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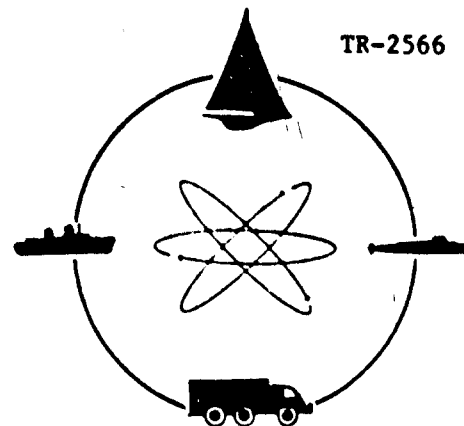


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DAVIDSON LABORATORY

Technical Report SIT-DL-87-9-2566
September 1987

PRESSURE DISTRIBUTIONS AND LOSSES
IN A WATERJET PROPULSION SYSTEM

by
Martin N. Burtness

Prepared for
Office of Naval Research
under

Contract N000014-83-C-0780
(Davidson Laboratory Project 5267/190)

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NOMENCLATURE

A_i	Jet inlet area, sq ft
A_p	Jet area at impeller, sq ft
A_T	Jet test section area, sq ft
C_{Di}	Inlet drag coefficient, $D_i / (0.5 \rho w \cdot V_o^2)$
C_{Li}	Inlet lift coefficient, $L_i / (0.5 \rho w \cdot V_o^2)$
D	Model drag, lb
D_h	Hull drag, lb
D_i	Inlet drag, lb, $D - D_h - D_m$
D_m	Momentum drag, lb, $\rho Q V_o$
D_p	Impeller diameter, ft
g	Acceleration of gravity, 32.174 ft ² /sec
H_{atm}	Atmospheric pressure head, 33.08 ft
H_p	Pressure head induced by the impeller, ft
H_{vap}	Vapor pressure of water, 1.0 ft
IVR	Inlet velocity ratio, V_i / V_o
K_{ot}	Inlet loss coefficient, $(V_o^2 / 2g - P_{T \text{ tot}}) / (V_T^2 / 2g)$
l	Inlet length, ft
L	Model lift, lb
L_h	Hull lift, lb
L_i	Inlet lift, lb, $L - L_h$
$P_{T \text{ stat}}$	Static pressure head at test section, ft
$P_{T \text{ tot}}$	Total pressure head at test section, ft
Q	Mass flow rate through jet, cfs
RPR	Ram pressure recovery $(P_{T \text{ tot}}) / (V_o^2 / 2g)$
TVR	Test section velocity ratio, V_T / V_o
V_i	Inlet velocity, fps, Q / A_i
V_o	Freestream velocity, fps
V_T	Test section velocity, fps, Q / A_T
w	Inlet width, ft
ρ	Mass density of water, lb-sec ² /ft ³
σ	Cavitation Index, $(H_{atm} + P_{T \text{ stat}} - H_{vap}) / (V_T^2 / 2g)$

INTRODUCTION

A simplified model of a waterjet was designed and built at Davidson Laboratory, Stevens Institute of Technology to evaluate the performance of several waterjet configurations suitable for installation on a high water speed amphibian landing craft. The objective of this experimental study was to investigate alternative combinations of inlet length and transition length and to use these data to design an optimum waterjet system with minimum losses. A 1:5.367 scale model having four interchangeable inlets and three transition sections was used and model tests were conducted to determine the flow rates, pressure distributions, and losses existing in the waterjet. Tests were conducted in the Davidson Laboratory Tank 3 facility in October and November of 1986. Portions of the testing were witnessed by Mr. John Hoyt, Code 1562, DWTNSRDC. All preliminary test results were previously submitted to Code 1562 and have been used in a design of a full scale waterjet. The study was funded by Code 12 of DWTNSRDC and administrated under Office of Naval Research Contract N00014-83-C-0780.

MODEL

The test model was designed to simulate a waterjet installation in a proposed high water speed amphibian vehicle being developed by Code 12 of DWTNSRDC. The amphibian is designed with a large fully retractable transom flap to increase the vehicle length when water-borne and to decrease the trim in the hump speed region. The size of the flap is such that the waterjet system can be completely installed within its geometry. When the flap is fully retracted for land operation, the waterjet system is rotated to a vertical position at the transom.

The purpose of this model study was to provide data on the pressures, velocities, and losses through the intake and transition region up to the impeller. These data would then be used to design the full scale waterjet. The model test impeller and drive motor were selected to provide the required flow quantities through the inlet and transition sections of the waterjet. No attempt was made to represent the full scale impeller. Figure

1 shows a sketch of the model and test apparatus. The scale of this model was 1:5.367 and was selected based on using a stock propeller existing at the Davidson Laboratory, which corresponded to the projected diameter of the full scale impeller. Detailed characteristics of the model are given in Table 1. The model hull was constructed in two parts, forward and aft of the hinge point. The forward section was constructed of clear acrylic plastic and represents the bottom of the amphibian. The aft section of the model was constructed of PVC and represents the retractable transom flap which houses the waterjet system. Both sections had zero degree deadrise with the aft section inclined downward 4 degrees relative to the forward section. This corresponds to the optimum flap setting determined by model tests of the bare hull at DWTNSRDC. These tests also showed that the optimum running trim of the forebody was at 10 degrees with the resulting trim of the transom flap at 14 degrees. These conditions were set in the model for all test runs.

The waterjet was composed of six separate sections as shown in Figure 2: the inlet, with static pressure taps I2, I3 and I4 in the wall; the transition section with static pressure taps T1, T2 and T3 in the wall; the circular test section with 6 Prandtl tubes in the flow; the diffuser; the impeller section with two static pressure taps H1 and H2 ahead and astern of the impeller; and the exit ducting. The test model was constructed so that various combinations of inlet and transition sections could easily be installed.

Inlets: The baseline inlet design was the so-called Stevens inlet which had previously been used in a manned-model test craft during the initial stages of the waterjet development program (References 1, 2 and 3). This was the longest of the four inlets tested and is shown in Figure 3. This inlet has a maximum cross-section width of 16.1 inches.

In an attempt to develop shorter inlets which could be more readily installed in the fixed length transom flap, DWTNSRDC developed three additional, but shorter inlets which are shown in Figures 4, 5, and 6. These inlets are 21.25" wide. In addition to being shorter than the Stevens inlet, the leading edge of each DWTNSRDC inlet rises above the trailing edge. These three inlets are identified as the 21/2.50, 27/0, and 21/0 inlets, where the first number refers to the full scale length of the inlet and the second number refers to the rise of the leading edge above the

tangent to the upper surface of the aft lip of the inlet. Eighty grit sandpaper was attached to this lip to provide turbulence stimulation to the flow entering the inlet.

Transition: Three interchangeable transition sections were molded from PVC and were mounted in an aluminum frame. The transition sections transferred the flow from the square section of the inlet to the round section of the impeller. These transitions modeled 6, 8, and 10 inch full-scale transition lengths.

Test Section: The test section was located immediately after the transitions. This section contained a row of Prandtl tubes to measure the velocity profile at the location of the prototype impeller. Ports were located in the test section to allow the Prandtl tubes to be set at three angular positions as seen in Figure 7.

Diffuser: The diffuser section transferred the flow from a 3 inch to a 4 inch diameter duct where the test impeller was located. This impeller was housed in a brass section carrying the shaft bearing on a cruciform strut.

Exit Ducting: Aft of the diffuser and impeller duct is the exit ducting. This ducting directed the flow out the sides of the test craft so that the waterjet would not impart any thrust to the model, allowing the hydrodynamic drag to be measured directly.

INSTRUMENTATION

Forces: Model lift and drag were measured using a multi-component balance fitted with linear-variable, differential transformers. The capacity of the balance allowed for measurements of up to 500 lb drag and 1000 lb lift.

Shaft Speed: The model impeller was belt driven by a 5 hp motor. The differential diameters between the motor and impeller shafts provided a 1.75 ratio impeller speed increase to allow for testing at up to 5100 rpm. The motor control box contained a frequency to voltage converter, which provided a voltage proportional to motor speed. This voltage was calibrated against the motor rpm using a strobe light.

Pressure Measurements: Pressure taps were connected to diaphragm-type, differential pressure gages (Schaevitz Pressure Transducer Model P-3091) with water-filled flexible tubing. Since zero values for all data channels were taken with the model at rest in the water, the pressure-transducer zeros represent a head of water equal to the submergence of each pressure tap. This head was calculated within the data processing program based on the model attitude and the location of each pressure tap. The static head for each tap with the model at 14 deg trim and 11 inch draft can be found as follows:

$$\text{head, ft} = 11/12 - [X * \sin(14 \text{ deg}) + Z * \cos(14 \text{ deg})]/12$$

Table 2 gives the horizontal distance (X) forward of the transom and the vertical distance (Z) above the baseline, in inches, for each pressure tap location.

PHOTOGRAPHY

All test runs were recorded on a VHS videocassette. The camera was set up to show a bow-quartering view. Above water photographs of the model and apparatus appear in Figures 8 and 9.

TEST PROCEDURE

Jet Velocity Calibration

The jet velocity was determined from a velocity survey of the test section and calibration of the bollard pull velocities. The velocities were measured with a rake of 6 Prandtl tubes inserted into the test section at three angular orientations: in the vertical plane (0 degrees), at 45 degrees and in the horizontal plane (90 degrees) so that pressure readings were obtained at 18 radial and angular locations within the test section as is shown in Figure 7. The flow was assumed to be symmetric about the centerplane so the pressures measured at 45 degrees were mirrored to the opposite side. These pressures were integrated over the test section to

determine an average pressure and thereby an average integrated velocity through the waterjet. The integration method employed in determining the average pressure in the section assumed that the pressures were constant in each radial segment of the annulus as follows:

$$P_{avg} = \left[(P_3+P_4)/2*(.6875^2-.2325^2) + (P_2+P_5)/2*(1.0625^2-.6875^2) + (P_1+P_6)/2*(1.5000^2-1.0625^2) \right] / (1.5000^2-.2325^2)$$

This calculated flow was then compared to the actual flow measured through the waterjet. To obtain a direct measurement of the flow, a PVC pipe was attached to each waterjet exit to redirect the flow into the docking basin. The actual mass flow rate through the jet was measured by recording the time required to fill the docking basin. Figure 10 shows the calculated flow rates and the measured flow rates plotted against the impeller rpm. These data are tabulated in Appendix A along with the pressure distributions used to develop the integrated flow rates. From these data the relationship between actual and integrated flow rates was determined to be:

$$\text{Actual flow rate} = \text{Integrated average flow rate} - 0.04 \text{ cfs}$$

The close agreement between measured and computed flow rates indicates that the method chosen to integrate the pressure distribution within the test section is valid. This relationship was applied to each test condition to determine the flow rates presented in this report. The flow rates for each inlet/transition combination and nominal impeller rpm are summarized in Table 3. While running the model tests, the impeller rpm could not be precisely controlled but was within ± 50 rpm of the set value. No attempt was made to correct for this rpm variation between runs. Results are tabulated in terms of the nominal rpm. The inlet velocity ratio (IVR) and test section velocity (TVR) determined from these flow rates are given in Table 4. The velocity ratios are defined as the velocities in the inlet or test section as a fraction of the free stream velocity; i.e. $IVR = V_I/V_0$ and $TVR = V_T/V_0$.

Bollard Pull

Bollard pull tests were conducted in the docking basin to determine the model lift and drag forces and pressure distributions in the waterjet ducting at zero model speed. A semi-circular, U-shaped fairing was fitted around the sides and aft end of the inlet during the bollard pull tests to smooth the flow entering into the duct and prevent flow separation along the bottom of the inlet. Once steady-state conditions were established at the desired impeller rpm, the data were averaged over a 10 second period.

Before testing at each configuration, a clear plexiglass box was placed in the exit stream to determine the degree of aeration in the flow by observing the passage of air bubbles. A small degree of aeration in the flow was present but was judged to have a minimal effect on the model data.

Ahead Speed

The test craft was towed at a constant speed of 26.5 fps. This is the same speed at which the prototype vessel will operate. Since the model waterjet impeller will be experiencing the same velocity as is present in the full scale, no expansion of the data was required. It must be noted that the lift and drag data presented in this report apply to the model test craft and not to the prototype vessel. The model was fixed in surge, sway, heave, roll, pitch and yaw. The trim of the baseline was set at 14 degrees corresponding to the full scale craft running at 10 degrees with the transom flap deflected 4 degrees. The model heave was adjusted to a transom draft of 11 inches. This draft allowed unaerated flow to enter the inlet while keeping much of the forward section of the hull out of the water.

Model force and pressure distribution data were taken and averaged over a 50 foot length of model travel after the test craft had accelerated to steady speed. Approximately 10 minutes were allowed to pass between successive runs to allow a surface skimmer to quiet the tank surface.

Three runs were made at each test condition to allow for an angular survey of the pressures in the test section. Therefore, three sets of inlet pressures, transition pressures, model lift, and model drag data were taken.

To determine the effect of the inlet alone on the vessel lift and drag, tests were run with the inlet covered by a flat plate at the design speed of 26.5 fps. These readings were compared with the test runs with the pump operating to determine the effect of inlet flow on the lift and drag.

Boundary Layer

Tests were conducted to determine the depth of the boundary layer ahead of the inlet. A Prandtl tube located in front of the inlet was used to determine the water velocity at varying depth from the hull at the design speed, with and without the impeller running.

TEST PROGRAM

Tests were conducted in Davidson Laboratory Tank 3, 313 ft x 12 ft x 5.4 ft deep. Each inlet and transition combination was tested at three impeller rpm's for both bollard pull (0 fps) and design speed (26.5 fps) to cover the range of inlet velocity ratios expected for the prototype vessel. To complete the velocity survey, three runs were made at each condition, with the Prandtl tubes in the test section set at 0 deg (top), 45 deg (diagonal) and 90 deg (side). The following combinations were tested:

Basic Test Program

Inlet	Transition length, in	Model Speed fps	Nominal Impeller rpm
Stevens	8	0	2200, 2800, 3600
		26.5	3600, 4300, 5100
21/2.50	6, 8, 10	0	2800, 3600, 4300
		26.5	3600, 4300, 5100
27/0	6, 10	0	2800, 3600, 4300
		26.5	3600, 4300, 5100
21/0	6, 10	0	2800, 3600, 4300
		26.5	3600, 4300, 5100

Boundary Layer Tests

Boundary layer tests were conducted at the following conditions, with the Prandtl tube located 4-1/2 inches ahead of the inlet and 9 inches aft of the calm water surface intersection with the hull.

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Similarly, the change in lift induced by the inlet was determined by subtracting the bare hull lift, L_h , from the measured lift.

$$L_i = L - L_h$$

where L_i = inlet lift

L = measured lift (with pump operating)

L_h = bare hull lift

Both the inlet lift and inlet drag results were non-dimensionalized by the inlet width, length and free stream velocity to develop the coefficients given in the tables and plotted in Figures 11 and 12. These figures show average coefficient values for every group of three runs at the same condition. Several runs contain spurious data. In these cases, the drag and lift coefficients plotted are the average of the two good runs at that condition. The 21/2.50 inlet shows the greatest reduction in drag while the Stevens inlet shows a slight increase in drag at the lower velocity ratios (Figure 11). The model inlet drag for all the inlets varied from about 10 to -10 lbs. All the inlets exhibited very similar performance with regard to decrease in lift. The lift coefficients varied from about -0.5 at an IVR of 0.95 to -0.8 at an IVR of 1.2.

The relative performance of the waterjet configurations may be evaluated on the basis of two key coefficients; K_{ot} and RPR.

K_{ot} is a loss coefficient related to the pressure drop occurring in the inlet and transition sections and is defined as follows:

$$K_{ot} = (V_o^2/2g - (P_T \text{ tot}) / (V_T^2/2g)$$

A low loss coefficient indicates high efficiency. These coefficients are tabulated in Table 8 and are plotted versus the test section velocity ratio in Figure 13 for each inlet and transition length. The Stevens inlet shows the lowest loss coefficient of 0.19 at the design TVR of 1.4. The 27/0 inlet is next best with loss coefficients of about 0.25. The 21/2.50 inlet has loss coefficients varying from between 0.27 and 0.30 for the three transition lengths of 6, 10 and 8 inches. The 21/0 inlet shows the worst performance by far having loss coefficients of 0.37 and 0.40 at the design TVR for the 6 and 10 inch transition lengths respectively.

RPR is the ram pressure recovery at the test section. A RPR of 1.00 indicates that all the energy available in the free stream flow has been recovered and is available to do work; this coefficient is a measure of the inlet and transition efficiency and is defined as:

$$RPR = (P_{T \text{ tot}})/(V_o^2/2g)$$

A summary of the coefficient is given in Table 9. These coefficients are plotted against the test section velocity ratio in Figure 14. This figure shows that the Stevens inlet has the highest recovery ratio of 0.62 while the 21/0 inlet has the lowest of about 0.25 at the design test section velocity ratio of 1.40. The 27/0 inlet has a RPR of 0.52 with transition length having little effect on the inlet performance. The 21/2.50 inlet has recovery ratios of 0.42 to 0.47 at the design TVR.

An additional parameter that is of interest in evaluating these inlets is the cavitation index, σ , in the test section where the prototype impeller will be located.

$$\sigma = (H_{\text{atm}} + P_{T \text{ stat}} - H_{\text{vap}})/(V_T^2/2g)$$

When this index falls below a critical value, cavitation will occur. σ is tabulated in Table 10 and plotted in Figure 15 as a function of the test section velocity ratio. These results show that the Stevens inlet is least likely to cavitate with $\sigma = 0.78$ and the 21/0 inlet is most susceptible to cavitation with $\sigma = 0.54$ at the design TVR of 1.40.

BOUNDARY LAYER RESULTS AND DISCUSSION

Results of the boundary layer study ahead of the inlet are given in Table 11. These results give the velocity profile at varying distance from the hull bottom for two inlet velocity ratios; IVR = 0 and IVR = 1.16. The velocity distribution is shown in Figure 16. As expected, with an IVR of 1.16, a positive pressure gradient in the flow develops and the local measured velocity exceeds the free stream velocity ($u/U > 1.0$). With zero pressure gradient in the flow (IVR = 0), the boundary layer thickness, defined as $u/U = 0.99$, is 0.265 inches, model scale.

CONCLUSIONS

The Stevens inlet with an 8 inch transition section showed the best overall performance. This good performance can be attributed to its relatively long inlet length compared to the other inlets tested. The Stevens inlet had the highest ram pressure recovery ratio, lowest loss coefficient and was the least susceptible to cavitation of all the inlets. However, it did suffer a slight increase in drag at the lower inlet velocity ratios.

The 27/0 inlet had the lowest losses and highest recovery ratio of the three DWTNSRDC inlets. The 21/2.50 inlet showed the greatest reduction in drag of all the inlets and better performance than the 21/0 inlet.

The inlet length is of primary importance in the efficiency of the waterjet configuration. The 27/0 inlet showed an increase in efficiency of approximately 52 percent over the 21/0 inlet. Inlet rise is also very important, shown by the 35 percent improvement in performance of the 21/2.50 inlet over the 21/0 inlet. The length of transition does not seem to significantly effect the inlet efficiency, lift and drag characteristics or likelihood of cavitation.

ACKNOWLEDGEMENT

I wish to thank Mr. Aldo Sori, Chief Designer at the Davidson Laboratory for his invaluable work in designing the waterjet model and his continued assistance throughout the completion of this project. Mr. John K. Roper of Roper Associates provided the major effort in developing the Stevens waterjet concept and assisted in the analysis of the test data. The support of our machinists Marshall Reid and Doug Meding, and our laboratory technician John Link are also gratefully acknowledged. Mr. Richard Krukowski, Chief Instrument Designer at the Davidson Laboratory provided his usual expertise in assuring proper behavior of all the electronics.

