Mean Flow Measurements of Heated Supersonic Slot Injection into a High Reynolds Number Supersonic Stream

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(ABSTRACT)

Mean flow measurements and short-duration Schlieren and Shadowgraph photographs of heated and unheated supersonic slot injection of air into a supersonic air stream are presented for the purpose of observing the mixing which occurs in the resulting shear layer. The heated injected jet ($M_j = 1.7$, $P_{tj} = 10.7$ psia , and $T_{tj} = 760°R$) passes through a slot of height 0.475 inches (1.2 cm) tangent to a free stream with $M_\infty = 3.0$, $P_{t\infty} = 95$ psia and $T_{t\infty} = 540°R$. The resulting density ratio is $\frac{\rho_j}{\rho_\infty} = 0.3$. The free stream Re/ft $= 6.1 \times 10^7$ (Re/cm $= 2 \times 10^6$). The thickness of the plate which separates the primary and secondary flows is 0.021 inches (0.052 cm). Pitot pressure, cone static pressure and stagnation temperature profiles are obtained at four axial stations downstream of the slot (x/H = 0.25, 4, 10, 20). An additional set of measurements is obtained at Station 4 for the case of a weak shock $\left(\frac{P_2}{P_1} = 1.8\right)$ interacting with the shear layer just upstream of Station 4. From the pressure and temperature measurements, Mach number, velocity, density, mass flux and static pressure profiles are generated. An unheated injection study is also performed at the same flow conditions for comparison to the heated case.

The heated and unheated cases are very similar except in the slot where the temperature difference creates changes in ρ, U, and ρU. This study is thus concerned with the effects of changes in $\frac{\rho_j}{\rho_\infty}$ and $\frac{U_j}{U_\infty}$, especially $(U_j - U_\infty)$, which are created by heating the injected flow. The heated slot flow did not create a marked difference in the location of the merging of the free stream boundary layer with the slot flow when compared to the unheated slot flow. Indeed, the appearance of the two flows on Schlieren photographs is similar even though the injected mass flow in the heated case is about 15% less than that in the unheated case. The pressure adjustments in the slot lip region are different for the two different cases. The flowfields are documented for both the heated and unheated cases with the added measurements and photographs for the shock impingement case.

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Nomenclature

H	Slot Height
M	Mach Number
P	Pressure
T	Temperature
U	Streamwise Velocity
a	Speed of Sound
t	Time
x,y,z	Coordinate Directions
ρ	Density
δ	Boundary Layer Thickness
γ	Ratio of Specific Heats
θ	Nondimensional Total Temperature Parameter

$$\theta = \frac{(T_{t2} - T_{t\infty})}{(T_{tj} - T_{t\infty})}$$

Subscripts

∞	Free Stream Condition for Primary Flow
1	Conditions Upstream of a Normal Shock Wave
t	Total or Stagnation Conditions
c	Referring to the Cone Static Probe Measurements
2	Conditions Downstream of a Normal Shock Wave
j	Conditions in the Slot Injected Jet
sh	Conditions Downstream of Shock Interaction Region
cold	Referring to the Unheated Injected Flow Case
hot	Referring to the Heated Injected Flow Case

Chapter 1

Introduction

There are a number of practical reasons for interest in slot injection flowfields. Specifically, tangential slot injection can be used for thermal protection, skin friction reduction, fuel injection, and it can also provide the energy necessary to deter separation of a boundary layer. References 1-4 detail how tangential slot injection for film cooling purposes provides thermal protection for a wall by inhibiting the heat transfer from the main flow to the wall. Reducing skin friction with the use of low energy injected streams is the subject of References 4-7.

New interest in hypersonic flight has sparked research in supersonic combustion ramjets (SCRAMjets) as well as in other areas of hypersonics. The National Aerospace Plane (NASP) and other future airbreathing hypersonic vehicles will use some form of fluid injection. Supersonic tangential fuel injection (shown schematically in Figure 1) has the advantages of retaining the thrust of the injectant, protecting the wall thermally, and maintaining a geometrically simple flowfield. Keeping the injectant in the axial direction can also reduce the overall drag of the system by reducing skin friction and by avoiding nonaxial forces from the injectant.

There are many different types of tangential slot injection. The many combinations of subsonic, supersonic, turbulent, laminar and transitional flows for the main stream or the injected jet can result in several different classes of slot injection. Many investigations of the case of tangential slot injection into a supersonic main flow are summarized in Table 1 on page 114 [1, 4, 5, 7-15]. For all types of slot injection, the shear layer produced by the interaction of the two streams becomes the vehicle through which the main flow can exchange energy with the injected flow. The velocity and density gradients encountered within the shear layer play a major role in the mixing of the main and injected flows. Note that there is not only a shear layer developed here, but also a wall layer which must be considered at the same time.

The governing flow parameters for this study nominally model a scramjet combustor. The chosen free-stream Mach number of 3.0 models the flow in a scramjet combustor where the flight speed of the vehicle would be between Mach 7 and Mach 10. The slot injectant Mach number of 1.7 obtains reasonable thrust from the injectant and produces a feasible scramjet flowfield. Since this is a basic research study, heated air was used as the injectant for simplicity. The boundary layers of most scramjet combustors are thick because the inlet is long, and the boundary layer is most likely to be ingested into the engine because boundary layer bleeding may not be feasible at higher Mach numbers. Accordingly, the slot height here is chosen to approximate the size of the boundary layer to provide a realistic model.

The overexpanded jet has a total pressure of 10.7 psia in order minimize additional waves at the injection station and in order to mix and merge the wall and shear layers substantially before reaching the last measurement station at x/H = 20 (Figure 11 on page 127). Figure 1 on page 117 shows the general features of the resulting flowfield. The splitter plate thickness is a thin 0.021 inches (0.052 cm) thereby eliminating most of the wake effects in the flowfield. The heated injected flow ($T_{tj} =$ 760°R) produces an injected to free-stream flow density ratio of $\frac{\rho_j}{\rho_\infty} = 0.3$. For the heated injected flow, the lower density in the slot flow provides a tracer mechanism. The heated flow's density can be compared to the unheated flow's density in order to examine the effectiveness of the density gradient on the flowfield. As the density of the slot flow is reduced by the heated flow, the velocity of the slot flow is increased. Accordingly, this study examines the effects of increasing the density gradient and decreasing the velocity gradient for supersonic injection into a supersonic stream. This study repeats the experiment of Reference 8 (unheated injection; $T_{tj} = 540$ °R, $\frac{\rho_j}{\rho_\infty} = 0.4$) in order to confirm the original unheated data and to directly compare the unheated and heated injection results.

During the experiments, the shear flow was observed optically as well as evaluated by probe measurements. Spark-Schlieren photographs and nanosecond Shadowgraphs were taken because they provide both visual assurance of the flow quality and relative magnitudes of the flow details. Cone static and Pitot pressure probes along with a stagnation temperature probe provide mean flow quantities at four measurement stations. Additional measurements and photographs at Station 4 (x/H = 20) were taken of a weak shock interacting with the shear layer just upstream of Station 4 (Figure 14 on page 130).

This heated air injection study investigates one possible configuration of supersonic injection in supersonic flow and is intended to be a foundation for future work toward turbulent supersonic mixing flows. Specifically, it provides flow measurements of the shear and wall layers and their interactions for the case of heated supersonic injection into a supersonic main stream. These measurements provide a set of initial conditions and standards for computational work as well as a basis for turbulence data which allows for turbulence modeling. Further injection studies with combinations of angled nozzles, normal nozzles, and foreign gases along with induced temperature gradients would provide a more complete overview of turbulent supersonic mixing possibilities.

Chapter 2

Description of Experimental Apparatus

2.1 Wind Tunnel

The data for this study was obtained in the 9 X 9 inch blowdown supersonic wind tunnel at Virginia Tech. A Mach 3 nozzle block was used for the tests. The slot injector and the nozzle block have been integrated as shown in Figure 2. Air is compressed by four Ingersoll Rand model 90 reciprocating compressors and held in 16 storage tanks which provide a combined volume of approximately 2800 cubic feet. The air then moves through a prefilter which removes oil from the flow. After the prefilter, the flow passes through a dryer and an after-filter which remove moisture and dust respectively. Next in line, a hydraulic valve with a feedback circuit controls the total pressure of the settling chamber. The settling chamber is kept to within 1% of 95 psia during each run by the control valve and feedback circuit. A quick opening pneumatic butterfly on/off valve follows the control valve. Four screens in the settling chamber improve the flow uniformity and reduce the free stream turbulence. In the beginning of the settling chamber is a wire mesh cone for the purpose of flow straightening. Probes for total temperature and total pressure measurements are also located in the settling chamber. Finally, as Figure 2 on page 118 shows, the air passes through a two dimensional nozzle into the test section and then out through a diffusor. The diffusor uses a ten degree ramp to provide supersonic pressure recovery as well as a ten degree wedge on the upper side of the tunnel to augment the pressure recovery. This particular diffusor set up is used to avoid the possibility of an unsteady normal shock occurring in the aft of the test section.

2.2 *Injector Model*

The injector system, shown in Figure 3 on page 119, is designed for hot flow and is more than capable of sustaining the 760°R injected air temperature. The air for the injector is supplied by an in-line heater described in detail in Section 2.3. A 1.25 inch gate valve is used for pressure control and is capable of 1585°R operation temperatures. It is attached to the hot end of the heated flow, so that the best heat transfer to the air is maintained. The control valve maintains the pressure of the heated injected flow to within 2% of 10.7 psia during each run. After the gate valve, the heated air passes through two manifolds. The first stage manifold separates the supply air into two streams, each of which travels through a 0.90 inch I. D. pipe to the second stage manifold. The second stage manifold distributes the air evenly across the injection chamber. After the second stage manifold, a thermocouple monitors the temperature of the injected flow. Next, the air passes through a flow straightener made of 440 3/16 inch stainless steel tubes encased in a wire mesh. Then it enters into the plenum chamber of the injector where the total pressure is monitored. Finally, the air turns 90 degrees and is simultaneously sent through a converging/diverging nozzle to make it supersonic as it enters the main flow (Figure 3 on page 119).

Other key parameters for the system which were selected are the slot height, the splitter plate thickness and the probe hole spacing and sizing. The slot height used was 0.475 inches (1.2 cm), which is close to the thickness of the main flow boundary layer. In order to avoid significant wake influence behind the splitter plate, the thickness of the plate is kept to a thin 0.0126 inches (0.032 cm). The stainless steel floor plate has 1/4 inch diameter probe holes at each station to accomodate the 1/4 inch O. D. probes. The 1/4 inch diameter holes are each located 3.06 inches (7.78 cm) downstream of their respective measurement stations. Nearly identical measurements were taken at 2 different spanwise locations showing that the flow was essentially two-dimensional.

2.3 *Heater Setup*

For the purpose of heating the slot injected air, a heater was constructed (see Figure 4 on page 120). High pressure air is bled off of the main tunnel flow downstream of the on/off and control valves of the main flow, but upstream of the settling chamber. Starting at room temperature, the air is sent through an on/off valve and into a 27 foot long, 1.25 inch nominal Inconel 601 pipe. The final 15 feet of Inconel is heated with a combination of 11 band heaters, 4 strip heaters and silicate type pipe insulation as shown in Figure 4. The band heaters are Chromalox type HBA-32050 and are rated at 500 Watts. The Heaters run off 240 Volts. They reached a temperature of 1460°R after approximately 25 minutes of continuous current. The heat from the band heaters and strip heaters conducts well through the Inconel and is retained by the silicate insulation which is rated at 1660°R. After the system has been on for an hour, the pipe is uniformally heated due to the high thermal conductivity of Inconel. Runs are then made when the temperature of the outer shell of the Inconel midway between two band heaters reaches approximately 1160°R. This gives an approximate reading of 760°R from the thermocouple in the injection chamber during a run. The temperature of the outer shell of the Inconel is monitored with a closed-end, Type K thermocouple attached directly to a self-calibrated digital thermocouple display. The resulting air temperature in the slot varies less than 2% for a given run. After the air leaves the heated Inconel pipe, its pressure is regulated and it is sent through the injector model as described in Section 2.2.

The heater is ready for subsequent runs at the desired temperature within approximately 10 minutes.

Chapter 3

Experimental Instrumentation and Procedures

3.1 Measurement Stations

Data profiles across the shear layer are measured and recorded at four stations (see Figure 11 on page 127). Each axial station is positioned at a different level of development of the shear flow in order to construct a complete picture of the flow and its behavior. Station 1, at $x/H = 0.25$, is clearly an initial value region. Values at Station 1 are good not only for examining the primary and secondary streams before significant mixing occurs, but also for initial values for computational work. Some inviscid interaction between the two streams has occurred by Station 1. At $x/H = 4$, Station 2 provides data for the beginning of the development of the shear layer. All waves have left the mixing region by this Station. At $x/H = 10$ (Station 3), the shear layer has developed substantially.

Station 4, at x/H = 20, provides data for a fully developed wall jet region as the wall layer has merged with the shear layer.

3.2 Optics

The optics for this investigation give qualitative and some quantitative data on the flowfield. Spark-Schlieren photographs and nanosecond Shadowgraphs provide the necessary visual description of the flow. A General Radio Company Type 1531-AB Strobotac is used as the light source for the 10^{-6} second spark-Schlieren photographs. For the nanosecond Shadowgraphs, a Model-437A Nanopulser provides the impulse for a Xenon Corporation Novatron-789B Nanopulse Lamp. The nanopulse system produces a 20 nanosecond nominal flash pulse duration. The flashes from both the Strobotac and the Nanopulse Lamp are directed through the test section with a collimating mirror. For proper focus of the nanosecond Shadowgraphs, the film is placed 13 inches from the Schlieren quality window of the test section. The spark-Schlieren set up includes a second collimating mirror on the opposite side of the test section which directs the light to a knife edge. The knife edge then passes on the needed amount of light to a plane mirror which, in turn, reflects the light to the camera. All of the photographs use Polaroid Type 57 (ASA 3000) film.

3.3 Pressure Instrumentation

Pressure measurements are taken with both traverse probes (see Figure 5) for the mean flow data measurements and Pitot probes for the settling chamber and the slot plenum chamber measurements. The settling chamber and traverse probe pressure measurements consist of a probe relaying its pressure signals to a transducer which, in turn, converts the signals to voltages. These voltage signals are passed through an amplifier and a filter before being sent to an A/D converter and to the PC. The slot pressure measurement is sent through a transducer and then through the PSI system as described in Section 3.3.3.

3.3.1 Traverse Pressure Probes and Instrumentation

The Pitot probe used for total pressure traverses has a rectangular opening of 0.0165 x 0.122 inches (0.042 x 0.310 cm). The thickness of the lip is approximately 0.001 inches (0.025 cm). These sizes lead to a capture area of about 0.002 square inches (1.3 square millimeters). This probe, as well as the cone static and total temperature traverse probes, has a 1/4 inch O. D. stainless steel sleeve soldered over the 3/16 inch probe stem to provide stiffness, so that flexing of the probe does not occur during a run.

The brass cone on the cone static probe has a 10 degree semivertex angle. The cone's base diameter is 0.062 inches (0.157 cm) and is soldered to a 0.063

inch (0.160 cm) O. D. stainless steel tube. Figure 6 on page 122 shows the arrangement of four 0.013 inch diameter (0.033 cm) static pressure ports drilled 0.106 inches (0.27 cm) from the probe tip at 90 degree angles from each other. With these four ports emptying into a common chamber, the resulting pressure becomes an average of the four individual pressures. This average corrects for any small misalignment of the probe in the flow. The vertex of the cone was ground and maintained to within 2 arc minutes of its assigned value. Other characteristics of this probe are the capture area, which is on the order of 0.002 square inches (one square millimeter), and the 0.08 second time response of the probe and its connected instrumentation.

The signals from the traverse pressure probes are sent through a Gould, Inc. model 13-4312-00 amplifier and then through a filter which cuts out any high frequency noise. The filter, shown in Figure 7 on page 123, is based on a design from Reference 16 and has a cutoff frequency of 400 Hz. Next, the signals are sent through the A/D converter and then onto a disk in the PC for storage.

3.3.2 Slot Total Pressure Measurement

The total pressure in the injection slot is measured by a Pitot probe which sends its signal through a Pressure Systems, Inc. Digital Pressure Measurement System. The PSI system includes a transducer array, a Pressure Calibration Unit (PCU) and a Data Acquisition and Control Unit (DACU). The transducer array has a ±15 psig range. The PSI system calibrates itself by exposing 3 known reference pressures to the transducer pressure ports. Constants of a quadratic equation which relates the output voltage of the transducer to the reference pressures are generated in order to complete the calibration. The slot total pressure was monitored both by a remote display which was incorporated in the PSI System, and by obtaining the PSI data through the PC onto disk storage.

3.3.3 Settling Chamber Pressure Measurement

In the main settling chamber, the total pressure is obtained with a Pitot probe which sends its signal through a 0-100 psia Setra Systems 50mV/1 psia pressure transducer. The resulting signal is filtered, amplified and passed on to the A/D converter.

3.4 Temperature Instrumentation

The three important temperature measurements required for this study are the stagnation temperature in the settling chamber, the stagnation temperature of the heated injected flow and the traverse total temperature. These measurements are described in detail in sections 3.4.1 through 3.4.3. The signal for each of these measurements is amplified and buffered in order to produce reasonable output signals.

3.4.1 Traverse Stagnation Temperature Probe and Instrumentation

Figure 8 on page 124 shows a ceramic tipped, vented thermocouple probe which is used to measure the traverse stagnation temperature. The ceramic tip and vent holes provide radiation protection and the necessary outflow to produce a recovery factor of 98%. That is, 98% of the flow's kinetic energy is converted to thermal energy and only 2% of the energy is lost as heat. The ceramic tip of the probe has a circular inlet opening of diameter 0.075 inches (0.19 cm). The 0.015 inch (0.038 cm) outflow holes located on the top and bottom of the ceramic piece are 0.375 inches (0.953 cm) from the tip. The design of this probe tip is based on a design found in Reference 17.

An Omega Engineering Type K (Chromel-Alumel) butt-welded thermocouple wire is used in the probe. The wire has a 0.005 inch diameter and possesses a thermal time response of 0.1 seconds for a bare wire. The signal from the probe is sent directly to an Omega Engineering Thermocouple D. C. Millivolt Amplifier. The amplifier provides the signal with a gain of 100 as well as providing an electronic ice point reference junction. The signal then passes through an additional amplifier with a gain of 6 and finally a low-pass filter with a cutoff frequency of 300 Hz before being sampled by the A/D board.

3.4.2 Settling Chamber Temperature Measurement

The Type K thermocouple used for the temperature measurement of the settling chamber has the same filtering and amplification techniques as the traverse probe thermocouple signals. Both the traverse probe thermocouple and the settling chamber stagnation temperature thermocouple are calibrated by heating distilled water to a known temperature and finding the corresponding voltage of the thermocouple and accompanying instrumentation.

3.4.3 Slot Injection Temperature Measurement

The slot injection temperature is obtained with a Type K themocouple from Omega Engineering. The signal from the thermocouple passes through an Omega Amplifier and ice point box set with a gain of one. The signal is then sent to a strip chart recorder which is set to read 10 millivolts per inch. The reason for using the strip chart recorder in this case is to acquire the slot temperature for each run in real time, so that runs can be made in succession without waiting to find out the resulting slot temperature. Since the strip chart produces a reading for each millivolt signal, no calibration is necessary. The temperature corresponding to the output voltage is found in tables published by Omega Engineering [18]. The slot temperature was considered acceptable for temperatures ranging from 750°R to 770°R. During each run the slot temperature varied less than 2%.

3.5 Probe Traverse System

Mounted below the test section, the traverse system includes a motor which drives a gear which, in turn, moves a slotted rod up and down. Each probe stem is placed through a 1/4 inch diameter hole in the test section corresponding to the station being measured. The probe is fastened to linkages which, in turn, are attached to the slotted rod. The slotted rod is connected to a Linear Voltage Displacement Transducer (LVDT) which produces a linear voltage output with a displacement of its central core. The connections between the probe and the slotted rod are rigid so that the LVDT provides an instantaneous position of the probe. The signal from the LVDT passes through a 4 pole Bessel filter with a cutoff frequency of 240 Hz in order to eliminate high frequency noise. The filter, shown in Figure 9 on page 125, has a time delay of 0.011 seconds.

For the mean flow traverses, the probes are advanced at a rate of approximately 0.2 inches/sec (0.5 cm/sec) while taking data. This speed allows for a sufficient volume of flow to enter the probe at any one height, so that steady measurements result. A PTI Cat. No. 2210 Cathetometer calibrates the traverse position by measuring distances in the y-direction very accurately. For each probe at each station, five height measurements corresponding to five voltage readings are fit on a straight line to provide probe height to voltage calibration data. The variance in the calibration data was on the order of 10^{-4}. Repeated cathetometer measurements are accurate to within 0.02 cm.

3.6 Data Acquisition System

An IBM PC equipped with a Metrabyte Model Dash-16F High Speed Analog/Digital I/O Board is the primary source of acquiring data. The A/D board, which is controlled with both BASIC and FORTRAN software, has a maximum of 16 channels and samples 12 bits at a maximum rate of 100 kHz. The primary use of the A/D board is to convert pressure, temperature and LVDT signals from analog to digital. An additional virtue of the Metrabyte Board is its digital output for relay switching. This digital switching is used for both starting and stopping the tunnel as well as controlling the position of a probe by switching a voltage to the traverse motor. Another quality of the A/D board is its ability to produce analog output for pressure control. The control system regulates the tunnel stagnation pressure by setting the voltage level with an analog output. Figure 10 on page 126 shows a block diagram of the system.

3.7 Data Reduction Procedure

The data files coming into the PC from the A/D board are numbers ranging from 0 to 4095 which correspond to voltages of 0 to 10 volts. These raw numbers are reduced with the proper calibration data to yield the corresponding pressures, temperatures and heights. A BASIC computer program listed in

Appendix B is used for this stage of the data reduction. After each run of the wind tunnel for data collection, the program is run in order to provide on the spot verification of the data recorded.

The next stage in the data reduction process is to apply shock and isentropic relations to the pressure and temperature data to yield Mach numbers, densities, velocities and static pressures of the flowfield. A FORTRAN code was written and used for these calculations. The reduction breaks down into two main sections. The first section is for the case of M_1 greater than 1.2 which corresponds to $\frac{P_c}{P_{t2}}$ less than 0.4782. When M_1 is greater than 1.2, the shock stays attached to the cone static probe, and the cone flow equations are valid as $M_c > 1.0$. The second section, for the case of $\frac{P_c}{P_{t2}}$ greater than 0.4782, includes the cases of subsonic M_1 and M_1 between 1.0 and 1.2. Because the regions of M_1 less than 1.2 occur only where a boundary layer has slowed the flow considerably, the values of static pressure just above the slowed regions can be used as the static pressure across the affected region of the boundary layer. The assumption of the static pressure being nearly constant across a boundary layer is generally reliable.

For the case of $M_1 > 1.2$, the Mach number data comes directly from the pressure measurements of P_{t2} and P_c. A polynomial expression for M_1 as a function of $\frac{P_c}{P_{t2}}$ was taken from Reference 19. This expression, based on the "Rayleigh Pitot Formula,"

$$\frac{P_1}{P_{t2}} = \frac{\left[\frac{2\gamma}{\gamma+1}M_1^2 - \frac{\gamma-1}{\gamma+1}\right]^{\frac{1}{(\gamma-1)}}}{\left[\frac{\gamma+1}{2}M_1^2\right]^{\frac{\gamma}{(\gamma-1)}}} = f_1(M_1,\gamma)$$

along with the cone flow equation

$$\frac{P_c}{P_1} = 1 + \frac{\gamma M_1^2}{2}\frac{(P_c - P_1)}{q_1}$$

and the fact that $\frac{(P_c - P_1)}{q_1} = f(M_1, \gamma)$ for a specified cone half angle, results in $\frac{P_c}{P_{t2}} = f(M_1)$ for a given value of γ. A γ of 1.4 for air at these temperatures and pressures is used. The resulting polynomial for the Mach number is:

$$M_1 = -1.92393X^9 + 10.117X^8 - 16.45154X^7 + 10.33433X^6 + 0.81891X^5$$

$$- 4.04847X^4 + 2.4034X^3 - 0.13547X^2 + 0.68905X + 1.19997$$

where $X = -2.86369\left(\frac{P_c}{P_{t2}}\right) + 1.36942$.

With the Mach number known, The static pressure P_1 was then found directly from P_{t2} and the "Rayleigh Pitot Formula": $P_1 = P_{t2}f_1(M_1, \gamma)$.

The streamwise velocity, U_1, was established from the simple relationship $U_1 = M_1 a_1$. The speed of sound came from the local static temperature T_1 which is a function of T_{t1} and M_1. The adiabatic relationship

$$T_1 = \frac{T_{t1}}{\left(1 + \frac{(\gamma - 1)}{2}M_1^2\right)}$$

coupled with the fact that a shock is adiabatic ($T_{t2} = T_{t1}$) yields the speed of sound as:

$$a_1 = \sqrt{\frac{\gamma R T_{t2}}{\left(1 + \frac{\gamma - 1}{2} M_1^2\right)}}$$

The density is derived from the equation of state for an ideal gas, $\rho_1 = \frac{P_1}{RT_1}$. P_1 and T_1 are known from above and R is constant, so that the full equation for the density becomes:

$$\rho_1 = \frac{P_1}{RT_1} = \frac{P_{t2}[f_1(M_1, \gamma)](1 + \frac{\gamma - 1}{2} M_1^2)}{RT_{t2}}$$

When $\frac{P_c}{P_{t2}}$ is greater than 0.4782 and $\frac{P_1}{P_{t2}}$ is less than 0.5283, the flow is supersonic but M_1 is less than 1.2 so that the shock in front of the cone static probe is detached. In this case the static pressure, P_1, is assumed constant across the region and only the total pressure, P_{t2}, varies. With the new value of $\frac{P_1}{P_{t2}}$, the "Rayleigh Pitot Formula" can be iterated to find M_1. Then, ρ_1 and U_1 are both found in the same manner as if M_1 is greater than 1.2.

For the case of $\frac{P_c}{P_{t2}}$ greater than 0.4782 and $\frac{P_1}{P_{t2}}$ greater than 0.5283, the flow is subsonic and without shocks, so that $P_{t2} = P_{t1}$. M_1 for this case comes from the isentropic relationship

$$M_1 = \left\{ \frac{2}{\gamma - 1} \left[\left(\frac{P_1}{P_{t2}} \right)^{-\frac{(\gamma - 1)}{\gamma}} - 1 \right] \right\}^{\frac{1}{2}}$$

Again, with M_1 known, ρ_1 and U_1 come from the same relationships used for M_1 greater than 1.2.

The nondimensionalization scheme used involves finding a "free stream" Mach number at each station which was above and therefore unaffected by the shear layer interaction. $T_{t\infty}$ values corresponding to the T_{t2} values at every y/H position are used to obtain the $U_{1\infty}$ nondimensionalizing profiles. The resulting data comes from $U_{1\infty} = M_{\infty}a_{\infty}$ where

$$a_{\infty} = \sqrt{\frac{\gamma R T_{t\infty}}{\left(1 + \frac{\gamma - 1}{2} M_{\infty}^2\right)}} \, .$$

For the ρ_{∞} profiles, not only are an M_{∞} value and $T_{t\infty}$ profile used but also an averaged value of P_{t2} from the freestream values of each station. The freestream P_{t2} at any station had a maximum variation of approximately 3%. The resulting equation for ρ_{∞} was:

$$\rho_{\infty} = \frac{P_{t2\infty}[f_1(M_{\infty}, \gamma)](1 + \frac{\gamma - 1}{2} M_{\infty}^2)}{R T_{t\infty}(t)}$$

The free stream arrays used for the nondimensionalization are acquired with the same equations as the mean flow data profiles but with the free stream inputs of M_{∞}, $T_{t\infty}$ (t) and $P_{t2\infty}$. Table 2 on page 115 shows the values of M_{∞} and $P_{t2\infty}$ used in the nondimensionalization. Accordingly, each station is nondimensionalized with separate free stream quantities. This form of nondimensionalization eliminates recognition of nonisentropic behavior between stations, so that the heated and unheated profiles of each station can be compared with confidence. The nonisentropic effects from station to station can be obtained by comparing dimensional profiles of different stations (listings of dimensional profiles are provided in Appendix C). Another reason for nondimensionalizing station by station is that waves in the upper part of the traverse (such as waves at Station 2) could produce confusion as if the "free stream" had taken on a different character at any given station. Station 4 with the shock impingement is nondimensionalized with the free stream values from Station 4 without the shock impingement, so that shock versus no-shock values can be compared.

The heated total temperature profiles are nondimensionalized with both the stagnation slot temperature, T_{tj}, and $T_{t\infty}$. A nondimensional quantity θ is used and is constructed as:

$$\theta = \frac{(T_{t2} - T_{t\infty})}{(T_{tj} - T_{t\infty})}$$

This form of temperature nondimensionalization shows the decay of the heated jet as the flow progresses down stream. Table 2 on page 115 has the T_{tj} values used for the nondimensionalization of the total temperature.

Chapter 4

Results and Discussion

In this chapter, the heated and unheated injection cases will be compared and the flowfield details of each case will be discussed. The results of this study include photographs as well as data profiles.

4.1 Visual Results

The photographs taken of the flow during each run provide a means of illustrating the structure of the flow, so that different regions of development of the shear layer can be recognized. They also show relative magnitudes of the flowfield constituents.

Spark-Schlieren photographs of both the unheated injection and heated injection flowfields are presented in Figures 11 and 12, respectively. The major flowfield features which the photographs show are detailed in Figure 1. Looking at the unheated slot injection Schlieren, the progression of the shear layer development is evident. The four measurement stations capture four distinct regions of the shear layer. Station 1 obviously includes many waves in both the slot and the main stream boundary layer. Nonetheless, Station 1 does provide regions of undisturbed slot and free stream flows. At Station 2, the photographs clearly show that the slot flow is not merged with the free stream boundary layer, so that it also provides an "initial condition" type flowfield. The Station 2 shear flow region is rid of the shocks emanating from the splitter plate. Some mixing occurs by Station 3, but the slot potential core still remains, although it is diminished. At Station 4, most of the potential core slot flow has disappeared, and a substantially developed wall-shear layer has been formed.

Figure 12 shows the Schlieren of the heated slot injection case. The overall flowfield features of the heated slot injection case are nearly the same as to the features found in the unheated case even though the heated slot mass flow is approximately 15% less than the unheated slot mass flow. Nonetheless, the Schlieren of the heated slot flowfield shows some slight differences when compared with its unheated counterpart. First, the heated injected flow Schlieren shows an extra weak oblique shock emanating from the upstream nozzle block. This weak shock originates at a junction in the wall upstream of the slot injection station and affects only the primary flow. This shock does not appear in the unheated injection Schlieren and it produces a slightly different free stream for the heated case than for the unheated case because of the jump conditions which the shock imposes. The mean flow data profiles show further evidence of this weak oblique shock as the heated free stream quantities have slight disparities when compared with their unheated free stream counterparts. No measurable differences in either the sizes of the shear layer features or the amount of mixing of the free stream with the slot flow are evident when comparing the Schlierens of the heated and unheated slot flows. However, the difference in the lighting of the Schlieren photographs for the heated and unheated injection cases creates difficulties in discerning any small differences in the two flowfields. The pressure adjustments, resulting from the shocks and expansions off the splitter plate, are different for the unheated and heated injected flows. The mean flow data profiles presented in Section 4.2 show some variations which are not evident in the photographs.

From the spark-Schlieren photograph, the free stream boundary layer thickness and other important magnitudes are obtained. The heated injection case has a free stream boundary layer thickness of $\delta \simeq 0.38$ inches (0.97 cm). The unheated injection case has a measured $\delta \simeq 0.35$ inches (0.89 cm). The difference may be due to the extra shock encountered by the heated flow or due to the hotter splitter plate created by the heated injection and a thin slot lip. Another magnitude of interest is that of the combined wall and shear layers. As Figures 11-13 show, the full layer for both the unheated and heated injection cases remains fairly straight and does not grow significantly into the main flow.

The heated and unheated flows both possess a full wall/shear layer of approximately 1.9 slot heights throughout the measurement area. This layer height corresponds to approximately 0.90 inches. Measurements comparing the sizes of the flowfield features show no remarkable difference in the major shear layer constituents for the heated and unheated slot cases.

The photographs show the shock and expansion waves and the wave angles, so that measurement profiles can be matched to appropriate flowfield features. The overexpanded slot flow causes an adjustment shock which emanates from the tip of the splitter plate. This shock is best visible on the nanosecond Shadowgraph (Figure 13 on page 129) which both captures shocks more clearly and shows the turbulence intensity of the flow better than a Schlieren. The overexpansion of the slot flow causes the free stream to turn towards the wall. This turning of the flow is approximately 1°. The angling of the free stream towards the slot flow sets the stage for the development of the shear layer which is monitored at the four stations.

Shock interaction photographs (Figure 14 on page 130) show the incident shock reflecting off of the top 1/4 of the shear layer. A weak shock also penetrates into the shear layer, but it is dissipated as it approaches the subsonic flow near the wall. The adverse pressure gradient produced creates an increase in the shear/boundary layer thickness. The increase in δ is approximately 10% (from 0.90 inches to about 1.00 inches).

4.2 Mean Flow Profiles

The mean flow profiles consist of both heated and unheated cases for comparison. The resulting Mach number, velocity, density, mass flux and static pressure profiles come from the P_c, P_{t2} and T_{t2} measurements. P_c and P_{t2} profiles are shown in Appendix D. The mean flow profiles are nondimensionalized with $T_{t\infty}$, $P_{t2\infty}$, and M_∞ as described in Section 3.7. Because of the weak shock from the upstream nozzle block, which was seen in the photographs, the heated profiles have some small differences from the unheated profiles.

The Mach number profiles at all of the stations for both heated and unheated cases are shown in Figure 15 on page 131. Station 1 profiles show evidence of the slot adjustment shock hitting the flow at approximately 0.8 slot heights as there is a large drop in Mach number at that height. The wake of the splitter plate also is involved in decreasing the Mach number in this region (y/H $\simeq$ 1.0). Above the wake of the splitter plate, the free stream boundary layer has evidently been turned toward the wall because the beginning traces of it occur below y/H = 1.0. The heated and unheated flows do not agree exactly in the region of the wake of the splitter plate and the free stream boundary layer. The precise reasons for the profiles not agreeing here are not easily found. The Pitot and cone static pressure profiles are nearly the same (see Appendix D). Because the heated and unheated injection experiments were performed on two separate occasions, small differences in the model set up are possible. A possible difference between the heated and unheated slot cases could be that the splitter plate was heated by the hot slot flow and, in turn, the main stream boundary layer had a higher wall temperature for the heated case. The heat transfer from the wall would affect the main stream flow, especially at Station 1. The many complexities in the flow encountered at Station 1 (multiple shock waves, heat transfer to the splitter plate, etc.) make comparison of Station 1 profiles difficult. Consequently, Station 2 provides a better "initial condition" type flowfield for the shear layer because it is free of the complexities in the flow which occur at Station 1. Other minor differences between the heated and unheated slot injection experiments will be discussed as the other mean flow profiles are analyzed. In general, the two flows are comparable and show the same major features of the flowfield.

Stations 1, 2 and 3 all show evidence of the slot potential core for both the heated and unheated cases. Station 4 contains minor traces of the slot potential core, but for the most part the layers have merged. Station 2 shows a small trace of the wake of the splitter plate, but by Station 3 that trace is gone. The effects of the nozzle block shock are evident at Station 1 in the free stream. $M_\infty \simeq 2.95$ for the heated case while $M_\infty \simeq 3.05$ for the unheated case. This loss of Mach number in the heated flow due to the shock produced in the nozzle block carries over to all four stations which each have $(M_\infty)_{cold} > (M_\infty)_{hot}$.

Figure 16 on page 132 shows nondimensionalized total temperature profiles for the heated flow. The profiles show a continually diminishing size of the potential core slot temperature as the flow progresses downstream. Station 1 has a heated core up to aproximately 0.8 slot heights whereas Stations 2, 3, and

4 only have heat up to 0.75, 0.65, and 0.45 slot heights respectively. By Station 4, the maximum value of the temperature is reduced approximately 20% to about 600°R. The decay of the total temperature can best be visualized in Figure 17, which is a log-log plot of the decay of the slot temperature versus x/H. The decay of the temperature tends towards the asymptote of $(\frac{x}{H})^{-0.8}$. Many experiments have found the line proportional to $x^{-0.8}$ to be somewhat universal as the decay asymptote [2].

As expected, Figure 18 shows that the injected velocities are greater for the heated flow than for the unheated flow in the slot. The heated U_1 in the slot is 15-20% greater than its unheated companion profile. Accordingly, the heated slot case produces a smaller velocity gradient, $(U_\infty - U_j)$, than the unheated slot case. With $(U_\infty - U_j)_{hot} < (U_\infty - U_j)_{cold}$, the heated slot flow should not tend to mix as quickly with the main flow as the unheated slot flow based on simple turbulent exchange models. Stations 1, 2 and 3 each have strong temperature effects in the slot (for the heated case) and the velocity gradients in the heated profiles are accordingly smaller than in the corresponding unheated profiles. Station 3 profiles show the largest difference between the unheated and heated velocity mixing. At Station 3, the unheated case, which has a larger velocity gradient, does not show as pronounced a slot flow as the heated slot flow. This suggests that the unheated velocity is mixing out slightly faster than the heated velocity. Nonetheless, at Station 4, the heated and unheated injection velocity profiles are nearly identical for the whole traverse. Although the heated slot velocity did not appear to be mixing as rapidly as the unheated slot velocity at Station 3, it appears to have mixed approximately the same amount as the unheated slot velocity by Station 4.

The flow features shown by the velocity profiles are the same as to those of the Mach number profiles with the exception of the velocity in the slot. At Station 2, the heated and unheated profiles show the low point of the free stream boundary layer approximately at y/H = 0.75 (The low point of the free stream boundary layer here is equivalent to the height at which the profile begins to take on a boundary layer type shape). At Station 3, the low point of the free stream boundary layer is approximately y/H = 0.65. At Station 4 the free stream boundary layer has merged substantially with the slot flow.

As the velocity in the slot increases with temperature, the density in the slot decreases with the increasing temperature. From Figure 19 on page 135, $\left(\frac{\rho_j}{\rho_\infty}\right)_{hot} \simeq 0.32$ and $\left(\frac{\rho_j}{\rho_\infty}\right)_{cold} \simeq 0.45$. These density ratios are consistent for Stations 1, 2 and 3, so that $\frac{(\rho_j)_{hot}}{(\rho_j)_{cold}} \simeq 0.7$ for these stations. This consistent ratio shows that the heated flow retains its heat in the potential core of the slot for several slot heights down stream. At Station 4, however, $\frac{(\rho_j)_{hot}}{(\rho_j)_{cold}} \simeq 0.88$. This density ratio is lower than at the first 3 stations because of the loss of heat by Station 4 as well as the entrainment of the free stream into the injected flow by Station 4. Because substantial mixing has occurred by Station 4, the heated flow density is closer to the unheated flow density at this station. As the density gradient produced by the heated injected flow is greater than that of the unheated injected flow, the heated flow density profiles may tend to mix quicker because of the density instabilities induced by the larger gradients. At Station 3, the slot flow density for the heated injection is not as pronounced as the slot flow density for the unheated flow. The top of the heated potential core of the slot at Station 3 seems to be mixing quicker than the top of the unheated potential core. This suggests that the 30% reduction in density in the slot has slightly boosted the density mixing . At Station 4, both the unheated and heated density profiles are substantially mixed. The temperature effects of the slot have been somewhat diminished by Station 4, so that the density gradient for the heated flow is not more than 10% larger than that of the unheated flow. Although the increased density gradient tended to mix the density slightly faster, the 30% reduction in slot density only resulted in minor changes.

The ρU profiles of Figure 20 on page 136 show the same flow features as the other mean flow quantities. The slot ρU is reduced approximately 15% in the heated injected flow case. Even with the reduction of mass flow in the slot, the overall flow structure remained the same. The boundary layers in the slot flow should tend to be thicker for the heated case because the temperature increase will both decrease ρU and increase the viscosity, μ. The boundary layer growth is proportional to $\frac{1}{f(Re)}$ with the Reynolds number per length coming from $\frac{\rho U}{\mu}$. The minor changes in ρU and μ should not create marked differences in the boundary layer sizes, but this effect may cause small differences between the heated and unheated profiles.

Figures 21 and 22 show the comparison of the $\rho_1 U_1$ mean flow data profiles with the $\overline{\rho_1 U_1}$ hot wire profiles [20] for both heated and unheated cases, respectively. Of course $\rho_1 U_1$ is not the same quantity as $\overline{\rho_1 U_1}$ so that some dissimilarities in the profiles are expected. Nonetheless, the two quantities should have similar values in the non-turbulent regions of the flow. The $\overline{\rho_1 U_1}$ measurements used in conjunction with the mean flow U_1 and ρ_1 provide information for the Favre-averaged velocity turbulence quantity, $\overline{u''}$, which has usually been neglected in the past.

Turbulence measurements in density stratified flows have raised questions about the magnitude of the $\overline{u''}$ term which is found in the relation of the turbulent mass flux intensity to the density weighted velocity [21]. $\overline{u''}$ is calculated by:

$$\overline{u''} = U - \frac{\overline{(\rho U)}}{\rho}$$

Figure 23 on page 139 shows $\frac{\overline{u''}}{U_1}$ profiles for heated and unheated cases at each of the 4 stations. Uncertainty in the profiles is evident, but trends exist for the $\overline{u''}$ values. The heated profiles, which reflect larger density gradients, seem to yield larger values of $\overline{u''}$. The heated Station 4 $\overline{u''}$ measurements do not follow the trends of the previous three stations. A possible reason for the different turbulence levels for the heated case at Station 4 is that the tunnel experienced some unsteadiness which affected the aft of the test section. Without the turbulence measurements [20] which correspond to the $\overline{\rho_1 U_1}$ values used in the $\overline{u''}$ calculations, a detailed discussion of these results cannot be undertaken. Accordingly, trends for the values of $\overline{u''}$ in flows of different density stratification are evident, but some uncertainty in the results remains.

Figure 24 on page 140 shows the static pressure profiles at all four stations for both the heated and unheated slot injection cases. The static pressures come from P_{t2} and a function of the Mach number. The static pressure should be fairly constant across a boundary layer type flow. The only major static pressure fluctuations occur when shock or expansion waves are present in the flowfield. Apparently, the Station 1 heated and unheated injection profiles result in different pressure adjustments at $y/H \simeq 1.0$. These different pressures at $y/H \simeq 1.0$ affect the other mean flow quantities as is evident in the profiles.

4.3 Station 4 Results With and Without Shock Interaction

An oblique shock impinges on the shear layer just upstream of Station 4 as shown in Figure 14 on page 130. This shock creates a streamwise pressure gradient which affects the mean flow data at Station 4 in Figures 25 and 26. The static pressure profiles for both the unheated and heated injected flow cases, shown in Figure 27 on page 143, are very similar to their matching cone static profiles which are found in Appendix D. Also shown in Figure 27, the temperature profile at Station 4 with shock interaction exhibits no change in the temperature across the adiabatic shock. The shock interaction creates an increase in static pressure at Station 4 by a factor of approximately 2.0 at the top edge of the shear layer ($y/H = 1.5$). From Reference 8, the shock interaction static pressure rise on the floor is a factor of 1.82. The Pitot pressure at Station 4 with and without the shock is presented in Appendix D. Again, the Pitot pressure profiles and the cone static pressure profiles are the main ingredients in the mean flow profiles which are found in Figures 25 and 26.

As expected, the Mach number and velocity profiles have lower values with the shock impingement. In the slot region, the shock produces smaller decreases in the heated Mach number profiles than in the unheated Mach number profiles. The velocity jump across the shock is equal for both the heated and unheated flows. Although the photographs do not illustrate this clearly, the shock must have penetrated the shear layer substantially because the Mach number and velocity have reduced values as far down as 0.4 slot heights from the floor. The velocity profiles with the shock impingement, for both the heated and unheated cases, show no traces of the slot potential core. The shock impingement velocity profiles are very much like boundary layer type profiles. Thus, the adverse pressure gradient, created by the shock impingement, does increase the mixing. The shock also created more turbulence in the flowfield as seen in the nanosecond Shadowgraph (Figure 14).

The density and mass flux profiles both result in larger values after the shock. The density jump in the free stream is considerably greater than the density jump in the middle of the shear layer. Like the Mach number, the heated flow density has a much smaller jump than the unheated flow density in the region of the slot flow. The heated mass flux profiles also tend to have a smaller jump condition in the slot region.

The shock impingement had little effect on the $\overline{u''}$ values. Figure 28 on page 144 examines the unheated Station 4 $\overline{u''}$ measurements with and without shock impingement. These profiles correspond well with the calculations from Walker, Campbell and Schetz [21]. A small increase in $\overline{u''}$ is evident in the slot region for the heated slot flow with shock impingement. However, the $\overline{u''}$ values are subject to some uncertainty.

