378	0.125	10.7206	1.33502
0.7828	0.125	11.1217	1.228
0.8278	0.125	11.4182	1.17684
0.9028	0.125	11.5645	0.97471
1.0528	0.125	11.1832	0.60815
1.2028	0.125	11.0066	0.29171
1.3528	0.125	10.9665	0.14615
1.5028	0.125	10.9776	0.12120
1.6528	0.125	10.957	0.12322
1.8028	0.125	10.9449	0.12443
2.0278	0.125	10.9322	0.13214
2.2528	0.125	10.902	0.15275
0.0035	.25	2.235	0.77700
0.00537	.25	2.15589	0.73154
0.00725	.25	2.17238	0.72965
0.00912	.25	2.45574	0.87766
0.011	.25	3.25238	1.10083
0.01475	.25	4.59188	1.44498
0.0185	.25	5.50272	1.47753
0.02225	.25	6.28383	1.50674
0.026	.25	6.78167	1.5042
0.02975	.25	7.13973	1.50517
0.0335	.25	7.42523	1.49421
0.03725	.25	7.75461	1.47111
0.041	.25	7.95766	1.5353
0.0485	.25	8.3956	1.41868
0.056	.25	8.82033	1.37932
0.0635	.25	9.04278	1.38956
0.071	.25	9.38168	1.27675
0.0785	.25	9.53322	1.25901
0.086	.25	9.77589	1.21274
0.0935	.25	9.9125	1.22065
0.101	.25	10.0891	1.14275
0.1085	.25	10.2587	1.16067
0.116	.25	10.2908	1.12156
0.1235	.25	10.4321	1.10104
0.1385	.25	10.6213	1.03909
0.1535	.25	10.697	1.062
0.1685	.25	10.7935	1.06451

0.1835	.25	10.8131	1.06235
0.1985	.25	10.8852	1.0633
0.2135	.25	10.8967	1.06141
0.2285	.25	10.867	1.10474
0.2585	.25	10.8336	1.16027
0.2885	.25	10.7072	1.19201
0.3185	.25	10.5907	1.2141
0.3485	.25	10.4285	1.27336
0.3785	.25	10.3249	1.31211
0.4235	.25	10.2736	1.33634
0.4685	.25	10.2207	1.38566
0.5135	.25	10.1961	1.39348
0.5585	.25	10.3896	1.35286
0.6035	.25	10.584	1.3659
0.6485	.25	10.8842	1.32911
0.6935	.25	11.1202	1.29415
0.7385	.25	11.3899	1.19319
0.7835	.25	11.4834	1.1079
0.8285	.25	11.5949	1.02025
0.9035	.25	11.4074	0.87536
1.0535	.25	11.0205	0.50274
1.2035	.25	10.9155	0.23589
1.3535	.25	10.939	0.13983
1.5035	.25	10.9392	0.12137
1.6535	.25	10.9221	0.11948
1.8035	.25	10.9145	0.13011
2.0285	.25	10.9107	0.13724
2.2535	.25	10.8837	0.13686
0.0042	.375	2.09254	0.66710
0.00607	.375	2.08339	0.68259
0.00795	.375	2.02817	0.67401
0.00982	.375	2.11901	0.70591
0.0117	.375	2.82241	0.99295
0.01545	.375	4.23965	1.29813
0.0192	.375	5.34366	1.40262
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0.0267	.375	6.64307	1.46144
0.03045	.375	7.10343	1.41319
0.0342	.375	7.46274	1.39543
0.03795	.375	7.78839	1.38566
0.0417	.375	8.07503	1.32898
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0.0642	.375	9.01573	1.22363
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0.0867	.375	9.62347	1.14995
0.0942	.375	9.83349	1.12671
0.1017	.375	9.93659	1.1058
0.1092	.375	10.0846	1.06271
0.1167	.375	10.2346	1.06213
0.1242	.375	10.3291	1.06796
0.1392	.375	10.5568	1.03626
0.1542	.375	10.6638	1.02048
0.1692	.375	10.8504	1.02063
0.1842	.375	10.9985	0.99999
0.1992	.375	11.125	1.0405
0.2142	.375	11.2177	1.05456
0.2292	.375	11.3093	1.02737
0.2592	.375	11.4312	1.07875
0.2892	.375	11.4924	1.09066
0.3192	.375	11.5036	1.14895
0.3492	.375	11.5025	1.14678
0.3792	.375	11.4779	1.16881
0.4242	.375	11.507	1.2041
0.4692	.375	11.5353	1.21084
0.5142	.375	11.5566	1.16123
0.5592	.375	11.6282	1.21727
0.6042	.375	11.6251	1.14006
0.6492	.375	11.7115	1.11537
0.6942	.375	11.7163	1.02786
0.7392	.375	11.6945	1.01618
0.7842	.375	11.5735	0.91912
0.8292	.375	11.451	0.83566
0.9042	.375	11.2644	0.72701
1.0542	.375	11.0201	0.35395
1.2042	.375	10.9602	0.17176
1.3542	.375	10.9622	0.12291
1.5042	.375	10.9464	0.12558
1.6542	.375	10.9485	0.12086
1.8042	.375	10.9322	0.12368
2.0292	.375	10.8981	0.13307
2.2542	.375	10.8684	0.13456
0.0049	.5	1.92995	0.59176
0.00677	.5	1.87748	0.56433
0.00865	.5	1.88895	0.56015
0.01052	.5	1.85203	0.58947
0.0124	.5	2.3326	0.74925
0.01615	.5	3.72433	1.12601
0.0199	.5	4.92907	1.34124
0.02365	.5	5.73261	1.32621
0.0274	.5	6.36508	1.33116
0.03115	.5	6.82265	1.31667
0.0349	.5	7.15529	1.31222
0.03865	.5	7.52809	1.26581
0.0424	.5	7.74931	1.28968
0.0499	.5	8.15139	1.22733
0.0574	.5	8.41421	1.15227
0.0649	.5	8.72804	1.10966
0.0724	.5	8.93892	1.05985
0.0799	.5	9.09448	1.03039
0.0874	.5	9.24996	1.01577
0.0949	.5	9.41272	0.98270
0.1024	.5	9.51665	1.00899
0.1099	.5	9.68299	0.95084
0.1174	.5	9.77614	0.9808
0.1249	.5	9.89766	0.94277
0.1399	.5	10.1131	0.97399
0.1549	.5	10.2842	0.93404
0.1699	.5	10.5045	0.98068
0.1849	.5	10.6168	0.92992
0.1999	.5	10.7368	0.98336
0.2149	.5	10.8984	0.94787
0.2299	.5	11.0301	0.96402
0.2599	.5	11.2256	0.96054
0.2899	.5	11.3881	0.95609
0.3199	.5	11.4864	0.95790
0.3499	.5	11.626	0.98050
0.3799	.5	11.7115	0.97
0.4249	.5	11.772	1.00497
0.4699	.5	11.8356	1.02818
0.5149	.5	11.7831	1.00871
0.5599	.5	11.7447	0.98853
0.6049	.5	11.6592	0.91766
0.6499	.5	11.6139	0.89069
0.6949	.5	11.5148	0.88788
0.7399	.5	11.3766	0.76483
0.7849	.5	11.2672	0.72241
0.8299	.5	11.1728	0.62368
0.9049	.5	11.0212	0.48442
1.0549	.5	10.9187	0.24839
1.2049	.5	10.9003	0.13967
1.3549	.5	10.91	0.11595
1.5049	.5	10.8994	0.12114
1.6549	.5	10.8829	0.12189
1.8049	.5	10.8562	0.12568
2.0299	.5	10.833	0.13600
2.2549	.5	10.839	0.14671
0.0056	.625	1.80918	0.53465
0.00747	.625	1.80254	0.53603
0.00935	.625	1.75761	0.50671
0.01122	.625	1.73533	0.48681
0.0131	.625	2.08178	0.64117
0.01685	.625	3.42017	1.01834
0.0206	.625	4.607	1.17732
0.02435	.625	5.44045	1.26459
0.0281	.625	6.05115	1.32031
0.03185	.625	6.52497	1.28167
0.0356	.625	6.86431	1.25838
0.03935	.625	7.16991	1.2544
0.0431	.625	7.43251	1.22167
0.0506	.625	7.85067	1.16844
0.0581	.625	8.11738	1.12993
0.0656	.625	8.37104	1.06756
0.0731	.625	8.54006	1.00924
0.0806	.625	8.74266	0.95737

0.0881	.625	8.87237	0.91436	0.0663	.75	8.05159	1.04728	0.0445	.875	6.85817	1.22761
0.0956	.625	9.02865	0.88364	0.0738	.75	8.24308	0.98587	0.052	.875	7.2392	1.1556
0.1031	.625	9.15571	0.85788	0.0813	.75	8.42745	0.92063	0.0595	.875	7.52452	1.11095
0.1106	.625	9.26053	0.83388	0.0888	.75	8.53012	0.89984	0.067	.875	7.78042	1.03804
0.1181	.625	9.33041	0.81947	0.0963	.75	8.69598	0.85392	0.0745	.875	7.98265	0.99185
0.1256	.625	9.45301	0.83709	0.1038	.75	8.82506	0.84422	0.082	.875	8.12521	0.94080
0.1406	.625	9.63524	0.76109	0.1113	.75	8.90442	0.80370	0.0895	.875	8.22396	0.90179
0.1556	.625	9.78554	0.80834	0.1188	.75	8.99784	0.78380	0.097	.875	8.31631	0.89901
0.1706	.625	9.92014	0.76390	0.1263	.75	9.06359	0.79068	0.1045	.875	8.48885	0.84145
0.1856	.625	10.0805	0.79701	0.1413	.75	9.26944	0.74148	0.112	.875	8.59218	0.83764
0.2006	.625	10.1942	0.76102	0.1563	.75	9.41589	0.69744	0.1195	.875	8.67472	0.83808
0.2156	.625	10.3767	0.78355	0.1713	.75	9.54537	0.68473	0.127	.875	8.78124	0.79641
0.2306	.625	10.4841	0.77268	0.1863	.75	9.65417	0.66523	0.142	.875	8.97551	0.74274
0.2606	.625	10.6314	0.75344	0.2013	.75	9.77365	0.68670	0.157	.875	9.10836	0.73901
0.2906	.625	10.8187	0.77791	0.2163	.75	9.89397	0.63698	0.172	.875	9.22605	0.71771
0.3206	.625	10.9486	0.82275	0.2313	.75	10.0061	0.63852	0.187	.875	9.33685	0.68930
0.3506	.625	11.0705	0.81334	0.2613	.75	10.2027	0.60431	0.202	.875	9.47237	0.67620
0.3806	.625	11.1638	0.82530	0.2913	.75	10.3579	0.56660	0.217	.875	9.54558	0.64801
0.4256	.625	11.2476	0.82750	0.3213	.75	10.4737	0.58783	0.232	.875	9.68526	0.64123
0.4706	.625	11.2943	0.78874	0.3513	.75	10.594	0.54715	0.262	.875	9.86339	0.60522
0.5156	.625	11.2831	0.79547	0.3813	.75	10.7006	0.51999	0.292	.875	10.0378	0.57757
0.5606	.625	11.2711	0.72678	0.4263	.75	10.8123	0.49337	0.322	.875	10.1917	0.54714
0.6056	.625	11.2456	0.70575	0.4713	.75	10.8966	0.51364	0.352	.875	10.333	0.51387
0.6506	.625	11.1842	0.62587	0.5163	.75	10.9468	0.46427	0.382	.875	10.4454	0.48125
0.6956	.625	11.1408	0.60516	0.5613	.75	10.9478	0.42387	0.427	.875	10.583	0.44413
0.7406	.625	11.0664	0.49697	0.6063	.75	11.0064	0.41630	0.472	.875	10.7229	0.36574
0.7856	.625	11.0319	0.40073	0.6513	.75	10.9714	0.36400	0.517	.875	10.8125	0.32027
0.8306	.625	10.9987	0.37312	0.6963	.75	10.9797	0.33020	0.562	.875	10.8509	0.28421
0.9056	.625	10.962	0.30345	0.7413	.75	10.9845	0.28554	0.607	.875	10.9106	0.23598
1.0556	.625	10.9344	0.16413	0.7863	.75	10.9828	0.25343	0.652	.875	10.9599	0.19558
1.2056	.625	10.942	0.12435	0.8313	.75	10.991	0.23498	0.697	.875	10.9614	0.1876
1.3556	.625	10.9403	0.11365	0.9063	.75	10.9647	0.17213	0.742	.875	10.9741	0.16071
1.5056	.625	10.9286	0.11844	1.0563	.75	10.9446	0.13265	0.787	.875	10.967	0.15067
1.6556	.625	10.9026	0.12243	1.2063	.75	10.9464	0.11083	0.832	.875	10.9719	0.12737
1.8056	.625	10.9005	0.11872	1.3563	.75	10.9333	0.11699	0.907	.875	10.9559	0.12641
2.0306	.625	10.8742	0.13456	1.5063	.75	10.919	0.11549	1.057	.875	10.9713	0.10974
2.2556	.625	10.8641	0.14529	1.6563	.75	10.9121	0.11805	1.207	.875	10.9472	0.10914
0.0063	.75	1.78627	0.49827	1.8063	.75	10.9018	0.12209	1.357	.875	10.9298	0.11345
0.00817	.75	1.74846	0.49576	2.0313	.75	10.8742	0.13527	1.507	.875	10.9222	0.11228
0.01005	.75	1.7261	0.50945	2.2563	.75	10.8678	0.14939	1.657	.875	10.9028	0.12600
0.01192	.75	1.68227	0.48285	0.007	.875	1.7292	0.49570	1.807	.875	10.9031	0.12282
0.0138	.75	1.81278	0.52120	0.00887	.875	1.70463	0.49577	2.032	.875	10.8909	0.13429
0.01755	.75	3.09509	0.92699	0.01075	.875	1.68965	0.48203	2.257	.875	10.8643	0.14341
0.0213	.75	4.29164	1.14999	0.01262	.875	1.67393	0.47842	0.0077	1.	1.69652	0.48299
0.02505	.75	5.14739	1.22908	0.0145	.875	1.69798	0.48745	0.00957	1.	1.64034	0.48279
0.0288	.75	5.75047	1.26159	0.01825	.875	2.90604	0.89385	0.01145	1.	1.6361	0.46930
0.03255	.75	6.24225	1.26717	0.022	.875	4.05564	1.15574	0.01332	1.	1.60571	0.45484
0.0363	.75	6.60854	1.25222	0.02575	.875	4.93747	1.27012	0.0152	1.	1.60119	0.46313
0.04005	.75	6.94953	1.23606	0.0295	.875	5.53617	1.28116	0.01895	1.	2.61958	0.83144
0.0438	.75	7.15182	1.2377	0.03325	.875	6.02421	1.26627	0.0227	1.	3.74511	1.15662
0.0513	.75	7.55388	1.14608	0.037	.875	6.39522	1.25622	0.02645	1.	4.61281	1.23486
0.0588	.75	7.80759	1.06624	0.04075	.875	6.66416	1.2234	0.0302	1.	5.27508	1.24811

0.03395	1.	5.70651	1.24666
0.0377	1.	6.01982	1.27163
0.04145	1.	6.29915	1.19818
0.0452	1.	6.59198	1.19834
0.0527	1.	6.94241	1.17937
0.0602	1.	7.22945	1.10792
0.0677	1.	7.42846	1.0451
0.0752	1.	7.67994	0.98678
0.0827	1.	7.84094	0.94904
0.0902	1.	7.95245	0.93207
0.0977	1.	8.09193	0.88770
0.1052	1.	8.14984	0.90997
0.1127	1.	8.31218	0.82742
0.1202	1.	8.37107	0.83062
0.1277	1.	8.50735	0.79013
0.1427	1.	8.67993	0.77917
0.1577	1.	8.78787	0.74721
0.1727	1.	8.99146	0.73444
0.1877	1.	9.06419	0.70816
0.2027	1.	9.16898	0.73046
0.2177	1.	9.3219	0.69571
0.2327	1.	9.43529	0.67144
0.2627	1.	9.64129	0.63324
0.2927	1.	9.83442	0.60863
0.3227	1.	9.97291	0.57243
0.3527	1.	10.1279	0.56658
0.3827	1.	10.2826	0.52271
0.4277	1.	10.4982	0.46489
0.4727	1.	10.6371	0.39626
0.5177	1.	10.7668	0.34525
0.5627	1.	10.8373	0.26249
0.6077	1.	10.8933	0.21467
0.6527	1.	10.9083	0.18344
0.6977	1.	10.9146	0.15066
0.7427	1.	10.9361	0.13485
0.7877	1.	10.9526	0.12417
0.8327	1.	10.946	0.11434
0.9077	1.	10.9405	0.11135
1.0577	1.	10.9233	0.10669
1.2077	1.	10.9279	0.10876
1.3577	1.	10.926	0.10941
1.5077	1.	10.9095	0.11681
1.6577	1.	10.9101	0.12338
1.8077	1.	10.9046	0.12369
2.0327	1.	10.8838	0.13321
2.2577	1.	10.8552	0.14808
0.0084	1.125	1.57234	0.48005
0.01027	1.125	1.52693	0.45768
0.01215	1.125	1.53216	0.44153
0.01402	1.125	1.54674	0.44687
0.0159	1.125	1.61142	0.47347
0.01965	1.125	2.39895	0.77677
0.0234	1.125	3.4883	1.07733
0.02715	1.125	4.35006	1.21008
0.0309	1.125	5.06634	1.24225
0.03465	1.125	5.50791	1.24427
0.0384	1.125	5.88974	1.25643
0.04215	1.125	6.12338	1.20651
0.0459	1.125	6.37596	1.20638
0.0534	1.125	6.72742	1.16022
0.0609	1.125	7.06406	1.11313
0.0684	1.125	7.23091	1.0511
0.0759	1.125	7.44224	1.02591
0.0834	1.125	7.59869	0.98224
0.0909	1.125	7.78486	0.93403
0.0984	1.125	7.91042	0.94314
0.1059	1.125	7.99903	0.91944
0.1134	1.125	8.11464	0.86254
0.1209	1.125	8.23664	0.82833
0.1284	1.125	8.35957	0.81330
0.1434	1.125	8.51827	0.77272
0.1584	1.125	8.68254	0.77422
0.1734	1.125	8.78664	0.76028
0.1884	1.125	8.93386	0.72755
0.2034	1.125	9.02543	0.69266
0.2184	1.125	9.18116	0.69824
0.2334	1.125	9.28714	0.70191
0.2634	1.125	9.48909	0.64689
0.2934	1.125	9.70974	0.61754
0.3234	1.125	9.8949	0.58642
0.3534	1.125	10.0382	0.57085
0.3834	1.125	10.1901	0.5475
0.4284	1.125	10.412	0.49342
0.4734	1.125	10.6002	0.43884
0.5184	1.125	10.7286	0.37852
0.5634	1.125	10.8516	0.31156
0.6084	1.125	10.9118	0.23090
0.6534	1.125	10.9536	0.18304
0.6984	1.125	10.9571	0.15459
0.7434	1.125	10.9844	0.13347
0.7884	1.125	10.9837	0.12234
0.8334	1.125	10.9721	0.11446
0.9084	1.125	10.9664	0.11141
1.0584	1.125	10.9638	0.10647
1.2084	1.125	10.9505	0.11073
1.3584	1.125	10.9383	0.11066
1.5084	1.125	10.9171	0.11722
1.6584	1.125	10.916	0.12285
1.8084	1.125	10.8991	0.12760
2.0334	1.125	10.8827	0.13512
2.2584	1.125	10.8628	0.14236
0.0091	1.25	1.65234	0.48480
0.01097	1.25	1.60454	0.47142
0.01285	1.25	1.5884	0.46534
0.01472	1.25	1.58677	0.45497
0.0166	1.25	1.59187	0.44783
0.02035	1.25	2.20135	0.68793
0.0241	1.25	3.30303	1.00372
0.02785	1.25	4.3458	1.16907
0.0316	1.25	5.02275	1.27137
0.03535	1.25	5.49203	1.22757
0.0391	1.25	5.81233	1.24992
0.04285	1.25	6.16271	1.2275
0.0466	1.25	6.38579	1.23134
0.0541	1.25	6.79744	1.15452
0.0616	1.25	7.07534	1.08966
0.0691	1.25	7.27972	1.09004
0.0766	1.25	7.46216	1.01993
0.0841	1.25	7.62855	0.98530
0.0916	1.25	7.75207	0.96271
0.0991	1.25	7.91799	0.89650
0.1066	1.25	8.04222	0.90328
0.1141	1.25	8.15385	0.85994
0.1216	1.25	8.25707	0.85522
0.1291	1.25	8.37359	0.84992
0.1441	1.25	8.49475	0.80792
0.1591	1.25	8.6884	0.76474
0.1741	1.25	8.81127	0.73344
0.1891	1.25	8.95955	0.70574
0.2041	1.25	9.08241	0.70965
0.2191	1.25	9.19648	0.69244
0.2341	1.25	9.29616	0.68673
0.2641	1.25	9.51678	0.64628
0.2941	1.25	9.70048	0.61040
0.3241	1.25	9.89851	0.58729
0.3541	1.25	10.0679	0.57362
0.3841	1.25	10.2028	0.55274
0.4291	1.25	10.4195	0.48433
0.4741	1.25	10.6015	0.42490
0.5191	1.25	10.7282	0.34739
0.5641	1.25	10.8211	0.29756
0.6091	1.25	10.8865	0.22724
0.6541	1.25	10.9138	0.18387
0.6991	1.25	10.9383	0.15112
0.7441	1.25	10.9457	0.12267
0.7891	1.25	10.9554	0.11787
0.8341	1.25	10.9454	0.11808
0.9091	1.25	10.9443	0.11906
1.0591	1.25	10.9256	0.11045
1.2091	1.25	10.9172	0.11569
1.3591	1.25	10.9079	0.10885
1.5091	1.25	10.8914	0.11419
1.6591	1.25	10.885	0.12669
1.8091	1.25	10.8834	0.12298
2.0341	1.25	10.8532	0.13085
2.2591	1.25	10.8185	0.14899

Run ID: 040896

VR=0.995
Uo=10.99 m/s
x/D=2.5 FSTI=0.5%
L/D=2.3

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.61637	0.40739
0.00187	-0.375	2.024	0.60163
0.00375	-0.375	2.74176	0.78601
0.00562	-0.375	3.45616	0.92627
0.0075	-0.375	4.22152	1.10975
0.01125	-0.375	5.46672	1.21216
0.015	-0.375	6.36802	1.26115
0.01875	-0.375	7.05352	1.22462
0.0225	-0.375	7.54312	1.2044
0.02625	-0.375	7.87337	1.18245
0.03	-0.375	8.15063	1.16254
0.03375	-0.375	8.37545	1.10579
0.0375	-0.375	8.48967	1.05293
0.045	-0.375	8.77787	1.07464
0.0525	-0.375	9.00305	1.102
0.06	-0.375	9.19515	1.06129
0.0675	-0.375	9.3837	1.07803
0.075	-0.375	9.5509	1.07288
0.0825	-0.375	9.67365	1.13718
0.09	-0.375	9.81509	1.17615
0.0975	-0.375	9.96821	1.15743
0.105	-0.375	10.1839	1.25582
0.1125	-0.375	10.2399	1.20466
0.12	-0.375	10.4156	1.28443
0.135	-0.375	10.6458	1.34228
0.15	-0.375	10.831	1.37925
0.165	-0.375	11.09	1.43485
0.18	-0.375	11.1925	1.49958
0.195	-0.375	11.4599	1.47546
0.21	-0.375	11.4485	1.53714
0.225	-0.375	11.6336	1.5392
0.255	-0.375	11.736	1.64722
0.285	-0.375	11.9411	1.60762
0.315	-0.375	12.1264	1.70368
0.345	-0.375	12.4419	1.61127
0.375	-0.375	12.7388	1.61935
0.42	-0.375	12.934	1.57048
0.465	-0.375	12.9891	1.51014
0.51	-0.375	12.8334	1.53409
0.555	-0.375	12.4304	1.42768
0.6	-0.375	12.0337	1.31542
0.645	-0.375	11.6554	1.10663
0.69	-0.375	11.4156	0.96643
0.735	-0.375	11.2799	0.74282
0.78	-0.375	11.1675	0.57914
0.825	-0.375	11.1749	0.42787
0.9	-0.375	11.1246	0.28508
1.05	-0.375	11.0959	0.12870
1.2	-0.375	11.0655	0.10167
1.35	-0.375	11.0222	0.09905
1.5	-0.375	11.0062	0.09407
1.65	-0.375	10.9798	0.09559
1.8	-0.375	10.9556	0.09250
2.025	-0.375	10.9159	0.10426
2.25	-0.375	10.8856	0.11339
0.0007	-0.25	1.43131	0.51137
0.00257	-0.25	1.73732	0.66166
0.00445	-0.25	2.24041	0.88018
0.00632	-0.25	2.77531	1.09365
0.0082	-0.25	3.26984	1.20438
0.01195	-0.25	4.27311	1.39669
0.0157	-0.25	5.24865	1.51855
0.01945	-0.25	5.91554	1.50979
0.0232	-0.25	6.53271	1.56719
0.02695	-0.25	6.99998	1.50035
0.0307	-0.25	7.38174	1.41896
0.03445	-0.25	7.71503	1.40951
0.0382	-0.25	8.04006	1.38954
0.0457	-0.25	8.4505	1.30762
0.0532	-0.25	8.72938	1.27271
0.0607	-0.25	8.95519	1.2158
0.0682	-0.25	9.164	1.19907
0.0757	-0.25	9.34606	1.21611
0.0832	-0.25	9.49295	1.19594
0.0907	-0.25	9.59478	1.21156
0.0982	-0.25	9.74873	1.27276
0.1057	-0.25	9.79184	1.22957
0.1132	-0.25	9.89248	1.29567
0.1207	-0.25	9.97771	1.34314
0.1357	-0.25	10.1569	1.39803
0.1507	-0.25	10.2081	1.42118
0.1657	-0.25	10.2137	1.49863
0.1807	-0.25	10.1771	1.58872
0.1957	-0.25	10.2513	1.66599
0.2107	-0.25	10.1122	1.69431
0.2257	-0.25	9.98623	1.79715
0.2557	-0.25	9.85402	1.83695
0.2857	-0.25	9.86704	1.93135
0.3157	-0.25	10.0701	2.00616
0.3457	-0.25	10.6494	2.09277
0.3757	-0.25	11.1187	2.14277
0.4207	-0.25	11.8471	2.05851
0.4657	-0.25	12.5542	1.90636
0.5107	-0.25	12.8904	1.7288
0.5557	-0.25	12.9472	1.6298
0.6007	-0.25	12.7039	1.51408
0.6457	-0.25	12.3337	1.41904
0.6907	-0.25	11.8803	1.21448
0.7357	-0.25	11.5894	1.04894
0.7807	-0.25	11.3611	0.82385
0.8257	-0.25	11.2694	0.61019
0.9007	-0.25	11.167	0.41097
1.0507	-0.25	11.158	0.15983
1.2007	-0.25	11.1094	0.11396
1.3507	-0.25	11.0805	0.10072
1.5007	-0.25	11.0571	0.09940
1.6507	-0.25	11.0278	0.09902
1.8007	-0.25	10.9964	0.09486
2.0257	-0.25	10.9584	0.10394
2.2507	-0.25	10.9415	0.09748
0.0014	-0.125	1.68261	0.65023
0.00327	-0.125	2.08837	0.86953
0.00515	-0.125	2.54651	1.014
0.00702	-0.125	3.01277	1.1267
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0.01265	-0.125	4.01514	1.28017
0.0164	-0.125	4.56111	1.35861
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0.0239	-0.125	5.25384	1.40746
0.02765	-0.125	5.49156	1.43007
0.0314	-0.125	5.81959	1.50751
0.03515	-0.125	5.98282	1.51873
0.0389	-0.125	6.23387	1.52169
0.0464	-0.125	6.66096	1.57784
0.0539	-0.125	7.08113	1.55575
0.0614	-0.125	7.40851	1.60982
0.0689	-0.125	7.78022	1.57548
0.0764	-0.125	8.012	1.5102
0.0839	-0.125	8.19164	1.4937
0.0914	-0.125	8.42394	1.5059
0.0989	-0.125	8.54348	1.45106
0.1064	-0.125	8.61031	1.48633
0.1139	-0.125	8.76764	1.42407
0.1214	-0.125	8.73959	1.42304
0.1364	-0.125	8.79188	1.44911
0.1514	-0.125	8.72051	1.41051
0.1664	-0.125	8.64504	1.51897
0.1814	-0.125	8.56474	1.44774
0.1964	-0.125	8.39674	1.53779
0.2114	-0.125	8.26164	1.54949
0.2264	-0.125	8.12466	1.62594
0.2564	-0.125	7.8751	1.57119
0.2864	-0.125	7.78344	1.62732
0.3164	-0.125	7.95999	1.79767
0.3464	-0.125	8.33051	1.91941
0.3764	-0.125	8.91037	2.14194

0.4214	-0.125	10.1105	2.25889
0.4664	-0.125	11.1965	2.16844
0.5114	-0.125	12.1953	1.97113
0.5564	-0.125	12.6755	1.83943
0.6014	-0.125	12.863	1.63464
0.6464	-0.125	12.6148	1.51111
0.6914	-0.125	12.203	1.38478
0.7364	-0.125	11.8435	1.17543
0.7814	-0.125	11.5512	0.99485
0.8264	-0.125	11.3461	0.74170
0.9014	-0.125	11.229	0.45876
1.0514	-0.125	11.1703	0.17878
1.2014	-0.125	11.131	0.12383
1.3514	-0.125	11.1111	0.10622
1.5014	-0.125	11.0785	0.10228
1.6514	-0.125	11.0585	0.10446
1.8014	-0.125	11.0241	0.10125
2.0264	-0.125	10.9849	0.10371
2.2514	-0.125	10.9642	0.10677
0.0021	0	1.97797	0.72099
0.00397	0	2.47286	0.90359
0.00585	0	3.07414	1.06638
0.00772	0	3.50215	1.15915
0.0096	0	3.94821	1.2044
0.01335	0	4.53212	1.22295
0.0171	0	4.8204	1.20358
0.02085	0	5.13666	1.21025
0.0246	0	5.37664	1.1894
0.02835	0	5.46728	1.18477
0.0321	0	5.58499	1.22856
0.03585	0	5.72345	1.21992
0.0396	0	5.83182	1.23622
0.0471	0	5.98348	1.28703
0.0546	0	6.149	1.30784
0.0621	0	6.31856	1.29343
0.0696	0	6.49998	1.34995
0.0771	0	6.68875	1.33616
0.0846	0	6.81046	1.34609
0.0921	0	6.90007	1.40157
0.0996	0	7.07389	1.38477
0.1071	0	7.24079	1.39035
0.1146	0	7.33992	1.37768
0.1221	0	7.40905	1.38532
0.1371	0	7.59563	1.38264
0.1521	0	7.68606	1.34483
0.1671	0	7.70477	1.35205
0.1821	0	7.73705	1.29518
0.1971	0	7.81844	1.36877
0.2121	0	7.6842	1.39854
0.2271	0	7.65974	1.36337
0.2571	0	7.54109	1.40306
0.2871	0	7.48293	1.48013
0.3171	0	7.57758	1.61246
0.3471	0	7.88218	1.79481
0.3771	0	8.49085	1.96264
0.4221	0	9.56912	2.13267
0.4671	0	10.8241	2.06699
0.5121	0	11.8546	1.99079
0.5571	0	12.5669	1.79052
0.6021	0	12.7819	1.68679
0.6471	0	12.6817	1.49774
0.6921	0	12.3457	1.38563
0.7371	0	11.8989	1.21126
0.7821	0	11.6217	1.01151
0.8271	0	11.4072	0.83002
0.9021	0	11.2576	0.48626
1.0521	0	11.1956	0.18291
1.2021	0	11.1493	0.11897
1.3521	0	11.1304	0.10881
1.5021	0	11.0982	0.10632
1.6521	0	11.0777	0.10787
1.8021	0	11.0479	0.10461
2.0271	0	11.0166	0.10790
2.2521	0	10.9872	0.11009
0.0028	0.125	1.41782	0.62606
0.00467	0.125	1.73049	0.78072
0.00655	0.125	2.11147	0.95537
0.00842	0.125	2.49742	1.07777
0.0103	0.125	2.77985	1.13962
0.01405	0.125	3.3694	1.20311
0.0178	0.125	3.85162	1.31861
0.02155	0.125	4.22171	1.36032
0.0253	0.125	4.62715	1.36626
0.02905	0.125	4.88441	1.5097
0.0328	0.125	5.17338	1.5449
0.03655	0.125	5.49832	1.58869
0.0403	0.125	5.71872	1.65164
0.0478	0.125	6.30027	1.74543
0.0553	0.125	6.83045	1.77846
0.0628	0.125	7.3105	1.7953
0.0703	0.125	7.61713	1.72408
0.0778	0.125	8.01003	1.66267
0.0853	0.125	8.31942	1.60533
0.0928	0.125	8.57691	1.57209
0.1003	0.125	8.80347	1.5464
0.1078	0.125	8.97826	1.52778
0.1153	0.125	9.16378	1.48094
0.1228	0.125	9.30214	1.44683
0.1378	0.125	9.42906	1.43203
0.1528	0.125	9.59488	1.46613
0.1678	0.125	9.49035	1.52687
0.1828	0.125	9.51703	1.56127
0.1978	0.125	9.24955	1.60408
0.2128	0.125	9.20713	1.63864
0.2278	0.125	8.99914	1.71001
0.2578	0.125	8.80586	1.76667
0.2878	0.125	8.75509	1.86564
0.3178	0.125	8.92342	2.00026
0.3478	0.125	9.33747	2.08489
0.3778	0.125	9.84586	2.13611
0.4228	0.125	10.8861	2.2116
0.4678	0.125	11.793	2.01897
0.5128	0.125	12.5396	1.85441
0.5578	0.125	12.9014	1.67468
0.6028	0.125	12.8891	1.57898
0.6478	0.125	12.5845	1.46376
0.6928	0.125	12.2207	1.30318
0.7378	0.125	11.8175	1.10889
0.7828	0.125	11.556	0.9174
0.8278	0.125	11.3868	0.74689
0.9028	0.125	11.324	0.43825
1.0528	0.125	11.2432	0.17558
1.2028	0.125	11.2225	0.12349
1.3528	0.125	11.1925	0.10898
1.5028	0.125	11.1554	0.10184
1.6528	0.125	11.1393	0.10793
1.8028	0.125	11.1109	0.10841
2.0278	0.125	11.0747	0.10988
2.2528	0.125	11.0385	0.11754
0.0035	0.25	1.50118	0.59230
0.00537	0.25	1.92569	0.80863
0.00725	0.25	2.42941	1.01226
0.00912	0.25	3.04555	1.26413
0.011	0.25	3.56049	1.41272
0.01475	0.25	4.70346	1.52339
0.0185	0.25	5.62026	1.65088
0.02225	0.25	6.32835	1.65313
0.026	0.25	6.96979	1.59887
0.02975	0.25	7.4669	1.58387
0.0335	0.25	7.86591	1.54022
0.03725	0.25	8.19162	1.49766
0.041	0.25	8.37797	1.42482
0.0485	0.25	8.89574	1.35247
0.056	0.25	9.1411	1.29051
0.0635	0.25	9.46538	1.33538
0.071	0.25	9.65612	1.32189
0.0785	0.25	9.84043	1.35783
0.086	0.25	9.9768	1.39522
0.0935	0.25	10.1637	1.40764
0.101	0.25	10.1846	1.39291
0.1085	0.25	10.3095	1.47608
0.116	0.25	10.4038	1.43709
0.1235	0.25	10.5158	1.48753
0.1385	0.25	10.5664	1.51256
0.1535	0.25	10.6126	1.54303
0.1685	0.25	10.7384	1.65977

0.1835	0.25	10.6355	1.58068
0.1985	0.25	10.5122	1.70216
0.2135	0.25	10.5236	1.68092
0.2285	0.25	10.5275	1.77333
0.2585	0.25	10.5508	1.86753
0.2885	0.25	10.8177	2.01901
0.3185	0.25	11.1998	2.05597
0.3485	0.25	11.7242	2.0316
0.3785	0.25	12.1851	1.99032
0.4235	0.25	12.7438	1.92919
0.4685	0.25	13.1889	1.77918
0.5135	0.25	13.2424	1.64321
0.5585	0.25	13.0435	1.56518
0.6035	0.25	12.7428	1.48386
0.6485	0.25	12.2701	1.32245
0.6935	0.25	11.8919	1.13118
0.7385	0.25	11.5977	0.93406
0.7835	0.25	11.4129	0.74945
0.8285	0.25	11.344	0.57385
0.9035	0.25	11.3314	0.36672
1.0535	0.25	11.2809	0.15914
1.2035	0.25	11.2267	0.11980
1.3535	0.25	11.1992	0.10877
1.5035	0.25	11.1767	0.10935
1.6535	0.25	11.1472	0.10341
1.8035	0.25	11.1194	0.10873
2.0285	0.25	11.0831	0.10995
2.2535	0.25	11.0465	0.11539
0.0042	0.375	1.90831	0.57641
0.00607	0.375	2.44788	0.77161
0.00795	0.375	3.24049	0.9544
0.00982	0.375	4.03366	1.07414
0.0117	0.375	4.8389	1.19226
0.01545	0.375	6.13103	1.24565
0.0192	0.375	7.02721	1.31439
0.02295	0.375	7.59462	1.3257
0.0267	0.375	8.00895	1.27171
0.03045	0.375	8.28981	1.2457
0.0342	0.375	8.63546	1.25321
0.03795	0.375	8.77465	1.25166
0.0417	0.375	9.00317	1.26448
0.0492	0.375	9.28721	1.2172
0.0567	0.375	9.61386	1.29733
0.0642	0.375	9.84798	1.33363
0.0717	0.375	10.0481	1.36037
0.0792	0.375	10.2609	1.42401
0.0867	0.375	10.4495	1.40233
0.0942	0.375	10.6181	1.46509
0.1017	0.375	10.8133	1.48165
0.1092	0.375	10.9902	1.49644
0.1167	0.375	11.1361	1.52645
0.1242	0.375	11.2148	1.56381
0.1392	0.375	11.4023	1.55521
0.1542	0.375	11.5649	1.66612
0.1692	0.375	11.7437	1.60239
0.1842	0.375	11.7356	1.6176
0.1992	0.375	11.8926	1.66379
0.2142	0.375	11.9088	1.69521
0.2292	0.375	12.0185	1.67304
0.2592	0.375	12.1771	1.65896
0.2892	0.375	12.4571	1.70105
0.3192	0.375	12.8674	1.70305
0.3492	0.375	13.1977	1.64443
0.3792	0.375	13.4494	1.5984
0.4242	0.375	13.6881	1.50721
0.4692	0.375	13.5144	1.55733
0.5142	0.375	13.1088	1.56942
0.5592	0.375	12.6295	1.43777
0.6042	0.375	12.2203	1.24579
0.6492	0.375	11.806	1.06506
0.6942	0.375	11.567	0.86578
0.7392	0.375	11.4266	0.69836
0.7842	0.375	11.381	0.53034
0.8292	0.375	11.3515	0.38310
0.9042	0.375	11.3334	0.24114
1.0542	0.375	11.2942	0.13852
1.2042	0.375	11.2617	0.11549
1.3542	0.375	11.2157	0.11234
1.5042	0.375	11.1792	0.10796
1.6542	0.375	11.1569	0.10727
1.8042	0.375	11.1368	0.10980
2.0292	0.375	11.0917	0.11225
2.2542	0.375	11.053	0.11320
0.0049	0.5	1.89734	0.44390
0.00677	0.5	2.48126	0.66251
0.00865	0.5	3.29615	0.81654
0.01052	0.5	4.13266	0.98151
0.0124	0.5	4.90325	1.06561
0.01615	0.5	6.15913	1.17736
0.0199	0.5	6.98126	1.19348
0.02365	0.5	7.50849	1.1664
0.0274	0.5	7.94063	1.13937
0.03115	0.5	8.17612	1.10198
0.0349	0.5	8.39926	1.1032
0.03865	0.5	8.59091	1.01653
0.0424	0.5	8.72275	1.03465
0.0499	0.5	8.93389	0.99651
0.0574	0.5	9.13894	0.99579
0.0649	0.5	9.3682	1.02626
0.0724	0.5	9.58656	1.05008
0.0799	0.5	9.71447	1.09586
0.0874	0.5	9.91689	1.10232
0.0949	0.5	10.0624	1.1116
0.1024	0.5	10.2689	1.2031
0.1099	0.5	10.4041	1.21879
0.1174	0.5	10.6285	1.28732
0.1249	0.5	10.789	1.27821
0.1399	0.5	11.0634	1.38396
0.1549	0.5	11.3161	1.4245
0.1699	0.5	11.6253	1.44448
0.1849	0.5	11.8906	1.44005
0.1999	0.5	12.1227	1.4845
0.2149	0.5	12.3759	1.51383
0.2299	0.5	12.4462	1.50252
0.2599	0.5	12.7303	1.48564
0.2899	0.5	12.9736	1.45989
0.3199	0.5	13.0448	1.4469
0.3499	0.5	13.0655	1.50919
0.3799	0.5	12.9723	1.48474
0.4249	0.5	12.7377	1.48577
0.4699	0.5	12.4119	1.40618
0.5149	0.5	12.0471	1.25788
0.5599	0.5	11.7894	1.06815
0.6049	0.5	11.5093	0.85584
0.6499	0.5	11.381	0.68270
0.6949	0.5	11.3666	0.56758
0.7399	0.5	11.369	0.43139
0.7849	0.5	11.3553	0.32556
0.8299	0.5	11.3515	0.2523
0.9049	0.5	11.3411	0.17623
1.0549	0.5	11.291	0.13326
1.2049	0.5	11.2648	0.11879
1.3549	0.5	11.2347	0.10606
1.5049	0.5	11.2001	0.10907
1.6549	0.5	11.1645	0.10893
1.8049	0.5	11.1329	0.11242
2.0299	0.5	11.1024	0.11314
2.2549	0.5	11.0701	0.11999
0.0056	0.625	1.89473	0.45973
0.00747	0.625	2.41305	0.61666
0.00935	0.625	3.16675	0.81236
0.01122	0.625	3.96572	0.98475
0.0131	0.625	4.71545	1.11808
0.01685	0.625	5.89699	1.19686
0.0206	0.625	6.70558	1.25075
0.02435	0.625	7.27056	1.20819
0.0281	0.625	7.67078	1.14935
0.03185	0.625	7.99138	1.10769
0.0356	0.625	8.12572	1.04586
0.03935	0.625	8.33496	0.96910
0.0431	0.625	8.46592	0.97960
0.0506	0.625	8.73197	0.92263
0.0581	0.625	8.88955	0.85854
0.0656	0.625	9.00829	0.85827
0.0731	0.625	9.19838	0.82350
0.0806	0.625	9.25894	0.82421

0.0881	0.625	9.36104	0.81325
0.0956	0.625	9.50328	0.80742
0.1031	0.625	9.6374	0.80943
0.1106	0.625	9.66957	0.79764
0.1181	0.625	9.77975	0.80970
0.1256	0.625	9.8719	0.80581
0.1406	0.625	10.0629	0.83568
0.1556	0.625	10.2429	0.83208
0.1706	0.625	10.4254	0.88378
0.1856	0.625	10.5621	0.88404
0.2006	0.625	10.6853	0.91694
0.2156	0.625	10.8351	0.97217
0.2306	0.625	10.9094	0.97876
0.2606	0.625	11.1752	0.99569
0.2906	0.625	11.2835	1.00086
0.3206	0.625	11.4338	1.05604
0.3506	0.625	11.4379	1.01858
0.3806	0.625	11.4785	1.04087
0.4256	0.625	11.4282	0.92566
0.4706	0.625	11.3347	0.78838
0.5156	0.625	11.3426	0.69059
0.5606	0.625	11.3116	0.62039
0.6056	0.625	11.344	0.51222
0.6506	0.625	11.3607	0.38670
0.6956	0.625	11.3778	0.32245
0.7406	0.625	11.3792	0.24571
0.7856	0.625	11.3938	0.20850
0.8306	0.625	11.3805	0.16391
0.9056	0.625	11.3598	0.13811
1.0556	0.625	11.3298	0.11536
1.2056	0.625	11.2894	0.113
1.3556	0.625	11.2613	0.10652
1.5056	0.625	11.2095	0.11225
1.6556	0.625	11.1753	0.11045
1.8056	0.625	11.1518	0.10848
2.0306	0.625	11.1052	0.11682
2.2556	0.625	11.0587	0.11494
0.0063	0.75	1.79487	0.43847
0.00817	0.75	2.29071	0.6281
0.01005	0.75	3.02633	0.81498
0.01192	0.75	3.80979	1.02903
0.0138	0.75	4.53955	1.12708
0.01755	0.75	5.68223	1.21924
0.0213	0.75	6.43229	1.28379
0.02505	0.75	7.03543	1.23288
0.0288	0.75	7.40383	1.17474
0.03255	0.75	7.69402	1.16665
0.0363	0.75	7.86475	1.09465
0.04005	0.75	8.0968	1.02937
0.0438	0.75	8.23268	0.97876
0.0513	0.75	8.43005	0.92849
0.0588	0.75	8.62492	0.87502
0.0663	0.75	8.75654	0.84951
0.0738	0.75	8.90689	0.79819
0.0813	0.75	8.97622	0.77595
0.0888	0.75	9.11433	0.78226
0.0963	0.75	9.20742	0.7473
0.1038	0.75	9.25797	0.73891
0.1113	0.75	9.33876	0.7574
0.1188	0.75	9.43874	0.75396
0.1263	0.75	9.51252	0.7295
0.1413	0.75	9.65819	0.73794
0.1563	0.75	9.81358	0.69031
0.1713	0.75	9.90552	0.68479
0.1863	0.75	10.0522	0.66779
0.2013	0.75	10.1304	0.67286
0.2163	0.75	10.2409	0.65658
0.2313	0.75	10.3124	0.65764
0.2613	0.75	10.4768	0.63879
0.2913	0.75	10.6069	0.61201
0.3213	0.75	10.7386	0.60658
0.3513	0.75	10.8333	0.56904
0.3813	0.75	10.9447	0.55943
0.4263	0.75	11.043	0.52462
0.4713	0.75	11.1453	0.48146
0.5163	0.75	11.2184	0.42907
0.5613	0.75	11.3041	0.34878
0.6063	0.75	11.3389	0.30188
0.6513	0.75	11.356	0.24054
0.6963	0.75	11.3771	0.19590
0.7413	0.75	11.3814	0.16357
0.7863	0.75	11.3683	0.14061
0.8313	0.75	11.3564	0.13211
0.9063	0.75	11.3204	0.12231
1.0563	0.75	11.2798	0.11102
1.2063	0.75	11.2387	0.11282
1.3563	0.75	11.2116	0.10493
1.5063	0.75	11.1791	0.10112
1.6563	0.75	11.15	0.10588
1.8063	0.75	11.1232	0.10930
2.0313	0.75	11.0795	0.10929
2.2563	0.75	11.0473	0.11697
0.007	0.875	1.75281	0.45745
0.00887	0.875	2.24428	0.65701
0.01075	0.875	2.95559	0.84915
0.01262	0.875	3.62919	1.02656
0.0145	0.875	4.37012	1.17791
0.01825	0.875	5.44648	1.32327
0.022	0.875	6.18337	1.34114
0.02575	0.875	6.72791	1.25428
0.0295	0.875	7.16703	1.25759
0.03325	0.875	7.51186	1.15086
0.037	0.875	7.73056	1.12311
0.04075	0.875	7.92914	1.06838
0.0445	0.875	8.09943	1.05257
0.052	0.875	8.33511	0.95788
0.0595	0.875	8.49827	0.91036
0.067	0.875	8.66141	0.85209
0.0745	0.875	8.75522	0.83245
0.082	0.875	8.8635	0.80523
0.0895	0.875	8.93918	0.78502
0.097	0.875	9.04114	0.77584
0.1045	0.875	9.094	0.79206
0.112	0.875	9.18185	0.74593
0.1195	0.875	9.26925	0.74654
0.127	0.875	9.35432	0.73367
0.142	0.875	9.46471	0.72872
0.157	0.875	9.6298	0.71515
0.172	0.875	9.71928	0.71217
0.187	0.875	9.83306	0.69201
0.202	0.875	9.93433	0.67076
0.217	0.875	10.0435	0.65646
0.232	0.875	10.1259	0.65208
0.262	0.875	10.3018	0.61837
0.292	0.875	10.4692	0.61675
0.322	0.875	10.6097	0.58353
0.352	0.875	10.7385	0.55435
0.382	0.875	10.8636	0.52878
0.427	0.875	11.0258	0.47401
0.472	0.875	11.1756	0.40697
0.517	0.875	11.2486	0.35858
0.562	0.875	11.3351	0.28263
0.607	0.875	11.372	0.21293
0.652	0.875	11.395	0.18407
0.697	0.875	11.4052	0.14279
0.742	0.875	11.3917	0.13045
0.787	0.875	11.3832	0.12255
0.832	0.875	11.3748	0.11494
0.907	0.875	11.3396	0.11084
1.057	0.875	11.2848	0.11291
1.207	0.875	11.2506	0.10490
1.357	0.875	11.2244	0.10134
1.507	0.875	11.1739	0.10460
1.657	0.875	11.141	0.10840
1.807	0.875	11.1091	0.10158
2.032	0.875	11.0782	0.10887
2.257	0.875	11.0307	0.11846
0.0077	1	1.70263	0.44428
0.00957	1	2.10223	0.61698
0.01145	1	2.79649	0.82866
0.01332	1	3.43586	1.01655
0.0152	1	4.13107	1.16812
0.01895	1	5.11826	1.31574
0.0227	1	5.92431	1.32216
0.02645	1	6.47048	1.33385
0.0302	1	6.93832	1.23752

0.03395	1	7.26809	1.17821
0.0377	1	7.40094	1.15033
0.04145	1	7.63319	1.07116
0.0452	1	7.7878	1.05778
0.0527	1	8.02447	0.96358
0.0602	1	8.20489	0.86982
0.0677	1	8.36847	0.84849
0.0752	1	8.44284	0.82300
0.0827	1	8.59231	0.80645
0.0902	1	8.65213	0.77275
0.0977	1	8.75117	0.77499
0.1052	1	8.82511	0.74964
0.1127	1	8.90627	0.75943
0.1202	1	8.9825	0.7637
0.1277	1	9.00445	0.73179
0.1427	1	9.17755	0.74022
0.1577	1	9.29904	0.71090
0.1727	1	9.40374	0.72059
0.1877	1	9.52683	0.70484
0.2027	1	9.62073	0.72047
0.2177	1	9.72958	0.69842
0.2327	1	9.83657	0.69105
0.2627	1	10.003	0.65659
0.2927	1	10.1974	0.63813
0.3227	1	10.3587	0.62348
0.3527	1	10.4816	0.60375
0.3827	1	10.6495	0.57722
0.4277	1	10.8446	0.52655
0.4727	1	11.008	0.46416
0.5177	1	11.1295	0.40009
0.5627	1	11.2302	0.33376
0.6077	1	11.2929	0.25162
0.6527	1	11.3289	0.18965
0.6977	1	11.3428	0.15961
0.7427	1	11.3518	0.12555
0.7877	1	11.3293	0.12778
0.8327	1	11.32	0.11301
0.9077	1	11.2853	0.11791
1.0577	1	11.2604	0.10490
1.2077	1	11.2124	0.11228
1.3577	1	11.191	0.09735
1.5077	1	11.1526	0.10286
1.6577	1	11.1195	0.10603
1.8077	1	11.0942	0.10445
2.0327	1	11.0525	0.10285
2.2577	1	11.0168	0.11720
0.0084	1.125	1.6014	0.42568
0.01027	1.125	1.93276	0.59337
0.01215	1.125	2.58557	0.79079
0.01402	1.125	3.23651	1.01313
0.0159	1.125	3.84808	1.13949
0.01965	1.125	4.87502	1.25734
0.0234	1.125	5.64744	1.33205
0.02715	1.125	6.20821	1.27786
0.0309	1.125	6.61245	1.25311
0.03465	1.125	6.88302	1.20411
0.0384	1.125	7.17316	1.14413
0.04215	1.125	7.3404	1.08269
0.0459	1.125	7.5158	1.03578
0.0534	1.125	7.74468	0.98501
0.0609	1.125	7.93173	0.87613
0.0684	1.125	8.09911	0.86711
0.0759	1.125	8.19891	0.83995
0.0834	1.125	8.32225	0.80119
0.0909	1.125	8.3975	0.78130
0.0984	1.125	8.47796	0.77097
0.1059	1.125	8.59298	0.76053
0.1134	1.125	8.65839	0.75034
0.1209	1.125	8.72704	0.72608
0.1284	1.125	8.79387	0.74381
0.1434	1.125	8.90604	0.73673
0.1584	1.125	9.03922	0.71757
0.1734	1.125	9.15049	0.71129
0.1884	1.125	9.28023	0.71943
0.2034	1.125	9.39225	0.71265
0.2184	1.125	9.48096	0.71982
0.2334	1.125	9.59799	0.70350
0.2634	1.125	9.78908	0.67623
0.2934	1.125	9.966	0.65267
0.3234	1.125	10.124	0.63959
0.3534	1.125	10.2955	0.62035
0.3834	1.125	10.4465	0.60167
0.4284	1.125	10.6396	0.54978
0.4734	1.125	10.834	0.50589
0.5184	1.125	10.9828	0.44308
0.5634	1.125	11.116	0.36738
0.6084	1.125	11.2046	0.27642
0.6534	1.125	11.2526	0.21643
0.6984	1.125	11.2731	0.17681
0.7434	1.125	11.2689	0.13807
0.7884	1.125	11.2712	0.12032
0.8334	1.125	11.2551	0.11453
0.9084	1.125	11.2345	0.11025
1.0584	1.125	11.1849	0.10129
1.2084	1.125	11.1587	0.10069
1.3584	1.125	11.1056	0.09924
1.5084	1.125	11.075	0.09776
1.6584	1.125	11.052	0.09541
1.8084	1.125	11.0239	0.09940
2.0334	1.125	10.9865	0.10427
2.2584	1.125	10.9684	0.10120
0.0091	1.25	1.60248	0.42893
0.01097	1.25	1.84772	0.53409
0.01285	1.25	2.4612	0.75827
0.01472	1.25	3.11015	0.94011
0.0166	1.25	3.73183	1.11671
0.02035	1.25	4.80868	1.26478
0.0241	1.25	5.61686	1.3221
0.02785	1.25	6.20126	1.24965
0.0316	1.25	6.58547	1.22379
0.03535	1.25	6.88659	1.172
0.0391	1.25	7.12178	1.12488
0.04285	1.25	7.302	1.06477
0.0466	1.25	7.50864	1.02947
0.0541	1.25	7.71927	0.96040
0.0616	1.25	7.88505	0.88945
0.0691	1.25	8.04709	0.86291
0.0766	1.25	8.15661	0.79792
0.0841	1.25	8.25694	0.79372
0.0916	1.25	8.34598	0.76490
0.0991	1.25	8.44686	0.75757
0.1066	1.25	8.4881	0.75451
0.1141	1.25	8.58972	0.74930
0.1216	1.25	8.66858	0.73026
0.1291	1.25	8.7213	0.72486
0.1441	1.25	8.85793	0.71036
0.1591	1.25	8.99245	0.70444
0.1741	1.25	9.08633	0.73186
0.1891	1.25	9.20841	0.72121
0.2041	1.25	9.33004	0.69982
0.2191	1.25	9.41906	0.69483
0.2341	1.25	9.50576	0.70135
0.2641	1.25	9.68216	0.67743
0.2941	1.25	9.91266	0.66413
0.3241	1.25	10.021	0.6432
0.3541	1.25	10.2431	0.60722
0.3841	1.25	10.3651	0.59469
0.4291	1.25	10.5745	0.53920
0.4741	1.25	10.7523	0.48628
0.5191	1.25	10.901	0.42216
0.5641	1.25	11.0353	0.34183
0.6091	1.25	11.1075	0.27591
0.6541	1.25	11.1521	0.20420
0.6991	1.25	11.1792	0.15597
0.7441	1.25	11.1799	0.12561
0.7891	1.25	11.1696	0.12005
0.8341	1.25	11.1471	0.10488
0.9091	1.25	11.1068	0.09697
1.0591	1.25	11.0607	0.09659
1.2091	1.25	11.0218	0.08739
1.3591	1.25	11.0091	0.08882
1.5091	1.25	10.9821	0.08486
1.6591	1.25	10.9357	0.09173
1.8091	1.25	10.9241	0.09282
2.0341	1.25	10.8947	0.09496
2.2591	1.25	10.8576	0.10911

Run ID: 041096

VR=0.506
Uo=10.92 m/s
x/D=2.5 FSTI=0.5%
L/D=2.3

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.92619	0.41049
0.00187	-0.375	2.09478	0.48878
0.00375	-0.375	2.75944	0.67194
0.00562	-0.375	3.44882	0.85133
0.0075	-0.375	4.17775	0.99003
0.01125	-0.375	5.4673	1.13524
0.015	-0.375	6.36474	1.16212
0.01875	-0.375	7.03801	1.10261
0.0225	-0.375	7.43157	1.02214
0.02625	-0.375	7.69207	0.99438
0.03	-0.375	7.93953	0.93221
0.03375	-0.375	8.0894	0.86162
0.0375	-0.375	8.20035	0.81513
0.045	-0.375	8.2587	0.78797
0.0525	-0.375	8.30058	0.76721
0.06	-0.375	8.34137	0.72687
0.0675	-0.375	8.33538	0.72983
0.075	-0.375	8.32679	0.76626
0.0825	-0.375	8.33244	0.73949
0.09	-0.375	8.28882	0.76178
0.0975	-0.375	8.25082	0.77543
0.105	-0.375	8.22627	0.78654
0.1125	-0.375	8.2878	0.78528
0.12	-0.375	8.24358	0.80607
0.135	-0.375	8.21732	0.87159
0.15	-0.375	8.30631	0.87253
0.165	-0.375	8.3568	0.87682
0.18	-0.375	8.47862	0.86019
0.195	-0.375	8.54824	0.86751
0.21	-0.375	8.63906	0.85727
0.225	-0.375	8.72662	0.80806
0.255	-0.375	8.96639	0.77542
0.285	-0.375	9.1145	0.73302
0.315	-0.375	9.29188	0.69700
0.345	-0.375	9.48413	0.70076
0.375	-0.375	9.61022	0.70446
0.42	-0.375	9.88504	0.71525
0.465	-0.375	10.1484	0.69160
0.51	-0.375	10.4059	0.63243
0.555	-0.375	10.639	0.54318
0.6	-0.375	10.8518	0.42578
0.645	-0.375	10.967	0.33244
0.69	-0.375	11.0375	0.23894
0.735	-0.375	11.077	0.19206
0.78	-0.375	11.097	0.15635
0.825	-0.375	11.0981	0.11908
0.9	-0.375	11.0845	0.09626
1.05	-0.375	11.0613	0.08761
1.2	-0.375	11.0382	0.09394
1.35	-0.375	10.9839	0.10061
1.5	-0.375	10.9645	0.10298
1.65	-0.375	10.9416	0.10715
1.8	-0.375	10.9153	0.10832
2.025	-0.375	10.8893	0.11472
2.25	-0.375	10.8659	0.11339
0.0006	-0.25	1.72534	0.44748
0.00247	-0.25	1.84916	0.51036
0.00435	-0.25	2.39428	0.72818
0.00622	-0.25	2.93264	0.86644
0.0081	-0.25	3.54864	1.03314
0.01185	-0.25	4.51742	1.15593
0.0156	-0.25	5.30891	1.15411
0.01935	-0.25	5.84377	1.14785
0.0231	-0.25	6.23397	1.10967
0.02685	-0.25	6.61101	1.10285
0.0306	-0.25	6.84302	1.04666
0.03435	-0.25	7.03292	1.05942
0.0381	-0.25	7.16967	0.99060
0.0456	-0.25	7.38574	0.94188
0.0531	-0.25	7.47501	0.91075
0.0606	-0.25	7.45172	0.94231
0.0681	-0.25	7.45425	0.89102
0.0756	-0.25	7.41638	0.92994
0.0831	-0.25	7.41589	0.91127
0.0906	-0.25	7.36102	0.94178
0.0981	-0.25	7.3514	0.95023
0.1056	-0.25	7.31157	0.98978
0.1131	-0.25	7.24637	1.01474
0.1206	-0.25	7.18427	1.0106
0.1356	-0.25	7.20184	1.0663
0.1506	-0.25	7.26053	1.1446
0.1656	-0.25	7.24804	1.14951
0.1806	-0.25	7.34288	1.15952
0.1956	-0.25	7.36884	1.19241
0.2106	-0.25	7.50055	1.17861
0.2256	-0.25	7.66091	1.173
0.2556	-0.25	7.91533	1.08991
0.2856	-0.25	8.22758	1.02348
0.3156	-0.25	8.48342	0.92837
0.3456	-0.25	8.79178	0.85457
0.3756	-0.25	9.02399	0.79349
0.4206	-0.25	9.42311	0.76877
0.4656	-0.25	9.78056	0.74298
0.5106	-0.25	10.0996	0.69795
0.5556	-0.25	10.4123	0.64562
0.6006	-0.25	10.6909	0.53540
0.6456	-0.25	10.9224	0.40769
0.6906	-0.25	11.0312	0.28553
0.7356	-0.25	11.0887	0.21439
0.7806	-0.25	11.1101	0.15841
0.8256	-0.25	11.116	0.13089
0.9006	-0.25	11.0945	0.10204
1.0506	-0.25	11.0605	0.08913
1.2006	-0.25	11.0476	0.08953
1.3506	-0.25	11.0162	0.09560
1.5006	-0.25	10.9863	0.10188
1.6506	-0.25	10.9587	0.10644
1.8006	-0.25	10.9378	0.10681
2.0256	-0.25	10.9012	0.11166
2.2506	-0.25	10.8734	0.11636
0.0012	-0.125	1.52746	0.39243
0.00307	-0.125	1.59566	0.42627
0.00495	-0.125	1.98083	0.60963
0.00682	-0.125	2.45041	0.75303
0.0087	-0.125	2.91664	0.84644
0.01245	-0.125	3.73355	0.98098
0.0162	-0.125	4.3036	1.0561
0.01995	-0.125	4.74883	1.05927
0.0237	-0.125	5.0611	1.01675
0.02745	-0.125	5.30248	1.02664
0.0312	-0.125	5.49335	1.03375
0.03495	-0.125	5.62291	1.04192
0.0387	-0.125	5.73696	1.02337
0.0462	-0.125	5.93299	0.99746
0.0537	-0.125	5.97023	0.96658
0.0612	-0.125	6.02018	0.98379
0.0687	-0.125	5.96412	0.97796
0.0762	-0.125	5.90049	1.01591
0.0837	-0.125	5.85029	0.98965
0.0912	-0.125	5.75781	0.98303
0.0987	-0.125	5.67049	0.98730
0.1062	-0.125	5.61338	1.0314
0.1137	-0.125	5.52722	1.01232
0.1212	-0.125	5.50254	0.99586
0.1362	-0.125	5.34011	1.04812
0.1512	-0.125	5.26771	1.04261
0.1662	-0.125	5.24652	1.08638
0.1812	-0.125	5.25723	1.10734
0.1962	-0.125	5.34444	1.17246
0.2112	-0.125	5.46805	1.21175
0.2262	-0.125	5.63335	1.21945
0.2562	-0.125	6.07466	1.34372
0.2862	-0.125	6.60675	1.36839
0.3162	-0.125	7.22467	1.30771
0.3462	-0.125	7.77443	1.21677
0.3762	-0.125	8.29893	1.08964

