AIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIM STANDARDS
BY APPLIED IMAGE, INC.

1 of 1

DECLASSIFIED

HW-73229

DATE
June 1, 1962

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

TITLE

FLOW TESTING REAR FACE HARDWARE COMBINATIONS

AUTHOR

F. E. Haun, Jr.

ISSUING FILE

JUN 6 1962
RETURN TO

THIS DOCUMENT MUST BE LEFT UNATTENDED OR WHERE AN UNAUTHORIZED PERSON MAY HAVE ACCESS TO IT. WHEN NOT IN USE, IT MUST BE STORED IN AN APPROVED LOCKED CONTAINER. WHEN GUARDED AND WHILE IT IS YOUR RESPONSIBILITY AND UNTIL YOU HAVE OBTAINED A SIGNED RECEIPT FROM CLASSIFIED FILES, IT IS YOUR RESPONSIBILITY TO KEEP IT AND ITS CONTENTS WITHIN THE LIMITS OF THIS SUBJECT AND FROM AN UNAUTHORIZED PERSON. UPON SUBMITTAL TO, AND RETURN AT YOUR PLACE OF RESIDENCE IS PROHIBITED. IT IS NOT TO BE REPRODUCED. IF ADDITIONAL COPIES ARE REQUIRED, OBTAIN THEM FROM THE RELATED ISSUING OFFICE. PERSONS READING THIS DOCUMENT ARE REQUESTED TO SIGN IN THE SPACE PROVIDED BELOW.

SIGNATURE AND DATE

RECORD
COPY

BEEN SCANNED
OPTICAL DISK DRIVE

THIS DOCUMENT HAS BEEN SCANNED
AND IS STORED ON THE OPTICAL DISK DRIVE

[illegible]

Authority

(CLASSIFICATION)

DECLASSIFIED

DECLASSIFIED

HW-73229

This document classified by

JR Spink

This document consists
of 35 pages. No. 1
of 9 copies. 1

Classification Cancelled and Changed To

DECLASSIFIED

By Authority of RM Jten

CG-PR-2, 3-8-94

By J. E. Savelly 3-25-94

Verified By DK Hansen, 3-29-94

FLOW TESTING REAR FACE HARDWARE COMBINATIONS

June 1, 1962

Distribution:

1. J. L. Deichman 1704-F, 100-F
2. D. H. Frieling 1704-F, 100-F
3. F. E. Haun, Jr. 1703-D, 100-D
4. D. L. Hovorka 1703-D, 100-D
5. R. T. Jaske 1704-F, 100-F
6. J. R. Spink 1703-D, 100-D
7. W. W. Windsheimer 1704-F, 100-F
8. 300 File 3760, 300
9. Record Center 712, 700

MASTER

[REDACTED]
This document contains information the disclosure of its
content in any manner to an unauthorized person is prohibited.

DECLASSIFIED

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

875

DECLASSIFIED

-2-

HW-73229

FLOW TESTING REAR FACE HARDWARE COMBINATIONS

INTRODUCTION

The purpose of these tests is to provide necessary laboratory data in support of an R,PEO program in determining the energy loss associated with various hardware size combinations on the rear face of the B-D-F reactors.

SUMMARY

The original method used to check for critical flow was determined to be faulty. A revised method demonstrated critical flow did occur in the 5/8-inch inconel connector and combination 1 fittings. The remaining fitting combinations with the 5/8-inch inconel and 3/4-inch aluminum connector were not rechecked because of the reaming of the I.D. to permit the continuation of the original tests.

During test number 6, audible cavitation was heard with the highest severity at a point midway between pressure points 3 and 4 on the connector. This condition appeared again in tests 6A, 7, and 7A, with incipient cavitation at approximately 40 gpm in each test, regardless of the rear header pressure and/or temperature.

The data sheets, delta P (rear nozzle barrel pressure minus rear header pressure) versus Q (tube flow) curves and pressure profile curves are in groups with a particular test combination and temperature. Groups 1 and 1A represent a given test combination at 100 C and 120 C, respectively, and so on through the eight test combinations.

