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RTR 036-1

RESEARCH STUDY:

THERMAL CURTAIN PERMEABILITY AND THERMAL RESPONSE TEST FOR SRB REENTRY

By

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Final Report

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For

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FOREWORD

This report presents the results of work performed at REMTECH's Huntsville office and the Marshall Space Flight Center's Impulse Base Flow Facility (IBFF). The work was conducted in response to requirements on NASA8-32997. This report is the final report on this contract and deals with thermal testing of solid rocket booster thermal curtain samples of the Space Shuttle.

The NASA technical monitor for this work was Mr. Eddie Brewer of the System Dynamics Laboratory.

ACKNOWLEDGEMENT

The authors wish to acknowledge the assistance of Mr. Richard Somers of REMTECH for his helpful contributions in several areas of the test technical design.

In addition, numerous personnel at the MSFC Wind Tunnel facilities were instrumental in the successful accomplishment of the test objectives. In particular, acknowledgement is given to Mr. Hal Gwin.

TABLE OF CONTENTS

Section I

INTRODUCTION

This report describes a series of heating tests conducted on samples of the thermal curtain material which will provide thermal and acoustic protection in the base region between the nozzle and outer skirt on the Space Shuttle solid rocket boosters (SRB). The tests were conducted to provide data on the porosity of the material and to provide data on the thermal response characteristics to a step change in heating. This data was required to support design calculations to predict if the curtain would remain on the SRBs during reentry. These calculations were conducted by NASA/MSFC personnel and were primarily concerned with predicting the temperatures which the curtain layers will reach for reentry flight conditions.

The tests were conducted at the Impulse Base Flow Facility (IBFF) located at Marshall Space Flight Center. For the porosity measurements a steady state flow of air at 70°F, 500°F, and 1,000°F was passed through a sample of the curtain material and measurements of the flow rates were made at different pressure drops across the sample. For the transient measurements, a sample of the curtain material was subjected to a step change in temperature as air was passed through the sample. Measurements of the heat flow through the sample were made as a function of time after the input of the heat pulse. All the measurements were conducted on a 9 inch diameter sample of the curtain material. The sample consisted of three layers of curtain panels. Each panel was made of combinations of quartz and fiberglass cloth between which a fiberfrax filler material had been stitched.

Descriptions of the hardware design and test procedures are provided. Data are provided in engineering units for the flow conditions and temperatures at

which measurements were conducted. No analysis of the measurements are provided since the contractural obligation was only to provide reliable measurements on the samples. These objectives were met.

Section 2

HARDWARE DESIGN

The hardware design consisted of the design of the curtain test sample, the design of the flow, and heating hardware needed to obtain the required measurements. These designs are described in the following subsections.

2.1 Thermal Curtain Sample

The design of the thermal curtain sample is shown in Fig. 1. The requirements of the design were that the sample provide the maximum flow area possible and be configured similar to the actual curtain utilized on the SRB. The maximum area was calculated utilizing the IBFF vacuum pumping capacity at the required simulated IBFF chamber pressure at which tests were to be conducted. These calculations indicated that a 9" diameter sample could be tested at a flow rate of 0.1 lbm/sec which was the maximum flow expected for the specified chamber pressure, which ranged from 0.5 psia to 4 psia.

The sample consisted of three individual curtains constructed as shown in Fig. 1. On the SRB three curtains are utilized for thermal and acoustic protection. The outer curtain (labeled 1 in Fig. 1) is constructed of two layers of quartz cloth between which a fiberfrax fill is quilted. The two inner curtains (labeled 2 and 3 in Fig. 1) are constructed with a quartz and fiberglass cloth between which the fiberfrax fill is quilted. The quilting pattern is basically a 2" square pattern as shown in Fig. 1.

On the flight curtain an 1/8" diameter fiberglass cord is woven through the two outer curtains to provide additional strength. In the test sample this weaving

was simulated by the five penetrations shown in Fig. 1. This number of penetrations per area was equivalent to the penetrations on the actual flight curtain. The penetrations at Position C in Fig. 1 are dimensionally correct to those on the flight curtain, however, the other penetrations are not dimensionally correct due to limitations on the test sample area. Figures 2 and 3 show photographs of the corded and instrumented test sample.

For the sample instrumentation, .010" diameter chromel-alumel thermocouples were placed inside the sample at the positions A, B, and C indicated in Fig. 1. The thermocouple wiring was woven through the curtain as shown in the photographs and connected to a viscorder for recording during the transient portion of the testing. Only spot checks of the thermocouple reading were made during the steady state measurements to assure that the curtain had reached the required steady state temperatures.

Also, on the actual flight curtain a layer of polyethylene is stitched on the backside of each curtain to prevent the curtains from abraiding against each other during assembly. Since it is predicted that the polyethylene will have melted prior to reentry the majority of the testing was conducted on samples on which this polyethelene had been removed. The polyethylene was attached on only one set of steady state data.

Two sets of test curtains were constructed. One set was principally utilized on the steady state measurements and the other set was utilized on the transient measurements. One additional curtain sample was utilized on the first steady state data measurements. This sample was made of scrapes of curtain material and did not conform to the criteria of Fig. 1. This sample was useful in initially establishing flow setting and heater settings needed to obtain the required test conditions.

2.2 Flow Hardware

The design of the flow hardware consisted of the selection of flow and heater components needed to achieve the test conditions. Two flow configurations were utilized, one for the steady state measurements and one for the transient measurements. Figure 4 shows the configuration assembly for the steady state measurements and Fig. 5 shows the configuration for the transient measurements. The principle differences between the two configurations were in the heater configurations and the run procedures. Both configurations utilized the IBFF vacuum tank and pumping facility to provide simulated downstream pressure conditions of 0.5 psia to 4.0 psia. The flow assembly utilized an existing steel plenum chamber (approximately 5.5 I.D. by 20" long) which was attached to the IBFF bulkhead flange. This plenum chamber had been utilized on some recently completed heating tests and already contained positions for the measurement of the plenum temperature and pressure. In addition, two Sylvania air heaters (Series 1 1/4") were available and were utilized in the test assemblies as shown in Figs. 4 and 5. The only major piece of additional hardware that was needed was a jig to attach to the existing plenum chamber which would hold the SRB curtain test sample. This jig allowed for the 9" diameter test sample to be clamped in place using eight "C" clamps. In addition, an air tight plate could be attached to the downstream curtain clamp ring to allow for checks of gas leakage at circumferential locations between the curtain samples and the clamp region. Checks on this leakage indicated an insignificant leakage occurred in this region and would therefore not introduce inaccuracies in the measured flow rates through the test samples.

For the steady state measurements the hardware was assembled as shown in Fig. 4. Facility air was passed through a rotameter and a turbine meter both of

which were utilized in recording flow rate measurements. The air was then passed across two of the Sylvania air heaters which provided the major air heating. The band heaters located along the plenum chamber provided additional energy input in order that the maximum required temperature of 1000°F could be reached and maintained. Insulation was also utilized along the plenum and exterior heater to prevent heat loss. The Sylvania heaters were controled with 120 volt Variac's. Thermocouples were available in the air diffuser manifold, in the plenum chamber, along the plenum walls and in the curtain sample. The thermocouples were referenced to a 150°F reference junction and read on a digital voltmeter. The plenum and chamber pressures were read with the IBFF pressure readout system.

For the transient sample measurements the upstream flow measurements and control arrangement was the same as that utilized on the steady state measurement. For the flow control at the plenum a different heating and flow arrangement was required in order to achieve a step change in the flow temperature. A two way bypass valvewas the key element in this arrangement. This valve allowed for the air to be flowed and heated through the bypass (not through the sample) until the air heaters could achieve the required temperature. The air was then quickly directed through the air sample and data was recorded as the sampled heated. An additional feature of this flow arrangement was the cooling control line, this allowed for cool ambient air to be passed through the sample after a run and before the next run. Another different feature was the lining of the interior plenum walls with a piece of the SRB curtain to reduce heat-losses between the air and the plenum walls. The use of this insulation was found to be insuffient to reduce heat lost from the air, and the band heaters had to be utilized to provide additional energy input in order to achieve the necessary 1000°F operating temperature.

Section 3
MEASUREMENTS

The tests were conducted in two phases. First, the steady state measurements were made followed by the transient measurements. Those are discussed in the following subsections.

3.1 Steady State

The steady state measurements consisted of making flow rate measurements at different gas temperatures and pressures across the sample. Flow rate measurements were obtained at gas plenum temperatures of approximately 70°F, 500°F, and 1000°F; for pressures across the sample from 0.5 to 6 psia. A summary of the steady state measurement conditions is given in Fig. 6 and the reduced data is provided in Appendix A. Different test samples were utilized in these measurements. For the data of October 2, the sample was three thicknesses of a disgarded curtain sample made to the actual flight dimensions. This sample allowed for initial check-out of the flow system and heating capability.

A good test sample, as specified by Fig. 1, was utilized for the data of October 9, October 10 and October 11. For the data of October 31 a different test sample which included the poleythylene backing was utilized. This sample conformed with Fig. 1. The polyethylene backing was removed for the transient measurements discussed in the next section.

For the reduced data of Fig. 6 and Appendix A the following nomenclature was utilized.

PP = Plenum Pressure (psia)

PC = Chamber Pressure (psia)

RM = Rotameter Reading (%)

PR = Rotameter Pressure (psia)

TF = Turbine Meter Frequency (Hz)

TP = Turbine Meter Pressure (psia)

PT = Plenum Temperature (°R)

MT = Manifold Temperature (°R)

M = Mach Number Across Test Sample

W_T = Weight Flow from Turbine Meter (lbm/sec)

W_R = Weight Flow from Rotameter (lbm/sec)

η_T = Porosity Using Turbine Flow Rate (%)

η_R = Porosity Using Rotameter Flow Rate (%)

For reduction of the steady state data the following equations were utilized.

$$W_T = (.015654 + 5.6788 \times 10^{-4}\ TF)\ TP/AT \quad (1)$$

$$W_R = 1.484 \times 10^{-3}\ RM\ \sqrt{PR/AT} \quad (2)$$

For M < 1

$$\eta = 1.7102\ W\ \sqrt{PT}/(PC)M\ \sqrt{1 + .2\ M^2} \quad (3)$$

and For M > 1

$$\eta = 2.955\ W\ \sqrt{PT/PP} \quad (4)$$

No unusual problems were encountered during the steady state measurements. The procedures were as follows. The sample was clamped in the test jig and the blocking plate was attached across the sample face to check for excessive leakage. The leak check was made by pressurizing the flow lines and plenum to approximately 30 to 40 psia and observing the flow meters for any indication of leaks. Neither of the flow meters indicated a measurable leak for any of the tests runs that were made. Next the blocking plate was removed and the desired flow rate and operating pressures were achieved by adjustment of the vacuum pump flow rates and the input gas rate. The air heaters and plenum heaters were then turned on and the plenum chamber and wall thermocouples were observed until the desired test temperature

was achieved at steady state conditions. The flow rate, pressures and temperatures were then hand recorded and subsequently reduced using a computer code written in BASIC and utilized on a PDP11-V03 mini-computer. This reduced data is tabulated in Appendix A.

3.2 Transient

The transient measurements consisted of subjecting the curtain sample to a step change in heating and recording the response of the nine thermocouples that were imbedded in the sample. Six of these measurements were conducted at the conditions outlined in Fig. 7 of the test matrix. Measurements were in two gas temperature ranges (600-700°F) and (900-1000°F). The data of October 13 was not at the desired test conditions which were a test gas temperature of 1000°F, at a ΔP of 4 and a plenum pressure of 5 psia. This was primarily due to insufficient heating in the plenum chamber. For these first runs the plenum walls were not heated, because it was expected that the heating of the plenum chamber prior to diverting the hot gas through the sample would also preheat the sample. However, during the runs of October 13, it was found that without the heating of the plenum walls the gas temperature would loose 300 to 400°F in the unheated piping from the two way valve to the plenum and in the plenum chamber.

To alleviate this problem, insulation was placed along the walls of the plenum chamber and a heater tape and insulation were utilized along the piping from the two way valve to the plenum chamber. This along with the heating of the plenum walls allowed for the transient measurements of October 17 to be obtained at gas temperatures of greater than 900°F. In order to keep the sample as cool as possible prior to subjecting it to the step change in heating, the bypass line shown in Fig. 5 was utilized to pass cooling air through the sample.

Immediately prior to diverting the hot gas to the sample the cooling gas was stopped.