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TABLE 1

MODEL CHARACTERISTICS

 $(\lambda = 1:5.367)$

<u>Test Craft</u>	<u>Particulars</u>
Length	5.33 ft
Breadth	1.25 ft
Baseline Trim	14 deg
Transom Draft	11 in
Impeller Diameter	.325 ft
Test Section Area	.0479 sq ft

WaterJet Inlet Particulars

Configuration	Length in	Width in	Inlet Flow Area sq ft
Stevens	5.25	3.00	.0654
21/2.50	3.91	3.96	.0614
27/0	5.03	3.96	.0631
21/0	3.91	3.96	.0560

TABLE 2

Pressure Tap Locations

Location of Inlet Static Pressure Taps, Inches

	Stevens		21/2.50		27/0		21/0	
	<u>X</u>	<u>Z</u>	<u>X</u>	<u>Z</u>	<u>X</u>	<u>Z</u>	<u>X</u>	<u>Z</u>
I1	40.25	- .43	36.75	.83	36.75	0.37	36.75	0.37
I2	36.00	0.30	33.12	1.03	34.00	0.66	33.12	0.66
I3	33.69	2.25	32.13	1.96	32.25	2.13	32.20	1.60
I4	32.62	1.00	31.39	1.20	31.50	1.32	31.50	0.98

Location of Transition Static Pressure Taps, Inches

	<u>X</u>	<u>Z</u>
T1	29.06	0.40
T2	29.06	1.90
T3	29.06	3.40

Location of Test Section Prandtl Tubes, Inches

	0°		45°		90°	
	<u>X</u>	<u>Z</u>	<u>X</u>	<u>Z</u>	<u>X</u>	<u>Z</u>
Top	27.5	3.16	27.5	2.79	27.5	1.91
2	27.5	2.785	27.5	2.53	27.5	1.91
3	27.5	2.41	27.5	2.26	27.5	1.91
4	27.5	1.41	27.5	1.56	27.5	1.91
5	27.5	1.035	27.5	1.29	27.5	1.91
Bottom	27.5	0.66	27.5	1.03	27.5	1.91

Location of Impeller Head Pressure Taps, Inches

	<u>X</u>	<u>Z</u>
H1	18.62	4.86
H2	17.25	5.16

X = Horizontal distance forward of transom, inches
 Z = Distance above baseline, inches

TABLE 3

Mass Flow Rate for all Inlets
Varying Transition, cfs

Model Velocity fps	Nominal Impeller rpm	Stevens	21/2.50			27/0		21/0	
		8	6	8	10	6	10	6	10
0	2180	.70							
0	2800	.93	.92	.90	.93	.93	.96	.89	.90
0	3600	1.14	1.16	1.15	1.14	1.18	1.22	1.13	1.12
0	4300		1.34	1.35	1.36	1.38	1.39	1.31	1.29
26.5	3600	1.59	1.60	1.59	1.59	1.60	1.59	1.54	1.53
26.5	4300	1.79	1.79	1.76	1.76	1.77	1.78	1.69	1.73
26.5	5100	1.92	1.88+	1.85+	1.88	1.90	1.93	1.80	1.79

TABLE 4

Velocity Ratios for all Inlets
Varying Transition

Model	Nominal	Stevens	21/2.50				27/0		21/0	
Velocity	Impeller									
fps	rpm	8	6	8	10	6	10	6	10	
Inlet Velocity Ratio, V_I/V_0										
26.5	3600	.92	.98	.98	.97	.96	.95	1.03	1.03	
26.5	4300	1.03	1.10	1.08	1.08	1.06	1.06	1.14	1.16	
26.5	5100	1.11	1.16+	1.13+	1.16	1.13	1.15	1.21	1.21	
Test Section Velocity Ratio, V_T/V_0										
26.5	3600	1.25	1.26	1.26	1.25	1.26	1.25	1.21	1.20	
26.5	4300	1.41	1.41	1.40	1.38	1.40	1.40	1.33	1.36	
26.5	5100	1.51	1.48+	1.45+	1.48	1.49	1.52	1.42	1.41	

+Estimated Value

TABLE 5.1

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
357#	0.0	2175.	0.	Static	-1.8	-1.8	-1.8	-1.9	-1.4	-1.2	-1.68	0.66
				Dynamic	1.8	1.8	1.9	1.0	1.2	0.6	1.35	
				Total	0.0	0.0	0.1	-0.9	-0.2	-0.6	-0.33	
372#	0.0	2182.	45.	Static	-1.8	-1.8	-1.9	-1.6	-1.7	-1.9	-1.88	0.73
				Dynamic	1.9	1.8	1.9	1.0	1.3	1.4	1.59	
				Total	0.1	0.0	0.0	-0.6	-0.4	-0.5	-0.29	
329#	0.0	2172.	90.	Static	-1.8	-1.8	-1.9	-1.9	-1.8	-1.6	-1.86	0.84
				Dynamic	1.8	1.9	1.7	1.7	2.8	2.4	2.10	
				Total	0.0	0.1	-0.2	-0.2	1.0	0.8	0.24	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
338#	0.0	2808.	0.	Static	-3.1	-3.0	-3.2	-3.2	-2.7	-2.4	-2.97	0.92
				Dynamic	3.1	3.1	3.3	1.7	2.7	1.5	2.53	
				Total	0.0	0.1	0.1	-1.5	0.0	-0.9	-0.44	
373#	0.0	2819.	45.	Static	-3.2	-3.1	-3.2	-2.9	-2.8	-3.0	-3.13	0.94
				Dynamic	3.2	3.1	2.8	2.0	2.0	2.2	2.62	
				Total	0.0	0.0	-0.4	-0.9	-0.8	-0.8	-0.51	
325#	0.0	2808.	90.	Static	-3.0	-3.0	-3.3	-3.2	-2.9	-2.8	-3.07	1.06
				Dynamic	3.1	3.0	2.7	2.6	4.3	3.7	3.34	
				Total	0.1	0.0	-0.6	-0.6	1.2	0.9	0.27	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
339#	0.0	3528.	0.	Static	-4.8	-4.7	-4.9	-5.0	-4.1	-3.5	-4.48	1.10
				Dynamic	4.9	4.7	5.2	2.5	3.9	1.7	3.70	
				Total	0.1	0.0	0.3	-2.5	-0.2	-1.8	-0.78	
374#	0.0	3598.	45.	Static	-5.1	-5.0	-5.3	-4.7	-4.5	-4.9	-5.03	1.15
				Dynamic	5.2	4.8	4.8	2.7	2.6	3.1	3.97	
				Total	0.1	-0.2	-0.5	-2.0	-1.9	-1.8	-1.06	
327#	0.0	3563.	90.	Static	-4.9	-4.9	-5.2	-5.3	-4.4	-4.0	-4.76	1.32
				Dynamic	5.0	4.9	4.8	4.2	6.1	5.3	5.14	
				Total	0.1	0.0	-0.4	-1.1	1.7	1.2	0.38	

#No bollard fairing attached at the inlet

TABLE 5.1
(Concluded)

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
341	26.5	3528.	0.	Static	-4.8	-4.8	-5.1	-5.1	-4.7	-4.7	-4.91	1.59
				Dynamic	7.2	8.3	8.5	9.7	8.5	5.3	7.44	
				Total	2.4	3.5	3.4	4.6	3.8	0.6	2.53	
369	26.5	3561.	45.	Static	-4.8	-4.9	-5.4	-4.2	-4.7	-5.3	-5.01	1.64
				Dynamic	7.0	6.6	8.1	8.7	9.3	8.3	7.89	
				Total	2.2	1.7	2.7	4.5	4.6	3.0	2.88	
322	26.5	3575.	90.	Static	-4.6	-4.5	-4.6	-5.0	-4.1	-4.4	-4.60	1.64
				Dynamic	7.1	8.6	8.1	8.6	8.8	7.4	7.90	
				Total	2.5	4.1	3.5	3.6	4.7	3.0	3.30	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
342	26.5	4320.	0.	Static	-6.0	-5.9	-6.0	-6.0	-5.1	-5.5	-5.83	1.67
				Dynamic	8.5	9.5	9.6	10.6	8.5	5.9	8.27	
				Total	2.5	3.6	3.6	4.6	3.4	0.4	2.44	
370	26.5	4357.	45.	Static	-7.2	-7.3	-7.8	-6.8	-6.9	-7.7	-7.41	1.87
				Dynamic	9.3	8.9	10.3	11.2	11.6	10.9	10.28	
				Total	2.1	1.6	2.5	4.4	4.7	3.2	2.87	
324	26.5	4289.	90.	Static	-6.7	-6.5	-6.3	-6.9	-5.5	-5.5	-6.35	1.84
				Dynamic	9.6	10.4	9.8	10.8	10.6	9.4	9.95	
				Total	2.9	3.9	3.5	3.9	5.1	3.5	3.60	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
343	26.5	4869.	0.	Static	-6.4	-6.3	-6.2	-6.1	-5.3	-6.1	-6.21	1.71
				Dynamic	9.0	9.7	9.8	10.8	8.3	6.6	8.62	
				Total	2.6	3.4	3.6	4.7	3.0	0.5	2.41	
371	26.5	5130.	45.	Static	-9.9	-9.6	-9.7	-9.5	-9.7	-10.2	-9.93	2.05
				Dynamic	11.9	11.2	12.1	13.8	15.0	11.5	12.37	
				Total	2.0	1.6	2.4	4.3	5.3	1.3	2.44	
324	26.5	4289.	90.	Static	-6.7	-6.5	-6.3	-6.9	-5.5	-5.9	-6.35	1.84
				Dynamic	9.6	10.4	9.8	10.8	10.6	9.4	9.95	
				Total	2.9	3.9	3.5	3.9	5.1	3.5	3.60	
323	26.5	5068.	90.	Static	-9.4	-9.1	-7.7	-8.4	-7.3	-7.7	-8.43	2.02
				Dynamic	12.1	12.9	11.0	11.9	12.8	11.3	11.99	
				Total	2.7	3.8	3.3	3.5	5.5	3.6	3.56	

TABLE 5.2

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
405	0.0	2826.	0.	Static	-3.5	-3.5	-3.4	-3.2	-3.3	-3.4	-3.48.	0.84
				Dynamic	3.4	3.5	3.4	2.8	1.2	0.5	2.29	
				Total	-0.1	0.0	0.0	-0.4	-2.1	-2.9	-1.19	
377#	0.0	2826.	45.	Static	-3.4	-3.5	-3.9	-3.0	-3.0	-3.2	-3.39	0.70
				Dynamic	3.5	3.4	3.2	1.2	0.5	0.1	1.90	
				Total	0.1	-0.1	-0.7	-1.8	-2.5	-3.1	-1.49	
446	0.0	2798.	90.	Static	-2.7	-2.6	-2.9	-2.3	-2.6	-3.1	-2.85	0.98
				Dynamic	2.8	2.7	2.7	2.2	2.7	3.3	2.84	
				Total	0.1	0.1	-0.2	-0.1	0.1	0.2	-0.01	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
406	0.0	3532.	0.	Static	-5.4	-5.4	-5.4	-5.0	-5.1	-5.2	-5.36	1.06
				Dynamic	5.4	5.0	5.3	4.7	2.4	0.8	3.66	
				Total	0.0	-0.4	-0.1	-0.3	-2.7	-4.4	-1.70	
376#	0.0	3535.	45.	Static	-5.2	-5.3	-5.8	-4.7	-4.4	-4.9	-5.12	0.83
				Dynamic	5.3	4.8	5.0	2.1	1.0	-0.2	2.84	
				Total	0.1	-0.5	-0.8	-2.6	-3.4	-5.1	-2.28	
447	0.0	3523.	90.	Static	-4.3	-4.3	-4.7	-3.7	-4.2	-5.0	-4.54	1.21
				Dynamic	4.5	4.1	4.4	3.7	4.3	5.2	4.49	
				Total	0.2	-0.2	-0.3	0.0	0.1	0.2	-0.05	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
407	0.0	4218.	0.	Static	-7.4	-7.3	-7.5	-6.9	-6.9	-7.0	-7.28	1.20
				Dynamic	7.4	7.0	7.5	5.8	2.4	0.9	4.80	
				Total	0.0	-0.3	0.0	-1.1	-4.5	-6.1	-2.48	
378#	0.0	4296.	45.	Static	-7.5	-7.4	-8.0	-6.7	-6.3	-6.9	-7.21	0.99
				Dynamic	7.5	6.9	7.2	3.2	1.3	-0.4	4.03	
				Total	0.0	-0.5	-0.8	-3.5	-5.0	-7.3	-3.18	
448	0.0	4262.	90.	Static	-6.0	-5.9	-6.3	-4.9	-5.7	-6.7	-6.14	1.44
				Dynamic	6.1	5.5	6.1	4.9	5.8	6.9	6.05	
				Total	0.1	-0.4	-0.2	0.0	0.1	0.2	-0.09	

#No bollard fairing attached at the inlet

TABLE 5.2
(Concluded)

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
409	26.5	3500.	0.	Static	-5.9	-6.3	-6.3	-5.4	-5.7	-5.8	-6.00	1.52
				Dynamic	8.1	7.1	8.8	10.1	5.6	4.5	6.91	
				Total	2.2	0.8	2.5	4.7	-0.1	-1.3	0.91	
379	26.5	3583.	45.	Static	-5.4	-5.4	-5.9	-4.9	-5.5	-5.7	-5.59	1.67
				Dynamic	8.2	8.0	9.1	9.6	10.9	6.2	8.27	
				Total	2.8	2.6	3.2	4.7	5.4	0.5	2.68	
450	26.5	3597.	90.	Static	-4.6	-4.7	-4.9	-3.6	-4.3	-5.0	-4.72	1.68
				Dynamic	7.2	8.3	9.0	6.9	9.2	9.0	8.27	
				Total	2.6	3.6	4.1	3.3	4.9	4.0	3.55	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
410	26.5	4343.	0.	Static	-8.0	-8.5	-8.4	-7.8	-7.8	-8.1	-8.18	1.64
				Dynamic	10.2	9.1	10.6	10.0+	5.3	4.5	7.87	
				Total	2.2	0.6	2.2	2.2+-	2.5	-3.6	-0.31	
380	26.5	4321.	45.	Static	-7.7	-7.7	-8.1	-6.9	-7.6	-8.1	-7.85	1.88
				Dynamic	10.5	9.8	11.0	11.1	12.6	8.9	10.41	
				Total	2.8	2.1	2.9	4.2	5.0	0.8	2.56	
451	26.5	4339.	90.	Static	-6.9	-6.5	-6.9	-5.6	-6.3	-7.4	-6.87	1.93
				Dynamic	10.8	10.3	11.4	8.8	11.3	11.9	10.94	
				Total	3.9	3.8	4.5	3.2	5.0	4.5	4.07	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
411*	0.0	3507.	0.	Static	-4.9	-5.2	-5.5	-6.1	-4.9	-6.7	-5.66	1.88
				Dynamic	9.2	8.6	9.1	55.5	6.5	6.0	12.29	
				Total	4.3	3.4	3.6	49.4	1.6	-0.7	6.63	
381	26.5	5045.	45.	Static	-9.4	-9.2	-9.6	-8.3	-9.2	-9.5	-9.37	2.00
				Dynamic	12.8	11.3	12.0	11.7	13.6	9.7	11.74	
				Total	3.6	2.1	2.4	3.4	4.4	0.2	2.37	
453	26.5	5085.	90.	Static	-8.0	-7.8	-8.2	-6.9	-7.5	-8.8	-8.09	2.04
				Dynamic	11.9	11.6	12.2	10.4	12.6	13.5	12.25	
				Total	3.9	3.8	4.0	3.5	5.1	4.7	4.16	

*Run is no good

+Estimated value

TABLE 5.3

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
416	0.0	2790.	0.	Static	-3.4	-3.3	-3.4	-3.2	-3.1	-3.2	-3.35	0.79
				Dynamic	3.3	3.3	3.4	2.8	1.1	0.2	2.16	
				Total	-0.1	0.0	0.0	-0.6	-2.0	-3.0	-1.19	
438	0.0	2816.	45.	Static	-3.5	-3.3	-3.3	-3.1	-3.2	-3.6	-3.46	0.98
				Dynamic	3.5	3.3	3.2	3.2	2.5	1.8	2.85	
				Total	0.0	0.0	-0.1	0.1	-0.7	-1.8	-0.61	
455	0.0	2822.	90.	Static	-2.9	-2.8	-3.1	-1.9	-2.8	-3.1	-2.93	0.99
				Dynamic	3.0	2.9	2.9	1.8	2.9	3.2	2.90	
				Total	0.1	0.1	-0.2	-0.1	0.1	0.1	-0.03	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
417	0.0	3550.	0.	Static	-5.3	-5.2	-5.3	-5.1	-4.9	-5.7	-5.41	1.05
				Dynamic	5.2	5.1	5.2	4.4	1.6	1.1	3.54	
				Total	-0.1	-0.1	-0.1	-0.7	-3.3	-4.6	-1.87	
439	0.0	3588.	45.	Static	-5.9	-5.4	-5.5	-5.1	-5.0	-5.9	-5.69	1.24
				Dynamic	6.0	5.2	5.2	5.1	4.0	2.8	4.60	
				Total	0.1	-0.2	-0.3	0.0	-1.0	-3.1	-1.09	
456	0.0	3560.	90.	Static	-4.7	-4.5	-4.9	-3.4	-4.5	-5.1	-4.71	1.24
				Dynamic	4.5	4.3	4.8	3.0	4.6	5.2	4.54	
				Total	-0.2	-0.2	-0.1	-0.4	0.1	0.1	-0.17	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
418	0.0	4255.	0.	Static	-7.6	-7.4	-7.6	-7.2	-7.0	-7.8	-7.60	1.23
				Dynamic	7.5	7.1	7.5	5.9	2.3	1.2	4.91	
				Total	-0.1	-0.3	-0.1	-1.3	-4.7	-6.6	-2.69	
440	0.0	4296.	45.	Static	-7.7	-7.1	-7.4	-7.0	-6.8	-7.6	-7.47	1.44
				Dynamic	7.9	6.7	7.0	6.5	4.8	4.5	6.17	
				Total	0.2	-0.4	-0.4	-0.5	-2.0	-3.1	-1.30	
457	0.0	4271.	90.	Static	-6.3	-6.2	-6.6	-4.5	-6.0	-6.8	-6.32	1.45
				Dynamic	6.4	5.8	6.4	3.9	6.2	7.0	6.19	
				Total	0.1	-0.4	-0.2	-0.6	0.2	0.2	-0.13	

TABLE 5.3
(Concluded)

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
422	26.5	3568.	0.	Static	-5.5	-5.9	-6.0	-5.5	-5.5	-6.1	-5.86	1.48
				Dynamic	8.0	7.0	8.5	8.7	4.7	4.5	6.56	
				Total	2.5	1.1	2.5	3.2	-0.8	-1.6	0.70	
442	26.5	3583.	45.	Static	-5.9	-5.7	-5.9	-5.3	-5.3	-6.1	-5.86	1.66
				Dynamic	8.9	8.1	8.9	7.1	9.6	6.7	8.14	
				Total	3.0	2.4	3.0	1.8	4.3	0.6	2.28	
458	26.5	3658.	90.	Static	-4.7	-4.7	-5.0	-2.9	-4.6	-5.2	-4.77	1.73
				Dynamic	8.5	8.7	9.3	6.4	9.2	9.5	8.78	
				Total	3.8	4.0	4.3	3.5	4.6	4.3	4.01	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
423	26.5	4367.	0.	Static	-7.8	-8.4	-8.3	-7.9	-7.8	-9.0	-8.34	1.58
				Dynamic	9.9	9.0	10.3	9.0	4.6	4.4	7.51	
				Total	2.1	0.6	2.0	1.1	-3.2	-4.6	-0.83	
444	26.5	4331.	45.	Static	-8.2	-7.7	-7.3	-7.6	-7.3	-8.3	-7.96	1.88
				Dynamic	11.3	10.2	11.0	9.4	11.6	9.1	10.43	
				Total	3.1	2.5	3.7	1.8	4.3	0.8	2.47	
459	26.5	4333.	90.	Static	-6.6	-6.5	-6.9	-4.2	-6.3	-7.4	-6.61	1.87
				Dynamic	10.2	10.0	10.9	7.1	10.8	11.3	10.31	
				Total	3.6	3.5	4.0	2.9	4.5	3.9	3.70	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
425	26.5	5106.	0.	Static	-10.4	-10.5	-9.7	-10.3	-9.3	-11.1	-10.44	1.69
				Dynamic	12.2	11.0	12.3	10.4	4.6	4.6	8.76	
				Total	1.8	0.5	2.6	0.1	-4.7	-6.5	-1.68	
445	26.5	5169.	45.	Static	-9.7	-9.3	-9.3	-9.9	-8.8	-10.5	-9.78	2.03
				Dynamic	13.7	12.4	11.7	11.2	12.0	10.9	12.10	
				Total	4.0	3.1	2.4	1.3	3.2	0.4	2.32	
460*	26.5	3987.	90.	Static	-6.4	-6.4	-7.2	-4.5	-6.5	-7.1	-6.59	1.79
				Dynamic	9.4	9.1	9.5	6.6	9.6	10.3	9.38	
				Total	3.0	2.7	2.3	2.1	3.1	3.2	2.79	