DESCRIPTION OF TEST APPARATUS AND TEST COMBINATIONS

All tests were performed on the 189-D three-tube mock-up, using a standard B-D-F ribbed process tube. Pumping power was supplied by an Ingersoll Rand 1-1/2 - 5 VP turbine pump. Cold water runs were made by valving the effluent to drain and the higher temperature runs were made with recirculating flow, using pump power to heat the water to the required temperatures. Temperature and pressure controls were obtained using a feed-and-bleed valving system. Temperatures were measured by using a Video Instrument null point indicator and standard copper-constantin thermocouples. Flow was measured with a Brooks Ar-met Rotameter. Previous calibrations of this rotameter indicated an accuracy of $\pm .4$ gpm over extended run periods. Due to the inability of the rotameter to adjust to minor flow changes, during the tests, the accuracy is estimated to be no greater than ± 2 gpm.

The standard B-D-F perf pattern was used in the process tube with one standard I&E fuel element upstream.

DECLASSIFIED

-3-

HW-73229

A standard B-D-F rear nozzle with the standard .625-inch horizontal side outlet port was utilized in the rear assembly. The connectors and connector fittings used with each test were as follows:

<u>Test Combination</u>	<u>Nozzle (side outlet)</u>	<u>Nozzle Fitting</u>	<u>Connector</u>	<u>Adapter Fitting (3/4")</u>	<u>Parker Fitting</u>
1 & 1A	.625	.469	.545	--	.469
2 & 2A	.625	.550	.545	--	.550 (.548)
3 & 3A	.625	.580	.545	--	.550 (.548)
4 & 4A	.625	.580	.545	--	.580 (.582)
5 & 5A	.625	.580	.634	.680/.580 (.581)	.580 (.582)
6 & 6A	.625	.610	.634	.680/.580 (.581)	.580 (.582)
7 & 7A	.625	.610	.634	.680/.610	.610
8 & 8A	.625	.610 (.615)	.545	--	.610

The figures in parentheses indicate the actual measured size of the fitting. All other figures are nominal drawing I.D.

Special pressure taps on the nozzle, connector, and rear header facilitated the collection of the pressure data. These taps were located as follows:

<u>Pressure Point</u>	<u>Location</u>
Nozzle	Stagnation zone of barrel.
P1	1-1/2" downstream of side outlet in the horizontal water channel.
P2	4" downstream of side outlet in the horizontal channel of nozzle.
P3	1-1/2" downstream of the inlet end of connector.
P4	Midway of connector.
P5	1-1/2" upstream of the outlet end of connector.
R.H.P.	Rear crossheader.

The exact location of these points is shown in the photograph, page 15.

DECLASSIFIED

-4-

HW-73229

DISCUSSION

The required 20 psig rear header pressure was obtained during tests 1 through 4, which were run at a temperature of 100 C. The 20 psig required at the rear header was not obtainable during the last four test series, due to the decrease in pressure drop across the 3/4-inch aluminum connector and associated fittings, and to the demand pressure required at the pump inlet (this is required to prevent pump cavitation). At 120 C, the lowest rear header pressure obtained was 39 psig, but in most cases, approximately 50 psig was obtained. This can be attributed to the higher vapor pressure of the water.

The original method used for checking critical flow was to lower the rear header pressure and check for a change in the front header pressure and/or flow. This method was used in each of the original test combinations. After evaluating the data from these tests, it was determined that a change in upstream pressure would always be encountered with a change in rear header pressure whether there was critical flow because of the nature of the recirculating system. From this determination, a revised test method was used on the 5/8-inch inconel connector and combination 1 fittings. During this test the front header pressure was held constant to compensate for varying pump inlet pressures. The rear header pressure was reduced and the changes in rear nozzle pressure and flow were observed. Due to the inability of the rotameter to adjust to the small changes in flow during this test, the rear nozzle barrel pressure was used as a more sensitive indicator of flow. When no pressure change was observed in the rear nozzle, critical flow had been reached. The results of this test are shown in Table 1, page 6. The point of critical flow is underlined in each column for the front header pressure indicated.

It was noted during the tests that at the higher flow rates, a higher level of noise was detected in the side outlet port of the nozzle. This can be attributed to the turbulence generated in the water by making the turn from the nozzle barrel into the side outlet port. With the use of a stethoscope, the turbulence seemed to dissipate very rapidly upon entering the nozzle outlet fitting and connector.