For the transient measurements, a curtain sample as shown in Fig. 1 and 2 was utilized. The polyethylene backing had been removed. Primary data was from the plenum chamber temperature and pressure, and 9 thermocouples imbedded in the sample as shown in Fig. 1. These 11 channels of data were recorded on a Visicorder trace as a function of time after the sample was subjected to the heating. Deflections from these Visicorder traces were read by hand and input to a data reduction program. A PDP-11-V03 minicomputer provided the pressure and temperature tabulations as functions of time. This data is given in Appendix B. For this data the zero time mark is the time at which the plenum pressure and temperature started to respond. Estimates of the data accuracy is $\pm$ 5% due to limitations on the readiability of the Visicorder tracer.

As indicated previously, the curtian sample thermocouples were of 0.010" diameter chromel-alumel. The plenum thermocouple was also of 0.010" diameter chromel-alumel. The junction bead on the plenum thermocouple was completely exposed and was approximately 1/4" from the 1/8" diameter insulator sheath which supported the thermocouple and allowed for the wiring to exit from the plenum chamber. The plenum thermocouple junction was located at the plenum centerline and 7 1/4" from the face of the curtain sample. The plenum pressure tap was at the same distance from the sample but 180° apart from the thermocouple.

The procedures followed in the transient measurements were as follows. The sample was clamped in the test jig and the blocking plate was installed to check for excessive leaks. The thermocouples were connected to the reference junction amplifiers and recorder. Zero and full scale readings were made on the recorder. The flow was started with the two way valve in the bypass mode. The

air heaters were turned on until the air temperature out of the air heaters reached a steady state maximum value. This was approximately 1200 to 1500°F. The heater outlet air temperature was monitored from a thermocouple located in the air line at the heater outlet. The air line from the two way valve to the plenum and the plenum chamber were also preheated. Bypass cooling air was passed through the sample to keep it at a low temperature prior to diverting the hot gas. The cooling gas was then cut-off, the recorder started and the hot-gas diverted through the sample. The plenum pressure had a tendency to over shoot the required pressure which made it necessary to watch the plenum pressure and make slight adjustments as the plenum and sample heated. At least two minutes of test time was recorded for each run. It was noted that the plenum pressure responded the quickest and reached essentially a steady state value within 5 to 10 seconds. The plenum temperature followed this closely, however for most of the runs it exhibited a slow drift upward in temperature with increasing run time. This was attributed to the slow heating of the plenum by the hot gas. Most of this upward drift was evident on the runs of October 13 on which the plenum chamber was not heated by the band heaters. On the runs of October 17 this drift was not as noticable due to the additional plenum heating.

The principle difficulties with the transient measurements were associated with achieving the required gas temperatures in the transient configuration and unreliable operation of the two way flow valve. The achievement of the required gas temperatures were obtained on the runs of October 17 after some trial and error adjustments of the heater controls and operating procedures. The two way valve was a continuing problem throughout the transient measurements. The valve was designed for hydraulic use at low temperatures. It was the only inhouse

valve that could be found which would provide the two way diversion control required for the flow arrangement. The valve continued to balk and freeze-up at the high temperature operation and the transient testing was discontinued on the fourth run of October 17 when the valve failed completely.

Section 4

CONCLUSIONS

The following conclusions were made based on the observations and results of the test performed.

1. Both steady state and transient measurements of the porosity and thermal response on samples of the SRB thermal curtain were successfully obtained in the MSFC/IBFF facility.
2. All hardware performed as designed with the exception of the twc way control valve. A new valve designed to operate at 1000°F should be acquired if similar tests are undertaken in the future.

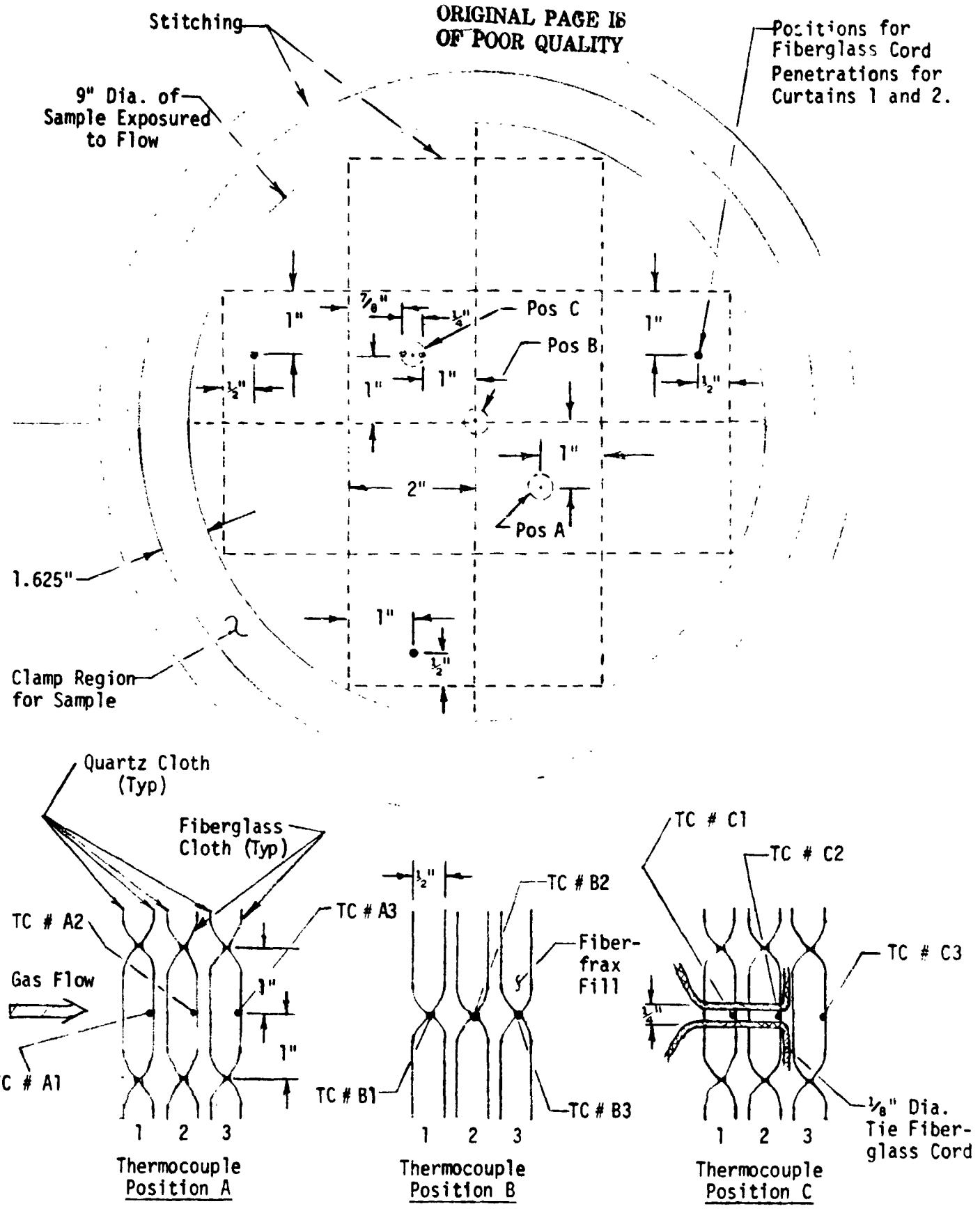
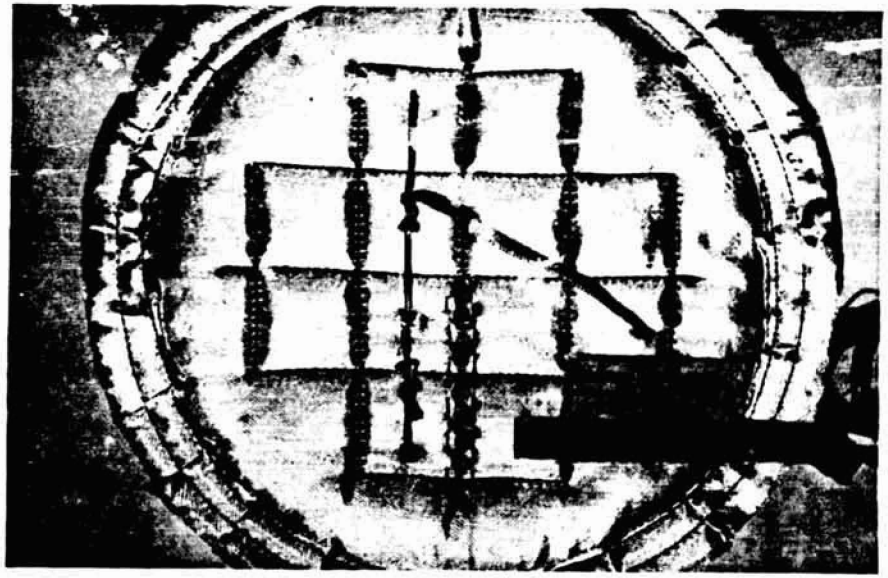
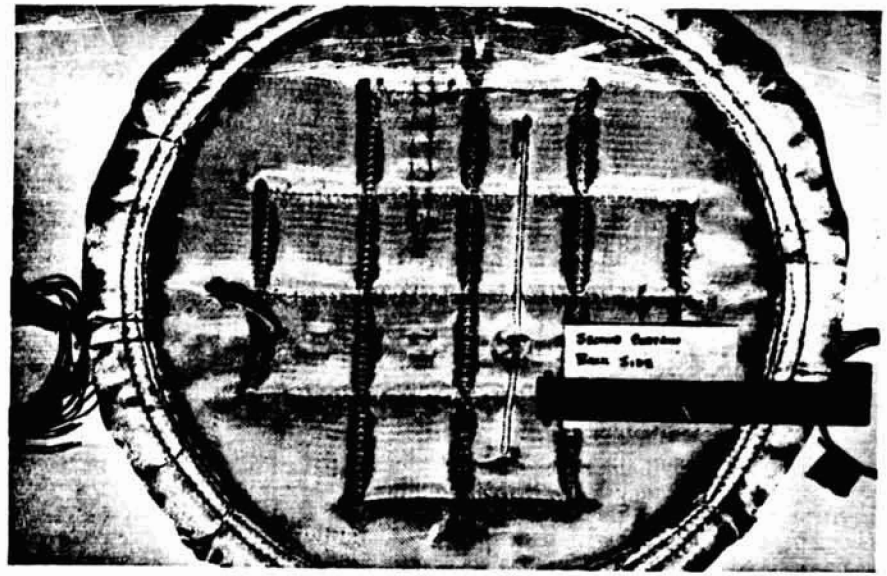


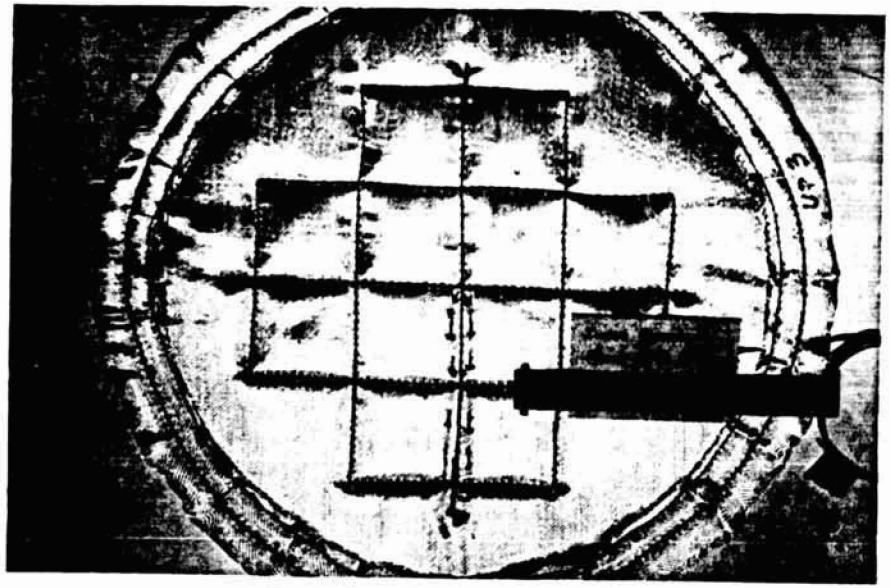
Fig. 1 SRB Thermal Curtain Test Sample Details and Thermocouple Locations for Transient Measurements.