Although the photographs show that the shear layer grows a small amount after the shock impingement, the data profiles appear to reach the edge of the shear layer at y/H = 1.5 for both the shock and the no shock cases. Nonetheless, the turbulence and the mixing were both boosted with the shock interaction.

Chapter 5

Conclusions and Recommendations

5.1 Conclusions

Measurements of the flowfield have been taken for both heated and unheated injected flows. The mean flow profiles and the photographs describe the flowfield and provide useful data for understanding the flow and for comparison with predictions. The effect of a streamwise pressure gradient on the fully developed wall/shear layer was examined. Although the shear layer did not change much qualitatively, the shock impingement did affect the magnitudes of the mean flow profiles. The shock impingement both added turbulence to the flow and augmented mixing in the layer.

The heated slot injection profiles have been compared with the unheated flow profiles. The heated flow profiles are very similar to the unheated case except in the slot where the temperature obviously boosted the velocity and decreased the density in the heated flow case. The density was driven down approximately 30% by heating the flow to approximately 760°R. This change in density produces only small effects on the mixing. Nonetheless, with the case of an overexpanded heated jet ($P_{tj} = 10.7$ psia, $T_{tj} = 760°R$) with $\delta \simeq H$, the free stream boundary layer merges substantially with the injected flow before x/H = 20.

Mach number, density, velocity, mass flux and static pressure profiles have been generated from the T_{t2}, P_c, and P_{t2} profiles. The profiles for both the heated case and the unheated case show the development of the shear/wall layer. The velocity in the unheated case tended to mix slightly faster than for the heated case; this was especially evident at Station 3. Similarly, the density in the heated case tended to mix slightly faster than in the unheated case. These trends of mixing were small and, in general, the heated and unheated flows exhibited similar mixing characteristics. Both sets of profiles agree that the free stream boundary layer has merged with the wall layer by Station 4 at x/H = 20.

A reliable set of data has been presented and is valid for comparison with other data as well as for numerical use. The data is also good for the calibration of hot wire probes which are used in turbulence measurements. Some turbulence measurements involve both mean flow and hot wire data. This study shows trends of the turbulence quantity $\overline{u''}$. In the heated flow, $\overline{u''}$ tended to have larger values than in the unheated flow.

5.2 Recommendations

Further studies in the area of tangential supersonic mixing should include a number of variables. The capability to have a much higher slot temperature is critical in order to reduce the density substantially and to provide the essential velocity and density gradients. The flowfield is strongly dependent on the splitter plate thickness, the free stream boundary layer thickness $\left(\text{or } \frac{\delta}{H}\right)$ and the free stream to injected stream pressure ratio $\left(\frac{P_\infty}{P_j}\right)$. Varying these parameters can produce an array of interesting shear layer mixing studies. Other future studies should also examine angled slots, normal injection in tandem with tangential injection, foreign gas injection and axisymmetric as well as 2-D cases.

Chapter 6

APPENDICES

APPENDIX A

Error Analysis

The profiles which resulted from the mean flow measurements have a number of possible errors. The errors estimated in this Appendix are intended to provide upper limits to the errors incurred to the data. Two classes of errors are discussed in this Appendix. The first type of error is that which applies to each probe and its associated instrumentation. These errors occur for all runs and, in general, had very small effects on the mean flow quantities. The second class of errors include those which result in different profiles for data taken on two separate occasions. These errors and profile offsets result from the differences in the model set up and the unintended effects of heating the slot flow.

The first class of errors involves the small errors associated with the probe measurements of P_c, P_{t2} and T_{t2}. These errors carry over to the mean flow quantities which are derived from the P_c, P_{t2} and T_{t2} measurements. All of the probes were subject to errors in the calibration of their vertical position. Repeated cathetometer measurements yield a possible vertical offset error of ± 0.008 inches (± 0.02 cm). This error is the largest absolute error which affects repeated run profiles.

The cone static measurements included possible errors of:

- The time response of the probe and instrumentation (0.08 sec).

- Shock waves hitting the probe tip in regions of the flow.

- The resolution of the data obtained because of tip dimensions.

- Calibration of the transducer.

With the traverse moving at 0.2 inches/sec (0.5 cm/sec) and the time constant of the probe equal to 0.08 seconds, a possible vertical offset of 0.0016 inches (0.004 cm) results. This vertical error added to the 0.008 inches (0.02 cm) original possible calibration error yields a 0.0094 inch (0.024 cm) offset. The presence of a shock hitting the probe tip would severely distort the readings of the cone static probe and is not taken into consideration here. In this study, the mixing flow was affected by shocks only in very small regions at Station 1. The dimensions of the probe tip and the calibration of the transducer both produce negligible errors compared to the 0.0094 inch (0.024 cm) vertical error produced by the previously mentioned errors. Consequently, the largest error incurred is a vertical shift in the data with a maximum value of approximately 0.01 inches (0.025 cm). With a full traverse of approximately 1.5 inches (3.8 cm), the maximum cone static error for repeated runs is estimated at $\pm 0.7\%$.

The Pitot pressure may have errors of:

- The time response of its instrumentation.
- Calibration of the transducer.
- Turbulence in the viscous layers.

These are the most significant of errors and have an estimated maximum combined error of 0.7%.

The stagnation temperature probe has the greatest potential for errors. These errors include:

- Lack of 100% radiation protection.

- Heat transfer from insulating supports to thermocouple wire.

- Retaining of heat by the probe tip (thermocouple does not read actual flow).

The total temperature measurements have estimated errors as large as $\pm 2\%$ in most of the flow. In the region where the probe is moving from the heated slot flow to the unheated free stream flow, the probe retains the heat from the slot and has errors of a greater magnitude. A time constant of the whole probe can be estimated using the Station 1 temperature profile (Figure 16). The time constant is a measure of the temperature profile decay. Reference 16 provides a method to obtain the time constant. Its value for the stagnation temperature probe used is approximately 0.7 seconds. This time lag could affect the flow measurements for a vertical height of 0.14 inches (.35 cm). Nevertheless, the temperature variance in this experiment was not large for most of the flow, so that the time constant did not influence the mean flow profiles significantly.

The Mach number profiles are derived directly from $\frac{P_c}{P_{t2}}$. The velocity and density both involve the Mach number and the total temperature as derived in Chapter 3. By running a program which finds the Mach number, velocity and density at given values of P_c, P_{t2} and T_{t2} , the percentage of error resulting in each of the mean flow quantities can be found. The program is run for the maximum possible combinations of the previously mentioned errors in P_c, P_{t2} and T_{t2}. The resulting errors in Mach number profiles, velocity profiles, and density profiles are ±1.0%, ±1.7%, and ±2.4%, respectively. These small errors apply to the equipment used and are evident in repeated runs.

The difference in heated and unheated injection profiles comes from the errors listed above as well as differences in the model set up and unintended effects of heating the slot flow. The model set up for the heated injection created an extra weak shock from the upstream nozzle block. This extra shock altered the free stream values up to 5%. The splitter plate's height for each model set up might not have been exactly 0.475 inches. This, too, could slightly offset the mean flow profiles.

As discussed previously, the heating of the slot might have created some changes in the flowfield other than the desired heated slot effects. The hot slot heated the splitter plate, which, in turn, heated the main stream boundary layer. The effect of slightly heating the main stream was not taken into account. Additionally, the slot boundary layers were affected by the hot slot flow, so that their magnitudes may have been different for the heated and unheated slot cases.

The combined effects of all of the possible errors result in some offsets between the heated and unheated injection profiles. In some cases, the offset between the heated and unheated profiles is as large as 0.1 slot heights (0.05 inches). Nonetheless, the offsets could have been influenced by different flowfield characteristics occurring in the different injection cases.

APPENDIX B

Program Listings for Data Acquisition and Reduction

The BASIC listing of the program used for data acquisition is listed first. This program manipulates the A/D board in conjunction with the PC to run the tunnel with digital output and to acquire data with analog input. The analog signals from the pressure and temperature devices are sent into the A/D board. This program also runs the PSI System which was used to monitor P_{tj}.

The second program listed is a BASIC program which converts the digital values obtained from the first program to pressures or temperatures. It uses the calibration data to convert the 0 to 4095 digital values to the required pressures or temperatures.

The third program takes the pressures and temperatures output from the second program and finds Mach numbers, velocities, densities, mass fluxes and static pressures. This program is a FORTRAN code which manipulates cone equations, isentropic relations and other fundamental equations as described in in Chapter 3.

Program 1. Data Acquisition With The Metrabyte Board

```
9Ø CLEAR, 59ØØØ! 'reduce workspace to 48K
1ØØ SCREEN Ø,Ø,Ø : CLS : KEY OFF : WIDTH 8Ø
11Ø DIM A$(3Ø),B$(3Ø),TU$(3Ø),TD$(3Ø),TRAV(1ØØØ)
12Ø FALSE=Ø:TRUE=NOT FALSE:XOFF$=CHR$(19):XON$=CHR$(17)
13Ø CLOSE
14Ø DEF SEG:WIDTH "COM1:",255:DEF SEG
15Ø CM$="COM1:96ØØ,N,8,1"
16Ø OPEN CM$ AS #1
17Ø PAUSE=FALSE
18Ø B$=CHR$(13):GOSUB 398Ø:GOSUB 398Ø:COLOR 4,Ø,Ø
19Ø PRINT:PRINT "Reset PSI system"
2ØØ PRINT "Hit any key when ready. . . . ":PRINT
2Ø5 A$=INKEY$ : IF A$="" THEN 2Ø5
21Ø '
22Ø PRINT"-Data will be dumped under B:RAWDAT , B:PRES
23Ø 'PRINT " and converted to files DATØ, DAT1, DAT2, DAT3, PRES1, PRES2"
24Ø PRINT
25Ø 'INPUT "Enter traverse UP command";TU$
26Ø TU$="V41 D33Ø ZØ R1 V35Ø D33Ø Z1 R1"
27Ø 'INPUT "Enter traverse DOWN command";TD$
28Ø B$=TU$+CHR$(13):GOSUB 398Ø 'send traverse up command
29Ø '
3ØØ '----------------- STEP 1 ------------------------------------------
31Ø 'First load DASH16.BIN routine by contracting BASIC to 48K workspace
32Ø 'CLEAR, 59ØØØ!                              'reduce workspace to 48K
33Ø DEF SEG = Ø                                'find BASIC's segment
34Ø SG = 256 * PEEK(&H511) + PEEK(&H51Ø)
35Ø SG = SG + 491521/16
36Ø DEF SEG = SG                               'SG = load location
37Ø BLOAD "DASH16.BIN", Ø                      'for DASH16.BIN
38Ø '
39Ø '----------------- STEP 2 ------------------------------------------
395 DIM DIO%(4)                'declare data array
47Ø 'Initialize using mode Ø
49Ø DIO%(Ø) = &H3ØØ                            'base I/O address
5ØØ DIO%(1) = 2                                'interrupt level
51Ø DIO%(2) = 3                                'D.M.A. level
52Ø 'Be sure that base address & DMA level correspond to switch settings
53Ø 'on DASH-16!
54Ø MD% = Ø                                    'initialize mode
55Ø FLAG% = Ø                                  'declare error variable
56Ø DASH16 = Ø                                 'CALL offset = Ø
57Ø CALL DASH16 (MD%, DIO%(Ø),FLAG%)           'initialize
58Ø 'Check if any initializing errors
59Ø '(try some dumb numbers for MD%, DIO%(Ø thru 2))
6ØØ IF FLAG%<>Ø THEN PRINT"Initialization error # ";FLAG% : STOP
61Ø '
611 '
612 ' Make sure that on/off valve is closed
613 MD% = 13
614 DIO%(Ø) = Ø
615 CALL DASH16 (MD%, DIO%(Ø), FLAG%):PRINT:PRINT "Tunnel valve closed":PRINT
616 IF FLAG%<>Ø THEN PRINT "Error # ";FLAG%;" on digital output"
617 '
```

```
630 'Set programmable timer to output desired sample rate
640 INPUT "Enter tunnel pressure";MAXPSI
650 VOLT=MAXPSI/10
660 DATOUT%=INT(VOLT/.00296)
670 '
680 PRINT"SAMPLE RATE = 1,000,000 / (N1 * N2)"
690 INPUT "Enter N1 & N2 :",F1%,F2%
700 SR%=1000000!/F1%/F2% :PRINT"Sampling Rate per channel = "SR%" Hz"
710 INPUT"Is sampling rate correct <y/n> ?:",B$
720 IF B$="y" OR B$="Y" THEN 730 ELSE 690
730 PRINT
740 DIO%(0) = F1%
750 DIO%(1) = F2%
760 MD% = 17                              'timer set mode
770 CALL DASH16 (MD%, DIO%(0),FLAG%)
780 IF FLAG%<>0 THEN PRINT "Error in setting timer. Error # ";FLAG%:STOP
790 '
800 '---------------- STEP 4 ----------------------------------------
810 'If you skip this step, scan limits will default to:-
820 '     0 to 7 for 8 channel differential input configuration
830 '     0 to 15 for 16 channel single ended input configuration
840 'Now find out what you want for scan limits:-
850 INPUT "Lower channel scan limit (0-7 diff., 0-15 s.e.)? : ",LL%
860 INPUT "Upper channel scan limit (0-7 diff., 0-15 s.e.)? : ",UL%
870 'Set the limits using mode 1
880 DIO%(0) = LL%                   'lower limit
890 DIO%(1) = UL%                   'upper limit
900 MD% = 1
910 CALL DASH16 (MD%, DIO%(0),FLAG%)
920 IF FLAG%<>0 THEN PRINT"Error in setting scan limits # ";FLAG% : STOP
930 PRINT
940 '
950 '---------------- STEP 5 ----------------------------------------
960 'Set conversions, delay parameters, PSI system
970 INPUT "Enter total number of A/D conversions :",N% : PRINT
980 INPUT "Enter time delay (sec) before starting tunnel";SEC
990 LIM3=SEC*320
1000 INPUT "Enter time delay (sec) from valve open to traverse up ";SEC
1010 LIM = SEC * 320
1020 INPUT"Enter time (sec) for data collection";SEC
1030 LIM2 = SEC * 320
1040 '-------------------------------------------------------------
1050 GOSUB 2590      ' setup psi system  I1,C1,F1
1060 '
1070 PRINT:PRINT"Hit any key to begin..."  'start tunnel and take data
1080 IF INKEY$="" THEN 1080
1090 FOR ZZ=1 TO LIM3:NEXT ZZ 'delay tunnel start
1100 '
1110 '-----------------STEP 6 ---------------------------------------
1120 '
1130 ' Set control valve circuit for proper operating pressure
1140 MD%=15
1150 DIO%(0) = 1
1160 DIO%(1) = DATOUT%
1170 CALL DASH16 (MD%, DIO%(0), FLAG%)
1180 IF FLAG%<>0 THEN PRINT "Error # ";FLAG%;" on digital output"
1190 '
1200 ' Write digital output using mode 13
1210 MD% = 13
1220 DIO%(0) = 1
1230 CALL DASH16 (MD%, DIO%(0), FLAG%):PRINT:PRINT "Tunnel valve open":PRINT
1240 IF FLAG%<>0 THEN PRINT "Error # ";FLAG%;" on digital output"
1250 FOR ZZ = 1 TO LIM: NEXT ZZ   'delays traverse to allow tunnel valve
1260                              'to open before moving
1270 'DIO%(0) = 3
```

```
1290 'IF FLAG%<>0 THEN PRINT "Error # ";FLAG%;" on digital output"
1300 '
1310 '
1320 '-----------------STEP 7 ----------------------------------------
1330 'Now set PSI measurement and the block scan operation going
1340 PRINT "PSI system reading . . ."
1350 'GOSUB 2680   ' set psi system going
1360 '
1370 PRINT:PRINT "A/D block scan reading . . ."
1380 DIO%(0) = N%              'Total number of conversions
1390 DIO%(1) = &H3000          'Memory segment to dump data - hope its clear
1400 '                          at 192K. Change this to suit your system.
1410 DIO%(2) = 1               '1 = trigger from timer
1420 DIO%(3) = 0               '0 = One shot and finish
1430 MD%=20                    'mode 20 - block scan on interrupt
1440 '
1450 '*********************************************************
1460 CALL DASH16 (MD%, DIO%(0), FLAG%) 'set it going
1470 GOSUB 3180  'set PSI system going  D2
1480 'GOSUB 6030  'Check input buffer for characters
1490 B$="Y1":GOSUB 3980:PRINT:PRINT "Traverse up"   'Start traverse up
1500 '*********************************************************
1510 '
1520 IF FLAG%<>0 THEN PRINT"Error in block scan setup=";FLAG%:STOP
1530 '
1540 '----------------- STEP 7a ---------------------------------------
1550 'Block scan check -- optional procedure
1560 ' ** Note:  Though this command is never executed, it is needed
1570 '           for proper program operation
1580 'PRINT:PRINT"( Check status of block scans <y/n>? ) ";
1590 A$="N": IF A$="" GOTO 1590
1600 IF A$ = "Y" OR A$ = "y" THEN GOTO 1610 ELSE GOTO 1690
1610 MD% = 8
1620 CALL DASH16 (MD%, DIO%(0), FLAG%)
1630 PRINT"Operation type - ";DIO%(0)
1640 PRINT"Status         - ";DIO%(1)
1650 PRINT"Scan count     - ";DIO%(2)
1660 PRINT
1670 GOTO 1580
1680 '
1690 PRINT:PRINT "Collecting . . ."
1700 '
1710 FOR ZZ = 1 TO LIM2 : NEXT ZZ  'delay to allow system to collect
1720                               'data before writing to arrays and
1730 PRINT:PRINT"Traverse down"
1740 '
1750 FOR ZZ=1 TO 320 : NEXT ZZ   'Wait 1 sec before shutting off tunnel
1760 '
1770 MD% = 13
1780 DIO%(0) = 0
1790 CALL DASH16 (MD%, DIO%(0), FLAG%):PRINT:PRINT "Tunnel valve closed"
1800 IF FLAG%<>0 THEN PRINT "Error # ";FLAG%;" on digital output"
1810 CLOSE #1 'close COM1: file
1820 '
1830 '----------------- STEP 8 ----------------------------------------
1840 'Retrieve data to arrays DT%(*) and CH%(*) using mode 9
1850 DIM DT%(N%),CH%(N%)          'set up integer arrays for data/channel #
1860 MD% = 9                     'mode 9 - data transfer
1870 DIO%(0)=N%                  'number of words to transfer
1880 DIO%(1) = &H3000             'memory segment to transfer from
1890 DIO%(2) = 0                  'start transferring at conversion 0
1900 DIO%(3) = VARPTR(DT%(0))     'location of DT%(*) array
1910 DIO%(4) = VARPTR(CH%(0))     'location of CH%(*) array
1920 CALL DASH16 (MD%, DIO%(0), FLAG%) 'make transfer
1930 IF FLAG%<>0 THEN PRINT "Mode 9 data transfer error # ";FLAG%:STOP
```

```
1950 '
1960 '----------------- STEP 10 -------------------------------------------
1970 'Dump A/D data to drive B
1980 PRINT:PRINT "Writing A/D data into file . . ."
1990 OPEN "b:rawdat" FOR OUTPUT AS #1
2000 FOR L%=0 TO N%-1
2010   WRITE #1,DT%(L%)
2020 NEXT L%
2030 CLOSE #1
2040 '
2050 '----------------- STEP 11 ------------------------------------------
2060 'End scan interrupts using mode 7 - strictly only needed in recycle mode.
2070 'This step is not needed if in one shot (non-recycle) mode as the
2080 'interrupt will terminate automatically on completion of scans.
2090 MD% = 7
2100 DIO%(0) = N%
2110 CALL DASH16 (MD%, DIO%(0), FLAG%) 'do it
2120 '
2130 '----------------- STEP 12 -------------------------------------------
2140 'Receive pressure data from PSI system
2150 GOSUB 3830  ' service request  SRQ
2160 GOSUB 3330  ' psi data reduction  F2
2170 GOSUB 3400  ' write out psi data to file  O6
2180 '
2190 END
2200 '----------------- STEP 13 --------------------------------------
2210 '- Output data into organized files to be plotted
2220 '- #'s 1-4 OUTPUT correspond to CHANNELS 0-3 A/D signal input
2230 ' NOTE:  Need to set BASIC to handle (5) files by BASICA/f:5 in DOS
2240 '
2250 CHANNEL% = UL% + 1
2260 PRINT:PRINT "Organizing all data into files for plotting . . ."
2270 OPEN "b:dat0" FOR OUTPUT AS #1
2280 OPEN "b:dat1" FOR OUTPUT AS #2
2290 OPEN "b:dat2" FOR OUTPUT AS #3
2300 OPEN "b:dat3" FOR OUTPUT AS #4
2310 OPEN "b:rawdat" FOR INPUT AS #5
2320 FOR I%=1 TO N%/CHANNEL%
2330   INPUT #5,TRAV(I%)
2340   PRINT #1,I%,TRAV(I%)
2350 NEXT I%
2360 FOR I% = 2 TO CHANNEL%
2370   FOR II% = 1 TO N%/CHANNEL%
2380     INPUT #5, Y
2390     PRINT #I%, Y,TRAV(II%)
2400   NEXT II%
2410 NEXT I%
2420 FOR I% = 1 TO 5 : CLOSE #I% : NEXT I%
2430 '
2440 OPEN "b:pres" FOR INPUT AS #1
2450 OPEN "b:pres1" FOR OUTPUT AS #2
2460 'OPEN "b:pres2" FOR OUTPUT AS #3
2470 FOR I% = 1 TO NUMB*TIME
2480   T = 1 / NUMB * I%
2490   FOR II% = 2 TO 2
2500     INPUT #1, P
2510     PRINT #II%, P,T
2520   NEXT II%
2530 NEXT I%
2540 CLOSE #1: CLOSE #2  ': CLOSE #3
2550 CLS : END
2560 '
2570 '=============== PSI SUBROUTINES ===================================
2580 '
2590 IBINIT1 = 59000!
```

```
2610 BLOAD "BIB.M",IBINIT1
2620 CALL IBINIT1(IBFIND,IBTRG,IBCLR,IBPCT,IBSIC,IBLOC,IBPPC,IBBNA,IBONL,
BSRE,IBRSV,IBPAD,IBSAD,IBIST,IBDMA,IBEOS,IBTMO,IBEOT,IBRDF,IBWRTF)
2630 CALL IBINIT2(IBGTS,IBCAC,IBWAIT,IBPOKE,IBWRT,IBWRTA,IBCMD,IBCMDA,IBRD,
,IBSTOP,IBRPP,IBRSP,IBDIAG,IBXTRC,IBRDI,IBWRTI,IBRDIA,IBWRTIA,IBSTA%,IBERR%
T%)
2640 DIM J(5),K(3),BYTE(3),CAL(3,112),COEFF(3,112),PARAMETER(21)
2650 DIM PERIOD(18),VOLTS(3,112)
2660 DIM BUFFER$(40)
2670 A1%=2 : A2%=0: A3%=0 : A4%=0 : A5%=0 : A6%=0
2680 B%=8
2690 C=.0001 : D%=25: E=.01: F%=3 : G%=2 : H%=3
2700 CH=A1%+A2%+A3%+A4%+A5%+A6% : SEN=CH/G% : BITS%=14
2710 BOARD$="DACU" : CALL IBFIND(BOARD$,DACU%)
2720 CLS : PRINT "780B SYSTEM TEST" : PRINT
2730 INPUT "Number of data frames averaged per measurement set ";B%
2740 INPUT "Total time (sec)";TIME
2750 INPUT "Number of measurement sets/sec/channel";NUMB
2760 T1=A1%*.0001
2770 T2=.6/NUMB/B%
2780 MTIME=(T1+T2)*B%
2790 D% = INT(TIME*NUMB)
2800 E = 1/NUMB-MTIME
2810 C=T2  '(100/NUMB-INT(100*E))/B%
2820 IF D%>255 THEN 2720
2830 IF C>.09999 THEN C = .09999
2840 IF C = 0 THEN C = .00001
2850 PRINT:PRINT "Hit Enter to calibrate . . ."
2855 A$=INKEY$ : IF A$="" THEN 2855
2860 GOSUB 2930  'I1
2870 GOSUB 3110  'C1
2880 GOSUB 3260  'F1
2890 RETURN
2900 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
2910 '$$$$$ I1:  Initialization $$$$$
2920 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
2930 CMD$="I1" : GOSUB 3940
2940 PARAMETER(1)=INT(A1%/100) : PARAMETER(2)=A1%-INT(A1%/100)*100
2950 PARAMETER(3)=INT(A2%/100) : PARAMETER(4)=A2%-INT(A2%/100)*100
2960 PARAMETER(5)=INT(A3%/100) : PARAMETER(6)=A3%-INT(A3%/100)*100
2970 PARAMETER(7)=INT(A4%/100) : PARAMETER(8)=A4%-INT(A4%/100)*100
2980 PARAMETER(9)=INT(A5%/100) : PARAMETER(10)=A5%-INT(A5%/100)*100
2990 PARAMETER(11)=INT(A6%/100) : PARAMETER(12)=A6%-INT(A6%/100)*100
3000 PARAMETER(13)=B%
3010 PARAMETER(14)=INT(10^5*C/100) : PARAMETER(15)=10^5*C-INT(10^5*C/100)
3020 PARAMETER(16)=D%
3030 PARAMETER(17)=INT(10^2*E/100) : PARAMETER(18)=10^2*E-INT(10^2*E/100)
3040 PARAMETER(19)=F% : PARAMETER(20)=G% : PARAMETER(21)=H%
3050 OUTP$="I1" : CALL IBWRT(DACU%,OUTP$)
3060 FOR X=1 TO 21 : OUTP$=CHR$(PARAMETER(X)) : CALL IBWRT(DACU%,OUTP$)
3070 NEXT X: GOSUB 3950: RETURN
3080 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3090 '$$$$$ C1:  Calibration $$$$$
3100 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3110 CMD$="C1" : GOSUB 3940
3120 OUTP$="C1" : CALL IBWRT(DACU%,OUTP$)
3130 GOSUB 3830  'SRQ
3140 GOSUB 3950 : RETURN
3150 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3160 '$$$$$ D2:  Average Data Acquisition $$$$$
3170 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3180 CMD$="D2" : GOSUB 3940
3190 OUTP$="D2" : CALL IBWRT(DACU%,OUTP$)
3200 GOSUB 3750  'Trigger acquisition
3210 GOSUB 3950
```

```
3230 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3240 '$$$$$ F1:  Cal Data Reduction $$$$$
3250 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3260 CMD$="F1" : GOSUB 3940
3270 OUTP$="F1" : CALL IBWRT(DACU%,OUTP$)
3280 GOSUB 3830  'SRQ
3290 GOSUB 3950 : RETURN
3300 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3310 '$$$$$ F2:  Acquisition Data Reduction $$$$$
3320 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3330 CMD$="F2" : GOSUB 3940
3340 OUTP$="F2" : CALL IBWRT(DACU%,OUTP$)
3350 GOSUB 3830  'SRQ
3360 GOSUB 3950 : RETURN
3370 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3380 '$$$$$ O6:  Input ASCII Data $$$$$
3390 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3400 CMD$="O6" : GOSUB 3940
3410 OUTP$="O6" : CALL IBWRT(DACU%,OUTP$)
3420 PRINT:PRINT "Reading pressure data"
3430 GOSUB 3660  'input pressure data
3440 BYTES=11*CH
3450 'PRINT : PRINT " CH     PRESSURE" : PRINT
3460 OPEN "b:pres" FOR OUTPUT AS #3
3470 PRINT:PRINT "Writing pressure data into file . . ."
3480 WANTLEN=11 : RANGE=1
3490 FOR X=0 TO D%-1:PRINT X;
3500    FOR Y=1 TO BYTES STEP 11
3510        Q=(Y+10)/11
3520        STARTPOS=Y+X*22 ': GOSUB 3770 'extract data
3530 BUFLINE=0 : SEGMENT$=""
3540 IF STARTPOS > 255 THEN BUFLINE=BUFLINE+1 : STARTPOS=STARTPOS-255 : GOTO
0
3550 FOR BUILDSEG=1 TO WANTLEN : SEGMENT$=SEGMENT$+MID$(BUFFER$(BUFLINE),STAR
S+BUILDSEG-1,1) : IF STARTPOS+BUILDSEG=256 THEN BUFLINE=BUFLINE+1 : STARTPOS=
UILDSEG
3560 NEXT BUILDSEG   ': RETURN
3570        PRESS=VAL(SEGMENT$)-CAL(1,1)
3580        PRINT #3, PRESS
3590    NEXT Y
3600 NEXT X
3610 PRINT:CLOSE #3
3620 GOSUB 3950 : RETURN
3630 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3640 '$$$$$ DATA_INPUT:  Input Measurement Data From DACU $$$$$
3650 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3660 BUFLINECOUNT=0
3670 BUFFER$(BUFLINECOUNT)=SPACE$(255) : CALL IBRD(DACU%,BUFFER$(BUFLINECOUNT
3680 IF IBSTA% AND &H2000 THEN 3700
3690 PRINT BUFLINECOUNT;:BUFLINECOUNT=BUFLINECOUNT+1 : GOTO 3670
3700 IF IBCNT%<255 THEN BUFFER$(BUFLINECOUNT)=LEFT$(BUFFER$(BUFLINECOUNT),IBC
)
3710 PRINT:RETURN
3720 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3730 '$$$$$ TRIGGER:  Initiate Acquisition $$$$$
3740 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3750 IF H%<>7 THEN 3780
3760 PRINT "Press any key for SOFTWARE TRIGGER"
3770 IF INKEY$="" THEN 3770 ELSE CLS
3780 IF H%<=7 THEN OUTP$=CHR$(13) : CALL IBWRT(DACU%,OUTP$)
3790 RETURN
3800 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3810 '$$$$$ SRQ:  DACU Service Request $$$$$
3820 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3830 RQSWAIT%=&H800 : CALL IBWAIT(DACU%,RQSWAIT%)
```

```
3850 IF SPOLL%-64 =13 THEN 3750
3860 RETURN
3870 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3880 '$$$$$ EXTRACT-BYTE:  Extract data from GPIB input $$$$$
3890 '$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3900 BUFLINE=0 : SEGMENT$=""
3910 IF STARTPOS > 255 THEN BUFLINE=BUFLINE+1 : STARTPOS=STARTPOS-255 : GOTO
0
3920 FOR BUILDSEG=1 TO WANTLEN : SEGMENT$=SEGMENT$+MID$(BUFFER$(BUFLINE),STA
S+BUILDSEG-1,1) : IF STARTPOS+BUILDSEG=256 THEN BUFLINE=BUFLINE+1 : STARTPOS
UILDSEG
3930 NEXT BUILDSEG : RETURN
3940 CXPOS=POS(0) : CYPOS=CSRLIN : LOCATE 1,60 : PRINT CMD$; : LOCATE CYPOS,
S : RETURN
3950 CXPOS=POS(0) : CYPOS=CSRLIN : LOCATE 1,60 : PRINT SPACE$(19); : LOCATE
S,CXPOS : RETURN
3960 'That's it
3970 '----------------------------------------------------------------
3980 'TALK TO TRAVERSE
3990 FOR JJ=1 TO LEN(B$)
4000 PRINT #1,MID$(B$,JJ,1);
4010 IF EOF(1) THEN 4100
4020 IF LOC(1)>128 THEN PAUSE=TRUE:PRINT#1,XOFF$;
4030 A$=INPUT$(LOC(1),#1)
4040 FOR II=1 TO LEN(A$)
4050 A1$=MID$(A$,II,1)
4060 IF (ASC(A1$)<31 AND A1$<>CHR$(13)) OR A1$=CHR$(127) THEN 4100
4070 NEXT II
4080 IF LOC(1)>0 THEN 4100
4090 IF PAUSE THEN PAUSE=FALSE:PRINT#1,XON$;
4100 NEXT JJ
4110 RETURN
4120 '-------------------------------------------------------------
4130 'Check input buffer
4140 IF EOF(1) THEN 4230
4150 IF LOC(1)>128 THEN PAUSE=TRUE:PRINT#1,XOFF$;
4160 A$=INPUT$(LOC(1),#1)
4170 FOR II=1 TO LEN(A$)
4180 A1$=MID$(A$,II,1)
4190 IF (ASC(A1$)<31 AND A1$<>CHR$(13)) OR A1$=CHR$(127) THEN 4230
4200 NEXT II
4210 IF LOC(1)>0 THEN 4230
4220 IF PAUSE THEN PAUSE=FALSE:PRINT#1,XON$;
4230 RETURN
```

Program 2. Converting Raw Voltage Data to Meaningful Data

```
10 '*****************************************************************
20 '*                                                               *
30 '*  Program RAWPS2.BAS -- METRABYTE DATA reduction    ( 6/21/88 ) *
40 '*                                                               *
50 '*****************************************************************
60 CLS : COLOR 4,0,0 : KEY ON
70 DIM CH0(704), CH1(704), CH2(704), CH3(704), PSI0(40), PSI1(40)
80 '
90 INPUT "Run number ";RN$
100 '
110 ' Input station data    ******************************************
120 OPEN "RUNDAT.NEW" FOR INPUT AS #1
130 INPUT #1,R$,NPTS,FL,PATM
140 IF R$=RN$ THEN GOTO 160
150 GOTO 130
160 '
170 SUM1=0 : SUM2=0 : SUM3=0 : SUM4=0
180 FOR I = 1 TO NPTS
190   INPUT #1, X,Y
200   XD = X * 409.5
210   SUM1 = SUM1 + XD*XD
220   SUM2 = SUM2 + XD
230   SUM3 = SUM3 + XD*Y
240   SUM4 = SUM4 + Y
250 NEXT I
260 B1 = (SUM3/SUM1-SUM4/SUM2) / (SUM2/SUM1-NPTS/SUM2)
270 M1 = SUM4/SUM2 - NPTS*B1/SUM2
280 B1 = B1 - FL
290 'PRINT "M = ";M1
300 'PRINT "B = ";B1
310 CLOSE #1
320 '
330 '
340 ' Read in metrabyte data ******************************************
350 A$="B:RAWDAT."+RN$
360 OPEN A$ FOR INPUT AS #1
370 '
380 FOR I=1 TO 704
390   INPUT #1,CH0(I)            'LVDT
400   INPUT #1,CH1(I)            'PS2A
410   INPUT #1,CH2(I)            'Tt1
420   INPUT #1,CH3(I)            'Pt1
430 NEXT I
440 CLOSE #1
450 '
460 ' Convert metrabyte data using calibrations     *******************
470 FOR I=1 TO 704
480   CH0(I)=(CH0(I)*M1+B1)/1.27
490   CH1(I)=CH1(I)*3.670558/409.5 - 2.863               'PS2A cal date
492 ' CH1(I)=CH1(I)*1.919/409.5 - 2.955              'PS2A cal date 8/23/
500   CH2(I) = CH2(I)*7.920392E-02-26.94829+273.15     'Tt1 cal date 6/21/
510   CH3(I)=CH3(I)*201/409.5 + .13                   'Pt1 cal date 8/23/
520 NEXT I
530 '
540 ' Output metrabyte data    ****************************************
550 '
560 A$="B:PS2A."+RN$
570 OPEN A$ FOR OUTPUT AS #1                      'PS2A
580 FOR I=1 TO 704
590   PRINT #1,CH1(I),CH0(I)
600 NEXT I
```

```
620 '
630 A$="B:TT1."+RN$
640 OPEN A$ FOR OUTPUT AS #1                         'Ttl
650 FOR I=1 TO 704
660   PRINT #1, CH2(I), CH0(I)
670 NEXT I
680 CLOSE #1
690 '
700 A$="B:PT1."+RN$
710 OPEN A$ FOR OUTPUT AS #1                         'Ptl
720 FOR I=1 TO 704
730   PRINT #1,CH3(I),CH0(I)
740 NEXT I
750 CLOSE #1
760 '
770 ' PSI data    ****************************************************
780 '
790 A$="B:PRES."+RN$
800 OPEN A$ FOR INPUT AS #1
810 FOR I=1 TO 40
820   INPUT #1,PSI0(I)
830   INPUT #1,PSI1(I)
840 NEXT I
850 CLOSE #1
860 '
870 A$="b:pslot."+RN$
880 OPEN A$ FOR OUTPUT AS #1
890 FOR I=1 TO 40
900   PRINT #1, PSI0(I)+PATM, I*.2
910 NEXT I
920 CLOSE #1
930 '
940 'A$="B:PT2."+RN$
950 'OPEN A$ FOR OUTPUT AS #1
960 'FOR I=1 TO 224
970   'PRINT #1, PSI1(I)+PATM, I*.2000
980 'NEXT I
990 CLOSE #1
1000 END
1010 '****************************************************************
```

Program 3. Mean Flow Quantities From Measured Pressures and Temperatures

```
C2345678901234567890
C
C    DATA REDUCTION PROGRAM YIELDING MACH #, DENSITY, VELOCITY, Rho
c    times U, and Pressure profiles in dimensional and nondimensional
C    form FROM CONE STATIC AND TOTAL PRESSURE AND TOTAL
C    TEMPERATURE MEASUREMENTS.
C
      character*40 fn1,fn2,fn3,fn4,fn13,fn7,fn8,fn9,fn10,fn11
      character*40 fn12,fn14,fn15,fn16
      DIMENSION PT2G(704), PS2A(704), PT2(704), PS(704), HPT2G(704)
      DIMENSION HPS2A(704), TT2(704), HTT2(704), U1(704), RHO1(704)
      DIMENSION rhou(704), RAT(24), P1(704), TT2A(704), HTT2A(704)
      Dimension uinf(704), rhoinf(704), tt1(704), rhouinf(704)
      Dimension htt1(704), pt1(704), hpt1(704), pinf(704)
      Dimension p1dim(704),u1dim(704),rho1dim(704),rhoudim(704)
      Dimension p1non(704), ynew(704)
      REAL M1(704)
      real m12, mf, minf, minf2, mfinf
C
      DATA RAT / .5283,.5221,.5160,.5100,.5039,.4980,
     D     .4920,.4861,.4803,.4746,.4689,.4632,.4576,.4521,.4467,.4413,
     E     .4360,.4307,.4255,.4204,.4154,.4104,.4055,.4006 /
C
      write(*,*) 'input files pt2g.?, ps2a.?, tt2.?, tt1.?, pt1.?'
      read(*,*) fn1,fn2,fn3,fn10,fn11
      open(1,file=fn1)
      open(2,file=fn2)
      open(3,file=fn3)
      open(10,file=fn10)
      open(11,file=fn11)
c
      write(*,*) 'input filenames m1.?, u1.?, rho1.?,rhou.?,p1.?'
      read(*,*) fn4,fn13,fn7,fn8,fn9
      open(4,file=fn4)
      open(13,file=fn13)
      open(7,file=fn7)
      open(8,file=fn8)
      open(9,file=fn9)
c
      write(*,*) 'input filenames udim.?, rhodim.?,rhoudim?,pdim.?'
      read(*,*) fn12,fn14,fn15,fn16
      open(12,file=fn12)
      open(14,file=fn14)
      open(15,file=fn15)
      open(16,file=fn16)
c
      do 10 i = 1,704
      read(1,*) pt2g(i), hpt2g(i)
      read(2,*)  ps2a(i), hps2a(i)
      read(3,*)  tt2a(i), htt2a(i)
      read(10,*)  tt1(i), htt1(i)
      read(11,*)  pt1(i), hpt1(i)
   10 continue
C
c
      G = 1.4
      R = 286.8
      hslot = .475
c
      write(*,*)
      write(*,*) 'input minf'
      read(*,*) minf
      write(*,*)
      write(*,*) 'input pt2inf'
      read(*,*) ptinf
      write(*,*)
```

```
C
c     This section matches the heights of the cone static, pitot, and
c     temperature profiles.
c
        DO 69 I5 = 2, 704
              IF(ABS(HTT2A(I5)-HTT2A(I5-1)).LT..005) THEN
               GOTO 69
              ELSE
               GOTO 79
          END IF
   69 CONTINUE
   79 DO 89 I6 = 1, 704-I5
         TT2(I6) = TT2A(I5 + I6 -1)
         HTT2(I6) = HTT2A(I5 + I6 -1)
   89 CONTINUE
C
       IMAX = I6
C
       DO 101 I = 1, IMAX
          DO 102 J = 1, IMAX
           IF(ABS(HTT2(I)-HPT2G(J)).LE..005) THEN
            GOTO 103
           END IF
  102     CONTINUE
  101 CONTINUE
C
  103 DO 105 I2 = 1, IMAX-J
         PT2(I2) = PT2G(J+I2-1)
  105 CONTINUE
C
       DO 104 I= 1,IMAX
        DO 106 K = 1,IMAX
         IF(ABS(HTT2(I)-HPS2A(K)).LE..005) THEN
          GOTO 107
         END IF
  106  CONTINUE
  104  CONTINUE
C
  107  DO 108 I3 = 1, IMAX-K
        PS(I3) = PS2A(K+I3-1)
  108 CONTINUE
       ILAST = IMAX- J
C
c    The actual slot height was .475 inches and the initial
c    nondimensionalization was made with .5 inches so this
c    loop makes the nondimensionalization with actual slot
c    heights.
c
       do 109 i = 1, ilast
       htt2(i) = htt2(i)*.5/hslot
  109 continue
C
c    The nondimensionalizing profiles are found here.
c
       do 111 i = 1, ilast
       minf2 = minf*minf
       mfinf = 1.+ (g - 1.)/2.*minf2
       rayinf = (2.*g/(g+1.)*minf2 - (g-1.)/(g+1.))**(1./(g-1.))/
      .          ((g+1.)/2.*minf2)**(g/(g-1.))
       pinf(i) = ptinf*rayinf
       uinf(i) = sqrt(g*R*tt1(i)/mfinf)*minf
       rhoinf(i) = ptinf*rayinf*mfinf/R/TT1(i)*6894.6
       rhouinf(i) = rhoinf(i)*uinf(i)
  111 continue
c
c
```

```
c  This loop finds the mean flow quantities if M1 > 1.2 and
c  therefore the shock on the cone static probe is attached.
c
      DO 1000 I = 1, ILAST
 200    PSDPT2 = PS(I)/PT2(I)
c
c  If Pc/Pt2 > .4782, then M1 < 1.2 and we must make an assumption
c  to acquire the static pressure.  This is done in the subsequent
c  loop.
c
        IF(PSDPT2.GT..4782) THEN
         M1(I) = -1.
           GOTO 1000
        END IF
C
c   This is the polynomial expression for the Mach number.
c
        X = -2.86369*PSDPT2 + 1.36942
        M1(I) = ((((((((-1.92393*X + 10.117)*X - 16.45154)*X +10.33433)
     A           *X + .81891)*X - 4.04847)*X + 2.4034)*X - .13547)*X +
     B           .68905)*X + 1.19997
c
C
            M12 = M1(I)*M1(I)
        MF = 1. + (g-1.)/2.*M12
        ray = (2.*g/(g+1.)*m12 - (g-1.)/(g+1.))**(1./(g-1.))/
     .         ((g+1.)/2.*m12)**(g/(g-1.))
        P1(I) = PT2(I)*RAY
        P1dim(i) = P1(i)
        A1 = SQRT(g*R*TT2(I)/MF)
        U1(I) = A1*M1(I)
        U1dim(i) = u1(i)
C       RHO1(I) = P1(I)/R/TT2(I)*MF*6894.76
        RHO1(I) = p1(i)*mf/R/Tt2(i)*6894.6
        rho1dim(I) = rho1(i)
        rhoudim(i) = rho1dim(i) * u1dim(i)
        P1non(i) = P1(i)/pinf(i)
        U1(I) = U1(I)/UINF(i)
        RHO1(I) = RHO1(I)/RHOINF(i)
        rhou(i) = rho1(i)*u1(i)
 1000 CONTINUE
C
c  This loop takes care of the cases of M1 < 1.2.
c
      DO 2000 I = ILAST, 1, -1
       IF(M1(I).GT.0.) THEN
        P1LST = P1(I)
        GOTO 2000
       END IF
C
        P1DPT2 = P1LST/PT2(I)
        P1(I) = P1LST
c
c   If P1/Pt2 < .5283 then the flow is 1.0 < M <1.2
c
        IF(P1DPT2.LE..5283) THEN
         GOTO 15
             END IF
          IF(P1DPT2.GT.1) THEN
         WRITE(*,*)' P1/PT2 > 1 , TROUBLE'
         WRITE(*,*)' I= ', I
          GOTO 23
        END IF
C
c   This section is for M < 1.0
c
```

```
          M1(I) = SQRT(2./(g-1.)*(P1DPT2**(-(g-1.)/g)-1.))
          M12 = M1(I)*M1(I)
          MF = 1. + (g-1.)/2.* M12
          GOTO 800
c
  15  DO 17 K = 2, 24
          IF(RAT(K).GT.P1DPT2)  GOTO 17
          M1(I) = .01/(RAT(K) - RAT(K-1))*(P1DPT2-RAT(K-1))+(K-2)*.01+1.
          M12 = M1(I)*M1(I)
          MF = 1. + (g-1.)/2.*M12
          GOTO 800
  17  CONTINUE
       WRITE(*,*) 'INTERPOLATION ERROR, I, P1DPT2, RAT(K) =', I, P1DPT2
     A             , RAT(K)
          GOTO 2000
 800  A1 = SQRT(g*R*TT2(I)/MF)
       P1dim(i) = P1(i)
       p1non(i) = p1(I)/pinf(i)
       U1(I) = A1*M1(I)
       U1dim(i) = u1(i)
       RHO1(I) = p1(i)*mf/R/Tt2(i)*6894.6
       rho1dim(I) = rho1(i)
       rhoudim(i) = rho1dim(i) * u1dim(i)
      U1(I) = U1(i)/UINF(i)
      RHO1(I) = RHO1(i)/RHOINF(i)
      rhou(i) = rho1(i)*u1(I)
2000 CONTINUE
c
c This last section filters the profiles to smooth the profiles.
c
      do 770 i = 4, ilast
       if(htt2(i).le.htt2(i-1).or.htt2(i).le.htt2(i-2).or.htt2(i).
     .   le.htt2(i-3)) then
         htt2(i) = 0.0
      end if
 770 continue
c
      call filter(m1,htt2,ilast,kount,ynew)
      call filter(u1,htt2,ilast,kount,ynew)
      call filter(rho1,htt2,ilast,kount,ynew)
      call filter(rhou,htt2,ilast,kount,ynew)
      call filter(p1non,htt2,ilast,kount,ynew)
      call filter(u1dim,htt2,ilast,kount,ynew)
      call filter(rho1dim,htt2,ilast,kount,ynew)
      call filter(rhoudim,htt2,ilast,kount,ynew)
      call filter(p1dim,htt2,ilast,kount,ynew)
c
      do 12 i = 1, kount
      write(4,*) m1(i), ynew(i)
      write(13,*) u1(i), ynew(i)
      write(7,*) rho1(i), ynew(i)
      write(8,*) rhou(i), ynew(i)
      write(9,*) p1non(i), ynew(i)
      write(12,*) u1dim(i), ynew(i)
      write(14,*) rho1dim(i), ynew(i)
      write(15,*) rhoudim(i), ynew(i)
      write(16,*) p1dim(i), ynew(i)
  12  continue
C
C
  23 STOP
     END
c
c
     subroutine filter(xold, yold, ilast,kount,ynew)
     dimension xold(704), yold(704), xnew(704),x2old(704)
```

```
      dimension y2old(704),ynew(704)
c
      kount = 0
      do 10 i = 1, ilast
       if (yold(i).lt.0.001) goto 10
         kount = kount + 1
         y2old(kount) = yold(i)
         x2old(kount) = xold(i)
   10 continue
c
c
      do 20 i = 2, kount - 1
        xnew(i) = (x2old(i-1) + 2.0*x2old(i) + x2old(i+1))/4.0
   20 continue
c
      xnew(1) = (2.0*x2old(1) + x2old(2))/3
      xnew(kount) = (2.0*x2old(kount) + x2old(kount-1))/3.0
c
      do 30 i = 1, kount
       ynew(i) = y2old(i)
       xold(i) = xnew(i)
   30 continue
      return
      end
```

APPENDIX C

Listings of Mean Flow Quantities

The data listed in this Appendix matches the data presented graphically in many figures. Every fifth point from each of the data files is listed in order to save space. The files are presented in nondimensional and dimensional forms. The nondimensionalized forms adhere to nondimensionalization scheme presented in Chapter 3.