0.4212	-0.125	8.96711	0.90952
0.4662	-0.125	9.47222	0.80619
0.5112	-0.125	9.87227	0.75816
0.5562	-0.125	10.2458	0.71120
0.6012	-0.125	10.5873	0.61065
0.6462	-0.125	10.8506	0.46932
0.6912	-0.125	11.0182	0.33474
0.7362	-0.125	11.1075	0.23186
0.7812	-0.125	11.1366	0.16423
0.8262	-0.125	11.1295	0.13830
0.9012	-0.125	11.1076	0.10751
1.0512	-0.125	11.0902	0.08853
1.2012	-0.125	11.0662	0.09103
1.3512	-0.125	11.0557	0.09181
1.5012	-0.125	11.0249	0.09286
1.6512	-0.125	10.9954	0.10636
1.8012	-0.125	10.9788	0.10423
2.0262	-0.125	10.9463	0.11242
2.2512	-0.125	10.9111	0.11970
0.0018	0	1.11249	0.28844
0.00367	0	1.15775	0.31244
0.00555	0	1.3526	0.44799
0.00742	0	1.62122	0.55514
0.0093	0	1.92724	0.65967
0.01305	0	2.43443	0.75382
0.0168	0	2.83033	0.79810
0.02055	0	3.14935	0.80784
0.0243	0	3.41796	0.83087
0.02805	0	3.55236	0.81742
0.0318	0	3.75335	0.83733
0.03555	0	3.90193	0.83197
0.0393	0	3.99823	0.84368
0.0468	0	4.19049	0.83627
0.0543	0	4.41344	0.85819
0.0618	0	4.49649	0.88246
0.0693	0	4.61036	0.88503
0.0768	0	4.68233	0.86005
0.0843	0	4.68695	0.86162
0.0918	0	4.7602	0.87491
0.0993	0	4.77676	0.86999
0.1068	0	4.78198	0.87667
0.1143	0	4.77152	0.88028
0.1218	0	4.79133	0.87644
0.1368	0	4.76435	0.89020
0.1518	0	4.72357	0.88417
0.1668	0	4.68515	0.89522
0.1818	0	4.71038	0.92645
0.1968	0	4.78763	0.96738
0.2118	0	4.81778	1.0174
0.2268	0	4.92097	1.09377
0.2568	0	5.30227	1.20356
0.2868	0	5.88423	1.34438
0.3168	0	6.55901	1.33985
0.3468	0	7.32399	1.29273
0.3768	0	8.01691	1.22461
0.4218	0	8.79034	0.97541
0.4668	0	9.37625	0.85017
0.5118	0	9.80848	0.76900
0.5568	0	10.2493	0.71651
0.6018	0	10.5674	0.62337
0.6468	0	10.8489	0.50452
0.6918	0	11.0627	0.33561
0.7368	0	11.128	0.24638
0.7818	0	11.1556	0.17806
0.8268	0	11.1528	0.13502
0.9018	0	11.1435	0.10498
1.0518	0	11.1183	0.08654
1.2018	0	11.0929	0.08838
1.3518	0	11.066	0.08812
1.5018	0	11.0361	0.09619
1.6518	0	11.0193	0.10314
1.8018	0	10.9924	0.1057
2.0268	0	10.9673	0.11511
2.2518	0	10.9249	0.12354
0.0024	0.125	1.59713	0.45190
0.00427	0.125	1.70429	0.48290
0.00615	0.125	2.02631	0.63077
0.00802	0.125	2.51181	0.78127
0.0099	0.125	3.0484	0.91694
0.01365	0.125	4.00336	1.0651
0.0174	0.125	4.69573	1.17561
0.02115	0.125	5.21016	1.15769
0.0249	0.125	5.56635	1.13684
0.02865	0.125	5.85086	1.11031
0.0324	0.125	6.04623	1.11427
0.03615	0.125	6.14367	1.09821
0.0399	0.125	6.26671	1.04063
0.0474	0.125	6.35247	1.0626
0.0549	0.125	6.40745	1.00677
0.0624	0.125	6.40589	0.99746
0.0699	0.125	6.37291	0.98276
0.0774	0.125	6.26792	1.03459
0.0849	0.125	6.2048	1.03524
0.0924	0.125	6.13657	1.04166
0.0999	0.125	6.1107	1.03498
0.1074	0.125	6.08034	1.08621
0.1149	0.125	6.00543	1.11973
0.1224	0.125	5.96954	1.09711
0.1374	0.125	5.86825	1.12696
0.1524	0.125	5.85379	1.15369
0.1674	0.125	5.82319	1.15682
0.1824	0.125	5.85937	1.24293
0.1974	0.125	5.89646	1.25725
0.2124	0.125	5.95273	1.27606
0.2274	0.125	6.19342	1.31431
0.2574	0.125	6.5266	1.32328
0.2874	0.125	7.00899	1.31904
0.3174	0.125	7.53431	1.2555
0.3474	0.125	8.13702	1.13883
0.3774	0.125	8.61855	1.01321
0.4224	0.125	9.16013	0.86454
0.4674	0.125	9.62811	0.78287
0.5124	0.125	10.0295	0.74271
0.5574	0.125	10.3842	0.67998
0.6024	0.125	10.6864	0.59612
0.6474	0.125	10.9487	0.45116
0.6924	0.125	11.0954	0.30920
0.7374	0.125	11.1479	0.23385
0.7824	0.125	11.1891	0.17337
0.8274	0.125	11.1784	0.13554
0.9024	0.125	11.1661	0.10072
1.0524	0.125	11.1291	0.08278
1.2024	0.125	11.1118	0.07998
1.3524	0.125	11.0953	0.08040
1.5024	0.125	11.067	0.08938
1.6524	0.125	11.0481	0.09624
1.8024	0.125	11.0205	0.10278
2.0274	0.125	10.9886	0.11223
2.2524	0.125	10.9581	0.11962
0.003	0.25	2.00543	0.42432
0.00487	0.25	2.09669	0.46794
0.00675	0.25	2.51761	0.63437
0.00862	0.25	3.26354	0.76313
0.0105	0.25	3.9825	0.94389
0.01425	0.25	5.3358	1.05112
0.018	0.25	6.21205	1.0715
0.02175	0.25	6.82705	1.02243
0.0255	0.25	7.15881	0.99562
0.02925	0.25	7.42398	0.96115
0.033	0.25	7.55754	0.97483
0.03675	0.25	7.68003	0.95068
0.0405	0.25	7.69009	0.93773
0.048	0.25	7.7177	0.91849
0.0555	0.25	7.65126	0.92567
0.063	0.25	7.60291	0.94708
0.0705	0.25	7.55834	0.95226
0.078	0.25	7.54055	0.99452
0.0855	0.25	7.45911	1.0273
0.093	0.25	7.44806	1.03324
0.1005	0.25	7.47974	1.04198
0.108	0.25	7.43349	1.08673
0.1155	0.25	7.48167	1.06425
0.123	0.25	7.46684	1.08158
0.138	0.25	7.52654	1.11901
0.153	0.25	7.64636	1.13235
0.168	0.25	7.75095	1.11937

0.183	0.25	7.8757	1.09919
0.198	0.25	7.96529	1.07833
0.213	0.25	8.09416	1.06474
0.228	0.25	8.19949	1.05652
0.258	0.25	8.45337	0.99072
0.288	0.25	8.70312	0.85887
0.318	0.25	8.91037	0.84214
0.348	0.25	9.1227	0.78615
0.378	0.25	9.37324	0.73223
0.423	0.25	9.67949	0.73707
0.468	0.25	10.0175	0.71924
0.513	0.25	10.3176	0.66774
0.558	0.25	10.6221	0.61739
0.603	0.25	10.8548	0.51235
0.648	0.25	11.0468	0.37107
0.693	0.25	11.1365	0.27118
0.738	0.25	11.177	0.20766
0.783	0.25	11.2035	0.15662
0.828	0.25	11.2045	0.13353
0.903	0.25	11.1892	0.10544
1.053	0.25	11.1534	0.08364
1.203	0.25	11.1316	0.08000
1.353	0.25	11.0942	0.09026
1.503	0.25	11.0856	0.08991
1.653	0.25	11.0696	0.09591
1.803	0.25	11.0558	0.09279
2.028	0.25	11.0333	0.10535
2.253	0.25	10.9851	0.11769
0.0036	0.375	1.96961	0.37128
0.00547	0.375	2.03883	0.38721
0.00735	0.375	2.40708	0.52690
0.00922	0.375	3.14656	0.68500
0.0111	0.375	3.88436	0.82655
0.01485	0.375	5.3656	0.97064
0.0186	0.375	6.49167	1.01328
0.02235	0.375	7.24092	1.01116
0.0261	0.375	7.67095	0.96653
0.02985	0.375	8.0612	0.86765
0.0336	0.375	8.27685	0.83062
0.03735	0.375	8.40189	0.79541
0.0411	0.375	8.49229	0.74222
0.0486	0.375	8.57276	0.71862
0.0561	0.375	8.59928	0.69003
0.0636	0.375	8.57197	0.72273
0.0711	0.375	8.56995	0.71596
0.0786	0.375	8.59553	0.71713
0.0861	0.375	8.54287	0.77115
0.0936	0.375	8.56702	0.77055
0.1011	0.375	8.61351	0.73670
0.1086	0.375	8.6238	0.77651
0.1161	0.375	8.64761	0.76309
0.1236	0.375	8.62112	0.82258
0.1386	0.375	8.7048	0.77314
0.1536	0.375	8.78083	0.77873
0.1686	0.375	8.85537	0.78071
0.1836	0.375	8.91599	0.74087
0.1986	0.375	9.04052	0.67781
0.2136	0.375	9.10576	0.63646
0.2286	0.375	9.19121	0.61582
0.2586	0.375	9.28507	0.60988
0.2886	0.375	9.39966	0.60237
0.3186	0.375	9.53289	0.62459
0.3486	0.375	9.64687	0.63232
0.3786	0.375	9.79397	0.66439
0.4236	0.375	10.0341	0.67360
0.4686	0.375	10.2587	0.68552
0.5136	0.375	10.5465	0.60625
0.5586	0.375	10.7927	0.53106
0.6036	0.375	10.9912	0.42371
0.6486	0.375	11.1194	0.32534
0.6936	0.375	11.1873	0.24463
0.7386	0.375	11.2149	0.18421
0.7836	0.375	11.229	0.13942
0.8286	0.375	11.2421	0.12879
0.9036	0.375	11.2108	0.10540
1.0536	0.375	11.169	0.08364
1.2036	0.375	11.1489	0.08244
1.3536	0.375	11.1177	0.08527
1.5036	0.375	11.0986	0.08363
1.6536	0.375	11.0819	0.09419
1.8036	0.375	11.057	0.10030
2.0286	0.375	11.0304	0.10474
2.2536	0.375	11.0051	0.1187
0.0042	0.5	1.99169	0.40290
0.00607	0.5	2.05416	0.42733
0.00795	0.5	2.33211	0.55807
0.00982	0.5	3.077	0.71608
0.0117	0.5	3.83236	0.88959
0.01545	0.5	5.24596	1.1049
0.0192	0.5	6.34104	1.15624
0.02295	0.5	7.06895	1.14172
0.0267	0.5	7.58431	1.11112
0.03045	0.5	7.88901	1.05667
0.0342	0.5	8.21659	0.97838
0.03795	0.5	8.36668	0.92997
0.0417	0.5	8.51305	0.85732
0.0492	0.5	8.70825	0.77948
0.0567	0.5	8.81705	0.72879
0.0642	0.5	8.91748	0.69394
0.0717	0.5	8.97817	0.65394
0.0792	0.5	9.01554	0.63633
0.0867	0.5	9.06439	0.60184
0.0942	0.5	9.10011	0.60720
0.1017	0.5	9.16752	0.59680
0.1092	0.5	9.17117	0.59339
0.1167	0.5	9.19742	0.60276
0.1242	0.5	9.19538	0.60161
0.1392	0.5	9.24475	0.584
0.1542	0.5	9.30823	0.60145
0.1692	0.5	9.36704	0.58660
0.1842	0.5	9.38749	0.58862
0.1992	0.5	9.44688	0.60373
0.2142	0.5	9.48638	0.60440
0.2292	0.5	9.5172	0.60917
0.2592	0.5	9.63824	0.60380
0.2892	0.5	9.71284	0.62740
0.3192	0.5	9.81247	0.63139
0.3492	0.5	9.95302	0.64351
0.3792	0.5	10.0713	0.64721
0.4242	0.5	10.2858	0.66093
0.4692	0.5	10.5001	0.62062
0.5142	0.5	10.731	0.54092
0.5592	0.5	10.9121	0.46797
0.6042	0.5	11.0517	0.37554
0.6492	0.5	11.1502	0.29820
0.6942	0.5	11.2078	0.22146
0.7392	0.5	11.2281	0.17319
0.7842	0.5	11.235	0.14379
0.8292	0.5	11.2414	0.12367
0.9042	0.5	11.2161	0.10617
1.0542	0.5	11.1959	0.09332
1.2042	0.5	11.1632	0.08925
1.3542	0.5	11.1486	0.07997
1.5042	0.5	11.1276	0.08136
1.6542	0.5	11.1044	0.09231
1.8042	0.5	11.0799	0.09620
2.0292	0.5	11.0468	0.10301
2.2542	0.5	11.0229	0.11403
0.0048	0.625	1.87756	0.45102
0.00667	0.625	1.90282	0.4777
0.00855	0.625	2.04192	0.54301
0.01042	0.625	2.62272	0.71934
0.0123	0.625	3.3039	0.90192
0.01605	0.625	4.53636	1.17975
0.0198	0.625	5.47178	1.28291
0.02355	0.625	6.20006	1.30828
0.0273	0.625	6.72311	1.28334
0.03105	0.625	7.09507	1.20598
0.0348	0.625	7.40634	1.19147
0.03855	0.625	7.59311	1.16364
0.0423	0.625	7.80715	1.08698
0.0498	0.625	8.11161	0.99610
0.0573	0.625	8.28497	0.91281
0.0648	0.625	8.4892	0.86903
0.0723	0.625	8.62359	0.78676
0.0798	0.625	8.72338	0.78114

0.0873	0.625	8.7809	0.74474
0.0948	0.625	8.87938	0.71522
0.1023	0.625	8.93004	0.70397
0.1098	0.625	9.00968	0.69360
0.1173	0.625	9.07342	0.67971
0.1248	0.625	9.13444	0.69267
0.1398	0.625	9.22402	0.66055
0.1548	0.625	9.31041	0.65409
0.1698	0.625	9.41036	0.65993
0.1848	0.625	9.45254	0.64166
0.1998	0.625	9.54886	0.64385
0.2148	0.625	9.61226	0.65311
0.2298	0.625	9.68691	0.64485
0.2598	0.625	9.83524	0.65755
0.2898	0.625	9.92845	0.64497
0.3198	0.625	10.0842	0.63255
0.3498	0.625	10.1742	0.64927
0.3798	0.625	10.2866	0.61290
0.4248	0.625	10.515	0.58996
0.4698	0.625	10.6908	0.54070
0.5148	0.625	10.8466	0.47829
0.5598	0.625	10.9799	0.42258
0.6048	0.625	11.0937	0.34718
0.6498	0.625	11.1852	0.26244
0.6948	0.625	11.2408	0.20667
0.7398	0.625	11.2571	0.15093
0.7848	0.625	11.2478	0.12901
0.8298	0.625	11.2495	0.12363
0.9048	0.625	11.2375	0.10462
1.0548	0.625	11.2124	0.09636
1.2048	0.625	11.1829	0.08713
1.3548	0.625	11.1488	0.08392
1.5048	0.625	11.1345	0.08427
1.6548	0.625	11.1186	0.08765
1.8048	0.625	11.0811	0.09536
2.0298	0.625	11.0567	0.10799
2.2548	0.625	11.0457	0.11082
0.0054	0.75	1.82339	0.46317
0.00727	0.75	1.84715	0.45131
0.00915	0.75	1.99829	0.55203
0.01102	0.75	2.60424	0.74703
0.0129	0.75	3.25601	0.94620
0.01665	0.75	4.44155	1.18932
0.0204	0.75	5.37554	1.28935
0.02415	0.75	6.01624	1.2991
0.0279	0.75	6.57156	1.24656
0.03165	0.75	6.94246	1.2113
0.0354	0.75	7.18789	1.14035
0.03915	0.75	7.44538	1.05919
0.0429	0.75	7.57657	1.08742
0.0504	0.75	7.87953	0.95933
0.0579	0.75	8.08077	0.92424
0.0654	0.75	8.2411	0.89412
0.0729	0.75	8.37873	0.83433
0.0804	0.75	8.44163	0.82927
0.0879	0.75	8.57939	0.78753
0.0954	0.75	8.68174	0.77737
0.1029	0.75	8.77561	0.78071
0.1104	0.75	8.85305	0.77430
0.1179	0.75	8.8915	0.75567
0.1254	0.75	8.9801	0.73642
0.1404	0.75	9.10141	0.71044
0.1554	0.75	9.24417	0.75307
0.1704	0.75	9.33534	0.72446
0.1854	0.75	9.45139	0.70187
0.2004	0.75	9.59353	0.72632
0.2154	0.75	9.64054	0.70063
0.2304	0.75	9.76792	0.69372
0.2604	0.75	9.91753	0.68414
0.2904	0.75	10.0811	0.65546
0.3204	0.75	10.2595	0.63107
0.3504	0.75	10.3755	0.60768
0.3804	0.75	10.5298	0.58293
0.4254	0.75	10.7127	0.53514
0.4704	0.75	10.8383	0.50133
0.5154	0.75	11.0152	0.41666
0.5604	0.75	11.1124	0.37052
0.6054	0.75	11.2002	0.28361
0.6504	0.75	11.2759	0.20290
0.6954	0.75	11.2801	0.17977
0.7404	0.75	11.2942	0.14420
0.7854	0.75	11.2895	0.12702
0.8304	0.75	11.2913	0.12354
0.9054	0.75	11.2765	0.10923
1.0554	0.75	11.2477	0.10466
1.2054	0.75	11.2142	0.09461
1.3554	0.75	11.1798	0.09168
1.5054	0.75	11.1634	0.08846
1.6554	0.75	11.1479	0.08589
1.8054	0.75	11.1344	0.08711
2.0304	0.75	11.0965	0.09562
2.2554	0.75	11.0616	0.11182
0.006	0.875	1.85081	0.46083
0.00787	0.875	1.80761	0.44601
0.00975	0.875	2.03621	0.53963
0.01162	0.875	2.66552	0.77058
0.0135	0.875	3.29817	0.93804
0.01725	0.875	4.5794	1.2326
0.021	0.875	5.53538	1.30755
0.02475	0.875	6.18812	1.28461
0.0285	0.875	6.63444	1.24629
0.03225	0.875	6.99659	1.19993
0.036	0.875	7.31373	1.1372
0.03975	0.875	7.54932	1.08377
0.0435	0.875	7.69889	1.05272
0.051	0.875	7.9395	0.98534
0.0585	0.875	8.09269	0.95980
0.066	0.875	8.27474	0.88045
0.0735	0.875	8.38856	0.86767
0.081	0.875	8.51154	0.81278
0.0885	0.875	8.60229	0.79486
0.096	0.875	8.69185	0.75418
0.1035	0.875	8.77564	0.76844
0.111	0.875	8.86376	0.75903
0.1185	0.875	8.92661	0.75666
0.126	0.875	8.98691	0.73634
0.141	0.875	9.11537	0.72879
0.156	0.875	9.21294	0.74448
0.171	0.875	9.29685	0.72757
0.186	0.875	9.46072	0.71786
0.201	0.875	9.55815	0.70701
0.216	0.875	9.6312	0.68470
0.231	0.875	9.75546	0.67842
0.261	0.875	9.91501	0.67615
0.291	0.875	10.0893	0.62826
0.321	0.875	10.1858	0.64591
0.351	0.875	10.339	0.60670
0.381	0.875	10.4792	0.57553
0.426	0.875	10.6682	0.54033
0.471	0.875	10.8157	0.48981
0.516	0.875	10.9793	0.41380
0.561	0.875	11.1001	0.34372
0.606	0.875	11.1882	0.27588
0.651	0.875	11.2472	0.21944
0.696	0.875	11.2787	0.16578
0.741	0.875	11.2813	0.14373
0.786	0.875	11.2764	0.12358
0.831	0.875	11.2576	0.11482
0.906	0.875	11.2547	0.10661
1.056	0.875	11.2254	0.09636
1.206	0.875	11.186	0.08449
1.356	0.875	11.1665	0.08756
1.506	0.875	11.1442	0.08477
1.656	0.875	11.1354	0.08760
1.806	0.875	11.1173	0.09253
2.031	0.875	11.0947	0.10163
2.256	0.875	11.0633	0.10768
0.0066	1	1.76522	0.43510
0.00847	1	1.75672	0.44327
0.01035	1	1.91903	0.51669
0.01222	1	2.49139	0.71311
0.0141	1	3.18355	0.95197
0.01785	1	4.38026	1.19137
0.0216	1	5.3326	1.26734
0.02535	1	5.94319	1.27535
0.0291	1	6.46692	1.24999

0.03285	1	6.79633	1.20568
0.0366	1	7.10632	1.15005
0.04035	1	7.33026	1.09798
0.0441	1	7.50299	1.03861
0.0516	1	7.7508	0.99304
0.0591	1	7.93716	0.90928
0.0666	1	8.1246	0.85570
0.0741	1	8.25254	0.81079
0.0816	1	8.38668	0.81322
0.0891	1	8.46132	0.76044
0.0966	1	8.55882	0.78062
0.1041	1	8.64325	0.74685
0.1116	1	8.70752	0.74982
0.1191	1	8.78691	0.74067
0.1266	1	8.83182	0.73463
0.1416	1	8.96421	0.75285
0.1566	1	9.07386	0.71825
0.1716	1	9.18466	0.73819
0.1866	1	9.26562	0.70149
0.2016	1	9.38057	0.71397
0.2166	1	9.4484	0.68702
0.2316	1	9.53934	0.68456
0.2616	1	9.69119	0.69134
0.2916	1	9.89799	0.66835
0.3216	1	10.0624	0.63888
0.3516	1	10.1934	0.62617
0.3816	1	10.361	0.58953
0.4266	1	10.5229	0.58832
0.4716	1	10.7185	0.52892
0.5166	1	10.8933	0.46528
0.5616	1	11.0563	0.38785
0.6066	1	11.16	0.31193
0.6516	1	11.2161	0.23605
0.6966	1	11.2525	0.18646
0.7416	1	11.2795	0.14367
0.7866	1	11.2631	0.11929
0.8316	1	11.242	0.11109
0.9066	1	11.2315	0.10076
1.0566	1	11.2073	0.09344
1.2066	1	11.1802	0.08745
1.3566	1	11.1597	0.08490
1.5066	1	11.1309	0.08620
1.6566	1	11.1075	0.09053
1.8066	1	11.0988	0.09405
2.0316	1	11.0715	0.09762
2.2566	1	11.0419	0.11021
0.0072	1.125	1.74879	0.44643
0.00907	1.125	1.69716	0.42409
0.01095	1.125	1.79314	0.47493
0.01282	1.125	2.35767	0.68617
0.0147	1.125	2.93653	0.87499
0.01845	1.125	4.12824	1.17883
0.0222	1.125	5.04852	1.26292
0.02595	1.125	5.72653	1.25457
0.0297	1.125	6.16438	1.22117
0.03345	1.125	6.5483	1.18212
0.0372	1.125	6.83276	1.13342
0.04095	1.125	7.05505	1.06471
0.0447	1.125	7.25228	1.04154
0.0522	1.125	7.53103	0.94936
0.0597	1.125	7.74715	0.90006
0.0672	1.125	7.91417	0.85678
0.0747	1.125	7.9893	0.81967
0.0822	1.125	8.12997	0.78035
0.0897	1.125	8.21806	0.76300
0.0972	1.125	8.29164	0.74787
0.1047	1.125	8.37516	0.73754
0.1122	1.125	8.46032	0.74044
0.1197	1.125	8.51875	0.72144
0.1272	1.125	8.56764	0.73820
0.1422	1.125	8.75265	0.70389
0.1572	1.125	8.83996	0.73117
0.1722	1.125	8.92509	0.69261
0.1872	1.125	9.05173	0.71339
0.2022	1.125	9.15737	0.70388
0.2172	1.125	9.23281	0.70462
0.2322	1.125	9.3475	0.71229
0.2622	1.125	9.48176	0.68874
0.2922	1.125	9.6822	0.67028
0.3222	1.125	9.85886	0.65649
0.3522	1.125	10.02	0.65136
0.3822	1.125	10.1731	0.63659
0.4272	1.125	10.3646	0.61754
0.4722	1.125	10.6173	0.58080
0.5172	1.125	10.8097	0.49242
0.5622	1.125	10.9463	0.44189
0.6072	1.125	11.0571	0.34725
0.6522	1.125	11.1498	0.27779
0.6972	1.125	11.2051	0.19687
0.7422	1.125	11.2268	0.14707
0.7872	1.125	11.2451	0.12899
0.8322	1.125	11.2332	0.11734
0.9072	1.125	11.2379	0.10483
1.0572	1.125	11.1939	0.09395
1.2072	1.125	11.178	0.08433
1.3572	1.125	11.1556	0.08617
1.5072	1.125	11.1225	0.08735
1.6572	1.125	11.0945	0.09266
1.8072	1.125	11.0819	0.09952
2.0322	1.125	11.0541	0.10540
2.2572	1.125	11.0327	0.11632
0.0078	1.25	1.74866	0.44608
0.00967	1.25	1.70977	0.41688
0.01155	1.25	1.79095	0.45264
0.01342	1.25	2.34075	0.68684
0.0153	1.25	2.9165	0.85987
0.01905	1.25	4.12991	1.16521
0.0228	1.25	5.01484	1.27618
0.02655	1.25	5.71629	1.26659
0.0303	1.25	6.15974	1.22579
0.03405	1.25	6.60413	1.19012
0.0378	1.25	6.86406	1.13482
0.04155	1.25	7.08127	1.06894
0.0453	1.25	7.27014	1.03724
0.0528	1.25	7.55827	0.94448
0.0603	1.25	7.72395	0.89136
0.0678	1.25	7.89597	0.84318
0.0753	1.25	8.04001	0.79468
0.0828	1.25	8.14743	0.79268
0.0903	1.25	8.26514	0.77164
0.0978	1.25	8.32032	0.74617
0.1053	1.25	8.40795	0.74516
0.1128	1.25	8.46484	0.75757
0.1203	1.25	8.53545	0.73724
0.1278	1.25	8.56083	0.73599
0.1428	1.25	8.71089	0.73732
0.1578	1.25	8.82712	0.72226
0.1728	1.25	8.94203	0.70614
0.1878	1.25	9.02041	0.71892
0.2028	1.25	9.13724	0.69779
0.2178	1.25	9.24812	0.72798
0.2328	1.25	9.34272	0.71592
0.2628	1.25	9.53185	0.70736
0.2928	1.25	9.72618	0.69635
0.3228	1.25	9.90208	0.67337
0.3528	1.25	10.0421	0.66356
0.3828	1.25	10.1994	0.63820
0.4278	1.25	10.4302	0.59593
0.4728	1.25	10.624	0.55766
0.5178	1.25	10.8118	0.49439
0.5628	1.25	10.9783	0.44254
0.6078	1.25	11.0925	0.36548
0.6528	1.25	11.19	0.27123
0.6978	1.25	11.2507	0.19869
0.7428	1.25	11.2589	0.16280
0.7878	1.25	11.256	0.12549
0.8328	1.25	11.2791	0.11502
0.9078	1.25	11.2595	0.10828
1.0578	1.25	11.2301	0.10041
1.2078	1.25	11.1963	0.09011
1.3578	1.25	11.1767	0.08675
1.5078	1.25	11.1444	0.08469
1.6578	1.25	11.1178	0.08799
1.8078	1.25	11.0984	0.09648
2.0328	1.25	11.0668	0.10150
2.2578	1.25	11.0381	0.11354

Run ID: 041296bb

VR=1.01
Uo=10.58 m/s
x/D=2.5 FSTI=12%
L/D=7.0

y (in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.95358	0.73636
0.00187	-0.375	1.92994	0.70735
0.00375	-0.375	2.10726	0.82868
0.00562	-0.375	2.84561	1.15437
0.0075	-0.375	3.65852	1.5194
0.01125	-0.375	5.29334	1.94767
0.015	-0.375	6.49015	2.11404
0.01875	-0.375	7.15069	2.13269
0.0225	-0.375	7.85193	2.07453
0.02625	-0.375	8.09544	2.09451
0.03	-0.375	8.41547	2.00111
0.03375	-0.375	8.61415	1.94642
0.0375	-0.375	8.82382	1.90067
0.045	-0.375	8.98855	1.73912
0.0525	-0.375	9.10516	1.71718
0.06	-0.375	9.23274	1.619
0.0675	-0.375	9.2223	1.6283
0.075	-0.375	9.36981	1.60306
0.0825	-0.375	9.35822	1.56682
0.09	-0.375	9.40144	1.57614
0.0975	-0.375	9.41378	1.62147
0.105	-0.375	9.47191	1.62038
0.1125	-0.375	9.53101	1.61536
0.12	-0.375	9.55184	1.64555
0.135	-0.375	9.59855	1.69612
0.15	-0.375	9.56531	1.78266
0.165	-0.375	9.72181	1.78894
0.18	-0.375	9.69867	1.81437
0.195	-0.375	9.92141	1.80582
0.21	-0.375	9.90963	1.83081
0.225	-0.375	10.0863	1.8926
0.255	-0.375	10.267	1.9868
0.285	-0.375	10.5881	1.96366
0.315	-0.375	10.7418	1.94528
0.345	-0.375	10.9223	1.88402
0.375	-0.375	11.237	1.80156
0.42	-0.375	11.4028	1.73458
0.465	-0.375	11.5527	1.55847
0.51	-0.375	11.5827	1.44574
0.555	-0.375	11.4191	1.39603
0.6	-0.375	11.3384	1.41934
0.645	-0.375	11.0859	1.31495
0.69	-0.375	10.9366	1.33271
0.735	-0.375	10.7558	1.24258
0.78	-0.375	10.6694	1.29945
0.825	-0.375	10.5506	1.28279
0.9	-0.375	10.4861	1.23627
1.05	-0.375	10.5538	1.25227
1.2	-0.375	10.608	1.23299
1.35	-0.375	10.5679	1.19819
1.5	-0.375	10.6325	1.1827
1.65	-0.375	10.5927	1.15622
1.8	-0.375	10.5826	1.22311
2.025	-0.375	10.6068	1.2059
2.25	-0.375	10.574	1.16147
0.001	-0.25	1.80391	0.76674
0.00287	-0.25	1.78404	0.76873
0.00475	-0.25	1.88459	0.85418
0.00662	-0.25	2.27826	1.0514
0.0085	-0.25	3.03071	1.37188
0.01225	-0.25	4.37525	1.92404
0.016	-0.25	5.39281	2.22674
0.01975	-0.25	6.23722	2.28646
0.0235	-0.25	6.822	2.31803
0.02725	-0.25	7.22292	2.32365
0.031	-0.25	7.50807	2.22549
0.03475	-0.25	7.82426	2.17474
0.0385	-0.25	7.90124	2.14622
0.046	-0.25	8.2873	1.94725
0.0535	-0.25	8.46021	1.92633
0.061	-0.25	8.56521	1.85447
0.0685	-0.25	8.57046	1.74869
0.076	-0.25	8.64429	1.75177
0.0835	-0.25	8.62377	1.72408
0.091	-0.25	8.67344	1.70965
0.0985	-0.25	8.70051	1.67507
0.106	-0.25	8.71387	1.69874
0.1135	-0.25	8.66903	1.68375
0.121	-0.25	8.67715	1.71135
0.136	-0.25	8.7187	1.79514
0.151	-0.25	8.6765	1.83858
0.166	-0.25	8.70863	1.86865
0.181	-0.25	8.61106	1.92948
0.196	-0.25	8.59432	2.02958
0.211	-0.25	8.708	2.08403
0.226	-0.25	8.73367	2.16179
0.256	-0.25	8.81418	2.27643
0.286	-0.25	9.15375	2.38885
0.316	-0.25	9.42288	2.42769
0.346	-0.25	9.62033	2.4617
0.376	-0.25	10.1181	2.3879
0.421	-0.25	10.8963	2.21698
0.466	-0.25	11.4308	1.89041
0.511	-0.25	11.7184	1.67079
0.556	-0.25	11.7575	1.43075
0.601	-0.25	11.5994	1.41622
0.646	-0.25	11.4045	1.38885
0.691	-0.25	11.1199	1.33756
0.736	-0.25	10.9651	1.30764
0.781	-0.25	10.726	1.28277
0.826	-0.25	10.6391	1.25337
0.901	-0.25	10.5872	1.25245
1.051	-0.25	10.5074	1.21691
1.201	-0.25	10.5764	1.22379
1.351	-0.25	10.5848	1.20967
1.501	-0.25	10.6379	1.22332
1.651	-0.25	10.627	1.22046
1.801	-0.25	10.5993	1.17312
2.026	-0.25	10.5667	1.18307
2.251	-0.25	10.5451	1.19123
0.002	-0.125	1.9147	0.87282
0.00387	-0.125	1.906	0.86863
0.00575	-0.125	1.71928	0.78897
0.00762	-0.125	2.06167	0.93712
0.0095	-0.125	2.61792	1.22127
0.01325	-0.125	3.61051	1.63313
0.017	-0.125	4.42558	1.85032
0.02075	-0.125	5.08885	2.01674
0.0245	-0.125	5.53331	2.11649
0.02825	-0.125	5.93731	2.10878
0.032	-0.125	6.13516	2.15451
0.03575	-0.125	6.42685	2.17639
0.0395	-0.125	6.75081	2.18024
0.047	-0.125	7.01593	2.1103
0.0545	-0.125	7.35884	1.97004
0.062	-0.125	7.48355	1.94598
0.0695	-0.125	7.60159	1.90669
0.077	-0.125	7.64875	1.82776
0.0845	-0.125	7.68207	1.74645
0.092	-0.125	7.7987	1.7155
0.0995	-0.125	7.76654	1.69296
0.107	-0.125	7.77895	1.69521
0.1145	-0.125	7.76131	1.67944
0.122	-0.125	7.71851	1.66557
0.137	-0.125	7.74932	1.70493
0.152	-0.125	7.66645	1.71618
0.167	-0.125	7.60552	1.71741
0.182	-0.125	7.47603	1.77233
0.197	-0.125	7.42128	1.77798
0.212	-0.125	7.46149	1.81414
0.227	-0.125	7.40614	1.884
0.257	-0.125	7.41454	1.95271
0.287	-0.125	7.52081	2.02456
0.317	-0.125	7.87146	2.17381
0.347	-0.125	8.11442	2.28806
0.377	-0.125	8.69614	2.43914

0.422	-0.125	9.67292	2.48552
0.467	-0.125	10.6533	2.36327
0.512	-0.125	11.5609	1.92502
0.557	-0.125	11.843	1.56584
0.602	-0.125	11.8621	1.51719
0.647	-0.125	11.6541	1.46185
0.692	-0.125	11.3841	1.33535
0.737	-0.125	11.1145	1.34036
0.782	-0.125	10.8392	1.27556
0.827	-0.125	10.762	1.25071
0.902	-0.125	10.6018	1.22162
1.052	-0.125	10.5219	1.25528
1.202	-0.125	10.6111	1.21171
1.352	-0.125	10.6169	1.24537
1.502	-0.125	10.6335	1.18264
1.652	-0.125	10.5984	1.175
1.802	-0.125	10.6213	1.19212
2.027	-0.125	10.6218	1.16181
2.252	-0.125	10.5933	1.201
0.003	0	1.77109	0.79207
0.00487	0	1.7573	0.80328
0.00675	0	1.84348	0.86026
0.00862	0	2.0531	0.93182
0.0105	0	2.71511	1.17057
0.01425	0	3.5981	1.47087
0.018	0	4.30968	1.65043
0.02175	0	4.89167	1.79177
0.0255	0	5.30992	1.88294
0.02925	0	5.67342	1.94435
0.033	0	5.87826	1.94139
0.03675	0	6.13295	2.00307
0.0405	0	6.38325	2.02523
0.048	0	6.75579	2.02578
0.0555	0	6.99957	2.04169
0.063	0	7.21581	2.06184
0.0705	0	7.32794	1.95972
0.078	0	7.47655	1.88742
0.0855	0	7.47016	1.90639
0.093	0	7.60821	1.80211
0.1005	0	7.61675	1.81268
0.108	0	7.69292	1.74228
0.1155	0	7.68676	1.73592
0.123	0	7.51819	1.70895
0.138	0	7.53677	1.71913
0.153	0	7.42647	1.70324
0.168	0	7.4615	1.69541
0.183	0	7.4494	1.67566
0.198	0	7.35245	1.76444
0.213	0	7.29786	1.75375
0.228	0	7.27559	1.72083
0.258	0	7.22005	1.73772
0.288	0	7.25828	1.75761
0.318	0	7.40956	1.91703
0.348	0	7.74805	2.1022
0.378	0	8.33227	2.26803
0.423	0	9.4005	2.43218
0.468	0	10.5552	2.38931
0.513	0	11.5552	2.01873
0.558	0	11.9517	1.61058
0.603	0	11.9329	1.45462
0.648	0	11.6823	1.47805
0.693	0	11.4353	1.34684
0.738	0	11.1646	1.32631
0.783	0	10.9041	1.29774
0.828	0	10.7742	1.27013
0.903	0	10.5928	1.26366
1.053	0	10.5535	1.21382
1.203	0	10.6067	1.25927
1.353	0	10.6044	1.17254
1.503	0	10.583	1.24562
1.653	0	10.6423	1.19584
1.803	0	10.5982	1.18931
2.028	0	10.6519	1.21355
2.253	0	10.58	1.20028
0.004	0.125	1.92798	0.84657
0.00587	0.125	1.94872	0.83284
0.00775	0.125	2.00273	0.86239
0.00962	0.125	2.14606	0.95525
0.0115	0.125	2.77832	1.25433
0.01525	0.125	3.97931	1.72499
0.019	0.125	4.9857	2.04442
0.02275	0.125	5.58834	2.24395
0.0265	0.125	6.24268	2.38513
0.03025	0.125	6.58095	2.43843
0.034	0.125	7.10138	2.47577
0.03775	0.125	7.35868	2.52164
0.0415	0.125	7.48978	2.50071
0.049	0.125	7.99573	2.41888
0.0565	0.125	8.13432	2.44549
0.064	0.125	8.39274	2.37308
0.0715	0.125	8.57022	2.29672
0.079	0.125	8.64139	2.22051
0.0865	0.125	8.54295	2.13746
0.094	0.125	8.75315	2.10279
0.1015	0.125	8.83174	2.02999
0.109	0.125	8.74548	2.05597
0.1165	0.125	8.65944	2.0202
0.124	0.125	8.69941	2.01662
0.139	0.125	8.58481	2.04721
0.154	0.125	8.51111	2.03919
0.169	0.125	8.51897	2.04909
0.184	0.125	8.35918	2.04359
0.199	0.125	8.26173	2.10402
0.214	0.125	8.19088	2.14933
0.229	0.125	8.1885	2.17999
0.259	0.125	8.20639	2.20837
0.289	0.125	8.2706	2.25121
0.319	0.125	8.50846	2.46682
0.349	0.125	8.89739	2.51056
0.379	0.125	9.41073	2.59344
0.424	0.125	10.3717	2.47772
0.469	0.125	11.3294	2.1822
0.514	0.125	11.8627	1.80677
0.559	0.125	11.9589	1.56724
0.604	0.125	11.8511	1.44508
0.649	0.125	11.6158	1.44449
0.694	0.125	11.2936	1.34169
0.739	0.125	11.0131	1.30093
0.784	0.125	10.873	1.2444
0.829	0.125	10.6457	1.26547
0.904	0.125	10.5822	1.20784
1.054	0.125	10.5689	1.27175
1.204	0.125	10.6653	1.22423
1.354	0.125	10.6336	1.20317
1.504	0.125	10.63	1.18513
1.654	0.125	10.5913	1.19218
1.804	0.125	10.5943	1.21242
2.029	0.125	10.6034	1.21661
2.254	0.125	10.5617	1.17609
0.005	0.25	2.34169	0.96600
0.00687	0.25	2.34069	0.95618
0.00875	0.25	2.07876	0.81631
0.01062	0.25	2.10123	0.88129
0.0125	0.25	2.83944	1.15735
0.01625	0.25	4.43688	1.83035
0.02	0.25	5.66444	2.23996
0.02375	0.25	6.69741	2.3062
0.0275	0.25	7.33212	2.45087
0.03125	0.25	7.91125	2.41711
0.035	0.25	8.21365	2.41281
0.03875	0.25	8.63976	2.33394
0.0425	0.25	8.76662	2.34492
0.05	0.25	9.25576	2.20265
0.0575	0.25	9.32798	2.15188
0.065	0.25	9.55141	2.01341
0.0725	0.25	9.76466	1.94214
0.08	0.25	9.80017	1.91521
0.0875	0.25	9.90338	1.91784
0.095	0.25	9.93655	1.88193
0.1025	0.25	10.0256	1.91169
0.11	0.25	9.92451	1.93135
0.1175	0.25	10.0566	1.92009
0.125	0.25	10.0436	1.90476
0.14	0.25	9.99087	2.01282
0.155	0.25	9.88234	2.09232
0.17	0.25	10.0121	2.03812

0.185	0.25	9.96304	2.21954
0.2	0.25	9.9956	2.2239
0.215	0.25	10.0967	2.28193
0.23	0.25	9.98853	2.43049
0.26	0.25	10.0461	2.45792
0.29	0.25	10.271	2.46076
0.32	0.25	10.4609	2.49358
0.35	0.25	10.832	2.42637
0.38	0.25	11	2.34109
0.425	0.25	11.5782	2.06882
0.47	0.25	11.7797	1.84153
0.515	0.25	11.9517	1.58908
0.56	0.25	11.8413	1.47259
0.605	0.25	11.6381	1.44418
0.65	0.25	11.3457	1.37805
0.695	0.25	11.0922	1.33431
0.74	0.25	10.9347	1.28884
0.785	0.25	10.7739	1.26244
0.83	0.25	10.6726	1.27999
0.905	0.25	10.5968	1.23698
1.055	0.25	10.5859	1.27313
1.205	0.25	10.6111	1.23016
1.355	0.25	10.6339	1.20676
1.505	0.25	10.5917	1.20949
1.655	0.25	10.6454	1.18832
1.805	0.25	10.6065	1.21469
2.03	0.25	10.6416	1.18622
2.255	0.25	10.5787	1.1859
0.006	0.375	2.51194	0.87428
0.00787	0.375	2.47286	0.88961
0.00975	0.375	2.41416	0.85626
0.01162	0.375	2.10149	0.76298
0.0135	0.375	2.84904	1.04569
0.01725	0.375	4.56223	1.6088
0.021	0.375	6.05567	1.93719
0.02475	0.375	7.11576	1.97992
0.0285	0.375	7.84159	2.01977
0.03225	0.375	8.28087	2.04407
0.036	0.375	8.66596	1.94134
0.03975	0.375	8.97179	1.95791
0.0435	0.375	9.13552	1.92118
0.051	0.375	9.41334	1.84184
0.0585	0.375	9.68697	1.78634
0.066	0.375	9.75091	1.7866
0.0735	0.375	9.93232	1.76529
0.081	0.375	9.98016	1.78996
0.0885	0.375	10.1344	1.70418
0.096	0.375	10.302	1.71933
0.1035	0.375	10.3227	1.71172
0.111	0.375	10.4701	1.76317
0.1185	0.375	10.4395	1.68941
0.126	0.375	10.5496	1.73513

0.141	0.375	10.554	1.74065
0.156	0.375	10.6755	1.80749
0.171	0.375	10.8793	1.77367
0.186	0.375	10.8801	1.83618
0.201	0.375	10.9708	1.83421
0.216	0.375	11.0361	1.87507
0.231	0.375	11.086	1.88779
0.261	0.375	11.2475	1.91632
0.291	0.375	11.2345	1.94854
0.321	0.375	11.5095	1.89715
0.351	0.375	11.5464	1.84176
0.381	0.375	11.5975	1.76915
0.426	0.375	11.7828	1.61087
0.471	0.375	11.7521	1.54852
0.516	0.375	11.5931	1.44898
0.561	0.375	11.4317	1.42258
0.606	0.375	11.2375	1.39132
0.651	0.375	11.0143	1.34352
0.696	0.375	10.8587	1.28462
0.741	0.375	10.7422	1.26083
0.786	0.375	10.6717	1.24882
0.831	0.375	10.6136	1.2418
0.906	0.375	10.5809	1.25052
1.056	0.375	10.6959	1.26802
1.206	0.375	10.6936	1.24568
1.356	0.375	10.6641	1.23321
1.506	0.375	10.655	1.20997
1.656	0.375	10.6674	1.21129
1.806	0.375	10.6444	1.18513
2.031	0.375	10.6845	1.21577
2.256	0.375	10.613	1.22599
0.007	0.5	1.99661	0.65349
0.00887	0.5	2.03268	0.64437
0.01075	0.5	1.96957	0.61615
0.01262	0.5	2.11416	0.69743
0.0145	0.5	2.64656	0.89542
0.01825	0.5	4.3341	1.37687
0.022	0.5	5.80408	1.72075
0.02575	0.5	6.75501	1.7977
0.0295	0.5	7.53322	1.82672
0.03325	0.5	8.00787	1.77656
0.037	0.5	8.34375	1.79113
0.04075	0.5	8.68324	1.74378
0.0445	0.5	8.8524	1.7526
0.052	0.5	9.15727	1.69249
0.0595	0.5	9.30684	1.65966
0.067	0.5	9.49196	1.6425
0.0745	0.5	9.61598	1.60341
0.082	0.5	9.76824	1.59072
0.0895	0.5	9.90513	1.62717
0.097	0.5	9.93688	1.5959
0.1045	0.5	10.07	1.61753

0.112	0.5	10.1042	1.61262
0.1195	0.5	10.2642	1.61422
0.127	0.5	10.2758	1.65057
0.142	0.5	10.4448	1.68136
0.157	0.5	10.5843	1.59334
0.172	0.5	10.6575	1.65959
0.187	0.5	10.7561	1.63202
0.202	0.5	10.7808	1.66312
0.217	0.5	10.8907	1.66765
0.232	0.5	10.9747	1.63736
0.262	0.5	11.1051	1.62043
0.292	0.5	11.2291	1.60554
0.322	0.5	11.2497	1.63211
0.352	0.5	11.2649	1.54753
0.382	0.5	11.2684	1.56457
0.427	0.5	11.2862	1.4885
0.472	0.5	11.1907	1.44498
0.517	0.5	11.0671	1.41616
0.562	0.5	10.9745	1.36569
0.607	0.5	10.8397	1.29999
0.652	0.5	10.7798	1.26892
0.697	0.5	10.6602	1.26352
0.742	0.5	10.6504	1.23947
0.787	0.5	10.6026	1.28027
0.832	0.5	10.5638	1.30195
0.907	0.5	10.5432	1.26954
1.057	0.5	10.646	1.24543
1.207	0.5	10.6617	1.2453
1.357	0.5	10.6841	1.199
1.507	0.5	10.681	1.2043
1.657	0.5	10.6917	1.17405
1.807	0.5	10.6535	1.21785
2.032	0.5	10.6304	1.19955
2.257	0.5	10.6616	1.19052
0.008	0.625	2.01953	0.64654
0.00987	0.625	2.03377	0.63979
0.01175	0.625	1.92157	0.60359
0.01362	0.625	1.98083	0.64824
0.0155	0.625	2.3142	0.77467
0.01925	0.625	3.97603	1.27347
0.023	0.625	5.30177	1.54297
0.02675	0.625	6.38498	1.66503
0.0305	0.625	7.10062	1.70702
0.03425	0.625	7.53608	1.66163
0.038	0.625	7.91192	1.65169
0.04175	0.625	8.21108	1.62664
0.0455	0.625	8.48259	1.60521
0.053	0.625	8.75574	1.54298
0.0605	0.625	8.88769	1.53117
0.068	0.625	9.0538	1.51035
0.0755	0.625	9.21553	1.47413
0.083	0.625	9.30813	1.44421

0.0905	0.625	9.41745	1.46088
0.098	0.625	9.49885	1.51045
0.1055	0.625	9.63545	1.46273
0.113	0.625	9.72195	1.4599
0.1205	0.625	9.73958	1.42512
0.128	0.625	9.89804	1.50273
0.143	0.625	9.94447	1.48908
0.158	0.625	10.053	1.45468
0.173	0.625	10.2166	1.51927
0.188	0.625	10.2703	1.4424
0.203	0.625	10.3331	1.52762
0.218	0.625	10.3666	1.49007
0.233	0.625	10.5032	1.53264
0.263	0.625	10.5793	1.53482
0.293	0.625	10.7415	1.50417
0.323	0.625	10.7278	1.4685
0.353	0.625	10.7313	1.49102
0.383	0.625	10.8172	1.37953
0.428	0.625	10.8027	1.36804
0.473	0.625	10.7276	1.3374
0.518	0.625	10.7272	1.33353
0.563	0.625	10.6928	1.2997
0.608	0.625	10.6617	1.28099
0.653	0.625	10.6478	1.28023
0.698	0.625	10.6165	1.2797
0.743	0.625	10.6243	1.31153
0.788	0.625	10.6396	1.23001
0.833	0.625	10.5916	1.26827
0.908	0.625	10.654	1.2388
1.058	0.625	10.7408	1.27464
1.208	0.625	10.6689	1.21525
1.358	0.625	10.6912	1.24199
1.508	0.625	10.7053	1.22287
1.658	0.625	10.7061	1.2306
1.808	0.625	10.6905	1.21515
2.033	0.625	10.738	1.18972
2.258	0.625	10.6441	1.17229
0.009	0.75	1.88565	0.60400
0.01087	0.75	1.84342	0.60072
0.01275	0.75	1.83938	0.58880
0.01462	0.75	1.87204	0.61095
0.0165	0.75	2.11109	0.71225
0.02025	0.75	3.57696	1.17153
0.024	0.75	4.96222	1.50663
0.02775	0.75	6.02645	1.55884
0.0315	0.75	6.74615	1.61385
0.03525	0.75	7.28637	1.60026
0.039	0.75	7.6002	1.56187
0.04275	0.75	7.8297	1.55616
0.0465	0.75	8.02241	1.49781
0.054	0.75	8.34807	1.41554
0.0615	0.75	8.55658	1.38826
0.069	0.75	8.81404	1.41172
0.0765	0.75	8.91639	1.33173
0.084	0.75	9.06366	1.37193
0.0915	0.75	9.16286	1.35892
0.099	0.75	9.20695	1.34486
0.1065	0.75	9.3432	1.34664
0.114	0.75	9.3307	1.37696
0.1215	0.75	9.46543	1.33861
0.129	0.75	9.55705	1.33061
0.144	0.75	9.6492	1.33386
0.159	0.75	9.71079	1.3324
0.174	0.75	9.8233	1.32992
0.189	0.75	9.96955	1.34991
0.204	0.75	10.0119	1.31079
0.219	0.75	10.1128	1.35655
0.234	0.75	10.129	1.3512
0.264	0.75	10.2343	1.37698
0.294	0.75	10.2841	1.36901
0.324	0.75	10.4247	1.2982
0.354	0.75	10.4077	1.31179
0.384	0.75	10.4568	1.3091
0.429	0.75	10.4704	1.29013
0.474	0.75	10.5643	1.29644
0.519	0.75	10.5752	1.31596
0.564	0.75	10.5378	1.28605
0.609	0.75	10.5717	1.28127
0.654	0.75	10.5889	1.24517
0.699	0.75	10.5737	1.25095
0.744	0.75	10.6253	1.27712
0.789	0.75	10.6249	1.29636
0.834	0.75	10.6465	1.27339
0.909	0.75	10.5944	1.2729
1.059	0.75	10.6898	1.23259
1.209	0.75	10.6952	1.29502
1.359	0.75	10.6787	1.2378
1.509	0.75	10.7292	1.20912
1.659	0.75	10.7017	1.18318
1.809	0.75	10.7064	1.1993
2.034	0.75	10.7371	1.20374
2.259	0.75	10.6028	1.20424
0.01	0.875	1.80819	0.57945
0.01187	0.875	1.80028	0.58452
0.01375	0.875	1.78513	0.58791
0.01562	0.875	1.76364	0.57621
0.0175	0.875	1.8996	0.63385
0.02125	0.875	3.36367	1.17144
0.025	0.875	4.73349	1.46091
0.02875	0.875	5.69236	1.55655
0.0325	0.875	6.43339	1.51709
0.03625	0.875	6.94256	1.48818
0.04	0.875	7.26712	1.49432
0.04375	0.875	7.6302	1.45545
0.0475	0.875	7.8352	1.48693
0.055	0.875	8.23222	1.40125
0.0625	0.875	8.36685	1.37959
0.07	0.875	8.672	1.33358
0.0775	0.875	8.76663	1.3174
0.085	0.875	8.87926	1.28697
0.0925	0.875	8.91557	1.28473
0.1	0.875	9.04435	1.27999
0.1075	0.875	9.18821	1.33549
0.115	0.875	9.24879	1.26304
0.1225	0.875	9.26335	1.27429
0.13	0.875	9.2551	1.28371
0.145	0.875	9.49143	1.28585
0.16	0.875	9.59091	1.27675
0.175	0.875	9.64473	1.30679
0.19	0.875	9.75828	1.29833
0.205	0.875	9.81237	1.29276
0.22	0.875	9.88554	1.28768
0.235	0.875	9.94994	1.27783
0.265	0.875	10.0133	1.2699
0.295	0.875	10.1377	1.28592
0.325	0.875	10.2315	1.29538
0.355	0.875	10.2576	1.2933
0.385	0.875	10.313	1.30037
0.43	0.875	10.3623	1.29128
0.475	0.875	10.3865	1.25237
0.52	0.875	10.5632	1.25636
0.565	0.875	10.5204	1.24115
0.61	0.875	10.5901	1.29043
0.655	0.875	10.5809	1.288
0.7	0.875	10.6161	1.31365
0.745	0.875	10.6459	1.28892
0.79	0.875	10.6066	1.2799
0.835	0.875	10.6592	1.28519
0.91	0.875	10.7024	1.27584
1.06	0.875	10.7267	1.18792
1.21	0.875	10.7985	1.22316
1.36	0.875	10.7257	1.20739
1.51	0.875	10.6867	1.18689
1.66	0.875	10.7334	1.19527
1.81	0.875	10.7203	1.19662
2.035	0.875	10.7214	1.23161
2.26	0.875	10.6488	1.21421
0.011	1	1.77491	0.59980
0.01287	1	1.72132	0.57143
0.01475	1	1.75666	0.57030
0.01662	1	1.75769	0.56642
0.0185	1	1.81038	0.60450
0.02225	1	3.17844	1.12445
0.026	1	4.51699	1.41384
0.02975	1	5.50824	1.52446
0.0335	1	6.32853	1.54809

0.03725	1	6.83636	1.55223
0.041	1	7.2618	1.54348
0.04475	1	7.53059	1.44821
0.0485	1	7.72194	1.44352
0.056	1	8.05738	1.40907
0.0635	1	8.30462	1.32603
0.071	1	8.48052	1.35115
0.0785	1	8.64732	1.29085
0.086	1	8.83534	1.29334
0.0935	1	8.88165	1.28619
0.101	1	8.94646	1.26907
0.1085	1	9.07944	1.29951
0.116	1	9.09976	1.28105
0.1235	1	9.21396	1.2681
0.131	1	9.25372	1.25648
0.146	1	9.42287	1.26954
0.161	1	9.47956	1.29353
0.176	1	9.60759	1.25866
0.191	1	9.65584	1.27538
0.206	1	9.73457	1.31174
0.221	1	9.79407	1.27916
0.236	1	9.83887	1.28994
0.266	1	10.0327	1.31047
0.296	1	10.0243	1.30197
0.326	1	10.1301	1.29645
0.356	1	10.15	1.28648
0.386	1	10.216	1.29761
0.431	1	10.3052	1.28812
0.476	1	10.3836	1.29423
0.521	1	10.5062	1.27318
0.566	1	10.4747	1.29021
0.611	1	10.5035	1.2695
0.656	1	10.6161	1.26288
0.701	1	10.6136	1.29456
0.746	1	10.7009	1.27758
0.791	1	10.6752	1.27492
0.836	1	10.7086	1.23035
0.911	1	10.7165	1.29292
1.061	1	10.7314	1.24882
1.211	1	10.7515	1.25395
1.361	1	10.6497	1.22583
1.511	1	10.6979	1.25379
1.661	1	10.6954	1.20843
1.811	1	10.7118	1.18321
2.036	1	10.6589	1.1995
2.261	1	10.66	1.189
0.012	1.125	1.80607	0.58689
0.01387	1.125	1.81371	0.60661
0.01575	1.125	1.80689	0.57875
0.01762	1.125	1.78913	0.58991
0.0195	1.125	1.80701	0.601
0.02325	1.125	2.99219	1.04081
0.027	1.125	4.33642	1.34911
0.03075	1.125	5.48743	1.5063
0.0345	1.125	6.14058	1.53828
0.03825	1.125	6.7351	1.53133
0.042	1.125	7.15331	1.50932
0.04575	1.125	7.4581	1.49434
0.0495	1.125	7.66458	1.45876
0.057	1.125	8.03843	1.36603
0.0645	1.125	8.27561	1.33357
0.072	1.125	8.42738	1.32378
0.0795	1.125	8.636	1.27245
0.087	1.125	8.74741	1.29321
0.0945	1.125	8.89103	1.32138
0.102	1.125	8.95548	1.27596
0.1095	1.125	9.03702	1.28719
0.117	1.125	9.1511	1.30081
0.1245	1.125	9.19257	1.31747
0.132	1.125	9.21168	1.29143
0.147	1.125	9.36058	1.27306
0.162	1.125	9.46183	1.31977
0.177	1.125	9.54865	1.29788
0.192	1.125	9.66304	1.29342
0.207	1.125	9.65968	1.27602
0.222	1.125	9.80994	1.2795
0.237	1.125	9.79071	1.29861
0.267	1.125	10.0348	1.30262
0.297	1.125	10.1067	1.28551
0.327	1.125	10.1597	1.29757
0.357	1.125	10.1927	1.28041
0.387	1.125	10.246	1.31811
0.432	1.125	10.4159	1.30782
0.477	1.125	10.4444	1.26436
0.522	1.125	10.4544	1.31338
0.567	1.125	10.5086	1.28189
0.612	1.125	10.5501	1.33385
0.657	1.125	10.6081	1.24578
0.702	1.125	10.5894	1.31322
0.747	1.125	10.6606	1.29033
0.792	1.125	10.7391	1.30258
0.837	1.125	10.6991	1.27749
0.912	1.125	10.6866	1.29818
1.062	1.125	10.6891	1.27204
1.212	1.125	10.7466	1.2512
1.362	1.125	10.7462	1.25732
1.512	1.125	10.7356	1.21444
1.662	1.125	10.7271	1.20612
1.812	1.125	10.6351	1.21038
2.037	1.125	10.7421	1.23022
2.262	1.125	10.6813	1.21672
0.013	1.25	1.82951	0.62315
0.01487	1.25	1.82393	0.61407
0.01675	1.25	1.8279	0.60992
0.01862	1.25	1.80866	0.58760
0.0205	1.25	1.84101	0.63781
0.02425	1.25	2.93007	1.04092
0.028	1.25	4.27309	1.37922
0.03175	1.25	5.38327	1.50997
0.0355	1.25	6.22925	1.54992
0.03925	1.25	6.71913	1.55507
0.043	1.25	7.23317	1.5007
0.04675	1.25	7.49777	1.51561
0.0505	1.25	7.75705	1.50315
0.058	1.25	8.12873	1.3997
0.0655	1.25	8.37217	1.3718
0.073	1.25	8.55993	1.31763
0.0805	1.25	8.75081	1.32238
0.088	1.25	8.81866	1.29869
0.0955	1.25	8.9656	1.31648
0.103	1.25	9.03957	1.30188
0.1105	1.25	9.17497	1.308
0.118	1.25	9.20967	1.34029
0.1255	1.25	9.32709	1.29511
0.133	1.25	9.37537	1.3332
0.148	1.25	9.45648	1.30304
0.163	1.25	9.49483	1.26618
0.178	1.25	9.62314	1.29745
0.193	1.25	9.74562	1.3031
0.208	1.25	9.79756	1.28705
0.223	1.25	9.8863	1.29319
0.238	1.25	9.89593	1.32204
0.268	1.25	10.0416	1.32809
0.298	1.25	10.1525	1.30257
0.328	1.25	10.2424	1.30777
0.358	1.25	10.3134	1.26424
0.388	1.25	10.3688	1.30967
0.433	1.25	10.4169	1.25582
0.478	1.25	10.5019	1.30571
0.523	1.25	10.5064	1.27944
0.568	1.25	10.5804	1.27556
0.613	1.25	10.6249	1.28704
0.658	1.25	10.6166	1.30261
0.703	1.25	10.6129	1.2848
0.748	1.25	10.6672	1.28146
0.793	1.25	10.6751	1.31148
0.838	1.25	10.6644	1.24969
0.913	1.25	10.737	1.28508
1.063	1.25	10.7499	1.22739
1.213	1.25	10.7539	1.2243
1.363	1.25	10.7775	1.23029
1.513	1.25	10.7331	1.24403
1.663	1.25	10.7094	1.18757
1.813	1.25	10.7	1.19279
2.038	1.25	10.7146	1.24265
2.263	1.25	10.7475	1.23167

Run ID: 041396

VR=0.503
Uo=10.95 m/s
x/D=2.5 FSTI=12%
L/D=7.0

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.65763	0.48561
0.00187	-0.375	1.72164	0.50781
0.00375	-0.375	2.37576	0.72727
0.00562	-0.375	3.05085	0.96061
0.0075	-0.375	3.74322	1.14195
0.01125	-0.375	4.96189	1.32998
0.015	-0.375	5.77192	1.42262
0.01875	-0.375	6.35016	1.41725
0.0225	-0.375	6.72193	1.39179
0.02625	-0.375	7.01261	1.36677
0.03	-0.375	7.20565	1.33567
0.03375	-0.375	7.40239	1.33593
0.0375	-0.375	7.44398	1.34141
0.045	-0.375	7.63922	1.33724
0.0525	-0.375	7.66432	1.33875
0.06	-0.375	7.68541	1.35497
0.0675	-0.375	7.7049	1.42822
0.075	-0.375	7.70367	1.46589
0.0825	-0.375	7.59718	1.50476
0.09	-0.375	7.6506	1.49286
0.0975	-0.375	7.68154	1.60887
0.105	-0.375	7.66361	1.60334
0.1125	-0.375	7.69475	1.71087
0.12	-0.375	7.63949	1.7663
0.135	-0.375	7.79543	1.76307
0.15	-0.375	7.839	1.8005
0.165	-0.375	7.90346	1.87114
0.18	-0.375	7.9785	1.86358
0.195	-0.375	8.04406	1.82996
0.21	-0.375	8.2398	1.89104
0.225	-0.375	8.26135	1.87081
0.255	-0.375	8.51315	1.81796
0.285	-0.375	8.77303	1.74236
0.315	-0.375	9.09992	1.6202
0.345	-0.375	9.27054	1.62415
0.375	-0.375	9.49286	1.48354
0.42	-0.375	9.76281	1.43644
0.465	-0.375	9.99414	1.43155
0.51	-0.375	10.232	1.41996
0.555	-0.375	10.284	1.41498
0.6	-0.375	10.3699	1.35903
0.645	-0.375	10.5774	1.42342
0.69	-0.375	10.6603	1.38414
0.735	-0.375	10.7465	1.36343
0.78	-0.375	10.7605	1.34683
0.825	-0.375	10.7757	1.30049
0.9	-0.375	10.8389	1.28288
1.05	-0.375	10.9411	1.24845
1.2	-0.375	10.9552	1.22405
1.35	-0.375	10.8782	1.22438
1.5	-0.375	10.9537	1.24117
1.65	-0.375	10.9272	1.24674
1.8	-0.375	10.9751	1.21914
2.025	-0.375	10.9549	1.22681
2.25	-0.375	10.9145	1.25471
0.001	-0.25	1.51091	0.47428
0.00287	-0.25	1.5803	0.55161
0.00475	-0.25	1.94678	0.68973
0.00662	-0.25	2.47808	0.91588
0.0085	-0.25	3.09123	1.10914
0.01225	-0.25	4.19278	1.35813
0.016	-0.25	4.9431	1.50516
0.01975	-0.25	5.53664	1.58334
0.0235	-0.25	5.99254	1.61485
0.02725	-0.25	6.14262	1.67473
0.031	-0.25	6.39867	1.6245
0.03475	-0.25	6.51655	1.59411
0.0385	-0.25	6.59384	1.5916
0.046	-0.25	6.81906	1.55193
0.0535	-0.25	6.79441	1.54089
0.061	-0.25	6.78703	1.54621
0.0685	-0.25	6.66232	1.63793
0.076	-0.25	6.65368	1.60024
0.0835	-0.25	6.74896	1.64027
0.091	-0.25	6.58008	1.70179
0.0985	-0.25	6.60935	1.74857
0.106	-0.25	6.53568	1.76449
0.1135	-0.25	6.53541	1.801
0.121	-0.25	6.46731	1.90463
0.136	-0.25	6.45184	1.94593
0.151	-0.25	6.52501	2.00943
0.166	-0.25	6.60594	2.05803
0.181	-0.25	6.61497	2.08926
0.196	-0.25	6.76291	2.10078
0.211	-0.25	6.90522	2.14627
0.226	-0.25	7.10786	2.09188
0.256	-0.25	7.54718	2.06905
0.286	-0.25	7.8188	1.99804
0.316	-0.25	8.22161	1.85622
0.346	-0.25	8.69455	1.71803
0.376	-0.25	9.03679	1.61956
0.421	-0.25	9.43773	1.51324
0.466	-0.25	9.87886	1.44282
0.511	-0.25	10.0267	1.39464
0.556	-0.25	10.3705	1.43888
0.601	-0.25	10.4239	1.38759
0.646	-0.25	10.5535	1.39181
0.691	-0.25	10.6636	1.37148
0.736	-0.25	10.7257	1.3715
0.781	-0.25	10.7767	1.33687
0.826	-0.25	10.8135	1.31584
0.901	-0.25	10.8402	1.33804
1.051	-0.25	10.9532	1.25532
1.201	-0.25	11.0193	1.30643
1.351	-0.25	11.0003	1.2222
1.501	-0.25	11.019	1.21917
1.651	-0.25	11.034	1.21884
1.801	-0.25	11.0804	1.25578
2.026	-0.25	11.0158	1.24776
2.251	-0.25	11.0143	1.22085
0.002	-0.125	1.40387	0.55253
0.00387	-0.125	1.29767	0.49094
0.00575	-0.125	1.54174	0.61729
0.00762	-0.125	1.96726	0.82873
0.0095	-0.125	2.44503	1.04948
0.01325	-0.125	3.18699	1.28922
0.017	-0.125	3.93003	1.50451
0.02075	-0.125	4.42061	1.65896
0.0245	-0.125	4.67139	1.61655
0.02825	-0.125	5.04506	1.64942
0.032	-0.125	5.24624	1.64082
0.03575	-0.125	5.34611	1.663
0.0395	-0.125	5.46527	1.67356
0.047	-0.125	5.62316	1.60827
0.0545	-0.125	5.65733	1.56941
0.062	-0.125	5.68582	1.54283
0.0695	-0.125	5.66984	1.52625
0.077	-0.125	5.64235	1.54204
0.0845	-0.125	5.66039	1.52329
0.092	-0.125	5.58752	1.49879
0.0995	-0.125	5.49355	1.54479
0.107	-0.125	5.4893	1.54805
0.1145	-0.125	5.41656	1.57232
0.122	-0.125	5.42301	1.62231
0.137	-0.125	5.4162	1.62364
0.152	-0.125	5.32371	1.70728
0.167	-0.125	5.35287	1.76162
0.182	-0.125	5.36262	1.8111
0.197	-0.125	5.51072	1.86251
0.212	-0.125	5.66316	1.92586
0.227	-0.125	5.76231	1.9729
0.257	-0.125	6.23531	2.01583
0.287	-0.125	6.75621	2.0267
0.317	-0.125	7.39258	1.96217
0.347	-0.125	7.97024	1.82032
0.377	-0.125	8.52451	1.71838