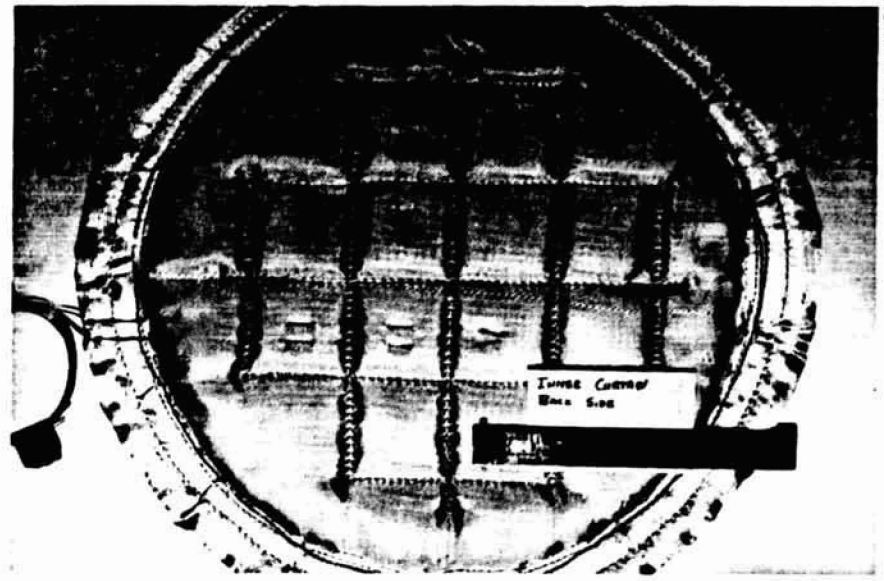
Curtain #1 - Front Side



Curtain #2 - Back Side



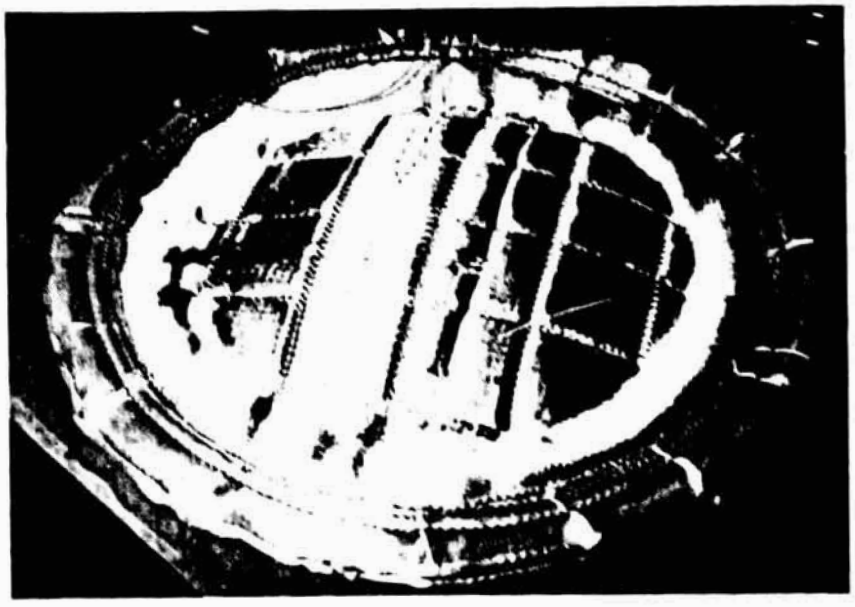
Curtain #3 - Front Side



Curtain #3 Back Side

Fig. 2 Photographs of Instrumented SRB Thermal Curtains Test Samples

Back Side Curtain #3



Back Side Curtain #2

Fig. 3 Photographs of Curtain Samples After Testing

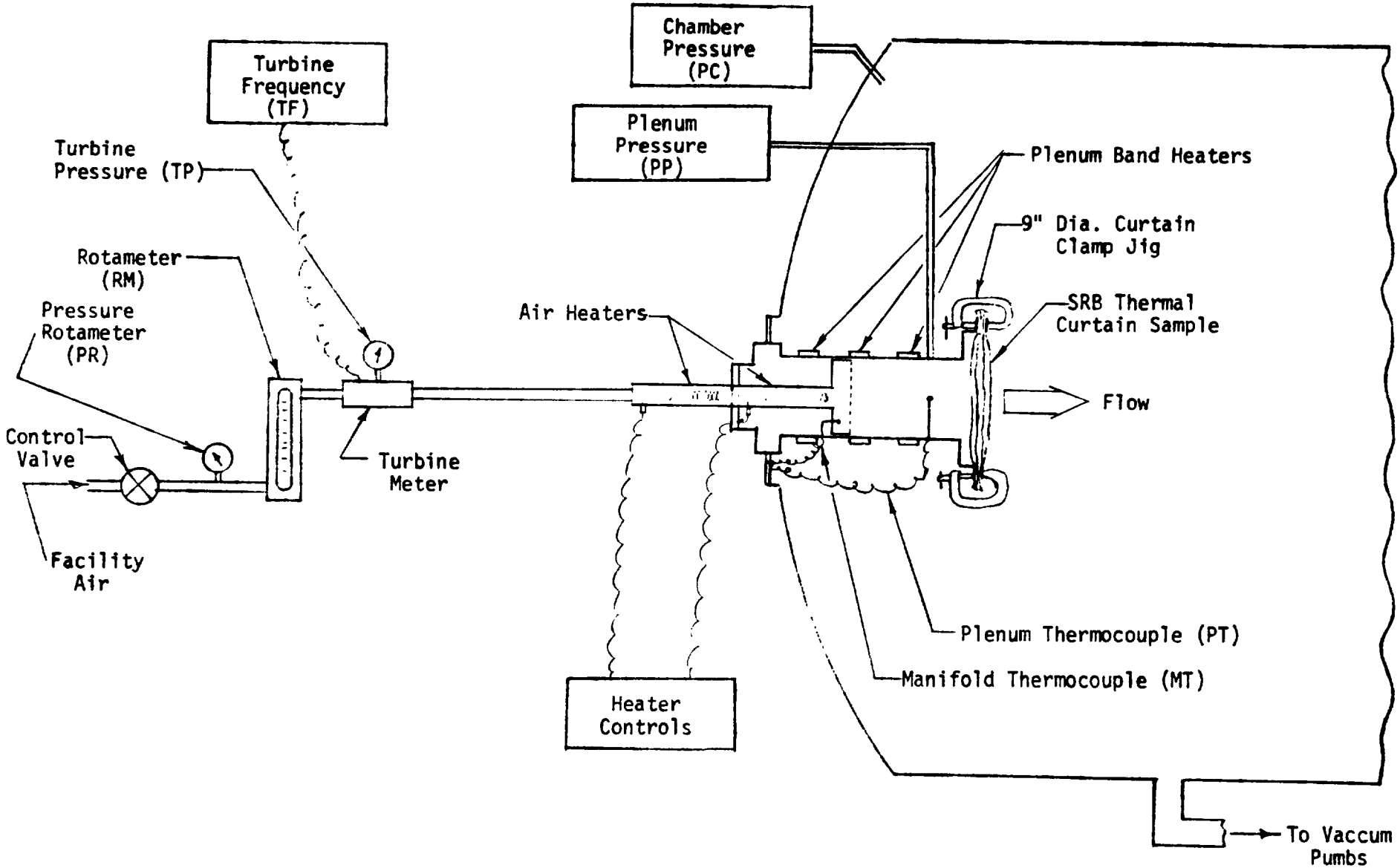


Fig. 4 Hardware Assembly for SRB Thermal Skirt Steady State Measurements

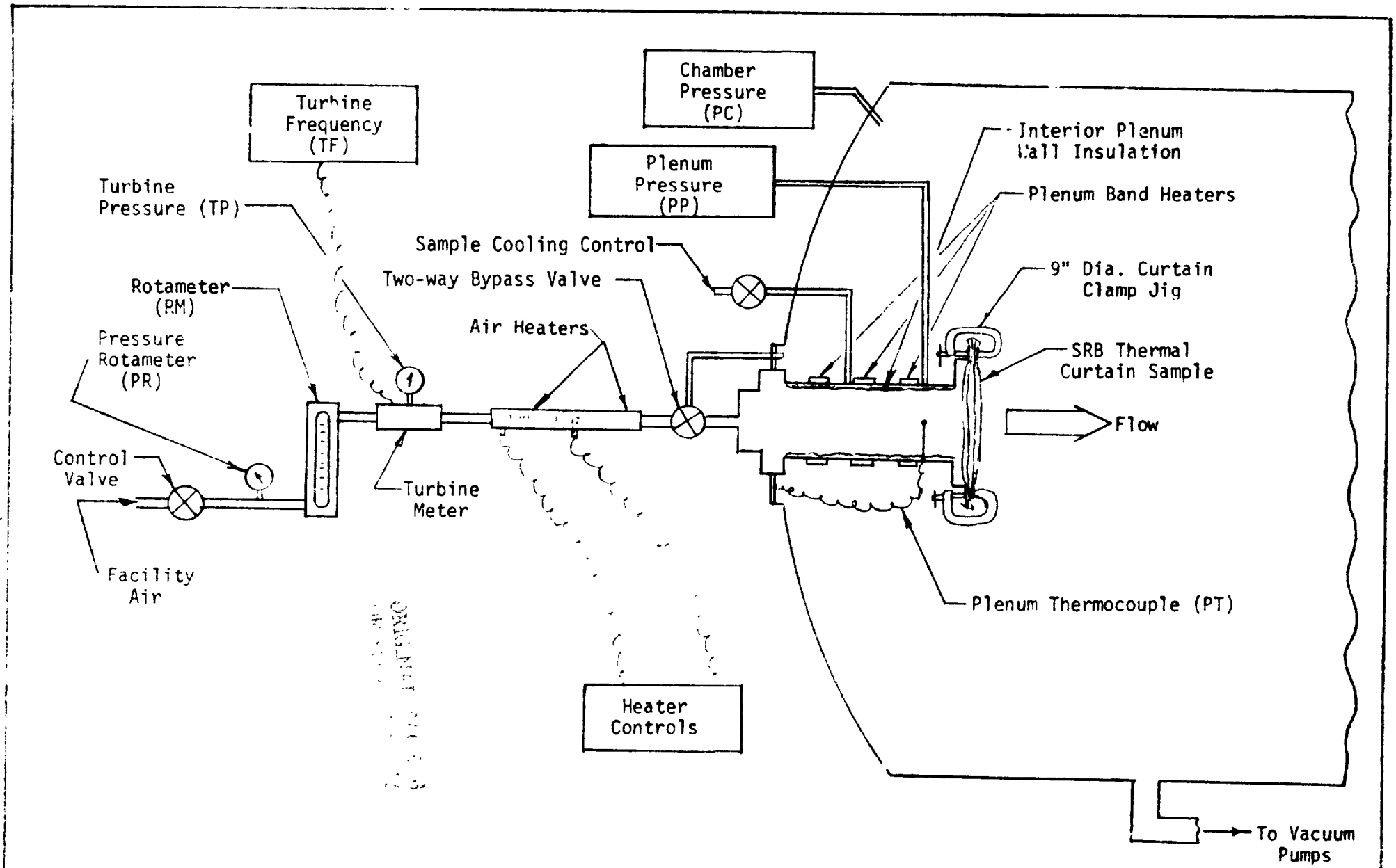


Fig. 5 Hardware Assembly for SRB Thermal Skirt Transient Heating Measurements

Fig. 6 SRB Curtain Steady State Measurements

Test Sample	Test Data	TP (°F)	PP (psia)	ΔP (psia)	W_T (lbm/sec)	W_R (lbm/sec)	$\P_T$	$\P_R$
Check-out sample - did not conform with Fig. 1	8/2/78	500°F	5	4	.0124	.0139	.233	.260
				3	.0103	.012	.1924	.2249
				2	.0077	.0093	.1468	.1769
				1	.0048	.0056	.1128	.1309
		1000°F	5	4	.0082	.0095	.188	.2176
				3	.0070	.0081	.1596	.1854
				2	.0059	.0065	.1321	.1463
				1	.0038	.0041	.1039	.1111
		1000°F	10	4	.0156	.0175	.1768	.1987
				3	.013	.0147	.155	.1764
				2	.0103	.0111	.1398	.1512
				1	.0059	.0068	.1066	.1234
Good Test sample - conformed with Fig. 1 - no polyethelene	8/9/78	78°F	5	4	.0272	.0277	.3764	.3831
				3	.0239	.0242	.3296	.3336
				2	.0189	.0192	.261	.2659
				1	.0108	.0123	.1809	.2061
		76°F	10	4	.057	.0483	.3963	.3317
				3	.046	.0438	.3437	.3209
				2	.0364	.0375	.3013	.3105
				1	.0222	.0224	.2442	.2458
		76°F	1	.5	.0014	.0019	.0973	.1303
			5	4	.0273	.0280	.3745	.3844
				1	.0107	.0121	.1804	.2040
			10	6	.0652	.0533	.4478	.3662
				4	.056	.0478	.3849	.3282
				1	.0219	.0223	.2415	.2453
		500°F	5	4	.0127	.0141	.2364	.2623
				3	.0105	.0123	.1937	.2271
				2	.0082	.0096	.1513	.1781
				1	.0053	.0060	.1198	.135
		500°F	10	4	.0273	.028	.2514	.2584
				3	.0224	.0227	.2204	.2235
				2	.0159	.0175	.1755	.1934
				1	.0097	.0108	.1434	.1597
	8/11/78	76°F	1	.5	.0010	.0016	.0693	.1056
			5	4	.0268	.0274	.3677	.3765
				3	.023	.0241	.3164	.3322
				2	.0186	.0191	.2573	.2644
				1	.0106	.0122	.1763	.2015
		76°F	10	6	.0653		.4465	
				5	.0622		.425	
				4	.056		.3843	
				3	.0459		.3337	
				2	.0355		.2923	
				1	.0205		.2229	
				.5	.0119		.1792	

