Lawrence Livermore Laboratory

MARK I 1/5-SCALE BOILING WATER REACTOR PRESSURE SUPPRESSION EXPERIMENT
SUMMARY OF EFFECTS DUE TO VENT LINE ORIFICE VARIATIONS - AIR TEST SERIES

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SUMMARY OF EFFECTS DUE TO VENT LINE ORIFICE VARIATIONS - AIR TEST SERIES*

1.0 INTRODUCTION

Twenty-seven air tests have been completed in the 1/5-scale Mark I test facility and Quick Look Reports discussing preliminary results distributed.^[1,7] The purpose of this report is to provide a focus on the observed effects of vent line orifice variations on the hydrodynamic vertical load function (HVLF). The supporting evidence is drawn from 13 pertinent tests (1.3, 1.3.1, 1.4, 1.5, 1.6, 2.4, 3.1, 3.2, 3.3a, 3.3b, 3.4a, 3.4b, and 3.5).

The conditions for standard tests, to which the orifice variation tests are compared, are defined in Table 1 and discussed in Section 3.1. These tests used the "standard" or 9.5 inch orifices in the 90° sector vent lines. The initialization parameters for the standard tests are referenced to all remaining tests in Table 2. Test 3.1, which used 10.58 inch diameter orifices in the vent lines, and Test 3.2, which did not have orifices in the vent lines, are discussed in Section 3.2. The final series of tests discussed in Section 3.3 are tests 3.3a and b and tests 3.4a and b. In each of these last 4 tests, one 90° vent line was blocked. Tests 3.3 use the basis vent line orifice. Tests 3.4 were run with no vent line orifices.

2.0 RESULTS

Orifice sizes for the referenced tests are listed in Table 3. In Table 4 are listed a complete summary of the resultant, un-normalized response and hydrodynamic peak loads from their respective vertical load functions (RVLF and HVLF). Also listed are the peak values adjusted to the common DBA pressurization rate of 27.3 psi/sec. The adjustments are based on load/pressurization rate data from tests 1.4, 1.5, and 1.6 as well as tests 1.1, 1.3, 1.3.1, 2.4, and 3.5. Included

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TABLE 1. General Characteristics of Standard Air Tests

	1/5-Scale Test Facility	Peachbottom 2
Torus Water Level, ft. (below centerline)	0.2	1.0
Downcomer Submergence, ft.	0.8	4.0
Initial Drywell/Wetwell Pressure, psia	2.94	14.7
Initial Drywell Pressurization Rate, psi/sec	27.3	61.0
Nominal Vent System Loss Coefficient	22.0	4.4
Vent Line Orifice Dia., in.	9.5	None

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TABLE 2. Initialization Parameters 1/5 Scale Air Tests

Test	Purpose	$\bar{P}_0$ -psia	$\bar{t}_0$ -sec	$\bar{\dot{P}}_{dw}$ -psi/sec	$\bar{t}_1$ -sec
1.1 } 1.2 } 1.3 }	Std	3.2623 2.9506 2.9460	1.9976 0.5862 2.6466	24.948 25.692 25.962	0.1328 0.1324 0.1314
1.3.1	Std	3.0844	2.9886	27.239	0.1529
1.4 } 1.5 } 1.6 }	$\dot{P}_{dw}$	3.0143 2.8961 2.9766	1.6452 2.6342 1.4999	18.400 29.964 34.876	0.1486 0.1276 0.1284
2.1 } 2.2 } 2.3 }	ΔP_{dw}	3.0976 3.1726 3.2071	2.8602 2.5814 3.0188	28.690 25.692 26.586	0.0947 0.0862 0.1156
2.4	Std	2.9944	2.8159	24.308	0.1319
2.5 } 2.6 } 2.7 }	Extended Downcomers +	2.8520 2.8890 2.9527	2.7221 3.2446 3.2518	27.095 25.432 23.566	0.1233 0.0970 0.1482
2.8	Water Level	2.8838	3.1622	23.662	0.1272
2.9 } 2.10 } 2.11 }	$\dot{P}_{dw}$ + Extended Downcomers	2.9470 2.8638 2.9150	1.3076 2.7266 1.4312	16.136 27.851 29.933	0.1630 0.1368 0.1264
3.1 } 3.2 } 3.3a } 3.3b } 3.4a } 3.4b }	Ventline Assymetry + mh	2.8972 2.9415 2.9844 2.9748 2.8589 2.9530	3.1348 2.9030 2.7786 2.9123 2.7964 2.2224	28.905 25.728 24.898 24.898 25.004 22.608	0.1184 0.1422 0.1383 0.1336 0.1290 0.1280
3.5	Std	3.0442	2.5218	25.628	0.1280