0.422	-0.125	9.24518	1.54182
0.467	-0.125	9.64217	1.45168
0.512	-0.125	10.0255	1.44134
0.557	-0.125	10.2077	1.3679
0.602	-0.125	10.2884	1.40332
0.647	-0.125	10.4987	1.39973
0.692	-0.125	10.6805	1.36263
0.737	-0.125	10.7144	1.41108
0.782	-0.125	10.7154	1.33072
0.827	-0.125	10.7832	1.35819
0.902	-0.125	10.831	1.31723
1.052	-0.125	10.9585	1.26791
1.202	-0.125	10.8858	1.24829
1.352	-0.125	10.9502	1.23733
1.502	-0.125	11.0285	1.23883
1.652	-0.125	10.9675	1.18574
1.802	-0.125	10.9794	1.23736
2.027	-0.125	10.9619	1.24121
2.252	-0.125	10.9773	1.25241
0.003	0	1.18089	0.45380
0.00487	0	1.19596	0.44646
0.00675	0	1.32887	0.55205
0.00862	0	1.72377	0.73444
0.0105	0	2.13583	0.92380
0.01425	0	2.88876	1.23037
0.018	0	3.56073	1.42501
0.02175	0	3.962	1.48575
0.0255	0	4.30317	1.55443
0.02925	0	4.54841	1.60564
0.033	0	4.76481	1.57811
0.03675	0	5.01603	1.59053
0.0405	0	5.01841	1.58238
0.048	0	5.29918	1.5074
0.0555	0	5.43741	1.50688
0.063	0	5.44617	1.47857
0.0705	0	5.36061	1.44611
0.078	0	5.40732	1.45002
0.0855	0	5.34278	1.46908
0.093	0	5.34272	1.44463
0.1005	0	5.24719	1.41978
0.108	0	5.17503	1.42159
0.1155	0	5.16567	1.43655
0.123	0	5.13775	1.44288
0.138	0	5.05868	1.48578
0.153	0	5.02277	1.51928
0.168	0	4.99196	1.59273
0.183	0	5.04725	1.59177
0.198	0	5.06438	1.69134
0.213	0	5.2534	1.73573
0.228	0	5.45091	1.77668
0.258	0	5.84238	1.90911
0.288	0	6.44782	1.95866
0.318	0	7.21206	1.93087
0.348	0	7.86207	1.82946
0.378	0	8.49851	1.70605
0.423	0	9.20517	1.55339
0.468	0	9.74536	1.47015
0.513	0	10.0395	1.41547
0.558	0	10.1031	1.45425
0.603	0	10.3824	1.39231
0.648	0	10.4225	1.42162
0.693	0	10.5246	1.36751
0.738	0	10.7137	1.36907
0.783	0	10.7319	1.35337
0.828	0	10.7929	1.33863
0.903	0	10.7958	1.29621
1.053	0	10.9403	1.26801
1.203	0	10.994	1.26868
1.353	0	10.9082	1.25481
1.503	0	10.9434	1.22738
1.653	0	10.944	1.25708
1.803	0	10.9475	1.21336
2.028	0	10.9867	1.25005
2.253	0	10.9534	1.24669
0.004	0.125	1.36413	0.50121
0.00587	0.125	1.38653	0.50624
0.00775	0.125	1.46455	0.57113
0.00962	0.125	1.94677	0.7998
0.0115	0.125	2.43913	1.01706
0.01525	0.125	3.42357	1.40267
0.019	0.125	4.23501	1.6023
0.02275	0.125	4.78063	1.71378
0.0265	0.125	5.28025	1.77754
0.03025	0.125	5.59726	1.83155
0.034	0.125	5.78826	1.83388
0.03775	0.125	5.94032	1.76983
0.0415	0.125	6.00803	1.75833
0.049	0.125	6.13415	1.73392
0.0565	0.125	6.22359	1.6735
0.064	0.125	6.25763	1.71866
0.0715	0.125	6.17715	1.6587
0.079	0.125	6.14719	1.64224
0.0865	0.125	6.15757	1.71321
0.094	0.125	6.10036	1.7045
0.1015	0.125	6.01702	1.74682
0.109	0.125	5.93495	1.737
0.1165	0.125	5.96023	1.82035
0.124	0.125	5.80878	1.79015
0.139	0.125	5.85056	1.87242
0.154	0.125	5.74479	1.91479
0.169	0.125	5.85728	1.95802
0.184	0.125	5.86783	2.00946
0.199	0.125	5.90441	2.03851
0.214	0.125	6.05361	2.09861
0.229	0.125	6.33945	2.09518
0.259	0.125	6.5264	2.08446
0.289	0.125	7.16615	2.04917
0.319	0.125	7.69342	1.98711
0.349	0.125	8.34088	1.81854
0.379	0.125	8.86111	1.70244
0.424	0.125	9.31502	1.49662
0.469	0.125	9.72142	1.41298
0.514	0.125	10.0224	1.41738
0.559	0.125	10.2644	1.40338
0.604	0.125	10.3958	1.41849
0.649	0.125	10.4603	1.39669
0.694	0.125	10.6831	1.36166
0.739	0.125	10.7548	1.38401
0.784	0.125	10.8449	1.30261
0.829	0.125	10.8431	1.34986
0.904	0.125	10.8851	1.32532
1.054	0.125	10.9178	1.26372
1.204	0.125	10.9423	1.26502
1.354	0.125	10.9322	1.23335
1.504	0.125	10.9692	1.24995
1.654	0.125	11.0206	1.25693
1.804	0.125	11.0334	1.20512
2.029	0.125	10.9294	1.25504
2.254	0.125	10.939	1.22279
0.005	0.25	1.59139	0.51109
0.00687	0.25	1.58317	0.51892
0.00875	0.25	1.66139	0.52804
0.01062	0.25	2.23864	0.74310
0.0125	0.25	2.83893	0.96794
0.01625	0.25	4.10922	1.33338
0.02	0.25	5.22417	1.51684
0.02375	0.25	5.91768	1.54563
0.0275	0.25	6.44203	1.6098
0.03125	0.25	6.74909	1.52381
0.035	0.25	6.9414	1.56673
0.03875	0.25	7.12262	1.57605
0.0425	0.25	7.30188	1.5528
0.05	0.25	7.33343	1.51719
0.0575	0.25	7.28103	1.57962
0.065	0.25	7.42723	1.49967
0.0725	0.25	7.34104	1.54997
0.08	0.25	7.23629	1.62279
0.0875	0.25	7.31578	1.63796
0.095	0.25	7.32637	1.6981
0.1025	0.25	7.27668	1.74175
0.11	0.25	7.15651	1.78776
0.1175	0.25	7.22561	1.83579
0.125	0.25	7.07387	1.91666
0.14	0.25	7.12582	1.96107
0.155	0.25	7.12598	2.02096
0.17	0.25	7.10166	2.08711

0.185	0.25	7.26795	2.08835
0.2	0.25	7.37354	2.1553
0.215	0.25	7.50576	2.10384
0.23	0.25	7.57316	2.11777
0.26	0.25	7.89544	2.06338
0.29	0.25	8.15376	1.94457
0.32	0.25	8.66158	1.81832
0.35	0.25	8.96318	1.68873
0.38	0.25	9.35751	1.57416
0.425	0.25	9.71945	1.47717
0.47	0.25	9.93514	1.42747
0.515	0.25	10.1649	1.44656
0.56	0.25	10.3728	1.44598
0.605	0.25	10.475	1.39969
0.65	0.25	10.639	1.37767
0.695	0.25	10.6639	1.38275
0.74	0.25	10.7262	1.36483
0.785	0.25	10.7905	1.3552
0.83	0.25	10.8235	1.33521
0.905	0.25	10.839	1.31583
1.055	0.25	10.9952	1.27373
1.205	0.25	10.9854	1.258
1.355	0.25	11.0422	1.2495
1.505	0.25	11.0413	1.26822
1.655	0.25	10.9821	1.24141
1.805	0.25	11.0144	1.1942
2.03	0.25	10.9787	1.26543
2.255	0.25	10.9891	1.23709
0.006	0.375	1.69094	0.48558
0.00787	0.375	1.66478	0.49292
0.00975	0.375	1.75244	0.51495
0.01162	0.375	2.32783	0.71744
0.0135	0.375	3.03459	0.92201
0.01725	0.375	4.47549	1.29484
0.021	0.375	5.48996	1.37374
0.02475	0.375	6.2895	1.40039
0.0285	0.375	6.91609	1.36653
0.03225	0.375	7.27565	1.31205
0.036	0.375	7.53126	1.2988
0.03975	0.375	7.68213	1.26343
0.0435	0.375	7.76654	1.25141
0.051	0.375	8.01855	1.23837
0.0585	0.375	8.11368	1.22728
0.066	0.375	8.12228	1.27532
0.0735	0.375	8.18095	1.28032
0.081	0.375	8.23195	1.33867
0.0885	0.375	8.22327	1.34474
0.096	0.375	8.23303	1.40614
0.1035	0.375	8.24063	1.50761
0.111	0.375	8.22987	1.45811
0.1185	0.375	8.26158	1.57785
0.126	0.375	8.2428	1.64842
0.141	0.375	8.304	1.66699
0.156	0.375	8.29236	1.72559
0.171	0.375	8.40886	1.84447
0.186	0.375	8.52505	1.82254
0.201	0.375	8.51396	1.80512
0.216	0.375	8.57386	1.80508
0.231	0.375	8.71367	1.74244
0.261	0.375	8.84562	1.77802
0.291	0.375	9.08571	1.65271
0.321	0.375	9.33168	1.57022
0.351	0.375	9.61407	1.47639
0.381	0.375	9.73961	1.46756
0.426	0.375	9.9182	1.42451
0.471	0.375	10.1705	1.40235
0.516	0.375	10.2637	1.41981
0.561	0.375	10.3931	1.42921
0.606	0.375	10.4797	1.34951
0.651	0.375	10.5736	1.38658
0.696	0.375	10.7047	1.37054
0.741	0.375	10.7565	1.37584
0.786	0.375	10.8688	1.31385
0.831	0.375	10.9	1.34638
0.906	0.375	10.8855	1.31444
1.056	0.375	10.9665	1.28114
1.206	0.375	10.9665	1.24577
1.356	0.375	11.0626	1.25978
1.506	0.375	10.9793	1.23734
1.656	0.375	10.9524	1.25218
1.806	0.375	10.9957	1.22411
2.031	0.375	10.9511	1.24329
2.256	0.375	10.9378	1.24019
0.007	0.5	1.83218	0.56770
0.00887	0.5	1.85275	0.57770
0.01075	0.5	1.77349	0.53409
0.01262	0.5	2.16308	0.64525
0.0145	0.5	2.92609	0.91280
0.01825	0.5	4.31076	1.28394
0.022	0.5	5.48405	1.388
0.02575	0.5	6.3442	1.41518
0.0295	0.5	6.86066	1.43319
0.03325	0.5	7.3318	1.37269
0.037	0.5	7.60897	1.33897
0.04075	0.5	7.7767	1.26983
0.0445	0.5	7.97778	1.32382
0.052	0.5	8.23877	1.22939
0.0595	0.5	8.35597	1.20625
0.067	0.5	8.45402	1.19347
0.0745	0.5	8.56309	1.18382
0.082	0.5	8.62119	1.19105
0.0895	0.5	8.73135	1.18098
0.097	0.5	8.7141	1.1976
0.1045	0.5	8.71121	1.24134
0.112	0.5	8.74647	1.21941
0.1195	0.5	8.73414	1.26917
0.127	0.5	8.74602	1.28999
0.142	0.5	8.79158	1.35028
0.157	0.5	8.83462	1.45501
0.172	0.5	9.00874	1.42591
0.187	0.5	9.05637	1.4415
0.202	0.5	9.15028	1.4434
0.217	0.5	9.15094	1.48732
0.232	0.5	9.16319	1.51678
0.262	0.5	9.39079	1.39455
0.292	0.5	9.47536	1.42026
0.322	0.5	9.68239	1.41792
0.352	0.5	9.82017	1.4293
0.382	0.5	9.85983	1.4047
0.427	0.5	10.0146	1.38073
0.472	0.5	10.0904	1.35409
0.517	0.5	10.3088	1.37289
0.562	0.5	10.3727	1.33434
0.607	0.5	10.4535	1.35219
0.652	0.5	10.4657	1.37761
0.697	0.5	10.4308	1.30503
0.742	0.5	10.669	1.32057
0.787	0.5	10.6354	1.31122
0.832	0.5	10.6574	1.3289
0.907	0.5	10.7088	1.27261
1.057	0.5	10.7895	1.2366
1.207	0.5	10.7582	1.22108
1.357	0.5	10.8658	1.24761
1.507	0.5	10.8632	1.21877
1.657	0.5	10.841	1.23209
1.807	0.5	10.8179	1.25451
2.032	0.5	10.8805	1.20528
2.257	0.5	10.8134	1.21841
0.008	0.625	1.70533	0.54412
0.00987	0.625	1.69588	0.52620
0.01175	0.625	1.77318	0.56624
0.01362	0.625	1.88309	0.60474
0.0155	0.625	2.59236	0.87707
0.01925	0.625	3.95817	1.23582
0.023	0.625	5.10279	1.39223
0.02675	0.625	6.03504	1.49618
0.0305	0.625	6.61343	1.5194
0.03425	0.625	7.05767	1.44461
0.038	0.625	7.32825	1.42333
0.04175	0.625	7.62947	1.37085
0.0455	0.625	7.81931	1.36693
0.053	0.625	8.0642	1.2812
0.0605	0.625	8.24803	1.22073
0.068	0.625	8.48431	1.2296
0.0755	0.625	8.51192	1.18044
0.083	0.625	8.62014	1.23868

0.0905	0.625	8.66301	1.19661
0.098	0.625	8.70772	1.21204
0.1055	0.625	8.81317	1.20056
0.113	0.625	8.89772	1.20401
0.1205	0.625	8.94098	1.24414
0.128	0.625	8.98907	1.23567
0.143	0.625	9.04348	1.28399
0.158	0.625	9.12071	1.28648
0.173	0.625	9.24059	1.31481
0.188	0.625	9.30028	1.34097
0.203	0.625	9.36423	1.3018
0.218	0.625	9.44186	1.35328
0.233	0.625	9.47961	1.35942
0.263	0.625	9.59406	1.35141
0.293	0.625	9.76696	1.32263
0.323	0.625	9.79481	1.33465
0.353	0.625	9.9279	1.36889
0.383	0.625	10.0297	1.34607
0.428	0.625	10.1383	1.33088
0.473	0.625	10.2074	1.37413
0.518	0.625	10.3745	1.3728
0.563	0.625	10.4294	1.34067
0.608	0.625	10.517	1.31822
0.653	0.625	10.5355	1.34087
0.698	0.625	10.6454	1.34942
0.743	0.625	10.6551	1.29434
0.788	0.625	10.6499	1.30223
0.833	0.625	10.6676	1.29482
0.908	0.625	10.7887	1.24826
1.058	0.625	10.7526	1.26457
1.208	0.625	10.8145	1.23038
1.358	0.625	10.832	1.23412
1.508	0.625	10.8454	1.22933
1.658	0.625	10.8166	1.18713
1.808	0.625	10.7463	1.23265
2.033	0.625	10.7945	1.21258
2.258	0.625	10.7751	1.25158
0.009	0.75	1.71353	0.57492
0.01087	0.75	1.71097	0.56145
0.01275	0.75	1.77539	0.58135
0.01462	0.75	1.87187	0.64887
0.0165	0.75	2.55575	0.90706
0.02025	0.75	3.93311	1.28858
0.024	0.75	5.03914	1.501
0.02775	0.75	5.93548	1.53172
0.0315	0.75	6.47177	1.5096
0.03525	0.75	6.91144	1.46689
0.039	0.75	7.275	1.4561
0.04275	0.75	7.47648	1.4241
0.0465	0.75	7.66985	1.42356
0.054	0.75	8.01409	1.36445
0.0615	0.75	8.16023	1.28675

0.069	0.75	8.34911	1.26529
0.0765	0.75	8.42358	1.27626
0.084	0.75	8.60241	1.27949
0.0915	0.75	8.74516	1.24314
0.099	0.75	8.78298	1.23146
0.1065	0.75	8.80024	1.24818
0.114	0.75	8.95683	1.2796
0.1215	0.75	8.9987	1.26138
0.129	0.75	9.04941	1.25424
0.144	0.75	9.07083	1.24667
0.159	0.75	9.1893	1.26934
0.174	0.75	9.32995	1.28548
0.189	0.75	9.42433	1.27453
0.204	0.75	9.50924	1.33763
0.219	0.75	9.53364	1.31315
0.234	0.75	9.6476	1.31004
0.264	0.75	9.73284	1.32988
0.294	0.75	9.86294	1.3213
0.324	0.75	9.91875	1.31143
0.354	0.75	10.0653	1.37396
0.384	0.75	10.0976	1.32725
0.429	0.75	10.2165	1.35821
0.474	0.75	10.2685	1.31791
0.519	0.75	10.3777	1.33
0.564	0.75	10.3456	1.32323
0.609	0.75	10.5259	1.34771
0.654	0.75	10.4898	1.29215
0.699	0.75	10.5513	1.30923
0.744	0.75	10.5669	1.29646
0.789	0.75	10.5694	1.25562
0.834	0.75	10.6183	1.25634
0.909	0.75	10.6453	1.24359
1.059	0.75	10.7335	1.23412
1.209	0.75	10.7446	1.24316
1.359	0.75	10.7201	1.24202
1.509	0.75	10.747	1.23613
1.659	0.75	10.7816	1.17094
1.809	0.75	10.7474	1.20129
2.034	0.75	10.7291	1.23019
2.259	0.75	10.7201	1.22627
0.01	0.875	1.75099	0.59978
0.01187	0.875	1.72721	0.57292
0.01375	0.875	1.69221	0.58279
0.01562	0.875	1.75852	0.58309
0.0175	0.875	2.3965	0.84251
0.02125	0.875	3.76135	1.27667
0.025	0.875	4.90656	1.47957
0.02875	0.875	5.76113	1.54102
0.0325	0.875	6.33395	1.52441
0.03625	0.875	6.83828	1.50112
0.04	0.875	7.11872	1.44833
0.04375	0.875	7.40352	1.43445

0.0475	0.875	7.53791	1.43026
0.055	0.875	7.88403	1.3798
0.0625	0.875	8.16074	1.3205
0.07	0.875	8.35778	1.29479
0.0775	0.875	8.45223	1.31394
0.085	0.875	8.59052	1.26486
0.0925	0.875	8.69829	1.26702
0.1	0.875	8.77226	1.26096
0.1075	0.875	8.88635	1.27509
0.115	0.875	8.87184	1.25178
0.1225	0.875	9.01958	1.26535
0.13	0.875	8.99638	1.28671
0.145	0.875	9.19538	1.26694
0.16	0.875	9.29216	1.30735
0.175	0.875	9.38278	1.26807
0.19	0.875	9.44726	1.32098
0.205	0.875	9.56153	1.32422
0.22	0.875	9.63426	1.30176
0.235	0.875	9.60806	1.34886
0.265	0.875	9.77697	1.34338
0.295	0.875	9.79936	1.31289
0.325	0.875	9.90444	1.33808
0.355	0.875	9.97477	1.30519
0.385	0.875	10.0814	1.34924
0.43	0.875	10.2793	1.3331
0.475	0.875	10.2963	1.34097
0.52	0.875	10.3502	1.31446
0.565	0.875	10.2968	1.26923
0.61	0.875	10.4318	1.28864
0.655	0.875	10.4994	1.2826
0.7	0.875	10.4867	1.29399
0.745	0.875	10.6003	1.29287
0.79	0.875	10.6312	1.26759
0.835	0.875	10.5582	1.29227
0.91	0.875	10.6485	1.2749
1.06	0.875	10.7398	1.24872
1.21	0.875	10.7862	1.24682
1.36	0.875	10.7415	1.21657
1.51	0.875	10.7371	1.24921
1.66	0.875	10.7584	1.22117
1.81	0.875	10.7453	1.23355
2.035	0.875	10.7176	1.22537
2.26	0.875	10.6511	1.20763
0.011	1	1.64433	0.55117
0.01287	1	1.62393	0.55022
0.01475	1	1.62479	0.53842
0.01662	1	1.7334	0.58169
0.0185	1	2.381	0.86064
0.02225	1	3.73173	1.2822
0.026	1	4.90284	1.48432
0.02975	1	5.83303	1.54729
0.0335	1	6.34791	1.55467

0.03725	1	6.72393	1.50661
0.041	1	7.06201	1.47617
0.04475	1	7.32269	1.45732
0.0485	1	7.62082	1.41172
0.056	1	7.82237	1.34564
0.0635	1	8.09365	1.3228
0.071	1	8.20146	1.29729
0.0785	1	8.4042	1.29795
0.086	1	8.46118	1.25064
0.0935	1	8.65113	1.25897
0.101	1	8.67411	1.28639
0.1085	1	8.82893	1.25932
0.116	1	8.84778	1.23775
0.1235	1	8.93747	1.28769
0.131	1	9.01657	1.26771
0.146	1	9.07843	1.27972
0.161	1	9.24322	1.30388
0.176	1	9.29161	1.33185
0.191	1	9.44597	1.30962
0.206	1	9.44659	1.30566
0.221	1	9.54413	1.32662
0.236	1	9.61815	1.33708
0.266	1	9.78384	1.32749
0.296	1	9.82759	1.31736
0.326	1	9.90377	1.35107
0.356	1	10.0477	1.31666
0.386	1	10.1142	1.31268
0.431	1	10.2274	1.33113
0.476	1	10.2356	1.29002
0.521	1	10.2537	1.27686
0.566	1	10.3869	1.30584
0.611	1	10.4475	1.31271
0.656	1	10.4263	1.29831
0.701	1	10.5752	1.31243
0.746	1	10.5763	1.29268
0.791	1	10.6209	1.28611
0.836	1	10.6031	1.29885
0.911	1	10.5758	1.24092
1.061	1	10.6853	1.25961
1.211	1	10.7186	1.25914
1.361	1	10.7083	1.26706
1.511	1	10.7117	1.23797
1.661	1	10.7573	1.22947
1.811	1	10.7284	1.20414
2.036	1	10.7391	1.21885
2.261	1	10.6744	1.21926
0.012	1.125	1.73372	0.57868
0.01387	1.125	1.69507	0.56759
0.01575	1.125	1.69183	0.56556
0.01762	1.125	1.76643	0.59455
0.0195	1.125	2.3168	0.85939
0.02325	1.125	3.61501	1.23051
0.027	1.125	4.85118	1.51482
0.03075	1.125	5.70311	1.5302
0.0345	1.125	6.35992	1.54326
0.03825	1.125	6.7727	1.48091
0.042	1.125	7.06783	1.45792
0.04575	1.125	7.38444	1.44681
0.0495	1.125	7.54727	1.41012
0.057	1.125	7.81459	1.348
0.0645	1.125	8.10751	1.32557
0.072	1.125	8.25202	1.31726
0.0795	1.125	8.38434	1.32128
0.087	1.125	8.50894	1.28709
0.0945	1.125	8.64548	1.27805
0.102	1.125	8.7499	1.30277
0.1095	1.125	8.85551	1.28775
0.117	1.125	8.89008	1.28062
0.1245	1.125	8.96667	1.27021
0.132	1.125	8.97676	1.28727
0.147	1.125	9.19317	1.33234
0.162	1.125	9.25891	1.29861
0.177	1.125	9.37411	1.30981
0.192	1.125	9.40394	1.31161
0.207	1.125	9.4643	1.29813
0.222	1.125	9.52349	1.30482
0.237	1.125	9.65348	1.32023
0.267	1.125	9.73549	1.30504
0.297	1.125	9.85263	1.30189
0.327	1.125	9.96852	1.31715
0.357	1.125	10.0953	1.35289
0.387	1.125	10.1328	1.31031
0.432	1.125	10.2176	1.33352
0.477	1.125	10.2365	1.31774
0.522	1.125	10.381	1.29875
0.567	1.125	10.4357	1.34614
0.612	1.125	10.4687	1.32507
0.657	1.125	10.4602	1.30689
0.702	1.125	10.445	1.25213
0.747	1.125	10.5212	1.30248
0.792	1.125	10.5652	1.2719
0.837	1.125	10.6102	1.30365
0.912	1.125	10.6585	1.23072
1.062	1.125	10.7102	1.22416
1.212	1.125	10.7399	1.22138
1.362	1.125	10.755	1.23081
1.512	1.125	10.7238	1.22954
1.662	1.125	10.698	1.20876
1.812	1.125	10.7044	1.17948
2.037	1.125	10.6555	1.21186
2.262	1.125	10.6885	1.23084
0.013	1.25	1.75321	0.59091
0.01487	1.25	1.75897	0.60805
0.01675	1.25	1.7874	0.60176
0.01862	1.25	1.76584	0.62805
0.0205	1.25	2.20816	0.76512
0.02425	1.25	3.54916	1.185
0.028	1.25	4.69156	1.43598
0.03175	1.25	5.60248	1.54477
0.0355	1.25	6.24841	1.52776
0.03925	1.25	6.73026	1.54063
0.043	1.25	7.08471	1.47705
0.04675	1.25	7.32609	1.48998
0.0505	1.25	7.47936	1.39418
0.058	1.25	7.83558	1.39039
0.0655	1.25	8.09867	1.33658
0.073	1.25	8.22132	1.31703
0.0805	1.25	8.38417	1.33026
0.088	1.25	8.48298	1.28382
0.0955	1.25	8.63223	1.27587
0.103	1.25	8.74403	1.30626
0.1105	1.25	8.72713	1.24706
0.118	1.25	8.90396	1.26335
0.1255	1.25	8.99841	1.2965
0.133	1.25	8.89351	1.27533
0.148	1.25	9.05872	1.2777
0.163	1.25	9.21384	1.30994
0.178	1.25	9.35707	1.30111
0.193	1.25	9.39615	1.3045
0.208	1.25	9.46392	1.33312
0.223	1.25	9.54784	1.34298
0.238	1.25	9.60233	1.31141
0.268	1.25	9.74026	1.35833
0.298	1.25	9.81611	1.32464
0.328	1.25	9.90719	1.30692
0.358	1.25	9.96394	1.27718
0.388	1.25	10.0837	1.31719
0.433	1.25	10.1721	1.31136
0.478	1.25	10.2179	1.35001
0.523	1.25	10.3077	1.29643
0.568	1.25	10.3548	1.31975
0.613	1.25	10.3321	1.28418
0.658	1.25	10.4231	1.33165
0.703	1.25	10.4618	1.33152
0.748	1.25	10.5584	1.32162
0.793	1.25	10.6407	1.28241
0.838	1.25	10.5193	1.2648
0.913	1.25	10.5755	1.2593
1.063	1.25	10.6976	1.25644
1.213	1.25	10.6599	1.19921
1.363	1.25	10.6395	1.25376
1.513	1.25	10.6675	1.20967
1.663	1.25	10.6782	1.22802
1.813	1.25	10.7211	1.22087
2.038	1.25	10.6882	1.19751
2.263	1.25	10.681	1.21606

Run ID: 041496

VR=0.998
Uo=10.87 m/s
x/D=2.5 FSTI=12%
L/D=2.3

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.69339	0.68615
0.00187	-0.375	1.79637	0.75104
0.00375	-0.375	2.46767	1.11756
0.00562	-0.375	3.14629	1.40729
0.0075	-0.375	3.81923	1.65791
0.01125	-0.375	5.2044	1.90366
0.015	-0.375	5.95559	2.05079
0.01875	-0.375	6.79528	2.02678
0.0225	-0.375	7.24453	2.09957
0.02625	-0.375	7.69016	2.06621
0.03	-0.375	7.92429	1.9577
0.03375	-0.375	8.17052	2.00698
0.0375	-0.375	8.39384	1.97983
0.045	-0.375	8.7292	1.87102
0.0525	-0.375	8.89745	1.89945
0.06	-0.375	9.09138	1.83212
0.0675	-0.375	9.28373	1.83169
0.075	-0.375	9.46578	1.75062
0.0825	-0.375	9.61015	1.81417
0.09	-0.375	9.62348	1.81542
0.0975	-0.375	9.7421	1.75249
0.105	-0.375	9.87878	1.7625
0.1125	-0.375	9.91672	1.80351
0.12	-0.375	10.0149	1.79413
0.135	-0.375	10.1262	1.80592
0.15	-0.375	10.2202	1.86217
0.165	-0.375	10.2998	1.84029
0.18	-0.375	10.3966	1.8409
0.195	-0.375	10.4898	1.95138
0.21	-0.375	10.517	1.92425
0.225	-0.375	10.5834	1.97458
0.255	-0.375	10.701	2.0151
0.285	-0.375	10.8757	2.10521
0.315	-0.375	10.9704	2.20867
0.345	-0.375	11.2026	2.12795
0.375	-0.375	11.4155	2.09363
0.42	-0.375	11.6481	1.94745
0.465	-0.375	11.6983	1.92064
0.51	-0.375	11.8123	1.77106
0.555	-0.375	11.847	1.71101
0.6	-0.375	11.7627	1.6981
0.645	-0.375	11.5343	1.60646
0.69	-0.375	11.3734	1.56504
0.735	-0.375	11.214	1.4741
0.78	-0.375	11.0566	1.44652
0.825	-0.375	10.9224	1.34882
0.9	-0.375	10.7661	1.32127
1.05	-0.375	10.7576	1.27854
1.2	-0.375	10.7175	1.22694
1.35	-0.375	10.778	1.22732
1.5	-0.375	10.7487	1.21069
1.65	-0.375	10.7097	1.18075
1.8	-0.375	10.719	1.17627
2.025	-0.375	10.7795	1.20451
2.25	-0.375	10.7155	1.22733
0.001	-0.25	1.70855	0.76059
0.00287	-0.25	1.79676	0.77315
0.00475	-0.25	2.37722	1.101
0.00662	-0.25	3.0624	1.43539
0.0085	-0.25	3.60633	1.57706
0.01225	-0.25	4.54688	1.84511
0.016	-0.25	5.41074	1.98869
0.01975	-0.25	6.04208	2.07574
0.0235	-0.25	6.54513	2.15744
0.02725	-0.25	6.81	2.15143
0.031	-0.25	7.05518	2.10209
0.03475	-0.25	7.4649	2.11204
0.0385	-0.25	7.71058	2.06958
0.046	-0.25	8.11406	2.07101
0.0535	-0.25	8.28444	2.05395
0.061	-0.25	8.57194	2.0225
0.0685	-0.25	8.71333	1.92129
0.076	-0.25	8.93462	1.89992
0.0835	-0.25	9.06927	1.87066
0.091	-0.25	9.25682	1.87172
0.0985	-0.25	9.25498	1.92588
0.106	-0.25	9.41712	1.86812
0.1135	-0.25	9.51008	1.8028
0.121	-0.25	9.55992	1.81308
0.136	-0.25	9.59602	1.8238
0.151	-0.25	9.71234	1.9094
0.166	-0.25	9.73944	1.95565
0.181	-0.25	9.8517	2.00439
0.196	-0.25	9.7131	2.01643
0.211	-0.25	9.87247	2.09422
0.226	-0.25	9.71895	2.17564
0.256	-0.25	9.67028	2.30419
0.286	-0.25	9.89868	2.42325
0.316	-0.25	10.1785	2.47825
0.346	-0.25	10.5484	2.49972
0.376	-0.25	10.7607	2.46114
0.421	-0.25	11.2703	2.25853
0.466	-0.25	11.7089	2.14656
0.511	-0.25	11.8774	1.97885
0.556	-0.25	12.1421	1.76848
0.601	-0.25	12.0843	1.65944
0.646	-0.25	11.9145	1.65286
0.691	-0.25	11.7585	1.61624
0.736	-0.25	11.5356	1.51674
0.781	-0.25	11.2843	1.5036
0.826	-0.25	11.0834	1.40618
0.901	-0.25	10.9077	1.32861
1.051	-0.25	10.7341	1.29337
1.201	-0.25	10.781	1.287
1.351	-0.25	10.7831	1.23167
1.501	-0.25	10.8018	1.20655
1.651	-0.25	10.7232	1.22231
1.801	-0.25	10.8038	1.20657
2.026	-0.25	10.7691	1.21755
2.251	-0.25	10.8357	1.23872
0.002	-0.125	1.7686	0.68928
0.00387	-0.125	1.90972	0.78978
0.00575	-0.125	2.52091	1.07289
0.00762	-0.125	3.10304	1.27044
0.0095	-0.125	3.60308	1.38797
0.01325	-0.125	4.46423	1.58009
0.017	-0.125	5.04329	1.61391
0.02075	-0.125	5.5018	1.76955
0.0245	-0.125	5.95754	1.87202
0.02825	-0.125	6.13907	1.81132
0.032	-0.125	6.41921	1.88183
0.03575	-0.125	6.70515	1.88161
0.0395	-0.125	6.86552	1.97371
0.047	-0.125	7.11775	1.931
0.0545	-0.125	7.46018	1.93985
0.062	-0.125	7.75944	1.98968
0.0695	-0.125	7.86563	1.90835
0.077	-0.125	8.1173	1.91124
0.0845	-0.125	8.13705	1.89433
0.092	-0.125	8.44305	1.89035
0.0995	-0.125	8.42054	1.89833
0.107	-0.125	8.39332	1.84163
0.1145	-0.125	8.55767	1.81709
0.122	-0.125	8.70257	1.85055
0.137	-0.125	8.80109	1.84658
0.152	-0.125	8.70839	1.83002
0.167	-0.125	8.72168	1.85855
0.182	-0.125	8.74786	1.90667
0.197	-0.125	8.5904	1.87599
0.212	-0.125	8.63714	1.92703
0.227	-0.125	8.51912	1.95628
0.257	-0.125	8.54461	2.01993
0.287	-0.125	8.64428	2.24521
0.317	-0.125	8.84478	2.37648
0.347	-0.125	9.10956	2.36949
0.377	-0.125	9.62299	2.43178

0.422	-0.125	10.3485	2.53995
0.467	-0.125	11.0918	2.26412
0.512	-0.125	11.7611	2.16424
0.557	-0.125	12.0905	1.8984
0.602	-0.125	12.2678	1.7844
0.647	-0.125	12.2198	1.67259
0.692	-0.125	11.9723	1.60714
0.737	-0.125	11.7641	1.511
0.782	-0.125	11.4746	1.51094
0.827	-0.125	11.2111	1.40541
0.902	-0.125	10.9732	1.32741
1.052	-0.125	10.8591	1.31979
1.202	-0.125	10.8069	1.28074
1.352	-0.125	10.8541	1.21431
1.502	-0.125	10.8106	1.22923
1.652	-0.125	10.8797	1.22855
1.802	-0.125	10.8212	1.23195
2.027	-0.125	10.8263	1.20622
2.252	-0.125	10.8409	1.2507
0.003	0	1.95276	0.73132
0.00487	0	2.05958	0.80013
0.00675	0	2.67566	1.06678
0.00862	0	3.2452	1.24085
0.0105	0	3.71917	1.38393
0.01425	0	4.55468	1.45348
0.018	0	5.03384	1.5473
0.02175	0	5.41908	1.56799
0.0255	0	5.72444	1.59825
0.02925	0	6.01855	1.65366
0.033	0	6.22362	1.72446
0.03675	0	6.45065	1.78387
0.0405	0	6.59661	1.78529
0.048	0	6.96862	1.81718
0.0555	0	7.16319	1.85654
0.063	0	7.35142	1.80434
0.0705	0	7.56377	1.91429
0.078	0	7.76526	1.85804
0.0855	0	7.96375	1.88771
0.093	0	7.94788	1.84309
0.1005	0	8.07532	1.79628
0.108	0	8.19906	1.82881
0.1155	0	8.26568	1.77157
0.123	0	8.23655	1.73415
0.138	0	8.43344	1.70031
0.153	0	8.4127	1.74324
0.168	0	8.381	1.67572
0.183	0	8.40864	1.76535
0.198	0	8.35312	1.71321
0.213	0	8.32784	1.76699
0.228	0	8.2949	1.76805
0.258	0	8.31255	1.87347
0.288	0	8.37915	1.98891

0.318	0	8.55204	2.06838
0.348	0	8.84022	2.2297
0.378	0	9.27014	2.35775
0.423	0	10.0733	2.45851
0.468	0	10.9658	2.3301
0.513	0	11.6761	2.10751
0.558	0	12.1444	1.89923
0.603	0	12.3394	1.76836
0.648	0	12.2593	1.70015
0.693	0	12.0478	1.61705
0.738	0	11.881	1.5802
0.783	0	11.5019	1.51792
0.828	0	11.3059	1.42418
0.903	0	11.0286	1.35326
1.053	0	10.9278	1.26783
1.203	0	10.8256	1.27075
1.353	0	10.8392	1.27526
1.503	0	10.9033	1.21991
1.653	0	10.8951	1.2424
1.803	0	10.8129	1.23576
2.028	0	10.8182	1.20876
2.253	0	10.8782	1.21307
0.004	0.125	1.98619	0.86505
0.00587	0.125	1.93868	0.87344
0.00775	0.125	2.38791	1.11524
0.00962	0.125	3.04724	1.34961
0.0115	0.125	3.57135	1.59922
0.01525	0.125	4.59457	1.85453
0.019	0.125	5.2179	2.01914
0.02275	0.125	5.66182	2.01877
0.0265	0.125	6.07281	2.10837
0.03025	0.125	6.3841	2.0991
0.034	0.125	6.67719	2.10079
0.03775	0.125	7.03931	2.20828
0.0415	0.125	7.0629	2.23676
0.049	0.125	7.60477	2.22321
0.0565	0.125	7.93607	2.23446
0.064	0.125	8.12492	2.22291
0.0715	0.125	8.29993	2.21964
0.079	0.125	8.56378	2.15523
0.0865	0.125	8.76806	2.13416
0.094	0.125	8.96781	2.13176
0.1015	0.125	8.96994	2.08413
0.109	0.125	9.09683	2.09171
0.1165	0.125	9.16944	2.01807
0.124	0.125	9.35475	2.01863
0.139	0.125	9.39072	1.97795
0.154	0.125	9.49744	2.03585
0.169	0.125	9.48734	2.02827
0.184	0.125	9.62007	2.03506
0.199	0.125	9.55816	2.08699
0.214	0.125	9.43617	2.09428

0.229	0.125	9.40717	2.17359
0.259	0.125	9.5605	2.36453
0.289	0.125	9.48942	2.43318
0.319	0.125	9.63868	2.51778
0.349	0.125	10.1285	2.64709
0.379	0.125	10.4972	2.66339
0.424	0.125	11.0373	2.55012
0.469	0.125	11.6715	2.30805
0.514	0.125	12.171	2.12638
0.559	0.125	12.3623	1.84551
0.604	0.125	12.3963	1.73618
0.649	0.125	12.1551	1.6315
0.694	0.125	11.9668	1.57367
0.739	0.125	11.7248	1.54936
0.784	0.125	11.5247	1.46792
0.829	0.125	11.2984	1.46242
0.904	0.125	10.9969	1.36014
1.054	0.125	10.8538	1.29522
1.204	0.125	10.8962	1.25776
1.354	0.125	10.9565	1.25305
1.504	0.125	10.8579	1.24731
1.654	0.125	10.8658	1.26202
1.804	0.125	10.9271	1.21854
2.029	0.125	10.7915	1.25226
2.254	0.125	10.8876	1.2557
0.005	0.25	1.89328	0.93321
0.00687	0.25	1.93425	0.92146
0.00875	0.25	2.45758	1.20708
0.01062	0.25	3.12759	1.53714
0.0125	0.25	3.90699	1.91393
0.01625	0.25	4.91335	2.16772
0.02	0.25	5.8815	2.34488
0.02375	0.25	6.54576	2.3658
0.0275	0.25	7.08729	2.4951
0.03125	0.25	7.515	2.43562
0.035	0.25	7.78496	2.46638
0.03875	0.25	7.97495	2.39209
0.0425	0.25	8.26876	2.34376
0.05	0.25	8.54941	2.31675
0.0575	0.25	8.93954	2.19129
0.065	0.25	9.25732	2.17668
0.0725	0.25	9.41724	2.15383
0.08	0.25	9.55668	2.06159
0.0875	0.25	9.77249	2.08079
0.095	0.25	9.82391	2.11772
0.1025	0.25	9.82162	1.99499
0.11	0.25	10.0201	1.96981
0.1175	0.25	10.1401	2.00994
0.125	0.25	10.2111	2.0081
0.14	0.25	10.4288	1.99269
0.155	0.25	10.5436	1.97487
0.17	0.25	10.6285	1.93454

0.185	0.25	10.6515	2.04715
0.2	0.25	10.6382	2.09702
0.215	0.25	10.7347	2.13659
0.23	0.25	10.7014	2.20855
0.26	0.25	11.0105	2.30826
0.29	0.25	11.0805	2.45342
0.32	0.25	11.3215	2.46357
0.35	0.25	11.5518	2.46927
0.38	0.25	11.7786	2.48978
0.425	0.25	12.1837	2.27411
0.47	0.25	12.3188	2.09314
0.515	0.25	12.4234	1.89369
0.56	0.25	12.4337	1.7
0.605	0.25	12.1986	1.63625
0.65	0.25	12.0344	1.60321
0.695	0.25	11.8157	1.53339
0.74	0.25	11.5452	1.52065
0.785	0.25	11.3938	1.44467
0.83	0.25	11.1836	1.39088
0.905	0.25	11.0529	1.29141
1.055	0.25	10.8516	1.33227
1.205	0.25	10.8886	1.22405
1.355	0.25	10.9492	1.25468
1.505	0.25	10.969	1.24709
1.655	0.25	10.9597	1.2179
1.805	0.25	10.8739	1.22002
2.03	0.25	10.8993	1.22157
2.255	0.25	10.9131	1.26691
0.006	0.375	2.2134	0.96066
0.00787	0.375	2.03271	0.867
0.00975	0.375	2.5653	1.16401
0.01162	0.375	3.45778	1.54054
0.0135	0.375	4.21208	1.8079
0.01725	0.375	5.53168	2.09899
0.021	0.375	6.56822	2.23174
0.02475	0.375	7.2822	2.24961
0.0285	0.375	7.79143	2.1765
0.03225	0.375	8.22994	2.17071
0.036	0.375	8.5432	2.1387
0.03975	0.375	8.77145	2.05115
0.0435	0.375	8.93566	2.06239
0.051	0.375	9.30468	1.98138
0.0585	0.375	9.41651	1.97567
0.066	0.375	9.63821	1.96021
0.0735	0.375	9.86369	1.9199
0.081	0.375	9.95102	1.89419
0.0885	0.375	10.1463	1.92268
0.096	0.375	10.1984	1.8773
0.1035	0.375	10.2905	1.8918
0.111	0.375	10.3855	1.931
0.1185	0.375	10.4384	1.90457
0.126	0.375	10.5137	1.88071

0.141	0.375	10.7689	1.97887
0.156	0.375	10.9247	1.97128
0.171	0.375	11.0376	1.9278
0.186	0.375	11.2607	2.01582
0.201	0.375	11.1988	1.95799
0.216	0.375	11.4106	1.98493
0.231	0.375	11.4073	1.99422
0.261	0.375	11.642	2.11373
0.291	0.375	11.7943	2.09396
0.321	0.375	11.882	2.06303
0.351	0.375	12.1179	2.04567
0.381	0.375	12.2198	2.07284
0.426	0.375	12.2153	1.95707
0.471	0.375	12.2976	1.83832
0.516	0.375	12.2204	1.73655
0.561	0.375	12.0793	1.6763
0.606	0.375	11.8871	1.60106
0.651	0.375	11.6603	1.52918
0.696	0.375	11.4548	1.52083
0.741	0.375	11.3091	1.43449
0.786	0.375	11.0951	1.36241
0.831	0.375	11.0259	1.33893
0.906	0.375	10.9209	1.31636
1.056	0.375	10.865	1.31363
1.206	0.375	10.8801	1.3128
1.356	0.375	10.9341	1.26142
1.506	0.375	10.9225	1.24929
1.656	0.375	10.9432	1.2233
1.806	0.375	10.8329	1.23622
2.031	0.375	10.8562	1.19665
2.256	0.375	10.8265	1.24038
0.007	0.5	2.13708	0.81512
0.00887	0.5	2.13659	0.81909
0.01075	0.5	2.55632	0.97159
0.01262	0.5	3.36212	1.27723
0.0145	0.5	4.19645	1.50466
0.01825	0.5	5.7275	1.80965
0.022	0.5	6.76834	1.90684
0.02575	0.5	7.41502	1.98366
0.0295	0.5	7.98282	1.92033
0.03325	0.5	8.31728	1.89406
0.037	0.5	8.61613	1.8765
0.04075	0.5	8.88101	1.88359
0.0445	0.5	9.04132	1.82385
0.052	0.5	9.2179	1.8123
0.0595	0.5	9.49649	1.79816
0.067	0.5	9.59883	1.78167
0.0745	0.5	9.80003	1.79241
0.082	0.5	9.96793	1.79
0.0895	0.5	10.0183	1.76239
0.097	0.5	10.0859	1.79872
0.1045	0.5	10.21	1.83939

0.112	0.5	10.2621	1.85551
0.1195	0.5	10.391	1.85799
0.127	0.5	10.5416	1.83378
0.142	0.5	10.6529	1.80474
0.157	0.5	10.8294	1.81025
0.172	0.5	10.9315	1.85459
0.187	0.5	11.0002	1.8025
0.202	0.5	11.0849	1.83683
0.217	0.5	11.2215	1.87143
0.232	0.5	11.2745	1.8457
0.262	0.5	11.4959	1.81316
0.292	0.5	11.593	1.86269
0.322	0.5	11.7242	1.86106
0.352	0.5	11.8202	1.85675
0.382	0.5	11.8019	1.80055
0.427	0.5	11.8362	1.75945
0.472	0.5	11.7854	1.6533
0.517	0.5	11.7576	1.61862
0.562	0.5	11.5914	1.57661
0.607	0.5	11.4699	1.50095
0.652	0.5	11.3384	1.45894
0.697	0.5	11.2547	1.38331
0.742	0.5	11.0894	1.37956
0.787	0.5	11.0345	1.38057
0.832	0.5	10.9712	1.33599
0.907	0.5	10.9526	1.29922
1.057	0.5	10.8973	1.30265
1.207	0.5	11.0259	1.26294
1.357	0.5	10.9714	1.26574
1.507	0.5	10.9808	1.27109
1.657	0.5	11.0176	1.24339
1.807	0.5	10.9048	1.24226
2.032	0.5	10.8958	1.25236
2.257	0.5	10.9313	1.23727
0	0.625	1.98686	0.71883
0.00187	0.625	1.93093	0.65265
0.00375	0.625	2.14856	0.76214
0.00562	0.625	2.94245	1.02846
0.0075	0.625	3.71416	1.21394
0.01125	0.625	5.1986	1.61385
0.015	0.625	6.23375	1.66114
0.01875	0.625	6.95858	1.73673
0.0225	0.625	7.49866	1.68098
0.02625	0.625	7.93325	1.69655
0.03	0.625	8.16155	1.6412
0.03375	0.625	8.39187	1.64356
0.0375	0.625	8.54485	1.61333
0.045	0.625	8.80156	1.5312
0.0525	0.625	8.95292	1.51857
0.06	0.625	9.16761	1.51711
0.0675	0.625	9.30463	1.53716
0.075	0.625	9.40869	1.56081

0.0825	0.625	9.53428	1.57453
0.09	0.625	9.66283	1.6156
0.0975	0.625	9.65326	1.54402
0.105	0.625	9.78945	1.60941
0.1125	0.625	9.91773	1.59647
0.12	0.625	9.90273	1.65463
0.135	0.625	10.0694	1.66081
0.15	0.625	10.223	1.6909
0.165	0.625	10.3396	1.66169
0.18	0.625	10.4342	1.70016
0.195	0.625	10.5288	1.66969
0.21	0.625	10.5133	1.63572
0.225	0.625	10.6749	1.59206
0.255	0.625	10.8346	1.6592
0.285	0.625	10.8392	1.6569
0.315	0.625	10.9649	1.58391
0.345	0.625	10.9353	1.56407
0.375	0.625	11.0521	1.55536
0.42	0.625	11.0062	1.53088
0.465	0.625	10.9577	1.47776
0.51	0.625	10.9942	1.43228
0.555	0.625	10.9626	1.42349
0.6	0.625	10.8461	1.35391
0.645	0.625	10.8205	1.32716
0.69	0.625	10.8122	1.34444
0.735	0.625	10.6827	1.26919
0.78	0.625	10.7316	1.26239
0.825	0.625	10.6911	1.28582
0.9	0.625	10.5685	1.2929
1.05	0.625	10.6247	1.24249
1.2	0.625	10.6876	1.24096
1.35	0.625	10.752	1.25651
1.5	0.625	10.6917	1.23823
1.65	0.625	10.6523	1.1824
1.8	0.625	10.6868	1.20021
2.025	0.625	10.6317	1.2226
2.25	0.625	10.6914	1.22262
0.001	0.75	1.85391	0.59819
0.00287	0.75	1.88975	0.6313
0.00475	0.75	1.90415	0.63767
0.00662	0.75	2.62164	0.91051
0.0085	0.75	3.4351	1.13363
0.01225	0.75	4.8054	1.49598
0.016	0.75	5.89224	1.58708
0.01975	0.75	6.66226	1.589
0.0235	0.75	7.24393	1.59366
0.02725	0.75	7.6643	1.59066
0.031	0.75	7.9143	1.50102
0.03475	0.75	8.12113	1.48435
0.0385	0.75	8.31162	1.51318
0.046	0.75	8.60786	1.46824
0.0535	0.75	8.71661	1.46416
0.061	0.75	8.84609	1.42401
0.0685	0.75	8.98854	1.41486
0.076	0.75	9.17887	1.41401
0.0835	0.75	9.22225	1.40836
0.091	0.75	9.37343	1.44656
0.0985	0.75	9.3601	1.38763
0.106	0.75	9.50911	1.41555
0.1135	0.75	9.53981	1.44516
0.121	0.75	9.63294	1.46
0.136	0.75	9.687	1.46278
0.151	0.75	9.83838	1.49043
0.166	0.75	9.99749	1.46906
0.181	0.75	10.0081	1.46876
0.196	0.75	10.1269	1.47148
0.211	0.75	10.2352	1.47707
0.226	0.75	10.2846	1.49072
0.256	0.75	10.3644	1.45588
0.286	0.75	10.4889	1.43866
0.316	0.75	10.5019	1.44109
0.346	0.75	10.614	1.40902
0.376	0.75	10.5971	1.39209
0.421	0.75	10.6747	1.36428
0.466	0.75	10.7074	1.34061
0.511	0.75	10.7132	1.31345
0.556	0.75	10.7348	1.31539
0.601	0.75	10.7373	1.30498
0.646	0.75	10.6719	1.2532
0.691	0.75	10.6175	1.26259
0.736	0.75	10.7284	1.26038
0.781	0.75	10.6349	1.28299
0.826	0.75	10.6669	1.26983
0.901	0.75	10.648	1.30466
1.051	0.75	10.652	1.24815
1.201	0.75	10.6441	1.23457
1.351	0.75	10.6766	1.2148
1.501	0.75	10.6872	1.20136
1.651	0.75	10.7507	1.20553
1.801	0.75	10.7365	1.21642
2.026	0.75	10.6727	1.237
2.251	0.75	10.6922	1.1972
0.002	0.875	1.81169	0.59922
0.00387	0.875	1.76035	0.57737
0.00575	0.875	1.92393	0.63897
0.00762	0.875	2.34099	0.7624
0.0095	0.875	3.14941	1.06137
0.01325	0.875	4.54216	1.35022
0.017	0.875	5.6723	1.5378
0.02075	0.875	6.40926	1.52775
0.0245	0.875	6.9836	1.50312
0.02825	0.875	7.34895	1.53007
0.032	0.875	7.59343	1.42724
0.03575	0.875	7.85274	1.40803
0.0395	0.875	8.02815	1.4235
0.047	0.875	8.33919	1.40479
0.0545	0.875	8.5381	1.35284
0.062	0.875	8.70164	1.3448
0.0695	0.875	8.85978	1.32048
0.077	0.875	8.94819	1.33802
0.0845	0.875	9.04259	1.29141
0.092	0.875	9.2156	1.33158
0.0995	0.875	9.30559	1.30612
0.107	0.875	9.32651	1.32273
0.1145	0.875	9.34346	1.29671
0.122	0.875	9.44606	1.33512
0.137	0.875	9.54448	1.3444
0.152	0.875	9.76574	1.33595
0.167	0.875	9.79309	1.3241
0.182	0.875	9.90329	1.35671
0.197	0.875	9.98961	1.34493
0.212	0.875	10.015	1.33198
0.227	0.875	9.97301	1.35217
0.257	0.875	10.0865	1.32612
0.287	0.875	10.2533	1.3386
0.317	0.875	10.3407	1.33761
0.347	0.875	10.349	1.3232
0.377	0.875	10.3609	1.32657
0.422	0.875	10.4643	1.31545
0.467	0.875	10.5201	1.28395
0.512	0.875	10.5415	1.27133
0.557	0.875	10.4987	1.26662
0.602	0.875	10.5587	1.28047
0.647	0.875	10.5869	1.28603
0.692	0.875	10.5643	1.25111
0.737	0.875	10.6273	1.28234
0.782	0.875	10.5982	1.25347
0.827	0.875	10.569	1.30675
0.902	0.875	10.5496	1.27045
1.052	0.875	10.6253	1.24344
1.202	0.875	10.6773	1.21686
1.352	0.875	10.6033	1.21874
1.502	0.875	10.6427	1.19613
1.652	0.875	10.6422	1.22151
1.802	0.875	10.6953	1.18687
2.027	0.875	10.6333	1.20846
2.252	0.875	10.5918	1.19425
0.003	1	1.71567	0.56852
0.00487	1	1.69319	0.55834
0.00675	1	1.83048	0.61566
0.00862	1	2.19926	0.74818
0.0105	1	2.89524	0.99414
0.01425	1	4.31277	1.34009
0.018	1	5.46771	1.53694
0.02175	1	6.23748	1.49729
0.0255	1	6.83626	1.51203

0.02925	1	7.14637	1.4641
0.033	1	7.4593	1.45506
0.03675	1	7.68915	1.41399
0.0405	1	7.87905	1.38081
0.048	1	8.17388	1.35593
0.0555	1	8.39227	1.2975
0.063	1	8.54259	1.29569
0.0705	1	8.70986	1.26882
0.078	1	8.77007	1.24471
0.0855	1	8.92067	1.2758
0.093	1	8.95818	1.27739
0.1005	1	9.0435	1.25265
0.108	1	9.14033	1.25084
0.1155	1	9.23989	1.25988
0.123	1	9.24593	1.27931
0.138	1	9.3729	1.2995
0.153	1	9.43496	1.26087
0.168	1	9.58347	1.22958
0.183	1	9.67086	1.26411
0.198	1	9.75459	1.29035
0.213	1	9.78392	1.27017
0.228	1	9.94621	1.33322
0.258	1	10.0628	1.29016
0.288	1	10.072	1.27202
0.318	1	10.0772	1.26258
0.348	1	10.105	1.23575
0.378	1	10.2334	1.30108
0.423	1	10.2897	1.31227
0.468	1	10.335	1.27334
0.513	1	10.3952	1.25078
0.558	1	10.4239	1.25178
0.603	1	10.4933	1.26826
0.648	1	10.489	1.26246
0.693	1	10.4896	1.2345
0.738	1	10.5182	1.27701
0.783	1	10.5224	1.26407
0.828	1	10.5022	1.24948
0.903	1	10.5575	1.22457
1.053	1	10.5866	1.22327
1.203	1	10.6234	1.23298
1.353	1	10.5595	1.19954
1.503	1	10.6017	1.18274
1.653	1	10.6074	1.15486
1.803	1	10.5479	1.196
2.028	1	10.5606	1.18599
2.253	1	10.493	1.20969
0.004	1.125	1.76976	0.58661
0.00587	1.125	1.70875	0.54402
0.00775	1.125	1.81886	0.58885
0.00962	1.125	2.00688	0.69448
0.0115	1.125	2.65642	0.91416
0.01525	1.125	4.07285	1.2998
0.019	1.125	5.18867	1.48834
0.02275	1.125	5.9898	1.51991
0.0265	1.125	6.62765	1.53833
0.03025	1.125	7.00203	1.49548
0.034	1.125	7.32362	1.45833
0.03775	1.125	7.56268	1.38832
0.0415	1.125	7.8148	1.40791
0.049	1.125	8.12204	1.31156
0.0565	1.125	8.32573	1.29656
0.064	1.125	8.46345	1.28472
0.0715	1.125	8.60217	1.27643
0.079	1.125	8.71288	1.23082
0.0865	1.125	8.84262	1.23111
0.094	1.125	8.8703	1.25683
0.1015	1.125	8.9299	1.261
0.109	1.125	9.05903	1.3036
0.1165	1.125	9.14986	1.29566
0.124	1.125	9.24597	1.25268
0.139	1.125	9.35949	1.29611
0.154	1.125	9.45078	1.27067
0.169	1.125	9.48765	1.28941
0.184	1.125	9.54991	1.27398
0.199	1.125	9.69711	1.28053
0.214	1.125	9.78727	1.26256
0.229	1.125	9.82453	1.25975
0.259	1.125	9.88701	1.29218
0.289	1.125	10.0043	1.29648
0.319	1.125	10.0305	1.2785
0.349	1.125	10.1015	1.26282
0.379	1.125	10.2186	1.27098
0.424	1.125	10.15	1.27109
0.469	1.125	10.2525	1.26674
0.514	1.125	10.3005	1.27763
0.559	1.125	10.3464	1.27027
0.604	1.125	10.3163	1.25271
0.649	1.125	10.4216	1.25082
0.694	1.125	10.4462	1.24447
0.739	1.125	10.5105	1.24897
0.784	1.125	10.4486	1.29036
0.829	1.125	10.4609	1.24652
0.904	1.125	10.5377	1.2135
1.054	1.125	10.5231	1.22181
1.204	1.125	10.539	1.2146
1.354	1.125	10.5419	1.20427
1.504	1.125	10.5621	1.21815
1.654	1.125	10.5137	1.15611
1.804	1.125	10.5808	1.21305
2.029	1.125	10.5611	1.19497
2.254	1.125	10.4625	1.19626
0.005	1.25	1.71466	0.56225
0.00687	1.25	1.76945	0.56209
0.00875	1.25	1.74742	0.57421
0.01062	1.25	1.82897	0.58897
0.0125	1.25	2.49633	0.85257
0.01625	1.25	3.86838	1.2498
0.02	1.25	5.08697	1.40758
0.02375	1.25	6.0006	1.50545
0.0275	1.25	6.55138	1.5033
0.03125	1.25	7.06759	1.49256
0.035	1.25	7.40059	1.46176
0.03875	1.25	7.61734	1.41332
0.0425	1.25	7.84289	1.40337
0.05	1.25	8.10553	1.35721
0.0575	1.25	8.30098	1.32165
0.065	1.25	8.49221	1.32836
0.0725	1.25	8.66292	1.29769
0.08	1.25	8.69415	1.29764
0.0875	1.25	8.8397	1.3039
0.095	1.25	8.95667	1.30249
0.1025	1.25	8.95315	1.26588
0.11	1.25	9.00439	1.24007
0.1175	1.25	9.13923	1.30576
0.125	1.25	9.14087	1.29176
0.14	1.25	9.30599	1.26216
0.155	1.25	9.33823	1.24087
0.17	1.25	9.50331	1.3194
0.185	1.25	9.59049	1.29442
0.2	1.25	9.59576	1.30839
0.215	1.25	9.76097	1.29288
0.23	1.25	9.78644	1.29352
0.26	1.25	9.87457	1.3129
0.29	1.25	9.96208	1.27468
0.32	1.25	10.0333	1.29568
0.35	1.25	10.1169	1.30217
0.38	1.25	10.1936	1.30523
0.425	1.25	10.2118	1.28331
0.47	1.25	10.3028	1.30156
0.515	1.25	10.2965	1.23868
0.56	1.25	10.4119	1.29665
0.605	1.25	10.3356	1.27135
0.65	1.25	10.4271	1.26069
0.695	1.25	10.4142	1.24097
0.74	1.25	10.3552	1.24372
0.785	1.25	10.4314	1.23529
0.83	1.25	10.4771	1.23483
0.905	1.25	10.5266	1.24456
1.055	1.25	10.4904	1.23918
1.205	1.25	10.5896	1.25386
1.355	1.25	10.4727	1.21651
1.505	1.25	10.4556	1.18062
1.655	1.25	10.5383	1.23592
1.805	1.25	10.4789	1.20273
2.03	1.25	10.5001	1.17365
2.255	1.25	10.4606	1.18348

Run ID: 041596

VR=0.508
Uo=10.22 m/s
x/D=2.5 FSTI=12%
L/D=2.3

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.5991	0.46306
0.00187	-0.375	1.58426	0.46658
0.00375	-0.375	1.70253	0.50311
0.00562	-0.375	1.7169	0.55675
0.0075	-0.375	2.34621	0.75984
0.01125	-0.375	3.63079	1.14119
0.015	-0.375	4.76234	1.36606
0.01875	-0.375	5.58162	1.44037
0.0225	-0.375	6.0232	1.49374
0.02625	-0.375	6.49471	1.45428
0.03	-0.375	6.79738	1.42778
0.03375	-0.375	7.01969	1.43122
0.0375	-0.375	7.16095	1.40917
0.045	-0.375	7.405	1.34114
0.0525	-0.375	7.51867	1.313
0.06	-0.375	7.61718	1.33615
0.0675	-0.375	7.61294	1.30016
0.075	-0.375	7.65316	1.31959
0.0825	-0.375	7.68447	1.34256
0.09	-0.375	7.65548	1.32398
0.0975	-0.375	7.69367	1.39021
0.105	-0.375	7.79069	1.37932
0.1125	-0.375	7.78129	1.40008
0.12	-0.375	7.78414	1.45937
0.135	-0.375	7.73168	1.47455
0.15	-0.375	7.74034	1.53322
0.165	-0.375	7.81612	1.60102
0.18	-0.375	8.00139	1.58212
0.195	-0.375	7.97369	1.62599
0.21	-0.375	8.08634	1.6448
0.225	-0.375	8.21963	1.617
0.255	-0.375	8.29039	1.63238
0.285	-0.375	8.51947	1.62524
0.315	-0.375	8.72765	1.53584
0.345	-0.375	8.92875	1.49093
0.375	-0.375	9.09217	1.4234
0.42	-0.375	9.415	1.41697
0.465	-0.375	9.58492	1.34845
0.51	-0.375	9.76155	1.32074
0.555	-0.375	9.87643	1.30338
0.6	-0.375	10.042	1.29244
0.645	-0.375	10.0495	1.2763
0.69	-0.375	10.1922	1.27274
0.735	-0.375	10.1464	1.28631
0.78	-0.375	10.3137	1.26441
0.825	-0.375	10.3438	1.25311
0.9	-0.375	10.3148	1.22276
1.05	-0.375	10.4322	1.19836
1.2	-0.375	10.5153	1.18959
1.35	-0.375	10.4251	1.17098
1.5	-0.375	10.5026	1.17808
1.65	-0.375	10.4865	1.15511
1.8	-0.375	10.4861	1.17305
2.025	-0.375	10.5059	1.20366
2.25	-0.375	10.4958	1.19133
0.001	-0.25	1.40187	0.44381
0.00287	-0.25	1.40167	0.44723
0.00475	-0.25	1.37853	0.43779
0.00662	-0.25	1.55394	0.51615
0.0085	-0.25	2.03268	0.72497
0.01225	-0.25	3.05534	1.11132
0.016	-0.25	4.1231	1.33925
0.01975	-0.25	4.8258	1.48209
0.0235	-0.25	5.31862	1.52615
0.02725	-0.25	5.68845	1.5416
0.031	-0.25	6.00333	1.54069
0.03475	-0.25	6.16124	1.56178
0.0385	-0.25	6.44618	1.56761
0.046	-0.25	6.59411	1.53942
0.0535	-0.25	6.72903	1.4752
0.061	-0.25	6.75256	1.49977
0.0685	-0.25	6.88643	1.51016
0.076	-0.25	6.82884	1.50765
0.0835	-0.25	6.88015	1.47518
0.091	-0.25	6.88314	1.47829
0.0985	-0.25	6.94742	1.51136
0.106	-0.25	6.89952	1.56105
0.1135	-0.25	6.83415	1.59755
0.121	-0.25	6.8581	1.59747
0.136	-0.25	6.90542	1.72125
0.151	-0.25	6.92519	1.753
0.166	-0.25	6.90484	1.78057
0.181	-0.25	6.96948	1.836
0.196	-0.25	7.0379	1.83774
0.211	-0.25	7.10732	1.92203
0.226	-0.25	7.26811	1.89483
0.256	-0.25	7.47793	1.90492
0.286	-0.25	7.77764	1.84911
0.316	-0.25	8.04943	1.7341
0.346	-0.25	8.45945	1.71933
0.376	-0.25	8.69077	1.60751
0.421	-0.25	9.09424	1.47304
0.466	-0.25	9.37036	1.42262
0.511	-0.25	9.64361	1.3732
0.556	-0.25	9.76626	1.33545
0.601	-0.25	9.92542	1.2957
0.646	-0.25	10.0084	1.31444
0.691	-0.25	10.0638	1.24971
0.736	-0.25	10.2067	1.26656
0.781	-0.25	10.2237	1.27964
0.826	-0.25	10.2153	1.23622
0.901	-0.25	10.2871	1.24511
1.051	-0.25	10.4076	1.23657
1.201	-0.25	10.3488	1.197
1.351	-0.25	10.4252	1.18689
1.501	-0.25	10.4439	1.18193
1.651	-0.25	10.4165	1.15647
1.801	-0.25	10.4081	1.17119
2.026	-0.25	10.3746	1.18667
2.251	-0.25	10.3995	1.16664
0.002	-0.125	1.20235	0.42885
0.00387	-0.125	1.19263	0.41065
0.00575	-0.125	1.19023	0.40049
0.00762	-0.125	1.27496	0.46168
0.0095	-0.125	1.5838	0.62319
0.01325	-0.125	2.49097	1.03366
0.017	-0.125	3.31041	1.28402
0.02075	-0.125	3.88079	1.38795
0.0245	-0.125	4.38389	1.51682
0.02825	-0.125	4.693	1.53112
0.032	-0.125	4.9107	1.54383
0.03575	-0.125	5.15635	1.55536
0.0395	-0.125	5.32882	1.57902
0.047	-0.125	5.54291	1.5782
0.0545	-0.125	5.69343	1.56762
0.062	-0.125	5.79556	1.55148
0.0695	-0.125	5.86008	1.52319
0.077	-0.125	5.91476	1.55848
0.0845	-0.125	5.81398	1.52709
0.092	-0.125	5.94517	1.52166
0.0995	-0.125	5.85705	1.56774
0.107	-0.125	5.8645	1.54268
0.1145	-0.125	5.84281	1.57772
0.122	-0.125	5.87552	1.56552
0.137	-0.125	5.71175	1.59927
0.152	-0.125	5.74295	1.64753
0.167	-0.125	5.71605	1.71438
0.182	-0.125	5.74603	1.7154
0.197	-0.125	5.82616	1.76441
0.212	-0.125	5.99669	1.79933
0.227	-0.125	6.05243	1.82362
0.257	-0.125	6.44965	1.94178
0.287	-0.125	6.88353	1.84897
0.317	-0.125	7.31143	1.82811
0.347	-0.125	7.71456	1.72689
0.377	-0.125	8.15139	1.68002