Fig. 6 (Continued)

Test Sample	Test Data	TP (°F)	PP (psia)	ΔP (psia)	W_T (lbm/sec)	W_R (lbm/sec)	$\P_T$	$\P_R$
	8/11/78	1000	5	4	.0087	.0097	.1968	.2201
				3	.0069	.0083	.1569	.1872
				2	.0055	.0064	.1246	.1446
				1	.0034	.0038	.0928	.1059
		1000	10	4	.0161	.0174	.1829	.2023
				3	.0136	.0149	.1626	.179
				2	.0099	.0114	.1347	.1554
				1	.0061	.0069	.1095	.1237
		97°F	1	.5	.0014	.0016	.0948	.1112
			5	4	.0256	.0262	.3512	.3589
				3	.0226	.0232	.3093	.3189
				2	.0169	.0186	.2373	.2558
				1	.0093	.0117	.1543	.1944
		84°F	10	6	.0657		.4497	
				5	.0632		.4324	
				4	.0563		.3863	
				3	.0462		.3362	
				2	.0355		.2923	
				1	.0204		.2235	
Good test sample - conformed with Fig. 1 with polyethelene	8/31/78	75°F	5	4	.0059	.0077	.081	.1057
				3	.0057	.0070	.0777	.0957
				2	.0046	.0057	.0638	.0781
				1	.0027	.0039	.0451	.0637
		71°F	10	6	.0154	.0172	.1047	.1169
				5	.0142	.016	.0964	.1089
				4	.0127	.0145	.0864	.0986
				3	.0109	.0126	.0792	.0914
				2	.0092	.0103	.0757	.0847
				1	.0062	.0068	.0668	.0736

Test Date	Run No.	TP* (°F)	PP * (psia)	ΔP (psia)	WT* (lbm/sec)
10/13/78	1	~630	~5.4	4	--
	2	~650	~5.2	4	--
	3	~740	~4.8	2	--
10/17/78	1	~920	~5.3	4	.0125
	2	~975	~5.6	4	.0116
	3	~966	~5.4	4	.0124

*At steady state t > 120 sec

Fig. 7 SRB Curtain Transient Test Measurements

APPENDIX A

STEADY STATE DATA FOR SRB CURTAIN TESTS

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/2/78 *****
HEADER:PLENUM TEMP APPROX 500 DEG F PRESS APPROX 5 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	1	58	13.9	797	14.2	999	969	536

MACH # = 1.73 PRES RATIO (PC/PP) = .199 DEL PRES SAMPLE = 3.98
WT FLOW-(LBM/SEC) * TURBINE = .0124 - RMETER = .0139
POROSITY-(%) * TURBINE = .2335 - RMETER = .2608

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	2	53	12.4	745	12.6	999	969	536

MACH # = 1.23 PRES RATIO (PC/PP) = .402 DEL PRES SAMPLE = 2.99
WT FLOW-(LBM/SEC) * TURBINE = .0103 - RMETER =
POROSITY-(%) * TURBINE = .1924 - RMETER =

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
4.9	3	46	10	689	10.2	999	969	536

MACH # = .88 PRES RATIO (PC/PP) = .608 DEL PRES SAMPLE = 1.94
WT FLOW-(LBM/SEC) * TURBINE = 7.70000E-03 - RMETER = 9.30000E-03
POROSITY-(%) * TURBINE = .1468 - RMETER = .1769

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	4	32	7.2	589	7.4	1004	973	536

MACH # = .56 PRES RATIO (PC/PP) = .81 DEL PRES SAMPLE = .94
WT FLOW-(LBM/SEC) * TURBINE = 4.80000E-03 - RMETER = 5.60000E-03
POROSITY-(%) * TURBINE = .1128 - RMETER = .1309

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/2/78 *****
HEADER:PLENUM TEMP APPROX 1000 DEG F PRESS APPROX 5 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
4.9	1	46	10.4	704	10.6	1469	1363	536

MACH # = 1.72 PRES RATIO (PC/PP) = .202 DEL PRES SAMPLE = 3.95
WT FLOW-(LBM/SEC) * TURBINE = 8.20000E-03 - RMETER = 9.50000E-03
POROSITY-(%) * TURBINE = .188 - RMETER = .2176

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	2	41	9.2	668	9.5	1477	1329	536

MACH # = 1.23 PRES RATIO (PC/PP) = .4 DEL PRES SAMPLE = 2.99
WT FLOW-(LBM/SEC) * TURBINE = 7.00000E-03 - RMETER = 8.10000E-03
POROSITY-(%) * TURBINE = .1596 - RMETER = .1854

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	3	35	8	649	8.2	1460	1329	536

MACH # = .9 PRES RATIO (PC/PP) = .596 DEL PRES SAMPLE = 2.03
WT FLOW-(LBM/SEC) * TURBINE = 5.90000E-03 - RMETER = 6.50000E-03
POROSITY-(%) * TURBINE = .1321 - RMETER = .1463

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	4	25	6.4	528	6.5	1443	1295	536

MACH # = .58 PRES RATIO (PC/PP) = .800 DEL PRES SAMPLE = 1
WT FLOW-(LBM/SEC) * TURBINE = 3.80000E-03 - RMETER = 4.10000E-03
POROSITY-(%) * TURBINE = .1029 - RMETER = .1111

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/2/78 *****
HEADER:PLENUM TEMP APPROX 1000 DEG F PRESS APPROX 10 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	6.1	62	19.4	719	19.7	1452	1270	536

MACH # = .87 PRES RATIO (PC/PP) = .614 DEL PRES SAMPLE = 3.86
WT FLOW-(LBM/SEC) * TURBINE = .0156 - RMETER = .0175
POROSITY-(%) * TURBINE = .1768 - RMETER = .1987

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	7	55	17.2	676	17.4	1456	1300	536

MACH # = .74 PRES RATIO (PC/PP) = .699 DEL PRES SAMPLE = 3.02
WT FLOW-(LBM/SEC) * TURBINE = .013 - RMETER = .0147
POROSITY-(%) * TURBINE = .155 - RMETER = .1764

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	8	45	14.4	637	14.6	1443	1278	536

MACH # = .58 PRES RATIO (PC/PP) = .8 DEL PRES SAMPLE = 2
WT FLOW-(LBM/SEC) * TURBINE = .0103 - RMETER = .0111
POROSITY-(%) * TURBINE = .1398 - RMETER = .1512

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	9	31	11.7	438	11.9	1443	1253	536

MACH # = .39 PRES RATIO (PC/PP) = .901 DEL PRES SAMPLE = .99
WT FLOW-(LBM/SEC) * TURBINE = 5.90000E-03 - RMETER = 6.80000E-03
POROSITY-(%) * TURBINE = .1066 - RMETER = .1234

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/9/78 *****
HEADER:PLENUM TEMP APPROX 70 DEG F PRESS APPROX 5 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	1	84	26.2	941	26.6	538	538	538

MACH # = 1.7 PRES RATIO (PC/PP) = .207 DEL PRES SAMPLE = 3.93
WT FLOW-(LBM/SEC) * TURBINE = .0272 - RMETER = .0277
POROSITY-(%) * TURBINE = .3764 - RMETER = .3831

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	2	78	23.2	932	23.6	538	538	538

MACH # = 1.21 PRES RATIO (PC/PP) = .412 DEL PRES SAMPLE = 2.92
WT FLOW-(LBM/SEC) * TURBINE = .0239 - RMETER = .0242
POROSITY-(%) * TURBINE = .3296 - RMETER = .3336

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	3	70	18.4	923	18.8	538	538	538

MACH # = .89 PRES RATIO (PC/PP) = .603 DEL PRES SAMPLE = 1.97
WT FLOW-(LBM/SEC) * TURBINE = .0189 - RMETER = .0192
POROSITY-(%) * TURBINE = .261 - RMETER = .2659

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	4	55	12	804	12.3	538	538	538

MACH # = .58 PRES RATIO (PC/PP) = .802 DEL PRES SAMPLE = .99
WT FLOW-(LBM/SEC) * TURBINE = .0108 - RMETER = .0123
POROSITY-(%) * TURBINE = .1809 - RMETER = .2061

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/9/78 *****
HEADER:PLENUM TEMP APPROX 70 DEG F PRESS APPROX 10 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	6.1	100	56.9	931	56.9	536	536	536

MACH # = .88 PRES RATIO (PC/PP) = .606 DEL PRES SAMPLE = 3.95
WT FLOW-(LBM/SEC) * TURBINE = .0577 - RMETER = .0483
POROSITY-(%) * TURBINE = .3963 - RMETER = .3317

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	7.1	100	46.8	920	46.8	536	536	536

MACH # = .73 PRES RATIO (PC/PP) = .706 DEL PRES SAMPLE = 2.94
WT FLOW-(LBM/SEC) * TURBINE = .0469 - RMETER = .0438
POROSITY-(%) * TURBINE = .3437 - RMETER = .3209

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	8	98	35.7	920	36.3	536	536	536

MACH # = .58 PRES RATIO (PC/PP) = .799 DEL PRES SAMPLE = 2.01
WT FLOW-(LBM/SEC) * TURBINE = .0364 - RMETER = .0375
POROSITY-(%) * TURBINE = .3013 - RMETER = .3105

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	9	73	22.6	890	22.9	536	536	536

MACH # = .4 PRES RATIO (PC/PP) = .899 DEL PRES SAMPLE = 1.01
WT FLOW-(LBM/SEC) * TURBINE = .0222 - RMETER = .0224
POROSITY-(%) * TURBINE = .2442 - RMETER = .2458

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/10/78 *****
HEADER:PLENUM TEMP APPROX 70 DEG F PRESS APPROX 1 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
1	.5	20	2.1	585	2.2	540	540	540

MACH # = 1.08 PRES RATIO (PC/PP) = .484 DEL PRES SAMPLE = .52
WT FLOW-(LBM/SEC) * TURBINE = 1.40000E-03 - RMETER = 1.90000E-03
POROSITY-(%) * TURBINE = .0973 - RMETER = .1303

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/10/78 *****
HEADER:PLENUM TEMP APPROX 70 DEG F PRESS APPROX 5 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	1	85	26.6	933	27	540	540	540

MACH # = 1.72 PRES RATIO (PC/PP) = .2 DEL PRES SAMPLE = 4
WT FLOW-(LBM/SEC) * TURBINE = .0273 - RMETER = .028
POROSITY-(%) * TURBINE = .3745 - RMETER = .3844

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	4	55	11.8	811	12.1	540	540	540

MACH # = .57 PRES RATIO (PC/PP) = .805 DEL PRES SAMPLE = .97
WT FLOW-(LBM/SEC) * TURBINE = .0107 - RMETER = .0121
POROSITY-(%) * TURBINE = .1804 - RMETER = .204

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/10/78 *****
HEADER:PLENUM TEMP APPROX 70 DEG F PRESS APPROX 10 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	4	100	69.7	862	69.7	540	540	540

MACH # = 1.24 PRES RATIO (PC/PP) = .398 DEL PRES SAMPLE = 6.01
WT FLOW-(LBM/SEC) * TURBINE = .0652 - RMETER = .0533
POROSITY-(%) * TURBINE = .4478 - RMETER = .3662

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	6	100	56	924	56	540	540	540

MACH # = .9 PRES RATIO (PC/PP) = .598 DEL PRES SAMPLE = 4.02
WT FLOW-(LBM/SEC) * TURBINE = .056 - RMETER = .0478
POROSITY-(%) * TURBINE = .3849 - RMETER = .3282

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	9	73	22.5	883	22.9	540	540	540

MACH # = .4 PRES RATIO (PC/PP) = .899 DEL PRES SAMPLE = 1.01
WT FLOW-(LBM/SEC) * TURBINE = .0219 - RMETER = .0223
POROSITY-(%) * TURBINE = .2415 - RMETER = .2453