Audible cavitation was encountered during tests 6, 6A, 7, and 7A. A stethoscope was used to ascertain the exact location of the cavitation. The location of greatest severity seemed to be midway between pressure points 3 and 4. This condition prevailed regardless of the temperature ranges or rear header pressures. The threshold flow for cavitation to exist in an audible range was approximately 40 gpm. It should be noted that during each test the delta P value decreased as the sequence of fitting size and/or connector was increased. This is shown by comparing the characteristic flow curves of test 1 with those of test 4 where the I.D. of the fittings were changed and the connector size remained unchanged. Pressure profile 1 (combination 8) and pressure profile 2 (combination 8) show the pressure changes that occurred by using the

DECLASSIFIED

-5-

HW-73229

5/8-inch inconel connector and enlarging the connector fittings only. Pressure profile 3 (combination 5) and pressure profile 4 (combination 7) show the same comparison for the 3/4-inch aluminum connector with only the fitting sizes being changed.

These tests were all performed with the rear nozzle so attached as to place the side outlet port in the 10 o'clock position.

F. E. Haun, Jr.

Technician
Equipment Laboratory and Testing

FE Haun, Jr.:bt

DECLASSIFIED

-6-

HW-73229

TABLE 1
CRITICAL FLOW TEST

R.H.P.	FHP Constant 375		FHP Constant 300		FHP Constant 225		FHP Constant 160	
	R.N.P.	Flow	R.N.P.	Flow	R.N.P.	Flow	R.N.P.	Flow
90	285	56	234	51	183	41	139	30
85	<u>284</u>	<u>57</u>	233	50	184	41	136	30
80	280	57	231	50	180	41	135	30
75	280	57	229	50	177	41	133	30
70	280	57	<u>227</u>	<u>50</u>	176	41	131	32
65	280	57	225	50	174	41	129	32.5
60	280	57	224	50	172	41	127	33
55	281	57	225	50	171	42	125	33.5
50	281	57	225	50	<u>170</u>	<u>43</u>	125	34
45	281	57	225	50	168	43	120	35
40	281	57	225	50	168	43.5	121	35.5
35	281	57	225	50	167	44	<u>119</u>	<u>36.5</u>
30	280	57	225	50	168	44	119	37
25	280	57	226	50	168	44	119	37

DECLASSIFIED

-7-

HW-73229

FLOW TESTING REAR FACE HARDWARE COMBINATIONS

<u>Flow</u>	<u>ΔP</u>	<u>Nozz.</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>R.H.P.</u>
<u>Test Combination 1 -- 100 C</u>								
30	52	72	51	50	37	31	28	20
40	127	147	100	98	66	49	43	20
45	148	168	113	111	76	56	49	20
50	211	231	156	155	102	78	63	20
55	248	268	181	179	119	89	79	20
60	324	344	240	239	151	114	100	20

Temperature ± 2 C

30	50	100	81	76	67	59	56	50
40	90	140	102	100	76	64	59	50
45	102	152	108	107	82	65	59	50
50	154	204	138	137	90	68	60	50
55	237	287	194	192	126	95	84	50
60	255	305	206	204	135	101	89	50
- - - - -								
40	95	185	144	143	114	100	95	90
45	134	224	165	164	123	102	95	90
50	149	239	175	174	128	106	99	90
55	171	261	185	184	131	106	96	90
60	234	324	219	217	145	110	98	90

Test Combination 1A -- 120 C

30	45	85	67	65	51	43	42	40
38	93	132	97	95	67	54	50	39
44	147	186	133	131	89	72	64	39
50	195	236	166	164	111	87	78	41
55	227	267	187	185	126	100	90	40
60	267	307	214	212	142	112	101	40

Limitation on rear header is due to pump cavitation at 120 C if pressure is not great enough at pump inlet.