Table 1. Nondimensionalized Profiles at Station 1 (Heated Flow)

y/H-slot	Velocity	Density	Pressure	Mach #	Rho X U
0.2587610	0.852775	0.309744	0.804321	1.574853	0.264143
0.2658010	0.844237	0.311985	0.817504	1.552041	0.263389
0.2992430	0.843001	0.315641	0.828422	1.548521	0.266086
0.3291640	0.840950	0.317796	0.836354	1.542649	0.267251
0.3555660	0.838217	0.319321	0.843930	1.534385	0.267660
0.3766870	0.836829	0.321046	0.851106	1.529490	0.268661
0.4013280	0.840203	0.322063	0.850659	1.538487	0.270598
0.4242090	0.847155	0.322919	0.846383	1.557204	0.273563
0.4488500	0.849007	0.320810	0.839967	1.561425	0.272370
0.4787720	0.853105	0.319275	0.834266	1.570563	0.272375
0.5016530	0.861378	0.317352	0.822469	1.592293	0.273358
0.5262940	0.867766	0.313601	0.808844	1.607965	0.272132
0.5526950	0.880468	0.310124	0.789848	1.641827	0.273057
0.5755760	0.890603	0.303588	0.765278	1.669300	0.270378
0.6072580	0.906763	0.295750	0.733867	1.713044	0.268173
0.6283790	0.914795	0.288012	0.709737	1.734212	0.263470
0.6530200	0.921830	0.282702	0.691624	1.753885	0.260604
0.6794210	0.916862	0.281641	0.694720	1.737287	0.258229
0.7005420	0.903445	0.283033	0.710713	1.696654	0.255704
0.7357440	0.882809	0.287150	0.739215	1.637424	0.253498
0.7568650	0.880154	0.293122	0.756901	1.629987	0.257993
0.7885460	0.863425	0.297361	0.780844	1.585710	0.256756
0.8131870	0.764569	0.281548	0.815170	1.338125	0.215451
0.8395890	0.674686	0.268630	0.835507	1.138660	0.181309
0.8712700	0.538064	0.245912	0.835507	0.871448	0.132446
0.8976720	0.611252	0.264646	0.835507	1.024647	0.162021
0.9258330	0.740827	0.303880	0.827698	1.337585	0.225489
0.9539940	0.845825	0.346093	0.791575	1.664695	0.292824
0.9786350	0.855233	0.365581	0.781691	1.740510	0.312659
1.0015171	0.863661	0.384616	0.771844	1.814367	0.332193
1.0279180	0.879290	0.405993	0.760030	1.912550	0.357004
1.0560790	0.896997	0.423891	0.744556	2.014149	0.380234
1.0789599	0.915771	0.435533	0.719451	2.120578	0.398867
1.1088810	0.944655	0.448944	0.683460	2.278686	0.424117
1.1317620	0.970004	0.458296	0.643924	2.435384	0.444552
1.1546431	0.985807	0.468394	0.622221	2.545323	0.461747
1.1863250	1.003125	0.490279	0.612054	2.671958	0.491843
1.2109660	1.011196	0.515942	0.619889	2.745328	0.521732
1.2426480	1.018098	0.550999	0.638399	2.814681	0.560979
1.2672880	1.021403	0.584935	0.663189	2.854691	0.597482
1.3007309	1.024172	0.622886	0.692146	2.891345	0.637959
1.3218520	1.019348	0.649546	0.726284	2.868855	0.662113
1.3500130	1.024604	0.688051	0.749972	2.920528	0.704992
1.3781750	1.025859	0.716672	0.772120	2.941199	0.735217
1.4045759	1.024938	0.747283	0.800387	2.947182	0.765933
1.4327370	1.018891	0.767509	0.832676	2.911155	0.782016
1.4608980	1.020100	0.795542	0.855129	2.928025	0.811541
1.4855390	1.024562	0.828558	0.871931	2.972212	0.848940
1.5189810	1.026581	0.860330	0.892908	2.998811	0.883208
1.5506630	1.026111	0.886679	0.915644	3.004936	0.909853
1.5753030	1.028743	0.911966	0.926788	3.036926	0.938191
1.6017050	1.028147	0.928077	0.938984	3.041863	0.954206
1.6298660	1.025337	0.938100	0.952446	3.028247	0.961871
1.6527470	1.021409	0.945460	0.968567	3.003138	0.965702
1.6826680	1.018404	0.951412	0.978996	2.987659	0.968922
1.7108300	1.014150	0.958755	0.994812	2.962819	0.972320
1.7337110	1.008969	0.962397	1.008658	2.932924	0.971029
1.7618730	1.008009	0.970442	1.014677	2.933609	0.978215
1.7865140	1.008482	0.978319	1.016817	2.943781	0.986619
1.8111550	1.008100	0.983018	1.018777	2.946888	0.990981
1.8393160	1.008321	0.988157	1.020797	2.952292	0.996379
1.8657180	1.008638	0.990817	1.019485	2.959098	0.999376

1.8903590	1.009572	0.989895	1.016997	2.964081	0.999370
1.9202800	1.009547	0.990703	1.018109	2.963596	1.000162
1.9466810	1.009366	0.990267	1.017717	2.962983	0.999543
1.9748420	1.009507	0.990812	1.017390	2.964690	1.000232
2.0030041	1.008500	0.991090	1.019484	2.959099	0.999514
2.0276451	1.007097	0.990528	1.021519	2.951207	0.997558
2.0540459	1.005918	0.991937	1.024011	2.946249	0.997807
2.0822079	1.004480	0.992051	1.030779	2.932532	0.996495
2.1121280	1.001461	0.994395	1.039350	2.915097	0.995849
2.1420510	0.999453	0.999605	1.049547	2.902637	0.999058
2.1684520	0.999611	1.007204	1.056348	2.904727	1.006817
2.1966140	1.001272	1.016959	1.056792	2.922986	1.018253
2.2247751	1.002457	1.021175	1.054859	2.935189	1.023684
2.2511761	1.000809	1.016387	1.053840	2.924897	1.017210
2.2775769	0.998787	1.015417	1.057290	2.912838	1.014187
2.3074989	0.996280	1.009690	1.059475	2.894328	1.005934
2.3303790	0.996395	1.008708	1.057637	2.895776	1.005072
2.3550210	0.996816	1.007134	1.055072	2.898262	1.003930
2.3831820	0.996827	1.005531	1.053563	2.898041	1.002341
2.4078231	0.996370	1.004018	1.052398	2.896145	1.000376
2.4342239	0.995901	1.000885	1.051176	2.891930	0.996782
2.4659050	0.995044	0.999357	1.049620	2.889379	0.994405
2.4905469	0.995154	0.999980	1.049283	2.891062	0.995135
2.5169480	0.994335	1.001503	1.052188	2.886887	0.995830
2.5451100	0.995151	1.004857	1.051618	2.894871	0.999986
2.5679910	0.997965	1.008584	1.044306	2.918604	1.006532
2.5943921	0.996512	1.005760	1.043751	2.911056	1.002254
2.6225541	0.995110	1.001163	1.043140	2.901149	0.996268
2.6436739	0.989332	0.988304	1.048607	2.858261	0.977770
2.6683159	0.985678	0.980259	1.052595	2.830717	0.966228
2.6964769	0.984856	0.976927	1.050276	2.826645	0.962138
2.7299190	0.982197	0.968631	1.049962	2.807429	0.951386
2.7510400	0.986110	0.968353	1.035491	2.837836	0.954903
2.7862411	0.990293	0.966797	1.018513	2.871222	0.957412
2.8161621	0.995710	0.963142	0.994388	2.916304	0.959009
2.8408041	1.002992	0.960156	0.967329	2.973727	0.963028
2.8619239	1.007159	0.955421	0.949141	3.007107	0.962261
2.8900859	1.008954	0.951624	0.939450	3.021934	0.960145
2.9147270	1.010689	0.952592	0.934295	3.037013	0.962774
2.9376080	1.011493	0.956624	0.935655	3.043669	0.967624
2.9657700	1.013675	0.966119	0.935292	3.065904	0.979330
2.9921710	1.013206	0.975684	0.938254	3.074755	0.988570
3.0150521	1.012275	0.978060	0.943617	3.066912	0.990065
3.0449741	1.012442	0.982354	0.948133	3.066813	0.994577
3.0678549	1.011385	0.984927	0.954923	3.056694	0.996141
3.0924959	1.010502	0.986442	0.959901	3.048439	0.996802
3.1206570	1.006497	0.984826	0.973380	3.012789	0.991225
3.1435380	1.004666	0.984104	0.979282	2.997137	0.988696
3.1681800	1.003574	0.985971	0.985736	2.986883	0.989496
3.1928201	1.002694	0.987461	0.991481	2.977855	0.990121
3.2174621	1.000787	0.992433	1.001616	2.964556	0.993215
3.2473831	0.999014	0.998750	1.013272	2.951584	0.997766
3.2702639	0.997201	1.001235	1.020817	2.938964	0.998433
3.2966650	0.997263	1.007515	1.025394	2.941766	1.004759
3.3248260	0.996106	1.010358	1.033008	2.931628	1.006424
3.3459470	0.997475	1.016633	1.033703	2.943779	1.014066
3.3741090	0.997488	1.023723	1.040836	2.943920	1.021153
3.3987510	0.998847	1.029899	1.042984	2.953762	1.028713
3.4216321	0.998050	1.031392	1.046588	2.948453	1.029381
3.4480331	0.997310	1.035163	1.052095	2.943934	1.032378
3.4761939	0.998212	1.034875	1.047216	2.953018	1.033025

Table 2. Nondimensionalized Profiles at Station 2 (Heated Flow)

y/H-slot	Velocity	Density	Pressure	Mach #	Rho X U
0.3266110	0.809896	0.431699	1.101538	1.539435	0.349631
0.3508710	0.816741	0.429123	1.091465	1.554934	0.350482
0.3820620	0.811222	0.421268	1.088015	1.532785	0.341774
0.4115200	0.824011	0.421481	1.079564	1.563293	0.347306
0.4461770	0.825810	0.420555	1.080182	1.564534	0.347299
0.4721690	0.826790	0.418719	1.078624	1.564098	0.346194
0.5085590	0.824900	0.416602	1.081798	1.554286	0.343656
0.5328180	0.825731	0.415764	1.081798	1.554286	0.343310
0.5830700	0.824959	0.412772	1.081212	1.547656	0.340521
0.6090630	0.824945	0.411809	1.081536	1.545592	0.339720
0.6385210	0.822023	0.409926	1.081746	1.536443	0.336969
0.6679790	0.819868	0.408360	1.079752	1.530904	0.334803
0.6974370	0.814266	0.406065	1.080939	1.515333	0.330648
0.7268950	0.804698	0.402696	1.081405	1.490971	0.324050
0.7511550	0.792895	0.399294	1.080646	1.463397	0.316599
0.7788800	0.783829	0.398956	1.081221	1.445682	0.312716
0.8048730	0.787398	0.405197	1.076881	1.466508	0.319052
0.8308650	0.803923	0.418561	1.067914	1.528181	0.336499
0.8707200	0.826529	0.444474	1.050837	1.632263	0.367412
0.9019110	0.843871	0.471738	1.036059	1.729069	0.398134
0.9279040	0.862852	0.504052	1.021592	1.840262	0.434931
0.9590950	0.878040	0.536432	1.012278	1.940719	0.471012
0.9798880	0.887734	0.572042	1.009046	2.029463	0.507851
1.0336061	0.898390	0.602159	1.005923	2.110745	0.541054
1.0544000	0.909455	0.626671	1.002068	2.183723	0.569941
1.0855920	0.920178	0.650052	0.999203	2.253536	0.598168
1.1185150	0.930273	0.675103	0.998724	2.322335	0.628058
1.1479729	0.950959	0.712939	0.987184	2.453875	0.678009
1.1705000	0.961181	0.737386	0.985236	2.524807	0.708768
1.1999580	0.967409	0.757867	0.985472	2.575974	0.733188
1.2242180	0.977367	0.784566	0.984354	2.649501	0.766849
1.2554090	0.987828	0.815781	0.982427	2.733407	0.805906
1.2848660	0.997546	0.844961	0.980309	2.812123	0.842921
1.3160580	1.009284	0.881903	0.976776	2.912031	0.890114
1.3420510	1.007599	0.898673	0.990825	2.913872	0.905546
1.3680420	1.016716	0.930315	0.986483	2.998022	0.945895
1.3940350	1.020341	0.951777	0.988390	3.040284	0.971175
1.4252260	1.019715	0.964939	0.996520	3.046770	0.983977
1.4477530	1.021962	0.983169	0.999942	3.076855	1.004765
1.4754781	1.020919	0.993426	1.007869	3.077511	1.014211
1.5014710	1.018791	0.998006	1.012465	3.071199	1.016767
1.5309280	1.016376	1.002067	1.014473	3.067091	1.018480
1.5586540	1.013777	1.003437	1.015983	3.059053	1.017262
1.5898449	1.011935	1.000903	1.014132	3.052498	1.012866
1.6141040	1.006560	0.989334	1.019587	3.010676	0.995863
1.6435630	1.004442	0.979198	1.016615	2.993128	0.983549
1.6695549	1.004578	0.971789	1.005947	2.997950	0.976239
1.7042120	1.009724	0.972252	0.981711	3.051063	0.981710
1.7302040	1.015870	0.970091	0.958402	3.103244	0.985491
1.7561970	1.020121	0.973540	0.945699	3.142667	0.993134
1.7873870	1.022657	0.976306	0.938890	3.166337	0.998426
1.8203120	1.023661	0.980496	0.938239	3.177345	1.003696
1.8428380	1.021306	0.984786	0.944308	3.166735	1.005768
1.8670980	1.019319	0.984177	0.948164	3.153183	1.003193
1.8965560	1.010898	0.968970	0.960008	3.083720	0.979543
1.9277461	1.007837	0.963443	0.963640	3.059795	0.971001
1.9520060	1.006672	0.961299	0.963207	3.053571	0.967715
1.9831980	1.005363	0.955830	0.957672	3.049665	0.960960
2.0161209	1.010436	0.952783	0.935158	3.096759	0.962727
2.0403810	1.015174	0.951425	0.917158	3.139421	0.965862
2.0715721	1.018871	0.949372	0.903311	3.171506	0.967288
2.1044960	1.016990	0.934653	0.896614	3.152701	0.950542

2.1408851	1.010082	0.906897	0.895095	3.087123	0.916071
2.1651440	1.011087	0.891550	0.877073	3.095181	0.901436
2.1998010	1.017295	0.886135	0.848728	3.156148	0.901459
2.2361910	1.026992	0.882275	0.814513	3.245380	0.906089
2.2725799	1.034896	0.885222	0.790448	3.325333	0.916114
2.3003049	1.039893	0.892484	0.779002	3.379574	0.928088
2.3314970	1.040926	0.897143	0.780035	3.389504	0.933859
2.3661530	1.042641	0.909823	0.785243	3.407649	0.948618
2.3990769	1.042601	0.919581	0.792531	3.409945	0.958756
2.4337339	1.041743	0.930634	0.804388	3.402208	0.969480
2.4649241	1.040441	0.941283	0.817914	3.388957	0.979350
2.4995811	1.038330	0.954604	0.832706	3.375552	0.991193
2.5342381	1.036187	0.963859	0.849426	3.351385	0.998737
2.5567639	1.034233	0.973522	0.863455	3.334369	1.006849
2.5914209	1.033565	0.987361	0.877646	3.328581	1.020501
2.6260779	1.031165	0.998491	0.894876	3.307204	1.029610
2.6590011	1.030428	1.012630	0.907809	3.304361	1.043441
2.6919250	1.029286	1.029788	0.926643	3.294560	1.059946
2.7161851	1.027707	1.042519	0.944521	3.278295	1.071405
2.7491090	1.025397	1.055586	0.963305	3.259126	1.082394
2.7733691	1.023436	1.065592	0.982188	3.236713	1.090564
2.8028259	1.020762	1.075993	0.999858	3.215153	1.098333
2.8270860	1.017515	1.082194	1.017112	3.186773	1.101149
2.8582771	1.016466	1.092526	1.030667	3.177548	1.110516
2.8825369	1.014403	1.097736	1.042764	3.160160	1.113546
2.9119949	1.013116	1.102615	1.052667	3.148242	1.117077
2.9379880	1.011613	1.108092	1.059971	3.140490	1.120961
2.9709110	1.010725	1.110396	1.066703	3.131067	1.122305
2.9969029	1.009558	1.113991	1.072326	3.124286	1.124637
3.0298271	1.008222	1.116589	1.081071	3.111133	1.125771
3.0558200	1.008071	1.120538	1.084844	3.110732	1.129582
3.0852780	1.007299	1.122628	1.091166	3.102223	1.130822
3.1147361	1.007581	1.125030	1.093873	3.102562	1.133559
3.1424611	1.006685	1.126199	1.098945	3.094249	1.133728
3.1684539	1.005759	1.128737	1.103085	3.089070	1.135238
3.1944461	1.006093	1.129872	1.103216	3.091464	1.136756
3.2291019	1.006423	1.131651	1.103099	3.095075	1.138919
3.2620270	1.006529	1.132087	1.101976	3.097579	1.139479
3.2897520	1.006719	1.130525	1.098962	3.100263	1.138121
3.3209419	1.007615	1.131771	1.095975	3.108966	1.140390
3.3469350	1.008108	1.131426	1.092667	3.114720	1.140599
3.3746600	1.009942	1.131354	1.085518	3.130540	1.142602
3.4058521	1.009479	1.127558	1.081360	3.129848	1.138246
3.4283781	1.010084	1.126346	1.077871	3.135110	1.137704
3.4613020	1.010407	1.120923	1.070661	3.139066	1.132588

Table 3. Nondimensionalized Profiles at Station 3 (Heated Flow)

y/H-slot	Velocity	Density	Pressure	Mach #	Rho X U
0.3336490	0.810381	0.390616	1.032096	1.472443	0.316548
0.3389450	0.820964	0.386890	1.015368	1.496723	0.317623
0.3883740	0.831287	0.382849	0.990358	1.526539	0.318259
0.4236810	0.834509	0.378511	0.977004	1.534117	0.315871
0.4819360	0.838622	0.375467	0.968073	1.542525	0.314876
0.5172430	0.843789	0.375679	0.966498	1.553731	0.316994
0.5525490	0.836886	0.375535	0.972188	1.536208	0.314280
0.6019780	0.837646	0.376996	0.975122	1.538287	0.315793
0.6355190	0.837511	0.378183	0.976959	1.538996	0.316734
0.6831830	0.840903	0.382111	0.978318	1.552155	0.321319
0.7096620	0.848792	0.387896	0.976229	1.580222	0.329246
0.7626220	0.862556	0.399434	0.970985	1.633946	0.344535
0.7908670	0.878112	0.412460	0.967178	1.693703	0.362209
0.8385310	0.902050	0.435186	0.957882	1.795758	0.392561
0.8614800	0.911491	0.451178	0.954145	1.851294	0.411276
0.9109090	0.930935	0.490244	0.942962	1.982512	0.456398
0.9568070	0.942039	0.527131	0.937999	2.085826	0.496620
0.9868170	0.951524	0.563151	0.935736	2.180187	0.535862
1.0327150	0.968324	0.592146	0.930579	2.281396	0.573417
1.0627260	0.973296	0.620671	0.932579	2.345205	0.604118
1.1121550	0.988942	0.671491	0.917261	2.499096	0.664086
1.1404001	0.989662	0.694658	0.919844	2.540199	0.687498
1.1827670	1.008772	0.743491	0.902099	2.704806	0.750014
1.2216040	1.020160	0.772835	0.897120	2.796565	0.788419
1.2622070	1.025792	0.807969	0.896844	2.875632	0.828811
1.3063400	1.029942	0.838738	0.909894	2.920585	0.863864
1.3540030	1.027926	0.877564	0.932203	2.945696	0.902067
1.3893100	1.026312	0.901382	0.949355	2.953599	0.925099
1.4352080	1.022412	0.925383	0.970964	2.947937	0.946125
1.4616890	1.024108	0.942444	0.975329	2.973257	0.965163
1.5093520	1.023065	0.961810	0.988454	2.980613	0.983995
1.5358320	1.023373	0.965003	0.991797	2.981404	0.987558
1.5852600	1.018935	0.971493	1.000208	2.965899	0.989891
1.6117400	1.014849	0.968704	1.007237	2.939447	0.983089
1.6646990	1.012306	0.968670	1.009900	2.928162	0.980592
1.7035370	1.011225	0.970230	1.003128	2.937266	0.981122
1.7547311	1.013769	0.974159	0.983630	2.979705	0.987572
1.7918020	1.016894	0.976014	0.966706	3.017816	0.992503
1.8394660	1.020202	0.979637	0.954568	3.052460	0.999429
1.8853641	1.021395	0.989823	0.956631	3.068563	1.011000
1.9224360	1.019634	0.996457	0.973945	3.046082	1.016023
1.9648030	1.019016	1.001719	0.990286	3.026982	1.020767
2.0107019	1.009968	1.010238	1.025151	2.961146	1.020309
2.0548351	1.002230	1.015673	1.054289	2.905364	1.017937
2.0919061	0.997913	1.023049	1.068168	2.884395	1.020914
2.1466310	0.998688	1.023349	1.062512	2.894745	1.022007
2.1748769	1.000894	1.023341	1.053028	2.914161	1.024257
2.2278359	1.004095	1.022366	1.037578	2.943768	1.026553
2.2631421	1.006124	1.024304	1.028240	2.965886	1.030580
2.3090410	1.006650	1.022662	1.022904	2.972768	1.029463
2.3478780	1.005522	1.024837	1.025733	2.968509	1.030495
2.3973060	1.003293	1.023451	1.031522	2.951596	1.026822
2.4326129	1.001497	1.026080	1.036806	2.942561	1.027616
2.4855731	0.998858	1.022233	1.042521	2.921265	1.021065
2.5208790	0.999458	1.025113	1.042308	2.927434	1.024558
2.5614810	0.998014	1.026189	1.047938	2.916872	1.024152
2.5985529	1.000616	1.029271	1.042542	2.936438	1.029906
2.6373899	1.002923	1.032137	1.036088	2.956479	1.035159
2.6709311	1.005065	1.033585	1.032421	2.970140	1.038820
2.7080021	1.004625	1.031252	1.032288	2.965651	1.036022
2.7291861	1.003591	1.031603	1.035760	2.958131	1.035307
2.7733190	1.001388	1.031840	1.040918	2.944660	1.033272

2.7997990	0.999065	1.037386	1.042720	2.943162	1.036416
2.8456981	0.999745	1.038473	1.041749	2.948085	1.038209
2.8721769	1.001610	1.041253	1.039166	2.961203	1.042929
2.9004221	1.000845	1.038686	1.040779	2.953005	1.039564
2.9374940	1.000457	1.036255	1.039947	2.949588	1.036730
2.9604430	0.998868	1.030497	1.040678	2.935670	1.029332
3.0028100	0.998060	1.025696	1.038314	2.929787	1.023706
3.0257599	0.998203	1.020789	1.031039	2.933481	1.018955
3.0504749	0.999599	1.019051	1.024330	2.944678	1.018643
3.0893121	1.000030	1.012775	1.016674	2.947902	1.012805
3.1140261	1.001515	1.014078	1.011521	2.961691	1.015614
3.1440370	1.001105	1.011704	1.009981	2.959275	1.012823
3.1793420	0.999561	1.006591	1.011084	2.945617	1.006150
3.2093530	0.999652	1.005637	1.009990	2.946083	1.005287
3.2481911	0.998836	1.004807	1.010254	2.942082	1.003638
3.2746711	1.000215	1.005459	1.006838	2.952127	1.005675
3.2958541	1.168438	0.776414	0.321131	8.152047	0.894502
3.3258641	1.224209	0.705097	0.094378	9.882783	0.863186
3.3541100	1.224077	0.706880	0.094596	9.882783	0.865276
3.3770580	1.223768	0.708688	0.094790	9.882783	0.867270

Table 4 . Nondimensionalized Profiles at Station 4 (Heated Flow)

y/H-slot	Velocity	Density	Pressure	Mach #	Rho X U
0.3903670	0.715217	0.485187	1.305472	1.269396	0.347014
0.4294770	0.720295	0.489136	1.313876	1.279490	0.352322
0.4614750	0.727674	0.491316	1.308813	1.297988	0.357522
0.5112510	0.738704	0.492102	1.284477	1.331145	0.363521
0.5556940	0.757238	0.495434	1.238850	1.394154	0.375162
0.6072470	0.767380	0.498479	1.192366	1.444532	0.382524
0.6392460	0.783643	0.507582	1.156198	1.511649	0.397766
0.6819110	0.792899	0.513873	1.118043	1.565011	0.407458
0.7245760	0.814786	0.531777	1.078793	1.665452	0.433288
0.7761290	0.830257	0.550746	1.052532	1.748515	0.457271
0.8365710	0.846385	0.575678	1.036479	1.836424	0.487256
0.8703470	0.871679	0.603487	1.019589	1.952418	0.526054
0.9219010	0.873168	0.617897	1.019778	1.978789	0.539541
0.9503440	0.890911	0.639731	1.006525	2.067811	0.569947
1.0036750	0.898827	0.659783	1.001881	2.123618	0.593060
1.0392290	0.916898	0.684564	0.989091	2.220759	0.627677
1.0854501	0.929670	0.708920	0.979337	2.302821	0.659076
1.1227810	0.939644	0.728366	0.972599	2.367377	0.684417
1.1636680	0.959052	0.762440	0.960402	2.487778	0.731226
1.2081100	0.961743	0.776061	0.962581	2.514167	0.746398
1.2365550	0.974942	0.801179	0.955445	2.599263	0.781131
1.2792190	0.978817	0.818147	0.960268	2.630393	0.800839
1.3112180	0.991758	0.847999	0.954340	2.721919	0.841067
1.3627720	0.996855	0.869445	0.959076	2.763251	0.866731
1.3965470	1.007810	0.898652	0.950867	2.852379	0.905678
1.4392130	1.009937	0.920744	0.956577	2.884704	0.929914
1.4747660	1.014732	0.939776	0.953244	2.933284	0.953624
1.5120990	1.015153	0.955622	0.960555	2.947908	0.970124
1.5316540	1.013447	0.963417	0.968424	2.942828	0.976375
1.5814290	1.010756	0.973724	0.980912	2.931837	0.984197
1.6063170	1.012134	0.983274	0.981007	2.950053	0.995206
1.6560930	1.008767	0.990251	0.990506	2.936469	0.998933
1.6880920	1.002910	0.985610	1.001593	2.896395	0.988479
1.7431999	1.000272	0.983184	1.004546	2.880978	0.983452
1.7787540	1.003204	0.979728	0.990492	2.904795	0.982867
1.8267530	1.009323	0.975682	0.961927	2.959446	0.984780
1.8783050	1.016075	0.968717	0.936309	3.008891	0.984288
1.9067481	1.021468	0.968058	0.918363	3.053229	0.988844
1.9529700	1.024947	0.968305	0.907660	3.082020	0.992462
1.9885230	1.029333	0.976903	0.900042	3.122055	1.005561
2.0329659	1.028967	0.981288	0.906090	3.117475	1.009712
2.0720761	1.031078	0.997369	0.912809	3.137754	1.028367
2.1094069	1.029340	1.005709	0.925784	3.123441	1.035215
2.1467390	1.029697	1.023278	0.939252	3.129027	1.053680
2.1911809	1.027941	1.038647	0.957778	3.116459	1.067668
2.2356241	1.024381	1.053531	0.983324	3.086958	1.079218
2.2871780	1.016475	1.058131	1.014256	3.022740	1.075576
2.3227310	0.999671	1.036433	1.052412	2.888220	1.036097
2.3778400	0.992837	1.034588	1.073237	2.837967	1.027178
2.4293940	0.990809	1.031912	1.075916	2.824972	1.022428
2.4720590	0.994983	1.027667	1.053298	2.861263	1.022512
2.5022800	0.998799	1.022393	1.033551	2.892086	1.021164
2.5467219	1.004052	1.020884	1.013408	2.933875	1.025021
2.5751650	1.005208	1.021210	1.008936	2.944230	1.026529
2.6178310	1.007306	1.023738	1.004278	2.960863	1.031218
2.6516061	1.006376	1.022254	1.006253	2.953080	1.028771
2.7013819	1.006504	1.021218	1.005171	2.953545	1.027860
2.7369370	1.006062	1.019696	1.004027	2.951727	1.025877
2.7796021	1.006657	1.018645	1.000525	2.957115	1.025426
2.8169341	1.010064	1.021199	0.990750	2.985461	1.031477
2.8560431	1.011474	1.021021	0.985625	2.997129	1.032737
2.8862641	1.011464	1.020275	0.984546	2.997645	1.031971

2.9253740	1.010776	1.019974	0.985869	2.993153	1.030966
2.9644830	1.006914	1.023295	0.995123	2.972655	1.030370
3.0035930	1.006324	1.023506	0.998935	2.965541	1.029978
3.0480349	1.006014	1.026433	1.002877	2.963020	1.032606
3.0942550	1.006111	1.028593	1.005422	2.962667	1.034879
3.1280320	1.006281	1.024307	1.001415	2.962895	1.030740
3.1635859	1.006158	1.021328	0.999889	2.960482	1.027619
3.2026949	1.006594	1.020536	0.997790	2.963730	1.027267
3.2311389	1.007090	1.018850	0.994610	2.967471	1.026075
3.2738030	1.007065	1.016549	0.992065	2.967838	1.023731
3.3164680	1.007263	1.013888	0.987424	2.971497	1.021252
3.3520219	1.007132	1.010963	0.985199	2.970170	1.018173
3.3840210	1.006743	1.009266	0.985451	2.966148	1.016071
3.4195750	1.006982	1.005691	0.981126	2.968111	1.012712
3.4462409	1.007206	1.004530	0.978648	2.970814	1.011768

Table 5. Nondimensionalized Profiles at Station 4 (Heated Flow, Shock)

y/H-slot	Velocity	Density	Pressure	Mach #	Rho X U
0.3850340	0.469263	0.616209	1.962268	0.775191	0.289172
0.4223660	0.477276	0.620100	1.962268	0.789372	0.296074
0.4579200	0.514540	0.639137	1.962268	0.857142	0.328865
0.5005850	0.529106	0.644095	1.962268	0.883736	0.340810
0.5343610	0.569165	0.660270	1.962268	0.961229	0.375804
0.5788040	0.577207	0.665819	1.962268	0.978880	0.384328
0.6143580	0.594697	0.679499	1.962268	1.018824	0.404103
0.6552450	0.600025	0.690996	1.962268	1.036639	0.414648
0.6943550	0.633783	0.725291	1.962268	1.121758	0.459686
0.7139090	0.645435	0.742052	1.962268	1.155575	0.479022
0.7654630	0.666693	0.781887	1.974566	1.221414	0.521314
0.8063500	0.672727	0.818565	2.000977	1.252676	0.550712
0.8472370	0.698021	0.876469	2.027818	1.336048	0.611829
0.8810140	0.699541	0.905112	2.052880	1.352282	0.633168
0.9201230	0.734293	0.968357	2.061469	1.465189	0.711059
0.9663430	0.746673	1.009953	2.074698	1.516702	0.754139
1.0001200	0.776672	1.065375	2.061379	1.625548	0.827449
1.0534500	0.792828	1.108750	2.052120	1.696741	0.879142
1.0818940	0.817715	1.157553	2.030720	1.797371	0.946550
1.1352251	0.832639	1.204785	2.024830	1.870053	1.003301
1.1707790	0.853580	1.252678	2.008571	1.962542	1.069285
1.2152220	0.882406	1.327307	1.987393	2.099963	1.171572
1.2525541	0.885510	1.354574	1.998769	2.122372	1.199534
1.2916631	0.916902	1.441639	1.970531	2.283514	1.322004
1.3414390	0.916523	1.463874	1.993007	2.286836	1.341709
1.3698820	0.938621	1.532443	1.970853	2.409703	1.438429
1.4196579	0.940745	1.560804	1.984559	2.428865	1.468318
1.4498791	0.949123	1.593195	1.973529	2.482719	1.512155
1.4943210	0.947738	1.606803	1.980782	2.485088	1.522835
1.5192100	0.948433	1.616495	1.981135	2.494181	1.533143
1.5672070	0.945927	1.625929	1.982949	2.493684	1.538010
1.6152050	0.945471	1.636797	1.983669	2.500346	1.547544
1.6596470	0.942217	1.643546	1.998930	2.487335	1.548587
1.7112010	0.939581	1.660790	2.027260	2.475868	1.560447
1.7396441	0.940590	1.682700	2.044673	2.484190	1.582747
1.7823100	0.937338	1.693025	2.071564	2.466997	1.586941
1.8196410	0.936070	1.699857	2.083556	2.461505	1.591184
1.8658620	0.936183	1.705942	2.086816	2.464277	1.597073
1.9067481	0.935555	1.703559	2.085006	2.461972	1.593773
1.9583020	0.934985	1.694676	2.075575	2.459627	1.584495
1.9814130	0.933472	1.683274	2.068341	2.451668	1.571301
2.0347431	0.934842	1.672702	2.049077	2.458996	1.563714
2.0685201	0.931996	1.651852	2.037145	2.443310	1.539520
2.1218519	0.931920	1.630472	2.009557	2.443855	1.519486
2.1502950	0.930158	1.613288	1.996154	2.434473	1.500613
2.2036250	0.933546	1.594238	1.953982	2.454941	1.488298
2.2427349	0.933897	1.574455	1.925294	2.458702	1.470381
2.2889559	0.938217	1.553939	1.877691	2.484842	1.457933
2.3333981	0.943375	1.543651	1.839559	2.515894	1.456240
2.3742850	0.948213	1.529995	1.798936	2.545856	1.450763
2.4116170	0.948628	1.521835	1.787324	2.548400	1.443654
2.4560599	0.952644	1.520208	1.765976	2.573236	1.448220
2.4862800	0.953192	1.519583	1.761996	2.577090	1.448456
2.5325010	0.954407	1.522216	1.760208	2.583918	1.452816
2.5609441	0.955042	1.529089	1.765306	2.587724	1.460345
2.6160531	0.954065	1.537097	1.777630	2.582838	1.466494
2.6516061	0.955444	1.552304	1.787110	2.592429	1.483141
2.7013819	0.955592	1.562164	1.799453	2.592126	1.492795
2.7316041	0.954498	1.569616	1.813581	2.585206	1.498200
2.7760460	0.953263	1.581066	1.831338	2.578652	1.507175
2.8062680	0.953169	1.588332	1.839324	2.578696	1.513949
2.8524871	0.950481	1.603164	1.869761	2.562287	1.523785

2.8898189	0.949099	1.629233	1.904954	2.555372	1.546300
2.9324839	0.947024	1.659250	1.948850	2.543999	1.571355
2.9715941	0.946338	1.676267	1.973162	2.539367	1.586317
3.0249250	0.944245	1.693268	2.005815	2.525754	1.598860
3.0480349	0.943970	1.702981	2.018156	2.524500	1.607565
3.1013660	0.941419	1.713642	2.045375	2.508688	1.613257
3.1262541	0.942169	1.722821	2.051546	2.513607	1.623190
3.1564751	0.939604	1.727443	2.071153	2.498214	1.623113
3.1884739	0.936569	1.724580	2.084250	2.480299	1.615213
3.2115841	0.935550	1.727023	2.091156	2.475265	1.615741
3.2524710	0.896631	1.628995	2.178863	2.257628	1.460948
3.2755809	0.870221	1.563488	2.216038	2.128132	1.360642
3.3093579	0.867722	1.535374	2.173928	2.123037	1.332276
3.3306890	0.876309	1.506748	2.081885	2.170404	1.320372
3.3555779	0.891372	1.461704	1.954833	2.244157	1.302887
3.3893549	0.919124	1.386778	1.738232	2.390576	1.274522
3.4177980	0.940911	1.325796	1.578933	2.510179	1.247444

Table 6. Nondimensionalized Profiles at Station 1 (Unheated Flow)

y/H-slot	Velocity	Density	Pressure	Mach #	Rho X U
0.2556830	0.742934	0.442788	0.794635	1.705695	0.328968
0.2645820	0.733901	0.448227	0.815928	1.672988	0.328955
0.2681420	0.724311	0.460024	0.848603	1.640216	0.333205
0.3073010	0.721078	0.465177	0.862049	1.629139	0.335435
0.3482390	0.720209	0.470351	0.872753	1.626151	0.338755
0.3962970	0.722199	0.474075	0.876666	1.633398	0.342377
0.4390150	0.723261	0.470492	0.870052	1.635809	0.340294
0.4763940	0.734135	0.461863	0.840583	1.673716	0.339071
0.5119920	0.743794	0.451466	0.809811	1.708051	0.335798
0.5547110	0.768148	0.432580	0.745717	1.799432	0.332280
0.5974290	0.786089	0.414448	0.693733	1.868922	0.325787
0.6365870	0.799212	0.399690	0.653369	1.922553	0.319440
0.6864250	0.780866	0.400110	0.676266	1.847386	0.312436
0.7202440	0.768561	0.410177	0.707778	1.799511	0.315249
0.7736420	0.703856	0.400103	0.762692	1.568177	0.281635
0.8039000	0.580473	0.370587	0.816550	1.203690	0.215345
0.8572980	0.592972	0.377923	0.822778	1.237843	0.224706
0.8822170	0.753569	0.436390	0.774170	1.740303	0.328895
0.9373950	0.830239	0.472209	0.728580	2.055996	0.392072
0.9712140	0.879428	0.484629	0.668127	2.304547	0.426232
1.0246120	0.941168	0.493752	0.576311	2.679710	0.464721
1.0566510	0.963377	0.520071	0.567993	2.835320	0.501051
1.1064880	0.957797	0.575739	0.642182	2.789709	0.551420
1.1616660	0.954070	0.640700	0.724194	2.760075	0.611268
1.2008240	0.949405	0.699382	0.802782	2.725494	0.663996
1.2506620	0.957225	0.753524	0.844908	2.780266	0.721311
1.2951610	0.969155	0.806940	0.873157	2.865457	0.782057
1.3414390	0.976385	0.847384	0.898921	2.915661	0.827381
1.3823770	0.986821	0.882749	0.905019	2.997515	0.871139
1.4339950	0.990024	0.910757	0.926582	3.018791	0.901677
1.4838330	0.996798	0.942628	0.938254	3.072881	0.939615
1.5212120	0.998236	0.960201	0.951794	3.083750	0.958519
1.5692689	0.998016	0.970142	0.964343	3.078721	0.968219
1.6137670	0.998582	0.982652	0.973736	3.085254	0.981259
1.6636050	0.998629	0.995802	0.984819	3.088469	0.994442
1.6992040	0.997317	1.002345	0.994350	3.079655	0.999655
1.7472620	0.995625	1.011855	1.006731	3.069917	1.007429
1.7917600	0.994356	1.017303	1.014239	3.062852	1.011562
1.8309190	0.993431	1.020103	1.020364	3.055001	1.013403
1.8807570	0.992931	1.020454	1.022795	3.050358	1.013242
1.9181360	0.992842	1.021519	1.022445	3.052195	1.014208
1.9661940	0.993132	1.020667	1.021620	3.053045	1.013658
2.0000110	0.993495	1.019960	1.020677	3.054513	1.013326
2.0551901	0.992135	1.020000	1.024552	3.044617	1.011978
2.0890081	0.991431	1.019619	1.026827	3.038518	1.010883
2.1210470	0.990107	1.020989	1.031704	3.029311	1.010889
2.1548660	0.988993	1.021645	1.036392	3.020019	1.010400
2.1886840	0.988741	1.022447	1.036590	3.020149	1.010936
2.2367420	0.989740	1.023700	1.033410	3.029726	1.013201
2.2759011	0.991982	1.025963	1.027879	3.048086	1.017737
2.3150589	0.993750	1.027405	1.023080	3.062822	1.020985
2.3559980	0.995735	1.028129	1.017480	3.078464	1.023746
2.3951559	0.996385	1.026662	1.013529	3.084269	1.022951
2.4218550	0.995562	1.020635	1.012874	3.073672	1.016106
2.4645741	0.994195	1.017564	1.015810	3.060388	1.011660
2.4966121	0.992974	1.017614	1.019558	3.051067	1.010465
2.5393300	0.989761	1.019403	1.031071	3.026838	1.008966
2.5624690	0.988883	1.019607	1.034813	3.018972	1.008273
2.6034069	0.988910	1.019293	1.033985	3.019801	1.007990
2.6318860	0.989418	1.017271	1.029410	3.025057	1.006508
2.6585851	0.990517	1.013568	1.022238	3.033486	1.003957
2.6888440	0.992127	1.009768	1.013464	3.045813	1.001820

