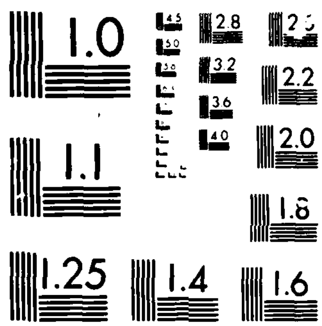
AD-A166 758 FLOW MEASUREMENTS IN A CENTRIFUGAL DIFFUSOR TEST DEVICE 1/2
(U) EXOTECH INC CAMPBELL CA T VITTING JUN 85 TR-8501
N00014-84-C-0766

UNCLASSIFIED F/G 13/7 NL



MICROCOP CHART

exotech inc.

3rd Floor, 1901 S. Bascom Ave., Campbell,
California, U.S.A. 95008

AD-A166 758

FINAL REPORT

FLOW MEASUREMENTS IN A CENTRIFUGAL DIFFUSOR TEST DEVICE

TR 8501

JUNE 1985

PREPARED BY

T. VITTING

SUBMITTED TO

NAVAL POSTGRADUATE SCHOOL,
MONTEREY, CALIFORNIA, 93943

UNDER CONTRACT

N00014-84-C-0766

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER A166 758
4. TITLE (and Subtitle) Flow Measurements in a Centrifugal Diffusor Test Device		5. TYPE OF REPORT & PERIOD COVERED Final 1 October 1984-31 May 1985
		6. PERFORMING ORG. REPORT NUMBER TR 8501
7. AUTHOR(s) Thomas Vitting		8. CONTRACT OR GRANT NUMBER(s) N00014-84-C-0766
9. PERFORMING ORGANIZATION NAME AND ADDRESS Exotech Inc. 1901 S. Bascom Ave., Ste. 337 Campbell, California 95008		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Department of Aeronautics Naval Postgraduate School Monterey, California 93943-5100		12. REPORT DATE June 1985
		13. NUMBER OF PAGES 127
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Office of Naval Research 800 N. Quincy St. Arlington, Virginia 22217		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Centrifugal Diffuser
Flow Measurement
Flow Models

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The measurement program conducted mainly surveyed the axial and circumferential uniformity of the flow at the inlet of a transonic wedge-type blading mounted in the device. Evaluation of the results showed the flow uniformity to be unsatisfactory. Leakage and other small perturbations in the flow field in the swirl generator are believed to be amplified by the basic flow configuration of the device.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

S/N 0102-LF-014-6601

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

exotech inc.

3rd Floor, 1901 S. Bascom Ave., Campbell,
California, U.S.A. 95008

FINAL REPORT

FLOW MEASUREMENTS IN A CENTRIFUGAL DIFFUSOR TEST DEVICE

TR 8501

JUNE 1985

PREPARED BY

T. VITTING

SUBMITTED TO

NAVAL POSTGRADUATE SCHOOL,
MONTEREY, CALIFORNIA, 93943

UNDER CONTRACT

N00014-84-C-0766

Table of Contents Page

1. Introduction 1

1.1 Discription of CDTD and Principle of Operation 2

1.2 Work Reported 4

2. Objectives and Results of Work Done 5

2.1 Hardware 5

2.1.1 Work on Device 5

2.1.2 Instrumentation 5

2.2 Measurements 7

2.2.1 Low Dynamic Head, Different Exposed SVC Lengths 7

2.2.1.1 Flow Angle 7

2.2.1.2 Total Pressure 11

2.2.2 High Dynamic Head, Different Exposed SVC Lengths 11

2.2.2.1 Flow Angle 11

2.2.2.2 Total Pressure 15

2.2.2.3 Static Pressure Distribution Along Outer Casing 15

2.2.2.4 Mass Averaged Total Pressure Losses 22

2.2.2.5 Spanwise Distribution of Flow Angle and Total Pressure 25

2.2.2.6 Circumferential Distribution of Total Pressure 26

2.2.3 Repeatability of Measurements 33

2.2.4 Conclusions from Measurements 33

2.3 Accuracy of Measurements 37

2.3.1 Pressure Measurements 37

2.3.1.1 Total Pressure 38

2.3.1.2 Static Pressure 38

2.3.2 Flow Angle Measurements 39

Table of Contents, continued

		Page
3.	Concept for Taking Initial Diffusor Measurements	40
4.	Proposed Hardware Changes	42
4.1	Requirements on New Device Hardware	42
4.2	Design of New Hardware	43
5.	Summary, Conclusions and Recomendations	47
6.	List of References	49
7.	List of Abbreviations, Symbols and Indexes	50
Appendix A	Design Drawings of Wedge Shape Probe	A-1
Appendix B	Tables of All Results	B-1
Appendix C	Design Drawings of Proposed SVC	C-1
Appendix D	Tables of Loss Measurements With Flow Models	D-1

List of Figures Page

1. Schematic of the CDTD 2

2 Total View of Unvaned CDTD 3

3. Single Jet Flow Model 6

4. 25 Jets Flow Model 6

5. Spanwise Distribution of Flow Angle, Influence of JW - Setting 8

6. Spanwise Distribution of Flow Angle, Influence of JWT - Setting 10

7. Spanwise Total Pressure Distribution, Influence of JW - Setting 12

8. Spanwise Total Pressure Distribution, Influence of JWT - Setting 13

9. Spanwise Distribution of Flow Angle, Influence of JW - Setting 14

10. Spanwise Flow Angle Distribution, Influence of JWT Setting 16

11. Spanwise Total Pressure Distribution, Influence of JW - Setting 17

12. Spanwise Total Pressure Distribution, Influence of JWT - Setting 18

13. Static Pressure Distribution Along Outer Casing and Contraction Ring; Influence of JWT - Setting 19

14. Static Pressure Distribution Along Outer Casing and CR; Influence of JW - Setting 20

15. Schematic of Idealized Streamlines Through CDTD For Different JW - Settings 21

16. Total Pressure Distribution Near the SVC-Surface, Ref.[2] 24

17. Circumferential Distribution of Maximum Total Pressure; Influence of JW - Setting 27

18. Circumferential Distribution of Max Total Pressure, Influence of SVC Position 29

19. Circumferential Distribution of Max Total Pressure, Run without SVC 30

20. Schematic of Pressure Distributions on Streamlines for Vaned and Unvaned CDTD, Not Scaled 31

21. Circumferential Distribution of Max Total Pressure, Influence of Diffuser 32

22. Circumferential Distribution of Max Total Pressure, Influence of Sealing 34

23. Comparison of Circumferential Static and Total Pressure Distribution 35

24. Circumferential Distribution of Max Total Pressure, Influence of Blocking SVC 36

25. Flow Field of Flow Model, Visualization with Tufts 43

26. Flow Field of Flow Model, Visualization with Smoke 44

27. 3D Sketch of Casting Mold 45

1. Introduction and Objectives of Project

The purpose of the work discussed was to verify the concepts used in the design of a large scale, low speed, radial cascade wind tunnel. The tunnel was to be used to investigate flow phenomena in and the performance of vaned radial diffusors.

A major contributor to centrifugal compressor efficiency is the performance of the vaned diffusor which closely follows the impeller of the compressor. The purpose of this diffusor is to efficiently convert most of the kinetic energy of the transonic flow entering the vane into pressure.

The design of centrifugal diffusors is presently based largely on experimental results of two-dimensional and conical diffusors. Two reasons for this dependence on empirical 2-D data are:

1. Theoretical analysis of the viscous, three-dimensional, nonuniform unsteady, transonic flow with strongly adverse static pressure gradients is, for the present, far from being a practical tool for design.

2. Centrifugal diffusors are frequently evaluated along with the rotor as a component of high speed compressors or gas turbine engines. This technique does not yield the detailed and accurate information necessary to confirm diffusor design systems, or to provide the basis for improved theoretical analysis of the diffusor alone.

The need for an experimental facility which could simulate adequately, at low cost and in a controlled way, the environment of the centrifugal compressor motivated the developement of the Centrifugal Diffusor Test Device (CDTD). It was expected that the generation of a three dimensional flow would provide improved empirical data on annular cascade performance. The following objectives were defined for the project:

1. Develop a large scale, low speed model of a vaned/unvaned radial diffusor for centrifugal compressors.

2. Develop the techniques required for investigating the diffusor flow field.

3. Obtain diffusor flow field data for computational code verification.

4. Apply the experience of a low speed device development to the design of a transonic speed test device

1.1 Description of CDTD and Principle of Operation

Figure 1 shows a schematic of the CDTD and Fig. 2 is a view of the apparatus, which is located in the Cascade Building at the Turbopropulsion Laboratory (TPL) at the Naval Postgraduate School.

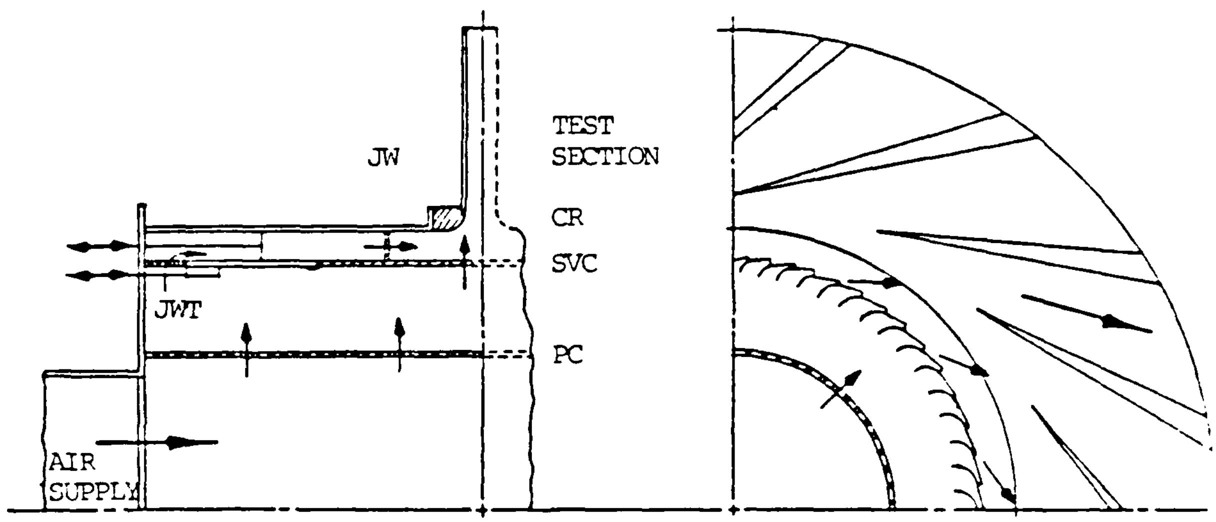


Figure 1 : Schematic of the CDTD

The CDTD is based on the concept of first generating a nearly tangential, swirling flow using many small nozzles arranged peripherally along the length of the surface of a central generating cylinder (SVC in Fig. 1). The angular momentum of this flow is then conserved as the flow passes outward through an annular contraction ring (CR in Fig. 1) and into the test section containing the particular vaned or unvaned diffusor under test. Conservation of angular momentum determines the tangential component of velocity at the test vanes in proportion to the tangential velocity at the SVC. The radial component of

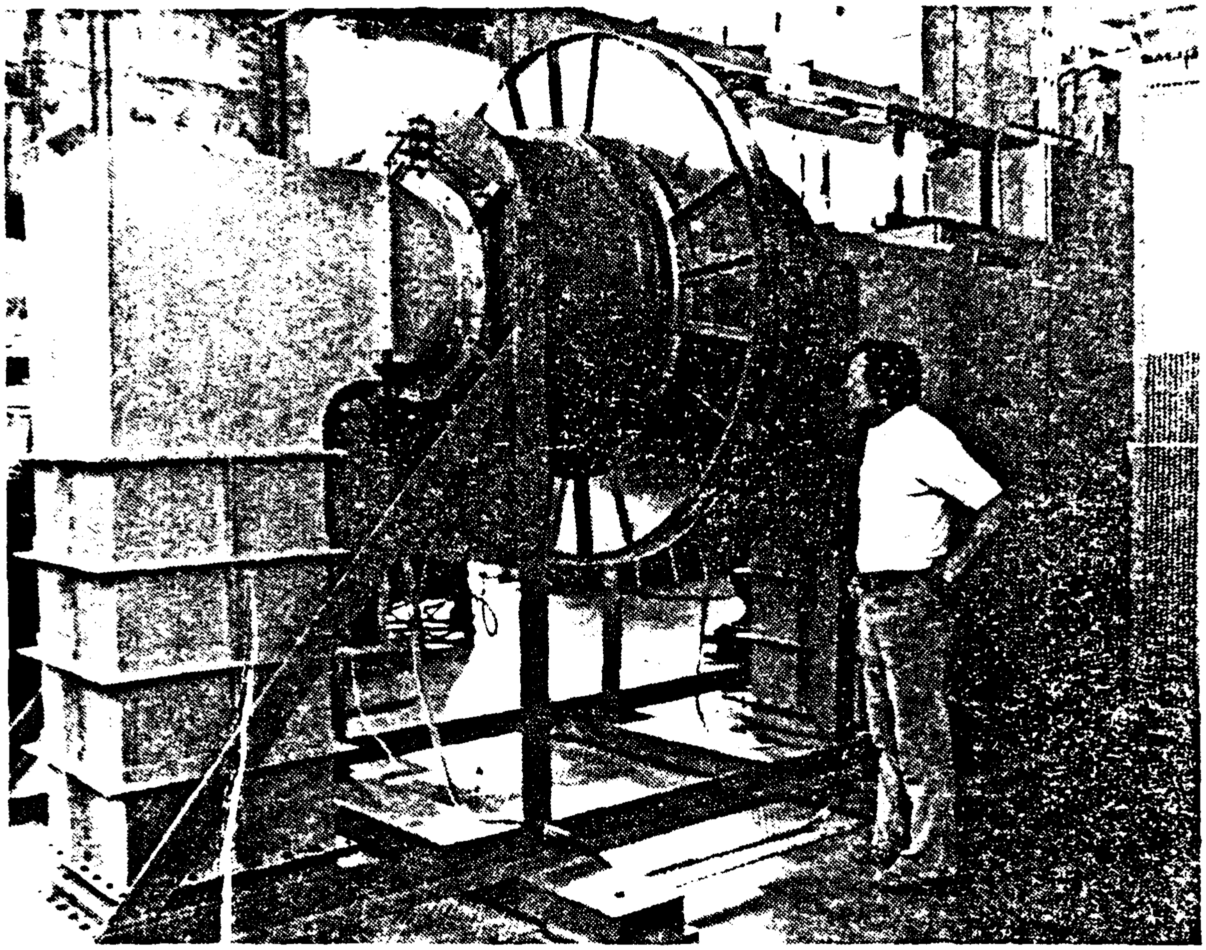


Figure 2 : Total View of Unvaned CDTD

velocity in the test section can be controlled in relation to the tangential component by changing the exposed length of the SVC.

This can be done by axially translating the annular end walls (JW in Fig. 1) across the surface of the SVC. The length of exposed SVC therefore, directly determines the average flow angle into the test diffusor. This control is independent of the magnitude of the velocity or flow rate. In addition, some control of the velocity profile into the test diffusor is obtained by allowing a secondary flow of air to be injected, also nearly tangentially, through similar small nozzles in the face of the JW. A detailed description of the design and the hardware of the CDTD is given in Ref. [1].

1.2 Work Reported

In the present progress report the actual status of the device hardware is described and the results of a measurement program to analyse the diffusor inlet flow are discussed. Also a new design for a central part of the device, the SVC, is presented which may provide improved circumferential and spanwise flow uniformity.

This redesign followed from the high circumferential nonuniformity measured at the inlet of the test section. A second major result of the measurement program was the observation that the range of the possible flow profile control achievable by varying the flow through the JW was not wide enough to be representative of rotor outflows.

A concept was also evaluated which may provide a way to obtain diffusor measurements with the present design using only one test section instead of five. Since only one probe can be used with this procedure, the time involved in obtaining diffusor data will increase significantly.

2. Objectives and Results of Work Done

2.1 Hardware

2.1.1 Work on Device

After some major changes on the hardware, the testrig was reassembled. The changes affected were:

- Repairing the brass SVC after a burst in October 1983.
- Enforcing it with surrounding safety wires.
- Soldering on sealing strips to reduce the leakage flow between SVC and JW.
- Installing the straight, wedge shaped diffusor vanes.

With these changes the reassembled CDTD was ready for initial test runs described later. During the test runs, which surveyed the circumferential flow distribution, the bearing for turning one of the diffusor walls and with it the survey probes jammed and had to be repaired.

Due to unexpectedly high circumferential flow nonuniformities the device was disassembled and reassembled several times. Screens were installed, different parts of the SVC were blocked, the SVC was rotated, the diffusor vanes were dismounted and the JW were blocked.

To demonstrate the potential of a new concept to generate the swirling flow, two models were built. Figure 3 shows the schematic cross-section of a one nozzle plain surface model and Fig. 4 the schematic cross-section of a 25 nozzlels curved surface model. These models were evaluated by flow visualization techniques and pressure measurements discussed later.

2.1.2 Instrumentation

A complete discription of the survey and control instrumentation is given in Ref. [1]. During the calibration of the wedge-shaped probes, which were manufactured in NPS workshops, blockage of pressure ports occured. A redesign was necessary to enlarge the ports while retaining the outer dimen-

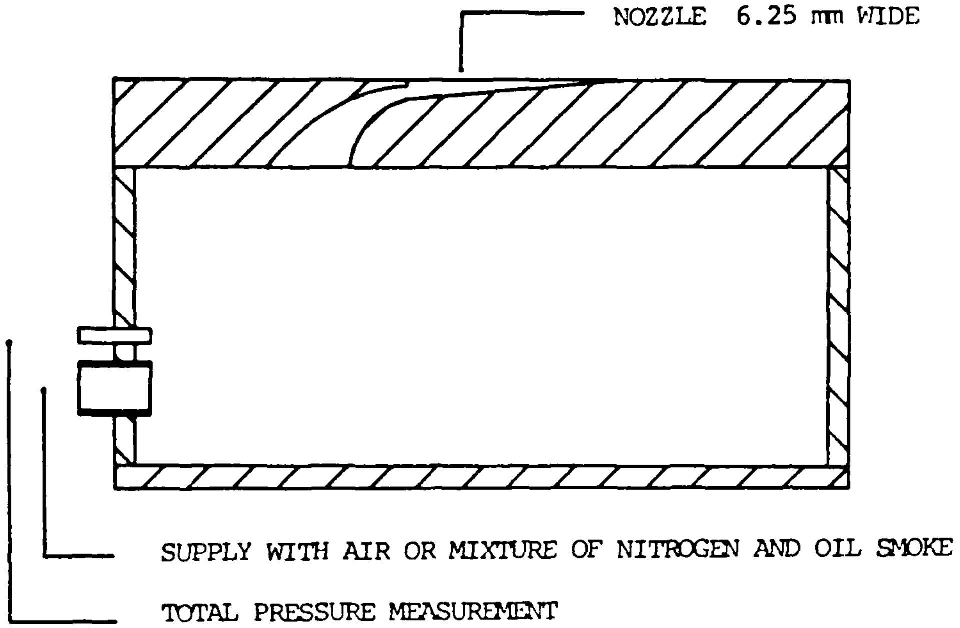


Figure 3 : Single Jet Flow Model

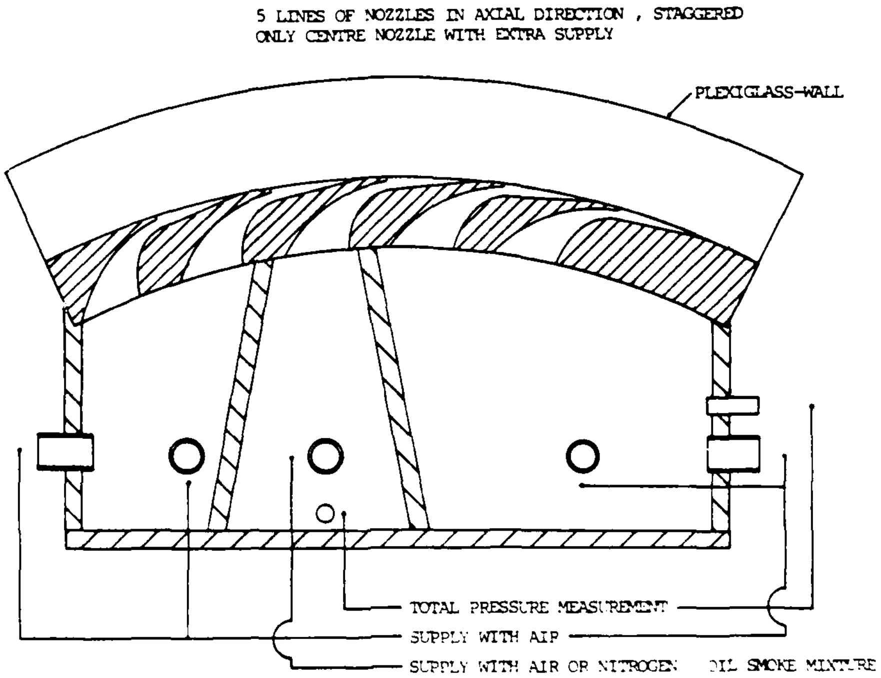


Figure 4 : 25 Jets Flow Model

sions of the probe. The design drawings are printed in Appendix A. The probe calibrated well after modification. If measurement experience with the probe type is satisfactory, more will be fabricated.

Cobra-type probes, also manufactured in NPS workshops, showed a low accuracy for flow angle measurements in the device due to an hysteresis. The reason for this behavior could not be determined.

To quicken surveys of circumferential flow uniformity, a rake of pitot tubes was designed and built which allowed ten total pressures in spanwise direction to be measured at the same time. The flow angle could no longer be measured, however.

One of the 32 diffusor passages was painted black and furnished with tufts in order to obatain a flow visualisation near the diffusor walls.

2.2 Measurements

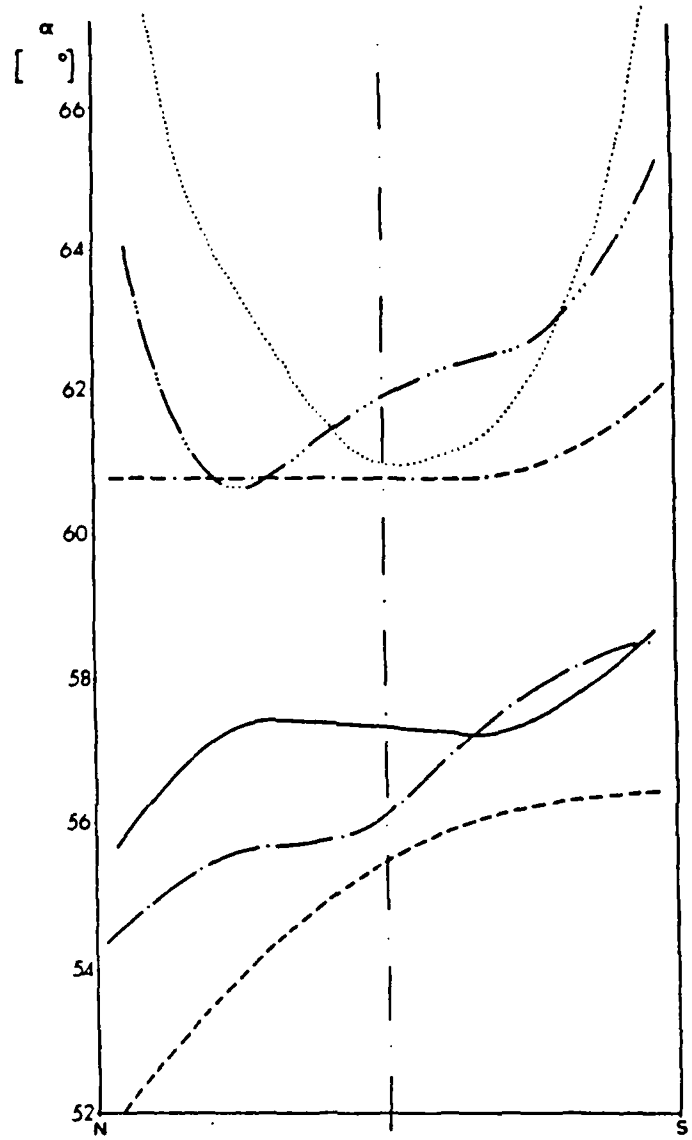
2.2.1 Low Dynamic Head, Different Exposed SVC Lengths

Initial runs with the rebuilt and reinforced SVC were made at low supply preasures, (P_p - P_a) below 250 N/m^2 (10 inches H_2O). All surveys were made at the same circumferential position and at a radius of 609.6 mm (24 inches). The leading edge of the diffusor is located at 635 mm (25 inches) radius and the vane position and angle were fixed.

2.2.1.1 Flow Angle

Influence of JW-setting.

Figure 5 shows the influence of the JW-setting on the flow angle. In all cases the JWT were open. By changing the exposed length of the SVC and with it the mass flow a mean flow angle variation from about 55° to about 62° could be achieved. At lower JW-spacings less than 228.6 mm (9 inches) a rotating stall occured due to the high flow angle in the wall and vane corner. The average flow angle decreases when JW-spacing and mass flow increase. With a first order approximation the conservation equations of angular momentum and continuity may be used to establish the flow angle :



	No	SJW	NJW	SJWT	NJWT	Vanes
	125	24"	24"	open	open	yes
	126	20"	20"	open	open	yes
	123	17"	17"	open	open	yes
	124	14"	14"	open	open	yes
	127	11"	11"	open	open	yes
	128	9"	9"	open	open	yes

Figure 5 : Spanwise Distribution of Flow Angle, Influence of JW-Setting

Conservation of angular momentum :

$$r_1 v_{\theta 1} = r_2 v_{\theta 2}$$

Continuity :

$$r_1 v_{r1} l_1 = r_2 v_{r2} l_2$$

Trigonometry :

$$\tan(\alpha_i) = v_{\theta i} / v_{ri}$$

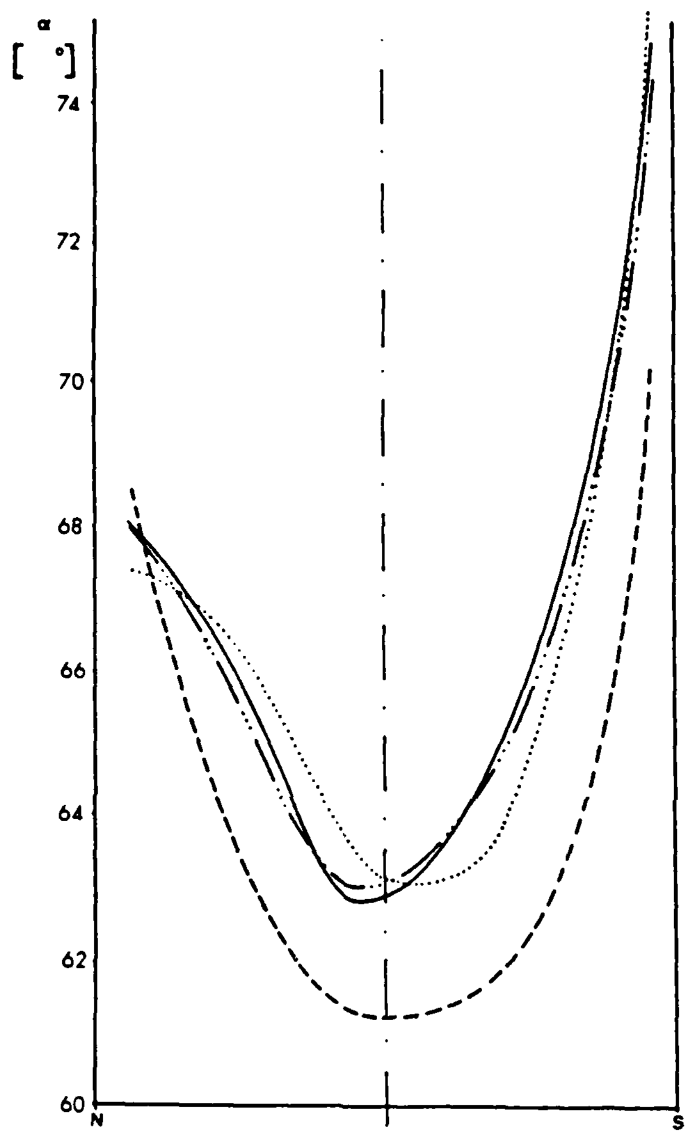
$$\rightarrow \qquad \underline{\underline{\alpha_2 = \arctan\left(\tan(\alpha_1) \cdot \frac{l_2}{l_1}\right)}}$$

The circumferential surveys discussed in detail later showed that the spanwise flow profiles depend on the peripheral location. Not only the magnitudes of flow angle and total pressure varied, but also the maximum in flow angle and total pressure shifted from closer to the southern diffusor wall to closer to the northern diffusor wall and back. Since Fig. 5 represents the flow conditions at only one peripheral position and no average conditions, this explains the reason for the flow angle being higher near the southern diffusor wall.

The actual layout of the SVC features three sealing strips in axial direction. These reduce the leakage flow between the SVC and the JW. They are installed for JW-spacings of 203.2 mm (8 inches), 304.8 mm (12 inches) and 457.2 mm (18 inches). The device is supposed to be run at these JW-settings and the wide open setting of 603.6 mm (24 inches) in order to operate with small leakage flows.

The sudden jump of flow angle between the JW-settings of 431.8 mm (18 inches) and 355.6 mm (14 inches) can not be explained by sealing strips as none are installed between these spacings.

Figure 6 shows the influence of the JWT opening on the flow angle. The three overlapping curves represent throttle settings very close to each other, hence the values are almost the same. Once the throttles are opened it is obvious that the whole profile is influenced and not the region near the wall selectively. Opening the JWT has much the same effect as increasing the



No	SJW	NJW	SJWT	NJWT	Vanes
128	9"	9"	open	open	yes
129	9"	9"	closed +.3	closed +.3	yes
130	9"	9"	closed +.1	closed +.1	yes
131	9"	9"	closed	closed	yes

Figure 6 : Spanwise Distribution of Flow Angle, Influence of JWT-Setting

exposed SVC length: the resulting mean flow angle decreases as the mass flow increases.

2.2.1.2 Total Pressure

Due to the lower mass flow rate, the total pressure drops when the exposed SVC length decreases as plotted in Fig. 7. Another undesired effect also occurs: the spanwise profiles turn from a bulky to a peaked shape. This is consistent with the flow angles of Fig. 5. One of the possible reasons for this behavior is described later in chapter 2.2.2.4 - mass averaged total pressure losses.

Figure 8 indicates that the effect of the secondary flow through the JW (controlled by opening the JWT) is limited to only changing the level of the total pressure. The same effect was already indicated by Fig. 6. The general shape of the spanwise total pressure distribution is not influenced by the secondary flow through the JW.

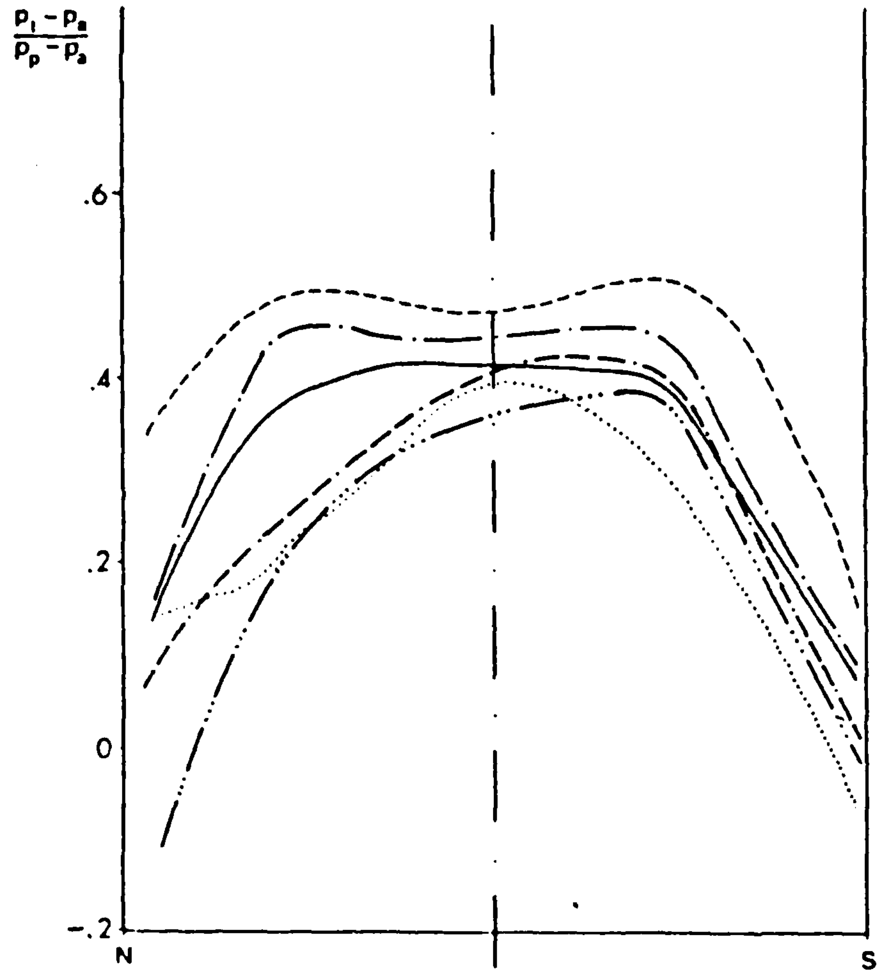
2.2.2 High Dynamic Head, Different Exposed SVC Lengths

2.2.2.1 Flow Angle

Influence of JW-setting.

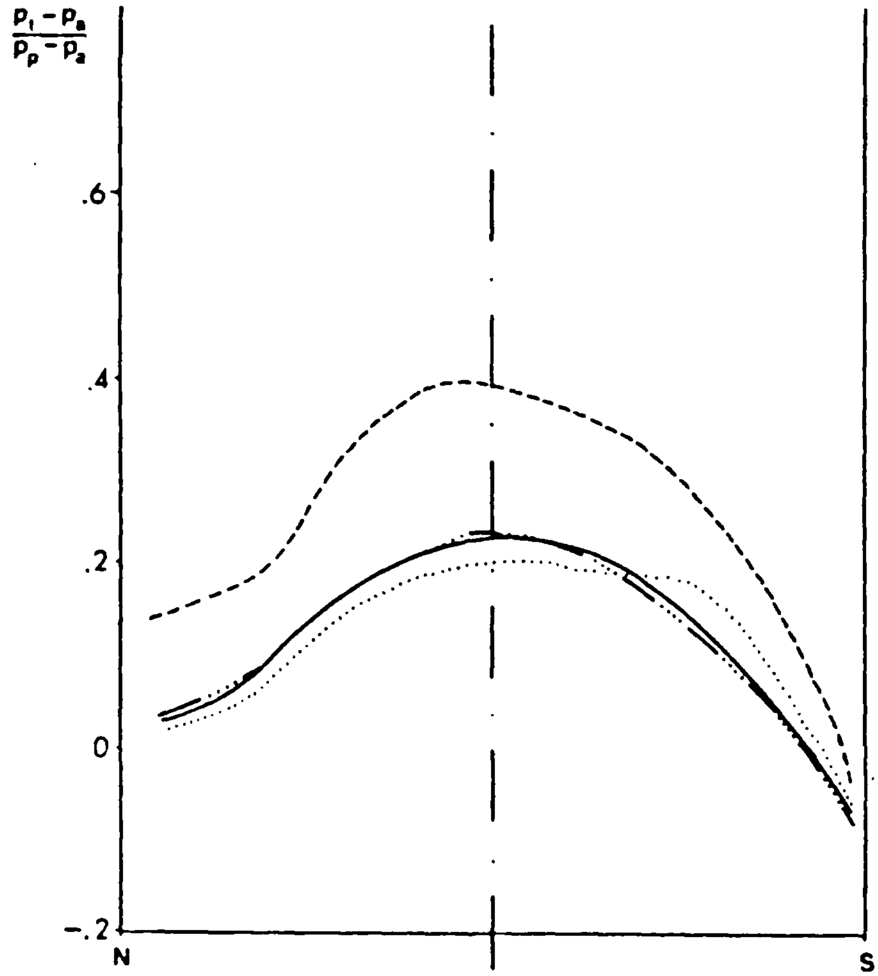
In all cases described below the plenum pressure had a value between P_a + 5625 N/m^2 (22.5 inches H_2O) and P_a + 5125 N/m^2 (20.5 inches H_2O). This range provides higher resolution in recording the probe pressures. Due to the strength limits of the brass sheet metal SVC, we did not exeed these supply pressures.

