SSC-255

FURTHER ANALYSIS OF SLAMMING DATA FROM THE S. S. WOLVERINE STATE

SHIP STRUCTURE COMMITTEE

1976

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SR-203

1 6 JAN 1976

This report describes the analysis of the data collected in an earlier instrumentation program on the *WOLVERINE STATE*. That project, reported in SSC-210, *Analysis of Slamming Data from the S.S. WOLVERINE STATE*, involved the measurement of impact pressures and strains with only a limited analysis of the data. This effort undertook a more sophisticated analysis and has extended the significant information.

Your comments and suggestions on this report or other structural problem areas will be most welcome.

W. M. Benkert
Rear Admiral, U.S. Coast Guard
Chairman, Ship Structure Committee

SSC-255

Final Report

on

Project SR-203, "Slamming Data Analysis"

FURTHER ANALYSIS OF SLAMMING DATA FROM THE S.S. WOLVERINE STATE

by

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Teledyne Materials Research

under

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ABSTRACT

The pressure, acceleration, and hull bending stress data from the full-scale slamming measurements on the S.S. WOLVERINE STATE were analyzed in detail to provide additional information on frequency of occurrence, elapsed time between slams, correlation with environmental conditions, pressure-velocity relationship, correlation with midship transient stress, and pressure-location-time distribution. Seventeen separate measurements were made on a group of 26 severe slams to provide a data base for the investigation and data from more than 1,000 slams which occurred over approximately 49 hours of slamming during 3 different voyages were used in establishing the correlation with environmental conditions.

A number of statistical correlations were examined, and pressure-velocity measurements provided additional data for comparison with model results.

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NOTES

I. INTRODUCTION

This report presents additional analyses of slamming pressures, accelerations, and midship longitudinal vertical bending stresses acquired during a program of data acquisition aboard the States Marine Line ship S.S. WOLVERINE STATE. The principal objective was to gather full-scale data for comparison with model data and theory reported by M. K. Ochi.[1] The first report on the full-scale work was published by the Ship Structure Committee as SSC-210, "Analysis of Slamming Data from the S.S. WOLVERINE STATE."[2] This previous report presented the results of the initial analyses, and also described the data acquisition system in detail. The present report extends the previous analyses by considering more slams in greater detail, and by examining statistically slams from rough weather portions of three voyages.

Data were acquired by a set of transducers to measure midship bending stress, bow and stern accelerations, and bottom pressures from 7 out of an array of 20 pressure transducers located on the bottom plating along the keel from the Forepeak to Frame 54. Transducer locations are shown in Figure 1 and Table I. The data acquisition system was unmanned, operating automatically on either a timed basis (one-half hour out of every four) or in response to high stresses or low pressure at the bow (indicating emergence).

Reels of magnetic tape were returned to the laboratory on a routine basis for data analysis. Processing involved reproduction of the stress signals on an oscillograph for a "quick-look", and then automatic processing to obtain certain statistical parameters relating stress variations and environmental conditions. The pressure data were analyzed using expanded oscillograph records, with scale factors determined by superimposed calibration signals. Figure 2 shows the form of the analog data. More details concerning the operational aspects of the program are contained in Reference 2.

These data were obtained from a single C4-S-B5 vessel, and the relationships developed in this report are directly applicable only to this particular hull shape. Comparisons can be made, however, to models and vessels of other shapes by considering the differences involved.

II. ELAPSED TIME AND FREQUENCY OF OCCURRENCE

The first item statistically examined was the elapsed time between and frequency of occurrence of slams. The intent was to develop more full-scale data for comparison with the theory and data presented by Ochi in Reference 1, and to supplement data previously presented in Reference 2.

A. Frequency of Occurrence

Ochi's conclusion from model tests, that slamming may be considered to be a sequence of events occurring in time following a Poisson process, was confirmed

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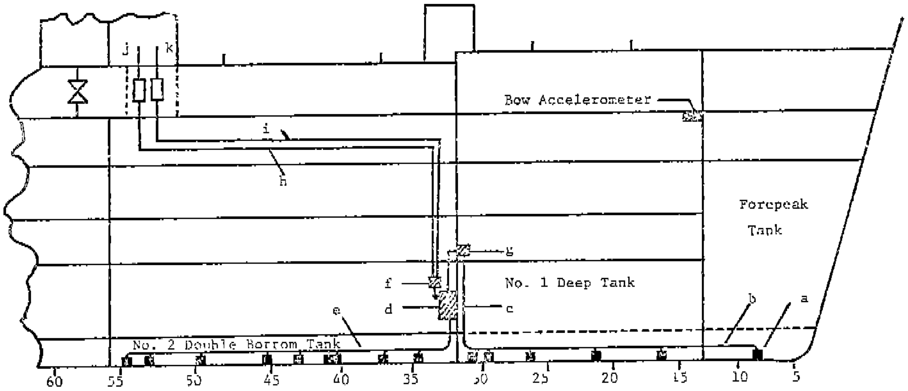
Superscripts indicate References.



a pressure cell

b cable to pressure cell in Forepeak Tank

c cable to 6 pressure cells in No. 1 DT and FPT

d 100-terminal junction box

c cables to 14 pressure cells in No. 2 DB

f pressure cell signal conditioning units (7 channels)

g 30-terminal junction box

h,i cables from signal conditioner to instrument room

j,k terminal boxes in instrument room

Figure 1A

Slamming Transducer Cabling, S.S. WOLVERINE STATE

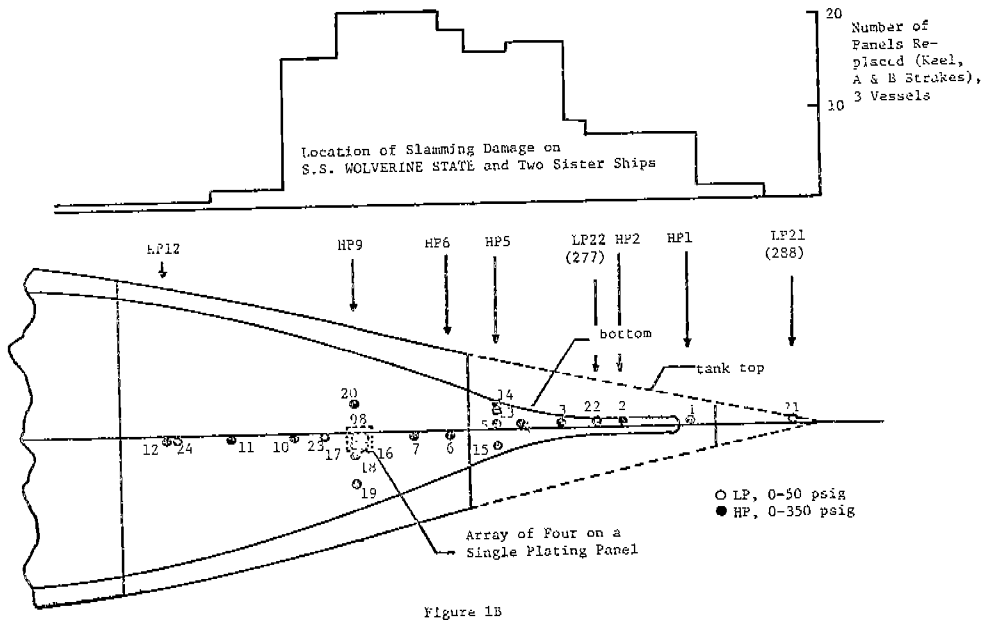


Figure 1B

Location of Slamming Damage on S.S. WOLVERINE STATE and Two Sister Ships; Locations of Pressure Transducers

TABLE I

PRESSURE TRANSDUCER MOUNTING LOCATIONS

Location Number	In Tank	In Bottom Plate	Between Frames	Distance Aft of Frame	Off Center Vertical Keel	Distance Aft from Bow
1	#1 D.T.	FK-1	16-17	11" aft FR.16	11" P	41' 5"
2	#1 D.T.	FK-1	21-22	11" aft FR.21	11" P	52' 8"
3	#1 D.T.	FK-2	26-27	11" aft FR.26	11" P	63'11"
4	#1 D.T.	FK-2	29-30	11" aft FR.29	11" P	70' 8"
5	#1 D.T.	FK-2	31-32	11" aft FR.31	11" P	75' 2"
6	#2 D.B.	FK-3	34-35	11" aft FR.34	9" S	82' 5"
7	#2 D.B.	FK-3	37-38	11" aft FR.37	11" S	89'11"
8	#2 D.B.	FK-3	40-41	6" aft FR.40	11" S	97' 0"
9	#2 D.B.	FK-3	40-41	24" aft FR.40	11" S	98' 6"
10	#2 D.B.	FK-4	45-46	11" aft FR.45	11" S	109'11"
11	#2 D.B.	FK-4	49-50	11" aft FR.49	9" S	119'11"
12	#2 D.B.	FK-4	54-55	11" aft FR.54	11" S	132' 5"
13	#1 D.T.	A-8	31-32	11" aft FR.31	41" P	75' 2"
14	#1 D.T.	A-8	31-32	11" aft FR.31	65" P	75' 2"
15	#1 D.T.	A-8	31-32	11" aft FR.31	41" S	75' 2"
16	#2 D.B.	A-9	40-41	6" aft FR.40	30" S	97' 0"
17	#2 D.B.	A-9	40-41	24" aft FR.40	30" S	98' 6"
18	#2 D.B.	A-9	40-41	24" aft FR.40	69" S	98' 6"
19	#2 D.B.	B-6	40-41	24" aft FR.40	105" S	98' 6"
20	#2 D.B.	A-9	40-41	24" aft FR.40	69" P	98' 6"
21	Forepeak	A-3	8-9	11" aft FR.8	11" P	24' 8"
22	#1 D.T.	FK-1	23-24	11" aft FR.23	11" P	57' 2"
23	#2 D.B.	FK-3	43-44	11" aft FR.43	11" S	104'11"
24	#2 D.B.	FK-4	53-54	11" aft FR.53	9" S	129'11"

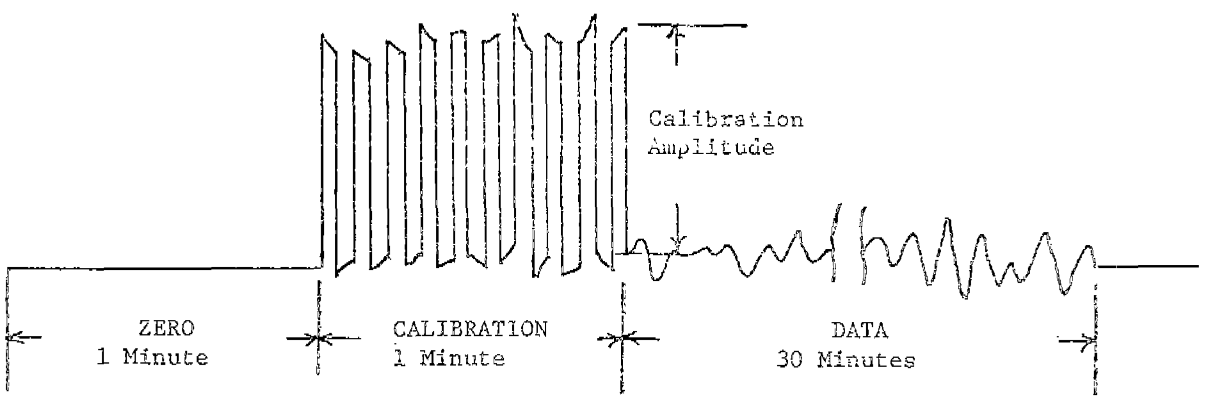


Figure 2

Analog Data Format

TABLE II

BASIC DATA, ELAPSED TIME AND FREQUENCY OF OCCURRENCE

Tape 263W2, Interval 12

Slam No.	Elapsed Time, Seconds	Time Between Slams, Seconds	Slam No.	Elapsed Time, Seconds	Time Between Slams, Seconds
1	520	-	29	3144	382
2	728	728	30	3152	8
3	735	7	31	3539	387
4	783	48	32	3570	31
5	790	7	33	3578	8
6	821	31	34	3668	90
7	828	7	35	3732	64
8	836	8	36	3890	158
9	903	67	37	3920	30
10	910	7	38	3936	16
11	1079	169	39	3951	15
12	1086	7	40	3958	7
13	1143	57	41	3965	7
14	1650	507	42	4094	129
15	1797	147	43	4324	230
16	1827	30	44	4331	7
17	1889	62	45	4550	219
18	1896	7	46	4557	7
19	2239	343	47	4680	123
20	2544	305	48	4687	7
21	2552	8	49	4719	32
22	2559	7	50	4727	8
23	2628	69	51	4734	7
24	2683	55	52	4982	248
25	2691	8	53	5317	335
26	2698	7	54	5369	52
27	2705	7	55	5949	580
28	2762	57	56	5956	7

TABLE II (Continued)

Slam No.	Elapsed Time, Seconds	Time Between Slams, Seconds	Slam No.	Elapsed Time, Seconds	Time Between Slams, Seconds
57	5963	7	88	8552	278
58	6254	291	89	8560	8
59	6261	7	90	8767	207
60	6343	82	91	8774	7
61	6439	96	92	8781	7
62	6479	40	93	9010	229
63	6653	174	94	9018	8
64	6660	7	95	9595	577
65	6850	190	96	9743	148
66	6857	7	97	9750	7
67	6964	107	98	9757	7
68	6972	8	99	9764	7
69	6983	11	100	9771	7
70	6990	7	101	10266	495
71	6997	7	102	10435	169
72	7044	47	103	10842	407
73	7149	105	104	10850	8
74	7326	177	105	10857	7
75	7370	44	106	11077	220
76	7377	7	107	11084	7
77	7384	7	108	11091	7
78	7489	105	109	11099	8
79	7497	8	110	11770	671
80	7485	8	111	11777	7
81	7668	163	112	11903	126
82	7880	232	113	12115	212
83	7888	8	114	12376	261
84	8136	248	115	13017	641
85	8244	108	116	13024	7
86	8252	8	117	13054	30
87	8274	22	118	13128	74

TABLE II (Continued)

Slam No.	Elapsed Time, Seconds	Time Between Slams, Seconds
119	13150	22
120	13165	15
121	13173	8
122	13181	8
123	13230	49
124	13310	80
125	14710	400
126	14718	8
127	14759	41
128	14845	86
129	14919	74
130	14927	8
131	14934	7
132	15053	119
133	15177	124

Tape 277W2 Interval 2

Slam No.	Elapsed Time, Seconds	Time Between Slams, Seconds
1	136	
2	196	60
3	536	340
4	542	7
5	729	187
6	936	207
7	943	7
8	950	7
9	957	7
10	1148	191
11	1156	8
12	1268	112
13	1342	74
14	1540	198
15	1548	8
16	1766	218
17	1774	8
18	1781	7
19	1944	163
20	2044	100
21	2052	8
22	2060	8
23	2347	287
24	2421	74
25	2716	295
26	2723	7
27	2730	7
28	3000	270
29	3282	282
30	3290	8
31	3298	8
32	3467	169
33	3605	138
34	3612	7
35	3714	102
36	3721	7
37	3882	161
38	3927	45
39	4093	166
40	4408	315
41	4427	9
42	4434	7
43	4529	95

TABLE II (Concluded)

Slam No.	Elapsed Time, Seconds	Time Between Slams, Seconds
44	4536	7
45	4720	184
46	4727	7
47	4770	43
48	4970	200
49	5256	286
50	5264	8
51	5539	275
52	5948	409
53	6225	277
54	6354	129
55	6627	273
56	6635	8
57	6644	9
58	6762	118

previously by a sample of 47 observations from full-scale data (Voyage 288W3, Interval* 57) reported in Reference 2. Additional analysis of the other two voyages was undertaken in order to establish if the frequency of occurrence of slamming was different from a deeper draft (277W2, Interval 2), or for few occurrences of slamming (263W2, Interval 12). In addition, the time intervals were increased because of the lower density of slamming, and in one case a long record was divided into thirds in an attempt to restrict the analysis to periods of constant environmental conditions.