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/10/78 *****
HEADER:PLENUM TEMP APPROX 500 DEG F PRESS APPROX 5 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	1	58	14.2	803	14.5	986	1021	538

MACH # = 1.72 PRES RATIO (PC/PP) = .202 DEL PRES SAMPLE = 3.98
WT FLOW-(LBM/SEC) * TURBINE = .0127 - RMETER = .0141
POROSITY-(%) * TURBINE = .2364 - RMETER = .2623

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	2	54	12.4	760	12.6	960	907	538

MACH # = 1.23 PRES RATIO (PC/PP) = .402 DEL PRES SAMPLE = 2.96
WT FLOW-(LBM/SEC) * TURBINE = .0105 - RMETER = .0123
POROSITY-(%) * TURBINE = .1937 - RMETER = .2271

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	3	47	10	722	10.3	960	907	538

MACH # = .89 PRES RATIO (PC/PP) = .603 DEL PRES SAMPLE = 1.97
WT FLOW-(LBM/SEC) * TURBINE = 8.20000E-03 - RMETER = 9.60000E-03
POROSITY-(%) * TURBINE = .1513 - RMETER = .1781

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	4	34	7.4	637	7.6	969	942	538

MACH # = .58 PRES RATIO (PC/PP) = .802 DEL PRES SAMPLE = .99
WT FLOW-(LBM/SEC) * TURBINE = 5.30000E-03 - RMETER = 6.00000E-03
POROSITY-(%) * TURBINE = .1198 - RMETER = .135

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/10/78 *****
HEADER:PLENUM TEMP APPROX 500 DEG F PRESS APPROX 10 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	6	82	28.2	876	28.6	973	977	538

MACH # = .9 PRES RATIO (PC/PP) = .598 DEL PRES SAMPLE = 4.02
WT FLOW-(LBM/SEC) * TURBINE = .0273 - RMETER = .028
POROSITY-(%) * TURBINE = .2514 - RMETER = .2584

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	7	73	23.6	856	24	991	964	538

MACH # = .74 PRES RATIO (PC/PP) = .697 DEL PRES SAMPLE = 3.04
WT FLOW-(LBM/SEC) * TURBINE = .0224 - RMETER = .0227
POROSITY-(%) * TURBINE = .2204 - RMETER = .2235

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	8	6?	19.1	747	19.4	969	907	538

MACH # = .58 PRES RATIO (PC/PP) = .797 DEL PRES SAMPLE = 2.03
WT FLOW-(LBM/SEC) * TURBINE = .0159 - RMETER = .0175
POROSITY-(%) * TURBINE = .1755 - RMETER = .1934

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	9	45	14	618	14.2	977	951	538

MACH # = .4 PRES RATIO (PC/PP) = .899 DEL PRES SAMPLE = 1.01
WT FLOW-(LBM/SEC) * TURBINE = 9.70000E-03 - RMETER = .0108
POROSITY-(%) * TURBINE = .1434 - RMETER = .1597

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/11/78 *****
HEADER:PLENUM TEMP APPROX 70 DEG F PRESS APPROX 1 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
1	.5	20	1.4	615	1.5	536	536	536

MACH # = 1.08 PRES RATIO (PC/PP) = .484 DEL PRES SAMPLE = .52
WT FLOW-(LBM/SEC) * TURBINE = 1.00000E-03 - RMETER = 1.60000E-03
POROSITY-(%) * TURBINE = .0693 - RMETER = .1056

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/11/78 *****
HEADER:PLENUM TEMP APPROX 70 DEG F PRESS APPROX 5 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	1	84	26	928	26.5	536	536	536

MACH # = 1.73 PRES RATIO (PC/PP) = .198 DEL PRES SAMPLE = 4
WT FLOW-(LBM/SEC) * TURBINE = .0268 - RMETER = .0274
POROSITY-(%) * TURBINE = .3677 - RMETER = .3765

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	2	78	23	900	23.4	536	536	536

MACH # = 1.23 PRES RATIO (PC/PP) = .401 DEL PRES SAMPLE = 2.98
WT FLOW-(LBM/SEC) * TURBINE = .023 - RMETER = .0241
POROSITY-(%) * TURBINE = .3164 - RMETER = .3322

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	3	70	18.2	918	18.6	536	536	536

MACH # = .89 PRES RATIO (PC/PP) = .603 DEL PRES SAMPLE = 1.97
WT FLOW-(LBM/SEC) * TURBINE = .0186 - RMETER = .0191
POROSITY-(%) * TURBINE = .2573 - RMETER = .2644

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	4	55	11.9	796	12.2	536	536	536

MACH # = .58 PRES RATIO (PC/PP) = .798 DEL PRES SAMPLE = 1.01
WT FLOW-(LBM/SEC) * TURBINE = .0106 - RMETER = .0122
POROSITY-(%) * TURBINE = .1763 - RMETER = .2015

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/11/78 *****
HEADER:PLENUM TEMP APPROX 70 DEG F PRESS APPROX 10 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	4	0	0	867	69	536	536	536

MACH # = 1.24 PRES RATIO (PC/PP) = .398 DEL PRES SAMPLE = 6.03
WT FLOW-(LBM/SEC) * TURBINE = .0653 - RMETER = 0
POROSITY-(%) * TURBINE = .4465 - RMETER = 0

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	5	0	0	908	62.8	536	536	536

MACH # = 1.06 PRES RATIO (PC/PP) = .496 DEL PRES SAMPLE = 5.05
WT FLOW-(LBM/SEC) * TURBINE = .0622 - RMETER = 0
POROSITY-(%) * TURBINE = .425 - RMETER = 0

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	6	0	0	931	55.2	536	536	536

MACH # = .89 PRES RATIO (PC/PP) = .6 DEL PRES SAMPLE = 4
WT FLOW-(LBM/SEC) * TURBINE = .056 - RMETER = 0
POROSITY-(%) * TURBINE = .3843 - RMETER = 0

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	7	0	0	907	46.4	536	536	536

MACH # = .74 PRES RATIO (PC/PP) = .698 DEL PRES SAMPLE = 3.02
WT FLOW-(LBM/SEC) * TURBINE = .0459 - RMETER = 0
POROSITY-(%) * TURBINE = .3337 - RMETER = 0

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	8	0	0	914	35.6	536	536	536

MACH # = .58 PRES RATIO (PC/PP) = .797 DEL PRES SAMPLE = 2.03
WT FLOW-(LBM/SEC) * TURBINE = .0355 - RMETER = 0
POROSITY-(%) * TURBINE = .2923 - RMETER = 0

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	9	0	0	814	23	536	536	536

MACH # = .4 PRES RATIO (PC/PP) = .898 DEL PRES SAMPLE = 1.02
WT FLOW-(LBM/SEC) * TURBINE = .0205 - RMETER = 0
POROSITY-(%) * TURBINE = .2229 - RMETER = 0

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	9.5	0	0	692	15.6	536	536	536

MACH # = .27 PRES RATIO (PC/PP) = .95 DEL PRES SAMPLE = .5
WT FLOW-(LBM/SEC) * TURBINE = .0119 - RMETER = 0
POROSITY-(%) * TURBINE = .1792 - RMETER = 0

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/11/78 *****
HEADER:PLENUM TEMP APPROX 1000 DEG F PRESS APPROX 5 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	1	47	10.4	739	10.7	1464	1540	536

MACH # = 1.72 PRES RATIO (PC/PP) = .202 DEL PRES SAMPLE = 3.98
WT FLOW-(LBM/SEC) * TURBINE = 8.70000E-03 - RMETER = 9.70000E-03
POROSITY-(%) * TURBINE = .1968 - RMETER = .2201

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	2	42	9.2	668	9.4	1464	1452	536

MACH # = 1.24 PRES RATIO (PC/PP) = .399 DEL PRES SAMPLE = 3
WT FLOW-(LBM/SEC) * TURBINE = 6.90000E-03 - RMETER = 8.30000E-03
POROSITY-(%) * TURBINE = .1569 - RMETER = .1872

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	3	35	7.8	611	8.1	1469	1473	536

MACH # = .89 PRES RATIO (PC/PP) = .601 DEL PRES SAMPLE = 1.99
WT FLOW-(LBM/SEC) * TURBINE = 5.50000E-03 - RMETER = 6.40000E-03
POROSITY-(%) * TURBINE = .1246 - RMETER = .1446

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	4	24	6.2	468	6.4	1464	1376	536

MACH # = .58 PRES RATIO (PC/PP) = .802 DEL PRES SAMPLE = .99
WT FLOW-(LBM/SEC) * TURBINE = 3.40000E-03 - RMETER = 3.80000E-03
POROSITY-(%) * TURBINE = .0928 - RMETER = .1059

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/11/78 *****
HEADER:PLENUM TEMP APPROX 1000 DEG F PRESS APPROX 10 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
9.9	6	63	19.6	739	19.9	1426	1338	536

MACH # = .88 PRES RATIO (PC/PP) = .605 DEL PRES SAMPLE = 3.91
WT FLOW-(LBM/SEC) * TURBINE = .0161 - RMETER = .0179
POROSITY-(%) * TURBINE = .1829 - RMETER = .2023

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	7	56	17.3	700	17.6	1464	1384	536

MACH # = .74 PRES RATIO (PC/PP) = .699 DEL PRES SAMPLE = 3.02
WT FLOW-(LBM/SEC) * TURBINE = .0136 - RMETER = .0149
POROSITY-(%) * TURBINE = .1626 - RMETER = .179

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	8	46	14.7	599	14.9	1469	1426	536

MACH # = .58 PRES RATIO (PC/PP) = .797 DEL PRES SAMPLE = 2.03
WT FLOW-(LBM/SEC) * TURBINE = 9.90000E-03 - RMETER = .0114
POROSITY-(%) * TURBINE = .1347 - RMETER = .1554

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	9	31	12	444	12.2	1464	1384	536

MACH # = .4 PRES RATIO (PC/PP) = .898 DEL PRES SAMPLE = 1.02
WT FLOW-(LBM/SEC) * TURBINE = 6.10000E-03 - RMETER = 6.90000E-03
POROSITY-(%) * TURBINE = .1095 - RMETER = .1237

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/11/78 *****
HEADER:PLENUM TEMP APPROX 97 DEG F PRESS APPROX 1 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TF (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
1	.5	18	1.9	599	2.1	536	536	536

MACH # = 1.06 PRES RATIO (PC/PP) = .5 DEL PRES SAMPLE = .5
WT FLOW-(LBM/SEC) * TURBINE = 1.40000E-03 - RMETER = 1.60000E-03
POROSITY-(%) * TURBINE = .0948 - RMETER = .1112

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/11/78 *****
HEADER:PLENUM TEMP APPROX 90 DEG F PRESS APPROX 5 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	1	82	24.8	932	25.2	536	536	536

MACH # = 1.72 PRES RATIO (PC/PP) = .202 DEL PRES SAMPLE = 3.98
WT FLOW-(LBM/SEC) * TURBINE = .0256 - RMETER = .0262
POROSITY-(%) * TURBINE = .3512 - RMETER = .3589

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG)
5	2	77	22.2	915	22.6	536	536	53

MACH # = 1.24 PRES RATIO (PC/PP) = .399 DEL PRES SAMPLE = 3
WT FLOW-(LBM/SEC) * TURBINE = .0226 - RMETER = .0232
POROSITY-(%) * TURBINE = .3093 - RMETER = .3189

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	3	69	17.7	854	18.1	536	536	536

MACH # = .89 PRES RATIO (PC/PP) = .601 DEL PRES SAMPLE = 1.99
WT FLOW-(LBM/SEC) * TURBINE = .0169 - RMETER = .0186
POROSITY-(%) * TURBINE = .2323 - RMETER = .2558

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	4	54	11.5	718	11.8	536	536	536

MACH # = .58 PRES RATIO (PC/PP) = .798 DEL PRES SAMPLE = 1.01
WT FLOW-(LBM/SEC) * TURBINE = 9.30000E-03 - RMETER = .0117
POROSITY-(%) * TURBINE = .1543 - RMETER = .1944

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/11/78 *****
HEADER:PLENUM TEMP APPROX 84 DEG F PRESS APPROX 10 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	4	0	0	873	68.9	536	536	536

MACH # = 1.24 PRES RATIO (PC/PP) = .398 DEL PRES SAMPLE = 6.01
WT FLOW-(LBM/SEC) * TURBINE = .0657 - RMETER = 0
POROSITY-(%) * TURBINE = .4497 - RMETER = 0

