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TECHNICAL MEMORANDUM NO. 4-76

DSRV ALVIN WEIGHT REPORT, 1976

Arnold G. Sharp

December 1976

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WOODS HOLE, MASSACHUSETTS 02543

WOODS HOLE OCEANOGRAPHIC INSTITUTION
Woods Hole, Massachusetts 02543

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DSRV ALVIN WEIGHT REPORT, 1976

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Woods Hole Oceanographic Institution

Arnold G. Sharp

December 1976

Office of Naval Research Contract No.
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Abstract

Weight and stability information is presented for the research submarine ALVIN for 1976. The report consists primarily of the results of the computations programmed for the Woods Hole Oceanographic Institution's XDS Sigma-7 computer. Structural and weight changes to the vehicle have been minimal since the 1975 operating season. Therefore, no inclining experiments were performed in 1976. Principal results are the weight, displacement, and longitudinal and vertical components of the BG distance, for the complete submersible and for various major subassemblies.

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I. Introduction

Only minor changes have been made to the submersible ALVIN during the overhaul period just completed. No structural members or operating equipment have been added to or removed from the vehicle. Tie-down brackets on the forward end of the skids were removed. These had an air weight of ten pounds. Aluminum outer skin support brackets forward were removed and replaced by new brackets made of fiberglass. This provided a weight saving of about 10 pounds.

During the overhaul period ALVIN's aluminum frame was inspected for cracks and repair-welded where necessary. Fourteen areas inspected by the visual dye penetrant method showed indications of cracks and those were repaired. Four other inspected areas showed no indications. No structural members were added to the frame during these repairs.

Because weight changes were minimal, and the arrangement of all components remains unchanged since 1975, no inclining experiments were performed following the reassembly of ALVIN. The tethered trim dive was done but the submersible's variable ballast system had not yet been made operational at the time of the test. The purpose of the trim dive is to determine experimentally the variable ballast

setting at the neutrally buoyant condition. In this case an approximate determination was made. The contents of the VB tanks were estimated, and sufficient steel weights were added to the weight droppers to make the vehicle neutral.

II. Weight and Stability Computations

Explanation of Procedure In computing the weight and stability of ALVIN, two separate force systems were considered. The weights, acting downward, were summed to find the total weight, which acts at the center of gravity G. Similarly, the buoyancy forces, which act upward, were summed to find the total buoyant force or displacement, which acts at the center of buoyancy B. The locations of G and B were determined by summing the moments of weights and displacements with respect to the forward perpendicular and the base plane. Points G and B are assumed to lie in a vertical plane which passes through the longitudinal centerline of the submarine.

For the computer run, data were obtained for the separate components (or packages) and a data card was punched for each. The items were broken down into subgroups as follows (refer to computer printout sheets):

1. Sphere only (pressure hull plus contents)
2. Other forebody
3. Afterbody
4. Variable load
5. Entire vehicle

Figure 1. Longitudinal Section of ALVIN Showing Sample of Data Used in Computations

Figure 2. Longitudinal Section of ALVIN Showing Components of BG Distance

Figure 3. Transverse Section of ALVIN Showing Locations of Points K, G, B, B' and M

6. Released forebody

7. Emergency conditions

At the end of each subgroup the weight, displacement and moment summations were made, and the locations of G and B were determined. At the end of Section 4 (variable load) cumulative summations were made which yielded G and B values for the entire submarine in what is called the "normal submerged" condition. In this condition the main ballast tanks are flooded, the variable ballast tanks are two-thirds flooded, and the trim mercury is divided 50 percent forward and 50 percent aft.

Definition of Symbols The following symbols which appear on the computer printout sheets are defined here for convenience.

W - weight of item in air, lbs.

X - distance of center of gravity of item from forward perpendicular, feet (positive x means aft of F.P.; see Figure 1.)

Y - distance of center of gravity of item above base plane, feet (see Figure 1.)

MX - product of W times X, foot-lbs.

MY - product of W times Y, foot-lbs.