0.422	-0.125	8.68731	1.52237
0.467	-0.125	9.19366	1.42846
0.512	-0.125	9.37784	1.37282
0.557	-0.125	9.53759	1.27103
0.602	-0.125	9.7168	1.27471
0.647	-0.125	9.84775	1.29408
0.692	-0.125	9.86414	1.25063
0.737	-0.125	9.99223	1.24713
0.782	-0.125	9.99047	1.25678
0.827	-0.125	10.0407	1.24976
0.902	-0.125	10.1569	1.23404
1.052	-0.125	10.2038	1.24112
1.202	-0.125	10.2332	1.18211
1.352	-0.125	10.2677	1.19686
1.502	-0.125	10.285	1.17705
1.652	-0.125	10.2608	1.15003
1.802	-0.125	10.3112	1.15654
2.027	-0.125	10.282	1.17558
2.252	-0.125	10.2248	1.18844
0.003	0	1.32599	0.53029
0.00487	0	1.31208	0.53188
0.00675	0	1.19579	0.44949
0.00862	0	1.15341	0.43573
0.0105	0	1.26065	0.48150
0.01425	0	2.0075	0.85035
0.018	0	2.76929	1.09026
0.02175	0	3.33684	1.27155
0.0255	0	3.82007	1.34503
0.02925	0	4.08738	1.40163
0.033	0	4.36801	1.40425
0.03675	0	4.56226	1.44042
0.0405	0	4.73489	1.48679
0.048	0	5.00499	1.50461
0.0555	0	5.14836	1.45731
0.063	0	5.20548	1.43207
0.0705	0	5.29594	1.41165
0.078	0	5.40175	1.38803
0.0855	0	5.35168	1.35962
0.093	0	5.37879	1.40497
0.1005	0	5.34471	1.39066
0.108	0	5.31236	1.38019
0.1155	0	5.30696	1.34269
0.123	0	5.28441	1.37517
0.138	0	5.26186	1.44076
0.153	0	5.26431	1.43086
0.168	0	5.3353	1.4781
0.183	0	5.33541	1.53321
0.198	0	5.38136	1.60274
0.213	0	5.53626	1.6485
0.228	0	5.65626	1.65984
0.258	0	6.005	1.79033
0.288	0	6.47705	1.80673

0.318	0	7.00722	1.86406
0.348	0	7.44842	1.80819
0.378	0	8.02186	1.71088
0.423	0	8.66438	1.5511
0.468	0	9.12854	1.41942
0.513	0	9.32823	1.33896
0.558	0	9.54717	1.30414
0.603	0	9.75977	1.29564
0.648	0	9.87243	1.30096
0.693	0	9.88397	1.27866
0.738	0	9.9449	1.22708
0.783	0	9.99025	1.23549
0.828	0	10.0375	1.22387
0.903	0	10.0909	1.21257
1.053	0	10.181	1.23319
1.203	0	10.2815	1.19083
1.353	0	10.2112	1.16988
1.503	0	10.2762	1.14171
1.653	0	10.2388	1.13289
1.803	0	10.2191	1.15726
2.028	0	10.2631	1.15897
2.253	0	10.2297	1.19143
0.004	0.125	1.25403	0.45763
0.00587	0.125	1.25919	0.45293
0.00775	0.125	1.26873	0.44796
0.00962	0.125	1.2816	0.47803
0.0115	0.125	1.3143	0.49209
0.01525	0.125	2.20954	0.91309
0.019	0.125	3.18925	1.2389
0.02275	0.125	3.84443	1.46523
0.0265	0.125	4.38479	1.55208
0.03025	0.125	4.77365	1.65003
0.034	0.125	5.04705	1.66629
0.03775	0.125	5.24585	1.66158
0.0415	0.125	5.44185	1.61806
0.049	0.125	5.72229	1.62868
0.0565	0.125	5.881	1.62381
0.064	0.125	5.92338	1.56902
0.0715	0.125	5.93979	1.54645
0.079	0.125	5.97095	1.54844
0.0865	0.125	5.9088	1.54654
0.094	0.125	6.01944	1.52401
0.1015	0.125	6.04171	1.52208
0.109	0.125	5.96953	1.49523
0.1165	0.125	6.00277	1.58061
0.124	0.125	5.96697	1.58291
0.139	0.125	6.00071	1.61889
0.154	0.125	6.00745	1.69351
0.169	0.125	5.95408	1.72282
0.184	0.125	6.02312	1.76228
0.199	0.125	6.083	1.7942
0.214	0.125	6.24194	1.82715

0.229	0.125	6.27069	1.85101
0.259	0.125	6.56866	1.91921
0.289	0.125	7.04573	1.94158
0.319	0.125	7.40883	1.82763
0.349	0.125	7.87586	1.80171
0.379	0.125	8.2715	1.64612
0.424	0.125	8.71265	1.51488
0.469	0.125	9.0819	1.37988
0.514	0.125	9.3649	1.32182
0.559	0.125	9.5599	1.33483
0.604	0.125	9.66665	1.27753
0.649	0.125	9.8345	1.26759
0.694	0.125	9.90439	1.26944
0.739	0.125	9.93739	1.24936
0.784	0.125	10.0253	1.26903
0.829	0.125	10.0411	1.24904
0.904	0.125	10.1357	1.22764
1.054	0.125	10.1787	1.2284
1.204	0.125	10.1602	1.1572
1.354	0.125	10.2661	1.18112
1.504	0.125	10.2558	1.15581
1.654	0.125	10.1941	1.16718
1.804	0.125	10.2003	1.17019
2.029	0.125	10.2007	1.16365
2.254	0.125	10.3063	1.14281
0.005	0.25	1.48699	0.48640
0.00687	0.25	1.49533	0.47564
0.00875	0.25	1.46351	0.48464
0.01062	0.25	1.46785	0.46919
0.0125	0.25	1.55143	0.51901
0.01625	0.25	2.57646	0.90546
0.02	0.25	3.71324	1.23938
0.02375	0.25	4.70997	1.43589
0.0275	0.25	5.33674	1.54667
0.03125	0.25	5.82281	1.57037
0.035	0.25	6.24842	1.54706
0.03875	0.25	6.42316	1.55397
0.0425	0.25	6.51863	1.64076
0.05	0.25	6.77464	1.559
0.0575	0.25	6.90277	1.47921
0.065	0.25	6.93072	1.5217
0.0725	0.25	6.97366	1.46484
0.08	0.25	6.96633	1.47944
0.0875	0.25	6.9485	1.4925
0.095	0.25	6.99662	1.53975
0.1025	0.25	6.95629	1.55492
0.11	0.25	7.00723	1.57232
0.1175	0.25	7.06428	1.56217
0.125	0.25	6.90396	1.64694
0.14	0.25	7.01781	1.67691
0.155	0.25	7.06359	1.71483
0.17	0.25	7.10727	1.79243

0.185	0.25	7.1416	1.77824
0.2	0.25	7.2771	1.8651
0.215	0.25	7.25776	1.8922
0.23	0.25	7.4504	1.9353
0.26	0.25	7.59198	1.90976
0.29	0.25	7.89651	1.79665
0.32	0.25	8.16311	1.78588
0.35	0.25	8.50389	1.6418
0.38	0.25	8.71652	1.58214
0.425	0.25	9.08928	1.46519
0.47	0.25	9.3561	1.38783
0.515	0.25	9.55592	1.31498
0.56	0.25	9.60299	1.32742
0.605	0.25	9.75752	1.28769
0.65	0.25	9.85621	1.25641
0.695	0.25	9.95762	1.27105
0.74	0.25	9.93359	1.24957
0.785	0.25	9.99255	1.25505
0.83	0.25	10.0135	1.2627
0.905	0.25	10.1009	1.23497
1.055	0.25	10.1426	1.18379
1.205	0.25	10.2147	1.18348
1.355	0.25	10.2121	1.15487
1.505	0.25	10.208	1.16853
1.655	0.25	10.2265	1.13965
1.805	0.25	10.2304	1.15019
2.03	0.25	10.2029	1.13782
2.255	0.25	10.1973	1.15365
0.006	0.375	1.68781	0.49236
0.00787	0.375	1.65361	0.48977
0.00975	0.375	1.67433	0.50241
0.01162	0.375	1.61696	0.46360
0.0135	0.375	1.64089	0.48348
0.01725	0.375	2.76658	0.87138
0.021	0.375	4.05754	1.18691
0.02475	0.375	5.14437	1.34741
0.0285	0.375	5.88501	1.41324
0.03225	0.375	6.44916	1.38015
0.036	0.375	6.82754	1.38255
0.03975	0.375	6.99363	1.38249
0.0435	0.375	7.21405	1.26533
0.051	0.375	7.5257	1.23633
0.0585	0.375	7.59529	1.2874
0.066	0.375	7.64325	1.28113
0.0735	0.375	7.69355	1.34665
0.081	0.375	7.71363	1.28554
0.0885	0.375	7.69495	1.32828
0.096	0.375	7.77722	1.38441
0.1035	0.375	7.80809	1.40192
0.111	0.375	7.75857	1.35699
0.1185	0.375	7.76161	1.41929
0.126	0.375	7.8052	1.47344
0.141	0.375	7.87484	1.4766
0.156	0.375	7.98754	1.48477
0.171	0.375	7.97238	1.5568
0.186	0.375	8.04526	1.58298
0.201	0.375	8.18812	1.58436
0.216	0.375	8.2167	1.59329
0.231	0.375	8.27192	1.62187
0.261	0.375	8.3902	1.59722
0.291	0.375	8.64167	1.56051
0.321	0.375	8.80361	1.50296
0.351	0.375	8.97317	1.49412
0.381	0.375	9.21872	1.40062
0.426	0.375	9.33679	1.35
0.471	0.375	9.51467	1.32444
0.516	0.375	9.58632	1.33276
0.561	0.375	9.72955	1.30294
0.606	0.375	9.81444	1.27085
0.651	0.375	9.8964	1.26722
0.696	0.375	9.97907	1.26022
0.741	0.375	9.92179	1.24824
0.786	0.375	10.0854	1.22545
0.831	0.375	10.0703	1.23041
0.906	0.375	10.0866	1.23155
1.056	0.375	10.1726	1.1809
1.206	0.375	10.2175	1.17865
1.356	0.375	10.273	1.16157
1.506	0.375	10.2203	1.14592
1.656	0.375	10.221	1.14122
1.806	0.375	10.2045	1.14088
2.031	0.375	10.2099	1.1359
2.256	0.375	10.2257	1.16823
0.007	0.5	1.61031	0.48022
0.00887	0.5	1.60008	0.47770
0.01075	0.5	1.61826	0.46156
0.01262	0.5	1.59223	0.45704
0.0145	0.5	1.68336	0.51418
0.01825	0.5	2.65559	0.82365
0.022	0.5	3.99939	1.15919
0.02575	0.5	5.1516	1.31181
0.0295	0.5	5.94877	1.36546
0.03325	0.5	6.52682	1.36672
0.037	0.5	6.91249	1.34616
0.04075	0.5	7.18561	1.37333
0.0445	0.5	7.40469	1.28036
0.052	0.5	7.66963	1.27582
0.0595	0.5	7.8167	1.21486
0.067	0.5	7.97515	1.16328
0.0745	0.5	8.00435	1.20273
0.082	0.5	8.11084	1.20137
0.0895	0.5	8.069	1.21971
0.097	0.5	8.22829	1.2018
0.1045	0.5	8.22084	1.21593
0.112	0.5	8.25786	1.24595
0.1195	0.5	8.28507	1.25421
0.127	0.5	8.31408	1.2422
0.142	0.5	8.36829	1.2951
0.157	0.5	8.45407	1.31629
0.172	0.5	8.47771	1.36684
0.187	0.5	8.58509	1.35943
0.202	0.5	8.63235	1.39393
0.217	0.5	8.676	1.38968
0.232	0.5	8.74695	1.42849
0.262	0.5	8.9133	1.33818
0.292	0.5	9.04626	1.38172
0.322	0.5	9.18661	1.37763
0.352	0.5	9.32728	1.33182
0.382	0.5	9.44381	1.32025
0.427	0.5	9.58594	1.28817
0.472	0.5	9.63886	1.29199
0.517	0.5	9.69405	1.32035
0.562	0.5	9.83249	1.28595
0.607	0.5	9.86638	1.27295
0.652	0.5	10.0208	1.254
0.697	0.5	9.96232	1.25249
0.742	0.5	10.0519	1.23535
0.787	0.5	10.0475	1.26345
0.832	0.5	10.1258	1.24521
0.907	0.5	10.1361	1.22073
1.057	0.5	10.2052	1.18013
1.207	0.5	10.232	1.18796
1.357	0.5	10.2483	1.1508
1.507	0.5	10.2288	1.17042
1.657	0.5	10.2443	1.17
1.807	0.5	10.2571	1.14047
2.032	0.5	10.2173	1.14203
2.257	0.5	10.1768	1.19451
0.008	0.625	1.77413	0.55662
0.00987	0.625	1.75304	0.56457
0.01175	0.625	1.68434	0.51494
0.01362	0.625	1.63649	0.51597
0.0155	0.625	1.71236	0.54947
0.01925	0.625	2.59929	0.85964
0.023	0.625	3.92807	1.21737
0.02675	0.625	5.10632	1.38087
0.0305	0.625	5.83384	1.41574
0.03425	0.625	6.44524	1.40209
0.038	0.625	6.76088	1.40086
0.04175	0.625	7.10449	1.37332
0.0455	0.625	7.29431	1.37832
0.053	0.625	7.6626	1.28349
0.0605	0.625	7.87536	1.25501
0.068	0.625	8.02925	1.23121
0.0755	0.625	8.13833	1.1868
0.083	0.625	8.19568	1.17882

0.0905	0.625	8.29502	1.16117
0.098	0.625	8.39356	1.2045
0.1055	0.625	8.43872	1.17142
0.113	0.625	8.44994	1.22306
0.1205	0.625	8.48082	1.19693
0.128	0.625	8.57988	1.20338
0.143	0.625	8.67967	1.21434
0.158	0.625	8.71248	1.22306
0.173	0.625	8.84447	1.27315
0.188	0.625	8.90735	1.31163
0.203	0.625	8.94656	1.29626
0.218	0.625	9.0192	1.27987
0.233	0.625	9.08187	1.28485
0.263	0.625	9.20272	1.24389
0.293	0.625	9.25979	1.31022
0.323	0.625	9.36943	1.28138
0.353	0.625	9.49533	1.27765
0.383	0.625	9.56184	1.28656
0.428	0.625	9.66931	1.29364
0.473	0.625	9.77458	1.24555
0.518	0.625	9.80498	1.25412
0.563	0.625	9.85709	1.24894
0.608	0.625	9.98295	1.25711
0.653	0.625	10.0023	1.25905
0.698	0.625	10.0767	1.22369
0.743	0.625	10.0387	1.25361
0.788	0.625	10.1539	1.26492
0.833	0.625	10.1232	1.24039
0.908	0.625	10.1607	1.22154
1.058	0.625	10.2517	1.20803
1.208	0.625	10.2325	1.17776
1.358	0.625	10.2687	1.1734
1.508	0.625	10.2585	1.17648
1.658	0.625	10.3165	1.16824
1.808	0.625	10.3094	1.15125
2.033	0.625	10.2789	1.15705
2.258	0.625	10.306	1.14517
0.009	0.75	1.71209	0.56391
0.01087	0.75	1.67133	0.55521
0.01275	0.75	1.65245	0.54229
0.01462	0.75	1.63004	0.53044
0.0165	0.75	1.75485	0.59618
0.02025	0.75	2.59219	0.91181
0.024	0.75	3.83393	1.21685
0.02775	0.75	4.94236	1.40739
0.0315	0.75	5.75253	1.45222
0.03525	0.75	6.29439	1.46724
0.039	0.75	6.80165	1.47197
0.04275	0.75	7.01541	1.41099
0.0465	0.75	7.25618	1.39126
0.054	0.75	7.62728	1.33435
0.0615	0.75	7.8756	1.28437
0.069	0.75	8.01671	1.27158
0.0765	0.75	8.15173	1.21882
0.084	0.75	8.22841	1.22612
0.0915	0.75	8.32643	1.17403
0.099	0.75	8.45927	1.18236
0.1065	0.75	8.47219	1.19902
0.114	0.75	8.52979	1.22143
0.1215	0.75	8.64402	1.2104
0.129	0.75	8.6712	1.18108
0.144	0.75	8.7675	1.18274
0.159	0.75	8.86128	1.24059
0.174	0.75	8.98789	1.26421
0.189	0.75	9.06082	1.24916
0.204	0.75	9.16209	1.26721
0.219	0.75	9.17594	1.22779
0.234	0.75	9.19118	1.27763
0.264	0.75	9.34266	1.26326
0.294	0.75	9.43537	1.25861
0.324	0.75	9.50122	1.273
0.354	0.75	9.57478	1.26219
0.384	0.75	9.66705	1.29199
0.429	0.75	9.76521	1.24864
0.474	0.75	9.86094	1.26509
0.519	0.75	9.90605	1.30142
0.564	0.75	9.97103	1.2639
0.609	0.75	10.0326	1.27688
0.654	0.75	10.0629	1.27429
0.699	0.75	10.1197	1.26223
0.744	0.75	10.1312	1.2633
0.789	0.75	10.2134	1.21149
0.834	0.75	10.1721	1.2073
0.909	0.75	10.2602	1.20735
1.059	0.75	10.2528	1.20123
1.209	0.75	10.3275	1.15499
1.359	0.75	10.3364	1.20963
1.509	0.75	10.2475	1.15871
1.659	0.75	10.2929	1.14882
1.809	0.75	10.2854	1.15749
2.034	0.75	10.3148	1.15651
2.259	0.75	10.2571	1.12115
0.01	0.875	1.91484	0.62244
0.01187	0.875	1.87132	0.62082
0.01375	0.875	1.84471	0.63040
0.01562	0.875	1.78123	0.60354
0.0175	0.875	1.67903	0.55105
0.02125	0.875	2.41872	0.85846
0.025	0.875	3.63991	1.21357
0.02875	0.875	4.80677	1.41969
0.0325	0.875	5.63718	1.50748
0.03625	0.875	6.17636	1.51705
0.04	0.875	6.62003	1.44501
0.04375	0.875	6.9282	1.40976
0.0475	0.875	7.15633	1.3858
0.055	0.875	7.48904	1.32592
0.0625	0.875	7.80205	1.2806
0.07	0.875	7.94768	1.26027
0.0775	0.875	8.04664	1.2315
0.085	0.875	8.26565	1.24839
0.0925	0.875	8.35967	1.2348
0.1	0.875	8.40315	1.17893
0.1075	0.875	8.49993	1.23696
0.115	0.875	8.61213	1.25492
0.1225	0.875	8.66099	1.24098
0.13	0.875	8.70635	1.23246
0.145	0.875	8.84395	1.22351
0.16	0.875	8.97262	1.23276
0.175	0.875	9.02563	1.26281
0.19	0.875	9.07368	1.24538
0.205	0.875	9.14657	1.24668
0.22	0.875	9.21599	1.23141
0.235	0.875	9.30779	1.25394
0.265	0.875	9.40516	1.27352
0.295	0.875	9.51686	1.23012
0.325	0.875	9.53217	1.29256
0.355	0.875	9.72711	1.25496
0.385	0.875	9.73275	1.28549
0.43	0.875	9.78529	1.24089
0.475	0.875	9.94633	1.24893
0.52	0.875	10.0325	1.26838
0.565	0.875	10.047	1.26791
0.61	0.875	10.0938	1.27141
0.655	0.875	10.0807	1.2683
0.7	0.875	10.1472	1.23767
0.745	0.875	10.1418	1.24773
0.79	0.875	10.2125	1.23885
0.835	0.875	10.218	1.25556
0.91	0.875	10.2566	1.23274
1.06	0.875	10.3249	1.20309
1.21	0.875	10.3303	1.18412
1.36	0.875	10.3702	1.1722
1.51	0.875	10.3383	1.17355
1.66	0.875	10.3089	1.20816
1.81	0.875	10.3331	1.19021
2.035	0.875	10.334	1.14506
2.26	0.875	10.3408	1.16238
0.011	1	1.69743	0.58371
0.01287	1	1.6798	0.56914
0.01475	1	1.7581	0.60666
0.01662	1	1.72317	0.59632
0.0185	1	1.66197	0.55439
0.02225	1	2.36516	0.82265
0.026	1	3.66922	1.25581
0.02975	1	4.78276	1.46065
0.0335	1	5.62226	1.50048

0.03725	1	6.19108	1.46925
0.041	1	6.57617	1.47883
0.04475	1	6.90507	1.4451
0.0485	1	7.09381	1.43291
0.056	1	7.53575	1.3651
0.0635	1	7.72876	1.30185
0.071	1	7.93949	1.30659
0.0785	1	8.11076	1.28323
0.086	1	8.19303	1.29269
0.0935	1	8.37035	1.29291
0.101	1	8.4908	1.21204
0.1085	1	8.49873	1.24604
0.116	1	8.59239	1.2268
0.1235	1	8.66154	1.24133
0.131	1	8.68166	1.24867
0.146	1	8.84851	1.24303
0.161	1	8.98024	1.2423
0.176	1	9.01026	1.2535
0.191	1	9.1846	1.28422
0.206	1	9.21101	1.24423
0.221	1	9.26973	1.24026
0.236	1	9.39841	1.26405
0.266	1	9.50645	1.23982
0.296	1	9.5506	1.25111
0.326	1	9.66372	1.29686
0.356	1	9.74438	1.23118
0.386	1	9.77084	1.28478
0.431	1	9.92466	1.29204
0.476	1	9.88867	1.27436
0.521	1	10.0464	1.276
0.566	1	10.1199	1.26117
0.611	1	10.1236	1.25032
0.656	1	10.1016	1.28394
0.701	1	10.134	1.2359
0.746	1	10.2299	1.25846
0.791	1	10.2218	1.2275
0.836	1	10.241	1.20991
0.911	1	10.2572	1.22668
1.061	1	10.3621	1.18267
1.211	1	10.3229	1.2061
1.361	1	10.3654	1.17928
1.511	1	10.3264	1.1676
1.661	1	10.3865	1.15395
1.811	1	10.3361	1.15841
2.036	1	10.3377	1.16181
2.261	1	10.3593	1.17852
0.012	1.125	1.69943	0.57732
0.01387	1.125	1.67035	0.61667
0.01575	1.125	1.67724	0.55725
0.01762	1.125	1.64535	0.56878
0.0195	1.125	1.54292	0.49283
0.02325	1.125	2.27759	0.80982

0.027	1.125	3.59743	1.25467
0.03075	1.125	4.66819	1.4614
0.0345	1.125	5.47113	1.46368
0.03825	1.125	6.1691	1.50118
0.042	1.125	6.58845	1.44309
0.04575	1.125	6.84326	1.46792
0.0495	1.125	7.12035	1.40675
0.057	1.125	7.45364	1.34638
0.0645	1.125	7.71708	1.3236
0.072	1.125	7.98336	1.27612
0.0795	1.125	8.0942	1.26574
0.087	1.125	8.23457	1.29174
0.0945	1.125	8.31375	1.29394
0.102	1.125	8.39005	1.26459
0.1095	1.125	8.51657	1.25832
0.117	1.125	8.54989	1.25607
0.1245	1.125	8.62276	1.23364
0.132	1.125	8.71093	1.23297
0.147	1.125	8.82588	1.29433
0.162	1.125	8.97305	1.27436
0.177	1.125	9.05962	1.26672
0.192	1.125	9.14071	1.23897
0.207	1.125	9.15853	1.26577
0.222	1.125	9.28462	1.26827
0.237	1.125	9.31591	1.27113
0.267	1.125	9.52017	1.27071
0.297	1.125	9.58162	1.31917
0.327	1.125	9.653	1.29101
0.357	1.125	9.796	1.28107
0.387	1.125	9.79605	1.30146
0.432	1.125	9.86622	1.25576
0.477	1.125	10.0397	1.28001
0.522	1.125	10.0401	1.26945
0.567	1.125	10.0349	1.25035
0.612	1.125	10.1271	1.25546
0.657	1.125	10.1423	1.25658
0.702	1.125	10.2251	1.27451
0.747	1.125	10.2142	1.2537
0.792	1.125	10.2271	1.2567
0.837	1.125	10.1954	1.23107
0.912	1.125	10.3043	1.23188
1.062	1.125	10.3224	1.23479
1.212	1.125	10.3627	1.19219
1.362	1.125	10.401	1.17593
1.512	1.125	10.4108	1.19436
1.662	1.125	10.364	1.11926
1.812	1.125	10.3441	1.14334
2.037	1.125	10.3835	1.16647
2.262	1.125	10.3359	1.17844
0.013	1.25	1.66309	0.56462
0.01487	1.25	1.64351	0.57674
0.01675	1.25	1.64132	0.55468

0.01862	1.25	1.60309	0.54285
0.0205	1.25	1.61002	0.55282
0.02425	1.25	2.20961	0.80473
0.028	1.25	3.5238	1.20503
0.03175	1.25	4.61514	1.42258
0.0355	1.25	5.51923	1.49928
0.03925	1.25	6.05302	1.48117
0.043	1.25	6.63379	1.48622
0.04675	1.25	6.91569	1.45946
0.0505	1.25	7.10268	1.41145
0.058	1.25	7.58519	1.36148
0.0655	1.25	7.78102	1.32911
0.073	1.25	7.93993	1.28485
0.0805	1.25	8.069	1.24567
0.088	1.25	8.22998	1.27703
0.0955	1.25	8.39977	1.30342
0.103	1.25	8.49381	1.275
0.1105	1.25	8.52494	1.26603
0.118	1.25	8.60586	1.23943
0.1255	1.25	8.65758	1.24503
0.133	1.25	8.7701	1.22392
0.148	1.25	8.86955	1.25926
0.163	1.25	8.98612	1.25887
0.178	1.25	9.03115	1.30397
0.193	1.25	9.16026	1.26296
0.208	1.25	9.23644	1.31751
0.223	1.25	9.2952	1.30486
0.238	1.25	9.39141	1.27319
0.268	1.25	9.39162	1.2956
0.298	1.25	9.57941	1.28494
0.328	1.25	9.6217	1.29734
0.358	1.25	9.70658	1.28739
0.388	1.25	9.79942	1.30357
0.433	1.25	9.88195	1.2737
0.478	1.25	9.91971	1.26706
0.523	1.25	10.0591	1.28597
0.568	1.25	10.0619	1.29799
0.613	1.25	10.1289	1.23861
0.658	1.25	10.1493	1.23986
0.703	1.25	10.2132	1.24464
0.748	1.25	10.2454	1.21739
0.793	1.25	10.1648	1.23991
0.838	1.25	10.2773	1.24209
0.913	1.25	10.27	1.251
1.063	1.25	10.3478	1.20848
1.213	1.25	10.4123	1.1691
1.363	1.25	10.3681	1.19211
1.513	1.25	10.3854	1.17676
1.663	1.25	10.3798	1.17115
1.813	1.25	10.3832	1.16896
2.038	1.25	10.3393	1.17435
2.263	1.25	10.3579	1.17873

Run ID: 090896b

VR=0.994
Uo=11.1 m/s
x/D=5.0 FSTI=12%
L/D=2.3

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.42051	0.45405
0.00187	-0.375	1.49177	0.44481
0.00375	-0.375	1.50859	0.41649
0.00562	-0.375	1.76505	0.47869
0.0075	-0.375	2.56419	0.88437
0.01125	-0.375	3.98131	1.26651
0.015	-0.375	5.47630	1.52043
0.01875	-0.375	5.89205	1.71152
0.0225	-0.375	6.43256	1.78982
0.02625	-0.375	6.84939	1.75998
0.03	-0.375	7.27971	1.7686
0.03375	-0.375	7.56484	1.81032
0.0375	-0.375	7.85686	1.78112
0.045	-0.375	8.22177	1.75659
0.0525	-0.375	8.54429	1.73796
0.06	-0.375	8.77122	1.73992
0.0675	-0.375	8.99497	1.69226
0.075	-0.375	9.20272	1.68739
0.0825	-0.375	9.37062	1.67665
0.09	-0.375	9.49905	1.64437
0.0975	-0.375	9.59712	1.6508
0.105	-0.375	9.67561	1.60714
0.1125	-0.375	9.79324	1.57493
0.12	-0.375	9.85658	1.54485
0.135	-0.375	9.90044	1.5234
0.15	-0.375	10.1035	1.50083
0.165	-0.375	10.1139	1.48696
0.18	-0.375	10.2197	1.47754
0.195	-0.375	10.2654	1.45749
0.21	-0.375	10.2694	1.49962
0.225	-0.375	10.3167	1.44037
0.255	-0.375	10.4003	1.4483
0.285	-0.375	10.4222	1.45324
0.315	-0.375	10.3891	1.47651
0.345	-0.375	10.4234	1.4872
0.375	-0.375	10.4679	1.48119
0.42	-0.375	10.4906	1.49622
0.465	-0.375	10.5225	1.51124
0.51	-0.375	10.6312	1.49787
0.555	-0.375	10.6689	1.49009
0.6	-0.375	10.7542	1.4348
0.645	-0.375	10.8165	1.41664
0.69	-0.375	10.9776	1.33234
0.735	-0.375	11.0011	1.31609
0.78	-0.375	11.0514	1.26978
0.825	-0.375	11.1087	1.2333
0.9	-0.375	11.1732	1.18266
1.05	-0.375	11.1232	1.15879
1.2	-0.375	11.0854	1.15549
1.35	-0.375	11.0946	1.15599
1.5	-0.375	11.0836	1.15687
1.65	-0.375	11.0883	1.14548
1.8	-0.375	11.0797	1.16017
2.025	-0.375	11.0812	1.16515
2.249	-0.375	11.0869	1.16982
0	-0.25	1.51537	0.35564
0.00187	-0.25	1.95368	0.65445
0.00375	-0.25	2.74782	0.98609
0.00562	-0.25	3.50178	1.25032
0.0075	-0.25	4.17211	1.46299
0.01125	-0.25	5.25604	1.59709
0.015	-0.25	6.01776	1.70459
0.01875	-0.25	6.49185	1.71899
0.0225	-0.25	6.85429	1.74127
0.02625	-0.25	7.18722	1.73215
0.03	-0.25	7.5046	1.78477
0.03375	-0.25	7.63072	1.7745
0.0375	-0.25	7.84612	1.76295
0.045	-0.25	8.1812	1.76666
0.0525	-0.25	8.40485	1.76519
0.06	-0.25	8.6068	1.72558
0.0675	-0.25	8.76778	1.75419
0.075	-0.25	8.90672	1.72248
0.0825	-0.25	9.08418	1.69782
0.09	-0.25	9.15858	1.7007
0.0975	-0.25	9.29593	1.65944
0.105	-0.25	9.33497	1.59731
0.1125	-0.25	9.46251	1.62013
0.12	-0.25	9.56696	1.60866
0.135	-0.25	9.58313	1.56323
0.15	-0.25	9.71902	1.56167
0.165	-0.25	9.81753	1.53244
0.18	-0.25	9.87873	1.50247
0.195	-0.25	9.87881	1.48453
0.21	-0.25	9.91425	1.45427
0.225	-0.25	9.93647	1.47578
0.255	-0.25	10.0063	1.4184
0.285	-0.25	10.0626	1.44113
0.315	-0.25	10.0585	1.43693
0.345	-0.25	10.1195	1.44124
0.375	-0.25	10.1678	1.47249
0.42	-0.25	10.1	1.46859
0.465	-0.25	10.1668	1.50157
0.51	-0.25	10.2042	1.51409
0.555	-0.25	10.4108	1.49591
0.6	-0.25	10.4625	1.47248
0.645	-0.25	10.6428	1.48511
0.69	-0.25	10.8266	1.39767
0.735	-0.25	10.8911	1.39247
0.78	-0.25	11.0422	1.32059
0.825	-0.25	11.167	1.27595
0.9	-0.25	11.2551	1.23015
1.05	-0.25	11.2153	1.17704
1.2	-0.25	11.1457	1.14469
1.35	-0.25	11.1511	1.15072
1.5	-0.25	11.1159	1.16804
1.65	-0.25	11.125	1.15275
1.8	-0.25	11.1598	1.14704
2.025	-0.25	11.1346	1.15076
2.249	-0.25	11.1538	1.19394
0	-0.125	1.47775	0.33615
0.00187	-0.125	1.49802	0.33674
0.00375	-0.125	1.98341	0.67030
0.00562	-0.125	2.7354	0.97413
0.0075	-0.125	3.44539	1.17055
0.01125	-0.125	4.6582	1.45174
0.015	-0.125	5.50704	1.57046
0.01875	-0.125	6.06148	1.58973
0.0225	-0.125	6.4809	1.58421
0.02625	-0.125	6.8038	1.64831
0.03	-0.125	7.04231	1.62498
0.03375	-0.125	7.27303	1.65624
0.0375	-0.125	7.43383	1.645
0.045	-0.125	7.76537	1.6502
0.0525	-0.125	7.98999	1.61685
0.06	-0.125	8.21631	1.62936
0.0675	-0.125	8.35352	1.64875
0.075	-0.125	8.55833	1.60858
0.0825	-0.125	8.6303	1.61173
0.09	-0.125	8.77722	1.59592
0.0975	-0.125	8.91125	1.58362
0.105	-0.125	8.97416	1.59175
0.1125	-0.125	9.01801	1.54019
0.12	-0.125	9.1117	1.55226
0.135	-0.125	9.25249	1.54383
0.15	-0.125	9.3798	1.50507
0.165	-0.125	9.371	1.45061
0.18	-0.125	9.47204	1.46361
0.195	-0.125	9.50705	1.46478
0.21	-0.125	9.5471	1.42803
0.225	-0.125	9.59759	1.44254
0.255	-0.125	9.61711	1.42358
0.285	-0.125	9.62942	1.41335
0.315	-0.125	9.63194	1.40044
0.345	-0.125	9.66057	1.38897
0.375	-0.125	9.65398	1.41683

0.42	-0.125	9.73985	1.45463
0.465	-0.125	9.74993	1.45217
0.51	-0.125	9.88913	1.48321
0.555	-0.125	10.0591	1.4898
0.6	-0.125	10.2059	1.51858
0.645	-0.125	10.3827	1.483
0.69	-0.125	10.5603	1.42212
0.735	-0.125	10.7303	1.37109
0.78	-0.125	10.8694	1.32073
0.825	-0.125	10.987	1.29033
0.9	-0.125	11.0819	1.20866
1.05	-0.125	11.0908	1.1554
1.2	-0.125	11.046	1.1271
1.35	-0.125	11.0044	1.14745
1.5	-0.125	10.962	1.17073
1.65	-0.125	11.0485	1.15782
1.8	-0.125	11.0208	1.15589
2.025	-0.125	11.0139	1.14158
2.249	-0.125	11.0371	1.18799
0	0	1.53094	0.36726
0.00187	0	1.49742	0.34557
0.00375	0	1.55328	0.38214
0.00562	0	2.15898	0.73857
0.0075	0	2.94794	1.03766
0.01125	0	4.28363	1.38947
0.015	0	5.24125	1.52678
0.01875	0	5.88737	1.56249
0.0225	0	6.34477	1.57619
0.02625	0	6.67963	1.54816
0.03	0	6.91087	1.55736
0.03375	0	7.15477	1.56762
0.0375	0	7.38332	1.59067
0.045	0	7.6909	1.6254
0.0525	0	7.91181	1.57059
0.06	0	8.1406	1.60974
0.0675	0	8.29355	1.59416
0.075	0	8.45276	1.61834
0.0825	0	8.59619	1.55601
0.09	0	8.70534	1.5881
0.0975	0	8.81934	1.61707
0.105	0	8.94586	1.56186
0.1125	0	9.00097	1.56808
0.12	0	9.04881	1.52584
0.135	0	9.19574	1.51755
0.15	0	9.30164	1.49741
0.165	0	9.43243	1.46356
0.18	0	9.44492	1.46637
0.195	0	9.48313	1.41413
0.21	0	9.53182	1.41488
0.225	0	9.57288	1.41994
0.255	0	9.57161	1.365
0.285	0	9.59153	1.41702
0.315	0	9.62725	1.40207
0.345	0	9.62719	1.41378
0.375	0	9.64217	1.46214
0.42	0	9.68707	1.44645
0.465	0	9.78475	1.49029
0.51	0	9.85028	1.49861
0.555	0	10.0043	1.48716
0.6	0	10.1563	1.49571
0.645	0	10.4431	1.50889
0.69	0	10.5753	1.45372
0.735	0	10.7428	1.39955
0.78	0	10.9226	1.31841
0.825	0	11.0123	1.29185
0.9	0	11.1297	1.21424
1.05	0	11.1137	1.11998
1.2	0	11.057	1.13831
1.35	0	11.0117	1.13507
1.5	0	11.0161	1.12414
1.65	0	11.0197	1.15347
1.8	0	11.0426	1.14648
2.025	0	11.0301	1.14661
2.249	0	11.0301	1.17003
0	0.125	1.58779	0.40483
0.00187	0.125	1.53672	0.37597
0.00375	0.125	1.5176	0.34884
0.00562	0.125	1.69804	0.48502
0.0075	0.125	2.47365	0.84262
0.01125	0.125	3.97056	1.33123
0.015	0.125	5.06795	1.57328
0.01875	0.125	5.75898	1.57912
0.0225	0.125	6.37085	1.6207
0.02625	0.125	6.72993	1.66558
0.03	0.125	6.98652	1.62554
0.03375	0.125	7.34349	1.66032
0.0375	0.125	7.5493	1.68905
0.045	0.125	7.78568	1.68355
0.0525	0.125	8.08843	1.64921
0.06	0.125	8.32402	1.64853
0.0675	0.125	8.52	1.67623
0.075	0.125	8.63528	1.64865
0.0825	0.125	8.74674	1.63244
0.09	0.125	8.92161	1.63335
0.0975	0.125	9.03306	1.62978
0.105	0.125	9.13286	1.62991
0.1125	0.125	9.1982	1.60718
0.12	0.125	9.25229	1.58964
0.135	0.125	9.40822	1.55277
0.15	0.125	9.50747	1.5272
0.165	0.125	9.59647	1.51146
0.18	0.125	9.66082	1.50947
0.195	0.125	9.64811	1.48652
0.21	0.125	9.75329	1.49379
0.225	0.125	9.75458	1.47342
0.255	0.125	9.782	1.4626
0.285	0.125	9.78101	1.4438
0.315	0.125	9.77818	1.4462
0.345	0.125	9.81116	1.48238
0.375	0.125	9.81797	1.49271
0.42	0.125	9.87772	1.49157
0.465	0.125	9.88189	1.52321
0.51	0.125	10.0031	1.536
0.555	0.125	10.1753	1.53011
0.6	0.125	10.3381	1.49812
0.645	0.125	10.5221	1.49848
0.69	0.125	10.5944	1.46071
0.735	0.125	10.8134	1.37525
0.78	0.125	10.9193	1.31416
0.825	0.125	11.0087	1.28347
0.9	0.125	11.1552	1.19517
1.05	0.125	11.118	1.16134
1.2	0.125	11.058	1.13909
1.35	0.125	11.0409	1.15236
1.5	0.125	11.0266	1.12364
1.65	0.125	11.0315	1.17109
1.8	0.125	11.0747	1.15631
2.025	0.125	11.0709	1.14578
2.249	0.125	11.0924	1.18908
0	0.25	1.65672	0.44892
0.00187	0.25	1.58911	0.40897
0.00375	0.25	1.53454	0.37256
0.00562	0.25	1.53684	0.35672
0.0075	0.25	1.91411	0.63508
0.01125	0.25	3.49866	1.23473
0.015	0.25	4.80098	1.57771
0.01875	0.25	5.75448	1.68497
0.0225	0.25	6.35774	1.73432
0.02625	0.25	6.79926	1.74318
0.03	0.25	7.16413	1.70958
0.03375	0.25	7.46973	1.77981
0.0375	0.25	7.62288	1.73228
0.045	0.25	8.01712	1.74172
0.0525	0.25	8.3393	1.76075
0.06	0.25	8.57583	1.72541
0.0675	0.25	8.75645	1.72744
0.075	0.25	8.94572	1.66802
0.0825	0.25	9.11142	1.70224
0.09	0.25	9.17439	1.64994
0.0975	0.25	9.30296	1.64772
0.105	0.25	9.36165	1.63193
0.1125	0.25	9.50777	1.61317
0.12	0.25	9.62476	1.58709
0.135	0.25	9.69789	1.54983
0.15	0.25	9.8029	1.55441
0.165	0.25	9.90979	1.52988

0.18	0.25	9.97017	1.51333
0.195	0.25	10.006	1.46992
0.21	0.25	10.0593	1.46945
0.225	0.25	10.0957	1.48733
0.255	0.25	10.0706	1.4693
0.285	0.25	10.093	1.48559
0.315	0.25	10.0896	1.50071
0.345	0.25	10.1549	1.51052
0.375	0.25	10.1154	1.53557
0.42	0.25	10.1631	1.52181
0.465	0.25	10.2523	1.54264
0.51	0.25	10.2745	1.56289
0.555	0.25	10.4194	1.55768
0.6	0.25	10.539	1.49016
0.645	0.25	10.6848	1.43649
0.69	0.25	10.828	1.38616
0.735	0.25	10.9073	1.36072
0.78	0.25	11.0023	1.29653
0.825	0.25	11.102	1.22784
0.9	0.25	11.1504	1.20426
1.05	0.25	11.1468	1.13819
1.2	0.25	11.0912	1.13813
1.35	0.25	11.0828	1.16201
1.5	0.25	11.046	1.17099
1.65	0.25	11.0396	1.15196
1.8	0.25	11.0996	1.18111
2.025	0.25	11.0604	1.14994
2.249	0.25	11.082	1.18368
0	0.375	1.7125	0.49940
0.00187	0.375	1.65753	0.45498
0.00375	0.375	1.60859	0.43964
0.00562	0.375	1.56976	0.37869
0.0075	0.375	1.56419	0.38437
0.01125	0.375	2.98131	1.06651
0.015	0.375	4.47643	1.5023
0.01875	0.375	5.59205	1.70352
0.0225	0.375	6.43256	1.77982
0.02625	0.375	6.87288	1.75298
0.03	0.375	7.28707	1.74308
0.03375	0.375	7.58081	1.81032
0.0375	0.375	7.86376	1.7794
0.045	0.375	8.23631	1.76897
0.0525	0.375	8.57199	1.72076
0.06	0.375	8.78791	1.74356
0.0675	0.375	9.01307	1.68526
0.075	0.375	9.21009	1.69149
0.0825	0.375	9.38169	1.67106
0.09	0.375	9.5014	1.63803
0.0975	0.375	9.62686	1.66108
0.105	0.375	9.70561	1.58387
0.1125	0.375	9.76924	1.5792
0.12	0.375	9.84185	1.55485
0.135	0.375	9.91144	1.51992
0.15	0.375	10.0344	1.4836
0.165	0.375	10.1153	1.49866
0.18	0.375	10.2291	1.48854
0.195	0.375	10.2825	1.46224
0.21	0.375	10.2984	1.49439
0.225	0.375	10.3225	1.4337
0.255	0.375	10.409	1.44683
0.285	0.375	10.4262	1.44243
0.315	0.375	10.4418	1.46446
0.345	0.375	10.4324	1.49292
0.375	0.375	10.4793	1.4839
0.42	0.375	10.4818	1.49362
0.465	0.375	10.5352	1.50867
0.51	0.375	10.622	1.49806
0.555	0.375	10.6709	1.48499
0.6	0.375	10.7566	1.43448
0.645	0.375	10.8191	1.42014
0.69	0.375	10.9805	1.31034
0.735	0.375	10.9941	1.32569
0.78	0.375	11.0751	1.27011
0.825	0.375	11.1095	1.23002
0.9	0.375	11.1447	1.17996
1.05	0.375	11.1144	1.15985
1.2	0.375	11.0618	1.14549
1.35	0.375	11.0918	1.15699
1.5	0.375	11.0836	1.1587
1.65	0.375	11.0888	1.1438
1.8	0.375	11.0774	1.15991
2.025	0.375	11.1191	1.17755
2.249	0.375	11.0869	1.16982
0	0.5	1.79976	0.55439
0.00187	0.5	1.68473	0.48501
0.00375	0.5	1.64668	0.44675
0.00562	0.5	1.5896	0.41036
0.0075	0.5	1.55193	0.37731
0.01125	0.5	2.33936	0.80620
0.015	0.5	3.96581	1.37148
0.01875	0.5	5.30128	1.66041
0.0225	0.5	6.18733	1.71915
0.02625	0.5	6.84435	1.74384
0.03	0.5	7.24609	1.77541
0.03375	0.5	7.63693	1.78604
0.0375	0.5	7.91139	1.76344
0.045	0.5	8.31565	1.72513
0.0525	0.5	8.71243	1.71812
0.06	0.5	8.92866	1.68098
0.0675	0.5	9.15716	1.6236
0.075	0.5	9.3164	1.60309
0.0825	0.5	9.43888	1.60322
0.09	0.5	9.57236	1.56525
0.0975	0.5	9.67534	1.57438
0.105	0.5	9.7362	1.5327
0.1125	0.5	9.86838	1.51439
0.12	0.5	9.89678	1.52875
0.135	0.5	10.0616	1.43021
0.15	0.5	10.121	1.42386
0.165	0.5	10.3038	1.41599
0.18	0.5	10.3593	1.40998
0.195	0.5	10.3288	1.40591
0.21	0.5	10.4655	1.40884
0.225	0.5	10.5014	1.36621
0.255	0.5	10.5883	1.40472
0.285	0.5	10.6238	1.38331
0.315	0.5	10.6459	1.39996
0.345	0.5	10.6765	1.39139
0.375	0.5	10.714	1.41086
0.42	0.5	10.7338	1.42896
0.465	0.5	10.7882	1.42532
0.51	0.5	10.7582	1.39321
0.555	0.5	10.8315	1.37635
0.6	0.5	10.9475	1.34175
0.645	0.5	10.9692	1.33623
0.69	0.5	11.0148	1.28797
0.735	0.5	11.071	1.27873
0.78	0.5	11.0976	1.20692
0.825	0.5	11.1163	1.17831
0.9	0.5	11.1472	1.1878
1.05	0.5	11.1213	1.16816
1.2	0.5	11.0985	1.14931
1.35	0.5	11.082	1.14369
1.5	0.5	11.1057	1.11348
1.65	0.5	11.1082	1.15566
1.8	0.5	11.0894	1.16563
2.025	0.5	11.0914	1.16925
2.249	0.5	11.0794	1.16763
0	0.625	1.87622	0.58844
0.00187	0.625	1.74266	0.52309
0.00375	0.625	1.64921	0.46041
0.00562	0.625	1.60617	0.40377
0.0075	0.625	1.55257	0.36277
0.01125	0.625	1.76798	0.53236
0.015	0.625	3.39748	1.19862
0.01875	0.625	4.82234	1.54305
0.0225	0.625	5.92651	1.69607
0.02625	0.625	6.58966	1.73505
0.03	0.625	7.18654	1.71362
0.03375	0.625	7.54417	1.72108
0.0375	0.625	7.8395	1.69893
0.045	0.625	8.34898	1.67292
0.0525	0.625	8.65546	1.62843
0.06	0.625	8.91461	1.62008
0.0675	0.625	9.17228	1.6148
0.075	0.625	9.31969	1.56558

0.0825	0.625	9.45257	1.51259
0.09	0.625	9.5807	1.49116
0.0975	0.625	9.70769	1.52237
0.105	0.625	9.77288	1.48201
0.1125	0.625	9.87878	1.4693
0.12	0.625	9.90785	1.43427
0.135	0.625	10.0593	1.40022
0.15	0.625	10.1997	1.39477
0.165	0.625	10.3265	1.36792
0.18	0.625	10.3752	1.36389
0.195	0.625	10.4312	1.374
0.21	0.625	10.4969	1.33214
0.225	0.625	10.528	1.35431
0.255	0.625	10.6359	1.3428
0.285	0.625	10.6751	1.33529
0.315	0.625	10.7485	1.32469
0.345	0.625	10.7834	1.31892
0.375	0.625	10.7804	1.35138
0.42	0.625	10.852	1.30872
0.465	0.625	10.9166	1.30628
0.51	0.625	10.9931	1.29707
0.555	0.625	10.9735	1.27431
0.6	0.625	11.0507	1.26291
0.645	0.625	11.022	1.25622
0.69	0.625	11.077	1.23333
0.735	0.625	11.1019	1.1933
0.78	0.625	11.1065	1.18829
0.825	0.625	11.1408	1.19278
0.9	0.625	11.0923	1.17953
1.05	0.625	11.1129	1.16536
1.2	0.625	11.1125	1.14905
1.35	0.625	11.0913	1.16751
1.5	0.625	11.1034	1.17073
1.65	0.625	11.1232	1.16472
1.8	0.625	11.128	1.13875
2.025	0.625	11.1048	1.16162
2.249	0.625	11.098	1.18114
0	0.75	2.01313	0.64927
0.00187	0.75	1.86142	0.57876
0.00375	0.75	1.71465	0.49209
0.00562	0.75	1.63575	0.45622
0.0075	0.75	1.56248	0.38667
0.01125	0.75	1.50531	0.32843
0.015	0.75	2.78507	0.97962
0.01875	0.75	4.3519	1.4358
0.0225	0.75	5.5191	1.60818
0.02625	0.75	6.34602	1.66464
0.03	0.75	6.92293	1.69494
0.03375	0.75	7.32976	1.67537
0.0375	0.75	7.65286	1.6207
0.045	0.75	8.17149	1.60186
0.0525	0.75	8.56652	1.60967
0.06	0.75	8.82669	1.56099
0.0675	0.75	9.05821	1.51529
0.075	0.75	9.22557	1.48658
0.0825	0.75	9.34526	1.46262
0.09	0.75	9.52104	1.41655
0.0975	0.75	9.64219	1.42633
0.105	0.75	9.73272	1.42092
0.1125	0.75	9.80221	1.38856
0.12	0.75	9.89797	1.40296
0.135	0.75	9.99685	1.33637
0.15	0.75	10.0771	1.34337
0.165	0.75	10.2526	1.33488
0.18	0.75	10.2907	1.30576
0.195	0.75	10.3914	1.32422
0.21	0.75	10.4614	1.32124
0.225	0.75	10.5241	1.3122
0.255	0.75	10.6095	1.28897
0.285	0.75	10.7097	1.29395
0.315	0.75	10.7474	1.26663
0.345	0.75	10.7952	1.24968
0.375	0.75	10.8332	1.27335
0.42	0.75	10.8999	1.26373
0.465	0.75	10.9636	1.25436
0.51	0.75	11.0061	1.25138
0.555	0.75	10.9987	1.215
0.6	0.75	11.0811	1.23468
0.645	0.75	11.0817	1.21033
0.69	0.75	11.052	1.21172
0.735	0.75	11.1036	1.20626
0.78	0.75	11.0874	1.17708
0.825	0.75	11.1126	1.18401
0.9	0.75	11.0854	1.17397
1.05	0.75	11.1012	1.16324
1.2	0.75	11.1051	1.1617
1.35	0.75	11.0916	1.1666
1.5	0.75	11.0821	1.15823
1.65	0.75	11.1274	1.14474
1.8	0.75	11.1301	1.16982
2.025	0.75	11.1682	1.1512
2.25	0.75	11.1543	1.15215
0	0.875	1.58324	0.41483
0.00187	0.875	1.5485	0.37926
0.00375	0.875	1.5054	0.33749
0.00562	0.875	1.48666	0.31549
0.0075	0.875	1.94706	0.62971
0.01125	0.875	3.49526	1.17457
0.015	0.875	4.90214	1.49029
0.01875	0.875	5.91709	1.57124
0.0225	0.875	6.61967	1.61452
0.02625	0.875	7.05913	1.6006
0.03	0.875	7.39042	1.58389
0.03375	0.875	7.73081	1.56823
0.0375	0.875	8.03108	1.55758
0.045	0.875	8.37191	1.50852
0.0525	0.875	8.65307	1.51054
0.06	0.875	8.93188	1.47887
0.0675	0.875	9.08643	1.4506
0.075	0.875	9.25053	1.39568
0.0825	0.875	9.38104	1.41044
0.09	0.875	9.53849	1.37208
0.0975	0.875	9.62692	1.36419
0.105	0.875	9.68211	1.36351
0.1125	0.875	9.80054	1.36673
0.12	0.875	9.87575	1.34031
0.135	0.875	9.94486	1.32469
0.15	0.875	10.0717	1.31158
0.165	0.875	10.1815	1.30847
0.18	0.875	10.2532	1.27232
0.195	0.875	10.3779	1.28494
0.21	0.875	10.4643	1.30497
0.225	0.875	10.4731	1.27999
0.255	0.875	10.5941	1.24071
0.285	0.875	10.6711	1.27914
0.315	0.875	10.694	1.21858
0.345	0.875	10.7579	1.21586
0.375	0.875	10.8231	1.21758
0.42	0.875	10.8707	1.25118
0.465	0.875	10.9034	1.21073
0.51	0.875	10.9911	1.17815
0.555	0.875	11.0097	1.21346
0.6	0.875	11.0071	1.19041
0.645	0.875	11.0473	1.18126
0.69	0.875	11.0385	1.18394
0.735	0.875	11.0766	1.19072
0.78	0.875	11.0826	1.19118
0.825	0.875	11.054	1.16992
0.9	0.875	11.0866	1.16229
1.05	0.875	11.0884	1.17201
1.2	0.875	11.136	1.17358
1.35	0.875	11.0953	1.17205
1.5	0.875	11.1224	1.17792
1.65	0.875	11.0944	1.17517
1.8	0.875	11.1416	1.19723
2.025	0.875	11.1172	1.19202
2.249	0.875	11.1351	1.17602
0	1	1.63689	0.44226
0.00187	1	1.57669	0.39419
0.00375	1	1.51641	0.35179
0.00562	1	1.48827	0.31973
0.0075	1	1.51956	0.34398
0.01125	1	2.92807	1.00529
0.015	1	4.42209	1.37295
0.01875	1	5.53767	1.52924
0.0225	1	6.34563	1.57697

0.02625	1	6.87056	1.59816
0.03	1	7.31432	1.56776
0.03375	1	7.61533	1.54461
0.0375	1	7.89002	1.54557
0.045	1	8.25707	1.49861
0.0525	1	8.58385	1.49091
0.06	1	8.81971	1.4529
0.0675	1	8.9909	1.41958
0.075	1		1.41049
0.0825	1	9.30999	1.40843
0.09	1	9.44241	1.35742
0.0975	1	9.57755	1.32997
0.105	1	9.64906	1.34117
0.1125	1	9.714	1.3141
0.12	1	9.8074	1.32931
0.135	1	9.95361	1.31476
0.15	1	10.0418	1.27969
0.165	1	10.1614	1.28677
0.18	1	10.2301	1.26351
0.195	1	10.2934	1.26756
0.21	1	10.4058	1.23631
0.225	1	10.4242	1.23075
0.255	1	10.5383	1.24194
0.285	1	10.6562	1.25495
0.315	1	10.7545	1.21732
0.345	1	10.7936	1.22181
0.375	1	10.8257	1.20589
0.42	1	10.8672	1.1998
0.465	1	10.9305	1.176
0.51	1	10.9713	1.18254
0.555	1	11.0199	1.21196
0.6	1	11.0507	1.18941
0.645	1	11.0346	1.18306
0.69	1	11.0554	1.15835
0.735	1	11.104	1.20121
0.78	1	11.0895	1.1666
0.825	1	11.0785	1.17515
0.9	1	11.1125	1.18342
1.05	1	11.1036	1.18637
1.2	1	11.0941	1.17647
1.35	1	11.1242	1.15821
1.5	1	11.1476	1.17759
1.65	1	11.1394	1.16551
1.8	1	11.1294	1.16178
2.025	1	11.1661	1.20029
2.249	1	11.1287	1.16791
0	1.125	1.69938	0.47138
0.00187	1.125	1.60977	0.42458
0.00375	1.125	1.54997	0.39349
0.00562	1.125	1.50583	0.33588
0.0075	1.125	1.46542	0.30338
0.01125	1.125	2.39296	0.81703
0.015	1.125	3.92755	1.29064
0.01875	1.125	5.20249	1.53198
0.0225	1.125	6.05323	1.57066
0.02625	1.125	6.67066	1.58368
0.03	1.125	7.16773	1.58777
0.03375	1.125	7.44623	1.56413
0.0375	1.125	7.76977	1.55626
0.045	1.125	8.19105	1.51694
0.0525	1.125	8.53727	1.47866
0.06	1.125	8.76695	1.46724
0.0675	1.125	8.95325	1.41339
0.075	1.125	9.11467	1.39026
0.0825	1.125	9.2937	1.40044
0.09	1.125	9.40211	1.36746
0.0975	1.125	9.47229	1.356
0.105	1.125	9.53858	1.36435
0.1125	1.125	9.70568	1.34036
0.12	1.125	9.75783	1.31276
0.135	1.125	9.92647	1.31367
0.15	1.125	10.0042	1.27608
0.165	1.125	10.0735	1.29138
0.18	1.125	10.2291	1.2954
0.195	1.125	10.3041	1.28026
0.21	1.125	10.3279	1.25748
0.225	1.125	10.4375	1.25275
0.255	1.125	10.5327	1.24571
0.285	1.125	10.6747	1.23493
0.315	1.125	10.6807	1.24279
0.345	1.125	10.7959	1.22844
0.375	1.125	10.8457	1.20835
0.42	1.125	10.8796	1.2111
0.465	1.125	10.9432	1.20931
0.51	1.125	10.9764	1.1854
0.555	1.125	11.0044	1.19389
0.6	1.125	11.0401	1.1868
0.645	1.125	11.0671	1.20209
0.69	1.125	11.0602	1.18202
0.735	1.125	11.0893	1.17459
0.78	1.125	11.0843	1.17197
0.825	1.125	11.1065	1.18148
0.9	1.125	11.1331	1.17359
1.05	1.125	11.1255	1.17904
1.2	1.125	11.1655	1.16261
1.35	1.125	11.1387	1.18499
1.5	1.125	11.1355	1.16547
1.65	1.125	11.1626	1.16183
1.8	1.125	11.1845	1.16494
2.025	1.125	11.151	1.16468
2.249	1.125	11.1523	1.16743
0	1.25	1.7918	0.54216
0.00187	1.25	1.66325	0.45699
0.00375	1.25	1.58458	0.40864
0.00562	1.25	1.52673	0.35955
0.0075	1.25	1.48533	0.32232
0.01125	1.25	1.82647	0.55311
0.015	1.25	3.43371	1.15096
0.01875	1.25	4.845	1.48023
0.0225	1.25	5.84835	1.57435
0.02625	1.25	6.50219	1.61408
0.03	1.25	7.01751	1.61302
0.03375	1.25	7.43804	1.59928
0.0375	1.25	7.73753	1.55996
0.045	1.25	8.1793	1.56038
0.0525	1.25	8.50892	1.4872
0.06	1.25	8.71117	1.45211
0.0675	1.25	8.97916	1.48591
0.075	1.25	9.1813	1.39735
0.0825	1.25	9.29753	1.42615
0.09	1.25	9.4054	1.41721
0.0975	1.25	9.54186	1.39242
0.105	1.25	9.65724	1.35542
0.1125	1.25	9.73235	1.37309
0.12	1.25	9.79981	1.36995
0.135	1.25	9.92828	1.31511
0.15	1.25	10.0382	1.31073
0.165	1.25	10.163	1.31606
0.18	1.25	10.2989	1.32631
0.195	1.25	10.3284	1.29777
0.21	1.25	10.4201	1.2814
0.225	1.25	10.4374	1.26444
0.255	1.25	10.574	1.25652
0.285	1.25	10.6502	1.25894
0.315	1.25	10.7222	1.25385
0.345	1.25	10.7865	1.23914
0.375	1.25	10.8255	1.24444
0.42	1.25	10.9017	1.23318
0.465	1.25	10.9402	1.24086
0.51	1.25	11.0049	1.22023
0.555	1.25	11.0333	1.21977
0.6	1.25	11.0539	1.21089
0.645	1.25	11.0231	1.19686
0.69	1.25	11.0921	1.19647
0.735	1.25	11.0927	1.17692
0.78	1.25	11.1044	1.1901
0.825	1.25	11.0998	1.18181
0.9	1.25	11.1269	1.1987
1.05	1.25	11.1426	1.17168
1.2	1.25	11.1658	1.17686
1.35	1.25	11.1262	1.17006
1.5	1.25	11.1797	1.16252
1.65	1.25	11.203	1.14729
1.8	1.25	11.1717	1.17397
2.025	1.25	11.1905	1.17995
2.249	1.25	11.1736	1.15797

Run ID: 091196

VR=0.493
Uo=11.2 m/s
x/D=5.0 FSTI=12%
L/D=2.3

y(in)	z(in)	U (m/s)	urms (m/s)
0	-0.375	1.32799	0.31623
0.00187	-0.375	1.46286	0.39584
0.00375	-0.375	2.02224	0.72224
0.00562	-0.375	2.68116	0.96666
0.0075	-0.375	3.25427	1.14467
0.01125	-0.375	4.25507	1.36508
0.015	-0.375	5.04389	1.4856
0.01875	-0.375	5.59507	1.50955
0.0225	-0.375	5.98347	1.51503
0.02625	-0.375	6.24536	1.55375
0.03	-0.375	6.5169	1.55653
0.03375	-0.375	6.78313	1.54611
0.0375	-0.375	6.89525	1.52716
0.045	-0.375	7.14711	1.53759
0.0525	-0.375	7.42434	1.53418
0.06	-0.375	7.57685	1.54495
0.0675	-0.375	7.80396	1.51405
0.075	-0.375	7.83339	1.50541
0.0825	-0.375	7.93982	1.48594
0.09	-0.375	8.03228	1.47886
0.0975	-0.375	8.11945	1.47792
0.105	-0.375	8.17482	1.48402
0.1125	-0.375	8.26659	1.503
0.12	-0.375	8.29882	1.49228
0.135	-0.375	8.40561	1.51897
0.15	-0.375	8.43538	1.53345
0.165	-0.375	8.51076	1.53175
0.18	-0.375	8.54612	1.59082
0.195	-0.375	8.63656	1.60362
0.21	-0.375	8.67449	1.60891
0.225	-0.375	8.70239	1.62053
0.255	-0.375	8.83539	1.64138
0.285	-0.375	8.91657	1.68124
0.315	-0.375	9.05099	1.70339
0.345	-0.375	9.19051	1.70067
0.375	-0.375	9.30215	1.65679
0.42	-0.375	9.45486	1.69105
0.465	-0.375	9.74157	1.65184
0.51	-0.375	9.92533	1.60904
0.555	-0.375	10.1186	1.57693
0.6	-0.375	10.3274	1.49461
0.645	-0.375	10.4629	1.45868
0.69	-0.375	10.5529	1.38054
0.735	-0.375	10.7485	1.35307
0.78	-0.375	10.7667	1.31519
0.825	-0.375	10.8355	1.28481
0.9	-0.375	10.9004	1.25009
1.05	-0.375	11.0392	1.22352
1.2	-0.375	11.0703	1.19588
1.35	-0.375	11.1491	1.16548
1.5	-0.375	11.1481	1.17261
1.65	-0.375	11.141	1.17138
1.8	-0.375	11.1592	1.16046
2.025	-0.375	11.1522	1.18706
2.248	-0.375	11.1778	1.17617
0	-0.25	1.32799	0.31623
0.00187	-0.25	1.38545	0.35587
0.00375	-0.25	1.81229	0.63049
0.00562	-0.25	2.42666	0.85836
0.0075	-0.25	3.00156	1.06416
0.01125	-0.25	3.97667	1.29661
0.015	-0.25	4.72578	1.41949
0.01875	-0.25	5.23884	1.48527
0.0225	-0.25	5.65424	1.49333
0.02625	-0.25	5.94371	1.53302
0.03	-0.25	6.22448	1.54109
0.03375	-0.25	6.40348	1.53891
0.0375	-0.25	6.56392	1.5323
0.045	-0.25	6.80938	1.51924
0.0525	-0.25	7.04272	1.53812
0.06	-0.25	7.20908	1.52714
0.0675	-0.25	7.35589	1.50577
0.075	-0.25	7.50207	1.4843
0.0825	-0.25	7.59003	1.49824
0.09	-0.25	7.66928	1.48162
0.0975	-0.25	7.79157	1.49388
0.105	-0.25	7.8677	1.49393
0.1125	-0.25	7.90361	1.49071
0.12	-0.25	7.91435	1.50893
0.135	-0.25	8.03043	1.52171
0.15	-0.25	8.1037	1.50841
0.165	-0.25	8.14798	1.55688
0.18	-0.25	8.22685	1.57476
0.195	-0.25	8.27414	1.55567
0.21	-0.25	8.31306	1.62188
0.225	-0.25	8.34163	1.61033
0.255	-0.25	8.49214	1.6641
0.285	-0.25	8.5936	1.68623
0.315	-0.25	8.70891	1.69743
0.345	-0.25	8.88972	1.7107
0.375	-0.25	9.0229	1.76099
0.42	-0.25	9.27139	1.73941
0.465	-0.25	9.55993	1.69299
0.51	-0.25	9.79597	1.66295
0.555	-0.25	9.99008	1.60331
0.6	-0.25	10.2045	1.53773
0.645	-0.25	10.4164	1.47856
0.69	-0.25	10.5468	1.44061
0.735	-0.25	10.6662	1.3833
0.78	-0.25	10.7632	1.33219
0.825	-0.25	10.822	1.31157
0.9	-0.25	10.9442	1.26799
1.05	-0.25	11.0733	1.2214
1.2	-0.25	11.1124	1.19222
1.35	-0.25	11.1874	1.17376
1.5	-0.25	11.1973	1.17139
1.65	-0.25	11.2165	1.16404
1.8	-0.25	11.2266	1.18497
2.025	-0.25	11.2084	1.15917
2.248	-0.25	11.2187	1.173
0	-0.125	1.3071	0.28765
0.00187	-0.125	1.34803	0.33794
0.00375	-0.125	1.7263	0.59913
0.00562	-0.125	2.31779	0.85049
0.0075	-0.125	2.86581	1.02464
0.01125	-0.125	3.81842	1.26133
0.015	-0.125	4.5236	1.36988
0.01875	-0.125	5.04163	1.4309
0.0225	-0.125	5.41991	1.42422
0.02625	-0.125	5.70693	1.44959
0.03	-0.125	5.94244	1.46771
0.03375	-0.125	6.11474	1.42826
0.0375	-0.125	6.28413	1.48072
0.045	-0.125	6.54325	1.46848
0.0525	-0.125	6.77895	1.45429
0.06	-0.125	7.00166	1.48677
0.0675	-0.125	7.09227	1.47976
0.075	-0.125	7.20209	1.45506
0.0825	-0.125	7.35379	1.43868
0.09	-0.125	7.44575	1.45408
0.0975	-0.125	7.49895	1.46304
0.105	-0.125	7.61189	1.48384
0.1125	-0.125	7.63671	1.45878
0.12	-0.125	7.65416	1.46608
0.135	-0.125	7.79384	1.50413
0.15	-0.125	7.85966	1.48483
0.165	-0.125	7.8773	1.52127
0.18	-0.125	7.97908	1.52419
0.195	-0.125	8.02437	1.56323
0.21	-0.125	8.05385	1.57921
0.225	-0.125	8.11316	1.57989
0.255	-0.125	8.1916	1.60582
0.285	-0.125	8.28147	1.69044
0.315	-0.125	8.46977	1.6954
0.345	-0.125	8.70374	1.71474
0.375	-0.125	8.86914	1.71767