*Run is no good

TABLE 5.4

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
402	0.0	2796.	0.	Static	-3.4	-3.3	-3.5	-3.2	-3.0	-3.2	-3.36	0.83
				Dynamic	3.4	3.4	3.5	3.1	1.6	0.3	2.33	
				Total	0.0	0.1	0.0	-0.1	-1.4	-2.9	-1.03	
389	0.0	2876.	45.	Static	-3.5	-3.6	-3.7	-3.3	-3.2	-3.4	-3.53	1.02
				Dynamic	3.6	3.6	3.1	3.2	2.7	2.4	3.05	
				Total	0.1	0.0	-0.6	-0.1	-0.5	-1.0	-0.48	
465	0.0	2817.	90.	Static	-2.9	-2.9	-3.0	-2.4	-2.8	-3.3	-3.04	1.02
				Dynamic	3.1	3.0	3.0	2.2	2.9	3.5	3.07	
				Total	0.2	0.1	0.0	-0.2	0.1	0.2	0.03	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
403	0.0	3528.	0.	Static	-5.5	-5.4	-5.5	-5.1	-4.9	-5.0	-5.33	0.98
				Dynamic	5.5	5.2	5.5	4.4	1.7	0.2	3.44	
				Total	0.0	-0.2	0.0	-0.7	-3.2	-4.8	-1.89	
390	0.0	3550.	45.	Static	-5.2	-5.2	-5.6	-5.0	-4.7	-4.9	-5.17	1.21
				Dynamic	5.4	5.0	4.8	4.9	3.2	3.3	4.34	
				Total	0.2	-0.2	-0.8	-0.1	-1.5	-1.6	-0.83	
466	0.0	3560.	90.	Static	-4.9	-4.6	-5.1	-4.8	-4.6	-5.3	-5.01	1.30
				Dynamic	5.0	4.3	5.1	4.2	4.8	5.6	4.93	
				Total	0.1	-0.3	0.0	-0.6	0.2	0.3	-0.08	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
404	0.0	4280.	0.	Static	-7.8	-7.6	-7.7	-7.1	-6.9	-7.0	-7.46	1.21
				Dynamic	7.8	7.3	7.7	6.4	2.6	0.7	4.98	
				Total	0.0	-0.3	0.0	-0.7	-4.3	-6.3	-2.48	
391	0.0	4312.	45.	Static	-7.4	-7.2	-7.2	-6.9	-6.6	-6.8	-7.13	1.44
				Dynamic	7.5	6.8	6.8	6.8	5.3	4.5	6.16	
				Total	0.1	-0.4	-0.4	-0.1	-1.3	-2.3	-0.97	
467	0.0	4271.	90.	Static	-6.6	-6.3	-6.8	-6.1	-6.2	-7.0	-6.67	1.50
				Dynamic	6.8	5.8	6.8	5.3	6.4	7.2	6.56	
				Total	0.2	-0.5	0.0	-0.8	0.2	0.2	-0.11	

TABLE 5.4
(Concluded)

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
399	26.5	3567.	0.	Static	-5.7	-5.9	-5.8	-5.6	-5.4	-5.6	-5.76	1.43
				Dynamic	7.8	6.7	8.7	8.8	4.2	3.5	6.20	
				Total	2.1	0.8	2.9	3.2	-1.2	-2.1	0.44	
394	26.5	3566.	45.	Static	-5.5	-5.4	-5.4	-5.3	-5.4	-5.7	-5.58	1.67
				Dynamic	7.6	7.5	8.9	9.8	10.8	6.9	8.23	
				Total	2.1	2.1	3.5	4.5	5.4	1.2	2.65	
468	26.5	3579.	90.	Static	-4.7	-4.6	-4.9	-4.4	-4.3	-5.1	-4.81	1.73
				Dynamic	8.5	8.5	9.2	8.1	8.9	9.3	8.78	
				Total	3.8	3.9	4.3	3.7	4.6	4.2	3.97	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
400	26.5	4318.	0.	Static	-7.8	-8.1	-7.7	-7.7	-7.4	-7.7	-7.84	1.52
				Dynamic	9.9	8.6	10.2	10.0	4.5	3.0	7.17	
				Total	2.1	0.5	2.5	2.3	-2.9	-4.7	-0.67	
395	26.5	4354.	45.	Static	-7.8	-7.5	-7.5	-7.8	-7.3	-7.7	-7.72	1.87
				Dynamic	11.3	10.2	10.1	11.9	11.2	8.3	10.28	
				Total	3.5	2.7	2.6	4.1	3.9	0.6	2.56	
470	26.5	4352.	90.	Static	-6.9	-6.7	-7.0	-6.4	-6.4	-7.5	-6.99	1.92
				Dynamic	10.7	10.3	10.7	9.5	11.1	11.6	10.80	
				Total	3.8	3.6	3.7	3.1	4.7	4.1	3.81	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
401	26.5	5102.	0.	Static	-10.3	-10.5	-9.5	-9.8	-8.9	-9.4	-9.85	1.65
				Dynamic	12.3	11.2	12.1	10.7	4.4	3.4	8.51	
				Total	2.0	0.7	2.6	0.9	-4.5	-6.0	-1.34	
397	26.5	5148.	45.	Static	-9.7	-9.5	-9.4	-9.7	-8.9	-9.6	-9.60	1.99
				Dynamic	13.1	12.3	12.0	12.8	11.8	9.0	11.60	
				Total	3.4	2.8	2.6	3.1	2.9	-0.6	2.00	
472	26.5	5033.	90.	Static	-8.2	-7.8	-8.2	-8.0	-7.6	-9.3	-8.40	2.05
				Dynamic	12.0	11.3	11.8	11.1	12.4	14.0	12.35	
				Total	3.8	3.5	3.6	3.1	4.8	4.7	3.95	

TABLE 5.5

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
493	0.0	2799.	0.	Static	-3.1	-3.1	-3.2	-3.2	-3.2	-3.3	-3.30	0.81
				Dynamic	3.2	3.2	3.2	2.4	0.9	0.6	2.12	
				Total	0.1	0.1	0.0	-0.8	-2.3	-2.7	-1.18	
501	0.0	2816.	45.	Static	-3.2	-3.2	-3.3	-3.1	-3.1	-3.6	-3.37	1.05
				Dynamic	3.3	3.3	3.1	3.0	2.9	3.6	3.25	
				Total	0.1	0.1	-0.2	-0.1	-0.2	0.0	-0.12	
476	0.0	2810.	90.	Static	-2.7	-2.7	-2.9	-2.6	-2.6	-3.0	-2.88	0.98
				Dynamic	2.8	2.8	2.6	2.1	2.8	3.1	2.81	
				Total	0.1	0.1	-0.3	-0.5	0.2	0.1	-0.07	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
495	0.0	3542.	0.	Static	-5.2	-5.2	-5.2	-5.2	-5.1	-5.3	-5.28	1.01
				Dynamic	5.2	4.9	5.0	4.1	1.8	0.7	3.35	
				Total	0.0	-0.3	-0.2	-1.1	-3.4	-4.6	-1.93	
502	0.0	3579.	45.	Static	-5.2	-5.1	-5.3	-5.1	-4.9	-5.5	-5.32	1.30
				Dynamic	5.3	4.9	4.9	4.5	4.3	5.2	4.94	
				Total	0.1	-0.2	-0.4	-0.6	-0.6	-0.3	-0.38	
477	0.0	3552.	90.	Static	-4.5	-4.5	-4.7	-4.3	-4.4	-4.9	-4.71	1.26
				Dynamic	4.7	4.4	4.5	3.8	4.6	5.2	4.63	
				Total	0.2	-0.1	-0.2	-0.5	0.2	0.3	-0.08	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
496	0.0	4296.	0.	Static	-7.3	-7.3	-7.2	-7.2	-7.1	-7.5	-7.40	1.17
				Dynamic	7.2	6.8	7.1	5.2	2.4	0.7	4.59	
				Total	-0.1	-0.5	-0.1	-2.0	-4.7	-6.8	-2.81	
503	0.0	4291.	45.	Static	-7.1	-6.8	-7.0	-7.0	-6.7	-7.4	-7.15	1.51
				Dynamic	7.3	6.4	6.7	6.2	6.3	6.7	6.71	
				Total	0.2	-0.4	-0.3	-0.8	-0.4	-0.7	-0.44	
478	0.0	4288.	90.	Static	-6.3	-6.1	-6.5	-5.8	-6.1	-6.7	-6.38	1.47
				Dynamic	6.4	5.6	6.0	5.5	6.4	6.9	6.30	
				Total	0.1	-0.5	-0.5	-0.3	0.3	0.2	-0.08	

TABLE 5.5
(Concluded)

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
497	26.5	3574.	0.	Static	-5.2	-5.6	-5.3	-5.5	-5.4	-5.3	-5.45	1.41
				Dynamic	7.3	7.0	7.4	7.7	3.9	4.1	5.97	
				Total	2.1	1.4	2.1	2.2	-1.5	-1.2	0.52	
504	26.5	3596.	45.	Static	-5.2	-5.2	-5.4	-5.2	-5.0	-5.5	-5.34	1.74
				Dynamic	8.2	8.8	7.9	9.3	9.5	9.2	8.83	
				Total	3.0	3.7	2.6	4.0	4.5	3.8	3.49	
480	26.5	3528.	90.	Static	-4.2	-4.2	-4.4	-4.4	-4.1	-4.6	-4.43	1.67
				Dynamic	7.8	8.2	7.9	7.4	8.4	8.7	8.13	
				Total	3.6	4.0	3.5	3.0	4.3	4.1	3.70	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
498	26.5	4340.	0.	Static	-7.4	-7.7	-7.3	-7.7	-7.6	-8.0	-7.72	1.54
				Dynamic	9.7	9.3	9.6	8.7	4.1	4.0	7.23	
				Total	2.3	1.6	2.3	1.0	-3.5	-4.0	-0.49	
505	26.5	4384.	45.	Static	-7.4	-7.2	-7.2	-7.4	-7.0	-7.7	-7.44	1.91
				Dynamic	10.4	10.9	10.0	11.0	10.8	10.9	10.69	
				Total	3.0	3.7	2.8	3.6	3.8	3.2	3.25	
481	26.5	4373.	90.	Static	-6.4	-6.3	-6.5	-6.5	-6.3	-7.2	-6.67	1.89
				Dynamic	9.9	10.0	9.7	9.6	10.8	11.5	10.42	
				Total	3.5	3.7	3.2	3.1	4.5	4.3	3.75	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
499	26.5	5099.	0.	Static	-10.2	-10.5	-10.0	-10.0	-9.3	-10.3	-10.20	1.67
				Dynamic	12.6	12.1	12.5	9.1	3.9	4.0	8.69	
				Total	2.4	1.6	2.5	-0.9	-5.4	-5.3	-1.51	
506	26.5	5132.	45.	Static	-9.6	-9.4	-9.1	-9.6	-9.0	-9.5	-9.51	2.07
				Dynamic	12.7	13.0	11.9	12.1	12.2	12.7	12.55	
				Total	3.1	3.6	2.8	2.5	3.2	3.2	3.04	
485	26.5	5103.	90.	Static	-7.4	-7.0	-7.0	-7.6	-6.9	-8.4	-7.59	1.93
				Dynamic	10.5	10.2	9.8	10.3	11.0	12.1	10.87	
				Total	3.1	3.2	2.8	2.7	4.1	3.7	3.28	

TABLE 5.6

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
513	0.0	2827.	0.	Static	-3.3	-3.3	-3.2	-3.3	-3.1	-3.5	-3.41	0.81
				Dynamic	3.3	3.3	3.2	2.8	1.2	0.4	2.19	
				Total	0.0	0.0	0.0	-0.5	-1.9	-3.1	-1.22	
507	0.0	2849.	45.	Static	-3.4	-3.3	-3.2	-3.4	-3.1	-3.6	-3.47	1.09
				Dynamic	3.5	3.4	3.2	3.3	3.2	3.8	3.46	
				Total	0.1	0.1	0.0	-0.1	0.1	0.2	-0.01	
487	0.0	2799.	90.	Static	-3.0	-2.8	-2.9	-3.1	-2.9	-3.2	-3.09	1.02
				Dynamic	3.1	3.0	2.4	2.7	3.0	3.5	3.07	
				Total	0.1	0.2	-0.5	-0.4	0.1	0.3	-0.02	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
514	0.0	3594.	0.	Static	-5.4	-5.4	-5.3	-5.1	-5.1	-5.7	-5.48	1.02
				Dynamic	5.4	5.1	5.1	3.9	1.8	0.7	3.44	
				Total	0.0	-0.3	-0.2	-1.2	-3.3	-5.0	-2.04	
508	0.0	3587.	45.	Static	-5.3	-5.2	-5.1	-5.2	-4.9	-5.6	-5.37	1.35
				Dynamic	5.4	5.0	5.0	5.0	4.9	5.9	5.33	
				Total	0.1	-0.2	-0.1	-0.2	0.0	0.3	-0.04	
488	0.0	3578.	90.	Static	-4.8	-4.7	-4.8	-4.9	-4.6	-5.1	-4.95	1.30
				Dynamic	5.1	4.6	4.2	4.6	4.9	5.4	4.93	
				Total	0.3	-0.1	-0.6	-0.3	0.3	0.3	-0.02	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
515	0.0	4299.	0.	Static	-7.6	-7.4	-7.2	-7.1	-6.9	-7.6	-7.45	1.15
				Dynamic	7.4	6.7	7.1	5.4	2.2	0.5	4.54	
				Total	-0.2	-0.7	-0.1	-1.7	-4.7	-7.1	-2.91	
509	0.0	4280.	45.	Static	-7.3	-7.0	-6.9	-6.9	-6.7	-7.4	-7.20	1.52
				Dynamic	7.5	6.6	6.8	6.4	6.4	6.4	6.73	
				Total	0.2	-0.4	-0.1	-0.5	-0.3	-1.0	-0.47	
489	0.0	4298.	90.	Static	-6.8	-6.5	-6.6	-6.3	-6.3	-6.9	-6.73	1.51
				Dynamic	7.0	6.0	5.9	6.0	6.7	7.2	6.68	
				Total	0.2	-0.5	-0.7	-0.3	0.4	0.3	-0.05	

TABLE 5.6
(Concluded)

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
516	26.5	3539.	0.	Static	-5.1	-5.6	-5.4	-5.3	-5.2	-5.4	-5.40	1.40
				Dynamic	6.9	7.0	7.1	7.7	4.2	4.0	5.87	
				Total	1.8	1.4	1.7	2.4	-1.0	-1.4	0.47	
510	26.5	3560.	45.	Static	-5.3	-5.2	-5.2	-5.2	-5.0	-5.3	-5.31	1.70
				Dynamic	7.9	8.6	7.9	9.2	9.3	8.3	8.45	
				Total	2.6	3.4	2.7	4.0	4.3	3.0	3.14	
490	26.5	3541.	90.	Static	-4.4	-4.5	-4.3	-4.4	-4.1	-4.6	-4.50	1.70
				Dynamic	8.3	8.6	7.8	8.0	8.7	8.9	8.50	
				Total	3.9	4.1	3.5	3.6	4.6	4.3	4.00	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
517	26.5	4305.	0.	Static	-7.4	-7.6	-7.3	-7.5	-7.3	-7.8	-7.61	1.56
				Dynamic	9.4	9.2	9.5	8.6	4.7	4.3	7.30	
				Total	2.0	1.6	2.2	1.1	-2.6	-3.5	-0.31	
511	26.5	4333.	45.	Static	-7.7	-7.4	-7.2	-7.4	-7.1	-7.7	-7.57	1.91
				Dynamic	10.5	11.1	10.0	11.0	11.4	10.3	10.66	
				Total	2.8	3.7	2.8	3.6	4.3	2.6	3.09	
491	26.5	4348.	90.	Static	-6.6	-6.4	-6.4	-6.4	-6.2	-6.9	-6.62	1.90
				Dynamic	10.5	10.4	9.5	10.0	11.0	11.2	10.60	
				Total	3.9	4.0	3.1	3.6	4.8	4.3	3.98	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
518	26.5	5108.	0.	Static	-10.4	-10.2	-9.9	-9.9	-8.9	-10.3	-10.13	1.72
				Dynamic	12.4	12.2	12.7	9.8	5.0	4.7	9.07	
				Total	2.0	2.0	2.8	-0.1	-3.9	-5.6	-1.06	
512	26.5	5107.	45.	Static	-10.6	-9.2	-9.0	-9.2	-8.6	-9.4	-9.60	2.07
				Dynamic	13.4	12.9	12.0	12.6	12.7	11.7	12.58	
				Total	2.8	3.7	3.0	3.4	4.1	2.3	2.98	
492	26.5	5095.	90.	Static	-7.8	-7.4	-7.4	-7.6	-7.3	-8.2	-7.79	2.00
				Dynamic	11.7	11.3	10.5	11.0	12.2	12.6	11.76	
				Total	3.9	3.9	3.1	3.4	4.9	4.4	3.97	

TABLE 5.7

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
519	0.0	2851.	0.	Static	-3.1	-3.2	-3.2	-2.9	-3.0	-3.4	-3.26	0.76
				Dynamic	3.0	3.0	3.0	2.3	0.9	0.3	1.93	
				Total	-0.1	-0.2	-0.2	-0.6	-2.1	-3.1	-1.33	
537	0.0	2791.	45.	Static	-3.1	-3.1	-3.1	-3.0	-2.9	-3.2	-3.16	0.97
				Dynamic	3.1	3.2	2.8	2.7	2.4	2.3	2.74	
				Total	0.0	0.1	-0.3	-0.3	-0.5	-0.9	-0.42	
547	0.0	2820.	90.	Static	-3.2	-2.9	-3.0	-3.0	-2.9	-2.9	-3.08	1.02
				Dynamic	3.3	3.0	2.7	3.0	3.0	3.1	3.06	
				Total	0.1	0.1	-0.3	0.0	0.1	0.2	-0.02	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
520	0.0	3565.	0.	Static	-5.0	-5.1	-4.9	-4.9	-4.7	-5.4	-5.13	0.90
				Dynamic	4.9	4.4	4.6	3.6	1.0	0.3	2.90	
				Total	-0.1	-0.7	-0.3	-1.3	-3.7	-5.1	-2.23	
538	0.0	3533.	45.	Static	-5.0	-5.0	-5.0	-4.9	-4.8	-5.2	-5.10	1.24
				Dynamic	5.1	4.8	4.5	4.5	4.2	4.0	4.52	
				Total	0.1	-0.2	-0.5	-0.4	-0.6	-1.2	-0.58	
548	0.0	3554.	90.	Static	-5.1	-4.6	-5.0	-4.9	-4.6	-4.7	-4.90	1.28
				Dynamic	5.2	4.4	4.3	4.9	4.7	4.8	4.80	
				Total	0.1	-0.2	-0.7	0.0	0.1	0.1	-0.10	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
521	0.0	4269.	0.	Static	-7.2	-7.4	-7.2	-7.1	-6.8	-7.3	-7.26	1.01
				Dynamic	7.0	6.3	6.0	4.7	1.3	0.1	3.95	
				Total	-0.2	-1.1	-1.2	-2.4	-5.5	-7.2	-3.31	
539	0.0	4256.	45.	Static	-6.8	-6.9	-7.0	-6.7	-6.5	-7.2	-6.97	1.43
				Dynamic	6.9	6.4	6.2	6.1	5.9	4.7	5.98	
				Total	0.1	-0.5	-0.8	-0.6	-0.6	-2.5	-0.99	
549	0.0	4266.	90.	Static	-7.1	-6.7	-6.9	-6.9	-6.5	-6.3	-6.83	1.51
				Dynamic	7.3	6.3	6.2	6.5	6.6	6.5	6.67	
				Total	0.2	-0.4	-0.7	-0.4	0.1	0.2	-0.16	

TABLE 5.7
(Concluded)

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
522	26.5	3568.	0.	Static	-5.1	-5.4	-5.5	-5.5	-5.3	-5.8	-5.52	1.27
				Dynamic	6.5	6.5	7.3	6.2	2.4	2.7	4.96	
				Total	1.4	1.1	1.8	0.7	-2.9	-3.1	-0.56	
540	26.5	3559.	45.	Static	-5.0	-5.2	-5.4	-5.6	-5.4	-6.3	-5.61	1.64
				Dynamic	7.2	9.0	8.3	9.4	9.0	6.7	7.91	
				Total	2.2	3.8	2.9	3.8	3.6	0.4	2.30	
550	26.5	3573.	90.	Static	-5.2	-5.0	-5.2	-5.2	-5.1	-4.6	-5.10	1.75
				Dynamic	7.8	9.6	8.9	9.0	9.9	9.4	9.00	
				Total	2.6	4.6	3.7	3.8	4.8	4.8	3.90	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
523	26.5	4382.	0.	Static	-7.4	-8.0	-7.9	-8.2	-7.6	-8.7	-8.06	1.39
				Dynamic	9.1	8.0	9.3	7.7	2.6	2.3	6.12	
				Total	1.7	0.0	1.4	-0.5	-5.0	-6.4	-1.94	
541	26.5	4376.	45.	Static	-7.3	-7.8	-7.7	-7.9	-7.4	-8.4	-7.87	1.92
				Dynamic	10.1	11.5	10.0	11.3	11.4	11.1	10.84	
				Total	2.8	3.7	2.3	3.4	4.0	2.7	2.97	
551	26.5	4342.	90.	Static	-7.3	-7.2	-7.4	-7.7	-7.4	-6.3	-7.20	1.95
				Dynamic	9.9	11.6	11.1	11.5	12.4	11.1	11.10	
				Total	2.6	4.4	3.7	3.8	5.0	4.8	3.90	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
524	26.5	5105.	0.	Static	-8.9	-10.2	-9.3	-10.0	-9.0	-10.6	-9.78	1.49
				Dynamic	10.7	10.7	10.6	10.1	2.5	2.2	7.25	
				Total	1.8	0.5	1.3	0.1	-6.5	-8.4	-2.53	
542	26.5	5119.	45.	Static	-8.9	-9.1	-9.0	-9.9	-8.6	-10.0	-9.35	1.92
				Dynamic	11.4	11.9	10.5	11.8	10.3	9.7	10.85	
				Total	2.5	2.8	1.5	1.9	1.7	-0.3	1.50	
554	26.5	4932.	90.	Static	-8.6	-8.5	-8.5	-9.1	-8.5	-7.3	-8.39	2.03
				Dynamic	11.1	12.6	11.9	12.9	13.7	11.7	12.12	
				Total	2.5	4.1	3.4	3.8	5.2	4.4	3.73	