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	5	0	0	921	62.9	536	536	536

MACH # = 1.06 PRES RATIO (PC/PP) = .499 DEL PRES SAMPLE = 5.01
WT FLOW-(LBM/SEC) * TURBINE = .0632 - RMETER = 0
POROSITY-(%) * TURBINE = .4324 - RMETER = 0

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	6	0	0	934	55.3	536	536	536

MACH # = .89 PRES RATIO (PC/PP) = .6 DEL PRES SAMPLE = 4
WT FLOW-(LBM/SEC) * TURBINE = .0563 - RMETER = 0
POROSITY-(%) * TURBINE = .3863 - RMETER = 0

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	7	0	0	918	46.2	536	536	536

MACH # = .74 PRES RATIO (PC/PP) = .698 DEL PRES SAMPLE = 3.02
WT FLOW-(LBM/SEC) * TURBINE = .0462 - RMETER = 0
POROSITY-(%) * TURBINE = .3362 - RMETER = 0

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	8	0	0	922	35.3	536	536	536

MACH # = .58 PRES RATIO (PC/PP) = .797 DEL PRES SAMPLE = 2.03
WT FLOW-(LBM/SEC) * TURBINE = .0355 - RMETER = 0
POROSITY-(%) * TURBINE = .2923 - RMETER = 0

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	9	0	0	831	22.4	536	536	536

MACH # = .4 PRES RATIO (PC/PP) = .899 DEL PRES SAMPLE = 1.01
WT FLOW-(LBM/SEC) * TURBINE = .0204 - RMETER = 0
POROSITY-(%) * TURBINE = .2235 - RMETER = 0

***** TITLE:SRB SKIRT STEADY S TE FLOW DATA OF 8/31/78 *****
HEADER:PLENUM TEMP APPROX 70 G F PRESS APPROX 5 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	1	41	8.4	620	8.6	534	534	534

MACH # = 1.72 PRES RATIO (PC/PP) = .2 DEL PRES SAMPLE = 3.99
WT FLOW-(LBM/SEC) * TURBINE = 5.90000E-03 - RMETER = 7.70000E-03
POROSITY-(%) * TURBINE = .081 - RMETER = .1057

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	2	39	7.8	632	8.1	534	534	534

MACH # = 1.24 PRES RATIO (PC/PP) = .399 DEL PRES SAMPLE = 3
WT FLOW-(LBM/SEC) * TURBINE = 5.70000E-03 - RMETER = 7.00000E-03
POROSITY-(%) * TURBINE = .0777 - RMETER = .0957

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	3	33	7	580	7.2	534	534	534

MACH # = .89 PRES RATIO (PC/PP) = .601 DEL PRES SAMPLE = 1.99
WT FLOW-(LBM/SEC) * TURBINE = 4.60000E-03 - RMETER = 5.70000E-03
POROSITY-(%) * TURBINE = .0638 - RMETER = .0781

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
5	4	24	6	386	6.2	534	534	534

MACH # = .58 PRES RATIO (PC/PP) = .798 DEL PRES SAMPLE = 1.01
WT FLOW-(LBM/SEC) * TURBINE = 2.70000E-03 - RMETER = 3.90000E-03
POROSITY-(%) * TURBINE = .0451 - RMETER = .0637

***** TITLE:SRB SKIRT STEADY STATE FLOW DATA OF 8/31/78 *****
HEADER:PLENUM TEMP APPROX 70 DEG F PRESS APPROX 10 PSIA

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	4	62	18.2	754	18.4	531	531	531

MACH # = 1.23 PRES RATIO (PC/PP) = .4 DEL PRES SAMPLE = 5.99
WT FLOW-(LBM/SEC) * TURBINE = .0154 - RMETER = .0172
POROSITY-(%) * TURBINE = .1047 - RMETER = .1169

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	5	60	17.2	730	17.5	531	531	531

MACH # = 1.06 PRES RATIO (PC/PP) = .498 DEL PRES SAMPLE = 5.03
WT FLOW-(LBM/SEC) * TURBINE = .0142 - RMETER = .016
POROSITY-(%) * TURBINE = .0964 - RMETER = .1089

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	6	56	16.1	696	16.4	531	531	531

MACH # = .9 PRES RATIO (PC/PP) = .598 DEL PRES SAMPLE = 4.02
WT FLOW-(LBM/SEC) * TURBINE = .0127 - RMETER = .0145
POROSITY-(%) * TURBINE = .0864 - RMETER = .0986

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	7	51	14.8	655	15	531	531	531

MACH # = .74 PRES RATIO (PC/PP) = .698 DEL PRES SAMPLE = 3.02
WT FLOW-(LBM/SEC) * TURBINE = .0109 - RMETER = .0126
POROSITY-(%) * TURBINE = .0792 - RMETER = .0914

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	8	44	13.3	612	13.5	531	531	531

MACH # = .58 PRES RATIO (PC/PP) = .797 DEL PRES SAMPLE = 2.03
WT FLOW-(LBM/SEC) * TURBINE = 9.20000E-03 - RMETER = .0103
POROSITY-(%) * TURBINE = .0757 - RMETER = .0847

PP (PSIA)	PC (PSIA)	RM (%)	PR (PSIA)	TF (HZ)	TP (PSIA)	PT (DEG R)	MT (DEG R)	AT (DEG R)
10	9	31	11.6	462	11.8	531	531	531

MACH # = .4 PRES RATIO (PC/PP) = .898 DEL PRES SAMPLE = 1.02
WT FLOW-(LBM/SEC) * TURBINE = 6.20000E-03 - RMETER = 6.80000E-03
POROSITY-(%) * TURBINE = .0668 - RMETER = .0736

APPENDIX B

TRANSIENT DATA FOR SRB CURTAIN TESTS

TITLE:10/13\78 RUN #1 DELTA P = 4 PSIA

	PLENUM CONDITIONS	
TIME (SEC)	PRESS (MMHG)	TEMP (DEG F)
0	50.5	163.4
.9	218.9	244.1
1.8	218.9	308
2.6	208.8	349.7
3.5	229	382.2
4.4	242.4	405.4
5.3	259.3	428.4
6.1	262.6	446.9
7	262.6	460.7
7.9	259.3	469.8
8.8	259.3	474.4
10.5	266	483.5
12.3	266	492.6
14	269.4	497.1
15.8	269.4	506.2
17.6	269.4	510.7
21.1	269.4	524.3
26.3	272.7	537.8
35.1	272.7	551.2
43.9	272.7	564.7
52.7	272.7	573.6
57.1	272.7	582.6
105.4	276.1	618.2
146.6	279.5	631.5

TITLE:10/13\78 RUN #1 DELTA P = 4 PSIA

TEST SAMPLE POS A

TIME (SEC)	TC #A1 (DEG F)	TC #A2 (DEG F)	TC #A3 (DEG F)
0	150	176	158.9
.9	150	176	158.9
6.1	181.1	176	158.9
7	207.8	176	158.9
7.9	243.6	176	158.9
8.8	279.8	176	158.9
9.7	307.2	176	158.9
10.5	330.2	176	158.9
11.4	353.3	176	158.9
12.3	371.8	176	158.9
14	399.5	176	158.9
15.8	418	189	158.9
16.7	422.5	193.3	158.9
17.6	427.1	197.7	158.9
18.4	431.6	210.7	158.9
19.3	436.3	223.8	158.9
20.2	436.3	241.3	158.9
21.1	440.9	256.2	158.9
22.8	445.5	272.1	158.9
24.6	450	303.3	163.3
25.5	454.6	321.2	172.1
26.3	459.2	330.2	181
28.1	463.7	348.2	198.7
29.9	468.3	366.3	212
31.6	477.3	375.3	225.3
33.4	481.9	388.8	238.6
35.1	490.9	402.3	266.5
38.6	490.9	424.7	306.4
42.1	495.4	433.7	324.7
45.7	499.9	442.7	338.5
49.2	504.4	456	361.5
52.7	513.5	464.9	379.9
57.1	518	464.9	398.3
61.5	518	473.8	412
105.4	549.3	531	484.8
146.6	571.6	565.9	502.7

TITLE:10/13\78 RUN #1 DELTA P = 4 PSIA

TEST SAMPLE POS B

TIME (SEC)	TC #B1 (DEG F)	TC #B2 (DEG F)	TC #B3 (DEG F)
0	150	158.7	167.1
.9	150	158.7	167.1
1.8	171.6	158.7	167.1
2.6	206.1	158.7	167.1
3.5	240.8	158.7	167.1
4.4	271.5	158.7	167.1
5.3	298.1	180.2	167.1
6.1	333.8	201.8	167.1
7	351.7	223.4	167.1
7.9	378.6	245.2	175.6
8.8	396.6	264.3	184.2
9.7	414.5	280.4	192.7
10.5	423.4	302.5	197
12.3	436.7	338.2	218.4
14	445.6	365.2	235.6
15.8	454.5	383.1	260
17.6	463.4	392.1	279
19.3	472.2	401.1	305.4
21.1	481	414.5	323
22.8	489.8	432.2	345.2
24.6	498.5	441.2	363
26.3	502.9	450.1	380.7
28.1	502.9	463.4	394.1
29.9	507.3	467.8	407.3
31.6	511.7	467.8	416.2
33.4	516	472.2	429.3
35.1	524.8	476.6	438.2
38.6	524.8	494.1	455.8
42.1	529.1	498.5	469
45.7	529.1	507.3	486.4
49.2	533.5	511.7	499.4
52.7	533.5	516	516.7
61.5	537.8	516	529.7
105.4	589.7	568.2	564
146.6	602.6	589.7	585.4

TITLE:10/13\78 RUN #1 DELTA P = 4 PSIA

TEST SAMPLE POS C

TIME (SEC)	TC #C1 (DEG F)	TC #C2 (DEG F)	TC #C3 (DEG F)
0	150	150	132.6
.9	150	150	132.6
1.8	165.8	150	132.6
2.6	193.3	150	132.6
3.5	217.1	162.1	132.6
4.4	240.9	178.2	132.6
5.3	262.8	198.4	141.3
6.1	289.1	214.6	154.3
7	309.4	234.8	171.7
7.9	325.7	257.3	193.3
8.8	346.2	275.8	215.1
9.7	358.5	296.5	232.5
10.5	374.9	321.5	245.7
11.4	387.2	338.2	264.7
12.3	399.5	355	281
13.2	407.6	371.8	294.4
14	415.8	384.4	307.8
14.9	423.9	392.7	325.7
15.8	432	405.3	334.7
17.6	436.1	422	357.3
19.3	440.2	434.4	375.3
21.1	448.3	451.1	393.3
22.8	456.4	463.5	402.3
24.6	464.5	475.9	415.8
26.3	472.6	480	424.7
28.1	476.6	484.1	433.7
29.9	476.6	488.2	442.7
33.4	480.6	492.3	460.5
38.6	496.6	500.5	482.6
42.1	504.6	500.5	495.9
45.7	516.6	504.6	504.7
49.2	524.6	508.7	504.7
52.7	532.6	508.7	504.7
57.1	540.5	512.8	509.1
61.5	540.5	516.8	509.1
105.4	591.8	601.8	548.4
146.6	572.1	621.9	561.5

TITLE:DATE 10\13\78 RUN #2 DELTA P=4 PSIA

PLENUM CONDITIONS

TIME (SEC)	PRESS (MMHG)	TEMP (DEG F)
0	40.4	158.9
.9	208.8	230.1
1.8	208.8	302.6
2.8	222.2	362.5
3.7	252.5	399.5
4.6	262.6	431.6
5.5	245.8	459.2
6.4	252.5	472.8
7.3	245.8	477.3
9.2	259.7	481.9
11	255.9	490.9
12.8	262.6	499.9
14.7	259.3	504.4
16.5	266	509
18.3	276.1	522.5
20.2	282.8	527
22	279.5	535.9
23.8	276.1	571.4
25.7	276.1	535.9
27.5	276.1	544.8
29.3	276.1	544.8
33	276.1	553.8
36.7	272.7	558.3
44	266	558.3
51.4	259.3	567.2
64.2	259.3	567.2
110	269.4	629.2
152.2	269.4	651.3