TABLE 3. Summary of Actual Test Conditions^a for Orifice-Effect Tests

Test No.	p_{dw}^0 psia	$\dot{p}$ psi/sec	Drywell ^b Volume ft ³	Vent Line Orifice Diameter - in.		
				90°		7.5°
				Left Vent	Right Vent	Vent
1.3	2.946	25.96	348	9.5	9.5	3.63
1.3.1	3.084	27.24	296	9.5	9.5	3.63
2.4	2.994	24.31	296	9.5	9.5	3.63
3.5	3.044	25.63	348	9.5	9.5	3.63
3.1	2.897	28.90	296	10.58	10.58	4.08
3.2	2.9415	25.73	348	None	None	4.08
3.3a	2.984	24.90	348	9.5	0.0	3.63
3.3b	2.975	24.90	348	0.0	9.5	3.63
3.4a	2.859	25.00	348	None	0.0	None
3.4b	2.953	22.61	348	0.0	None	None

^aduring all of these tests, the initial torus water level was 0.2 feet below torus centerline, the downcomer submergence set at 0.8 feet, and drywell overpressure was zero.

TABLE 4. Peak Down and Uoloads from the Response VLF and Hydrodynamic VLF (1/5-Scale)

Test No.	Response VLF - 90°				Hvdro VLF - 90°				Combined for 90°		Hydro VLF - 7.5°					
	Un-normalized		Normalized ^a		Un-normalized		Normalized ^a		Dn-kin	Un-kin	Un-normalized		Normalized ^a		90° Comparison ^d	
	Dn-kip	Up-kip	Dn-kin	Un-kin	Dn-kip	Un-kip	Dn-kin	Un-kin			Dn-kin	Un-kin	Dn-kin	Un-kin	Dn-kin	Un-kin
1.3	40.5	19.2	42.0	19.7	37.3	16.8	38.5	17.1	-	-	3.40	0.906	3.50	0.923	42.	11.1
1.3.1	42.0	19.5	42.0	19.5	40.9	18.8	40.9	18.8	-	-	2.88	1.14	2.88	1.14	34.6	13.7
2.4	41.2	19.9	44.5	21.1	39.1	17.6	41.8	18.4	-	-	2.93	1.06	3.16	1.09	37.9	13.1
3.5	42.2	20.8	44.0	21.5	39.0	17.9	40.5	18.3	-	-	2.71	1.16	2.84	1.18	34.1	14.2
Mean Value			42.4	20.3			39.8	17.7					3.04	1.12		
3.1	42.2	20.9	40.4	20.2	38.9	18.2	37.4	17.7	-	-	2.86	1.09	2.74	1.08	32.9	13.0
3.2	38.9	20.6	40.6	21.2	34.2	22.1	35.6	22.5	-	-	2.70	1.25	2.82	1.26	33.8	15.1
3.3a	39.4	17.3	42.0	18.3	17.8 ^b	7.65 ^b	18.9 ^b	7.95 ^b	37.7 ^c	17.7 ^c	2.71	1.05	2.90	0.958	34.8	11.5
3.3b	37.5	19.8	40.3	20.4	17.6 ^b	9.43 ^b	18.9 ^b	9.75 ^b			2.70	1.06	2.90	0.968	34.8	11.6
3.4a	42.2	20.0	44.7	20.9	19.1 ^b	9.10 ^b	20.2 ^b	9.40 ^b	40.8 ^c	18.8 ^c	2.80	1.28	2.99	1.30	35.9	15.6
3.4b	38.7	18.9	43.8	20.8	18.4 ^b	8.71 ^b	20.6 ^b	9.35 ^b			2.78	1.28	3.14	1.32	37.7	15.8