2.7137630	0.994357	1.009900	1.005129	3.065483	1.004201
2.7422421	0.995640	1.009542	0.999312	3.077814	1.005140
2.7671609	0.996423	1.009778	0.996749	3.084552	1.006166
2.7920799	0.996596	1.011947	0.998221	3.086125	1.008502
2.8187790	0.995676	1.011953	1.001723	3.077892	1.007578
2.8436980	0.994788	1.011893	1.005231	3.069686	1.006620
2.8668370	0.994712	1.011427	1.006400	3.066959	1.006079
2.8935361	0.994315	1.013848	1.009156	3.065209	1.008086
2.9184549	0.993852	1.013559	1.011188	3.060269	1.007329
2.9415951	0.994217	1.016812	1.012074	3.064953	1.010932
2.9771931	0.994715	1.022491	1.017139	3.067373	1.017087
3.0038919	0.994592	1.028845	1.022752	3.068070	1.023282
3.0305910	0.993564	1.030201	1.027684	3.059534	1.023571
3.0519500	0.992233	1.031000	1.033405	3.048154	1.022993
3.0786490	0.991832	1.033763	1.035734	3.047569	1.025320
3.1053469	0.991365	1.034289	1.039623	3.041207	1.025359
3.1373861	0.989800	1.034993	1.045601	3.028750	1.024438
3.1623051	0.988405	1.033133	1.048745	3.017217	1.021154
3.1854441	0.987247	1.030202	1.051195	3.005895	1.017064
3.2174830	0.986964	1.027643	1.049657	3.003496	1.014246
3.2424021	0.986880	1.026427	1.047728	3.004241	1.012964
3.2691009	0.985719	1.022070	1.048885	2.992672	1.007475
3.2922399	0.985246	1.020136	1.048498	2.988953	1.005086
3.3189390	0.984733	1.018594	1.047673	2.986307	1.003043
3.3474181	0.984697	1.015773	1.046656	2.983514	1.000230
3.3705571	0.985382	1.018795	1.045807	2.991235	1.003902
3.3990359	0.985915	1.018633	1.044185	2.994949	1.004288
3.4292951	0.987072	1.019282	1.041411	3.003410	1.006107
3.4631131	0.987675	1.019020	1.038841	3.008570	1.006462
3.4880321	0.988466	1.018770	1.033628	3.018189	1.007020
3.5182910	1.200337	0.716087	0.099924	9.882783	0.859546

Table 7. Nondimensionalized Profiles at Station 2 (Unheated Flow)

y/H-slot	Velocity	Density	Pressure	Mach #	Rho X U
0.2856710	0.713809	0.576881	1.081871	1.602722	0.411782
0.3159810	0.717530	0.571109	1.065646	1.615155	0.409790
0.3516390	0.717358	0.567800	1.056273	1.617213	0.407322
0.3944300	0.719309	0.563772	1.045859	1.623883	0.405533
0.4300880	0.717897	0.562248	1.045725	1.618589	0.403638
0.4675300	0.718732	0.562184	1.045770	1.620357	0.404063
0.4942740	0.720412	0.562638	1.046445	1.624270	0.405335
0.5352810	0.718493	0.562632	1.052000	1.615653	0.404249
0.5691570	0.719198	0.563239	1.053385	1.617072	0.405093
0.6119470	0.717522	0.563650	1.057269	1.610912	0.404438
0.6369080	0.715917	0.562211	1.059018	1.603940	0.402503
0.6672180	0.715608	0.561400	1.059350	1.601831	0.401748
0.6975280	0.702989	0.555331	1.066594	1.559733	0.390399
0.7224890	0.694242	0.550825	1.069600	1.531913	0.382416
0.7634960	0.692579	0.550876	1.068761	1.528889	0.381528
0.7902400	0.703951	0.557540	1.062371	1.568061	0.392483
0.8294640	0.740446	0.579596	1.042018	1.698125	0.429197
0.8669060	0.769220	0.598625	1.025373	1.807224	0.460483
0.9096960	0.812941	0.629481	0.998062	1.985229	0.511769
0.9417890	0.837863	0.650812	0.985021	2.094142	0.545301
0.9756640	0.861511	0.674214	0.971806	2.206626	0.580911
1.0077569	0.877082	0.693918	0.968465	2.282822	0.608623
1.0327179	0.892294	0.712398	0.959968	2.363616	0.635688
1.0701600	0.913440	0.741173	0.949255	2.481810	0.677021
1.0951210	0.921678	0.758200	0.949421	2.532565	0.698821
1.1218640	0.936192	0.779580	0.940420	2.620939	0.729845
1.1628720	0.947646	0.803402	0.939000	2.695263	0.761356
1.1913990	0.957797	0.825698	0.937043	2.764588	0.790869
1.2288400	0.971367	0.856426	0.931437	2.863982	0.831905
1.2591500	0.978279	0.876355	0.934561	2.912899	0.857337
1.2965920	0.992042	0.913714	0.928299	3.026292	0.906454
1.3340330	0.999984	0.940159	0.931729	3.088659	0.940151
1.3607770	1.004747	0.959776	0.932924	3.133601	0.964344
1.3964360	1.010186	0.982343	0.936244	3.181678	0.992350
1.4231790	1.012424	0.996911	0.940255	3.205446	1.009300
1.4748840	1.007046	1.000991	0.963262	3.156598	1.008050
1.5034120	0.996967	0.991190	0.990484	3.066710	0.988201
1.5426360	0.990426	0.990798	1.010465	3.015620	0.981320
1.5782940	0.991613	1.003647	1.013102	3.034775	0.995235
1.6103860	0.996349	1.018053	1.004634	3.083974	1.014336
1.6496120	0.998720	1.012423	0.992492	3.101551	1.011128
1.6763550	1.000817	1.002557	0.972967	3.123818	1.003377
1.7102309	1.003978	0.989327	0.947125	3.155084	0.993264
1.7369750	1.007758	0.980492	0.927156	3.186550	0.988100
1.7601531	1.009676	0.978161	0.915734	3.208658	0.987626
1.7993770	1.011817	0.980480	0.910585	3.228359	0.992069
1.8207730	1.011397	0.980690	0.910131	3.228154	0.991868
1.8510820	1.012105	0.978554	0.905677	3.234813	0.990400
1.8813920	1.014012	0.975207	0.897105	3.250784	0.988872
1.9063530	1.016843	0.974860	0.885802	3.280036	0.991282
1.9330970	1.019229	0.973485	0.875246	3.305143	0.992205
1.9634060	1.022681	0.974363	0.864882	3.337651	0.996463
1.9883670	1.023305	0.972172	0.858933	3.347475	0.994831
2.0329399	1.001593	0.917087	0.888859	3.128327	0.918567
2.0632510	0.991445	0.895318	0.902930	3.035653	0.887662
2.0917780	0.990349	0.895805	0.899688	3.038567	0.887162
2.1203041	0.991715	0.904167	0.897840	3.060079	0.896678
2.1452651	0.995770	0.907200	0.888895	3.093170	0.903364
2.1702261	1.001600	0.907321	0.869934	3.145283	0.908774
2.2005360	1.011122	0.901756	0.833839	3.233190	0.911784
2.2272799	1.022166	0.893007	0.788005	3.345890	0.912798
2.2486751	1.032220	0.885597	0.747718	3.454234	0.914134

2.2807670	1.040666	0.884737	0.719379	3.548647	0.920718
2.3039451	1.044218	0.886840	0.706311	3.597807	0.926056
2.3289070	1.048443	0.893982	0.698427	3.647259	0.937289
2.3663480	1.050613	0.903314	0.699479	3.671075	0.949034
2.3930931	1.050891	0.910769	0.704572	3.673835	0.957123
2.4162700	1.049991	0.919846	0.713835	3.664910	0.965834
2.4447970	1.050113	0.929188	0.723109	3.660210	0.975752
2.4697580	1.049010	0.940929	0.734196	3.651494	0.987048
2.4947190	1.047795	0.952523	0.748551	3.634337	0.998051
2.5268121	1.046068	0.964703	0.766197	3.609168	1.009145
2.5535560	1.043827	0.974172	0.781596	3.583215	1.016868
2.5803001	1.041548	0.982282	0.797866	3.553483	1.023093
2.6034780	1.040166	0.993522	0.812966	3.535687	1.033429
2.6284390	1.037365	1.000641	0.830383	3.501472	1.038029
2.6551831	1.035501	1.008749	0.846010	3.476767	1.044562
2.6837101	1.033009	1.018337	0.864556	3.447262	1.051954
2.7211521	1.028902	1.030995	0.889825	3.405413	1.060793
2.7425461	1.026868	1.038496	0.904095	3.383981	1.066400
2.7710731	1.025100	1.047011	0.918878	3.364600	1.073293
2.7978170	1.024251	1.054729	0.930333	3.353346	1.080310
2.8209951	1.021322	1.059047	0.943912	3.326390	1.081630
2.8477390	1.020328	1.061403	0.952482	3.311852	1.082980
2.8727000	1.017913	1.064202	0.962664	3.290813	1.083265
2.8976610	1.016180	1.065340	0.970968	3.272897	1.082579
2.9190559	1.015211	1.067748	0.977558	3.262400	1.083989
2.9440169	1.013005	1.068026	0.985594	3.242452	1.081918
2.9671950	1.013085	1.069870	0.990251	3.237854	1.083869
2.9903729	1.011639	1.073035	0.995628	3.229251	1.085524
3.0171170	1.012151	1.079259	1.000683	3.232062	1.092373
3.0385120	1.012964	1.090415	1.006351	3.242159	1.104556
3.0652561	1.011721	1.097309	1.018999	3.228213	1.110172
3.0920000	1.009592	1.101424	1.032423	3.206364	1.111989
3.1223090	1.007419	1.102536	1.044707	3.182209	1.110718
3.1544030	1.006002	1.101318	1.050117	3.167784	1.107929
3.1847129	1.005319	1.100562	1.050981	3.163244	1.106417
3.2114561	1.005317	1.099320	1.050432	3.162279	1.105165
3.2346351	1.005243	1.098009	1.047573	3.164465	1.103767
3.2578130	1.006739	1.098095	1.042871	3.176439	1.105496
3.2863390	1.007383	1.099350	1.039467	3.185490	1.107468
3.3113000	1.009138	1.099179	1.034669	3.198176	1.109224
3.3344779	1.009311	1.097422	1.029747	3.203799	1.107640
3.3683550	1.009657	1.095289	1.024829	3.209454	1.105867
3.3933151	1.010410	1.092542	1.021172	3.213555	1.103917
3.4182761	1.011216	1.091626	1.016111	3.222768	1.103870
3.4450200	1.012488	1.091606	1.010347	3.235983	1.105240
3.4771130	1.013164	1.090923	1.006677	3.243017	1.105283
3.5056391	1.153563	0.871602	0.335551	8.220624	0.995188
3.5323830	1.200391	0.797926	0.111298	9.882783	0.957823

Table 8. Nondimensionalized Profiles at Station 3 (Unheated Flow)

y/H-slot	Velocity	Density	Pressure	Mach #	Rho X U
0.2870130	0.643138	0.599936	1.206445	1.369902	0.385859
0.3063550	0.646737	0.606228	1.212549	1.381287	0.392085
0.3380040	0.641214	0.609091	1.224605	1.365973	0.390584
0.3608620	0.637276	0.610945	1.234001	1.354427	0.389356
0.3907530	0.634929	0.610494	1.237220	1.347168	0.387629
0.4136110	0.636789	0.607803	1.230400	1.351875	0.387057
0.4399860	0.641395	0.605113	1.218998	1.364984	0.388123
0.4628430	0.640239	0.598367	1.206631	1.361820	0.383115
0.4857010	0.650511	0.592804	1.182382	1.391319	0.385640
0.5155920	0.655361	0.583099	1.155496	1.406254	0.382149
0.5419670	0.659811	0.575167	1.132755	1.420140	0.379520
0.5718580	0.665420	0.568065	1.111106	1.437137	0.378017
0.6017490	0.671495	0.564976	1.095800	1.456419	0.379392
0.6263650	0.668410	0.559978	1.088920	1.447869	0.374325
0.6509820	0.676990	0.560553	1.077312	1.475065	0.379507
0.6773560	0.673410	0.558674	1.075681	1.465891	0.376230
0.7037310	0.683210	0.563136	1.068748	1.497969	0.384748
0.7248310	0.688251	0.566712	1.065696	1.516015	0.390064
0.7547220	0.693243	0.570225	1.062305	1.534240	0.395343
0.7846130	0.709572	0.580028	1.054993	1.589241	0.411593
0.8127460	0.720572	0.588528	1.051523	1.628274	0.424079
0.8408780	0.730768	0.595132	1.047292	1.663963	0.434926
0.8672530	0.738690	0.601461	1.046017	1.691884	0.444294
0.8901110	0.753650	0.612068	1.041332	1.745286	0.461308
0.9164850	0.769165	0.623791	1.035434	1.803239	0.479800
0.9446180	0.780235	0.632030	1.033252	1.843194	0.493141
0.9727510	0.799014	0.648195	1.028068	1.916349	0.517925
0.9973670	0.812624	0.661293	1.024173	1.972451	0.537432
1.0202250	0.830037	0.676990	1.017475	2.045127	0.561950
1.0501159	0.841523	0.690089	1.015330	2.095552	0.580742
1.0729740	0.855670	0.706905	1.012103	2.160029	0.604890
1.0993479	0.869860	0.722989	1.007267	2.226063	0.628929
1.1292400	0.880882	0.739043	1.006617	2.279801	0.651012
1.1503400	0.891697	0.754383	1.004976	2.333517	0.672686
1.1784730	0.906859	0.776182	0.998389	2.415203	0.703901
1.2066050	0.916969	0.792720	0.995667	2.471336	0.726902
1.2294630	0.928088	0.810739	0.990348	2.536484	0.752475
1.2558380	0.934820	0.825054	0.990970	2.576557	0.771307
1.2804540	0.938542	0.836682	0.994662	2.600029	0.785279
1.3050690	0.952238	0.861208	0.984561	2.690202	0.820127
1.3296860	0.964138	0.882325	0.975568	2.769520	0.850693
1.3595780	0.967091	0.895180	0.978996	2.793417	0.865772
1.3912270	0.979103	0.924170	0.972353	2.883157	0.904861
1.4140850	0.985667	0.943288	0.970431	2.935257	0.929774
1.4404590	0.989470	0.959594	0.974909	2.965134	0.949504
1.4668339	0.986495	0.961740	0.989219	2.938045	0.948757
1.4914510	0.990007	0.978457	0.994013	2.966799	0.968685
1.5213410	0.995866	1.000015	0.995037	3.015535	0.995884
1.5441990	0.996165	1.010529	1.002177	3.021437	1.006658
1.5705740	0.997187	1.018426	1.006893	3.029239	1.015578
1.5969490	0.996806	1.023299	1.010389	3.030005	1.020033
1.6215640	0.997032	1.026915	1.013260	3.031738	1.023869
1.6479390	0.995264	1.026713	1.018901	3.017672	1.021855
1.6760720	0.994021	1.026127	1.022369	3.007928	1.019993
1.7024460	0.993337	1.026228	1.024799	3.002437	1.019392
1.7270620	0.990481	1.022804	1.030059	2.981185	1.013073
1.7551960	0.989055	1.019559	1.032174	2.969132	1.008410
1.7868440	0.988295	1.017482	1.032322	2.963578	1.005573
1.8097030	0.985590	1.012531	1.034544	2.945115	0.997945
1.8431110	0.987634	1.012446	1.024565	2.965432	0.999928
1.8642110	0.991111	1.013723	1.013255	2.994325	1.004714
1.8941010	0.993872	1.012251	1.000765	3.019135	1.006048

1.9239930	0.998527	1.013585	0.986403	3.057311	1.012097
1.9521250	1.002274	1.015883	0.977531	3.086174	1.018198
1.9767410	1.003387	1.018419	0.976014	3.095873	1.021879
2.0048740	1.006042	1.026060	0.975452	3.116550	1.032259
2.0312481	1.006834	1.034833	0.979998	3.125040	1.041911
2.0558651	1.006940	1.043140	0.987457	3.126036	1.050382
2.0804811	1.006321	1.051073	0.997510	3.120111	1.057723
2.1050980	1.003411	1.056034	1.011178	3.097277	1.059639
2.1314721	1.004273	1.066304	1.019182	3.102725	1.070865
2.1560891	1.001093	1.068354	1.032996	3.075098	1.069527
2.1982870	1.000872	1.080136	1.047649	3.069633	1.081079
2.2229040	0.998833	1.084078	1.058930	3.052561	1.082816
2.2510369	0.998106	1.089539	1.066328	3.047400	1.087479
2.2738950	0.997331	1.093833	1.075811	3.037538	1.090919
2.3055439	0.997210	1.100990	1.083319	3.036509	1.097920
2.3284020	0.994236	1.103454	1.095443	3.014038	1.097097
2.3530180	0.990571	1.102548	1.108904	2.983429	1.092160
2.3811510	0.982581	1.094289	1.131091	2.919168	1.075228
2.4075251	0.977389	1.090242	1.146699	2.878653	1.065605
2.4321420	0.976237	1.090020	1.153975	2.865828	1.064124
2.4567580	0.974506	1.088669	1.158664	2.853183	1.060918
2.4848900	0.975768	1.089286	1.151765	2.866238	1.062896
2.5130241	0.977516	1.084219	1.136017	2.884471	1.059842
2.5393980	0.979497	1.078563	1.122276	2.900358	1.056453
2.5604980	0.983348	1.077499	1.108680	2.928119	1.059561
2.5833559	0.984224	1.071598	1.101232	2.932557	1.054694
2.6114891	0.986124	1.069109	1.091563	2.947772	1.054277
2.6361041	0.987525	1.068162	1.085591	2.958753	1.054842
2.6624789	0.986465	1.061953	1.084123	2.948962	1.047580
2.6888540	0.988675	1.061842	1.075542	2.967188	1.049818
2.7152290	0.987828	1.056415	1.073259	2.960220	1.043563
2.7416029	0.988319	1.054890	1.070233	2.963719	1.042571
2.7644610	0.987849	1.052232	1.070071	2.958807	1.039451
2.7890770	0.986670	1.050410	1.071140	2.951249	1.036414
2.8136940	0.987743	1.050668	1.068851	2.957991	1.037797
2.8365519	0.986097	1.047368	1.070570	2.946033	1.032810
2.8611670	0.988044	1.050719	1.066970	2.961565	1.038164
2.8893001	0.988654	1.049575	1.063697	2.966319	1.037669
2.9139171	0.986988	1.045744	1.064352	2.954998	1.032140
2.9438069	0.989211	1.047374	1.058962	2.971493	1.036077
2.9701819	0.990919	1.048842	1.053758	2.986066	1.039322
3.0000730	0.991987	1.047408	1.048632	2.994523	1.039019
3.0246899	0.991612	1.044670	1.046174	2.992983	1.035909
3.0493050	0.992833	1.045266	1.042696	3.002532	1.037779
3.0774381	0.992406	1.042558	1.042189	2.998076	1.034644
3.1020551	0.993259	1.042728	1.038545	3.006165	1.035705
3.1266720	0.993647	1.043687	1.039766	3.006933	1.037057
3.1530449	0.992327	1.043919	1.042679	2.999076	1.035910
3.1794200	0.993236	1.048002	1.043850	3.006000	1.040916
3.2022779	0.991874	1.047664	1.048306	2.995017	1.039153
3.2304111	0.992929	1.052615	1.049975	3.002913	1.045179
3.2585430	0.990213	1.050172	1.057668	2.980303	1.039898
3.2814009	0.988842	1.052787	1.064525	2.970294	1.041047
3.3165669	0.987167	1.051235	1.070075	2.955364	1.037750
3.3429420	1.207531	0.727839	0.099134	9.882783	0.878889
3.3710749	1.207213	0.729038	0.099245	9.882783	0.880104
3.3956900	1.207367	0.730074	0.099411	9.882783	0.881467
3.4203069	1.206986	0.725103	0.098672	9.882783	0.875190

Table 9. Nondimensionalized Profiles at Station 4 (Unheated Flow)

y/H-slot	Velocity	Density	Pressure	Mach #	Rho X U
0.2724930	0.678211	0.519323	1.031846	1.464813	0.352233
0.2654190	0.686054	0.526133	1.032442	1.490996	0.360978
0.2654190	0.695091	0.527973	1.025200	1.518606	0.367012
0.2866400	0.703163	0.530726	1.020306	1.543947	0.373210
0.3149340	0.705610	0.531330	1.019269	1.550981	0.374928
0.3379230	0.706353	0.531350	1.019972	1.552080	0.375335
0.3715220	0.714795	0.535911	1.016356	1.580168	0.383087
0.4104260	0.721914	0.540719	1.014714	1.604410	0.390388
0.4581720	0.733386	0.548421	1.010245	1.645075	0.402230
0.4988440	0.736681	0.553716	1.011456	1.659415	0.407934
0.5536640	0.754066	0.568720	1.004837	1.727088	0.428876
0.5961050	0.761196	0.578040	1.002796	1.759388	0.440012
0.6403140	0.773703	0.591969	0.998495	1.813686	0.458043
0.7022070	0.789444	0.607033	0.990722	1.881397	0.479272
0.7340380	0.804587	0.620753	0.982293	1.947159	0.499456
0.7853200	0.818556	0.634472	0.976595	2.008577	0.519359
0.8330660	0.841650	0.654441	0.962033	2.113303	0.550818
0.8648970	0.850268	0.663090	0.960331	2.150885	0.563806
0.9179480	0.873756	0.687209	0.946505	2.266634	0.600492
0.9603890	0.882835	0.698615	0.946187	2.309388	0.616766
1.0045980	0.905991	0.726882	0.933158	2.434385	0.658591
1.0576490	0.925825	0.753513	0.921780	2.548398	0.697661
1.0983220	0.932137	0.767542	0.927218	2.581844	0.715462
1.1513730	0.956381	0.809278	0.914492	2.738904	0.773988
1.1991190	0.967981	0.838519	0.914867	2.821219	0.811696
1.2433280	0.973166	0.862539	0.927381	2.857662	0.839493
1.2893060	0.987755	0.897920	0.922047	2.967596	0.886968
1.3264420	0.996776	0.925140	0.923910	3.036664	0.922193
1.3724190	1.004804	0.956180	0.928308	3.104512	0.960802
1.4148600	1.005713	0.979164	0.946603	3.114062	0.984807
1.4661430	1.009508	1.005282	0.957759	3.148624	1.014856
1.4979740	1.007452	1.010331	0.970785	3.128821	1.017861
1.5527940	1.008559	1.023484	0.977984	3.140972	1.032249
1.6023070	1.005514	1.022956	0.988502	3.114004	1.028605
1.6394430	1.001395	1.022798	1.001311	3.081060	1.024226
1.6606640	0.997380	1.015852	1.009389	3.046023	1.013196
1.6889580	0.992620	1.007849	1.017627	3.007426	1.000448
1.7137150	0.993374	1.009355	1.015181	3.015563	1.002704
1.7455450	0.990914	1.002635	1.015767	2.997053	0.993525
1.7667660	0.991357	0.998388	1.010890	2.999273	0.989765
1.7950600	0.993327	0.998644	1.000853	3.020695	0.991995
1.8251220	0.995591	0.996111	0.988310	3.042829	0.991723
1.8463430	0.999578	0.997503	0.972648	3.081647	0.997093
1.8746370	1.003087	0.999972	0.959515	3.117500	1.003078
1.9011620	1.006555	1.000772	0.947410	3.149346	1.007333
1.9259191	1.010131	1.006590	0.937376	3.186638	1.016789
1.9542140	1.011665	1.005994	0.932530	3.198812	1.017732
1.9807390	1.014343	1.010980	0.928100	3.222923	1.025492
2.0143380	1.015254	1.013917	0.928450	3.229918	1.029401
2.0373261	1.016854	1.019176	0.927721	3.244612	1.036365
2.0638530	1.016788	1.024157	0.933122	3.242897	1.041355
2.0974519	1.018032	1.033537	0.936830	3.255223	1.052176
2.1292820	1.018049	1.041871	0.944525	3.255025	1.060676
2.1593440	1.019055	1.052133	0.950182	3.264526	1.072188
2.1894059	1.017740	1.060273	0.962231	3.252298	1.079082
2.2230051	1.014716	1.066710	0.980795	3.221615	1.082409
2.2530680	1.010412	1.072337	1.004099	3.178789	1.083505
2.2778251	1.006590	1.074851	1.023838	3.139757	1.081934
2.3025820	1.000677	1.077271	1.047379	3.089715	1.078043
2.3291080	0.992106	1.068001	1.074268	3.011700	1.059638
2.3556340	0.988195	1.069686	1.091205	2.978565	1.057064
2.3803899	0.985135	1.072225	1.103751	2.955911	1.056294

2.4104531	0.982765	1.071836	1.115037	2.933292	1.053366
2.4352109	0.982911	1.076521	1.117098	2.937430	1.058131
2.4599669	0.983148	1.072271	1.112967	2.937794	1.054211
2.4900301	0.987290	1.074657	1.097792	2.973766	1.060998
2.5200920	0.989801	1.067922	1.079020	2.997700	1.057031
2.5448489	0.992710	1.062181	1.059600	3.025772	1.054439
2.5784490	0.995059	1.056044	1.044284	3.046264	1.050828
2.6032050	0.997528	1.051638	1.031330	3.066526	1.049043
2.6314991	0.999855	1.050335	1.021635	3.086304	1.050186
2.6597929	1.001688	1.046845	1.012917	3.100085	1.048617
2.6880870	1.001591	1.040527	1.009921	3.094990	1.042187
2.7128439	1.003606	1.043787	1.003684	3.115722	1.047559
2.7393701	1.003104	1.038580	1.001806	3.109291	1.041809
2.7676640	1.003265	1.036903	0.999571	3.110733	1.040291
2.7888839	1.004321	1.036848	0.996616	3.118561	1.041333
2.8136411	1.003055	1.033334	0.998669	3.106147	1.036496
2.8419361	1.004136	1.036656	0.996533	3.117841	1.040949
2.8666930	1.002582	1.032557	0.999343	3.102459	1.035227
2.8949859	1.002941	1.035828	0.999940	3.107568	1.038877
2.9197431	1.002969	1.034930	0.999344	3.107218	1.038006
2.9498050	1.002161	1.032776	1.001125	3.098719	1.035012
2.9763310	1.003221	1.034754	0.997988	3.109843	1.038090
3.0010879	1.001859	1.029712	0.999487	3.095728	1.031630
3.0311501	1.001064	1.027275	1.000143	3.088590	1.028371
3.0541401	1.002599	1.031230	0.995560	3.106421	1.033916
3.0859711	1.003558	1.031416	0.992277	3.114787	1.035087
3.1178010	1.003386	1.029780	0.991517	3.112984	1.033271
3.1443260	1.003450	1.029357	0.991629	3.112371	1.032912
3.1708529	1.004156	1.030571	0.989689	3.119450	1.034859
3.1956100	1.004546	1.031284	0.987886	3.124581	1.035975
3.2203660	1.003840	1.031448	0.991130	3.117534	1.035414
3.2468920	1.005202	1.036154	0.989780	3.131023	1.041554
3.2751870	1.004321	1.034439	0.992348	3.121612	1.038912
3.2981751	1.001961	1.029271	0.997742	3.098104	1.031299
3.3211629	1.001969	1.031843	0.998271	3.101162	1.033879
3.3494580	1.001551	1.031216	0.999456	3.097076	1.032818
3.3742149	0.999512	1.026249	1.003929	3.076442	1.025753

Table 10. Nondimensionalized Profiles at Station 4 (Unheated Flow, Shock)

y/H-slot	Velocity	Density	Pressure	Mach #	Rho X U
0.2724930	0.407865	0.741566	1.892272	0.785495	0.302459
0.2671880	0.407674	0.742260	1.892272	0.785495	0.302600
0.2760300	0.457077	0.781710	1.892272	0.895315	0.357347
0.2990180	0.476255	0.792848	1.892272	0.938727	0.377632
0.3273120	0.485669	0.798952	1.892272	0.960894	0.388114
0.3573750	0.498195	0.805926	1.892272	0.989826	0.401548
0.4086570	0.509149	0.812200	1.892272	1.015498	0.413551
0.4457930	0.519933	0.817924	1.892272	1.040670	0.425292
0.5006130	0.538358	0.829879	1.892272	1.085366	0.446800
0.5430540	0.555246	0.842716	1.892272	1.128054	0.467959
0.5943360	0.575410	0.860224	1.892272	1.181072	0.494998
0.6456190	0.595012	0.883292	1.903270	1.234016	0.525587
0.6898280	0.609051	0.907422	1.922964	1.273670	0.552665
0.7375740	0.631213	0.942293	1.943833	1.337959	0.594835
0.7800150	0.645906	0.965590	1.952937	1.382657	0.623721
0.8224560	0.668449	1.001901	1.967885	1.452030	0.669727
0.8755070	0.696088	1.041100	1.968260	1.541374	0.724830
0.9161800	0.720640	1.074196	1.961048	1.623850	0.774224
0.9639260	0.752410	1.115303	1.941819	1.735989	0.839210
0.9975250	0.777076	1.150902	1.926090	1.828707	0.894390
1.0488080	0.807099	1.196582	1.904298	1.947697	0.965784
1.0965540	0.840535	1.254605	1.877575	2.091685	1.054550
1.1425320	0.857682	1.292241	1.873712	2.168518	1.108433
1.1867400	0.886084	1.356257	1.850554	2.309313	1.201765
1.2291811	0.902316	1.397879	1.840463	2.393980	1.261360
1.2663170	0.919434	1.451761	1.834156	2.490214	1.334802
1.3211370	0.934192	1.499493	1.826600	2.576860	1.400892
1.3582730	0.934519	1.516940	1.851038	2.575553	1.417665
1.4060190	0.942356	1.548040	1.852556	2.622463	1.458817
1.4378500	0.942367	1.554169	1.867397	2.617218	1.464609
1.4891320	0.942016	1.557149	1.877908	2.611389	1.466863
1.5191950	0.940390	1.558689	1.883007	2.604641	1.465779
1.5757819	0.939784	1.559264	1.878767	2.606371	1.465374
1.6129180	0.939882	1.561402	1.875197	2.610914	1.467535
1.6588960	0.939376	1.560015	1.870655	2.611512	1.465442
1.6783470	0.938908	1.560689	1.868116	2.612557	1.465349
1.7243249	0.938521	1.558100	1.866791	2.610233	1.462311
1.7508510	0.939933	1.561498	1.862558	2.619983	1.467706
1.7791440	0.938932	1.558437	1.865460	2.612594	1.463271
1.8127440	0.938300	1.557881	1.865889	2.610069	1.461764
1.8375010	0.938765	1.559044	1.864474	2.613321	1.463578
1.8604890	0.939090	1.557661	1.863631	2.613675	1.462791
1.8923200	0.937884	1.554958	1.866341	2.606145	1.458373
1.9206140	0.936881	1.553277	1.867395	2.601220	1.455242
1.9471400	0.937125	1.550892	1.865781	2.601028	1.453386
1.9789710	0.935764	1.546416	1.867153	2.592529	1.447080
2.0037270	0.933879	1.542189	1.870069	2.581775	1.440226
2.0497050	0.933157	1.533878	1.864393	2.576712	1.431349
2.0779991	0.934379	1.530015	1.854357	2.583800	1.429614
2.1292820	0.933170	1.514970	1.840746	2.577217	1.413729
2.1558070	0.935107	1.508893	1.822971	2.589914	1.410977
2.2035539	0.935579	1.495314	1.804343	2.592853	1.398990
2.2318470	0.937963	1.491563	1.786069	2.609408	1.399035
2.2672150	0.937792	1.480725	1.775878	2.606885	1.388612
2.2955079	0.940188	1.480124	1.760858	2.624140	1.391597
2.3238029	0.942680	1.478152	1.747571	2.639318	1.393426
2.3485601	0.943547	1.476131	1.739589	2.645990	1.392803
2.3803899	0.944753	1.473779	1.730035	2.654567	1.392361
2.4069159	0.947198	1.472828	1.719319	2.668844	1.395060
2.4387469	0.948655	1.473497	1.711441	2.679709	1.397844
2.4670410	0.948493	1.469914	1.708937	2.677961	1.394211
2.4935660	0.950548	1.473757	1.703826	2.691288	1.400882

2.5147870	0.950869	1.473571	1.700299	2.694814	1.401175
2.5430810	0.951731	1.473612	1.696957	2.699954	1.402487
2.5696070	0.952264	1.474188	1.697010	2.701968	1.403823
2.5996690	0.951831	1.474809	1.698580	2.700062	1.403780
2.6244249	0.952597	1.479478	1.698590	2.706494	1.409354
2.6509521	0.953162	1.481114	1.701685	2.707109	1.411742
2.6792450	0.952198	1.486584	1.709623	2.703100	1.415540
2.7093070	0.951799	1.493166	1.719606	2.700057	1.421201
2.7340641	0.950750	1.499315	1.734757	2.690776	1.425475
2.7588220	0.949491	1.507081	1.749534	2.682802	1.430973
2.7906530	0.946684	1.520466	1.780409	2.663299	1.439401
2.8224831	0.944066	1.542532	1.822342	2.644218	1.456268
2.8543141	0.944745	1.565639	1.844783	2.649560	1.479129
2.8896811	0.944106	1.588919	1.872449	2.647618	1.500107
2.9232800	0.942983	1.601521	1.893259	2.640281	1.510208
2.9480381	0.943217	1.611794	1.907383	2.639569	1.520275
2.9727950	0.942026	1.618829	1.920951	2.632643	1.524983
3.0028570	0.940721	1.626456	1.937986	2.623574	1.530046
3.0258460	0.941126	1.633852	1.945986	2.625246	1.537665
3.0523720	0.940522	1.640039	1.956860	2.621204	1.542494
3.0842021	0.939494	1.646792	1.973251	2.612806	1.547156
3.1089590	0.938024	1.652007	1.986089	2.604401	1.549627
3.1390209	0.938472	1.662452	1.996336	2.607154	1.560173
3.1708529	0.938484	1.671714	2.008975	2.606189	1.568878
3.1956100	0.937938	1.679042	2.020299	2.603055	1.574845
3.2239029	0.936381	1.682984	2.034476	2.592698	1.575915
3.2468920	0.936956	1.691766	2.042638	2.595840	1.585111
3.2698810	0.936010	1.700532	2.055603	2.591722	1.591716
3.2999430	0.934261	1.707701	2.073298	2.581255	1.595446
3.3229320	0.927985	1.697692	2.103912	2.537736	1.575453
3.3459210	0.910125	1.666420	2.161182	2.433750	1.517016
3.3689101	0.895683	1.638808	2.206731	2.350343	1.468144
3.3989730	1.206146	0.878269	0.121237	9.882783	1.059319
3.4237289	1.205828	0.870600	0.120115	9.882783	1.049792

Table 11. Dimensional Profiles at Station 1 (Heated Flow)

y/H-slot	U (m/s)	rho(kg/m^3)	P(psi)	Mach #	RhoXU(kg/m^2/s)
0.2587610	515.858	0.206	2.285	1.575	106.046
0.2658010	511.083	0.207	2.322	1.552	105.662
0.2992430	510.529	0.209	2.353	1.549	106.704
0.3291640	509.464	0.210	2.376	1.543	107.134
0.3555660	507.737	0.211	2.397	1.534	107.313
0.3766870	506.862	0.213	2.418	1.529	107.721
0.4013280	508.800	0.213	2.417	1.538	108.521
0.4242090	512.832	0.214	2.404	1.557	109.748
0.4488500	513.757	0.213	2.386	1.561	109.311
0.4787720	515.896	0.212	2.370	1.571	109.385
0.5016530	520.935	0.211	2.337	1.592	109.772
0.5262940	524.689	0.208	2.298	1.608	109.303
0.5526950	532.184	0.206	2.244	1.642	109.712
0.5755760	538.217	0.202	2.174	1.669	108.655
0.6072580	547.830	0.197	2.085	1.713	107.799
0.6283790	552.644	0.192	2.016	1.734	105.915
0.6530200	556.933	0.188	1.965	1.754	104.756
0.6794210	553.893	0.187	1.974	1.737	103.809
0.7005420	545.826	0.188	2.019	1.697	102.786
0.7357440	533.506	0.191	2.100	1.637	101.871
0.7568650	531.902	0.195	2.150	1.630	103.678
0.7885460	521.828	0.198	2.218	1.586	103.173
0.8131870	462.115	0.187	2.316	1.338	86.569
0.8395890	407.787	0.179	2.374	1.139	72.851
0.8712700	325.182	0.164	2.374	0.871	53.223
0.8976720	369.331	0.176	2.374	1.025	65.122
0.9258330	447.606	0.202	2.351	1.338	90.635
0.9539940	510.907	0.230	2.249	1.665	117.732
0.9786350	516.482	0.243	2.221	1.741	125.733
1.0015171	521.535	0.256	2.193	1.814	133.598
1.0279180	530.862	0.271	2.159	1.913	143.606
1.0560790	541.458	0.283	2.115	2.014	152.977
1.0789599	552.714	0.290	2.044	2.121	160.496
1.1088810	570.048	0.299	1.942	2.279	170.686
1.1317620	585.446	0.306	1.829	2.435	178.879
1.1546431	594.838	0.312	1.768	2.545	185.843
1.1863250	605.330	0.327	1.739	2.672	197.943
1.2109660	610.180	0.344	1.761	2.745	209.978
1.2426480	614.323	0.368	1.814	2.815	225.782
1.2672880	616.274	0.390	1.884	2.855	240.491
1.3007309	617.989	0.415	1.966	2.891	256.764
1.3218520	615.120	0.433	2.063	2.869	266.468
1.3500130	618.292	0.459	2.131	2.921	283.725
1.3781750	619.049	0.478	2.193	2.941	295.888
1.4045759	618.494	0.498	2.274	2.947	308.250
1.4327370	614.887	0.512	2.366	2.911	314.701
1.4608980	615.424	0.531	2.429	2.928	326.685
1.4855390	618.072	0.553	2.477	2.972	341.764
1.5189810	619.161	0.574	2.537	2.999	355.634
1.5506630	618.683	0.592	2.601	3.005	366.478
1.5753030	620.226	0.609	2.633	3.037	377.919
1.6017050	619.823	0.620	2.668	3.042	384.397
1.6298660	618.130	0.627	2.706	3.028	387.484
1.6527470	615.589	0.632	2.752	3.003	389.136
1.6826680	613.757	0.636	2.781	2.988	390.447
1.7108300	611.150	0.641	2.826	2.963	391.844
1.7337110	608.113	0.643	2.865	2.933	391.269
1.7618730	607.513	0.649	2.883	2.934	394.178
1.7865140	607.841	0.654	2.889	2.944	397.537
1.8111550	607.611	0.657	2.894	2.947	399.295
1.8393160	607.680	0.661	2.900	2.952	401.512
1.8657180	607.914	0.662	2.896	2.959	402.691

1.8903590	608.349	0.662	2.889	2.964	402.774
1.9202800	608.376	0.663	2.892	2.964	403.064
1.9466810	608.182	0.662	2.891	2.963	402.871
1.9748420	608.246	0.663	2.890	2.965	403.163
2.0030041	607.575	0.663	2.896	2.959	402.916
2.0276451	606.709	0.663	2.902	2.951	402.142
2.0540459	605.956	0.664	2.909	2.946	402.270
2.0822079	604.899	0.664	2.928	2.933	401.868
2.1121280	603.039	0.666	2.953	2.915	401.636
2.1420510	601.787	0.670	2.982	2.903	402.958
2.1684520	601.735	0.675	3.001	2.905	406.187
2.1966140	602.777	0.681	3.002	2.923	410.772
2.2247751	603.490	0.684	2.997	2.935	412.963
2.2511761	602.351	0.681	2.994	2.925	410.452
2.2775769	601.218	0.681	3.004	2.913	409.175
2.3074989	599.583	0.677	3.010	2.894	405.931
2.3303790	599.673	0.676	3.005	2.896	405.569
2.3550210	599.905	0.675	2.997	2.898	405.122
2.3831820	599.849	0.674	2.993	2.898	404.523
2.4078231	599.616	0.673	2.990	2.896	403.702
2.4342239	599.207	0.671	2.986	2.892	402.336
2.4659050	598.734	0.670	2.982	2.889	401.349
2.4905469	598.653	0.671	2.981	2.891	401.742
2.5169480	598.139	0.672	2.989	2.887	402.037
2.5451100	598.588	0.674	2.987	2.895	403.743
2.5679910	600.260	0.677	2.967	2.919	406.400
2.5943921	599.449	0.675	2.965	2.911	404.630
2.6225541	598.542	0.672	2.963	2.901	402.256
2.6436739	595.088	0.663	2.979	2.858	394.773
2.6683159	592.786	0.658	2.990	2.831	390.181
2.6964769	592.209	0.656	2.984	2.827	388.584
2.7299190	590.547	0.651	2.983	2.807	384.283
2.7510400	592.921	0.650	2.942	2.838	385.690
2.7862411	595.310	0.650	2.893	2.871	386.784
2.8161621	598.546	0.647	2.825	2.916	387.443
2.8408041	602.965	0.645	2.748	2.974	389.040
2.8619239	605.449	0.642	2.696	3.007	388.743
2.8900859	606.464	0.640	2.669	3.022	387.929
2.9147270	607.443	0.640	2.654	3.037	389.033
2.9376080	607.841	0.643	2.658	3.044	391.048
2.9657700	609.131	0.650	2.657	3.066	395.793
2.9921710	608.849	0.656	2.665	3.075	399.526
3.0150521	608.310	0.658	2.681	3.067	400.117
3.0449741	608.304	0.661	2.693	3.067	402.011
3.0678549	607.605	0.663	2.713	3.057	402.685
3.0924959	607.032	0.664	2.727	3.048	402.981
3.1206570	604.519	0.663	2.765	3.013	400.797
3.1435380	603.398	0.663	2.782	2.997	399.789
3.1681800	602.658	0.664	2.800	2.987	400.168
3.1928201	602.002	0.665	2.817	2.978	400.506
3.2174621	600.899	0.669	2.845	2.965	401.729
3.2473831	599.835	0.673	2.879	2.952	403.570
3.2702639	598.725	0.675	2.900	2.939	403.854
3.2966650	598.784	0.679	2.913	2.942	406.398
3.3248260	598.004	0.681	2.935	2.932	407.129
3.3459470	598.847	0.685	2.937	2.944	410.206
3.3741090	598.665	0.690	2.957	2.944	413.204
3.3987510	599.459	0.694	2.963	2.954	416.278
3.4216321	599.002	0.695	2.973	2.948	416.533
3.4480331	598.558	0.698	2.989	2.944	417.746
3.4761939	599.234	0.697	2.975	2.953	417.914

Table 12. Dimensional Profiles at Station 2 (Heated Flow)

y/H-slot	U (m/s)	rho(kg/m^3)	P(psi)	Mach #	RhoXU(kg/m^2/s)
0.3266110	502.267	0.239	2.635	1.539	120.034
0.3508710	506.597	0.237	2.611	1.555	120.306
0.3820620	503.004	0.233	2.603	1.533	117.357
0.4115200	510.422	0.234	2.583	1.563	119.376
0.4461770	510.968	0.234	2.584	1.565	119.506
0.4721690	511.041	0.233	2.581	1.564	119.250
0.5085590	509.270	0.233	2.588	1.554	118.516
0.5328180	509.593	0.232	2.588	1.554	118.441
0.5830700	508.910	0.231	2.587	1.548	117.526
0.6090630	508.850	0.230	2.588	1.546	117.262
0.6385210	507.253	0.229	2.588	1.536	116.265
0.6679790	506.299	0.228	2.583	1.531	115.432
0.6974370	503.028	0.227	2.586	1.515	113.957
0.7268950	497.385	0.224	2.587	1.491	111.623
0.7511550	490.371	0.222	2.585	1.463	108.994
0.7788800	484.747	0.222	2.587	1.446	107.661
0.8048730	487.119	0.225	2.576	1.467	109.805
0.8308650	497.275	0.233	2.555	1.528	115.825
0.8707200	511.171	0.247	2.514	1.632	126.487
0.9019110	521.668	0.263	2.479	1.729	137.123
0.9279040	532.989	0.281	2.444	1.840	149.913
0.9590950	542.077	0.300	2.422	1.941	162.437
0.9798880	547.932	0.320	2.414	2.029	175.184
1.0336061	554.190	0.337	2.407	2.111	186.745
1.0544000	560.883	0.351	2.397	2.184	196.761
1.0855920	567.400	0.364	2.391	2.254	206.541
1.1185150	573.547	0.378	2.389	2.322	216.892
1.1479729	586.281	0.399	2.362	2.454	234.148
1.1705000	592.442	0.413	2.357	2.525	244.829
1.1999580	596.342	0.425	2.358	2.576	253.239
1.2242180	602.541	0.440	2.355	2.650	264.839
1.2554090	609.073	0.457	2.350	2.733	278.290
1.2848660	615.148	0.473	2.345	2.812	291.032
1.3160580	622.345	0.494	2.337	2.912	307.346
1.3420510	621.431	0.503	2.371	2.914	312.612
1.3680420	627.033	0.521	2.360	2.998	326.553
1.3940350	629.333	0.533	2.365	3.040	335.246
1.4252260	628.818	0.540	2.384	3.047	339.735
1.4477530	630.247	0.550	2.392	3.077	346.888
1.4754781	629.391	0.557	2.411	3.078	350.268
1.5014710	628.016	0.559	2.422	3.071	351.186
1.5309280	626.505	0.562	2.427	3.067	351.790
1.5586540	624.776	0.563	2.431	3.059	351.441
1.5898449	623.619	0.561	2.426	3.052	349.934
1.6141040	620.180	0.555	2.439	3.011	344.130
1.6435630	618.729	0.549	2.432	2.993	339.955
1.6695549	618.855	0.545	2.407	2.998	337.405
1.7042120	622.004	0.546	2.349	3.051	339.307
1.7302040	625.513	0.545	2.293	3.103	340.765
1.7561970	628.238	0.547	2.263	3.143	343.349
1.7873870	629.799	0.548	2.246	3.166	345.179
1.8203120	630.268	0.551	2.245	3.177	347.084
1.8428380	628.946	0.553	2.259	3.167	347.729
1.8670980	627.573	0.553	2.268	3.153	346.922
1.8965560	622.388	0.544	2.297	3.084	338.743
1.9277461	620.610	0.541	2.305	3.060	335.731
1.9520060	619.745	0.540	2.304	3.054	334.675
1.9831980	619.023	0.537	2.291	3.050	332.294
2.0161209	622.019	0.535	2.237	3.097	332.973
2.0403810	624.745	0.535	2.194	3.139	334.160
2.0715721	626.913	0.534	2.161	3.172	334.710
2.1044960	625.841	0.525	2.145	3.153	328.870