In order to survey the influence of the JW-setting more accurately tests were carried out where only one JW was set to different positions. The measurement locations were placed arround the sealing tubes installed at 304.8 mm (12 inches) to also survey the influence of these sealing elements. Figure 9 shows the results of these investigations. As expected, the flow angle did not change much near the fixed southern JW but changed near the northern JW. The variation of flow angle was small and in the expected direction: Decreasing the exposed length of the SVC results in an increased flow angle.



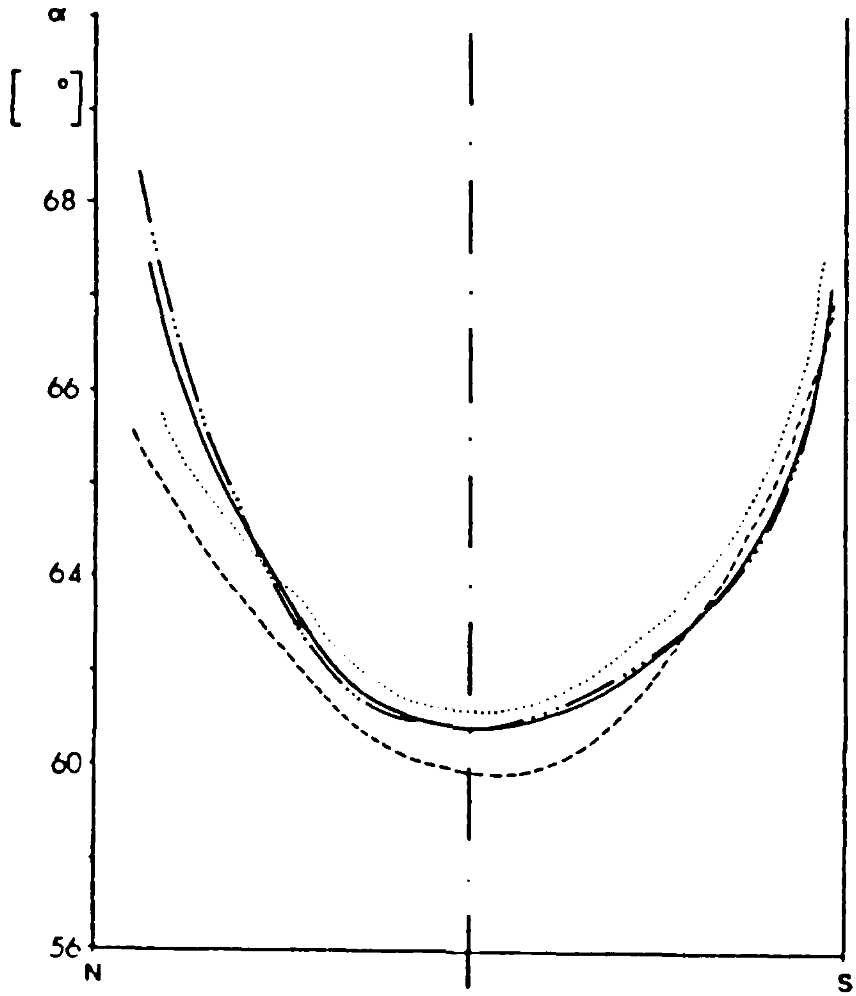
	No	SJW	NJW	SJWT	NJWT	Vanes
	125	24"	24"	open	open	yes
	126	20"	20"	open	open	yes
	123	17"	17"	open	open	yes
	124	14"	14"	open	open	yes
	127	11"	11"	open	open	yes
	128	9"	9"	open	open	yes

Figure 7 : Spanwise Total Pressure Distribution, Influence of JW-Setting



No	SJW	NJW	SJWT	NJWT	Vanes
128	9"	9"	open	open	yes
129	9"	9"	closed +.3	closed +.3	yes
130	9"	9"	closed +.1	closed +.1	yes
131	9"	9"	closed	closed	yes

Figure 8 : Spanwise Total Pressure Distribution, Influence of JWT-Setting



	No	SJW	NJW	SJWT	NJWT	Vanes
--------	137	11"	15"	closed	closed	yes
—·····—···	136	11"	13"	closed	closed	yes
— ——	135	11"	12"	closed	closed	yes
···············	134	11"	11"	closed	closed	yes

Figure 9 : Spanwise Distribution of Flow Angle , Influence of JW- setting

Influence of the JWT-opening

Some tests were carried out to check on the influence of a single JWT through flow. Figure 10 shows the results. The magnitude of flow angle variation is independent on the magnitude of the supply pressure. By opening one throttle only just the flow on that side is affected. The range of angle variation remains below one degree, which is not satisfactory for good control over the flow profile entering the test section. Near the wall a range of about 5° would be a more desirable influence on the distribution.

2.2.2.2 Total Pressure

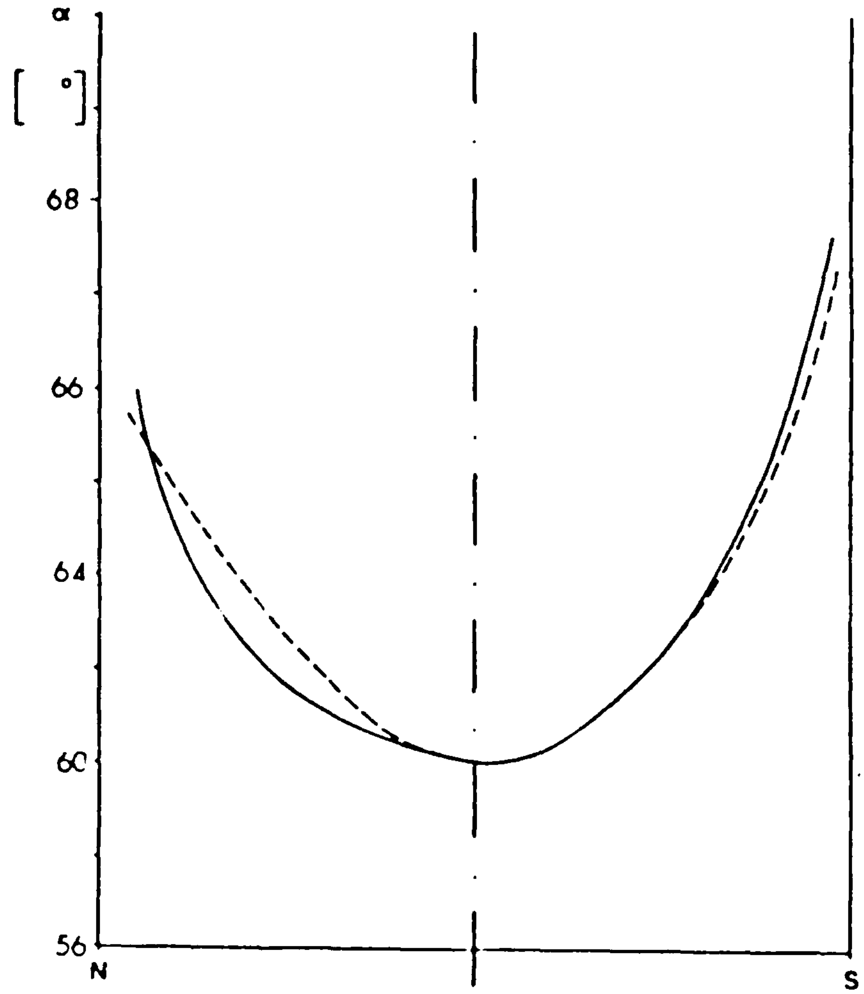
Similar to the flow angle variation caused by moving only one JW (described in Fig. 9) the total pressure in Fig. 11 on the NJW side increased when the NJW was retracted. The behavior can be explained with the same mechanisms changing the distribution of comparable cases as described in paragraph 2.2.1.2, namely, increasing the exposed length of the SVC increases the mass flow and with it the total pressure.

On the side of the test section where the JW was not moved almost no change is visible. The JW movement also has an effect on more than the half span.

The effect of increasing the mass flow on one side of the device by opening one of the JWT is almost the same as increasing the exposed SVC length. Fig. 12 shows in addition the flow through the JW is not only influencing the wall near flow at the entrance of the test section, but at least half of the span. The effects of the JW through flow do not depend on the magnitude of the supply pressure, as indicated by a comparison of Figs. 8 and 12.

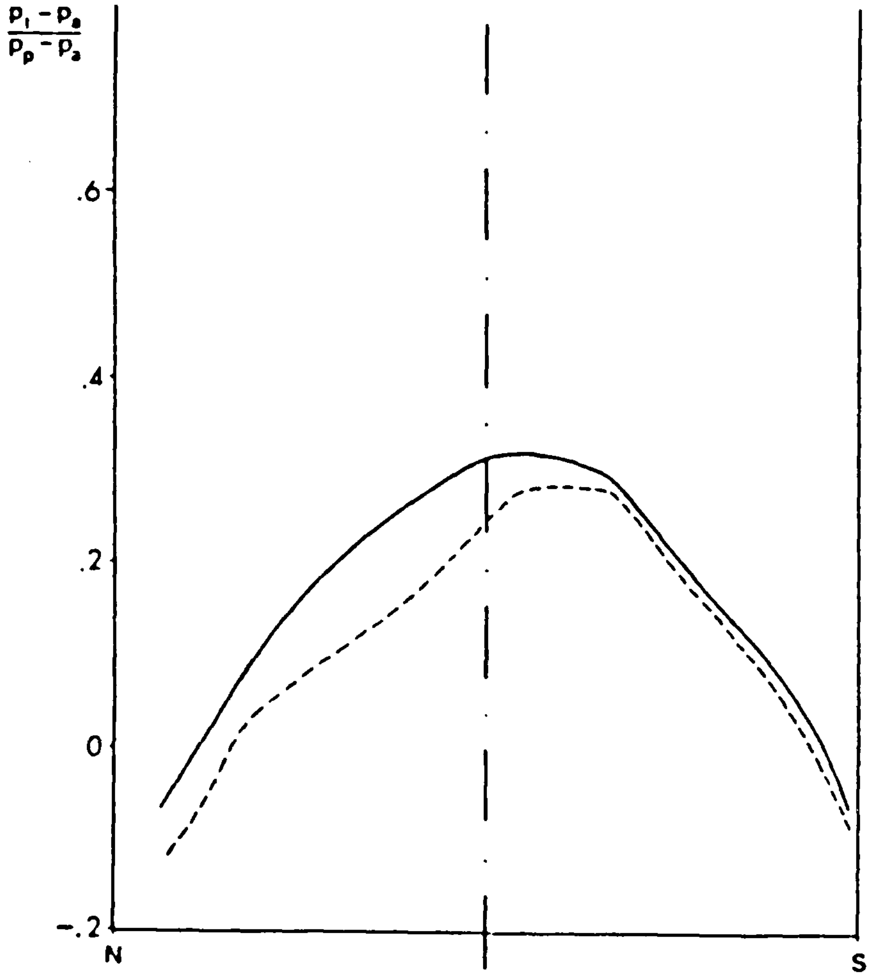
2.2.2.3 Static Pressure Distribution Along Outer Casing

The following static pressure distributions were measured along the outer casing of the device and almost to the inlet of the test section. Circumferential surveys were not possible since the survey orifices are installed at only one circumferential position. Selected results are presented as the general



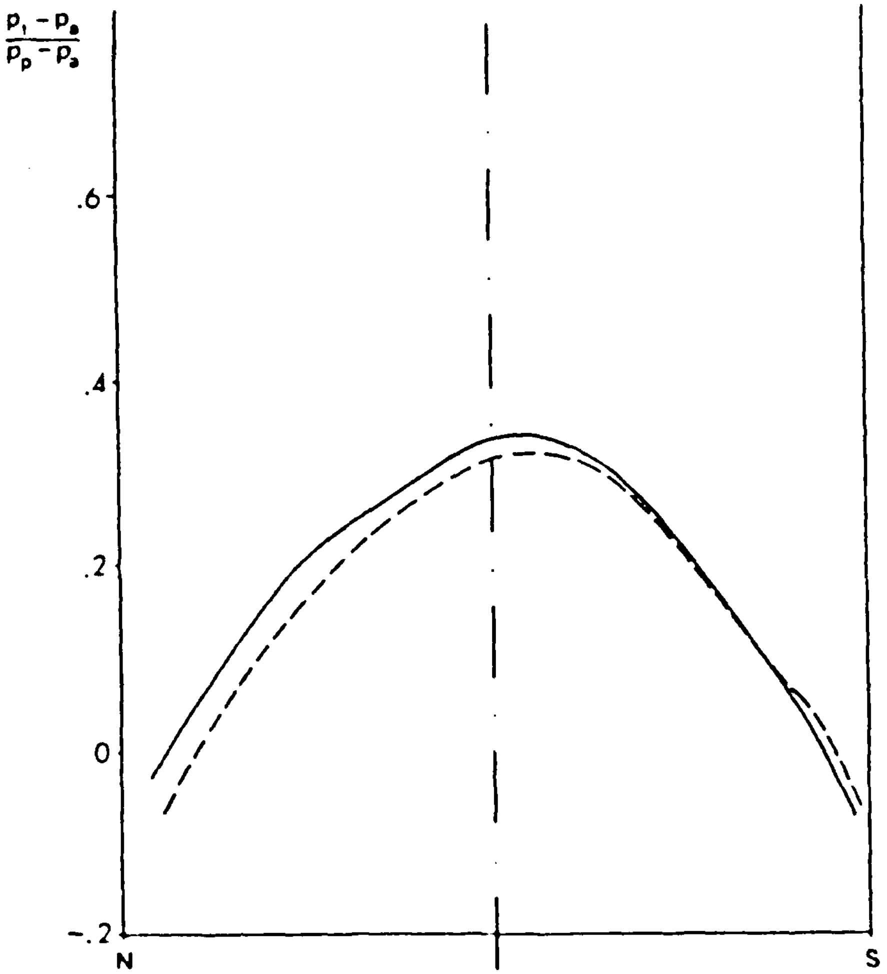
	No	SJW	NJW	SJWT	NJWT	Vanes
———	143	11"	15"	closed	open	yes
- - - - -	137	11"	15"	closed	closed	yes

Figure 10 : Spanwise Flow Angle Distribution, Influence of JWT-setting



	No	SJW	NJW	SJWT	NJWT	Vanes
———	137	11"	15"	closed	closed	yes
- - - - -	134	11"	11"	closed	closed	yes

Figure 11 : Spanwise Total Pressure Distribution, Influence of JW-Setting

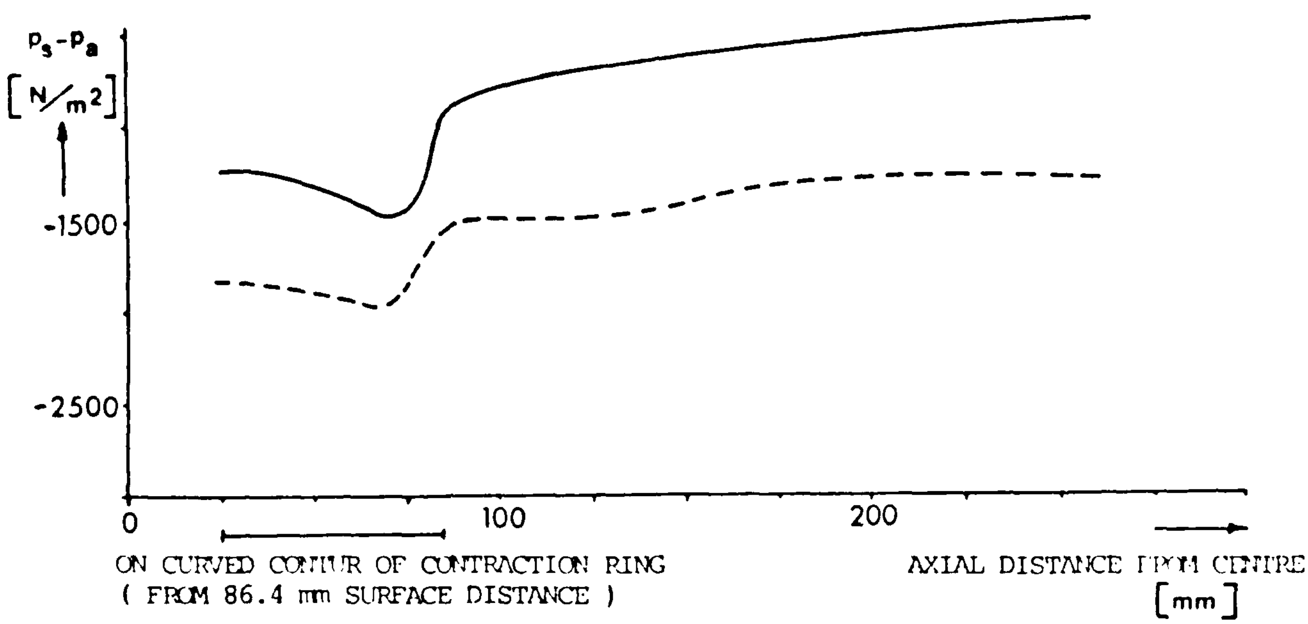


	No	SJW	NJW	SJWT	NJWT	Vanes
———	143	11"	15"	closed	open	yes
- - - -	137	11"	15"	closed	closed	yes

Figure 12 : Spanwise Total Pressure Distribution, Influence of JWT-Setting

shape always remains the same.

Figure 13 indicates that the static wall pressures are strongly dependent on the flow through the JW. The general shape is the same but in the case of closed JWT the static pressure along the wall is about 500 to 750 N/m^2 (2 to 3

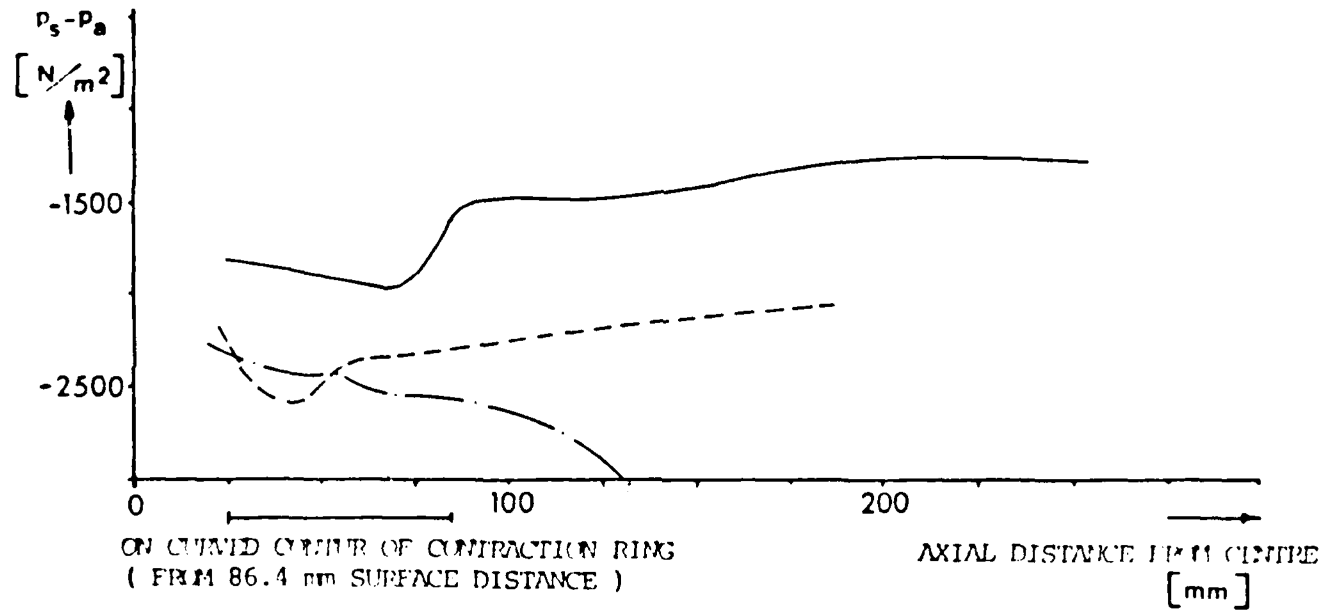


	No	SJW	NJW	SJWT	NJWT	Vanes	p_p
———	181	24"	24"	open	open	yes	5200 N/m^2
- - - - -	180	24"	24"	closed	closed	yes	5200 N/m^2

Figure 13 : Static Pressure Distribution Along Outer Casing and Contraction Ring, Influence of JWT-Setting

inches H_2O) lower. According to Fig. 8 the total pressure at the diffusor inlet is higher when the throttles are open. Since the mass flow through the device does not increase much (the area ratio of SVC to JW for a JW-setting at 609.6 mm (24 inches) is about 6:1) the static pressure also has to grow when the total pressure increases.

Along the outer casing the static pressure is fairly constant until the flow enters the contraction area ahead of the diffusor inlet, then drops to a minimum. In the case of wide open JW, however, it increases again before entering the test section. The smaller the exposed length of the SVC, the closer the minimum of static pressure shifts to the inlet of the diffusor. In the case of narrowly spaced JW (279.4 mm (11 inches)), the minimum in static pressure disappears and the profile shows a continual deceleration ahead of the diffusor (see Fig. 14).



	No	SJW	NJW	SJWT	NJWT	Vanes	$p_p - p_a$
———	180	closed	closed	24"	24"	yes	5200 N/m^2
- - - - -	206	closed	closed	18"	18"	yes	5200 N/m^2
— —·-	208	closed	closed	11"	11"	yes	5200 N/m^2

Figure 14 : Static Pressure Distribution Along Outer Casing and Contraction Ring, Influence of JW-Setting

An explanation for this behavior could be that a flow region with low kinetic energy in the corner of the JW and the outer casing moves towards the diffusor inlet when the JW-spacing decreases. This low energy region was found in measurements not described in this report. Figure 15 shows a schematic of this flow region.

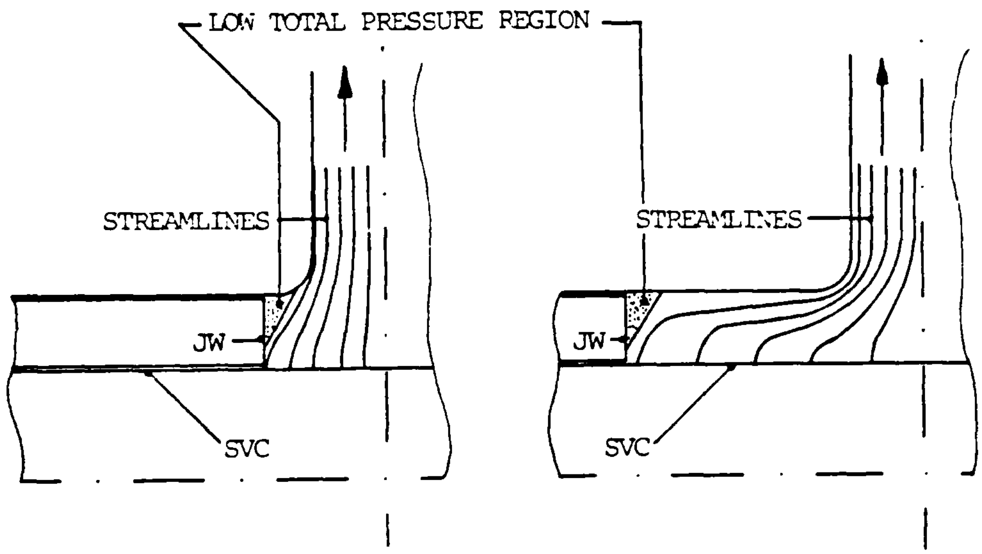


Figure 15 : Schematic of Idealized Streamlines Through CDTD for Different JW-settings

In the case of small JW-spacing, the flow area increases continuously from the surface of the SVC to the inlet of the diffusor due to the growing radius since the low energy area fills out a significant part of the flow path available. This causes a steady decelerating flow with increasing static wall pressures. When the JW-spacing is enlarged the relative influence of the low energy area is smaller. Following the streamlines there is a minimum geometric flow area ahead of the diffusor where the minimum static wall pressure occures. The density of the idealized streamlines indicates the location of the minimum area where the minimum static pressure is measured.

2.2.2.4 Mass Averaged Total Pressure Losses

Although the probe readings for the static pressure in the channel flow are recorded they are not yet reduced as the recording was done manually. If one studies the raw data it is clear that there is no strong spanwise gradient in the static pressure distribution at the inlet of the test section. It is a good approximation to consider the spanwise static pressure as constant.

With this approximation the spanwise partial mass flows can be calculated along with the mass averaged total pressure losses. The following equations are used for the calculations :

$$\overline{\xi} = \frac{\overline{P_{t1}-P_{t2}}}{P_{t1}} = \frac{(P_{t1}-P_{t2})_i \cdot \dot{m}_i + \ldots + (P_{t1}-P_{t2})_k \cdot \dot{m}_k}{P_{t1} \cdot \sum_{i=1}^{k} \dot{m}_i}$$

$$\overline{\zeta} = \frac{\overline{P_{t1}-P_{t2}}}{P_{t1}-P_a} = \frac{(P_{t1}-P_{t2})_i \cdot \dot{m}_i + \ldots + (P_{t1}-P_{t2})_k \cdot \dot{m}_k}{(P_{t1}-P_a) \cdot \sum_{i=1}^{k} \dot{m}_i}$$

$$\overline{\zeta} = \overline{\xi} \cdot \frac{P_{t1}}{P_{t1}-P_a}$$

with $\dot{m}_i = \rho_i \; v_i \; A_i$

incompressible $\rightarrow$ $\rho_i = \rho = \text{const.}$

and where v_i is of the value :

$$v_i = \sqrt{\frac{2\gamma RT}{\gamma-1} \left(\left(\frac{P_{t2i}}{P_{s2i}} \right)^{\frac{\gamma-1}{\gamma}} - 1 \right)}$$

with $R = 287$ kJ/kg K and $\gamma = 1.4$

$$\vec{\bar{\zeta}} = \frac{(1 - \frac{P_{t2}}{P_{t1}})_i \cdot v_i + \ldots + (1 - \frac{P_{t2}}{P_{t1}})_k \cdot v_k}{\sum_{i=1}^{k} v_i}$$

Typical pressure losses for different flow conditions are :

Case/Circumference		$\bar{\xi}$ [%]	$\bar{\zeta}$ [%]	JW	JWT
A	180/2	2.98	61.6	24"	closed
B	181/2	2.87	58.8	24"	open
C	206/2	3.53	70.3	18"	closed
D	207/2	3.54	71.8	12"	closed
E	217/2	3.33	66.9	12",sealead	closed, sealed

Since the definition of the loss coefficient $\bar{\zeta}$ is based on the difference between inlet total pressure and ambient pressure and not on the dynamic head, the only two comparable cases are D and E. In all other cases the pressure recovery through the diffusor varies due to different inlet flow angles. Thus the level of static pressure at the diffusor inlet is different.

A comparison of the cases D and E points out that the presence of leakage flows increases the total pressure losses. The magnitude of the loss coefficient $\bar{\zeta}$ in case E is about 5% lower than in the unsealed case.

However, the main component of the pressure loss is due to the mixing just above the SVC surface. Some previous measurements, published in Ref. [2], investigated the flow profile at the SVC exit (Fig. 16).

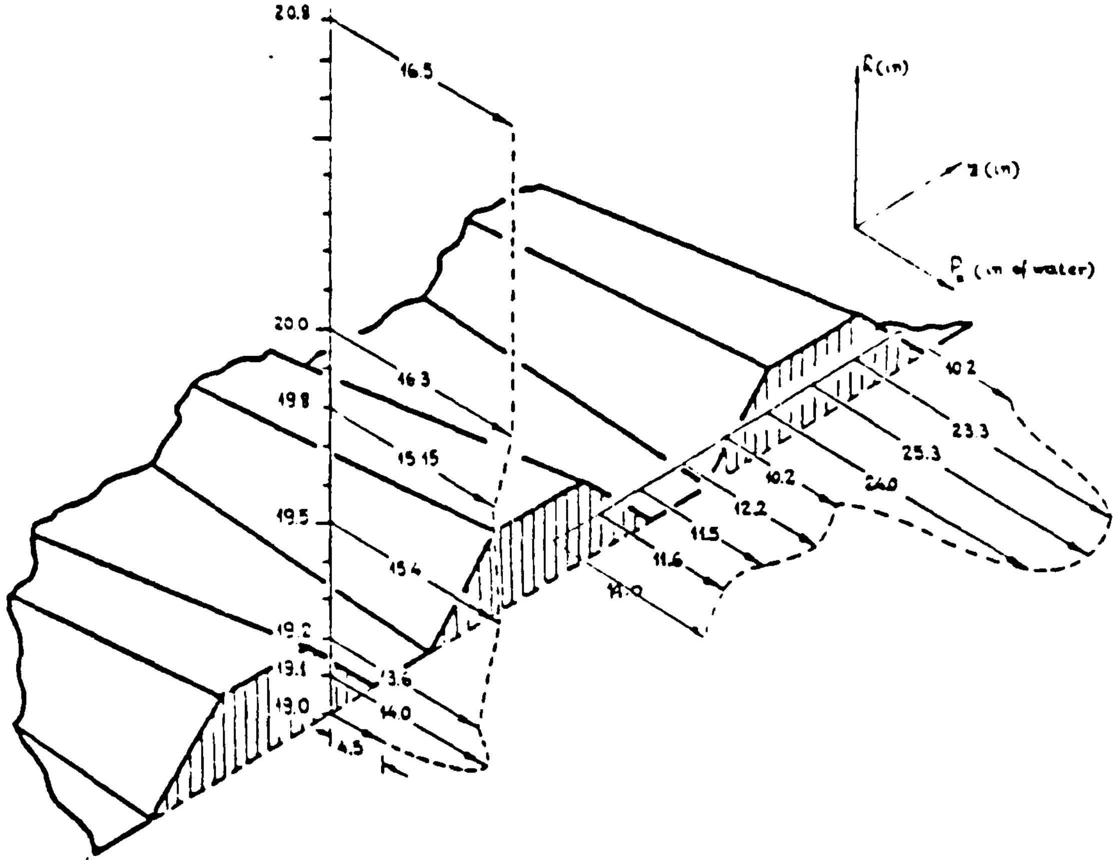


Figure 16 : Total Pressure Distribution Near the SVC Surface, Ref. [2]

There is no value for the supply pressure given in Ref. [2] but according to the maximum probe pressure which occured, $P_p - P_a$ is > 6325 N/m^2 (25.3 inches H_2O). Applying the same mass averaged loss determination as described above, the losses produced by jet mixing are (assuming $P_s = P_a$ as no magnitudes are given in Ref. [2]) :

$\bar{\zeta}_a = 35\%$ (axial measurements)

$\bar{\zeta}_r = 42\%$ (radial measurements)

To the first order the mixing losses can be described with the losses produced by a sudden expansion of a pipe flow. The loss coefficient for this expansion is (Ref.[3]) :

$$\Phi = (1 - \frac{A_1}{A_2})^2$$

$$\Delta P_t = \Phi \cdot \rho/2 \quad v^2$$

The areas involved are :

$A_1 = 60 \, A_{sv} = 0.0223 \; m^2$

$A_2 = 0.01669m \cdot \pi \cdot 1.016m \cdot \sin 10° = 0.0925 \; m^2$

(assuming the expansion is complete 25.4 mm (1 inch) above the SVC surface and the flow angle at that radius is 80° referred to the radial direction)

$\rightarrow$

$\underline{\underline{\Phi = 0.567}}$

This means that the total pressure loss in the case of a sudden expansion is about 57% of the dynamic head, considering the above used assumptions are true. Since the case of a sudden expansion represents the case with the maximum losses, this figure can be related to the measured ζ_a and ζ_r of 35% and 42 %.

2.2.2.5 Spanwise Distribution of Flow Angle and Total Pressure

The spanwise distribution of the flow parameters flow angle and total pressure depends strongly on the JW-spacing and on the circumferential position of the measurement. The Figs. 5 and 7 show typical distributions all recorded in one passage. (The circumferential effects will be discribed in the following chapter.)

Although the mechanical layout of the CDTD and the setting of the flow control devices JW and JWT was axially and circumferentially symmetric, the spanwise distributions in this passage were in most cases totally asymmetric about the midspan. Only the case with the shortest exposed length of the SVC showed a somewhat symmetric flow angle and total pressure behaviour. Despite the asymmetry the main effects on the flow angle and total pressure distributions can be determined. Both curves change from a more bulky, flat shape to a peaked shape when the JW-spacing is decreased. As discussed above, this might partly be consequence of a relatively larger portion of the losses being produced in the corner region of JW and outer casing. A final explanation for this behavior can only be found if complete measurements of total and static pressure inside of the device along the SVC surface are carried out.

The flow angle and total pressure profile contol devices are not efficient enough to influence the distributions as much as expected in the device design.

Some efforts to influence the distributions by total pressure loss producing screens, which were installed upstream of the SVC did not lead to any measurable improvements as the velocities at that radius of the device are very low.

2.2.2.6 Circumferential Distribution of Total Pressure

Since the total pressure and the flow angle always behaved in a similar way, only the total pressure distributions will be discussed. Contrary to some remarks in Ref. [4] describing the flow uniformity, the circumferential uniformity is not good and in fact keeps us from surveying the diffusor flow itself.