The results of these analyses are shown in Figures 3 through 9. The comparison of the theoretical Poisson distribution with the experimental data for 263W2-12 is somewhat better for the 100-second analysis (Figure 4) than for the 240-second interval (Figure 3), but both have rather wide separations in the 1- and 2-number-of-slams regions compared with previous results in References 1 and 2, and the fit is poor as measured by the Chi-squared test. Figure 3 is based on analysis of 133 slams over sixty-four 240-second intervals, and Figure 4 is based on the same number of slams over one hundred fifty-two 100-second intervals. The basic data are presented in Table II, and the data for Figures 3 and 6 are presented in Tables III and IV, respectively.

The last part of Interval 2, Voyage 277W2 was also analyzed in 240- and 100-second groups for the entire run (Figures 5 and 6), and then was divided into three separate parts for re-analysis at 100-second groups (Figures 7, 8, and 9). The fit appears to improve with the subdivision into thirds, especially in the final third (Figure 9). It was hoped that additional environmental data could be obtained from the ship's logbooks to establish headings, speeds, and sea states for the subdivided parts of Interval 2, but the logbooks could not be located.

B. Elapsed Time Between Slams

The same basic data from voyages 263W2 and 277W2 were used to develop (see Table V) the elapsed time information for comparison with previous results. Figures 10 and 11 are plots of the probability density of the time between slams, showing a comparison of experimental data and a theoretical Rayleigh distribution truncated at the pitching period, 7 seconds. In both cases the probability density difference between the first and second groups appeared unusually large. The data were re-examined to determine if the tolerance on the time measurements could have caused this result (by causing too many borderline points to be counted one way or the other). It was found that it would require a measurement tolerance of ±4 seconds to result in any change in distribution of data between the first and second time intervals in Figure 11. The basic data of Table II were measured to an accuracy of ±1 second.

To determine if the apparent differences between the theoretical and actual distributions were significant, the Chi-squared test was used. The expected values are shown in Table V as "n'". Applying the standard Chi-squared test, it was found that while the data from 263W2 (Figure 10) demonstrated a poor fit to the theoretical distribution, the data from 277W2 was a probable fit at the 5% level.

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*An "interval" of data is a nominal 30-minute sample recorded every four hours, with calibration signals at the beginning. All of the intervals of data considered here, however, were approximately four hours in length because the tape recorder was running continuously.

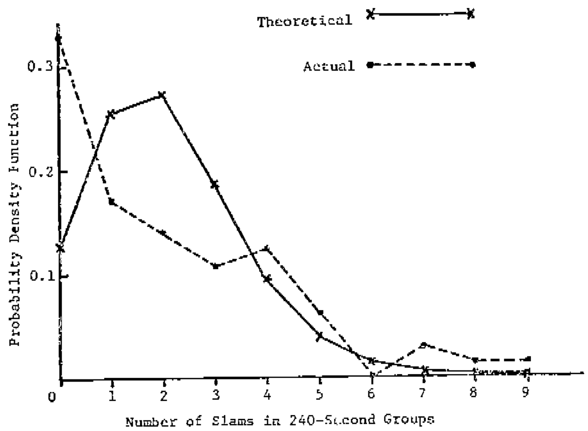


Figure 3

Frequency of Occurrence of Slams
Voyage 236W2 Interval 17
(240-Second Groups)

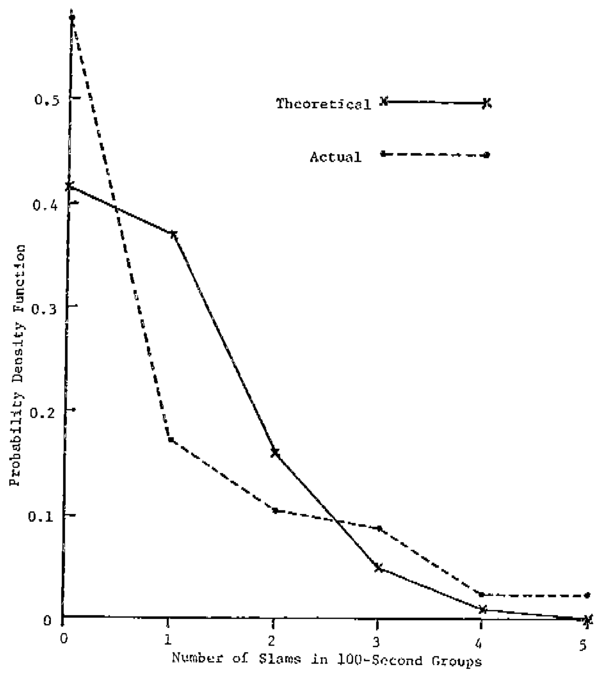


Figure 4

Frequency of Occurrence of Slams
Voyage 263W2, Interval 12
(100-Second Groups)

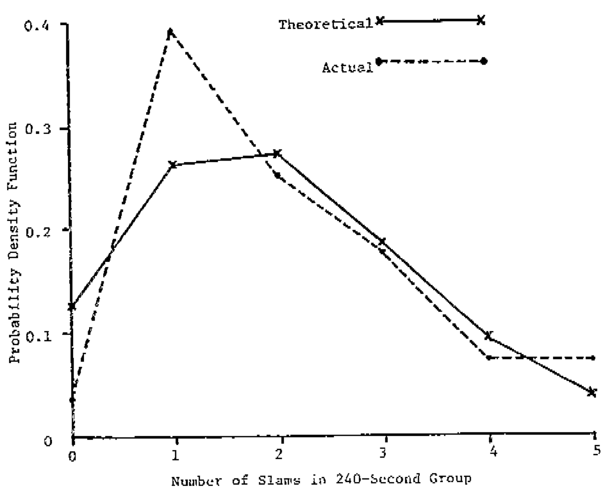


Figure 5

Frequency of Occurrence of Slams
Voyage 277W2, Interval 2
240-Second Groups

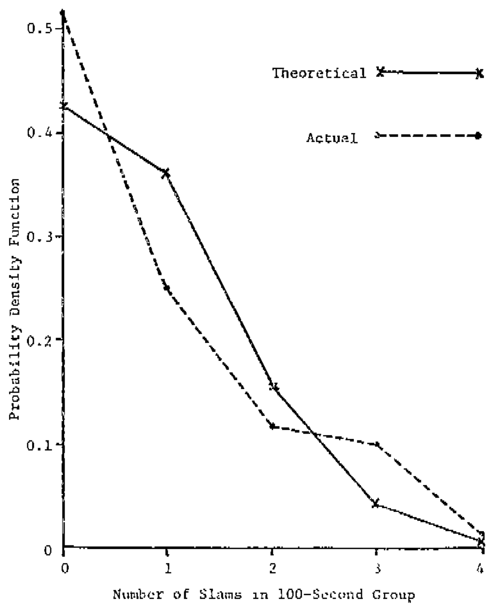


Figure 6

Frequency of Occurrence of Slams
Voyage 277W2, Interval 2
100-Second Groups

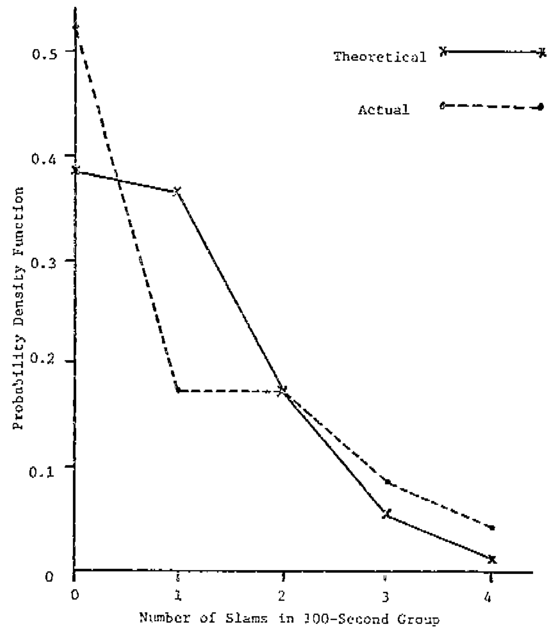


Figure 7

Frequency of Occurrence of Slams
Voyage 277W2, Interval 2
First Third

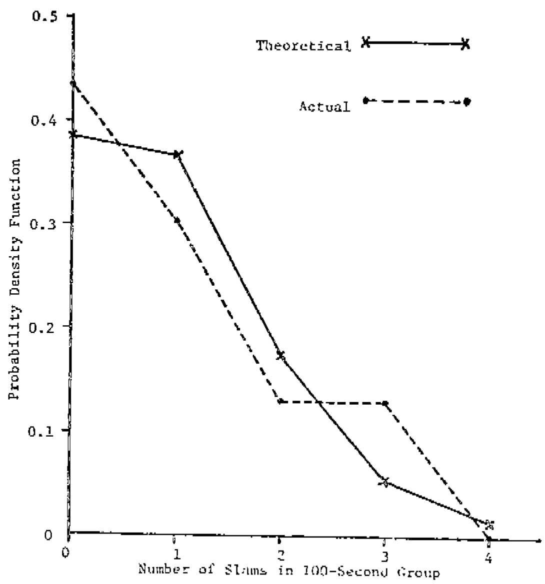


Figure 8

Frequency of Occurrence of Slams
Voyage 277W2, Interval 2
Second Third

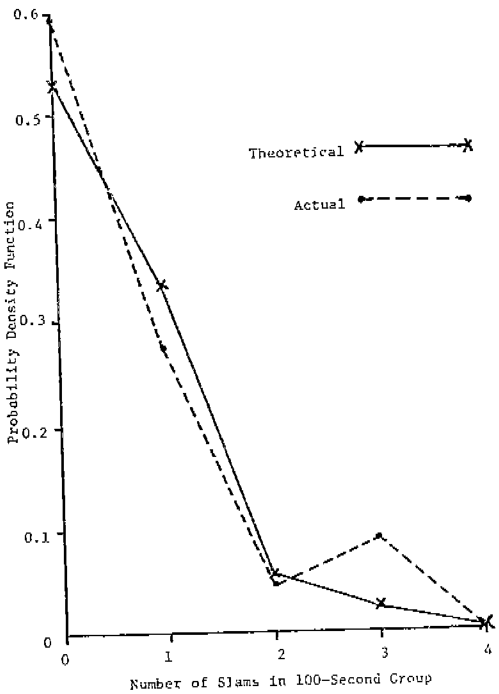


Figure 9

Frequency of Occurrence of Slams
Voyage 277W2, interval 2
Third Third

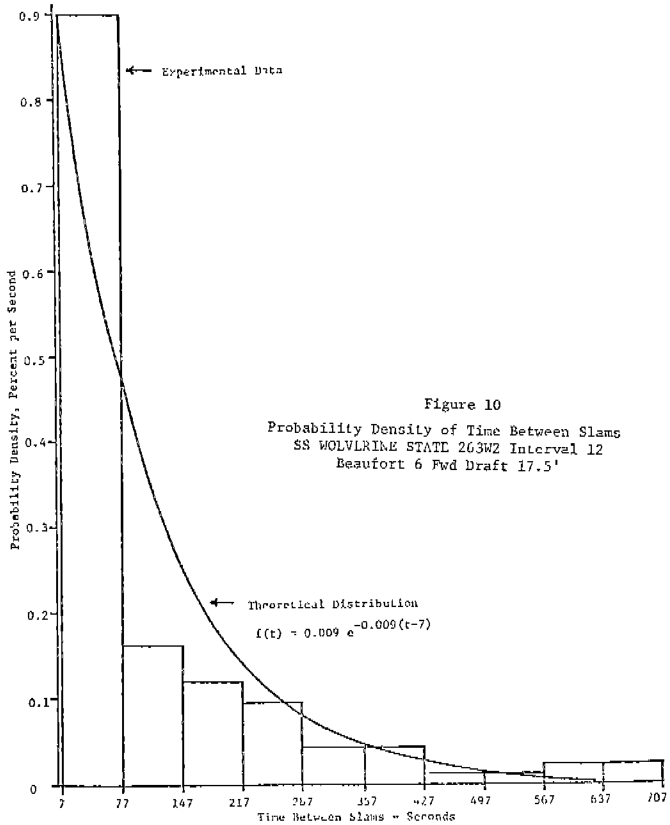


Figure 10

Probability Density of Time Between Slams
SS WOLVERINE STATE 263W2 Interval 12
Beaufort 6 Fwd Draft 17.5'

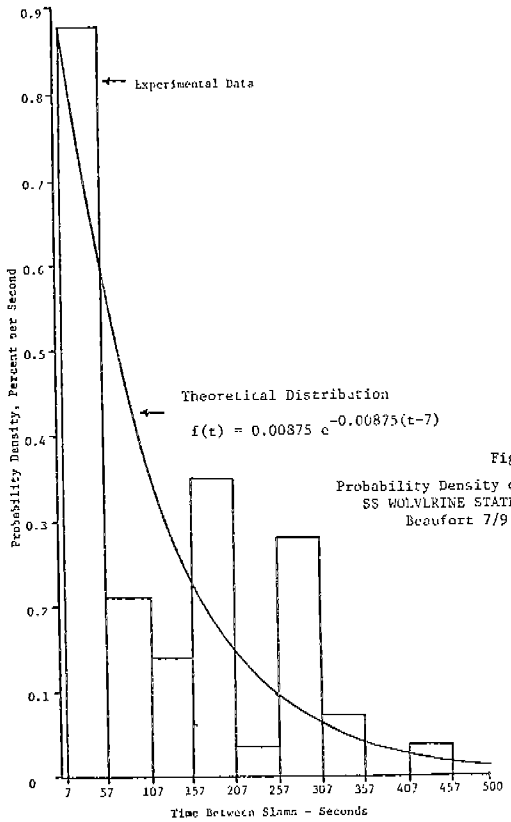


Figure 11

Probability Density of Time Between Slams
SS WOLVERINE STATE 277W2 Interval 2
Beaufort 7/9 Fwd Draft 18.5'

TABLE III

FREQUENCY-OF-OCCURRENCE ANALYSIS, 263W2, INTERVAL 12

(Figure 3)

No. Slams per 240-Sec. Group (r)	No. 240-Sec. Groups with r Slams	Theoretical Distribution, Percent	Experimental Distribution, Percent
0	21	12.5	32.8
1	11	26.0	17.2
2	9	27.0	14.1
3	7	18.7	10.9
4	8	9.7	12.5
5	4	4.1	6.25
6	0	1.4	0.0
7	2	0.4	3.1
8	1	0.1	1.6
9	1	0.0	1.6
	64		

Theoretical: $P = \frac{\lambda^r}{r!} e^{-\lambda}$, where λ = expected value, $\frac{133 \text{ slams}}{64 \text{ groups}} = 2.08$

TABLE IV

FREQUENCY-OF-OCCURRENCE ANALYSIS, 277W2, INTERVAL 2

(Figure 6)

No. Slams per 240-Sec. Group (r)	No. 100-Sec. Groups with r Slams	Theoretical Distribution Percent	Experimental Distribution, Percent
0	35	42.6	51.5
1	17	36.3	25.0
2	8	15.5	11.8
3	7	4.4	10.3
4	1	0.9	1.5
	68		

Theoretical: $P = \frac{\lambda^r}{r!} C^{-\lambda}$ where λ = expected value, $\frac{58 \text{ slams}}{64 \text{ groups}} = 0.853$

TABLE V

ELAPSED TIME ANALYSIS

(Figures 10 and 11)

Voyage 263W2, Interval 12				Voyage 277W2, Interval 2			
ΔT, Sec.	n	n'	$\frac{n}{70 \cdot N}$	ΔT, Sec.	n	n'	$\frac{n}{70 \cdot N}$
7-77	83	60.7	0.00898	7-57	25	3.0	0.00877
78-147	15	32.3	0.00162	58-107	6	12.1	0.00210
148-217	11	17.2	0.00119	108-157	4	7.9	0.00140
218-287	9	9.2	0.00097	158-207	10	5.5	0.00350
288-357	4	4.4	0.00043	208-257	1	3.3	0.00035
358-427	4	2.6	0.00043	258-307	8	2.1	0.00280
428-497	1	1.4	0.00011	308-357	2	1.4	0.00070
498-567	1	0.7	0.00011	358-407	0	0.9	0.0
568-637	2	0.4	0.00022	408-457	1	0.6	0.00035
638-707	2	0.2	0.00022	458-500	0	0.4	0.0

Voyage 263W2, Interval 12

$$f(t) = N_s e^{-N_s(t-7)}$$

$$N_s = \frac{132}{15,177-520} = 0.009$$

t	f(t)
7	0.00900
77	0.00479
147	0.00255
217	0.00136
357	0.00043
497	0.00011

n' = expected number

$X^2 = 21.1$ d.f. = 4

(last 6 groups lumped)

Voyage 277W2, Interval 2

$$f(t) = N_s e^{-N_s(t-7)}$$

$$N_s = \frac{57}{6762-136} = 0.0086$$

t	f(t)
7	0.0086
10	0.0085
20	0.0078
50	0.0060
100	0.0039
200	0.0016
300	0.0007
400	0.0003
500	0.0001

n' = expected number

$X^2 = 7.83$ d.f. = 3

(last 6 groups lumped)

The same test was on Ochi's model results (Reference 1, Figures 12 and 14), confirming the good fit of the model data.