2.1408851	621.632	0.510	2.141	3.087	316.923
2.1651440	621.976	0.502	2.098	3.095	311.997
2.1998010	625.751	0.499	2.031	3.156	312.027
2.2361910	631.630	0.497	1.949	3.245	313.672
2.2725799	636.491	0.498	1.891	3.325	317.143
2.3003049	639.608	0.502	1.864	3.380	321.266
2.3314970	640.091	0.505	1.866	3.390	323.341
2.3661530	641.036	0.512	1.879	3.408	328.507
2.3990769	640.990	0.518	1.896	3.410	332.029
2.4337339	640.375	0.524	1.924	3.402	335.789
2.4649241	639.510	0.530	1.957	3.389	339.242
2.4995811	638.343	0.538	1.992	3.376	343.274
2.5342381	636.873	0.543	2.032	3.351	345.969
2.5567639	635.542	0.549	2.066	3.334	348.850
2.5914209	635.001	0.557	2.100	3.329	353.653
2.6260779	633.484	0.563	2.141	3.307	356.834
2.6590011	633.182	0.571	2.172	3.304	361.541
2.6919250	632.502	0.581	2.217	3.295	367.248
2.7161851	631.359	0.588	2.260	3.278	371.319
2.7491090	629.983	0.595	2.305	3.259	375.102
2.7733691	628.542	0.602	2.350	3.237	378.075
2.8028259	626.943	0.607	2.392	3.215	380.743
2.8270860	624.927	0.611	2.433	3.187	381.732
2.8582771	624.133	0.617	2.466	3.178	385.072
2.8825369	622.888	0.620	2.495	3.160	386.109
2.9119949	621.885	0.623	2.518	3.148	387.466
2.9379880	621.111	0.626	2.536	3.140	388.720
2.9709110	620.396	0.627	2.552	3.131	389.292
2.9969029	619.553	0.630	2.566	3.124	390.181
3.0298271	618.924	0.631	2.586	3.111	390.454
3.0558200	618.724	0.633	2.595	3.111	391.843
3.0852780	618.082	0.635	2.611	3.102	392.381
3.1147361	618.213	0.636	2.617	3.103	393.357
3.1424611	617.472	0.637	2.629	3.094	393.537
3.1684539	617.010	0.639	2.639	3.089	393.994
3.1944461	617.067	0.640	2.639	3.091	394.615
3.2291019	617.185	0.641	2.639	3.095	395.421
3.2620270	617.334	0.641	2.636	3.098	395.561
3.2897520	617.323	0.640	2.629	3.100	395.170
3.3209419	617.979	0.641	2.622	3.109	395.891
3.3469350	618.260	0.640	2.614	3.115	395.977
3.3746600	619.215	0.641	2.597	3.131	396.781
3.4058521	618.952	0.639	2.587	3.130	395.254
3.4283781	619.260	0.638	2.579	3.135	395.107
3.4613020	619.436	0.635	2.562	3.139	393.343

Table 13. Dimensional Profiles at Station 3 (Heated Flow)

y/H-slot	U (m/s)	rho(kg/m^3)	P(psi)	Mach #	RhoXU(kg/m^2/s)
0.3336490	489.030	0.261	2.985	1.472	127.735
0.3389450	495.324	0.259	2.936	1.497	128.192
0.3883740	501.813	0.256	2.864	1.527	128.383
0.4236810	503.898	0.253	2.825	1.534	127.384
0.4819360	506.610	0.251	2.800	1.543	126.925
0.5172430	509.819	0.251	2.795	1.554	127.757
0.5525490	505.614	0.251	2.811	1.536	126.672
0.6019780	506.020	0.252	2.820	1.538	127.295
0.6355190	505.798	0.252	2.825	1.539	127.710
0.6831830	507.724	0.255	2.829	1.552	129.590
0.7096620	512.274	0.259	2.823	1.580	132.842
0.7626220	520.418	0.267	2.808	1.634	139.054
0.7908670	529.657	0.276	2.797	1.694	146.228
0.8385310	543.926	0.291	2.770	1.796	158.531
0.8614800	549.466	0.302	2.759	1.851	166.135
0.9109090	561.148	0.329	2.727	1.983	184.375
0.9568070	567.821	0.353	2.713	2.086	200.631
0.9868170	573.479	0.378	2.706	2.180	216.507
1.0327150	583.705	0.397	2.691	2.281	231.640
1.0627260	586.662	0.416	2.697	2.345	244.059
1.1121550	595.989	0.450	2.653	2.499	268.332
1.1404001	596.320	0.466	2.660	2.540	277.840
1.1827670	607.855	0.499	2.609	2.705	303.095
1.2216040	614.674	0.518	2.594	2.797	318.637
1.2622070	618.003	0.542	2.594	2.876	334.996
1.3063400	620.331	0.563	2.631	2.921	349.261
1.3540030	618.965	0.589	2.696	2.946	364.796
1.3893100	618.058	0.605	2.745	2.954	374.072
1.4352080	615.666	0.621	2.808	2.948	382.600
1.4616890	616.516	0.633	2.821	2.973	390.408
1.5093520	615.931	0.646	2.858	2.981	397.997
1.5358320	616.138	0.648	2.868	2.981	399.425
1.5852600	613.402	0.653	2.892	2.966	400.410
1.6117400	610.942	0.651	2.913	2.939	397.659
1.6646990	609.220	0.651	2.921	2.928	396.773
1.7035370	608.548	0.652	2.901	2.937	397.001
1.7547311	609.972	0.655	2.845	2.980	399.681
1.7918020	611.831	0.657	2.796	3.018	401.691
1.8394660	613.758	0.659	2.760	3.052	404.536
1.8853641	614.497	0.666	2.766	3.069	409.205
1.9224360	613.330	0.671	2.817	3.046	411.310
1.9648030	612.894	0.674	2.864	3.027	413.274
2.0107019	607.304	0.680	2.965	2.961	413.190
2.0548351	602.524	0.684	3.049	2.905	412.315
2.0919061	600.013	0.689	3.089	2.884	413.463
2.1466310	600.290	0.690	3.073	2.895	414.036
2.1748769	601.616	0.690	3.045	2.914	414.948
2.2278359	603.519	0.689	3.001	2.944	415.893
2.2631421	604.612	0.691	2.974	2.966	417.612
2.3090410	604.822	0.690	2.958	2.973	417.232
2.3478780	604.165	0.691	2.966	2.969	417.636
2.3973060	602.615	0.691	2.983	2.952	416.293
2.4326129	601.578	0.692	2.998	2.943	416.586
2.4855731	599.888	0.690	3.015	2.921	414.003
2.5208790	600.227	0.692	3.014	2.927	415.433
2.5614810	599.192	0.693	3.031	2.917	415.385
2.5985529	600.649	0.696	3.015	2.936	417.792
2.6373899	601.950	0.698	2.996	2.956	419.982
2.6709311	603.108	0.699	2.986	2.970	421.556
2.7080021	602.844	0.697	2.985	2.966	420.421
2.7291861	602.118	0.698	2.995	2.958	420.204
2.7733190	600.839	0.698	3.010	2.945	419.349

2.7997990	599.444	0.702	3.015	2.943	420.625
2.8456981	599.810	0.703	3.013	2.948	421.382
2.8721769	600.781	0.705	3.005	2.961	423.402
2.9004221	600.175	0.703	3.010	2.953	422.140
2.9374940	599.922	0.702	3.007	2.950	421.004
2.9604430	598.885	0.698	3.010	2.936	418.058
3.0028100	598.379	0.695	3.003	2.930	415.788
3.0257599	598.486	0.691	2.982	2.933	413.843
3.0504749	599.365	0.690	2.962	2.945	413.687
3.0893121	599.455	0.686	2.940	2.948	411.432
3.1140261	600.303	0.687	2.925	2.962	412.603
3.1440370	599.952	0.686	2.921	2.959	411.541
3.1793420	598.942	0.683	2.924	2.946	408.887
3.2093530	598.891	0.682	2.921	2.946	408.608
3.2481911	598.507	0.681	2.922	2.942	407.866
3.2746711	599.165	0.682	2.912	2.952	408.809
3.2958541	699.743	0.527	0.929	8.152	363.721
3.3258641	733.087	0.479	0.273	9.883	351.011
3.3541100	733.008	0.480	0.274	9.883	351.861
3.3770580	732.763	0.481	0.274	9.883	352.700

Table 14. Dimensional Profiles at Station 4 (Heated Flow)

y/H-slot	U (m/s)	rho(kg/m^3)	P(psi)	Mach #	RhoXU(kg/m^2/s)
0.3903670	429.922	0.321	3.816	1.269	138.074
0.4294770	432.429	0.325	3.841	1.279	140.363
0.4614750	436.374	0.327	3.826	1.298	142.593
0.5112510	442.881	0.327	3.755	1.331	145.021
0.5556940	454.371	0.329	3.622	1.394	149.540
0.6072470	461.000	0.330	3.486	1.445	152.295
0.6392460	471.211	0.336	3.380	1.512	158.215
0.6819110	477.205	0.339	3.268	1.565	161.925
0.7245760	490.377	0.351	3.154	1.665	172.190
0.7761290	499.205	0.364	3.077	1.749	181.897
0.8365710	508.127	0.382	3.030	1.836	194.121
0.8703470	522.950	0.401	2.981	1.952	209.722
0.9219010	523.552	0.411	2.981	1.979	215.219
0.9503440	534.227	0.426	2.942	2.068	227.332
1.0036750	539.236	0.438	2.929	2.124	236.436
1.0392290	550.346	0.454	2.891	2.221	250.115
1.0854501	558.341	0.470	2.863	2.303	262.472
1.1227810	564.585	0.483	2.843	2.367	272.441
1.1636680	576.107	0.505	2.808	2.488	291.145
1.2081100	577.582	0.515	2.814	2.514	297.258
1.2365550	585.043	0.532	2.793	2.599	311.339
1.2792190	587.062	0.544	2.807	2.630	319.361
1.3112180	594.514	0.564	2.790	2.722	335.577
1.3627720	597.403	0.579	2.804	2.763	345.913
1.3965470	603.926	0.599	2.780	2.852	361.483
1.4392130	605.242	0.613	2.796	2.885	371.130
1.4747660	608.222	0.626	2.787	2.933	380.526
1.5120990	608.622	0.636	2.808	2.948	387.016
1.5316540	607.706	0.641	2.831	2.943	389.442
1.5814290	606.071	0.648	2.867	2.932	392.576
1.6063170	606.897	0.654	2.868	2.950	396.967
1.6560930	604.773	0.659	2.896	2.936	398.523
1.6880920	601.157	0.656	2.928	2.896	394.421
1.7431999	599.450	0.655	2.937	2.881	392.497
1.7787540	600.956	0.653	2.895	2.905	392.427
1.8267530	604.664	0.650	2.812	2.959	393.164
1.8783050	608.603	0.646	2.737	3.009	393.036
1.9067481	611.854	0.645	2.685	3.053	394.841
1.9529700	613.853	0.646	2.653	3.082	396.341
1.9885230	616.480	0.651	2.631	3.122	401.572
2.0329659	616.153	0.655	2.649	3.117	403.300
2.0720761	617.352	0.665	2.668	3.138	410.794
2.1094069	616.269	0.671	2.706	3.123	413.559
2.1467390	616.440	0.683	2.746	3.129	420.965
2.1911809	615.346	0.693	2.800	3.116	426.583
2.2356241	613.065	0.704	2.875	3.087	431.303
2.2871780	608.185	0.707	2.965	3.023	429.953
2.3227310	598.047	0.693	3.077	2.888	414.229
2.3778400	593.875	0.692	3.137	2.838	410.721
2.4293940	592.641	0.690	3.145	2.825	408.836
2.4720590	595.055	0.687	3.079	2.861	408.927
2.5022800	597.441	0.683	3.021	2.892	408.316
2.5467219	600.500	0.683	2.962	2.934	409.915
2.5751650	601.233	0.683	2.949	2.944	410.490
2.6178310	602.319	0.685	2.936	2.961	412.480
2.6516061	601.658	0.684	2.942	2.953	411.574
2.7013819	601.693	0.683	2.938	2.954	411.238
2.7369370	601.365	0.683	2.935	2.952	410.487
2.7796021	601.658	0.682	2.925	2.957	410.350
2.8169341	603.715	0.684	2.896	2.985	412.757
2.8560431	604.452	0.684	2.881	2.997	413.333
2.8862641	604.404	0.683	2.878	2.998	413.056

2.9253740	603.951	0.683	2.882	2.993	412.683
2.9644830	601.622	0.686	2.909	2.973	412.459
3.0035930	601.100	0.686	2.920	2.966	412.417
3.0480349	600.915	0.688	2.932	2.963	413.469
3.0942550	600.889	0.690	2.939	2.963	414.438
3.1280320	600.906	0.687	2.927	2.963	412.838
3.1635859	600.728	0.685	2.923	2.960	411.660
3.2026949	600.967	0.685	2.917	2.964	411.533
3.2311389	601.242	0.684	2.908	2.967	411.070
3.2738030	601.248	0.682	2.900	2.968	410.117
3.3164680	601.409	0.680	2.887	2.971	409.095
3.3520219	601.183	0.679	2.880	2.970	407.962
3.3840210	600.845	0.678	2.881	2.966	407.191
3.4195750	600.903	0.675	2.868	2.968	405.902
3.4462409	601.058	0.675	2.861	2.971	405.509

Table 15. Dimensional Profiles at Station 4 (Heated Flow, Shock)

y/H-slot	U (m/s)	rho(kg/m^3)	P(psi)	Mach #	RhoXU(kg/m^2/s)
0.3850340	282.960	0.405	5.736	0.775	114.700
0.4223660	287.751	0.408	5.736	0.789	117.456
0.4579200	309.771	0.422	5.736	0.857	130.651
0.5005850	318.265	0.426	5.736	0.884	135.514
0.5343610	342.089	0.437	5.736	0.961	149.547
0.5788040	347.043	0.441	5.736	0.979	152.886
0.6143580	357.843	0.449	5.736	1.019	160.625
0.6552450	361.423	0.456	5.736	1.037	164.646
0.6943550	382.164	0.477	5.736	1.122	182.335
0.7139090	389.190	0.488	5.736	1.156	190.005
0.7654630	402.009	0.514	5.772	1.221	206.780
0.8063500	405.633	0.538	5.849	1.253	218.448
0.8472370	420.566	0.577	5.928	1.336	242.875
0.8810140	421.191	0.597	6.001	1.352	251.519
0.9201230	441.688	0.640	6.026	1.465	282.733
0.9663430	448.933	0.668	6.065	1.517	299.998
1.0001200	466.906	0.705	6.026	1.626	329.206
1.0534500	476.717	0.733	5.999	1.697	349.700
1.0818940	491.885	0.765	5.936	1.797	376.357
1.1352251	501.105	0.796	5.919	1.870	398.729
1.1707790	513.796	0.827	5.872	1.963	424.879
1.2152220	531.056	0.876	5.810	2.100	465.603
1.2525541	532.869	0.895	5.843	2.122	476.764
1.2916631	551.530	0.953	5.760	2.284	525.660
1.3414390	550.998	0.969	5.826	2.287	533.790
1.3698820	564.049	1.015	5.761	2.410	572.506
1.4196579	565.129	1.034	5.801	2.429	584.605
1.4498791	570.103	1.056	5.769	2.483	602.121
1.4943210	569.310	1.065	5.790	2.485	606.332
1.5192100	569.787	1.071	5.791	2.494	610.372
1.5672070	568.340	1.077	5.797	2.494	612.247
1.6152050	568.086	1.084	5.799	2.500	616.021
1.6596470	566.111	1.089	5.843	2.487	616.457
1.7112010	564.410	1.101	5.926	2.476	621.307
1.7396441	564.919	1.116	5.977	2.484	630.295
1.7823100	562.887	1.123	6.056	2.467	632.053
1.8196410	562.126	1.127	6.091	2.462	633.743
1.8658620	562.116	1.132	6.100	2.464	636.177
1.9067481	561.641	1.131	6.095	2.462	634.972
1.9583020	561.241	1.125	6.068	2.460	631.342
1.9814130	560.333	1.117	6.046	2.452	626.085
2.0347431	561.077	1.111	5.990	2.459	623.148
2.0685201	559.310	1.097	5.955	2.443	613.571
2.1218519	559.265	1.083	5.875	2.444	605.586
2.1502950	558.091	1.072	5.835	2.434	598.189
2.2036250	560.066	1.059	5.712	2.455	593.342
2.2427349	560.296	1.046	5.628	2.459	586.178
2.2889559	562.770	1.033	5.489	2.485	581.337
2.3333981	565.786	1.026	5.378	2.516	580.742
2.3742850	568.608	1.018	5.259	2.546	578.639
2.4116170	568.857	1.012	5.225	2.548	575.804
2.4560599	571.106	1.012	5.162	2.573	577.785
2.4862800	571.475	1.011	5.151	2.577	577.839
2.5325010	572.123	1.013	5.146	2.584	579.659
2.5609441	572.484	1.018	5.161	2.588	582.683
2.6160531	571.878	1.023	5.197	2.583	585.157
2.6516061	572.685	1.033	5.224	2.592	591.820
2.7013819	572.614	1.041	5.260	2.592	595.839
2.7316041	571.919	1.046	5.302	2.585	598.037
2.7760460	571.219	1.053	5.354	2.579	601.578
2.8062680	571.122	1.058	5.377	2.579	604.324
2.8524871	569.492	1.068	5.466	2.562	608.271

2.8898189	568.644	1.086	5.569	2.555	617.281
2.9324839	567.322	1.106	5.697	2.544	627.370
2.9715941	566.833	1.117	5.768	2.539	633.432
3.0249250	565.519	1.129	5.864	2.526	638.507
3.0480349	565.335	1.136	5.900	2.524	642.006
3.1013660	563.670	1.143	5.979	2.509	644.436
3.1262541	564.099	1.149	5.997	2.514	648.427
3.1564751	562.465	1.153	6.055	2.498	648.509
3.1884739	560.609	1.151	6.093	2.480	645.398
3.2115841	560.058	1.153	6.113	2.475	645.541
3.2524710	536.554	1.088	6.369	2.258	583.920
3.2755809	520.677	1.045	6.478	2.128	543.905
3.3093579	519.164	1.026	6.355	2.123	532.585
3.3306890	524.338	1.007	6.086	2.170	527.789
3.3555779	533.276	0.977	5.715	2.244	520.873
3.3893549	549.937	0.927	5.081	2.391	509.479
3.4177980	562.874	0.886	4.616	2.510	498.742

Table 16. Dimensional Profiles at Station 1 (Unheated Flow)

y/H-slot	U (m/s)	rho(kg/m^3)	P(psi)	Mach #	RhoXU(kg/m^2/s)
0.2556830	469.117	0.269	2.106	1.706	126.059
0.2645820	463.377	0.272	2.162	1.673	126.063
0.2681420	457.427	0.279	2.249	1.640	127.663
0.3073010	455.430	0.282	2.284	1.629	128.505
0.3482390	454.852	0.285	2.313	1.626	129.785
0.3962970	456.152	0.288	2.323	1.633	131.160
0.4390150	456.615	0.286	2.306	1.636	130.421
0.4763940	463.344	0.281	2.227	1.674	129.991
0.5119920	469.347	0.274	2.146	1.708	128.761
0.5547110	484.668	0.263	1.976	1.799	127.425
0.5974290	495.794	0.252	1.838	1.869	124.984
0.6365870	503.989	0.243	1.731	1.923	122.569
0.6864250	492.274	0.244	1.792	1.847	119.917
0.7202440	484.565	0.250	1.876	1.800	120.985
0.7736420	443.726	0.244	2.021	1.568	108.095
0.8039000	365.979	0.226	2.164	1.204	82.644
0.8572980	373.816	0.230	2.180	1.238	86.246
0.8822170	475.063	0.266	2.051	1.740	126.235
0.9373950	523.331	0.288	1.931	2.056	150.502
0.9712140	554.373	0.295	1.770	2.305	163.604
1.0246120	593.157	0.301	1.527	2.680	178.418
1.0566510	607.075	0.317	1.505	2.835	192.391
1.1064880	603.440	0.351	1.702	2.790	211.774
1.1616660	600.953	0.391	1.919	2.760	234.812
1.2008240	597.976	0.427	2.127	2.725	255.085
1.2506620	602.901	0.460	2.239	2.780	277.103
1.2951610	610.275	0.492	2.314	2.865	300.509
1.3414390	614.848	0.517	2.382	2.916	317.913
1.3823770	621.338	0.539	2.398	2.998	334.770
1.4339950	623.273	0.556	2.455	3.019	346.552
1.4838330	627.435	0.576	2.486	3.073	361.192
1.5212120	628.361	0.586	2.522	3.084	368.446
1.5692689	628.057	0.593	2.555	3.079	372.273
1.6137670	628.392	0.600	2.580	3.085	377.300
1.6636050	628.299	0.609	2.610	3.088	382.443
1.6992040	627.452	0.613	2.635	3.080	384.461
1.7472620	626.429	0.618	2.668	3.070	387.426
1.7917600	625.528	0.622	2.688	3.063	389.079
1.8309190	624.843	0.624	2.704	3.055	389.851
1.8807570	624.385	0.624	2.710	3.050	389.879
1.9181360	624.370	0.625	2.709	3.052	390.225
1.9661940	624.368	0.625	2.707	3.053	390.129
2.0000110	624.473	0.625	2.705	3.055	390.078
2.0551901	623.618	0.625	2.715	3.045	389.559
2.0890081	623.011	0.625	2.721	3.039	389.240
2.1210470	622.220	0.626	2.734	3.029	389.217
2.1548660	621.336	0.626	2.746	3.020	389.144
2.1886840	621.198	0.627	2.747	3.020	389.337
2.2367420	621.805	0.628	2.738	3.030	390.222
2.2759011	623.173	0.629	2.724	3.048	391.996
2.3150589	624.222	0.630	2.711	3.063	393.285
2.3559980	625.366	0.631	2.696	3.078	394.414
2.3951559	625.815	0.630	2.686	3.084	394.082
2.4218550	625.092	0.626	2.684	3.074	391.574
2.4645741	624.110	0.625	2.692	3.060	389.937
2.4966121	623.323	0.625	2.702	3.051	389.490
2.5393300	621.326	0.626	2.732	3.027	388.899
2.5624690	620.714	0.626	2.742	3.019	388.671
2.6034069	620.690	0.626	2.740	3.020	388.587
2.6318860	621.009	0.625	2.728	3.025	388.016
2.6585851	621.534	0.623	2.709	3.033	387.134
2.6888440	622.463	0.621	2.686	3.046	386.362

2.7137630	623.820	0.621	2.663	3.065	387.306
2.7422421	624.646	0.621	2.648	3.078	387.655
2.7671609	625.075	0.621	2.641	3.085	388.089
2.7920799	625.142	0.622	2.645	3.086	389.016
2.8187790	624.524	0.622	2.654	3.078	388.685
2.8436980	623.926	0.622	2.664	3.070	388.341
2.8668370	623.713	0.622	2.667	3.067	388.235
2.8935361	623.547	0.624	2.674	3.065	388.958
2.9184549	623.091	0.624	2.680	3.060	388.769
2.9415951	623.382	0.626	2.682	3.065	390.121
2.9771931	623.426	0.630	2.695	3.067	392.665
3.0038919	623.431	0.634	2.710	3.068	395.004
3.0305910	622.766	0.634	2.723	3.060	395.129
3.0519500	621.809	0.635	2.738	3.048	394.984
3.0786490	621.619	0.637	2.745	3.048	395.843
3.1053469	621.080	0.638	2.755	3.041	396.016
3.1373861	620.140	0.638	2.771	3.029	395.634
3.1623051	619.348	0.637	2.779	3.017	394.313
3.1854441	618.479	0.635	2.786	3.006	392.825
3.2174830	618.240	0.634	2.781	3.003	391.776
3.2424021	618.229	0.633	2.776	3.004	391.254
3.2691009	617.358	0.630	2.779	2.993	389.224
3.2922399	617.041	0.629	2.778	2.989	388.314
3.3189390	616.720	0.628	2.776	2.986	387.525
3.3474181	616.596	0.627	2.774	2.984	386.502
3.3705571	617.106	0.629	2.771	2.991	387.870
3.3990359	617.379	0.629	2.767	2.995	388.057
3.4292951	617.959	0.629	2.760	3.003	388.850
3.4631131	618.296	0.629	2.753	3.009	389.013
3.4880321	618.935	0.629	2.739	3.018	389.139
3.5182910	751.350	0.442	0.265	9.883	332.261

Table 17. Dimensional Profiles at Station 2 (Unheated Flow)

y/H-slot	U (m/s)	rho(kg/m^3)	P(psi)	Mach #	RhoXU(kg/m^2/s)
0.2856710	450.372	0.311	2.546	1.603	140.190
0.3159810	452.867	0.308	2.508	1.615	139.467
0.3516390	452.847	0.306	2.486	1.617	138.600
0.3944300	453.946	0.304	2.462	1.624	138.031
0.4300880	452.936	0.303	2.461	1.619	137.422
0.4675300	453.226	0.304	2.461	1.620	137.639
0.4942740	453.929	0.304	2.463	1.624	138.181
0.5352810	452.349	0.305	2.476	1.616	137.923
0.5691570	452.613	0.305	2.479	1.617	138.266
0.6119470	451.499	0.306	2.488	1.611	138.061
0.6369080	450.224	0.305	2.493	1.604	137.481
0.6672180	449.911	0.305	2.493	1.602	137.260
0.6975280	442.050	0.302	2.510	1.560	133.360
0.7224890	436.565	0.299	2.517	1.532	130.628
0.7634960	435.619	0.299	2.515	1.529	130.295
0.7902400	442.786	0.303	2.500	1.568	134.032
0.8294640	465.849	0.315	2.453	1.698	146.536
0.8669060	484.033	0.325	2.413	1.807	157.191
0.9096960	511.511	0.342	2.349	1.985	174.709
0.9417890	527.190	0.353	2.318	2.094	186.158
0.9756640	542.071	0.366	2.287	2.207	198.314
1.0077569	551.831	0.377	2.279	2.283	207.789
1.0327179	561.383	0.387	2.259	2.364	217.036
1.0701600	574.442	0.403	2.234	2.482	231.247
1.0951210	579.813	0.412	2.235	2.533	238.614
1.1218640	588.654	0.424	2.213	2.621	249.330
1.1628720	595.816	0.437	2.210	2.695	260.113
1.1913990	602.140	0.449	2.205	2.765	270.221
1.2288400	610.751	0.465	2.192	2.864	284.205
1.2591500	614.854	0.477	2.200	2.913	293.010
1.2965920	623.627	0.497	2.185	3.026	309.734
1.3340330	628.310	0.512	2.193	3.089	321.407
1.3607770	631.468	0.522	2.196	3.134	329.592
1.3964360	634.719	0.534	2.204	3.182	339.253
1.4231790	636.272	0.542	2.213	3.205	344.969
1.4748840	632.726	0.545	2.267	3.157	344.632
1.5034120	626.351	0.539	2.331	3.067	337.869
1.5426360	622.180	0.539	2.378	3.016	335.549
1.5782940	622.968	0.546	2.384	3.035	340.284
1.6103860	625.943	0.554	2.365	3.084	346.815
1.6496120	627.102	0.552	2.336	3.102	345.901
1.6763550	628.604	0.546	2.290	3.124	343.148
1.7102309	630.570	0.539	2.229	3.155	339.701
1.7369750	632.631	0.534	2.182	3.187	338.101
1.7601531	633.918	0.533	2.155	3.209	337.894
1.7993770	635.054	0.535	2.143	3.228	339.526
1.8207730	634.999	0.534	2.142	3.228	339.346
1.8510820	635.380	0.533	2.132	3.235	338.877
1.8813920	636.346	0.532	2.111	3.251	338.477
1.9063530	638.144	0.532	2.085	3.280	339.291
1.9330970	639.663	0.531	2.060	3.305	339.595
1.9634060	641.554	0.532	2.036	3.338	341.199
1.9883670	642.157	0.530	2.022	3.347	340.528
2.0329399	628.325	0.501	2.092	3.128	314.526
2.0632510	621.856	0.489	2.125	3.036	303.995
2.0917780	621.415	0.489	2.118	3.039	303.703
2.1203041	622.211	0.493	2.113	3.060	306.991
2.1452651	624.424	0.496	2.092	3.093	309.444
2.1702261	628.204	0.495	2.047	3.145	311.236
2.2005360	634.072	0.493	1.963	3.233	312.318
2.2272799	641.018	0.488	1.855	3.346	312.655
2.2486751	647.324	0.484	1.760	3.454	313.112

2.2807670	652.383	0.484	1.693	3.549	315.483
2.3039451	654.848	0.484	1.662	3.598	317.196
2.3289070	657.411	0.488	1.644	3.647	321.086
2.3663480	658.575	0.494	1.646	3.671	325.206
2.3930931	658.662	0.498	1.658	3.674	328.022
2.4162700	658.251	0.503	1.680	3.665	330.931
2.4447970	657.978	0.508	1.702	3.660	334.506
2.4697580	657.462	0.515	1.728	3.651	338.289
2.4947190	656.613	0.521	1.762	3.634	342.104
2.5268121	655.357	0.528	1.803	3.609	345.999
2.5535560	653.997	0.533	1.840	3.583	348.624
2.5803001	652.482	0.538	1.878	3.553	350.805
2.6034780	651.552	0.544	1.913	3.536	354.384
2.6284390	649.798	0.548	1.954	3.501	355.961
2.6551831	648.436	0.553	1.991	3.477	358.309
2.6837101	646.833	0.558	2.035	3.447	360.868
2.7211521	644.304	0.565	2.094	3.405	363.876
2.7425461	642.988	0.569	2.128	3.384	365.824
2.7710731	641.859	0.574	2.163	3.365	368.201
2.7978170	641.243	0.578	2.190	3.353	370.657
2.8209951	639.536	0.580	2.222	3.326	371.036
2.8477390	638.553	0.582	2.242	3.312	371.708
2.8727000	637.211	0.583	2.266	3.291	371.708
2.8976610	636.021	0.584	2.285	3.273	371.534
2.9190559	635.393	0.586	2.301	3.262	372.030
2.9440169	634.034	0.586	2.320	3.242	371.308
2.9671950	633.831	0.587	2.331	3.238	372.125
2.9903729	633.179	0.588	2.343	3.229	372.545
3.0171170	633.183	0.592	2.355	3.232	375.082
3.0385120	633.713	0.598	2.369	3.242	379.253
3.0652561	632.894	0.602	2.398	3.228	381.206
3.0920000	631.499	0.605	2.430	3.206	381.868
3.1223090	629.972	0.606	2.459	3.182	381.534
3.1544030	628.981	0.605	2.472	3.168	380.639
3.1847129	628.617	0.605	2.474	3.163	380.081
3.2114561	628.553	0.604	2.472	3.162	379.689
3.2346351	628.549	0.603	2.466	3.164	379.183
3.2578130	629.337	0.604	2.455	3.176	379.866
3.2863390	629.887	0.604	2.447	3.185	380.455
3.3113000	630.669	0.605	2.435	3.198	381.248
3.3344779	630.904	0.603	2.424	3.204	380.628
3.3683550	631.224	0.602	2.412	3.209	379.955
3.3933151	631.380	0.601	2.403	3.214	379.475
3.4182761	631.926	0.600	2.392	3.223	379.434
3.4450200	632.700	0.600	2.378	3.236	379.917
3.4771130	633.101	0.600	2.369	3.243	379.944
3.5056391	720.645	0.480	0.790	8.221	342.171
3.5323830	749.945	0.439	0.262	9.883	329.321

Table 18. Dimensional Profiles at Station 3 (Unheated Flow)

y/H-slot	U (m/s)	rho(kg/m^3)	P(psi)	Mach #	RhoXU(kg/m^2/s)
0.2870130	406.807	0.340	3.105	1.370	138.257
0.3063550	409.179	0.343	3.121	1.381	140.455
0.3380040	405.814	0.345	3.152	1.366	139.873
0.3608620	403.310	0.346	3.176	1.354	139.437
0.3907530	401.799	0.346	3.184	1.347	138.828
0.4136110	402.783	0.344	3.166	1.352	138.690
0.4399860	405.591	0.343	3.137	1.365	139.107
0.4628430	404.718	0.339	3.105	1.362	137.361
0.4857010	410.906	0.337	3.043	1.391	138.369
0.5155920	413.770	0.332	2.974	1.406	137.182
0.5419670	416.486	0.327	2.915	1.420	136.269
0.5718580	419.756	0.324	2.859	1.437	135.817
0.6017490	423.451	0.322	2.820	1.456	136.355
0.6263650	421.478	0.319	2.802	1.448	134.543
0.6509820	426.764	0.320	2.772	1.475	136.445
0.6773560	424.618	0.318	2.768	1.466	135.232
0.7037310	430.742	0.321	2.750	1.498	138.311
0.7248310	433.919	0.323	2.743	1.516	140.223
0.7547220	437.052	0.325	2.734	1.534	142.125
0.7846130	447.304	0.331	2.715	1.589	147.981
0.8127460	454.385	0.335	2.706	1.628	152.420
0.8408780	460.874	0.339	2.695	1.664	156.299
0.8672530	465.992	0.343	2.692	1.692	159.624
0.8901110	475.351	0.349	2.680	1.745	165.764
0.9164850	485.248	0.355	2.665	1.803	172.369
0.9446180	492.152	0.360	2.659	1.843	177.191
0.9727510	503.931	0.369	2.646	1.916	186.120
0.9973670	512.597	0.377	2.636	1.972	193.099
1.0202250	523.413	0.386	2.618	2.045	201.973
1.0501159	530.673	0.393	2.613	2.096	208.721
1.0729740	539.508	0.403	2.605	2.160	217.434
1.0993479	548.276	0.412	2.592	2.226	226.149
1.1292400	555.278	0.422	2.591	2.280	234.066
1.1503400	561.878	0.431	2.586	2.334	241.953
1.1784730	571.487	0.443	2.569	2.415	253.156
1.2066050	577.784	0.453	2.562	2.471	261.461
1.2294630	584.751	0.463	2.549	2.536	270.678
1.2558380	589.032	0.471	2.550	2.577	277.434
1.2804540	591.396	0.478	2.560	2.600	282.450
1.3050690	599.870	0.492	2.534	2.690	295.062
1.3296860	607.131	0.504	2.511	2.770	306.177
1.3595780	609.207	0.511	2.519	2.793	311.494
1.3912270	616.775	0.528	2.502	2.883	325.556
1.4140850	620.890	0.539	2.497	2.935	334.530
1.4404590	623.285	0.548	2.509	2.965	341.631
1.4668339	621.371	0.549	2.546	2.938	341.383
1.4914510	623.543	0.559	2.558	2.967	348.577
1.5213410	627.091	0.572	2.561	3.016	358.444
1.5441990	627.442	0.577	2.579	3.021	362.229
1.5705740	627.902	0.582	2.591	3.029	365.546
1.5969490	627.886	0.585	2.600	3.030	367.018
1.6215640	627.804	0.587	2.608	3.032	368.529
1.6479390	626.752	0.587	2.622	3.018	367.769
1.6760720	625.868	0.587	2.631	3.008	367.158
1.7024460	625.336	0.587	2.637	3.002	367.001
1.7270620	623.619	0.585	2.651	2.981	364.680
1.7551960	622.539	0.583	2.656	2.969	363.107
1.7868440	622.021	0.582	2.657	2.964	362.108
1.8097030	620.439	0.579	2.662	2.945	359.292
1.8431110	621.706	0.579	2.637	2.965	360.017
1.8642110	623.632	0.580	2.608	2.994	361.893
1.8941010	625.511	0.579	2.575	3.019	362.291

1.9239930	628.379	0.580	2.539	3.057	364.505
1.9521250	630.553	0.582	2.516	3.086	366.809
1.9767410	631.335	0.583	2.512	3.096	368.088
2.0048740	632.862	0.588	2.510	3.117	371.911
2.0312481	633.401	0.593	2.522	3.125	375.364
2.0558651	633.407	0.597	2.541	3.126	378.453
2.0804811	632.873	0.602	2.567	3.120	381.185
2.1050980	631.186	0.605	2.602	3.097	381.788
2.1314721	631.565	0.611	2.623	3.103	385.933
2.1560891	629.647	0.612	2.658	3.075	385.401
2.1982870	629.344	0.619	2.696	3.070	389.664
2.2229040	628.083	0.621	2.725	3.053	390.278
2.2510369	627.605	0.625	2.744	3.047	391.971
2.2738950	626.935	0.627	2.769	3.038	393.326
2.3055439	626.757	0.632	2.788	3.037	395.915
2.3284020	625.050	0.633	2.819	3.014	395.515
2.3530180	622.564	0.633	2.854	2.983	393.849
2.3811510	617.522	0.628	2.911	2.919	387.757
2.4075251	614.318	0.625	2.951	2.879	384.250
2.4321420	613.375	0.626	2.970	2.866	383.853
2.4567580	612.348	0.625	2.982	2.853	382.659
2.4848900	613.061	0.625	2.964	2.866	383.422
2.5130241	614.099	0.623	2.924	2.884	382.358
2.5393980	615.444	0.619	2.888	2.900	381.073
2.5604980	617.743	0.619	2.853	2.928	382.269
2.5833559	618.233	0.616	2.834	2.933	380.550
2.6114891	619.406	0.614	2.809	2.948	380.412
2.6361041	620.246	0.614	2.794	2.959	380.641
2.6624789	619.500	0.610	2.790	2.949	378.069
2.6888540	620.867	0.610	2.768	2.967	378.889
2.7152290	620.355	0.607	2.762	2.960	376.620
2.7416029	620.623	0.606	2.754	2.964	376.286
2.7644610	620.187	0.605	2.754	2.959	375.246
2.7890770	619.588	0.604	2.757	2.951	374.064
2.8136940	620.039	0.604	2.751	2.958	374.698
2.8365519	619.107	0.602	2.755	2.946	372.836
2.8611670	620.188	0.604	2.746	2.962	374.854
2.8893001	620.490	0.604	2.737	2.966	374.724
2.9139171	619.525	0.602	2.739	2.955	372.679
2.9438069	620.819	0.603	2.725	2.971	374.161
2.9701819	621.810	0.604	2.712	2.986	375.382
3.0000730	622.358	0.603	2.699	2.995	375.346
3.0246899	622.245	0.601	2.692	2.993	374.150
3.0493050	622.889	0.602	2.683	3.003	374.899
3.0774381	622.580	0.600	2.682	2.998	373.790
3.1020551	623.136	0.600	2.673	3.006	374.161
3.1266720	623.197	0.601	2.676	3.007	374.760
3.1530449	622.511	0.601	2.683	2.999	374.260
3.1794200	622.918	0.604	2.686	3.006	376.167
3.2022779	622.125	0.604	2.698	2.995	375.493
3.2304111	622.664	0.607	2.702	3.003	377.744
3.2585430	620.921	0.605	2.722	2.980	375.860
3.2814009	620.102	0.607	2.740	2.970	376.251
3.3165669	618.950	0.606	2.754	2.955	375.121
3.3429420	756.920	0.420	0.255	9.883	317.780
3.3710749	756.869	0.420	0.255	9.883	318.156
3.3956900	756.768	0.421	0.256	9.883	318.732
3.4203069	756.768	0.418	0.254	9.883	316.362

Table 19. Dimensional Profiles at Station 4 (Unheated Flow)

y/H-slot	U (m/s)	rho(kg/m^3)	P(psi)	Mach #	RhoXU(kg/m^2/s)
0.2724930	426.280	0.312	2.740	1.465	133.148
0.2654190	431.571	0.316	2.742	1.491	136.339
0.2654190	436.998	0.317	2.723	1.519	138.700
0.2866400	441.828	0.319	2.710	1.544	141.121
0.3149340	443.075	0.320	2.707	1.551	141.863
0.3379230	443.251	0.321	2.709	1.552	142.110
0.3715220	448.401	0.324	2.699	1.580	145.094
0.4104260	452.675	0.327	2.695	1.604	147.921
0.4581720	459.718	0.332	2.683	1.645	152.458
0.4988440	461.722	0.335	2.686	1.659	154.641
0.5536640	472.666	0.344	2.669	1.727	162.563
0.5961050	477.307	0.349	2.663	1.759	166.724
0.6403140	485.261	0.358	2.652	1.814	173.516
0.7022070	495.149	0.367	2.631	1.881	181.553
0.7340380	504.763	0.375	2.609	1.947	189.155
0.7853200	513.476	0.383	2.594	2.009	196.712
0.8330660	527.823	0.395	2.555	2.113	208.683
0.8648970	533.036	0.401	2.550	2.151	213.680
0.9179480	547.707	0.416	2.514	2.267	227.606
0.9603890	553.161	0.423	2.513	2.309	233.875
1.0045980	567.502	0.440	2.478	2.434	249.808
1.0576490	579.889	0.456	2.448	2.548	264.645
1.0983220	583.745	0.465	2.463	2.582	271.444
1.1513730	598.888	0.490	2.429	2.739	293.667
1.1991190	606.192	0.508	2.430	2.821	307.954
1.2433280	609.320	0.523	2.463	2.858	318.560
1.2893060	618.454	0.544	2.449	2.968	336.577
1.3264420	623.999	0.561	2.454	3.037	350.003
1.3724190	628.982	0.580	2.465	3.105	364.681
1.4148600	629.491	0.594	2.514	3.114	373.826
1.4661430	631.782	0.610	2.544	3.149	385.285
1.4979740	630.453	0.613	2.578	3.129	386.451
1.5527940	631.084	0.621	2.597	3.141	391.953
1.6023070	629.137	0.621	2.625	3.114	390.595
1.6394430	626.497	0.621	2.659	3.081	388.970
1.6606640	623.904	0.617	2.681	3.046	384.832
1.6889580	620.886	0.612	2.703	3.007	380.014
1.7137150	621.316	0.613	2.696	3.016	380.897
1.7455450	619.838	0.609	2.698	2.997	377.374
1.7667660	619.808	0.607	2.685	2.999	376.131
1.7950600	621.184	0.607	2.658	3.021	376.891
1.8251220	622.476	0.605	2.625	3.043	376.863
1.8463430	624.887	0.606	2.583	3.082	378.953
1.8746370	627.142	0.608	2.548	3.118	381.190
1.9011620	629.144	0.609	2.516	3.149	382.909
1.9259191	631.525	0.612	2.490	3.187	386.415
1.9542140	632.317	0.612	2.477	3.199	386.875
1.9807390	633.970	0.615	2.465	3.223	389.837
2.0143380	634.518	0.617	2.466	3.230	391.336
2.0373261	635.434	0.620	2.464	3.245	394.036
2.0638530	635.351	0.623	2.478	3.243	395.959
2.0974519	636.107	0.629	2.488	3.255	400.087
2.1292820	636.139	0.634	2.508	3.255	403.306
2.1593440	636.683	0.640	2.524	3.265	407.737
2.1894059	635.883	0.645	2.556	3.252	410.345
2.2230051	633.868	0.649	2.605	3.222	411.692
2.2530680	631.116	0.653	2.667	3.179	412.150
2.2778251	628.500	0.655	2.719	3.140	411.703
2.3025820	624.912	0.656	2.782	3.090	410.152
2.3291080	619.313	0.651	2.853	3.012	403.310
2.3556340	616.892	0.652	2.898	2.979	402.319
2.3803899	615.104	0.653	2.931	2.956	401.945