TABLE 5.8

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
525	0.0	2811.	0.	Static	-3.2	-3.2	-3.1	-3.2	-3.0	-3.3	-3.26	0.73
				Dynamic	3.1	3.1	3.1	2.6	0.8	0.1	1.95	
				Total	-0.1	-0.1	-0.0	-0.6	-2.2	-3.2	-1.31	
531	0.0	2820.	45.	Static	-3.2	-3.1	-3.1	-3.2	-3.0	-3.4	-3.27	0.99
				Dynamic	3.2	3.2	3.0	2.9	2.7	2.3	2.86	
				Total	0.0	0.1	-0.1	-0.3	-0.3	-1.1	-0.41	
555	0.0	2802.	90.	Static	-3.2	-3.0	-3.1	-3.0	-2.9	-3.1	-3.15	1.03
				Dynamic	3.3	3.1	2.7	2.9	3.0	3.3	3.13	
				Total	0.1	0.1	-0.4	-0.1	0.1	0.2	-0.02	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
526	0.0	3558.	0.	Static	-5.2	-5.1	-5.1	-5.0	-4.8	-5.2	-5.18	0.91
				Dynamic	5.2	4.6	4.8	3.8	1.2	0.1	3.05	
				Total	0.0	-0.5	-0.3	-1.2	-3.6	-5.1	-2.13	
532	0.0	3582.	45.	Static	-5.1	-5.2	-5.1	-5.0	-4.8	-5.4	-5.24	1.21
				Dynamic	5.2	4.9	4.8	4.5	4.2	3.0	4.34	
				Total	0.1	-0.3	-0.3	-0.5	-0.6	-2.4	-0.90	
556	0.0	3550.	90.	Static	-5.1	-4.8	-5.0	-5.1	-4.8	-4.7	-5.00	1.30
				Dynamic	5.3	4.6	4.5	4.9	4.9	5.0	4.94	
				Total	0.2	-0.2	-0.5	-0.3	0.1	0.3	-0.06	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
527	0.0	4270.	0.	Static	-7.3	-7.4	-7.2	-7.1	-6.7	-7.2	-7.27	0.98
				Dynamic	7.2	6.4	6.4	4.9	1.3	-0.1	4.03	
				Total	-0.1	-1.0	-0.8	-2.2	-5.4	-7.3	-3.24	
533	0.0	4201.	45.	Static	-7.0	-6.9	-6.8	-6.6	-6.4	-7.1	-6.96	1.40
				Dynamic	7.2	6.3	6.5	6.1	5.9	3.7	5.83	
				Total	0.2	-0.6	-0.3	-0.5	-0.5	-3.4	-1.13	
557	0.0	4242.	90.	Static	-7.0	-6.7	-6.8	-6.9	-6.7	-6.5	-6.85	1.52
				Dynamic	7.2	6.2	6.3	6.5	7.0	6.9	6.82	
				Total	0.2	-0.5	-0.5	-0.4	0.3	0.4	-0.03	

TABLE 5.8
(Concluded)

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
528	26.5	3582.	0.	Static	-5.4	-5.8	-5.7	-5.6	-5.4	-6.0	-5.73	1.28
				Dynamic	7.0	7.1	7.8	6.7	2.8	2.0	5.16	
				Total	1.6	1.3	2.1	1.1	-2.6	-4.0	-0.57	
534	26.5	3539.	45.	Static	-5.1	-5.1	-5.2	-5.3	-5.0	-5.6	-5.34	1.62
				Dynamic	7.1	8.7	8.4	8.8	8.7	6.4	7.69	
				Total	2.0	3.4	3.2	3.5	3.7	0.8	2.35	
560	26.5	3545.	90.	Static	-5.4	-5.0	-5.2	-5.2	-5.1	-4.9	-5.20	1.75
				Dynamic	7.8	9.4	9.3	9.3	9.7	9.3	8.99	
				Total	2.4	4.4	4.1	4.1	4.6	4.4	3.79	
560	26.5	3545.	90.	Static	-5.4	-5.0	-5.2	-5.2	-5.1	-4.9	-5.20	1.75
				Dynamic	7.8	9.4	9.3	9.3	9.7	9.3	8.99	
				Total	2.4	4.4	4.1	4.1	4.6	4.4	3.79	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
529	26.5	4352.	0.	Static	-7.5	-8.3	-7.9	-7.9	-7.6	-8.5	-8.04	1.42
				Dynamic	9.4	8.8	9.7	8.0	3.7	1.9	6.44	
				Total	1.9	0.5	1.8	0.1	-3.9	-6.6	-1.60	
535	26.5	4313.	45.	Static	-7.4	-7.5	-7.5	-7.5	-7.2	-8.1	-7.68	1.84
				Dynamic	10.0	11.3	10.1	10.7	10.9	8.3	9.96	
				Total	2.6	3.8	2.6	3.2	3.7	0.2	2.28	
561	26.5	4382.	90.	Static	-7.8	-7.4	-7.5	-7.7	-7.3	-6.9	-7.48	1.95
				Dynamic	10.1	11.8	11.3	11.6	12.3	11.4	11.29	
				Total	2.3	4.4	3.8	3.9	5.0	4.5	3.81	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
530	26.5	5106.	0.	Static	-9.6	-9.9	-9.3	-9.9	-9.0	-10.4	-9.85	1.52
				Dynamic	11.3	10.7	11.5	10.1	3.5	1.9	7.54	
				Total	1.7	0.8	2.2	0.2	-5.5	-8.5	-2.31	
536	26.5	5114.	45.	Static	-9.1	-9.3	-9.2	-9.3	-8.7	-9.9	-9.36	1.86
				Dynamic	11.5	12.7	11.0	12.1	11.4	6.2	10.33	
				Total	2.4	3.4	1.8	2.8	2.7	-3.7	0.97	
562	26.5	5060.	90.	Static	-9.8	-9.1	-8.7	-9.4	-9.7	-7.5	-9.04	2.09
				Dynamic	12.0	13.3	12.0	13.4	14.9	12.0	12.77	
				Total	2.2	4.2	3.3	4.0	5.2	4.5	3.73	

TABLE 6.1

Static Pressures, Stevens Inlet, 8 inch Transition

Run No	Model Vel fps	Impeller Speed rpm	I1	I2	I3	I4	T1	T2	T3	H _p
337#	0.00	2175	-0.1	-0.1	-0.5	-0.8	-1.8	-1.8	-1.5	5.8
372#	0.00	2182	-0.5	-0.2	-0.9	-0.8	-1.8	-1.8	-1.7	4.2
329#	0.00	2172	-0.1	-0.2	-0.5	-0.7	-1.7	-1.7	-1.6	5.8
338#	0.00	2808	-0.2	-0.3	-1.0	-1.3	-3.1	-3.1	-2.5	27.2
373#	0.00	2819	-0.5	-0.3	-1.3	-1.2	-3.0	-3.1	-2.8	6.1
325#	0.00	2808	-0.2	-0.2	-1.1	-1.2	-2.9	-3.0	-2.8	15.6
339#	0.00	3528	-0.3	-0.5	-1.4	-1.9	-4.7	-4.8	-4.3	23.1
374#	0.00	3598	-0.7	-0.6	-1.9	-2.0	-4.8	-5.0	-4.4	8.8
327#	0.00	3563	-0.3	-0.4	-1.4	-1.9	-4.5	-4.8	-4.3	9.3
341	26.50	3528	-0.1	-1.2	-0.2	-0.3	-5.1	-4.6	-3.4	4.0
369	26.50	3561	0.4	-1.0	0.4	-0.1	-4.9	-4.4	-3.2	4.7
322	26.50	3575	0.3	-1.1	0.5	-0.2	-5.0	-4.3	-3.4	4.6
342	26.50	4320	-0.6	-1.6	-0.2	-1.0	-7.2	-6.5	-5.1	8.9
370	26.50	4357	0.3	-1.5	0.1	-0.8	-7.9	-6.9	-5.3	9.6
324	26.50	4289	0.1	-1.5	0.0	-0.9	-7.4	-6.6	-5.2	8.5
343	26.50	4869	-0.7	-1.7	-0.3	-1.1	-8.3	-7.9	-6.0	12.0
371	26.50	5130	0.3	-1.8	-0.2	-1.3	-11.0	-9.4	-7.3	14.7
323	26.50	5068	0.1	-1.8	-0.3	-1.3	-10.0	-8.5	-6.4	15.1

TABLE 6.2

Static Pressures, 21/2.50 Inlet, 6 inch Transition

Run No	Model Vel fps	Impeller Speed rpm	I1	I2	I3	I4	T1	T2	T3	H _p
405	0.00	2826	-0.3	-1.0	-1.3	-1.6	-3.2	-2.4	-2.3	7.0
377#	0.00	2826	-0.3	-0.7	-1.1	-1.1	-3.1	-2.6	-2.9	6.8
446	0.00	2798	-0.4	-0.9	-1.2	-1.3	-2.6	-2.3	-2.1	7.2
406	0.00	3532	-0.5	-1.5	-1.9	-2.5	-5.2	-3.8	-3.8	8.0
376#	0.00	3535	-0.5	-1.1	-1.7	-1.8	-4.8	-4.2	-4.3	10.1
447	0.00	3523	-0.6	-1.3	-1.9	-2.2	-4.4	-3.7	-3.4	9.9
407	0.00	4218	-0.7	-2.0	-2.5	-3.3	-6.9	-5.4	-5.3	13.3
378#	0.00	4296	-0.7	-1.5	-2.5	-2.6	-6.7	-6.0	-6.4	12.9
448	0.00	4262	-0.8	-1.8	-2.6	-3.0	-5.4	-4.9	-4.7	12.3
409	26.50	3550	0.4	-4.5	-1.5	-2.8	-4.3	-2.9	-2.4	4.6
379	26.50	3583	1.0	-5.0	-0.9	-2.8	-3.9	-2.9	-3.3	5.2
450	26.50	3597	-0.1	-3.6	-2.8	-2.8	-3.5	-2.7	-1.4	5.3
410	26.50	4343	-0.2	-5.7	-2.3	-4.0	-6.0	-4.5	-3.7	7.3
380	26.50	4321	0.8	-6.5	-2.1	-3.9	-5.5	-4.5	-5.3	9.4
451	26.50	4339	-0.7	-5.3	-2.2	-2.7	-5.1	-4.1	-3.4	8.1
411*	26.50	3507	-3.1	-4.2	-3.8	-4.1	-4.1	-4.9	-4.3	10.4
381	26.50	5045	0.7	-6.3	-2.5	-4.6	-7.4	-5.5	-5.0	15.3
453	26.50	5085	-0.9	-6.1	-2.5	-3.9	-6.3	-5.0	-4.0	14.0

#No bollard fairing attached at the inlet

*Run is no good

TABLE 6.3

Static Pressures, 21/2.50 Inlet, 8 inch Transition

Run No	Model Vel fps	Impeller Speed rpm	I1	I2	I3	I4	T1	T2	T3	H _p
416	0.00	2790	-0.4	-1.0	-1.4	-1.6	-3.1	-2.7	-2.1	4.6
438	0.00	2816	-0.3	-1.1	-1.2	-1.7	-3.4	-3.0	-2.1	5.8
455	0.00	2822	-0.4	-0.8	-1.3	-1.4	-2.7	-2.3	-1.9	7.0
417	0.00	3550	-0.7	-1.7	-2.0	-2.6	-5.0	-4.5	-3.3	8.6
439	0.00	3588	-0.5	-1.9	-1.9	-2.7	-5.5	-4.9	-3.3	8.8
456	0.00	3560	-0.5	-1.4	-1.9	-2.4	-4.7	-3.9	-3.1	10.6
418	0.00	4255	-1.0	-2.3	-2.9	-3.6	-7.5	-6.6	-4.6	12.2
440	0.00	4296	-0.7	-2.5	-2.6	-3.5	-6.9	-6.2	-4.4	12.4
457	0.00	4271	-0.9	-1.8	-2.7	-3.2	-6.3	-5.5	-4.1	13.9
422	26.50	3568	0.2	3.2	-1.5	-2.2	-4.0	-3.7	-1.6	4.1
442	26.50	3583	0.3	-4.3	-2.9	-3.5	-4.0	-3.7	-1.4	3.5
458	26.50	3658	-0.1	-3.9	-1.5	-1.7	-3.5	-3.2	-1.3	5.4
423	26.50	4367	-0.7	1.0	-2.6	-3.8	-5.6	-5.5	-2.5	7.9
444	26.50	4331	-0.3	-5.9	-2.3	-3.9	-5.8	-5.2	-2.7	6.9
459	26.50	4333	-0.7	-5.1	-2.2	-3.2	-4.9	-4.5	-2.2	9.3
425	26.50	5106	-1.2	0.1	-3.5	-4.9	-8.1	-7.1	-3.7	12.9
445	26.50	5169	-0.7	-6.9	-3.1	-5.1	-8.3	-7.1	-3.7	14.0
460*	26.50	3987	-1.3	-4.1	-2.0	-3.1	-4.8	-4.3	-2.4	12.0

TABLE 6.4

Static Pressures, 21/2.50 Inlet, 10 inch Transition

Run No	Model Vel fps	Impeller Speed rpm	I1	I2	I3	I4	T1	T2	T3	H _p
402	0.00	2796	-0.3	-0.9	-1.4	-1.7	-3.6	-2.8	-1.9	4.7
389	0.00	2876	-0.1	-1.1	-1.4	-1.4	-3.2	-2.7	-2.0	5.0
465	0.00	2817	-0.4	-0.9	-1.4	-1.4	-3.0	-2.2	-1.7	6.4
403	0.00	3528	-0.5	-1.3	-2.0	-2.5	-5.7	-4.5	-2.9	8.1
390	0.00	3550	-0.4	-1.6	-2.0	-2.2	-4.7	-4.0	-2.9	8.2
466	0.00	3560	-0.6	-1.5	-2.1	-2.4	-5.0	-3.7	-2.8	10.4
404	0.00	4280	-0.7	-1.8	-2.7	-3.6	-8.1	-6.4	-4.2	12.4
391	0.00	4312	-0.5	-2.1	-2.8	-3.2	-7.2	-5.6	-4.0	12.1
467	0.00	4271	-0.8	-2.1	-2.8	-3.1	-6.8	-5.1	-3.8	13.3
399	26.50	3567	0.3	-4.7	-1.5	-2.3	-4.1	-3.2	-0.9	3.3
394	26.50	3566	0.8	-4.4	-1.5	-2.1	-3.9	-2.9	-0.8	3.6
468	26.50	3579	0.3	-4.2	-1.1	-1.9	-3.3	-2.4	-0.7	6.3
400	26.50	4318	-0.4	-5.4	-2.6	-4.3	-5.8	-4.7	-1.9	7.5
395	26.50	4354	-0.5	-5.7	-2.4	-3.8	-5.7	-4.7	-2.1	7.8
470	26.50	4352	-0.4	-5.2	-2.0	-3.3	-4.8	-3.9	-1.6	9.9
401	26.50	5102	-0.5	-6.2	-2.9	-4.8	-7.9	-6.1	-2.6	13.7
397	26.50	5148	-0.6	-6.4	-3.0	-4.5	-7.8	-6.0	-2.7	13.4
472	26.50	5033	-1.2	-6.2	-2.7	-4.0	-5.8	-4.9	-2.2	14.8

*Run is no good

TABLE 6.5

Static Pressures, 27/0 Inlet, 6 inch Transition

Run No	Model Vel fps	Impeller Speed rpm	I1	I2	I3	I4	T1	T2	T3	H _p
493	0.00	2799	-0.3	-0.5	-1.4	-1.5	-3.1	-2.7	-3.0	8.1
501	0.00	2816	-0.4	-0.5	-1.5	-1.5	-3.3	-2.9	-3.0	8.5
476	0.00	2810	-0.3	-0.4	-1.4	-1.3	-2.8	-2.3	-2.5	8.2
495	0.00	3542	-0.4	-0.7	-2.4	-2.5	-5.2	-4.5	-4.8	12.2
502	0.00	3579	-0.6	-0.8	-2.2	-2.4	-5.1	-4.5	-4.7	14.6
477	0.00	3552	-0.5	-0.6	-2.1	-2.2	-4.7	-3.9	-4.3	12.4
496	0.00	4296	-0.6	-1.0	-3.3	-3.5	-7.5	-6.4	-6.7	16.5
503	0.00	4291	-0.8	-1.1	-3.1	-3.4	-7.3	-6.2	-6.4	19.2
478	0.00	4288	-0.6	-0.9	-2.7	-3.1	-6.7	-5.6	-5.8	17.1
497	26.50	3574	0.0	-3.3	-0.4	-0.4	-3.5	-3.5	-2.8	1.2
504	26.50	3596	0.0	-3.3	-0.6	-0.4	-3.3	-3.5	-2.7	3.2
480	26.50	3528	-0.3	-2.7	-0.6	-0.4	-2.9	-2.5	-2.1	4.7
498	26.50	4340	-0.3	-4.1	-1.3	-1.4	-5.1	-5.1	-4.7	5.4
505	26.50	4384	-0.5	-4.1	-1.3	-1.1	-5.2	-5.1	-4.5	6.8
481	26.50	4373	-1.0	-3.5	-1.7	-1.1	-4.5	-4.1	-3.7	10.3
499	26.50	5099	-0.6	-4.7	-2.1	-2.0	-6.6	-6.5	-6.5	11.8
506	26.50	5132	-0.7	-4.5	-2.1	-1.9	-6.4	-6.5	-6.1	12.9
485	26.50	5103	-1.3	-3.7	-2.1	-1.6	-5.2	-4.9	-4.7	15.3

TABLE 6.6

Static Pressures, 27/0 Inlet, 10 inch Transition

Run No	Model Vel fps	Impeller Speed rpm	I1	I2	I3	I4	T1	T2	T3	H _p
513	0.00	2827	-0.4	-0.5	-1.6	-1.5	-3.5	-2.8	-2.2	8.9
507	0.00	2849	-0.4	-0.5	-1.6	-1.6	-3.6	-2.8	-2.1	9.0
487	0.00	2799	-0.3	-0.3	-1.4	-1.3	-3.3	-2.7	-2.0	8.2
514	0.00	3594	-0.6	-0.7	-2.5	-2.6	-5.5	-4.4	-3.4	13.9
508	0.00	3587	-0.6	-0.8	-2.5	-2.5	-5.5	-4.3	-3.2	14.0
488	0.00	3578	-0.6	-0.5	-2.2	-2.2	-5.4	-4.5	-3.3	13.3
515	0.00	4299	-0.8	-1.0	-3.3	-3.5	-8.1	-6.3	-4.7	18.5
509	0.00	4280	-0.8	-1.0	-3.2	-3.4	-7.7	-6.0	-4.4	18.4
489	0.00	4298	-0.7	-0.8	-2.9	-3.1	-7.4	-6.2	-4.5	17.8
516	26.50	3539	-0.1	-3.1	-1.1	-0.6	-3.6	-2.9	-1.1	3.2
510	26.50	3560	0.1	-3.2	-0.8	-0.5	-3.5	-2.9	-1.1	2.5
490	26.50	3541	0.0	-2.7	-0.8	-0.3	-3.1	-2.7	-0.7	2.3
517	26.50	4305	-0.6	-3.9	-1.7	-1.3	-5.1	-4.5	-2.4	8.5
511	26.50	4333	-0.6	-4.0	-1.7	-1.3	-5.2	-4.4	-2.2	7.4
491	26.50	4348	-0.5	-3.5	-1.4	-1.1	-4.7	-4.3	-2.0	6.9
518	26.50	5108	-1.0	-4.7	-2.2	-2.0	-7.0	-6.1	-3.6	14.6
512	26.50	5107	-0.8	-4.4	-2.2	-1.8	-6.8	-5.6	-3.2	14.2
492	26.50	5095	-0.6	-3.8	-1.7	-1.5	-5.4	-5.1	-2.6	12.8

TABLE 6.7

Static Pressures, 21/0 Inlet 6 inch Transition

Run No	Model Vel fps	Impeller Speed rpm	I1	I2	I3	I4	T1	T2	T3	H _p
519	0.00	2851	-0.3	-0.9	-1.5	-1.6	-3.5	-2.7	-2.5	8.7
537	0.00	2791	-0.2	-0.8	-1.5	-1.6	-3.7	-2.8	-2.6	7.8
547	0.00	2820	0.2	-0.9	-1.3	-1.6	-3.5	-2.6	-2.6	6.2
520	0.00	3565	-0.5	-1.4	-2.4	-2.7	-5.6	-4.3	-4.1	13.4
538	0.00	3533	-0.4	-1.4	-2.5	-2.7	-5.8	-4.6	-4.1	11.2
548	0.00	3554	0.2	-1.4	-2.2	-2.6	-5.8	-4.3	-4.2	10.3
521	0.00	4269	-0.5	-2.0	-3.2	-3.6	-8.4	-6.4	-5.9	16.6
539	0.00	4256	-0.6	-2.0	-3.3	-3.7	-7.9	-6.3	-5.5	15.3
549	0.00	4266	0.2	-2.0	-3.0	-3.6	-8.2	-6.1	-5.9	13.3
522	26.50	3568	-0.1	-4.8	-2.0	-2.6	-4.5	-3.5	-2.3	5.7
540	26.50	3559	-0.1	-5.2	-2.3	-2.9	-4.7	-4.0	-2.3	5.6
550	26.50	3573	0.2	-5.0	-1.9	-2.5	-4.5	-3.3	-1.8	5.3
523	26.50	4382	-0.6	-6.5	-2.6	-3.9	-7.0	-5.4	-3.8	11.0
541	26.50	4376	-0.7	-6.5	-2.7	-3.9	-6.9	-5.4	-3.7	10.6
551	26.50	4342	0.2	-6.4	-2.6	-4.1	-7.3	-5.1	-3.7	10.1
524	26.50	5105	-1.0	-7.1	-3.3	-4.9	-9.1	-6.9	-5.1	17.8
542	26.50	5119	-1.2	-7.1	-3.4	-4.7	-8.2	-6.8	-4.7	17.8
554	26.50	4932	0.2	-6.9	-3.2	-4.9	-8.2	-6.2	-4.6	14.7