The probable explanation for the results of the elapsed-time-between-slams analysis is the fact that the 7-second pitching period of the ship can cause, in a wave system with encounter periods in the same range, a number of sequential slams at 7-second intervals. This reasoning can also be applied to the frequency-of-occurrence data, since repeated slams due to a pitching resonance with the wave system imply that the Poisson distribution may not be applicable. In Ochi's model tests[3], the encounter period was 9.2 seconds.

III. CORRELATION WITH ENVIRONMENTAL CONDITIONS

The correlation of slamming incidence with environmental conditions, sea state, heading, speed, and forward draft was accomplished by counting both the number of slams and the maximum pressure from HP2 for sequential 20-minute intervals for all three voyages under consideration. For each interval, the sea state, relative heading, ship speed, and draft were noted from the logbook data (see Appendix B, SSC-210). These data are plotted in Figures 12, 13, and 14.

Note that observed sea states should be used with caution. For example, Reference 3, p. 17, refers to a typical design case of Sea State 7 in the North Atlantic, giving a significant wave height of 30.2 feet, and using the Pierson-Moskowitz wave spectrum for a 40.5-kt wind. Logbook data used in the present full-scale study (Appendix B, Reference 2) rarely show wave or swell heights greater than 20 feet, even at Sea State 9.

Figures 12, 13, and 14 show graphically the changes in the rate of slamming and in the maximum HP2 pressure as changes occurred in the other variables. For example, Figure 12 shows the events during Voyage 263W2 on June 4, 1966. The WOLVERINE STATE was westbound in the North Atlantic near latitude 50°N, longitude 17°W, with a forward draft of 17.5 feet (molded design draft is 30 feet). Recorded Interval 9 began just before logbook Index 80 at 0024 GMT, with a sea state equivalent to Beaufort 5. Engine RPM was 81.5, which is close to the maximum found in the logbook for calm conditions. Relative heading was 32°, determined by taking the difference between the Course (270°) and the true wave direction (SW x W, or about 238°).

Slamming began about 0320, and RPM was decreased in two steps to 65 RPM. At 0423 logbook Index 81 reported Sea State 6, and true wave direction WSW, for a relative heading of 22 degrees. The slamming rate increased rapidly during the next few hours, and at 0820, just before Index 82, RPM was reduced to 60, with sea state reported as 7. At the same time true wave direction changed to West, and Course was 264°, for a relative heading of 6 degrees. These conditions continued throughout the day, with slamming rate averaging about 10 every 20 minutes, and maximum HP2 pressures averaging between 30 and 40 psi, with two excursions exceeding 50 psi. Sea state gradually decreased as did slamming rate, and at 1725 RPM was increased to 65. True wave direction was reported as W x N at 2048, for a relative heading of 16 degrees with Course now 265 degrees. There was a temporary increase in slamming rate and maximum pressures, but sea state decreased to 5 and RPM was advanced in several steps back to the full throttle value of 80 RPM as slamming decreased and ceased altogether.

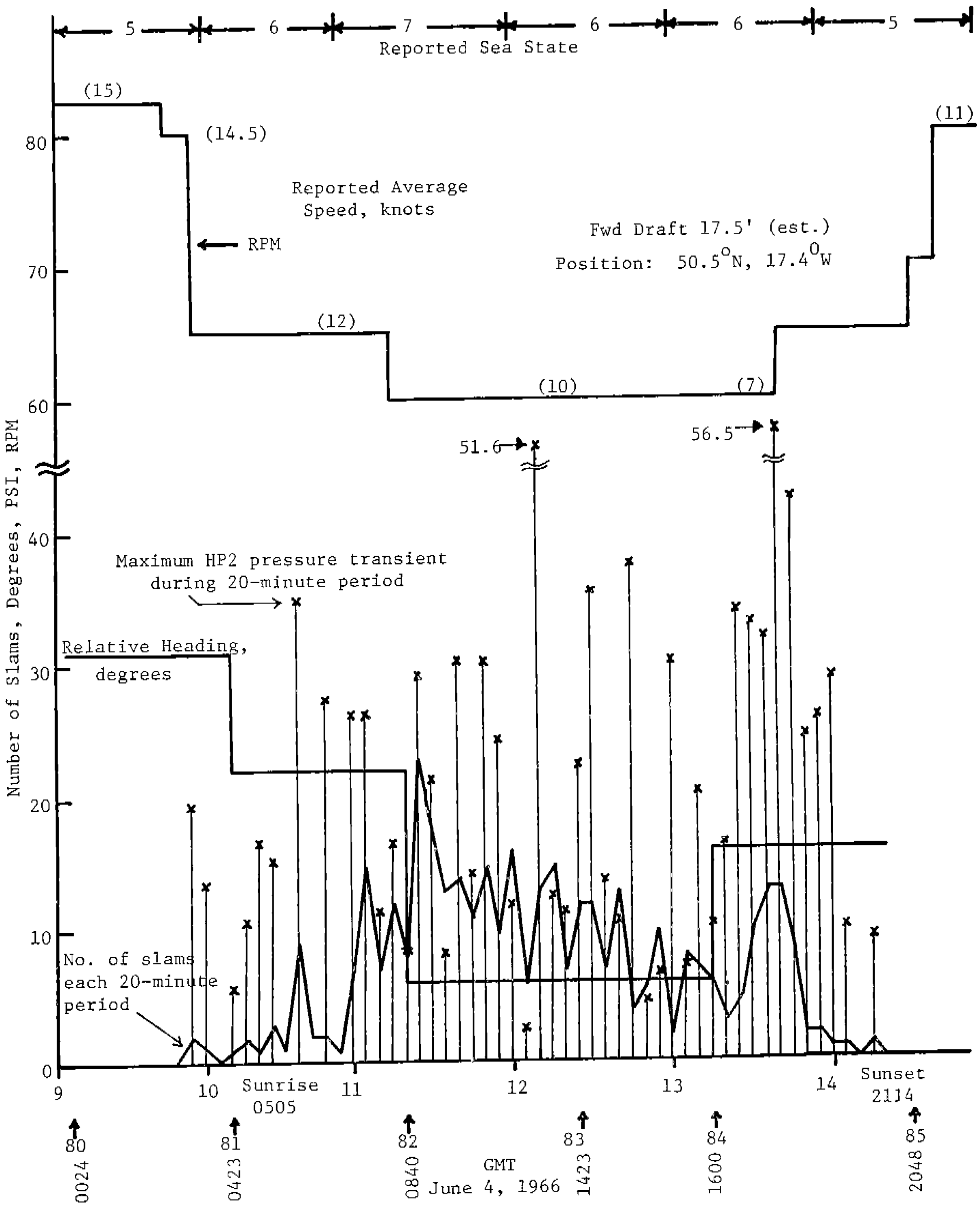


Figure 12

Slamming History, 263W2, Intervals 9-14

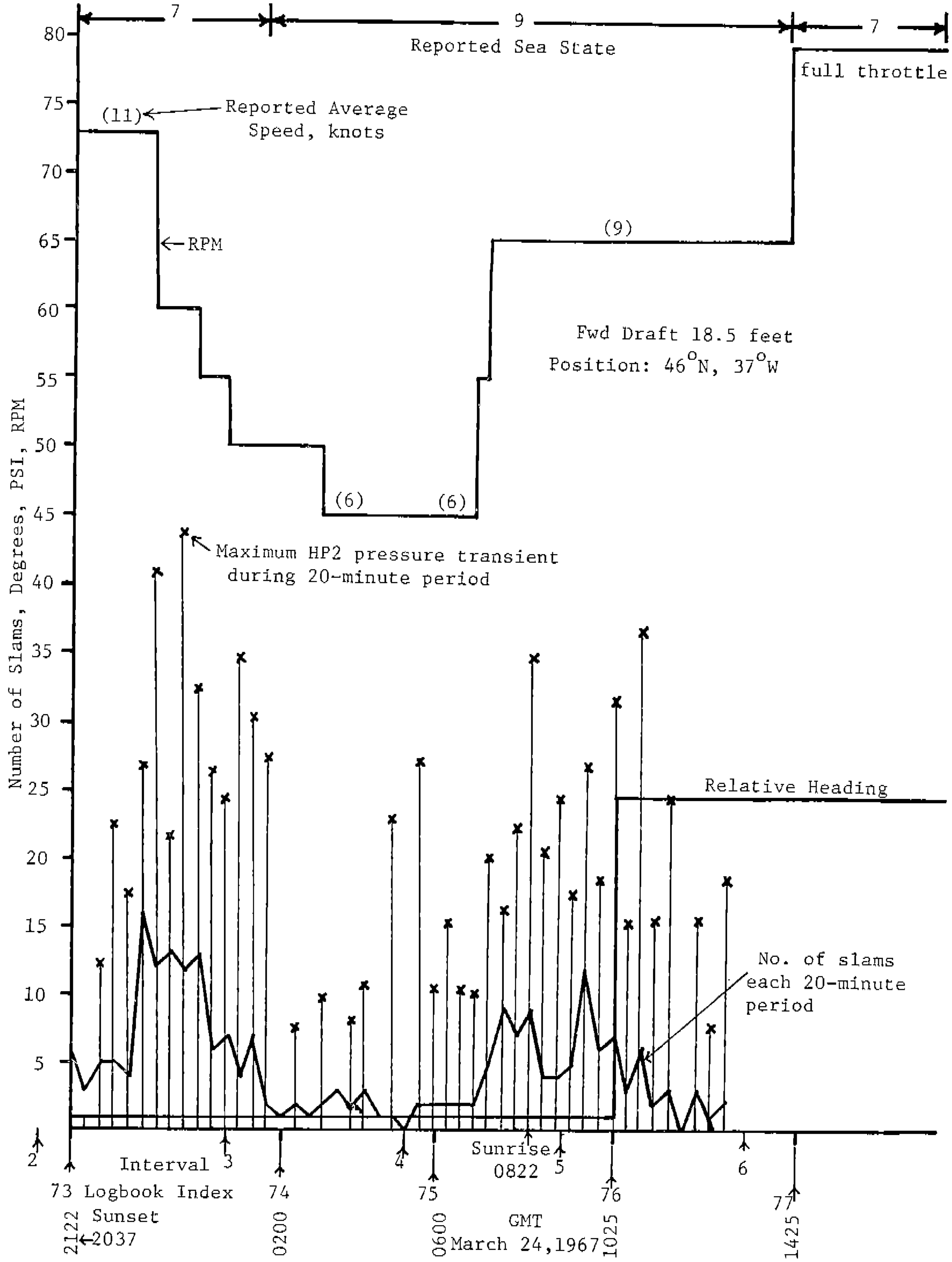


Figure 13

Slamming History, 277W2, Intervals 2-5

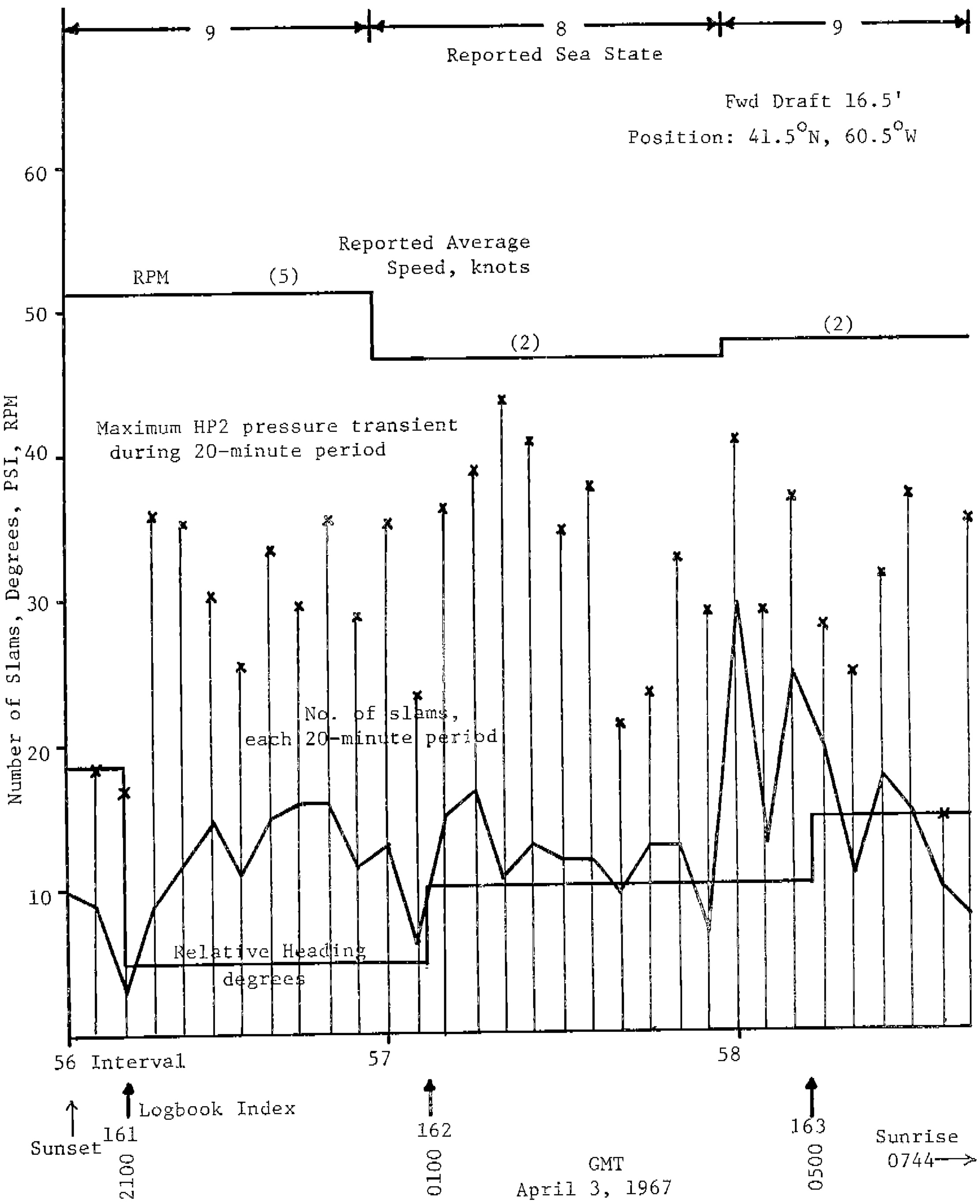


Figure 14

Slamming History, 288W3, Intervals 56-58

Lack of maximum pressure data for several 20-minute periods during Interval 10 is the result of the fact that several slams occurred, as defined by the dual criteria of bow emergence and midship transient stress ("whipping"), but there were no measurable transient pressures on HP2. This situation also occurred at several times during Voyage 277W2.

The information on RPM changes is also quite detailed in Figure 13 (277W2) because the mates on watch made notes in the data logbook each time there was a change in RPM. It is obvious that a reduction in RPM had a significant effect on the rate of slamming, even though the reported sea state increased from 7 to 9 during this period. Despite the reduction in speed to about 6 knots, there was still an occasional slam of significant pressure on transducer HP2.

Figure 14 (288W3) is not quite so detailed. It indicates an average RPM of about 50 for about 11 hours, under sea states of 8 and 9; in general, worse conditions than the portion of 277W2 examined above. Average number of slams in 20 minutes is also higher. The results for 263W2 (Figure 12) are quite similar to those of 277W2, in that there appears to be a definite correlation between the number of slams and both RPM and relative heading.