2.4104531	613.319	0.654	2.961	2.933	401.030
2.4352109	613.614	0.656	2.967	2.937	402.711
2.4599669	613.701	0.654	2.956	2.938	401.259
2.4900301	616.286	0.655	2.916	2.974	403.843
2.5200920	617.792	0.651	2.866	2.998	402.372
2.5448489	619.526	0.648	2.814	3.026	401.439
2.5784490	620.786	0.645	2.773	3.046	400.197
2.6032050	622.306	0.642	2.739	3.067	399.530
2.6314991	623.840	0.641	2.713	3.086	399.913
2.6597929	624.943	0.639	2.690	3.100	399.341
2.6880870	624.633	0.636	2.682	3.095	397.051
2.7128439	626.077	0.637	2.666	3.116	398.978
2.7393701	625.639	0.634	2.661	3.109	396.867
2.7676640	625.718	0.633	2.655	3.111	396.302
2.7888839	626.315	0.633	2.647	3.119	396.739
2.8136411	625.401	0.632	2.652	3.106	394.974
2.8419361	626.158	0.633	2.647	3.118	396.619
2.8666930	625.085	0.631	2.654	3.102	394.504
2.8949859	625.330	0.633	2.656	3.108	395.882
2.9197431	625.264	0.633	2.654	3.107	395.603
2.9498050	624.615	0.632	2.659	3.099	394.553
2.9763310	625.338	0.633	2.650	3.110	395.687
3.0010879	624.323	0.630	2.654	3.096	393.329
3.0311501	623.744	0.629	2.656	3.089	392.139
3.0541401	624.888	0.631	2.644	3.106	394.135
3.0859711	625.465	0.631	2.635	3.115	394.595
3.1178010	625.212	0.630	2.633	3.113	393.994
3.1443260	625.127	0.630	2.634	3.112	393.936
3.1708529	625.567	0.631	2.628	3.119	394.678
3.1956100	625.789	0.631	2.624	3.125	395.117
3.2203660	625.287	0.632	2.632	3.118	394.943
3.2468920	626.156	0.634	2.629	3.131	397.272
3.2751870	625.524	0.634	2.635	3.122	396.316
3.2981751	623.867	0.631	2.650	3.098	393.530
3.3211629	624.018	0.632	2.651	3.101	394.423
3.3494580	623.695	0.632	2.654	3.097	394.058
3.3742149	622.218	0.629	2.666	3.076	391.492

Table 20. Dimensional Profiles at Station 4 (Unheated Flow, Shock)

y/H-slot	U (m/s)	rho(kg/m^3)	P(psi)	Mach #	RhoXU(kg/m^2/s)
0.2724930	257.706	0.441	5.026	0.785	113.735
0.2671880	257.671	0.441	5.026	0.785	113.750
0.2760300	288.923	0.465	5.026	0.895	134.317
0.2990180	300.880	0.472	5.026	0.939	142.020
0.3273120	306.876	0.475	5.026	0.961	145.939
0.3573750	314.588	0.480	5.026	0.990	151.088
0.4086570	321.434	0.484	5.026	1.015	155.639
0.4457930	328.103	0.488	5.026	1.041	160.126
0.5006130	339.610	0.495	5.026	1.085	168.283
0.5430540	350.148	0.503	5.026	1.128	176.310
0.5943360	362.806	0.514	5.026	1.181	186.527
0.6456190	375.018	0.528	5.055	1.234	198.132
0.6898280	383.805	0.543	5.107	1.274	208.373
0.7375740	397.692	0.564	5.162	1.338	224.317
0.7800150	407.016	0.578	5.187	1.383	235.171
0.8224560	421.249	0.599	5.226	1.452	252.501
0.8755070	438.694	0.623	5.227	1.541	273.260
0.9161800	454.139	0.643	5.208	1.624	291.899
0.9639260	474.270	0.667	5.157	1.736	316.326
0.9975250	489.721	0.688	5.115	1.829	337.192
1.0488080	508.460	0.716	5.057	1.948	364.238
1.0965540	529.542	0.751	4.987	2.092	397.702
1.1425320	540.274	0.774	4.976	2.169	418.078
1.1867400	557.984	0.813	4.915	2.309	453.427
1.2291811	568.205	0.838	4.888	2.394	475.913
1.2663170	578.871	0.870	4.871	2.490	503.722
1.3211370	588.123	0.899	4.851	2.577	528.699
1.3582730	588.293	0.909	4.916	2.576	535.060
1.4060190	593.244	0.928	4.920	2.622	550.577
1.4378500	593.019	0.932	4.959	2.617	552.979
1.4891320	592.741	0.934	4.987	2.611	553.883
1.5191950	591.698	0.935	5.001	2.605	553.492
1.5757819	591.337	0.936	4.990	2.606	553.321
1.6129180	591.359	0.937	4.980	2.611	554.174
1.6588960	590.945	0.937	4.968	2.612	553.473
1.6783470	590.708	0.937	4.961	2.613	553.385
1.7243249	590.329	0.936	4.958	2.610	552.363
1.7508510	591.121	0.938	4.947	2.620	554.491
1.7791440	590.338	0.937	4.954	2.613	552.961
1.8127440	590.017	0.936	4.955	2.610	552.319
1.8375010	590.310	0.937	4.952	2.613	553.004
1.8604890	590.341	0.937	4.949	2.614	552.869
1.8923200	589.563	0.935	4.957	2.606	551.218
1.9206140	588.991	0.934	4.959	2.601	549.980
1.9471400	588.952	0.933	4.955	2.601	549.457
1.9789710	588.096	0.930	4.959	2.593	547.074
2.0037270	586.988	0.927	4.967	2.582	544.412
2.0497050	586.400	0.923	4.951	2.577	541.180
2.0779991	587.091	0.921	4.925	2.584	540.595
2.1292820	586.370	0.912	4.889	2.577	534.553
2.1558070	587.607	0.908	4.841	2.590	533.495
2.2035539	587.807	0.900	4.792	2.593	529.049
2.2318470	589.304	0.898	4.743	2.609	529.066
2.2672150	588.985	0.892	4.716	2.607	525.314
2.2955079	590.529	0.891	4.677	2.624	526.408
2.3238029	591.958	0.891	4.641	2.639	527.221
2.3485601	592.542	0.889	4.620	2.646	526.950
2.3803899	593.279	0.888	4.595	2.655	526.801
2.4069159	594.639	0.888	4.566	2.669	527.978
2.4387469	595.593	0.888	4.545	2.680	528.997
2.4670410	595.492	0.886	4.539	2.678	527.622
2.4935660	596.645	0.889	4.525	2.691	530.268

2.5147870	596.905	0.888	4.516	2.695	530.327
2.5430810	597.388	0.889	4.507	2.700	530.875
2.5696070	597.526	0.890	4.507	2.702	531.556
2.5996690	597.313	0.890	4.511	2.700	531.487
2.6244249	597.852	0.892	4.511	2.706	533.545
2.6509521	597.972	0.894	4.519	2.707	534.659
2.6792450	597.524	0.897	4.540	2.703	535.957
2.7093070	597.235	0.901	4.567	2.700	538.135
2.7340641	596.361	0.905	4.607	2.691	539.948
2.7588220	595.629	0.910	4.646	2.683	541.978
2.7906530	593.869	0.918	4.728	2.663	545.169
2.8224831	592.090	0.932	4.840	2.644	551.685
2.8543141	592.458	0.946	4.899	2.650	560.401
2.8896811	592.076	0.960	4.973	2.648	568.330
2.9232800	591.295	0.968	5.028	2.640	572.231
2.9480381	591.247	0.975	5.066	2.640	576.236
2.9727950	590.656	0.978	5.102	2.633	577.869
3.0028570	589.721	0.983	5.147	2.624	579.901
3.0258460	589.800	0.988	5.168	2.625	582.961
3.0523720	589.519	0.992	5.197	2.621	584.696
3.0842021	588.700	0.996	5.241	2.613	586.637
3.1089590	587.876	0.999	5.275	2.604	587.477
3.1390209	588.079	1.006	5.302	2.607	591.554
3.1708529	587.990	1.012	5.335	2.606	594.951
3.1956100	587.629	1.016	5.366	2.603	597.234
3.2239029	586.615	1.019	5.403	2.593	597.679
3.2468920	586.840	1.025	5.425	2.596	601.305
3.2698810	586.344	1.030	5.459	2.592	603.711
3.2999430	585.267	1.034	5.506	2.581	605.106
3.3229320	581.030	1.029	5.588	2.538	597.839
3.3459210	569.997	1.009	5.740	2.434	575.512
3.3689101	560.747	0.993	5.861	2.350	557.178
3.3989730	755.042	0.532	0.322	9.883	402.059
3.4237289	755.042	0.528	0.319	9.883	398.339

Table 21. Dimensional Temperature Profiles in K (Unheated Flow)

y/h-slot	stat. 1	stat. 2	stat. 3	stat. 4	stat. 4 with shock
0.2513531	298.021	297.860	302.600	301.395	301.154
0.2513531	298.021	297.780	302.439	301.395	301.154
0.2530442	298.021	297.780	302.359	301.475	301.154
0.2513531	298.021	297.780	302.359	301.475	301.073
0.2513531	298.021	297.780	302.279	301.395	301.073
0.2513531	297.940	297.699	302.198	301.475	301.073
0.2564260	297.940	297.699	302.118	301.315	300.993
0.2919355	297.940	297.619	302.118	301.234	301.073
0.3189904	297.940	297.458	302.038	301.073	300.913
0.3325179	297.940	297.378	301.957	301.073	300.993
0.3680274	297.860	297.217	301.797	300.752	300.913
0.3883186	297.940	297.217	302.038	300.591	300.993
0.4086098	297.860	297.217	301.877	300.431	301.073
0.4407376	297.860	297.137	301.877	300.029	301.154
0.4593378	297.780	297.217	301.556	299.547	301.234
0.4762472	297.699	297.137	301.395	299.145	301.315
0.5117567	297.699	297.217	301.073	298.663	301.154
0.5320478	297.699	297.217	300.752	297.940	301.073
0.5489571	297.699	297.217	300.431	297.458	300.913
0.5827757	297.699	297.217	300.109	296.735	300.591
0.6047579	297.699	297.217	299.788	296.173	300.431
0.6216673	297.619	297.378	299.467	295.610	300.109
0.6605586	297.619	297.378	298.985	295.128	299.868
0.6808500	297.619	297.378	298.583	294.727	299.467
0.6994501	297.539	297.137	298.101	294.486	299.145
0.7349596	297.619	296.815	297.619	294.164	298.744
0.7535598	297.378	296.333	297.137	294.164	298.422
0.7721601	297.780	295.771	296.896	294.084	298.181
0.8076696	298.101	295.450	296.815	294.164	298.021
0.8245790	298.181	295.369	296.896	294.164	297.699
0.8448702	297.940	295.530	297.137	294.486	297.699
0.8820707	297.940	295.851	297.378	294.727	297.780
0.8939071	297.699	296.333	297.780	294.887	297.619
0.9175802	297.378	296.655	298.262	295.209	297.619
0.9564717	297.217	296.976	298.744	295.369	297.860
0.9716901	297.378	297.378	299.145	295.610	298.101
0.9919812	297.780	297.539	299.627	295.932	298.422
1.0274910	297.940	297.780	299.949	296.333	298.342
1.0393270	297.940	298.021	300.270	296.655	298.904
1.0646909	297.860	298.262	300.832	296.896	299.306
1.1035830	297.940	298.262	301.395	297.378	299.788
1.1154190	297.860	298.663	301.716	297.619	300.109
1.1424741	297.940	298.824	302.118	297.860	300.350
1.1762930	298.101	299.065	302.439	298.021	300.511
1.1915110	298.262	299.226	302.680	298.262	301.154
1.2168750	298.422	299.467	303.002	298.262	301.395
1.2523850	298.663	299.547	303.082	298.663	301.475
1.2642210	299.065	299.708	303.082	298.904	301.716
1.2895850	299.306	299.788	303.323	299.145	302.279
1.3217130	299.386	299.788	303.403	299.226	302.279
1.3352400	299.547	299.788	303.484	299.306	302.520
1.3656770	299.868	299.708	303.403	299.226	302.761
1.3978050	299.868	299.547	303.564	299.145	302.921
1.4096410	299.949	299.386	303.644	299.145	303.323
1.4400780	300.109	299.226	303.644	298.985	303.403
1.4705150	300.109	298.824	303.644	299.065	303.564
1.4823509	300.109	298.422	303.564	299.065	302.921
1.5144790	300.029	297.940	303.484	298.904	302.600
1.5432251	299.949	297.780	303.403	298.824	302.279
1.5550610	299.788	297.699	303.243	298.744	302.038
1.5854980	299.627	297.619	303.162	298.663	301.797
1.6142440	299.467	297.297	302.921	298.422	301.475

1.6277720	299.306	297.619	302.921	298.342	301.234
1.6598990	299.226	297.378	302.761	298.181	301.073
1.6903360	298.904	297.217	302.680	298.021	300.993
1.7038640	298.663	297.217	302.600	297.940	300.913
1.7376820	298.663	297.217	302.359	297.780	300.832
1.7630460	298.503	297.137	302.198	297.539	300.752
1.7799550	298.503	297.137	301.957	297.297	300.672
1.8120830	298.422	297.056	301.797	297.056	300.672
1.8391380	298.422	297.056	301.797	296.735	300.591
1.8526660	298.342	297.056	301.877	296.574	300.752
1.8847930	298.422	297.056	302.038	296.414	300.511
1.9101570	298.342	296.976	302.118	296.414	300.511
1.9287580	298.262	297.056	302.198	296.574	300.431
1.9608850	298.181	297.137	302.118	296.655	300.350
1.9845580	298.021	296.494	302.118	296.655	300.350
2.0048490	297.860	295.851	301.957	296.655	300.350
2.0335951	297.780	295.691	301.877	296.735	300.270
2.0572679	297.699	295.932	301.877	296.896	300.190
2.0758691	297.539	296.012	301.877	296.735	300.190
2.1079960	297.539	296.092	301.957	296.655	300.190
2.1299779	297.458	296.173	301.957	296.655	300.109
2.1519599	297.539	296.173	301.957	296.494	300.109
2.1840880	297.539	296.173	301.877	296.574	300.109
2.2060699	297.539	296.173	301.797	296.574	299.949
2.2263610	297.539	296.173	301.716	296.494	299.949
2.2584889	297.619	296.173	301.716	296.414	299.788
2.2787800	297.619	296.173	301.556	296.414	299.788
2.3007619	297.619	296.092	301.395	296.333	299.788
2.3278170	297.699	296.092	301.475	296.253	299.788
2.3514900	297.539	296.012	301.475	296.253	299.788
2.3717811	297.539	296.012	301.475	296.253	299.708
2.4005280	297.378	296.092	301.234	296.253	299.788
2.4208190	297.217	295.932	300.672	296.092	299.708
2.4444921	297.217	296.012	300.752	295.932	299.708
2.4732370	297.137	296.012	300.913	295.610	299.627
2.4952199	297.056	296.092	301.073	295.450	299.627
2.5188930	296.976	296.092	301.073	295.450	299.547
2.5442560	297.056	296.092	301.073	295.530	299.547
2.5662391	296.976	295.932	301.073	295.610	299.627
2.5865300	296.976	295.932	301.073	295.691	299.547
2.6102030	296.976	295.851	301.073	295.851	299.547
2.6321850	296.896	295.771	301.073	295.851	299.547
2.6524761	296.896	295.851	301.073	295.851	299.547
2.6778400	296.815	295.771	300.993	295.851	299.547
2.7015131	296.815	295.610	300.993	295.851	299.467
2.7234950	296.735	295.691	300.913	295.851	299.467
2.7488589	296.735	295.610	300.913	295.771	299.306
2.7725320	296.655	295.530	300.832	295.691	299.145
2.7945149	296.574	295.530	300.752	295.610	299.065
2.8215699	296.494	295.450	300.672	295.530	299.065
2.8384790	296.494	295.450	300.672	295.530	299.145
2.8638430	296.414	295.289	300.591	295.450	299.145
2.8858249	296.333	295.209	300.591	295.369	299.145
2.9094980	296.173	295.209	300.511	295.369	299.065
2.9314799	296.012	295.610	300.511	295.289	299.065
2.9619169	296.012	295.289	300.431	295.289	299.065
2.9838991	295.932	295.289	300.431	295.209	299.065
3.0075719	295.932	295.209	300.431	295.209	298.985
3.0329361	295.932	295.128	300.431	295.048	298.985
3.0566089	295.932	295.128	300.270	295.048	298.985
3.0802820	295.851	295.048	300.109	294.968	298.904
3.1056459	295.851	294.968	300.190	294.968	298.824
3.1276281	295.771	294.968	300.190	294.887	298.824
3.1529920	295.691	294.887	300.109	294.887	298.744
3.1800470	295.771	294.807	300.109	294.887	298.663
3.2020290	295.691	294.727	299.868	294.727	298.663

3.2290840	295.691	294.646	300.029	294.807	298.663
3.2561390	295.691	294.566	299.949	294.727	298.503
3.2747390	295.610	294.646	299.949	294.646	298.503
3.3051760	295.610	294.566	299.868	294.646	298.503
3.3322310	295.691	294.566	299.868	294.486	298.422
3.3525219	295.691	294.486	299.788	294.486	298.744
3.3795769	295.610	294.405	299.788	294.325	299.065
3.3981769	295.530	294.405	299.708	294.325	298.744
3.4286139	295.450	294.325	299.627	294.325	297.860
3.4556689	295.369	294.325	299.547	294.245	297.137
3.4810331	295.289	294.245	299.627	294.245	296.655
3.5047059	295.209	294.084	299.467	294.164	296.896
3.5334520	295.209	294.084	299.145	294.164	297.137

Table 22. Dimensional Temperature Profiles in K (Heated Flow)

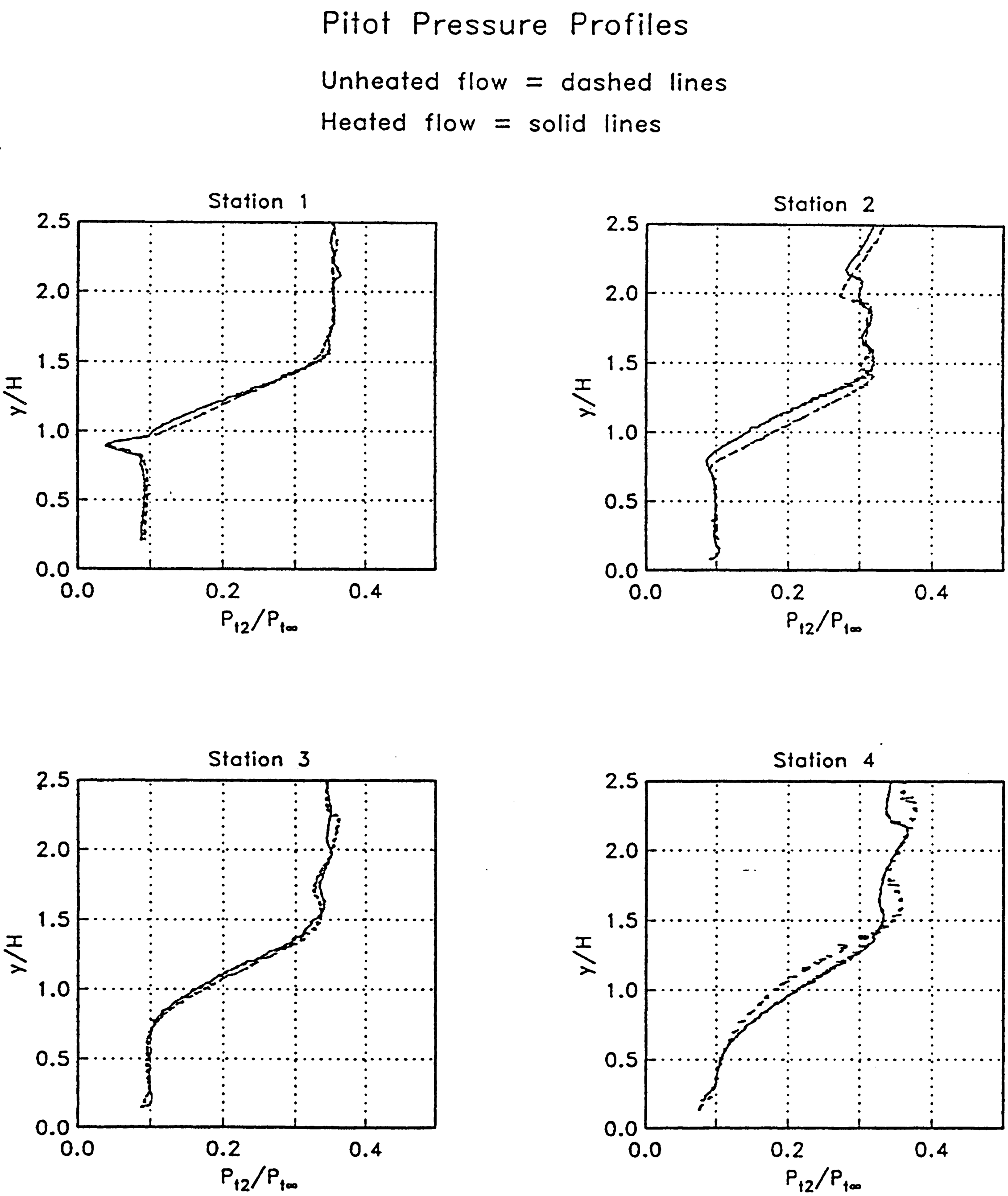
y/h-slot	stat. 1	stat. 2	stat. 3	stat. 4	stat. 4 with shock
0.2391348	397.494	386.209	393.786	375.326	369.925
0.2408069	397.817	386.854	394.512	375.729	370.167
0.2408069	398.220	387.257	395.076	375.971	370.490
0.2408069	398.703	387.660	394.108	376.374	370.651
0.2408069	399.026	388.063	393.947	376.777	371.134
0.2408069	399.268	388.466	394.834	377.100	371.538
0.2408069	399.671	388.788	395.398	377.583	371.699
0.2424788	399.913	389.272	394.431	377.825	372.021
0.2525114	400.154	389.997	394.431	377.583	372.505
0.2809367	400.477	390.884	394.915	376.535	372.988
0.3026737	400.960	392.577	395.237	375.084	373.311
0.3310992	401.041	394.270	395.479	372.908	373.553
0.3545082	401.444	395.237	396.204	370.328	373.795
0.3762452	401.363	395.479	397.091	366.459	373.392
0.3996543	401.122	395.801	397.655	362.348	372.666
0.4247356	401.041	396.043	397.575	357.511	371.296
0.4448005	401.283	396.527	397.172	352.594	369.442
0.4715539	401.605	397.010	397.010	347.919	366.701
0.4949630	402.169	397.575	396.688	343.082	362.993
0.5183720	402.734	398.139	396.527	338.004	359.607
0.5434532	403.056	398.784	395.560	333.167	355.415
0.5668624	403.943	399.429	394.431	328.733	351.063
0.5885996	404.749	399.913	392.577	324.864	346.145
0.6120085	405.475	400.235	390.159	321.317	341.147
0.6370898	405.878	400.557	387.418	318.173	336.714
0.6588268	406.120	400.396	384.758	315.513	332.361
0.6822357	406.120	399.429	380.647	312.934	328.330
0.7039727	406.281	397.575	377.261	310.838	324.945
0.7290540	405.797	393.947	371.457	309.145	321.559
0.7558072	405.152	388.305	365.895	307.533	318.577
0.7792165	403.943	379.921	359.688	306.082	315.916
0.8009535	402.089	370.006	351.627	304.631	312.853
0.8277067	399.832	359.849	346.790	303.583	310.757
0.8410833	394.108	350.418	339.938	302.454	308.661
0.8728527	382.823	342.195	336.150	301.487	306.727
0.8979339	369.361	335.182	334.296	300.600	305.195
0.9213432	356.786	329.459	330.991	299.633	303.664
0.9414080	345.420	324.784	328.814	298.908	302.374
0.9681612	335.505	320.995	323.091	298.021	301.326
0.9898982	328.250	318.254	318.173	297.376	299.955
1.0149800	323.091	315.997	315.836	296.731	299.069
1.0434051	319.141	313.982	312.370	296.005	298.101
1.0684860	315.836	312.450	309.790	295.522	297.053
1.0902230	313.095	311.241	309.467	295.119	296.570
1.1153049	311.080	310.032	308.661	294.555	295.844
1.1387130	309.145	309.145	306.162	294.232	295.280
1.1637950	307.452	308.258	304.067	293.668	294.555
1.1905479	306.001	307.372	304.631	293.023	294.151
1.2156290	304.873	306.485	302.696	292.378	293.668
1.2373660	303.744	305.518	301.003	291.814	293.184
1.2624470	302.857	304.711	299.955	291.250	292.620
1.2908731	301.890	303.905	298.908	290.927	292.056
1.3126100	301.003	302.938	297.860	290.443	291.491
1.3427070	300.117	302.212	296.973	290.040	290.685
1.3677880	299.311	301.326	296.086	289.557	290.121
1.3911980	298.585	300.439	295.199	289.234	289.557
1.4179510	297.860	299.230	296.005	288.670	289.154
1.4430320	297.134	298.343	295.199	288.025	288.751
1.4647690	296.489	297.618	294.393	287.703	288.428
1.4931940	295.603	297.295	293.668	287.300	288.186
1.5182760	294.958	297.134	293.587	286.977	288.025
1.5400130	294.232	296.892	293.184	286.816	287.783

1.5684381	293.587	296.328	292.297	286.735	287.622
1.5918469	292.781	296.005	291.411	286.413	287.461
1.6169280	292.297	296.005	290.282	286.171	287.300
1.6453530	291.411	296.086	289.798	286.090	287.138
1.6670901	290.685	296.005	288.992	286.332	286.897
1.6905000	290.363	295.441	288.509	286.413	286.816
1.7189250	289.798	294.958	288.589	286.493	286.655
1.7423340	289.476	294.555	288.025	286.493	286.493
1.7657430	289.315	294.393	287.864	286.655	286.574
1.7924970	289.234	294.071	288.106	286.332	286.493
1.8192500	289.315	293.587	288.912	286.413	286.493
1.8443310	289.234	293.345	289.073	286.332	286.413
1.8727560	289.234	293.103	288.751	286.252	286.332
1.8944930	288.992	293.023	288.267	286.252	286.252
1.9212470	288.670	293.103	288.025	286.090	286.252
1.9496720	288.509	293.265	287.622	285.929	286.010
1.9714090	288.267	293.507	287.058	285.768	285.929
1.9981620	287.864	293.184	286.735	285.607	285.849
2.0249159	287.541	292.942	286.574	285.526	285.768
2.0499971	287.300	292.942	286.413	285.284	285.607
2.0750780	287.058	293.023	286.171	285.043	285.526
2.1051750	286.816	293.023	285.929	285.043	285.445
2.1269121	286.493	292.942	285.526	284.881	285.445
2.1553380	286.171	292.781	285.445	284.801	285.284
2.1804190	286.010	292.781	285.204	284.639	285.123
2.2021561	285.929	292.620	285.043	284.639	285.284
2.2289090	285.929	292.539	284.801	284.398	285.204
2.2556629	285.929	292.459	284.720	284.156	285.204
2.2774000	285.929	292.217	284.478	284.075	285.123
2.3041530	285.849	292.056	284.317	284.075	285.123
2.3275621	285.526	292.056	284.398	283.995	285.123
2.3543150	285.365	291.652	284.236	283.914	285.123
2.3810680	285.204	291.491	283.995	283.914	284.962
2.4061501	285.043	291.330	283.995	283.753	284.962
2.4312310	284.881	291.169	283.995	283.672	284.881
2.4563119	284.639	291.088	283.833	283.753	284.881
2.4813931	284.478	291.008	283.753	283.591	284.801
2.5014579	284.398	290.846	283.914	283.511	284.801
2.5298841	284.317	290.605	283.914	283.430	284.801
2.5516210	284.075	290.605	283.672	283.350	284.639
2.5750301	283.995	290.363	283.914	283.350	284.639
2.6017830	283.995	290.202	283.753	283.269	284.639
2.6268640	283.672	290.121	283.511	283.269	284.559
2.6486011	283.672	289.960	282.302	283.189	284.398
2.6753540	283.350	289.718	282.302	283.108	284.236
2.6987641	283.511	289.557	282.302	282.302	284.075
2.7188280	283.591	289.476	282.302	282.302	284.075
2.7455821	283.511	289.476	282.302	282.302	284.156
2.7689910	283.430	289.315	282.302	282.302	284.156
2.7907281	283.350	289.154	282.302	282.302	284.075
2.8174810	283.108	289.154	282.302	282.302	283.995
2.8425620	282.302	289.154	282.302	282.302	283.995
2.8642991	282.302	289.073	282.141	282.302	283.914
2.8927250	282.302	288.992	282.221	282.302	283.833
2.9144621	282.302	288.831	282.060	282.302	283.914
2.9378710	282.302	288.751	281.899	282.302	283.833
2.9646239	282.302	288.831	281.818	282.302	283.833
2.9863610	282.302	288.509	281.657	282.302	284.398
3.0097711	282.302	288.670	281.496	282.221	283.995
3.0331790	282.302	288.509	281.576	282.302	283.189
3.0565889	282.221	288.428	281.576	282.141	282.302
3.0766530	282.060	288.267	281.496	282.060	282.302
3.1034069	281.979	288.186	281.415	281.979	282.302
3.1284881	281.737	288.106	281.415	281.979	283.027
3.1518970	281.818	288.025	281.334	281.979	283.108
3.1753061	281.737	287.944	281.334	281.899	283.027

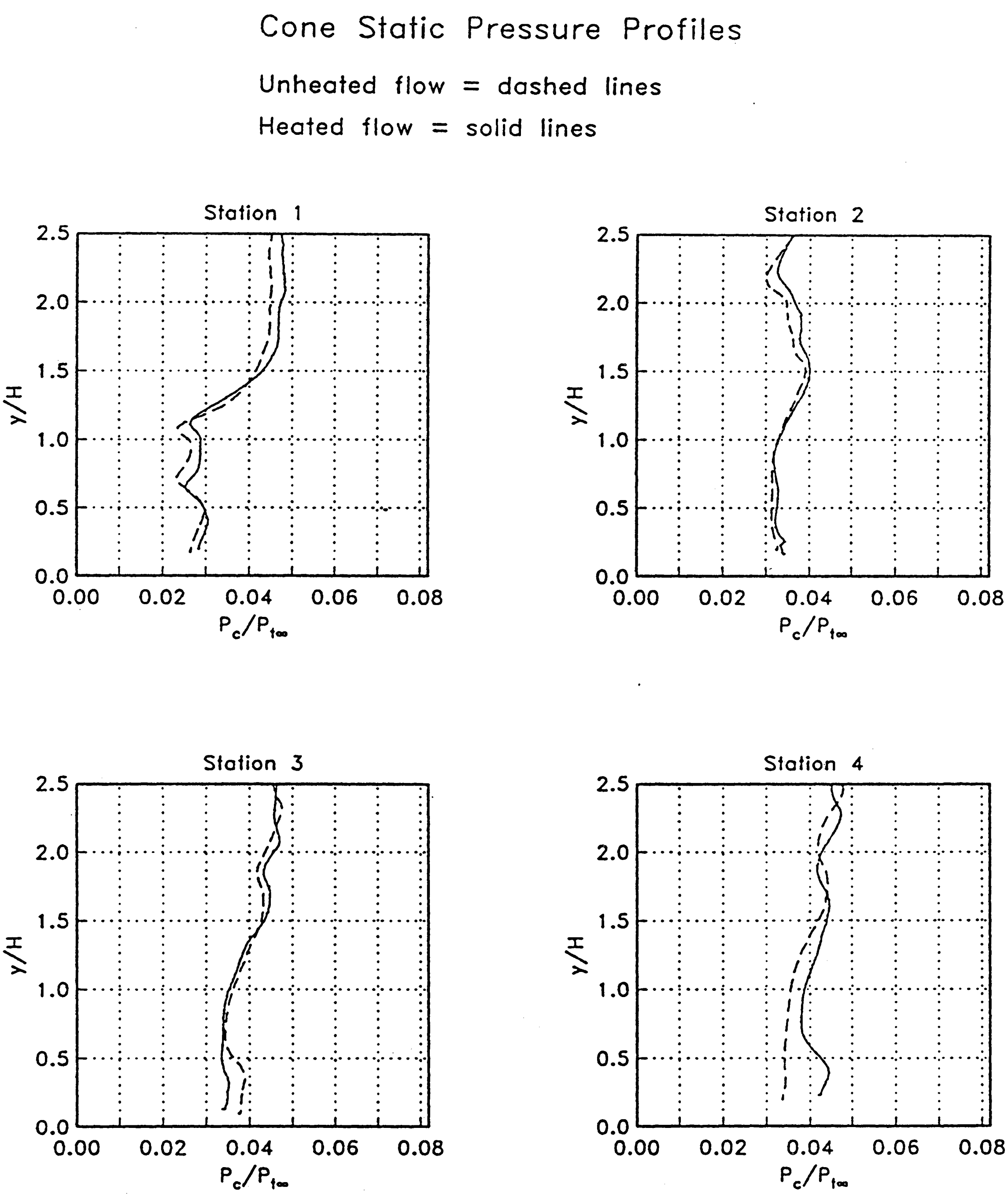
APPENDIX D

Pitot and Cone Static Pressure Profiles

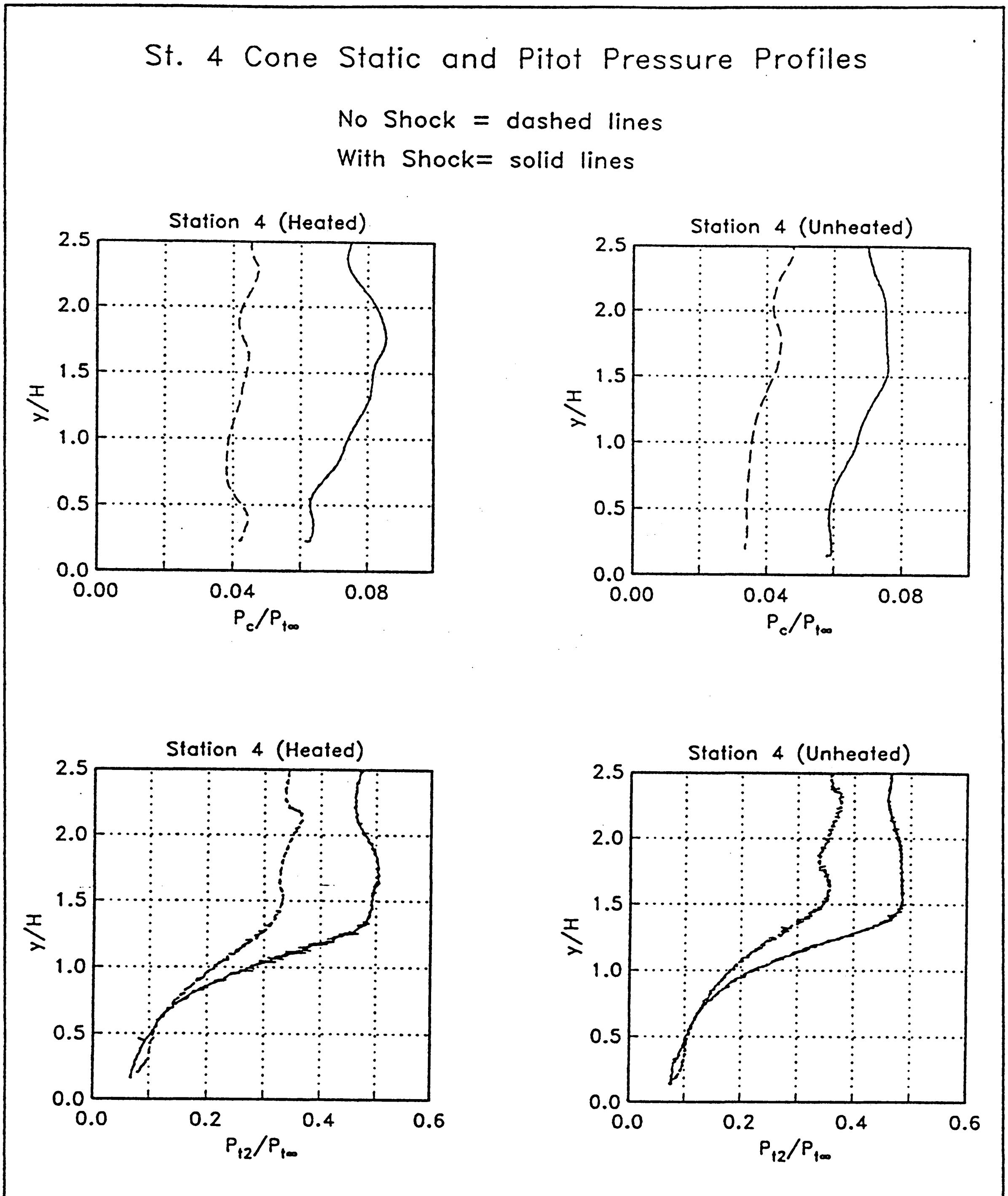
The mean flow profiles are derived from cone static and Pitot pressure measurements in conjunction with the stagnation temperature measurements. The Pitot and cone static profiles used in the data reduction are presented in this Appendix.



Pitot Pressure Profiles



Cone Static Pressure Profiles



Pitot and Cone Static Profiles at Station 4

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Tables

Table 1: Survey of Previous Work								
Authors	Ref No	Date	M_1	M_j	Gas	Profiles	Flow Vis .	Notes
Visich & Libby	9	1960	3.95	0-0.44	Air	P_{t2}	Schlieren	Flow not very uniform in x-direction
McRee, et. al.	7	1964	3.0	< 1	Air	P_{t2}, U	none	Pourous and Flush slot injection
Peake	10	1966	1.8	2.37	Air	P_{t2}, U	Schlieren	Profiles after shock interaction
Goldstein, et. al.	1	1966	3.01	< 1	Air/He	none	Schlieren	Varied many parameters
Peterson, et. al.	5	1966	3.0	< 1	Air	P_{t2}, U	none	Wall pressures
Howell & Tatro	11	1966	3.2 & 4.2	3.0	Air	M	none	Profiles after shock interaction
Schetz & Gilreath	12	1967	2.1	< 1	Air	ρ	Schlieren interferometer	Concerned with transition
Gilreath & Schetz	13	1971	2.85 & 4.19	< 1 & 1.98	Air	ρ	Schlieren interferometer	Supersonic, underexpanded
Waltrup & Schetz	14	1972	2.85	< 1	Air,He & CO_2	none	Schlieren	Wall pressures
Cary & Hefner	4	1972	6.0	< 1	Air	none	none	T_{t2} & U profiles in slot
Kenworthy & Schetz	15	1973	2.37	0.31 & 0.66	Air	M	Schlieren	Profiles for entire flowfield
Campbell	8	1987	2.93	1.70	Air	P_c, P_{t2}, M, T_{t2} U, & ρ	Schlieren	Includes shock interaction
Smith		1989	3.0	1.70	Air	P_c, P_{t2}, M, T_{t2} U, & ρ	Schlieren	Heated Slot Flow Includes Shock Interaction

Table 1. Previous Investigations of Slot Injection

Table 2: Nondimensionalization Parameters			
Station #	T_{tj} (°R)	$P_{t2\infty}$ (*psia*)	M_∞
1; Heated	770	33.74	2.98
1; Unheated	Ambient	33.53	3.08
2; Heated	755	29.53	3.04
2; Unheated	Ambient	29.76	3.07
3; Heated	765	33.85	2.95
3; Unheated	Ambient	31.45	3.02
4; Heated	760	33.29	2.91
4; Unheated	Ambient	32.95	3.04
4; Shock Heated	760	33.29	2.91
4; Shock Unheated	Ambient	32.95	3.04