- D - displacement of item, lbs. of seawater
- XP - distance of center of buoyancy of item from forward perpendicular, feet (positive XP means aft of F.P.)
- YP - distance of center of buoyancy of item above base plane, feet
- MXP - product of D times XP, foot-lbs.
- MYP - product of D times YP, foot-lbs.
- BG longitudinal - distance between center of buoyancy B and center of gravity G, longitudinal component, feet (negative value indicates tendency for bow-up angle of trim; see Figure 2.)
- BG vertical - distance between center of buoyancy B and center of gravity G, vertical component, feet (positive value indicates vertical stability of submerged vehicle; see Figure 2.)

The following additional terms and symbols appear in various places in this report:

Forward Perpendicular - vertical plane passing through foremost edge of front window cone of ALVIN (see Figure 1.)

Base Plane - horizontal plane passing through
bottom of skids of ALVIN (see Figure 1.)

B' - new position of center of buoyancy B.
Lateral shift occurs due to change of
underwater form when vehicle is inclined
on the surface (see Figure 3.)

Metacenter M - point found by extending line of
action of vertical buoyancy force through
B' to intersect with original vertical
centerline of vehicle inclined on the sur-
face (see Figure 3.)

GM - vertical distance from center of gravity G
to metacenter M (M above G indicates positive
stability of surfaced vehicle (see Figure 3.)

Outline of Programmed Computations

1. Total weight = summation W
2. Total displacement = summation D
3. Distance to center of gravity, longitudinal
$$XW = (\text{summation } MX) / (\text{summation } W)$$
4. Distance to center of gravity, vertical
$$YW = (\text{summation } MY) / (\text{summation } W)$$
5. Distance to center of buoyancy, longitudinal
$$XPD = (\text{summation } MXP) / (\text{summation } D)$$