In order to determine more accurately the degree to which sea state, RPM, relative heading, and draft are correlated with slamming incidence, a multiple linear regression analysis was performed for a set of independent variables and a dependent variable. From the data in Figures 12, 13, and 14 "number of slams" was assigned as the dependent variable for Selection 1, and "maximum HP2 pressure" was assigned for Selection 2. The results of the regression analysis are shown in Table VI-A for the three voyages separately, and in Table VI-B for all three combined.

The regression analysis results may be interpreted by examining the "t" values with respect to the degrees-of-freedom involved. A relatively high "t" value with respect to the value tabulated in statistical tables for the confidence level assumed indicates that the regression coefficient in question is highly unlikely to be zero. An examination of the data in Table VI-A reveals that there is a strong correlation between the number of slams in a 20-minute period and the maximum pressure during that period, as would be expected. The sign of the regression coefficients and the value of "t" for the independent variables 3 (sea state), 4 (RPM), and 5 (relative heading) confirm what Figures 12, 13, and 14 have already revealed. For example, in Figure 12 the rate of slamming (Variable 1) increases as the relative heading (Variable 5) decreases (numerically, toward 000°, or head seas). This is confirmed by the "t" value of -2.257. For the other voyages, however, inspection of the figures indicates that there are little data concerning this relationship, and the regression analysis confirms this with very small "t" values.

The three-voyage analysis (Table VI-B) includes Draft as a sixth variable, resulting in a somewhat different set of correlations. With slamming rate as the dependent variable (Selection 1), the correlations with maximum pressure, relative heading, and draft have the highest "t" values, higher than those for any single voyage. However, taking all three voyages together and using maximum HP2 pressure as the dependent variable (Table VI-B, Selection 2) the correlations with all independent variables except slamming rate remain at relative low "t" values.

MULTIPLE REGRESSION.....V263W2

TABLE VI-A(1)

SELECTION..... 1

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT	STD. ERROR OF REG.COEF.	COMPUTED T VALUE
2 HP2 PSI	14.22854	14.22984	0.50292	0.09091	0.03767	2.41327
3 SEA STATE	5.84285	0.69440	0.72836	3.94891	0.90208	4.37742
4 RPM	66.21429	7.86826	-0.60687	0.06506	0.09958	0.65332
5 REL HEAD	13.98571	9.66015	-0.67459	-0.17931	0.07943	-2.25734
DEPENDENT						
1 NO. SLAMS	5.27142	5.73047				

INTERCEPT	-20.89463
MULTIPLE CORRELATION	0.79361
STD. ERROR OF ESTIMATE	3.59219

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	4	1427.09204	356.77301	27.64854
DEVIATION FROM REGRESSION	65	838.75110	12.90386	
TOTAL	69	2265.84326		

MULTIPLE REGRESSION.....V263W2

TABLE VI-A(2)

SELECTION..... 2

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT	STD. ERROR OF REG.COEF.	COMPUTED T VALUE
1 NO. SLAMS	5.27142	5.73047	0.58292	0.90448	0.37479	2.41327
3 SEA STATE	5.84285	0.69440	0.49282	-0.43523	3.23723	-0.13444
4 RPM	66.21429	7.86826	-0.53774	-0.34346	0.31224	-1.09997
5 REL HEAD	13.98571	9.66015	-0.56036	-0.25962	0.25818	-1.00955
DEPENDENT						
2 HP2 PSI	14.22854	14.22984				

INTERCEPT	38.37670
MULTIPLE CORRELATION	0.63462
STD. ERROR OF ESTIMATE	11.33041

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	4	5627.12106	1406.78076	10.95808
DEVIATION FROM REGRESSION	65	8344.59377	128.37835	
TOTAL	69	13971.71487		

MULTIPLE REGRESSION.....V277W2

TABLE VI-A(3)

SELECTION..... 1

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT	STD. ERROR OF REG.COEF.	COMPUTED T VALUE
2 HP2 PSI	18.85413	12.51608	0.61506	0.13374	0.03399	3.93485
3 SEA STATE	8.22916	1.07662	-0.60563	-1.03015	0.47741	-2.15780
4 RPM	57.74583	10.38013	0.39520	0.08498	0.04754	1.78766
5 REL HEAD	5.31250	9.07218	-0.22236	-0.08208	0.05364	-1.53030
DEPENDENT						
1 NO. SLAMS	4.77083	3.86605				

INTERCEPT	6.25494
MULTIPLE CORRELATION	0.75701
STD. ERROR OF ESTIMATE	2.64093

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	4	402.57470	100.64367	14.43018
DEVIATION FROM REGRESSION	43	299.90454	6.97457	
TOTAL	47	702.47924		

MULTIPLE REGRESSION.....V277W2

TABLE VI-A(4)

SELECTION..... 2

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y.	REGRESSION COEFFICIENT	STD. ERROR OF REG.COEF.	COMPUTED T VALUE
1 NO. SLAMS	4.77083	3.86605	0.61506	1.97945	0.50305	3.93485
3 SEA STATE	9.22916	1.07662	-0.39888	-1.00221	1.92747	-0.51996
4 RPM	57.74593	10.38013	0.29446	-0.03971	0.18947	-0.20962
5 REL HEAD	5.31250	9.07218	-0.01718	0.22062	0.20921	1.05450
DEPENDENT						
2 HP2 PSI	18.85413	12.51608				

INTERCEPT	18.77935
MULTIPLE CORRELATION	0.63019
STD. ERROR OF ESTIMATE	10.15990

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	4	2924.04102	731.01025	7.08180
DEVIATION FROM REGRESSION	43	4438.62013	103.22370	
TOTAL	47	7362.66016		

MULTIPLE REGRESSION.....V28BN3

SELECTION..... 1

TABLE VI-A(5)

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT	STD. ERROR OF REG.COEF.	COMPUTED T VALUE
2 HP2 PSI	30.56872	8.40734	0.47631	0.30830	0.09573	3.22044
3 SEA STATE	8.62500	0.49186	0.10873	-1.76766	1215.58594	-0.00145
4 RPM	49.64995	1.93779	-0.11481	0.53531	233.76660	0.00228
5 REL HEAD	1.25000	10.54942	-0.41780	-0.26711	37.40252	-0.00714
DEPENDENT						
1 NO. SLAMS	13.15625	5.16882				

INTERCEPT -6.73122

MULTIPLE CORRELATION 0.64175

STD. ERROR OF ESTIMATE 4.24753

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	4	341.09594	85.27398	4.72652
DEVIATION FROM REGRESSION	27	487.12231	18.04156	
TOTAL	31	828.21826		

MULTIPLE REGRESSION.....V28BN3

SELECTION..... 2

TABLE VI-A(6)

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT	STD. ERROR OF REG.COEF.	COMPUTED T VALUE
1 NO. SLAMS	13.15625	5.16882	0.47631	0.90117	0.27907	3.22914
3 SEA STATE	8.62500	0.49186	-0.25966	5.31380	2072.65820	0.00256
4 RPM	49.64995	1.93779	-0.31774	-2.16447	398.58837	-0.00543
5 REL HEAD	1.25000	10.54942	0.02264	0.37874	63.77389	0.00593
DEPENDENT						
2 HP2 PSI	30.56872	8.40734				

INTERCEPT 77.70901

MULTIPLE CORRELATION 0.59471

STD. ERROR OF ESTIMATE 7.24234

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	4	774.99438	193.74859	3.69385
DEVIATION FROM REGRESSION	27	1416.19166	52.45154	
TOTAL	31	2191.18604		

MULTIPLE REGRESSION.....3 VOYG

SELECTION..... 1

TABLE VI-B(1)

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT	STD. ERROR OF REG.COEF.	COMPUTED T VALUE
2 HP2 PSI	19.19459	14.04629	0.64765	0.18784	0.02709	6.93348
3 SEA STATE	7.20000	1.51058	0.31675	0.70282	0.31973	2.19816
4 RPM	59.75720	10.52740	-0.41451	0.07901	0.05493	1.43823
5 REL HEAD	10.29333	9.32669	-0.32538	-0.18470	0.04820	-3.83149
6 DRAFT	17.60667	0.72488	-0.46029	-3.74179	0.55973	-6.68491
DEPENDENT						
1 NO. SLAMS	6.79333	6.04823				

INTERCEPT 61.18772

MULTIPLE CORRELATION 0.76173

STD. ERROR OF ESTIMATE 3.98603

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	5	3162.64893	632.52978	39.81053
DEVIATION FROM REGRESSION	144	2287.94482	15.88850	
TOTAL	149	5450.59376		

MULTIPLE REGRESSION.....3 VOYG

SELECTION..... 2

TABLE VI-B(2)

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT	STD. ERROR OF REG.COEF.	COMPUTED T VALUE
1 NO. SLAMS	6.79333	6.04823	0.64765	1.33240	0.19216	6.93349
3 SEA STATE	7.20000	1.51058	0.32597	0.57088	0.86439	0.66043
4 RPM	59.75720	10.52740	-0.39810	-0.09532	0.14714	-0.64783
5 REL HEAD	10.29333	9.32669	-0.33886	-0.13395	0.13431	-0.99733
6 DRAFT	17.60667	0.72488	-0.25068	0.17127	1.70639	0.10037
DEPENDENT						
2 HP2 PSI	19.19459	14.04629				

INTERCEPT 10.09240

MULTIPLE CORRELATION 0.66929

STD. ERROR OF ESTIMATE 10.61597

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	5	13168.85549	2633.77100	23.36999
DEVIATION FROM REGRESSION	144	16228.62893	112.69880	
TOTAL	149	29397.48442		

IV. PRESSURE-VELOCITY RELATIONSHIP

Detailed measurements were made on a number of slams which occurred during Interval 57 of Voyage 288W3. These measurements are described and illustrated in the Appendix.

The relationship between relative impact velocity and slamming pressure was studied, with emphasis on the "threshold" velocity for slamming. This relationship is of particular interest to naval architects because it brings together two facets of design which are capable of some control: seakeeping qualities having to do with pitching motion, and the hull form forward.

There is a considerable literature on slamming which considers the pressure-velocity relationship. Model tests have shown that the pressures associated with slamming are proportional to the square of the impact velocity, and that the relationship depends on a coefficient "k" which is a function only of the shape of the hull section:[1]

$$p = kv_r^n$$

where

p = peak pressure, psi

v_r = relative impact velocity, feet/second

n = exponent, experimentally determined as very close to 2

Ochi[1] showed that, in both regular and irregular waves, a MARINER model had a $k = 0.086$ at Station 2. He also summarized[3] from a number of sources data indicating that there is a threshold velocity of about 12 feet/second for all hull forms below which slamming impact does not occur. Recent studies on a barge model[4] indicated a "k" of 0.11 at Station 3 on the particular model instrumented.

Reference 2 considered data from 5 slams on the WOLVERINE STATE, and reported a k value of 0.077. In that investigation relative velocity was determined by the slope of the pressure-time record of the pressure transducer (LP21) at the forepeak during reentry following a slam. As derived in the reference:

$$p = \rho g h$$

$$p = \rho g \int v_r dt$$

or,

$$\Delta p = \rho g v_r \Delta t$$

where

p = impact pressure, psi

ρ = sea water mass density

g = acceleration of gravity

h = depth of immersion of pressure transducer

v_r = impact velocity, feet/second

Solving for v_r: $$v_r = \frac{\Delta p}{\Delta t} \frac{1}{\rho g}$$

This same relationship has been used in the present work, with values obtained from the basic data in the Appendix (derived parameter No. 18, VREL). However, the approach has been modified and improved.

One obvious source of error in the earlier work was the fact that relative velocities determined by measurements at the forepeak were being used in conjunction with pressure data from transducer HP2, located just forward of Station 2, 28 feet further aft. Dr. Ochi provided additional information bearing on this problem by examining the distribution of relative velocity along the length of a V-MARINER model. These experimental data indicated that the amplitudes of relative motion velocity in waves reduce significantly with increase of distance from the forward perpendicular, and it appears that the reduction is linear with increase in distance. Significant relative velocity amplitudes along the ship length were also computed for the MARINER, and were also found to be linear.

To review some past history of this slamming investigation on the WOLVERINE STATE, the original decisions concerning the dynamic range of the pressure transducers were based on the premises that a) slamming pressures were likely to be as high as 300 psi, and b) transducers having a range of 0-50 psi would be useful for 1) detecting bow emergence, and 2) providing the reentry slope for determining relative velocity. Thus, of the 20 pressure transducers installed, 16 were "high-pressure" (HP), and 4 were "low-pressure" (LP). The locations of these transducers are shown in Figure 1. Only 7 of the 20 could be recorded at one time.

Review of the data for the preparation of Reference 2 was accomplished by reproducing the signals on the oscillograph in the normal manner. Both the calibration signals and the transient data were of relatively low amplitude on these records.

In the course of doing the detailed measurements on the HP transducers reported here, the HP signals were reproduced at significantly higher amplitudes, as described in the Appendix. Examination of the resulting records indicated that the HP transducers, despite their range of 0-350 psi, were quite capable of responding to the emergence and reentry pressures with adequate resolution, in exactly the same manner as the LP transducers. Therefore, it was possible to derive relative velocity information directly from HP2 itself by measuring the DEL P* and DEL T* values in the same manner as reported in the Appendix for LP21. The results are shown in Table VII, which summarizes transient pressure data for all of the HP transducers, plus VREL* data for LP21 and HP2.

Having now measured VREL at a different station from LP21, the question of the linear distribution along the ship was investigated. The VREL data for LP21 and HP2 were plotted for each slam as shown in Figure 15. It is obvious that there is no consistent linear decrease in relative velocity with distance along the ship at the instant of slam impact. A possible explanation for the result is the fact that the relative velocity is a function of both the downward vertical velocity of the ship, and the upward (or downward) vertical velocity of the wave surface at the instant of impact. Over the 28 feet which separate the two locations, significant changes in wave shape and velocity are certainly plausible.

*See Appendix for definitions.