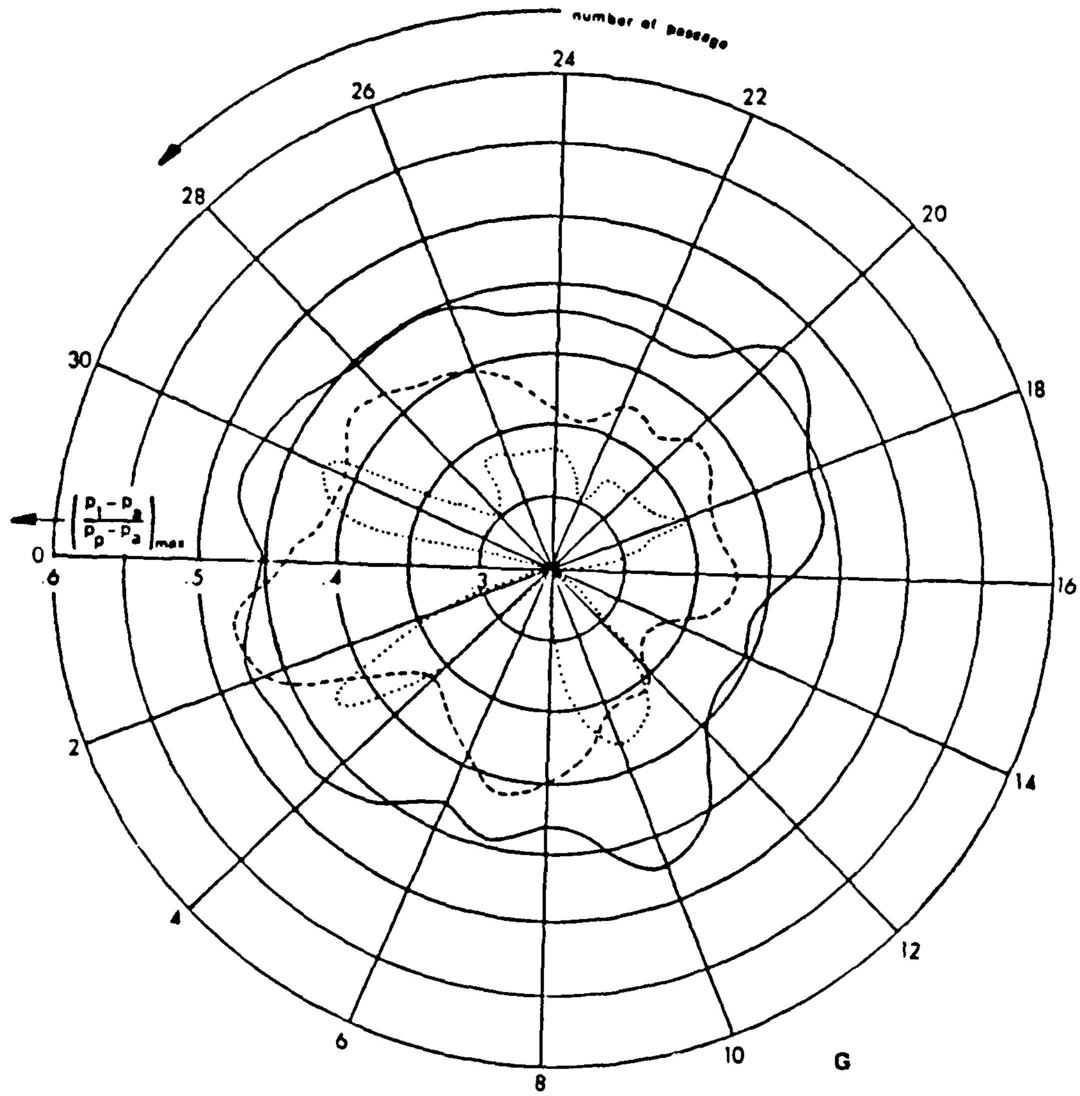
The measurements used to evaluate circumferential uniformity reported in Ref. [4] were taken at only four locations, which were too few. The results presented here are for the inlet of every passage (a total of 32 passages).

Figure 17 shows the circumferential distribution of the difference between total and ambient pressure referred to the difference between supply and ambient pressure $(P_t - P_a)/(P_p - P_a)$ for three different exposed SVC lengths. Only the maximum of this ratio is plotted. It is obtained from the measurements of the spanwise distribution at the inlet of each passage.

The magnitude of total pressure variation increases if the exposed SVC length decreases. In the case of full opened JW (609.6 mm (24 inches)) the magnitude for

$$var = \frac{\left(\left(\frac{P_t - P_a}{P_p - P_a}\right)_{max}\right)_{max} - \left(\left(\frac{P_t - P_a}{P_p - P_a}\right)_{max}\right)_{min}}{\left(\left(\frac{P_t - P_a}{P_p - P_a}\right)_{max}\right)_{min}}$$

is :



	No	SJW	NJW	SJWT	NJWT	Vanes
————	205	24"	24"	closed	closed	yes
------	206	18"	18"	closed	closed	yes
	208	11"	11"	closed	closed	yes

Figure 17 : Circumferential Distribution of Max. Total Pressure, Influence of JW-Setti

$$\text{var} = \frac{0.475 - 0.39}{0.39} = 22\%$$

In the case of a JW-setting at 457.2 mm (18 inches) :

$$\text{var} = \frac{0.48 - 0.33}{0.33} = 46\%$$

And in the case of a JW-setting at 279.4 mm (11 inches) :

$$\text{var} = \frac{0.43 - 0.19}{0.19} = 126\%$$

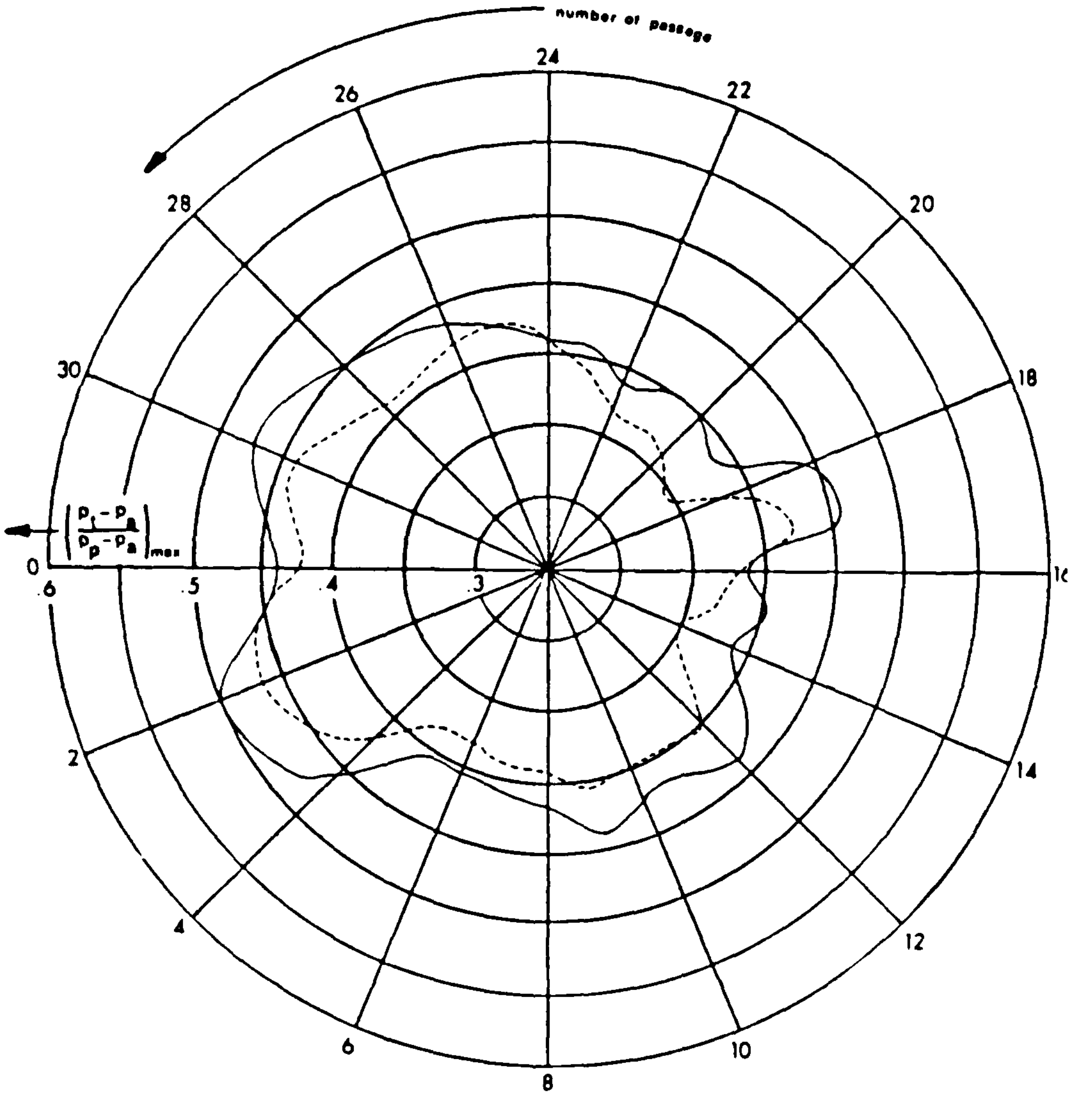
This distortion of the circumferential flow uniformity may have several reasons. One is inaccuracies in manufacturing the SVC. The smaller the JW - spacing the larger the relative portion of perturbations caused by these inaccuracies. Another possibility is the introduction of leakage flow at the interface of SVC and JW. As long as the JW are in fully retracted position there is no leak, however, as they are moved over the SVC the relative error increases.

Other surveys were carried out in order to determine the sources of the nonuniformity. In Fig. 18 the total pressure distribution of two flow cases is compared. These were both runs with the same flow control settings, but in one case, the SVC was rotated 60° relative to the original position. To simplify the comparison the plotting scale for this case is also displaced 60° in the same direction.

In both cases the JW were sealed to the SVC and the JWT were also sealed to make sure that no leakage flow influenced the uniformity. No explanation could be found for the fact that the overall pressure drop is higher, when the SVC was rotated. However, it is apparent that the general shape of the pressure distribution is generated by the SVC since it rotates with the rotation of the SVC.

In order to survey the uniformity of the inlet conditions to the SVC, the device was run without diffusor vanes. The pressure distribution was measured at the inlet of the test section.

The results of these surveys are plotted in Fig. 19. From the obtained uniformity at the diffusor inlet, it can be concluded that the upstream inlet conditions at the radius of the SVC are also fairly uniform. (The JWT



	No	SJW	NJW	SJWT	NJWT	Vanes	
———	213	12"	12"	closed	closed	no	
- - - - - - -	214	12"	12"	closed	closed	no	SVC and plotting scale turned for 60°

Figure 18 : Circumferential Distribution of Max. Total Pressure, Influence of SVC Position

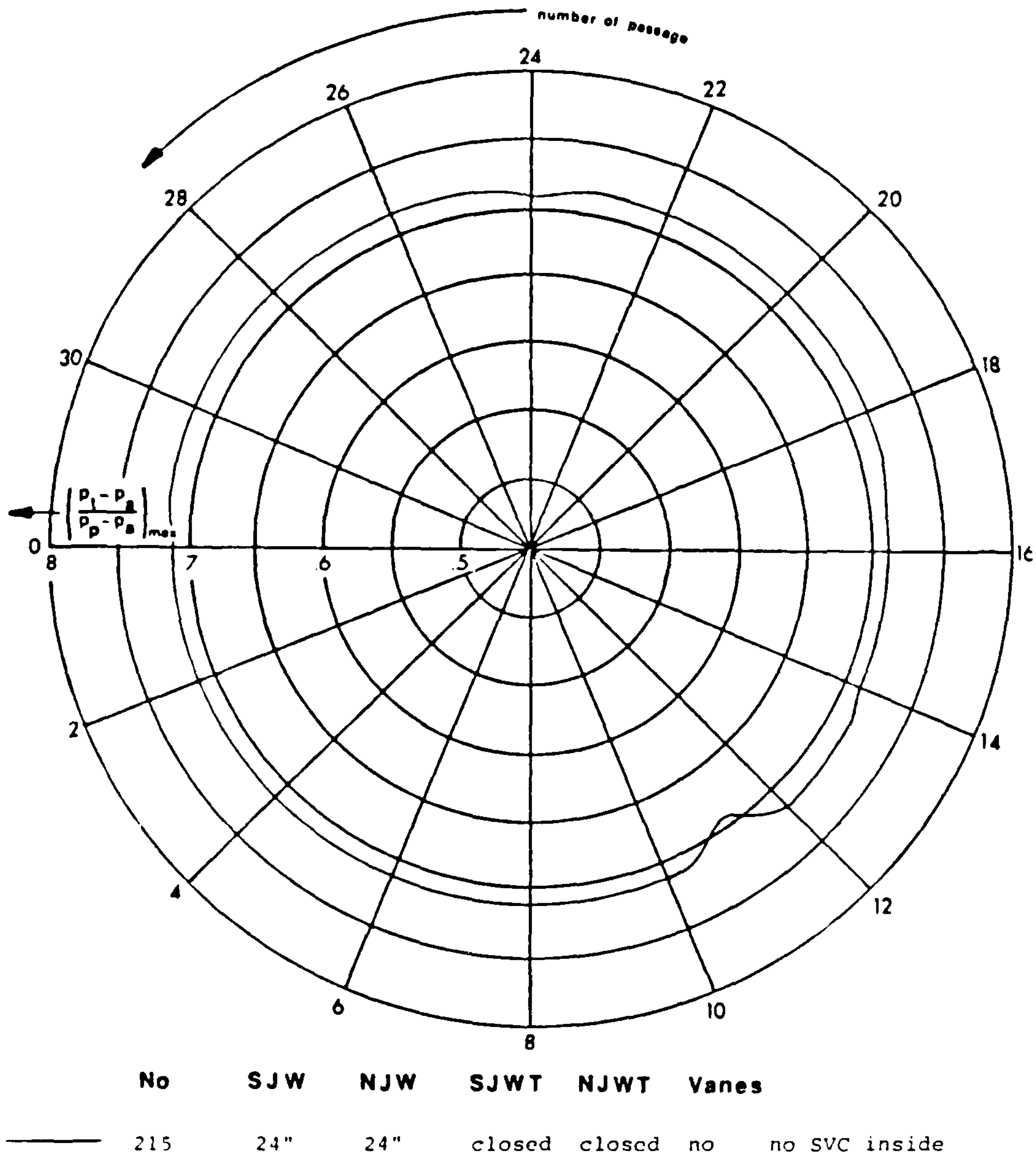


Figure 19 : Circumferential Distribution of Max Total Pressure, Run Without SVC

were sealed to prevent any leakage.) The pressure dip ahead of passage 11 is not caused by an error during the measurements as it was reproducable. This lower total pressure occured over the whole passage width (not only for the maximum total pressure) but the sources for this behavior could not be found.

Further circumferential measurements were undertaken to check on the influence of the diffusor flow itself and on the influence of the leakage flow at the interface of SVC and JW. A schematic of the total and static pressure curves on streamlines through the device for the vaned and unvaned configuration (Fig. 20) indicates that the value of P_t at the diffusor inlet increases if P_p is kept constant. This is due to the lower pressure recovery through the unvaned diffusor.

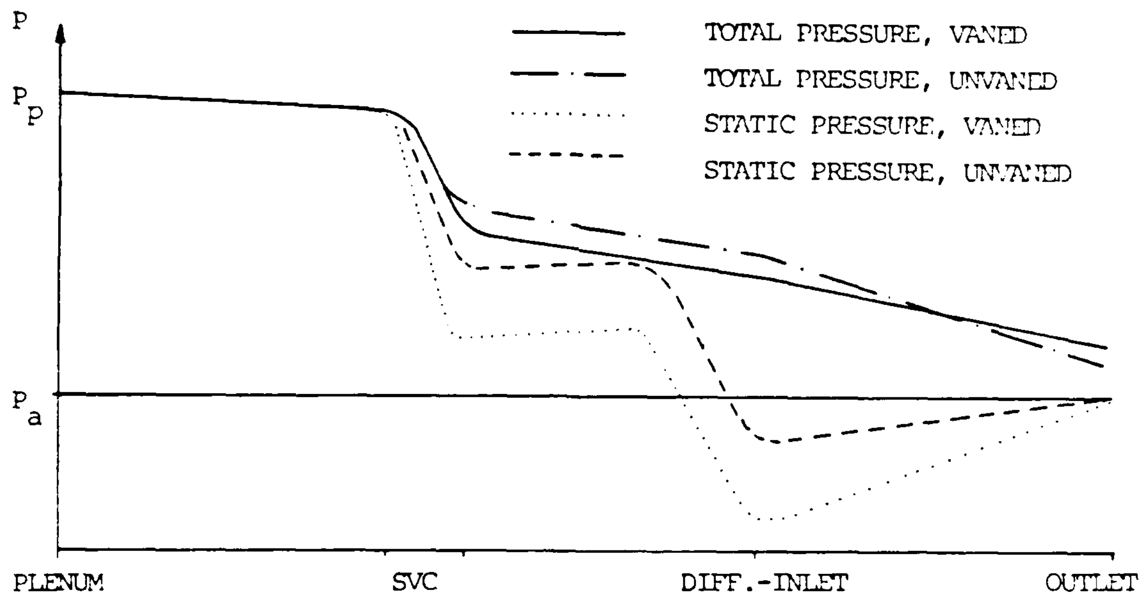
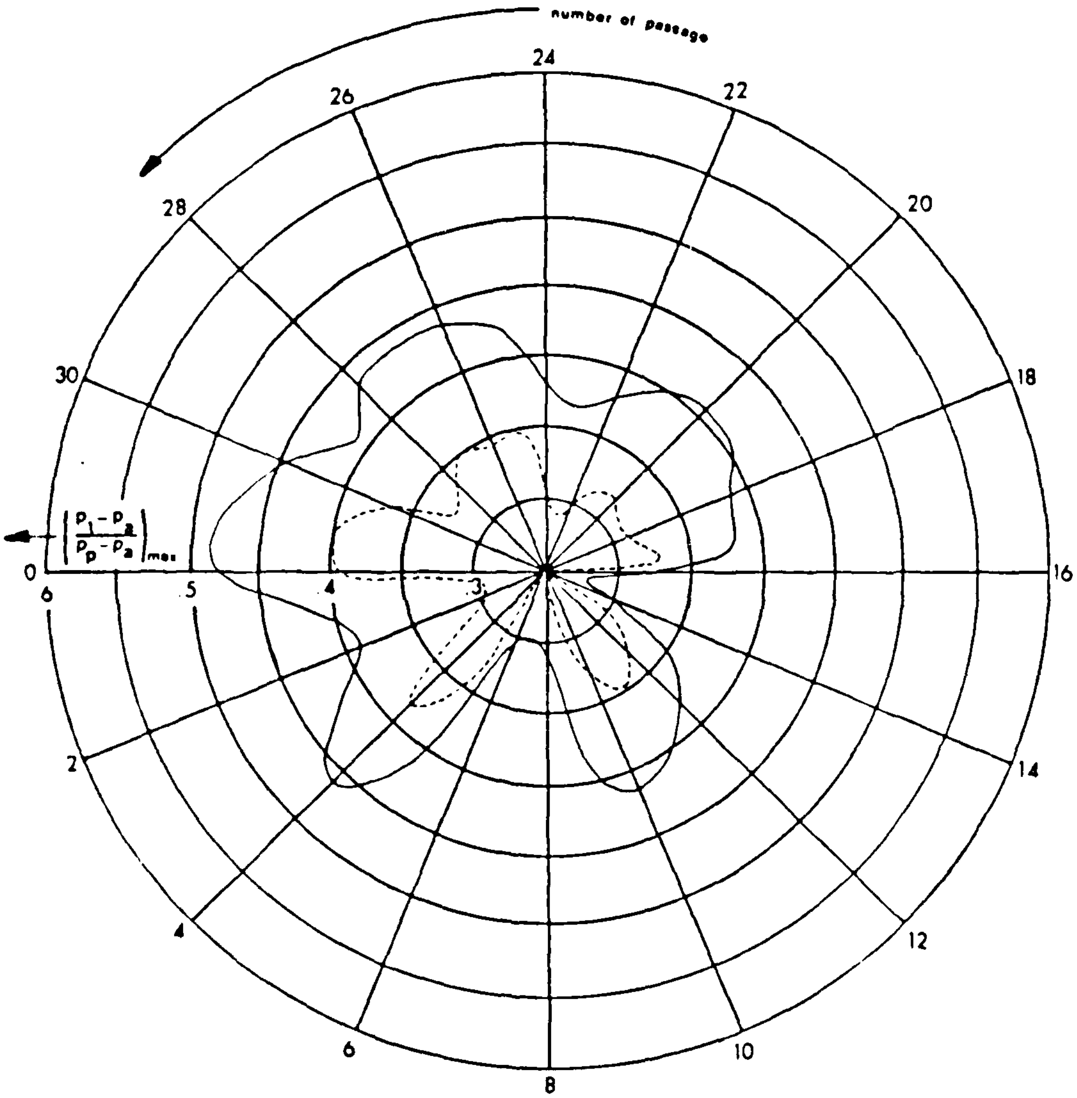


Figure 20 : Schematic of Pressure Distributions On Streamlines for Vaned and Unvaned CDTD, Not Scaled

Thus the magnitude of $((P_t - P_a)/(P_p - P_a))_{max}$ in Fig. 21 is higher for the unvaned diffusor. It is apparent that the general shape of the total pressure distribution is not influenced by the diffusor downstream.



	No	SJW	NJW	SJWT	NJWT	Vanes
————	210	12"	12"	closed	closed	no
- - - - - - -	207	12"	12"	closed	closed	yes

Figure 21 : Circumferential Distribution of Max. Total Pressure, Influence of diffusor

The influence of leakage, however, is significant. On one hand the overall pressure losses increase due to leakage at the SVC - JW interface and through the JWT and on the other hand the general shape of the circumferential distribution changes completely. Figure 22 demonstrates the point.

A comparison of the circumferential static and total pressure distributions (Fig. 23) indicates that, distinct from the total pressure, the static pressure is fairly constant and does not follow the total pressure distribution. Therefore it can be concluded that the nonuniformity in the total pressure distribution is equivalent to a nonuniformity in the velocity and Mach number profile (the diffusor inlet flow is incompressible).

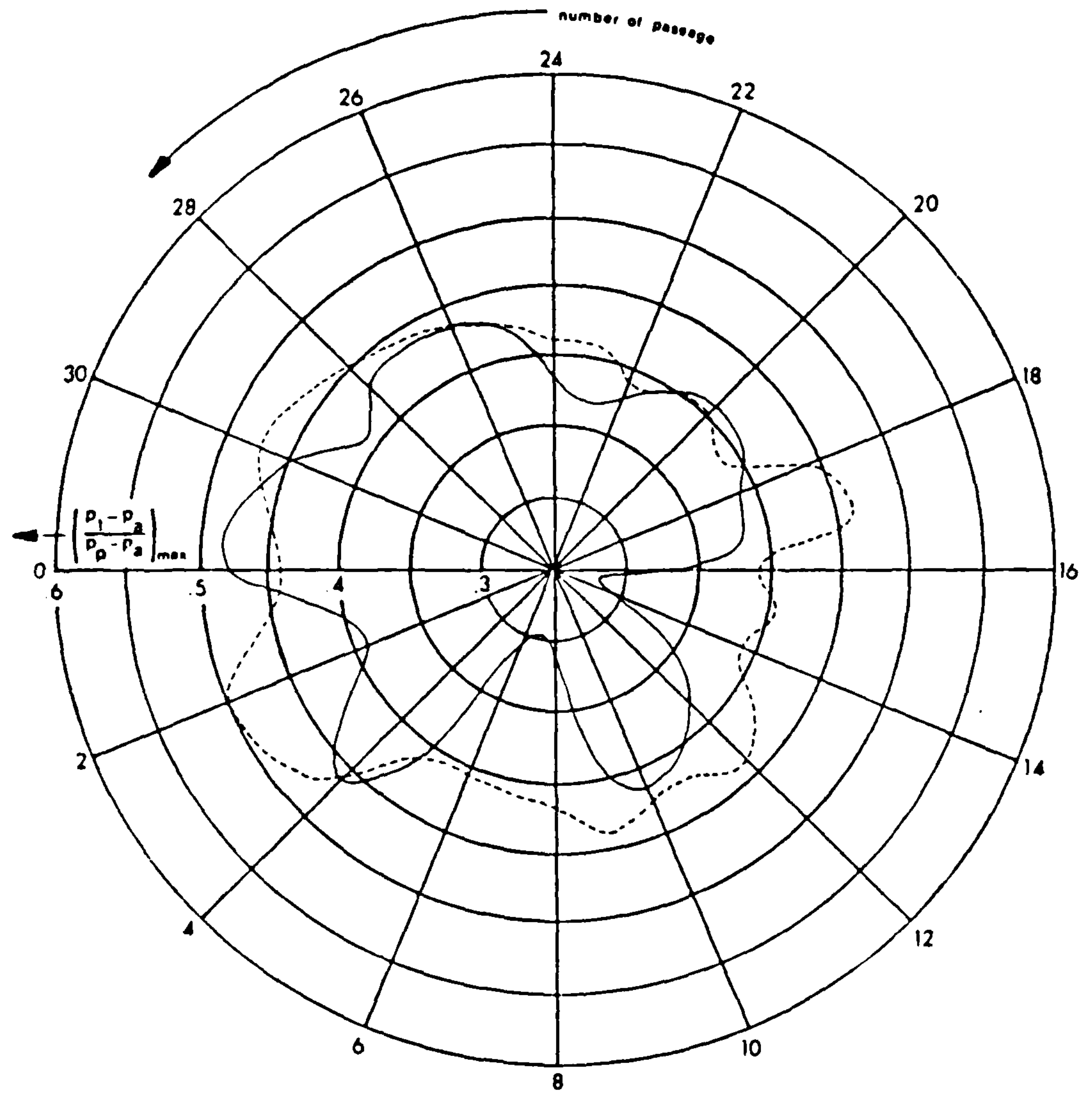
Figure 24 shows the effect of blocking four neighboring rows of nozzles of the SVC from the inside. Some tracing efforts using smoke to feed single nozzles of the SVC indicated that the flow leaving the SVC enters the test section after a rotation of about 90°. This observation corresponds with the data of Fig. 24 - the largest change in the profile occurs after the flow rotated about 90° (the position of the blockage is shaded). It is apparent that the blocking of these four rows does not only influence the flow pattern where the disturbance occurs but that the level of the total pressure increases on the opposite side. The physical mechanisms are not yet understood.

2.2.3 Repeatability of Measurements

To make sure that the measurements were reproducible and did not record any unstationary effects in the flow field two runs were repeated. A comparison of the runs 147 - 148 and 215 - 216 (see Appendix B) proves that almost identical numbers were measured. Hence it can be concluded that the flow is stationary and that the measured nonuniformities were not single events but repeatable characteristics of the flow-field.

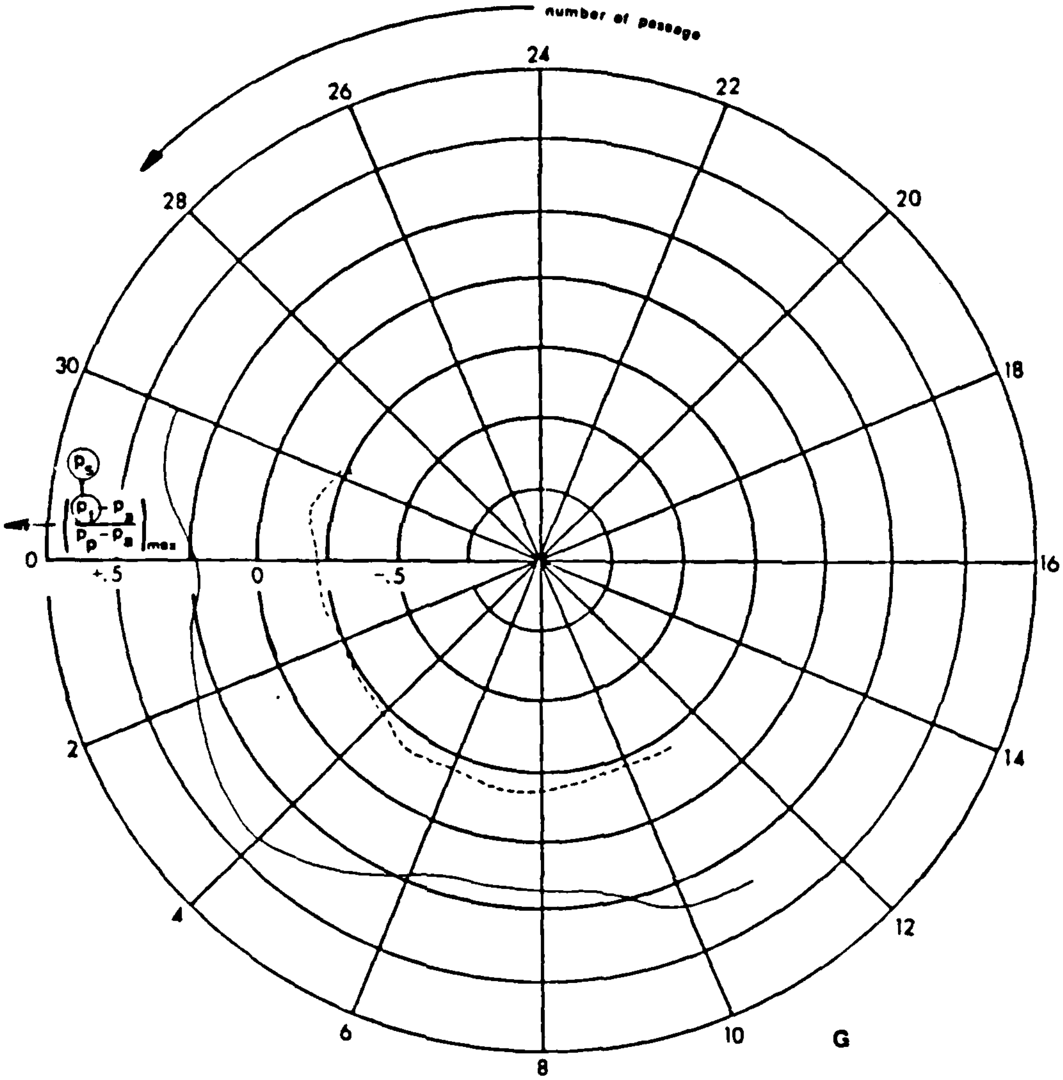
2.2.4 Conclusions from Measurements

The results presented suggest the decelerated, swirling flow leaving the SVC is very sensitive to pertubations at the inlet of the test section; an amplification mechanism seems to be inherent in this flow field. (The measurements



	No	SJW	NJW	SJWT	NJWT	Vanes	
————	210	12"	12"	closed	closed	no	
- - - - - - -	213	12"	12"	closed	closed	no	SVC from the inside up to 12" sealed; JWT sealed

Figure 22 : Circumferential Distribution of Max. Total Pressure, Influence of Sealing

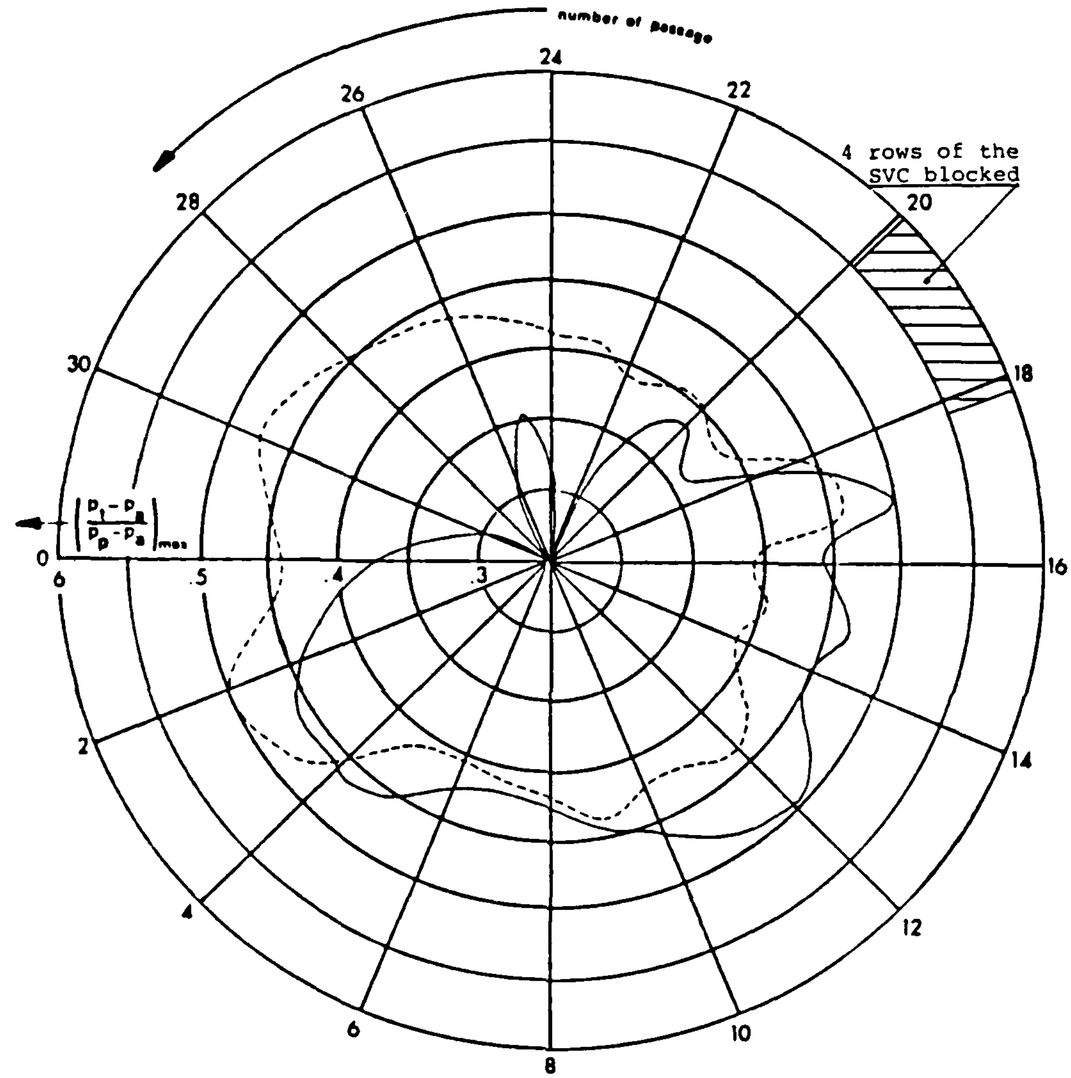


No	SJW	NJW	SJWT	NJWT	Vanes
208	11"	11"	closed	closed	yes

———— total pressure

-------- static pressure

Figure 23 : Comparison of Circumferential Static and Total Pressure Distribution



	No	SJW	NJW	SJWT	NJWT	Vanes	
———	217	12"	12"	closed	closed	no	4rows of nozzles blocked
-------	213	12"	12"	closed	closed	no	

Figure 24 : Circumferential Distribution of Max. Total Pressure, Influence of Blocking SVC

at the SVC surface are not presented but do not show such large nonuniformities.)

The amplified perturbations are produced by two major factors. One is leakage flows and the other is an inaccuracy in the manufacturing of the SVC. The leakage flows appear at the interface between SVC and JW and at the throttles of the JW. Due to a noncircularity of the SVC the leakage is not circumferentially uniform. In addition the leakage flow increases the overall pressure losses through the device.

By careful inspection of the SVC, which is fabricated out of six sections of soldered brass sheet metal, it is apparent that the joints of the six sections are different. Due to a miscalculation the sections were too long and thus the length of the nozzles at the joints is different from the designed length. The flow leaves the SVC with a flow angle different from the design flow angle.

In October 1983 some cracked solder spots of the SVC were resoldered. After the repair the SVC was 'out of round' in some places and some rows of nozzles were inclined at a different angle from the design angle.

The flow control devices - mainly the flow through the JW - are not efficient enough to control the spanwise flow profiles and the boundary layers. Instead they influence the flow throughout the whole passage - their action can not be distinguished from an increase in SVC length by JW movement.

2.3 Accuracy of Measurements

The surveys did not measure unsteady effects in the flow, such as high frequency fluctuations of the supply pressure. The observation techniques were limited to pressure and flow angle measurements and flow visualisation with tufts and smoke.

2.3.1 Pressure Measurements

All pressures were displayed on a multitube manometer which could be read with an accuracy of 2.5 mm (0.1 inches). One end of the manometer was open to the atmosphere. Assuming an average ambient pressure of P_a = 1.018 bar (407 inches H_2O) the maximum error in reading the board was in the order of

$$\Delta P_{max} = \frac{0.1}{407} = 0.025\ \%$$

2.3.1.1 Total Pressure

The total pressures were recorded either with a cobra type probe or with a rake of pitot tubes. Since the readings of the cobra probe were not corrected by the calibration coefficient for the total pressure, a maximum error of about 1% of the dynamic head occured. This error varied with the pitch angle. The pitch angle was almost constant so that the error is almost constant.