29	42	131	115	113	99	93	91	89
41	105	194	150	148	114	99	93	89
47	141	229	170	168	122	102	94	88
52	173	263	188	187	129	104	95	90
58	206	295	203	201	136	107	96	89
64	254	343	237	235	157	122	108	89

DECLASSIFIED

-8-

HW-73229

FLOW TESTING REAR FACE HARDWARE COMBINATIONS

<u>Flow</u>	<u>ΔP</u>	<u>Nozz.</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>R.H.P.</u>
<u>Test Combination 2 -- 100 C</u>								
30	36	56	36	36	29	22	19	20
39	65	88	53	52	36	23	18	23
45	93	119	71	70	46	27	21	26
51	112	147	85	84	51	27	20	35
54	120	157	93	92	59	35	26	37
60	167	201	110	109	63	29	17	34
<u>Test Combination 2A -- 120 C</u>								
32	42	92	70	70	58	50	47	50
41	79	129	86	85	64	48	42	50
45	88	136	89	88	64	45	40	48
48.5	102	151	96	95	67	46	37	49
57.5	154	203	120	119	77	44	33	49
64	210	263	150	148	90	46	31	53
<u>Test Combination 2A -- 120 C</u>								
30	36	126	107	106	97	90	87	90
38	64	154	119	118	101	89	84	90
44	86	175	129	128	105	87	80	89
50	116	206	144	143	110	86	78	90
56	142	232	156	154	115	85	75	90
60	169	258	167	165	119	84	71	89
<u>Test Combination 2A -- 120 C</u>								
29	33	83	67	66	57	50	47	50
36	52	100	74	73	59	48	45	48
40.5	74	123	84	83	64	48	43	49
43	78	128	86	85	65	49	43	50
50	111	160	100	98	68	46	37	49
54	127	177	108	107	72	46	37	50
60.5	156	219	140	138	86	46	33	53
<u>Test Combination 2A -- 120 C</u>								
30	38	128	106	105	96	87	85	90
40	69	159	122	121	102	88	83	90
44	83	173	128	127	104	87	81	90
50	109	199	140	138	109	86	78	90
57	143	233	156	154	115	85	75	90
63.5	192	282	178	176	123	83	68	90

DECLASSIFIED

-9-

HW-73229

FLOW TESTING REAR FACE HARDWARE COMBINATIONS

<u>Flow</u>	<u>ΔP</u>	<u>Nozz.</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>R.H.P.</u>
<u>Test Combination 3 -- 100 C</u>								
30-31	34	56	38	37	28	19	16	20-22
40-38	54	74	46	45	30	17	12	20-20
45-45	87	108	63	62	38	18	11	20-21
50-48	101	121	71	70	43	20	13	20-20
55-55	125	147	84	82	49	20	11	20-22
64	167	198	112	111	65	27	14	31
30-30	35	84	67	66	57	49	46	50-49
40-43	86	136	92	91	67	47	40	50-50
45-47.5	102	153	100	98	70	46	39	50-51
50-50	110	161	103	102	72	46	38	50-51
55-53	118	168	107	106	73	45	36	50-50
60-64.5	191	245	145	144	90	47	32	50-54
30-30	32	122	106	104	96	89	86	90-90
40-37.5	55	145	117	116	101	88	84	90-90
45-45.5	80	170	127	125	105	87	81	90-90
50-49.5	98	188	137	135	108	85	78	90-90
55-56.5	137	227	155	153	116	84	74	90-90
60-60.5	149	239	161	159	118	84	73	90-90
<u>Test Combination 3A -- 120 C</u>								
28	28	68	54	53	46	39	37	40
39	61	101	69	68	52	38	33	40
45	85	124	80	79	56	37	30	40
48.5	95	135	85	84	58	36	29	40
55	122	162	108	106	63	35	25	40
60.5	149	189	111	109	68	34	23	41
29	33	123	107	106	97	90	87	90
38	57	147	117	116	101	88	83	90
44.5	79	169	128	127	105	87	81	90
49	96	186	136	135	107	85	77	90
56.5	132	222	152	150	115	84	74	90
62	154	244	163	160	118	83	72	90