^aNormalized to an initial pressurization rated 27.3 psi/sec

^bComputed over L.H. 45° sector only

^cSum of 45° sector peak loads - normalized

^d90°-Comparison peak loads = 12 x 7.5° normalized peak loads

are a significant number of graphs to further aid in comparing results of the several tests; the complexity of the 3-D phenomena and the lack of total agreement on the unique characteristics which determine "correspondence" (or its absence) between tests suggest all of these plots are required for a data base.

Included in Appendix A for each of the 10 tests are:

- a) a composite graph of drywell, plane 9 ullage, and plane 9 pool bottom pressure histories in the 90° sector.
- b) two composite graphs of 90°-sector wall pressure/histories at plane 9.
- c) two composite graphs of 90°-sector pool bottom pressure histories.
- d) two composite graphs of 7.5°-sector wall pressure histories.

3.0 DISCUSSION

The hydrodynamic vertical load function (HVLF) rather than the related response VLF is selected as the proper basis for intercomparing effects of test condition variants; for the same hydrodynamic input, different structures will response differently.

3.1 NORMALIZED LOADS

Tests 1.1, 1.3, 1.3.1, 2.4, 1.4, 1.5, 1.6, and 3.5 were used to determine the dependence of peak load on drywell pressurization rate. As shown in Table 1, some had the reduced drywell volume (V_{dw}) of 296 ft³.^[3] Subsequently, those standard tests with the reduced drywell volume were separately analyzed. The resulting slopes and mean standard test peak load values for the two test groups are listed in Table 5. Due to the insignificant variations between Test Groups A and B and because group A is the more general, it is selected as basis for later effects comparisons.

TABLE 5. Peak Load Sensitivity to Drywell Pressurization Rate and Drywell Volume

Test Group	RVLF				HVLF							
	90°				90°				7.5°			
	$c_{\alpha_{dn}}(\dot{p})$	$\bar{L}_{dn}^d$	$\alpha_{up}(\dot{p})$	$\bar{L}_{up}$	$\alpha_{dn}(\dot{p})$	$\bar{L}_{dn}$	$\alpha_{up}(\dot{p})$	$\bar{L}_{up}$	$\alpha_{dn}(\dot{p})$	$\bar{L}_{dn}$	$\alpha_{up}(\dot{p})$	$\bar{L}_{up}$
A ^a	1.097	42.4	0.410	20.3	0.910	39.8	0.273	17.7	0.0772	3.0	0.0087	1.12
B ^b	1.057	43.0	0.420	20.3	0.874	40.4	0.262	17.9	0.0789	3.0	0.0075	1.2

^aincludes tests 1.1, 1.3, 1.3.1, 1.4, 1.5, 1.6, 2.4 and 3.5 (mixed drywell volumes)

^bincludes tests 1.3.1, 1.4, 1.5, 1.6, and 2.4 (all with $V_{dw} = 296 \text{ ft}^3$)

^cunits of this coefficient are $\text{klb}_f/\text{psi}/\text{sec}$

^dmean standard test peak load - kips

The normalized loads listed in Table 4 are based on Test Group A findings. For example, for Test 1.3, peak download of the HVLF-90°:

$$\begin{aligned}\text{normalized } L_{dn} &= 37.3 + (27.3-25.962) \times 0.910 \\ &= 38.52\end{aligned}$$

3.2 EFFECTS OF VENT LINE ORIFICE - OPEN VENT LINES

Tests 3.1 and 3.2, as listed in Table 3, were standard condition tests conducted with non-standard vent line orifices. The orifices of Test 3.1 had an aperture area 5/4ths that of the standard tests. In Test 3.2, the orifice plates were entirely removed from the vent lines.