According to Ref. [5] the error of the used pitot probes is less than 1% of the dynamic head as long as the incidence angle is less than 11°. The rake probe was used within this range.

Assuming a maximum dynamic head of 5000 N/m^2 (20 inches H_2O) the possible error which might occur for the total pressure measurements is of the order of :

$$\Delta P_t = \Delta P_{man} + \Delta P_{probe} = 0.025\ \% + \frac{0.2}{490} = 0.06\ \%$$

2.3.1.2 Static Pressure

The static pressures in the flow had to be reduced from the cobra probe output of 4 pressures which were also displayed on the manometer board. A misreading of the board (0.1 inches) might add up to an error in the two reduction coefficients and with those in the static pressure reduction of about 0.1 %. Due to the approximation of the calibration curves by polinomials, an additional error of less than 1 % might occur in the determination of the Mach number and with that an error of less than 0.6 % in static pressure. Thus the total maximum error in the static pressure measured with the cobra probe is :

$$\Delta P_s = 0.7\ \%$$

The other static pressures were taken as wall pressures or in fact as the pressure in tappings perpendicular to the wall. With a correct layout of the orifices (see Ref. [5]) the pressure in the orifices is higher than the wall pressure. The pressure taps all have a diameter to length of the drill greater than 6. According to Ref. [5] the error is proportional to the wall friction

$$\Delta P_s \sim 2.5\ \tau_w \quad \text{with} \quad \tau_w = \rho/2 \cdot v_\infty^2 \cdot c_f$$

Assuming reasonable numbers for c_f, ΔP_s remains below 1 N/m^2 (0.004 inches H_2O) and is negligible. The error in reading the display is again about 0.025 %.

$$\Delta P_{s\ wall} = 0.025\ \%$$

2.3.2 Flow Angle Measurements

To measure the flow angle (jaw angle) the cobra probe was always balanced and the value was indicated on the actuator. The accuracy in reading the scale is about 0.2°. The balancing was a problem since the probe showed a hysteresis, depending on the side from which one approached the equilibrium. This hysteresis decreased the accuracy of the angle measurements. The maximum error is about :

$$\Delta\alpha = \pm 1° \quad .$$

3. Concept for Taking Initial Diffusor Measurements

Due to the high total pressure gradients in the peripheral direction the original instrumentation layout is not useable. It requires 5 neighboring passages with approximately the same inlet conditions. Regarding the results it is clear that 5 such passages are not available.

For many passages there is a strong gradient in inlet condition over its circumference so that the pressure is different for the pressure and the suction side of the blades bounding that passage. As the flow pattern is mostly generated by the SVC and rotates with it, one can find a single passage with fairly uniform inlet conditions by rotating the SVC as long as such a flow enters an instrumented passage. This is a trial an error method and might take a couple of days for each desired flow condition, since the whole aparatus has to be disassembled for rotation of the SVC. In addition all leakage flows have to be sealed manually to exclude other sources of nonuniformities. This procedure also has to be repeated for each desired flow condition.

Based on these suppositions the following measurement concept for diffusor surveys could be implemented :

1. Static pressures

1.1 instrument the passage with two instrumented blades (no Probes!)

1.2 set the desired plenum pressure

1.3 read static wall pressures and P_p

1.4 read static wall pressures on outer casing

1.5 read static blade pressures on suction side and P_p

1.6 read static blade pressures on pressure side and P_p

1.7 shut off the pressure supply

1.8 instrument the passage with the other two instrumented blades (a total of 4 are available)

1.9 set P_p as in 1.2

1.10 read static blade pressures on suction side and P_p

1.11 read static blade pressures on pressure side and P_p

1.12 shut off the pressure supply

Some of the installed diffusor wall taps can not be read as they are located in another passage. The procedure for the total pressures and the flow angles would be :

2. Total pressures and flow angles

2.1 instrument the passage with one probe at the desired location

2.2 set the desired circumferential position

2.3 set the desired spanwise position

2.4 read these data into aqusition program

2.5 set P_p as in 1.2

2.6 pre-adjust probe to flow angle

2.7 read potentiometer of actuator

2.8 read probe pressures

2.9 read circumferential control pressures

2.10 go back to 2.3 as often as required

2.11 go back to 2.2 as often as required

2.12 shut off pressure supply

2.13 go back to 2.1 until all possible probe positions are choosen

Note : The test passage is instrumented with only one probe. the experience with the amplifying of nonuniformities in diffusing flows forces this reduction. An estimate of the time involved in a complete measurement of the diffusor flow field for one flow condition yields to the following times :

- find the right SVC position	32	hrs
- measure static and total pressures	20	hrs
each desired flow condition	52	hrs

4. Proposed Hardware Changes

4.1 Requirements on New Device Hardware

The parts of the device which need an urgent improvement are : the flow profile / boundary layer control and the generation of the swirling flow. The means to control the flow profile / boundary layer are not effective, see Figures 6, 8 and 10.

Several improvements are concievable such as : supplying the JW with a seperate controllable pressure, concentrating the flow through the JW on the wall near region, sucking off the low energy flow near the wall just before the diffusor inlet.

A blower, which could supply the JW with separate air and which could provide the suction for a boundary layer control is available and installed next to the CDTD and could be hooked up.

Up to now calculations or design studies have not been carried out which support the gains of such improvements if the blower is used to supply the required mass flow. These calculations can be accomplished with further work.

The need to improve the production of the swirling flow is obvious after studying section 2.2.2.6. The requirements for new hardware are to :

- provide sealing at the interface of SVC and JW
- provide sealing at the JWT
- keep mass flow and flow angle at the same order of magnitude as the design condition
- keep pressure losses at the same order of magnitude
- introduce the swirling flow uniform in axial and circumferential direction
- provide better application of flow tracing methods on single jets of the SVC

In order to fulfill the first point of these requirements the surface of the SVC has to be even. The minimized clearance gap between SVC and JW can then be sealed with an O-ring or a tube which can be pressurized.

4.2 Design of New Hardware

Based on the requirements a new design for a SVC was prepared. The design drawings are printed in Appendix C. To make sure that the prinziple of the new concept works some initial tests with the flow models described in Chapter 2.1.1 (Figs. 3 and 4) were carried out. These tests included flow visualisation with smoke and tufts and pressure loss measurements. The Figs. 25 and 26 show contour tracings of some typical photographs of the smoke and tuft tests (the quality of the original photographs was not good enough for reproduction).

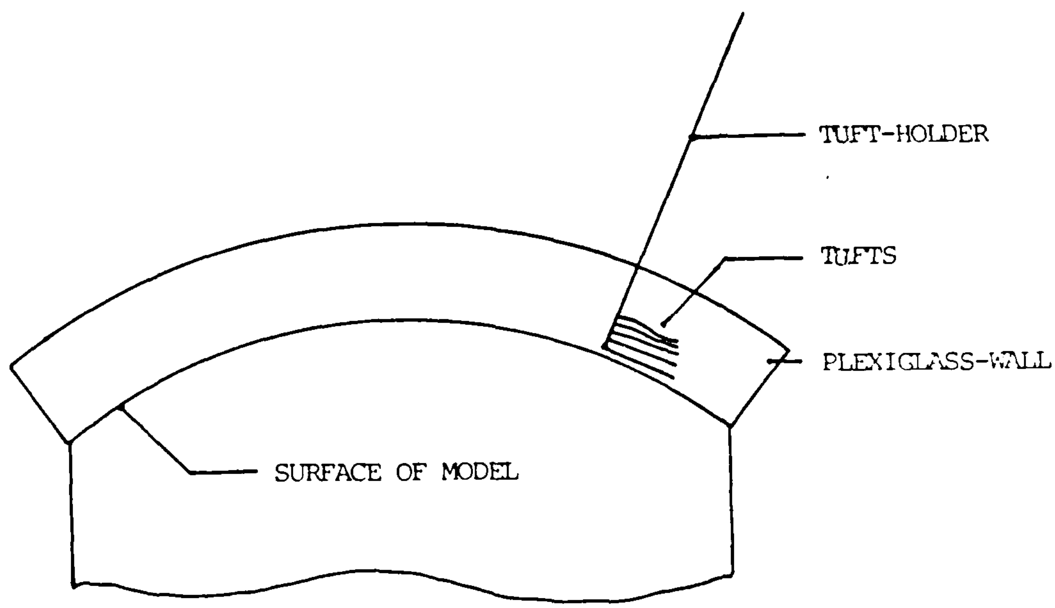


Figure 25 : Flow Field of Flow Model, Visualisation with Tufts

Figures 25 and 26 are side views of the 25 nozzle (5x5 in axial and circumferential direction) model. There are side walls mounted to allow a radial

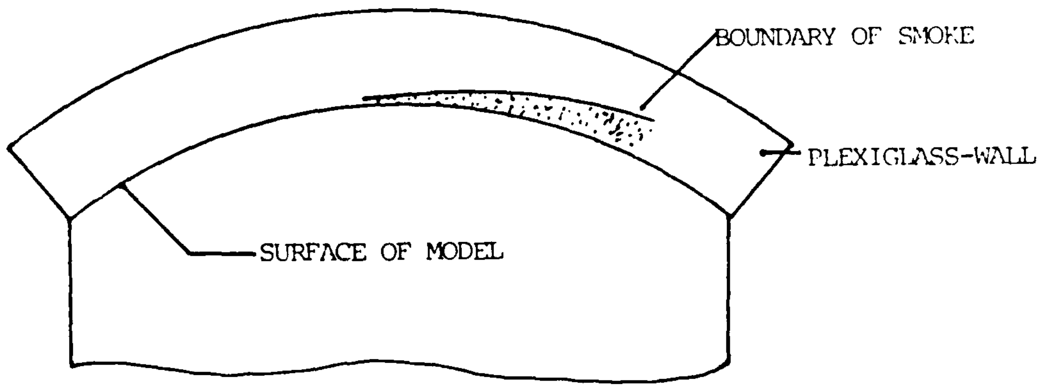


Figure 26 : Flow Field of Flow Model, Visualisation with Smoke

static pressure gradient as it will appear in a closed apparatus. The supply pressures are adjusted to a typical flow case in the apparatus.

Figure 25 proves that the flow angles do not change in radial direction and that the flow angle is very low (3°-4° referred to tangential direction). Some pressure loss measurements were undertaken but they carry some uncertainties. As the flow model is only 5 nozzles long the loss measurements were taken above the last row of nozzles downstream. Careful interpretation is required. Since there was no plateau in the pressure losses visible it can be assumed that the jets did not mix out before the mixing with the surrounding air began.

Based on a flow angle of 4° referred to tangential the boundary between jet and surrounding air from the first jet (furthest upstream) would be only 0.9 inches above the surface at the location of the measurement. Thus at 1 inch there is probably mixing with the surrounding air included in the measurements. Depending on the circumferential and axial position the losses always reached a level of 50% - 60% for $(P_t - P_a)/(P_p - P_a)$ at 1 inch above the surface. At 0.5 inches above the the surface the losses were in a range of 39% - 50%. A complete table of all loss measurements is given in Appendix D.

Using these results a design of a new SVC using exactely the same nozzle cross section was carried out. To fulfill the requirements No. 4, 5 and 6 a concept was chosen, which builds up the SVC out of one basic molded part. The mold will be a machined part to provide close tolerances. Figure 27 shows a 3-D sketch of a section of the mold.

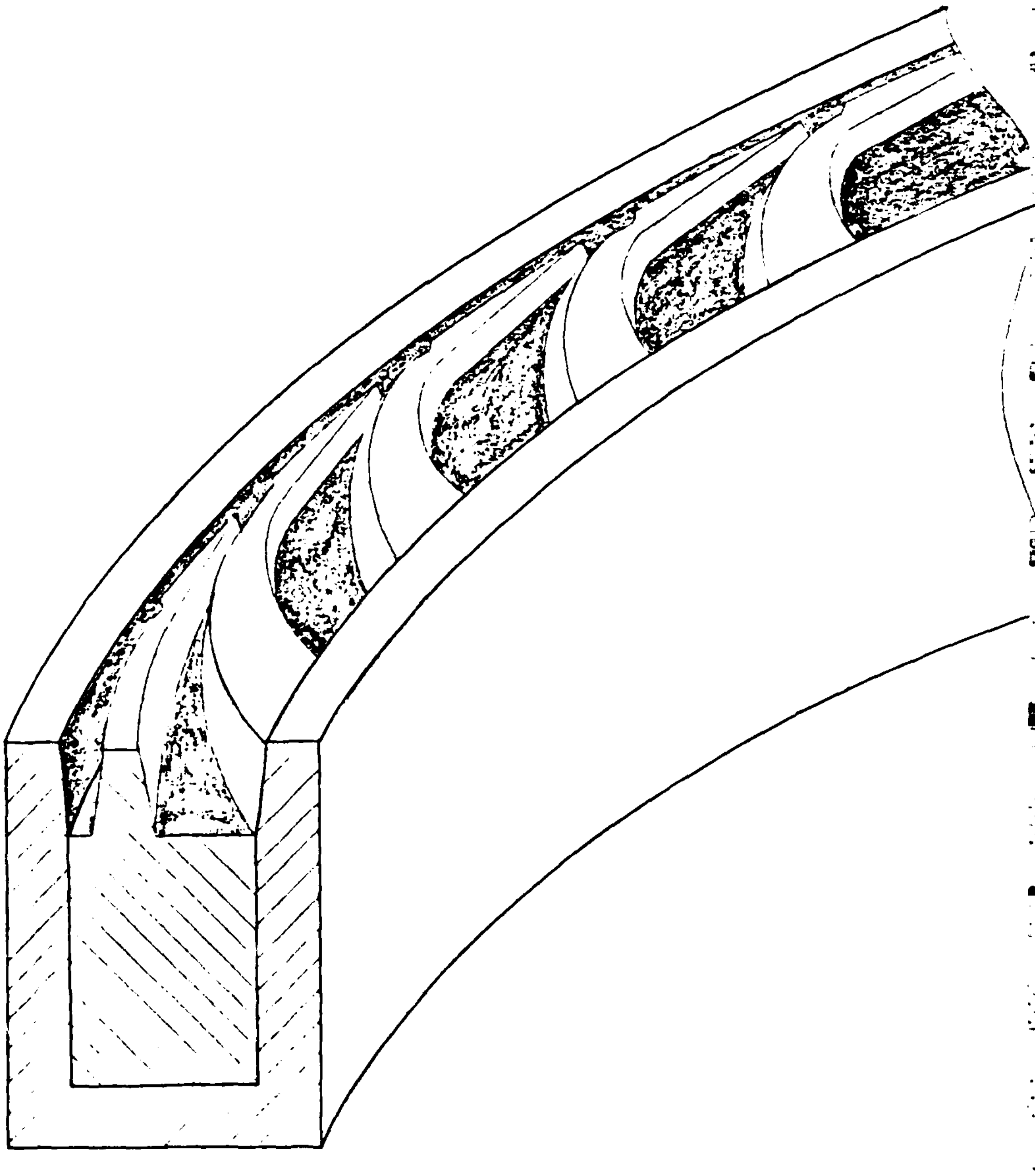


Figure 27 : 3-D Sketch of Casting Mold

Epoxy rings of 0.6 inches thickness can be cast in this mold and 40 of such rings will build up to make the whole cylinder. As all these rings have the same mold reasonable axial uniformity can be achieved.

The cylinder has an even surface on the inside and the outside and each nozzle has a seperate inlet so that it can be supplied with other gases or smoke. In order to reduce the mixing losses and the number of parts, the width of one nozzle was increased to 0.5 inches instead of 0.25 inches in the flow models tested. This decreases the surface with no through flow and with it the pressure losses due to mixing.

5. Summary, Conclusions and Recommendations

The work reported is discussed in two main sections. One describes the hardware status of the CDTD and the other discusses the results of flow measurements. After the final assembly the device was run and the instrumentation - in the initial phase only pneumatic measurement techniques were used - was completed. Some auxiliary flow models were built and tested to obtain information about a new concept to generate a swirling flow.

The measurements carried out surveyed mainly the axial and and circumferential uniformity at the inlet of the diffusor. Evaluation of the results made it clear that the flow uniformity is unsatifactory for obtaining comparable diffusor flow field measurements. The spanwise total pressure and flow angle distributions are unpredictably nonuniform as well as the circumferential distributions. Several reasons for this flow behavior could be established.

Leakage flow which occured at the interface of SVC and JW and at the JWT disturbed the regular flow pattern compared with manually sealed flow cases. Although the introduced mass flows caused by an imperfect sealing are very low an amplification behavior inherent in this kind of flow field makes pertubations into large differences in total pressure and and flow angle.

Some other surveys proved that the generator for the swirling flow - the SVC - itself produced a nonuniform output from a uniform inlet flow. This behavior is attributed to a lack of geometric accuracy in manufacturing and subsequent modification.

Not only did the generated flow field not fulfill the expectations but also the effect of the flow profile control devices was less than expected. Except for the levels of total pressure and flow angle there is almost no control over the flow profile.

It can be concluded that the actual layout of the device hardware needs an improvement, which handles the uniformity problem as well as the flow profile control problem. Some possible solutions are proposed in the last part of the report, affecting main parts of the CDTD, particulary the SVC.

As soon as the requisite hardware improvements are carried out an automatic data acquisition system needs to be adopted and flow visualization techniques - mainly smoke and other tracing methods - should be installed. Also, an accurate scale to observe the circumferential position of the turnable diffusor wall should be added. Static pressure probes or orifices would be very helpful near the SVC surface as well as a mass flow measurement station in one of the inlet ducts to evaluate overall characteristics of the device.

6. List of References

[1] Erwin,J ; Phillips,R.L. ; Schulz,H.D. ; Shreeve,R.P.
Development of a Centrifugal Diffusor Test Device (CDTD),
Part I - Design and Construction of Low Speed Aparatus
Naval Postgraduate School; Monterey, California; 1984
NPS 67-84-003 PR

[2] Vidos,P.
Flow Generation in a Novel Centrifugal Diffusor Test Device
Naval Postgraduate School; Monterey, California; 1983
Master's Thesis

[3] Gersten,K.
Einfuehrung in die Stroemungsmechanik
Bertelsmann Universitaetsverlag; Duesseldorf; 1974

[4] Schulz,H.D.
Development of a Centrifugal Diffusor Test Device (CDTD)
Part II - Initial Measurements and Flow Analysis
Naval Postgraduate School; Monterey, California; 1984
NPS 67-84-004 PR

[5] Wuest,W.
Stroemungsmesstechnik
Viewegverlag; Braunschweig; 1969

7. List of Abbreviations, Symbols and Indizes

The dimensions of the symbols are listed below unless other stated in the text.

Symbol	Dimension	Meaning
A	[m^2]	area
CDTD	[-]	Centrifugal Diffusor Test Device
CR	[-]	Contrction Ring
Diff.	[-]	diffusor
JW	[-]	Jet Wall(s)
JWT	[-]	Jet Wall Throttle(s)
l	[m]	length, exposed length of the SVC
$\dot{m}$	[kg/s]	mass flow rate
NJW	[-]	Northern Jet Wall
NJWT	[-]	Northern Jet Wall Throttle
NPS	[-]	Naval Postgraduate School
p, P	[N/m^2]	pressure
PC	[-]	Perforated Cylinder
q	[N/m^2]	dynamic head; $q = \rho v^2/2$
R	[kJ/kg K]	general gasconstant
r	[m]	radius
SJW	[-]	Southern Jet Wall
SJWT	[-]	Southern Jet Wall Throttle
SVC	[-]	Swirl Vane Cylinder
T	[K]	temperature
TPL	[-]	Turbopropulsion Laboratory
v, V	[m/s]	velocity
var	[-]	pressure variation coefficient
x	[m]	spanwise coordinate
2D	[-]	two-dimensional
3D	[-]	three-dimensional
α	[°]	flow angle, referred to radial direction
κ	[-]	isentropic exponent
Δ	[-]	difference
$\bar{\zeta}$	[-]	coefficient for total pressure loss
[illegible]	[-]	coefficient for total pressure loss

List of Abbreviations, Symbols and Indizes; cont.

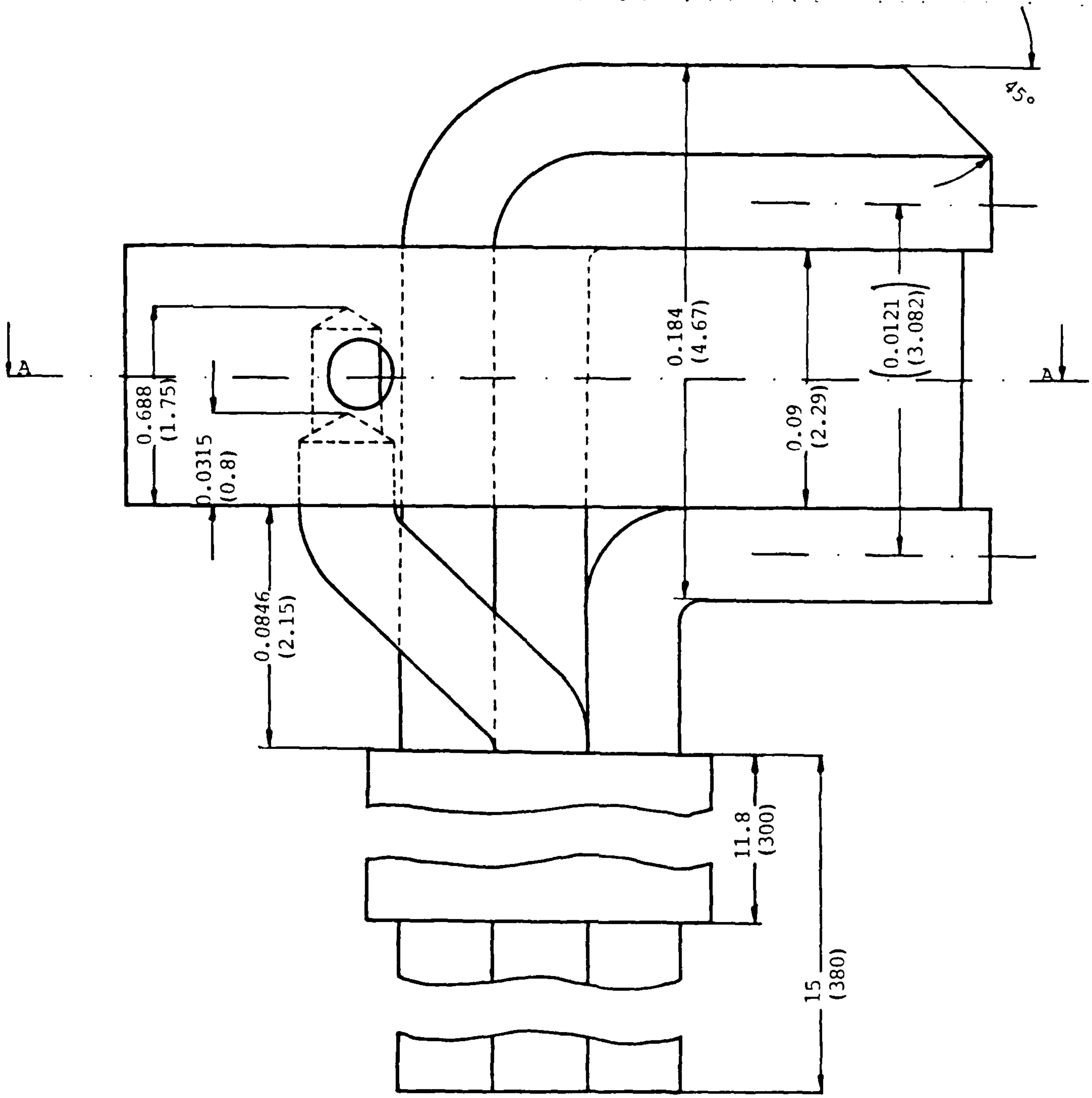
Symbol	Dimension	Meaning
ρ	[kg/m^3]	density
Σ	[-]	sum

Indizes

a	-	ambient
man	-	manometer
max	-	maximum
min	-	minimum
p	-	plenum
r	-	radial
s	-	static
t	-	total
1	-	station 1
2	-	station 2
Θ	-	tangential

Appendix A

Design drawings of wedge shape probe



ALL DIMENSIONS IN INCHES (mm)

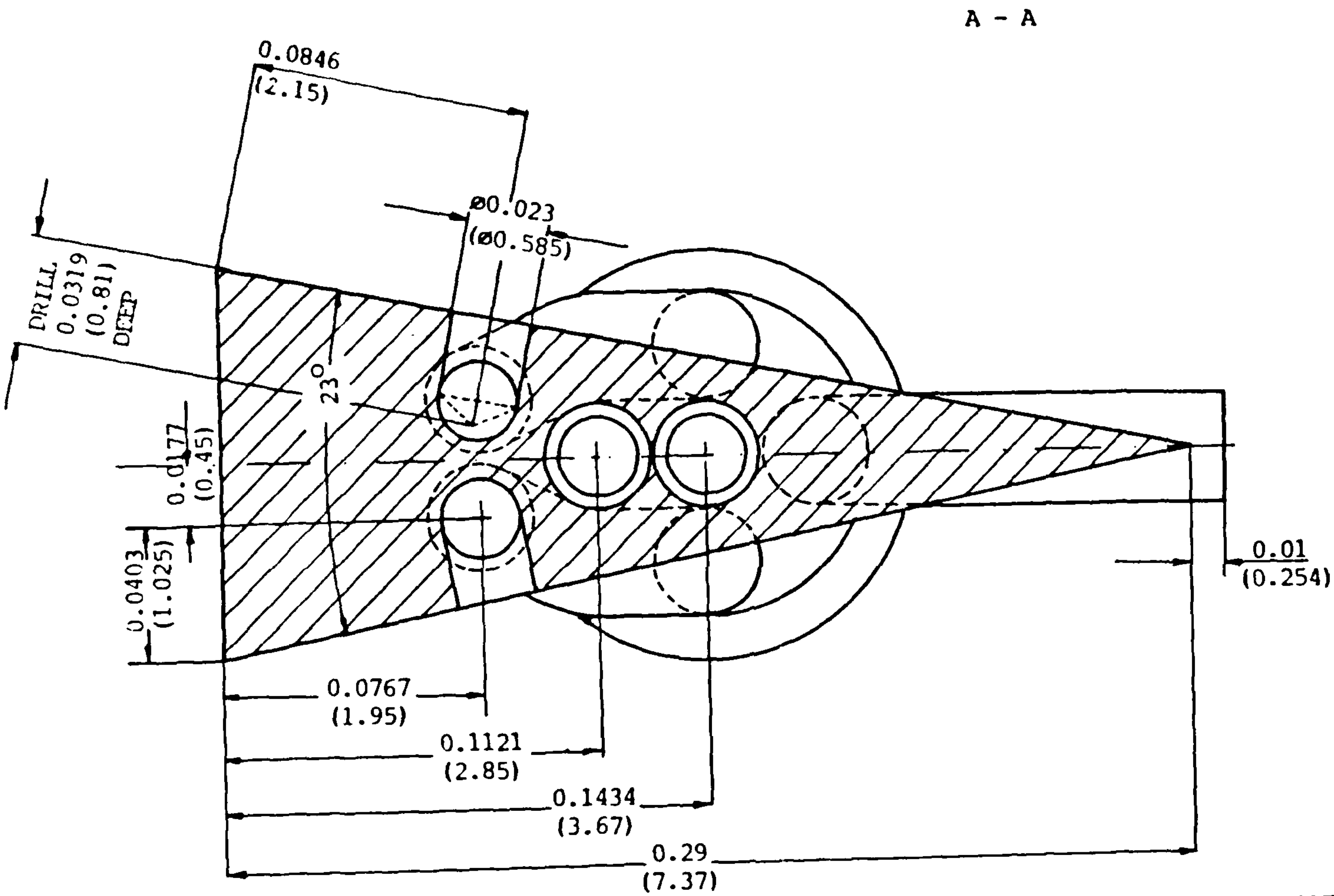
THIN TUBINGS : 1/32 (0.8) OD

0.023(0.585) ID

HOLDER TUBING: 1/8 (3.178) OD

0.07 (1.78) ID

DWG TITLE WEDGE SHAPE PROBE	
DWG NO 7028	SCALE 20 : 1
SIGNATURE	DATE SEPT 10th 1984



ALL DIMENSIONS IN INCHES (mm)

ALL TUBINGS : 1/32 (0.8) OD

0.023 (0.585) ID

DWG TITLE	
WEDGE SHAPE PROBE	
DWG NO 7029	SKALE 20 : 1
SIGNATURE	DATE SEPT 10th 1984

Appendix B   Tables of all results

In addition to the abbreviations listed above some more are used in the tables :

Tables run no. 123 - 204

circumfer		- circumferential position of survey
p_1	[inches H_2O]	- total pressure cobra-probe
p_2	[inches H_2O]	- jaw angle pressure, balanced with p_3
p_3	[inches H_2O]	- jaw angle pressure, balanced with p_2
p_4	[inches H_2O]	- pitch angle pressure

Tables run no. 205 - 220

all pressures have to be corrected by level

circ	- circumferential position of survey, number of passage
level[inches H_2O]	- water level of manometer board
1..10[inches H2O]	- total pressures of rake, pitot tubes spanwise equally spaced over 1.95 inches

common

all pressures in [inches H_2O]

CN1...CN4	- static pressure outer casing north
CR1...CR5	- static pressure contraction ring
CS11...CS43	- static pressure outer casing south
NC1...NC2	- static pressure end wall north
NJ1...NJ2	- static pressure end wall north
radius [inches]	- radial position of survey
SC1...SC2	- static pressure end wall south
SJ1...SJ2	- static pressure end wall south

run no. : 123   radius : 24.0 "
date : 08-16-84   Pp : 9.1
circumfer. : west   Pa : 407
NJW : 17 "   NJWT : open
SJW : 17 "   SJWT : open
comment : devide all probe pressures by 2 as the manometer was installed at an angle of 30°

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	2.1	-3.6	-3.6	-3.4	5.2	58.6
2	7.55	-1.05	-1.05	-4.55	4.7	57.0
3	7.65	- .8	- .8	-4.55	4.2	57.4
4	6.8	- .6	- .6	-4.2	3.7	57.4
5	3.7	-1.85	-1.85	-3.2	3.41	56.2
6						
7						
8						
9						
10						

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 124   radius : 24.0 "
date : 08-16-84   Pp : 9.6
circumfer. : west   Pa : 407
NJW : 14 "   NJWT : open
SJW : 14 "   SJWT : open
comment : devide all probe pressures by 2 as the manometer was installed at an angle of 30°; temp. rotating stall

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	1.2	-4.9	-4.9	-4.8	5.2	62.0
2	7.75	-1.8	-1.8	-6.0	4.7	60.8
3	7.6	-1.75	-1.75	-5.9	4.2	60.8
4	4.65	-2.5	-2.5	-6.1	3.7	61.2
5	2.3	-3.45	-3.45	-4.95	3.41	60.8
6						
7						
8						
9						
10						

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 125
date : 08-16-84
circumfer. : west
NJW : 24 "
SJW : 24 "
comment :

radius : 24 "
Pp : 9.1
Pa : 407
NJWT : open
SJWT : open

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	2.12	- .8	- .8	- .7	5.2	56.5
2	4.62	.45	.45	-1.2	4.7	56.2
3	4.28	.22	.22	-1.27	4.2	55.4
4	4.4	.62	.62	-1.22	3.7	53.6
5	3.45	.45	.45	- .55	3.41	52.4
6						
7						
8						
9						
10						

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 126
date : 08-16-84
circumfer. : west
NJW : 20 "
SJW : 20 "
comment :

radius : 24 "
Pp : 9.1
Pa : 407
NJWT : open
SJWT : open

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	1.35	-1.4	-1.4	-1.27	5.2	58.6
2	4.15	- .1	- .1	-1.75	4.7	57.8
3	4.1	- .15	- .15	-2.0	4.2	55.8
4	3.75	.1	.1	-1.65	3.7	55.6
5	2.02	- .6	- .6	-1.3	3.41	54.8
6						
7						
8						
9						
10						

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 127	radius	: 24 "
date	: 08-17-84	Pp	: 8.5
circumfer.	: west	Pa	: 407
NJW	: 11 "	NJWT	: open
SJW	: 11 "	SJWT	: open
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	.7	-2.3	-2.3	-2.22	5.2	65.0
2	3.35	-1.1	-1.1	-3.22	4.7	62.6
3	3.05	-2.17	-2.17	-3.17	4.2	61.8
4	1.85	-1.4	-1.4	-3.2	3.7	60.8
5	-.45	-2.55	-2.55	-3.1	3.41	63.6
6						
7						
8						
9						
10						

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 128	radius	: 24 "
date	: 08-17-84	Pp	: 8.7
circumfer.	: west	Pa	: 407
NJW	: 9.0 "	NJWT	: open
SJW	: 9.0 "	SJWT	: open
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	.05	-2.75	-2.75	-2.65	5.2	69.8
2	2.8	-1.57	-1.57	-3.55	4.7	61.8
3	3.55	-1.2	-1.2	-3.3	4.2	61.2
4	1.9	-1.75	-1.75	-3.25	3.7	64.0
5	1.3	-1.77	-1.77	-2.9	3.41	68.2
6						
7						
8						
9						
10						

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 131 radius : 24 "
date : 08-17-84 Pp : 10.2
circumfer. : west Pa : 407
NJW : 9 " NJWT : closed
SJW : 9 " SJWT : closed
comment : temporary rotating stall, hysteresis to stop stall

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	- .35	-2.2	-2.2	-2.0	5.2	75.0
2	2.0	-1.35	-1.35	-2.75	4.7	64.0
3	2.12	-1.1	-1.1	-2.57	4.2	63.2
4	.97	-1.52	-1.52	-2.6	3.7	66.6
5	.3	-1.7	-1.7	-2.3	3.41	67.4
6						
7						
8						
9						
10						

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 132 radius : 24 "
date : 08-17-84 Pp : 8.9
circumfer. : east Pa : 407
NJW : 9 " NJWT : closed
SJW : 9 " SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	- .62	-2.3	-2.3	-2.15	5.2	72.6
2	1.75	-1.27	-1.27	-2.6	4.7	65.0
3	1.95	-1.05	-1.05	-2.32	4.2	63.4
4	.5	-1.6	-1.6	-2.4	3.7	68.2
5	- .5	-2.0	-2.0	-2.4	3.41	75.8
6						
7						
8						
9						
10						