TITLE:DATE 10\13\78 RUN #2 DELTA P=4 PSIA

TEST SAMPLE POS A

TIME (SEC)	TC #A1 (DEG F)	TC #A2 (DEG F)	TC #A3 (DEG F)
0	163.4	150	110.2
.9	163.4	150	110.2
5.5	176.7	150	110.2
6.4	207.8	150	110.2
7.3	243.6	150	110.2
8.3	267	154.3	123.5
9.2	298.1	154.3	127.9
10.1	325.6	154.3	127.9
11	344	154.3	127.9
11.9	371.8	154.3	132.3
12.8	390.3	158.7	132.3
13.8	399.5	167.4	136.8
14.7	404.1	176	141.2
15.6	413.3	189	145.6
16.5	427.1	197.7	150
17.4	436.3	206.4	154.4
18.3	440.9	228.2	154.4
19.3	445.5	241.3	154.4
20.2	445.5	261.3	154.4
22	459.2	289.9	154.4
23.8	468.3	321.2	167.6
25.7	477.3	339.2	180.8
27.5	481.9	366.3	202.8
29.3	490.9	379.8	224.9
31.2	490.9	393.3	242.7
33	495.4	415.8	266.1
34.8	490.9	420.3	287.5
36.7	495.4	433.7	310.2
40.3	499.9	442.7	337.5
44	513.5	464.9	369.6
47.7	527	478.2	378.8
51.4	527	482.6	392.5
55	527	491.5	397
59.6	527	504.7	401.6
64.2	527	509.1	419.9
110	553.8	544.1	487.6
152.2	580.5	570.2	510

TITLE:DATE 10\13\78 RUN #2 DELTA P=4 PSIA

TEST SAMPLE POS R

TIME (SEC)	TC #R1 (DEG F)	TC #R2 (DEG F)	TC #R3 (DEG F)
0	162.7	154.3	141.5
.9	162.7	154.3	141.5
1.8	188	158.5	141.5
2.8	217.7	167	141.5
3.7	258.5	179.7	141.5
4.6	303.8	196.7	145.7
5.5	338.7	209.5	154.3
6.4	369.5	230.9	167
7.3	391.5	253.3	175.5
8.3	404.7	269.7	184
9.2	417.8	282.7	188.2
10.1	426.5	295.8	196.7
11	435.2	313.3	205.3
11.9	444	330.9	213.8
12.8	448.4	344.2	226.6
13.8	457	361.8	243.7
14.7	465.7	375.1	253.3
15.6	470	384	266.3
16.5	474.4	401.6	274
17.4	478.7	410.4	282.7
18.3	487.3	419.2	304.6
20.2	487.3	432.3	322.1
22	487.3	449.9	344.2
23.8	491.6	467.3	370.7
25.7	500.2	471.7	392.8
27.5	508.7	471.7	410.4
29.3	508.7	476	419.2
31.2	513	480.4	432.3
33	517.3	493.3	445.5
34.8	513	493.3	458.6
36.7	517.3	497.6	463
40.3	521.6	506.3	476
44	517.3	514.9	484.7
47.7	525.9	519.2	489
51.4	542.9	519.2	493.3
55	547.1	527.8	497.6
59.6	547.1	536.3	501.9
64.2	547.1	536.3	510.6
110	581	583.2	583.2
152.2	602.1	604.4	604.4

TITLE:DATE 10\13\78 RUN #? DELTA P=4 PSIA

TEST SAMPLE POS C

TIME (SEC)	TC #C1 (DEG F)	TC #C2 (DEG F)	TC #C3 (DEG F)
0	173.7	150	106.4
.9	177.6	150	106 4
1.8	197.3	150	106.4
2.8	217.1	150	106.4
3.7	244.9	154	110.8
4.6	272.9	170.2	119.5
5.5	293.1	194.3	137
6.4	313.4	218.6	150
7.3	333.9	243	171.7
8.3	350.3	264.9	189
9.2	370.7	284.1	206.4
10.1	383.1	309	228.2
11	395.4	317.3	250.1
11.9	407.6	334	268.2
12.8	415.8	350.8	294.4
13.8	423.9	363.4	307.8
14.7	432	384.4	325.7
15.6	436.1	401.1	334.7
16.5	444.3	413.6	348 2
17.4	448.3	434.4	366.3
18.3	452.4	438.6	375.3
20.2	456.4	451.1	388.8
22	464.5	471.8	411.3
23.8	468.5	486.2	424.7
25.7	476.6	508.7	438.2
27.5	476.6	533.1	442.7
29.3	484.6	545.3	451.6
31.2	496.6	549.3	460.5
33	500.6	557.5	464.9
34.8	504.6	561.5	469.4
36.7	516.6	561.5	478.2
40.3	520.6	561.5	482.6
44	520.6	561.5	504.7
47.7	516.6	561.5	504.7
55	524.6	561.5	522.2
59.6	532.6	573.6	526.6
64.2	532.6	573.6	526.6
110	568.2	609.9	557.2
152.2	576.1	650	574.5

TITLE:DATE 10/13/78 RUN #3 DELTA P = 2 PSIA

TIME (SEC)	PLENUM CONDITIONS PRESS (MMHG)	TEMP (DEG F)
0	151.5	194.4
.9	235.7	239.1
1.8	222.2	307.2
2.8	229	362.5
3.7	242.4	404.1
4.6	259.3	445.5
5.5	266	481.9
6.4	266	504.4
7.3	259.3	522.5
8.3	259.3	535.9
9.2	259.3	544.8
11	262.6	558.3
12.8	262.6	562.7
14.7	262.6	576.1
18.3	262.6	593.8
22	262.6	611.6
25.7	262.6	616
31.2	262.6	629.2
36.7	262.6	646.9
51.4	262.6	664.5
64.2	262.6	668.9
110	252.5	708.5
176.1	252.5	743.5

TITLE:DATE 10/13/78 RUN #3 DELTA P = 2 PSIA

TEST SAMPLE POS A

TIME (SEC)	TC #A1 (DEG F)	TC #A2 (DEG F)	TC #A3 (DEG F)
0	176.5	189	176.4
.9	176.5	189	176.4
7.3	176.5	189	176.4
8.3	189.8	189	176.4
9.2	220.8	189	176.4
10.1	243.1	189	176.4
11	266.5	189	176.4
11.9	288.2	189	176.4
12.8	311	189	176.4
13.8	329.3	189	176.4
14.7	343.1	189	176.4
15.6	370.7	189	176.4
16.5	384.5	189	176.4
17.4	398.3	189	176.4
18.3	412	189	176.4
19.3	425.7	189	176.4
20.2	430.2	189	176.4
22	444	189	176.4
22.9	457.6	202	176.4
23.8	462.2	210.7	176.4
24.8	471.2	219.4	176.4
25.7	480.3	228.2	176.4
26.6	484.8	232.5	176.4
27.5	493.7	241.3	180.8
29.3	498.2	256.2	185.2
31.2	502.7	268.2	185.2
33	516.2	285.5	189.6
34.8	520.7	303.3	198.4
36.7	525.1	325.7	202.8
40.3	529.6	352.7	216.1
44	538.5	375.3	233.8
47.7	543	388.8	252.2
51.4	551.8	420.3	269.6
55	560.7	433.7	287.5
59.6	560.7	456	310.2
64.2	560.7	464.9	314.7
110	587.3	517.9	442.6
176.1	613.8	591.9	487.6

TITLE:DATE 10/13/78 RUN #3 DELTA P = 2 PSIA

TEST SAMPLE POS B

TIME (SEC)	TC #B1 (DEG F)	TC #B2 (DEG F)	TC #B3 (DEG F)
0	178.9	179.4	192.5
.9	178.9	179.4	192.5
1.8	195.4	179.4	192.5
2.8	212	179.4	192.5
3.7	232.7	179.4	192.5
4.6	245.2	179.4	192.5
5.5	267	179.4	192.5
7.3	325.6	192	192.5
8.3	347.1	200.5	192.5
9.2	364.2	204.7	201
11	402.9	221.6	209.5
12.8	424.2	242.8	213.8
14.7	454	277	218
16.5	466.7	298.6	222.3
18.3	479.4	320.3	243.7
20.2	483.6	342.1	258.3
22	496.1	364	269.1
23.8	517.1	385.9	287.1
25.7	521.3	412.1	304.6
27.5	525.4	429.4	326.5
29.3	525.4	451.2	344.2
31.2	525.4	455.5	353
33	533.8	459.8	370.7
34.8	537.9	468.4	384
36.7	546.2	472.7	392.8
40.3	542.1	489.8	410.4
44	550.3	506.9	432.3
47.7	562.8	515.4	445.5
51.4	566.9	528.2	476
55	562.8	540.9	489
59.6	562.8	549.3	493.3
64.2	566.9	553.6	497.6
110	599.9	608.3	608.7
176.1	628.7	637.5	638.2

TITLE:DATE 10/13/78 RUN #3 DELTA P = 2 PSIA

TEST SAMPLE POS C

TIME (SEC)	TC #C1 (DEG F)	TC #C2 (DEG F)	TC #C3 (DEG F)
0	177.6	166.1	158.7
.9	177.6	166.1	158.7
1.8	185.5	166.1	158.7
2.8	197.3	166.1	158.7
3.7	217.1	166.1	158.7
4.6	232.9	166.1	167.4
5.5	248.9	182.3	171.7
7.3	281	214.6	180.3
9.2	317.5	251.6	189
11	354.4	288.2	202
12.8	379	313.1	215.1
14.7	411.7	346.6	228.2
16.5	436.1	371.8	250.1
18.3	444.3	401.1	268.2
20.2	460.5	426.1	294.4
22	472.6	447	321.2
23.8	484.6	471.8	348.2
25.7	500.6	488.2	366.3
27.5	508.6	504.6	379.8
29.3	512.6	512.8	402.3
31.2	516.6	516.8	420.3
33	520.6	525	429.2
34.8	524.6	529.1	438.2
36.7	520.6	533.1	447.1
40.3	524.6	549.3	469.4
44	524.6	561.5	478.2
47.7	532.6	569.6	491.5
51.4	540.5	577.7	495.9
55	548.4	577.7	513.5
59.6	540.5	597.8	517.9
64.2	540.5	597.8	526.6
110	599.7	673.9	557.2
176.1	631.1	701.8	591.9

TITLE:DATA 10/17/78 RUN #1 DELTA P = 4 PSIA

PLENUM CONDITIONS

TIME (SEC)	PRESS (MMHG)	TEMP (DEG F)
0	67.8	370.8
.9	284.7	561.5
1.7	169.4	591.9
3.5	230.5	708
4.4	216.9	712.3
5.2	223.7	725.1
6.1	237.2	733.7
7	254.2	750.7
7.9	271.1	759.3
8.8	281.3	763.5
9.6	281.3	772
10.5	277.9	780.6
11.4	271.1	776.3
12.3	264.3	780.6
14	271.1	784.8
15.8	281.3	797.6
17.5	301.6	801.8
19.2	305	801.8
21	294.8	806.1
24.5	298.2	818.8
26.3	298.2	823.1
35	291.5	840
43.8	291.5	848.5
52.5	288.1	852.7
61.3	288.1	865.4
105	288.1	865.4
157.5	277.9	920.4

TITLE:DATA 10/17/78 RUN #1 DELTA P = 4 PSIA

TEST SAMPLE POS A

TIME (SEC)	TC #A1 (DEG F)	TC #A2 (DEG F)	TC #A3 (DEG F)
0	193.3	158.7	115.5
5.2	206.4	158.7	115.5
6.1	232.5	158.7	115.5
7	256.2	158.7	115.5
7.9	307.8	167.4	115.5
8.8	348.2	167.4	115.5
9.6	379.8	171.7	128.5
10.5	415.8	180.3	132.8
12.3	495.9	176	145.7
14	548.4	184.7	150
15.8	587.5	202	154.3
17.5	630.7	219.4	158.6
19.2	665.2	256.2	162.9
21	678	281	167.2
22.8	690.9	316.7	175.8
24.5	699.5	361.8	188.6
26.3	712.3	397.8	201.5
28	716.6	433.7	210.1
29.7	720.9	473.8	231.7
31.5	733.7	495.9	244.7
33.3	733.7	513.5	254.7
35	733.7	526.6	270.9
38.5	733.7	570.2	315
42	737.9	609.2	359.6
45.5	742.2	635	408.7
49	746.5	652.3	448.6
52.5	750.7	673.7	475
56.9	750.7	699.5	509.9
61.3	755	716.6	540.2
105	801.8	772	647.4
157.5	797.6	806.1	681.4