Table 2. Numbers for Nondimensionalization

Figures

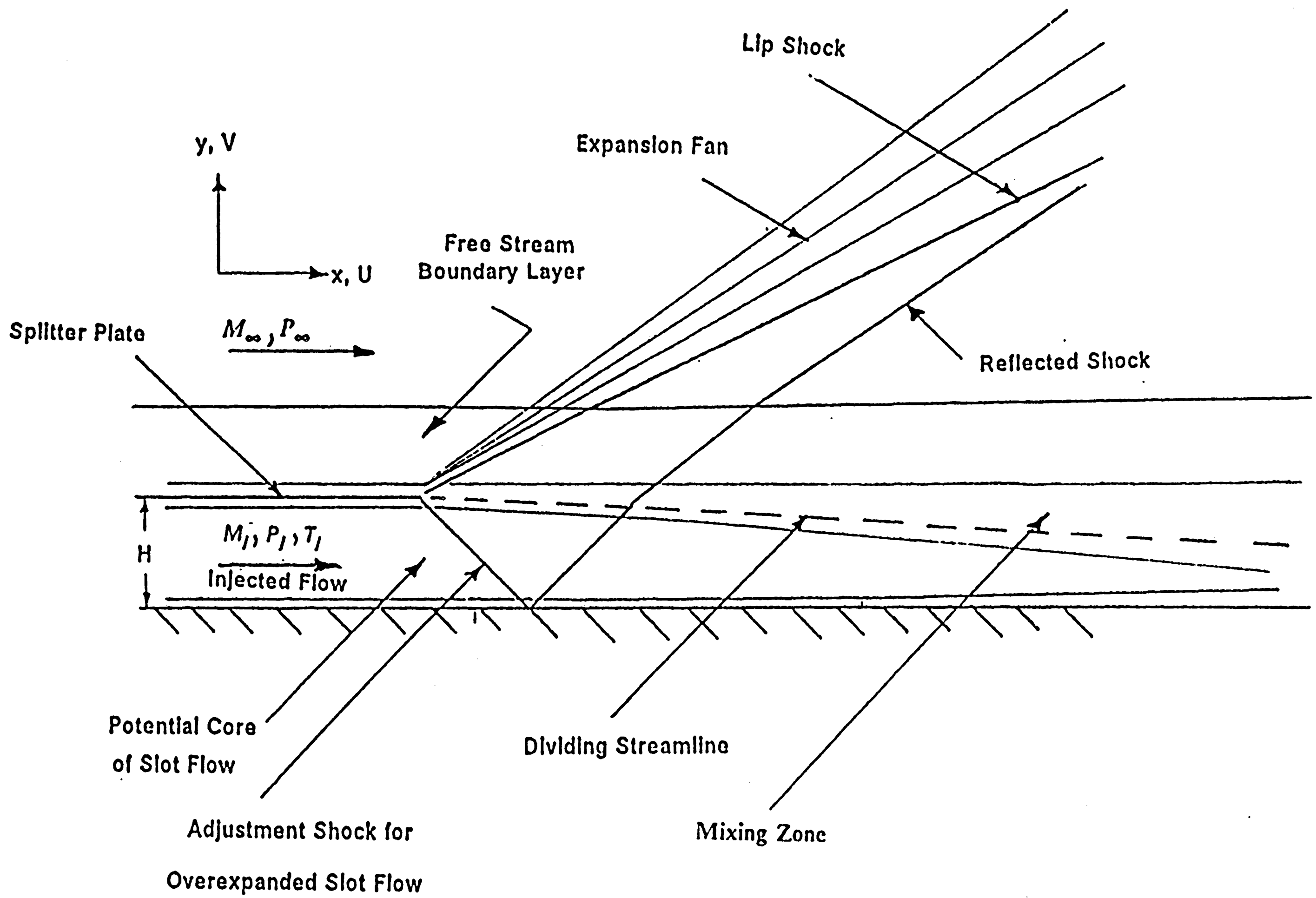


Figure 1. General Features of Flowfield

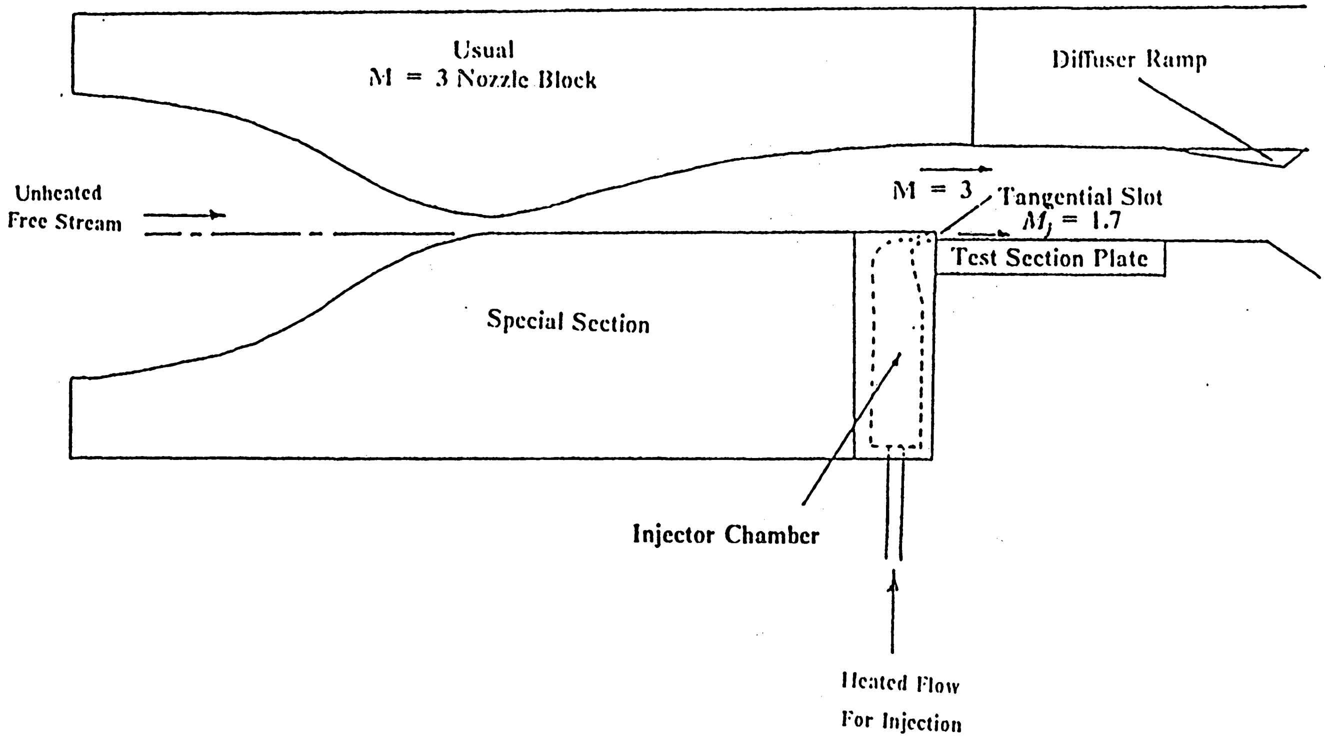


Figure 2. Schematic of Wind Tunnel Arrangement

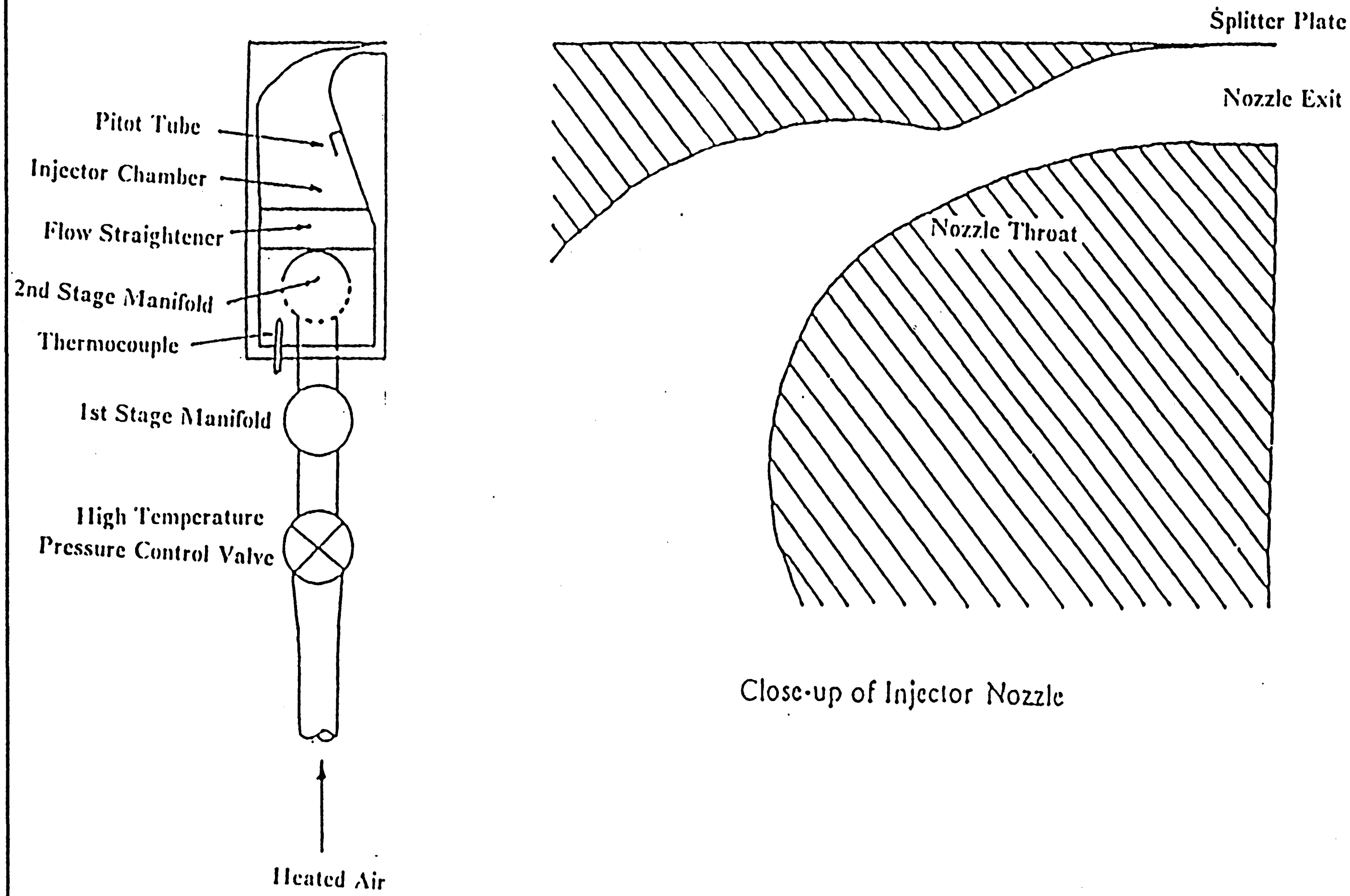


Figure 3. Schematic of Injector System

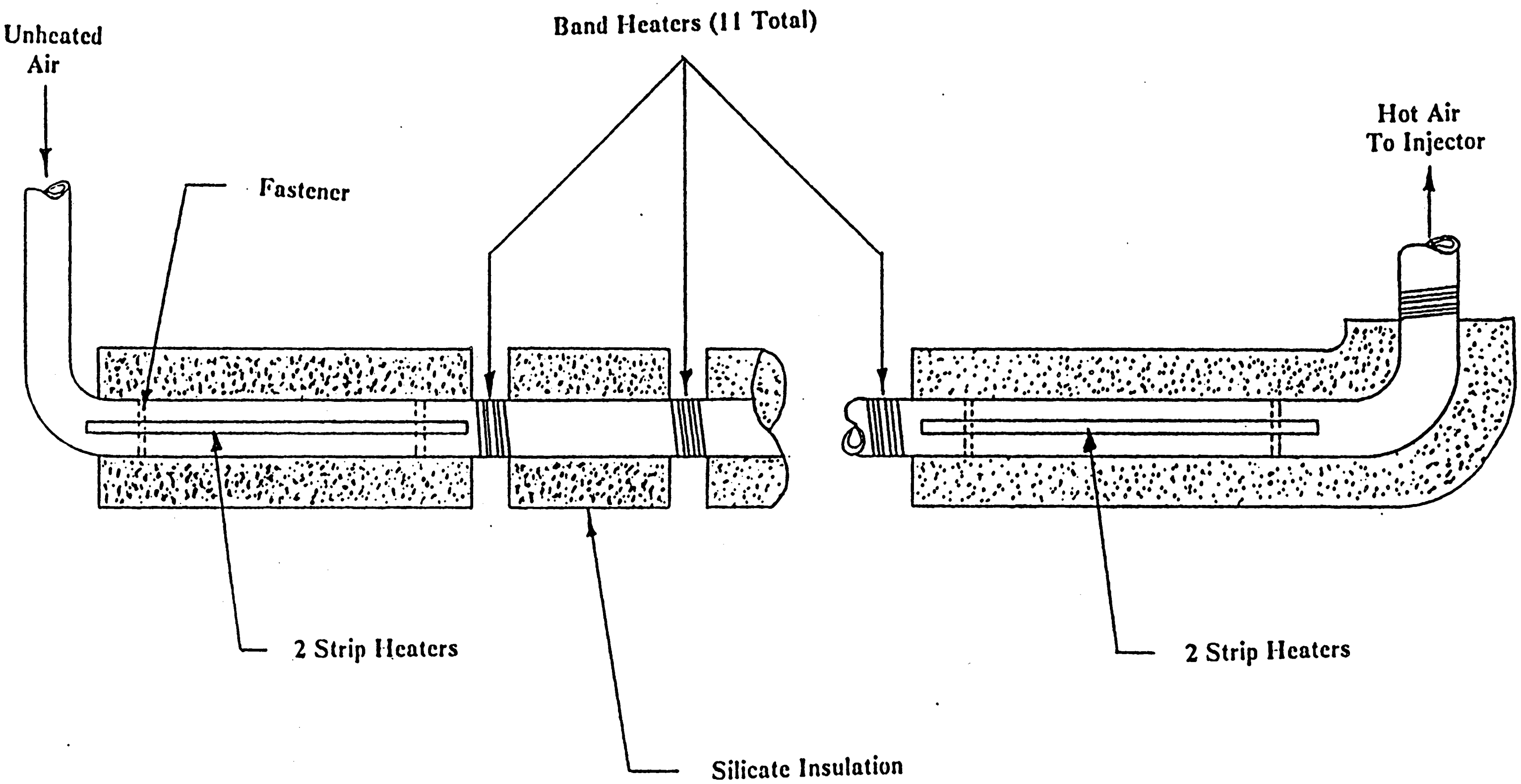


Figure 4. Schematic of Heater System Arrangement

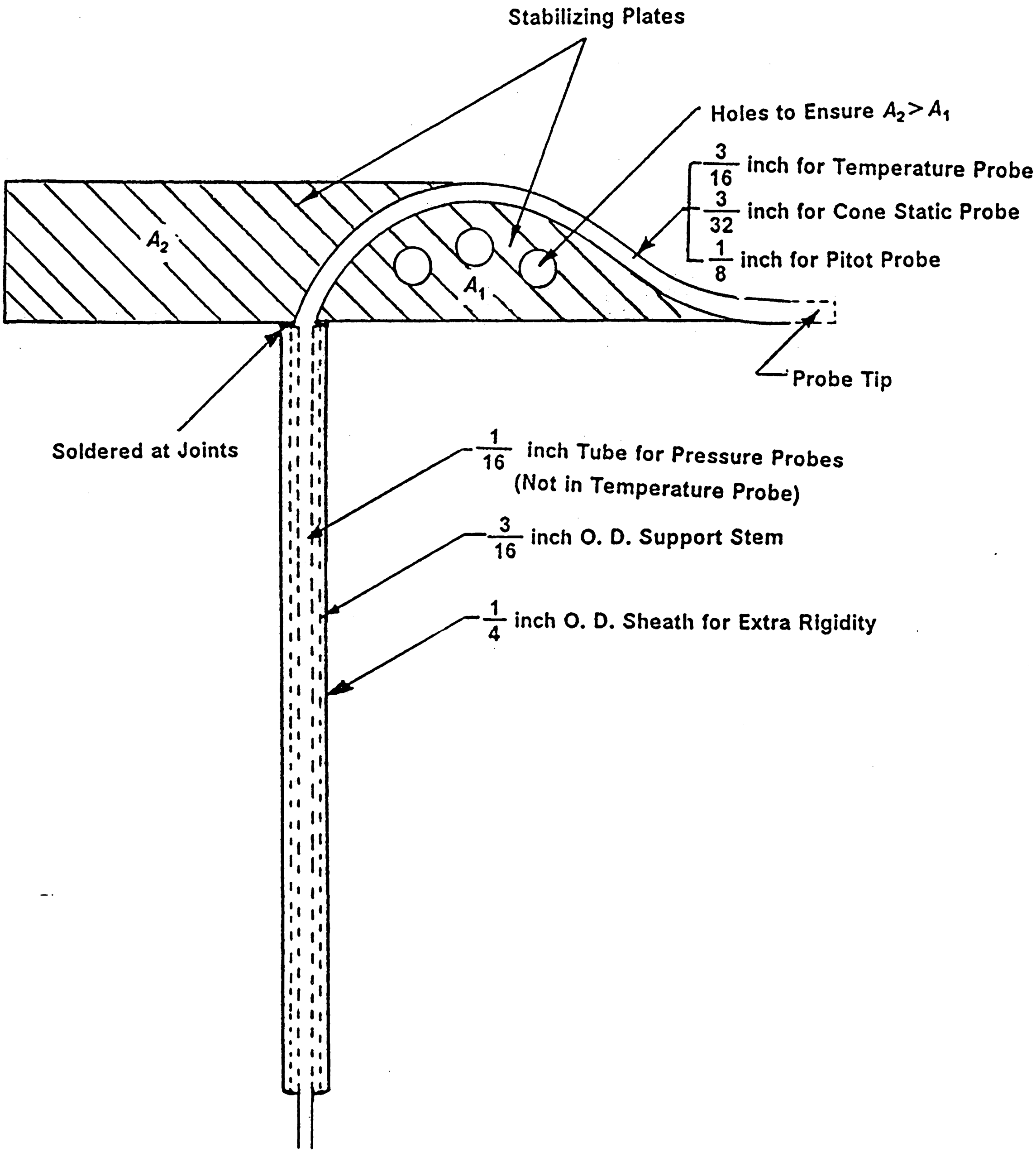


Figure 5. Configuration of Traverse Probes

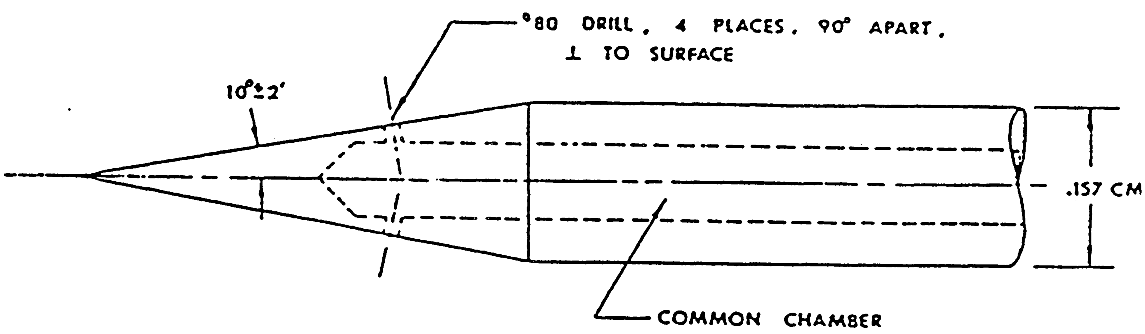


Figure 6. Detail of Cone Static Probe Tip

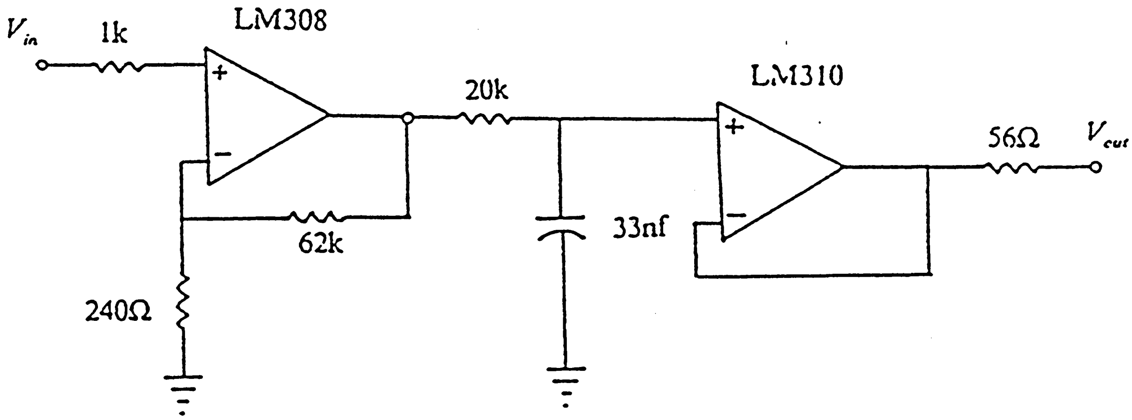


Figure 7. Circuit Diagram for Transducer Buffer/Filter

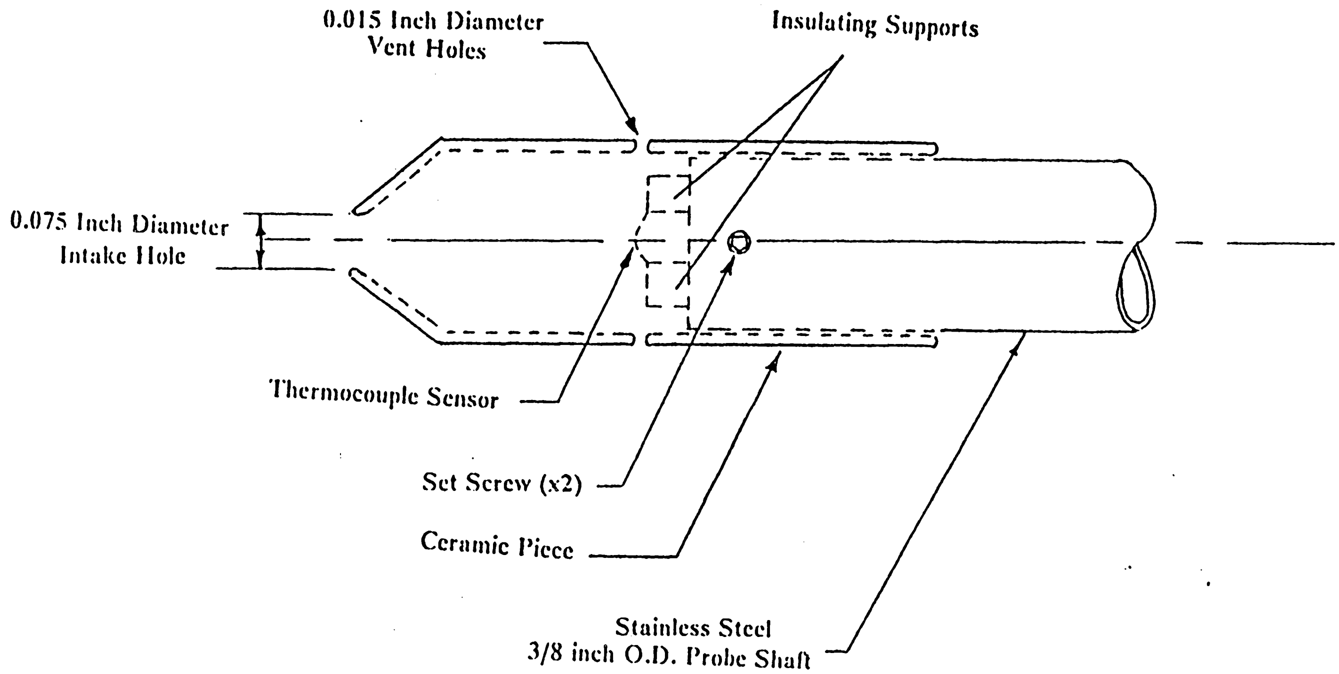


Figure 8. Detail of Stagnation Temperature Probe Tip

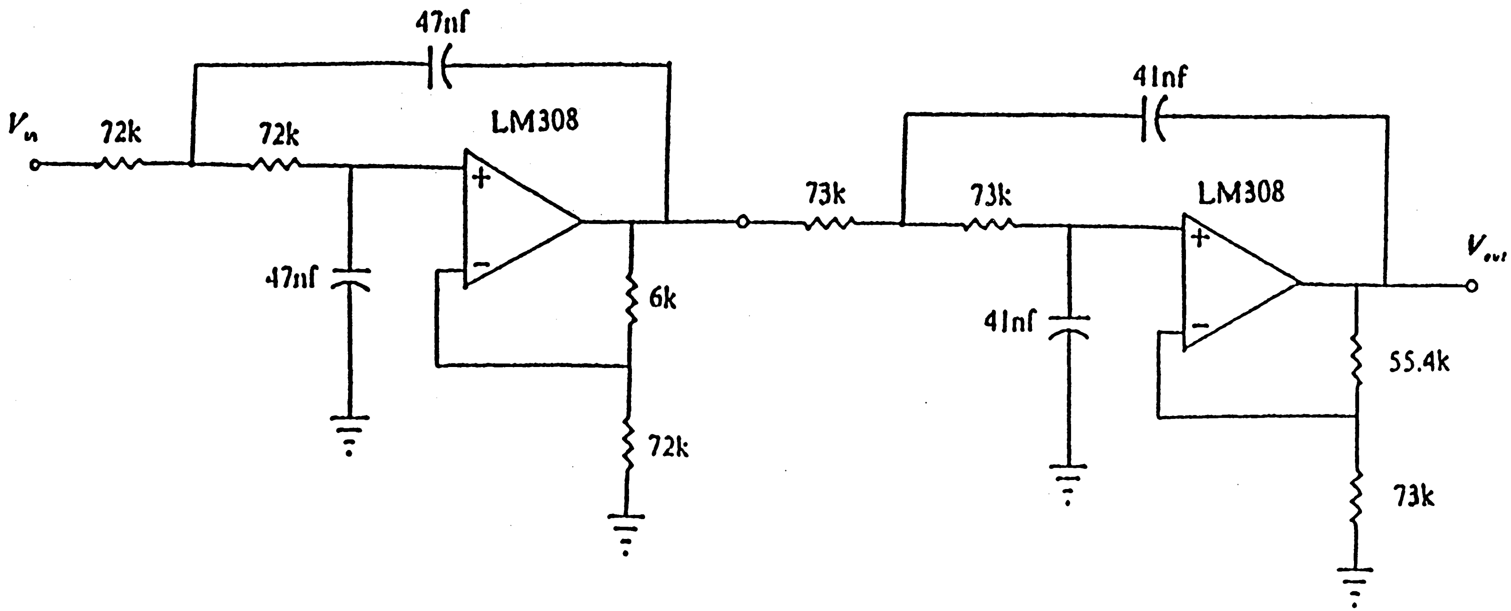


Figure 9. Circuit Diagram for LVDT Filter

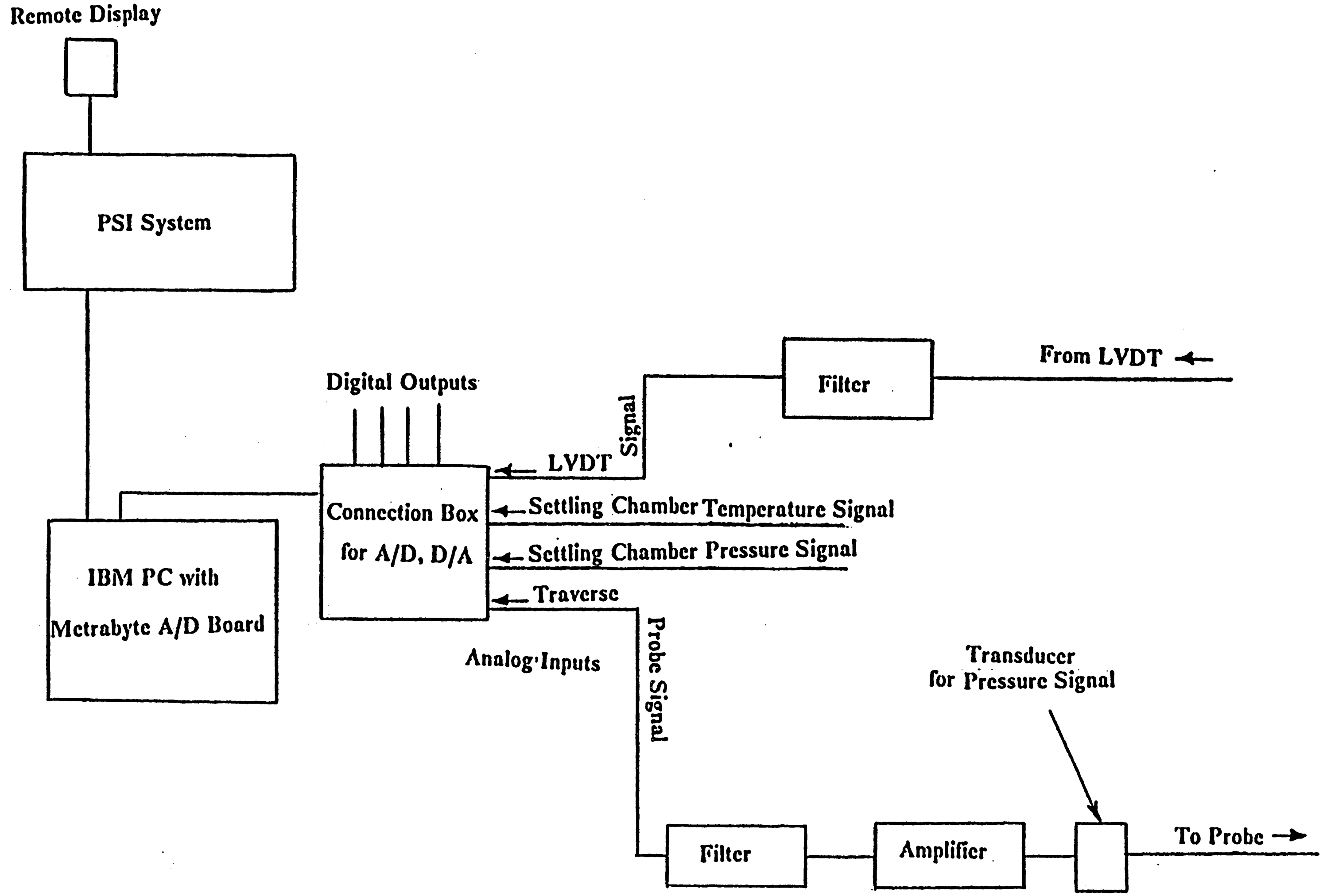
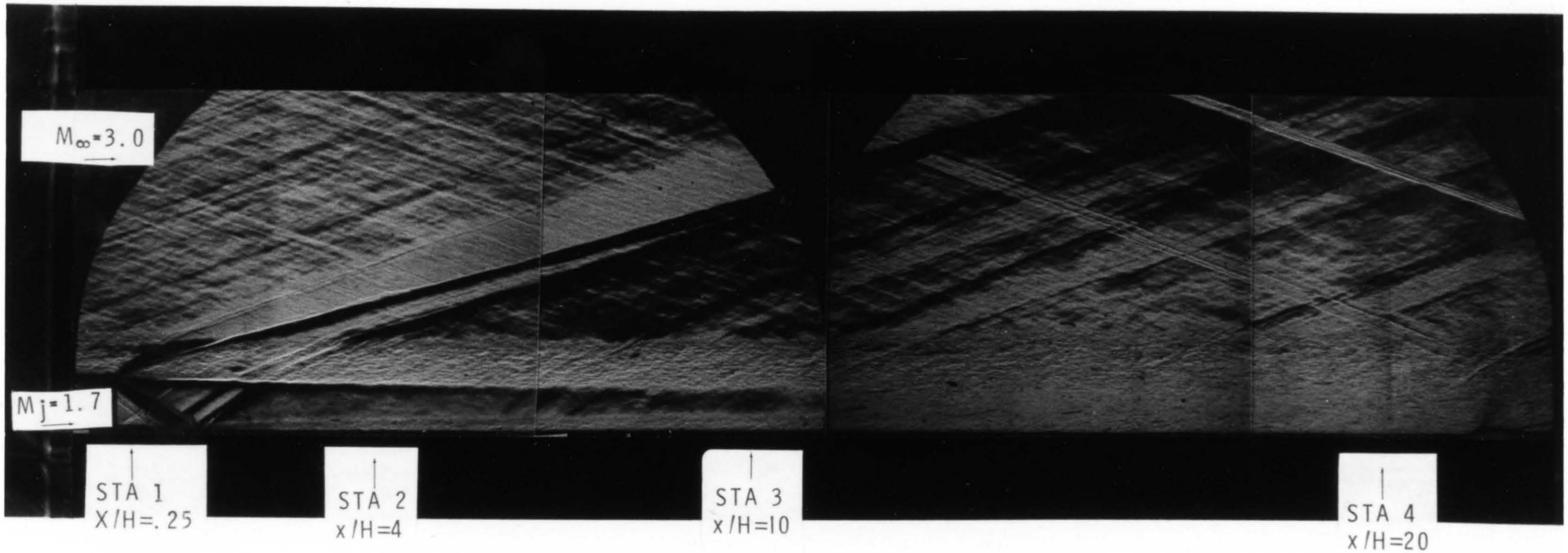
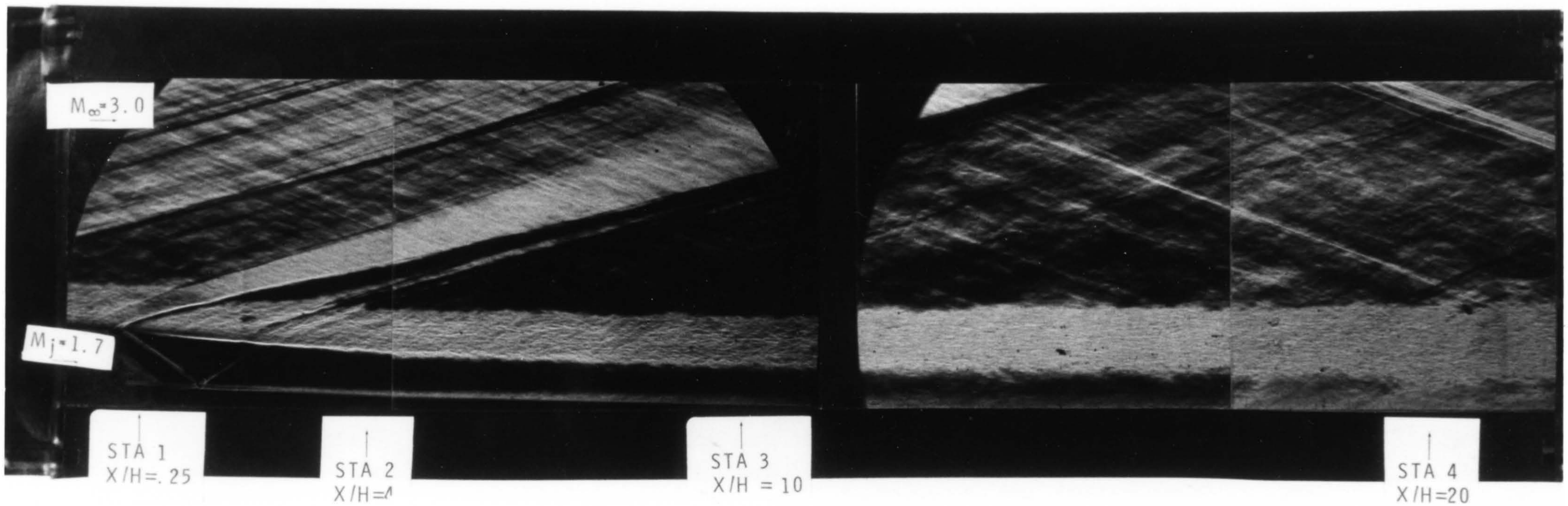


Figure 10. Data Acquisition Block Diagram



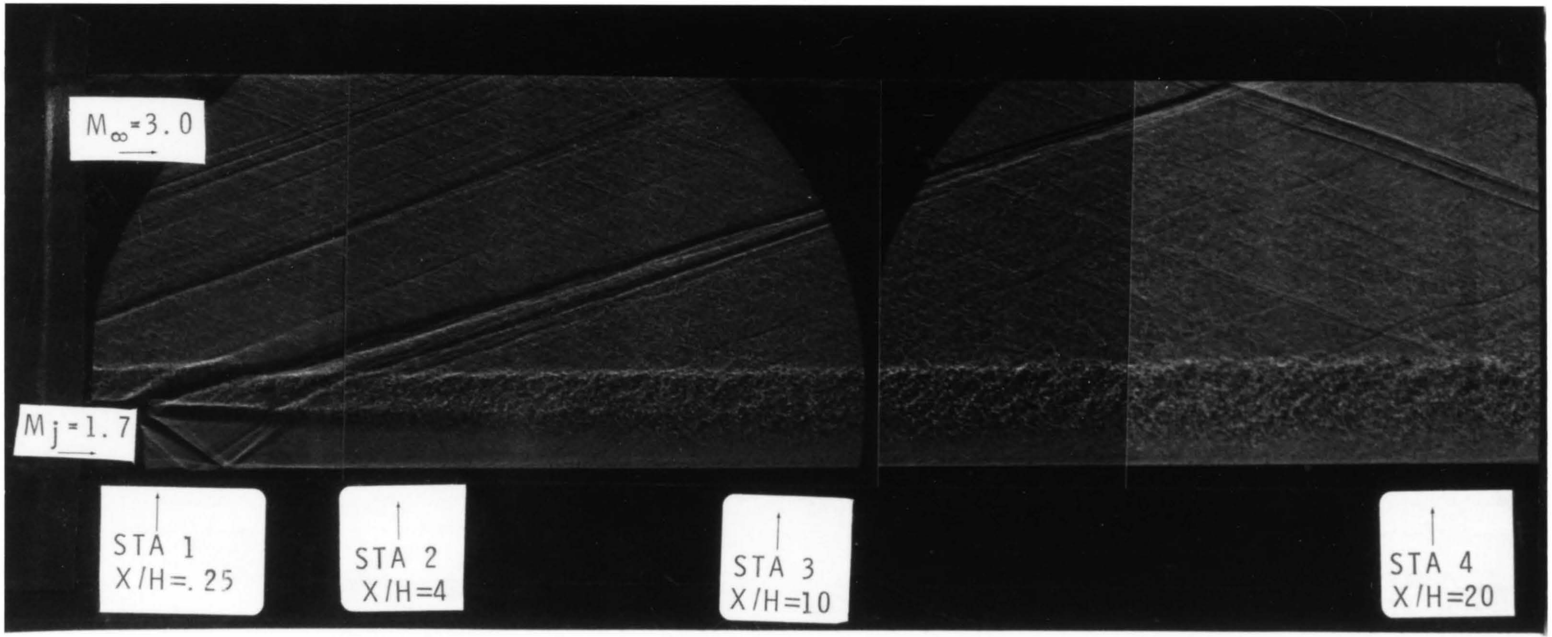
Spark Schlieren Photograph of Unheated Freestream ($T_{tinf} = 540R$) with Unheated Tangential Injection ($T_{tj} = 540R$, $P_{tj} = 10.7$ psia), H = 0.5 inches.

Figure 11. Spark-Schlieren of Unheated Injection Case



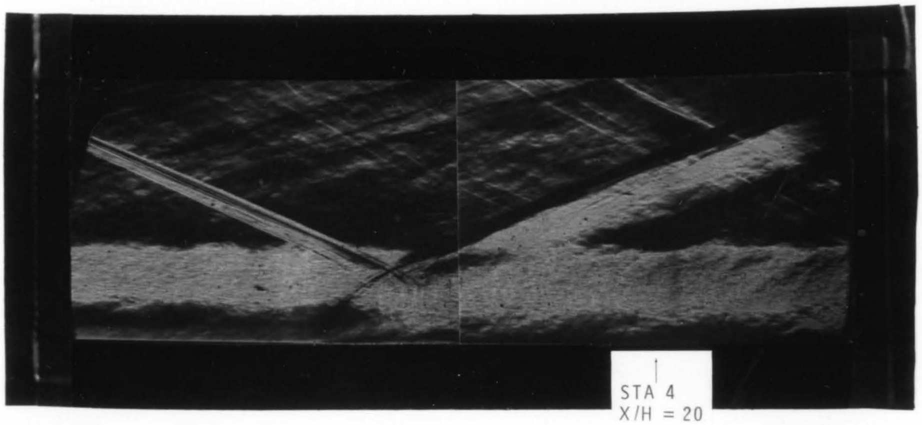
Spark Schlieren Photograph of Unheated Freestream ($T_{tinf} = 540R$) with Heated Tangential Injection ($T_{tj} = 760R$, $P_{tj} = 10.7$ psia), H = 0.5 inches.

Figure 12. Spark-Schlieren of Heated Injection Case

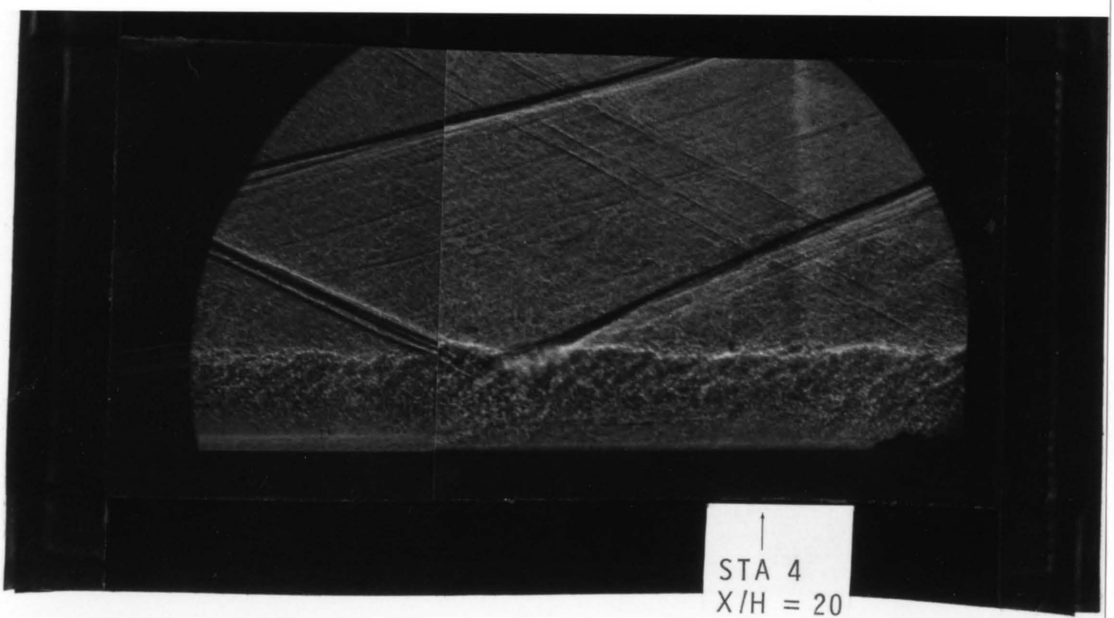


Nanosecond Shadowgraph of Unheated Freestream ($T_{tinf} = 540R$) with Heated Tangential Injection ($T_{tj} = 760R$, $P_{tj} = 10.7$ psia), H = 0.5 inches.

Figure 13. Nanosecond Shadowgraph of Heated Injection Case



Spark Schlieren Photograph of Shock Impingement Region. Unheated Freestream ($T_{tinf} = 540R$) with Heated Tangential Injection ($T_{tj} = 760R$, $P_{tj} = 10.7$ psia), H = 0.5 inches.



Nanosecond Shadowgraph of Shock Impingement Region. Unheated Freestream ($T_{tinf} = 540R$) with Heated Tangential Injection ($T_{tj} = 760R$, $P_{tj} = 10.7$ psia), H = 0.5 inches.