TABLE VII

PRESSURE AND RELATIVE VELOCITY DATA

Slam	Transient Pressure PSUBTR, psi (Transducer, distance aft of FP)					VREL, f/s	
	HP1 41' 5"	HP2 52' 8"	HP6 82' 5"	HP9 98' 6"	HP12 132' 5"	LP21 24' 8"	HP2 52' 8"
1	16.69	26.53	0	0	0	20.35	25.8
2	15.9	12.86	0	0	0	21.41	18.6
3	10.33	17.68	0	0	0	19.89	13.4
4	16.69	32.42	0	0	0	20.37	27.5
5	22.25	17.95	0	0	0	20.07	21.4
6	15.10	16.34	0	0	0	17.87	17.3
8	19.87	20.90	0	0	0	17.31	20.1
9	31.80	29.47	4.50	0	0	21.46	27.0
10	10.33	13.66	0	0	0	18.56	15.5
12	15.10	36.71	11.00	6.23	0	27.71	29.9
13	25.43	35.64	48.00	7.01	0	35.03	35.1
14	15.90	24.38	9.00	0	0	22.20	24.8
15	15.10	26.26	0	0	0	19.98	18.9
16	12.71	25.19	0	0	0	16.69	17.8
17	30.20	40.73	39.50	8.19	0	35.17	33.4
18	31.00	37.25	8.50	0	0	24.61	24.0
19	23.05	0	0	0	0	19.75	23.4
20	11.12	23.04	0	0	0	16.95	18.8
21	10.33	26.77	0	0	0	24.16	20.8
22	11.92	32.69	0	0	0	15.27	17.0
23	11.92	35.64	37.00	9.75	0	28.92	23.4
24	23.85	56.54	0	0	0	18.80	19.4
25	19.87	30.28	8.50	0	0	23.57	22.1
26	14.30	27.33	0	0	0	17.38	22.2
27	23.85	20.63	0	0	0	19.90	30.9
28	15.10	27.33	0	0	0	28.02	26.6

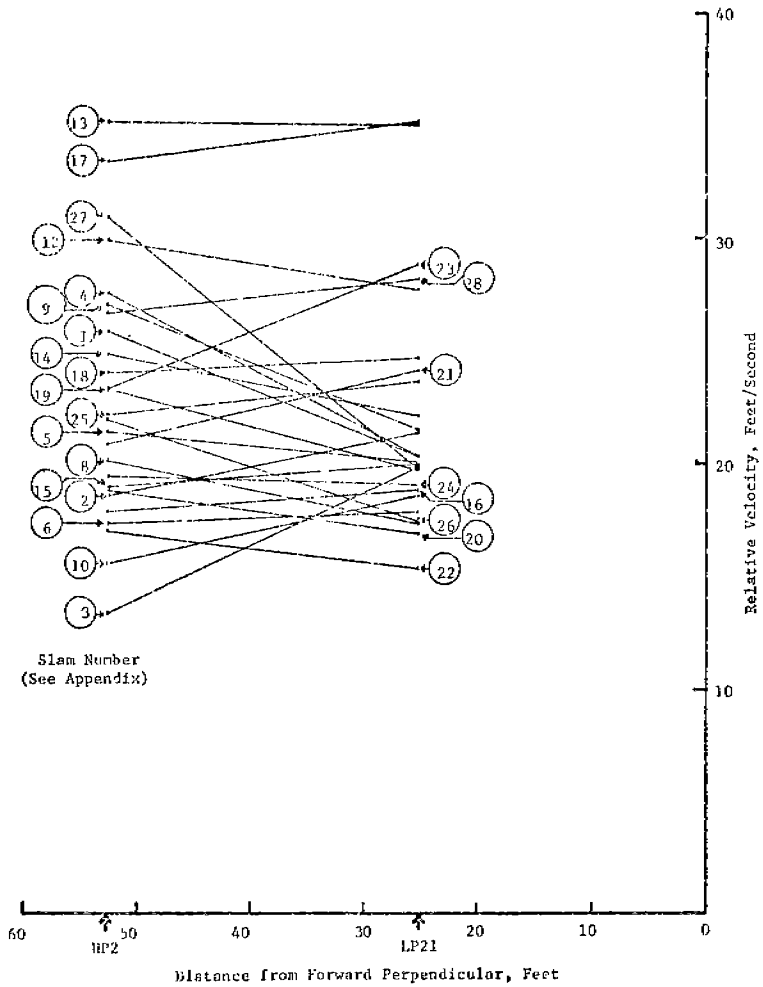


Figure 15

Relative Velocity vs. Distance

The derivation of the relative velocity relationship with pressure turned, therefore, to direct use of pressure and velocity data derived entirely from HP2. The results are based on data from Table VII, and are plotted in Figure 16. Although there is some scatter in the data, a straight line with a slope of 2 fits quite reasonably, and the intercept produces a "k" value of 0.053. Dr. Ochi provided also a plot of calculated "k" value vs. station for the WOLVERINE STATE, based on the changing hull form. This plot is reproduced here as Figure 17, and the experimental value of 0.053 has been added at the location of HP2. Although the experimentally-determined "k" is low in comparison with the theoretical value, the method is inherently subject to quite variable results because of the difficulty of estimating the slope of the tangent (see Figure A-1). This rather crude approximation method was used only because there was no direct measurement of relative velocity. It should be noted that no bottom damage was reported as a result of the slamming experienced on this voyage.

The threshold velocity again appears to be approximately 12 feet/second. The total of 52 new values of VREL from Table VII range from 13.4 to 35.17 feet/second. These slams, of course, were selected to be the largest, so the general average is expected to be considerably above the threshold. The distribution of the 52 VREL values is shown as a histogram in Figure 18. The average of the LP21 VREL values is 22.17, and that of the HP2 values is 22.89, for an overall average of 22.53 feet/second. The overall results from the two transducers are almost identical, even though, as shown by Table VII, the individual values vary widely for each specific slam.

V. CORRELATION WITH MIDSHIP TRANSIENT STRESS

Several investigations were undertaken to determine how midship transient stress (SSUBTR), or "whipping", is related to bow acceleration.

A. SSUBTR vs. Acceleration Phase

"Acceleration phase" is defined as the portion of an acceleration period by which the slam lags behind the peak of the static acceleration (ASUBST), as illustrated in Figure 19. Figure 19 also shows the relationship of acceleration phase to transient stress for the 26 detailed slams, from data summarized in Table VIII. This table also includes the stress phase data (PHASE). Inspection of the figure indicates that the slam occurs between 50° and 80° after the acceleration peak, but there does not appear to be a consistent trend relating the magnitude of transient stress to acceleration phase.

B. SSUBTR vs. Transient Acceleration

To gain insight into the relationship between the magnitudes of midship whipping stress (SSUBTR) and transient bow acceleration (ASUBTR), the two were plotted from the data given in the Appendix. As shown in Figure 20, for low values there is a definite position correlation between the two. At higher values the data are scattered and sparse. With only 3 data points over 3 kpsi whipping stress and over 0.5g transient acceleration, no firm conclusions can be stated.

C. HP2 Transient Pressure vs. Transient Acceleration

Figure 21 plots this relationship, and, as expected, there is a good correlation between the two. There are two extreme data points evident, but because of the variability of wave form beneath the ship, it is certainly possible that an

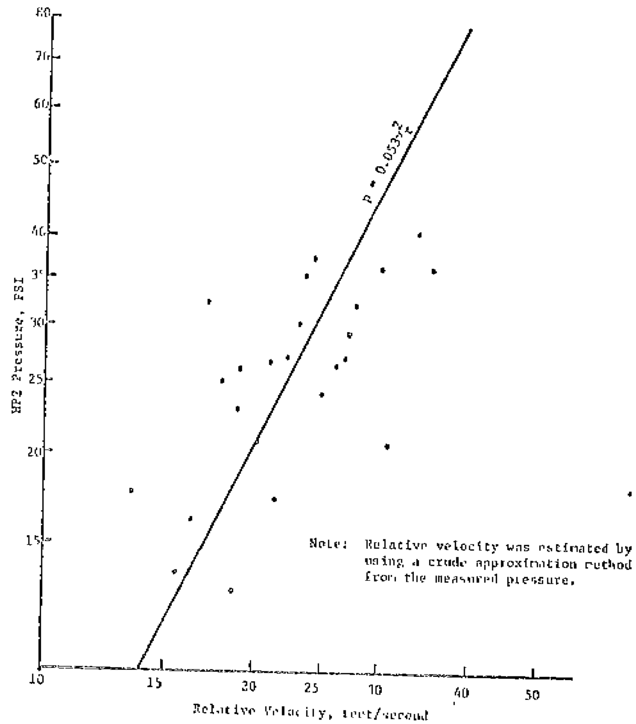


Figure 16
Pressure vs. Relative Velocity, HP2

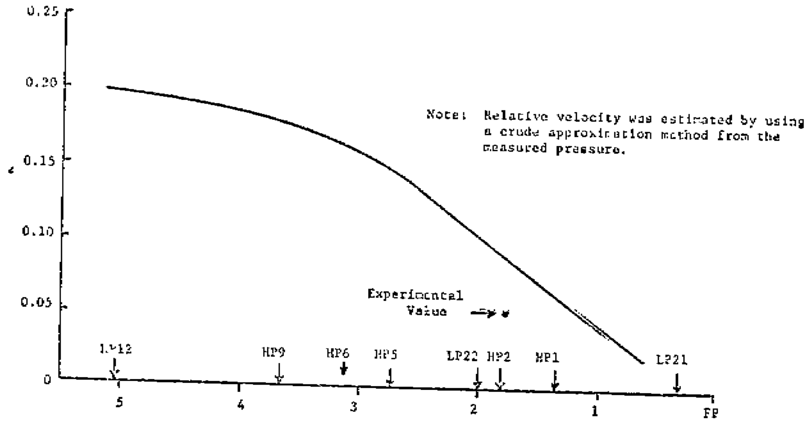


Figure 17
Computed "k" vs. Station
SS WOLVERINE STATE

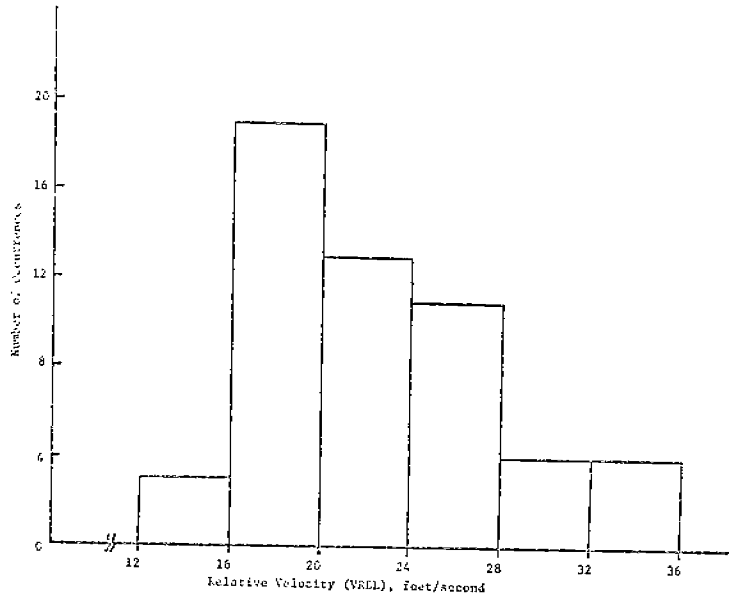


Figure 18
Histogram of VREL, LP21 and HP2

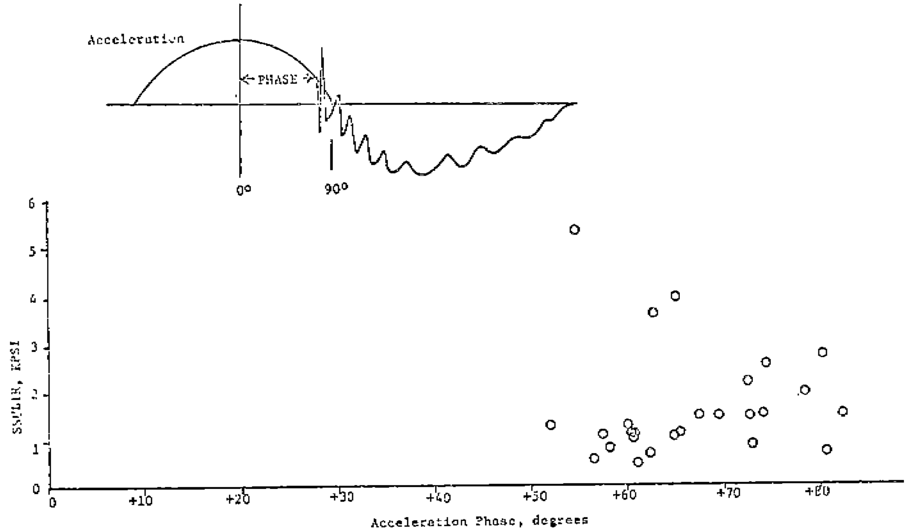


Figure 19
Acceleration Phase vs. Transient Stress
Voyage 28BW3

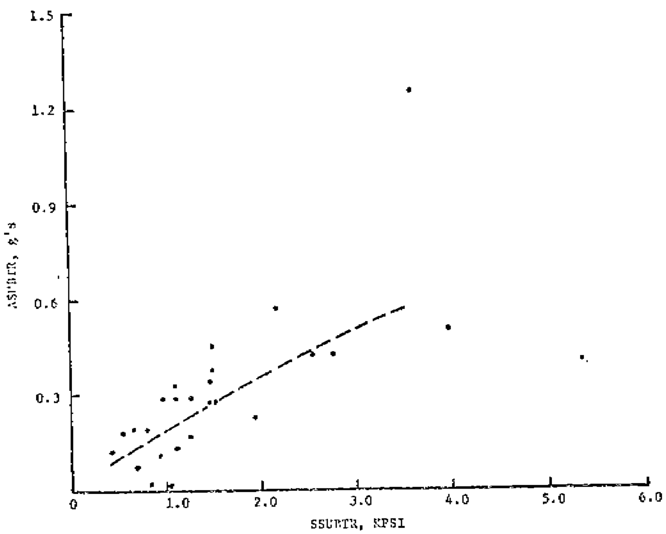


Figure 20
Midship Transient Stress vs. Transient Acceleration

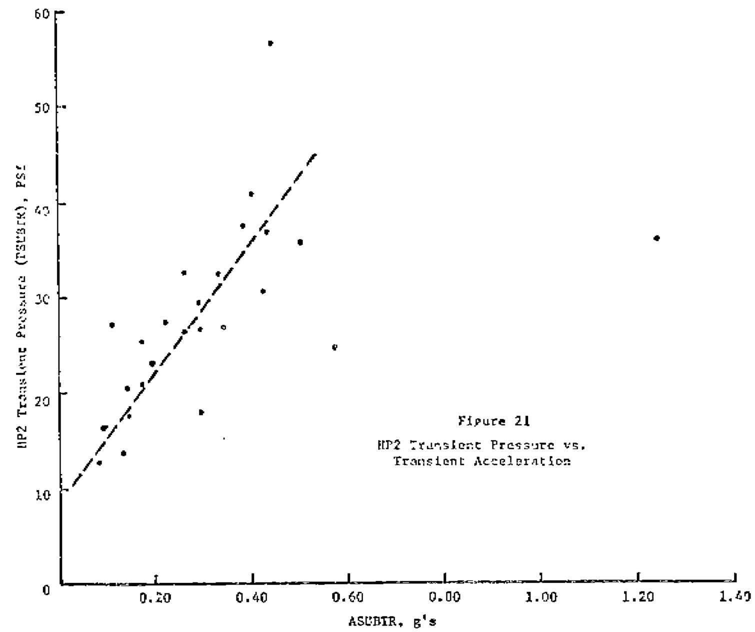


Figure 21
HP2 Transient Pressure vs.
Transient Acceleration

TABLE VIII

ACCELERATION PHASE DATA

SLAM NO.	PHASE	SSUBTR	ACC. PHASE
1	39.6	1.08	57.4
2	24.0	1.02	64.9
3	20.7	0.55	56.5
4	23.0	1.10	60.8
5	27.6	1.27	60.0
6	19.0	0.83	73.0
7	23.8	0.66	62.3
8	-	-	61.6
9	32.9	1.10	60.5
10	25.4	0.44	61.1
11	-	-	56.8
12	33.7	2.76	80.2
13	21.0	3.98	65.6
14	21.2	2.18	72.5
15	67.8	1.44	67.5
16	50.4	1.24	52.0
17	33.0	5.34	54.5
18	25.0	1.49	74.1
19	-52.0	0.69	80.6
20	20.1	0.80	58.1
21	22.7	1.46	72.6
22	25.8	1.49	69.6
23	25.1	3.60	62.8
24	32.6	1.49	82.4
25	35.0	2.54	74.3
26	72.0	0.94	60.5
27	32.9	1.10	65.5
28	51.1	1.93	78.3

occasional large acceleration will not be accompanied by a corresponding high pressure at HP2, and vice versa.

VI. PRESSURE-LOCATION-TIME DISTRIBUTION

Two slams were selected from the 26 for a detailed study of the passage of the pressure wave along the keel; for each, two figures are presented: the first showing an amplitude-time distribution with emphasis on the duration of the pressure, and the second showing amplitude, time, and location.

Figure 22 shows the amplitude-time distribution for Slam 12. The first three pressure impulses are approximately 100 milliseconds in duration, rising to 150 and 300 milliseconds at HP6 and HP9. Slam 23 (Figure 23) is somewhat different, with all of the HP transducers showing pressure durations of approximately 100 milliseconds. The time base zero was arbitrarily established at the time of the peak pressure at LP21. Positive times are earlier; negative times are later.

In order to show the entire passage of the pressure wave in amplitude, time, and location for the same 2 slams, the basic data were displayed as shown in Figures 24 (Slam 12) and 25 (Slam 23). Pressure amplitudes are shown by vertical lines, time progresses from bottom to top, and location from right to left. Comparing these two figures, it is evident that Slam 12 progressed forward hitting HP9 first, then HP6, HP2, HP1, and LP21. Slam 23, however, hit HP1, HP2, HP6, and HP9 almost simultaneously, and finally, LP21. Using Midship transient stress (SSUBTR) as a criterion of slamming intensity. Slam 23 was 30 percent more intense than Slam 12. The pressure at HP2, however, was about the same in both cases.