DECLASSIFIED

-10-

HW-73229

FLOW TESTING REAR FACE HARDWARE COMBINATIONS

<u>Flow</u>	<u>ΔP</u>	<u>Nozz.</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>R.H.P.</u>
<u>Test Combination 4 -- 100 C</u>								
30-29	26	57	43	42	35	29	26	31
40-39.5	58	89	58	57	40	26	21	31
45-44	70	100	63	61	41	25	19	30
50-49	88	117	70	69	44	23	15	29
60-60	135	167	95	93	54	21	10	32
69	198	227	122	120	63	16	3	29
- - - - -								
30-29.5	31	81	64	64	55	48	45	50-50
40-40	60	110	78	76	60	46	41	50-50
45-44.5	78	128	86	85	63	44	38	50-50
50-50	100	153	99	97	69	45	37	50-53
55-54	111	162	103	102	70	43	34	50-52
60.5	165	217	128	126	79	39	26	50-52
- - - - -								
30-30.5	33	123	106	105	96	88	85	90-90
40-38	49	139	113	111	98	87	82	90-90
45-44	68	158	121	120	101	85	79	90-90
55-52.5	101	191	136	135	108	82	70	90-90
60-61	150	240	158	156	114	78	66	90-90
<u>Test Combination 4A -- 120 C</u>								
30-28	27	69	55	55	47	41	39	42
40-40	63	103	70	69	51	36	31	40
45-43	64	105	71	70	52	36	31	41
50-49.5	95	139	87	86	59	37	29	44
55-53.5	99	143	89	87	60	36	28	44
60-61	165	216	127	124	78	38	24	51
69	222	278	158	154	93	40	22	56
- - - - -								
30-33	37	127	108	107	96	88	84	90
40-38.5	51	141	114	114	99	86	82	90
45-44	67	157	121	120	101	85	79	90
50-50.5	91	180	131	129	104	82	75	90-89
55-54.5	104	194	138	137	107	82	73	90
60-60	147	237	157	154	113	78	57	90
71	208	298	185	182	123	74	56	90-90

DECLASSIFIED

-11-

HW-73229

FLOW TESTING REAR FACE HARDWARE COMBINATIONS

<u>Flow</u>	<u>ΔP</u>	<u>Nozz.</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>R.H.P.</u>
<u>Test Combination 5 -- 100 C</u>								
30	20	36	23	22	20	16	16	16
40-39	41	60	32	31	28	18	18	19
45-44.5	62	84	42	40	35	19	19	22
50-49.5	80	105	49	47	41	21	21	25
55-53.5	98	125	56	54	46	22	22	27
60-60	117	146	65	62	52	23	24	29
<u>Test Combination 5A -- 120 C</u>								
30-30.5	28	78	59	58	56	49	49	50
40-39	51	101	66	65	60	47	47	50
45-44	66	116	71	69	63	47	47	50
50-47.5	73	122	73	71	65	46	47	49
55-57	108	158	83	81	71	45	45	50
60-66	146	195	94	92	76	41	42	49
<u>Test Combination 5A -- 120 C</u>								
30-30	25	115	98	98	95	89	89	90
40-40	46	137	106	105	100	89	89	91
45-45	58	148	108	107	102	88	88	90
50-50	79	171	115	113	107	87	88	92
55-54.5	84	174	116	114	106	86	86	90
60-59	109	199	123	120	110	83	84	90
60-64	123	213	129	126	114	84	85	91
<u>Test Combination 5A -- 120 C</u>								
30	31	81	60	59	57	49	49	50-50
40-39	43	93	64	62	59	49	49	50-50
45-44	54	104	67	65	60	48	48	50-50
50-49	70	120	72	70	64	48	48	50-50
55-54	84	133	75	73	66	46	46	50-49
60-60	108	157	82	79	69	43	44	50-49
<u>Test Combination 5A -- 120 C</u>								
30-32	31	121	100	99	97	90	90	90-91
40-40.5	60	150	108	106	101	87	87	90-90
45-45	66	156	111	110	103	88	88	90-91
50-52	89	179	117	115	107	85	85	90-90
55-55.5	99	189	119	117	107	85	85	90-90
60	105	195	121	119	109	84	85	90-90