Figure 14. Shock Interaction Region; Spark-Schlieren/Nano-Shadowgraph

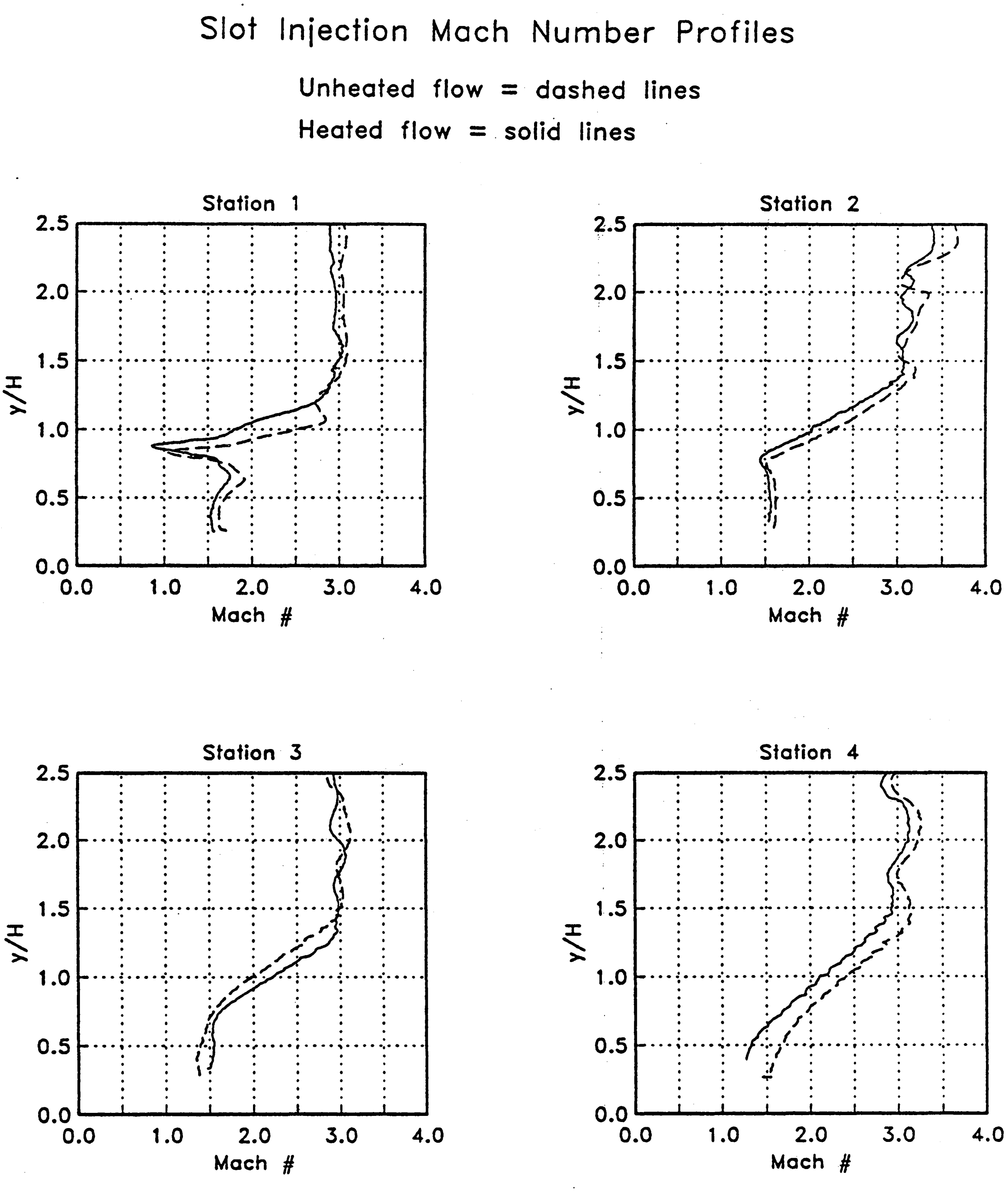


Figure 15. **Mach Number Profiles**

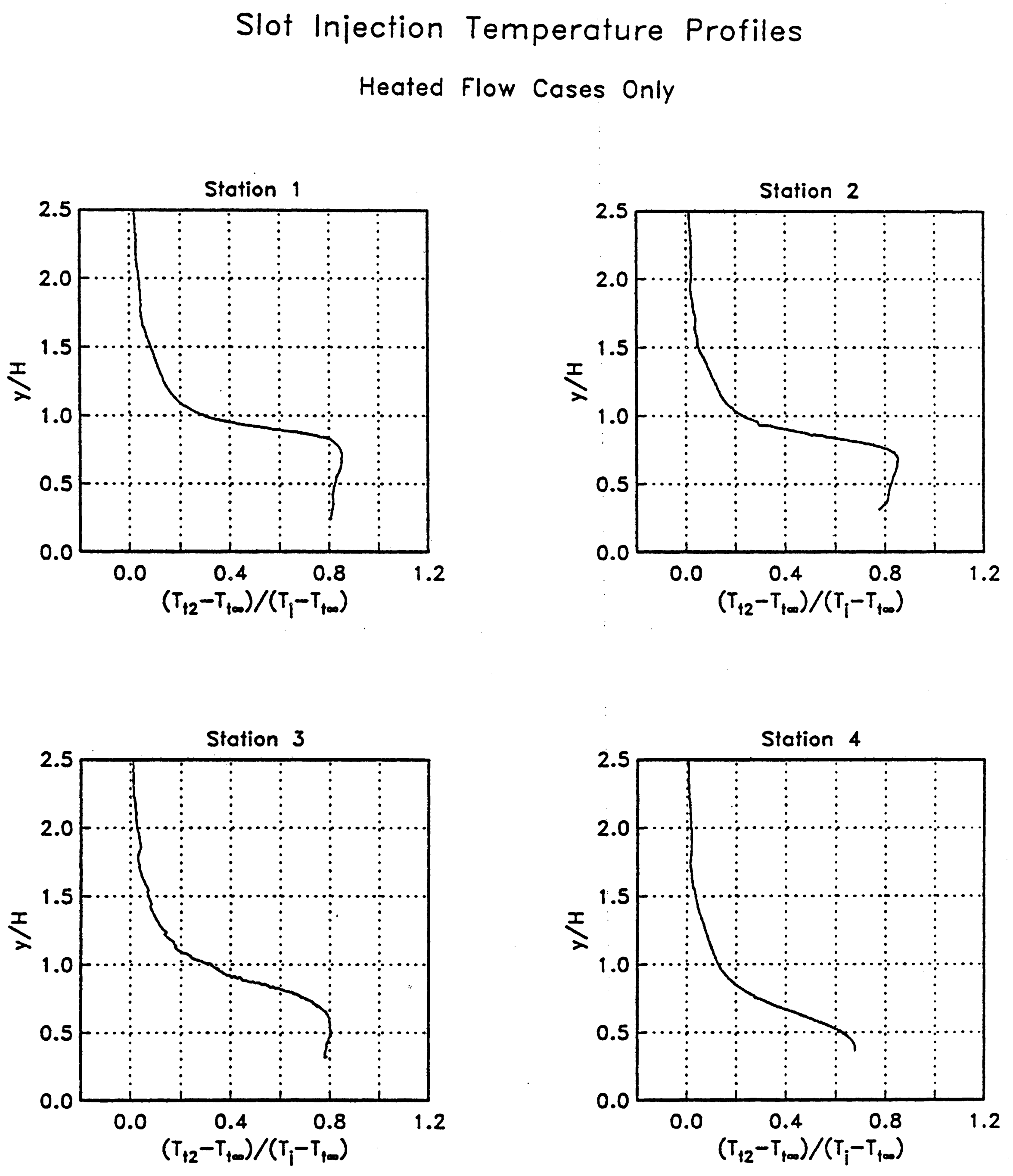


Figure 16. Total Temperature Profiles

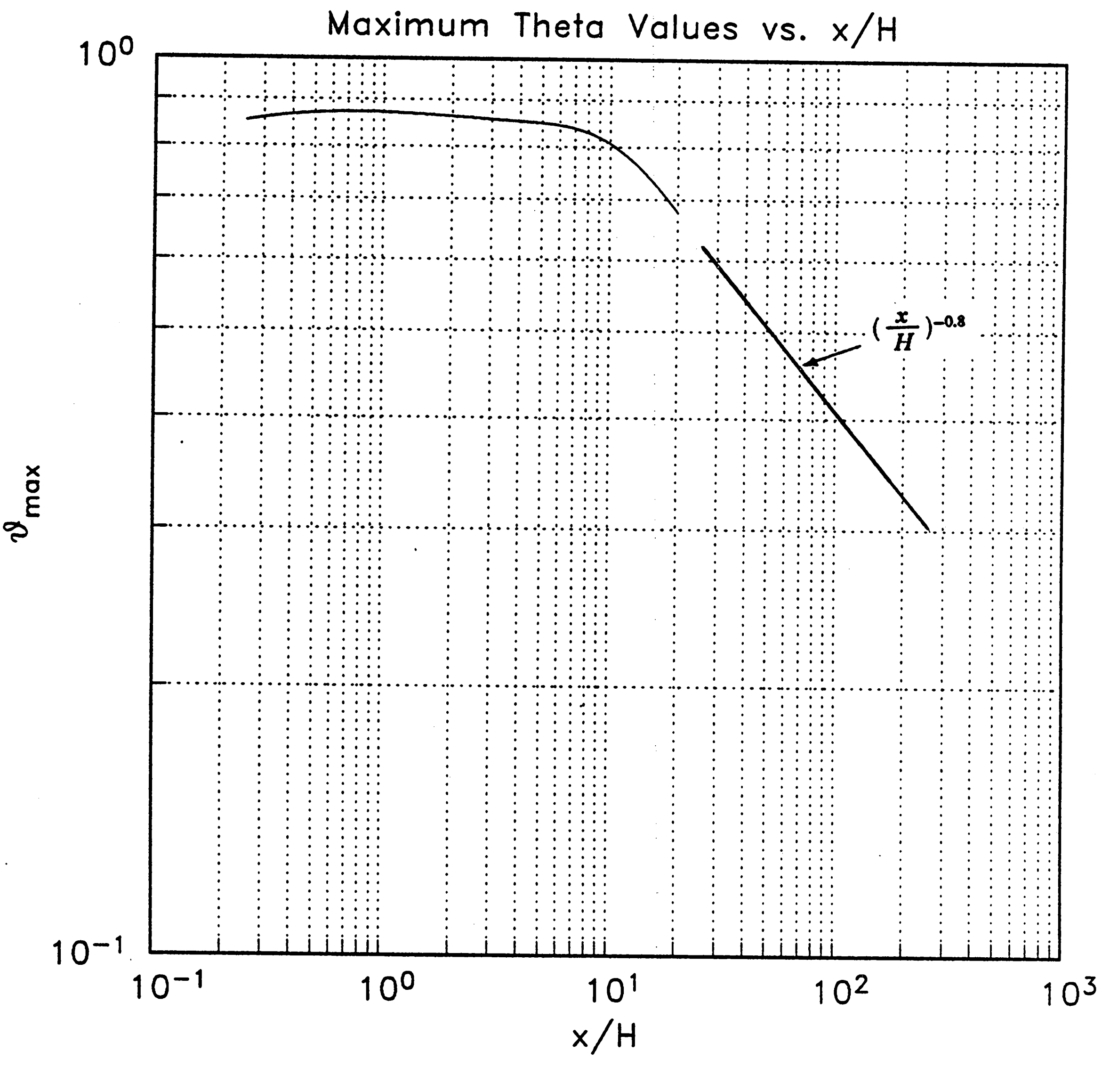


Figure 17. Decay of Slot Temperature with x/H

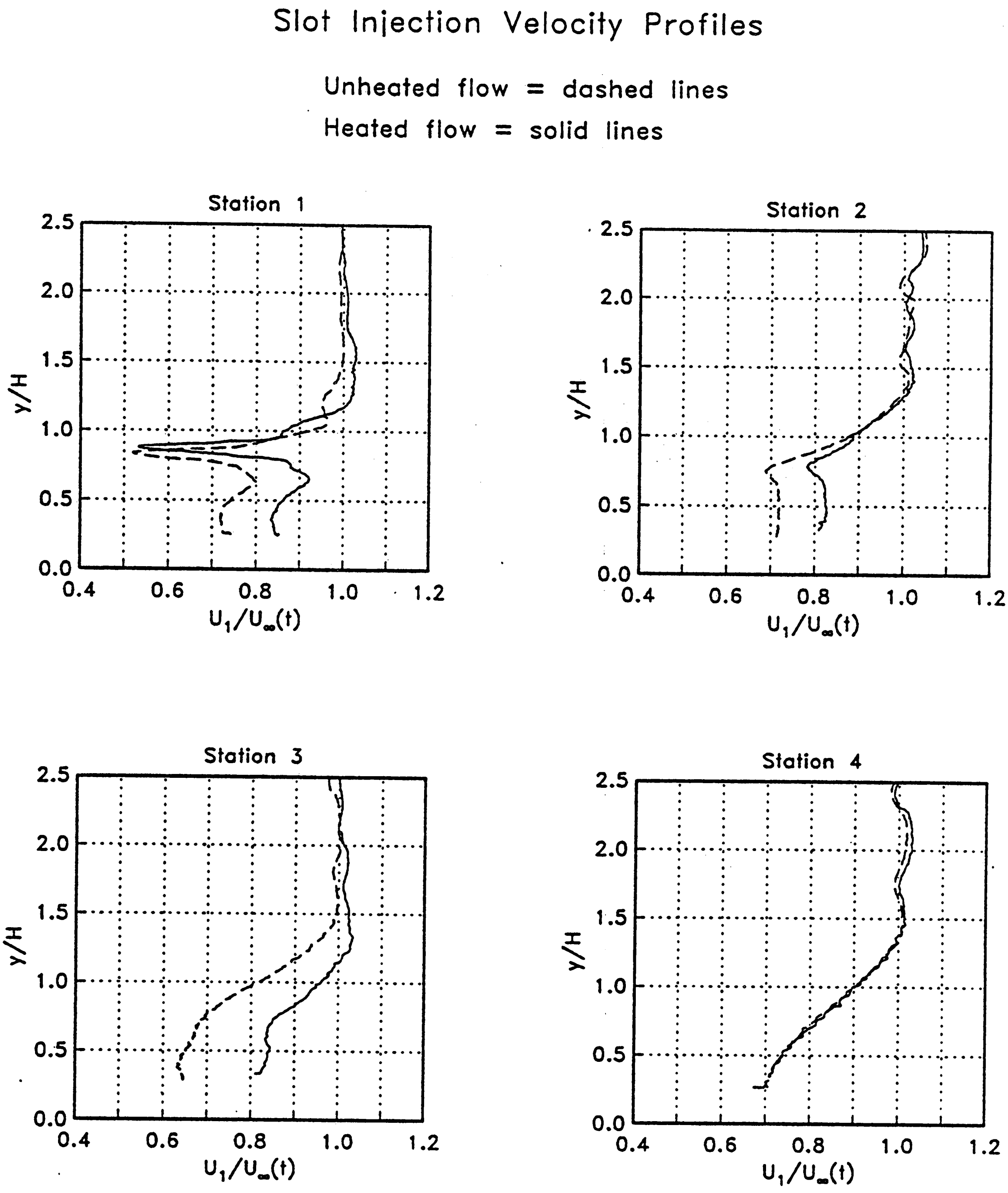


Figure 18. Streamwise Velocity Profiles

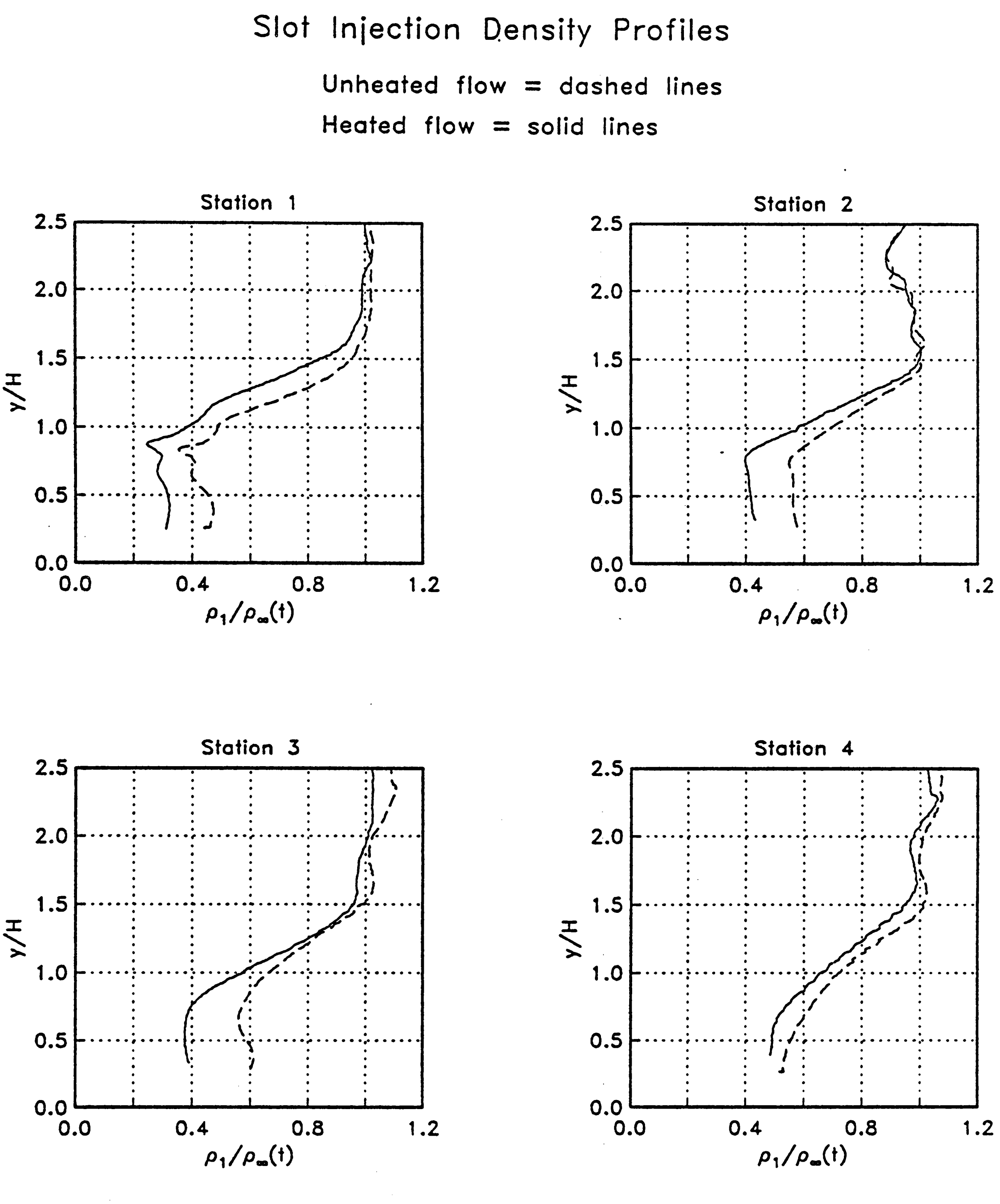


Figure 19. Density Profiles

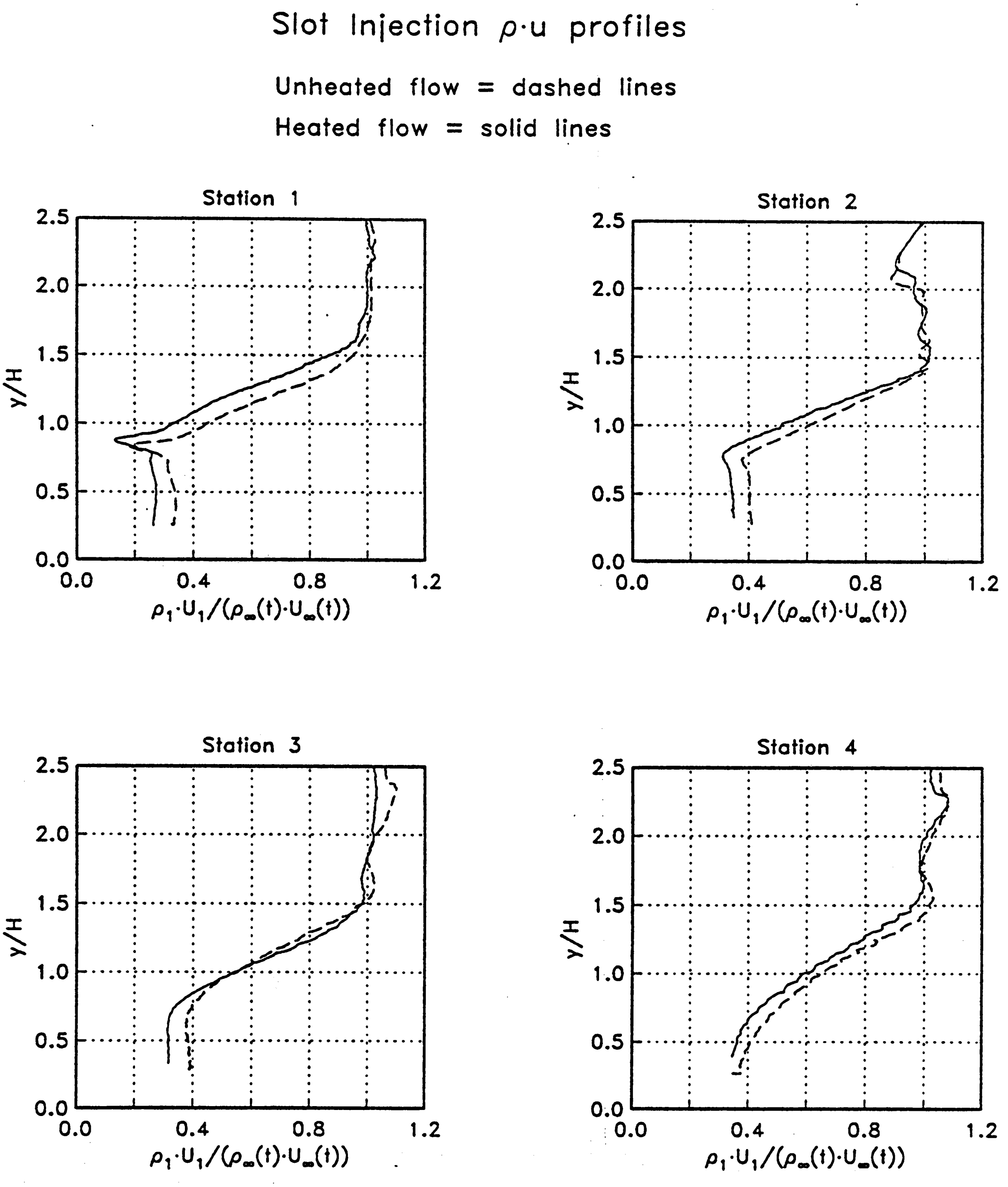


Figure 20. Mass Flux Profiles

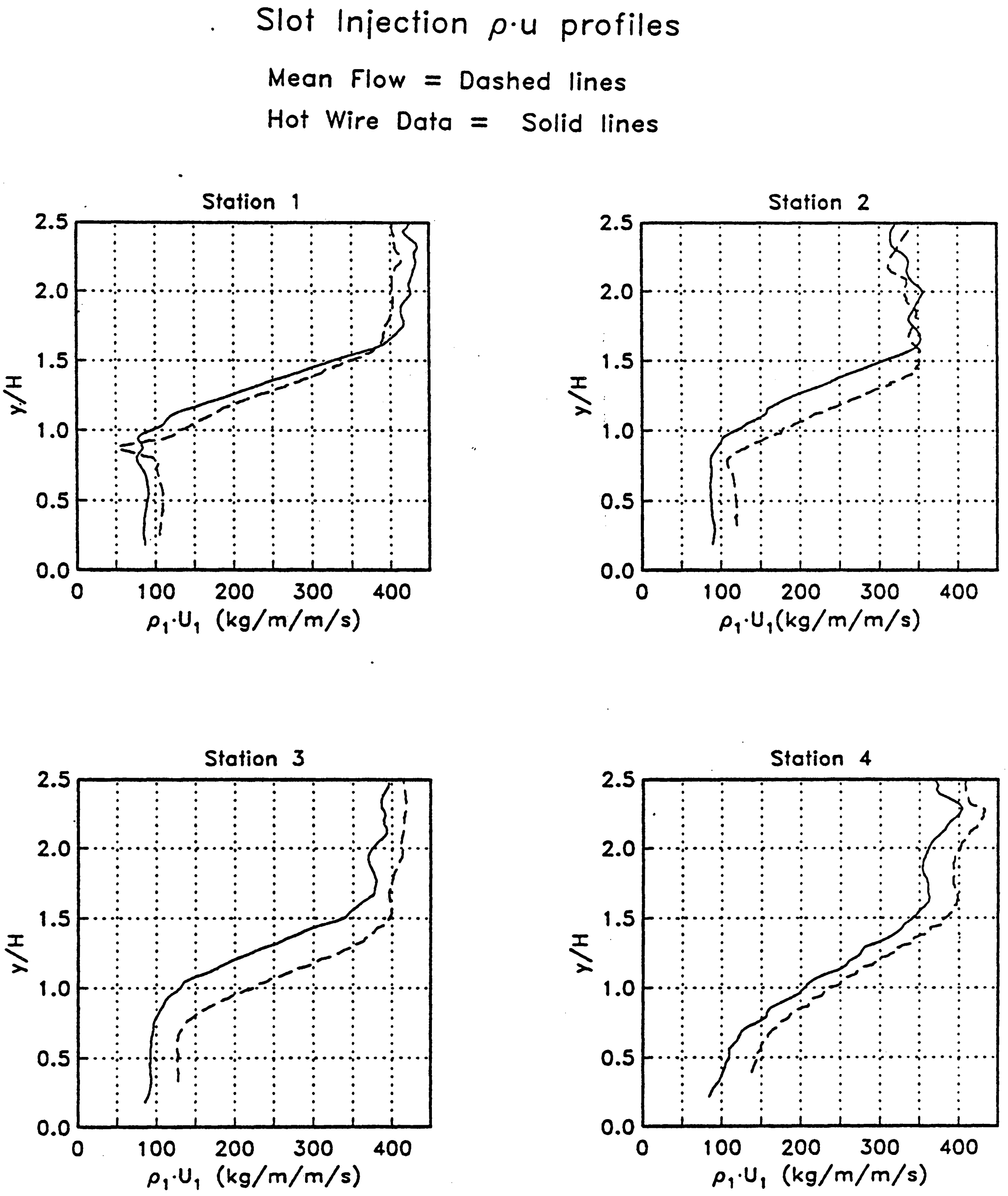


Figure 21. Mean Flow Mass Flux versus Hot Wire Mass Flux (Heated)

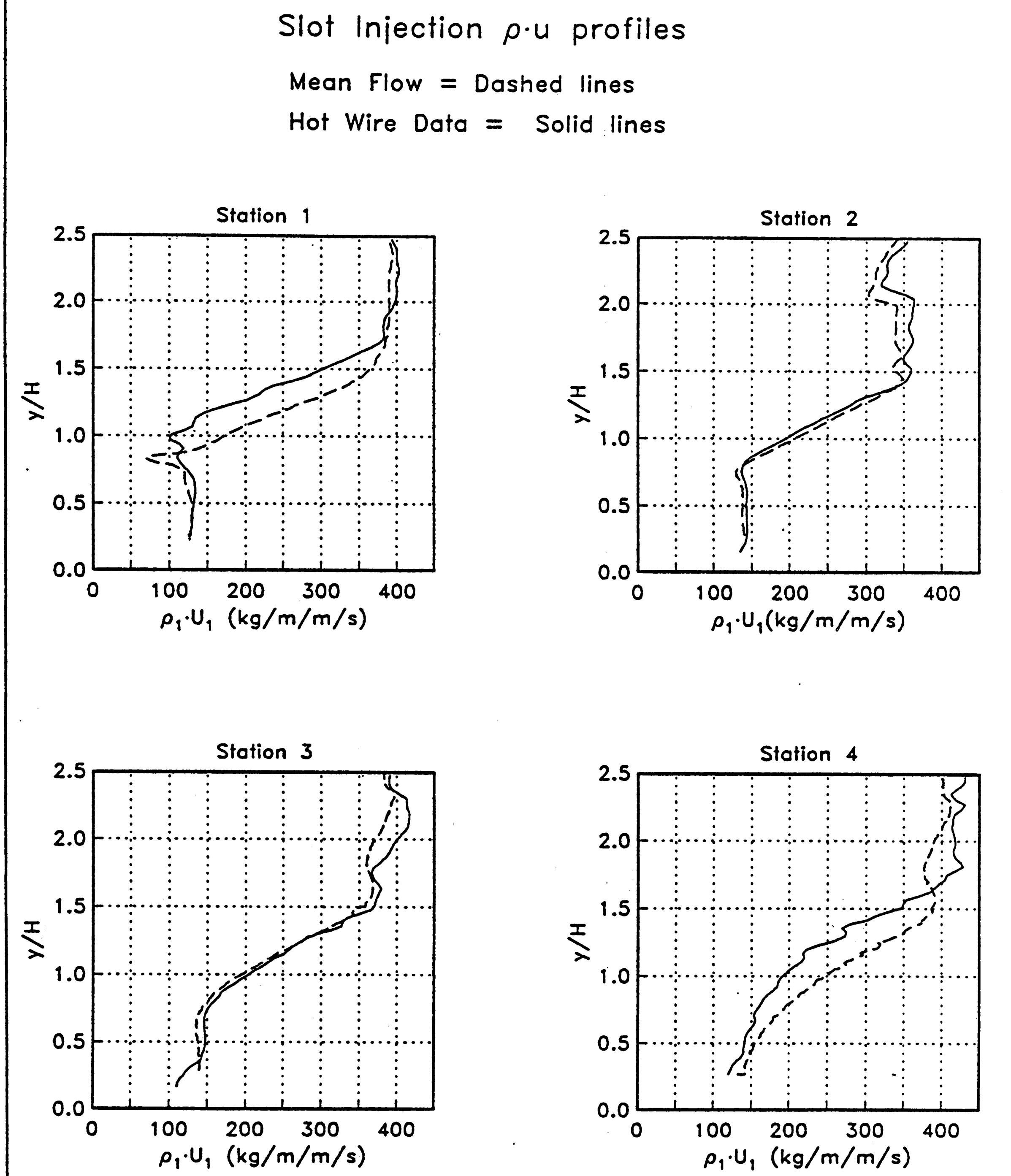


Figure 22. **Mean Flow Mass Flux versus Hot Wire Mass Flux** (Unheated)

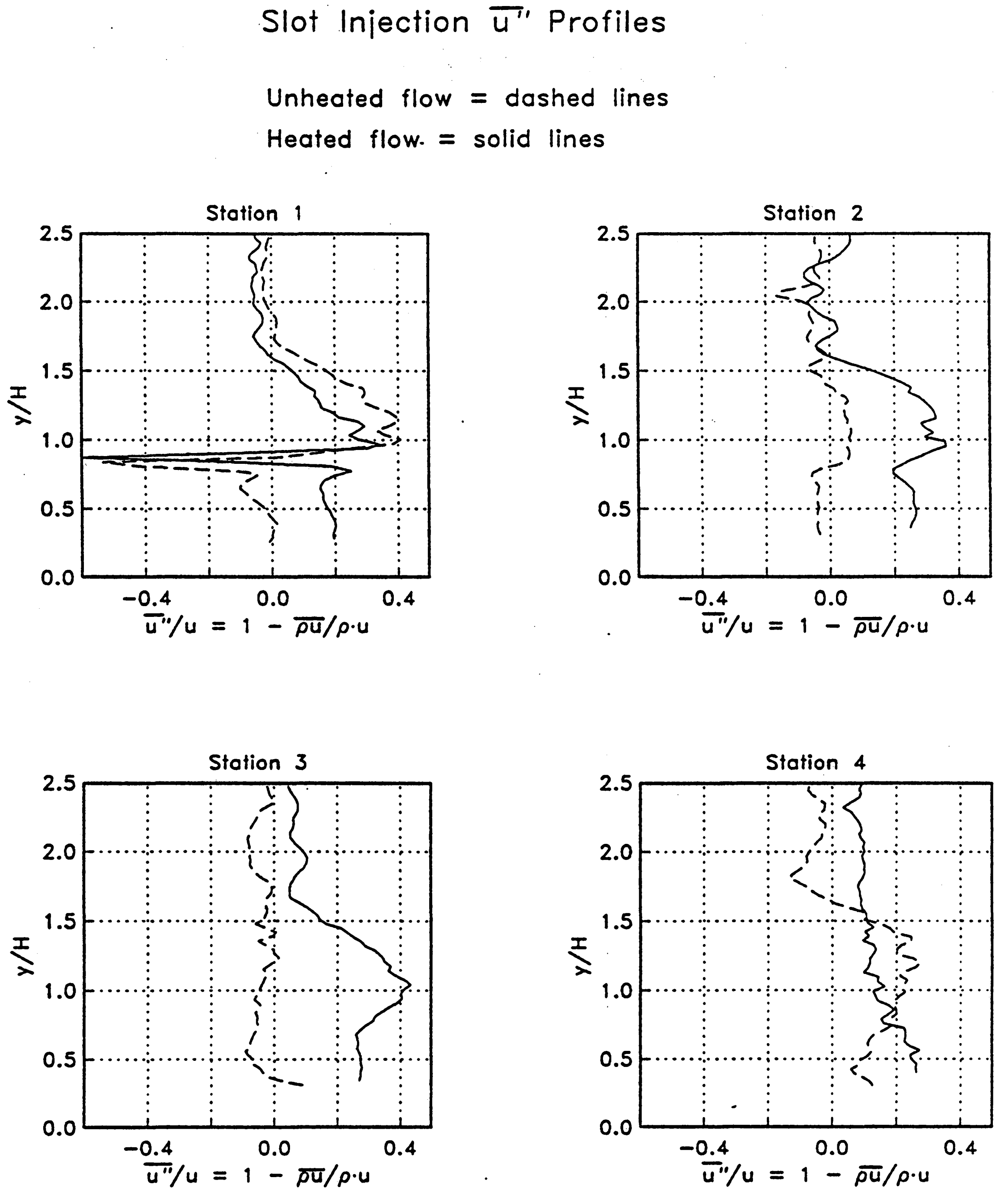


Figure 23. Favre Averaged Fluctuating Velocities, Stations 1-4

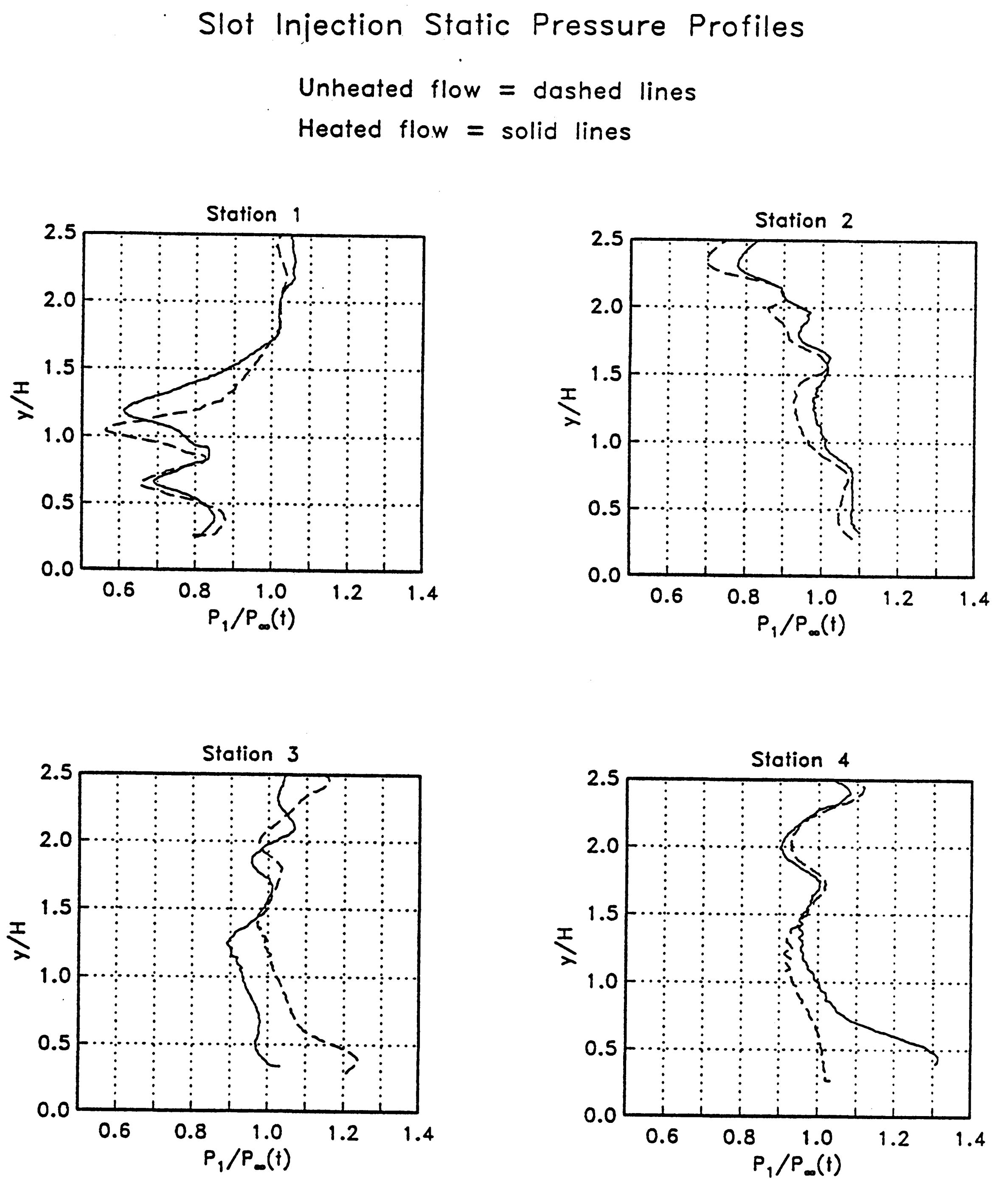


Figure 24. Static Pressure Profiles

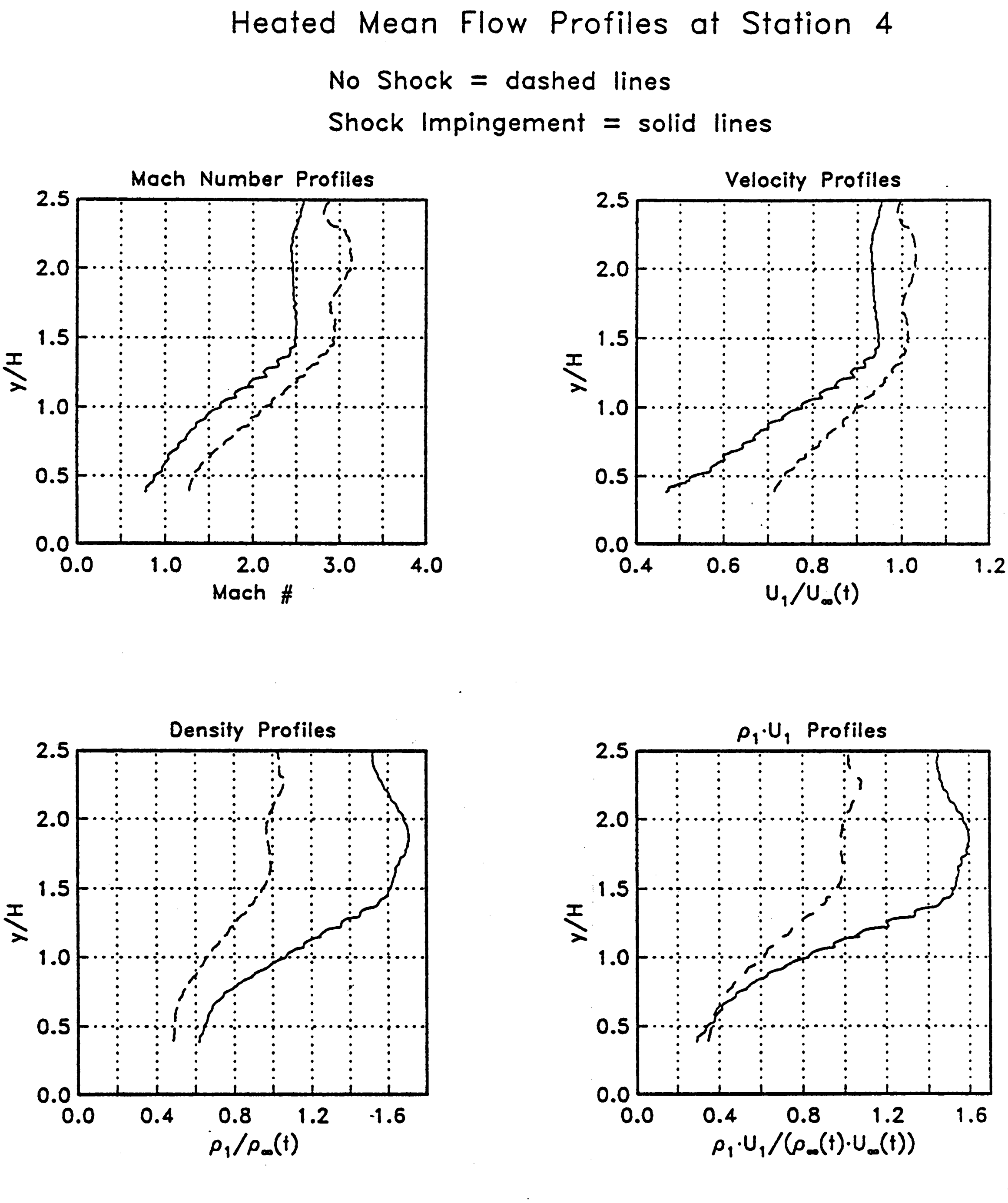


Figure 25. Heated Case Mean Flow Profiles at Station 4 /Shock

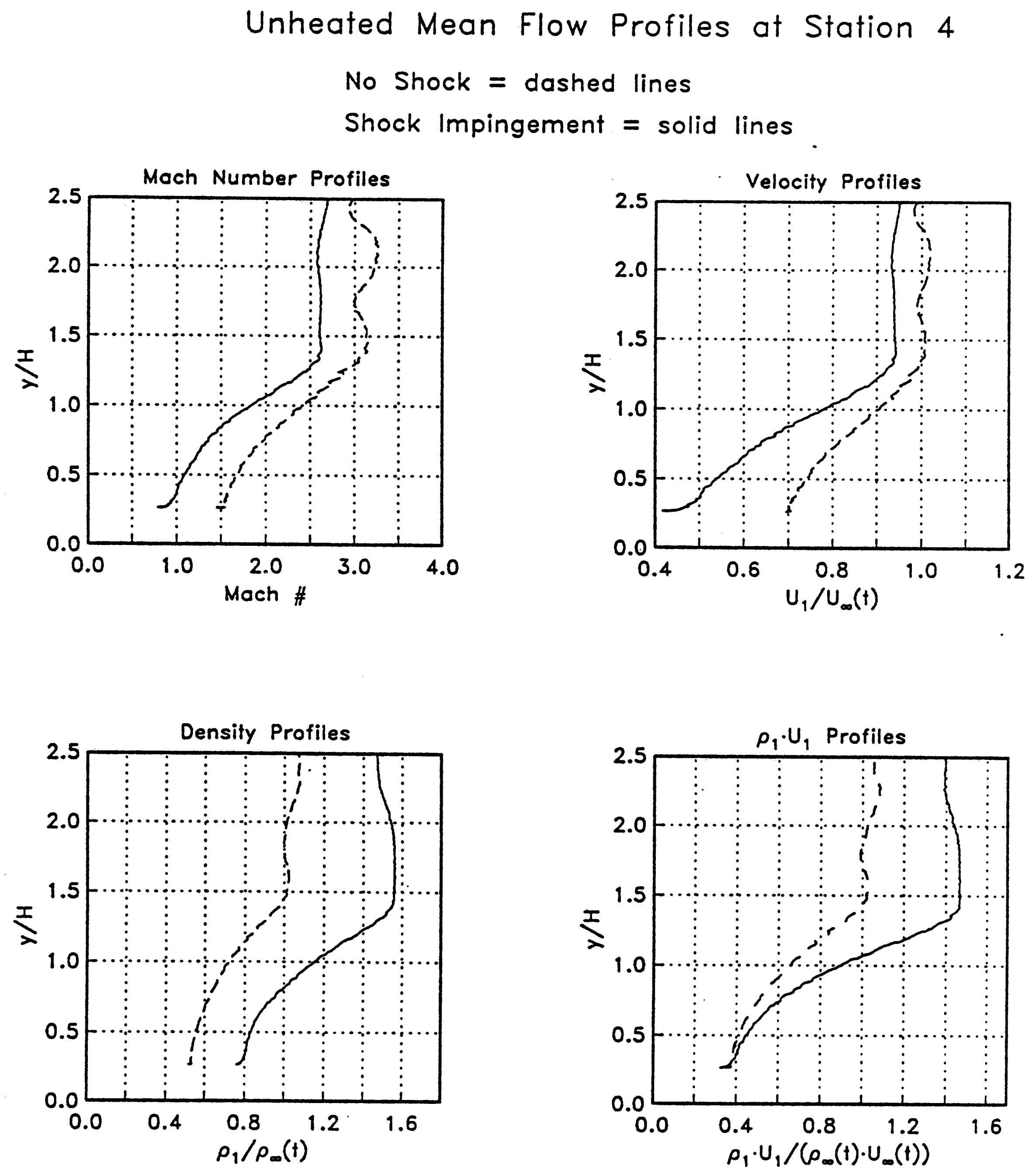


Figure 26. Unheated Case Mean Flow Profiles at Station 4/Shock

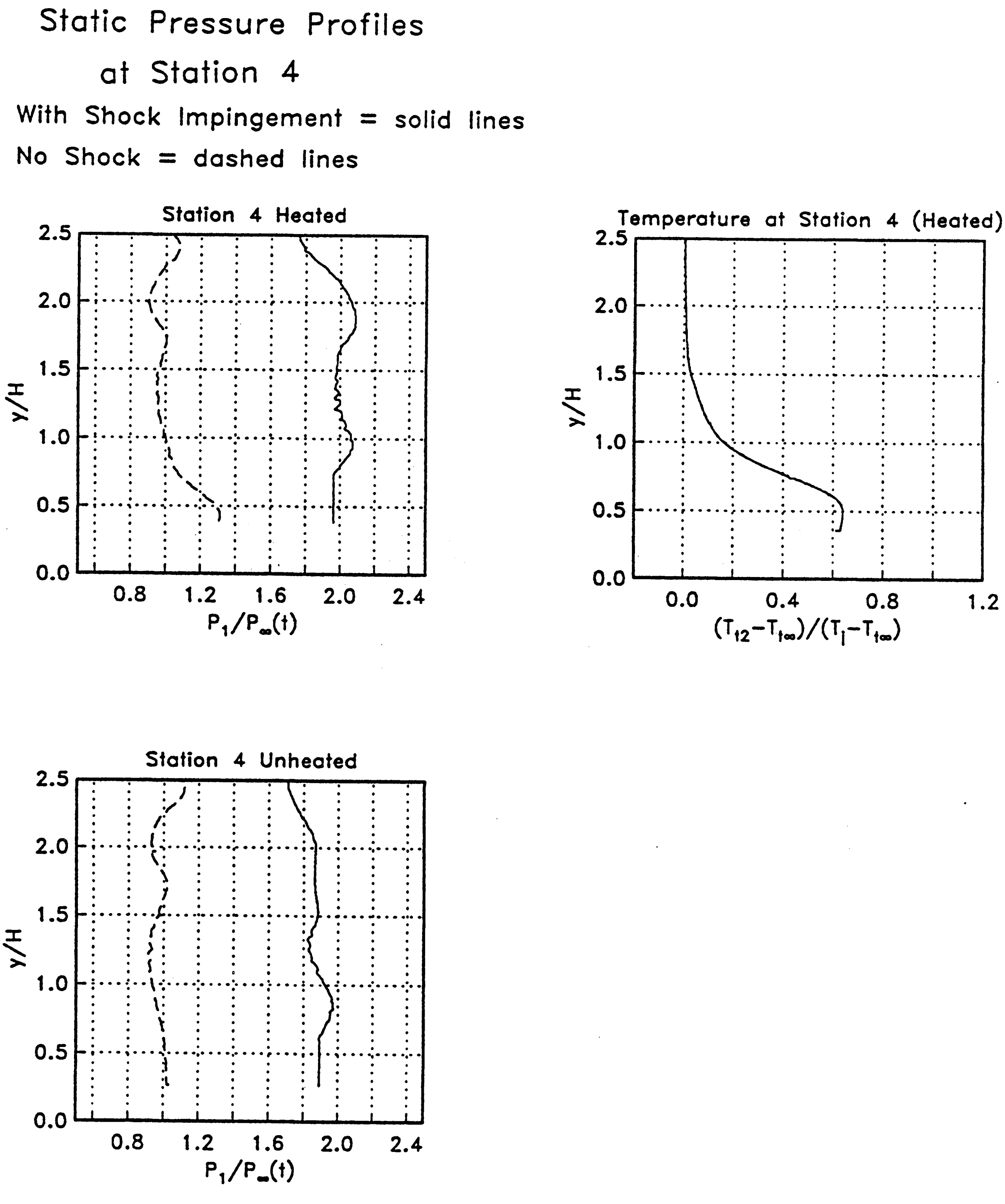


Figure 27. Static Pressure and Total Temperature Profiles at Station 4

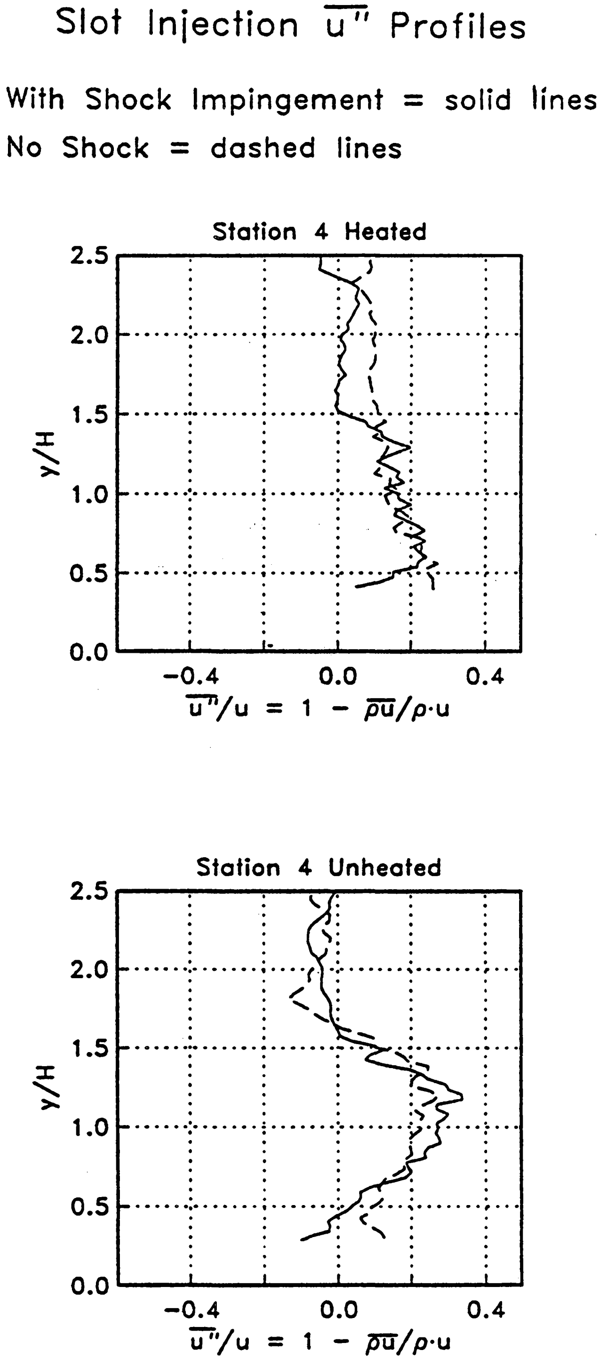


Figure 28. Favre Averaged Fluctuating Velocities, Station 4/Shock

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