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 134	radius	: 24 "
date	: 08-27-84	Pp	: 20.8
circumfer.	: west	Pa	: 470
NJW	: 11 "	NJWT	: closed
SJW	: 11 "	SJWT	: closed
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.0	-5.0	-5.0	-4.6	5.2	70.0
2	1.75	-4.1	-4.1	-6.8	5.0	62.0
3	4.15	-3.0	-3.0	-6.6	4.8	64.5
4	5.7	-2.2	-2.2	-6.3	4.6	63.0
5	5.7	-2.2	-2.2	-6.15	4.4	60.3
6	4.4	-2.8	-2.8	-6.15	4.2	61.8
7	2.8	-3.5	-3.5	-6.6	4.0	63.0
8	1.45	-3.95	-3.95	-6.7	3.8	64.0
9	.15	-4.4	-4.4	-6.5	3.6	63.4
10	-2.6	-5.6	-5.6	-6.5	3.4	66.2

level: 41.5

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
21.1	21.2	21.2	21.1	50.5	50.6	50.5	50.8	49.8	50.2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
50.4	50.8	50.9	53.0	51.7	51.6	52.6	51.6		52.9
CS42	CS43	CS31	CN1	CN2	CN3	CN4			
52.0	51.7	45.1							

run no.	: 135	radius	: 24 "
date	: 08-27-84	Pp	: 22.2
circumfer.	: west	Pa	: 407
NJW	: 12 "	NJWT	: closed
SJW	: 11 "	SJWT	: closed
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.3	-5.5	-5.5	-5.05	5.2	69.0
2	1.55	-4.55	-4.55	-7.3	5.0	64.0
3	4.15	-3.4	-3.4	-7.1	4.8	62.1
4	6.05	-2.35	-2.35	-6.8	4.6	61.8
5	6.8	-1.85	-1.85	-6.3	4.4	58.1
6	6.1	-2.3	-2.3	-6.2	4.2	61.0
7	4.1	-3.15	-3.15	-6.35	4.0	61.4
8	1.9	-4.0	-4.0	-6.7	3.8	64.2
9	.1	-4.65	-4.65	-6.7	3.6	65.7
10	-2.3	-5.7	-5.7	-6.6	3.4	70.0

level: 41.5

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
19.9	19.8	19.9	19.9	51.5	51.1	50.8	51.15	50.6	50.9
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
51.0	51.4	51.4	53.0	52.1	52.1	53.6	52.5	41.5	53.9
CS42	CS43	CS31	CN1	CN2	CN3	CN4			
52.6	52.0	45.4							

run no. : 136 radius : 24 "
date : 08-30-84 Pp : 22.4
circumfer. : west Pa : 407
NJW : 13 " NJWT : closed
SJW : 11 " SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.35	-5.6	-5.6	-5.15	5.2	69
2	+1.75	-4.95	-4.45	-7.3	5.0	64
3	4.15	-3.3	-3.3	-7.1	4.8	62.9
4	6.25	-2.5	-2.5	-6.6	4.6	61.9
5	6.8	-1.9	-1.9	-6.3	4.4	58
6	6.0	-2.4	-2.4	-6.2	4.2	61.2
7	3.8	-3.5	-3.5	-6.4	4.0	61.4
8	1.35	-4.3	-4.3	-6.8	3.8	63
9	-.6	-5.4	-5.4	-6.8	3.6	66.8
10	-2.5	-5.9	-5.9	-6.5	3.4	71.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
19.8	19.8	19.8	19.8	51.2	51.3	50.9	51.2	50.7	51.0
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
51.1	51.5	51.6	53.2	52.3	52.2	51.6	50.5	49.95	51.6
CS42	CS43	CS31	CN1	CN2	CN3	CN4			
50.5	50.0	51.5	49.9	50.0	52.2	49.9			

run no. : 137 radius : 24 "
date : 08-30-84 Pp : 22.5
circumfer. : west Pa : 407
NJW : 15 " NJWT : closed
SJW : 11 " SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-.6	-5.65	-5.65	-5.1	5.2	69
2	2.45	-4.5	-4.5	-7.7	5.0	65
3	4.6	-3.8	-3.8	-7.5	4.8	62.5
4	6.6	-2.5	-2.5	-7.2	4.6	60
5	7.1	-2.2	-2.2	-6.9	4.4	60
6	6.8	-2.25	-2.25	-6.8	4.2	60
7	5.4	-3.0	-3.0	-6.8	4.0	61.5
8	3.7	-3.45	-3.45	-6.9	3.8	62.0
9	1.7	-4.1	-4.1	-6.8	3.6	64.5
10	-1.1	-5.4	-5.4	-6.4	3.4	66.5

level: 41.5

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
19.5	19.5	19.5	19.5	50.8	50.9	50.9	51.1	50.9	51.2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
51.1	51.4	51.4	53.1	52.2	52.1	53.1	52.1	51.6	53.0
CS42	CS43	CS31	CN1	CN2	CN3	CN4			
52.1	51.9	53.0	51.7	52.6	52.4	52.1			

run no. : 143 radius : 24 "
date : 09-07-85 Pp : 22.1
circumfer. : west Pa : 407
NJW : 15 " NJWT : open
SJW : 11 " SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.0	-5.8	-5.8	-5.3	5.2	70
2	2.2	-4.8	-4.8	-7.9	5.0	64.5
3	5.7	-3.6	-3.6	-7.7	4.8	63
4	6.6	-2.5	-2.5	-7.3	4.6	60.5
5	7.4	-2.0	-2.0	-7.0	4.4	60
6	7.0	-2.7	-2.7	-6.9	4.2	60
7	5.7	-3.0	-3.0	-7.0	4.0	60.5
8	4.5	-3.1	-3.1	-7.0	3.8	61.5
9	3.1	-3.4	-3.4	-6.7	3.6	62
10	-.2	-5.2	-5.2	-6.2	3.4	67

level: 41.5

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
20.1	20.1	20.2	20.2	51.2	51.3	20.2	20.2	51.2	51.9
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
51.4	51.7	51.8	53.6	52.6	52.4	52.9	52.0	51.6	53.2
CS42	CS43	CS31	CN1	CN2	CN3	CN4			
52.6	52.4	53.0	43.8	45.0	46.3	45.1			

run no. : 144 radius : 24 "
date : 09-07-84 Pp : 22.8
circumfer. : west Pa : 407
NJW : 15 " NJWT : closed
SJW : 7 " SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.3	-6.0	-6.0	-5.5	5.2	71.5
2	1.4	-5.0	-5.0	-7.8	5.0	66
3	3.8	-4.0	-4.0	-7.6	4.8	65
4	5.7	-3.0	-3.0	-7.2	4.6	62
5	6.6	-2.3	-2.3	-7.1	4.4	60
6	6.6	-2.1	-2.1	-7.1	4.2	61
7	5.3	-3.0	-3.0	-7.0	4.0	62
8	3.7	-3.8	-3.8	-7.1	3.8	64
9	1.4	-4.5	-4.5	-7.1	3.6	65.5
10	-1.3	-5.8	-5.8	-6.8	3.4	70.5

level: 41.5

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
19.2	19.2	19.2	19.2	49.3	49.5	51.3	51.5	50.7	51.1
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
51.9	52.8	52.8	52.7	52.5	52.3	52.6	51.6	51.2	52.9
CS42	CS43	CS31	CN1	CN2	CN3	CN4			
52.1	52.0	49.5	51.8	52.8	53.0	52.4			

run no. : 145 radius : 24 "
date : 09-07-84 Pp : 22.9
circumfer. : west Pa : 407
NJW : 9 " NJWT : open
SJW : 7 " SJWT : closed
comment : at x-positions 4.4 and 3.6 rotating stall occured

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.5	-6.8	-6.8	-6.1	5.2	74.5
2	1.1	-5.6	-5.6	-8.6	5.0	67.5
3	3.6	-4.6	-4.6	-8.7	4.8	65.5
4	5.9	-3.6	-3.6	-8.3	4.6	62.5
5	6.9	-3.0	-3.0	-7.9	4.4	62
6	6.4	-3.4	-3.4	-7.9	4.2	62
7	4.6	-4.2	-4.2	-8.4	4.0	63
8	3.2	-5.0	-5.0	-8.7	3.8	65
9	2.3	-4.8	-4.8	-8.5	3.6	67.5
10	1.3	-5.2	-5.2	-6.9	3.4	71

level: 41.5

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
19.1	19.1	19.1	19.1	50.2	50.4	19.3	19.3	52.0	52.5
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
53.1	53.9	53.9	53.6	53.4	53.3	53.2	52.5	52.1	54.3
CS42	CS43	CS31	CN1	CN2	CN3	CN4			
53.4	53.2	50.2							

run no. : 146 radius : 24 "
date : 09-11-84 Pp : 22.7
circumfer. : west Pa : 407
NJW : 15 " NJWT : closed
SJW : 7 " SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.6	-6.3	-6.3	-7.0	5.2	74
2	1.0	-5.5	-5.5	-8.5	5.0	69
3	2.1	-5.3	-5.3	-8.7	4.8	66
4	3.6	-4.6	-4.6	-8.8	4.6	63.5
5	5.4	-3.7	-3.7	-8.7	4.4	61.5
6	6.3	-2.8	-2.8	-8.3	4.2	60.5
7	6.2	-3.1	-3.1	-7.9	4.0	61
8	4.6	-3.6	-3.6	-7.7	3.8	62
9	2.1	-4.7	-4.7	-7.6	3.6	66
10	0	-2.5	-2.5	-7.6	3.4	69

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 147   radius : 24 "
date : 09-11-84   Pp : 20.7
circumfer. : east   Pa : 407
NJW : 11 "   NJWT : closed
SJW : 11 "   SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-2.2	-6.0	-6.0	-5.5	5.2	76
2	.1	-5.0	-5.0	-7.5	5.0	68.5
3	2.4	-4.2	-4.2	-7.4	4.8	66
4	4.1	-3.4	-3.4	-7.2	4.6	63.5
5	5.2	-2.9	-2.9	-7.0	4.4	61.5
6	5.0	-2.9	-2.9	-6.8	4.2	62
7	4.2	-3.0	-3.0	-6.9	4.0	63.5
8	2.9	-3.5	-3.5	-6.8	3.8	65
9	1.5	-4.0	-4.0	-6.7	3.6	67
10	-1.4	-5.5	-5.5	-6.9	3.9	70

level: 41.5

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
21.1	21.2	21.2	21.1	50.5	50.6	50.5	50.8	49.8	50.2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
50.4	50.8	50.9	53.0	51.7	51.6	52.6	51.6		52.9
CS42	CS43	CS31	CN1	CN2	CN3	CN4			
52.0	51.7	45.1							

run no. : 148   radius : 24 "
date : 09-13-85   Pp : 21.1
circumfer. : 0   Pa : 407
NJW : 11 "   NJWT : closed
SJW : 11 "   SJWT : closed
comment : from here on screens inside the perforated cylinder; left in until run no. 205 as there was no obvious influence

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.9	-5.9	-5.9	-5.5	5.2	75
2	.3	-5.2	-5.2	-7.6	5.0	69
3	2.5	-4.2	-4.2	-7.6	4.8	66
4	4.2	-3.4	-3.4	-7.5	4.6	63.5
5	5.2	-2.9	-2.9	-7.3	4.4	61.5
6	5.2	-3.0	-3.0	-7.1	4.2	62
7	4.4	-3.5	-3.5	-7.0	4.0	63
8	3.2	-3.5	-3.5	-7.1	3.8	64.5
9	1.7	-4.1	-4.1	-6.9	3.6	66.5
10	-1.1	-5.4	-5.4	-6.6	3.4	70

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 149	radius	: 24 "
date	: 10-02-84	Pp	: 20.7
circumfer.	: 31	Pa	: 407
NJW	: 11 "	NJWT	: closed
SJW	: 11 "	SJWT	: closed
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.2	-5.9	-5.9	-5.4	5.2	68
2	2.0	-4.8	-4.8	-4.8	5.0	66.5
3	4.9	-3.3	-3.3	-7.5	4.8	63.5
4	7.1	-2.1	-2.1	-6.7	4.6	59.5
5	7.5	-1.5	-1.5	-6.1	4.4	59.5
6	6.6	-2.0	-2.0	-5.8	4.2	60
7	4.5	-2.9	-2.9	-6.0	4.0	62
8	2.0	-3.9	-3.9	-6.2	3.8	64
9	0	-4.6	-4.6	-6.6	3.6	67
10	-2.1	-5.5	-5.5	-6.9	3.4	70

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 150	radius	: 24 "
date	: 10-02-84	Pp	: 21.1
circumfer.	: 1	Pa	: 407
NJW	: 11 "	NJWT	: closed
SJW	: 11 "	SJWT	: closed
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-.8	-5.1	-5.1	-4.8	5.2	75
2	1.2	-4.3	-4.3	-7.0	5.0	72
3	3.2	-3.9	-3.9	-6.9	4.8	66
4	4.7	-3.2	-3.2	-6.8	4.6	63
5	5.4	-2.9	-2.9	-6.6	4.4	61.5
6	5.4	-2.9	-2.9	-6.7	4.2	62.
7	4.9	-3.1	-3.1	-6.8	4.0	63.5
8	4.3	-3.0	-3.0	-6.8	3.8	64
9	3.7	-3.0	-3.0	-6.3	3.6	66
10	1.6	-3.8	-3.8	-5.4	3.4	68

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 151	radius	: 24 "
date	: 10-02-84	Pp	: 20.9
circumfer.	: 2	Pa	: 407
NJW	: 11 "	NJWT	: closed
SJW	: 11 "	SJWT	: closed
comment	:		

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	1.1	-5.0	-5.0	-4.8	5.2	68
2	4.8	-3.5	-3.5	-7.2	5.0	66
3	6.2	-3.1	-3.1	-6.8	4.8	63
4	6.6	-2.9	-2.9	-6.8	4.6	63
5	6.7	-2.9	-2.9	-6.9	4.4	62
6	6.8	-2.8	-2.8	-7.1	4.2	63
7	6.8	-2.8	-2.8	-7.2	4.0	63
8	6.6	-2.7	-2.7	-7.2	3.8	64
9	5.4	-2.6	-2.6	-6.6	3.6	69
10	3.6	-3.4	-3.4	-5.6	3.4	67

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 152	radius	: 24 "
date	: 10-02-84	Pp	: 21.0
circumfer.	: 30	Pa	: 407
NJW	: 11 "	NJWT	: closed
SJW	: 11 "	SJWT	: closed
comment	:		

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	.6	-5.5	-5.5	-5.0	5.2	67
2	4.1	-4.05	-4.05	-8.1	5.0	69
3	6.6	-3.0	-3.0	-7.7	4.8	62
4	7.9	-2.2	-2.2	-7.4	4.6	60
5	8.3	-2.1	-2.1	-7.1	4.4	59.5
6	8.1	-2.0	-2.0	-7.0	4.2	60
7	7.2	-2.3	-2.3	-6.9	4.0	61
8	5.5	-2.8	-2.8	-6.8	3.8	63
9	3.6	-3.5	-3.5	-6.7	3.6	65.5
10	1.0	-4.8	-4.8	-6.0	3.4	69.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 153
date : 10-04-84
circumfer. : 3
NJW : 11 "
SJW : 11 "
comment :

radius : 24 "
Pp : 21.1
Pa : 407
NJWT : closed
SJWT : closed

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	2.5	-4.7	-4.7	-4.4	5.2	65.5
2	6.7	-3.1	-3.1	-7.8	5.0	60.5
3	8.3	-2.0	-2.0	-7.6	4.8	61
4	9.0	-1.9	-1.9	-7.4	4.6	61
5	9.0	-1.8	-1.8	-7.4	4.4	61
6	8.9	-1.8	-1.8	-7.4	4.2	60.5
7	8.3	-1.8	-1.8	-7.2	4.0	61
8	7.0	-2.2	-2.2	-7.0	3.8	61
9	5.1	-2.8	-2.8	-6.6	3.6	63
10	2.2	-4.1	-4.1	-5.6	3.4	66.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 154
date : 10-04-84
circumfer. : 4
NJW : 11 "
SJW : 11 "
comment :

radius : 24 "
Pp : 21.0
Pa : 407
NJWT : closed
SJWT : closed

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-2.6	-5.8	-5.8	-5.3	5.2	70
2	-0.3	-5.1	-5.1	-7.1	5.0	67.5
3	1.4	-4.5	-4.5	-7.1	4.8	62.5
4	3.9	-3.3	-3.3	-7.0	4.6	62
5	6.1	-2.0	-2.0	-6.5	4.4	61
6	6.9	-1.5	-1.5	-5.8	4.2	59.5
7	6.4	-1.8	-1.8	-5.4	4.0	60
8	4.4	-2.5	-2.5	-5.4	3.8	60.5
9	1.8	-3.6	-3.6	-5.6	3.6	63.5
10	-1.1	-4.9	-4.9	-5.7	3.4	64.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 155 radius : 24 "
date : 10-05-84 Pp : 21.1
circumfer. : 5 Pa : 407
NJW : 11 " NJWT : closed
SJW : 11 " SJWT : closed
comment :

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	-2.8	-5.1				
2	-1.0	-4.5				
3	1.0	-4.0				
4	2.6	-3.2				
5	4.1	-2.6				
6	4.9	-2.0				
7	4.6	-2.0				
8	3.1	-2.7				
9	1.3	-3.2				
10	-1.0	-4.4				

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 156 radius : 24 "
date : 10-05-84 Pp : 21.2
circumfer. : 6 Pa : 407
NJW : 11 " NJWT : closed
SJW : 11 " SJWT : closed
comment : probe inizialized rotating stall near the northern wall; p_2 and p_3 oszilated sometimes

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1						
2						
3						
4						
5	3.3	-2.8	-2.8	-5.2	4.4	
6	4.0	-2.3	-2.3	-5.1	4.2	
7	4.0	-2.3	-2.3	-5.1	4.0	
8	3.2	-2.5	-2.5	-5.0	3.8	
9	1.7	-3.0	-3.0	-4.9	3.6	
10	-1.7	-4.5	-4.5	-4.0	3.4	

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 157 radius : 24 "
date : 10-08-84 Pp : 21.0
circumfer. : 7 Pa : 407
NJW : 11 " NJWT : closed
SJW : 11 " SJWT : closed
comment : probe inizializes rotating stall near the northern wall

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1						
2						
3						
4	3.4	-2.9	-2.9	-5.0	4.6	67
5	4.0	-2.6	-2.6	-5.1	4.4	66
6	4.2	-2.4	-2.4	-5.1	4.2	65
7	4.2	-2.4	-2.4	-5.1	4.0	65
8	3.6	-2.5	-2.5	-5.0	3.8	66
9	2.6	-2.7	-2.7	-4.8	3.6	69
10	.6	-3.6	-3.6	-4.5	3.4	72

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 158 radius : 24 "
date : 10-09-84 Pp : 21.1
circumfer. : 8 Pa : 407
NJW : 11 " NJWT : closed
SJW : 11 " SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.8	-6.1	-6.1	-5.4	5.2	78.5
2	1.1	-4.9	-4.9	-7.1	5.0	75
3	2.9	-4.1	-4.1	-6.5	4.8	69.5
4	4.2	-3.5	-3.5	-6.1	4.6	67
5	5.0	-3.0	-3.0	-6.0	4.4	66
6	5.3	-2.9	-2.9	-6.0	4.2	66
7	5.3	-2.7	-2.7	-5.8	4.0	65.5
8	4.8	-2.6	-2.6	-5.7	3.8	66.5
9	3.9	-2.9	-2.9	-5.5	3.6	69
10	1.7	-3.6	-3.6	-5.0	3.4	72

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 159 radius : 24 "
date : 10-09-84 Pp : 20.8
circumfer. : 9 Pa : 407
NJW : 11 " NJWT : closed
SJW : 11 " SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.5	-6.5	-6.5	-5.7	5.2	76
2	1.5	-5.3	-5.3	-7.8	5.0	71
3	3.3	-4.5	-4.5	-7.3	4.8	67.5
4	4.9	-3.8	-3.8	-7.0	4.6	65.5
5	6.0	-3.3	-3.3	-6.8	4.4	63.5
6	6.7	-3.0	-3.0	-6.7	4.2	63
7	6.8	-2.8	-2.8	-6.6	4.0	63.5
8	6.6	-2.6	-2.6	-6.4	3.8	64
9	5.7	-2.5	-2.5	-5.9	3.6	66
10	4.0	-3.3	-3.3	-5.5	3.4	69

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 160 radius : 24 "
date : 10-09-84 Pp : 20.8
circumfer. : 10 Pa : 407
NJW : 11 " NJWT : closed
SJW : 11 " SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-.7	-6.1	-6.1	-5.3	5.2	68
2	2.5	-4.8	-4.8	-7.7	5.0	67
3	4.8	-3.8	-3.8	-7.0	4.8	64
4	6.3	-3.2	-3.2	-6.5	4.6	62
5	7.4	-2.6	-2.6	-6.2	4.4	60
6	7.8	-2.4	-2.4	-5.9	4.2	61.5
7	7.5	-2.5	-2.5	-5.8	4.0	62.5
8	6.5	-2.8	-2.8	-6.0	3.8	65
9	5.4	-3.0	-3.0	-5.9	3.6	67
10	4.1	-3.4	-3.4	-5.1	3.2	69.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 161 radius : 24 "
date : 10-10-84 Pp : 21.1
circumfer. : 11 Pa : 407
NJW : 11 " NJWT : closed
SJW : 11 " SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-.3	-5.6	-5.6	-5.1	5.2	67
2	+3.5	-4.1	-4.1	-7.3	5.0	65
3	+6.1	-2.7	-2.7	-6.8	4.8	62
4	+7.2	-2.2	-2.2	-6.4	4.6	61
5	+6.7	-2.4	-2.4	-7.3	4.4	60.5
6	+5.4	-3.1	-3.1	-6.7	4.2	61
7	3.8	-3.8	-3.8	-7.0	4.0	62.5
8	2.6	-4.1	-4.1	-7.1	3.8	65
9	1.6	-4.3	-4.3	-7.0	3.6	66
10	-.7	-5.4	-5.4	-6.7	3.4	67.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 162 radius : 24 "
date : 10-10-84 Pp : 21.1
circumfer. : 12 Pa : 407
NJW : 11 " NJWT : closed
SJW : 11 " SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.7	-5.8	-5.8	-5.1	5.2	73
2	1.7	-4.7	-4.7	-7.4	5.0	66
3	4.0	-3.7	-3.7	-7.1	4.8	64
4	5.7	-2.9	-2.9	-6.7	4.6	61.5
5	6.3	-2.5	-2.5	-6.5	4.4	60.5
6	5.7	-2.7	-2.7	-6.4	4.2	61
7	4.3	-3.3	-3.3	-6.5	4.0	62
8	2.8	-3.9	-3.9	-6.6	3.8	63.5
9	1.4	-4.4	-4.4	-6.6	3.6	65
10	-.7	-5.3	-5.3	-6.5	3.4	68.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 163	radius	: 24 "
date	: 10-10-84	Pp	: 21.1
circumfer.	: 13	Pa	: 407
NJW	: 11 "	NJWT	: closed
SJW	: 11 "	SJWT	: closed
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.9	-6.1	-6.1	-5.1	5.2	74
2	0	-5.6	-5.6	-7.0	5.0	69
3	2.3	-5.0	-5.0	-7.0	4.8	63.5
4	3.8	-4.3	-4.3	-6.9	4.6	61
5	5.0	-3.7	-3.7	-6.7	4.4	60.5
6	5.1	-3.5	-3.5	-6.5	4.2	59
7	4.5	-3.7	-3.7	-6.5	4.0	60
8	3.4	-4.0	-4.0	-6.3	3.8	61
9	1.7	-4.4	-4.4	-6.1	3.6	63
10	-.5	-5.3	-5.3	-7.1	3.4	66

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 164	radius	: 24 "
date	: 10-10-84	Pp	: 21.1
circumfer.	: 14	Pa	: 407
NJW	: 11 "	NJWT	: closed
SJW	: 11 "	SJWT	: closed
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-2.5	-5.8	-5.8	-5.3	5.2	75.5
2	0	-4.0	-4.0	-6.9	5.0	70
3	2.2	-4.1	-4.1	-6.5	4.8	67
4	3.5	-3.7	-3.7	-6.3	4.6	65
5	4.5	-3.2	-3.2	-6.3	4.4	63
6	5.0	-3.0	-3.0	-6.4	4.2	63
7	4.9	-3.0	-3.0	-6.4	4.0	63
8	3.7	-3.5	-3.5	-6.2	3.8	64
9	1.9	-3.9	-3.9	-6.1	3.6	65
10	-.6	-5.0	-5.0	-6.1	3.4	70.5

evel:

C1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
R3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
S42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 165
date : 10-10-84
circumfer. : 15
NJW : 11"
SJW : 11"
comment :

radius : 24"
Pp : 21.1
Pa : 407
NJWT : closed
SJWT : closed

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.7	-5.9	-5.9	-5.5	5.2	75.5
2	1.1	-5.1	-5.1	-7.5	5.0	70.
3	3.2	-4.1	-4.1	-7.1	4.8	66
4	4.6	-3.7	-3.7	-6.7	4.6	65
5	5.4	-3.3	-3.3	-6.8	4.4	65
6	5.6	-3.3	-3.3	-6.7	4.2	64
7	5.6	-3.1	-3.1	-6.7	4.0	63.5
8	4.9	-3.3	-3.3	-6.6	3.8	64
9	3.6	-3.5	-3.5	-6.3	3.6	66
10	1.4	-3.9	-3.9	-6.0	3.4	69.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 166
date : 10-10-84
circumfer. : 16
NJW : 11"
SJW : 11"
comment :

radius : 24"
Pp : 21.3
Pa : 407
NJWT : closed
SJWT : closed

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.0	-6.9	-6.9	-5.7	5.2	68
2	2.7	-5.7	-5.7	-8.0	5.0	65
3	5.3	-4.5	-4.5	-7.3	4.8	62
4	6.5	-4.1	-4.1	-7.0	4.6	60
5	7.0	-3.9	-3.9	-6.9	4.4	59.5
6	7.3	-3.9	-3.9	-6.9	4.2	60.5
7	7.3	-3.7	-3.7	-6.8	4.0	60.5
8	6.5	-3.9	-3.9	-6.5	3.8	61
9	5.1	-4.1	-4.1	-6.3	3.6	64
10	2.6	-5.0	-5.0	-6.1	3.4	66

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 167   radius : 24"
date : 10-10-84   Pp : 20.9
circumfer. : 17   Pa : 407
NJW : 11"   NJWT : closed
SJW : 11"   SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.0	-7.0	-7.0	-5.3	5.2	63
2	3.1	-5.8	-5.8	-7.6	6.0	60.5
3	6.1	-4.9	-4.9	-7.1	4.8	56.5
4	7.6	-3.9	-3.9	-6.5	4.6	55
5	7.8	-3.7	-3.7	-6.2	4.4	54
6	7.0	-3.9	-3.9	-6.1	4.2	55
7	5.0	-4.9	-4.9	-6.3	4.0	57
8	2.8	-5.3	-5.3	-6.7	3.8	59
9	.7	-5.8	-5.8	-6.9	3.6	61
10	-1.3	-6.3	-6.3	-6.9	3.4	66

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 168   radius : 24"
date : 10-10-84   Pp : 21.3
circumfer. : 18   Pa : 407
NJW : 11"   NJWT : closed
SJW : 11"   SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-2.6	-6.4	-6.4	-5.7	5.2	73
2	1.0	-5.3	-5.3	-7.5	6.0	69.5
3	3.0	-4.3	-4.3	-7.3	4.8	66
4	5.9	-3.3	-3.3	-6.9	4.6	63
5	6.8	-2.7	-2.7	-6.3	4.4	61
6	6.1	-3.0	-3.0	-6.3	4.2	60.5
7	4.3	-3.7	-3.7	-6.3	4.0	61.5
8	2.3	-4.5	-4.5	-6.7	3.8	63
9	.5	-5.0	-5.0	-6.7	3.6	64
10	-1.9	-5.9	-5.9	-6.6	3.4	66

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 169	radius	: 24"
date	: 10-10-84	Pp	: 21.1
circumfer.	: 19	Pa	: 407
NJW	: 11"	NJWT	: closed
SJW	: 11"	SJWT	: closed
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-2.0	-6.6	-6.6	-5.8	5.2	73
2	1.3	-5.4	-5.4	-7.6	5.0	69.5
3	3.4	-4.6	-4.6	-7.3	4.8	66
4	4.9	-3.9	-3.9	-7.1	4.6	63
5	5.8	-3.5	-3.5	-7.0	4.4	61
6	6.0	-3.4	-3.4	-7.0	4.2	60.5
7	5.5	-3.7	-3.7	-7.0	4.0	61.5
8	4.5	-3.9	-3.9	-6.9	3.8	63
9	3.2	-3.9	-3.9	-6.7	3.6	64
10	.9	-5.0	-5.0	-6.3	3.4	66

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 170	radius	: 24"
date	: 10-12-84	Pp	: 21.3
circumfer.	: 20	Pa	: 407
NJW	: 11"	NJWT	: closed
SJW	: 11"	SJWT	: closed
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.6	-6.8	-6.8	-5.9	5.2	71
2	1.6	-5.5	-5.5	-7.9	5.0	68
3	3.9	-4.6	-4.6	-7.7	4.8	64
4	5.5	-3.7	-3.7	-7.4	4.6	61
5	6.7	-3.3	-3.3	-7.1	4.4	60
6	6.9	-3.1	-3.1	-6.9	4.2	60
7	6.0	-3.5	-3.5	-6.8	4.0	61.5
8	4.1	-4.5	-4.5	-7.0	3.8	63
9	2.2	-4.9	-4.9	-7.0	3.6	66
10	-.3	-5.9	-5.9	-7.0	3.4	69.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 171 radius : 24"
date : 10-12-84 Pp : 21.1
circumfer. : 21 Pa : 407
NJW : 11" NJWT : closed
SJW : 11" SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-2.1	-6.8	-6.8	-5.8	5.2	70
2	1.3	-5.7	-5.7	-7.7	5.0	66.5
3	3.7	-4.7	-4.7	-7.3	4.8	63
4	5.7	-3.5	-3.5	-6.9	4.6	61.5
5	6.5	-3.1	-3.1	-6.5	4.4	59
6	5.9	-3.3	-3.3	-6.4	4.2	59.5
7	4.0	-3.9	-3.9	-6.5	4.0	61
8	1.8	-5.0	-5.0	-6.9	3.8	63.5
9	-.1	-5.5	-5.5	-7.0	3.6	65.5
10	-2.5	-5.6	-5.6	-7.0	3.4	70.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 172 radius : 24"
date : 10-12-84 Pp : 21.0
circumfer. : 22 Pa : 407
NJW : 11" NJWT : closed
SJW : 11" SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.2	-5.3	-5.3	-4.9	5.2	71
2	1.6	-4.9	-4.9	-6.8	5.0	68
3	3.6	-4.0	-4.0	-6.6	4.8	64
4	4.9	-4.1	-4.1	-6.4	4.6	61.5
5	5.5	-3.3	-3.3	-6.3	4.4	61
6	4.9	-3.5	-3.5	-6.3	4.2	62
7	3.4	-4.1	-4.1	-6.4	4.0	62.5
8	1.6	-4.7	-4.7	-6.6	3.8	64.5
9	-.3	-5.1	-5.1	-6.6	3.6	66.5
10	-2.3	-6.0	-6.0	-6.6	3.4	69.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 173	radius	: 24"
date	: 10-12-84	Pp	: 21.1
circumfer.	: 23	Pa	: 407
NJW	: 11"	NJWT	: closed
SJW	: 11"	SJWT	: closed
comment	:		

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	-1.3	-6.2	-6.2	-5.4	5.2	74
2	+1.0	-5.5	-5.5	-7.5	5.0	70
3	+2.8	-5.0	-5.0	-7.6	4.8	65
4	+4.1	-4.3	-4.3	-7.4	4.6	64
5	+5.3	-3.8	-3.8	-7.3	4.4	61
6	+5.6	-3.7	-3.7	-6.2	4.2	63
7	+5.3	-3.7	-3.7	-7.2	4.0	63
8	4.5	-3.7	-3.7	-7.0	3.8	63
9	3.0	-4.0	-4.0	-6.6	3.6	65
10	.7	-5.1	-5.1	-6.1	3.4	70

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 174	radius	: 24"
date	: 10-12-84	Pp	: 21.1
circumfer.	: 24	Pa	: 407
NJW	: 11"	NJWT	: closed
SJW	: 11"	SJWT	: closed
comment	:		

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	-1.9	-6.9	-6.9	-5.6	5.2	70
2	1.4	-5.5	-5.5	-8.1	5.0	65
3	3.5	-4.9	-4.9	-7.4	4.8	64
4	4.3	-4.7	-4.7	-7.3	4.6	63
5	5.1	-4.3	-4.3	-7.3	4.4	61
6	5.7	-4.0	-4.0	-7.3	4.2	60.5
7	5.9	-3.8	-3.8	-7.2	4.0	60.5
8	5.2	-3.8	-3.8	-7.2	3.8	64
9	4.0	-3.9	-3.9	-6.8	3.6	65
10	2.0	-5.0	-5.0	-6.1	3.4	68

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 175 radius : 24"
date : 10-12-84 Pp : 21
circumfer. : 25 Pa : 407
NJW : 11" NJWT : closed
SJW : 11" SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-.7	-7.2	-7.2	-6.0	5.2	69
2	2.9	-5.7	-5.7	-9.4	5.0	65
3	5.3	-4.7	-4.7	-9.2	4.8	62
4	6.5	-3.9	-3.9	-8.8	4.6	59
5	7.1	-3.6	-3.6	-8.6	4.4	57
6	6.9	-3.7	-3.7	-8.5	4.2	60
7	5.6	-4.1	-4.1	-8.4	4.0	60
8	4.0	-4.7	-4.7	-8.4	3.8	62
9	2.2	-5.1	-5.1	-8.1	3.6	64
10	.3	-5.0	-5.0	-7.5	3.4	68

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 176 radius : 24"
date : 11-06-84 Pp : 21.2
circumfer. : 26 Pa : 407
NJW : 11" NJWT : closed
SJW : 11" SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.8	-6.3	-6.3	-5.4	5.2	67
2	1.5	-5.3	-5.3	-8.1	5.0	62.5
3	3.4	-4.4	-4.4	-8.0	4.8	61
4	5.4	-3.5	-3.5	-7.7	4.6	61
5	6.9	-2.7	-2.7	-7.3	4.4	60
6	7.2	-2.6	-2.6	-6.9	4.2	59
7	6.1	-3.1	-3.1	-6.8	4.0	59
8	3.9	-4.0	-4.0	-6.9	3.8	60
9	1.7	-4.6	-4.6	-6.8	3.6	63
10	-.6	-5.8	-5.8	-6.6	3.4	67

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 177 radius : 24"
date : 11-06-84 Pp : 21.0
circumfer. : 27 Pa : 407
NJW : 11" NJWT : closed
SJW : 11" SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-1.8	-6.3	-6.3	-5.4	5.2	67
2	1.5	-5.3	-5.3	-8.1	5.0	62.5
3	3.4	-4.4	-4.4	-8.0	4.8	61.
4	5.4	-3.5	-3.5	-7.7	4.6	61
5	6.9	-2.7	-2.7	-7.3	4.4	60
6	7.2	-2.6	-2.6	-6.9	4.2	59
7	6.1	-3.1	-3.1	-6.8	4.0	59
8	3.9	-4.0	-4.0	-6.9	3.8	60
9	1.7	-4.6	-4.6	-6.8	3.6	63
10	-.6	-5.8	-5.8	-6.6	3.4	67

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 178 radius : 24"
date : 11-06-84 Pp : 21.2
circumfer. : 28 Pa : 407
NJW : 11" NJWT : closed
SJW : 11" SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	-2.3	-5.9	-5.9	-5.2	5.2	67
2	.2	-5.0	-5.0	-7.2	5.0	64
3	2.4	-4.3	-4.3	-7.1	4.8	60
4	4.3	-3.5	-3.5	-7.0	4.6	59.5
5	5.6	-2.8	-2.8	-6.7	4.4	57
6	5.6	-2.8	-2.8	-6.5	4.2	57.5
7	4.3	-3.2	-3.2	-6.6	4.0	59.5
8	2.5	-4.0	-4.0	-6.8	3.8	61.5
9	.8	-4.7	-4.7	-6.7	3.6	64
10	-1.6	-5.7	-5.7	-6.4	3.4	67