Figures 24 and 25 are informative in terms of the propagation characteristics of the pressure wave along the hull. In Figure 24, Slam 12 appears to have a uniform rate of propagation from HP6 through HP2 to LP21 of 232 feet/second. Slam 23 (Figure 25), however, may have actually been two separate impacts, one concentrated in the region from HP1 aft, and the other only at the forepeak. The apparent simultaneous impact over a fairly large region is probably the reason why Slam 23 caused a more severe structural response in the hull.

VII. RESULTS AND CONCLUSIONS

A. Additional analysis of frequency-of-occurrence data showed considerable variation in goodness-of-fit to the Poisson distribution. The general applicability of the Poisson distribution to these severe slamming data is somewhat questionable. The distribution of elapsed-time-between-slams appears to be overly heavy in the first group, probably due to the repeated slams separated by one pitching period. Chi-squared tests of the goodness-of-fit of the experimental data to the truncated Rayleigh probability density function indicated a fit at the 5 per cent level for the data from 277W2.

B. A detailed correlation of slamming incidence with environmental conditions showed the relative effects of sea state, RPM, and relative heading. A regression analysis providing the same information in the form of regression coefficients and "t" values showed that for Voyage 263W2 the correlation between slamming rate and relative heading was significant. Analyzing all three voyages together, relative heading and draft appeared to have the most probable correlation with a slamming rate, but not with maximum pressure.

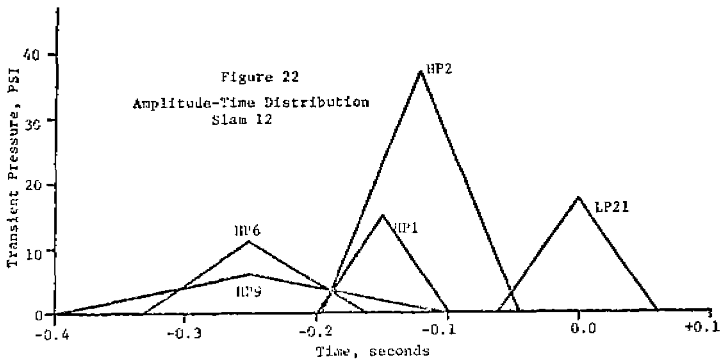


Figure 22
Amplitude-Time Distribution
Slam 12

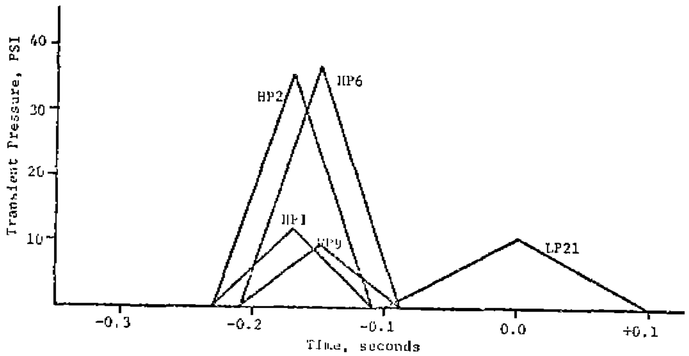


Figure 23
Amplitude-Time Distribution
Slam 23

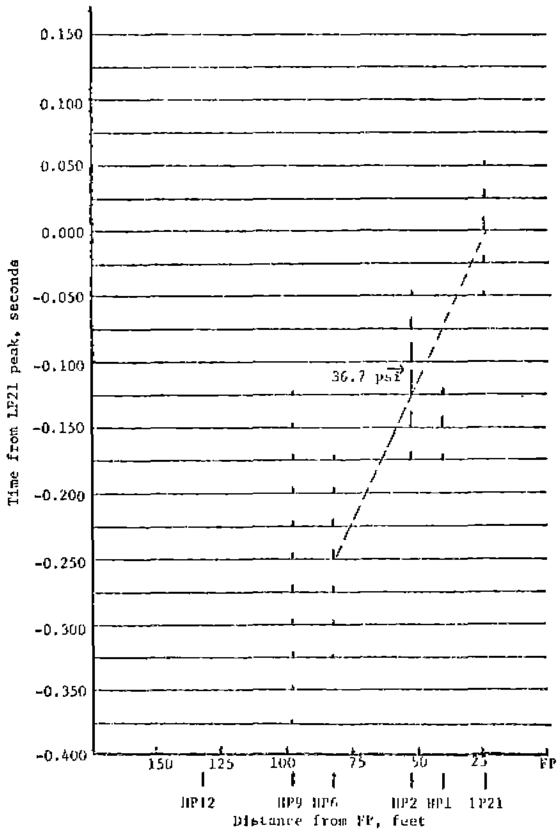


Figure 24
Pressure-Location-Time Distribution, Slam 12

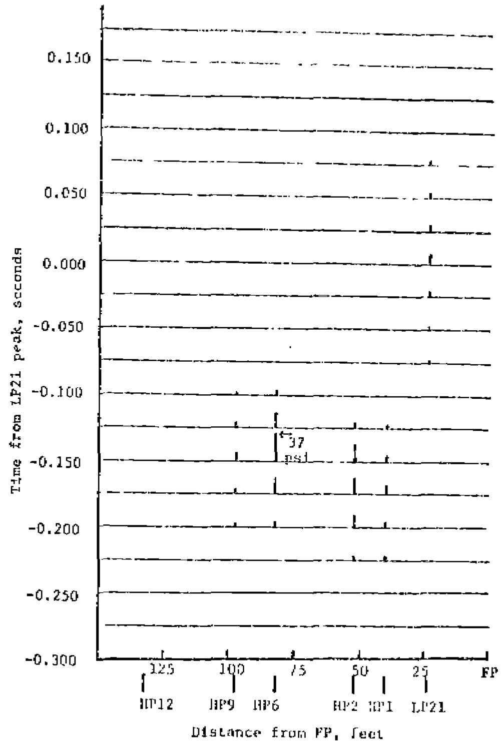


Figure 25
Pressure-Location-Time Distribution, Slam 23

C. Since the relative velocity between waves and ship bow was not measured in the trials, the velocity was estimated by using a crude approximation method from the measured pressure. The k-value, which gives the pressure-velocity relationship, thus estimated was 0.053 near Station 2 as compared with the calculated value 0.092.

Comparison of relative velocity values associated with slam impact at the two locations LP21 and HP2 showed that there was no consistent relationship between them. The relative velocity values indicated, as before, a threshold at 12 feet/second. The average relative impact velocity at the two locations for a group of 26 slams was practically identical at 22.53 feet/seconds.

D. Midship transient ("whipping") stress was examined in conjunction with transient acceleration and acceleration phase, and it was found that slamming occurs within the acceleration phase range 50-80 degrees, but that there was no evident correlation with midship transient stress. There was, however, a definitive positive correlation with transient acceleration.

E. Two slams were examined in detail to determine if pressure-time information would be useful. The results showed that in the case where the impact occurred at all locations more-or-less simultaneously, the midship transient stress was 30 percent more severe than in a case of progression of the impact from aft to forward.

VIII. REFERENCES

1. Ochi, M. K. "Prediction of Occurrence and Severity of Ship Slamming at Sea." Office of Naval Research, Fifth Symposium of Naval Hydrodynamics, 1964.

   See also

   Ochi, M. K. "Extreme Behavior of a Ship in Rough Seas--Slamming and Shipping of Green Water." SNAME Transactions 1964, pp. 143-202.

2. Wheaton, J. W., Kano, C. H., Diamant, P. T., and Bailey, F. C. "Analysis of Slamming Data from the S.S. WOLVERINE STATE," Ship Structure Committee Report SSC-210, 1970.

3. Ochi, M. K., and Motter, L. E. "A Method to Estimate Slamming Characteristics for Ship Design," Marine Technology, April 1971.

4. Huang, R. T., and Sibul, O. J. "Slamming Pressures on a Barge Model," SNAME Technical & Research Report R-12, October 1971.

5. Ochi, M. K. "Ship Slamming-Hydrodynamic Impact Between Waves and Ship Bottom Forward," Symposium on Fluid-Solid Interaction, ASME Winter Meeting, Pittsburgh, November 1967.

APPENDIX

DETAILED MEASUREMENTS

26 SEVERE SLAMS
TAPE 288W3, INTERVAL 57

Seventeen basic measurements were made on pressure, stress, and acceleration time-histories from 26 severe slams. These measurements are defined and illustrated below. A computer program was written to take the raw data (in terms of vertical divisions and horizontal inches on the oscillograph record), convert it to engineering units, and tabulate it. The calibration derivation shown was necessary because, in order to achieve sufficient resolution of the pressure data, the pressure data had to be amplified to the point that the calibration signals were off the paper. The conversion technique involved running a sample of pressure data with a readable calibration signal and an identifiable slam following it, then increasing the amplitude as required and re-running the same events. Since the same slam appeared on both runs, the calibration amplitude could be derived for the amplified run by simple proportion.

For example, referring to the HP2 column of the calibration derivation, the first run had a calibration signal of 35.0 divisions, and a "Cal Slam" of 7.3 divisions. Increasing the amplitude and re-running the same slam ("Run Slam"), its amplitude was found to be 13.6 divisions. Therefore, the calibration amplitude for the data run was derived as (13.6/7.3) x 35.0 = 65.2 divisions ("Run Cal"). Knowing what the amplitude of the calibration signal represents in engineering units ("Cal Amp" and "Cal Unit"), the final conversion factor ("Units/Div") is found.

The detailed measurements were made on 28 slams from Interval 57, Voyage 288W3. In the cases of Slams 7 and 11, parts of the records were off the paper and not read, and these slams have been omitted from the tabulation, leaving a total of 26.

TELEDYNE MATERIALS RESEARCH
WALTHAM, MASS.

23 AUG 72

PROJECT 1434
ANALYSIS OF SLAMMING DATA FROM SS WOLVERINE STATE
CONTRACT NSSC-N00024-72-C-5047

DETAILED MEASUREMENTS FROM TAPE 288W3, INTERVAL 57

LOGBOOK DATA

MARCH 3, 1969 0100 GMT POSITION APPROX 41.6 DEG
NORTH, 61 DEG WEST, COURSE 215 DEG AVG SPEED 2 KT
RPM 46.8 WIND SPEED 43 KT WIND DIRECTION SW TRUE
BEAUFORT 8 WAVE DIRECTION SW TRUE AVG WAVE HT 20 FT
AVG WAVE PERIOD 5 SEC AVG WAVE LENGTH 100 FT
AVG SWELL HT 20 FT AVG SWELL LENGTH 100 FT SWELL
DIRECTION SW TRUE BAROMETER 29.84 SEA TEMP 59F
AIR TEMP 58F WEATHER OVERCAST FWD DRAFT 16.5 FT
HOVE TO IN SW GALE

DEFINITIONS OF PARAMETERS MEASURED FROM OSCILLOGRAPH RECORD

NO.	ABBREVIATION	DESCRIPTION	UNIT
1	TSUBE	DURATION OF EMERGENCE	INCH
2	PSUBST	STATIC PRESSURE	DIVISIONS
3	PSUBTR	TRANSIENT PRESSURE	DIVISIONS
4	PSUBSM	STAGNATION PRESSURE	DIVISIONS
5	DEL P	RE-ENTRY PRESSURE CHANGE	DIVISIONS
6	DEL T	RE-ENTRY TIME CHANGE	INCH
7	TSUBREL	SLAM TIME REF LP21 SLAM	INCH
8	TSUBDT	TRANSIENT PRESSURE DURATION	INCH
9	ASUBST	STATIC BOW ACCELERATION	DIVISIONS
10	ASUBTR	TRANSIENT BOW ACCELERATION	DIVISIONS
11	SSUBWB	STATIC WAVE BENDING STRESS	DIVISIONS
12	SSUBTR	TRANSIENT WAVE BENDING STRESS	DIVISIONS
13	SSUBT	TOTAL WAVE BENDING STRESS	DIVISIONS
14	PHASE	SLAM PHASE FROM HOG PEAK	DEGREES
15	DEL ST	ADDITIVE PART OF SLAM STRESS	DIVISIONS
16	SSUBWH	P-T WHIPPING STRESS	DIVISIONS
17	VSUBA	INTEGRATED ACCELERATION	DIV X TIME

DEFINITIONS OF DERIVED PARAMETERS

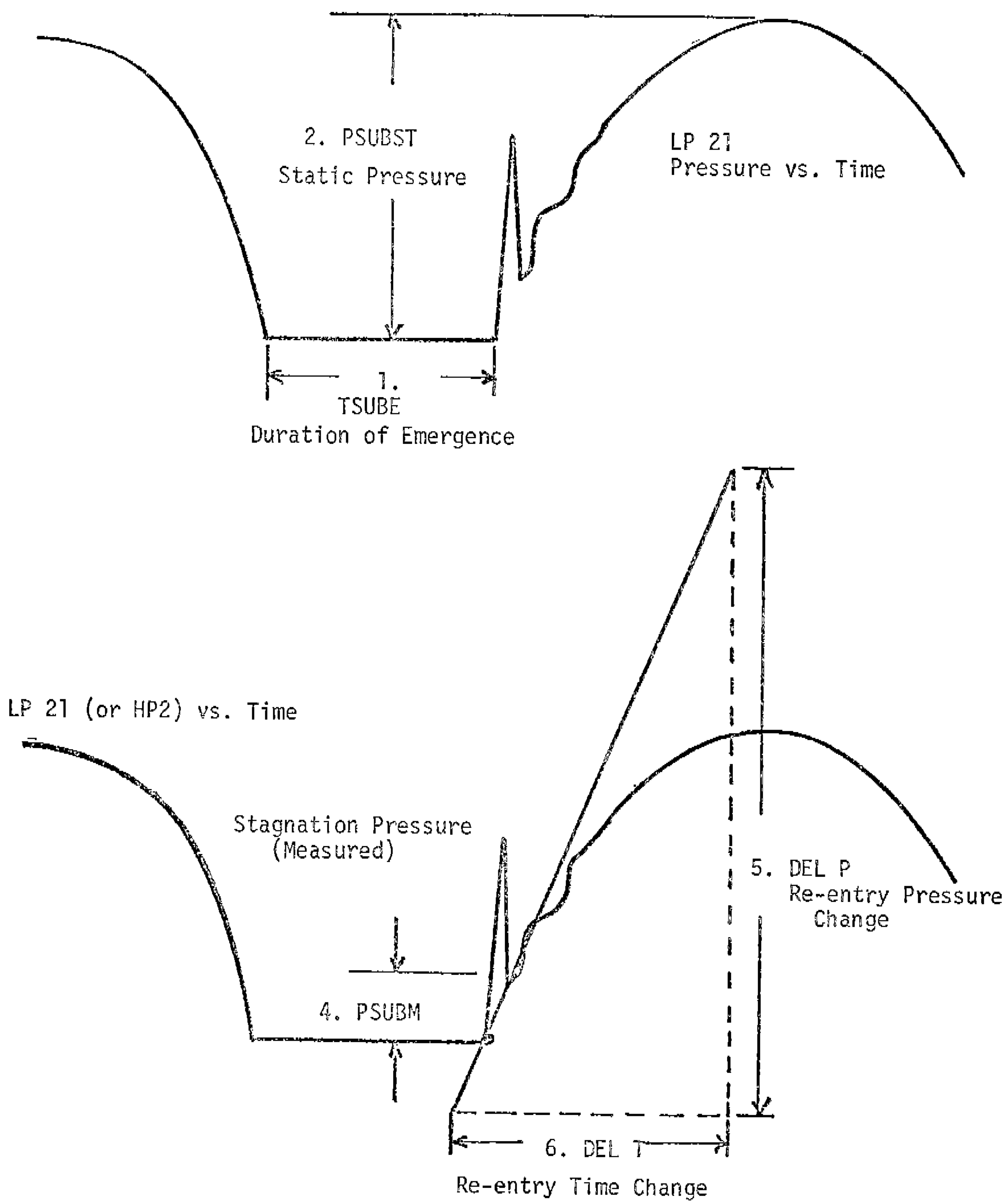
NO.	ABBREVIATION	DESCRIPTION	UNIT
18	VREL	VELOCITY FROM DEL P, DEL T, RHO, AND G	FT/SEC
19	PSUBSC	STAGNATION PRESSURE FROM VREL AND RHO	PSI