TABLE 6.8

Static Pressures, 27/0 Inlet, 10 inch Transition

Run No	Model Vel fps	Impeller Speed rpm	I1	I2	I3	I4	T1	T2	T3	H _p
525	0.00	2811	-0.3	-0.8	-1.6	-1.7	-3.8	-2.8	-2.0	7.8
531	0.00	2820	-0.3	-0.8	-1.7	-1.7	-4.0	-2.8	-2.1	7.9
555	0.00	2802	0.2	-0.9	-1.6	-1.7	-3.8	-2.8	-2.0	9.6
526	0.00	3558	-0.4	-1.4	-2.5	-2.7	-6.1	-4.5	-3.2	11.5
532	0.00	3582	-0.5	-1.4	-2.6	-2.8	-6.3	-4.5	-3.3	12.1
556	0.00	3550	0.2	-1.5	-2.5	-2.7	-6.1	-4.5	-3.1	15.4
527	0.00	4270	-0.6	-2.0	-3.4	-3.7	-8.9	-6.5	-4.6	15.3
533	0.00	4201	-0.6	-1.9	-3.3	-3.7	-8.2	-6.0	-4.3	15.8
557	0.00	4242	0.2	-2.1	-3.4	-3.7	-8.3	-6.1	-4.2	20.5
528	26.50	3582	-0.1	-5.0	-2.1	-3.1	-5.6	-3.3	-1.0	6.1
534	26.50	3539	-0.1	-4.8	-2.1	-2.4	-5.6	-3.3	-1.1	5.2
560	26.50	3545	0.2	-5.1	-1.9	-2.5	-5.5	-3.3	-1.1	5.7
529	26.50	4352	-0.6	-6.4	-2.7	-4.2	-7.7	-5.0	-2.1	10.3
535	26.50	4313	-0.6	-6.3	-2.7	-4.1	-7.5	-4.7	-2.0	10.2
561	26.50	4382	0.2	-6.6	-2.9	-4.5	-8.1	-5.2	-2.5	11.6
530	26.50	5106	-0.9	-7.1	-3.7	-5.5	-10.6	-6.8	-3.3	17.3
536	26.50	5114	-0.9	-6.9	-3.4	-4.8	-9.7	-6.3	-3.0	17.7
562	26.50	5060	0.2	-7.4	-3.2	-4.9	-9.6	-6.5	-3.0	16.4

TABLE 7.1

Lift and Drag Characteristics
Stevens Inlet, 8 inch Transition

Hull Drag = 144.0 Hull Lift = 334.0

Run	Vel	RPM	Drag	D_1	C_{D1}	Lift	L_1	C_{L1}	IVR
337	0.0	2175	0.3	0.3	0.00	-2.4	-2.4	0.00	0.00
372	0.0	2182	-0.2	-0.2	0.00	-7.1	-7.1	0.00	0.00
329	0.0	2172	0.0	0.0	0.00	-2.6	-2.6	0.00	0.00
338	0.0	2808	0.1	0.1	0.00	1.0	1.0	0.00	0.00
373	0.0	2819	-0.4	-0.4	0.00	-0.6	-0.6	0.00	0.00
325	0.0	2808	0.0	0.0	0.00	27.7	27.7	0.00	0.00
339	0.0	3528	0.0	0.0	0.00	-4.9	-4.9	0.00	0.00
374	0.0	3598	-0.6	-0.6	0.00	-4.9	-4.9	0.00	0.00
327	0.0	3563	0.0	0.0	0.00	1.6	1.6	0.00	0.00
341	26.5	3528	227.2	1.6	0.02	295.2	-38.8	-0.52	0.92
369	26.5	3561	228.1	2.5	0.03	299.5	-34.5	-0.46	0.92
322	26.5	3575	236.8	11.2	0.15	284.9	-49.1	-0.66	0.92
342	26.5	4320	234.5	-1.3	-0.02	302.0	-32.0	-0.43	1.03
370	26.5	4357	236.4	0.6	0.01	297.4	-36.6	-0.49	1.03
324	26.5	4289	240.1	4.3	0.06	291.0	-43.0	-0.58	1.03
343	26.5	4869	236.2	-6.3	-0.08	287.3	-46.7	-0.63	1.11
371	26.5	5130	240.5	-2.0	-0.03	287.3	-46.7	-0.63	1.11
323	26.5	5068	242.4	-0.1	0.00	285.5	-48.5	-0.65	1.11

TABLE 7.2

Lift and Drag Characteristics
2 1/2.5 Inlet, 6 inch Transition

Hull Drag = 152.0 Hull Lift = 358.0

Run	Vel	RPM	Drag	D _i	C _{Di}	Lift	L _i	C _{Li}	IVR
405	0.0	2826	-0.1	-0.1	0.00	-5.0	-5.0	0.00	0.00
377	0.0	2826	-0.2	-0.2	0.00	0.2	0.2	0.00	0.00
446	0.0	2798	0.1	0.1	0.00	-1.9	-1.9	0.00	0.00
406	0.0	3532	0.4	0.4	0.00	-1.8	-1.8	0.00	0.00
376	0.0	3535	0.3	0.3	0.00	-2.2	-2.2	0.00	0.00
447	0.0	3523	0.6	0.6	0.00	-3.2	-3.2	0.00	0.00
407	0.0	4218	0.5	0.5	0.00	-3.0	-3.0	0.00	0.00
378	0.0	4296	0.3	0.3	0.00	-2.8	-2.8	0.00	0.00
448	0.0	4262	0.0	0.0	0.00	-3.1	-3.1	0.00	0.00
409	26.5	3550	227.9	-6.2	-0.08	324.6	-33.4	-0.46	0.98
379	26.5	3583	228.6	-5.5	-0.07	326.7	-31.3	-0.43	0.98
450	26.5	3597	223.4	-10.7	-0.15	337.8	-20.2	-0.28	0.98
410	26.5	4343	234.1	-9.7	-0.13	313.0	-45.0	-0.62	1.10
380	26.5	4321	236.7	-7.1	-0.10	318.4	-39.6	-0.54	1.10
451	26.5	4339	231.2	-12.6	-0.17	298.4	-59.6	-0.82	1.10
411*	26.5	3507	69.8	-178.6	-2.44	134.0	-224.0	-3.07	1.16
381	26.5	5045	237.2	-11.2	-0.15	302.8	-55.2	-0.76	1.16
453	26.5	5085	232.9	-15.5	-0.21	317.4	-40.6	-0.56	1.16

*Run is no good

TABLE 7.3

Lift and Drag Characteristics
2 1/2 Inlet, 8 inch Transition

Hull Drag = 152.0 Hull Lift = 358.0

Run	Vel	RPM	Drag	D _i	C _{Di}	Lift	L _i	C _{Li}	IVR
416	0.0	2790	0.2	0.2	0.00	-1.3	-1.3	0.00	0.00
438	0.0	2816	0.3	0.3	0.00	-2.3	-2.3	0.00	0.00
455	0.0	2822	0.5	0.5	0.00	-1.7	-1.7	0.00	0.00
417	0.0	3550	0.5	0.5	0.00	0.1	0.1	0.00	0.00
439	0.0	3588	0.5	0.5	0.00	-3.6	-3.6	0.00	0.00
456	0.0	3560	0.0	0.0	0.00	-2.9	-2.9	0.00	0.00
418	0.0	4255	0.6	0.6	0.00	-4.9	-4.9	0.00	0.00
440	0.0	4296	0.4	0.4	0.00	-3.0	-3.0	0.00	0.00
457	0.0	4271	0.1	0.1	0.00	-3.2	-3.2	0.00	0.00
422	26.5	3568	230.4	-3.2	-0.04	311.7	-46.3	-0.63	0.98
442	26.5	3583	226.8	-6.8	-0.09	330.5	-27.5	-0.38	0.98
458	26.5	3658	225.5	-8.1	-0.11	315.0	-43.0	-0.59	0.98
423	26.5	4367	238.3	-4.0	-0.05	299.8	-58.2	-0.80	1.08
444	26.5	4331	235.5	-6.8	-0.09	315.1	-42.9	-0.59	1.08
459	26.5	4333	233.7	-8.6	-0.12	299.1	-58.9	-0.81	1.08
425	26.5	5106	242.0	-4.9	-0.07	292.3	-65.7	-0.90	1.14
445	26.5	5169	238.4	-8.5	-0.12	308.3	-49.7	-0.68	1.14
460*	26.5	3987	85.9	-161.0	-2.20	97.6	-260.4	-3.56	1.14

*Run is no good

TABLE 7.4

Lift and Drag Characteristics
21/2.5 Inlet, 10 inch Transition

Hull Drag = 152.0 Hull Lift = 358.0

Run	Vel	RPM	Drag	D_i	C_{Di}	Lift	L_i	C_{Li}	IVR
402	0.0	2796	0.4	0.4	0.00	-5.0	-5.0	0.00	0.00
389	0.0	2876	0.2	0.2	0.00	-1.3	-1.3	0.00	0.00
465	0.0	2817	0.1	0.1	0.00	-5.2	-5.2	0.00	0.00
403	0.0	3528	0.5	0.5	0.00	-3.0	-3.0	0.00	0.00
390	0.0	3550	0.0	0.0	0.00	-1.6	-1.6	0.00	0.00
466	0.0	3560	0.2	0.2	0.00	-5.8	-5.8	0.00	0.00
404	0.0	4280	0.6	0.6	0.00	-3.7	-3.7	0.00	0.00
391	0.0	4312	1.4	1.4	0.00	-3.9	-3.9	0.00	0.00
467	0.0	4271	-0.2	-0.2	0.00	-6.6	-6.6	0.00	0.00
399	26.5	3567	226.5	-7.1	-0.10	304.4	-53.6	-0.73	0.98
394	26.5	3566	225.9	-7.7	-0.10	313.4	-44.6	-0.61	0.98
468	26.5	3579	225.8	-7.8	-0.11	311.5	-46.5	-0.64	0.98
400	26.5	4318	234.1	-7.7	-0.11	299.1	-58.9	-0.81	1.08
395	26.5	4354	240.5	-1.3	-0.02	300.0	-58.0	-0.79	1.08
470	26.5	4352	232.9	-8.9	-0.12	298.4	-59.6	-0.82	1.08
401	26.5	5102	240.5	-7.9	-0.11	299.6	-58.4	-0.80	1.16
397	26.5	5148	244.7	-3.7	-0.05	294.3	-63.7	-0.87	1.16
472	26.5	5033	237.2	-11.2	-0.15	317.2	-40.8	-0.56	1.16

TABLE 7.5

Lift and Drag Characteristics
27/0 Inlet, 6 inch Transition

Hull Drag = 135.0 Hull Lift = 349.0

Run	Vel	RPM	Drag	D_i	C_{Di}	Lift	L_i	C_{Li}	IVR
493	0.0	2799	0.4	0.4	0.00	0.1	0.1	0.00	0.00
501	0.0	2816	0.4	0.4	0.00	1.4	1.4	0.00	0.00
476	0.0	2810	0.5	0.5	0.00	-1.0	-1.0	0.00	0.00
495	0.0	3542	0.3	0.3	0.00	-2.9	-2.9	0.00	0.00
502	0.0	3579	0.6	0.6	0.00	-0.1	-0.1	0.00	0.00
477	0.0	3552	0.7	0.7	0.00	-2.7	-2.7	0.00	0.00
496	0.0	4296	0.4	0.4	0.00	-4.0	-4.0	0.00	0.00
503	0.0	4291	0.7	0.7	0.00	-1.3	-1.3	0.00	0.00
478	0.0	4288	0.6	0.6	0.00	-5.1	-5.1	0.00	0.00
497	26.5	3574	218.3	1.2	0.01	305.2	-43.8	-0.47	0.96
504	26.5	3596	217.9	0.8	0.01	303.5	-45.5	-0.48	0.96
480	26.5	3528	217.2	0.1	0.00	298.8	-50.2	-0.53	0.96
498	26.5	4340	224.2	-1.6	-0.02	292.9	-56.1	-0.60	1.06
505	26.5	4384	223.2	-2.6	-0.03	299.8	-49.2	-0.52	1.06
481	26.5	4373	225.0	-0.8	-0.01	298.0	-51.0	-0.54	1.06
499	26.5	5099	230.3	-1.7	-0.02	300.5	-48.5	-0.52	1.13
506	26.5	5132	228.3	-3.7	-0.04	302.8	-46.2	-0.49	1.13
485	26.5	5103	231.7	-0.3	0.00	242.2	-106.8	-1.14	1.13

TABLE 7.6

Lift and Drag Characteristics
27/0 Inlet, 10 inch Transition

Hull Drag = 135.0 Hull Lift = 349.0

Run	Vel	RPM	Drag	D_i	C_{Di}	Lift	L_i	C_{Li}	IVR
513	0.0	2827	0.2	0.2	0.00	-0.8	-0.8	0.00	0.00
507	0.0	2849	0.3	0.3	0.00	-0.6	-0.6	0.00	0.00
487	0.0	2799	0.0	0.0	0.00	-1.1	-1.1	0.00	0.00
514	0.0	3594	0.5	0.5	0.00	-6.3	-6.3	0.00	0.00
508	0.0	3587	0.3	0.3	0.00	-2.8	-2.8	0.00	0.00
488	0.0	3578	0.3	0.3	0.00	-4.0	-4.0	0.00	0.00
515	0.0	4299	0.5	0.5	0.00	-4.7	-4.7	0.00	0.00
509	0.0	4280	0.3	0.3	0.00	-4.5	-4.5	0.00	0.00
489	0.0	4298	0.5	0.5	0.00	-1.1	-1.1	0.00	0.00
516	26.5	3539	217.5	0.9	0.01	306.3	-42.7	-0.45	0.95
510	26.5	3560	217.1	0.5	0.01	306.7	-42.3	-0.45	0.95
490	26.5	3541	211.3	-5.3	-0.06	298.5	-50.5	-0.54	0.95
517	26.5	4305	225.4	-0.9	-0.01	300.4	-48.6	-0.52	1.06
511	26.5	4333	224.4	-1.9	-0.02	301.9	-47.1	-0.50	1.06
491	26.5	4348	220.9	-5.4	-0.06	290.2	-58.8	-0.63	1.06
518	26.5	5108	228.8	-4.7	-0.05	300.5	-40.4	-0.51	1.15
512	26.5	5107	227.5	-6.0	-0.06	287.8	-61.2	-0.65	1.15
492	26.5	5095	222.0	-11.5	-0.12	300.8	-48.2	-0.51	1.15

TABLE 7.7

Lift and Drag Characteristics
21/0 Inlet, 6 inch Transition

Hull Drag = 135.0 Hull Lift = 349.0

Run	Vel	RPM	Drag	D_i	C_{Di}	Lift	L_i	C_{Li}	IVR
519	0.0	2851	0.3	0.3	0.00	-2.5	-2.5	0.00	0.00
537	0.0	2791	-0.1	-0.1	0.00	0.3	0.3	0.00	0.00
547	0.0	2820	0.2	0.2	0.00	-1.6	-1.6	0.00	0.00
520	0.0	3565	0.4	0.4	0.00	-4.0	-4.0	0.00	0.00
538	0.0	3533	0.2	0.2	0.00	-1.3	-1.3	0.00	0.00
548	0.0	3554	0.1	0.1	0.00	-2.9	-2.9	0.00	0.00
521	0.0	4269	0.1	0.1	0.00	-4.0	-4.0	0.00	0.00
539	0.0	4256	0.2	0.2	0.00	-3.1	-3.1	0.00	0.00
549	0.0	4266	0.2	0.2	0.00	-2.4	-2.4	0.00	0.00
522	26.5	3568	214.3	0.8	0.01	312.5	-36.5	-0.50	1.03
540	26.5	3559	212.7	-0.8	-0.01	313.2	-35.8	-0.49	1.03
550	26.5	3573	210.8	-2.7	-0.04	301.3	-47.7	-0.65	1.03
523	26.5	4382	224.1	2.4	0.03	303.9	-45.1	-0.62	1.14
541	26.5	4376	222.2	0.5	0.01	300.1	-48.9	-0.67	1.14
551	26.5	4342	218.3	-3.4	-0.05	296.0	-53.0	-0.73	1.14
524	26.5	5105	227.0	-0.3	0.00	310.6	-38.4	-0.53	1.21
542	26.5	5119	226.0	-1.3	-0.02	283.8	-65.2	-0.89	1.21
554	26.5	4932	217.7	-9.6	-0.13	275.1	-73.9	-1.01	1.21

TABLE 7.8

Lift and Drag Characteristics
21/0 Inlet, 10 inch Transition

Hull Drag = 135.0 Hull Lift = 349.0

Run	Vel	RPM	Drag	D_i	C_{Di}	Lift	L_i	C_{Li}	IVR
525	0.0	2811	0.4	0.4	0.00	-1.5	-1.5	0.00	0.00
531	0.0	2820	0.2	0.2	0.00	-0.2	-0.2	0.00	0.00
555	0.0	2802	0.0	0.0	0.00	-3.3	-3.3	0.00	0.00
526	0.0	3558	0.5	0.5	0.00	-2.8	-2.8	0.00	0.00
532	0.0	3582	0.2	0.2	0.00	-1.0	-1.0	0.00	0.00
556	0.0	3550	-0.2	-0.2	0.00	-1.6	-1.6	0.00	0.00
527	0.0	4270	0.3	0.3	0.00	-2.3	-2.3	0.00	0.00
533	0.0	4201	0.1	0.1	0.00	-3.0	-3.0	0.00	0.00
557	0.0	4242	0.1	0.1	0.00	-2.4	-2.4	0.00	0.00
528	26.5	3582	213.6	0.1	0.00	308.0	-41.0	-0.56	1.03
534	26.5	3539	212.2	-1.3	-0.02	301.8	-47.2	-0.65	1.03
560	26.5	3545	211.4	-2.1	-0.03	300.3	-48.7	-0.67	1.03
529	26.5	4352	221.9	-1.8	-0.03	302.6	-46.4	-0.64	1.17
535	26.5	4313	221.9	-1.8	-0.03	304.6	-44.4	-0.61	1.17
561	26.5	4382	220.7	-3.0	-0.04	288.4	-60.6	-0.83	1.17
530	26.5	5106	229.1	2.3	0.03	292.4	-56.6	-0.77	1.21
536	26.5	5114	223.2	-3.6	-0.05	288.4	-60.6	-0.83	1.21
562	26.5	5060	225.9	-0.9	-0.01	290.7	-58.3	-0.80	1.21

TABLE 8

Loss Coefficient, for all Inlets

Model Velocity fps	Nominal Impeller rpm	<u>Stevens</u>	<u>21/2.50</u>			<u>27/0</u>		<u>21/0</u>	
		8	6	8	10	6	10	6	10
0	2180	0.119#							
0	2800	0.119#	0.425#	0.260	0.193	0.146	0.116	0.235	0.230
0	3600	0.166#	0.403#	0.270	0.239	0.170	0.124	0.235	0.271
0	4300		0.425#	0.253	0.208	0.170	0.174	0.273	0.287
26.5	3600	0.247	0.304	0.323	0.312	0.255	0.275	0.397	0.400
26.5	4300	0.188	0.266	0.304	0.294	0.247	0.244	0.328	0.347
26.5	5100	0.186	0.270+	0.304+	0.296	0.262	0.230	0.387	0.413

TABLE 9

Ram Pressure Recovery for all Inlet

Model Velocity fps	Nominal Impeller rpm	<u>Stevens</u>	<u>21/2.50</u>			<u>27/0</u>		<u>21/0</u>	
		8	6	8	10	6	10	6	10
26.5	3600	0.613	0.520	0.491	0.514	0.595	0.570	0.420	0.420
26.5	4300	0.625	0.470	0.414	0.438	0.517	0.522	0.419	0.359
26.5	5100	0.574	0.407+	0.358+	0.350	0.415	0.470	0.222	0.178

TABLE 10

Cavitation Index for all Inlets

Model Velocity fps	Nominal Impeller rpm	<u>Stevens</u>	<u>21/2.50</u>			<u>27/0</u>		<u>21/0</u>	
		8	6	8	10	6	10	6	10
26.5	3600	1.218	1.127	1.115	1.148	1.165	1.189	1.220	1.240
26.5	4300	0.757	0.657	0.676	0.699	0.713	0.704	0.733	0.707
26.5	5100	0.488	0.474+	0.439+	0.436	0.444	0.424	0.491	0.477