0.42	-0.125	9.06816	1.7492
0.465	-0.125	9.41314	1.74141
0.51	-0.125	9.67902	1.7146
0.555	-0.125	9.92433	1.64429
0.6	-0.125	10.201	1.5526
0.645	-0.125	10.3614	1.53248
0.69	-0.125	10.5362	1.46069
0.735	-0.125	10.7021	1.37632
0.78	-0.125	10.7961	1.33015
0.825	-0.125	10.8643	1.29526
0.9	-0.125	10.9316	1.28297
1.05	-0.125	11.0719	1.20671
1.2	-0.125	11.1595	1.186
1.35	-0.125	11.108	1.18382
1.5	-0.125	11.1928	1.16751
1.65	-0.125	11.2147	1.16871
1.8	-0.125	11.2791	1.16662
2.025	-0.125	11.2266	1.17188
2.248	-0.125	11.2328	1.17043
0	0	1.30688	0.29518
0.00187	0	1.33095	0.32353
0.00375	0	1.6449	0.54072
0.00562	0	2.22083	0.79193
0.0075	0	2.75882	0.99341
0.01125	0	3.79761	1.27398
0.015	0	4.47776	1.37155
0.01875	0	4.98284	1.39285
0.0225	0	5.33641	1.42617
0.02625	0	5.64017	1.42932
0.03	0	5.86681	1.41915
0.03375	0	6.03231	1.44048
0.0375	0	6.21966	1.448
0.045	0	6.48524	1.42446
0.0525	0	6.73463	1.46705
0.06	0	6.89101	1.44357
0.0675	0	7.06142	1.45954
0.075	0	7.14914	1.44138
0.0825	0	7.27839	1.44856
0.09	0	7.35006	1.45232
0.0975	0	7.49598	1.42272
0.105	0	7.54391	1.43264
0.1125	0	7.61766	1.45581
0.12	0	7.61445	1.43379
0.135	0	7.73643	1.47521
0.15	0	7.79123	1.47886
0.165	0	7.83563	1.5124
0.18	0	7.90411	1.50677
0.195	0	7.98203	1.56591
0.21	0	8.07074	1.58143
0.225	0	8.06054	1.57379
0.255	0	8.18601	1.61905
0.285	0	8.29166	1.6488
0.315	0	8.48586	1.69178
0.345	0	8.62966	1.74708
0.375	0	8.79011	1.74229
0.42	0	9.05076	1.76323
0.465	0	9.38793	1.72544
0.51	0	9.70808	1.70755
0.555	0	9.91986	1.63601
0.6	0	10.1899	1.59799
0.645	0	10.372	1.50708
0.69	0	10.532	1.45016
0.735	0	10.6775	1.41692
0.78	0	10.7504	1.38064
0.825	0	10.8423	1.32535
0.9	0	10.9246	1.2662
1.05	0	11.0685	1.23785
1.2	0	11.1172	1.20457
1.35	0	11.1873	1.20278
1.5	0	11.1775	1.1552
1.65	0	11.2059	1.18487
1.8	0	11.219	1.16424
2.025	0	11.2427	1.16112
2.248	0	11.208	1.18519
0	0.125	1.32509	0.29759
0.00187	0.125	1.33365	0.30876
0.00375	0.125	1.55135	0.48807
0.00562	0.125	2.09105	0.73942
0.0075	0.125	2.67781	0.96433
0.01125	0.125	3.72037	1.26285
0.015	0.125	4.49629	1.35026
0.01875	0.125	5.08086	1.41621
0.0225	0.125	5.44075	1.44251
0.02625	0.125	5.72951	1.44383
0.03	0.125	5.99172	1.45132
0.03375	0.125	6.11968	1.46008
0.0375	0.125	6.38168	1.46199
0.045	0.125	6.6367	1.46539
0.0525	0.125	6.89638	1.47559
0.06	0.125	7.06135	1.46667
0.0675	0.125	7.16431	1.44597
0.075	0.125	7.33321	1.46478
0.0825	0.125	7.44237	1.44353
0.09	0.125	7.45324	1.46411
0.0975	0.125	7.61786	1.44167
0.105	0.125	7.65941	1.44973
0.1125	0.125	7.75235	1.46411
0.12	0.125	7.84302	1.50327
0.135	0.125	7.90053	1.51401
0.15	0.125	7.96107	1.49201
0.165	0.125	7.99561	1.53009
0.18	0.125	8.11724	1.53137
0.195	0.125	8.16606	1.5863
0.21	0.125	8.19762	1.59705
0.225	0.125	8.26709	1.62795
0.255	0.125	8.32476	1.67084
0.285	0.125	8.4203	1.67188
0.315	0.125	8.68303	1.74032
0.345	0.125	8.82159	1.73276
0.375	0.125	8.8966	1.74802
0.42	0.125	9.14599	1.78751
0.465	0.125	9.46627	1.74851
0.51	0.125	9.7471	1.681
0.555	0.125	10.0047	1.65977
0.6	0.125	10.2342	1.56976
0.645	0.125	10.4376	1.47858
0.69	0.125	10.5933	1.45444
0.735	0.125	10.7326	1.35408
0.78	0.125	10.8047	1.3354
0.825	0.125	10.8866	1.31025
0.9	0.125	10.9742	1.26833
1.05	0.125	11.0929	1.20991
1.2	0.125	11.1545	1.20819
1.35	0.125	11.1758	1.19122
1.5	0.125	11.2089	1.1766
1.65	0.125	11.2264	1.17067
1.8	0.125	11.2199	1.17671
2.025	0.125	11.2167	1.18283
2.248	0.125	11.217	1.18638
0	0.25	1.35859	0.31152
0.00187	0.25	1.36146	0.32756
0.00375	0.25	1.50757	0.43733
0.00562	0.25	2.05373	0.72202
0.0075	0.25	2.66593	0.96185
0.01125	0.25	3.77007	1.27269
0.015	0.25	4.63761	1.40537
0.01875	0.25	5.1894	1.45482
0.0225	0.25	5.64517	1.46897
0.02625	0.25	5.97435	1.5317
0.03	0.25	6.18474	1.47397
0.03375	0.25	6.45224	1.48921
0.0375	0.25	6.66497	1.51281
0.045	0.25	6.96684	1.50975
0.0525	0.25	7.13234	1.50299
0.06	0.25	7.32541	1.54225
0.0675	0.25	7.53071	1.4768
0.075	0.25	7.66003	1.48033
0.0825	0.25	7.79366	1.5145
0.09	0.25	7.86522	1.49901
0.0975	0.25	7.91117	1.47438
0.105	0.25	7.96268	1.49628
0.1125	0.25	8.02811	1.49872
0.12	0.25	8.10015	1.53233
0.135	0.25	8.21191	1.51373
0.15	0.25	8.25704	1.53592
0.165	0.25	8.3319	1.5701

0.18	0.25	8.44384	1.58693
0.195	0.25	8.46018	1.618
0.21	0.25	8.55727	1.61511
0.225	0.25	8.61149	1.66017
0.255	0.25	8.71826	1.68912
0.285	0.25	8.78038	1.75821
0.315	0.25	8.92967	1.76318
0.345	0.25	9.06799	1.75878
0.375	0.25	9.22618	1.76164
0.42	0.25	9.45073	1.75793
0.465	0.25	9.69084	1.74237
0.51	0.25	9.89441	1.69523
0.555	0.25	10.1496	1.62722
0.6	0.25	10.3208	1.5636
0.645	0.25	10.4694	1.47572
0.69	0.25	10.6531	1.37311
0.735	0.25	10.7799	1.36757
0.78	0.25	10.7947	1.30545
0.825	0.25	10.8442	1.3145
0.9	0.25	11.0349	1.24965
1.05	0.25	11.0559	1.22456
1.2	0.25	11.1924	1.17743
1.35	0.25	11.1904	1.1751
1.5	0.25	11.1972	1.18223
1.65	0.25	11.2089	1.17881
1.8	0.25	11.2268	1.18589
2.025	0.25	11.2173	1.15216
2.248	0.25	11.2	1.187
0	0.375	1.41013	0.33963
0.00187	0.375	1.40494	0.34156
0.00375	0.375	1.46945	0.39443
0.00562	0.375	1.97124	0.67738
0.0075	0.375	2.6414	0.94625
0.01125	0.375	3.81999	1.28804
0.015	0.375	4.74082	1.4264
0.01875	0.375	5.38419	1.50015
0.0225	0.375	5.87646	1.52626
0.02625	0.375	6.19198	1.49722
0.03	0.375	6.47915	1.51423
0.03375	0.375	6.74756	1.52771
0.0375	0.375	6.91321	1.50002
0.045	0.375	7.2184	1.50425
0.0525	0.375	7.47294	1.49309
0.06	0.375	7.67766	1.50677
0.0675	0.375	7.85576	1.469
0.075	0.375	7.9936	1.47093
0.0825	0.375	8.10573	1.45622
0.09	0.375	8.19015	1.44705
0.0975	0.375	8.28795	1.44004
0.105	0.375	8.35405	1.46637
0.1125	0.375	8.40558	1.45604
0.12	0.375	8.53209	1.49111
0.135	0.375	8.60145	1.48286
0.15	0.375	8.62106	1.53192
0.165	0.375	8.71807	1.53633
0.18	0.375	8.81012	1.5623
0.195	0.375	8.84566	1.5703
0.21	0.375	8.89979	1.6055
0.225	0.375	8.9649	1.65631
0.255	0.375	9.06163	1.68418
0.285	0.375	9.19564	1.68295
0.315	0.375	9.26496	1.72169
0.345	0.375	9.42677	1.73615
0.375	0.375	9.53715	1.75482
0.42	0.375	9.72734	1.68704
0.465	0.375	9.96439	1.65572
0.51	0.375	10.1706	1.61318
0.555	0.375	10.323	1.57084
0.6	0.375	10.4824	1.47497
0.645	0.375	10.6539	1.42142
0.69	0.375	10.6959	1.3839
0.735	0.375	10.7715	1.32627
0.78	0.375	10.9107	1.30957
0.825	0.375	10.9349	1.26345
0.9	0.375	11.0544	1.24782
1.05	0.375	11.051	1.21857
1.2	0.375	11.195	1.18786
1.35	0.375	11.1873	1.19069
1.5	0.375	11.2067	1.1831
1.65	0.375	11.2248	1.19234
1.8	0.375	11.2295	1.18736
2.025	0.375	11.2439	1.20895
2.248	0.375	11.2641	1.20098
0	0.5	1.43262	0.34911
0.00187	0.5	1.40658	0.32719
0.00375	0.5	1.46589	0.36880
0.00562	0.5	1.89103	0.63125
0.0075	0.5	2.58569	0.91923
0.01125	0.5	3.84134	1.29694
0.015	0.5	4.79005	1.40713
0.01875	0.5	5.51027	1.46549
0.0225	0.5	6.04807	1.52091
0.02625	0.5	6.4005	1.52075
0.03	0.5	6.69278	1.49508
0.03375	0.5	6.95359	1.51662
0.0375	0.5	7.16641	1.51312
0.045	0.5	7.49024	1.48603
0.0525	0.5	7.74805	1.47618
0.06	0.5	7.96419	1.45598
0.0675	0.5	8.11873	1.44437
0.075	0.5	8.28909	1.42032
0.0825	0.5	8.4264	1.40313
0.09	0.5	8.48246	1.4071
0.0975	0.5	8.60092	1.40753
0.105	0.5	8.63922	1.43902
0.1125	0.5	8.74036	1.43603
0.12	0.5	8.78739	1.42397
0.135	0.5	8.86173	1.45565
0.15	0.5	8.994	1.45098
0.165	0.5	9.06799	1.48542
0.18	0.5	9.06485	1.4871
0.195	0.5	9.21382	1.51014
0.21	0.5	9.24943	1.51129
0.225	0.5	9.31589	1.57071
0.255	0.5	9.49727	1.57293
0.285	0.5	9.56389	1.62521
0.315	0.5	9.61693	1.66443
0.345	0.5	9.74983	1.68305
0.375	0.5	9.84495	1.67174
0.42	0.5	10.0616	1.62389
0.465	0.5	10.2268	1.56367
0.51	0.5	10.3797	1.48255
0.555	0.5	10.5337	1.46298
0.6	0.5	10.6345	1.42467
0.645	0.5	10.6906	1.38191
0.69	0.5	10.83	1.32524
0.735	0.5	10.8633	1.30335
0.78	0.5	10.9226	1.29652
0.825	0.5	10.9985	1.2718
0.9	0.5	11.0269	1.26064
1.05	0.5	11.1103	1.18783
1.2	0.5	11.1832	1.22023
1.35	0.5	11.2123	1.17079
1.5	0.5	11.2281	1.18872
1.65	0.5	11.2623	1.17818
1.8	0.5	11.2487	1.17483
2.025	0.5	11.2323	1.16012
2.248	0.5	11.2356	1.19139
0	0.625	1.49182	0.37056
0.00187	0.625	1.43488	0.33278
0.00375	0.625	1.48278	0.37501
0.00562	0.625	1.82215	0.58151
0.0075	0.625	2.54514	0.86815
0.01125	0.625	3.86623	1.27018
0.015	0.625	4.91685	1.45004
0.01875	0.625	5.57911	1.53249
0.0225	0.625	6.13676	1.51807
0.02625	0.625	6.54931	1.49459
0.03	0.625	6.85087	1.53451
0.03375	0.625	7.12213	1.50517
0.0375	0.625	7.33908	1.47827
0.045	0.625	7.71563	1.47733
0.0525	0.625	7.88424	1.43335
0.06	0.625	8.09892	1.43046
0.0675	0.625	8.25391	1.40492
0.075	0.625	8.48692	1.38594

0.0825	0.625	8.56774	1.383
0.09	0.625	8.64686	1.35742
0.0975	0.625	8.80154	1.33614
0.105	0.625	8.87051	1.37226
0.1125	0.625	8.95878	1.34976
0.12	0.625	9.03246	1.36071
0.135	0.625	9.12216	1.35581
0.15	0.625	9.24195	1.41462
0.165	0.625	9.3109	1.37188
0.18	0.625	9.36902	1.43329
0.195	0.625	9.5152	1.45561
0.21	0.625	9.53799	1.47541
0.225	0.625	9.58198	1.48707
0.255	0.625	9.71664	1.53152
0.285	0.625	9.86453	1.52342
0.315	0.625	9.94475	1.5583
0.345	0.625	10.0498	1.52916
0.375	0.625	10.1088	1.54985
0.42	0.625	10.2751	1.52299
0.465	0.625	10.4341	1.43963
0.51	0.625	10.5014	1.42213
0.555	0.625	10.6217	1.4141
0.6	0.625	10.7304	1.36055
0.645	0.625	10.8312	1.34906
0.69	0.625	10.8357	1.31778
0.735	0.625	10.902	1.2781
0.78	0.625	10.9517	1.28605
0.825	0.625	10.975	1.23546
0.9	0.625	11.0803	1.24961
1.05	0.625	11.107	1.18895
1.2	0.625	11.2028	1.20566
1.35	0.625	11.2188	1.16562
1.5	0.625	11.2471	1.18056
1.65	0.625	11.2319	1.17628
1.8	0.625	11.2829	1.17366
2.025	0.625	11.2809	1.19309
2.248	0.625	11.2753	1.19129
0	0.75	1.52029	0.38511
0.00187	0.75	1.46918	0.35677
0.00375	0.75	1.48995	0.36508
0.00562	0.75	1.75482	0.54930
0.0075	0.75	2.44586	0.84892
0.01125	0.75	3.77786	1.25835
0.015	0.75	4.87796	1.42301
0.01875	0.75	5.62049	1.47455
0.0225	0.75	6.17507	1.50876
0.02625	0.75	6.57871	1.4957
0.03	0.75	6.90258	1.5124
0.03375	0.75	7.16534	1.48262
0.0375	0.75	7.39138	1.45215
0.045	0.75	7.74729	1.44791
0.0525	0.75	8.05154	1.42766
0.06	0.75	8.22091	1.39317
0.0675	0.75	8.42138	1.38328
0.075	0.75	8.59492	1.35251
0.0825	0.75	8.66742	1.34016
0.09	0.75	8.81304	1.32207
0.0975	0.75	8.92821	1.32059
0.105	0.75	9.00498	1.31824
0.1125	0.75	9.09484	1.3319
0.12	0.75	9.16583	1.33459
0.135	0.75	9.30456	1.3239
0.15	0.75	9.38677	1.32709
0.165	0.75	9.4565	1.32654
0.18	0.75	9.55857	1.35836
0.195	0.75	9.62137	1.38951
0.21	0.75	9.71986	1.37257
0.225	0.75	9.77732	1.36583
0.255	0.75	9.92164	1.43698
0.285	0.75	10.0177	1.41809
0.315	0.75	10.0842	1.4318
0.345	0.75	10.2253	1.41739
0.375	0.75	10.3232	1.42226
0.42	0.75	10.4031	1.398
0.465	0.75	10.5643	1.407
0.51	0.75	10.6151	1.3962
0.555	0.75	10.73	1.33803
0.6	0.75	10.8108	1.30168
0.645	0.75	10.878	1.31206
0.69	0.75	10.9317	1.25062
0.735	0.75	10.9833	1.26869
0.78	0.75	10.9691	1.25286
0.825	0.75	11.0522	1.2686
0.9	0.75	11.085	1.23964
1.05	0.75	11.1487	1.24859
1.2	0.75	11.2181	1.19139
1.35	0.75	11.2112	1.17851
1.5	0.75	11.2424	1.19615
1.65	0.75	11.2714	1.18369
1.8	0.75	11.2929	1.17822
2.025	0.75	11.2696	1.16814
2.248	0.75	11.2465	1.19739
0	0.875	1.5433	0.40865
0.00187	0.875	1.47835	0.36155
0.00375	0.875	1.43679	0.34258
0.00562	0.875	1.65259	0.48602
0.0075	0.875	2.33871	0.79677
0.01125	0.875	3.72585	1.21811
0.015	0.875	4.90809	1.47838
0.01875	0.875	5.6645	1.50142
0.0225	0.875	6.22426	1.5115
0.02625	0.875	6.68415	1.52437
0.03	0.875	6.95869	1.511
0.03375	0.875	7.22857	1.47836
0.0375	0.875	7.44608	1.48906
0.045	0.875	7.8191	1.43388
0.0525	0.875	8.08392	1.4248
0.06	0.875	8.3338	1.38791
0.0675	0.875	8.49514	1.3517
0.075	0.875	8.65915	1.3646
0.0825	0.875	8.75768	1.3433
0.09	0.875	8.8981	1.32262
0.0975	0.875	8.98701	1.30117
0.105	0.875	9.0709	1.29575
0.1125	0.875	9.18435	1.31927
0.12	0.875	9.22623	1.30661
0.135	0.875	9.37182	1.32142
0.15	0.875	9.48371	1.31183
0.165	0.875	9.65753	1.31499
0.18	0.875	9.72347	1.33054
0.195	0.875	9.74771	1.32472
0.21	0.875	9.87769	1.34273
0.225	0.875	9.92372	1.33689
0.255	0.875	10.04	1.36925
0.285	0.875	10.1415	1.34546
0.315	0.875	10.2634	1.34548
0.345	0.875	10.3103	1.3729
0.375	0.875	10.4153	1.33161
0.42	0.875	10.5353	1.35276
0.465	0.875	10.6455	1.33415
0.51	0.875	10.6876	1.32653
0.555	0.875	10.7682	1.29017
0.6	0.875	10.8433	1.28541
0.645	0.875	10.8678	1.2664
0.69	0.875	10.9438	1.27321
0.735	0.875	10.9826	1.25326
0.78	0.875	11.0027	1.25121
0.825	0.875	11.1139	1.22598
0.9	0.875	11.1134	1.21575
1.05	0.875	11.1823	1.22582
1.2	0.875	11.25	1.20477
1.35	0.875	11.2391	1.18443
1.5	0.875	11.2433	1.1805
1.65	0.875	11.2701	1.16552
1.8	0.875	11.26	1.15772
2.025	0.875	11.3033	1.19886
2.248	0.875	11.2417	1.19839
0	1	1.57801	0.42423
0.00187	1	1.51952	0.36547
0.00375	1	1.47072	0.35336
0.00562	1	1.59705	0.43248
0.0075	1	2.22857	0.74174
0.01125	1	3.61969	1.17456
0.015	1	4.8339	1.45236
0.01875	1	5.6463	1.51399
0.0225	1	6.20838	1.54535

0.02625	1	6.64207	1.55079
0.03	1	6.99831	1.52216
0.03375	1	7.25182	1.51098
0.0375	1	7.53138	1.44781
0.045	1	7.85406	1.4643
0.0525	1	8.06995	1.43333
0.06	1	8.33164	1.40512
0.0675	1	8.50251	1.36812
0.075	1	8.65102	1.35665
0.0825	1	8.81361	1.35842
0.09	1	8.9392	1.31899
0.0975	1	9.06016	1.3195
0.105	1	9.13748	1.28351
0.1125	1	9.21664	1.30538
0.12	1	9.31741	1.29452
0.135	1	9.42681	1.32259
0.15	1	9.55614	1.29028
0.165	1	9.67436	1.29342
0.18	1	9.69015	1.27787
0.195	1	9.8713	1.29928
0.21	1	9.92865	1.29825
0.225	1	9.99594	1.32194
0.255	1	10.1156	1.30321
0.285	1	10.2215	1.34647
0.315	1	10.3236	1.30879
0.345	1	10.3979	1.33563
0.375	1	10.4525	1.30803
0.42	1	10.5887	1.32672
0.465	1	10.6722	1.32167
0.51	1	10.7558	1.30845
0.555	1	10.8267	1.28757
0.6	1	10.8767	1.27974
0.645	1	10.9141	1.28759
0.69	1	10.9741	1.2394
0.735	1	11.0591	1.25876
0.78	1	11.0787	1.23408
0.825	1	11.1312	1.23575
0.9	1	11.1358	1.22994
1.05	1	11.1993	1.23927
1.2	1	11.2377	1.15603
1.35	1	11.2494	1.19711
1.5	1	11.3007	1.18473
1.65	1	11.3146	1.18468
1.8	1	11.2812	1.1815
2.025	1	11.2885	1.1747
2.248	1	11.3038	1.19778
0	1.125	1.592	0.43059
0.00187	1.125	1.53077	0.39013
0.00375	1.125	1.47297	0.34560
0.00562	1.125	1.54149	0.39182
0.0075	1.125	2.09523	0.69492
0.01125	1.125	3.57477	1.1858
0.015	1.125	4.73882	1.41268
0.01875	1.125	5.63765	1.5063
0.0225	1.125	6.1536	1.52022
0.02625	1.125	6.61739	1.50896
0.03	1.125	7.01286	1.49337
0.03375	1.125	7.28324	1.49669
0.0375	1.125	7.47246	1.48868
0.045	1.125	7.85491	1.44838
0.0525	1.125	8.13111	1.42834
0.06	1.125	8.37102	1.39465
0.0675	1.125	8.54752	1.38209
0.075	1.125	8.69422	1.34273
0.0825	1.125	8.82778	1.32537
0.09	1.125	8.96967	1.3428
0.0975	1.125	9.06725	1.33799
0.105	1.125	9.16945	1.33551
0.1125	1.125	9.21686	1.2928
0.12	1.125	9.31022	1.2871
0.135	1.125	9.48227	1.28756
0.15	1.125	9.62304	1.30157
0.165	1.125	9.69714	1.31731
0.18	1.125	9.80997	1.28428
0.195	1.125	9.86069	1.27687
0.21	1.125	9.97384	1.31327
0.225	1.125	10.0122	1.32247
0.255	1.125	10.0955	1.28677
0.285	1.125	10.2127	1.28756
0.315	1.125	10.367	1.30703
0.345	1.125	10.4282	1.32588
0.375	1.125	10.4767	1.31138
0.42	1.125	10.655	1.31836
0.465	1.125	10.7057	1.3154
0.51	1.125	10.8103	1.28827
0.555	1.125	10.8151	1.28872
0.6	1.125	10.9034	1.29564
0.645	1.125	10.9853	1.26589
0.69	1.125	10.9882	1.25549
0.735	1.125	11.065	1.2577
0.78	1.125	11.0612	1.21147
0.825	1.125	11.128	1.24687
0.9	1.125	11.1274	1.21703
1.05	1.125	11.2198	1.22501
1.2	1.125	11.2534	1.205
1.35	1.125	11.258	1.17488
1.5	1.125	11.2553	1.18557
1.65	1.125	11.326	1.18907
1.8	1.125	11.3119	1.18867
2.025	1.125	11.2954	1.16934
2.248	1.125	11.3147	1.21618
0	1.25	1.61652	0.46315
0.00187	1.25	1.55255	0.40833
0.00375	1.25	1.47821	0.36836
0.00562	1.25	1.53718	0.39806
0.0075	1.25	1.96172	0.62799
0.01125	1.25	3.41131	1.14094
0.015	1.25	4.65136	1.44307
0.01875	1.25	5.54655	1.51295
0.0225	1.25	6.13038	1.53028
0.02625	1.25	6.57296	1.49466
0.03	1.25	6.98572	1.50397
0.03375	1.25	7.2751	1.52371
0.0375	1.25	7.45501	1.50026
0.045	1.25	7.86558	1.45247
0.0525	1.25	8.12142	1.45036
0.06	1.25	8.3416	1.4119
0.0675	1.25	8.59303	1.38219
0.075	1.25	8.67521	1.33948
0.0825	1.25	8.83666	1.34256
0.09	1.25	8.97572	1.32816
0.0975	1.25	9.08352	1.30841
0.105	1.25	9.14946	1.27881
0.1125	1.25	9.28516	1.32245
0.12	1.25	9.35316	1.31364
0.135	1.25	9.48272	1.33165
0.15	1.25	9.54231	1.27644
0.165	1.25	9.69629	1.27868
0.18	1.25	9.76024	1.33157
0.195	1.25	9.846	1.33559
0.21	1.25	9.91629	1.31445
0.225	1.25	9.99023	1.3318
0.255	1.25	10.1033	1.34426
0.285	1.25	10.2118	1.35975
0.315	1.25	10.3139	1.31744
0.345	1.25	10.4363	1.3247
0.375	1.25	10.4491	1.33147
0.42	1.25	10.5553	1.36141
0.465	1.25	10.6638	1.3525
0.51	1.25	10.7467	1.32679
0.555	1.25	10.8494	1.30041
0.6	1.25	10.8634	1.2976
0.645	1.25	10.9119	1.28106
0.69	1.25	10.9917	1.27053
0.735	1.25	11.0187	1.25606
0.78	1.25	11.0838	1.27918
0.825	1.25	11.0444	1.23383
0.9	1.25	11.1474	1.2304
1.05	1.25	11.2291	1.23082
1.2	1.25	11.2459	1.20345
1.35	1.25	11.2972	1.20355
1.5	1.25	11.288	1.16746
1.65	1.25	11.2936	1.16888
1.8	1.25	11.3358	1.17414
2.025	1.25	11.3229	1.18916
2.248	1.25	11.3057	1.18117

Run ID: 050796

VR=1.002
Uo=10.75 m/s
HOLE-EXIT FSTI=12%
<u>CONFIGURATION</u>:
L/D=2.3, Open Plenum

*x=x0-0.715;z=-z0

x0(in)*	z0(in)*	Ueff (m/s)	ueff,rms (m/s)
0	-0.45	1.17605	0.428253
0	-0.375	1.09817	0.436498
0	-0.3	1.05212	0.475658
0	-0.225	0.842706	0.40227
0	-0.15	0.72372	0.319738
0	-0.075	0.652708	0.240825
0	0	0.650771	0.249441
0	0.075	0.662628	0.266719
0	0.15	0.74989	0.339603
0.065	-0.45	1.2241	0.448868
0.065	-0.375	1.10535	0.439163
0.065	-0.3	0.961697	0.412732
0.065	-0.225	0.841673	0.383846
0.065	-0.15	0.723767	0.265052
0.065	-0.075	0.763739	0.297116
0.065	0	1.30986	0.721111
0.065	0.075	0.758471	0.333056
0.065	0.15	0.722766	0.324642
0.13	-0.45	1.25002	0.437875
0.13	-0.375	1.12742	0.415453
0.13	-0.3	1.02849	0.393459
0.13	-0.225	0.813299	0.236201
0.13	-0.15	6.7107	1.83447
0.13	-0.075	13.8771	0.553641
0.13	0	13.9331	0.482302
0.13	0.075	13.4417	0.960473
0.13	0.15	4.14752	1.44348
0.195	-0.45	1.37424	0.510486
0.195	-0.375	1.21745	0.416902
0.195	-0.3	1.13117	0.364424
0.195	-0.225	4.40916	0.96561
0.195	-0.15	14.1936	0.42579
0.195	-0.075	14.237	0.369384
0.195	0	14.2057	0.369379
0.195	0.075	14.1941	0.38729
0.195	0.15	14.1243	0.53565
0.26	-0.45	1.59327	0.536934
0.26	-0.375	1.41646	0.461767
0.26	-0.3	1.77027	0.528236
0.26	-0.225	13.9232	0.802792
0.26	-0.15	14.4144	0.402628
0.26	-0.075	14.3791	0.367082
0.26	0	14.3597	0.362873
0.26	0.075	14.3527	0.372485
0.26	0.15	14.3428	0.40033
0.325	-0.45	1.5081	0.459358
0.325	-0.375	1.76299	0.506706
0.325	-0.3	4.98372	0.939898
0.325	-0.225	14.5214	0.415728
0.325	-0.15	14.4998	0.403692
0.325	-0.075	14.492	0.414865
0.325	0	14.4732	0.415702
0.325	0.075	14.4724	0.418003
0.325	0.15	14.4548	0.409935
0.39	-0.45	1.92967	0.574118
0.39	-0.375	1.59988	0.530081
0.39	-0.3	11.0585	1.63202
0.39	-0.225	14.6585	0.461458
0.39	-0.15	14.6081	0.477635
0.39	-0.075	14.5771	0.513585
0.39	0	14.5631	0.532681
0.39	0.075	14.5626	0.508178
0.39	0.15	14.5285	0.448005
0.455	-0.45	1.78291	0.504865
0.455	-0.375	1.9945	0.591385
0.455	-0.3	14.2969	0.844466
0.455	-0.225	14.7471	0.54036
0.455	-0.15	14.6981	0.627025
0.455	-0.075	14.6975	0.726142
0.455	0	14.6677	0.76433
0.455	0.075	14.6548	0.704552
0.455	0.15	14.6551	0.577037
0.52	-0.45	2.03006	0.578939
0.52	-0.375	2.80728	0.704982
0.52	-0.3	14.8281	0.616183
0.52	-0.225	14.8165	0.668574
0.52	-0.15	14.708	0.825011
0.52	-0.075	14.6707	0.952154
0.52	0	14.6616	1.03869
0.52	0.075	14.6542	0.935344
0.52	0.15	14.7368	0.753311
0.585	-0.45	2.24911	0.684402
0.585	-0.375	4.52114	1.0354
0.585	-0.3	14.9238	0.719477
0.585	-0.225	14.8645	0.856802
0.585	-0.15	14.626	1.14731
0.585	-0.075	14.3992	1.41725
0.585	0	14.2694	1.48598
0.585	0.075	14.4208	1.31627
0.585	0.15	14.6655	1.04401
0.65	-0.45	2.42695	0.780908
0.65	-0.375	4.89948	1.07845
0.65	-0.3	15.0074	0.818715
0.65	-0.225	14.729	1.18694
0.65	-0.15	14.0397	1.6447
0.65	-0.075	13.4267	2.03873
0.65	0	13.1319	2.14766
0.65	0.075	13.5321	1.93999
0.65	0.15	14.287	1.44096
0.715	-0.45	2.66507	0.882997
0.715	-0.375	6.35811	1.21445
0.715	-0.3	14.9574	0.950593
0.715	-0.225	14.2906	1.57022
0.715	-0.15	13.023	2.24705
0.715	-0.075	11.7896	2.63798
0.715	0	11.568	2.65852
0.715	0.075	12.0906	2.50373
0.715	0.15	13.4799	1.96764
0.78	-0.45	2.97353	0.955238
0.78	-0.375	7.36583	1.45705
0.78	-0.3	14.9663	1.20398
0.78	-0.225	13.766	2.06431
0.78	-0.15	11.6897	2.75279
0.78	-0.075	10.4336	2.81737
0.78	0	10.1201	2.85238
0.78	0.075	10.8388	2.78654
0.78	0.15	12.4228	2.51263
0.845	-0.45	3.18604	0.966328
0.845	-0.375	7.91832	1.71317
0.845	-0.3	15.0647	1.49507
0.845	-0.225	13.1711	2.5285
0.845	-0.15	10.7712	2.95037
0.845	-0.075	9.34538	2.83937
0.845	0	9.04389	2.76509
0.845	0.075	9.92317	2.79485
0.845	0.15	11.6433	2.74639
0.91	-0.45	3.28202	0.961138
0.91	-0.375	7.2055	1.45286
0.91	-0.3	14.6954	1.75076
0.91	-0.225	12.511	2.65422
0.91	-0.15	9.85063	2.80784
0.91	-0.075	8.45222	2.61767
0.91	0	8.14741	2.55334
0.91	0.075	8.94073	2.6399
0.91	0.15	11.0534	2.75289
0.975	-0.45	3.47883	1.00046
0.975	-0.375	6.3384	1.01194
0.975	-0.3	14.2475	2.00359
0.975	-0.225	12.0977	2.70069
0.975	-0.15	9.4265	2.64564
0.975	-0.075	8.10744	2.2332
0.975	0	7.94474	2.28174
0.975	0.075	8.77824	2.43918
0.975	0.15	10.6819	2.65348
1.04	-0.45	3.57695	0.996669
1.04	-0.375	3.64927	0.598964
1.04	-0.3	13.7923	2.09708
1.04	-0.225	12.1418	2.54314
1.04	-0.15	9.60583	2.44756
1.04	-0.075	8.3061	2.01136
1.04	0	8.03233	2.03307
1.04	0.075	8.95784	2.27255
1.04	0.15	10.8591	2.43762
1.105	-0.45	3.39262	0.989898
1.105	-0.375	3.28285	0.634978
1.105	-0.3	13.6357	2.15278

1.105	-0.225	12.4151	2.30552
1.105	-0.15	10.2418	2.29329
1.105	-0.075	8.78874	1.94947
1.105	0	8.63988	1.87911
1.105	0.075	9.45783	2.11464
1.105	0.15	11.5726	2.29496
1.17	-0.45	3.38638	1.02679
1.17	-0.375	3.58973	1.09135
1.17	-0.3	7.94172	1.33335
1.17	-0.225	12.8866	2.20259
1.17	-0.15	10.9833	2.21622
1.17	-0.075	9.52778	1.90466
1.17	0	9.38951	1.84295
1.17	0.075	10.3718	2.00807
1.17	0.15	12.1394	2.14149
1.235	-0.45	3.03955	0.953579
1.235	-0.375	3.8658	1.35917
1.235	-0.3	1.99501	0.56675
1.235	-0.225	12.8949	2.16538
1.235	-0.15	11.7531	2.06264
1.235	-0.075	10.455	1.81127
1.235	0	10.3233	1.77034
1.235	0.075	11.4774	2.00184
1.235	0.15	12.9901	2.17695
1.3	-0.45	2.94293	0.992032
1.3	-0.375	2.88356	1.11252
1.3	-0.3	2.48984	0.983618
1.3	-0.225	1.41959	0.563303
1.3	-0.15	11.9395	2.06492
1.3	-0.075	11.3482	1.8324
1.3	0	11.2484	1.79644
1.3	0.075	12.2122	2.03684
1.3	0.15	13.1689	2.23599
1.365	-0.45	2.30795	0.777188
1.365	-0.375	2.59161	1.01451
1.365	-0.3	2.23762	1.00757
1.365	-0.225	1.44908	0.605075
1.365	-0.15	0.764943	0.26081
1.365	-0.075	9.15486	1.81638
1.365	0	11.0254	1.77239
1.365	0.075	11.3385	2.06299
1.365	0.15	0.8735	0.366428
1.43	-0.45	2.48904	0.86291
1.43	-0.375	2.27809	0.921162
1.43	-0.3	2.08126	1.02721
1.43	-0.225	1.41415	0.623269
1.43	-0.15	0.976773	0.468464
1.43	-0.075	1.06702	0.628151
1.43	0	0.89699	0.482174
1.43	0.075	0.924641	0.552705
1.43	0.15	0.962117	0.415491

Run ID: 051096

VR=0.497
Uo=10.66 m/s
HOLE-EXIT FSTI=12%
<u>CONFIGURATION</u>:
L/D=2.3, Open Plenum

*x=x0-0.715;z=-z0

x0(in)*	z0(in)*	Ueff (m/s)	ueff,rms (m/s)
0	-0.45	1.3424	0.508492
0	-0.375	1.23356	0.481913
0	-0.3	1.11426	0.462714
0	-0.225	1.07528	0.506404
0	-0.15	0.955923	0.477638
0	-0.075	0.840698	0.419389
0	0	0.811431	0.410651
0	0.075	0.845462	0.412629
0	0.15	0.95107	0.478873
0.065	-0.45	1.35439	0.524293
0.065	-0.375	1.20771	0.45794
0.065	-0.3	1.14053	0.505824
0.065	-0.225	1.00777	0.479607
0.065	-0.15	0.809294	0.347965
0.065	-0.075	0.704397	0.340691
0.065	0	0.687391	0.351996
0.065	0.075	0.725924	0.33401
0.065	0.15	0.838654	0.44642
0.13	-0.45	1.30266	0.503921
0.13	-0.375	1.19253	0.452351
0.13	-0.3	1.05012	0.429371
0.13	-0.225	0.949605	0.474705
0.13	-0.15	0.75577	0.313733
0.13	-0.075	2.56502	1.17337
0.13	0	3.76034	1.4502
0.13	0.075	1.57834	0.866682
0.13	0.15	0.885193	0.492964
0.195	-0.45	1.20467	0.410042
0.195	-0.375	1.15108	0.413993
0.195	-0.3	1.13667	0.464825
0.195	-0.225	1.18844	0.359984
0.195	-0.15	5.12319	1.1482
0.195	-0.075	7.07154	0.595088
0.195	0	7.09473	0.572249
0.195	0.075	6.86191	0.762713
0.195	0.15	5.46748	1.19598
0.26	-0.45	1.29922	0.461988
0.26	-0.375	1.15184	0.378277
0.26	-0.3	1.14446	0.367442
0.26	-0.225	3.83498	0.948408
0.26	-0.15	7.39879	0.51635
0.26	-0.075	7.47281	0.394256
0.26	0	7.48228	0.391235
0.26	0.075	7.46166	0.421565
0.26	0.15	7.34263	0.512059
0.325	-0.45	1.32279	0.432257
0.325	-0.375	1.30519	0.426577
0.325	-0.3	2.3453	0.526249
0.325	-0.225	7.30492	0.723743
0.325	-0.15	7.70096	0.389592
0.325	-0.075	7.71017	0.346246
0.325	0	7.719	0.343597
0.325	0.075	7.68614	0.373901
0.325	0.15	7.65666	0.402211
0.39	-0.45	1.39599	0.428179
0.39	-0.375	1.57462	0.513634
0.39	-0.3	4.35624	0.683568
0.39	-0.225	7.93198	0.430708
0.39	-0.15	7.91602	0.367882
0.39	-0.075	7.92123	0.340911
0.39	0	7.90799	0.334481
0.39	0.075	7.90147	0.355142
0.39	0.15	7.88588	0.377889
0.455	-0.45	1.52993	0.454557
0.455	-0.375	1.62738	0.517731
0.455	-0.3	6.64079	0.957395
0.455	-0.225	8.07939	0.405558
0.455	-0.15	8.0639	0.356959
0.455	-0.075	8.06502	0.361984
0.455	0	8.04643	0.350394
0.455	0.075	8.05096	0.358095
0.455	0.15	8.03958	0.348877
0.52	-0.45	1.63673	0.497236
0.52	-0.375	1.98082	0.479904
0.52	-0.3	7.92877	0.679253
0.52	-0.225	8.21247	0.385008
0.52	-0.15	8.19023	0.389586
0.52	-0.075	8.18106	0.431852
0.52	0	8.17016	0.421378
0.52	0.075	8.1804	0.401287
0.52	0.15	8.16233	0.367245
0.585	-0.45	1.81429	0.605242
0.585	-0.375	2.75267	0.734371
0.585	-0.3	8.35247	0.517097
0.585	-0.225	8.32725	0.417404
0.585	-0.15	8.29271	0.469574
0.585	-0.075	8.26662	0.50669
0.585	0	8.27564	0.526386
0.585	0.075	8.263	0.472199
0.585	0.15	8.26365	0.416794
0.65	-0.45	2.02994	0.710038
0.65	-0.375	3.30713	0.878097
0.65	-0.3	8.47478	0.475135
0.65	-0.225	8.38801	0.451914
0.65	-0.15	8.31697	0.548254
0.65	-0.075	8.26549	0.625888
0.65	0	8.24185	0.651863
0.65	0.075	8.27472	0.593995
0.65	0.15	8.33055	0.508841
0.715	-0.45	2.3646	0.852188
0.715	-0.375	4.00579	1.04595
0.715	-0.3	8.59084	0.520936
0.715	-0.225	8.4403	0.553906
0.715	-0.15	8.24746	0.726724
0.715	-0.075	8.06303	0.916166
0.715	0	8.01663	0.91379
0.715	0.075	8.12058	0.824936
0.715	0.15	8.31293	0.633961
0.78	-0.45	2.5906	0.881893
0.78	-0.375	4.28151	0.955517
0.78	-0.3	8.6408	0.55721
0.78	-0.225	8.36751	0.688944
0.78	-0.15	7.94772	1.02376
0.78	-0.075	7.5361	1.21788
0.78	0	7.5088	1.20026
0.78	0.075	7.80621	1.08818
0.78	0.15	8.15116	0.874215
0.845	-0.45	2.64048	0.807165
0.845	-0.375	4.78201	1.01602
0.845	-0.3	8.69178	0.615503
0.845	-0.225	8.22883	0.902225
0.845	-0.15	7.53949	1.26158
0.845	-0.075	7.07331	1.42462
0.845	0	6.99063	1.42829
0.845	0.075	7.277	1.36278
0.845	0.15	7.87352	1.08101
0.91	-0.45	2.907	0.83562
0.91	-0.375	4.14357	0.856624
0.91	-0.3	8.67864	0.742973
0.91	-0.225	7.98441	1.10871
0.91	-0.15	7.06717	1.43226
0.91	-0.075	6.41703	1.49281
0.91	0	6.37767	1.45352
0.91	0.075	6.73935	1.44067
0.91	0.15	7.48598	1.304
0.975	-0.45	3.11626	0.876266
0.975	-0.375	3.27085	0.591003
0.975	-0.3	8.64185	0.87247
0.975	-0.225	7.8319	1.23272
0.975	-0.15	6.67852	1.51358
0.975	-0.075	6.17978	1.43056
0.975	0	5.99494	1.42065
0.975	0.075	6.44124	1.4449
0.975	0.15	7.315	1.3723
1.04	-0.45	3.23148	0.8642
1.04	-0.375	2.49673	0.404091
1.04	-0.3	8.5237	1.03769
1.04	-0.225	7.71519	1.32206
1.04	-0.15	6.65131	1.42813
1.04	-0.075	5.96583	1.27212
1.04	0	5.9295	1.27805
1.04	0.075	6.37767	1.3858
1.04	0.15	7.2139	1.33201
1.105	-0.45	3.38872	0.950719
1.105	-0.375	2.25138	0.334791
1.105	-0.3	8.69499	1.16456
1.105	-0.225	7.95479	1.29569

1.105	-0.15	6.8701	1.32388
1.105	-0.075	6.18276	1.19986
1.105	0	6.17216	1.17545
1.105	0.075	6.51044	1.28341
1.105	0.15	7.54818	1.30638
1.17	-0.45	3.13713	0.91105
1.17	-0.375	2.25855	0.488614
1.17	-0.3	7.56003	1.1694
1.17	-0.225	8.38465	1.23075
1.17	-0.15	7.3392	1.2373
1.17	-0.075	6.58211	1.1323
1.17	0	6.52126	1.08074
1.17	0.075	7.02541	1.1849
1.17	0.15	7.96612	1.22498
1.235	-0.45	3.08842	0.932773
1.235	-0.375	2.60338	0.740166
1.235	-0.3	1.3564	0.273446
1.235	-0.225	8.71379	1.24758
1.235	-0.15	7.85596	1.19739
1.235	-0.075	7.12574	1.07066
1.235	0	7.05883	1.02918
1.235	0.075	7.53977	1.16274
1.235	0.15	8.47752	1.17643
1.3	-0.45	2.68872	0.868017
1.3	-0.375	2.47802	0.80627
1.3	-0.3	1.50909	0.380209
1.3	-0.225	4.02245	0.849267
1.3	-0.15	8.34085	1.22594
1.3	-0.075	7.76006	1.07089
1.3	0	7.63961	1.03523
1.3	0.075	8.13655	1.14927
1.3	0.15	8.87914	1.23161
1.365	-0.45	2.61923	0.866399
1.365	-0.375	2.47401	0.843794
1.365	-0.3	1.67424	0.485456
1.365	-0.225	0.875041	0.233567
1.365	-0.15	1.1719	0.29569
1.365	-0.075	8.23691	1.12037
1.365	0	8.23776	1.09199
1.365	0.075	8.56522	1.2123
1.365	0.15	3.21113	0.97572
1.43	-0.45	2.55809	0.849655
1.43	-0.375	2.27512	0.810879
1.43	-0.3	1.76079	0.604001
1.43	-0.225	0.995594	0.267388
1.43	-0.15	0.655561	0.244215
1.43	-0.075	0.662007	0.161705
1.43	0	0.553189	0.092129
1.43	0.075	0.561956	0.106154
1.43	0.15	0.58771	0.18147

Run ID: 051396

VR=1.005
Uo=11.0 m/s
HOLE-EXIT FSTI=12%
CONFIGURATION:
L/D=7.0, Open Plenum

*x=x0-0.715;z=-z0

x0(in)*	z0(in)*	Ueff (m/s)	ueff,rms (m/s)
0	-0.45	1.29451	0.533749
0	-0.375	1.06282	0.392381
0	-0.3	0.945791	0.381181
0	-0.225	0.853557	0.350095
0	-0.15	0.739592	0.301211
0	-0.075	0.660774	0.226955
0	0	0.665203	0.238475
0	0.075	0.679882	0.239173
0	0.15	0.751093	0.321946
0.065	-0.45	1.12609	0.396818
0.065	-0.375	1.05212	0.407883
0.065	-0.3	0.912191	0.361757
0.065	-0.225	0.780611	0.310126
0.065	-0.15	0.696543	0.247806
0.065	-0.075	0.697798	0.234014
0.065	0	0.723217	0.259621
0.065	0.075	0.694102	0.224509
0.065	0.15	0.697761	0.271717
0.13	-0.45	1.14319	0.409791
0.13	-0.375	1.07651	0.423329
0.13	-0.3	0.940538	0.370127
0.13	-0.225	0.79017	0.300247
0.13	-0.15	0.778814	0.219661
0.13	-0.075	4.66127	2.12123
0.13	0	6.097	2.27202
0.13	0.075	3.31776	1.75176
0.13	0.15	0.943205	0.417853
0.195	-0.45	1.20785	0.432127
0.195	-0.375	1.10235	0.411189
0.195	-0.3	1.00816	0.342366
0.195	-0.225	1.3057	0.476121
0.195	-0.15	7.44072	2.06189
0.195	-0.075	8.90402	1.74067
0.195	0	9.27994	1.73927
0.195	0.075	8.90021	1.8444
0.195	0.15	7.56886	2.02209
0.26	-0.45	1.21803	0.403932
0.26	-0.375	1.19703	0.412861
0.26	-0.3	1.32124	0.518384
0.26	-0.225	6.52583	1.88473
0.26	-0.15	9.69693	1.70851
0.26	-0.075	10.2308	1.49415
0.26	0	10.4471	1.46924
0.26	0.075	10.3952	1.49686
0.26	0.15	9.76255	1.68451
0.325	-0.45	1.42144	0.452031
0.325	-0.375	1.45899	0.471672
0.325	-0.3	2.83927	0.904036
0.325	-0.225	9.89021	1.84018
0.325	-0.15	10.9856	1.51013
0.325	-0.075	11.2678	1.37279
0.325	0	11.2986	1.26575
0.325	0.075	11.3501	1.33592
0.325	0.15	11.12	1.46094
0.39	-0.45	1.56662	0.457475
0.39	-0.375	2.46317	0.897967
0.39	-0.3	6.37844	1.3512
0.39	-0.225	11.24	1.63338
0.39	-0.15	11.7401	1.30664
0.39	-0.075	11.8965	1.1894
0.39	0	12.0969	1.16338
0.39	0.075	12.1805	1.19429
0.39	0.15	11.8855	1.28728
0.455	-0.45	1.84329	0.525632
0.455	-0.375	3.13924	1.22333
0.455	-0.3	10.2569	1.67837
0.455	-0.225	12.1333	1.39932
0.455	-0.15	12.4346	1.15787
0.455	-0.075	12.5501	1.05338
0.455	0	12.6647	1.06562
0.455	0.075	12.7002	1.03203
0.455	0.15	12.6216	1.12993
0.52	-0.45	2.20512	0.702499
0.52	-0.375	3.20084	0.952217
0.52	-0.3	11.2513	1.48707
0.52	-0.225	12.6101	1.23025
0.52	-0.15	12.7653	1.0319
0.52	-0.075	12.8649	0.958831
0.52	0	12.9484	0.941347
0.52	0.075	13.0595	0.941942
0.52	0.15	12.9729	1.01943
0.585	-0.45	2.50554	0.865025
0.585	-0.375	3.7713	0.818375
0.585	-0.3	11.7634	1.39162
0.585	-0.225	12.8841	1.07789
0.585	-0.15	13.0623	0.964484
0.585	-0.075	13.0465	0.95827
0.585	0	13.105	0.949025
0.585	0.075	13.259	0.923911
0.585	0.15	13.3068	0.941806
0.65	-0.45	2.86957	1.0285
0.65	-0.375	4.17645	0.722773
0.65	-0.3	12.0836	1.30338
0.65	-0.225	13.0617	1.06908
0.65	-0.15	13.1133	0.95953
0.65	-0.075	13.1237	0.978278
0.65	0	13.163	1.02666
0.65	0.075	13.3473	0.940807
0.65	0.15	13.4336	0.910122
0.715	-0.45	3.22547	1.13279
0.715	-0.375	4.904	0.835773
0.715	-0.3	12.3407	1.27358
0.715	-0.225	13.0786	1.04673
0.715	-0.15	13.0637	1.02181
0.715	-0.075	13.0007	1.07788
0.715	0	13.1251	1.0424
0.715	0.075	13.286	1.02577
0.715	0.15	13.502	0.955615
0.78	-0.45	3.50678	1.14422
0.78	-0.375	6.24056	1.12539
0.78	-0.3	12.5151	1.19489
0.78	-0.225	12.9936	1.0745
0.78	-0.15	12.7516	1.07251
0.78	-0.075	12.7876	1.11564
0.78	0	12.9332	1.11862
0.78	0.075	13.15	1.03967
0.78	0.15	13.4016	0.97614
0.845	-0.45	3.48799	1.05006
0.845	-0.375	7.05711	1.23936
0.845	-0.3	12.5353	1.19194
0.845	-0.225	12.8951	1.08884
0.845	-0.15	12.7023	1.10543
0.845	-0.075	12.5465	1.13133
0.845	0	12.6817	1.15751
0.845	0.075	13.1071	1.10335
0.845	0.15	13.3484	1.05158
0.91	-0.45	3.65958	1.0212
0.91	-0.375	6.84083	1.03207
0.91	-0.3	12.6325	1.13539
0.91	-0.225	12.81	1.06716
0.91	-0.15	12.5097	1.05157
0.91	-0.075	12.4721	1.10587
0.91	0	12.6098	1.13802
0.91	0.075	12.9937	1.1114
0.91	0.15	13.3702	1.01792
0.975	-0.45	3.82238	1.1001
0.975	-0.375	5.56525	0.755872
0.975	-0.3	12.6849	1.19852
0.975	-0.225	12.7143	1.11877
0.975	-0.15	12.4617	1.09121
0.975	-0.075	12.3347	1.08103
0.975	0	12.5667	1.09368
0.975	0.075	12.9327	1.10136
0.975	0.15	13.3143	1.02952
1.04	-0.45	3.86762	1.0679
1.04	-0.375	3.90374	0.506318
1.04	-0.3	12.5111	1.21017
1.04	-0.225	12.6532	1.11312
1.04	-0.15	12.3881	1.03042
1.04	-0.075	12.2842	1.03459
1.04	0	12.5365	1.07625
1.04	0.075	12.8992	1.10428
1.04	0.15	13.3699	1.0491
1.105	-0.45	3.9013	1.07797
1.105	-0.375	3.36766	0.533806
1.105	-0.3	12.4739	1.23414

1.105	-0.225	12.7255	1.12691
1.105	-0.15	12.3645	1.02301
1.105	-0.075	12.3194	1.00479
1.105	0	12.4889	1.01085
1.105	0.075	12.8933	1.06694
1.105	0.15	13.4289	1.06791
1.17	-0.45	3.5252	1.01195
1.17	-0.375	3.00137	0.67098
1.17	-0.3	10.1398	1.23016
1.17	-0.225	12.6584	1.11482
1.17	-0.15	12.4314	1.00646
1.17	-0.075	12.4656	1.00339
1.17	0	12.6298	1.02469
1.17	0.075	13.0703	1.05038
1.17	0.15	13.6025	1.0361
1.235	-0.45	3.33108	1.02554
1.235	-0.375	3.04022	0.849316
1.235	-0.3	2.23299	0.488675
1.235	-0.225	12.5706	1.13617
1.235	-0.15	12.4043	1.03833
1.235	-0.075	12.5293	1.00518
1.235	0	12.6963	1.02364
1.235	0.075	13.249	1.08577
1.235	0.15	13.6797	1.05002
1.3	-0.45	3.02174	0.974764
1.3	-0.375	2.83472	0.868776
1.3	-0.3	2.24907	0.628227
1.3	-0.225	2.63879	0.56288
1.3	-0.15	12.5013	1.06054
1.3	-0.075	12.685	1.03808
1.3	0	12.9472	1.05605
1.3	0.075	13.3864	1.07867
1.3	0.15	13.5857	1.12599
1.365	-0.45	2.77699	0.874142
1.365	-0.375	2.55497	0.806619
1.365	-0.3	2.00085	0.586102
1.365	-0.225	0.985419	0.485169
1.365	-0.15	1.72197	0.390714
1.365	-0.075	12.5206	1.19219
1.365	0	13.0181	1.14502
1.365	0.075	13.3973	1.22707
1.365	0.15	6.62787	2.02877
1.43	-0.45	2.52277	0.837992
1.43	-0.375	2.42212	0.84967
1.43	-0.3	2.05206	0.710856
1.43	-0.225	1.07486	0.386973
1.43	-0.15	0.599842	0.218434
1.43	-0.075	0.912441	0.253357
1.43	0	0.664596	0.151083
1.43	0.075	0.656581	0.14187
1.43	0.15	0.609425	0.180825

Run ID: 051496

VR=0.499
Uo=10.65 m/s
HOLE-EXIT FSTI=12%
<u>CONFIGURATION</u>:
L/D=7.0, Open Plenum

*x=x0-0.715;z=-z0

x0(in)*	z0(in)*	Ueff (m/s)	ueff,rms (m/s)
0	-0.45	1.23819	0.484931
0	-0.375	1.11819	0.430566
0	-0.3	1.1005	0.480316
0	-0.225	0.970463	0.418713
0	-0.15	0.875425	0.393877
0	-0.075	0.812229	0.371348
0	0	0.814848	0.410158
0	0.075	0.818939	0.375731
0	0.15	0.911069	0.448798
0.065	-0.45	1.12295	0.391216
0.065	-0.375	1.13182	0.458841
0.065	-0.3	1.02389	0.449988
0.065	-0.225	0.962964	0.482921
0.065	-0.15	0.828646	0.43245
0.065	-0.075	0.676509	0.271636
0.065	0	0.621744	0.348615
0.065	0.075	0.712131	0.361596
0.065	0.15	0.818094	0.43453
0.13	-0.45	1.1994	0.470903
0.13	-0.375	1.12487	0.460929
0.13	-0.3	0.961395	0.390886
0.13	-0.225	0.837668	0.32959
0.13	-0.15	0.914813	0.491694
0.13	-0.075	1.77839	1.00779
0.13	0	2.28725	1.20587
0.13	0.075	1.69357	0.949838
0.13	0.15	1.07196	0.685517
0.195	-0.45	1.15391	0.420052
0.195	-0.375	1.06921	0.392969
0.195	-0.3	1.02072	0.436046
0.195	-0.225	1.2643	0.552635
0.195	-0.15	2.79043	1.14458
0.195	-0.075	3.84833	1.26887
0.195	0	4.24608	1.22184
0.195	0.075	4.05646	1.2583
0.195	0.15	3.13088	1.20762
0.26	-0.45	1.16839	0.408926
0.26	-0.375	1.16226	0.443431
0.26	-0.3	1.16788	0.468205
0.26	-0.225	2.90471	0.9397
0.26	-0.15	4.31584	1.16312
0.26	-0.075	4.81445	1.11694
0.26	0	5.26051	1.05697
0.26	0.075	5.26202	1.06338
0.26	0.15	4.78276	1.14045
0.325	-0.45	1.27909	0.455076
0.325	-0.375	1.45136	0.548458
0.325	-0.3	2.17643	0.674531
0.325	-0.225	4.11619	1.09341
0.325	-0.15	5.12515	1.0203
0.325	-0.075	5.60921	0.942734
0.325	0	5.86694	0.896117
0.325	0.075	5.90836	0.92379
0.325	0.15	5.69012	1.02175
0.39	-0.45	1.49708	0.532806
0.39	-0.375	1.889	0.70571
0.39	-0.3	3.73101	0.921697
0.39	-0.225	5.12129	1.07414
0.39	-0.15	5.6729	0.906323
0.39	-0.075	6.09644	0.802291
0.39	0	6.3727	0.743946
0.39	0.075	6.38257	0.773691
0.39	0.15	6.2927	0.855357
0.455	-0.45	1.76406	0.593103
0.455	-0.375	2.19843	0.72712
0.455	-0.3	4.82085	1.05016
0.455	-0.225	5.83297	1.01339
0.455	-0.15	6.16618	0.808236
0.455	-0.075	6.50833	0.728827
0.455	0	6.70915	0.642754
0.455	0.075	6.78726	0.663427
0.455	0.15	6.69229	0.723629
0.52	-0.45	2.13594	0.730762
0.52	-0.375	2.41023	0.646705
0.52	-0.3	5.63499	1.04387
0.52	-0.225	6.23106	0.871632
0.52	-0.15	6.5344	0.774921
0.52	-0.075	6.81377	0.672492
0.52	0	7.0249	0.593268
0.52	0.075	7.13532	0.529065
0.52	0.15	7.05302	0.627307
0.585	-0.45	2.54863	0.864776
0.585	-0.375	2.77287	0.666339
0.585	-0.3	6.13664	0.985168
0.585	-0.225	6.65191	0.785317
0.585	-0.15	6.92177	0.646048
0.585	-0.075	7.06162	0.589875
0.585	0	7.21614	0.523964
0.585	0.075	7.37639	0.452242
0.585	0.15	7.33528	0.516434
0.65	-0.45	2.98365	0.953815
0.65	-0.375	3.0986	0.68312
0.65	-0.3	6.46652	0.918217
0.65	-0.225	6.97168	0.707105
0.65	-0.15	7.1889	0.58257
0.65	-0.075	7.32692	0.505668
0.65	0	7.45208	0.458969
0.65	0.075	7.56878	0.438349
0.65	0.15	7.52953	0.484405
0.715	-0.45	2.37074	0.708119
0.715	-0.375	3.02997	0.590438
0.715	-0.3	6.74801	0.893248
0.715	-0.225	7.31656	0.686178
0.715	-0.15	7.43975	0.528668
0.715	-0.075	7.52121	0.496116
0.715	0	7.66569	0.469182
0.715	0.075	7.72511	0.466857
0.715	0.15	7.80537	0.443984
0.78	-0.45	2.45002	0.64981
0.78	-0.375	3.88422	0.752974
0.78	-0.3	7.11276	0.851497
0.78	-0.225	7.47125	0.62021
0.78	-0.15	7.58739	0.526875
0.78	-0.075	7.62759	0.532733
0.78	0	7.76147	0.495007
0.78	0.075	7.85442	0.480187
0.78	0.15	7.91056	0.470394
0.845	-0.45	2.70518	0.680809
0.845	-0.375	4.21676	0.712927
0.845	-0.3	7.47589	0.818442
0.845	-0.225	7.69549	0.587583
0.845	-0.15	7.70432	0.542103
0.845	-0.075	7.72204	0.546471
0.845	0	7.79342	0.520247
0.845	0.075	7.90216	0.523393
0.845	0.15	8.01795	0.476826
0.91	-0.45	2.82395	0.702432
0.91	-0.375	3.78775	0.621502
0.91	-0.3	7.71632	0.809344
0.91	-0.225	7.79186	0.598603
0.91	-0.15	7.75637	0.545742
0.91	-0.075	7.80259	0.559248
0.91	0	7.82373	0.566076
0.91	0.075	7.90841	0.548139
0.91	0.15	8.08975	0.521679
0.975	-0.45	2.9219	0.659333
0.975	-0.375	2.63779	0.336043
0.975	-0.3	7.90302	0.764737
0.975	-0.225	7.91238	0.594755
0.975	-0.15	7.77194	0.557718
0.975	-0.075	7.79087	0.552536
0.975	0	7.85756	0.5655
0.975	0.075	7.93779	0.585683
0.975	0.15	8.16359	0.531821
1.04	-0.45	3.09335	0.701414
1.04	-0.375	2.03287	0.262866
1.04	-0.3	8.07833	0.770252
1.04	-0.225	8.08899	0.608797
1.04	-0.15	7.92858	0.554431
1.04	-0.075	7.91973	0.548318
1.04	0	7.95463	0.569525
1.04	0.075	8.08396	0.555839
1.04	0.15	8.34028	0.54307
1.105	-0.45	3.01346	0.687731
1.105	-0.375	1.96721	0.276168
1.105	-0.3	8.14387	0.825446

1.105	-0.225	8.35258	0.639019
1.105	-0.15	8.08833	0.568433
1.105	-0.075	8.06557	0.547944
1.105	0	8.07939	0.557872
1.105	0.075	8.24189	0.550146
1.105	0.15	8.50286	0.532037
1.17	-0.45	2.8829	0.683407
1.17	-0.375	2.25293	0.440797
1.17	-0.3	3.57312	0.413243
1.17	-0.225	8.43942	0.677464
1.17	-0.15	8.2677	0.575635
1.17	-0.075	8.13225	0.555454
1.17	0	8.22147	0.539097
1.17	0.075	8.42503	0.557678
1.17	0.15	8.6966	0.556084
1.235	-0.45	2.70084	0.670566
1.235	-0.375	2.37271	0.581108
1.235	-0.3	1.34015	0.274335
1.235	-0.225	8.59995	0.716058
1.235	-0.15	8.50464	0.601647
1.235	-0.075	8.43901	0.54373
1.235	0	8.46999	0.549624
1.235	0.075	8.66273	0.560547
1.235	0.15	8.98042	0.587391
1.3	-0.45	2.64391	0.66783
1.3	-0.375	2.51802	0.651017
1.3	-0.3	1.60007	0.330843
1.3	-0.225	0.835223	0.277077
1.3	-0.15	8.66529	0.671567
1.3	-0.075	8.7079	0.596167
1.3	0	8.77529	0.604255
1.3	0.075	8.93184	0.613609
1.3	0.15	9.26004	0.670065
1.365	-0.45	2.57201	0.682967
1.365	-0.375	2.28699	0.652666
1.365	-0.3	1.55794	0.382405
1.365	-0.225	0.919105	0.275631
1.365	-0.15	0.584967	0.082313
1.365	-0.075	6.285	1.04794
1.365	0	8.75365	0.771311
1.365	0.075	8.69144	0.8178
1.365	0.15	1.03488	0.198396
1.43	-0.45	2.43306	0.633224
1.43	-0.375	2.19846	0.625091
1.43	-0.3	1.55059	0.474313
1.43	-0.225	0.932253	0.298932
1.43	-0.15	0.54152	0.11889
1.43	-0.075	0.625836	0.108318
1.43	0	0.599086	0.076115
1.43	0.075	0.587443	0.090010
1.43	0.15	0.543331	0.10751