CALIBRATION DERIVATION

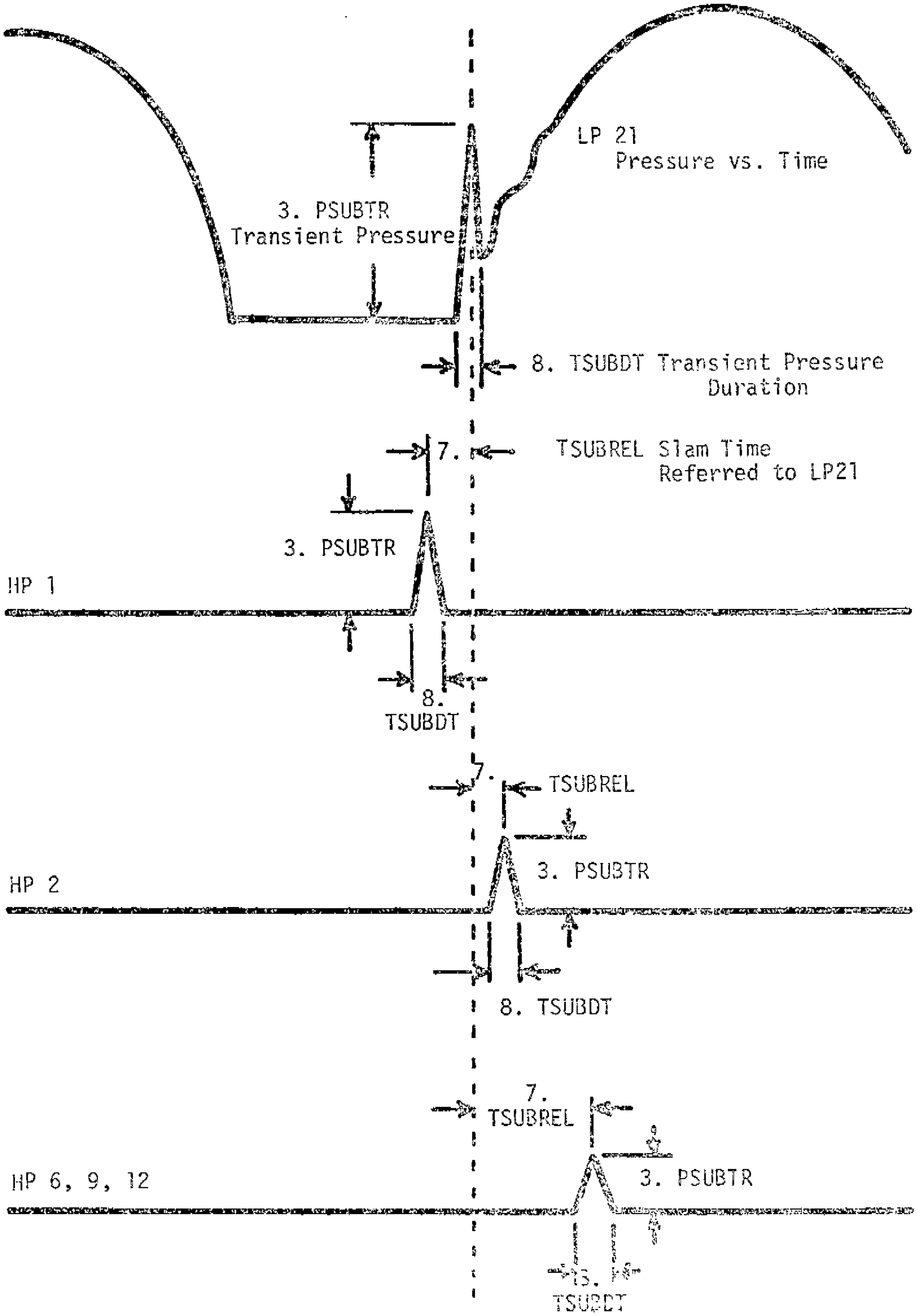
XDCR	LP21	HP1	HP2	HP6	HP9	HP12	BOW ACC	STRESS
TRACK	1	10	5	6	9	13	3	11
CAL DIV	19.4	23.4	35.0	34.3	34.2	33.8	27.9	36.1
CAL SLAM	15.7	3.4	7.3	9.3	1.6	3.5	18.0	37.0
RUN SLAM	16.7	3.2	13.6	9.5	2.1	5.8	8.7	37.0
RUN CAL	19.9	22.0	65.2	35.0	44.9	56.0	13.5	36.1
CAL AMP	25.0	175.0	175.0	175.0	175.0	175.0	1.0	10.0
CAL UNIT	PSI	PSI	PSI	PSI	PSI	PSI	G	KPSI
UNITS/DIV	1.26	7.95	2.68	5.00	3.90	3.12	0.07	0.27

CONSTANTS

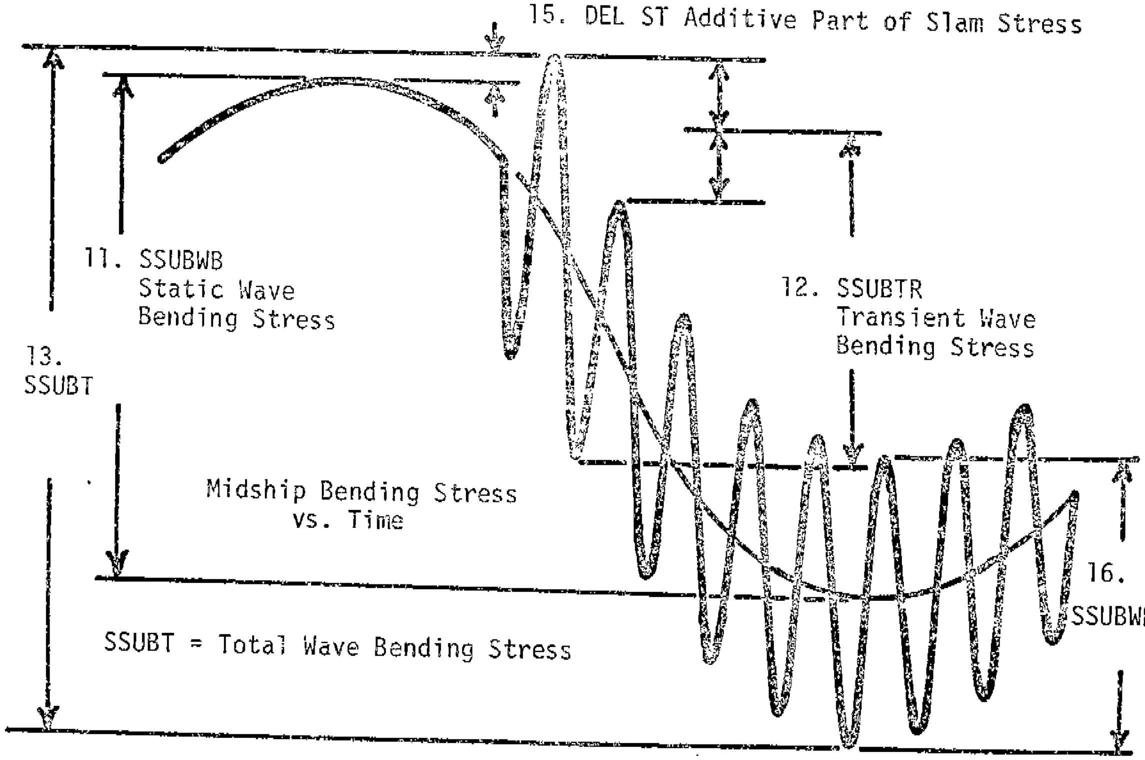
ONE INCH HORIZONTALLY ON OSCILLOGRAPH RECORD EQUALS 2.5 SECONDS
RHO FOR SEA WATER EQUALS 2.00 POUNDS-SEC-SQ OVER FEET 4TH
ACCELERATION OF GRAVITY EQUALS 32.2 FT/SEC/SEC

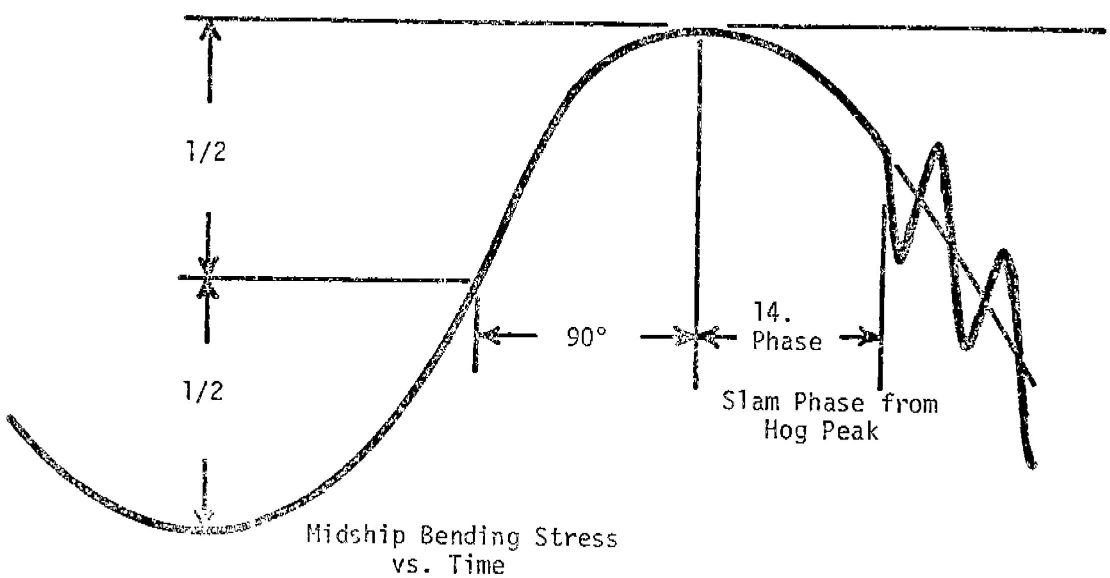


DEFINITIONS OF OSCILLOGRAPHIC MEASUREMENTS
Figure A-1

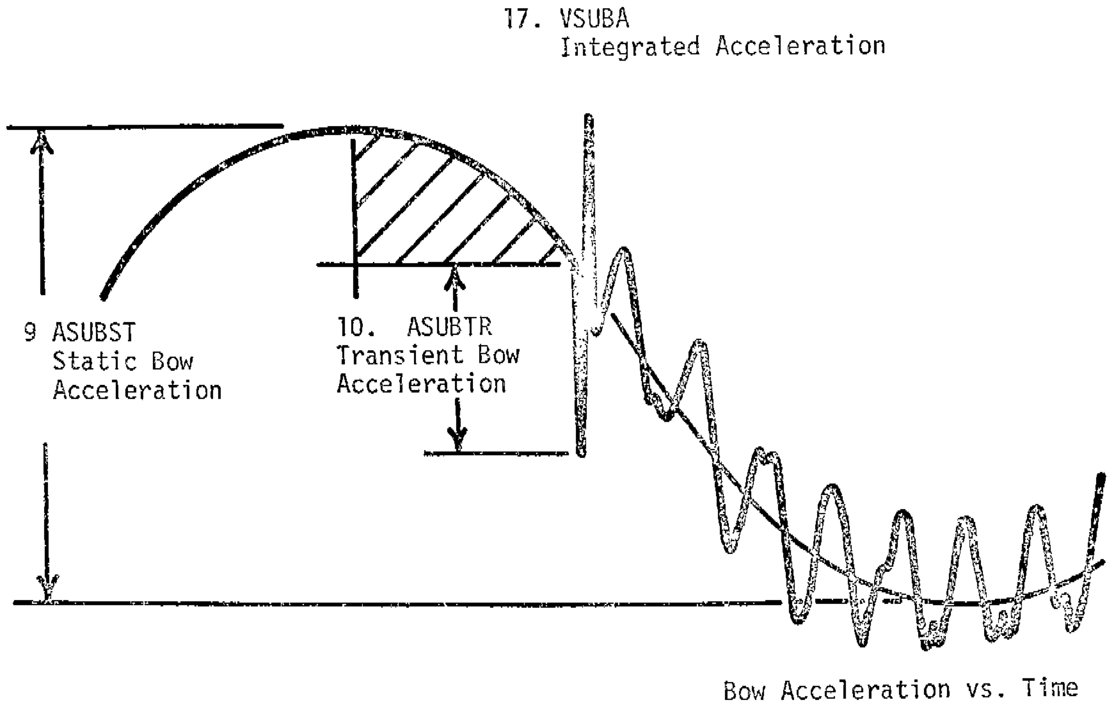


DEFINITIONS OF OSCILLOGRAPH MEASUREMENTS
Figure A-2





DEFINITIONS OF OSCILLOGRAPH MEASUREMENTS
Figure A-3



DEFINITIONS OF OSCILLOGRAPH MEASUREMENTS

Figure A-4

SLAM NO. 1 — TABLE 1

RAW DATA ''-SURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	11.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	6.60	2.10	9.90	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	17.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.04	-0.04	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.06	0.04	0.03	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.70
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.90
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.70
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.60
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.19	0.00

SLAM NO. 1 — TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	14.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	5.31	16.69	26.53	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	3.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	22.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	2.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.10	-0.10	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.15	0.10	0.07	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.45
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.08
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.01
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.60
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	7.08	0.00

SLAM NO. 1 — TABLE 3 — DERIVED PARAMETERS

18	VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 20.35 FT/SEC
19	PSUBSC	FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 2.87 PSI. COMPARE WITH PSUBSM. MEASURED STAGNATION PRESSURE

SLAM NO. 2 — TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	11.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	7.90	2.00	4.80	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	3.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	19.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.09	-0.14	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.06	0.04	0.07	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.70
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.20
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.05	0.00

SLAM NO. 2 — TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	14.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	9.95	15.90	12.86	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	4.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	23.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.22	-0.35	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.15	0.10	0.17	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.70
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.02
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.53
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	6.25	0.00

SLAM NO. 2 — TABLE 3 — DERIVED PARAMETERS

18	VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 21.41 FT/SEC
19	PSUBSC	FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 3.18 PSI. COMPARE WITH PSUBSM. MEASURED STAGNATION PRESSURE

SLAM NO. 3 — TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	11.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	3.40	1.30	6.60	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	22.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.20	-0.25	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.06	0.03	0.03	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	9.20	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.60
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.50
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.70
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.10
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00

SLAM NO. 4 — TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	12.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	6.60	2.10	12.10	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	3.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	22.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.04	-0.04	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.07	0.03	0.04	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	9.20	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	4.50	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.80
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.70
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.00
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.60
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.00

SLAM NO. 3 — TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	14.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	4.28	10.33	17.68	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	1.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	28.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.50	-0.62	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.15	0.07	0.07	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.59
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.84
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.70
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	2.85	0.00

SLAM NO. 3 — TABLE 3 — DERIVED PARAMETERS

18	VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 19.89 FT/SEC
19	PSUBSC	FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 2.74 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 4 — TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	15.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	8.31	15.69	32.42	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	4.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	28.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.10	-0.10	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.17	0.07	0.10	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.03
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.56
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.00
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	4.11	0.00

SLAM NO. 4 — TABLE 3 — DERIVED PARAMETERS

18	VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 20.37 FT/SEC
19	PSUBSC	FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 2.88 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 5 — TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	5.20	2.80	5.70	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	22.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.06	-0.06	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.07	0.02	0.04	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	9.70	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.30
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.60
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.60
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.60
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.70
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00

SLAM NO. 5 — TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	15.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	6.55	22.25	17.95	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	3.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	28.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.15	-0.15	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.17	0.05	0.10	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.45
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.27
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.09
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.60
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	4.76	0.00

SLAM NO. 5 — TABLE 3 — DERIVED PARAMETERS

18 VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 20.07 FT/SEC
19 PSUBSC	FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 2.79 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 6 — TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	11.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	7.40	1.90	5.10	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	23.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.06	-0.08	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.07	0.04	0.04	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	9.40	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	1.30	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.30
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.70
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.00
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.90
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00

SLAM NO. 6 — TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	3.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	13.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	9.32	15.10	16.34	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	3.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	28.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.15	-0.20	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.17	0.10	0.10	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.23
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.90
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.00
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	7.14	0.00

SLAM NO. 6 — TABLE 3 — DERIVED PARAMETERS

18 VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 17.87 FT/SEC
19 PSUBSC	FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 2.21 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 8 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	4.30	2.50	7.80	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	2.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	22.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.03	-0.04	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.06	0.03	0.02	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	2.30	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.50
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.20
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.80
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.10
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00