Table 6 shows that the major effect of orifice diameter variation was observed in the 90° torus sector where the peak upload increased by less than 30%. The corresponding increase in the 7.5° sector was less than 15%. It will be noted from Table 4 that the corresponding effects observed by the response VLF were significantly smaller.

TABLE 6. Variation in the Peak Hydrodynamic Loads Due to the Vent Line Orifice - Standard Tests

Test	90° Sector				7.5° Sector			
	L_{dn}^a	$\epsilon\%$	L_{up}	$\epsilon\%$	L_{dn}	$\epsilon\%$	L_{up}	$\epsilon\%$
Group A	39.8	-	17.7	-	3.04	-	1.12	-
3.1	37.4	-6.0	17.7	0.0	2.74	-9.9	1.08	-3.6
3.2	35.6	-10.6	22.5	+27.1	2.82	-7.2	1.26	+12.5

^a L in units of kips

A clear peak load dependence on orifice size is exhibited, as expected. The magnitude of this dependence is not, however, as large (factor of two), as has been suggested in the past.

3.3 EFFECTS OF VENT LINE ORIFICE - BLOCK VENT TESTS

Four otherwise standard condition tests were conducted with one of the two 90°-sector vent lines entirely blocked off. Tests 3.3 had the standard orifice. Test 3.3a was run with the right vent line closed. Test 3.3b had the left vent line closed. The 3.4 series tests were analogous to the 3.3 series tests, except the orifice was removed from the open vent line in both test 3.4a and 3.4b.

With reference to tests 3.3, the vent line blockage appears to have had an insignificant effect on the peak vertical loads of the 90°-sector. Of some surprise is the significant decrease in observed peak upload in the 7.5° torus sector (Table 7).

TABLE 7. Variation in the Peak Hydrodynamic Loads Due to the Vent Line Orifice - Blocked Vent Line

Test	90°Sector				7.5° Sector			
	L _{dn} ^a	ε-%	L _{up}	ε-%	L _{dn}	ε-%	L _{up}	ε-%
Group A	39.8	-	17.7	-	3.04	-	1.12	-
3.3a	18.9	-	7.95	-	2.90	-4.6	0.958	-14.5
3.3b	18.8	-	9.75	-	2.90	-4.6	0.968	-13.6
3.3 sum	37.7	-5.3	17.7	0.0	-	-	-	-
3.4a	20.2	-	9.40	-	2.99	-1.6	1.30	+16.1
3.4b	20.6	-	9.35	-	3.14	+3.3	1.32	+17.9
3.4 sum	40.8	+2.5	18.8	+6.2	-	-	-	-

^aL in units of kips

Removal of the vent line orifices in tests 3.4 produced only small changes in the peak loads of the 90°-sector. Due, however, to the zero upload change observed in Tests 3.3, the 6% increase seen in the tests 3.4 does suggest an orifice size dependence (Col. 5, Table 7). The observed results in the 7.5° torus

sector are more dramatic; while the peak downloads were little affected, the uploads were (as in Test 3.2) increased by about 15% (see Section 3.2).

4.0 CONCLUSIONS

The results show that the peak loads depend on vent line orifice size. However, the dependency is not as strong as had been anticipated. The peak upload showed the greatest increase when the standard vent line orifice was removed (~30%).