Run ID: 052296

VR= 1.007
Uo=10.90 m/s
HOLE-EXIT FSTI=12%
<u>CONFIGURATION</u>:
Counter-Flow

*x=x0-0.715;z=-z0

x0(in)*	z0(in)*	Ueff (m/s)	ueff,rms (m/s)
0	-0.45	1.19078	0.414677
0	-0.375	1.11344	0.411758
0	-0.3	1.07051	0.445072
0	-0.225	0.893826	0.383271
0	-0.15	0.774441	0.335341
0	-0.075	0.673894	0.248705
0	0	0.655171	0.273683
0	0.075	0.656574	0.268921
0	0.15	0.694043	0.271837
0.065	-0.45	1.21334	0.398484
0.065	-0.375	1.14588	0.425196
0.065	-0.3	1.00179	0.377126
0.065	-0.225	0.927397	0.435951
0.065	-0.15	0.734498	0.279217
0.065	-0.075	0.678566	0.215963
0.065	0	0.768335	0.277029
0.065	0.075	0.774622	0.29833
0.065	0.15	0.680717	0.232881
0.13	-0.45	1.31405	0.487226
0.13	-0.375	1.13481	0.382116
0.13	-0.3	1.04917	0.379151
0.13	-0.225	0.914224	0.340456
0.13	-0.15	0.817555	0.189105
0.13	-0.075	10.1214	3.84252
0.13	0	13.5787	2.6086
0.13	0.075	12.7907	2.7399
0.13	0.15	7.33545	3.88755
0.195	-0.45	1.29416	0.423236
0.195	-0.375	1.1708	0.39147
0.195	-0.3	1.15432	0.413583
0.195	-0.225	0.974755	0.212299
0.195	-0.15	10.9707	3.56689
0.195	-0.075	14.9785	1.46011
0.195	0	15.1564	1.13137
0.195	0.075	15.0655	1.23164
0.195	0.15	14.8008	1.73963
0.26	-0.45	1.33191	0.428064
0.26	-0.375	1.2552	0.393189
0.26	-0.3	1.5791	0.558194
0.26	-0.225	4.41486	1.26675
0.26	-0.15	15.1202	1.53869
0.26	-0.075	15.5866	0.956164
0.26	0	15.6246	0.874108
0.26	0.075	15.5411	0.902618
0.26	0.15	15.42	1.11742
0.325	-0.45	1.5222	0.484372
0.325	-0.375	1.42824	0.430389
0.325	-0.3	1.37426	0.360527
0.325	-0.225	13.1171	2.83457
0.325	-0.15	15.6381	1.04607
0.325	-0.075	15.8635	0.828829
0.325	0	15.8466	0.855778
0.325	0.075	15.8331	0.864843
0.325	0.15	15.8045	0.950459
0.39	-0.45	1.54976	0.440337
0.39	-0.375	1.67878	0.483511
0.39	-0.3	2.39678	0.546933
0.39	-0.225	15.4747	1.54298
0.39	-0.15	15.9468	0.972105
0.39	-0.075	16.05	0.952571
0.39	0	16.0804	0.914495
0.39	0.075	16.0831	0.934282
0.39	0.15	16.0264	0.912794
0.455	-0.45	1.69803	0.462617
0.455	-0.375	1.93309	0.558685
0.455	-0.3	6.45636	1.36672
0.455	-0.225	16.4122	1.17398
0.455	-0.15	16.5769	1.00943
0.455	-0.075	16.5929	1.09575
0.455	0	16.5811	1.19191
0.455	0.075	16.5967	1.14872
0.455	0.15	16.5203	1.11498
0.52	-0.45	1.82586	0.48266
0.52	-0.375	2.41549	0.787223
0.52	-0.3	9.92681	2.19347
0.52	-0.225	16.3989	1.18428
0.52	-0.15	16.4218	1.1677
0.52	-0.075	16.3271	1.38666
0.52	0	16.2567	1.50328
0.52	0.075	16.1448	1.5764
0.52	0.15	16.2382	1.45713
0.585	-0.45	1.94697	0.510369
0.585	-0.375	2.74092	0.984956
0.585	-0.3	14.3051	2.34108
0.585	-0.225	16.3835	1.28526
0.585	-0.15	16.0779	1.63132
0.585	-0.075	15.679	2.08012
0.585	0	15.4756	2.24502
0.585	0.075	15.6023	2.17531
0.585	0.15	15.6188	2.12813
0.65	-0.45	2.09873	0.606627
0.65	-0.375	2.67871	0.895889
0.65	-0.3	15.1979	2.07032
0.65	-0.225	16.1628	1.51928
0.65	-0.15	15.5665	2.09162
0.65	-0.075	14.7174	2.78902
0.65	0	14.4941	2.93267
0.65	0.075	14.702	2.78833
0.65	0.15	14.5017	2.82302
0.715	-0.45	2.48028	0.750617
0.715	-0.375	2.75303	0.854209
0.715	-0.3	15.5208	1.83343
0.715	-0.225	15.7151	1.90273
0.715	-0.15	14.5878	2.80629
0.715	-0.075	13.6096	3.15242
0.715	0	13.1974	3.28065
0.715	0.075	13.2826	3.27115
0.715	0.15	13.3296	3.24652
0.78	-0.45	2.48488	0.758393
0.78	-0.375	2.91747	0.781348
0.78	-0.3	15.4183	1.92246
0.78	-0.225	15.1717	2.34263
0.78	-0.15	13.8043	3.15703
0.78	-0.075	12.5353	3.4434
0.78	0	11.798	3.49592
0.78	0.075	11.6158	3.44365
0.78	0.15	11.961	3.52442
0.845	-0.45	2.61278	0.788315
0.845	-0.375	3.32591	0.76487
0.845	-0.3	15.1839	1.98538
0.845	-0.225	14.4033	2.70202
0.845	-0.15	12.6401	3.33434
0.845	-0.075	11.3911	3.48304
0.845	0	10.8731	3.5313
0.845	0.075	10.3762	3.55884
0.845	0.15	10.9846	3.56118
0.91	-0.45	2.85671	0.876538
0.91	-0.375	2.97157	0.666328
0.91	-0.3	14.7778	2.18757
0.91	-0.225	13.898	2.89444
0.91	-0.15	11.7866	3.36743
0.91	-0.075	10.3303	3.38757
0.91	0	9.6013	3.23466
0.91	0.075	9.60978	3.18356
0.91	0.15	10.2637	3.37952
0.975	-0.45	2.93445	0.866526
0.975	-0.375	2.58687	0.576358
0.975	-0.3	14.2765	2.18999
0.975	-0.225	13.7132	2.68588
0.975	-0.15	11.5244	3.21532
0.975	-0.075	10.1054	3.12321
0.975	0	9.15931	2.92377
0.975	0.075	9.04757	2.95604
0.975	0.15	9.67104	3.04971
1.04	-0.45	3.62625	1.1098
1.04	-0.375	3.6118	0.939351
1.04	-0.3	13.3614	2.27579
1.04	-0.225	13.7487	2.65427
1.04	-0.15	11.3911	3.08432
1.04	-0.075	9.94573	2.89067
1.04	0	8.99648	2.64188
1.04	0.075	9.02883	2.68314
1.04	0.15	9.82996	2.80479
1.105	-0.45	2.93613	0.885981
1.105	-0.375	3.75322	1.06763
1.105	-0.3	6.96111	1.26917

1.105	-0.225	13.6737	2.60803
1.105	-0.15	12.051	2.78856
1.105	-0.075	10.009	2.64025
1.105	0	8.94455	2.40772
1.105	0.075	9.10331	2.42399
1.105	0.15	10.305	2.77495
1.17	-0.45	2.85332	0.873251
1.17	-0.375	3.57703	1.17247
1.17	-0.3	3.03457	0.552327
1.17	-0.225	13.0095	2.55618
1.17	-0.15	12.0318	2.69873
1.17	-0.075	10.3419	2.5699
1.17	0	9.45211	2.26553
1.17	0.075	9.56144	2.35664
1.17	0.15	10.5632	2.53334
1.235	-0.45	2.614	0.825922
1.235	-0.375	3.04891	1.06487
1.235	-0.3	2.61411	0.764937
1.235	-0.225	8.15172	1.59765
1.235	-0.15	12.3882	2.65301
1.235	-0.075	10.7643	2.37677
1.235	0	10.0384	2.17807
1.235	0.075	10.3045	2.25338
1.235	0.15	11.414	2.48032
1.3	-0.45	2.78734	0.952706
1.3	-0.375	3.23362	1.15615
1.3	-0.3	2.44613	0.945824
1.3	-0.225	1.5837	0.607042
1.3	-0.15	11.5044	2.54896
1.3	-0.075	11.269	2.34925
1.3	0	10.6627	2.09344
1.3	0.075	11.1295	2.22229
1.3	0.15	11.9406	2.51831
1.365	-0.45	2.64113	0.899724
1.365	-0.375	2.71299	1.06366
1.365	-0.3	2.23911	0.971799
1.365	-0.225	1.62463	0.687696
1.365	-0.15	0.821599	0.335254
1.365	-0.075	8.13066	2.11098
1.365	0	10.7911	2.12852
1.365	0.075	11.5864	2.39292
1.365	0.15	9.53198	2.34823
1.43	-0.45	2.12884	0.779093
1.43	-0.375	2.1186	0.881464
1.43	-0.3	2.13892	1.01794
1.43	-0.225	1.63809	0.816422
1.43	-0.15	1.04318	0.462822
1.43	-0.075	1.19469	0.683542
1.43	0	0.948602	0.466497
1.43	0.075	0.871282	0.40712
1.43	0.15	0.943601	0.518187

Run ID: 052996

VR=0.494
Uo=10.62 m/s
HOLE-EXIT FSTI=12%
CONFIGURATION:
Counter-flow

*x=x0-0.715;z=-z0

x0(in)*	z0(in)*	Ueff (m/s)	ueff,rms (m/s)
0	-0.45	1.3524	0.537265
0	-0.375	1.17392	0.456797
0	-0.3	1.22681	0.5405
0	-0.225	1.07903	0.479662
0	-0.15	0.980408	0.498106
0	-0.075	0.822765	0.41365
0	0	0.763449	0.368987
0	0.075	0.79618	0.405463
0	0.15	0.886239	0.459212
0.065	-0.45	1.38174	0.560006
0.065	-0.375	1.29379	0.556193
0.065	-0.3	1.15678	0.517793
0.065	-0.225	0.99065	0.462787
0.065	-0.15	0.834312	0.387328
0.065	-0.075	0.739051	0.395433
0.065	0	0.637716	0.259174
0.065	0.075	0.662324	0.332974
0.065	0.15	0.749298	0.400921
0.13	-0.45	1.33397	0.515562
0.13	-0.375	1.18573	0.457149
0.13	-0.3	1.13258	0.488898
0.13	-0.225	0.987953	0.471556
0.13	-0.15	0.771411	0.298409
0.13	-0.075	2.00388	1.39865
0.13	0	4.19827	2.06496
0.13	0.075	3.17142	1.8001
0.13	0.15	1.23248	0.748268
0.195	-0.45	1.37048	0.52222
0.195	-0.375	1.19476	0.452935
0.195	-0.3	1.09048	0.395164
0.195	-0.225	0.976999	0.360319
0.195	-0.15	3.37206	1.49196
0.195	-0.075	6.44742	1.3742
0.195	0	6.69012	1.20476
0.195	0.075	6.59175	1.23049
0.195	0.15	6.04683	1.59035
0.26	-0.45	1.38047	0.494604
0.26	-0.375	1.20624	0.415067
0.26	-0.3	1.2641	0.482873
0.26	-0.225	2.78077	0.804395
0.26	-0.15	6.75547	1.29824
0.26	-0.075	7.30982	0.864793
0.26	0	7.34085	0.76341
0.26	0.075	7.30801	0.807348
0.26	0.15	7.15893	0.964939
0.325	-0.45	1.45216	0.518383
0.325	-0.375	1.29223	0.418116
0.325	-0.3	1.52419	0.528885
0.325	-0.225	5.88976	1.4647
0.325	-0.15	7.53273	0.836274
0.325	-0.075	7.65151	0.63965
0.325	0	7.68455	0.616241
0.325	0.075	7.62255	0.683448
0.325	0.15	7.58825	0.692691
0.39	-0.45	1.44	0.480996
0.39	-0.375	1.39865	0.427597
0.39	-0.3	2.42292	0.615507
0.39	-0.225	7.33191	1.10002
0.39	-0.15	7.79162	0.679076
0.39	-0.075	7.90609	0.568953
0.39	0	7.90399	0.600844
0.39	0.075	7.91417	0.593226
0.39	0.15	7.85036	0.583943
0.455	-0.45	1.51678	0.444407
0.455	-0.375	1.82373	0.668586
0.455	-0.3	4.78002	0.910705
0.455	-0.225	8.02431	0.815662
0.455	-0.15	8.15361	0.556006
0.455	-0.075	8.20924	0.535539
0.455	0	8.19593	0.55212
0.455	0.075	8.15975	0.557698
0.455	0.15	8.13778	0.57665
0.52	-0.45	1.63583	0.483192
0.52	-0.375	2.19498	0.826375
0.52	-0.3	6.37367	1.23254
0.52	-0.225	8.20504	0.686827
0.52	-0.15	8.289	0.556881
0.52	-0.075	8.26959	0.541569
0.52	0	8.27452	0.597912
0.52	0.075	8.28194	0.593646
0.52	0.15	8.2429	0.576868
0.585	-0.45	1.8442	0.577098
0.585	-0.375	2.4773	0.8585
0.585	-0.3	7.32192	1.23375
0.585	-0.225	8.35325	0.608432
0.585	-0.15	8.32605	0.60444
0.585	-0.075	8.23972	0.697306
0.585	0	8.24598	0.693409
0.585	0.075	8.20483	0.724092
0.585	0.15	8.24856	0.702008
0.65	-0.45	2.06894	0.730493
0.65	-0.375	2.71198	0.810441
0.65	-0.3	7.80034	1.10242
0.65	-0.225	8.36255	0.689949
0.65	-0.15	8.24046	0.720036
0.65	-0.075	8.19062	0.802711
0.65	0	8.14052	0.852601
0.65	0.075	8.12441	0.883072
0.65	0.15	8.14234	0.862817
0.715	-0.45	2.06536	0.744139
0.715	-0.375	2.71759	0.773967
0.715	-0.3	8.07443	0.998041
0.715	-0.225	8.3185	0.73896
0.715	-0.15	8.09528	0.942192
0.715	-0.075	7.94976	1.05925
0.715	0	7.83613	1.12625
0.715	0.075	7.91307	1.06526
0.715	0.15	7.95261	1.01818
0.78	-0.45	2.26581	0.833815
0.78	-0.375	2.20313	0.569605
0.78	-0.3	8.03718	1.00557
0.78	-0.225	8.05301	0.931912
0.78	-0.15	7.69996	1.19165
0.78	-0.075	7.52039	1.29376
0.78	0	7.51984	1.33388
0.78	0.075	7.51622	1.29958
0.78	0.15	7.57544	1.26575
0.845	-0.45	2.49128	0.878896
0.845	-0.375	2.32645	0.516578
0.845	-0.3	8.07618	1.04442
0.845	-0.225	7.91129	1.09405
0.845	-0.15	7.36478	1.39183
0.845	-0.075	6.95589	1.51201
0.845	0	6.92999	1.56171
0.845	0.075	7.09255	1.4609
0.845	0.15	7.22536	1.4441
0.91	-0.45	2.81731	0.9327
0.91	-0.375	2.05544	0.42079
0.91	-0.3	8.02877	1.10209
0.91	-0.225	7.7247	1.24337
0.91	-0.15	6.9368	1.4978
0.91	-0.075	6.69877	1.6057
0.91	0	6.59046	1.58587
0.91	0.075	6.68116	1.5529
0.91	0.15	6.72454	1.56268
0.975	-0.45	2.94629	0.951605
0.975	-0.375	1.95249	0.359946
0.975	-0.3	7.97218	1.19365
0.975	-0.225	7.8011	1.21684
0.975	-0.15	6.91044	1.48362
0.975	-0.075	6.52699	1.5406
0.975	0	6.25936	1.54823
0.975	0.075	6.4747	1.58242
0.975	0.15	6.64061	1.53741
1.04	-0.45	2.95075	0.910767
1.04	-0.375	2.65454	0.551921
1.04	-0.3	7.70504	1.1929
1.04	-0.225	7.96136	1.23779
1.04	-0.15	7.03274	1.45444
1.04	-0.075	6.53617	1.52637
1.04	0	6.27463	1.42703
1.04	0.075	6.31149	1.43316
1.04	0.15	6.86943	1.50684
1.105	-0.45	2.90024	0.905567
1.105	-0.375	2.35645	0.515659
1.105	-0.3	4.85074	0.842805

1.105	-0.225	8.05211	1.25643
1.105	-0.15	7.11665	1.37589
1.105	-0.075	6.51457	1.36809
1.105	0	6.26739	1.31087
1.105	0.075	6.44933	1.35078
1.105	0.15	6.76351	1.38679
1.17	-0.45	3.16343	1.04244
1.17	-0.375	3.10204	0.935015
1.17	-0.3	1.81141	0.254516
1.17	-0.225	7.93588	1.24867
1.17	-0.15	7.43315	1.29563
1.17	-0.075	6.72187	1.2431
1.17	0	6.44808	1.17092
1.17	0.075	6.58511	1.23394
1.17	0.15	7.02341	1.27387
1.235	-0.45	2.78779	0.904159
1.235	-0.375	2.66969	0.835573
1.235	-0.3	1.98007	0.428214
1.235	-0.225	5.09733	0.895725
1.235	-0.15	7.9158	1.32188
1.235	-0.075	7.08292	1.22651
1.235	0	6.85667	1.16422
1.235	0.075	6.96496	1.19189
1.235	0.15	7.46586	1.25207
1.3	-0.45	2.83226	0.960718
1.3	-0.375	2.48969	0.850421
1.3	-0.3	1.89146	0.517481
1.3	-0.225	1.02087	0.361488
1.3	-0.15	7.61154	1.38485
1.3	-0.075	7.59152	1.24612
1.3	0	7.38139	1.11727
1.3	0.075	7.54825	1.21562
1.3	0.15	7.99854	1.29029
1.365	-0.45	2.4419	0.830673
1.365	-0.375	2.90758	0.980687
1.365	-0.3	1.94319	0.665054
1.365	-0.225	1.16087	0.322905
1.365	-0.15	0.530057	0.132296
1.365	-0.075	5.01752	1.2241
1.365	0	7.67672	1.21583
1.365	0.075	8.00628	1.29975
1.365	0.15	7.19531	1.42789
1.43	-0.45	2.41777	0.834763
1.43	-0.375	2.32501	0.782851
1.43	-0.3	1.96507	0.707831
1.43	-0.225	1.33944	0.447917
1.43	-0.15	0.672338	0.189708
1.43	-0.075	0.613987	0.256137
1.43	0	0.56938	0.145872
1.43	0.075	0.529074	0.103282
1.43	0.15	0.558285	0.17552

Run ID: 061496

VR=0.997
Uo=10.68 m/s
HOLE-EXIT FSTI=12%
<u>CONFIGURATION</u>:
Co-flow

*x=x0-0.715;z=-z0

x0(in)*	z0(in)*	Ueff (m/s)	ueff,rms (m/s)
0	-0.375	1.02106	0.406992
0	-0.3	0.875003	0.358267
0	-0.225	0.802734	0.348225
0	-0.15	0.674158	0.302283
0	-0.075	0.620234	0.247483
0	0	0.609533	0.214026
0	0.075	0.64327	0.234317
0	0.15	0.702706	0.292498
0.065	-0.45	1.0761	0.383915
0.065	-0.375	1.0039	0.385334
0.065	-0.3	0.897	0.355686
0.065	-0.225	0.753493	0.308109
0.065	-0.15	0.671587	0.266614
0.065	-0.075	0.751023	0.167968
0.065	0	0.628729	0.223557
0.065	0.075	0.850862	0.159898
0.065	0.15	0.682642	0.270237
0.13	-0.45	1.27398	0.482512
0.13	-0.375	1.16055	0.471099
0.13	-0.3	1.04892	0.461292
0.13	-0.225	0.835792	0.301358
0.13	-0.15	1.73484	0.685148
0.13	-0.075	12.3316	1.62285
0.13	0	12.9349	1.13278
0.13	0.075	11.192	1.72229
0.13	0.15	2.76853	1.26522
0.195	-0.45	1.21753	0.428698
0.195	-0.375	1.08467	0.377922
0.195	-0.3	1.11928	0.414841
0.195	-0.225	2.33405	0.73401
0.195	-0.15	13.2408	1.14221
0.195	-0.075	13.6226	0.713544
0.195	0	13.6069	0.692412
0.195	0.075	13.5751	0.779039
0.195	0.15	13.2276	1.13525
0.26	-0.45	1.27739	0.406372
0.26	-0.375	1.30098	0.439903
0.26	-0.3	1.3207	0.225987
0.26	-0.225	12.0005	2.01746
0.26	-0.15	13.7928	0.750207
0.26	-0.075	13.8752	0.766175
0.26	0	13.8247	0.777098
0.26	0.075	13.8008	0.777983
0.26	0.15	13.7761	0.785148
0.325	-0.45	1.38679	0.439462
0.325	-0.375	1.76611	0.568001
0.325	-0.3	3.38101	0.876721
0.325	-0.225	13.8217	1.00036
0.325	-0.15	13.9565	0.847005
0.325	-0.075	13.9484	0.885331
0.325	0	13.9314	0.940792
0.325	0.075	13.9521	0.924644
0.325	0.15	13.913	0.819958
0.39	-0.45	1.55524	0.456249
0.39	-0.375	1.64903	0.580415
0.39	-0.3	10.5143	2.20423
0.39	-0.225	14.1079	0.886525
0.39	-0.15	14.0085	0.988409
0.39	-0.075	13.936	1.14629
0.39	0	13.9158	1.16838
0.39	0.075	13.9339	1.10066
0.39	0.15	14.0063	0.971825
0.455	-0.45	1.68247	0.471485
0.455	-0.375	1.703	0.591663
0.455	-0.3	13.1077	1.66928
0.455	-0.225	14.0816	0.990779
0.455	-0.15	13.9083	1.26795
0.455	-0.075	13.6863	1.52333
0.455	0	13.6135	1.58975
0.455	0.075	13.7655	1.46758
0.455	0.15	13.8975	1.25671
0.52	-0.45	2.01711	0.603561
0.52	-0.375	2.06154	0.553356
0.52	-0.3	13.9477	1.26086
0.52	-0.225	14.0376	1.25086
0.52	-0.15	13.6982	1.62232
0.52	-0.075	13.3494	2.0058
0.52	0	13.3817	1.94467
0.52	0.075	13.5174	1.82485
0.52	0.15	13.7954	1.53201
0.585	-0.45	2.40654	0.755768
0.585	-0.375	3.43068	0.855478
0.585	-0.3	14.17	1.2192
0.585	-0.225	13.8147	1.59035
0.585	-0.15	13.3115	2.16813
0.585	-0.075	12.8417	2.40883
0.585	0	12.7175	2.56014
0.585	0.075	12.8038	2.56475
0.585	0.15	13.3532	2.07631
0.65	-0.45	2.54388	0.877918
0.65	-0.375	4.08564	0.918311
0.65	-0.3	14.1189	1.29812
0.65	-0.225	13.5161	2.01023
0.65	-0.15	12.6137	2.61266
0.65	-0.075	12.0762	2.78043
0.65	0	11.7771	2.92972
0.65	0.075	12.1183	2.79925
0.65	0.15	12.7749	2.48429
0.715	-0.45	2.93095	1.04013
0.715	-0.375	5.76897	1.23547
0.715	-0.3	13.9631	1.57402
0.715	-0.225	13.0644	2.30891
0.715	-0.15	11.8905	2.95088
0.715	-0.075	11.1151	3.07723
0.715	0	10.9009	3.06182
0.715	0.075	11.4061	2.96577
0.715	0.15	12.2778	2.77166
0.78	-0.45	2.89686	0.98393
0.78	-0.375	6.99767	1.59819
0.78	-0.3	13.7163	1.73781
0.78	-0.225	12.5513	2.58511
0.78	-0.15	11.2576	2.98725
0.78	-0.075	10.4016	3.06749
0.78	0	10.2117	2.95594
0.78	0.075	10.4934	2.99104
0.78	0.15	11.6139	2.91275
0.845	-0.45	3.39425	1.07673
0.845	-0.375	7.03193	1.53497
0.845	-0.3	13.5618	1.85771
0.845	-0.225	12.0902	2.73695
0.845	-0.15	10.6335	2.93887
0.845	-0.075	9.8042	2.88564
0.845	0	9.56099	2.76762
0.845	0.075	10.0398	2.87192
0.845	0.15	11.0053	2.91327
0.91	-0.45	3.48152	1.04916
0.91	-0.375	7.58958	1.4405
0.91	-0.3	13.4028	1.99625
0.91	-0.225	11.8593	2.75982
0.91	-0.15	10.3414	2.86046
0.91	-0.075	9.54138	2.64559
0.91	0	9.36859	2.55019
0.91	0.075	9.94948	2.65431
0.91	0.15	10.9613	2.82376
0.975	-0.45	3.57021	1.03581
0.975	-0.375	5.60634	0.858715
0.975	-0.3	13.4769	2.02981
0.975	-0.225	11.9475	2.62539
0.975	-0.15	10.4236	2.72052
0.975	-0.075	9.66794	2.4585
0.975	0	9.41592	2.32893
0.975	0.075	9.83686	2.51587
0.975	0.15	10.975	2.71591
1.04	-0.45	3.70277	1.08623
1.04	-0.375	2.92573	0.411566
1.04	-0.3	13.6882	1.9209
1.04	-0.225	12.2116	2.5111
1.04	-0.15	10.6733	2.60195
1.04	-0.075	9.90901	2.33365
1.04	0	9.71158	2.27927
1.04	0.075	10.2611	2.45082
1.04	0.15	11.3739	2.58636
1.105	-0.45	3.7803	1.13525
1.105	-0.375	2.97197	0.553357
1.105	-0.3	13.2759	1.90578
1.105	-0.225	12.6262	2.30491

1.105	-0.15	11.1359	2.47508
1.105	-0.075	10.3067	2.32407
1.105	0	10.2227	2.18404
1.105	0.075	10.7375	2.25182
1.105	0.15	11.7346	2.47025
1.17	-0.45	4.23814	1.276
1.17	-0.375	3.63117	1.03125
1.17	-0.3	9.62731	1.48152
1.17	-0.225	13.317	2.10209
1.17	-0.15	11.7838	2.32496
1.17	-0.075	10.9162	2.21514
1.17	0	10.7499	2.1519
1.17	0.075	11.2632	2.20685
1.17	0.15	12.6082	2.2189
1.235	-0.45	3.05569	1.0079
1.235	-0.375	3.31313	1.14907
1.235	-0.3	2.10196	0.500363
1.235	-0.225	13.2722	2.05713
1.235	-0.15	12.5159	2.14066
1.235	-0.075	11.6552	2.0953
1.235	0	11.3108	2.05182
1.235	0.075	11.9575	2.15872
1.235	0.15	13.1607	2.09004
1.3	-0.45	2.87522	0.987171
1.3	-0.375	3.00292	1.12383
1.3	-0.3	2.24645	0.791479
1.3	-0.225	2.07131	0.614644
1.3	-0.15	12.2615	2.00284
1.3	-0.075	12.3542	2.01978
1.3	0	12.213	1.95509
1.3	0.075	12.636	1.97554
1.3	0.15	13.5476	2.11608
1.365	-0.45	2.52069	0.944472
1.365	-0.375	2.6639	1.09503
1.365	-0.3	2.09694	0.902254
1.365	-0.225	1.27922	0.524886
1.365	-0.15	0.757866	0.205382
1.365	-0.075	11.6109	2.02999
1.365	0	11.9682	1.94921
1.365	0.075	12.4312	2.10681
1.365	0.15	1.28184	0.48344
1.43	-0.45	2.24197	0.872006
1.43	-0.375	2.27039	0.975884
1.43	-0.3	2.01956	1.01137
1.43	-0.225	1.18969	0.531545
1.43	-0.15	0.88719	0.465775
1.43	-0.075	0.91105	0.504871
1.43	0	0.818963	0.370953
1.43	0.075	0.735204	0.336394
1.43	0.15	0.790615	0.378975

Run ID: 061796

VR=0.496
Uo=10.66 m/s
HOLE-EXIT FSTI=12%
<u>CONFIGURATION</u>:
Co-flow

*x=x0-0.715;z=-z0

x0(in)*	z0(in)*	Ueff (m/s)	ueff,rms (m/s)
0	-0.375	1.14817	0.462927
0	-0.3	1.06196	0.457619
0	-0.225	0.94857	0.431195
0	-0.15	0.881461	0.451074
0	-0.075	0.756278	0.405355
0	0	0.681712	0.353271
0	0.075	0.719048	0.373415
0	0.15	0.777948	0.385927
0.065	-0.45	1.23535	0.504739
0.065	-0.375	1.17027	0.483163
0.065	-0.3	1.01179	0.420041
0.065	-0.225	0.919942	0.437514
0.065	-0.15	0.798817	0.392177
0.065	-0.075	0.632917	0.194045
0.065	0	0.467687	0.175414
0.065	0.075	0.595513	0.321692
0.065	0.15	0.719693	0.399627
0.13	-0.45	1.26901	0.49282
0.13	-0.375	1.19071	0.49355
0.13	-0.3	0.984111	0.427391
0.13	-0.225	0.891972	0.394989
0.13	-0.15	0.656069	0.254994
0.13	-0.075	3.15087	1.60617
0.13	0	4.79139	1.43236
0.13	0.075	3.8784	1.41333
0.13	0.15	1.57778	0.936272
0.195	-0.45	1.26037	0.487086
0.195	-0.375	1.28002	0.539303
0.195	-0.3	1.12878	0.502476
0.195	-0.225	0.858807	0.253477
0.195	-0.15	4.11752	1.44341
0.195	-0.075	6.273	0.847584
0.195	0	6.49848	0.653313
0.195	0.075	6.40849	0.722089
0.195	0.15	6.04711	1.009
0.26	-0.45	1.26907	0.463211
0.26	-0.375	1.2371	0.472225
0.26	-0.3	1.20854	0.475192
0.26	-0.225	3.20191	0.881454
0.26	-0.15	6.5859	0.822558
0.26	-0.075	6.875	0.536206
0.26	0	6.90436	0.49053
0.26	0.075	6.87198	0.529538
0.26	0.15	6.81681	0.597259
0.325	-0.45	1.35716	0.484969
0.325	-0.375	1.29103	0.422214
0.325	-0.3	1.30112	0.289626
0.325	-0.225	6.10917	1.15951
0.325	-0.15	7.08716	0.524348
0.325	-0.075	7.12343	0.497237
0.325	0	7.15152	0.475739
0.325	0.075	7.14839	0.488419
0.325	0.15	7.12385	0.497536
0.39	-0.45	1.42403	0.457513
0.39	-0.375	1.45776	0.486956
0.39	-0.3	2.79482	0.64849
0.39	-0.225	7.13743	0.754565
0.39	-0.15	7.29407	0.514121
0.39	-0.075	7.31389	0.510197
0.39	0	7.33336	0.498292
0.39	0.075	7.32542	0.517789
0.39	0.15	7.29677	0.532591
0.455	-0.45	1.59941	0.507107
0.455	-0.375	2.17574	0.795681
0.455	-0.3	4.84197	0.956556
0.455	-0.225	7.44404	0.609056
0.455	-0.15	7.43881	0.526319
0.455	-0.075	7.43058	0.572825
0.455	0	7.42511	0.578791
0.455	0.075	7.44511	0.5443
0.455	0.15	7.42403	0.564353
0.52	-0.45	1.7158	0.519874
0.52	-0.375	1.99946	0.715897
0.52	-0.3	6.49067	1.17288
0.52	-0.225	7.53362	0.596427
0.52	-0.15	7.49895	0.596503
0.52	-0.075	7.43221	0.719828
0.52	0	7.4335	0.687136
0.52	0.075	7.45791	0.688788
0.52	0.15	7.51206	0.634469
0.585	-0.45	1.86853	0.624815
0.585	-0.375	2.34165	0.693229
0.585	-0.3	7.315	0.943343
0.585	-0.225	7.66013	0.578721
0.585	-0.15	7.52012	0.713515
0.585	-0.075	7.41629	0.858263
0.585	0	7.36275	0.910132
0.585	0.075	7.44062	0.840196
0.585	0.15	7.50678	0.795635
0.65	-0.45	2.09129	0.751459
0.65	-0.375	2.43277	0.62946
0.65	-0.3	7.62802	0.845324
0.65	-0.225	7.71185	0.676999
0.65	-0.15	7.4414	0.906671
0.65	-0.075	7.32401	1.05529
0.65	0	7.20117	1.11185
0.65	0.075	7.23411	1.10611
0.65	0.15	7.39328	0.995816
0.715	-0.45	2.34465	0.878558
0.715	-0.375	2.65229	0.719803
0.715	-0.3	7.76679	0.783502
0.715	-0.225	7.66634	0.804354
0.715	-0.15	7.38517	1.0704
0.715	-0.075	7.07685	1.2586
0.715	0	7.00253	1.30951
0.715	0.075	7.02623	1.28714
0.715	0.15	7.26214	1.15772
0.78	-0.45	2.78559	1.00436
0.78	-0.375	2.85119	0.723656
0.78	-0.3	7.85046	0.851059
0.78	-0.225	7.56457	1.03669
0.78	-0.15	7.27048	1.23167
0.78	-0.075	6.87805	1.34893
0.78	0	6.69985	1.43097
0.78	0.075	6.78228	1.45041
0.78	0.15	7.08732	1.26967
0.845	-0.45	3.07815	1.01064
0.845	-0.375	3.0618	0.65662
0.845	-0.3	7.94912	0.87017
0.845	-0.225	7.57494	1.11011
0.845	-0.15	7.1675	1.28382
0.845	-0.075	6.67006	1.43875
0.845	0	6.41196	1.4276
0.845	0.075	6.5526	1.43585
0.845	0.15	6.96611	1.35942
0.91	-0.45	3.05727	0.977888
0.91	-0.375	2.06455	0.380027
0.91	-0.3	8.10139	0.908806
0.91	-0.225	7.6127	1.13791
0.91	-0.15	6.93721	1.40817
0.91	-0.075	6.49495	1.42954
0.91	0	6.1828	1.39594
0.91	0.075	6.3793	1.39156
0.91	0.15	6.76958	1.38951
0.975	-0.45	3.11921	0.921524
0.975	-0.375	1.82279	0.279989
0.975	-0.3	8.20038	0.993934
0.975	-0.225	7.67492	1.20302
0.975	-0.15	6.79077	1.40027
0.975	-0.075	6.45304	1.30765
0.975	0	6.17618	1.29379
0.975	0.075	6.29293	1.33675
0.975	0.15	6.78675	1.33363
1.04	-0.45	3.20748	0.929038
1.04	-0.375	2.37867	0.364084
1.04	-0.3	8.44352	1.00543
1.04	-0.225	7.90681	1.16187
1.04	-0.15	7.14847	1.34747
1.04	-0.075	6.53823	1.2822
1.04	0	6.30446	1.22876
1.04	0.075	6.50806	1.2176
1.04	0.15	6.96708	1.27516
1.105	-0.45	3.09415	0.863949
1.105	-0.375	2.5294	0.515131
1.105	-0.3	6.67549	0.939913
1.105	-0.225	8.29643	1.06479

1.105	-0.15	7.37276	1.23739
1.105	-0.075	6.7557	1.21215
1.105	0	6.56828	1.14034
1.105	0.075	6.69112	1.17518
1.105	0.15	7.35953	1.20192
1.17	-0.45	3.07102	0.904316
1.17	-0.375	2.56193	0.698461
1.17	-0.3	2.06848	0.273521
1.17	-0.225	8.61211	1.06274
1.17	-0.15	7.95344	1.2101
1.17	-0.075	7.32711	1.19234
1.17	0	7.00415	1.10007
1.17	0.075	7.20883	1.16552
1.17	0.15	7.69839	1.18876
1.235	-0.45	3.45314	1.07113
1.235	-0.375	2.89062	0.893146
1.235	-0.3	1.95158	0.401259
1.235	-0.225	7.83067	1.02954
1.235	-0.15	8.45723	1.14509
1.235	-0.075	7.78358	1.18321
1.235	0	7.5552	1.09357
1.235	0.075	7.74923	1.13372
1.235	0.15	8.24795	1.14216
1.3	-0.45	2.99664	0.946242
1.3	-0.375	2.70064	0.879659
1.3	-0.3	2.00969	0.508767
1.3	-0.225	0.961844	0.3233
1.3	-0.15	8.54298	1.17402
1.3	-0.075	8.41411	1.1263
1.3	0	8.1482	1.08229
1.3	0.075	8.27795	1.11687
1.3	0.15	8.7994	1.14324
1.365	-0.45	2.73622	0.897012
1.365	-0.375	2.62946	0.911246
1.365	-0.3	2.06424	0.663226
1.365	-0.225	1.15695	0.309987
1.365	-0.15	0.562864	0.146241
1.365	-0.075	5.16522	1.08188
1.365	0	8.49037	1.13603
1.365	0.075	8.60101	1.15355
1.365	0.15	4.17359	1.09434
1.43	-0.45	2.65729	0.911034
1.43	-0.375	2.37992	0.822637
1.43	-0.3	2.10561	0.763701
1.43	-0.225	1.25085	0.420164
1.43	-0.15	0.636759	0.205433
1.43	-0.075	0.689907	0.272665
1.43	0	0.60489	0.146383
1.43	0.075	0.567777	0.132744
1.43	0.15	0.546251	0.162896

Run ID: 090796a

Uhole=5.49m/s
HOLE-EXIT, NO FREESTREAM
CONFIGURATION:
L/D=2.3, Open Plenum

*x=x0-0.715;z=-z0

x0(in)*	z0(in)*	Ueff (m/s)	ueff,rms (m/s)
0	-0.45	0.24383	0.012728
0	-0.375	0.255398	0.019182
0	-0.3	0.245937	0.013681
0	-0.225	0.248124	0.015745
0	-0.15	0.25026	0.014522
0	-0.075	0.258454	0.012757
0	0	0.259538	0.012804
0	0.075	0.257708	0.012964
0	0.15	0.253711	0.011257
0.065	-0.45	0.252473	0.016479
0.065	-0.375	0.253297	0.021266
0.065	-0.3	0.251995	0.018770
0.065	-0.225	0.24996	0.016022
0.065	-0.15	0.256551	0.016398
0.065	-0.075	0.28361	0.017400
0.065	0	0.304773	0.015262
0.065	0.075	0.290706	0.013920
0.065	0.15	0.275461	0.016347
0.13	-0.45	0.263328	0.018467
0.13	-0.375	0.264374	0.020068
0.13	-0.3	0.261601	0.022934
0.13	-0.225	0.264869	0.023021
0.13	-0.15	0.342273	0.033744
0.13	-0.075	2.50696	0.519765
0.13	0	6.47971	0.741381
0.13	0.075	5.117	0.754165
0.13	0.15	0.8224	0.128989
0.195	-0.45	0.276314	0.028324
0.195	-0.375	0.272489	0.029704
0.195	-0.3	0.287569	0.031370
0.195	-0.225	0.323281	0.042766
0.195	-0.15	3.96873	0.732982
0.195	-0.075	7.95679	0.196076
0.195	0	8.0136	0.164951
0.195	0.075	7.97435	0.213387
0.195	0.15	7.66614	0.349889
0.26	-0.45	0.281065	0.029693
0.26	-0.375	0.285943	0.033214
0.26	-0.3	0.284529	0.044837
0.26	-0.225	1.07088	0.189375
0.26	-0.15	7.87781	0.309434
0.26	-0.075	8.06498	0.121455
0.26	0	8.0761	0.124276
0.26	0.075	8.0778	0.114185
0.26	0.15	8.04958	0.123432
0.325	-0.45	0.319659	0.045214
0.325	-0.375	0.323444	0.053564
0.325	-0.3	0.38106	0.082836
0.325	-0.225	6.17332	0.886476
0.325	-0.15	8.0463	0.165551
0.325	-0.075	8.09575	0.15568
0.325	0	8.09862	0.159743
0.325	0.075	8.09266	0.150779
0.325	0.15	8.06504	0.145625
0.39	-0.45	0.358994	0.053740
0.39	-0.375	0.386695	0.070309
0.39	-0.3	0.713144	0.105639
0.39	-0.225	7.91992	0.29041
0.39	-0.15	8.08491	0.191377
0.39	-0.075	8.10709	0.230221
0.39	0	8.11496	0.225807
0.39	0.075	8.10222	0.22368
0.39	0.15	8.08748	0.214209
0.455	-0.45	0.391733	0.073276
0.455	-0.375	0.449431	0.112239
0.455	-0.3	2.77533	0.757136
0.455	-0.225	8.01233	0.296332
0.455	-0.15	8.08159	0.290014
0.455	-0.075	8.09168	0.325763
0.455	0	8.10285	0.38723
0.455	0.075	8.09553	0.352449
0.455	0.15	8.08285	0.313079
0.52	-0.45	0.472787	0.102659
0.52	-0.375	0.535192	0.164985
0.52	-0.3	5.15963	1.12525
0.52	-0.225	8.05522	0.329847
0.52	-0.15	8.0859	0.398051
0.52	-0.075	8.03224	0.511907
0.52	0	8.01166	0.594981
0.52	0.075	8.00891	0.536378
0.52	0.15	8.03037	0.44628
0.585	-0.45	0.540354	0.144378
0.585	-0.375	0.673519	0.261267
0.585	-0.3	7.02801	0.756571
0.585	-0.225	7.99568	0.446754
0.585	-0.15	7.91758	0.64221
0.585	-0.075	7.64338	0.879073
0.585	0	7.4799	0.988947
0.585	0.075	7.55399	0.893625
0.585	0.15	7.81295	0.724561
0.65	-0.45	0.586574	0.175981
0.65	-0.375	0.809972	0.33585
0.65	-0.3	7.49185	0.677564
0.65	-0.225	7.93952	0.600675
0.65	-0.15	7.50151	0.935839
0.65	-0.075	6.87905	1.26617
0.65	0	6.572	1.33708
0.65	0.075	6.75424	1.29244
0.65	0.15	7.29029	1.05661
0.715	-0.45	0.640475	0.216396
0.715	-0.375	0.969975	0.383344
0.715	-0.3	7.58856	0.751766
0.715	-0.225	7.6967	0.832976
0.715	-0.15	6.86531	1.26475
0.715	-0.075	5.91655	1.50314
0.715	0	5.52162	1.51785
0.715	0.075	5.64968	1.50021
0.715	0.15	6.50776	1.34978
0.78	-0.45	0.706534	0.246797
0.78	-0.375	1.25174	0.486191
0.78	-0.3	7.5664	0.910477
0.78	-0.225	7.17158	1.15465
0.78	-0.15	5.74462	1.52152
0.78	-0.075	4.6681	1.51191
0.78	0	4.36845	1.48378
0.78	0.075	4.49608	1.53264
0.78	0.15	5.52342	1.50601
0.845	-0.45	0.743322	0.27307
0.845	-0.375	1.6586	0.702569
0.845	-0.3	7.29825	1.10896
0.845	-0.225	6.86244	1.33257
0.845	-0.15	5.21316	1.55582
0.845	-0.075	4.0283	1.41938
0.845	0	3.53905	1.30382
0.845	0.075	3.88753	1.37055
0.845	0.15	4.87161	1.47847
0.91	-0.45	0.786934	0.277442
0.91	-0.375	1.76763	0.633221
0.91	-0.3	6.8987	1.22702
0.91	-0.225	6.34666	1.42966
0.91	-0.15	4.49429	1.45445
0.91	-0.075	3.5091	1.25585
0.91	0	3.22453	1.17226
0.91	0.075	3.47937	1.21987
0.91	0.15	4.4346	1.39321
0.975	-0.45	0.805529	0.284347
0.975	-0.375	1.66194	0.650474
0.975	-0.3	6.46886	1.25933
0.975	-0.225	5.87595	1.43125
0.975	-0.15	4.1881	1.41498
0.975	-0.075	3.16506	1.10844
0.975	0	2.96576	0.98657
0.975	0.075	3.22049	1.09739
0.975	0.15	4.25707	1.31221
1.04	-0.45	0.853419	0.308067
1.04	-0.375	1.47588	0.567073
1.04	-0.3	5.98899	1.3141
1.04	-0.225	5.77615	1.39564
1.04	-0.15	4.04108	1.27546
1.04	-0.075	3.16943	1.00276
1.04	0	2.945	0.84739
1.04	0.075	3.30481	1.0123
1.04	0.15	4.3125	1.27703
1.105	-0.45	0.859466	0.290038
1.105	-0.375	1.19575	0.483389
1.105	-0.3	5.4909	1.27966

1.105	-0.225	5.66251	1.20948
1.105	-0.15	4.30207	1.20061
1.105	-0.075	3.38475	0.911313
1.105	0	3.17177	0.841993
1.105	0.075	3.55907	1.00079
1.105	0.15	4.53083	1.19259
1.17	-0.45	0.851768	0.275893
1.17	-0.375	1.10848	0.45866
1.17	-0.3	4.03084	1.1519
1.17	-0.225	5.57044	1.13033
1.17	-0.15	4.49418	1.09729
1.17	-0.075	3.65886	0.90525
1.17	0	3.47404	0.822404
1.17	0.075	3.85626	0.978974
1.17	0.15	4.9257	1.15223
1.235	-0.45	0.81402	0.253027
1.235	-0.375	1.03667	0.394293
1.235	-0.3	1.88591	0.856154
1.235	-0.225	5.26625	1.11938
1.235	-0.15	4.85355	1.02779
1.235	-0.075	4.03563	0.88687
1.235	0	3.74426	0.762733
1.235	0.075	4.31484	0.960432
1.235	0.15	5.2625	1.06531
1.3	-0.45	0.769006	0.264678
1.3	-0.375	0.989286	0.385631
1.3	-0.3	1.26823	0.627479
1.3	-0.225	3.66212	1.06198
1.3	-0.15	4.82655	0.971799
1.3	-0.075	4.25745	0.814333
1.3	0	3.97342	0.770912
1.3	0.075	4.54914	0.923843
1.3	0.15	5.23241	0.996833
1.365	-0.45	0.753513	0.251546
1.365	-0.375	0.894427	0.336001
1.365	-0.3	1.09561	0.50648
1.365	-0.225	1.34686	0.745283
1.365	-0.15	2.96903	1.01823
1.365	-0.075	4.17865	0.866554
1.365	0	4.11115	0.754568

Run ID: 090796a

Uhole=10.84m/s
HOLE-EXIT, NO FREESTREAM
<u>CONFIGURATION</u>:
L/D=2.3, Open Plenum

*x=x0-0.715;z=0
Note: Only Hole Centerline Data is Presented

x0(in)*	Ueff (m/s)	ueff,rms (m/s)
0.0	0.364826	0.018888
0.065	0.429792	0.029305
0.13	13.3338	1.70797
0.195	15.7045	0.259376
0.260	15.7964	0.253179
0.325	15.8426	0.354687
0.39	15.8398	0.525839
0.455	15.8499	0.776972
0.520	15.5816	1.19089
0.585	14.7544	1.86537
0.650	12.9132	2.60217
0.715	10.4137	2.99223
0.78	8.55516	2.92404
0.845	6.89299	2.61549
0.910	6.00157	2.19688
0.975	5.6645	1.94148
1.040	5.71682	1.77588
1.105	6.1696	1.73644
1.17	6.62856	1.70648
1.235	7.23202	1.65474
1.30	7.81682	1.5953
1.365	8.2886	1.53378
1.43	1.72617	1.06587

Run ID: 092196a

VR=0.507 Uo=10.76 m/s
ADIABATIC EFFECTIVENESS,
FSTI=12%
CONFIGURATION:
OPEN PLENUM/SHORT-HOLE

x/D	z(in)	Tinf(C)	Tjet(C)	Taw(C)	Eta
1.25	-1.125	25.92523	36.78527	26.23379	0.028412
1.25	-0.875	25.92686	36.78607	26.39286	0.042912
1.25	-0.750	25.88195	36.76603	26.73463	0.078342
1.25	-0.625	25.83541	36.76282	27.65970	0.166946
1.25	-0.500	25.84439	36.75159	29.18879	0.306623
1.25	-0.375	25.89910	36.76683	30.16299	0.392344
1.25	-0.313	25.92931	36.74277	30.84385	0.454483
1.25	-0.250	25.87869	36.75239	31.64649	0.530436
1.25	-0.188	25.89747	36.75159	32.10813	0.572194
1.25	-0.125	25.89175	36.76442	32.59942	0.616929
1.25	-0.063	25.90645	36.76522	32.93970	0.647702
1.25	0.0	25.98973	36.74838	33.00769	0.652308
1.25	0.0625	25.95789	36.73475	32.88844	0.643095
1.25	0.125	25.93993	36.76202	32.32556	0.590055
1.25	0.188	25.89992	36.80051	31.98086	0.557854
1.25	0.250	25.96769	36.79490	31.55116	0.515689
1.25	0.313	25.99953	36.81093	30.97341	0.460059
1.25	0.375	25.99300	36.81254	30.43174	0.410253
1.25	0.500	26.01994	36.81574	28.94503	0.270947
1.25	0.625	25.98075	36.83579	27.38621	0.129475
1.25	0.750	26.02729	36.84541	26.55656	0.048000
1.25	0.875	26.00443	36.87348	26.37065	0.033694
1.25	1.125	25.98973	36.87348	26.31160	0.029573
2.50	-1.125	26.00851	36.90234	26.48090	0.043363
2.50	-0.875	25.97422	36.90956	26.77329	0.073072
2.50	-0.750	26.02321	36.90074	27.39208	0.125844
2.50	-0.625	26.02565	36.87909	28.22153	0.202321
2.50	-0.500	26.03790	36.89272	29.40690	0.310369
2.50	-0.375	26.05259	36.87187	30.33426	0.395744
2.50	-0.313	26.04198	36.86546	30.85904	0.445057
2.50	-0.250	26.07464	36.85423	31.35823	0.490147
2.50	-0.188	26.06566	36.83258	31.87301	0.539370
2.50	-0.125	26.11627	36.84221	32.30563	0.577046
2.50	-0.063	26.07219	36.83499	32.59575	0.606121
2.50	0.0	26.00606	36.83579	32.61411	0.610177
2.50	0.0625	26.06076	36.82777	32.55844	0.603481
2.50	0.125	26.10647	36.81815	32.24890	0.573433
2.50	0.188	26.00280	36.83820	31.88731	0.543082
2.50	0.250	26.06892	36.84782	31.24700	0.480390
2.50	0.313	26.06974	36.86386	30.66572	0.425786
2.50	0.375	26.05913	36.87829	30.03400	0.367392
2.50	0.500	26.06239	36.90154	29.20186	0.289642
2.50	0.625	26.02810	36.92158	28.05913	0.186444
2.50	0.750	26.01014	36.90394	26.99963	0.090831
2.50	0.875	26.04770	36.94163	26.64508	0.054836
2.50	1.125	26.04770	36.94323	26.48288	0.039941
3.75	-1.125	26.09096	37.09954	26.81574	0.065837
3.75	-0.875	26.08443	37.11237	27.26112	0.106701
3.75	-0.750	26.11137	37.09634	27.69077	0.143779
3.75	-0.625	26.14483	37.11958	28.46187	0.211124
3.75	-0.500	26.18564	37.12679	29.33660	0.287992
3.75	-0.375	26.19381	37.12839	30.13652	0.360573
3.75	-0.313	26.18891	37.11477	30.50042	0.394616
3.75	-0.250	26.16687	37.09874	30.77493	0.421525
3.75	-0.188	26.15218	37.10515	31.07418	0.449376
3.75	-0.125	26.24848	37.10275	31.32594	0.467785
3.75	-0.063	26.16606	37.10675	31.45941	0.483822
3.75	0.0	26.17993	37.09313	31.50321	0.487783
3.75	0.0625	26.20197	37.11397	31.43924	0.479955
3.75	0.125	26.17911	37.13801	31.21457	0.459486
3.75	0.188	26.19054	37.13240	30.90915	0.431244
3.75	0.250	26.16769	37.14442	30.53496	0.397866
3.75	0.313	26.17340	37.15244	30.13574	0.360901
3.75	0.375	26.15300	37.15805	29.64508	0.317316
3.75	0.500	26.13994	37.14282	28.74858	0.237087
3.75	0.625	26.21747	37.17247	27.88294	0.152028
3.75	0.750	26.28765	37.15885	27.27002	0.090364
3.75	0.875	26.24767	37.14683	27.02830	0.071624
3.75	1.125	26.26236	37.16847	27.03691	0.071020
5.0	-1.125	26.37251	37.23177	27.26924	0.082577
5.0	-0.875	26.38475	37.23819	27.54430	0.106837
5.0	-0.750	26.41494	37.22617	27.85647	0.133337
5.0	-0.625	26.42799	37.23658	28.30047	0.173239
5.0	-0.500	26.37659	37.23418	28.81950	0.224995
5.0	-0.375	26.43697	37.25421	29.50892	0.283987
5.0	-0.313	26.33825	37.24620	29.75247	0.313004
5.0	-0.250	26.39862	37.23498	30.09568	0.341171
5.0	-0.188	26.41004	37.24700	30.48823	0.376322
5.0	-0.125	26.41983	37.23418	30.65605	0.391722
5.0	-0.063	26.44023	37.21975	30.77991	0.402585
5.0	0.0	26.45899	37.22697	30.80858	0.403937
5.0	0.0625	26.44349	37.20293	30.90042	0.414234
5.0	0.125	26.44431	37.19972	30.68102	0.393914
5.0	0.188	26.42473	37.21094	30.54310	0.381818
5.0	0.250	26.49897	37.22857	30.34393	0.358351
5.0	0.313	26.45084	37.26142	30.00149	0.328443
5.0	0.375	26.49733	37.23899	29.59551	0.288427
5.0	0.500	26.43860	37.23738	28.99802	0.237010
5.0	0.625	26.43044	37.23578	28.43050	0.185099
5.0	0.750	26.46878	37.24139	27.97835	0.140130
5.0	0.875	26.46470	37.28306	27.52832	0.098316
5.0	1.125	26.46389	37.30229	27.40019	0.086387
7.50	-1.125	26.50631	37.34315	27.85480	0.124436
7.50	-0.875	26.52996	37.36478	28.04080	0.139442

7.50	-0.750	26.57809	37.38080	28.26561	0.156213
7.50	-0.625	26.53975	37.39122	28.46044	0.176999
7.50	-0.500	26.55688	37.40564	28.70532	0.198035
7.50	-0.375	26.52915	37.41365	28.92993	0.220569
7.50	-0.313	26.53404	37.41846	29.02428	0.228789
7.50	-0.250	26.51039	37.43688	29.15882	0.242386
7.50	-0.188	26.59440	37.43848	29.21663	0.241812
7.50	-0.125	26.57727	37.46572	29.29129	0.249257
7.50	-0.063	26.59195	37.49135	29.34343	0.252443
7.50	0.0	26.57645	37.48334	29.31513	0.251096
7.50	0.0625	26.57890	37.50817	29.28849	0.247920
7.50	0.125	26.56014	37.50176	29.19396	0.240716
7.50	0.188	26.57564	37.51137	29.16326	0.236621
7.50	0.250	26.66453	37.52099	29.10802	0.225072
7.50	0.313	26.63681	37.54501	29.02051	0.218524
7.50	0.375	26.62294	37.53861	28.91555	0.210029
7.50	0.500	26.63273	37.54581	28.68011	0.187608
7.50	0.625	26.60174	37.53941	28.40251	0.164639
7.50	0.750	26.67595	37.53941	28.19985	0.140278
7.50	0.875	26.64333	37.56263	28.08343	0.131886
7.50	1.125	26.64496	37.58266	28.01240	0.125020
10.0	-1.125	26.74282	37.65073	28.15334	0.129312
10.0	-0.875	26.77951	37.63391	28.14491	0.125792
10.0	-0.750	26.75668	37.63631	28.21679	0.134206
10.0	-0.625	26.75016	37.61469	28.32836	0.145262
10.0	-0.500	26.66780	37.62270	28.40565	0.158637
10.0	-0.375	26.72896	37.65233	28.49532	0.161705
10.0	-0.313	26.77054	37.66274	28.56661	0.164896
10.0	-0.250	26.73711	37.67235	28.58126	0.168643
10.0	-0.188	26.76809	37.65713	28.60073	0.168301
10.0	-0.125	26.78603	37.66194	28.62308	0.168910
10.0	-0.063	26.76728	37.67475	28.60651	0.168621
10.0	0.0	26.79174	37.68996	28.61338	0.167150
10.0	0.0625	26.82843	37.70518	28.62751	0.165407
10.0	0.125	26.76565	37.70518	28.60545	0.168180
10.0	0.188	26.85533	37.70998	28.59510	0.160278
10.0	0.250	26.77869	37.74041	28.52417	0.159233
10.0	0.313	26.80397	37.72680	28.47378	0.152873
10.0	0.375	26.85859	37.77323	28.48618	0.149120
10.0	0.500	26.92136	37.77003	28.39964	0.136264
10.0	0.625	26.82354	37.79565	28.30730	0.135231
10.0	0.750	26.85452	37.76603	28.20498	0.123765
10.0	0.875	26.87653	37.77644	28.18835	0.120352
10.0	1.125	26.79500	37.78764	28.14611	0.122910

Run ID: 092196b

VR=1.04 Uo=10.82 m/s
ADIABATIC EFFECTIVENESS,
FSTI=12%
<u>CONFIGURATION</u>:
OPEN PLENUM/SHORT-HOLE

x/D	z(in)	Tinf(C)	Tjet(C)	Taw(C)	Eta
10.0	-1.125	26.46715	36.93200	27.48140	0.096919
10.0	-0.875	26.96864	37.47773	28.06472	0.104299
10.0	-0.750	26.99064	37.50577	28.14474	0.109756
10.0	-0.625	26.98331	37.49295	28.18194	0.114051
10.0	-0.500	26.99961	37.52259	28.27146	0.120864
10.0	-0.375	26.93114	37.51778	28.36411	0.135356
10.0	-0.313	26.94092	37.52179	28.38713	0.136682
10.0	-0.250	26.98901	37.51778	28.45557	0.139291
10.0	-0.188	26.96864	37.52659	28.47017	0.142218
10.0	-0.125	26.92625	37.52179	28.49769	0.148311
10.0	-0.063	27.03058	37.52499	28.52862	0.142747
10.0	0.0	26.97271	37.51618	28.52467	0.147196
10.0	0.0625	27.03139	37.51938	28.51880	0.141820
10.0	0.125	27.00694	37.55943	28.50619	0.142075
10.0	0.188	26.99635	37.56904	28.51411	0.143555
10.0	0.250	27.05421	37.59066	28.46098	0.133515
10.0	0.313	27.03139	37.59867	28.43823	0.133131
10.0	0.375	27.03547	37.61149	28.41877	0.130796
10.0	0.500	27.05666	37.62030	28.35876	0.123262
10.0	0.625	27.06318	37.65873	28.27709	0.114568
10.0	0.750	27.05503	37.65873	28.20544	0.108491
10.0	0.875	27.14548	37.65553	28.16846	0.097334
10.0	1.125	27.11289	37.65873	28.18766	0.101914
7.50	-1.125	27.20007	37.77964	28.19948	0.094466
7.50	-0.875	27.14385	37.78204	28.27462	0.106293
7.50	-0.750	27.22778	37.75722	28.38112	0.109535
7.50	-0.625	27.26607	37.73240	28.50625	0.118493
7.50	-0.500	27.18215	37.71639	28.67483	0.141698
7.50	-0.375	27.12919	37.72439	28.85523	0.162908
7.50	-0.313	27.12674	37.73800	28.95357	0.172159
7.50	-0.250	27.14141	37.71559	29.04636	0.180151
7.50	-0.188	27.13489	37.71238	29.11907	0.187585
7.50	-0.125	27.13652	37.73320	29.16435	0.191365
7.50	-0.063	27.14793	37.73881	29.21577	0.195248
7.50	0.0	27.09333	37.73881	29.21080	0.198908
7.50	0.0625	27.09904	37.77003	29.21766	0.198540
7.50	0.125	27.02324	37.80846	29.18314	0.200264
7.50	0.188	27.04443	37.79485	29.16460	0.197217
7.50	0.250	27.15200	37.74841	29.07902	0.181856
7.50	0.313	27.07214	37.71639	29.01314	0.182352
7.50	0.375	27.07540	37.69797	28.90904	0.172617
7.50	0.500	27.15608	37.69477	28.71437	0.147864
7.50	0.625	27.11370	37.68276	28.54209	0.135148
7.50	0.750	27.08600	37.69477	28.37941	0.121919
7.50	0.875	27.07622	37.68596	28.25795	0.111382
7.50	1.125	27.09333	37.67715	28.11589	0.096615
5.0	-1.125	27.09578	37.72279	27.78319	0.064685
5.0	-0.875	27.17889	37.72439	28.01665	0.079442
5.0	-0.750	27.13163	37.70838	28.16794	0.097980
5.0	-0.625	27.14793	37.70998	28.40641	0.119152
5.0	-0.500	27.12022	37.72279	28.65709	0.144952
5.0	-0.375	27.12430	37.71318	28.98713	0.175924
5.0	-0.313	27.18296	37.70678	29.20639	0.192271
5.0	-0.250	27.25059	37.71238	29.50357	0.215353
5.0	-0.188	27.13733	37.70518	29.59978	0.233013
5.0	-0.125	27.15689	37.68916	29.77781	0.248846
5.0	-0.063	27.08926	37.68916	29.90281	0.265432
5.0	0.0	27.16422	37.70758	29.94932	0.264157
5.0	0.0625	27.12837	37.68756	29.98046	0.270105
5.0	0.125	27.17726	37.69797	29.96681	0.265149
5.0	0.188	27.16015	37.68115	29.88799	0.259276
5.0	0.250	27.10067	37.67315	29.73434	0.249107
5.0	0.313	27.17400	37.67235	29.61077	0.232110
5.0	0.375	27.14059	37.65233	29.47018	0.221617
5.0	0.500	27.07051	37.62110	29.06000	0.188567
5.0	0.625	27.14467	37.61389	28.52967	0.132292
5.0	0.750	27.11452	37.60027	28.23561	0.106916
5.0	0.875	27.14304	37.60268	28.02476	0.084297
5.0	1.125	27.16178	37.59707	27.81681	0.062771
3.75	-1.125	27.13815	37.63471	27.46911	0.031530
3.75	-0.875	27.08111	37.63391	27.73325	0.061798
3.75	-0.750	27.16178	37.62991	28.00849	0.080885
3.75	-0.625	27.08274	37.61789	28.23058	0.108954
3.75	-0.500	27.06399	37.60588	28.53872	0.139892
3.75	-0.375	27.10392	37.60268	28.92073	0.173050
3.75	-0.313	27.04280	37.60348	29.15533	0.200037
3.75	-0.250	27.06155	37.57144	29.48577	0.230661
3.75	-0.188	27.04688	37.56664	29.78168	0.259968
3.75	-0.125	27.06155	37.57545	30.13163	0.292002
3.75	-0.063	27.11859	37.55142	30.36370	0.311048
3.75	0.0	27.05177	37.54101	30.47199	0.326070
3.75	0.0625	27.05014	37.53778	30.36351	0.316535
3.75	0.125	27.06481	37.52659	30.34080	0.313139
3.75	0.188	27.08844	37.50897	30.10678	0.289653
3.75	0.250	27.06073	37.48334	29.86502	0.269058
3.75	0.313	27.05910	37.46492	29.50789	0.235329
3.75	0.375	27.10555	37.48574	29.27542	0.209039
3.75	0.500	27.08355	37.47533	28.69623	0.155188
3.75	0.625	27.10392	37.49295	28.33382	0.118384
3.75	0.750	27.05747	37.50336	27.88824	0.079531
3.75	0.875	27.09578	37.49616	27.61320	0.049751
3.75	1.125	27.03873	37.45530	27.32025	0.027026
2.50	-1.125	27.14222	37.50977	27.31377	0.016547
2.50	-0.875	27.07540	37.51698	27.43817	0.034743

2.50	-0.750	27.09904	37.50657	27.64271	0.052239
2.50	-0.625	27.05584	37.50977	27.93307	0.083913
2.50	-0.500	27.03465	37.51938	28.15270	0.106635
2.50	-0.375	26.97353	37.49616	28.48127	0.143286
2.50	-0.313	27.01835	37.48014	28.76302	0.166766
2.50	-0.250	27.02569	37.47132	29.28455	0.216249
2.50	-0.188	27.02976	37.43368	29.80496	0.266745
2.50	-0.125	26.97190	37.41765	30.26928	0.315667
2.50	-0.063	26.91484	37.44008	30.68921	0.358602
2.50	0.0	26.93848	37.41685	30.84108	0.372443
2.50	0.0625	26.98901	37.37279	30.72651	0.359936
2.50	0.125	26.96538	37.36077	30.47375	0.337493
2.50	0.188	26.99553	37.37039	30.08519	0.297802
2.50	0.250	26.94744	37.36718	29.75688	0.269626
2.50	0.313	26.92788	37.34395	29.47840	0.244864
2.50	0.375	26.97760	37.35356	29.20000	0.214187
2.50	0.500	26.92381	37.34715	28.37593	0.139315
2.50	0.625	26.92462	37.33193	27.98551	0.101937
2.50	0.750	26.91321	37.29187	27.48352	0.054950
2.50	0.875	26.89528	37.26944	27.24980	0.034174
2.50	1.125	26.85615	37.26944	27.11745	0.025093
1.25	-1.125	26.68574	37.11477	26.83273	0.014095
1.25	-0.875	26.60418	37.11798	26.82046	0.020571
1.25	-0.750	26.69063	37.11958	26.98355	0.028088
1.25	-0.625	26.57564	37.12679	27.04620	0.044598
1.25	-0.500	26.62539	37.11878	27.54502	0.087639
1.25	-0:375	26.67432	37.11717	27.83732	0.111368
1.25	-0.313	26.62294	37.12439	28.31605	0.161226
1.25	-0.250	26.58543	37.10515	29.31580	0.259548
1.25	-0.188	26.64496	37.13000	30.44257	0.362194
1.25	-0.125	26.65556	37.15564	31.24471	0.437058
1.25	-0.063	26.64741	37.16125	31.75894	0.486172
1.25	0.0	26.64741	37.13160	31.96290	0.507000
1.25	0.0625	26.61152	37.12519	31.37817	0.453376
1.25	0.125	26.63110	37.11557	30.42169	0.361543
1.25	0.188	26.63681	37.10836	29.64844	0.287601
1.25	0.250	26.60989	37.10515	29.07117	0.234513
1.25	0.313	26.64088	37.12759	28.52639	0.179799
1.25	0.375	26.69552	37.16686	28.16725	0.140548
1.25	0.500	26.65230	37.15003	27.62655	0.092806
1.25	0.625	26.64170	37.16766	27.27056	0.059743
1.25	0.750	26.61642	37.16847	26.91181	0.027994
1.25	0.875	26.61723	37.16847	26.84864	0.021932
1.25	1.125	26.59440	37.15885	26.92061	0.030878