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 179　　radius : 24"
date : 11-06-84　　Pp : 21.1
circumfer. : 29　　Pa : 402
NJW : 11"　　NJWT : closed
SJW : 11"　　SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	.4	-5.0	-5.0	-6.2	5.2	65
2	3.3	-4.0	-4.0	-7.0	5.0	64
3	4.7	-3.4	-3.4	-6.7	4.8	62.5
4	5.6	-3.2	-3.2	-6.6	4.6	60
5	6.1	-3.0	-3.0	-6.7	4.4	60
6	5.9	-3.2	-3.2	-6.9	4.2	60.5
7	5.5	-3.4	-3.4	-7.1	4.0	61.5
8	4.5	-3.6	-3.6	-7.1	3.8	62.5
9	3.3	-3.8	-3.8	-6.7	3.6	63.5
10	1.4	-4.8	-4.8	-6.0	3.4	64.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. :　　radius :
date :　　Pp :
circumfer. :　　Pa :
NJW :　　NJWT :
SJW :　　SJWT :
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 180 radius : 24"
date : 11-07-84 Pp : 20.6
circumfer. : 2 Pa : 407
NJW : open NJWT : closed
SJW : open SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	3.8	-3.2	-3.2	-2.3	5.2	55.5
2	8.7	-1.0	-1.0	-5.4	5.0	53.5
3	9.5	-.7	-.7	-4.8	4.8	54.5
4	9.5	-1.1	-1.1	-4.9	4.6	56.
5	9.0	-1.3	-1.3	-5.4	4.4	55.5
6	8.7	-1.3	-1.3	-5.8	4.2	55.
7	8.5	-1.1	-1.1	-5.8	4.0	55.
8	8.5	-.6	-.6	-5.7	3.8	54.5
9	8.3	-.3	-.3	-4.6	3.6	55.5
10	6.0	-1.5	-1.5	-3.4	3.4	54.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 181 radius : 24"
date : 11-07-84 Pp : 20.7
circumfer. : 2 Pa : 407
NJW : open NJWT : open
SJW : open SJWT : open
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	5.0	-1.3	-1.3	-.6	5.2	52.5
2	10.2	+.7	+.7	-3.4	5.0	50.
3	11.1	+1.1	+1.1	-2.7	4.8	52.
4	11.2	+1.1	+1.1	-2.8	4.6	52.5
5	11.1	+1.0	+1.0	-3.0	4.4	53.5
6	10.8	+1.1	+1.1	-3.2	4.2	53.5
7	10.6	+1.2	+1.2	-3.3	4.0	53.5
8	10.1	+1.3	+1.3	-3.2	3.8	53.
9	9.4	+1.5	+1.5	-2.4	3.6	53.
10	7.1	+.1	+.1	-1.4	3.4	51.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 182 radius : 24"
date : 11-07-84 Pp : 20.7
circumfer. : 3 Pa : 407
NJW : open NJWT : closed
SJW : open SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	3.3	-3.3	-3.3	-24	5.2	55.
2	8.0	-1.3	-1.3	-5.4	5.0	56.
3	9.0	-.7	-.7	-5.0	4.8	55.5
4	9.2	-.7	-.7	-5.0	4.6	55.5
5	9.2	-.7	-.7	-5.1	4.4	55.5
6	9.2	-.7	-.7	-5.2	4.2	55.5
7	9.0	-.6	-.6	-5.4	4.0	55.5
8	8.5	-.5	-.5	-5.2	3.8	55.5
9	7.3	-.6	-.6	-4.5	3.6	55.5
10	4.8	-2.3	-2.3	-3.8	3.4	56

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 183 radius : 24"
date : 11-07-85 Pp : 20.8
circumfer. : 3 Pa : 407
NJW : open NJWT open
SJW : open SJWT : open
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	5.7	-1.0	-1.0	-.4		
2	11.0	+1.3	+1.3	-2.8		
3	11.4	+1.3	+1.3	-2.4		
4	11.2	+1.3	+1.3	-2.5		
5	11.1	+.9	+.9	-2.8		
6	10.8	+.9	+.9	-3.1		
7	10.5	+.9	+.9	-3.2		
8	10.0	+1.0	+1.0	-3.2		
9	9.6	+1.3	+1.3	-2.4		
10	7.5	+.1	+.1	-1.4		

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 184	radius	: 24"
date	: 11-07-84	Pp	: 20.7
circumfer.	: 4	Pa	: 407
NJW	: open	NJWT	: closed
SJW	: open	SJWT	: closed
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	3.7	-3.0	-3.0	-5.9	5.2	55.5
2	6.5	-1.7	-1.7	-5.6	5.0	55.
3	7.7	-1.0	-1.0	-5.2	4.8	55.
4	8.5	-.7	-.7	-5.0	4.6	55.
5	8.8	-.7	-.7	-5.1	4.4	55.
6	8.8	-.7	-.7	-5.2	4.2	55.
7	8.6	-.7	-.7	-5.2	4.0	55.
8	7.9	-.7	-.7	-5.3	3.8	55.
9	6.7	-1.0	-1.0	-4.7	3.6	55.5
10	4.1	-2.8	-2.8	-3.9	3.4	56.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 185	radius	: 24"
date	: 11-07-84	Pp	: 20.7
circumfer.	: 4	Pa	: 407
NJW	: open	NJWT	: open
SJW	: open	SJWT	: open
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	5.4	-1.0	-1.0	0	5.2	51
2	9.6	+.5	+.5	-3.1	5.0	53
3	10.4	+1.0	+1.0	-2.6	4.8	52.5
4	10.4	+.7	+.7	-2.6	4.6	53.
5	10.3	+.6	+.6	-3.0	4.4	54.
6	10.0	+.7	+.7	-3.2	4.2	53.
7	10.0	+.6	+.6	-3.4	4.0	54.
8	10.0	+1.3	+1.3	-3.2	3.8	54.5
9	9.8	+1.9	+1.9	-2.4	3.6	53.5
10	7.4	+.4	+.4	-1.4	3.4	53.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 186 radius : 24"
date : 11-09-84 Pp : 20.7
circumfer. : 1 Pa : 407
NJW : open NJWT : closed
SJW : open SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	3.6	-3.6	-3.6	-2.4	5.2	54
2	8.8	-1.2	-1.2	-6.2	5.0	52.5
3	9.7	-.8	-.8	-5.6	4.8	54
4	9.6	-.8	-.8	-5.7	4.6	53
5	9.0	-1.2	-1.2	-6.1	4.4	54
6	8.8	-1.4	-1.4	-6.4	4.2	54
7	8.6	-1.4	-1.4	-6.5	4.0	54
8	8.6	-.8	-.8	-6.2	3.8	54
9	8.1	-.2	-.2	-4.9	3.6	53
10	5.2	-1.8	-1.8	-4.0	3.4	54

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 187 radius : 24"
date : 11-09-84 Pp : 20.9
circumfer. : 1 Pa : 407
NJW : open NJWT : open
SJW : open SJWT : open
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	5.4	-1.6	-1.6	-.6	5.2	52.5
2	10.4	+.7	+.7	-4.0	5.0	50.5
3	11.7	+1.3	+1.3	-3.5	4.8	52.
4	11.7	+1.3	+1.3	3.4	4.6	51.
5	11.3	+.9	+.9	-3.8	4.4	50.5
6	11.1	+.9	+.9	-4.2	4.2	51.
7	11.1	+1.3	+1.3	-4.2	4.0	52.
8	11.1	+1.9	+1.9	-3.6	3.8	52.
9	10.5	+2.1	+2.1	-2.4	3.6	52.
10	7.6	+.5	+.5	-1.8	3.4	51.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 188 radius : 24"
date : 11-09-84 Pp : 20.7
circumfer. : 0 Pa : 407
NJW : open NJWT : closed
SJW : open SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	3.2	-3.6	-3.6	-2.6	5.2	55.5
2	8.2	-1.3	-1.3	-6.0	5.0	53.
3	9.3	-1.0	-1.0	-5.6	4.8	54.
4	9.4	-1.0	-1.0	-5.7	4.6	54.
5	9.3	-1.0	-1.0	-5.9	4.4	54.
6	8.9	-1.2	-1.2	-6.1	4.2	54.
7	8.6	-1.2	-1.2	-6.2	4.0	54.
8	8.4	-.8	-.8	-5.9	3.8	54.
9	7.7	-.5	-.5	-4.8	3.6	54.
10	4.8	-2.0	-2.0	-4.0	3.4	54.

level: 41.5

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
21.8	21.8	21.8	21.8	47.5	47.5	47.3	47.3	48.85	48.9
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
49.1	49.3	47.7	47.3	46.6	46.5	47.2	46.4	46.5	46.9
CS42	CS43	CS31	CN1	CN2	CN3	CN4			
46.6	46.5	47.0	46.4	47.1	47.0	47.1			

run no. : 189 radius : 24"
date : 11-09-84 Pp : 20.9
circumfer. : 0 Pa : 407
NJW : open NJWT : open
SJW : open SJWT : open
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	+5.1	-1.4	-1.4	-.6	5.2	50.5
2	+10.4	+.8	+.8	-3.8	5.0	52.
3	+11.4	+1.4	+1.4	-3.3	4.8	52.
4	+11.5	+1.3	+1.3	-3.3	4.6	52.
5	+11.1	+.9	+.9	-3.6	4.4	52.
6	+10.6	+.7	+.7	-4.1	4.2	52.
7	+10.5	+.9	+.9	-4.2	4.0	52.
8	+10.9	+1.7	+1.7	-4.0	3.8	52.
9	+11.0	+2.7	+2.7	-2.6	3.6	52.
10	+8.9	+1.4	+1.4	-1.1	3.9	48.

level: 41.5

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	46.4	46.5
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
46.8	47.4	45.3	44.1	43.6	43.0	43.6	43.0	42.3	43.8
CS42	CS43	CS31	CN1	CN2	CN3	CN4			
43.6	43.0	43.6	42.8	43.2	42.5	43.4			

run no. : 189 A   radius : 24"
date : 11-10-84   Pp : 20.6
circumfer. : 31   Pa : 407
NJW : open   NJWT : closed
SJW : open   SJWT : closed
comment :

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	+2.6	-3.8	-3.8	-3.0	5.2	55.5
2	+7.5	-1.6	-1.6	-6.1	5.0	54
3	+8.7	-1.3	-1.3	-5.7	4.8	55
4	+9.0	-1.0	-1.0	-5.7	4.6	54
5	+9.0	-1.1	-1.0	-5.9	4.4	54.5
6	+9.0	-1.0	-1.0	-6.0	4.2	54.5
7	+8.8	-1.0	-1.0	-6.0	4.0	55.
8	+8.3	-.5	-.5	-5.7	3.8	54.5
9	+7.3	-.5	-.5	-4.7	3.6	55.
10	+4.5	-2.2	-2.2	-4.2	3.4	56.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 190   radius : 24"
date : 11-10-84   Pp : 20.7
circumfer. : 31   Pa : 407
NJW : open   NJWT : open
SJW : open   SJWT : open
comment :

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	5.5	-1.3	-1.3	-2.0	5.2	51.5
2	10.0	+.8	+.8	-3.7	5.0	51.5
3	10.9	+1.1	+1.1	-3.3	4.8	51.5
4	11.0	+1.0	+1.0	-3.3	4.6	52.
5	11.0	+.9	+.9	-3.6	4.4	53.
6	10.9	+1.3	+1.3	-3.7	4.2	54.
7	10.7	+1.6	+1.6	-3.8	4.0	53.
8	10.6	+1.7	+1.7	-3.7	3.8	52.
9	10.7	+2.5	+2.5	-2.4	3.6	52.
10	8.8	+1.3	+1.3	-1.2	3.4	52.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 191	radius	: 24"
date	: 11-10-84	Pp	: 20.7
circumfer.	: 30	Pa	: 407
NJW	: open	NJWT	: closed
SJW	: open	SJWT	: closed
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	2.8	-2.8	-2.8	-2.7	5.2	56.
2	7.3	-1.7	-1.7	-7.2	5.0	55.
3	8.7	-1.2	-1.2	-5.7	4.8	54.
4	9.0	-1.0	-1.0	-5.7	4.6	54.
5	9.0	-1.0	-1.0	-5.9	4.4	54.
6	9.0	-1.0	-1.0	-6.1	4.2	54.
7	9.0	-1.0	-1.0	-6.1	4.0	54.
8	8.8	-.6	-.6	-5.8	3.8	54.
9	7.9	-.3	-.3	-4.7	3.6	54.5
10	5.3	-1.6	-1.6	-3.7	3.4	54.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 192	radius	: 24"
date	: 11-10-84	Pp	: 20.8
circumfer.	: 30	Pa	: 407
NJW	: open	NJWT	: open
SJW	: open	SJWT	: open
comment	:		

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	6.3	-1.2	-1.2	-.3	5.2	52.
2	9.5	+.6	+.6	-3.6	5.0	51.
3	10.4	+.9	+.9	-3.3	4.8	51.
4	11.0	+1.2	+1.2	-3.3	4.6	51.5
5	11.4	+1.5	+1.5	-3.4	4.4	53.
6	11.4	+1.6	+1.6	-3.3	4.2	53.
7	11.1	+1.7	+1.7	-3.4	4.0	52.
8	10.7	+1.7	+1.7	-3.3	3.8	52.
9	10.4	+2.5	+2.5	-2.3	3.6	51.5
10	8.2	+1.0	+1.0	-1.1	3.4	52.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 193 radius : 24
date : 11-10-84 Pp : 20.6
circumfer. : 29 Pa : 407
NJW : open NJWT : closed
SJW : open SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	3.6	-3.3	-3.3	-4.2	5.2	55.
2	8.1	-1.2	-1.2	-5.7	5.0	54.
3	9.0	-.8	-.8	-5.3	4.8	54.
4	9.1	-1.0	-1.0	-5.3	4.6	54.
5	9.0	-1.4	-1.4	-5.7	4.4	54.
6	8.7	-1.4	-1.4	-6.0	4.2	54.
7	8.7	-1.2	-1.2	-6.1	4.0	54.
8	8.8	-.6	-.6	-5.8	3.8	54.
9	8.6	0	0	-4.6	3.6	54.
10	5.7	-1.4	-1.4	-3.4	3.4	54.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 194 radius : 24
date : 11-10-84 Pp : 20.8
circumfer. : 29 Pa : 407
NJW : open NJWT : open
SJW : open SJWT : open
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	6.0	-.8	-.8	-.9	5.2	50.5
2	10.3	+1.3	+1.3	-3.1	5.0	52.
3	11.1	+1.5	+1.5	-2.8	4.8	52.
4	11.4	+1.6	+1.6	-2.7	4.6	52.
5	11.5	+1.6	+1.6	-2.9	4.4	52.
6	11.5	+1.7	+1.7	-3.1	4.2	52.
7	11.4	+1.9	+1.9	-3.1	4.0	52.
8	11.0	+2.3	+2.3	-2.7	3.8	52.
9	9.9	+2.3	+2.3	-1.8	3.6	51.
10	7.4	+1.1	+1.1	-1.2	3.4	50.5

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 195 radius : 24
date : 11-10-84 Pp : 20.7
circumfer. : 28 Pa : 407
NJW : open NJWT : closed
SJW : open SJWT : closed
comment :

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	3.4	-3.4	-3.4	-2.5	5.2	54.
2	8.4	-1.0	-1.0	-5.6	5.0	54.
3	9.2	-.8	-.8	-5.1	4.8	54.
4	9.2	-1.0	-1.0	-5.2	4.6	54.
5	8.8	-1.4	-1.4	-5.7	4.4	54.
6	8.6	-1.4	-1.4	-6.1	4.2	54.5
7	8.6	-1.0	-1.0	-6.1	4.0	54.
8	8.7	-.3	-.3	-5.7	3.8	54.
9	8.2	-.2	-.2	-4.6	3.6	54.
10	5.0	-1.7	-1.7	-3.6	3.4	54.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 196 radius : 24
date : 11-10-84 Pp : 20.8
circumfer. : 28 Pa : 407
NJW : open NJWT : open
SJW : open SJWT : open
comment :

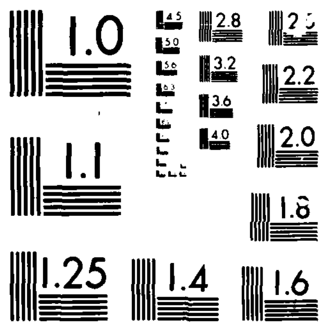
no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	6.0	-.7	-.7	+.3	5.2	52.
2	10.9	+1.5	+1.5	-2.8	5.0	52.
3	11.5	+1.6	+1.6	-2.4	4.8	51.
4	11.3	+1.4	+1.4	-2.5	4.6	51.
5	11.1	+1.3	+1.3	-3.1	4.4	52.
6	11.1	+1.4	+1.4	-3.3	4.2	52.
7	11.3	+1.9	+1.9	-3.3	4.0	52.
8	11.3	+2.5	+2.5	-2.9	3.8	52.
9	10.5	+2.8	+2.8	-1.7	3.6	51.
10	7.7	+1.1	+1.1	-.9	3.4	50.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

AD-A166 758 FLOW MEASUREMENTS IN A CENTRIFUGAL DIFFUSOR TEST DEVICE 2/2
(U) EXOTECH INC CAMPBELL CA T VITTING JUN 85 TR-8501
N00014-84-C-0766

UNCLASSIFIED F/G 13/7 NL



MICROCOP' CHART

run no. : 197 radius : 24
date : 11-11-84 Pp : 20.7
circumfer. : 27 Pa : 407
NJW : open NJWT : closed
SJW : open SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	2.8	-3.8	-3.8	-2.7	5.2	55.
2	8.0	-1.5	-1.5	-5.7	5.0	53.5
3	9.1	-1.1	-1.1	-5.3	4.8	54.
4	9.2	-1.0	-1.0	-5.3	4.6	54.
5	9.0	-1.2	-1.2	-5.6	4.4	54.
6	8.8	-1.4	-1.4	-5.9	4.2	54.
7	8.7	-1.0	-1.0	-5.9	4.0	54.
8	8.5	-.6	-.6	-5.5	3.8	53.5
9	7.5	-.6	-.6	-4.6	3.6	54.
10	5.5	-2.0	-2.0	-3.9	3.4	55.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 198 radius : 24
date : 11-11-84 Pp : 20.7
circumfer. : 27 Pa : 407
NJW : open NJWT : open
SJW : open SJWT : open
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	5.5	-.9	-.9	-1.3	5.2	50.5
2	10.0	+1.1	+1.1	-2.9	5.0	51.
3	10.9	+1.3	+1.3	-2.6	4.8	51.
4	11.0	+1.2	+1.2	-2.7	4.6	52.
5	11.0	+1.2	+1.2	-3.1	4.4	52.
6	10.9	+1.3	+1.3	-3.3	4.2	52.
7	11.1	+1.6	+1.6	-3.3	4.0	52.
8	11.1	+2.1	+2.1	-2.8	3.8	52.
9	10.5	+2.6	+2.6	-1.8	3.6	52.
10	7.5	+.9	+.9	-1.0	3.4	51.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 199	radius	: 24
date	: 11-11-84	Pp	: 20.7
circumfer.	: 5	Pa	: 407
NJW	: open	NJWT	: closed
SJW	: open	SJWT	: closed
comment	:		

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	+2.1	-3.8	-3.8	-2.9	5.2	55.
2	+6.3	-2.0	-2.0	-6.0	5.0	54.
3	+7.7	-1.6	-1.6	-5.5	4.8	54.
4	+8.4	-1.2	-1.2	-5.5	4.6	54.
5	+8.6	-1.4	-1.4	-5.7	4.4	55.
6	+8.6	-1.0	-1.0	-5.8	4.2	55.
7	+8.5	-1.0	-1.0	-5.8	4.0	55.
8	+7.9	-.8	-.8	-5.5	3.8	55.
9	+6.7	-.8	-.8	-4.7	3.6	55.
10	+4.0	-2.4	-2.4	-4.2	3.4	55.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.	: 200	radius	: 24
date	: 11-11-84	Pp	: 20.8
circumfer.	: 5	Pa	: 407
NJW	: open	NJWT	: closed
SJW	: open	SJWT	: closed
comment	:		

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	5.2	-1.4	-1.4	-.6	5.2	52.5
2	10.0	+.7	+.7	-3.7	5.0	51.
3	10.5	+.8	+.8	-3.3	4.8	52.
4	10.5	+.7	+.7	-3.6	4.6	52.
5	10.5	+.7	+.7	-3.9	4.4	52.
6	10.3	+.6	+.6	-4.2	4.2	52.
7	10.4	+.8	+.8	-4.2	4.0	52.
8	10.4	+1.3	+1.3	-3.8	3.8	52.
9	9.9	+1.8	+1.8	-2.7	3.6	52.
10	7.0	+.1	+.1	-1.9	3.4	51.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 201
date : 11-12-84
circumfer. : 6
NJW : open
SJW : open
comment :

radius : 24
Pp : 20.7
Pa : 407
NJWT : closed
SJWT : closed

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	24	-4.0	-4.0	-2.9	5.2	56.
2	7.1	-2.0	-2.0	-6.1	5.0	55.
3	8.0	-1.6	-1.6	-5.7	4.8	55.
4	8.0	-1.6	-1.6	-5.8	4.6	55.
5	8.1	-1.6	-1.6	-6.2	4.4	55.
6	8.2	-1.6	-1.6	-6.3	4.2	55.
7	8.2	-1.2	-1.2	-6.3	4.0	55.
8	8.1	-.7	-.7	-5.9	3.8	55.
9	7.2	-.5	-.5	-4.9	3.6	55.
10	4.1	-2.4	-2.4	-4.0	3.4	55.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 202
date : 11-12-84
circumfer. : 6
NJW : open
SJW : open
comment :

radius : 24
Pp : 20.8
Pa : 407
NJWT : open
SJWT : open

no.	p_1-p_a	p_2-p_a	p_3-p_a	p_4-p_a	x	α
1	5.0	-1.8	-1.8	-.6	5.2	52.5
2	10.1	+.5	+.5	-3.6	5.0	51.
3	10.5	+.6	+.6	-3.3	4.8	52.
4	10.4	+.3	+.3	-3.6	4.6	52.
5	10.1	+.1	+.1	-4.1	4.4	52.
6	10.1	+.2	+.2	-4.4	4.2	52.
7	10.5	+.8	+.8	-4.4	4.0	52.
8	10.5	+1.5	+1.5	-3.9	3.8	52.
9	10.0	+1.7	+1.7	-2.7	3.6	51.
10	7.2	+.1	+.1	-1.4	3.4	51.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 203 radius : 24
date : 11-12-84 Pp : 20.7
circumfer. : 7 Pa : 407
NJW : open NJWT : closed
SJW : open SJWT : closed
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	2.3	-4.3	-4.3	-2.9	5.2	56.
2	7.2	-2.0	-2.0	-6.0	5.0	55.
3	8.4	-1.5	-1.5	-5.7	4.8	55.
4	8.3	-1.7	-1.7	-5.9	4.6	55.
5	8.2	-2.0	-2.0	-6.3	4.4	55.
6	8.2	-2.0	-2.0	-6.5	4.2	55.
7	8.6	-1.3	-1.3	-6.5	4.0	55.
8	8.9	-.6	-.6	-6.1	3.8	55.
9	8.5	+.1	+.1	-4.8	3.6	55.
10	5.5	-1.5	-1.5	-4.0	3.4	54.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no. : 204 radius : 24
date : 11-12-84 Pp : 20.8
circumfer. : 7 Pa : 407
NJW : open NJWT : open
SJW : open SJWT : open
comment :

no.	P_1-P_a	P_2-P_a	P_3-P_a	P_4-P_a	x	α
1	4.9	-1.8	-1.8	-.7	5.2	53.5
2	10.3	+1.6	+1.6	-3.5	5.0	51.
3	10.7	+.7	+.7	-3.2	4.8	52.
4	10.5	+.2	+.2	-3.4	4.6	52.5
5	10.3	+.1	+.1	-3.9	4.4	52.5
6	10.3	+.4	+.4	-4.3	4.2	52.
7	10.7	+.9	+.9	-4.3	4.0	52.5
8	10.8	+1.9	+1.9	-3.8	3.8	52.
9	10.5	+2.2	+2.2	-2.4	3.6	52.
10	7.6	+.4	+.4	-1.4	3.4	51.

level:

SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2
CR3	CR4	CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41
CS42	CS43	CS31	CN1	CN2	CN3	CN4			

run no.: 205 date: 11-21-84 radius: 24 Pa: 407 NJW: open SJW: open

NJWT: closed SJWT: closed level : 41.5

comment: one line of nozzles in the SVC toped (axial)

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	20.6	36.9	33.0	32.0	32.0	32.2	32.6	32.9	33.4	34.6	37.8
1	20.6	36.5	32.3	31.6	31.8	32.2	32.4	32.5	32.8	33.9	38.1
2	20.6	35.6	31.8	31.4	31.7	32.1	32.2	32.2	32.4	33.2	37.1
3	20.6	36.2	32.6	31.8	31.7	31.7	31.8	32.1	32.8	34.3	38.0
4	20.5	37.3	33.7	32.6	32.1	31.9	32.0	32.4	33.3	34.9	38.9
5	20.5	38.5	35.0	33.6	32.8	32.5	32.4	32.7	33.5	34.8	38.7
6	20.4	38.0	34.4	33.4	33.2	33.1	32.9	32.7	33.1	34.3	38.5
7	20.4	38.0	34.2	33.2	33.2	33.3	32.9	32.5	32.4	33.4	37.9
8	20.4	38.3	34.0	32.7	32.7	32.8	32.7	32.3	32.4	33.6	37.9
9	20.4	37.7	33.4	32.1	32.0	32.2	32.2	32.3	33.1	35.1	39.1
10	20.4	37.0	32.7	31.5	31.5	31.9	32.6	33.3	34.5	36.3	40.0
11	20.4	37.5	33.2	32.0	31.9	32.4	33.0	33.5	33.8	34.9	38.8
12	20.4	38.3	34.5	33.2	32.8	32.8	33.0	33.2	33.5	34.7	38.7
13	20.4	39.6	35.5	34.3	33.9	33.6	33.3	33.2	33.8	35.0	38.8
14	20.4	38.7	34.4	33.8	34.1	34.2	34.0	33.1	33.6	34.9	38.4
15	20.4	38.8	34.3	33.4	33.7	34.0	33.8	33.2	33.4	34.4	38.6
16	20.4	39.1	33.7	32.6	33.0	33.5	33.5	33.1	33.3	34.9	38.6
17	20.6	38.0	33.0	32.2	32.7	33.2	33.2	32.8	32.6	33.2	37.1
18	20.4	38.6	33.7	32.3	32.1	32.3	32.4	32.2	32.2	32.8	36.3
19	20.4	38.7	34.7	32.8	32.0	31.7	31.6	31.6	32.2	33.6	37.2
20	20.4	38.7	34.5	33.0	32.2	31.7	31.5	32.0	33.7	36.2	39.8
21	20.5	38.3	34.0	32.7	32.4	32.4	32.6	33.4	34.8	36.9	40.5
22	20.6	37.7	33.6	32.7	32.6	32.8	33.1	33.6	34.6	36.6	39.9
23	20.3	36.5	33.0	32.4	32.7	33.1	33.4	33.7	34.4	36.0	39.7
24	20.3	38.0	33.5	32.4	32.4	32.8	33.1	33.2	33.6	35.1	39.1
25	20.3	39.1	35.0	33.3	32.7	32.7	32.6	32.4	32.7	34.1	38.4
26	20.6	39.6	35.4	33.8	33.3	33.0	32.6	32.2	32.4	33.7	38.0
27	20.6	38.8	34.7	33.2	32.9	32.9	32.6	32.2	32.3	33.5	37.7
28	20.6	37.8	33.3	32.2	32.4	32.7	32.7	32.3	32.2	33.1	37.2
29	20.6	36.7	32.7	31.8	32.1	32.5	32.6	32.3	32.2	32.8	36.4
30	20.5	36.7	32.9	31.7	31.6	32.0	32.2	32.4	32.9	34.0	37.5
31	20.5	37.4	33.2	31.8	31.5	31.7	32.3	32.9	33.8	35.2	39.2
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
CP5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
CN2	CN3	CN4									

run no.: 206 date: 11-21-84 radius: 24 Pa: 407 NJW: 18" SJW: 18"

NJWT: closed SJWT: closed level : 41.5

comment: one line of nozzles in the SVC taped

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	20.5	38.4	34.4	32.7	32.3	32.4	32.7	33.0	33.6	35.2	39.0
1	20.5	39.4	34.9	32.3	31.5	31.6	32.1	32.7	34.1	36.6	40.0
2	20.5	40.4	36.7	33.9	32.2	31.7	32.3	33.8	35.7	38.0	41.2
3	20.5	39.4	35.8	34.1	33.4	33.2	33.2	33.8	34.6	36.2	39.6
4	20.5	38.7	35.0	34.0	34.0	34.2	34.1	34.0	33.8	34.7	38.5
5	20.5	39.0	35.2	34.0	33.9	34.2	34.3	34.0	33.6	34.1	37.2
6	20.5	40.7	37.1	34.8	33.8	33.6	33.5	33.3	33.2	34.3	38.2
7	20.5	41.3	37.8	35.7	34.3	33.5	33.0	32.8	33.6	36.0	40.1
8	20.5	40.3	36.8	34.7	33.6	33.0	33.1	33.9	35.5	37.8	41.1
9	20.5	39.7	36.5	34.5	33.5	33.4	33.8	34.9	35.2	36.7	39.9
10	20.5	39.9	37.9	34.9	34.0	33.9	34.0	34.1	34.1	35.1	38.6
11	20.5	40.6	37.4	35.5	34.4	34.0	33.8	33.8	34.1	35.6	39.0
12	20.5	41.1	38.0	36.2	35.0	34.2	33.7	34.1	35.3	37.6	40.9
13	20.5	40.4	37.0	35.5	34.8	34.6	34.8	35.6	36.8	38.5	41.4
14	20.5	38.6	34.3	34.7	35.0	35.3	35.7	36.4	37.8	37.8	40.6
15	20.5	38.0	34.3	33.7	34.1	34.7	35.5	36.2	37.2	38.7	41.2
16	20.5	39.4	35.0	33.5	33.6	34.3	35.1	35.9	37.0	38.5	40.9
17	20.5	40.4	37.2	35.2	34.0	33.7	34.0	34.7	35.7	37.3	39.9
18	20.5	41.0	37.1	35.3	34.5	34.1	33.7	33.7	34.2	35.6	38.7
19	20.5	39.5	36.2	34.9	34.3	33.9	33.6	33.5	34.0	35.5	38.8
20	20.5	40.1	36.8	35.0	34.0	33.5	33.6	34.2	35.4	37.3	40.5
21	20.5	40.6	37.2	35.2	34.1	33.7	33.8	34.4	35.4	37.2	40.3
22	20.5	40.5	37.4	35.4	34.2	33.7	33.6	34.1	35.2	37.0	40.2
23	20.8	39.8	37.0	35.2	34.4	34.1	34.1	34.7	35.8	37.6	40.6
24	20.6	40.1	36.6	35.8	34.1	34.0	34.0	34.3	35.0	37.6	40.0
25	20.5	40.3	36.4	34.5	34.0	33.8	33.7	33.5	33.8	35.2	39.0
26	20.5	40.1	36.2	34.3	33.7	33.5	33.2	33.1	33.4	35.0	38.9
27	20.6	39.6	35.9	33.9	33.1	32.9	33.0	33.3	34.2	36.1	39.6
28	20.6	39.6	36.1	33.8	32.9	32.7	32.9	33.4	34.1	35.7	38.9
29	20.5	39.6	36.4	34.2	33.0	32.5	32.5	32.9	33.6	35.3	38.6
30	20.5	39.1	35.7	34.0	33.2	32.9	32.9	33.1	33.7	35.2	38.7
31	20.5	38.6	34.6	33.0	32.7	32.8	33.0	33.2	33.7	35.1	38.8
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
21.3	21.3	21.3	21.3	49.5	49.5	45.8	45.9	50.7	50.8	50.9	51.8
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
50.5	50.0	49.6	50.0	49.6	49.1	49.7	48.4	48.6	49.2	48.7	49.8
CN2	CN3	CN4									
49.6	48.6	49.4									

run no.: 207 date: 11-22-84 radius: 24 Pa: 407 NJW: 12" SJW: 12"

NJWT: closed SJWT: closed level : 41.5

comment: one line of nozzles in the SVC taped

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	20.4	41.7	38.8	36.4	35.2	35.5	36.4	36.9	36.9	38.1	42.2
1	20.4	42.1	39.5	37.6	36.2	35.6	35.5	35.6	35.3	34.9	37.1
2	20.4	39.5	36.3	35.0	34.6	34.5	34.6	34.7	34.9	35.3	37.4
3	20.4	41.0	37.8	35.7	34.1	33.4	33.5	34.3	36.0	38.1	41.0
4	20.4	44.0	41.3	38.5	36.0	34.5	34.8	36.5	38.9	41.3	44.0
5	20.4	44.4	42.2	39.9	37.7	36.5	36.6	37.9	39.6	41.8	44.4
6	20.4	44.2	42.2	40.3	38.8	37.9	37.3	37.1	37.4	39.0	42.7
7	20.4	43.8	41.4	39.4	38.1	37.4	37.0	36.6	36.6	37.6	40.9
8	20.4	42.7	39.9	37.9	36.6	35.9	35.6	35.5	35.7	36.7	39.3
9	20.4	41.5	39.0	37.5	36.1	35.2	34.6	34.6	35.1	36.3	39.0
10	20.4	41.7	38.4	36.7	35.4	34.5	34.2	34.7	35.8	37.5	40.0
11	20.4	41.5	37.7	35.8	34.7	34.5	35.2	36.7	38.5	40.5	43.4
12	20.3	41.2	37.8	35.9	35.0	35.1	36.4	38.0	39.6	41.5	44.1
13	20.3	42.4	39.4	37.5	36.3	36.2	37.0	38.1	39.4	41.2	44.1
14	20.3	43.2	40.9	39.1	37.7	37.0	36.9	37.2	37.8	39.7	43.4
15	20.3	43.6	41.5	39.5	38.1	37.1	36.4	36.0	36.1	37.3	40.8
16	20.3	43.6	41.0	38.9	37.5	36.5	35.5	34.7	34.6	37.5	38.8
17	20.4	42.7	39.1	37.4	36.2	35.3	34.9	35.2	36.5	38.3	41.0
18	20.4	41.7	38.3	36.5	35.4	35.0	35.3	36.4	38.0	40.0	43.2
19	20.4	42.3	38.9	37.0	35.3	34.8	35.1	36.0	37.3	39.1	42.2
20	20.4	43.0	39.4	37.0	35.3	34.8	35.1	36.3	38.0	40.1	43.2
21	20.4	42.0	39.1	36.8	35.4	35.1	35.6	36.9	38.7	41.0	44.2
22	20.4	41.7	38.8	36.9	35.7	35.5	35.8	36.6	38.0	40.0	43.2
23	20.5	42.0	38.9	37.1	35.8	35.2	35.0	35.2	36.1	37.7	41.0
24	20.5	42.1	38.4	36.3	35.0	34.4	34.2	34.1	35.9	37.9	41.2
25	20.5	43.2	40.0	37.6	35.6	34.3	33.7	34.2	35.7	38.2	41.9
26	20.5	43.0	39.9	37.7	35.9	34.6	34.1	34.8	36.8	39.5	42.9
27	20.6	41.4	38.6	36.6	35.0	34.5	35.0	36.3	38.0	40.1	43.2
28	20.6	41.7	39.2	37.1	35.6	34.8	34.7	35.1	35.6	36.7	40.0
29	20.6	41.2	38.3	36.5	35.3	34.5	33.9	33.7	33.9	35.1	38.7
30	20.4	40.3	36.7	34.6	33.4	33.0	33.3	34.5	36.7	39.0	41.7
31	20.4	40.6	36.7	34.0	33.3	34.5	36.9	39.3	41.2	43.0	45.4
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CP1	CP2	CP3	CP4
21.0	21.0	21.0	21.0	52.4	52.4	47.2	47.4	51.1	51.5	51.8	52.0
CP5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
51.8	53.8	52.6	52.5	53.8	53.2	52.6	52.6	52.2	52.2	54.1	52.1
CN2	CN3	CN4									
48.5	49.7	51.3									

run no.: 208 date: 11-23-84 radius: 24 Pa: 407 NJW: 11" SJW: 11"
NJWT: closed SJWT: closed level : 41.5
comment: one row of nozzles in the SVC taped