SLAM NO. 8 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	12.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	5.41	19.87	20.90	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	2.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	29.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.07	-0.10	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.15	0.07	0.05	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.57
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.04
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.80
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	3.63	0.00

SLAM NO. 8 TABLE 3 DERIVED PARAMETERS

18	VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 17.31 FT/SEC
19	PSUBSC	FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 2.08 PSI. COMPARE WITH PSUBSM. MEASURED STAGNATION PRESSURE

SLAM NO. 9 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	6.70	4.00	11.00	0.90	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.03	-0.04	-0.17	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.07	0.02	0.04	0.02	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	10.20	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.20
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.50
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.90
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.00

SLAM NO. 9 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	15.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	8.44	31.80	29.47	4.50	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	3.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	35.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.07	-0.10	-0.42	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.17	0.05	0.10	0.05	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.31
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.95
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.90
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.24
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	4.70	0.00

SLAM NO. 9 TABLE 3 DERIVED PARAMETERS

18	VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 21.46 FT/SEC
19	PSUBSC	FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 3.19 PSI. COMPARE WITH PSUBSM. MEASURED STAGNATION PRESSURE

SLAM NO. 10 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	11.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	1.90	1.30	5.10	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.06	-0.19	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.05	0.04	0.05	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	9.90	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	1.80	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.30
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.60
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.20
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.40
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.80
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00

SLAM NO. 12 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	14.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	13.50	1.90	13.70	2.20	1.60	0.00	0.00	0.00
4	PSUBSM	DIV	6.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	33.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.06	-0.05	-0.10	-0.10	0.00	0.00	0.00
8	TSUBDT	IN	0.05	0.04	0.06	0.07	0.12	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	12.60	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	5.90	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.60
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.70
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.90
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	2.80	0.00

SLAM NO. 10 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	14.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	2.39	10.33	13.66	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	35.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	4.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.15	-0.47	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.12	0.10	0.12	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.96
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.48
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.40
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	4.94	0.00

SLAM NO. 10 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G, VREL EQUALS 18.56 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 2.39 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 12 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	18.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	17.01	15.10	36.71	11.00	6.23	0.00	0.00	0.00
4	PSUBSM	PSI	8.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	41.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.15	-0.12	-0.25	-0.25	0.00	0.00	0.00
8	TSUBDT	SEC	0.12	0.10	0.15	0.17	0.30	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.30
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.26
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.76
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.13
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.70
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.18
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	16.67	0.00

SLAM NO. 12 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G, VREL EQUALS 27.71 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 5.33 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 13 — TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	8.80	3.20	13.30	9.60	1.60	0.00	0.00	0.00
4	PSUBSM	DIV	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	42.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.02	0.00	-0.02	-0.03	0.00	0.00	0.00
8	TSUBDT	IN	0.07	0.05	0.03	0.04	0.12	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	12.80	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	6.80	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.70
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.40
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.50
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.00
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.30
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.20
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.00

SLAM NO. 14 — TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	9.50	2.00	9.10	1.80	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	33.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.03	-0.03	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.05	0.04	0.02	0.06	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	11.20	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	7.80	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.10
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.90
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.70
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.20
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.54	0.00

SLAM NO. 13 — TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	3.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	18.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	11.09	25.63	35.64	48.00	7.01	0.00	0.00	0.00
4	PSUBSM	PSI	3.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	54.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.05	0.00	-0.05	-0.07	0.00	0.00	0.00
8	TSUBDT	SEC	0.17	0.12	0.07	0.10	0.30	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.39
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.98
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.11
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.00
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.21
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	5.42	0.00

SLAM NO. 13 — TABLE 3 — DERIVED PARAMETERS

18 VREL — FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 35.03 FT/SEC

19 PSUBSC — FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 9.51 PSI. COMPARE WITH PSUBSM. MEASURED STAGNATION PRESSURE

SLAM NO. 14 — TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	3.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	17.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	11.97	15.90	24.35	9.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	5.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	41.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	4.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.07	-0.07	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.12	0.10	0.05	0.15	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.12
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.18
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.11
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.20
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.93
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	9.17	0.00

SLAM NO. 14 — TABLE 3 — DERIVED PARAMETERS

18 VREL — FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 22.20 FT/SEC

19 PSUBSC — FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 3.42 PSI. COMPARE WITH PSUBSM. MEASURED STAGNATION PRESSURE

SLAM NO. 15 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	4.00	1.90	9.80	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	28.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.06	-0.07	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.06	0.03	0.03	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	11.00	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	3.60	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.30
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.20
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.80
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	67.80
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.31	0.00

SLAM NO. 16 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	10.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	2.30	1.60	9.40	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	28.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.05	-0.03	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.05	0.04	0.03	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	8.80	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	2.30	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.30
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.60
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.40
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00

SLAM NO. 15 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	13.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	5.04	15.10	26.26	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	35.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.15	-0.17	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.15	0.07	0.07	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.02
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.44
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.99
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	67.80
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.24
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	7.80	0.00

SLAM NO. 15 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 19.98 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 2.77 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 16 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	12.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	2.89	12.71	25.19	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	2.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	35.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	4.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.12	-0.07	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.12	0.10	0.07	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.65	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.51
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.24
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.15
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.40
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.24
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	5.06	0.00

SLAM NO. 16 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 18.69 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 2.42 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 17 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	15.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	14.60	3.80	15.20	7.90	2.10	0.00	0.00	0.00
4	PSUBSM	DIV	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	38.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.03	-0.01	0.02	-0.06	0.00	0.00	0.00
8	TSUBDT	IN	0.05	0.02	0.05	0.05	0.03	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	14.50	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	5.50	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.20
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.30
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.20
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.00
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.40
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.00
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.21	0.00

SLAM NO. 18 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	4.10	3.90	13.90	1.70	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	33.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.06	-0.06	-0.09	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.06	0.02	0.03	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	13.40	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	5.20	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.80
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.40
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10
17	VS?BA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.51	0.00

SLAM NO. 17 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	19.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	18.39	30.20	40.73	39.50	8.19	0.00	0.00	0.00
4	PSUBSM	PSI	2.14	0.00	0.00	0.00 ,	0.00	0.00	0.00	0.00
5	DEL P	PSI	48.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSURREL	SEC	0.00	-0.07	-0.02	0.05	-0.15	0.00	0.00	0.00
8	TSUBDT	SEC	0.12	0.05	0.12	0.12	0.07	0.00	0.00	0.00
9	ASURST	G	0.00	0.00	0.00	0.00	0.00	0.00	1.07	0.00
10	ASUSTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.08
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.34
13	SSU?T	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.24
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.00
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.49
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.26
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	7.20	0.00

SLAM NO. 17 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 35.17 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 8.58 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 18 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	18.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	5.16	31.00	37.25	8.50	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	1.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	41.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.15	-0.15	-0.22	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.15	0.05	0.07	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.14
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.49
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.30
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30
16	SSU?WH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.41
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	8.99	0.00

SLAM NO. 18 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 24.61 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 4.20 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 19 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	4.00	2.90	0.00	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	2.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	28.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.04	0.00	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	10.20	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.30
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50
13	SSUBT	DIV	0.00	0.20	0.00	0.00	0.00	0.00	0.00	12.50
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-52.00
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.80
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00

SLAM NO. 20 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	9.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	6.30	1.40	8.60	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	33.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	2.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.06	-0.06	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.07	0.03	0.03	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	7.80	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	2.70	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.90
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.10
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.10
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00

SLAM NO. 19 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	13.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	5.04	23.05	0.00	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	35.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	4.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.10	0.00	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.17	0.05	0.00	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.85
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.46
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-52.00
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	4.58	0.00

SLAM NO. 19 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G, VREL EQUALS 19.75 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO, CALCULATED STAGNATION PRESSURE EQUALS 2.70 PSI, COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 20 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	12.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	7.93	11.12	23.04	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	3.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	42.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	5.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.15	-0.15	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.17	0.07	0.07	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.04
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.35
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.10
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	3.15	0.00

SLAM NO. 20 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G, VREL EQUALS 16.95 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO, CALCULATED STAGNATION PRESSURE EQUALS 1.99 PSI, COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 21 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	13.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	3.70	1.30	10.00	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	38.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.06	-0.06	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.06	0.00	0.05	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	4.60	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.90
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.30
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.70
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.70
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.60
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.08	0.00

SLAM NO. 22 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	10.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	5.10	1.50	12.20	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	28.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	2.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.05	-0.05	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.06	0.04	0.04	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	8.90	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	3.60	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.50
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.40
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.80
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.80
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.70
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.05	0.00

SLAM NO. 21 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	17.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	4.66	10.33	26.79	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	1.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	48.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.15	-0.15	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.15	0.00	0.12	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.23
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.46
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.28
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.70
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.27
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	6.43	0.00

SLAM NO. 21 TABLE 3 DERIVED PARAMETERS

18	VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G, VREL EQUALS 24.16 FT/SEC
19	PSUBSC	FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 4.05 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 22 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	13.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	6.42	11.92	32.69	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	1.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	36.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	5.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.12	-0.12	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.15	0.10	0.10	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.65	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.95
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.49
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.59
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.80
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	6.25	0.00

SLAM NO. 22 TABLE 3 DERIVED PARAMETERS

18	VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G, VREL EQUALS 15.27 FT/SEC
19	PSUBSC	FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 1.61 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 23 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ADR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	14.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	8.30	1.50	13.30	7.40	2.50	0.00	0.00	0.00
4	PSUBSM	DIV	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	38.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.07	-0.07	-0.06	-0.06	0.00	0.00	0.00
8	TSUBDT	IN	0.08	0.05	0.05	0.05	0.05	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	13.30	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	16.80	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.90
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.80
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.10
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
16	SSUBWH	DIV	0.00	0.03	0.00	0.00	0.00	0.00	0.00	13.50
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.96	0.00

SLAM NO. 23 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	16.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	10.45	11.92	35.64	37.00	9.75	0.00	0.00	0.00
4	PSUBSM	PSI	3.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	48.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.17	-0.17	-0.15	-0.15	0.00	0.00	0.00
8	TSUBDT	SEC	0.20	0.12	0.12	0.12	0.12	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	1.24	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.52
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.60
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.19
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.10
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.38
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.73
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	11.67	0.00

SLAM NO. 23 TABLE 3 DERIVED PARAMETERS

18	VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G, VREL EQUALS 28.92 FT/SEC
19	PSUBSC	FROM RHO X VREL SQUARED OVER TWO, CALCULATED STAGNATION PRESSURE EQUALS 5.80 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 24 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	13.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	5.70	3.00	21.10	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	33.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	2.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.04	-0.05	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.08	0.03	0.04	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	11.00	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.50
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.40
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.90
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.60
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.70
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.71	0.00

SLAM NO. 24 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	16.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	7.18	23.85	56.54	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	4.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	42.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	5.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.10	-0.12	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.20	0.07	0.10	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.57
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.49
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.23
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.60
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	10.18	0.00

SLAM NO. 24 TABLE 3 DERIVED PARAMETERS

18	VREL	FROM DEL P OVER DEL T TIMES ONE OVER RHO X G, VREL EQUALS 18.80 FT/SEC
19	PSUBSC	FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 2.45 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 25 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	13.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	6.00	2.50	11.30	1.70	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	38.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.04	-0.04	-0.01	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.07	0.03	0.04	0.03	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	10.10	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	5.70	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.00
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.20
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.50
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBHH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.40
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.44	0.00

SLAM NO. 25 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	16.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	7.56	19.87	30.26	8.50	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	3.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	48.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	4.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.10	-0.10	-0.02	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.17	0.07	0.10	0.07	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.47
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.54
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.44
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.77
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	8.57	0.00

SLAM NO. 25 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 23.57 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 3.85 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 26 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	10.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	3.30	1.80	10.20	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.03	-0.06	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.05	0.02	0.04	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	9.90	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	1.50	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.30
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.40
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.50
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	72.00
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.30
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00

SLAM NO. 26 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	13.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	4.15	14.30	27.33	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	36.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	4.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.07	-0.15	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.12	0.05	0.10	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.40
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.73
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	72.00
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	5.46	0.00

SLAM NO. 26 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G. VREL EQUALS 17.38 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO. CALCULATED STAGNATION PRESSURE EQUALS 2.39 PSI. COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 27 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	13.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	5.80	3.00	7.70	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	38.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	2.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.07	0.04	0.03	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	10.50	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.70
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.40
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.90
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	1.57	0.00

SLAM NO. 28 TABLE 1

RAW DATA MEASURED FROM OSCILLOGRAPH RECORDS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	IN	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	DIV	14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	DIV	4.50	1.90	10.20	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	DIV	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	DIV	36.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	IN	1.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	IN	0.00	-0.05	-0.05	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	IN	0.07	0.03	0.03	0.00	0.00	0.00	0.00	0.00
9	ASUBST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	12.10	0.00
10	ASUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	3.10	0.00
11	SSUBWB	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.70
12	SSUBTR	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
13	SSUBT	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.30
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.10
15	DEL ST	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	DIV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
17	VSUBA	DXI	0.00	0.00	0.00	0.00	0.00	0.00	2.11	0.00

SLAM NO. 27 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	2.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	17.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	7.30	23.85	20.63	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	2.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	48.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	5.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.17	0.10	0.07	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.11
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.58
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.90
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	9.35	0.00

SLAM NO. 27 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G, VREL EQUALS 19.90 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO, CALCULATED STAGNATION PRESSURE EQUALS 2.74 PSI, COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

SLAM NO. 28 TABLE 2

DATA CONVERTED TO ENGINEERING UNITS

NO.	ABR	UNIT	LP 21	HP 1	HP 2	HP 6	HP 9	HP 12	BOWACC	STRESS
1	TSUBE	SEC	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PSUBST	PSI	17.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	PSUBTR	PSI	6.04	15.10	27.33	0.00	0.00	0.00	0.00	0.00
4	PSUBSM	PSI	1.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	DEL P	PSI	46.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	DEL T	SEC	3.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	TSUBREL	SEC	0.00	-0.12	-0.12	0.00	0.00	0.00	0.00	0.00
8	TSUBDT	SEC	0.17	0.07	0.07	0.00	0.00	0.00	0.00	0.00
9	ASUBST	G	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.00
10	ASUBTR	G	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00
11	SSUBWB	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.01
12	SSUBTR	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.93
13	SSUBT	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.73
14	PHASE	DEG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.10
15	DEL ST	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SSUBWH	KPSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.38
17	VSUBA	FSEC	0.00	0.00	0.00	0.00	0.00	0.00	12.56	0.00

SLAM NO. 28 TABLE 3 DERIVED PARAMETERS

18 VREL FROM DEL P OVER DEL T TIMES ONE OVER RHO X G, VREL EQUALS 28.02 FT/SEC

19 PSUBSC FROM RHO X VREL SQUARED OVER TWO, CALCULATED STAGNATION PRESSURE EQUALS 5.45 PSI, COMPARE WITH PSUBSM, MEASURED STAGNATION PRESSURE

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13. ABSTRACT

The pressure, acceleration, and hull bending stress data from the full-scale slamming measurements on the S.S. WOLVERINE STATE were analyzed in detail to provide additional information on frequency-of-occurrence, elapsed time between slams, correlation with environmental conditions, pressure-velocity relationship, correlation with midship transient stress, and pressure-location-time distribution. Seventeen separate measurements were made on a group of 26 severe slams to provide a data base for the investigation, and data from more than 1,000 slams which occurred over approximately 49 hours of slamming during 3 different voyages were used in establishing the correlation with environmental conditions.

A number of statistical correlations were examined, and pressure-velocity measurements provided additional data for comparison with model results.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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SLAMMING						
PRESSURE						
VELOCITY						
ACCELERATION						
STRESS						
WAVE LOADS						

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SHIP STRUCTURE COMMITTEE PUBLICATIONS

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SSC-246, *Theoretical Estimates of Wave Loads On The SL-7 Containership In Regular and Irregular Seas* by P. Kaplan, T. P. Sargent, and J. Cilmi. 1974. AD-A 004554.

SSC-247, *Flame Straightening Quenched-And-Tempered Steels in Ship Construction* by R. L. Rothman. 1974. AD-A 002621.

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