#No bollard fairing attached at the inlet

+Estimated value

TABLE 11

Boundary Layer Profile

Run No	Velocity fps	Inlet Velocity Ratio	Depth in	Boundary Layer Velocity, % free steam
566	26.5	0	0.06	.843
565	26.5	0	0.10	.913
567	26.5	0	0.20	.957
564	26.5	0	0.30	1.000
563	26.5	0	0.50	1.000
571	26.5	1.16	0.10	.930
568	26.5	1.16	0.20	1.022
569	26.5	1.16	0.30	1.057
570	26.5	1.16	0.50	1.035

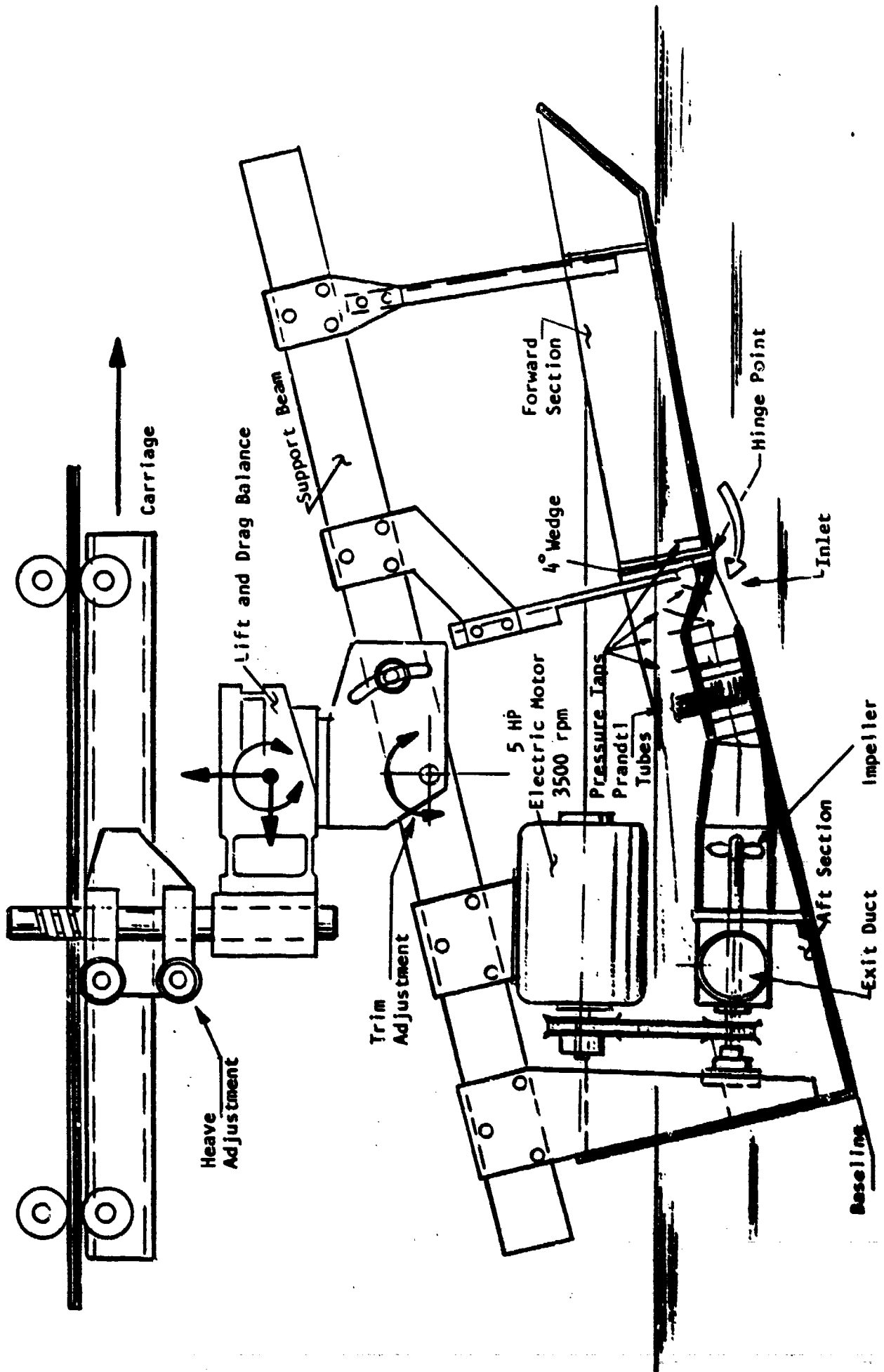


FIGURE 1 SKETCH OF MODEL AND TEST APPARATUS

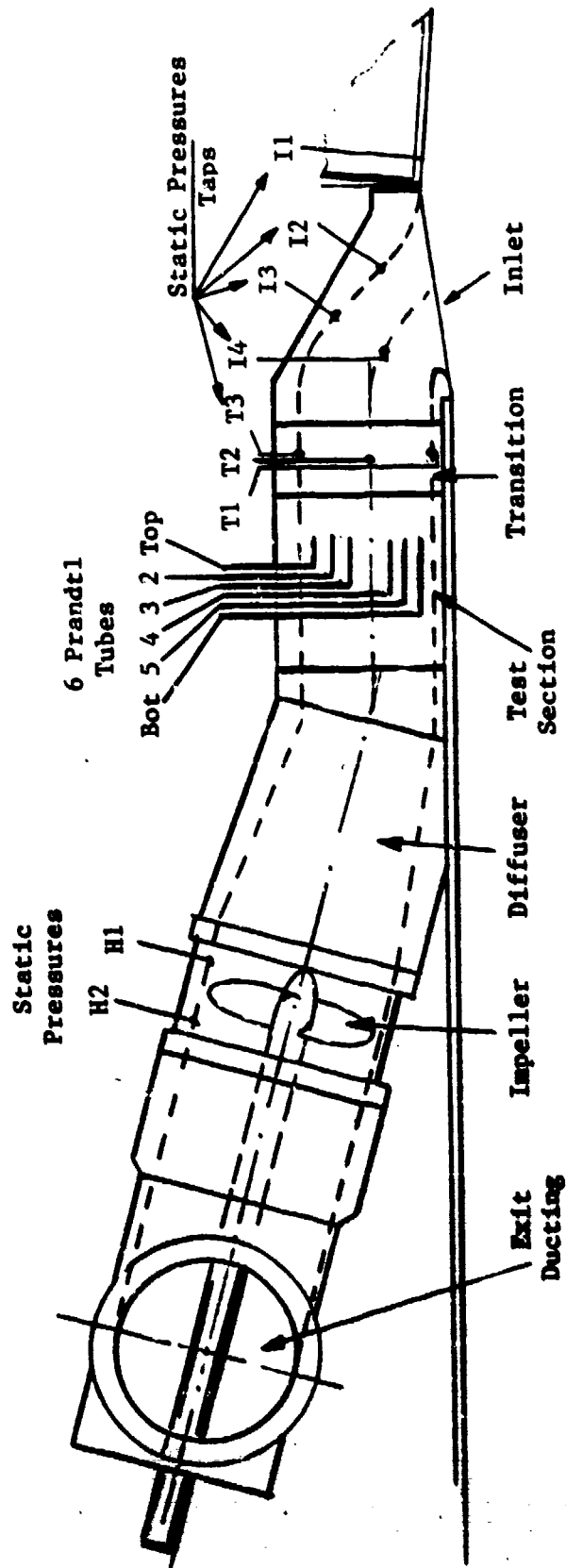