Run ID: 092296a

VR=1.02 Uo=10.85 m/s
ADIABATIC EFFECTIVENESS,
FSTI=12%
<u>CONFIGURATION</u>:
COUNTER-FLOW

x/D	z(in)	Tinf(C)	Tjet(C)	Taw(C)	Eta
1.25	-1.125	26.45818	36.69305	26.54241	0.008230
1.25	-0.875	26.43615	36.72833	26.63657	0.019473
1.25	-0.750	26.35538	36.76362	26.61688	0.025125
1.25	-0.625	26.45818	36.81494	26.99166	0.051510
1.25	-0.500	26.56667	36.81254	27.54288	0.095279
1.25	-0.375	26.47449	36.81574	27.93896	0.141614
1.25	-0.313	26.43289	36.85343	28.77339	0.224605
1.25	-0.250	26.41820	36.85744	29.64927	0.309512
1.25	-0.188	26.52833	36.90074	30.64843	0.397217
1.25	-0.125	26.58950	36.92319	31.32554	0.458311
1.25	-0.063	26.67677	36.97289	32.08521	0.525290
1.25	0.0	26.63762	36.97930	32.57464	0.574086
1.25	0.0625	26.63110	36.98572	32.26504	0.544099
1.25	0.125	26.60337	37.00816	31.45733	0.466512
1.25	0.188	26.48755	37.00255	30.64714	0.395587
1.25	0.250	26.55199	37.02019	29.89280	0.319139
1.25	0.313	26.51283	37.02259	29.06159	0.242513
1.25	0.375	26.51773	37.06187	28.60363	0.197826
1.25	0.500	26.55362	37.06588	27.63610	0.102973
1.25	0.625	26.56096	37.06908	27.25112	0.065679
1.25	0.750	26.54464	37.11798	26.88308	0.032008
1.25	0.875	26.59277	37.12439	26.84693	0.024133
1.25	1.125	26.53322	37.12759	26.79953	0.025136
2.50	-1.125	26.61479	37.24860	26.83141	0.020371
2.50	-0.875	26.63110	37.23177	27.02108	0.036788
2.50	-0.750	26.59032	37.20613	27.26024	0.063106
2.50	-0.625	26.59277	37.22617	27.66628	0.100957
2.50	-0.500	26.54791	37.23738	27.98996	0.134904
2.50	-0.375	26.61560	37.27024	28.49674	0.176556
2.50	-0.313	26.64170	37.29427	28.95876	0.217512
2.50	-0.250	26.66127	37.27424	29.49978	0.267457
2.50	-0.188	26.63110	37.27264	30.07946	0.324047
2.50	-0.125	26.65475	37.29828	30.64027	0.374454
2.50	-0.063	26.68574	37.29588	31.10427	0.416444
2.50	0.0	26.59114	37.32552	31.17525	0.427050
2.50	0.0625	26.72080	37.32552	30.93367	0.397264
2.50	0.125	26.63273	37.34395	30.60285	0.370651
2.50	0.188	26.65475	37.34475	30.09255	0.321590
2.50	0.250	26.77054	37.35517	29.58982	0.266356
2.50	0.313	26.72896	37.41445	29.28304	0.239023
2.50	0.375	26.78359	37.38241	28.81723	0.191874
2.50	0.500	26.80071	37.40243	28.24339	0.136080
2.50	0.625	26.83495	37.39202	27.79135	0.090593
2.50	0.750	26.90995	37.38881	27.55330	0.061395
2.50	0.875	26.70939	37.40804	27.16975	0.043030
2.50	1.125	26.88712	37.42807	27.13773	0.023774
3.75	-1.125	26.87000	37.47213	27.28042	0.038711
3.75	-0.875	26.80315	37.49135	27.53506	0.068478
3.75	-0.750	26.82598	37.51618	27.84938	0.095733
3.75	-0.625	26.88223	37.53300	28.19768	0.123508
3.75	-0.500	26.80560	37.55142	28.54124	0.161517
3.75	-0.375	26.81864	37.52739	29.13270	0.216090
3.75	-0.313	26.81864	37.51938	29.38097	0.239453
3.75	-0.250	26.81049	37.51538	29.67750	0.267823
3.75	-0.188	26.76483	37.54822	30.06252	0.305812
3.75	-0.125	26.84229	37.58266	30.44708	0.335630
3.75	-0.063	26.84229	37.59707	30.62765	0.351970
3.75	0.0	26.82190	37.57865	30.67745	0.358430
3.75	0.0625	26.85452	37.56343	30.48653	0.339158
3.75	0.125	26.96456	37.57465	30.31106	0.315407
3.75	0.188	26.91076	37.55062	30.04281	0.294369
3.75	0.250	26.93359	37.58826	29.70346	0.259968
3.75	0.313	26.87571	37.60668	29.35474	0.231016
3.75	0.375	26.87245	37.58906	29.08635	0.206586
3.75	0.500	26.84473	37.60348	28.54829	0.158342
3.75	0.625	26.84962	37.61149	28.12636	0.118635
3.75	0.750	26.83250	37.66594	27.78342	0.087777
3.75	0.875	26.86919	37.67155	27.49526	0.057957
3.75	1.125	26.88386	37.67475	27.35834	0.043970
5.0	-1.125	26.95723	37.72599	27.63651	0.063079
5.0	-0.875	26.99798	37.75242	27.90523	0.084361
5.0	-0.750	27.11370	37.72199	28.15552	0.098208
5.0	-0.625	27.01835	37.73961	28.37604	0.126635
5.0	-0.500	26.92544	37.74441	28.66419	0.160714
5.0	-0.375	26.96130	37.76603	29.15151	0.202708
5.0	-0.313	26.99879	37.78604	29.39696	0.222315
5.0	-0.250	26.92544	37.81727	29.54240	0.240268
5.0	-0.188	26.96945	37.82367	29.81506	0.262166
5.0	-0.125	27.03954	37.85409	30.04887	0.278267
5.0	-0.063	26.95723	37.85729	30.17584	0.295283
5.0	0.0	27.00287	37.85489	30.27277	0.301317
5.0	0.0625	27.01591	37.82447	30.25379	0.299566
5.0	0.125	27.02406	37.84368	30.23240	0.296530
5.0	0.188	27.04443	37.84609	29.98514	0.272246
5.0	0.250	27.06644	37.85009	29.86444	0.259467
5.0	0.313	27.09089	37.88131	29.55697	0.228543
5.0	0.375	27.04199	37.91573	29.37265	0.214339
5.0	0.500	27.09985	37.92933	28.95372	0.171188
5.0	0.625	27.09089	37.93574	28.57049	0.136433
5.0	0.750	27.02813	37.94774	28.29207	0.115749
5.0	0.875	27.06073	37.95495	27.93677	0.080413
5.0	1.125	27.01428	37.97176	27.83387	0.074798
7.50	-1.125	27.13407	38.03658	28.21654	0.099286
7.50	-0.875	27.12593	38.02458	28.34922	0.112243

7.50	-0.750	27.13489	38.02298	28.47850	0.123402
7.50	-0.625	27.18378	38.02138	28.70597	0.140455
7.50	-0.500	27.10555	37.99577	28.87240	0.162241
7.50	-0.375	27.15282	38.05979	29.19212	0.186973
7.50	-0.313	27.11044	38.05899	29.25569	0.195939
7.50	-0.250	27.15037	38.06939	29.35438	0.201850
7.50	-0.188	27.14874	38.08700	29.50248	0.215184
7.50	-0.125	27.12185	38.09260	29.58265	0.224306
7.50	-0.063	27.06318	37.99657	29.46165	0.219371
7.50	0.0	27.06562	38.02618	29.47361	0.219696
7.50	0.0625	27.04117	38.07579	29.48725	0.221672
7.50	0.125	27.09252	38.05899	29.44077	0.214130
7.50	0.188	27.10718	38.06299	29.37670	0.207152
7.50	0.250	27.18704	38.05499	29.34839	0.198874
7.50	0.313	27.16830	38.07579	29.23923	0.189863
7.50	0.375	27.17482	38.08620	29.11647	0.177947
7.50	0.500	27.17074	38.11900	28.82935	0.151495
7.50	0.625	27.18948	38.10940	28.64205	0.133020
7.50	0.750	27.17237	38.08780	28.46920	0.118807
7.50	0.875	27.08600	38.07019	28.32700	0.112981
7.50	1.125	27.13896	38.09580	28.19318	0.096215
10.0	-1.125	27.14304	38.18942	28.39284	0.113141
10.0	-0.875	27.16667	38.18942	28.44928	0.116361
10.0	-0.750	27.10555	38.17501	28.46731	0.123019
10.0	-0.625	27.11370	38.15501	28.56315	0.131275
10.0	-0.500	27.07703	38.16381	28.67627	0.144248
10.0	-0.375	27.11044	38.15021	28.75464	0.148934
10.0	-0.313	27.13652	38.11100	28.75489	0.147467
10.0	-0.250	27.13733	38.16541	28.83163	0.153635
10.0	-0.188	27.13000	38.14541	28.84321	0.155528
10.0	-0.125	27.12593	38.11820	28.87545	0.159159
10.0	-0.063	27.13978	38.14141	28.91370	0.161242
10.0	0.0	27.11207	38.11900	28.89355	0.161851
10.0	0.0625	27.14874	38.12141	28.87865	0.157656
10.0	0.125	27.14222	38.14061	28.86641	0.156768
10.0	0.188	27.18133	38.14861	28.86910	0.153891
10.0	0.250	27.23266	38.17181	28.81242	0.144413
10.0	0.313	27.16504	38.16781	28.79837	0.148448
10.0	0.375	27.23755	38.22302	28.75849	0.138450
10.0	0.500	27.17970	38.19182	28.65354	0.133837
10.0	0.625	27.15200	38.18302	28.52838	0.124774
10.0	0.750	27.16504	38.17181	28.44947	0.116695
10.0	0.875	27.21148	38.15901	28.40894	0.109382
10.0	1.125	27.13733	38.16541	28.40349	0.114812

Run ID: 092296b

VR=0.502   Uo=10.78 m/s
ADIABATIC EFFECTIVENESS,
FSTI=12%
<u>CONFIGURATION</u>:
COUNTER-FLOW

x/D	z(in)	Tinf(C)	Tjet(C)	Taw(C)	Eta
10.0	-1.125	26.99716	38.04458	28.54944	0.140510
10.0	-0.875	27.07296	37.97656	28.57427	0.137689
10.0	-0.750	27.09659	37.96295	28.67778	0.145512
10.0	-0.625	27.08518	37.95575	28.75695	0.153789
10.0	-0.500	27.04688	37.97015	28.85557	0.165582
10.0	-0.375	27.06399	37.92213	28.93860	0.172645
10.0	-0.313	27.07866	37.87250	28.95471	0.173808
10.0	-0.250	27.01509	37.87731	28.96611	0.179615
10.0	-0.188	27.06155	37.88531	29.00137	0.179218
10.0	-0.125	27.04443	37.86210	29.02503	0.183090
10.0	-0.063	27.16911	37.83248	29.08184	0.179374
10.0	0.0	27.13082	37.84448	29.02936	0.177208
10.0	0.0625	27.08111	37.80286	29.04494	0.183164
10.0	0.125	27.05421	37.78364	28.98331	0.179794
10.0	0.188	27.06562	37.78284	28.89210	0.170425
10.0	0.250	27.00368	37.77964	28.87562	0.173714
10.0	0.313	26.99390	37.81486	28.83604	0.170237
10.0	0.375	27.00613	37.78844	28.81212	0.167496
10.0	0.500	27.09496	37.79085	28.73108	0.152967
10.0	0.625	27.14222	37.78684	28.66848	0.143383
10.0	0.750	27.03058	37.75802	28.48554	0.135629
10.0	0.875	27.01998	37.78124	28.43233	0.131243
10.0	1.125	27.00857	37.74361	28.42556	0.131997
7.50	-1.125	26.99716	37.70197	28.32476	0.124018
7.50	-0.875	26.95315	37.73000	28.49423	0.143000
7.50	-0.750	26.93848	37.69397	28.62919	0.157196
7.50	-0.625	26.98901	37.64912	28.92711	0.181808
7.50	-0.500	26.98494	37.66274	29.19552	0.207026
7.50	-0.375	26.94174	37.65073	29.41896	0.231322
7.50	-0.313	26.99227	37.61709	29.51197	0.237152
7.50	-0.250	26.98249	37.63951	29.60663	0.246235
7.50	-0.188	26.96619	37.64032	29.68762	0.254956
7.50	-0.125	26.95723	37.61389	29.72534	0.259754
7.50	-0.063	26.95641	37.66354	29.73579	0.259582
7.50	0.0	26.92707	37.61949	29.72826	0.261979
7.50	0.0625	26.95478	37.61389	29.69331	0.256919
7.50	0.125	26.91728	37.64432	29.65680	0.255384
7.50	0.188	26.86511	37.63071	29.56746	0.251017
7.50	0.250	26.91321	37.63071	29.47484	0.239014
7.50	0.313	26.88957	37.62590	29.37954	0.231920
7.50	0.375	26.91321	37.62350	29.25350	0.218508
7.50	0.500	26.85370	37.63871	28.97599	0.196782
7.50	0.625	26.89854	37.59627	28.78992	0.176802
7.50	0.750	26.87653	37.63151	28.46387	0.147591
7.50	0.875	26.84881	37.61469	28.29907	0.134709
7.50	1.125	26.83495	37.64672	28.23761	0.129735
5.0	-1.125	26.90098	37.60428	27.97032	0.099908
5.0	-0.875	26.90750	37.59467	28.21426	0.122273
5.0	-0.750	26.80723	37.58346	28.47135	0.154425
5.0	-0.625	26.85452	37.58266	28.94188	0.194569
5.0	-0.500	26.85533	37.58105	29.54634	0.250893
5.0	-0.375	26.87734	37.58426	30.06156	0.297399
5.0	-0.313	26.87734	37.59947	30.29421	0.318674
5.0	-0.250	26.86674	37.57064	30.71389	0.359415
5.0	-0.188	26.79418	37.58746	30.90476	0.380846
5.0	-0.125	26.87082	37.58266	31.00317	0.385774
5.0	-0.063	26.85207	37.55623	31.09458	0.396342
5.0	0.0	26.80152	37.58185	31.10705	0.399388
5.0	0.0625	26.84392	37.55382	31.06987	0.394583
5.0	0.125	26.84147	37.51298	30.93951	0.384017
5.0	0.188	26.77462	37.51378	30.77344	0.372359
5.0	0.250	26.81864	37.50577	30.62732	0.356380
5.0	0.313	26.83332	37.52259	30.36171	0.330087
5.0	0.375	26.82761	37.50417	29.76472	0.275099
5.0	0.500	26.82517	37.52579	29.33249	0.234315
5.0	0.625	26.82761	37.50016	28.77447	0.182417
5.0	0.750	26.91158	37.52259	28.37914	0.138305
5.0	0.875	26.84392	37.46492	28.12698	0.120805
5.0	1.125	26.82435	37.49696	27.89085	0.099928
3.75	-1.125	26.82598	37.51778	27.53814	0.066607
3.75	-0.875	26.96782	37.54261	27.99609	0.097237
3.75	-0.750	26.91892	37.51858	28.41343	0.140997
3.75	-0.625	26.89935	37.53380	29.05968	0.203145
3.75	-0.500	26.85615	37.52900	29.93805	0.288761
3.75	-0.375	26.84310	37.51618	30.99944	0.389423
3.75	-0.313	26.87571	37.50977	31.24667	0.411034
3.75	-0.250	26.84799	37.52259	31.53091	0.438697
3.75	-0.188	26.80152	37.49696	31.78852	0.466274
3.75	-0.125	26.84473	37.50256	31.95643	0.479619
3.75	-0.063	26.91239	37.47773	32.07230	0.488381
3.75	0.0	26.86267	37.45691	32.08724	0.493152
3.75	0.0625	26.85370	37.45050	32.02154	0.487680
3.75	0.125	26.90506	37.45851	31.84641	0.468221
3.75	0.188	26.99961	37.44729	31.63197	0.443387
3.75	0.250	26.87082	37.46331	31.33345	0.421301
3.75	0.313	26.81864	37.48014	30.97572	0.389915
3.75	0.375	26.77543	37.47693	30.40361	0.339035
3.75	0.500	26.76972	37.48334	29.45577	0.250714
3.75	0.625	26.80723	37.45691	28.59140	0.167533
3.75	0.750	26.70857	37.47132	28.04184	0.123878
3.75	0.875	26.76972	37.47533	27.69653	0.086572
3.75	1.125	26.74363	37.48174	27.43961	0.064814
2.50	-1.125	26.80397	37.48094	27.20057	0.037145
2.50	-0.875	26.86185	37.49295	27.58707	0.068217

2.50	-0.750	26.88386	37.46091	28.10304	0.115266
2.50	-0.625	26.78685	37.42326	28.92932	0.201428
2.50	-0.500	26.79255	37.42887	30.11172	0.312059
2.50	-0.375	26.78848	37.42166	31.21026	0.415847
2.50	-0.313	26.76320	37.42166	31.73177	0.466162
2.50	-0.250	26.79418	37.39843	32.20442	0.510195
2.50	-0.188	26.78929	37.39122	32.70124	0.557630
2.50	-0.125	26.80478	37.36238	33.10688	0.596925
2.50	-0.063	26.87571	37.31831	33.26648	0.611990
2.50	0.0	26.78277	37.27745	33.34504	0.625295
2.50	0.0625	26.74200	37.25581	33.20363	0.614584
2.50	0.125	26.67758	37.29187	32.99927	0.595583
2.50	0.188	26.78603	37.27745	32.61823	0.555902
2.50	0.250	26.74119	37.30068	32.19602	0.516580
2.50	0.313	26.70612	37.29988	31.65339	0.466999
2.50	0.375	26.71346	37.33193	31.07011	0.410290
2.50	0.500	26.77054	37.32472	29.82573	0.289477
2.50	0.625	26.67514	37.31991	28.67611	0.187977
2.50	0.750	26.70123	37.29748	27.76665	0.100546
2.50	0.875	26.67351	37.30870	27.33925	0.062598
2.50	1.125	26.72243	37.33754	27.11034	0.036543
1.25	-1.125	26.76402	37.28947	26.99565	0.022007
1.25	-0.875	26.74363	37.27104	27.11867	0.035625
1.25	-0.750	26.74119	37.28145	27.44595	0.066864
1.25	-0.625	26.75831	37.27905	28.21298	0.138267
1.25	-0.500	26.69308	37.30309	29.79799	0.292640
1.25	-0.375	26.72325	37.33113	31.22032	0.423936
1.25	-0.313	26.74526	37.30068	31.91094	0.489386
1.25	-0.250	26.75097	37.32152	32.65018	0.558080
1.25	-0.188	26.74771	37.32072	33.24953	0.614945
1.25	-0.125	26.74363	37.29668	33.64520	0.653988
1.25	-0.063	26.83250	37.29187	33.91245	0.676900
1.25	0.0	26.75586	37.29748	34.08073	0.694853
1.25	0.0625	26.74771	37.27264	33.87306	0.676998
1.25	0.125	26.71428	37.25822	33.53554	0.646937
1.25	0.188	26.75260	37.22857	33.14201	0.609911
1.25	0.250	26.74608	37.23979	32.72496	0.569759
1.25	0.313	26.76891	37.24540	32.22465	0.520761
1.25	0.375	26.74771	37.23899	31.52080	0.454958
1.25	0.500	26.80804	37.26383	29.96595	0.302024
1.25	0.625	26.81212	37.22617	28.44873	0.157154
1.25	0.750	26.77136	37.26142	27.47854	0.067415
1.25	0.875	26.69308	37.24700	27.12549	0.040972
1.25	1.125	26.71836	37.26944	27.01969	0.028560

Run ID: 092396a

VR=0.506 Uo=10.91 m/s
ADIABATIC EFFECTIVENESS,
FSTI=12%
CONFIGURATION:
CO-FLOW

x/D	z(in)	Tinf(C)	Tjet(C)	Taw(C)	Eta
1.25	-1.125	26.58216	37.41685	26.76954	0.017294
1.25	-0.875	26.53404	37.50016	27.00062	0.042548
1.25	-0.750	26.55280	37.46892	27.31545	0.069865
1.25	-0.625	26.56585	37.53540	28.16596	0.145868
1.25	-0.500	26.57809	37.51137	29.77431	0.292339
1.25	-0.375	26.70286	37.32312	30.93409	0.398411
1.25	-0.313	26.68166	37.33674	31.62095	0.463562
1.25	-0.250	26.62621	37.31911	32.21703	0.522854
1.25	-0.188	26.68574	37.27825	32.72902	0.570524
1.25	-0.125	26.63599	37.31030	33.06546	0.602331
1.25	-0.063	26.74689	37.22376	33.26797	0.622426
1.25	0.0	26.68655	37.24379	33.37070	0.633134
1.25	0.0625	26.72896	37.22697	33.25744	0.621878
1.25	0.125	26.67269	37.24540	33.04353	0.602574
1.25	0.188	26.66209	37.27504	32.87934	0.585817
1.25	0.250	26.74771	37.30629	32.57839	0.552222
1.25	0.313	26.72814	37.31991	32.40246	0.535729
1.25	0.375	26.69878	37.36558	31.96894	0.494071
1.25	0.500	26.77869	37.39362	30.47455	0.348175
1.25	0.625	26.76809	37.39683	28.73736	0.185278
1.25	0.750	26.83821	37.45450	27.67973	0.079267
1.25	0.875	26.78359	37.41365	27.23691	0.042645
1.25	1.125	26.82109	37.49776	27.12928	0.028865
2.50	-1.125	26.78766	37.51938	27.22318	0.040582
2.50	-0.875	26.82924	37.55142	27.57051	0.069134
2.50	-0.750	26.77706	37.52659	28.11404	0.124376
2.50	-0.625	26.85207	37.51298	28.81088	0.183738
2.50	-0.500	26.75668	37.55783	30.22243	0.320869
2.50	-0.375	26.83250	37.55943	31.10050	0.397876
2.50	-0.313	26.76483	37.54662	31.58353	0.446929
2.50	-0.250	26.83739	37.59147	32.03682	0.483484
2.50	-0.188	26.83576	37.58986	32.43857	0.520993
2.50	-0.125	26.85125	37.61229	32.76446	0.549501
2.50	-0.063	26.91484	37.61549	33.01540	0.570111
2.50	0.0	26.95152	37.66354	33.14692	0.578360
2.50	0.0625	26.98005	37.68756	33.16386	0.577521
2.50	0.125	26.89528	37.66194	33.03639	0.570383
2.50	0.188	26.96782	37.65633	32.76858	0.542710
2.50	0.250	26.98983	37.69156	32.43221	0.508551
2.50	0.313	27.01020	37.66594	31.95920	0.464444
2.50	0.375	27.01998	37.68596	31.50258	0.420270
2.50	0.500	27.00450	37.71959	30.42903	0.319598
2.50	0.625	27.04362	37.77483	28.98303	0.180726
2.50	0.750	27.01591	37.79405	28.21525	0.111276
2.50	0.875	27.04525	37.81486	27.73527	0.064071
2.50	1.125	27.03058	37.86850	27.44744	0.038464
3.75	-1.125	27.05584	37.81406	27.65840	0.056009
3.75	-0.875	27.01346	37.83568	28.13803	0.103912
3.75	-0.750	27.05095	37.80766	28.62061	0.145924
3.75	-0.625	27.08518	37.87170	29.20098	0.196152
3.75	-0.500	27.05258	37.85249	30.06305	0.278749
3.75	-0.375	27.10067	37.82367	31.02168	0.365664
3.75	-0.313	27.15689	37.86370	31.38712	0.395097
3.75	-0.250	27.10718	37.86210	31.76684	0.433259
3.75	-0.188	27.18378	37.89492	32.13381	0.462139
3.75	-0.125	27.22289	37.92773	32.34587	0.478566
3.75	-0.063	27.21881	37.94134	32.52566	0.494925
3.75	0.0	27.23755	37.94054	32.58105	0.499253
3.75	0.0625	27.20415	37.92453	32.53572	0.497330
3.75	0.125	27.17237	37.96215	32.31494	0.476615
3.75	0.188	27.21392	38.00297	32.11878	0.454615
3.75	0.250	27.20007	38.01097	31.71494	0.417622
3.75	0.313	27.19926	38.01817	31.36253	0.384814
3.75	0.375	27.24814	37.99256	31.01002	0.350124
3.75	0.500	27.27177	38.01497	29.93810	0.248187
3.75	0.625	27.27340	38.04939	29.16896	0.175906
3.75	0.750	27.26932	38.07099	28.59086	0.122346
3.75	0.875	27.33612	38.10940	28.20045	0.080229
3.75	1.125	27.29702	38.05419	27.98119	0.063601
5.0	-1.125	27.42328	38.26462	28.54328	0.103309
5.0	-0.875	27.43631	38.26302	28.72333	0.118874
5.0	-0.750	27.50634	38.23822	29.13103	0.151389
5.0	-0.625	27.46888	38.25902	29.43562	0.182272
5.0	-0.500	27.54055	38.28942	30.04436	0.232937
5.0	-0.375	27.56253	38.27662	30.72508	0.295176
5.0	-0.313	27.58207	38.25902	30.90635	0.311351
5.0	-0.250	27.55439	38.25022	31.17538	0.338542
5.0	-0.188	27.54380	38.24622	31.33331	0.354080
5.0	-0.125	27.57475	38.25502	31.44426	0.362305
5.0	-0.063	27.51205	38.30222	31.53919	0.373223
5.0	0.0	27.59429	38.32781	31.61191	0.374306
5.0	0.0625	27.62523	38.32222	31.58935	0.370583
5.0	0.125	27.56090	38.41180	31.53970	0.366679
5.0	0.188	27.64395	38.36781	31.45909	0.355761
5.0	0.250	27.60976	38.41980	31.30327	0.341674
5.0	0.313	27.65861	38.38780	31.06949	0.317906
5.0	0.375	27.60650	38.43179	30.74281	0.289720
5.0	0.500	27.61790	38.43739	30.25895	0.244101
5.0	0.625	27.63744	38.42060	29.55147	0.177502
5.0	0.750	27.61139	38.43419	29.22296	0.148906
5.0	0.875	27.62197	38.40300	28.85005	0.113912
5.0	1.125	27.59429	38.42779	28.65765	0.098155
7.50	-1.125	27.63011	38.54055	28.98623	0.124295
7.50	-0.875	27.61220	38.55255	29.14614	0.140209

7.50	-0.750	27.56823	38.52616	29.41228	0.168284
7.50	-0.625	27.63174	38.57094	29.60646	0.180518
7.50	-0.500	27.69524	38.53495	29.80505	0.194637
7.50	-0.375	27.58940	38.52376	29.99777	0.220257
7.50	-0.313	27.61383	38.54055	30.12796	0.230091
7.50	-0.250	27.66023	38.54775	30.21953	0.235067
7.50	-0.188	27.70501	38.55654	30.31223	0.240262
7.50	-0.125	27.65209	38.52616	30.32806	0.246087
7.50	-0.063	27.55846	38.54215	30.30629	0.250174
7.50	0.0	27.67245	38.53176	30.32565	0.244325
7.50	0.0625	27.64965	38.47738	30.29597	0.244402
7.50	0.125	27.71071	38.47658	30.24106	0.235035
7.50	0.188	27.65616	38.45579	30.18251	0.233929
7.50	0.250	27.68710	38.48378	30.07531	0.221199
7.50	0.313	27.70664	38.46618	29.98769	0.212003
7.50	0.375	27.64232	38.50857	29.88886	0.206745
7.50	0.500	27.65616	38.50217	29.57444	0.176865
7.50	0.625	27.68466	38.50697	29.33474	0.152471
7.50	0.750	27.67570	38.51976	29.25244	0.145401
7.50	0.875	27.63825	38.49977	29.13695	0.137982
7.50	1.125	27.59429	38.52136	28.96640	0.125570
10.0	-1.125	27.63011	38.59332	28.98515	0.123598
10.0	-0.875	27.65372	38.55974	29.05696	0.128666
10.0	-0.750	27.63907	38.56614	29.10837	0.134465
10.0	-0.625	27.59754	38.54615	29.16323	0.143004
10.0	-0.500	27.59429	38.54855	29.27366	0.153308
10.0	-0.375	27.62848	38.56134	29.35144	0.157594
10.0	-0.313	27.51612	38.58293	29.34103	0.164899
10.0	-0.250	27.55602	38.53495	29.38667	0.166743
10.0	-0.188	27.53077	38.52856	29.39552	0.169557
10.0	-0.125	27.55032	38.53975	29.40290	0.168578
10.0	-0.063	27.50553	38.48138	29.42059	0.174479
10.0	0.0	27.51775	38.49657	29.43377	0.174520
10.0	0.0625	27.54787	38.47738	29.41383	0.170727
10.0	0.125	27.53159	38.49257	29.38018	0.168652
10.0	0.188	27.48354	38.47738	29.34183	0.169030
10.0	0.250	27.55113	38.48937	29.29835	0.159735
10.0	0.313	27.49739	38.50617	29.27673	0.161630
10.0	0.375	27.51937	38.50377	29.23566	0.156247
10.0	0.500	27.49983	38.49417	29.12702	0.148002
10.0	0.625	27.55602	38.51736	29.06457	0.137625
10.0	0.750	27.53566	38.52536	28.98886	0.132233
10.0	0.875	27.58614	38.53975	28.92772	0.122478
10.0	1.125	27.51612	38.54135	28.87849	0.123569

Run ID: 092396b

VR=1.04 Uo=10.73 m/s
ADIABATIC EFFECTIVENESS,
FSTI=12%
CONFIGURATION:
CO-FLOW

x/D	z(in)	Tinf(C)	Tjet(C)	Taw(C)	Eta
10.0	-1.125	27.52345	37.87731	28.75386	0.118836
10.0	-0.875	27.48354	37.85409	28.70725	0.117999
10.0	-0.750	27.55195	37.88291	28.74881	0.115852
10.0	-0.625	27.39803	37.81406	28.83202	0.137672
10.0	-0.500	27.53240	37.81086	28.93400	0.136363
10.0	-0.375	27.42979	37.86049	28.97215	0.147867
10.0	-0.313	27.43712	37.87891	29.03170	0.152711
10.0	-0.250	27.41758	37.88531	29.06704	0.157576
10.0	-0.188	27.52182	37.89732	29.08444	0.150607
10.0	-0.125	27.37929	37.82207	29.0890	0.163727
10.0	-0.063	27.35241	37.85329	29.09507	0.165953
10.0	0.0	27.47214	37.80846	29.11291	0.158738
10.0	0.0625	27.41350	37.88131	29.15116	0.166001
10.0	0.125	27.25710	37.79085	29.07176	0.172271
10.0	0.188	27.44364	37.77564	29.06247	0.156681
10.0	0.250	27.39884	37.75162	29.00337	0.154985
10.0	0.313	27.42328	37.69637	28.97186	0.150742
10.0	0.375	27.44364	37.76923	28.92065	0.143044
10.0	0.500	27.28888	37.86850	28.81981	0.144706
10.0	0.625	27.44445	37.77083	28.71076	0.122628
10.0	0.750	27.34427	37.77724	28.60167	0.120522
10.0	0.875	27.23918	37.81006	28.52204	0.121358
10.0	1.125	27.18622	37.75722	28.39831	0.114661
7.50	-1.125	27.18704	37.91413	28.33108	0.106650
7.50	-0.875	27.19844	37.88691	28.36891	0.109508
7.50	-0.750	27.19844	37.93734	28.51725	0.122807
7.50	-0.625	27.18296	37.96055	28.62276	0.133592
7.50	-0.500	27.08844	37.91092	28.74430	0.153002
7.50	-0.375	27.00939	37.87250	29.01161	0.184314
7.50	-0.313	27.11941	37.92133	29.15506	0.188453
7.50	-0.250	27.13082	37.93014	29.30665	0.201479
7.50	-0.188	27.11126	37.95895	29.36489	0.207752
7.50	-0.125	27.17889	37.99417	29.47988	0.212753
7.50	-0.063	27.16993	38.04298	29.58098	0.221746
7.50	0.0	27.31250	38.04699	29.62522	0.215448
7.50	0.0625	27.17726	38.00697	29.58670	0.222484
7.50	0.125	27.27340	38.01577	29.65950	0.222121
7.50	0.188	27.23755	38.03898	29.58393	0.217229
7.50	0.250	27.17400	38.07579	29.51863	0.215068
7.50	0.313	27.23592	38.03418	29.41729	0.202011
7.50	0.375	27.14467	38.05339	29.31197	0.198676
7.50	0.500	27.15526	37.98696	29.06795	0.176583
7.50	0.625	27.10555	37.96535	28.79634	0.155693
7.50	0.750	27.28643	38.00217	28.67416	0.129504
7.50	0.875	27.28888	37.97576	28.49273	0.112647
7.50	1.125	27.27014	37.95415	28.35741	0.101766
5.0	-1.125	27.15200	37.92293	27.88636	0.068179
5.0	-0.875	27.04036	37.97256	27.96367	0.084458
5.0	-0.750	27.12022	37.96775	28.27750	0.106686
5.0	-0.625	27.12837	37.96135	28.58996	0.134920
5.0	-0.500	27.12511	37.91733	28.92284	0.166576
5.0	-0.375	27.14467	37.95975	29.34454	0.203408
5.0	-0.313	27.31006	37.96215	29.67761	0.222262
5.0	-0.250	27.11696	37.97015	29.79590	0.246834
5.0	-0.188	27.08844	37.97576	30.09066	0.275754
5.0	-0.125	27.25303	38.02218	30.26784	0.279948
5.0	-0.063	27.13978	37.99016	30.44389	0.304516
5.0	0.0	27.09659	38.01417	30.53777	0.315196
5.0	0.0625	27.20659	37.98456	30.56827	0.311902
5.0	0.125	27.24081	38.00217	30.57272	0.309618
5.0	0.188	27.21392	38.01177	30.46889	0.301446
5.0	0.250	27.14874	38.00377	30.31543	0.291725
5.0	0.313	27.27829	38.05979	30.19036	0.270099
5.0	0.375	27.18133	38.05659	29.98900	0.258170
5.0	0.500	27.09415	38.02538	29.30992	0.202701
5.0	0.625	27.03547	38.02138	28.90665	0.170325
5.0	0.750	27.01346	38.04859	28.50036	0.134742
5.0	0.875	27.08600	38.03738	28.13007	0.095337
5.0	1.125	27.08600	38.07899	27.87723	0.071976
3.75	-1.125	27.18867	38.06059	27.62669	0.040289
3.75	-0.875	27.13570	38.02378	27.79396	0.060456
3.75	-0.750	27.19519	38.05499	28.16712	0.089499
3.75	-0.625	27.24896	38.03898	28.53834	0.119497
3.75	-0.500	27.13163	38.05899	29.19747	0.189052
3.75	-0.375	27.20089	38.05099	29.76110	0.235962
3.75	-0.313	27.21474	38.04218	29.92050	0.249898
3.75	-0.250	27.33042	38.00617	30.21251	0.269966
3.75	-0.188	27.21067	37.98776	30.51884	0.306963
3.75	-0.125	27.14711	37.97015	30.75709	0.333545
3.75	-0.063	27.09089	37.94694	31.01874	0.361812
3.75	0.0	27.07540	37.96455	31.17209	0.376217
3.75	0.0625	27.11941	37.97015	31.20951	0.376942
3.75	0.125	27.08763	37.96375	31.12485	0.371200
3.75	0.188	27.16178	37.94534	30.86273	0.343203
3.75	0.250	27.10148	37.91493	30.59723	0.323278
3.75	0.313	27.07051	37.92133	30.24567	0.292620
3.75	0.375	27.09496	37.91413	29.87907	0.257331
3.75	0.500	27.02487	37.88851	29.23658	0.203588
3.75	0.625	27.01917	37.89572	28.70487	0.154985
3.75	0.750	27.02080	37.89732	28.05687	0.095258
3.75	0.875	27.05014	37.87410	27.69627	0.059695
3.75	1.125	27.03302	37.86130	27.53343	0.046213
2.50	-1.125	27.12022	37.84609	27.33628	0.020143
2.50	-0.875	27.05421	37.86530	27.43919	0.035609

2.50	-0.750	27.10555	37.81166	27.78323	0.063298
2.50	-0.625	27.03954	37.81006	28.25643	0.112983
2.50	-0.500	27.02487	37.82927	28.89640	0.173219
2.50	-0.375	27.05258	37.85409	29.45743	0.222640
2.50	-0.313	27.03221	37.87250	29.68700	0.244900
2.50	-0.250	27.16096	37.89171	30.01552	0.266016
2.50	-0.188	27.21392	37.84128	30.43619	0.303205
2.50	-0.125	27.24325	37.88451	30.81091	0.335266
2.50	-0.063	27.22044	37.89412	31.17005	0.370033
2.50	0.0	27.12267	37.85569	31.36484	0.395245
2.50	0.0625	27.02243	37.88851	31.38480	0.401467
2.50	0.125	27.11941	37.92213	31.30230	0.387207
2.50	0.188	27.08926	37.93654	31.07228	0.367191
2.50	0.250	27.09822	37.91973	30.69253	0.332145
2.50	0.313	27.11370	37.93254	30.32242	0.296586
2.50	0.375	27.01428	37.94854	29.82869	0.257394
2.50	0.500	27.04932	37.94694	29.22997	0.200103
2.50	0.625	27.02243	37.96215	28.53686	0.138434
2.50	0.750	27.05095	37.97896	27.83096	0.071377
2.50	0.875	27.05014	38.02218	27.52071	0.042888
2.50	1.125	27.07133	38.01657	27.37465	0.027713
1.25	-1.125	27.02976	38.10380	27.26476	0.021221
1.25	-0.875	27.02243	38.06459	27.32611	0.027501
1.25	-0.750	27.06481	38.10060	27.39543	0.029959
1.25	-0.625	27.04362	38.08300	27.63499	0.053569
1.25	-0.500	27.07459	38.06939	28.60443	0.139142
1.25	-0.375	26.99879	38.07899	29.21580	0.200087
1.25	-0.313	27.02569	38.07980	29.35577	0.210789
1.25	-0.250	26.95967	38.04939	29.63560	0.241298
1.25	-0.188	27.00205	38.06379	30.31469	0.299468
1.25	-0.125	26.98494	38.06139	31.10296	0.371782
1.25	-0.063	26.96456	38.08620	31.69707	0.425523
1.25	0.0	26.95478	38.10860	31.94291	0.447212
1.25	0.0625	27.02324	38.13981	31.64651	0.415890
1.25	0.125	26.95478	38.12621	30.98889	0.361109
1.25	0.188	27.06888	38.14061	30.42459	0.303088
1.25	0.250	27.12185	38.06379	29.95054	0.258518
1.25	0.313	26.98575	38.11660	29.68795	0.242766
1.25	0.375	27.05666	38.13341	29.35334	0.207342
1.25	0.500	27.16911	38.11980	28.66740	0.136821
1.25	0.625	27.08681	38.10540	27.96678	0.079862
1.25	0.750	26.98657	38.11500	27.45005	0.041649
1.25	0.875	27.02976	38.05899	27.36447	0.030347
1.25	1.125	27.06155	38.08300	27.32404	0.023816

Run ID: 092896a

VR=0.504 Uo=10.83 m/s
ADIABATIC EFFECTIVENESS, FSTI=12%
CONFIGURATION: LONG-HOLE

x/D	z(in)	Tinf(C)	Tjet(C)	Taw(C)	Eta
1.25	0.00000	28.4364	39.5760	35.1636	0.60390
2.5	0.00000	28.3754	39.5991	34.9151	0.58266
3.75	0.00000	28.3839	39.5822	33.8934	0.49199
5.0	0.00000	28.3922	39.5873	32.6764	0.38268
7.5	0.00000	28.4038	39.5791	31.2312	0.25300
10.0	0.00000	28.4157	39.5782	30.2613	0.16534

Run ID: 092896b

VR=1.05 Uo=10.92 m/s
ADIABATIC EFFECTIVENESS, FSTI=12%
CONFIGURATION: LONG-HOLE

x/D	z(in)	Tinf(C)	Tjet(C)	Taw(C)	Eta
1.25	0.00000	28.5015	38.9402	32.5725	0.38999
2.5	0.00000	28.6428	38.7452	32.7826	0.40978
3.75	0.00000	28.6211	38.7593	32.5723	0.38973
5.0	0.00000	28.5934	38.7614	31.9066	0.32584
7.5	0.00000	28.5979	38.7722	30.8893	0.22522
10.0	0.00000	28.5867	38.7839	30.4067	0.17847

File: htprofile

Approach BL for High-Turbulence Facility

x/D=-4.0

* Near-wall data given has not been corrected for near-wall effects or sensor diameter

y(in)*	z(in)	U (m/s)	urms (m/s)
0	0	1.76215	0.635879
0.001875	0	2.02521	0.746919
0.00375	0	2.76821	1.01997
0.005625	0	3.39417	1.24018
0.0075	0	4.10743	1.39157
0.01125	0	5.10932	1.56182
0.015	0	5.82319	1.61945
0.01875	0	6.2839	1.61337
0.0225	0	6.7233	1.62191
0.02625	0	7.03909	1.59693
0.03	0	7.26864	1.56222
0.03375	0	7.47518	1.57628
0.0375	0	7.55786	1.56086
0.045	0	7.85441	1.54098
0.0525	0	7.97517	1.51162
0.06	0	8.17843	1.5261
0.0675	0	8.33034	1.51131
0.075	0	8.40708	1.49393
0.0825	0	8.58074	1.52094
0.09	0	8.59402	1.51857
0.0975	0	8.71367	1.49318
0.105	0	8.81713	1.50853
0.1125	0	8.83896	1.50661
0.12	0	8.90047	1.59403
0.135	0	9.03551	1.56071
0.15	0	9.15462	1.52341
0.165	0	9.19013	1.52717
0.18	0	9.28015	1.53869
0.195	0	9.35503	1.55948
0.21	0	9.48143	1.53625
0.225	0	9.61987	1.52428
0.255	0	9.73391	1.53826
0.285	0	9.82852	1.55864
0.315	0	9.94553	1.54502
0.345	0	10.0141	1.50856
0.375	0	10.0159	1.59027
0.42	0	10.2482	1.50365
0.465	0	10.2839	1.5125
0.51	0	10.4295	1.50991
0.555	0	10.4701	1.4723
0.6	0	10.4589	1.4885
0.645	0	10.5686	1.47479
0.69	0	10.6069	1.43831
0.735	0	10.6308	1.48164
0.78	0	10.6467	1.41236
0.825	0	10.6693	1.38312
0.9	0	10.7216	1.42587
1.05	0	10.7269	1.37559
1.2	0	10.7697	1.39481
1.35	0	10.7313	1.33666
1.5	0	10.773	1.31144
1.65	0	10.7875	1.35673
1.8	0	10.7306	1.28579
2.025	0	10.7402	1.34678
2.25	0	10.7544	1.34572

File: ltprofile

Approach BL for Low-Turbulence Facility

x/D=-4.0

* Near-wall data given has not been corrected for near-wall effects or sensor diameter

y(in)*	z(in)	U (m/s)	urms (m/s)
0	0	1.90692	0.493513
0.001875	0	2.03295	0.544055
0.00375	0	2.67146	0.761169
0.005625	0	3.36138	0.978678
0.0075	0	3.95976	1.1129
0.01125	0	5.07033	1.25905
0.015	0	5.72446	1.25413
0.01875	0	6.2649	1.22502
0.0225	0	6.6478	1.18543
0.02625	0	6.89263	1.13831
0.03	0	7.10197	1.07581
0.03375	0	7.30432	1.05298
0.0375	0	7.45233	1.00871
0.045	0	7.70938	0.986815
0.0525	0	7.93087	0.914132
0.06	0	8.03039	0.918817
0.0675	0	8.15534	0.877159
0.075	0	8.27771	0.848399
0.0825	0	8.39777	0.869178
0.09	0	8.50467	0.858319
0.0975	0	8.60102	0.838416
0.105	0	8.67029	0.841842
0.1125	0	8.77474	0.832189
0.12	0	8.83543	0.8383
0.135	0	9.05767	0.810876
0.15	0	9.16428	0.792117
0.165	0	9.34302	0.763628
0.18	0	9.4548	0.752569
0.195	0	9.6225	0.747374
0.21	0	9.75373	0.719443
0.225	0	9.88299	0.710693
0.255	0	10.1261	0.64525
0.285	0	10.3051	0.594315
0.315	0	10.4724	0.453034
0.345	0	10.5956	0.367804
0.375	0	10.6978	0.297444
0.42	0	10.7524	0.191758
0.465	0	10.7731	0.134891
0.51	0	10.7805	0.102864
0.555	0	10.7777	0.086418
0.6	0	10.7674	0.078412
0.645	0	10.7495	0.067239
0.69	0	10.734	0.060464
0.735	0	10.7398	0.061070
0.78	0	10.742	0.061564
0.825	0	10.7428	0.058831
0.9	0	10.7328	0.055185
1.05	0	10.7422	0.058029
1.2	0	10.7393	0.057844
1.35	0	10.7251	0.050260
1.5	0	10.7235	0.051457
1.65	0	10.7163	0.048136
1.8	0	10.7112	0.042105
2.025	0	10.7196	0.049022
2.25	0	10.7071	0.044430