DECLASSIFIED

-12-

HW-73229

FLOW TESTING REAR FACE HARDWARE COMBINATIONS

<u>Flow</u>	<u>ΔP</u>	<u>Nozz.</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>R.H.P.</u>	<u>Cavitation</u>
<u>Test Combination 6 -- 100 C</u>									
30-32	27	65	47	46	44	37	37	38	
40-39.5	42	80	52	51	47	36	36	38	Cavitation
45-45	55	93	56	54	50	36	36	38	Cavitation
50-50	78	116	63	61	54	34	34	38	Cavitation
55-56.5	98	136	68	66	57	32	32	38	Cavitation
60-62	114	152	73	69	60	31	31	38	
- - - - -									
30-30	24	75	69	69	56	50	50	50-51	
40-40	48	98	67	65	60	49	48	50-50	38 to 40 gpm
									Cavitation
45-46	69	119	73	71	64	47	46	50-50	Cavitation
50-50	75	127	76	74	68	49	48	50-52	Cavitation
55-53.5	87	137	79	76	68	46	46	50-50	Cavitation
60-59	118	168	87	85	74	44	44	50-50	Cavitation
70	171	224	105	102	86	44		53	Cavitation
- - - - -									
30	27	118	100	99	97	90	90	90-91	
40-38	41	131	103	102	99	88.5	88.5	90-90	Cavitation
45-44.5	60	150	110	108	103	88	88	90-90	Cavitation
50-49	71	161	113	111	105	87	87	90-90	Cavitation
55-56	94	184	120	117	108	86	86	90-90	Cavitation
60-58	100	190	121	119	109	85	85	90-90	Cavitation

Test Combination 6A -- 100 C

30-27.5	20	70	57	56	55	50	49	50-51	
40-40	44	94	65	64	60	49	49	50-50	Cavitation
45-43	55	104	68	67	62	48	47	50-49	Cavitation
50-49	74	128	77	76	68	51	51	50-54	Cavitation
55-57	103	152	81	79	69	43	43	50-49	Cavitation
- - - - -									
30-32	27	117	100	99	97	90	90.5	90-91	
40-41	57	147	109	107	101	89	89	90-90	
45-46	71	161	113	112	104	87	87	90-90	Cavitation
50-51	87	177	117	115	107	86	86	90-90	Cavitation
55-55.5	101	190	121	119	110	86	86	90-89	Cavitation
60	124	214	128	126	114	85	84	90-90	Cavitation

DECLASSIFIED

-13-

HW-73229

FLOW TESTING REAR FACE HARDWARE COMBINATIONS

<u>Flow</u>	<u>ΔP</u>	<u>Nozz.</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>R.H.P.</u>	<u>Cavitation</u>
<u>Test Combination 7 -- 100 C</u>									
30	Due to the small pressure drop across the							20	
40								20	
45	3/4-inch aluminum connector, the required							20	
50								20	
55	20 psig rear header pressure is not obtain-							20	
60	able in the present recirculating system.							20	
30-31	24	75	61	60	58	53	52	50-51	
40-38.5	39	89	63	62	58	49	49	50-50	Cavitation
45-45	51	101	68	67	62	50	49	50-50	Cavitation
50-50	68	118	71	70	64	48	47	50-50	Cavitation
60-56.5	88	136	75	73	65	45	43	50-48	
70-71.5	153	201	93	89	75	38	36	50-48	
76-76	174	222	98	94	77	36	34	50-48	
- - - - -									
30-29	22	113	100	99	97	92	91	90-91	
40-40	43	133	105	104	100	90	90	90-90	
45-47	73	164	114	111	105	87	86	90-91	Cavitation
50-51	84	174	115	113	105	86	84	90-90	Cavitation
55-55	103	194	122	119	109	85	83	90-91	Cavitation
60-60	96	187	119	117	108	85	84	90-91	Cavitation
73	167	258	138	135	118	79	77	91	Cavitation
<u>Test Combination 7A -- 120 C</u>									
30-31	26	76	60	59	57	52	50	50-50	Cavitation
40.5	51	100	66	64	60	49	47	50-49	Cavitation
45-45	64	114	71	69	64	50	48	50-50	Cavitation
50-50	78	128	74	72	65	48	45	50-50	Cavitation
55-54.5	91	141	77	75	66	46	43	50-50	Cavitation
60-58	103	152	79	77	67	45	42	50-49	Cavitation
67	130	179	86	83	71	42	39	49	Cavitation
75	165	219	100	96	81	44	40	54	Cavitation
- - - - -									
30-30	25	115	100	100	98	93	92	90-91	
40	45	136	106	105	101	91	90	90-91	Cavitation
45-56	67	157	111	110	103	88	86	90-90	Cavitation
50-52	86	176	115	114	105	87	85	90-90	Cavitation
55-54	90	180	115	114	105	86	83	90-90	Cavitation
60-62	111	202	123	120	110	86	83	90-91	Cavitation
72	158	248	133	130	115	81	77	90-90	