FIGURE 2 SCHEMATIC OF WATERJET DUCTING AND PRESSURE TAPS

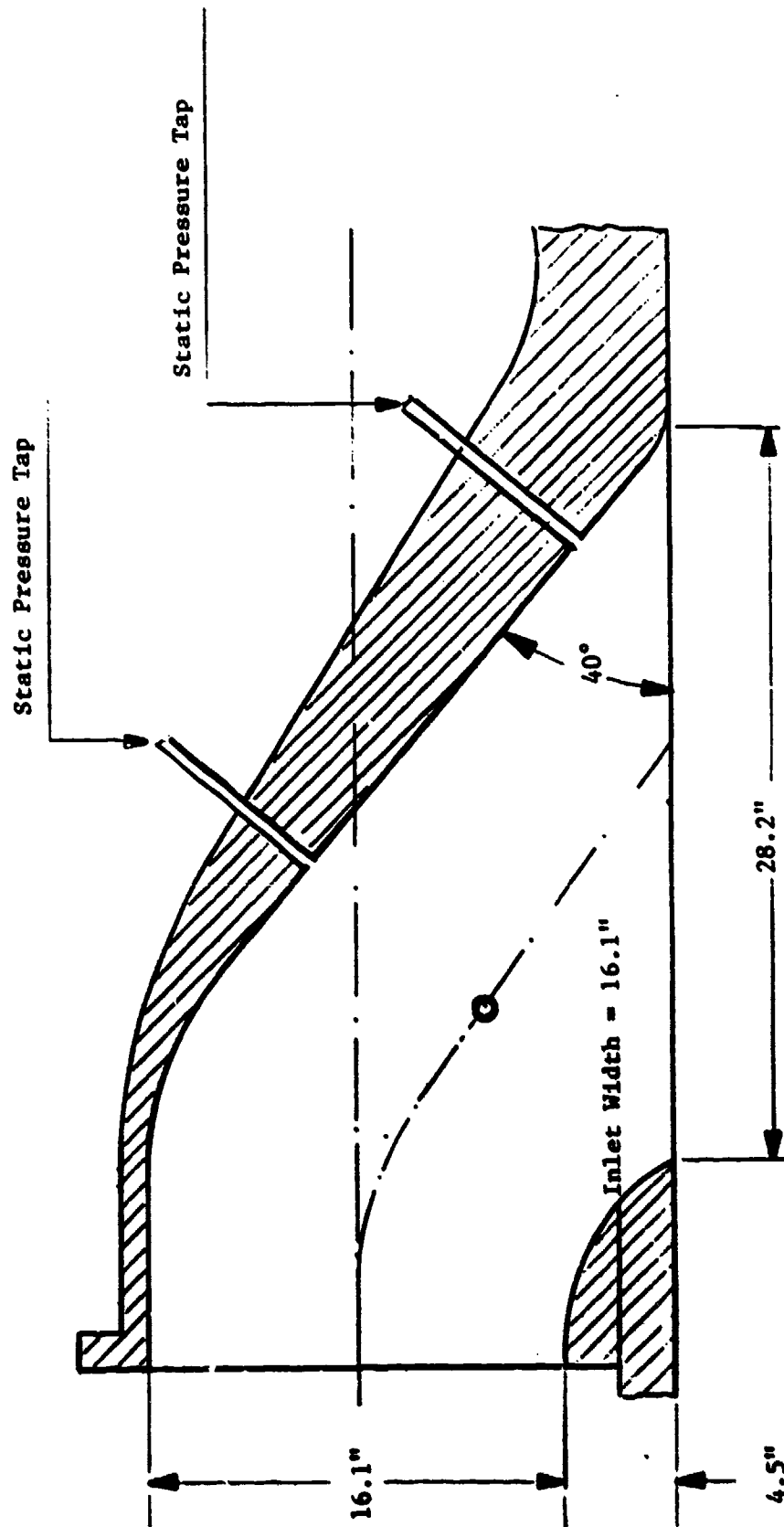


FIGURE 3 STEVENS INLET

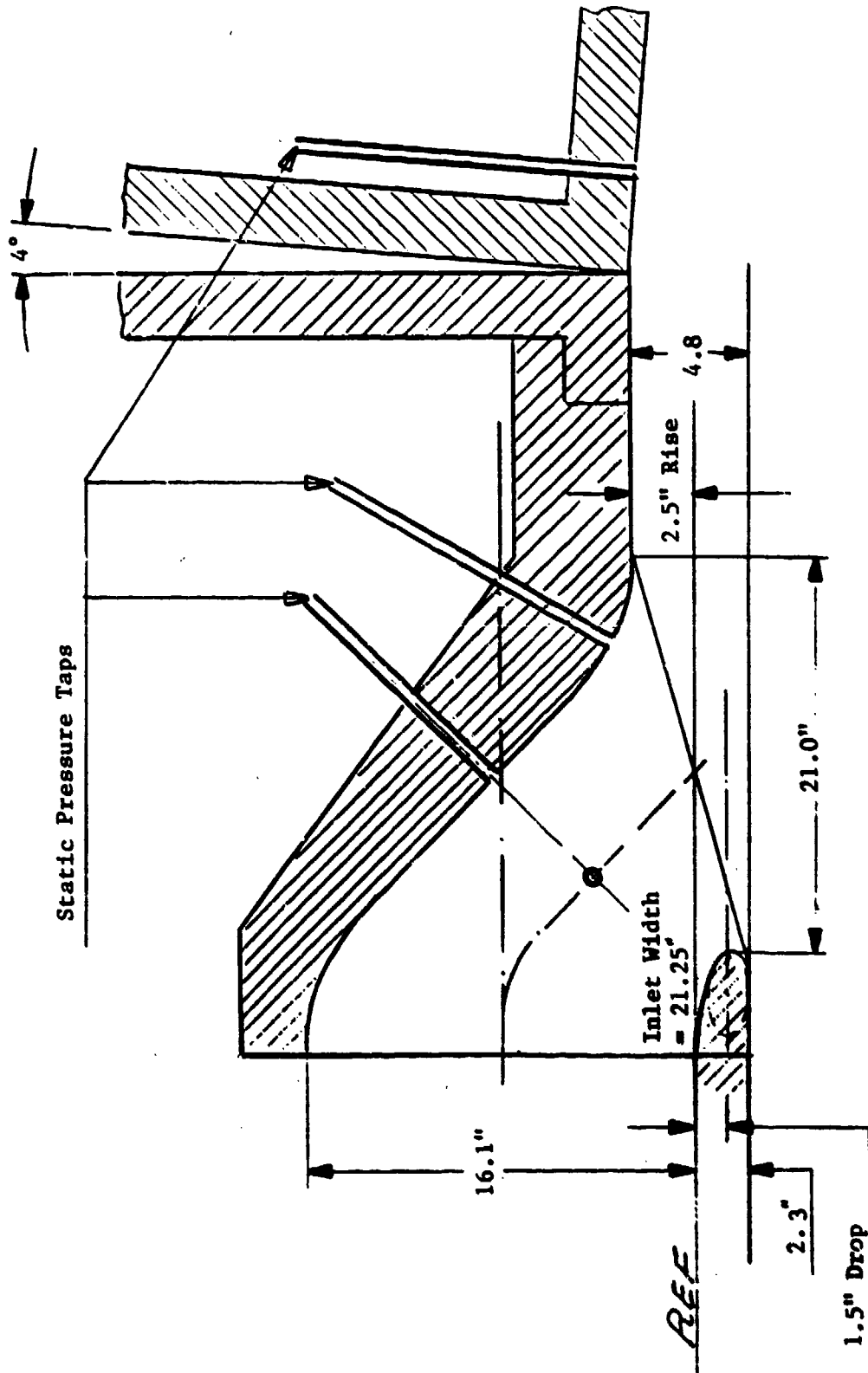


FIGURE 4 21/2.50 INLET

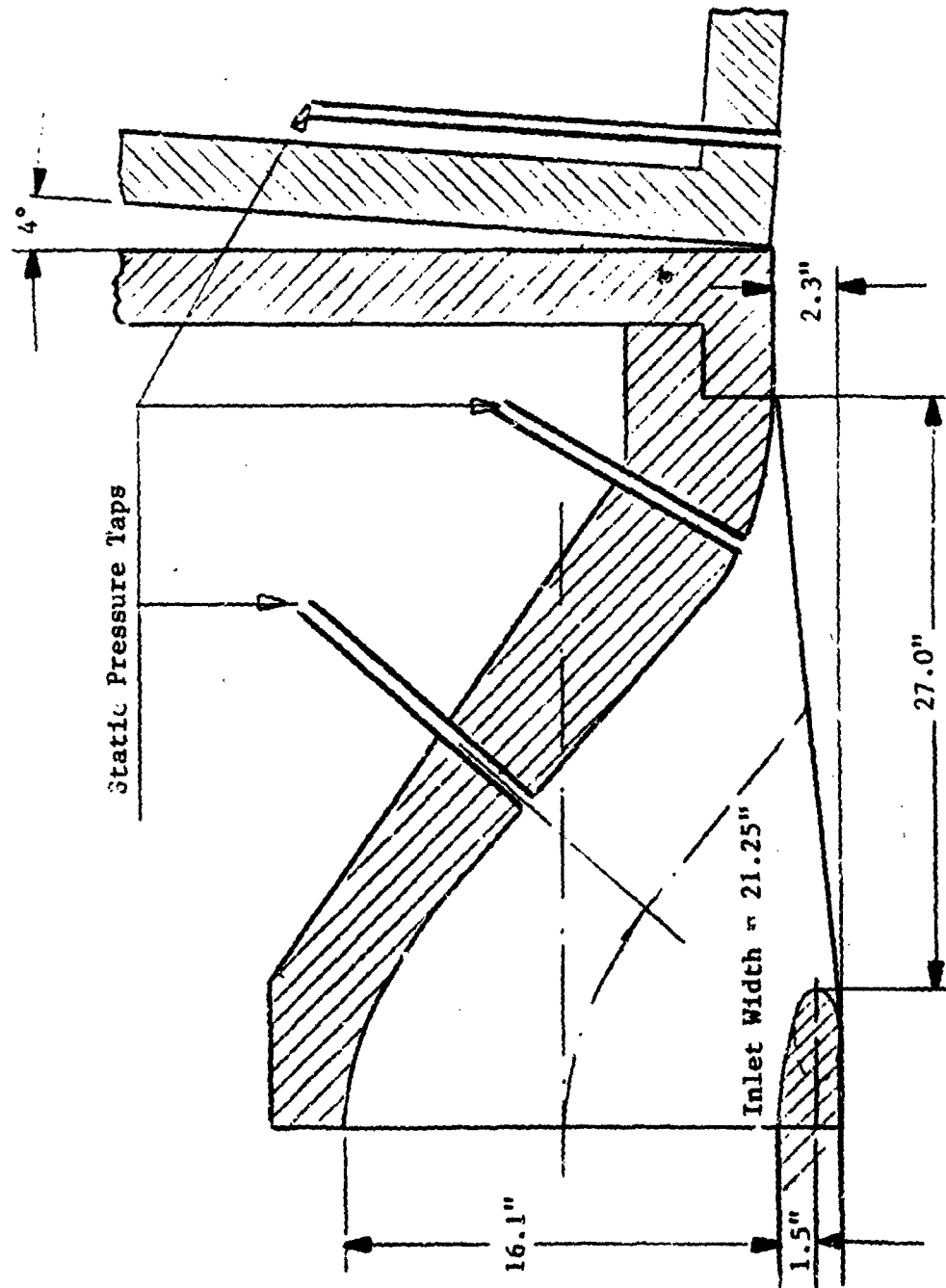


FIGURE 5 27/0 INLET

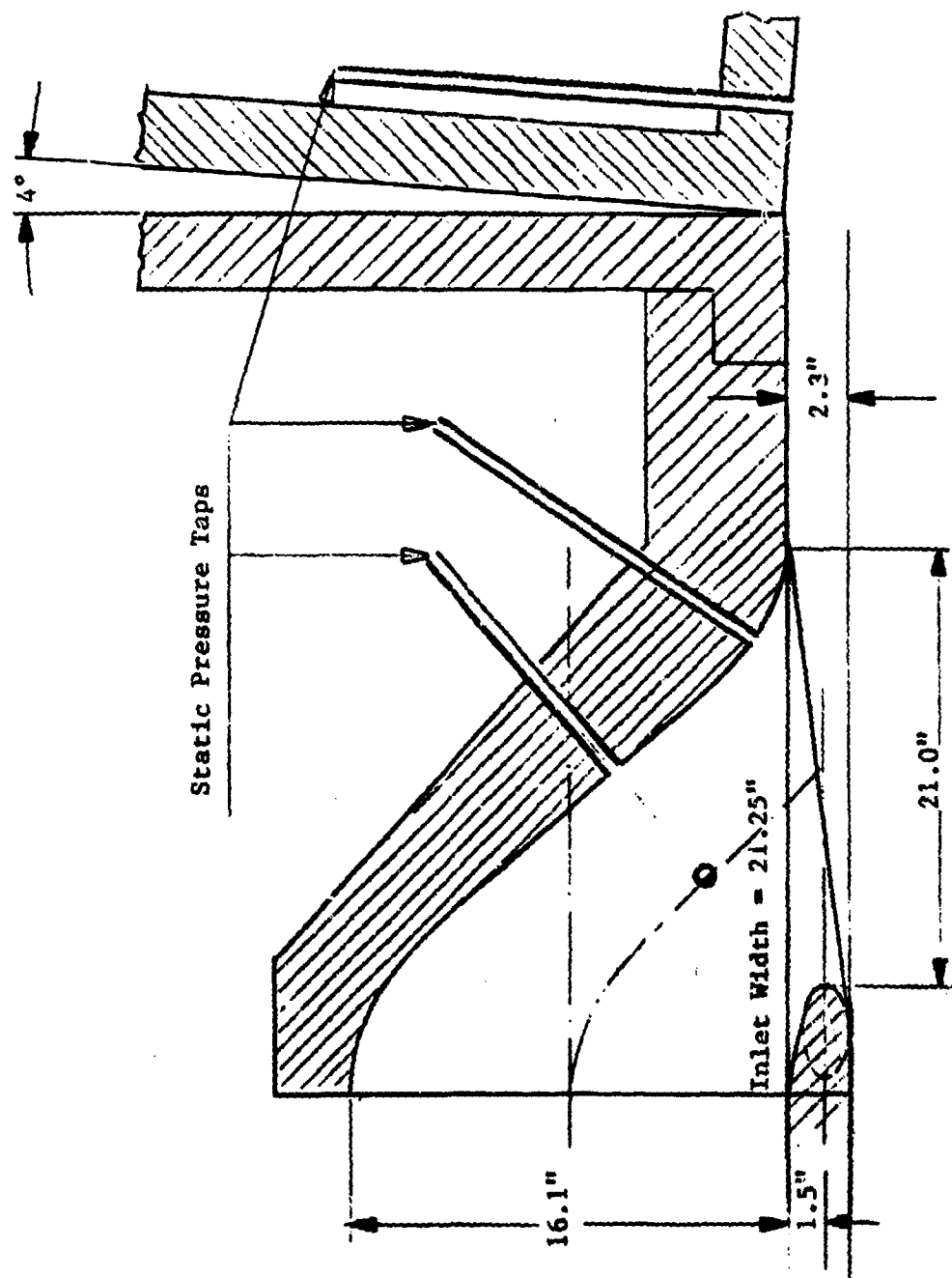


FIGURE 6 21/0 INLET

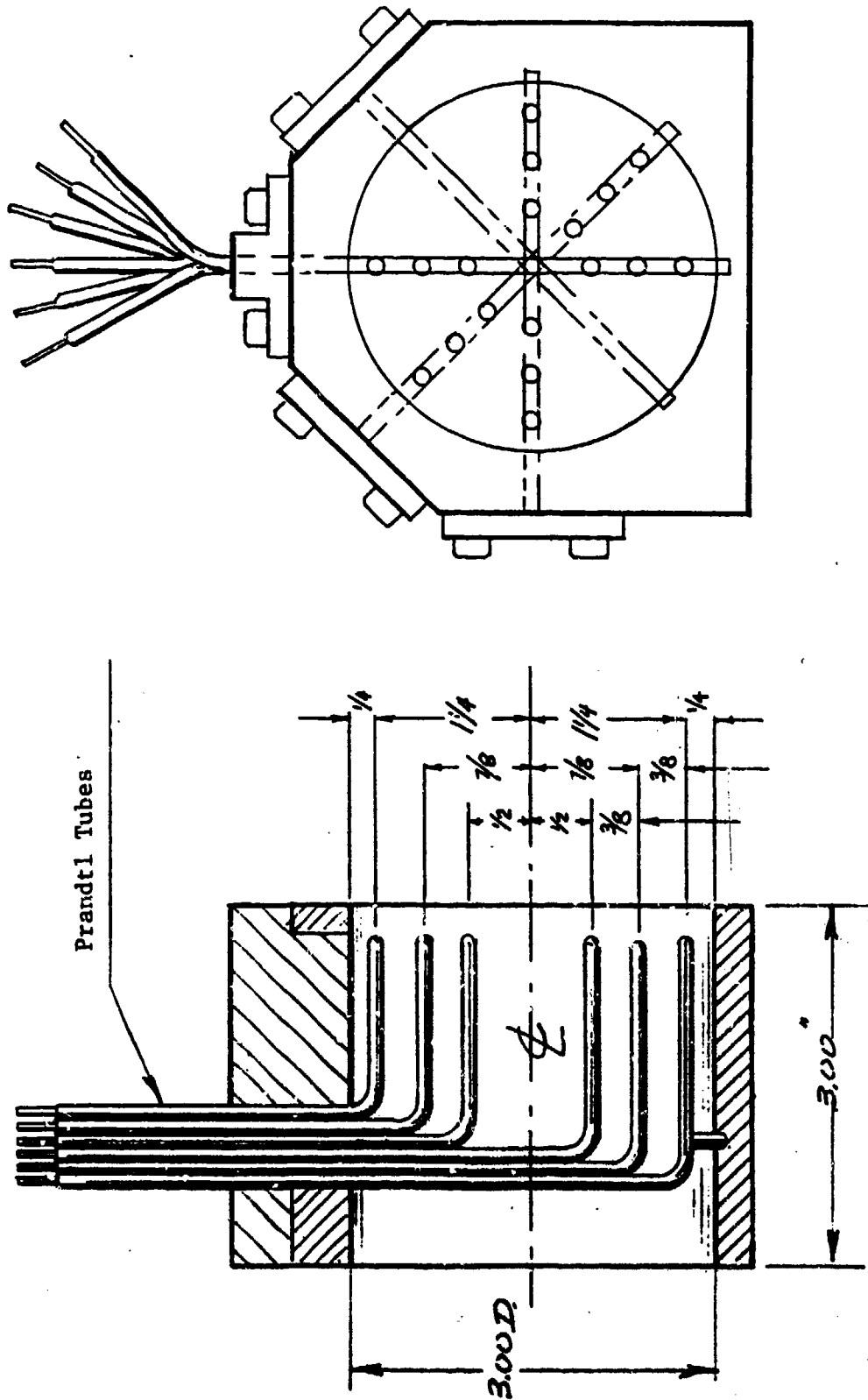
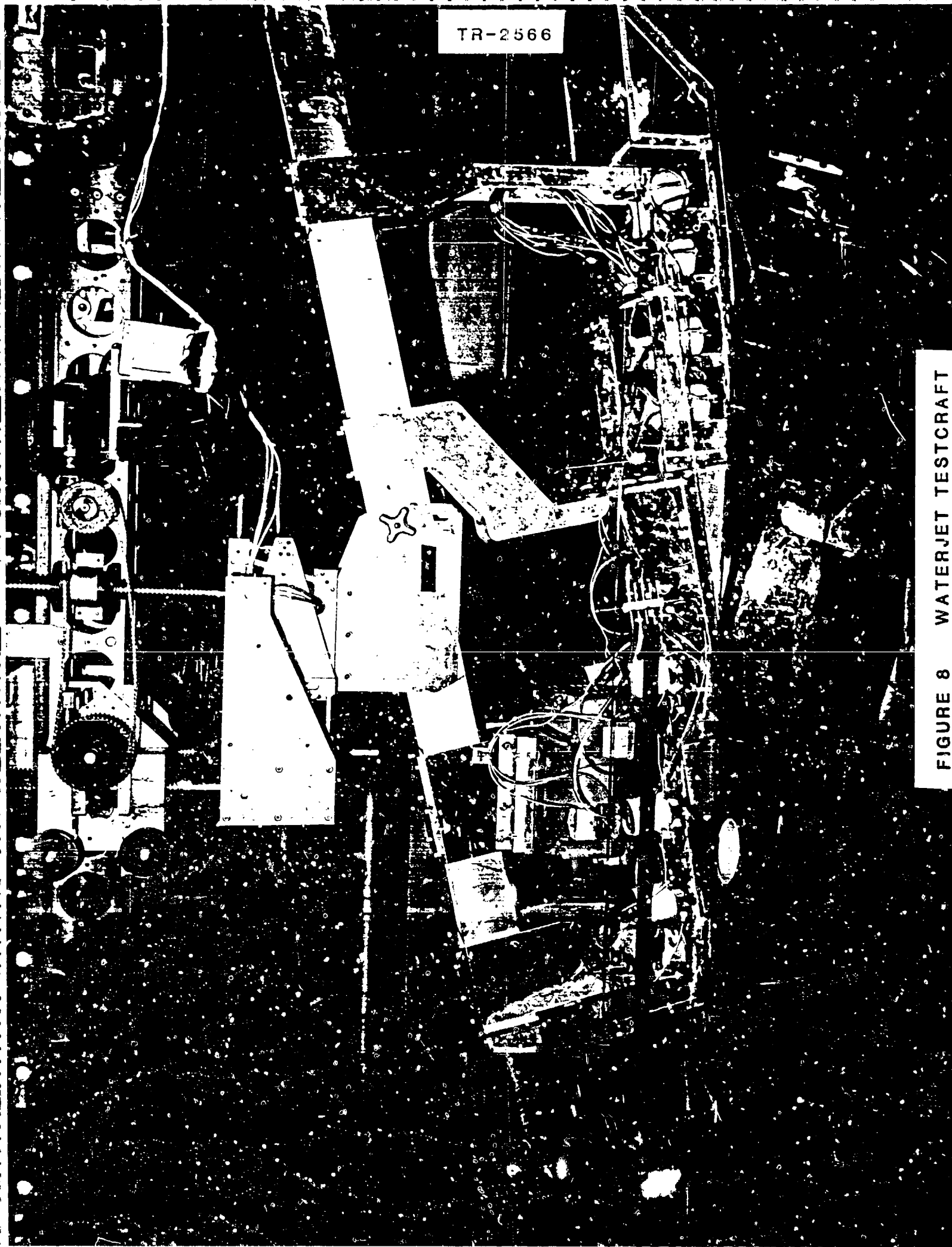


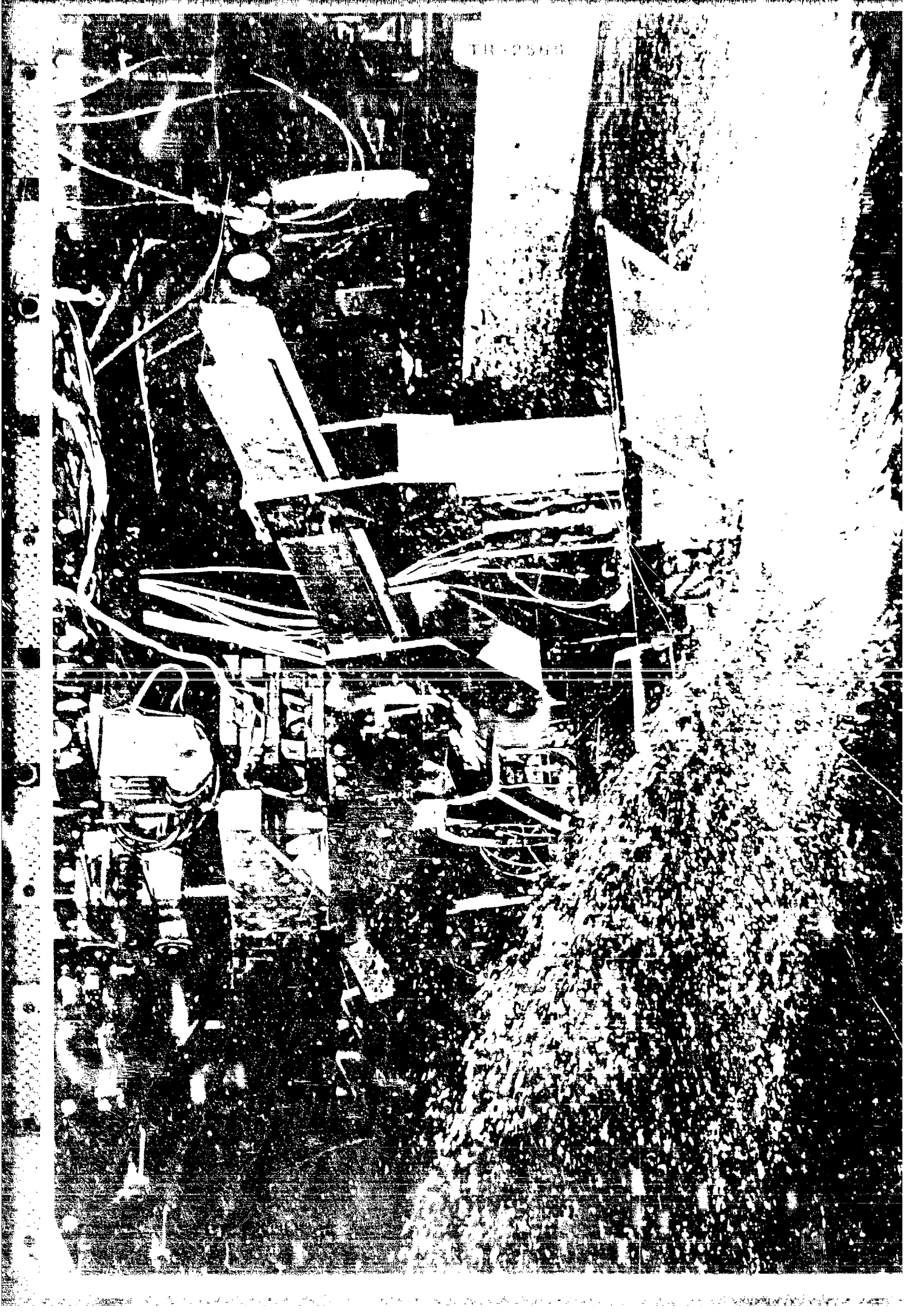
FIGURE 7 TEST SECTION AND LOCATION OF PRANDTL TUBES