6. Distance to center of buoyancy, vertical

$$YPD = (\text{summation MYP}) / (\text{summation D})$$

7. BG longitudinal = XPD - XW

8. BG vertical = YPD - YW

ALVIN WEIGHT AND STABILITY COMPUTATIONS

SPHERE ONLY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MP	MP
P HULL MINUS INSERTS										
HULL INSERT FWD	5081.54	4.97	4.89	25255.25	24848.73	10604.98	4.50	4.75	47718.36	50369.38
HULL INSERT BBT	383.78	1.14	4.75	437.51	1822.95	14.77	1.14	4.75	16.84	70.15
HULL INSERT PBT	386.28	3.39	1.42	1436.96	548.52	14.77	3.72	1.42	54.94	20.97
HULL INSERT STBD	387.29	2.39	3.46	925.62	1340.02	14.77	2.39	3.46	35.30	51.10
HATCH INSERT	385.54	2.39	3.46	921.44	1333.97	14.77	2.39	3.46	35.30	51.10
WINDAW FWD	261.53	4.50	8.11	1176.28	2121.01	19.28	4.50	8.11	41.76	75.25
WINDAW BBT	9.02	1.14	4.75	10.28	42.84	3.48	1.14	4.75	3.97	16.53
WINDAW P/S	9.02	3.72	1.44	33.55	12.99	3.48	3.72	1.44	12.95	5.01
WINDAW RET RING FWD	18.04	2.39	3.46	43.12	62.42	6.96	2.39	3.46	16.63	24.03
WINDAW RET RING BBT	4.80	1.14	4.75	5.47	22.80	1.09	1.14	4.75	1.24	5.13
WINDAW RET RING P/S	4.80	3.72	1.44	17.86	6.24	1.09	3.72	1.44	4.05	1.42
WIND RET RINGS P/S	9.60	2.39	3.46	22.94	33.22	5.49	2.39	3.46	5.21	7.54
SPHERE REL UPPER	48.50	4.50	8.11	22.94	64.50	11.37	4.50	8.11	21.18	32.21
HATCH	199.34	4.21	8.28	897.03	1616.65	1.05	4.21	8.28	4.42	8.63
HINGE ARMS	4.57	4.00	8.28	19.24	37.84	.75	4.00	8.28	3.00	6.21
HINGE SHAFT	3.25	4.00	8.28	13.00	26.31	.08	4.00	8.28	.08	.97
INSIDE HANDLE	2.57	4.91	7.94	12.62	20.41	.61	4.91	7.94	5.28	9.97
OUTSIDE HANDLE	5.14	4.91	8.28	25.24	42.56	.05	4.91	8.28	5.28	5.05
SPRING RETAINER	2.67	4.14	8.28	11.05	22.11	.05	4.14	8.28	2.53	.02
INT SWING CLAMP	1.52	4.60	7.94	6.99	12.97	.05	4.60	7.94	5.28	.02
HINGE SPRINGS	12.05	4.00	8.28	48.20	93.77	.94	4.00	8.28	4.23	12.70
HATCH WINDAW	2.02	4.50	8.19	9.09	16.54	.50	4.50	8.19	2.25	4.05
HATCH WIND RET RING	2.16	4.50	8.10	9.72	17.50	.50	4.50	8.10	2.25	4.05
HINGE HLOCKS	6.58	3.92	8.05	25.79	52.97	1.51	3.92	8.05	4.75	12.18
PENETRATORS (7) FWD	36.68	1.06	4.75	38.28	174.23	3.20	1.06	4.75	13.73	21.34
PENETRATORS (5) BBT	26.20	4.29	1.42	112.40	37.20	1.28	4.29	1.42	3.52	5.44
PENETRATORS (2) P	10.43	2.75	4.25	28.22	44.54	1.28	2.75	4.25	3.52	5.44
PENETRATORS (2) S	10.43	2.21	3.52	23.16	36.59	1.28	2.21	3.52	3.52	5.44
CABLE 24 CAND 220 FT	85.80	2.50	2.70	214.50	231.66	42.24	2.50	2.70	105.60	114.05
BLANKING PLUGS (3) P	18.00	2.97	3.26	53.46	84.48	1.63	2.97	3.26	3.63	4.97
BLANKING PLUGS (4) S	24.00	3.04	3.52	72.96	84.48	1.63	3.04	3.52	4.99	5.77
LIFT PADS	10.20	4.50	8.17	45.90	83.33	2.35	4.50	8.17	10.57	19.20
CANN HALVES UPPER	52.50	4.50	1.09	236.25	57.22	5.25	4.50	1.09	23.63	5.72
MISC OUTSIDE	10.00	4.50	8.10	45.00	81.00	.00	4.50	8.10	.00	.00
STRAZA MBD 100	30.00	3.13	5.53	93.90	165.90	.00	.00	.00	.00	.00
STRAZA MBD 200	32.00	4.04	5.96	129.28	190.72	.00	.00	.00	.00	.00
STRAZA MBD 300	40.00	4.37	6.47	174.80	266.80	.00	.00	.00	.00	.00
TAPE RECORDER	2.00	4.13	4.50	8.26	9.00	.00	.00	.00	.00	.00
ANALYZER	3.50	5.38	6.70	18.83	23.45	.00	.00	.00	.00	.00
02 BOTTLES (3)	105.00	6.71	3.79	704.55	397.95	.00	.00	.00	.00	.00