DECLASSIFIED

-14-

HW-73229

FLOW TESTING REAR FACE HARDWARE COMBINATIONS

<u>Flow</u>	<u>ΔP</u>	<u>Nozz.</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>R.F.P.</u>
<u>Test Combination 8 -- 100 C</u>								
30								20
40								20
45								20
50								20
55								20
60								20
30-31	34	79	62	61	52	45	41	50-45
40-40	58	103	73	72	56	42	37	50-45
45-45	82	128	84	83	59	40	32	50-46
50-50	88	134	87	86	61	40	33	50-46
55-54	110	156	96	94	63	36	26	50-46
60-61	148	194	114	111	69	33	21	50-46
- - - - -								
30-30	32	123	107	107	98	91	88	90-91
40-39	57	147	117	116	100	87	83	90-90
45-44	69	159	123	122	102	86	80	90-90
50-50	91	182	133	132	105	84	76	90-90
55-53	100	191	137	135	107	83	74	90-91
60-59	117	207	158	156	110	80	69	90-90
<u>Test Combination 8A -- 120 C</u>								
30-28.5	28	74	60	59	52	46	43	50-46
40-39.5	60	106	74	73	57	44	38	50-46
45-44	75	121	81	80	58	40	34	50-46
50-50	89	134	86	85	59	38	31	50-45
55-55	116	162	98	97	63	35	26	50-46
60-62.5	159	206	120	117	72	33	20	50-47
- - - - -								
30-32	38	128	108	107	98	90	86	90-90
40	55	145	115	114	99	87	82	90-90
45-45	74	165	125	124	103	86	79	90-91
50-50	89	180	132	130	105	84	77	90-91
55-54	106	196	139	137	107	82	73	90-90
60-61	148	238	157	153	112	76	64	90-90

Orientation of Pressure Taps on Nozzle and Connector

-5-

DECLASSIFIED

BM-73229

DELTA P

DECLASSIFIED

SERIES 1A

LEGEND:

+++ 40 RHP

AAA 90 RHP

DELTA P

DELTA P

DECLASSIFIED

SERIES 2A

LEGEND:

*** - 50 RMP

AAA - 90 RMP

DELTA P

DELTA P

DELTA P

SECRET

DECLASSIFIED

THE
MUSIC
OF
THE
FUTURE

卷之四

THE UNIVERSITY OF CHICAGO

DELTA P

REVISED

SERIES 5A

LEGEND:

+++ 50 RHP

AAA 90 RHP

DELTA P

Delta P

SERIES 6

DELTA P

LEGEND:

- • • • • 38 RHP
- + + + + + 50 RHP
- Δ Δ Δ Δ Δ 90 RHP

DELTA P

SERIES 7

RECALCULATED

Legend:

--- 50 RHP

--- 90 RHP

Delta P

Delta P

C/P W

DECLASSIFIED

SERIES 8

LEGEND

- + + + - 46 RHP
- Δ Δ Δ - 90 RHP

DELTA P

Flow

DECLASSIFIED

上海外灘

90X1115

ΔP

DECLASSIFIED

DECLASSIFIED

PRESSURE PROFILE 2

ENLARGED FITTINGS

TEMP 100 C

SERIES 8

Note 1 2 3 4 5 RHP

Note 1 2 3 4 5 RHP

PRESSURE PROFILE 3 3/4 AL. Connector

0.580 FITTINGS

Temp 100C

SERIES 5

260

240

220

GPM

200

180

160

140

120

100

80

60

40

20

66

108

47.5

44

39

30.5

5.0 PSIG R.H.P.

NOZZ 1 2 3 4 5 RHP

67

59

54.5

50

45

40

30

9.0 PSIG R.H.P.

NOZZ 1 2 3 4 5 RHP

DECLASSIFIED

34

INT-1329

DECLASSIFIED

Pressure 100 PSIG

0.610 Fittings

Temp 100°C

Series 7

415 GPM

415

RHP

RHP

RHP

RHP

RHP

RHP

DATE

FILMED

9/16/94

END