APPENDIX B: COMPUTER PROGRAMS

```
/*****************************************************************/
/*                                                               */
/*  Program: calibrate.c                                         */
/*  Written by: Steven Burd                                      */
/*  Purpose: This program is used to calibrate a single-wire     */
/*          using either a reference wind tunnel or the          */
/*          calibration jet                                      */
/*  Acknowledgements: Some of the content of this program        */
/*          is extracted from programs written by Songgang       */
/*          Qui, Ralph Volino, Henry Tsang, and Ling Wang        */
/*                                                               */
/*****************************************************************/

#include <gpib.h>
#include <stdio.h>
#include <fcntl.h>
#include <string.h>
#include <math.h>

#define void int

/* Definition of External Variables */
int ib3;
int nread;
int aabort, diagnosis, add_to_set;
int oldfile;
int no_inst;
int rdnumber;
double s_interval, v_mg_A;
double t_dry, t_wet, p_atm, density, waterden;
char filename[30];
char usage[] = "Usage: calib_1hw [-a runid or -d or -m nread
or -n]\n";

/* Area ratio correction for calibration jet */
#define AR 0.98992339

main(argc,argv)

int argc;
char *argv[];
{

extern int aabort, diagnosis, add_to_set;
extern int no_inst, rdnumber;
extern int nread;
extern char filename[];

void set_up_vm();
void enter_cond();
void acquire();

/* Set default values. */
diagnosis = 0;
add_to_set = 0;
no_inst = 0;
rdnumber = 0;

/* Enter experimental conditions. */
enter_cond();
if(aabort) goto the_end;

/* Set up A/D converter. */
if(! no_inst) set_up_vm();
if(aabort) goto the_end;

/* Acquire data */
acquire();
if(aabort) goto the_end;

/* Address for abort sequence. */
the_end:;
}


/*****************************************************************/
/* Routine for entering nominal test conditions                  */
/*****************************************************************/
enter_cond()
/*****************************************************************/


{
#define NDUMMY 50
#define AMAX 4096

int babort, diagnosis, add_to_set; /* = 1 =>  Add runs to an
existing
                                set of data. */
extern int oldfile; /* = 1  => file exists */
extern int rdnumber, nread;
extern double s_interval, v_mg_A;
extern char filename[];

FILE *storefile;
int i; /* index */
int si; /* index */
int inerr; /* = 1  => error in input */
static double sample_int[17] = {0.0,
10.e-06,20.e-06,50.e-06,
100.e-06,200.e-06,500.e-06,
1.e-03,2.e-03,5.e-03,
10.e-03,20.e-03,50.e-03,
100.e-03,200.e-03,500.e-03,
1.0
}; /* array of NORLAND sample intervals */
static double voltage_mg[9] = {0.0,
0.1,0.2,0.5,
1.0,2.0,5.0,
10.,20.
}; /* array of NORLAND voltage ranges */

static char dummy[NDUMMY]; /* dummy array to keep room
for furtherdescriptors for runs */
char runid[10], resp[20];

/* Set size of data set. */
if(! rdnumber) nread = 1024;

if(! add_to_set) {
    /* Read run identification and check whether the
corresponding
          file already exists. */
    for(inerr = 1; inerr; ) {
          printf("\nEnter run identification: \n\n");
          printf("(Use the format mmddyyss where: \n");
          printf(" mm = month, dd = day, yy = year,\n");
          printf(" and ss = a sequence number of the day's");
          printf(" runs)\n");
          scanf("%s", runid);
          printf("mm = %c%c   ", runid[0], runid[1]);
          printf("dd = %c%c   ", runid[2], runid[3]);
          printf("yy = %c%c   ", runid[4], runid[5]);
          printf("ss = %c%c\n ", runid[6], runid[7]);
          strcpy(filename,"cal");
          strcpy(&filename[3],runid);
          printf(" The filename is "%s"\n\n", filename);
          storefile = fopen(filename, "r+");
          if(storefile == (FILE*)NULL)
               {printf(" This file did not exist but may now ");
               printf("be created.\n");
               oldfile = 0;}
          else
               {printf(" This file exists and data may be
added.\n");
               oldfile = 1;}
          printf("\n Entry correct? (y or n)\n");
          scanf("%s", resp);
          if(resp[0] == 'y' || resp[0] == 'Y')
               {inerr = 0;}
          else if(resp[0] == 'n' || resp[0] == 'N')
               {inerr = 1;}
          else
          {printf(" Respond with y, Y for 'yes' ");
          printf("or with n, N for 'no' next time.\n");}
          }

    if(! oldfile)
          {printf(" File has now been created.\n");
```

```
        storefile = fopen(filename,"a+");}
    fclose(storefile);

    if(! oldfile) {
        /* Read nominal test conditions from key board. */
        for(inerr = 1; inerr; ) {
            printf("\nEnter a 50 character comment line:\n");
            printf("Include sensor type and serial number.\n");
            printf("(Use _ instead of blank spaces!)\n");
            for(i = 1; i <= 5; i++) printf("1234567890");
            printf("\n");
            for(i = 1; i <= 6; i++) printf("%d         ", i-1);
            printf("\n");
            scanf("%s", dummy);
            printf("Comment line: \n%s", dummy);
            printf("\n Entry correct? (y or n)\n");
            scanf("%s", resp);
            if(resp[0] == 'y' || resp[0] == 'Y')
                {inerr = 0;}
            else if(resp[0] == 'n' || resp[0] == 'N')
                {inerr = 1;}
            else
                {printf(" Respond with y, Y for 'yes' ");
                printf("or with n, N for 'no' next time.\n");}
            }

        for(inerr = 1; inerr; )
            {printf("\nEnter sample interval: \n");
            printf("  sample      code\n");
            printf("  interval  number\n");
            printf("  (seconds)\n");
            printf("\tEXT\t\t0\n");
            for(i = 1; i <= 16; i++)
                printf("\t%7.3e\t%d\n", sample_int[i], i);
            printf("EXT => TTL-signal on SAMPLE IN \n");
            printf("      triggers sampling.\n");
            printf("\n Enter code for sample interval.\n");
            while(scanf("%d", &si) == 0){
                getchar();
                printf(" Enter an integer code number!\n");
                }
            printf(" sample interval = %g sec\n",
sample_int[si]);
            printf(" sample frequency = %e Hz\n",
                                1./sample_int[si]);
            printf(" Entry correct? (y or n)\n");
            scanf("%s", resp);
            if(resp[0] == 'y' || resp[0] == 'Y') {
                s_interval = sample_int[si];
                inerr = 0;
                }
            else if(resp[0] == 'n' || resp[0] == 'N') {
                inerr = 1;
                }
            else {
                printf(" Respond with y, Y for 'yes' ");
                printf("or with n, N for 'no' next time.\n");
                }
            }

        for(inerr = 1; inerr; )
            {printf("\nEnter voltage range ");
            printf("for channel A: \n");
            printf("  voltage       code\n");
            printf("  range         number\n");
            printf("  (V)\n");
            for(i = 0; i <= 8; i++)
                printf("\t%7.3e\t%d\n", voltage_rng[i], i);
            printf("\n Enter code for voltage range.\n");
            while(scanf("%d", &si) == 0){
                getchar();
                printf(" Enter an integer code number!\n");
                }
            printf(" voltage range = %g V\n", voltage_rng[si]);
            printf(" Entry correct? (y or n)\n");
            scanf("%s", resp);
            if(resp[0] == 'y' || resp[0] == 'Y') {
                v_rng_A = voltage_rng[si];
                inerr = 0;
```

```
                }
            else if(resp[0] == 'n' || resp[0] == 'N') {
                inerr = 1;
                }
            else {
                printf(" Respond with y, Y for 'yes' ");
                printf("or with n, N for 'no' next time.\n");
                }
            }

        /* Write runid and parameters to new data file. */
        storefile = fopen(filename, "r+");
        fwrite(runid,sizeof(char),10,storefile);
        fwrite(&s_interval,sizeof(double),1,storefile);
        fwrite(&v_rng_A,sizeof(double),1,storefile);
        fwrite(&nread,sizeof(int),1,storefile);
        fwrite(dummy,sizeof(char),NDUMMY,storefile);
        fclose(storefile);
        }
    else {
        /* Read parameters from old data file and provide a
summary. */
        storefile = fopen(filename, "r+");
        fread(runid,sizeof(char),10,storefile);
        fread(&s_interval,sizeof(double),1,storefile);
        fread(&v_rng_A,sizeof(double),1,storefile);
        fread(&nread,sizeof(int),1,storefile);
        fread(dummy,sizeof(char),NDUMMY,storefile);
        fclose(storefile);
        printf(" sample interval = %f sec\n", s_interval);
        printf(" voltage range channel A = %g V\n", v_rng_A);
        printf(" %d readings per calibration point\n", nread);
        printf(" %s\n", dummy);
        }
    }
else {
    storefile = fopen(filename, "r+");
    if(storefile == (FILE*)NULL) {
        printf(" This file does not exist.\n");
        babort = 1;}
    else {
        oldfile = 1;

        /* Read parameters from old data file. */
        fread(runid,sizeof(char),10,storefile);
        fread(&s_interval,sizeof(double),1,storefile);
        fread(&v_rng_A,sizeof(double),1,storefile);
        fread(&nread,sizeof(int),1,storefile);
        fread(dummy,sizeof(char),NDUMMY,storefile);
        fclose(storefile);
        }
    }
}
/*********************************************************************/
/*  Routine for setting up/initializing Norland Prowler             */
/*  on IEEE Interface                                                */
/*********************************************************************/
set_up_vm()
/*********************************************************************/
{
extern int  ib3;
extern double  s_interval, v_rng_A;
int  i, ichar, len;  /* indeces */
char  status_byte;
static char  set3[100];
static char  resp[10];
static char  str_s_int[12];
static char  rng_A[12];

/* Send message to screen. */
printf("NORLAND Prowler will now be configured.\n");

/* Identify device and set up interface. */
ib3 = ibfind("dev3"); /* Define device ID. */
ibtmo(ib3,14); /* Timeout = 30sec */

/* Generate character string representing the sample interval. */
sprintf(str_s_int,"%5e",s_interval);
len = strlen(str_s_int);
```

```
 for(ichar = 0; ichar < len; ichar++) {
      if(str_s_int[ichar] == 'e') str_s_int[ichar] = ';';
      if(str_s_int[ichar] == '+') str_s_int[ichar] = ';';
      if(str_s_int[ichar] == '-') str_s_int[ichar] = '<';
      if(str_s_int[ichar] == '.') str_s_int[ichar] = ':';
      }
 if(diagnosis) printf("str_s_int = %s\n", str_s_int);

 /* Generate character string representing voltage range A. */
 sprintf(rng_A,"%5e",v_rng_A);
 len = strlen(rng_A);
 for(ichar = 0; ichar < len; ichar++) {
      if(rng_A[ichar] == 'e') rng_A[ichar] = ';';
      if(rng_A[ichar] == '+') rng_A[ichar] = ';';
      if(rng_A[ichar] == '-') rng_A[ichar] = '<';
      if(rng_A[ichar] == '.') rng_A[ichar] = ':';
      }
 if(diagnosis) printf("rng_A = %s\n", rng_A);

 /* Set controls on device and check interface communications.
 */

 /* Generate string of control commands to be sent to device. */
 strcpy(set3,"]LA"); /* Beeper off */
 strcat(set3,"Y"); /* ACQ. MODE */
 strcat(set3,"C"); /* MEASURED HOLD */
 strcat(set3,"L1:00;<2="); /* SAMPLE INTERVAL */
 strcat(set3,"["); /* A SETUP */
 strcat(set3,"@"); /* ACTIVE */
 strcat(set3,"C"); /* RANGE */
 strncat(set3,rng_A,12);
 strcat(set3,"=");
 strcat(set3,"E0="); /* BIAS = 0% */
 strcat(set3,"GC"); /* COUPLING = DC */
 strcat(set3,"\\"); /* B SETUP */
 strcat(set3,"@"); /* ACTIVE */
 strcat(set3,"C5="); /* RANGE */
 strcat(set3,"E0="); /* BIAS = 0% */
 strcat(set3,"GC"); /* COUPLING = DC */
 strcat(set3,"\0"); /* Terminate string with null character. */

 if(diagnosis) printf("set3 = %s\n", set3);

 /* Set controls on device and check interface communications.
 */
 if(diagnosis) {
      len = strlen(set3);
      for(ichar = 0; ichar < len; ichar++) {
           ibwrt(ib3,&set3[ichar],1); /* Send string. */
           printf("character = %c\t", set3[ichar]);
           ibrsp(ib3, &status_byte);
           printf("status byte = %d\n", status_byte);
           }
      }
 else {
      len=strlen(set3);
      for(ichar = 0; ichar < len; ichar++) {
           ibwrt(ib3,&set3[ichar],1); /* Send string to device. */ }
      }
 sleep(5);
 }

/******************************************************************/
/* Routine to acquire voltage data from Norland Prowler.  User
 enters data from calibration facility and calibration velocity and
data is writen to file 'calfile' */
/******************************************************************/
acquire()
/******************************************************************/
{
#define  STRLNG 30
#define  SMAX 8452  /* number of entries in string received
from
              NORLAND */
#define pi 3.141592654

extern int  ib3;
extern int  aabort, diagnosis, no_inst, rdnumber;
extern double  s_interval, v_rng_A;
extern double  t_dry, t_wet, p_atm, density, waterden; /* air
conditions during run */
extern int  nread;
extern char  filename[];

FILE  *storefile, *calfile;

int    inerr, /* error in input data */
     channel, /* channel number: 1 = A, 2 = B */
     more_pts, /* acquire more calibration points */
     i, j  /* auxiliary counter */
     ;
double  voffset, /* voltage that was subtracted from
                    hot wire signal during conditioning */
     vgain, /* multiplication factor that was
                    applied to voltage during signal
                    conditioning */
     voltage, /* hot-wire bridge output voltage */
     off_set, /* auxiliary voltage offset variable */
     mvalue,  /* manually entered numerical value e.g. valve
position */
     a1, a2,
     ncalib = 0.5,
     acalib = 5.4754,
     bcalib = 1.5778
     ;
static double   sumu, /* sum of instantaneous velocities */
          sumu2, /* sum of squares of instantaneous
                         velocities */
          umean, /* ensemble averaged velocity */
          urms /* velocity fluctuation */
          ;
double  pinpa, /* pressure in Pa */
     ujet; /* calibration jet velocity */
static char  dummy[NDUMMY], buffer[NDUMMY];
char  resp[STRLNG];
char  status_byte;
char  acquire[2], beeper_on[4];
char  rdcmd[STRLNG], inactive[50], command[STRLNG];

int  *iptr, ifactor1, hexdigit, sign, ivalue;
int  bit7, bit6, bit5, bit4, bit3, bit2, bit1, bit0;
double  *dptr, factor1, factor2, factor, offset;
static char  readstring[SMAX], digit[2];
char  *ptrd;

/* Generate strings for ACQUIRE and Beeper On commands.
*/
strcpy(acquire,"R");
strcpy(beeper_on,"]LC"); /* Beeper on */

/* Generate command string for data transfer from NORLAND.
*/
strcpy(rdcmd,"_"); /* I/O */
strcat(rdcmd,"K"); /* TRANSFER */
strcat(rdcmd,"C"); /* OUTPUT */
strcat(rdcmd,"G"); /* XFAST BINARY */
strcat(rdcmd,"A"); /* ARRAY A */
strcpy(command,rdcmd);

/* Make the B channel setup inactive */
strcpy(inactive,"\\A");
ibwrt(ib3,inactive,strlen(inactive));

/* Enter voltage gain */
for(inerr = 1; inerr; ){
     printf("\nEnter voltage gain.\n");
     scanf("%lf",&vgain);
     printf("\n Voltage gain = %8.4g\n", vgain);
     printf("\nEntry correct ? (y or n)\n");
     scanf("%s", resp);
     if(resp[0] == 'y' || resp[0] == 'Y')
     {inerr = 0;}
     else if(resp[0] == 'n' || resp[0] == 'N')
          {inerr = 1;}
     else
          {printf("\n Respond with y, Y for 'yes' or n, N for 'no' ");
          printf("next time. \n");}
     }
```

```
/* Enter voltage offset */
for(inerr = 1; inerr; ){
     printf("\n Enter voltage offset. \n");
     scanf("%lf", &voffset);
     printf(" Voltage offset = %8.4g V\n", voffset);
     printf(" Entry correct ? (y or n)\n");
     scanf("%s",resp);
     if(resp[0] == 'y' || resp[0] == 'Y')
          {inerr = 0;}
     else if(resp[0] == 'n' || resp[0] == 'N')
          {inerr = 1;}
     else
          {printf("\n Respond with y, Y for 'yes' or n, N for 'no' ");
          printf("next time\n");}
     }

/* Wake up the operator with a bell */
/* for(i = 0; i < 10; i++ ) printf("%c", '\007'); */

/* loop for calibration points */
for(more_pts = 1; more_pts;){

     /* Enter room air conditions - go to routine */
     air_state();

      /* Enter water density for manometer reading */
      printf("Enter water density corresponding to ambient
conditions\n");
      scanf("%lf",&waterden);
      printf("    \n");

     /* Enter pressure differential measured with manometer,
mvalue.
          mvalue is the total pressure differential in inches of
water */
     for(inerr = 1; inerr; ){
          printf("\ndescriptive value \n");
          printf("(e.g. valve position, manometer pressure):\n");
          printf(" Enter number.\n");
          scanf("%lf", &mvalue);
          printf(" mvalue = %f \n", mvalue);
          printf(" Entry correct? (y or n)\n");
          printf(" Enter 'y' to start acquisition.\n");
          scanf("%s", resp);
          if(resp[0] == 'y' || resp[0] == 'Y')
               {inerr = 0;}
          else if(resp[0] == 'n' || resp[0] == 'N')
               {inerr = 1;}
          else
               {printf(" Respond with y, Y for 'yes', ");
               printf("or with n, N for 'no' next time.\n");}
          }

     /* If no instrument is available on the IEEE interface ... */
     if(no_inst) goto the_end;

     /* Acquire data with NORLAND until either the maximum
number of AMAX
          is reached or the results have converged. */
     printf(" Data will be acquired now.\n");

     sleep(5);
     /* Send string to start acquisition. */
     ibwrt(ib3,acquire,strlen(acquire));

     /* Wait until NORLAND starts acquisition. */
     /* (Loop to test whether NORLAND is already acquiring). */
     do{
          ibrsp(ib3,&status_byte);
          if(diagnosis)printf("status_byte = %o\n", status_byte);
          }
     while(!status_byte & 5);
     if(diagnosis)printf("N started acquisition\n");

     if(diagnosis)printf("wait for end of acquisition\n");
     if(diagnosis)printf("status_byte = %o\n", status_byte);

     /* Wait until NORLAND is done acquiring. */
```

```
     /* (Loop to test whether NORLAND is still acquiring.) */
     i = 0;
     do{
          ibrsp(ib3,&status_byte);
          if(diagnosis){
               i += 1;
               if(i > 100){
                    i = 0;
                    printf("%o\n", status_byte);
                    }
               }
          }
     while(status_byte & 5);
     if(diagnosis)printf("N stopped acquisition\n");
     if(diagnosis)printf("status_byte = %o\n", status_byte);

          /* Reset sums. */
          sumu = 0.0;
          sumu2 = 0.0;

          /* Send command to read NORLAND buffer. */
          ibwrt(ib3,command,strlen(command));

          /* Read data from NORLAND. */
          ibrd(ib3,readstring,SMAX);

          if(diagnosis)printf("reading done\n");
          if(diagnosis)printf("status_byte = %o\n", status_byte);

          /* Evaluate Factor and Offset from data sent in
          XFAST binary format. See NORLAND Prowler
manual
          volume 2 "Options for the Prowler", pp.46-48. */

          /* Calculate Factor. */

          /* The first two hex digits (Word 1) represent
               the log to the base two,
               biased by 128, of the first factor
               of the Factor. */
          ptrd = readstring;
          sscanf(ptrd,"%2X",&ifactor1);

          /* Compute the first factor of the Factor. */
          factor1 = pow(2.,((double)ifactor1 - 128.));

          /* The next six hex digits (Words 2, 3, 4) represent
          the sign and the base two fractions of the second
          factor of Factor.  Calculate contributions to the
          second factor, hex-digit by hex-digit. */
          for(i=0, factor2=0; i<6; i++){
               strncpy(digit,(ptrd+2+i),1);
               digit[1] = '\0';

               /* Determine bit pattern corresponding to each
               hex-digit and calculate the second factor. */
               sscanf(digit,"%X",&hexdigit);
               bit0 = hexdigit & 1;
               bit1 = hexdigit & 2;
               bit2 = hexdigit & 4;
               bit3 = hexdigit & 8;
               if(i==0){
                    if(bit3)
                         sign = -1;
                    else
                         sign = 1;
                    bit3 = 1;
                    }
               if(bit3) factor2 = factor2
                         + pow(2.,-(double)(i*4 + 1));
               if(bit2) factor2 = factor2
                         + pow(2.,-(double)(i*4 + 2));
               if(bit1) factor2 = factor2
                         + pow(2.,-(double)(i*4 + 3));
               if(bit0) factor2 = factor2
                         + pow(2.,-(double)(i*4 + 4));
               }
          factor = (double) sign * factor1 * factor2;
```

```
    /* Calculate Offset. */

    /* The first two hex digits
         (Word 1) represent the log to the base two,
         biased by 128, of the first factor
         of the Offset. */
    sscanf((ptrd+8),"%2X",&ifactor1);

    /* Compute the first factor of the Offset. */
    factor1 = pow(2.,((double)ifactor1 - 128.));

    /* The next six hex digits (Words 2, 3, 4) represent
    the sign and the base two fractions of the second
    factor of Offset. */
    /* Calculate contributions to the second factor,
    hex-digit by hex-digit. */
    for(i=0, factor2=0; i<6; i++){
         stmcpy(digit,(ptrd+10+i),1);
         digit[1] = '\0';

         /* Determine bit pattern corresponding to each
         hex-digit and calculate the second factor. */
         sscanf(digit,"%X",&hexdigit);
         bit0 = hexdigit & 1;
         bit1 = hexdigit & 2;
         bit2 = hexdigit & 4;
         bit3 = hexdigit & 8;
         if(i==0){
              if(bit3)
                   sign = -1;
              else
                   sign = 1;
              bit3 = 1;
              }
         if(bit3) factor2 = factor2
                   + pow(2.,-(double)(i*4 + 1));
         if(bit2) factor2 = factor2
                   + pow(2.,-(double)(i*4 + 2));
         if(bit1) factor2 = factor2
                   + pow(2.,-(double)(i*4 + 3));
         if(bit0) factor2 = factor2
                   + pow(2.,-(double)(i*4 + 4));
         }
    offset = (double) sign * factor1 * factor2;
    if(diagnosis)printf("fraction and offset are calc\n");

    /* Evaluate data points. */
    off_set = offset + voffset * vgain;
    for(j = 0, i = 256; i < (2 * nread + 256); j++, i+=2) {

         /* Calculate voltage value according to
          NORLAND Prowler manual pp.48-49 of 5/20/85.
*/
         stmcpy(digit, (ptrd + i), 1);
         digit[1] = '\0';
         a1 = *digit;
         if(a1 < 0)
              a1 += 256;
         stmcpy(digit, (ptrd + i +1), 1);
         digit[1] = '\0';
         a2 = *digit;
         if(a2 < 0)
              a2 +=256;
         voltage = ((a2 * 256 + a1 - 32768)*factor
                   + off_set) / vgain;

         if(diagnosis) printf("voltage = %g\n", voltage);

         /* Update sums. */
         sumu += voltage;
         sumu2 += voltage*voltage;
         }

    /* Calculate ensemble averaged voltage
          and rms voltage fluctuation. */
         umean = sumu / (double)nread;
         urms = sqrt(sumu2/(double)nread -
umean*umean);
         printf("Mean voltage = %g\n",
                   umean);
              printf("\tvoltage fluctuation = %g\n",
                   urms);

    /* Determine the calibration jet velocities, based upon the
         manometer pressure */

          /* For calibration with calibration jet */
         /* Note, conceming calculating p ( in Pa):
                   @249.1 " water = Pa
                 1.009    conversion from static to dynamic P
                   mvalue   total manometer reading
                   waterden density of manometer fluid*/
         /* pinpa = 9.81*waterden*.0254 * 1.009 * mvalue; */

         /* For calibration using a reference flow source
(tunnel) */
         /* Note, conceming calculating p ( in Pa):
                waterden  density of manometer fluid
                   mvalue    total manometer reading in in. water
                   AR = 1    no area correction needed*/
          /* For calibration in the wind tunnel */
          pinpa = mvalue*9.81*waterden*.0254;
          AR =1;

          /* Calibration velocity */
         ujet = sqrt((2.0 / density) * pinpa/AR);
         printf("calibration jet velocity = %lf", ujet);

          /* Store Calibration Information in output file --
calfile*/
              calfile = fopen("calfile","a");
              if(calfile == (FILE*)NULL) printf("calfile was not
opened\n");
              if(fprintf(calfile, "%f\t%f\n", ujet, umean ) < 0)
              printf("fprintf failed\n");
              fclose(calfile);
         if(diagnosis)printf("data converted\n");

    /* Store the results from this radial location.
    if(diagnosis) printf("will open storefile\n");
    storefile = fopen(filename,"r+");
    if(diagnosis) printf("opened storefile\n");
    if(storefile == (FILE*)NULL)
         printf("fopen failed\n");
    if(fseek(storefile,0L,2))
         printf("fseek failed\n"); /* Move to end of file. */
    if(fwrite(&mvalue,sizeof(double),1,storefile) != 1)
         printf("fwrite failed\n");
    if(fwrite(&umean,sizeof(double),1,storefile) != 1)
         printf("fwrite failed\n");
    if(fwrite(&urms,sizeof(double),1,storefile) != 1)
         printf("fwrite failed\n");
    if(fwrite(&t_dry,sizeof(double),1,storefile) != 1)
         printf("fwrite failed\n");
    if(fwrite(&t_wet,sizeof(double),1,storefile) != 1)
         printf("fwrite failed\n");
    if(fwrite(&p_atm,sizeof(double),1,storefile) != 1)
         printf("fwrite failed\n");
    if(diagnosis) printf("will close storefile\n");
    if(fclose(storefile) == EOF) printf("fclose failed\n");
    printf("Data were stored in file.\n"); */

    /* Wake up the operator with a bell */
    /* for(i = 0; i < 10; i++; ) printf("%c", '\007'); */

    /* Calibrate wire for another velocity ? */
    for(inerr = 1; inerr;)
    {
    printf("Calibrate wire at another calibration jet velocity ? ");
    printf("Respond with y, Y for 'yes' or n, N for 'no'\n");
    scanf("%s",resp);
    if(resp[0] == 'y' || resp[0] == 'Y')
         {more_pts = 1;}
    else
         {more_pts = 0;}
    if(more_pts)
         printf("\n Take data at another calibration jet
velocity\n");
```

```
        else
              printf("\n No further data will be taken\n");
        printf("\n Entry correct ? (y or n)");
        scanf("%s",resp);
        if(resp[0] == 'y' || resp[0] == 'Y')
              {inerr = 0;}
        else if(resp[0] == 'n' || resp[0] == 'N')
              {inerr = 1;}
        else
              {printf("\n Respond with y, Y for 'yes' ");
              printf("or n, N for 'no' next time.\n");}
        }
        }

/* Send string to turn beeper on. */
ibwrt(ib3,beeper_on,strlen(beeper_on));

the_end: printf("No further data will be acquired.\n");
}


/*************************************************************************/
/* Routine which gathers data relevant to calibration.                  */
/* User enters values or values taken from data file.                   */
/*************************************************************************/
air_state()
/*************************************************************************/
{

extern int  diagnosis, oldfile;
extern char  filename[];
extern double  t_dry, t_wet, p_atm, density; /* air conditions
during run,
                stored in Kelvin and Pascal internally. */

FILE  *storefile;

int    inerr, /* error in input data */
      nread, /* number of readings per cycle */
      i /* auxiliary counter */
      ;
long  offset, sizeofheader, sizeofset;
char  resp[STRLNG];
double  gas_const = 8315.,
      air_mwt = 28.96;

      /* Enter ambient air conditions. */
      if(diagnosis) printf("oldfile = %d\n", oldfile);
      if(oldfile) {
           printf("Current ambient air conditions:\n");
           resp[0] = 'n';
           }
      else {
           printf("\nEnter ambient air conditions.\n");
           resp[0] = 'y';
           oldfile = 1;
           }
      switch(resp[0]) {
      case 'n': case 'N':{
           /* Determine the size of the header. */
           sizeofheader = (long)((10+NDUMMY)*sizeof(char)
                          + 2*sizeof(double)
                          + sizeof(int));
           storefile = fopen(filename, "r");
           if(diagnosis) printf("fopen ok\n");
           offset = (long)(sizeofheader - sizeof(int)
                          - NDUMMY * sizeof(char));
           fseek(storefile,offset,0);
           if(diagnosis) printf("fseek @ beginning ok\n");
           fread(&nread,sizeof(int),1,storefile);
           if(diagnosis) printf("fread ok\n");

           /* Determine the size of a data set. */
           sizeofset = (long)(6 * sizeof(double));
           if(diagnosis) printf("sizeofset ok\n");
           /* Determine offset of latest air data
                          from end of file. */
           fseek(storefile,0L,2); /* Move to end of file. */
           if(diagnosis) printf("fseek @ end ok\n");
```

```
           /* Check whether there is an entry for the state
                of the air. Read the air data. */
           if(ftell(storefile) >= sizeofheader + sizeofset) {
                if(diagnosis) printf("ftell >\n");
                offset = - (long)(3 * sizeof(double));
                fseek(storefile,offset,2);
                if(diagnosis) printf("fseek ok\n");
                fread(&t_dry,sizeof(double),1,storefile);
                fread(&t_wet,sizeof(double),1,storefile);
                fread(&p_atm,sizeof(double),1,storefile);
                printf("dry-bulb temperature = %lf degr.C\n",
                          t_dry - 273.15);
                printf("wet-bulb temperature = %lf degr.C\n",
                          t_wet - 273.15);
                printf("atmospheric pressure = %lf bar\n",
                          p_atm / 1.e+05);

                /* density, in kg/m^3 */
                density = p_atm * air_mwt / gas_const / t_dry;
                printf("dry air density = %1f Kg/m^3\n",
                          density);

                printf("Entry correct? (y/n)");
                scanf("%s", resp);
                if(resp[0] == 'y' || resp[0] == 'Y')
                     break;
                }
           else {
                printf("There is no old entry of ambient air
data.\n");
                }
           }
      case 'y': case 'Y':{
           /* Enter ambient air conditions. */
           for(inerr = 1; inerr; ){
                printf("Enter\tdry-bulb temperature (degr.C),\n");
                printf("\twet-bulb temperature (degr.C),\n");
                printf("\tatmospheric pressure (bar),\n");
                scanf("%lf%lf%lf", &t_dry, &t_wet, &p_atm);
                printf("dry-bulb temperature = %lf degr.C\n",
                       t_dry);
                printf("wet-bulb temperature = %lf degr.C\n",
                       t_wet);
                printf("atmospheric pressure = %lf bar\n",
                       p_atm);
                t_dry += 273.15;
                t_wet += 273.15;
                p_atm *= 1.e+05;

                /* density, in kg/m^3 */
                density = p_atm * air_mwt / gas_const / t_dry;
                printf("dry air density = %1f kg/m^3\n",
                       density);

                printf("Entry correct? (y/n)\n");
                scanf("%s", resp);
                if(resp[0] == 'y' || resp[0] == 'Y')
                     inerr = 0;
                else if(resp[0] == 'n' || resp[0] == 'N')
                     inerr = 1;
                else {
                     printf("Enter numbers and \n");
                     printf("respond with y, Y for 'yes' ");
                     printf("or with n, N for 'no' next time.
                          \n");
                     }
                }
           }
      break;
      }
}
```

```c
/*****************************************************************/
/*                                                               */
/* Program: single.c                                             */
/* Written by: Steven Burd                                       */
/* Purpose: This program is used to calculate the velocities     */
/*       and rms velocity fluctuations as measured by a          */
/*       single hot-wire sensor.  The program is designed        */
/*       for reading hot-wire voltages from a Norland            */
/*       Prowler unit.                                           */
/* Acknowledgements: Some of the content of this program         */
/*       is extracted from programs written by Songgang          */
/*       Qui, Ralph Volino, Henry Tsang, and Ling Wang           */
/*                                                               */
/*****************************************************************/


#include <gpib.h>
#include <stdio.h>
#include <fcntl.h>
#include <string.h>
#include <math.h>

#define void int

/* Definition of External Variables */
int  ib3;
int  nread;
int  aabort, diagnosis;
double  s_interval, v_mg_A, v_mg_B,t_ref,t_dry,t_sensor,vcorr;
char  usage[] = "Usage: steady_hw [-d]\n";
char  vA[40];
char  filename[40];
char  volt[40];

main(argc,argv)
int argc;
char *argv[];
{

extern int  aabort, diagnosis;
extern int  nread;
extern char vA[], vB[];
extern char filename[];
extern char volt[];

void  set_up_vmss();
void  enter_condss();
void  acquiress();

/* Set Default Values. */
diagnosis = 0;
t_sensor=250;

/* Enter Experimental Conditions. */
enter_condss();
if(aabort) goto the_end;

/* Set Up A/D Converter. */
set_up_vmss();
if(aabort) goto the_end;

/* Acquire Signal. */
acquiress();
if(aabort) goto the_end;

/* Address for Abort Sequence. */
the_end:;
}

/***************************************************************/
/*  Routine for entering nominal test conditions               */
/***************************************************************/
enter_condss()
/***************************************************************/
{
#define NDUMMY 50
#define AMAX 4096
#define NPTS 4096
extern int aabort, diagnosis;
extern int nread;
extern double s_interval, v_mg_A, v_mg_B,t_ref,t_dry;
extern char vA[], vB[];
extern char filename[], volt[];

int  i;  /* index */
int  si;  /* index */
int  inerr;  /* = 1  => error in input */
static double  sample_int[17] = {0.0,
10.e-06,20.e-06,50.e-06,
100.e-06,200.e-06,500.e-06,
1.e-03,2.e-03,5.e-03,
10.e-03,20.e-03,50.e-03,
100.e-03,200.e-03,500.e-03,
1.0
};  /* Array of NORLAND Sample Intervals */
static double  voltage_mg[9] = {0.0,
                        0.1,0.2,0.5,
                        1.0,2.0,5.0,
                        10.,20.
                        };  /* Array of NORLAND Voltage Ranges */

static char  dummy[NDUMMY]; /* dummy array to keep room
for further
                        descriptors for runs */
char  runid[10], resp[20];
FILE  *storefile;

/* Set Size of Data Set. */
nread = NPTS;

     printf("This program (steady) is used to acquire 1 or 2
channels\n");
     printf("of voltages via the NORLAND\n");

      /* Output file assignment */
     for(inerr = 1; inerr; ){
          printf("\nEnter run identification: \n\n");
          printf("(Use the format mmddyyss where: \n");
          printf(" mm = month, dd = day, yy = year,\n");
          printf(" and ss = a sequence number of the day's");
          printf(" runs) \n");
          scanf("%s", runid);
          strcpy(vA,"vA");
          strcpy(&filename[0],runid);
          strcpy(&vA[2],runid);
          printf(" The store file name is '%s' \n", filename);
          printf(" The channel A file is '%s' \n", vA);
          printf("Entries correct? (y or n)\n");
          scanf("%s",resp);
          if(resp[0] == 'y' || resp[0] == 'Y')
               inerr = 0;
          else if(resp[0] == 'n' || resp[0] == 'N')
               inerr = 1;
          else
               {printf(" Respond with y, Y for 'yes' ");
               printf("or with n, N for 'no' next time.\n");}
          }

      /* Set sample interval */
     for(inerr = 1; inerr; )
          {printf("\nEnter sample interval: \n");
          printf("  sample      code\n");
          printf("  interval  number\n");
          printf("  (seconds)\n");
          printf("\tEXT\t\t0\n");
          for(i = 1; i <= 16; i++)
          printf("\t%7.3e\t%d\n", sample_int[i], i);
          printf("EXT => TTL-signal on SAMPLE IN \n");
          printf("       triggers sampling.\n");
          printf("\n Enter code for sample interval.\n");
          while(scanf("%d", &si) == 0){
               getchar();
               printf(" Enter an integer code number!\n");
               }
          printf(" sample interval = %g sec\n", sample_int[si]);
          printf(" sample frequency = %e Hz\n",
                         1./sample_int[si]);
```

```
        printf(" Entry correct? (y or n)\n");
        scanf("%s", resp);
        if(resp[0] == 'y' || resp[0] == 'Y') {
            s_interval = sample_int[si];
            inerr = 0;
            }
        else if(resp[0] == 'n' || resp[0] == 'N') {
            inerr = 1;
            }
        else {
            printf(" Respond with y, Y for 'yes' ");
            printf("or with n, N for 'no' next time.\n");
            }
        }

    /* First channel - channel to which hot-wire connected */
    for(inerr = 1; inerr; )
        {printf("\nEnter voltage range ");
        printf("for channel A: \n");
        printf("  voltage       code\n");
        printf("  range         number\n");
        printf("  (V)\n");
        for(i = 0; i <= 8; i++)
        printf("\t%7.3e\t%d\n", voltage_rng[i], i);
        printf("\n Enter code for voltage range.\n");
        while(scanf("%d", &si) == 0){
            getchar();
            printf(" Enter an integer code number!\n");
            }
        printf(" voltage range = %g V\n", voltage_rng[si]);
        printf(" Entry correct? (y or n)\n");
        scanf("%s", resp);
        if(resp[0] == 'y' || resp[0] == 'Y') {
            v_rng_A = voltage_rng[si];
            inerr = 0;
            }
        else if(resp[0] == 'n' || resp[0] == 'N') {
            inerr = 1;
            }
        else {
            printf(" Respond with y, Y for 'yes' ");
            printf("or with n, N for 'no' next time.\n");
            }
        }

    /* Second channel - Not used when measuring with one
hot-wire */
    for(inerr = 1; inerr; )
        {printf("\nEnter voltage range ");
        printf("for channel B: \n");
        printf("  voltage       code\n");
        printf("  range         number\n");
        printf("  (V)\n");
        for(i = 0; i <= 8; i++)
        printf("\t%7.3e\t%d\n", voltage_rng[i], i);
        printf("\n Enter code for voltage range.\n");
        while(scanf("%d", &si) == 0){
            getchar();
            printf(" Enter an integer code number!\n");
            }
        printf(" voltage range = %g V\n", voltage_rng[si]);
        printf(" Entry correct? (y or n)\n");
        scanf("%s", resp);
        if(resp[0] == 'y' || resp[0] == 'Y') {
            v_rng_B = voltage_rng[si];
            inerr = 0;
            }
        else if(resp[0] == 'n' || resp[0] == 'N') {
            inerr = 1;
            }
        else {
            printf(" Respond with y, Y for 'yes' ");
            printf("or with n, N for 'no' next time.\n");
            }
        }

    /* Temperatures for Corrections to Hot-Wire Sensitivity */
        for(inerr = 1; inerr; )
        {printf("Enter ambient temperature (degrees C)\n");
          scanf("%g",&t_dry);
          printf("Enter reference temperature (degrees C)\n");
          scanf("%g",&t_ref);
            }
}

/*****************************************************************/
/*  Routine to set up Norland Prowler on IEEE Interface         */
/*****************************************************************/
set_up_vmss()
/******************************************************************
*/
{
extern int  ib3;
extern double  s_interval, v_rng_A, v_rng_B;
int  i, ichar, len;  /* indeces */
char  status_byte;
static char  set3[100];
static char  resp[10];
static char  str_s_int[12];
static char  rng_A[12];
static char  rng_B[12];

/* Send message to screen. */
printf("NORLAND Prowler will now be configured.\n");

/* Identify device and set up interface. */
ib3 = ibfind("dev3"); /* Define device ID. */

/* Generate character string representing the sample interval. */
sprintf(str_s_int,"%5e",s_interval);
len = strlen(str_s_int);
for(ichar = 0; ichar < len; ichar++) {
    if(str_s_int[ichar] == 'e') str_s_int[ichar] = ';';
    if(str_s_int[ichar] == '+') str_s_int[ichar] = ';';
    if(str_s_int[ichar] == '-') str_s_int[ichar] = '<';
    if(str_s_int[ichar] == '.') str_s_int[ichar] = ':';
    }
if(diagnosis) printf("str_s_int = %s\n", str_s_int);

/* Generate character string representing voltage range A. */
sprintf(rng_A,"%5e",v_rng_A);
len = strlen(rng_A);
for(ichar = 0; ichar < len; ichar++) {
    if(rng_A[ichar] == 'e') rng_A[ichar] = ';';
    if(rng_A[ichar] == '+') rng_A[ichar] = ';';
    if(rng_A[ichar] == '-') rng_A[ichar] = '<';
    if(rng_A[ichar] == '.') rng_A[ichar] = ':';
    }
if(diagnosis) printf("rng_A = %s\n", rng_A);

/* Generate character string representing voltage range B. */
/* Not used for only one sigle-wire                        */
sprintf(rng_B,"%5e",v_rng_B);
len = strlen(rng_B);
for(ichar = 0; ichar < len; ichar++) {
    if(rng_B[ichar] == 'e') rng_B[ichar] = ';';
    if(rng_B[ichar] == '+') rng_B[ichar] = ';';
    if(rng_B[ichar] == '-') rng_B[ichar] = '<';
    if(rng_B[ichar] == '.') rng_B[ichar] = ':';
    }
if(diagnosis) printf("rng_B = %s\n", rng_B);

/* Set controls on device and check interface communications.
*/

/* Generate string of control commands to be sent to device. */
strcpy(set3,"]LA"); /* Beeper off */
strcat(set3,"Y"); /* ACQ. MODE */
strcat(set3,"C"); /* MEASURED HOLD */
strcat(set3,"L1:00;<2="); /* SAMPLE INTERVAL */
/* strcat(set3,"Z");  TRIGGER SETUP            */
/* strcat(set3,"G4096=");  EXTERNAL TRIGGER DELAY =
4096 */
/* strcat(set3,"ME");  SOURCE = EXTERNAL  */
strcat(set3,"["); /* A SETUP */
strcat(set3,"@"); /* ACTIVE */
strcat(set3,"C"); /* RANGE */
strncat(set3,rng_A,12);
```

```
strcat(set3,"=");
strcat(set3,"E0="); /* BIAS = 0% */
strcat(set3,"GC"); /* COUPLING = DC */
/*strcat(set3,"\\"); B SETUP
strcat(set3,"@"); ACTIVE
strcat(set3,"C"); RANGE
strncat(set3,rng_B,12);
strcat(set3,"=");
strcat(set3,"E0="); BIAS = 0%
strcat(set3,"GC"); COUPLING = DC */
strcat(set3,"\0"); /* Terminate string with null character. */

if(diagnosis) printf("set3 = %s\n", set3);

/* Set controls on device and check interface communications.
*/
if(diagnosis) {
     len = strlen(set3);
     for(ichar = 0; ichar < len; ichar++) {
          ibwrt(ib3,&set3[ichar],1); /* Send string. */
          printf("character = %c\t", set3[ichar]);
          ibrsp(ib3, &status_byte);
          printf("status byte = %d\n", status_byte);
          }
     }
else {
     len = strlen(set3);
     for(ichar = 0; ichar < len; ichar++) {
          ibwrt(ib3,&set3[ichar],1); /* Send string. */
          }
     }
}

/****************************************************************/
/* Routine for acquiring voltage signal(s) from hot-wire        */
/* um = Mean Velocity on first channel (m/s)                    */
/* urms = rms Fluctuation of Velocity (m/s)                     */
/****************************************************************/
acquiress()
/****************************************************************/
{
#define  STRLNG 30
#define  SMAX 8452  /* number of entries in string received
from NORLAND */

extern int  ib3;
extern int  aabort, diagnosis;
extern double  s_interval, v_rng_A, v_rng_B;
extern int  nread;
extern char vA[];
extern char  filename[];

FILE  *Afile, *storefile, *vol;

int    store,              /* indicator for data storing */
     inerr,               /* error in input data */
     irad,                /* number of current radial probe location */
     channel,              /* channel number: 1 = A, 2 = B */
     more_pts,             /* acquire more qualification points */
     i, j, sequence        /* auxiliary counters */
     ;
double  voltage,            /* hot-wire bridge output voltage */
     velocity,           /* instantaneous velocity */
     voffset = 0.0,       /* voltage offset */
     vgain = 1.0,         /* voltage gain */
     off_set,            /* auxiliary voltage offset variable */
     base,argument,        /* auxiliary variables */
     ninv,
     ncalib = 0.5,
     acalib = 5.4754,
     bcalib = 1.5778,
     dist,
     a1, a2, vcorr, t_dry, t_ref, t_sensor
     ;
static double  sumu,       /* sum of instantaneous voltages */
        sumv,
        sumu2,      /* sum of squares of instantaneous
                 voltages */
        sumv2,
        um,          /* ensemble averaged voltage */
        urms,         /* voltage fluctuation */
        vm,
        vrms
        ;
static char  dummy[NDUMMY], buffer[NDUMMY];
char  resp[STRLNG];
char  status_byte;
char  acquire[2], beeper_on[4];
char  rdcmd[STRLNG], command[STRLNG];

int  *iptr, ifactor1, hexdigit, sign, ivalue;
int  bit7, bit6, bit5, bit4, bit3, bit2, bit1, bit0;
double  *dptr, factor1, factor2, factor, offset;
static char  readstring[SMAX], digit[2];
char  *ptrd;

/* Variables associated with traverse */
double xx, yy, xcur, ycur, xdif, ydif;
long step,wait;
int ib10;
FILE *f1;

#define BUFSIZE 65550
#define STEPSIZE 400
#define LOWSPEED 1000

sleep(5);

/* Initialize Traverse */
ib10=ibfind("dev10");

ibwrt(ib10,"E,",2);
sprintf(command,"S1MLOWSPEED,");
ibwrt(ib10,command,strlen(command));
sprintf(command,"S2MLOWSPEED,");
ibwrt(ib10,command,strlen(command));


/* Generate strings for ACQUIRE and Beeper On commands.
*/
strcpy(acquire,"R");
strcpy(beeper_on,"]LC"); /* Beeper on */

/* Generate command string for data transfer from NORLAND.
*/
strcpy(rdcmd,"_"); /* I/O */
strcat(rdcmd,"K"); /* TRANSFER */
strcat(rdcmd,"C"); /* OUTPUT */
strcat(rdcmd,"G"); /* XFAST BINARY */

sequence = 0;
xx=0.;
yy=0.;

/* loop for qualification points */
for(more_pts = 1; more_pts;){

     sequence ++;

     /* Wake up the operator with a bell. */
     for(i = 0; i < 10; i++) printf("%c", '\007');

     /* Continue, or terminate the run? */
     if(sequence > 1){
          printf("\nContinue the run? (y or n)\n");
          scanf("%s",resp);
          if(resp[0] != 'y' && resp[0] != 'Y')
               goto the_end;
     }

      xcur=xx;
      ycur=yy;
      printf("Current Probe Location\n");
     printf("Y=%lf in\n",ycur);
     printf("Z=%lf in\n",xcur);

     /* Traverse Movement with User Input */
      printf("Enter Desired Probe Location for Measurement\n");
```

```
    printf("Y Location (xx.xx) in in :  \n");
   scanf("%lf",&yy);
    printf("Z Location (xx.xx) in in :  \n");
   scanf("%lf",&xx);

    /* Alternatively, the traverse may be moved using a series
of  algebraic functions without the user entering values.  An
example of such a function is given below.  To use such a
function, though, the whole acquisition sequence must be
included in a 'for' loop that permits a new value of xx and yy to
be recorded per each measurement set.  Thus, each
measurement will correspond to a particularspatial location.
    In this example, zloc and sequence are used as counters
to identify movement positions.  Statements would have to be
added to intialize these counters in the program.  zloc
corresponds to xx movements while sequence corresponds to
yy movements.  Incorporating such counters permits
automation of the traverses.
    Traverse Movement - xx direction (listing values with
counter)
    if(sequence>0){
      if(zloc==1){
     xx=0.0;}
      if(zloc==2){
     xx=0.1250;}
      if(zloc==3){
     xx=0.250;}
      if(zloc==4){
     xx=0.3750;}
      if(zloc==5){
     xx=0.50;}
      if(zloc==6){
     xx=0.6250;}
      if(zloc==7){
     xx=0.750;}
      if(zloc==8){
     xx=0.8750;}
      if(zloc==9){
     xx=1.000;}
      if(zloc==10){
     xx=1.1250;}
      if(zloc==11){
     xx=1.250;}
      if(zloc==12){
     xx=1.3750;}
      if(zloc==13){
     xx=1.50;}
      if(zloc==14){
     xx=1.6250;}
      if(zloc==15){
     xx=1.750;}
      if(zloc>15){
        goto the_end;}
     }

    Traverse Movement - yy direction (using algebraic
relations)
   if(sequence>0 && sequence<6){
        yy=.001875*(sequence-1)+.002*(zloc-1);}
   if(sequence>5 && sequence<14){
        yy=.00375*(sequence-5)+.0075+.002*(zloc-1);)
   if(sequence>13 && sequence<25){
        yy=.0075*(sequence-13)+.0375+.002*(zloc-1);)
   if(sequence>24 && sequence<32){
        yy=.0150*(sequence-24)+.12+.002*(zloc-1);}
   if(sequence>31 && sequence<37){
        yy=.03*(sequence-31)+.225+.002*(zloc-1);}
   if(sequence>36 && sequence<47){
        yy=.045*(sequence-36)+.375+.002*(zloc-1);}
   if(sequence==47){
        yy=.075*(sequence-46)+.825+.002*(zloc-1);}
   if(sequence>47 && sequence<54){
        yy=.15*(sequence-47)+.9+.002*(zloc-1);}
   if(sequence>53 && sequence<56){
        yy=.225*(sequence-53)+1.8+.002*(zloc-1);
          if(sequence==55){
            if(zloc>0 && zloc<3){
              sequence=0;}
            if(zloc>2 && zloc<5){
              sequence=1;}
              if(zloc>4 && zloc<7){
              sequence=2;}
              if(zloc>6 && zloc<9){
              sequence=3;}
              if(zloc>8 && zloc<11){
              sequence=4;}
              if(zloc>10 && zloc<14){
              sequence=5;}
              if(zloc>13 && zloc<17){
              sequence=6;}*/
           sequence=0;
           zloc++;}
           }*/

    /* Command to Traverse to Move */
   xdif=xx-xcur;
   ydif=ycur-yy;

   if(fabs(xdif) >= 0.001){
        step = (long)(xdif*25.4*STEPSIZE);
          printf("Z: %ld steps to %lf from %lf -- %lf
moved\n",step,xx,xcur,xdif);
          if(step < 0){
             sprintf(command,"C,I1M-%ld,R,C",(step*(-1)));
             wait=3-step/LOWSPEED;
               }
          if(step > 0){
             sprintf(command,"C,I1M%ld,R,C",step);
             wait=3+step/LOWSPEED;
               }
         ibwrt(ib10,command,strlen(command));
        sleep(wait);
        }
   if(fabs(ydif) >= 0.001){
        step = (long)(ydif*25.4*STEPSIZE);
          printf("Y: %ld steps to %lf from %lf -- %lf
moved\n",step,yy,ycur,(ydif*(-1)));
          if(step < 0){
             sprintf(command,"C,I2M-%ld,R,C",(step*(-1)));
             wait=3-step/LOWSPEED;
               }
          if(step > 0){
             sprintf(command,"C,I2M%ld,R,C",step);
             wait=3+step/LOWSPEED;
               }
         ibwrt(ib10,command,strlen(command));
        sleep(wait);
        }

   printf("Measurement Location is: Y = %lf, Z =
%lf\n",yy,xx);
   printf("     ");
   printf("Starting Data Acquisition Sequence\n");
   printf("     ");

   printf("\n***********************\n");
   printf("Sequence # %d\n",sequence);
   printf("************************\n");

   /* Acquire data with NORLAND until the maximum
number of AMAX */
   /* is reached.                              */
   printf("Enter any character to start the acquisition. \n");
   scanf("%s",resp);

   /*printf("Data will be acquired now.\n");*/

   /* Send string to start acquisition. */
   ibwrt(ib3,acquire,strlen(acquire));
    sleep(2);

   /* Wait until NORLAND starts acquisition. */
   /* (Loop to test whether NORLAND is already acquiring). */
   do{
        ibrsp(ib3,&status_byte);
        /*if(diagnosis)printf("status_byte = %o\n",
status_byte);*/
        }
```

```
  while(!status_byte & 5);
  /*printf("N started acquisition\n");
  printf("wait for end of acquisition\n");
  printf("status_byte = %o\n", status_byte);*/

  /* Wait until NORLAND is done acquiring. */
  /* (Loop to test whether NORLAND is still acquiring.) */
  i = 0;
  do{
      ibrsp(ib3,&status_byte);
      if(diagnosis){
          i += 1;
          if(i > 100){
              i = 0;
              /*printf("%o\n", status_byte);*/
              }
          }
      }
  while(status_byte & 5);
  /*printf("End of acquisition\n");*/
  /*printf("status_byte = %o\n", status_byte);*/

  /* Reset sums. */
  sumu = 0.0;
  sumu2 = 0.0;

  /* Open files if storage of voltages is desired */

      /*printf("\nOpening file %s ",vA,"for storage\n");*/
       fflush(stdout);
      if((Afile = fopen(vA,"a")) == (FILE*)NULL) {
      printf("Can't open %s\n",vA);
      }

      strcpy(command,rdcmd);
      strcat(command,"A");
      /*printf("A = %s\n", command);*/

      /* Send command to read NORLAND buffer. */
      ibwrt(ib3,command,strlen(command));

      /* Read data from NORLAND. */
      ibrd(ib3,readstring,SMAX);
      /*printf("readstring = %s\n", readstring);*/

      /*printf("reading done\n");
      if(diagnosis)printf("status_byte = %o\n", status_byte);*/

      /* Evaluate Factor and Offset from data sent in
      XFAST binary format.  See NORLAND Prowler
manual
      volume 2 "Options for the Prowler", pp.46-48. */

      /* Calculate Factor. */

      /* The first two hex digits (Word 1) represent
          the log to the base two,
          biased by 128, of the first factor
          of the Factor. */
      ptrd = readstring;
      sscanf(ptrd,"%2X",&ifactor1);

      /* Compute the first factor of the Factor. */
      factor1 = pow(2.,((double)ifactor1 - 128.));

      /* The next six hex digits (Words 2, 3, 4) represent
      the sign and the base two fractions of the second
      factor of Factor.  Calculate contributions to the
      second factor, hex-digit by hex-digit. */
      for(i=0, factor2=0; i<6; i++){
          stmcpy(digit,(ptrd+2+i),1);
          digit[1] = '\0';

          /* Determine bit pattern corresponding to each
          hex-digit and calculate the second factor. */
          sscanf(digit,"%X",&hexdigit);
          bit0 = hexdigit & 1;
          bit1 = hexdigit & 2;
          bit2 = hexdigit & 4;
```

```
          bit3 = hexdigit & 8;
          if(i==0){
              if(bit3)
                  sign = -1;
              else
                  sign = 1;
              bit3 = 1;
              }
          if(bit3) factor2 = factor2
                  + pow(2.,-(double)(i*4 + 1));
          if(bit2) factor2 = factor2
                  + pow(2.,-(double)(i*4 + 2));
          if(bit1) factor2 = factor2
                  + pow(2.,-(double)(i*4 + 3));
          if(bit0) factor2 = factor2
                  + pow(2.,-(double)(i*4 + 4));
          }
      factor = (double) sign * factor1 * factor2;

      /* Calculate Offset. */

      /* The first two hex digits
          (Word 1) represent the log to the base two,
          biased by 128, of the first factor
          of the Offset. */
      sscanf((ptrd+8),"%2X",&ifactor1);

      /* Compute the first factor of the Offset. */
      factor1 = pow(2.,((double)ifactor1 - 128.));

      /* The next six hex digits (Words 2, 3, 4) represent
      the sign and the base two fractions of the second
      factor of Offset. */
      /* Calculate contributions to the second factor,
      hex-digit by hex-digit. */
      for(i=0, factor2=0; i<6; i++){
          stmcpy(digit,(ptrd+10+i),1);
          digit[1] = '\0';

          /* Determine bit pattern corresponding to each
          hex-digit and calculate the second factor. */
          sscanf(digit,"%X",&hexdigit);
          bit0 = hexdigit & 1;
          bit1 = hexdigit & 2;
          bit2 = hexdigit & 4;
          bit3 = hexdigit & 8;
          if(i==0){
              if(bit3)
                  sign = -1;
              else
                  sign = 1;
              bit3 = 1;
              }
          if(bit3) factor2 = factor2
                  + pow(2.,-(double)(i*4 + 1));
          if(bit2) factor2 = factor2
                  + pow(2.,-(double)(i*4 + 2));
          if(bit1) factor2 = factor2
                  + pow(2.,-(double)(i*4 + 3));
          if(bit0) factor2 = factor2
                  + pow(2.,-(double)(i*4 + 4));
          }
      offset = (double) sign * factor1 * factor2;
      if(diagnosis)printf("fraction and offset are calc\n");

      /* Evaluate data points. */
      off_set = offset + voffset * vgain;
      for(j = 0, i = 256; i < (2 * nread + 256); j++, i+=2) {

          /* Calculate voltage value according to
           NORLAND Prowler manual pp.48-49 of 5/20/85.
*/
          stmcpy(digit, (ptrd + i), 1);
          digit[1] = '\0';
          a1 = *digit;
          if(a1 < 0)
              a1 += 256;
          stmcpy(digit, (ptrd + i +1), 1);
          digit[1] = '\0';
```

```
                a2 = *digit;
                if(a2 < 0)
                     a2 +=256;
                voltage = ((a2 * 256 + a1 - 32768)*factor
                          + off_set) / vgain;

      /*Hot-wire Calibration - Covert Voltage to Velocity */
       /*Example Calibration has 3.06 for second coefficient
         for calibration at t_ref degrees C.  Correct Voltage as
         with formula below:*/
             vcorr= ((t_sensor-t_ref)/(t_sensor-t_dry));
               coefficient=vcorr*3.06

              velocity= pow((-
1.4164+voltage*voltage*coefficient),2.29885);
             sumu += velocity;
             sumu2 += velocity * velocity ;
             }


     /* Calculate desired quantities and store them in files */
     um = sumu / (double)nread;
     if((argument=1./(double)(nread - 1) * (sumu2 -
um*um*nread))>0.0)
          urms=sqrt(fabs(argument));
     else
          urms = 0.0;
           if((storefile = fopen(filename, "a")) == (FILE*)NULL)
          printf("fopen failed\n");
     if(fprintf(storefile, "%d\t%g\t%g\n",sequence,um,urms) <
0)
         printf("fprintf failed\n");
         fclose(storefile);
     if(fprintf(Afile,"%d\t%g\t%g\t%g\t%g\n",sequence,yy,xx,um,
urms) < 0)
     printf("fprintf failed\n");

     /* Print the results to the screen */
     printf("\nResults of this run:\n");
     printf("Mean velocity on channel A = %f\n",um);
     printf("Velocity fluctuation= %f\n",urms);

     fclose(Afile);


}
the_end: printf("No further data will be acquired.\n");
}
```

```
/************ *******************************************************/
/*                                                                   */
/*  Program tcouple.c                                                */
/*  Written by: Steven Burd                                          */
/*  Purpose:  This program is used for the following-                */
/*          (a) Calibration of Thermocouples                         */
/*          (b) Measuring Thermocouple Voltages using                */
/*               Hewlett Packard 3421A DAU                           */
/*          (c) Effectiveness Measurements                           */
/*                                                                   */
/*********************************************************************/


#include<stdlib.h>
#include<stdio.h>
#include<gpib.h>
#include<math.h>

main (){

char spr,rd[512],command[20],resp[20],chn[20], tarray[20];
char output[20], dummy[20], filename[20], runid[20],temp[20],
channel[20];
int ib5,i,j,k,inerr,imerr,iberr,tcnumber,nread;
double
volt,volt1,volt2,volt3,volt4,volt5,vref1,vref2,vel,voltsum,value;
double
emf,voltage[100],voltage1[100],temp_ref,voltav,sumdiff,voltsdev
;
double
calib1(),calib2(),calib3(),voltav1,sumdiff1,voltsdev1,voltsum1;
double voltref, prb_volt, vjet1, vjet2, vjet;
FILE *out, *fp;
double xx,yy,xcur,ycur,xdif,ydif;
long step, wait;
int ib10,sequence,zloc,more_pts;

/* Determine if data collection or calibration */
printf("\n");
printf("Please specify purpose in running program ...\n");
printf("Enter (A) for data collection or (B) for calibration of
thermocouples: \t");
scanf("%s",resp);
printf("\n");
  if (resp[0] == 'a' || resp[0] == 'A'){
        printf("You have specified (A) data collection\n");
        collect();
        }
  else if (resp[0] == 'b' || resp[0] == 'B'){
        printf("You have specified (2) calibration for
thermocouples\n");
        calib();
        }
  else{
        printf("Sorry, you entered an invalid selection\n");
       goto the_end;
        }
the_end: printf("End of program\n");
}

/*********************************************************************/
/*  Routine for thermocouple data collection                         */
/*********************************************************************/
collect()
/*********************************************************************/
{
char spr,rd[512],command[20],resp[20],chn[20], tarray[20];
char output[20], dummy[20], filename[20], runid[20],
channel[20];
int ib5,i,j,k,inerr,imerr,iberr,tcnumber,nread;
double
volt,volt1,volt2,volt3,volt4,volt5,vref1,vref2,vel,voltsum,value;
double emf,voltage[100],temp_ref,voltav,sumdiff,voltsdev;
double calib1(),calib2(),calib3();
double voltref, prb_volt, vjet1, vjet2, vjet;
FILE *out, *fp;
double xx,yy,xcur,ycur,xdif,ydif;
long step, wait;
int ib10,sequence,zloc, more_pts;
```

```
#define BUFSIZE 65550
#define STEPSIZE 400
#define LOWSPEED 1000

/* Read run identification */
for(inerr = 1; inerr; ){
     printf("\nEnter run identification: \n\n");
     printf("(Use the format mmddyyss where: \n");
     printf(" mm = month, dd = day, yy = year,\n");
     printf(" and ss = a sequence number of the day's");
     printf(" runs)\n");
     scanf("%s", runid);
     printf("mm = %c%c   ", runid[0], runid[1]);
     printf("dd = %c%c   ", runid[2], runid[3]);
     printf("yy = %c%c   ", runid[4], runid[5]);
     printf("ss = %c%c\n ", runid[6], runid[7]);
     strcpy(filename,"tc");
     strcpy(&filename[2],runid);
     printf(" The filename is '%s'\n\n",filename);
     printf("\n Entry correct? (y or n)\n");
     scanf("%s",resp);
     if(resp[0] == 'y' || resp[0] == 'Y')
          {inerr = 0;}
     else if(resp[0] == 'n' || resp[0] == 'N')
          {inerr = 1;}
     else
          {printf(" Respond with y, Y for 'yes' ");
          printf("or with n, N for 'no' next time.\n");}
}

volt=0.0;
ib5=ibfind("dev5");
ibrsp(ib5,&spr);
i=1;

/* Open output file */
out=fopen(filename,"a");
sleep(1);

/* Initialize Traverse - If Used  */
ib10=ibfind("dev10");

ibwrt(ib10,"E,",2);

sprintf(command,"S1MLOWSPEED,");
ibwrt(ib10,command,strlen(command));
sprintf(command,"S2MLOWSPEED,");
ibwrt(ib10,command,strlen(command));

sequence = 1;
zloc = 1;
xx=0.;
yy=0.;

xcur=xx;
ycur=yy;
printf("Current Probe Location\n");
printf("Y=%lf in\n",ycur);
printf("Z=%lf in\n",xcur);

more_pts = 1;
for(more_pts=1; more_pts; ){

     /* Traverse Movement -  If traverse used  */
     /* Prescribed Traverse Locations */

     /* Prescribed Lateral Traverse Locations */
     /* (i.e. For Adiabatic Effectiveness at Fixed Streamwise
Station */
     /* if(sequence>0){
        if(zloc==1){
        xx=-1.50;}
        if(zloc==2){
        xx=-1.375;}
        if(zloc==3){
        xx=-1.25;}
        if(zloc==4){
        xx=-1.125;}
        if(zloc==5){
```

```
     xx=-1.0;}
      if(zloc==6){
     xx=-0.875;}
      if(zloc==7){
     xx=-0.75;}
      if(zloc==8){
     xx=-0.625;}
      if(zloc==9){
     xx=-0.5;}
      if(zloc==10){
     xx=-0.375;}
      if(zloc==11){
     xx=-0.25;}
      if(zloc==12){
     xx=-0.125;}
      if(zloc==13){
     xx=0.0;}
      if(zloc==14){
     xx=0.1250;}
      if(zloc==15){
     xx=0.25;}
      if(zloc==16){
     xx=0.375;}
      if(zloc==17){
     xx=0.5;}
      if(zloc==18){
     xx=0.625;}
      if(zloc==19){
     xx=0.75;}
      if(zloc==20){
     xx=0.875;}
      if(zloc==21){
     xx=1.0;}
      if(zloc==22){
     xx=1.125;}
      if(zloc==23){
     xx=1.250;}
      if(zloc==24){
     xx=1.3750;}
      if(zloc==25){
     xx=1.50;}
      if(zloc>25){
         sequence=0;}
     }*/

/* For 2-D traverse at fixed streamwise station */
/* if(sequence>0 && sequence<6){
       yy=.001875*(sequence-1)+.001*(zloc-1);}
if(sequence>5 && sequence<14){
       yy=.00375*(sequence-5)+.0075+.001*(zloc-1);}
if(sequence>13 && sequence<25){
       yy=.0075*(sequence-13)+.0375+.001*(zloc-1);}
if(sequence>24 && sequence<32){
       yy=.0150*(sequence-24)+.12+.001*(zloc-1);}
if(sequence>31 && sequence<37){
       yy=.03*(sequence-31)+.225+.001*(zloc-1);}
if(sequence>36 && sequence<47){
       yy=.045*(sequence-36)+.375+.001*(zloc-1);}
if(sequence==47){
       yy=.075*(sequence-46)+.825+.001*(zloc-1);}
if(sequence>47 && sequence<54){
       yy=.15*(sequence-47)+.9+.001*(zloc-1);}
if(sequence>53 && sequence<56){
       yy=.225*(sequence-53)+1.8+.001*(zloc-1);
       if(sequence==55){
           if(zloc>0 && zloc<3){
             sequence=0;}
           if(zloc>2 && zloc<5){
             sequence=1;}
           if(zloc>4 && zloc<7){
             sequence=2;}
           if(zloc>6 && zloc<9){
             sequence=3;}
           if(zloc>8 && zloc<11){
             sequence=4;}
           if(zloc>10 && zloc<14){
             sequence=5;}
           if(zloc>13 && zloc<17){
             sequence=6;}
```

```
            sequence=0;
             zloc++;}
            }*/

      /* Entering Traverse Coordinates Manually */
       for(inerr=1; inerr; ){
            printf("Do you wish to find the wall?\n");
            scanf("%s", resp);
             if(resp[0] == 'y' || resp[0] == 'Y')
            /* Go to routine for near-wall traverse if not adiabatic
*/
               {wall();
               inerr = 0;}
             else if(resp[0] == 'n' || resp[0] == 'N')
               {inerr = 1;
               printf("Enter Desired Probe Location for
Measurement\n");
               printf("Z Location (xx.xx) in in : \n");
               scanf("%f",xx);
               sleep(1);
               printf("Y Location (xx.xx) in in : \n");
               scanf("%lf",yy);}
            else
               {printf(" Respond with y, Y for 'yes' ");
               printf("or with n, N for 'no' next time.\n");
               }
            }
      }

      /* Commands sent to traverse */

      xdif=xx-xcur;
      ydif=ycur-yy;

      if(fabs(xdif) >= 0.001){
            step = (long)(xdif*25.4*STEPSIZE);
            printf("Z: %ld steps to %lf from %lf -- %lf
moved\n",step,xx,xcur,xdif);
            if(step < 0){
                  sprintf(command,"C,I1M-%ld,R,C",(step*(-1)));
                  wait=3-step/LOWSPEED;
                  }
            if(step > 0){
                  sprintf(command,"C,I1M%ld,R,C",step);
                  wait=3+step/LOWSPEED;
                  }
            ibwrt(ib10,command,strlen(command));
            sleep(wait);
            }
      if(fabs(ydif) >= 0.001){
            step = (long)(ydif*25.4*STEPSIZE);
            printf("Y: %ld steps to %lf from %lf -- %lf
moved\n",step,yy,ycur,(ydif*(-1
)));
            if(step < 0){
                  sprintf(command,"C,I2M-%ld,R,C",(step*(-1)));
                  wait=3-step/LOWSPEED;
                  }
            if(step > 0){
                  sprintf(command,"C,I2M%ld,R,C",step);
                  wait=3+step/LOWSPEED;
                  }
            ibwrt(ib10,command,strlen(command));
            sleep(wait);
            }*/
      /*
      printf("Measurement Location is: Y = %lf, Z =
%lf\n",yy,xx);
      printf("Starting Data Acquisition Sequence\n");

      printf("\n**********************\n");
      printf("Sequence # %d\n",sequence);
      printf("************************\n");
      */

      /* Sequential reading command for channels */
      /*ibwrt(ib5,"ls02-06;",8);
      ibwrt(ib5,"si0;",4);*/
```

```
        /* Collection of Thermocouple Data */

        /* Open different channel/switches corresponding to
thermocouple locations */
        inerr=1;
        for(k=2; k<10; k++){
        i=k;
        printf("\n*************************************\n");
        printf("Collecting data for Thermocouple #%d\n",i);
        printf("\n*************************************\n");
         if(i==2){
      ibwrt(ib5,"cls02;",6);
       j=10;}
         if(i==3){
      ibwrt(ib5,"cls03;",6);
       j=10;}
         if(i==4){
      ibwrt(ib5,"cls01;",6);
       j=10;}
         if(i==5){
      ibwrt(ib5,"cls04;",6);
       j=10;}
         if(i==6){
      ibwrt(ib5,"cls05;",6);
       j=10;}
         if(i==7){
      ibwrt(ib5,"cls06;",6);
       j=10;}
         if(i==8){
      ibwrt(ib5,"cls08;",6);
       j=10;}
         if(i==9){
      ibwrt(ib5,"cls09;",6);
       j=50;}
        for(l=1;l<=j+1;l++){
                volt=0.0;
                ibrd(ib5,rd,40);
               rd[ibcnt-2]='\0';
               volt=fabs(atof(rd));
                /*printf("%d\t%lf\n",l,volt);*/
               voltsum=voltsum+volt;
               }
      voltav=voltsum/10;
       if(i==9){
      voltav=voltav/5;
      }
      /* Record reference thermocouple1 */
       if(i==2){
               voltref=voltav;
               temp_ref=calib1(voltref);
               voltsum=0.0;
               voltav=0.0;
               }
      /* Record reference thermocouple2 */
       if(i==3){
               voltref=(voltav+voltref)/2;
               temp_ref=calib1(voltref);
               prb_volt=fabs(voltav-voltref);
               printf("Reference Thermocouple Average\t
Voltage=%lf V\tTemperature=%lf C\tVoltage
Diff=%f\n",voltref,temp_ref,prb_volt);
               voltsum=0.0;
               voltav=0.0;
               }

      /* Record freestream temperature */
       if(i==4){
               voltfs=voltref+voltav;
               printf("Freestream\t Voltage=%lf
V\tTemperature=%lf C\n",voltfs,calib1(voltfs)-.05);
               voltsum=0.0;
               voltav=0.0;
               }

      /* Record temperatures through meters */
       if(i==5){
               voltav=voltav+voltref;
               printf("Meter A voltage =
%f\ttemp=%f\n",voltav,calib1(voltav));
               voltsum=0.0;
               voltav=0.0;
               }
       if(i==6){
               voltav=voltav+voltref;
               printf("Meter B voltage =
%f\ttemp=%f\n",voltav,calib1(voltav));
               voltsum=0.0;
               voltav=0.0;
               }
      /* Record coolant/injectant temperature */
       if(i==7){
               printf("Voltage >ref=%f\n",voltav);
               voltav=voltav+voltref;
               printf("Jet temp1=%f\n",calib1(voltav));
               voltsum=0.0;
               voltav=0.0;
               }
      /* Secondary measurement location for coolant temp */
       if(i==8){
               vjet=voltav+voltref;
               printf("Jet temp2=%f\n",calib1(voltav+voltref));
               printf("Jet voltage = %f\ttemp =
%f\n",vjet,calib1(vjet));
               voltsum=0.0;
               voltav=0.0;
               }
      /* Traversing Probe - Calculate Effectiveness */
       if(i==9){
               temp_ref=calib1(voltref);
               voltref=calib3(temp_ref);
               printf("Reference voltage for Probe=%f
Corresponding temp=%f\n",voltref,temp_ref);
               printf("Voltage above reference = %f\n",voltav);
               voltav=voltav+voltref;
                adiaeff=(calib2(voltav)-calib1(voltfs))/(calib1(vjet)-
calib1(voltfs));
               printf("Probe voltage = %f\ttemp =
%f\n",voltav,calib2(voltav));
               printf("Adiabatic effectiveness =%f\n",adiaeff);
             out=fopen(filename,"a");

fprintf(out,"%lf\t%lf\t%lf\t%lf\t%lf\t%lf\t%lf\n",yy,xx,calib1(voltfs
),calib1(vjet),calib2(voltav),adiaeff,temp_ref);
               fclose(out);
               voltsum=0.0;
               }
      }
      ibclr(ib5);
      voltsum = 0.0;
      inerr=1;
      for(inerr=1; inerr; ){
               printf("Do you wish to continue?\n");
               scanf("%s", resp);
                if(resp[0] == 'y' || resp[0] == 'Y')
                   {more_pts=1;
                   zloc++;
                 xcur=xx;
                 ycur=yy;
                    printf("Z-location identifier=%d\n",zloc);
                 printf("Current Probe Location\n");
                 printf("Y=%lf in\n",ycur);
                 printf("Z=%lf in\n",xcur);
                   inerr=0;}
                else if(resp[0] == 'n' || resp[0] == 'N')
                   {more_pts=0;
                   inerr = 0;}
              else
                   {printf(" Respond with y, Y for 'yes' ");
                   printf("or with n, N for 'no' next time.\n");
                   }
              }
      }
}

/*********************************************************************/
/*    Subroutine for thermocouple calibration                        */
/*********************************************************************/
```

```
calib()

/*****************************************************************/


{
char spr,rd[512],command[20],resp[20],chn[20], tarray[20];
char output[20], dummy[20], filename[20], runid[20],temp[20];
int ib5,i,j,k,inerr,imerr,iberr,tcnumber,nread;
double
volt,volt1,volt2,volt3,volt4,volt5,vref1,vref2,vel,voltsum,value;
double
emf,voltage[100],voltage1[100],temp_ref,voltav,voltav1,sumdiff,
voltsdev;
double calib1(),calib2(),calib3(),sumdiff1,voltsdev1,voltsum1;
FILE *out, *fp;


volt=0.0;
ib5=ibfind("dev5");
ibrsp(ib5,&spr);

for(imerr = 1;imerr; )
{
/*printf("\nEnter channel number of thermocouple for calibration
point\n");
scanf("%s",chn);
printf("%s",chn);*/

printf("Enter calibration temperature\n");
scanf("%s",temp);
printf("Calibration temperature = %s\n",temp);

printf("\nEnter number of readings to be taken\n");
scanf("%d",&nread);

strcpy(dummy,"\"cls");
strcpy(&dummy[4],chn);
strcpy(&dummy[5],";\"");
printf("Command --> %s\n",dummy);

strcpy(output,"tc_cal");
printf("Thermocouple output file name is %s\n",output);

voltsum=0.0;
voltsum1=0.0;
voltage[0]=0.0;
voltage1[0]=0.0;

/* As written, will read two thermocouples */

for(i=1;i<=nread;i++)
      {
      ibwrt(ib5,"cls02;",6);
      ibrd(ib5,rd,20);
     rd[ibcnt-2]='\0';
      voltage[i-1]=fabs(atof(rd));
      voltsum=voltsum+voltage[i-1];
      ibwrt(ib5,"cls03;",6);
      ibrd(ib5,rd,20);
      rd[ibcnt-2]='\0';
      voltage1[i-1]=fabs(atof(rd));
      voltsum1=voltsum1+voltage1[i-1];
      printf("Voltage = %f\n",voltage[i-1]);
      }
      voltav=voltsum/((double)nread);
      voltav1=voltsum1/((double)nread);
      printf("Voltage = %f\n",voltav);
      sumdiff=0.0;
      sumdiff1=0.0;

for(i=1;i<=nread;i++){
      sumdiff=sumdiff+pow((voltage[i-1]-voltav),2.);
      sumdiff1=sumdiff1+pow((voltage1[i-1]-voltav1),2.);
      }

      voltsdev=sqrt(sumdiff/((double)(nread-1)));
      voltsdev1=sqrt(sumdiff1/((double)(nread-1)));
      printf("TEMPERATURE=%s C\tVOLT1=%lf
V\tSTDDEV1=%lf\tVOLT2=%lf\tSTDDEV2=%lf\n",temp,voltav
,voltsdev,voltav1,voltsdev1);
      fp=fopen(output,"a");

fprintf(fp,"%s\t%e\t%e\t%e\t%e\n",temp,voltav,voltsdev,voltav1,
voltsdev1);
      fclose(fp);
      /*out=fopen(filename,"a");
      fprintf(out,"TC#%s\tTEMPERATURE=%s
C\tVOLTAGE=%lf
V\tSTDDEV=%lf\n",chn,temp,voltav,voltsdev);
      fclose(out);*/

      for(iberr = 1; iberr; ){
            printf("Do you wish to calibrate at another
temperature or another thermocouple?\n");
            printf("Enter 'Y' if you wish to continue calibration
procedure\n");
            printf("Enter 'N' if you wish to end program\n");
            scanf("%s",resp);
            if (resp[0] == 'y' || resp[0] == 'Y'){
                  iberr = 0;
                  imerr = 1;
                  printf("\n");
                  printf("Next calibration point ...\n");
                  printf("\n");
                  }
            else if (resp[0] == 'n' || resp[0] == 'N'){
                  iberr = 0;
                  ibclr(ib5);
                  imerr = 0;
                  }
            else{
                  printf("Sorry, you entered an invalid
selection\n");
                  iberr = 1;
                  }
            }
      }
}

/*****************************************************************/
/*   Subroutine for finding the wall                             */
/*************************************** ************************/
wall()
{

/* This routine is used to step in small increments in the near-
region and
  will sample until a specified criteria is met.  It was not used
for in
  the present study.  It is automated using the traverse.  */

char spr,rd[512],command[20],resp[20];
double xx,yy,xcur,ycur,yval[100],xdif, ydif;
long step, wait;
int ib10,sequence,zloc,ib5;
double voltage[100], slope1, slope2;
int trial, inerr;

#define BUFSIZE 65550
#define STEPSIZE 400
#define LOWSPEED 1000

trial = 0;
inerr = 1;
for(inerr=1; inerr; ){
      trial ++;
      xx = xcur;

      if(trial == 1){
         yy = ycur - 0.015;
         yval[trial-1]=yy;
         }
      if(trial > 1){
         yy = ycur + 0.0015;
         yval[trial-1]=yy;
         }
```

```
      xdif=xx-xcur;
      ydif=ycur-yy;

      if(fabs(xdif) >= 0.001){
            step = (long)(xdif*25.4*STEPSIZE);
            printf("Z: %ld steps to %lf from %lf -- %lf
movedn",step,xx,xcur,xdif);
            if(step < 0){
                  sprintf(command,"C,I1M-%ld,R,C",(step*(-1)));
                  wait=3-step/LOWSPEED;
                  }
            if(step > 0){
                  sprintf(command,"C,I1M%ld,R,C",step);
                  wait=3+step/LOWSPEED;
                  }
            ibwrt(ib10,command,strlen(command));
            sleep(wait);
            }
      if(fabs(ydif) >= 0.001){
            step = (long)(ydif*25.4*STEPSIZE);
            printf("Y: %ld steps to %lf from %lf -- %lf
moved\n",step,yy,ycur,(ydif*(-1
)));
            if(step < 0){
                  sprintf(command,"C,I2M-%ld,R,C",(step*(-1)));
                  wait=3-step/LOWSPEED;
                  }
            if(step > 0){
                  sprintf(command,"C,I2M%ld,R,C",step);
                  wait=3+step/LOWSPEED;
                  }
            ibwrt(ib10,command,strlen(command));
            sleep(wait);
            }
      printf("Moving Traverse in finding wall .......\n");
      printf("Measurement Location is: Y = %lf, Z =
%lf\n",yy,xx);
      printf("      ");

     ibwrt(ib5,"cls02;",6);
      sleep(1);
      ibrd(ib5,rd,20);
     rd[ibcnt-2]='\0';
      voltage[trial-1]=fabs(atof(rd));
      if(trial>2){
           slope1=voltage[trial-1]-voltage[trial-2];
           slope2=voltage[trial-2]-voltage[trial-3];
           printf("Current Voltage = %f\n",voltage[trial-1]);
           printf("Slope1 = %f\tSlope2 = %f\n",slope1,slope2);
           }

      if(slope1 > 0.0 && slope2 > 0.0){
           yy = yval[trial-3];
           xx = xcur;
           inerr = 0;
           }
      }
}

/*************************************************************/
/*                                                           */
/*    Calibration equations for thermocouples                */
/*                                                           */
/*************************************************************/

/* Calibration equation for Type E Thermocouples */
/* Calibration Performed By Steven Burd        */
/* Date: 09/96              */
/* Calibration Range: 20-45 degrees C           */

double calib1(emf)
double emf;
{
/* Define coefficients */
double a[]={0.0,17105.,-275500.,1.225e7,-5.35e8,0.00};

/* Return temperature in degrees Celcius */
return(a[0]+a[1]*emf+a[2]*pow(emf,2.)+a[3]*pow(emf,3.)+a[4]*
pow(emf,4)+a[5]*pow(emf,5));
}

/* Calibration equation for Thermocouple Probe */
/* Deducing Temperature Value from Voltage    */

double calib2(emf)
double emf;
{
/* Define coefficients */
double a[]={0.0,13522.,7.649e6,-4.1957e9,7.1741e11,0.0};

/* Return temperature in degrees Celcius */
return(a[0]+a[1]*emf+a[2]*pow(emf,2.)+a[3]*pow(emf,3.)+a[4]*
pow(emf,4)+a[5]*pow(emf,5));
}


/* Calibration equation for Thermocouple Probe */
/* Deducing Voltage from Temperature Calibration */

double calib3(emf)
double emf;
{
/* Define coefficients */
double a[]={0.0,7.1594e-5,-1.5331e-6,4.7105e-8,-4.5355e-
10,0.00};

/* Return temperature in degrees Celcius */
return(a[0]+a[1]*emf+a[2]*pow(emf,2.)+a[3]*pow(emf,3.)+a[4]*
pow(emf,4)+a[5]*pow(emf,5));
}
```

```
/*********************************************************************/
/*                                                                   */
/*  Program: velratio.c                                              */
/*  Written by: Steven Burd                                          */
/*  Purpose:  This program is used to calculate the                  */
/*              velocity ratio between the film cooling holes        */
/*              and the freestream                                   */
/*                                                                   */
/*********************************************************************/

#include<math.h>
#include<stdio.h>
#include<gpib.h>

main()
{

/* Define Variable Types */
double pamb,tamb,pa,pb,rh,RHVC,RHDC,TVC,IGDC,Theta;
double psat,uinf,uhole,ACFMA,ACFMB,SCFM,ACFM;
double WDC,a1,a2,a3,a4,a5;

printf("Enter the ambient pressure in bars\n");
scanf("%lf",&pamb);
printf("Enter the ambient temperature in degrees C\n");
scanf("%lf",&tamb);
printf("Enter the relative humidity in percent\n");
scanf("%lf",&rh);
printf("Enter the pressure drop across meter A in inches
H2O\n");
scanf("%lf",&pa);
printf("Enter the pressure drop across meter B in inches
H2O\n");
scanf("%lf",&pb);
printf("Enter characteristic freestream velocity\n");
scanf("%lf",&uinf);

printf("                    \n");

/*Convert Temperature to Kelvin*/
tamb=tamb+273.15;

/*Relative Humidity to Decimal*/
rh=rh/100;

/*Correct Pressure Drop Readings back to Standard 4 degrees
C*/
WDC=1-0.0003*(tamb-277.15);
pa=pa*WDC;
pb=pb*WDC;

/*Calculate Viscosity Corrections*/

/*Correction Due to Relative Humidity*/
/*RHVC=1+0.0001703*rh*1.01325/pamb*(tamb-273.15)*(1-
0.07264*(tamb-273.15));*/
RHVC=1+0.0001703*rh*(tamb-273.15)*(1-0.07264*(tamb-
273.15));

/*Correction Due to Temperature*/
TVC=0.014164*pow(tamb,0.7489);

/*Actual Volumetric Flows with Viscosity Correction*/
ACFMA=.1135*25.4*pa/RHVC/TVC;
ACFMA=ACFMA*3.28*3.28*3.28;
printf("ACFMA = %lf\n",ACFMA);
ACFMB=0.1228*25.4*pb/RHVC/TVC;
ACFMB=ACFMB*3.28*3.28*3.28;
printf("ACFMB = %lf\n",ACFMB);

/*Combined Total*/
ACFM=ACFMA+ACFMB;

/*Relative Humidity Density Correction*/
/*Use for high flow rates only*/
/*Theta=273.15/tamb;
printf("Theta = %lf\n",Theta);
a1=10.79586*(1-Theta);
a2=5.02808*log10(Theta);
a3=0.00015047*(1-pow(10,(-8.29692*(1/Theta-1))));
a4=0.00042873*(pow(10,(4.76955*(1-Theta))-1));
a5=-2.2195983;
psat=pow(10,(a1+a2+a3+a4+a5));
psat=1.01325*psat;
printf("Psat = %lf\n",psat);

RHDC=1/(1-0.378*rh*psat/pamb);
IGDC=1.01325*tamb/(pamb*294.25);*/

/*Hole Velocity*/
uhole=0.00508*ACFM/0.03375;

/*Print out Hole Velocity and Velocity Ratio*/
printf("Film Cooling Hole Velocity = %f m/s\n",uhole);
printf("Characteristic Freestream Velocity = %f m/s\n",uinf);
printf("Velocity Ratio = %f\n",(uhole/uinf));

}
```

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13. ABSTRACT *(Maximum 200 words)*

Experimental measurements are presented in this report to document the sensitivity of film cooling performance to the hole length and coolant delivery plenum geometry. Measurements with hot-wire anemometry detail velocity, local turbulence, and spectral distributions over the exit plane of film cooling holes and downstream of injection in the coolant-freestream interaction zone. Measurements of discharge coefficients and adiabatic effectiveness are also provided. Coolant is supplied to the film cooling holes by means of a large, open plenum and through plenums which force the coolant to approach the holes either co-current or counter-current to the freestream. A single row of film cooling holes with 35°-inclined streamwise at two coolant-to-freestream velocity ratios, 0.5 and 1.0, is investigated. The coolant-to-freestream density ratio is maintained in the range 0.96 to 1.0. Measurements were taken under high-freestream (FSTI=12%) and low-freestream turbulence intensity (FSTI=0.5%) conditions. The results document the effects of the hole L/D, coolant supply plenum geometry, velocity ratio, and FSTI. In general, hole L/D and the supply plenum geometry play influential roles in the film cooling performance. Hole L/D effects, however, are more pronounced. Film cooling performance is also dependent upon the velocity ratio and FSTI.

14. SUBJECT TERMS

Film cooling; Gas turbine engines; Turbulence; Adiabatic effectiveness; Coolant; Hole length; Plenum geometry

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