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	20.4	41.6	38.3	35.9	35.1	36.1	38.0	39.5	40.7	42.8	45.8
1	20.4	42.0	39.8	38.0	36.5	36.0	36.1	36.9	36.5	37.2	40.0
2	20.4	39.0	35.7	34.9	34.6	34.5	34.5	34.7	35.1	36.1	38.5
3	20.4	36.5	33.6	32.5	32.4	32.7	33.5	34.7	36.6	38.7	41.6
4	20.4	43.0	40.9	39.2	37.0	35.2	34.3	35.3	37.5	39.9	43.0
5	20.4	44.6	42.5	40.7	38.9	37.3	36.2	36.4	37.8	39.6	42.6
6	20.4	44.6	42.7	40.9	39.3	38.0	37.0	37.0	38.2	40.1	42.6
7	20.4	43.9	41.3	39.1	37.9	37.3	36.9	37.0	37.8	39.5	42.4
8	20.4	44.2	41.1	38.3	36.7	36.0	35.8	35.8	36.7	37.7	41.0
9	20.4	43.3	40.3	37.8	36.2	35.1	34.4	34.1	34.2	35.2	38.3
10	20.4	42.6	39.9	38.1	36.6	35.2	34.0	33.5	34.1	35.5	37.9
11	20.4	41.3	37.6	35.4	34.0	33.7	34.8	36.5	38.4	40.2	43.1
12	20.4	42.9	39.5	37.2	35.3	34.4	34.8	36.1	37.7	39.3	42.0
13	20.4	43.7	41.2	39.0	37.0	35.9	35.9	37.3	39.0	40.8	43.4
14	20.4	44.3	42.1	40.2	38.5	37.0	37.3	38.1	39.5	41.5	44.2
15	20.4	44.0	41.7	39.6	38.3	37.7	37.3	37.4	38.1	39.8	42.9
16	20.4	43.9	41.3	38.7	37.3	36.7	36.5	36.4	37.0	38.5	41.6
17	20.4	43.1	39.9	37.0	35.6	35.3	35.2	35.5	36.5	38.2	41.0
18	20.4	40.8	36.8	35.1	34.3	34.1	34.6	35.7	37.5	39.3	41.8
19	20.4	41.8	38.7	36.8	35.1	34.5	35.1	36.5	38.2	40.0	43.5
20	20.4	43.5	40.2	38.1	36.4	35.2	34.6	35.0	36.1	37.9	41.2
21	20.4	43.7	39.8	37.4	35.6	34.6	34.6	35.8	37.0	40.4	43.7
22	20.5	42.6	39.2	37.0	35.5	35.0	35.6	36.8	38.6	41.0	44.3
23	20.7	42.5	39.6	37.7	36.1	35.1	34.7	35.2	36.2	37.9	41.1
24	20.6	42.1	38.5	36.7	35.4	34.4	33.8	34.0	35.0	36.8	40.1
25	20.5	43.4	39.5	37.0	34.7	33.4	33.5	35.0	37.3	39.8	43.0
26	20.4	42.9	39.3	37.1	35.3	34.5	34.8	36.4	38.7	41.1	44.3
27	20.4	42.4	39.5	37.4	35.5	34.5	34.7	36.1	38.1	40.3	43.1
28	20.4	43.5	41.3	39.2	37.1	35.6	35.1	36.0	37.5	39.3	42.1
29	20.4	42.0	39.2	37.5	36.2	35.2	34.6	34.5	35.1	36.5	39.5
30	20.4	40.9	38.1	35.9	34.1	33.0	32.5	32.7	34.0	36.3	39.6
31	20.4	41.8	38.5	35.9	33.9	33.4	34.6	37.0	39.5	41.6	44.1
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
19.9	19.9	19.9	19.9	52.2	52.2	47.0	47.0	50.8	51.2	57.2	51.6
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
51.7	53.3	52.6	52.5	53.5	52.6	52.3	52.5	52.3	52.2	53.5	52.1
CN2	CN3	CN4									
48.3	49.4	51.2									

run no.: 209 date: 11-27-84 radius: 24 Pa: 407 NJW: 12" SJW: 12"

NJWT: open SJWT: closed level : 41.5

comment: 1½ rows of the NJWT-nozzles taped to concentrate the flow to the wall near region

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	20.7	40.1	36.8	34.5	33.7	34.4	36.2	38.0	39.6	41.4	43.7
1											
2	20.4	41.2	38.4	36.4	35.3	35.1	35.5	35.9	35.8	36.1	39.2
3											
4											
5											
6											
7	20.4	43.0	40.2	38.2	37.3	36.8	36.6	37.1	38.1	40.2	43.5
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
31											
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CP1	CP2	CP3	CP4
20.8	20.8	20.8	20.8	52.8	52.8	20.9	20.9	51.3	51.7	51.9	52.3
CP5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
52.2	54.5	53.2	52.9	53.6	53.0	52.7	52.9	52.7	52.8	54.7	59.6
CN2	CN3	CN4									
31.9	39.2	46.3									

run no.: 210 date: 11-27-84 radius: 24 Pa: 407 NJW: 12" SJW: 12"

NJWT: closed SJWT: closed level : 41.5

comment: one line of nozzles in the SVC taped ; no vanes in the diffuser

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	20.5	38.6	35.0	32.6	31.4	31.6	33.1	35.2	37.4	39.4	41.5
1	20.5	39.9	36.6	34.1	32.9	33.3	34.5	35.3	35.4	36.5	40.7
2	20.5	39.9	36.3	34.4	33.4	33.3	33.6	34.0	33.8	33.3	35.2
3	20.5	38.6	34.8	33.1	32.4	32.4	32.7	33.0	33.2	33.6	35.9
4	20.5	40.0	36.7	34.5	32.8	31.9	31.8	32.4	33.7	35.5	38.5
5	20.5	42.5	39.8	37.5	35.1	33.4	32.9	34.0	36.2	38.6	41.4
6	20.4	42.6	40.4	38.4	36.4	35.3	35.1	36.1	37.7	39.6	42.3
7	20.4	40.9	38.3	37.0	36.3	36.2	35.9	35.6	35.3	35.7	38.5
8	20.4	39.8	37.1	35.6	34.9	34.7	34.7	34.6	34.5	35.0	37.0
9	20.4	39.9	37.4	35.6	34.3	33.6	33.4	33.5	34.1	35.3	38.0
10	20.4	40.5	38.0	36.1	34.5	33.3	32.7	32.8	33.8	35.5	38.5
11	20.4	40.7	37.7	35.8	34.2	33.2	32.9	33.8	35.5	37.4	39.9
12	20.4	40.3	36.0	35.2	33.8	33.4	34.0	35.4	37.2	38.9	41.3
13	20.4	40.0	37.3	35.6	34.3	34.0	34.7	36.1	37.6	39.1	41.2
14	20.4	41.1	39.7	37.1	35.8	35.2	35.6	36.6	37.9	39.3	41.6
15	20.5	41.4	39.5	38.0	36.7	35.9	35.7	35.8	36.2	37.2	40.6
16	20.5	41.5	39.3	37.8	36.6	35.8	35.3	34.9	34.6	35.2	37.7
17	20.5	40.6	38.0	36.4	35.5	34.8	34.1	33.5	33.4	34.7	36.8
18	20.6	40.1	37.0	35.3	34.3	33.6	33.3	33.5	34.5	36.1	38.4
19	20.6	39.4	35.7	34.1	33.2	32.9	33.3	34.2	35.7	37.5	40.1
20	20.6	39.4	36.5	34.8	33.5	32.9	33.2	34.0	35.4	37.0	39.7
21	20.6										
22	20.5	39.5	37.1	35.2	33.9	33.5	34.1	35.2	36.7	38.6	41.3
23	20.6	39.4	37.0	35.3	34.2	33.8	34.0	34.7	35.9	37.6	40.4
24	20.6	39.4	36.6	35.0	34.1	33.6	33.4	33.6	34.2	35.6	38.4
25	20.6	39.2	36.0	34.3	33.3	32.8	32.6	32.9	33.9	35.5	38.5
26	20.6	39.5	36.9	35.1	33.6	32.4	32.3	32.6	33.8	35.8	39.0
27	20.6	40.3	37.5	35.5	33.9	32.8	32.3	32.6	34.0	36.1	39.0
28	20.6	38.7	35.9	34.2	32.9	32.4	32.8	34.0	35.8	37.7	40.4
29	20.6	39.2	36.6	34.9	33.5	32.9	33.0	33.4	33.9	34.8	37.9
30	20.6	39.4	36.6	34.8	33.6	32.9	32.4	32.1	32.2	33.1	36.4
31	20.6	39.1	35.7	33.8	32.6	31.9	31.5	31.6	32.6	34.4	37.4
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
21.1	21.1	21.1	21.1	48.5	48.5	44.3	44.4	48.5	48.8	49.0	49.1
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
48.8	50.7	49.5	49.3	49.5	48.9	48.7	48.6	48.4	48.8	49.1	49.0
CN2	CN3	CN4									
46.0	46.6	49.0									

run no.: 212 date: 12-06-84 radius: 24 Pa: 407 NJW: 12" SJW: 12"

NJWT: closed SJWT: closed level : 41.5

comment: without diffusor vanes; JW pulled back but SVC at 12" taped

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	20.4	37.2	33.3	31.8	31.6	32.1	32.9	33.8	35.0	36.6	39.6
1	20.4	38.0	34.1	32.1	31.7	32.2	33.1	33.9	34.8	36.1	39.1
2	20.4	39.0	35.5	33.4	32.1	31.8	31.9	32.4	33.4	35.0	37.8
3	20.4	39.3	36.0	34.2	33.0	32.5	32.7	33.7	35.4	37.4	40.0
4	20.4	39.4	35.8	34.3	33.4	33.3	33.8	34.9	36.5	38.2	40.8
5	20.5	39.6	36.5	34.7	33.8	33.8	34.5	35.7	37.1	38.5	40.8
6	20.5	39.9	36.8	35.1	34.3	34.3	34.9	35.7	36.6	37.9	40.6
7	20.5	39.6	36.8	35.2	34.3	33.9	34.0	34.4	35.2	36.7	39.5
8	20.5	40.0	37.2	35.5	34.3	33.8	33.8	34.5	35.7	37.3	39.4
9	20.5	39.5	36.4	34.7	33.8	33.6	33.9	34.7	35.9	37.4	40.0
10	20.5	38.5	34.8	33.4	33.9	33.1	33.7	34.6	35.7	37.1	39.6
11	20.5	39.0	34.2	32.8	32.7	33.4	34.6	35.9	37.2	38.4	40.7
12	20.4	39.0	35.0	33.8	33.7	34.1	36.0	37.3	38.7	40.0	41.9
13	20.4	39.7	36.8	35.4	34.8	35.0	35.8	36.9	38.3	39.5	41.8
14	20.4	40.1	37.4	35.8	35.0	34.9	35.3	36.1	37.3	38.8	41.3
15	20.4	39.8	36.5	35.0	34.4	34.3	34.7	35.4	36.6	38.2	40.9
16	20.4	39.3	35.7	34.1	33.6	33.7	34.1	34.9	36.0	37.6	40.3
17	20.4	38.9	35.1	33.7	33.2	33.3	33.9	34.6	35.7	37.0	39.4
18	20.4	39.3	35.5	33.9	33.2	33.3	33.9	34.8	35.9	37.2	39.3
19	20.4	39.5	36.0	34.4	33.6	33.4	33.9	34.7	36.0	37.5	40.2
20	20.4	39.6	36.4	34.6	33.7	33.4	33.6	34.1	35.2	36.9	40.1
21	20.4										
22	20.5	38.1	34.4	33.0	32.6	32.8	33.3	34.0	35.1	36.6	39.6
23	20.4	37.7	34.6	33.2	32.5	32.4	32.5	32.9	33.7	35.5	39.5
24	20.4	38.9	35.8	34.3	33.1	32.4	31.9	31.9	32.3	33.6	37.4
25	20.4	40.7	37.0	34.0	33.6	32.6	32.1	32.1	32.8	34.2	37.5
26	20.4	40.6	36.9	34.9	33.5	32.7	32.3	32.6	33.5	35.1	38.2
27	20.4	40.4	36.8	34.8	33.3	32.6	32.5	33.1	34.2	35.8	38.9
28	20.4	40.0	36.6	34.6	33.2	32.5	34.9	35.7	36.6	37.9	40.6
29	20.4	39.5	36.6	34.3	33.1	32.5	32.4	32.8	33.7	35.3	38.2
30	20.4	39.2	35.7	33.9	32.9	32.6	32.5	32.8	33.6	35.2	38.2
31	20.4	38.0	33.9	32.4	32.1	32.3	32.7	33.3	34.2	35.7	38.9
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CP1	CP2	CP3	CP4
20.7	20.7	20.7	20.7	49.7	49.7	49.2	49.2	48.3	48.9	49.1	49.4
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
49.2	49.6	49.7	49.7	49.8	49.9	49.9	48.9	49.5	49.5	49.1	49.7
CN2	CN3	CN4									
50.4	49.9	49.9									

run no.: 213 date: 12-13-84 radius: 24 Pa: 407 NJW: 12" SJW: 12"

NJWT: closed SJWT: closed level : 41.5

comment: without diffusor vanes; SVC at the inside sealed at 12" with hard foam and silicon; air supply for JWT also sealed; JW moved to 12"

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	20.6	40.0	35.8	33.7	32.6	32.3	32.4	33.1	34.4	36.4	40.0
1	20.6	39.0	34.0	32.2	31.8	32.0	32.5	33.2	34.3	36.1	39.8
2	20.6	37.7	32.3	31.0	31.2	31.9	32.6	33.4	34.6	36.5	40.5
3	20.6	37.8	32.8	31.3	31.2	31.5	31.9	32.4	33.3	35.1	39.6
4	20.6	38.5	35.5	33.6	32.3	31.8	32.1	33.1	34.7	36.4	39.6
5	20.6	40.8	36.2	34.1	33.1	32.9	33.3	34.3	35.8	37.7	40.8
6	20.6	40.6	35.4	33.5	32.9	33.1	33.7	34.4	35.5	37.3	40.8
7	20.6	40.7	35.1	33.2	32.8	33.0	33.6	34.0	34.7	36.4	40.6
8	20.6	40.9	36.0	33.9	32.9	32.7	32.9	33.0	33.6	35.9	39.4
9	20.6	41.2	36.7	34.5	33.1	32.5	32.3	32.4	32.9	34.2	37.8
10	20.6	42.0	37.9	35.5	33.8	32.9	32.6	33.1	34.2	35.2	38.1
11	20.6	41.7	34.9	33.1	32.6	32.9	33.8	35.0	36.6	38.3	40.9
12	20.6	41.7	33.7	32.3	32.4	33.1	34.0	34.9	36.3	37.2	41.5
13	20.6	39.8	34.4	33.1	32.8	33.2	33.7	34.3	35.1	36.8	40.5
14	20.6	40.8	36.5	35.0	34.0	33.5	33.2	33.2	33.6	35.0	39.0
15	20.6	41.8	38.3	36.4	35.1	34.2	33.4	32.9	33.1	34.2	38.0
16	20.6	42.1	37.2	34.5	33.5	33.3	33.2	33.4	34.1	35.4	38.2
17	20.6	38.3	32.5	31.8	32.2	33.0	34.0	35.1	36.4	37.6	39.8
18	20.6	38.7	33.9	32.2	32.7	33.7	35.0	36.2	37.5	38.9	41.3
19	20.6	38.9	34.6	33.6	33.3	33.3	33.5	34.1	35.0	36.3	41.3
20	20.6	40.9	36.2	35.5	34.2	33.4	33.0	33.3	34.3	36.2	40.2
21	20.6	42.1	37.7	35.5	34.1	33.3	33.0	33.4	34.6	36.2	39.4
22	20.6	40.5	36.1	34.3	33.4	33.2	33.5	34.4	35.8	37.6	40.6
23	20.6	39.8	35.7	34.1	33.1	32.9	33.1	33.9	35.3	37.2	40.7
24	20.6	39.9	35.8	34.0	33.1	32.8	33.2	34.1	35.6	37.3	40.4
25	20.6	40.6	36.0	33.9	32.8	32.6	33.1	34.0	35.5	37.2	40.3
26	20.6	40.8	35.9	33.6	32.6	32.4	32.8	33.6	35.0	36.8	40.1
27	20.6	40.5	35.6	33.4	32.4	32.2	32.5	33.3	34.5	36.4	39.9
28	20.6	40.1	35.3	33.2	32.2	32.0	32.3	33.0	34.3	35.0	39.3
29	20.6	39.4	34.7	32.8	31.9	31.7	31.9	32.5	33.7	35.4	38.7
30	20.6	39.2	35.4	33.6	32.3	31.7	31.6	32.1	33.1	34.8	38.4
31	20.6	40.0	36.2	34.4	33.0	32.1	32.0	32.5	33.8	35.6	38.9
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
20.8	20.8	20.8	20.8	52.0	52.0	51.0	51.5	49.1	49.5	49.8	50.2
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
50.0	51.0	50.6	50.6	50.3	50.3	50.8	50.0	50.2	50.7	49.5	50.7
CN2	CN3	CN4									
50.7	50.5	50.7									

run no.: 214 date: 12-13-84 radius: 24 Pa: 407 NJW: 12" SJW: 12"

NJWT: closed SJWT: closed level : 41.5

comment: same conditions as 213 but SVC turned 60° in direction of swirl

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	20.6	40.5	36.5	34.4	33.1	32.8	33.2	34.2	35.5	37.2	39.9
1	20.6	40.3	36.0	34.0	33.0	32.8	33.3	34.2	35.6	37.1	39.2
2	20.6	38.5	35.3	33.5	32.7	32.6	33.0	33.7	34.7	36.3	39.4
3	20.6	39.5	35.5	33.7	32.6	32.3	32.4	32.6	33.3	34.8	38.3
4	20.6	40.2	36.3	34.5	33.1	32.5	32.4	32.8	33.8	35.2	38.2
5	20.6	40.3	35.7	33.7	32.7	32.6	32.8	33.6	34.8	36.5	39.5
6	20.6	39.7	34.5	32.5	32.0	32.2	32.9	33.6	34.5	35.9	39.5
7	20.6	38.6	32.8	31.8	31.7	32.2	32.8	33.4	34.3	35.8	39.5
8	20.6	39.3	34.9	32.8	32.0	32.1	32.6	33.2	34.3	35.9	39.5
9	20.6	40.7	36.4	34.3	33.0	32.7	33.2	34.2	35.6	37.0	39.5
10	20.6	41.0	36.3	34.4	33.6	33.5	34.0	34.9	36.2	37.9	40.9
11	20.6	42.1	36.0	34.1	33.5	33.6	34.1	34.7	35.6	37.3	40.8
12	20.6	43.0	35.9	33.8	33.3	33.5	34.0	34.4	35.1	36.5	40.3
13	20.6	42.0	36.6	34.3	33.3	33.2	33.4	33.6	34.0	35.0	38.5
14	20.6	42.4	38.0	35.6	34.0	33.3	32.9	33.0	33.5	34.6	37.8
15	20.6	42.4	38.2	35.6	34.1	33.3	33.1	33.3	34.1	35.4	38.2
16	20.6	41.8	36.6	34.1	33.1	33.1	33.9	34.9	36.1	37.3	39.5
17	20.6	40.3	35.0	33.2	33.0	33.8	35.0	36.2	37.4	38.6	40.8
18	20.6	40.9	35.9	34.2	33.8	34.1	34.8	35.0	36.4	38.0	41.0
19	20.6	41.8	38.0	36.3	35.1	34.5	34.2	34.2	34.6	35.9	39.4
20	20.6	42.7	38.8	36.3	35.3	34.8	34.3	33.8	34.4	34.6	38.2
21	20.6	42.5	36.2	33.5	33.5	33.9	33.9	33.8	33.8	34.4	37.1
22	20.5	38.0	33.2	32.5	32.7	33.1	33.7	34.3	35.2	36.0	38.1
23	20.5	37.9	34.3	33.3	33.3	34.0	35.1	36.2	37.4	38.4	40.9
24	20.5	38.9	36.7	35.2	34.4	34.2	34.6	35.4	36.6	38.2	41.0
25	20.5	41.5	37.9	36.1	34.9	34.2	33.9	34.1	34.1	36.2	39.4
26	20.5	41.7	37.9	36.0	34.8	34.2	33.7	33.9	34.6	35.9	38.8
27	20.5	41.1	36.9	35.0	34.1	33.7	33.8	34.3	35.3	36.9	39.8
28	20.5	40.4	35.9	34.1	33.3	33.2	33.5	34.0	35.1	36.6	39.7
29	20.5	40.0	35.9	34.0	33.1	32.8	33.0	33.5	34.4	35.8	39.0
30	20.6	40.3	36.2	34.2	33.0	32.6	32.7	33.2	34.1	35.5	38.6
31	20.6	40.5	36.5	34.3	33.1	32.7	33.0	33.8	35.1	36.7	39.5
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
22.2	22.2	21.6	21.6	51.0	51.0	50.9	50.9	47.9	48.3	48.5	48.8
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
48.6	49.1	49.2	49.3	49.7	49.5	50.0	48.8	48.9	50.0	49.3	49.7
CN2	CN3	CN4									
50.2	50.1	50.2									

run no.: 215 date: 12-17-84 radius: 24 Pa: 407 NJW: 12" SJW: 12"
NJWT: closed SJWT: closed level : 41.5
comment: without vanes, without SVC (just radial outlet flow), JW moved to 12" and JWT sealed

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	29.1	33.3	33.1	32.9	32.7	32.7	32.8	33.0	33.2	33.3	33.4
1	29.1	33.3	33.1	32.9	32.8	32.7	32.8	33.0	33.2	33.4	33.5
2	29.1	33.3	33.1	32.9	32.7	32.7	32.8	33.1	33.2	33.3	33.4
3	29.1	33.2	33.0	32.8	32.7	32.7	32.8	33.0	33.2	33.3	33.4
4	29.1	33.2	33.0	32.8	32.7	32.7	32.8	33.0	33.2	33.3	33.4
5	29.1	33.2	33.0	32.8	32.7	32.7	32.8	33.0	33.2	33.3	33.4
6	29.1	33.2	33.0	32.9	32.7	32.7	32.9	33.1	33.2	33.3	33.4
7	29.1	33.3	33.1	32.9	32.8	32.7	32.9	33.1	33.2	33.4	33.5
8	29.1	33.3	33.1	33.0	32.8	32.8	32.9	33.1	33.3	33.4	33.5
9	29.1	33.3	33.1	33.0	32.8	32.7	32.9	33.1	33.2	33.4	33.5
10	29.1	33.3	33.1	32.9	32.7	32.7	32.8	33.0	33.2	33.3	33.4
11	29.1	33.4	33.1	33.0	32.9	32.9	33.0	33.1	33.2	33.2	33.3
12	29.1	35.1	32.9	32.8	32.6	32.6	32.8	32.9	33.1	33.3	33.3
13	29.1	33.3	33.0	32.8	32.6	32.6	32.7	32.9	33.1	33.3	33.4
14	29.1	33.3	33.1	33.0	32.8	32.7	32.8	33.0	33.2	33.5	33.4
15	29.1	33.3	33.2	33.0	32.8	32.7	32.8	33.0	33.2	33.3	33.4
16	29.1	33.3	33.1	33.0	32.8	32.7	32.8	32.9	33.1	33.3	33.4
17	29.1	33.3	33.1	33.0	32.7	32.6	32.7	32.9	33.1	33.2	33.3
18	29.1	33.3	33.1	33.0	32.8	32.6	32.7	32.9	33.1	33.2	33.3
19	29.1	33.3	33.1	33.0	32.7	32.6	32.6	32.8	33.1	33.2	33.3
20	29.1	42.9	33.1	32.9	32.7	32.6	32.6	32.8	33.1	33.2	33.3
21	29.1	33.4	33.1	32.9	32.7	32.6	32.6	32.8	33.1	33.2	33.3
22	29.0	33.3	33.1	33.0	32.8	32.6	32.6	32.9	33.1	33.2	33.3
23	29.1	33.3	33.1	33.0	32.8	32.6	32.6	32.9	33.1	33.3	33.4
24	29.1	33.3	33.1	33.0	32.8	32.7	32.7	32.9	33.2	33.3	33.4
25	29.1	33.3	33.1	33.0	32.8	32.6	32.6	32.9	33.1	33.3	33.4
26	29.1	33.2	33.0	32.9	32.7	32.6	32.6	32.9	33.1	33.3	33.4
27	29.1	33.2	33.0	32.9	32.7	32.6	32.6	32.9	33.1	33.2	33.3
28	29.1	33.3	33.1	32.9	32.7	32.6	32.6	32.9	33.1	33.2	33.3
29	29.1	33.2	33.0	32.9	32.6	32.6	32.6	33.0	33.1	33.3	33.4
30	29.1	33.2	33.0	32.9	32.7	32.6	32.6	33.0	33.2	33.3	33.4
31	29.1	33.2	33.0	32.8	32.7	32.6	32.6	33.0	33.2	33.3	35.5
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
33.0	33.0	33.3	33.3	33.5	33.5	33.6	33.6	49.5	45.6	42.4	38.2
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
34.2	33.5	33.5	33.5	33.6	33.5	33.6	33.5	33.6	33.6	33.6	33.8
CN2	CN3	CN4									
33.7	33.7	33.8									

run no.: 216 date: 12-17-84 radius: 24 Pa: 407 NJW: 12" SJW: 12"
NJWT: closed SJWT: closed level : 41.5
comment: same conditions like 215

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0											
1											
2											
3											
4											
5											
6	29.1	33.2	33.0	32.9	32.7	32.7	32.9	33.1	33.2	33.3	33.5
7	29.1	33.2	33.1	32.9	32.8	32.7	32.9	33.1	33.2	33.4	33.5
8	29.1	33.3	33.1	33.0	32.8	32.8	32.9	33.1	33.3	33.4	33.5
9	29.1	33.3	33.1	32.9	32.8	32.7	32.9	33.1	33.3	33.4	33.5
10	29.1	33.3	33.1	32.9	32.7	32.7	32.8	33.0	33.2	33.3	33.4
11	29.1	33.4	33.1	33.0	32.9	32.9	33.0	33.1	33.2	33.3	33.5
12	29.1	34.6	32.9	32.8	32.7	32.7	32.8	32.9	33.1	33.3	33.4
13	29.1	33.4	33.0	32.9	32.7	32.6	32.6	33.0	33.2	33.3	33.4
14	29.1	33.3	33.1	33.0	32.8	32.7	32.8	33.0	33.2	33.3	33.5
15	29.1	33.3	33.2	33.0	32.8	32.7	32.8	33.0	33.2	33.3	33.5
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
31											
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
CN2	CN3	CN4									

run no.: 217 date: 12-18-84 radius: 24 Pa: 407 NJW: 12" SJW: 12"

NJWT: closed SJWT: closed level : 41.5

comment: without diffusor vanes; SVC inside sealed up to 12"; JW moved to 12", JWT sealed, sealing tubes at 8" pluged

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	20.3	38.9	35.4	33.7	32.7	32.5	33.0	34.1	35.5	37.0	39.6
1	20.3	38.9	35.2	33.5	32.6	32.5	33.0	33.9	35.2	37.0	40.2
2	20.3	38.7	34.7	33.0	32.2	32.2	32.6	33.2	34.4	36.2	39.7
3	20.3	38.8	34.7	32.8	32.0	31.7	31.9	32.4	33.5	35.3	39.3
4	20.3	39.4	35.1	33.4	32.2	31.8	31.9	32.7	34.0	35.7	39.1
5	20.3	40.2	36.1	34.2	33.0	32.1	33.0	34.1	35.7	37.2	39.7
6	20.3	40.3	36.3	34.2	33.1	33.0	33.7	35.1	36.7	38.5	41.2
7	20.3	40.6	36.6	34.5	33.4	33.3	33.9	35.0	36.5	38.4	41.7
8	20.3	40.8	36.6	34.4	33.3	33.1	33.3	33.9	35.0	36.8	40.4
9	20.3	40.4	36.0	33.7	32.6	32.5	32.6	33.0	33.8	35.3	38.7
10	20.3	40.3	36.2	33.9	32.6	32.1	32.2	32.8	33.7	34.9	37.9
11	20.3	41.7	36.2	33.9	32.7	32.7	33.1	34.9	36.3	37.5	39.5
12	20.3	41.8	36.1	34.2	33.2	33.3	34.1	35.5	37.0	38.7	41.2
13	20.3	41.2	36.9	35.2	34.1	33.7	33.8	34.5	35.6	37.3	40.4
14	20.3	41.4	37.6	35.6	34.5	34.0	33.6	33.6	33.8	35.0	38.8
15	20.3	41.3	37.0	34.9	33.9	33.6	33.3	33.1	32.8	33.3	36.6
16	20.3	40.8	36.2	33.8	32.8	32.5	32.4	32.5	32.8	33.6	36.3
17	20.5	40.7	35.8	33.5	32.2	31.9	32.1	32.6	33.6	34.6	37.0
18	20.3	40.1	34.1	32.5	32.0	32.5	34.9	36.0	36.8	36.8	38.6
19	20.3	39.5	35.1	34.2	34.2	35.0	36.2	37.4	38.5	39.5	41.2
20	20.3	40.4	36.9	35.6	34.9	34.9	35.3	36.1	37.3	39.0	41.6
21	20.3	41.4	37.7	35.9	34.9	34.4	34.3	34.7	35.6	37.0	39.8
22	20.4	40.7	37.1	35.4	34.3	33.8	33.7	34.2	35.3	36.9	39.6
23	20.3	40.4	37.0	35.3	34.2	33.4	33.2	33.6	34.7	36.6	39.6
24	20.3	40.3	36.9	35.3	34.0	33.2	32.9	33.1	34.0	35.7	38.8
25	20.3	40.8	37.1	35.1	33.7	33.0	32.6	33.0	34.0	35.4	38.2
26	20.3	41.1	37.0	34.7	33.3	32.5	32.4	33.0	34.1	35.7	38.5
27	20.3	40.5	36.2	34.0	32.7	32.2	32.2	32.9	34.2	35.8	38.8
28	20.3	40.2	36.1	34.1	32.8	32.5	32.9	33.9	35.2	36.6	39.0
29	20.3	39.0	35.0	33.4	32.6	32.6	33.2	34.2	35.4	36.8	39.3
30	20.3	38.0	34.2	32.8	32.1	31.9	32.1	32.6	33.5	35.0	38.2
31	20.3	38.5	35.0	33.5	32.4	31.9	32.0	32.7	33.8	35.2	38.1
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
20.7	20.7	20.7	20.7	51.6	51.6	51.1	51.1	48.7	49.2	49.4	49.8
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
49.8	50.7	50.4	50.3	49.9	50.1	50.8	49.7	49.9	50.4	49.3	50.4
CN2	CN3	CN4									
50.4	50.3	50.4									

run no.: 218 date: 12-20-84 radius: 24 Pa: 407 NJW: 12" SJW: 12"

NJWT: closed SJWT: closed level : 41.5

comment: without diffusor vanes; SVC inside sealed up to 12", JW moved to 12", JWT sealed, 4 rows of nozzles of the SVC taped at the inside (east-side)

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	20.4	39.0	36.1	34.7	34.0	33.7	33.7	34.0	34.7	36.0	38.5
1	20.4	38.5	35.0	33.5	33.0	32.9	33.1	33.4	34.0	35.3	38.1
2	20.4	37.8	33.4	32.2	32.1	32.3	32.6	32.9	33.6	35.0	37.9
3	204	37.1	32.5	31.6	31.7	32.0	32.2	32.4	33.1	34.9	38.4
4	204	37.1	32.3	31.6	31.7	31.8	31.9	32.1	32.8	34.5	38.3
5	204	37.5	33.4	32.4	31.9	31.8	32.0	32.5	33.3	34.5	37.5
6	20.4	38.8	34.9	33.4	32.6	32.4	32.8	33.8	35.1	36.5	38.9
7	20.4	38.4	35.5	33.7	32.7	32.5	32.8	33.6	35.0	37.1	40.7
8	204	40.6	36.0	33.7	32.7	32.4	32.4	32.7	33.5	35.4	39.6
9	20.4	40.9	36.0	33.5	32.3	32.1	32.0	32.1	32.5	33.9	37.7
10	20.4	41.1	36.1	33.3	32.0	31.7	31.7	32.0	32.6	33.8	37.0
11	204	41.9	34.2	31.7	31.2	31.6	32.2	33.1	34.5	36.1	38.9
12	20.4	41.8	33.2	31.2	31.1	31.8	32.6	33.4	34.7	36.9	40.7
13	20.4	40.4	34.1	32.1	31.5	31.8	32.4	32.9	33.7	35.6	40.3
14	204	41.3	36.1	34.0	32.7	32.2	32.0	32.0	32.2	33.6	38.8
15	20.4	42.6	37.3	35.5	33.9	33.2	32.4	31.8	31.6	32.5	37.0
16	20.4	43.0	37.7	33.6	32.4	32.4	32.3	32.1	32.5	33.7	36.8
17	20.4	38.2	31.8	31.0	31.3	32.1	33.3	34.5	35.8	36.8	38.7
18	20.4	39.3	33.5	32.5	32.8	33.0	35.7	37.2	38.4	39.4	41.9
19	20.4	40.3	36.0	34.6	33.9	34.0	34.6	35.4	36.4	38.0	41.1
20	20.4	41.2	37.3	35.5	34.3	33.7	33.4	33.6	34.3	35.8	39.3
21	204	41.9	37.4	35.5	34.5	33.9	33.7	34.0	34.9	36.2	38.6
22	204	41.5	36.9	35.6	35.1	34.9	35.3	36.1	37.3	38.5	40.7
23	20.4	40.9	37.4	36.4	36.1	36.2	36.8	37.6	38.5	39.5	41.2
24	204	40.5	36.8	36.2	36.2	36.3	36.7	37.2	38.0	39.3	41.6
25	20.5	39.8	35.7	35.0	35.0	35.1	35.5	36.0	36.7	37.9	40.3
26	205	39.4	35.5	34.9	34.0	34.0	34.5	35.2	36.1	37.3	39.5
27	20.5	39.4	36.2	35.3	35.0	35.2	35.8	36.5	37.3	38.1	39.9
28	205	39.5	37.1	36.3	36.2	36.5	37.2	38.0	38.7	39.4	40.7
29	20.5	39.8	37.8	37.0	36.4	36.1	36.1	36.5	37.3	38.4	40.2
30	20.5	40.0	37.9	36.9	36.2	35.6	35.3	35.2	35.6	36.6	38.8
31	20.4	39.8	37.1	35.9	35.1	34.7	34.5	34.6	35.1	36.2	38.6
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
20.7	20.7	20.7	20.7	51.4	51.4	50.8	50.8	47.0	47.5	47.7	48.3
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
48.4	49.5	49.2	49.1	48.0	48.5	48.6	50.6	50.8	50.9	49.7	49.4
CN2	CN3	CN4									
49.6	50.9	50.7									

run no.: 219 date: 04-15-85 radius: 24 Pa: 407 NJW: 8" SJW: 8"