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APPENDIX A

PRESSURE COMPARISON OF PSE TEST NO. 1.3

DRYWELL P-73 POOL BOTTOM P-49 ULLAGE P-43

PSE AIR TEST NO. 1.3
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 45 120 155 165 180

PSE AIR TEST NO. 1.3
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 180 195 205 235 315

PSE AIR TEST NO. 1.3
TOTAL PRESSURE 90 DEG. TORUS
PLANES 1 3 4 7 9 11 THETA = 180

PSE AIR TEST NO. 1.3
TOTAL PRESSURE 90 DEG. TORUS
PLANES 4 6 THETA = 100

PSE AIR TEST NO. 1.3
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 45 128 155 160 165 180

PSE AIR TEST NO. 1.3
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 180 195 200 205 235 315

PRESSURE COMPARISON OF PSE TEST NO. 1.3.1

DRYWELL P-73

POOL BOTTOM P-49

ULLAGE P-43

PSE AIR TEST NO. 1.3.1
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 45 120 155 165 180

PSE AIR TEST NO. 1.3.1
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 180 195 205 235 315

PSE AIR TEST NO. 1.3.1
TOTAL PRESSURE 90 DEG. TORUS
PLANES 20 3 4 7 9 11 THETA = 180

PSE AIR TEST NO. 1.3.1
TOTAL PRESSURE 90 DEG. TORUS
PLANES 4 5 6 THETA = 180

PSE AIR TEST NO. 1.3.1
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 45 128 155 160 165 180

PSE AIR TEST NO. 1.3.1
TOTAL PRESSURE 7.6 DEG. TORUS
THETA = 180 195 200 205 235 315

PRESSURE COMPARISON OF PSE TEST NO. 2.4

DRYWELL P-73

POOL BOTTOM P-49

ULLAGE P-43

PSE AIR TEST NO. 2.4
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 45 128 165 165 188

PSE AIR TEST NO. 2.4
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 100 195 205 235 315

PSE AIR TEST NO. 2.4
TOTAL PRESSURE 90 DEG. TORUS
PLANES 20 3 4 7 9 11 THETA = 180

PSE AIR TEST NO. 2.4
TOTAL PRESSURE 90 DEG. TORUS
PLANES 4 5 6 THETA = 180

PSE AIR TEST NO. 2.4
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 45 128 155 160 165 180

PSE AIR TEST NO. 2.4
TOTAL PRESSURE 7.6 DEG. TORUS
THETA = 180 195 200 205 235 315

PRESSURE COMPARISON OF PSE TEST NO. 3.1

DRYWELL P-73

POOL BOTTOM P-49

ULLAGE P-43

PSE AIR TEST NO. 3.1
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 45 128 155 165 180

PSE AIR TEST NO. 3.1
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 180 195 285 235 315

PSE AIR TEST NO. 3.1
TOTAL PRESSURE 90 DEG. TORUS
PLANES 20 3 4 7 9 11 THETA = 180

PSE AIR TEST NO. 3.1
TOTAL PRESSURE 90 DEG. TORUS
PLANES 4 5 6 THETA = 180

PSE AIR TEST NO. 3.1
TOTAL PRESSURE 7.6 DEG. TORUS
THETA = 45 128 155 160 165 180

P&E AIR TEST NO. 3.1
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 180 195 200 205 235 315

PRESSURE COMPARISON OF PSE TEST NO. 3.2

DRYWELL P-73

POOL BOTTOM P-49

ULLAGE P-43

PSE AIR TEST NO. 3.2
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 45 120 155 165 180

PSE AIR TEST NO. 3.2
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 180 195 205 235 315

PSE AIR TEST NO. 3.2
TOTAL PRESSURE 90 DEG. TORUS
PLANES 20 3 4 7 9 11 THETA = 180

PSE AIR TEST NO. 3.2
TOTAL PRESSURE 90 DEG. TORUS
PLANES 4 5 6 THETA = 180

PSE AIR TEST NO. 3.2
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 45 120 155 160 165 180

PSE AIR TEST NO. 3.2
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 180 195 200 205 235 315

PRESSURE COMPARISON OF PSE TEST NO. 3.3A

DRYWELL P-73

POOL BOTTOM P-49

ULLAGE P-43

PSE AIR TEST NO. 3.3A
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 45 120 155 165 180