TR-2566

FIGURE 8 WATERJET TESTCRAFT



TR-2560



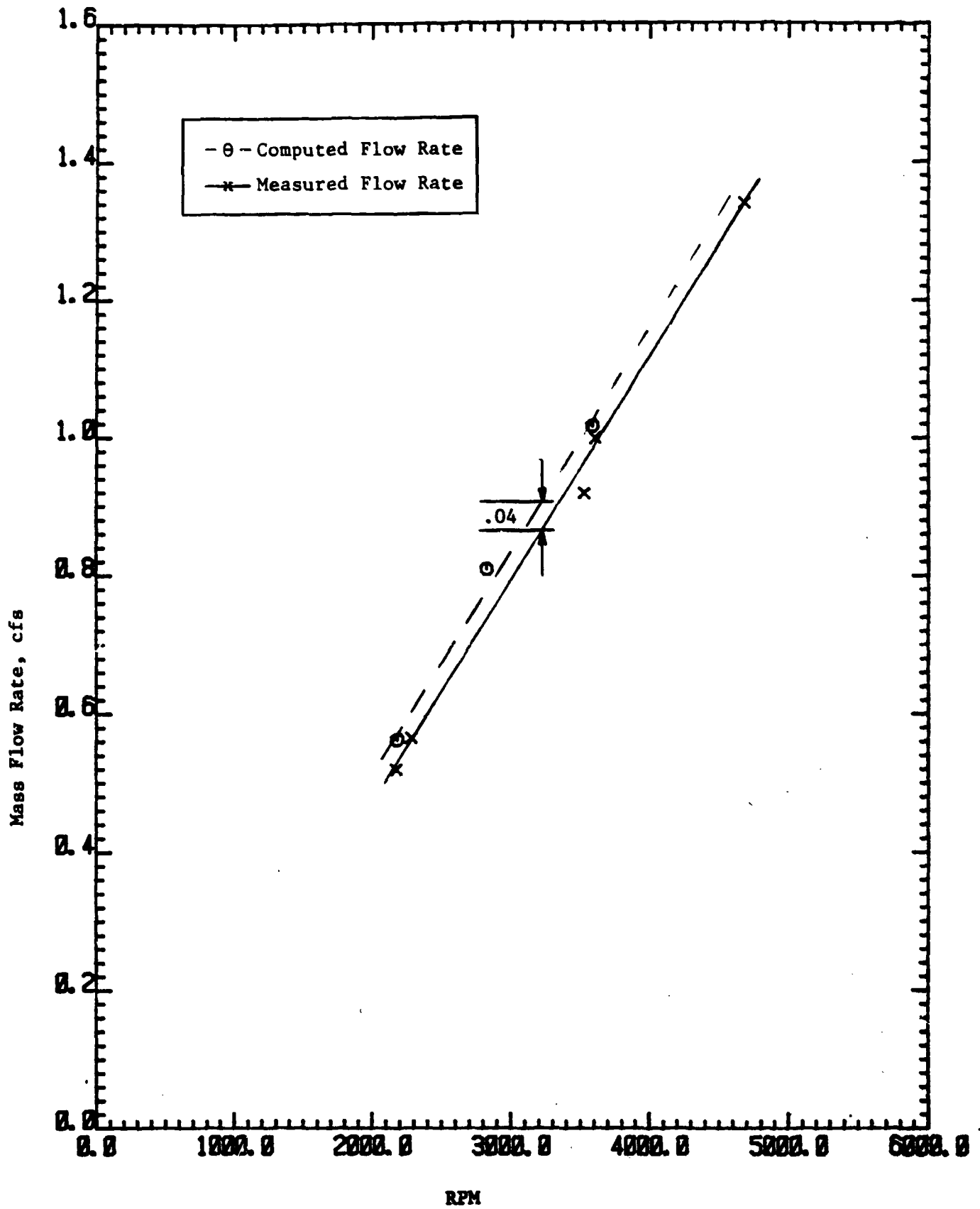


FIGURE 10 CALIBRATION OF FLOW RATE

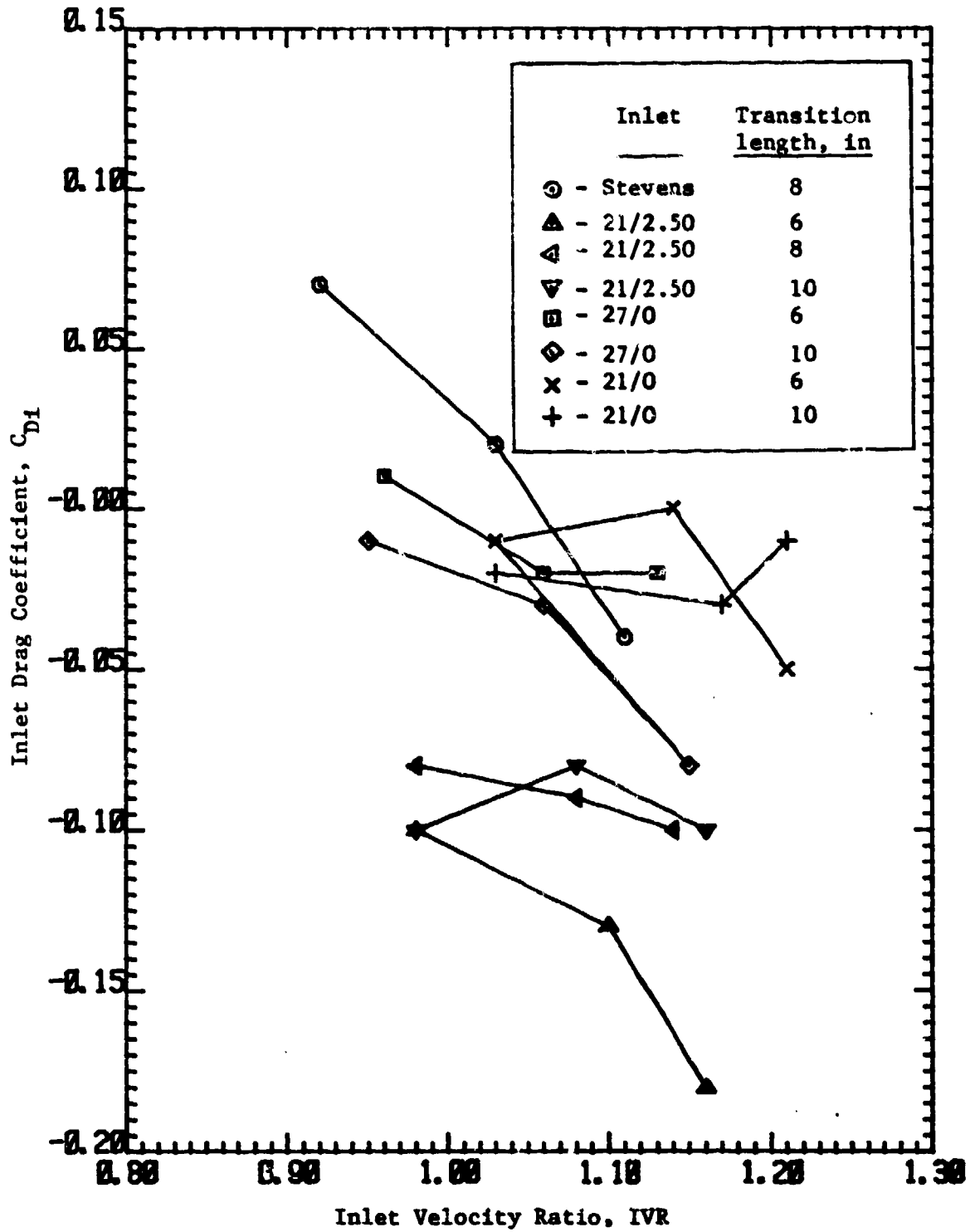


FIGURE 11 INLET DRAG COEFFICIENT VS IVR

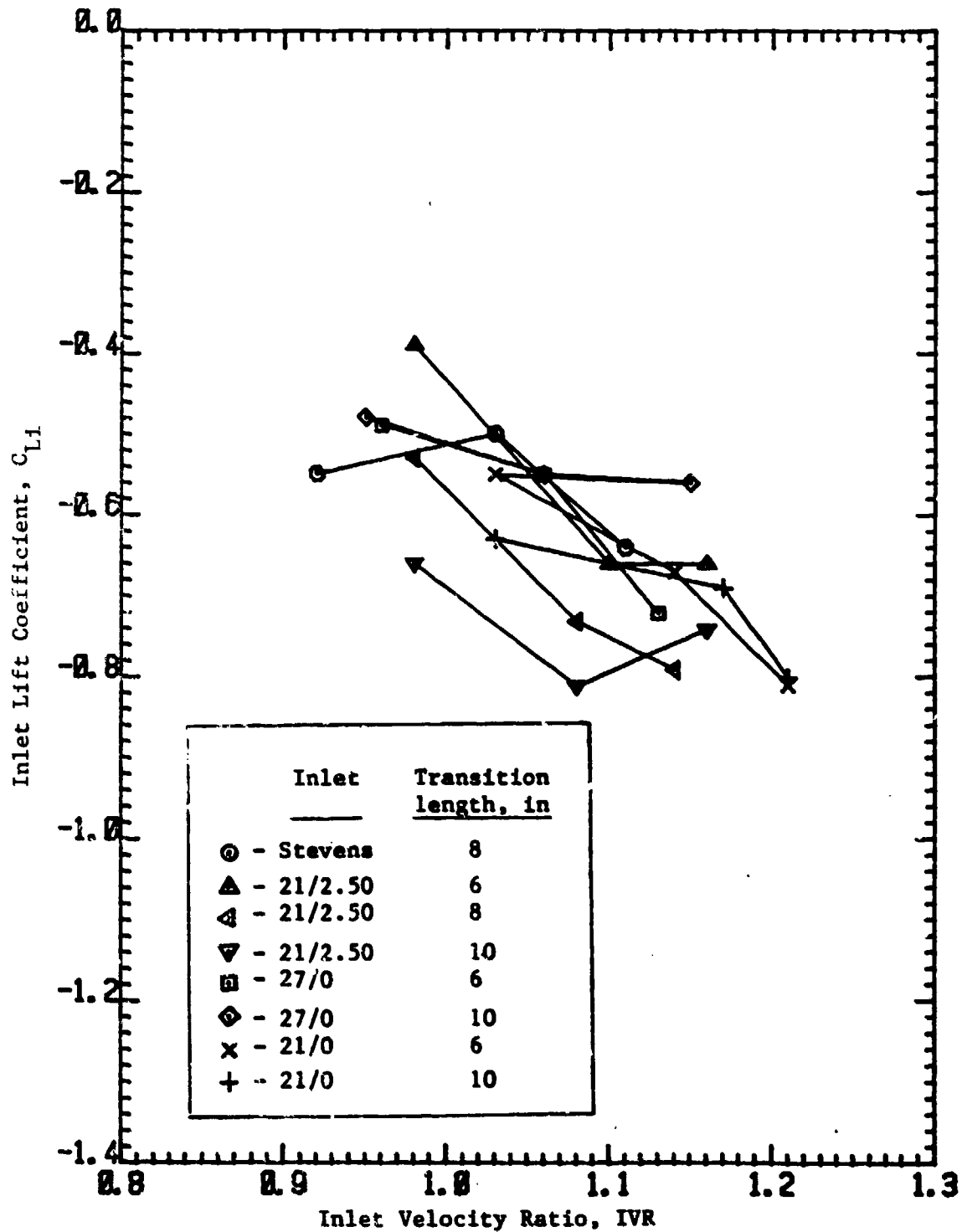


FIGURE 12 INLET LIFT COEFFICIENT VS IVR

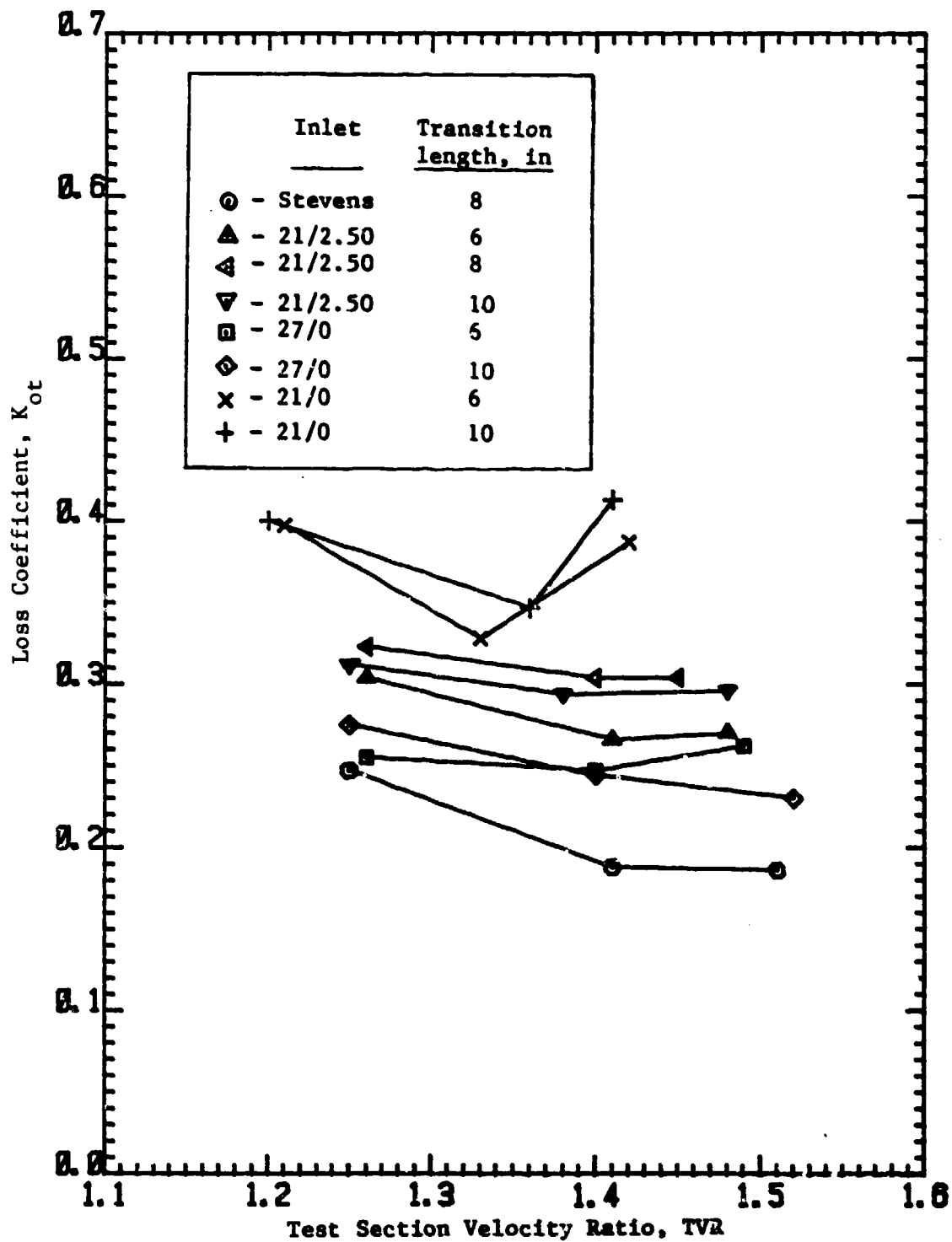


FIGURE 13 LOSS COEFFICIENT VS TVR

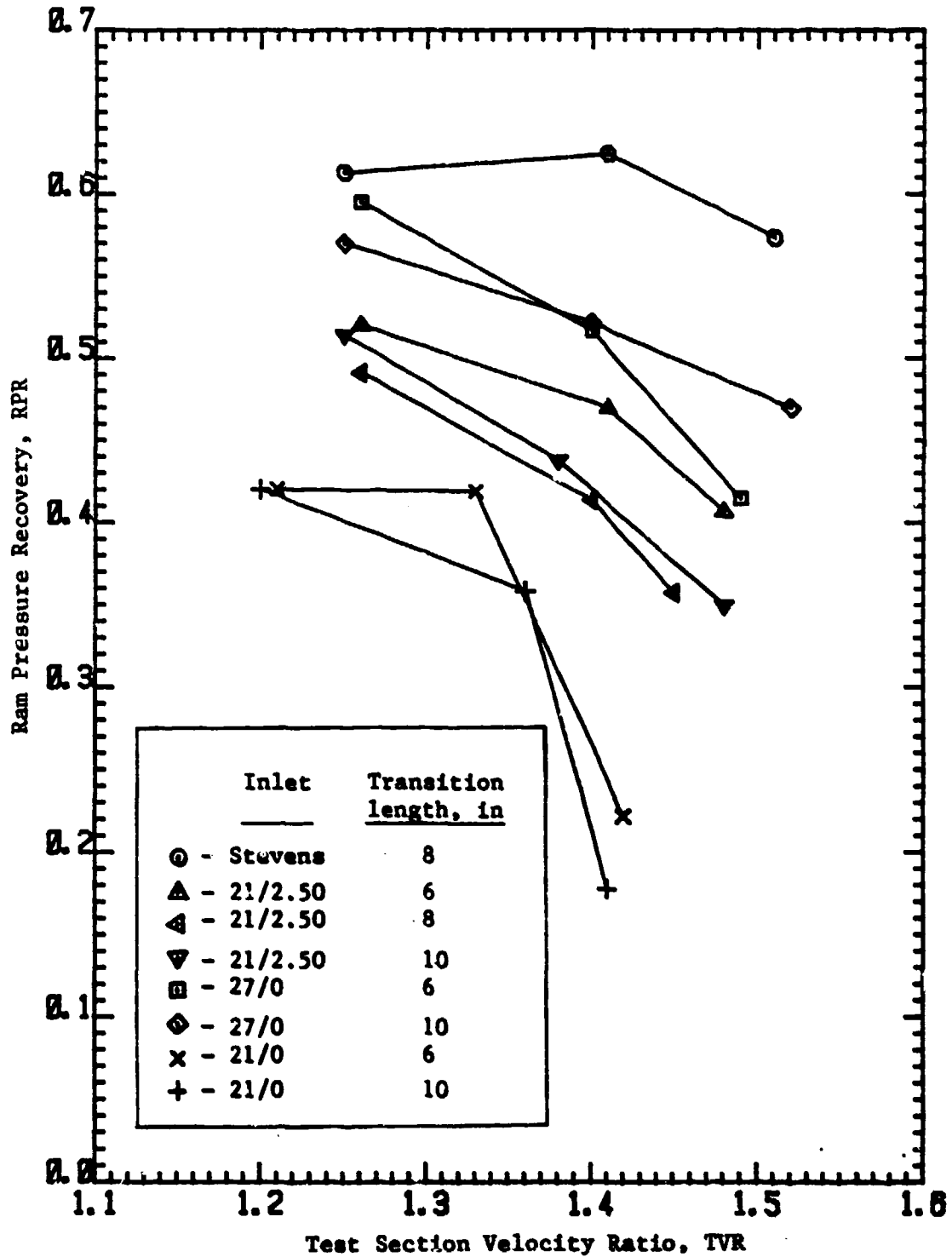


FIGURE 14 RAM PRESSURE RECOVERY, VS TVR

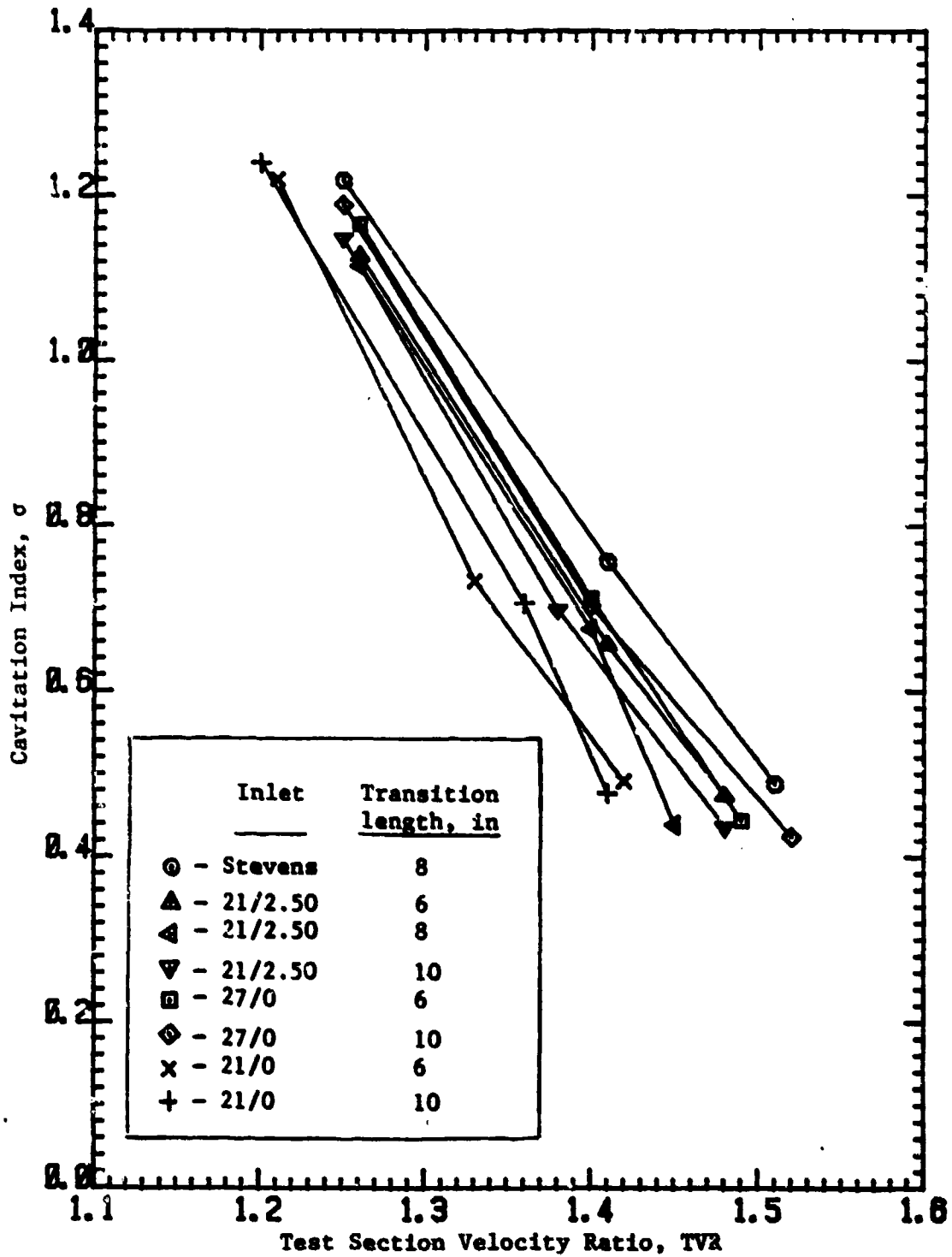


FIGURE 15 CAVITATION INDEX VS TVR

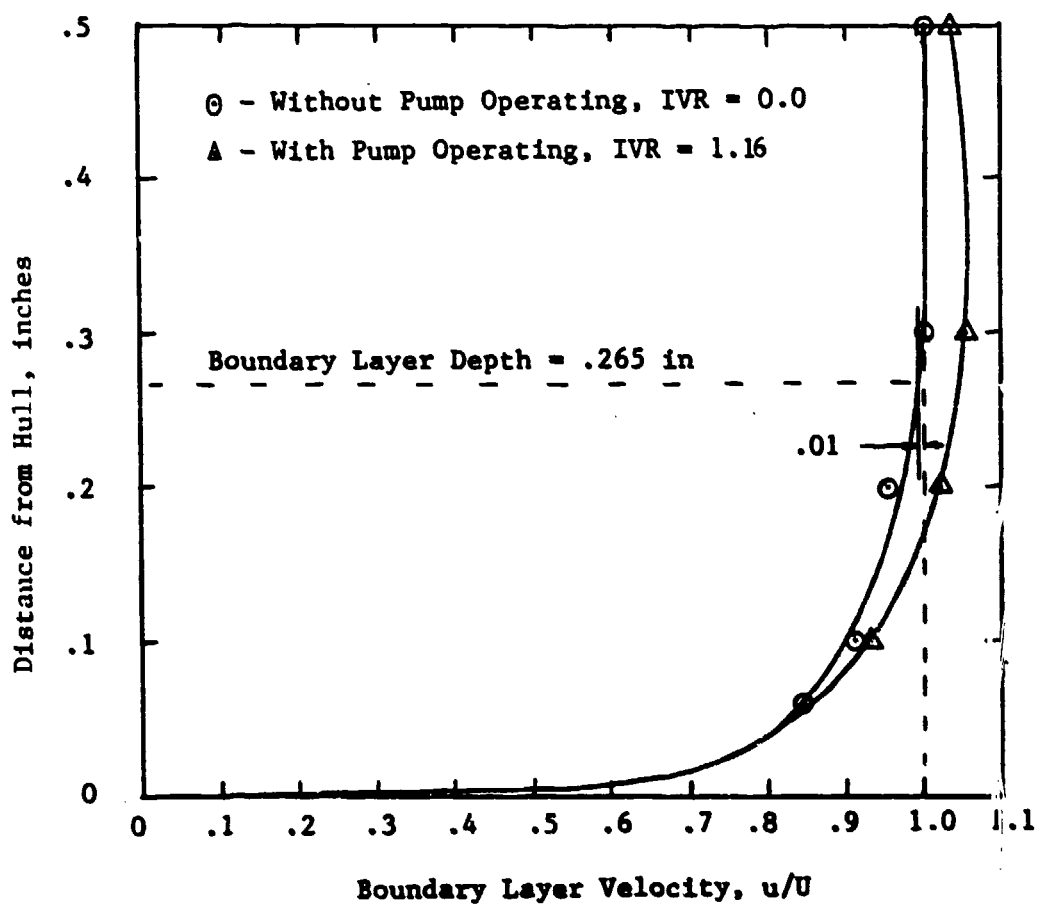


FIGURE 16 VELOCITY PROFILE WITH AND WITHOUT PUMP OPERATING

APPENDIX A

Jet Velocity Calibration

Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
334	0.0	2184.	0.	Static	-1.1	-1.1	-1.1	-1.3	-0.8	-0.6	-1.05	0.52
				Dynamic	1.1	1.1	1.2	0.9	0.8	0.3	0.83	
				Total	0.0	0.0	0.1	-0.4	0.0	-0.3	-0.22	
365	0.0	2190.	45.	Static	-1.1	-1.1	-1.2	-0.9	-1.0	-1.1	-1.16	0.54
				Dynamic	1.1	1.2	1.1	0.5	0.5	0.8	0.90	
				Total	0.0	0.1	-0.1	-0.4	-0.5	-0.3	-0.26	
330	0.0	2182.	90.	Static	-1.1	-1.1	-1.1	-1.2	-1.1	-0.9	-1.14	0.65
				Dynamic	1.2	1.2	1.1	1.1	1.6	1.3	1.26	
				Total	0.1	0.1	0.0	-0.1	0.5	0.4	0.12	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
335	0.0	2803.	0.	Static	-2.1	-2.1	-2.2	-2.2	-2.0	-1.8	-2.10	0.81
				Dynamic	2.1	2.1	2.3	1.3	2.4	1.5	1.93	
				Total	0.0	0.0	0.1	-0.9	0.4	-0.3	-0.17	
366	0.0	2836.	45.	Static	-2.1	-2.1	-2.2	-1.9	-1.9	-2.1	-2.16	0.75
				Dynamic	2.2	2.2	2.2	0.9	0.8	1.5	1.68	
				Total	0.1	0.1	0.0	-1.0	-1.1	-0.6	-0.48	
331	0.0	2834.	90.	Static	-2.1	-2.1	-2.3	-2.3	-2.2	-2.1	-2.23	0.93
				Dynamic	2.2	2.2	2.1	2.0	3.5	3.0	2.56	
				Total	0.1	0.1	-0.2	-0.3	1.3	0.9	0.33	
Run	Vel	RPM	Deg	Location	Top	2nd	3rd	4th	5th	Bottom	Average	Q-tot
336	0.0	3533.	0.	Static	-3.6	-3.5	-3.7	-3.7	-3.1	-2.8	-3.40	0.99
				Dynamic	3.6	3.5	3.9	1.8	3.3	1.8	2.94	
				Total	0.0	0.0	0.2	-1.9	0.2	-1.0	-0.46	
367	0.0	3603.	45.	Static	-3.7	-3.7	-3.9	-3.4	-3.2	-3.6	-3.66	0.96
				Dynamic	3.8	3.9	3.8	1.3	1.1	2.4	2.83	
				Total	0.1	0.2	-0.1	-2.1	-2.1	-1.2	-0.83	
332	0.0	3609.	90.	Static	-3.7	-3.7	-3.9	-4.0	-3.5	-3.0	-3.61	1.16
				Dynamic	3.8	3.7	3.6	3.2	4.8	4.1	3.95	
				Total	0.1	0.0	-0.3	-0.8	1.3	1.1	0.34	

APPENDIX A
(Concluded)

Jet Velocity Calibration

Impeller rpm	Mass Flow Rate cfs	
2186	0.563	Integrated flow rate
2827	0.810	Integrated flow rate
3587	1.018	Integrated flow rate
2283	0.567	Measured flow rate
3607	1.000	Measured flow rate
4687	1.340	Measured flow rate
2182	0.520	Measured flow rate
3524	0.920	Measured flow rate

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