NJWT: closed SJWT: closed level : 40.0

comment: without diffusor vanes; SVC inside sealed up to 8"; JW moved to 8" (over the last sealing tubes); JWT sealed;

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	19.1	40.8	37.2	34.3	31.9	30.7	30.7	31.7	32.9	33.7	35.9
1	19.1	39.9	35.0	32.1	30.8	30.9	32.1	33.4	34.5	35.0	36.5
2	19.1	38.8	33.0	30.5	30.2	30.9	32.1	33.5	34.8	35.8	37.7
3	19.1	38.6	32.7	30.4	29.6	29.7	30.2	32.1	33.6	35.4	38.3
4	19.1	39.6	34.9	32.9	32.0	31.6	31.9	32.7	33.7	34.9	38.0
5	19.1	40.6	36.3	33.0	32.9	33.0	34.0	35.1	35.7	36.1	38.1
6	19.0	39.6	34.6	32.4	32.2	32.7	33.8	35.0	36.1	36.9	38.8
7	19.0	39.1	34.5	32.8	32.2	32.3	33.2	34.3	35.6	36.9	39.2
8	19.0	39.6	35.6	33.1	32.7	32.2	32.7	34.0	35.4	36.8	39.3
9	18.9	40.2	37.1	35.5	34.1	32.7	31.7	31.9	33.6	36.0	39.2
10	18.9	40.9	37.4	36.6	34.9	32.6	31.3	30.9	31.3	33.1	37.2
11	18.9	41.7	38.5	35.8	33.3	31.7	31.1	31.3	31.9	32.5	35.2
12	18.9	41.5	38.3	35.2	33.0	32.3	32.8	33.6	34.2	34.2	35.3
13	18.9	40.5	36.3	33.8	33.2	33.8	34.9	35.7	35.9	35.6	36.5
14	19.0	39.9	35.7	33.9	33.5	34.0	34.9	35.8	36.4	36.5	37.8
15	19.0	39.9	36.0	34.3	33.5	33.1	33.2	33.9	35.1	36.4	38.6
16	19.0	40.3	37.2	36.0	34.9	33.9	33.0	32.6	33.0	34.6	37.9
17	19.0	40.5	38.3	37.4	35.8	34.2	32.8	32.3	32.3	32.9	35.7
18	19.0	40.9	38.8	36.0	33.6	32.1	31.5	31.6	32.2	32.9	34.5
19	19.0	40.9	37.1	33.7	31.5	30.5	30.6	31.3	32.2	33.0	34.8
20	19.0	40.8	37.1	34.1	32.1	31.2	31.0	31.6	32.6	33.4	35.1
21	19.0	41.5	38.4	36.4	34.1	32.4	31.4	31.4	32.1	33.1	35.3
22	19.1	41.3	38.4	35.7	33.1	31.6	31.1	31.6	32.4	33.1	35.0
23	19.1	40.7	36.7	33.5	31.7	31.3	31.8	32.7	33.7	34.0	35.3
24	19.1	40.3	36.2	33.5	32.1	31.6	32.2	33.3	34.4	34.8	36.1
25	19.1	40.5	36.7	33.7	31.8	31.3	31.7	32.7	34.0	35.0	36.8
26	19.1	41.0	36.7	33.4	31.4	30.7	30.8	31.6	33.0	34.5	37.1
27	19.1	41.2	37.2	34.1	32.1	31.1	30.7	31.1	32.3	33.7	36.7
28	19.1	41.3	37.9	35.7	33.4	31.9	31.3	31.9	32.9	33.9	36.1
29	19.1	41.1	37.6	34.6	32.2	31.1	31.4	32.6	34.0	34.8	36.5
30	19.1	40.1	35.6	32.7	30.8	29.9	30.0	31.0	32.6	34.1	37.1
31	19.1	40.5	37.4	35.1	33.2	31.6	30.5	30.6	31.7	33.2	36.5
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
19.7	19.7	19.5	19.5	50.7	50.7	49.6	49.6	47.2	47.7	48.0	48.8
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
49.3	49.5	49.4	49.3	49.3	50.0	50.1	48.6	49.4	49.5	48.3	49.3
CN2	CN3	CN4									
49.5	49.1	48.9									

run no.: 220 date: 04-16-85 radius: 24" Pa: 407 NJW: 8" SJW: 8"

NJWT: closed SJWT: closed level : 40.0

comment: conditions like 219 but SVC 60° turned in swirl-direction

circ.	Pp	1	2	3	4	5	6	7	8	9	10
0	19.8	40.2	36.5	33.6	31.7	30.9	30.6	31.1	32.3	33.8	36.9
1	19.7	40.4	36.9	34.5	32.9	31.9	31.5	31.9	32.8	33.6	36.1
2	19.8	40.6	37.5	35.1	33.1	31.9	31.7	32.5	33.7	34.6	36.4
3	19.7	40.6	36.6	33.5	31.5	30.5	30.4	31.3	32.8	34.6	37.2
4	19.8	40.6	37.1	35.0	33.3	32.1	30.8	30.5	31.4	33.1	36.5
5	19.8	41.1	38.0	35.5	33.1	31.5	30.8	31.3	32.4	33.3	35.5
6	19.8	40.1	35.8	33.2	31.6	31.1	31.7	32.9	34.1	34.8	36.2
7	19.7	39.6	35.1	32.3	31.0	31.2	32.3	33.5	34.7	35.5	37.3
8	19.7	39.1	34.1	31.3	30.3	30.5	31.6	33.1	34.5	35.6	37.7
9	19.7	39.2	34.7	32.6	31.5	31.1	31.6	32.7	34.1	35.4	38.1
10	19.8	40.7	36.2	33.9	32.2	32.8	33.6	34.7	35.5	36.0	38.2
11	19.7	41.1	35.5	33.2	32.5	32.7	33.6	34.7	35.9	36.9	38.9
12	19.7	40.9	35.9	33.7	32.8	32.8	33.5	34.4	35.4	36.6	39.0
13	19.8	40.3	36.1	34.1	33.1	33.0	33.7	34.8	36.0	37.0	39.4
14	19.7	40.4	37.2	35.8	34.6	33.5	32.7	32.8	34.3	36.6	39.5
15	19.7	40.9	38.7	37.6	36.1	34.5	33.1	32.2	32.2	33.6	37.3
16	19.8	41.0	38.9	37.4	35.2	33.3	32.0	31.6	31.9	32.6	35.0
17	19.7	41.0	38.7	36.6	34.4	32.9	32.4	32.8	33.4	33.6	34.7
18	19.7	40.8	37.7	35.2	33.5	33.3	34.0	34.9	35.4	35.3	36.0
19	19.7	40.4	36.1	34.4	33.2	34.0	34.8	35.7	36.3	36.4	37.4
20	19.7	40.2	36.4	34.4	33.6	33.3	33.6	34.3	35.4	36.5	38.3
21	19.7	40.7	37.0	35.6	34.6	33.8	33.0	32.7	33.3	34.9	38.1
22	19.8	40.5	38.2	37.2	35.7	34.3	33.1	32.5	32.3	32.8	35.6
23	19.7	40.6	38.4	36.8	34.8	33.1	31.9	31.7	32.2	32.7	34.4
24	19.7	40.5	37.9	35.6	33.3	31.8	31.1	31.4	32.2	33.0	34.5
25	19.7	40.6	37.6	35.1	33.1	31.9	31.4	31.8	32.6	33.3	35.0
26	19.7	40.9	38.2	36.3	34.4	33.0	31.9	31.8	32.4	33.3	35.2
27	19.7	41.1	38.6	36.6	34.3	32.1	31.5	31.5	32.2	33.0	34.9
28	19.7	40.9	37.4	34.8	32.7	31.2	31.6	32.2	32.9	33.4	34.8
29	19.7	40.1	36.3	34.0	32.7	32.4	32.9	33.8	34.6	34.8	35.7
30	19.8	39.9	36.2	33.9	32.5	32.0	32.4	33.4	34.5	35.3	36.9
31	19.8	40.1	36.3	33.5	31.9	31.2	31.4	32.8	33.4	34.9	37.4
SC1	SC2	NC1	NC2	SJ1	SJ2	NJ1	NJ2	CR1	CR2	CR3	CR4
20.2	20.2	20.0	20.0	50.2	50.2	49.3	49.2	46.5	47.0	47.4	47.9
CR5	CS11	CS12	CS13	CS21	CS22	CS23	CS41	CS42	CS43	CS31	CN1
48.5	48.6	48.6	48.8	48.6	49.3	49.3	48.8	49.4	49.3	48.0	48.5
CN2	CN3	CN4									
49.0	48.9	48.8									

Appendix C

Design drawings of proposed SVC

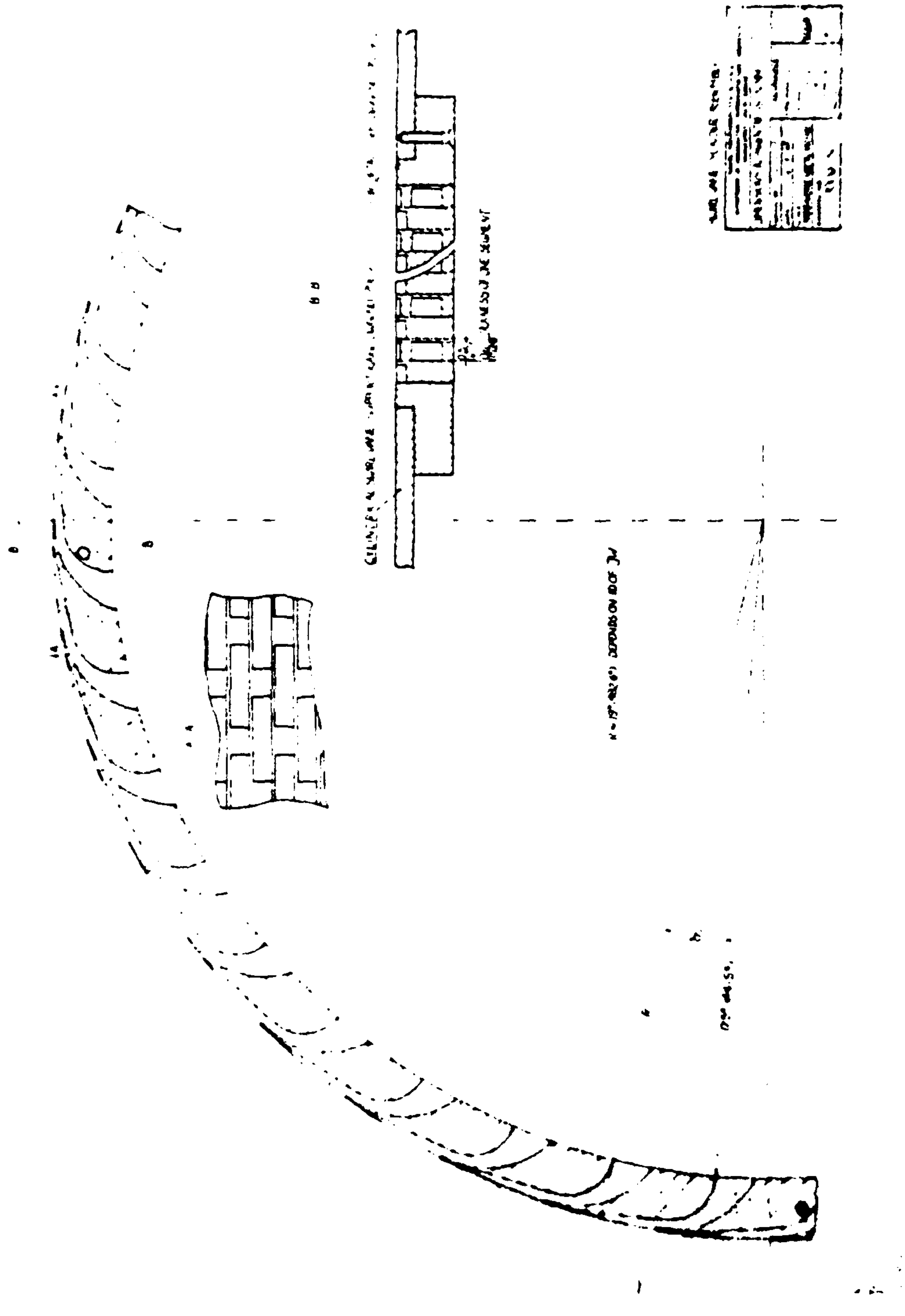


Figure C1 : Svirl Vane Cylinder Assembly

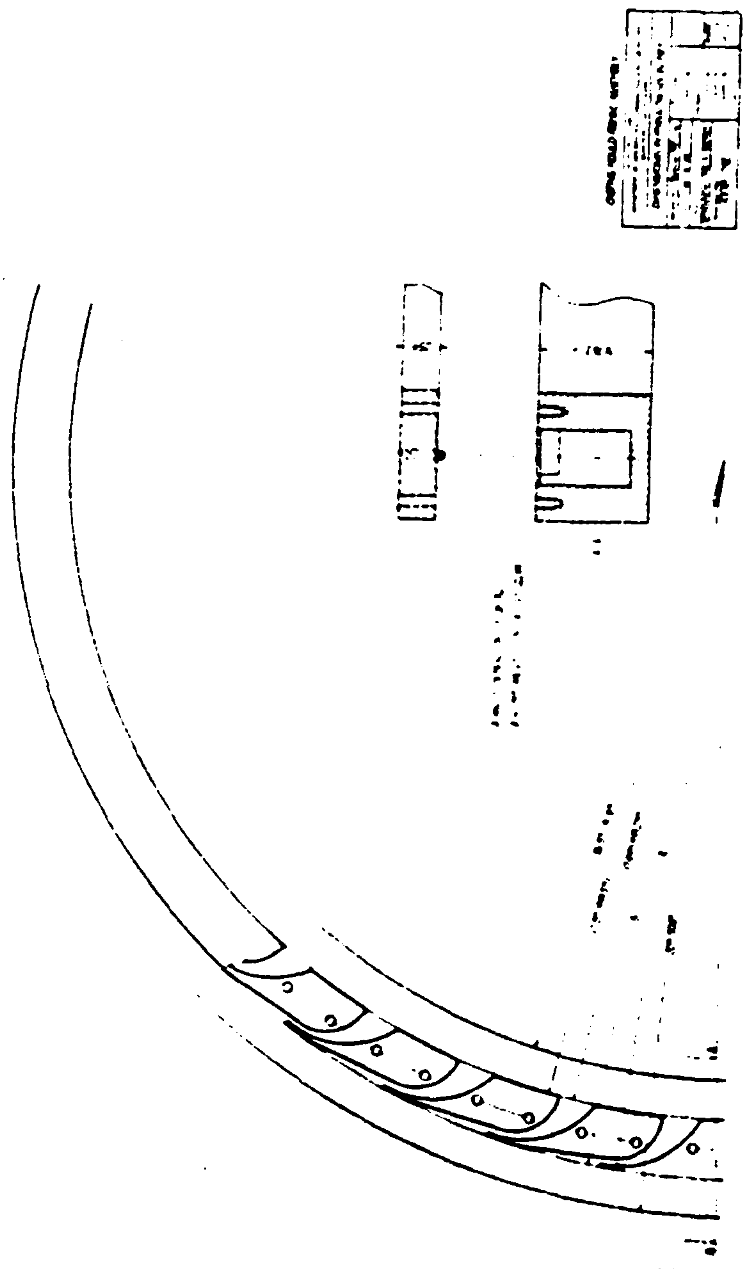


Figure C-2 : Casting Mould for SVC, Assembly

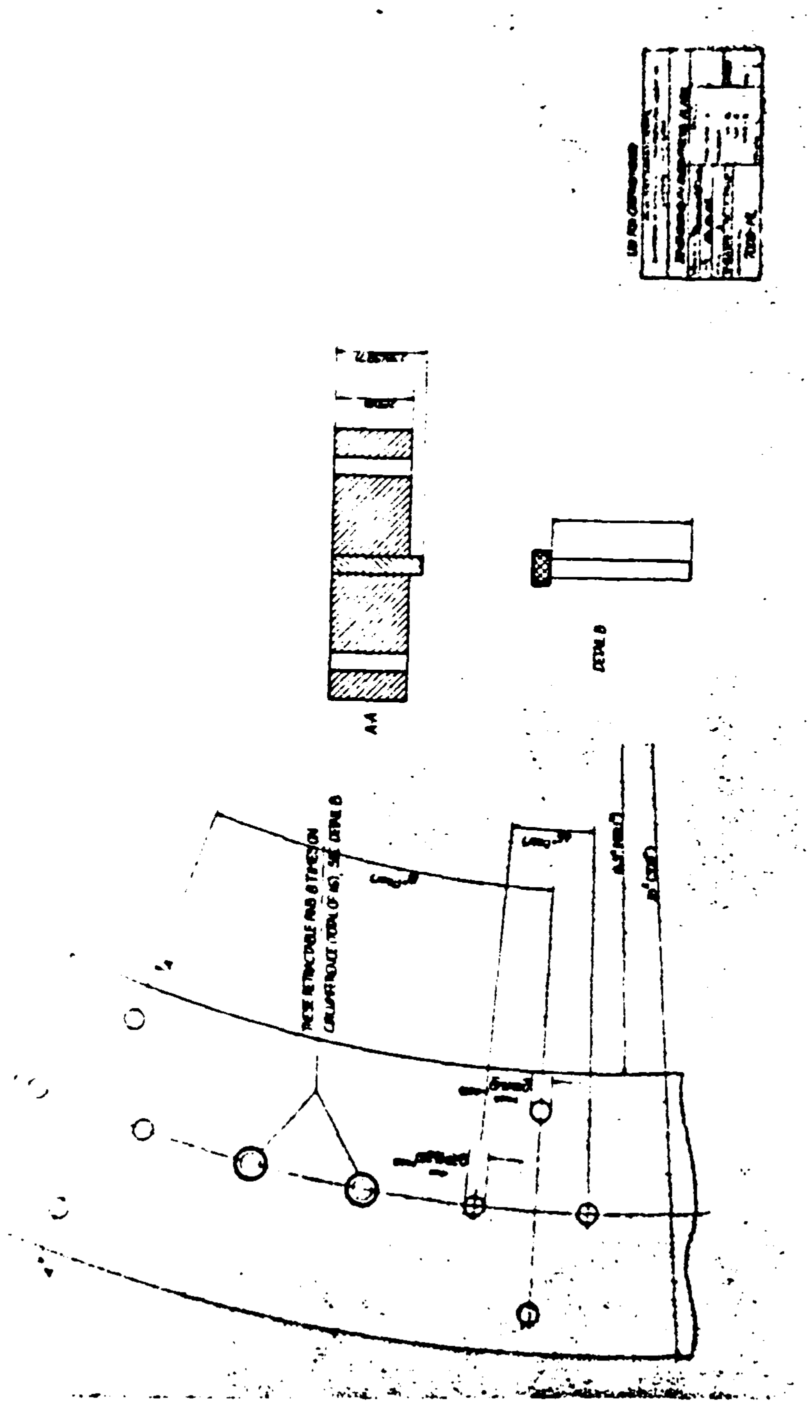


Figure C3 : Lid for Casting Mould

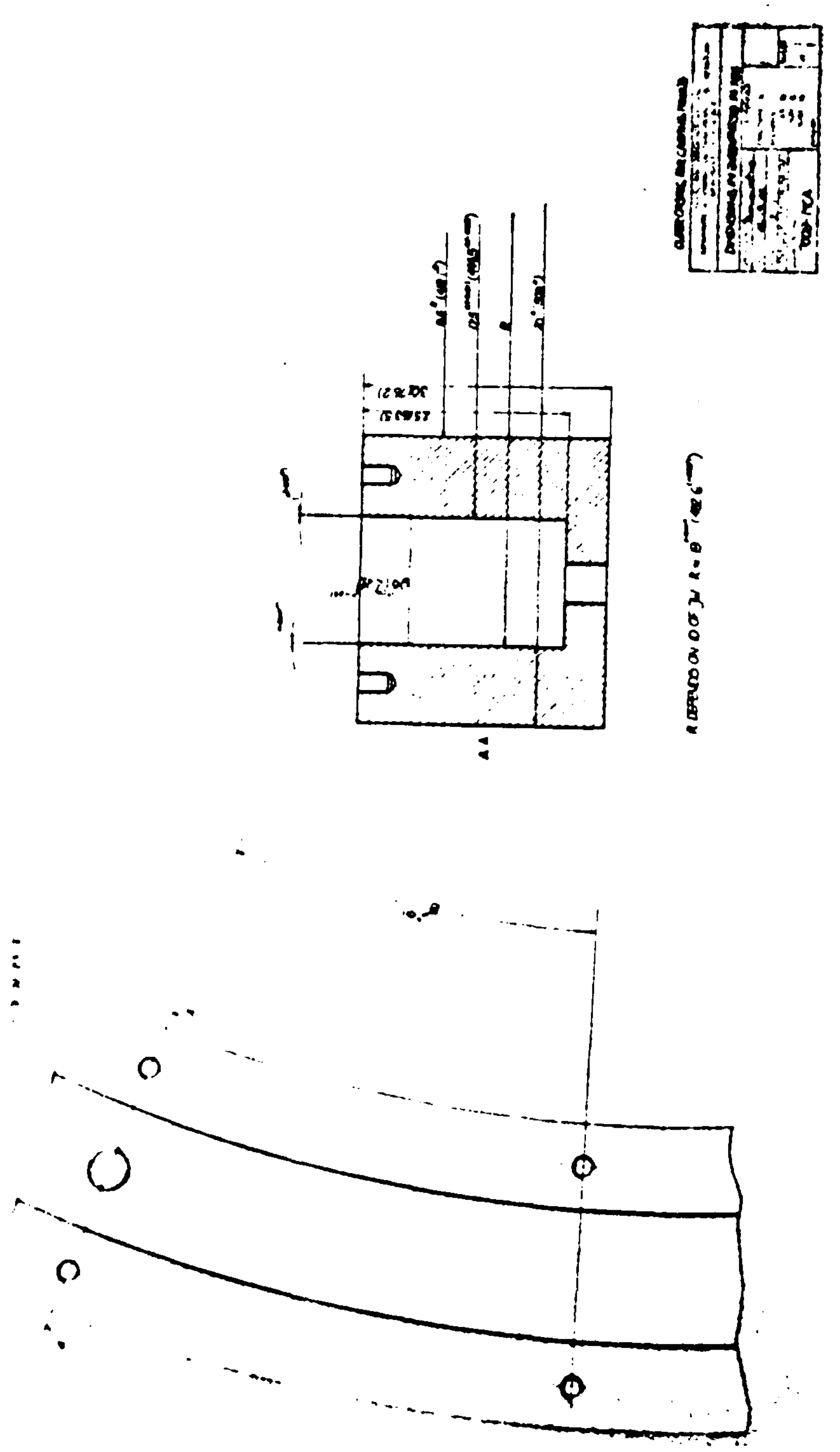


Figure C-4 : Outer Casing for Casting Mould

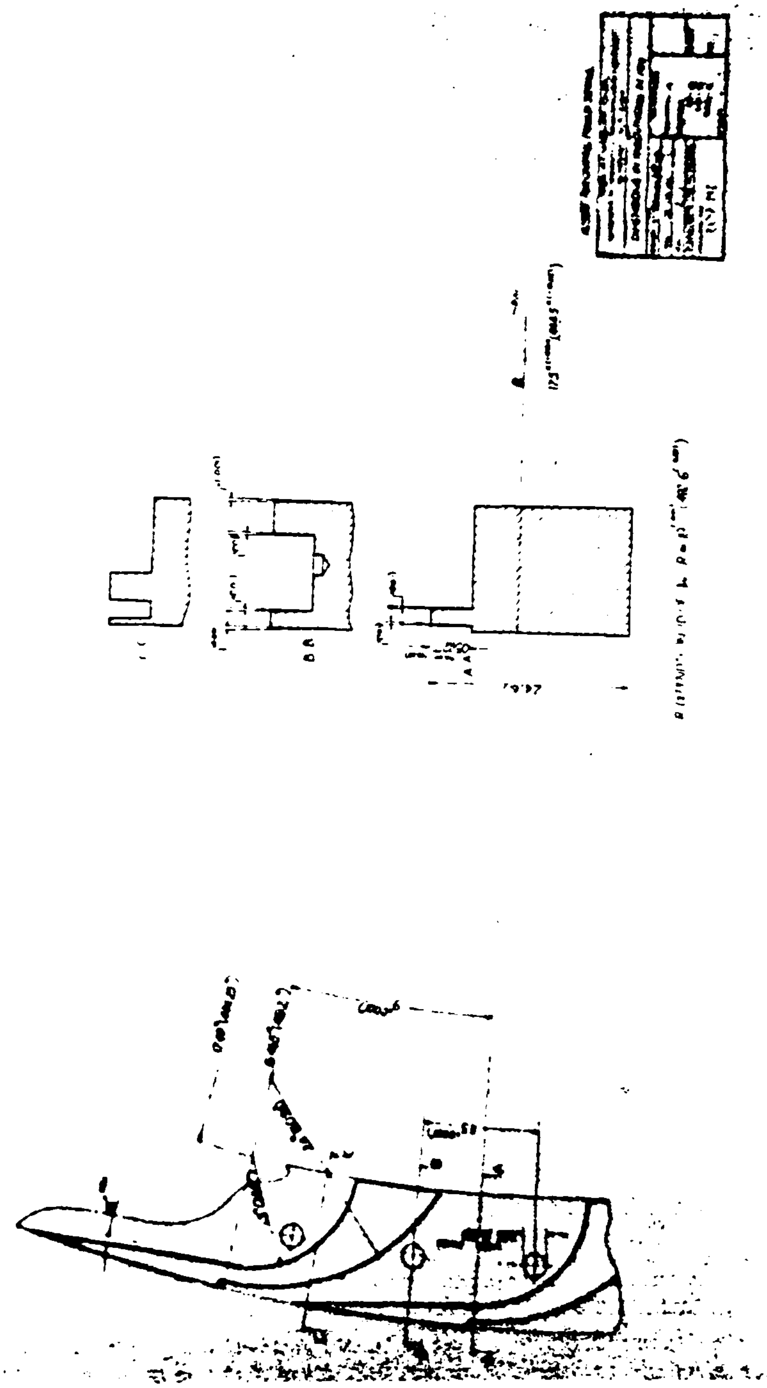


Figure C-5 : Insert for Casting Mould, Detail

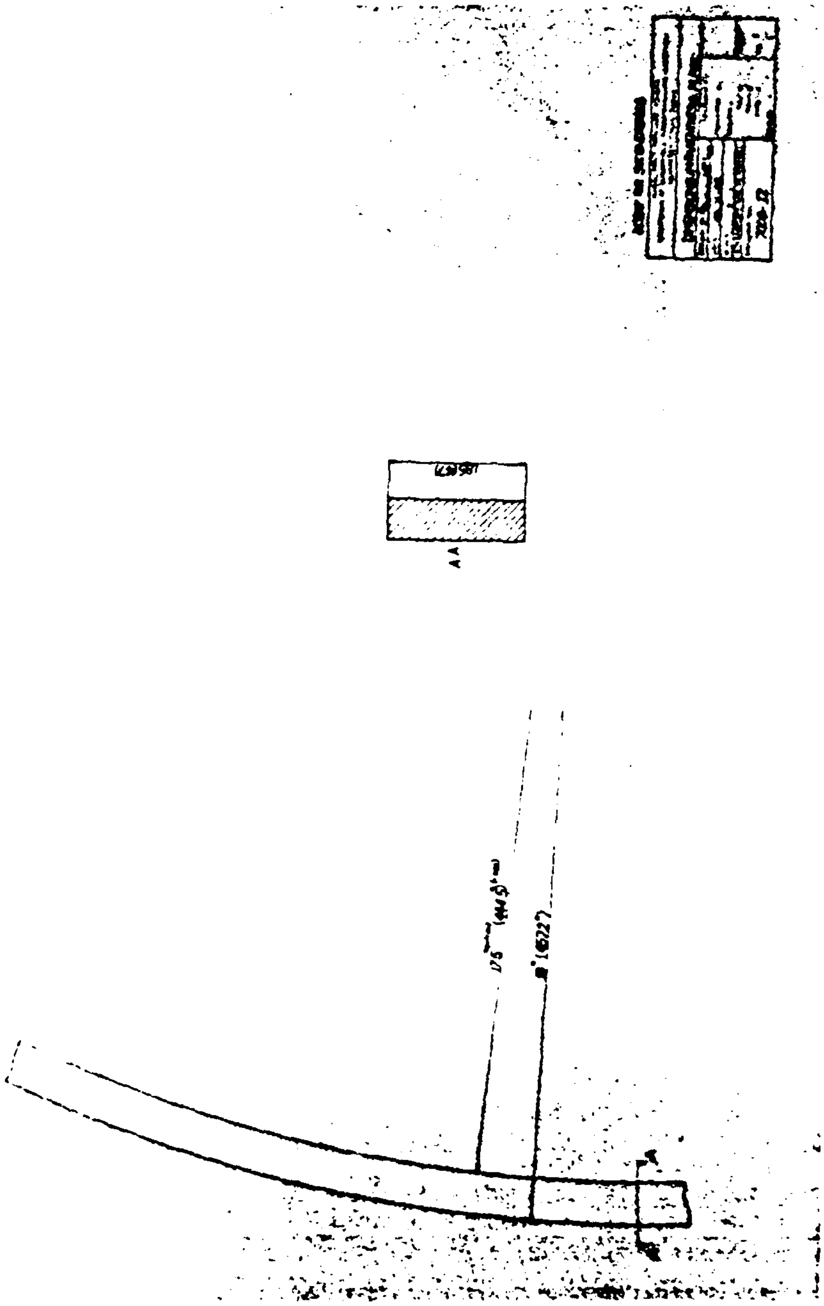
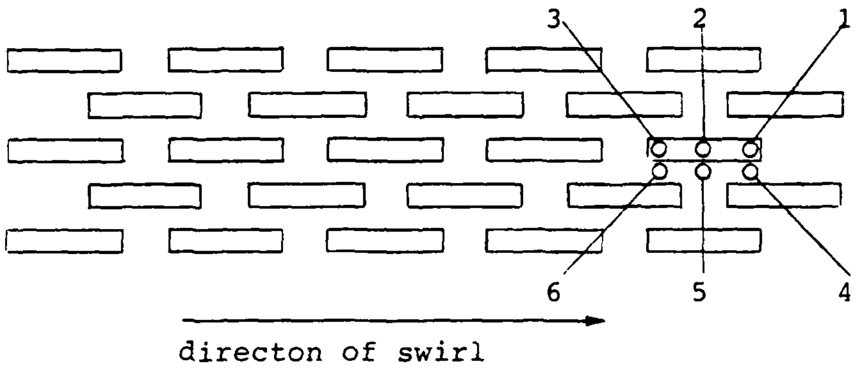


Figure C6 : Insert for SVC-ends

Appendix D

Tables of loss measurements with flow models

The sketch shown below marks the locations ϕ of the loss measurements in a view on the 25 slots model.



r ["]	ϕ [-]	$p_{t1}-p_a$ ["H_2O]	$p_{t2}-p_a$ ["H_2O]	$\Delta p_t/(p_{t1}-p_a)$ [%]
19.1	1	8.0	5.3	34
19.2	1	7.4	4.4	40
19.3	1	7.2	3.8	53
19.4	1	6.8	3.4	50
19.5	1	6.5	3.1	52
19.6	1	6.3	2.8	56
19.7	1	6.0	2.6	58
19.8	1	5.8	2.4	62
19.9	1	5.5	2.1	62
20.0	1	5.3	2.0	62
20.1	1	5.1	1.8	65
20.2	1	4.9	1.6	67
20.3	1	4.7	1.4	70
20.4	1	4.5	1.3	71
20.5	1	4.3	1.2	72

r ["]	ϕ [-]	$p_{t1}-p_a$ ["H_2O]	$p_{t2}-p_a$ ["H_2O]	$\Delta p_t/(p_{t1}-p_a)$ [%]
19.0	2	5.2	4.4	15
19.1	2	5.1	4.6	10
19.2	2	5.1	2.8	45
19.3	2	4.9	2.8	43
19.4	2	4.7	2.7	43
19.5	2	4.6	2.6	43
19.6	2	4.5	2.2	51
19.7	2	4.3	2.4	44
19.8	2	4.4	2.1	52
19.9	2	4.3	2.0	53
20.0	2	4.0	1.8	55
20.1	2	3.9	1.6	59
20.2	2	3.7	1.5	59
20.3	2	3.7	1.4	62
20.4	2	3.5	1.1	69

r ["]	ϕ [-]	$p_{t1}-p_a$ ["H_2O]	$p_{t2}-p_a$ ["H_2O]	$\Delta p_t/(p_{t1}-p_a)$ [%]
18.9	3	5.5	4.8	13
19.0	3	3.7	3.6	3
19.1	3	3.5	2.0	43
19.2	3	3.3	2.3	30
19.3	3	3.3	2.2	33
19.4	3	3.2	2.0	38
19.5	3	3.1	1.9	39
19.6	3	3.1	1.7	45
19.7	3	4.4	2.3	48
19.8	3	3.0	1.5	50
19.9	3	2.9	1.4	52
20.0	3	2.8	1.2	57
20.1	3	2.8	1.0	64
20.2	3	2.7	0.8	70
20.3	3	2.6	0.8	69

r ["]	ϕ [-]	$p_{t1}-p_a$ ["H_2O]	$p_{t2}-p_a$ ["H_2O]	$\Delta p_t/(p_{t1}-p_a)$ [%]
19.1	4	4.7	2.4	49
19.2	4	5.4	3.0	45
19.3	4	3.7	1.9	49
19.4	4	3.4	1.6	53
19.5	4	2.9	1.2	58
19.6	4	3.2	1.4	56
19.7	4	3.1	1.4	55
19.8	4	3.2	1.4	56
19.9	4	2.9	1.3	55
20.0	4	4.0	1.6	60
20.1	4	4.0	1.6	60
20.2	4	4.0	1.5	63
20.3	4	4.0	1.4	65
20.4	4	4.2	1.3	69
20.5	4	4.2	1.2	71

r ["]	ϕ [-]	$p_{t1}-p_a$ ["H_2O]	$p_{t2}-p_a$ ["H_2O]	$\Delta p_t/(p_{t1}-p_a)$ [%]
19.1	5	5.0	2.8	44
19.2	5	5.1	2.7	47
19.3	5	6.9	3.4	51
19.4	5	6.9	3.3	52
19.5	5	6.9	3.4	51
19.6	5	6.7	3.2	52
19.7	5	7.0	3.2	54
19.8	5	7.0	3.1	56
19.9	5	7.0	3.1	56
20.0	5	7.0	3.0	57
20.1	5	7.0	2.9	59
20.2	5	7.0	2.7	61
20.3	5	7.0	2.4	66
20.4	5	7.0	2.2	69
20.5	5	6.4	1.9	70

r ["]	ϕ [-]	$p_{t1}-p_a$ ["H_2O]	$p_{t2}-p_a$ ["H_2O]	$\Delta p_t/(p_{t1}-p_a)$ [%]
19.1	6	7.1	4.1	42
19.2	6	7.1	4.1	42
19.3	6	7.0	4.3	39
19.4	6	7.0	4.3	39
19.5	6	7.0	4.3	39
19.6	6	7.0	4.3	39
19.7	6	7.0	4.1	41
19.8	6	7.0	3.9	44
19.9	6	7.1	3.8	46
20.0	6	7.1	3.4	52
20.1	6	7.1	3.0	58
20.2	6	7.0	2.6	63
20.3	6	7.1	2.3	68
20.4	6	7.0	2.0	72
20.5	6	7.0	1.7	76

END
FILMED

5-86

DTIC