PSE AIR TEST NO. 3.3A
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 180 195 205 235 315

PSE AIR TEST NO. 3.3A
TOTAL PRESSURE 90 DEG. TORUS
PLANES 20 3 4 7 9 11 THETA = 180

PSE AIR TEST NO. 3.3A
TOTAL PRESSURE 90 DEG. TORUS
PLANES 4 5 6 THETA = 180

PSE AIR TEST NO. 3.3A
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 45 128 155 160 165 180

PSE AIR TEST NO. 3.3A
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 180 195 200 205 235 315

PRESSURE COMPARISON OF PSE TEST NO. 3.38

DRYWELL P-73

POOL BOTTOM P-49

ULLAGE P-43

PSE AIR TEST NO. 3.38
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 45 129 155 165 180

PSE AIR TEST NO. 3.3B
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 180 195 205 235 315

PSE AIR TEST NO. 3.38
TOTAL PRESSURE 90 DEG. TORUS
PLANES 20 3 4 7 9 11 THETA = 180

PSE AIR TEST NO. 3.38
TOTAL PRESSURE 90 DEG. TORUS
PLANES 4 5 6 THETA = 180

PSE AIR TEST NO. 3.38
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 45 120 155 160 165 180

PSE AIR TEST NO. 3.39
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 180 195 200 205 235 315

PRESSURE COMPARISON OF PSE TEST NO. 3.4A

DRYWELL P-73

POOL BOTTOM P-49

ULLAGE P-43

PSE AIR TEST NO. 3.4A
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 45 120 155 165 180

PSE AIR TEST NO. 3.4A
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 180 195 205 235 315

PSE AIR TEST NO. 3.4A
TOTAL PRESSURE 90 DEG. TORUS
PLANES 28 3 4 7 9 11 THETA = 180

PSE AIR TEST NO. 3.4A
TOTAL PRESSURE 90 DEG. TORUS
PLANES 4 5 6 THETA = 180

PGE AIR TEST NO. 3.4A
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 45 128 155 160 165 180

PSE AIR TEST NO. 3.4A
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 180 195 200 205 235 315

PRESSURE COMPARISON OF PSE TEST NO. 3.48

DRYWELL P-73

POOL BOTTOM P-49

ULLAGE P-43

PSE AIR TEST NO. 3.48
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 45 128 165 165 180

PSE AIR TEST NO. 3.48
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 180 195 205 235 315

PSE AIR TEST NO. 3.4B
TOTAL PRESSURE 90 DEG. TORUS
PLANES 20 3 4 7 9 11 THETA = 180

PSE AIR TEST NO. 3.4B
TOTAL PRESSURE 90 DEG. TORUS
PLANES 4 5 6 THETA = 180

PSE AIR TEST NO. 3.48
TOTAL PRESSURE 7.6 DEG. TORUS
THETA = 45 128 155 160 165 180

PSE AIR TEST NO. 3.48
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 180 195 200 205 235 315

PRESSURE COMPARISON OF PSE TEST NO. 3.6

DRYWELL P-73

POOL BOTTOM P-49

ULLAGE P-43

PSE AIR TEST NO. 3.5
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 45 128 165 165 189

PSE AIR TEST NO. 3.6
TOTAL PRESSURE 90 DEG. TORUS
PLANE 9 THETA = 189.195 205 235 315

PSE AIR TEST NO. 3.6
TOTAL PRESSURE 90 DEG. TORUS
PLANES 20 3 4 7 9 11 THETA = 180

PSE AIR TEST NO. 3.5
TOTAL PRESSURE 90 DEG. TORUS
PLANES 4 & 6 THETA = 180

PSE AIR TEST NO. 3.5
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 45 120 165 160 165 180

PSE AIR TEST NO. 3.5
TOTAL PRESSURE 7.5 DEG. TORUS
THETA = 180 195 200 205 235 315

Technical Information Department

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