TITLE:DATA 10/17/78 RUN #1 DELTA P = 4 PSIA

TEST SAMPLE POS B

TIME (SEC)	TC #B1 (DEG F)	TC #B2 (DEG F)	TC #B3 (DEG F)
0	210.7	185.4	167.2
.9	256.2	189.8	171.5
1.7	303.3	198.7	175.8
2.6	357.3	203.1	184.3
3.5	397.8	225.3	188.6
4.4	433.7	238.6	205.8
5.2	469.4	259.1	210.1
6.1	500.3	274.6	214.4
7	535.4	288.2	218.7
7.9	544.1	306.4	223.1
8.8	565.9	320.1	231.7
9.6	578.9	347.7	240.4
10.5	596.2	366.1	249.1
11.4	613.5	407.4	267.3
12.3	630.7	412	279.7
13.1	635	434.8	292.9
14	639.4	457.6	310.6
14.9	643.7	480.3	328.4
15.8	648	502.7	341.7
17.5	652.3	534.1	359.6
19.2	656.6	560.7	395.3
21	660.9	591.7	422
22.8	669.4	613.8	457.4
24.5	678	640.1	488.1
26.3	686.6	657.7	514.2
28	690.9	666.4	535.9
29.7	695.2	679.6	553.1
31.5	695.2	688.3	574.7
33.3	695.2	697.1	591.8
35	695.2	710.2	604.7
38.5	695.2	723.2	630.3
42	695.2	723.2	655.9
45.5	703.8	727.6	681.4
49	708	740.7	698.4
52.5	720.9	740.7	711.1
56.9	725.1	740.7	732.2
61.3	729.4	745	740.7
105	801.8	797.1	791.3
157.5	806.1	810.1	812.3

TITLE:DATA 10/17/78 RUN #1 DELTA P = 4 PSIA

TEST SAMPLE POS C

TIME (SEC)	TC #C1 (DEG F)	TC #C2 (DEG F)	TC #C3 (DEG F)
0	229	203.7	114.6
.9	246.7	203.7	114.6
1.7	273.4	203.7	114.6
2.6	304.9	217.1	114.6
3.5	332.1	239.6	123.5
4.4	354.8	264	132.3
5.2	377.6	289.7	141.2
6.1	404.9	312.8	150
7	427.5	331.3	158.8
7.9	459.1	345.2	167.6
8.8	485.9	368.5	189.6
9.6	508.2	391.7	207.2
10.5	530.3	419.5	229.3
11.4	548	442.6	252.2
12.3	570	461	274
13.1	591.8	483.8	301.1
14	604.9	506.5	323.9
14.9	626.7	524.6	351.3
15.8	639.8	542.6	369.6
16.6	644.1	560.6	401.6
17.5	652.8	569.6	424.4
18.4	661.5	583	447.1
19.2	674.5	596.4	465.2
20.1	678.8	609.7	478.7
21	683.2	614.2	487.6
22.8	691.8	632	518.9
24.5	713.5	649.7	527.8
26.3	717.8	663	549.9
28	730.7	676.3	567.6
29.7	735	685.1	580.8
31.5	739.4	694	594
33.3	748	711.6	607.1
35	752.3	720.5	615.9
38.5	760.9	746.9	629
42	765.2	746.9	642.2
45.5	769.5	755.7	646.5
49	769.5	760.1	655.3
52.5	773.8	764.5	664
56.9	782.4	786.4	672.7
61.3	786.7	790.8	681.4
105	816.7	834.5	724.9
157.5	846.7	838.9	750.8

TITLE:DATA 10/17/78 RUN #2 DELTA P = 4 PSIA

	PLENUM CONDITIONS	
TIME (SEC)	PRESS (MMHG)	TEMP (DEG F)
0	81.3	411.3
.9	315.2	596.2
1.7	298.2	678
2.6	284.7	716.6
3.5	261	742.2
4.4	250.8	755
5.2	261	763.5
6.1	284.7	772
7	298.2	780.6
7.9	291.5	789.1
8.8	284.7	797.6
10.5	291.5	801.8
12.3	294.8	810.3
14	294.8	823.1
26.3	294.8	844.2
42	294.8	865.4
52.5	294.8	882.4
61.3	294.8	907.7
105	294.8	954.2
157.5	294.8	975.3

TITLE:DATA 10/17/78 RUN #2 DELTA P = 4 PSIA

TEST SAMPLE POS A

TIME (SEC)	TC #A1 (DEG F)	TC #A2 (DEG F)	TC #A3 (DEG F)
0	193.3	193.3	167.2
2.6	193.3	193.3	167.2
3.5	206.4	193.3	167.2
4.4	215.1	193.3	167.2
5.2	236.9	193.3	167.2
6.1	276.6	193.3	167.2
7	325.7	193.3	167.2
7.9	379.8	193.3	167.2
8.8	429.2	193.3	167.2
9.6	473.8	193.3	167.2
10.5	509.1	193.3	167.2
11.4	539.7	193.3	167.2
12.3	565.9	193.3	167.2
13.1	587.5	193.3	167.2
14	609.2	202	167.2
14.9	622.1	210.7	167.2
15.8	635	223.8	167.2
16.6	648	236.9	167.2
17.5	665.2	245.7	167.2
18.4	678	256.2	171.5
19.2	686.6	276.6	175.8
21	699.5	316.7	180
22.8	716.6	357.3	192.9
24.5	720.9	388.8	201.5
26.3	720.9	420.3	210.1
28	725.1	451.6	223.1
29.7	729.4	482.6	244.7
31.5	729.4	509.1	263.8
33.3	733.7	526.6	275.3
35	737.9	548.4	292.9
38.5	746.5	591.9	323.9
42	755	626.4	368.5
45.5	755	643.7	408.7
49	763.5	665.2	444.2
52.5	767.8	690.9	475
56.9	776.3	708	514.2
61.3	784.8	720.9	544.5
105	827.3	784.8	668.6
157.5	882.4	827.3	706.8

TITLE:DATA 10/17/78 RUN #2 DELTA P = 4 PSIA

TEST SAMPLE POS B

TIME (SEC)	TC #B1 (DEG F)	TC #B2 (DEG F)	TC #B3 (DEG F)
0	225.3	193.3	192.9
.9	266.5	193.3	192.9
1.7	361.5	193.3	192.9
2.6	430.2	228.2	192.9
3.5	471.2	250.1	192.9
4.4	507.2	261.3	192.9
5.2	543	272.1	192.9
6.1	569.6	294.4	205.8
7	596.1	316.7	214.4
7.9	622.5	339.2	231.7
8.8	640.1	361.8	240.4
9.6	666.4	388.8	244.7
10.5	688.3	411.3	263.8
12.3	710.2	460.5	284.1
14	727.6	500.3	319.5
15.8	732	539.7	346.2
17.5	740.7	565.9	373
19.2	749.4	591.9	408.7
21	753.7	609.2	439.7
22.8	758.1	630.7	479.3
24.5	762.4	652.3	505.5
26.3	771.1	660.9	522.9
28	775.4	673.7	544.5
31.5	779.8	678	579
35	784.1	690.9	609
38.5	788.5	708	634.6
42	797.1	716.6	664.4
45.5	801.5	729.4	689.9
49	805.8	733.7	698.4
52.5	805.8	746.5	715.3
56.9	810.1	759.3	728
61.3	810.1	763.5	740.7
105	849.1	806.1	808.1
157.5	849.1	831.5	850.1

TITLE:DATA 10/17/78 RUN #2 DELTA P = 4 PSIA

TEST SAMPLE POS C

TIME (SEC)	TC #C1 (DEG F)	TC #C2 (DEG F)	TC #C3 (DEG F)
0	215.7	203.7	176.4
.9	229	203.7	176.4
1.7	262.1	212.6	176.4
2.6	300.4	221.6	176.4
3.5	350.3	244.1	185.2
4.4	391.3	260.4	189.6
5.2	427.5	289.7	198.4
6.1	454.6	317.4	207.2
7	481.5	349.9	220.5
7.9	512.6	377.8	233.8
8.8	539.2	405.6	258.4
9.6	565.6	438	278.5
10.5	591.8	470.1	301.1
11.4	613.7	492.9	323.9
12.3	631.1	515.6	346.7
13.1	648.5	538.1	374.2
14	661.5	560.6	397
14.9	674.5	578.5	419.9
15.8	687.5	596.4	438
16.6	700.5	609.7	456.1
17.5	704.8	623.1	474.2
19.2	717.8	645.3	510
21	726.4	663	536.6
22.8	735	685.1	554.3
24.5	748	698.4	580.8
26.3	752.3	711.6	594
28	760.9	724.9	607.1
29.7	769.5	742.5	620.3
31.5	782.4	746.9	629
35	791	746.9	642.2
45.5	791	786.4	681.4
52.5	812.4	808.3	711.8
56.9	821	817.1	711.8
61.3	833.9	817.1	716.2
105	868.1	869.5	776.8
157.5	906.5	904.4	789.7

TITLE:DATA 10/17/78 RUN #3 DELTA P = 4 PSIA

	PLENUM CONDITIONS	
TIME (SEC)	PRESS (MMHG)	TEMP (DEG F)
0	47.4	438.2
.9	176.2	548.4
1.7	284.7	690.9
2.6	250.8	746.5
3.4	206.7	759.3
4.3	203.3	772
5.1	216.9	784.8
6	237.2	806.1
6.8	250.8	818.8
7.7	257.6	831.5
8.5	274.5	840
10.2	261	852.7
11.9	261	856.9
13.6	261	861.2
17	267.7	869.7
25.5	284.7	882.4
34	284.7	899.3
42.5	284.7	903.5
51	281.3	911.9
59.5	281.3	924.6
102	284.7	954.2
144.5	277.9	966.9

TITLE:DATA 10/17/78 RUN #3 DELTA P = 4 PSIA

TEST SAMPLE POS A

TIME (SEC)	TC #A1 (DEG F)	TC #A2 (DEG F)	TC #A3 (DEG F)
0	288.5	315	245.7
2.6	288.5	315	245.7
3.4	297.3	315	245.7
4.3	301.7	315	256.2
5.1	306.2	315	261.3
6	319.5	315	264.7
6.8	346.2	315	268.2
7.7	377.5	315	268.2
8.5	422	315	272.1
9.3	466.2	315	272.1
10.2	505.5	315	272.1
11.9	553.1	315	272.1
13.6	600.4	315	276.6
15.3	638.8	315	276.6
17	664.4	315	281
18.7	685.6	315	281
20.4	719.5	328.4	281
22.1	736.5	355.1	285.5
23.8	749.1	377.5	285.5
25.5	766	413.1	289.9
27.2	778.6	439.7	289.9
28.9	791.3	466.2	289.9
34	808.1	553.1	312.2
44.2	812.3	647.4	424.7
45.9	816.5	664.4	438.2
47.6	816.5	706.8	456
51	820.7	749.1	491.5
59.5	850.1	782.9	565.9
102	858.5	833.3	686.6
144.5	862.7	862.7	699.5

TITLE:DATA 10/17/78 RUN #3 DELTA P = 4 PSIA

TEST SAMPLE POS B

TIME (SEC)	TC #B1 (DEG F)	TC #B2 (DEG F)	TC #B3 (DEG F)
0	303.3	270.3	277.8
.9	312.2	270.3	277.8
1.7	357.3	283.4	277.8
2.6	424.7	296.6	277.8
3.4	469.4	314.2	277.8
4.3	513.5	340.7	277.8
5.1	552.8	363	277.8
6	583.2	385.2	286.5
6.8	600.5	407.3	290.8
7.7	622.1	429.3	290.8
8.5	643.7	447.1	299.6
9.3	656.6	464.6	317
10.2	682.3	482	330.2
11.9	708	512.4	361
13.6	720.9	546.8	383
15.3	737.9	576.8	391.8
17	750.7	602.4	409.3
18.7	759.3	619.4	431.1
20.4	772	649.2	456
22.1	784.8	666.1	474.7
23.8	793.3	691.4	496.2
25.5	797.6	716.7	513.4
30.6	814.6	767.2	594.1
34	827.3	788.1	623.7
42.5	827.3	788.1	720
51	827.3	809	770
59.5	827.3	830	790.8
102	848.5	850.8	836.3
144.5	882.4	871.7	865.3

TITLE:DATA 10/17/76 RUN #3 DELTA P = 4 PSIA

TEST SAMPLE POS C

TIME (SEC)	TC #C1 (DEG F)	TC #C2 (DEG F)	TC #C3 (DEG F)
0	288.2	268.5	212.6
1.7	315.6	268.5	212.6
2.6	347.7	282	212.6
3.4	389.1	309.9	212.6
4.3	435.7	319.2	226.1
5.1	466.7	342.6	239.6
6	493.7	370.8	244.1
6.8	516.2	389.7	254.4
8.5	574	445.8	285.2
10.2	613.8	496.5	317.4
11.9	648.9	537.7	349.9
13.6	675.2	574	382.4
15.3	697.1	601	410.3
17	718.9	628	442.6
22.1	771.1	677.3	520.1
25.5	801.5	726.4	578.5
34	836.1	788.6	654.2
42.5	866.4	815.1	694
51	879.3	846	724.9
59.5	888	859.3	736.7
102	909.5	881.4	760.1
144.5	922.4	907.8	808.3