ALVIN WEIGHT AND STABILITY COMPUTATIONS

SPHERE ONLY (CONTINUED)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MP	MP
LIGH CANISTERS (3)	24.00	6.29	5.00	150.96	120.00	.00	.00	.00	.00	.00
CABIN LIGHT	1.00	5.67	6.79	5.67	6.79	.00	.00	.00	.00	.00
RATIONS	2.00	4.29	7.17	8.58	14.34	.00	.00	.00	.00	.00
EMERG BREATH APPAR 3	45.00	5.33	5.88	239.85	264.60	.00	.00	.00	.00	.00
VESTS (3)	6.00	5.33	5.88	31.98	35.28	.00	.00	.00	.00	.00
PILOTS CHAIR	9.31	2.88	2.88	26.81	26.81	.00	.00	.00	.00	.00
TRIM INDICATOR	.30	1.63	5.50	.49	1.65	.00	.00	.00	.00	.00
CABIN LIGHTS,P,S(2)	2.00	3.67	5.46	7.34	10.92	.00	.00	.00	.00	.00
MAP LIGHTS (4)	4.00	2.58	6.50	10.32	26.00	.00	.00	.00	.00	.00
FL98R 88ARDS	8.00	4.58	2.12	36.64	16.96	.00	.00	.00	.00	.00
MISC WIRING,HQWR	10.00	4.55	4.75	45.50	47.50	.00	.00	.00	.00	.00
PENETRATOR LEADS	80.00	4.50	4.75	360.00	380.00	.00	.00	.00	.00	.00
URINALS (3)	1.00	5.50	2.50	5.50	2.50	.00	.00	.00	.00	.00
CAMERAS	6.00	5.80	5.20	34.80	31.20	.00	.00	.00	.00	.00
TRAIL KIT	4.00	5.50	2.40	22.00	9.60	.00	.00	.00	.00	.00
FLASHLIGHTS(6)	4.80	5.50	2.40	26.40	11.52	.00	.00	.00	.00	.00
RADAR REFLECTOR	.50	5.50	2.50	2.75	1.25	.00	.00	.00	.00	.00
SOUND PHONES(2)	6.00	4.30	7.00	25.80	42.00	.00	.00	.00	.00	.00
CUSHIONS	4.00	4.60	2.20	18.40	8.80	.00	.00	.00	.00	.00
RELEASE T-BAR	4.00	5.60	2.40	22.40	9.60	.00	.00	.00	.00	.00
RACK ASSEMBLIES	35.00	4.60	5.00	161.00	175.00	.00	.00	.00	.00	.00
EMERG WATER	5.00	6.00	2.80	30.00	14.00	.00	.00	.00	.00	.00
STAD DISTR PANEL	42.00	2.90	6.25	121.80	262.50	.00	2.90	6.25	.00	.00
PORT WING PANEL	12.50	2.90	6.25	36.25	78.13	.00	.00	.00	.00	.00
RAD19	11.25	4.58	5.96	51.52	67.05	.00	.00	.00	.00	.00
U 3 C	31.00	4.29	6.75	132.99	209.25	.00	.00	.00	.00	.00
INSTR PANEL	17.00	1.75	6.25	29.75	106.25	.00	.00	.00	.00	.00
LOWER SHELVES(3)	12.50	2.90	5.50	36.25	68.75	.00	.00	.00	.00	.00
GYR9 C9MP	17.00	3.50	5.75	59.50	97.75	.00	.00	.00	.00	.00
INVERTER	7.00	7.00	5.12	49.00	35.84	.00	.00	.00	.00	.00
PANEL SUPPLY 6V.	27.00	7.67	6.54	207.09	176.58	.00	.00	.00	.00	.00
PANEL PANEL ST3D	20.00	6.00	3.75	120.00	75.00	.00	6.00	3.75	.00	.00
SHELF UPPER PORT	2.00	4.35	6.75	8.70	13.50	.00	.00	.00	.00	.00
SHELF UPPER IND PANEL	3.50	4.35	6.75	15.22	23.63	.00	.00	.00	.00	.00
SHELF OVER LEAK DET.	1.50	1.70	6.40	2.55	9.90	.00	.00	.00	.00	.00
SHELF OVER LEAK DET.	2.00	2.88	7.04	5.76	14.08	.00	.00	.00	.00	.00
FATHMETER SCOPE	7.00	3.88	6.25	26.81	44.03	.00	.00	.00	.00	.00
FATHMETER XMTR (2)	14.00	3.00	5.50	42.00	77.00	.00	.00	.00	.00	.00
ALTIMETER	5.00	2.25	7.00	11.25	35.00	.00	.00	.00	.00	.00
62 BOTTLE BRK (3)	8.00	6.71	3.79	53.68	30.32	.00	.00	.00	.00	.00

ALVIN WEIGHT AND STABILITY COMPUTATIONS

(CONTINUED)

SPHERE ONLY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
AIR REGEN UNIT	13.50	6.38	4.50	86.13	60.75	.00	.00	.00	.00	.00
SPHERE STEP HDWR	6.00	5.00	6.50	30.00	39.00	.00	.00	.00	.00	.00
BATTERY SHELF	3.00	5.63	7.33	16.89	21.99	.00	.00	.00	.00	.00
FIRE EXTING	10.50	5.57	4.50	58.48	47.25	.00	.00	.00	.00	.00
EMERG LIGHT BATT	5.00	6.50	4.50	32.50	22.50	.00	.00	.00	.00	.00
MISC SHEET METAL	5.00	4.50	4.50	22.50	22.50	.00	.00	.00	.00	.00
GYRØ REPEATER	2.00	1.54	4.83	3.08	9.66	.00	.00	.00	.00	.00
FLARE BØX FLARES	6.00	5.38	5.87	32.28	35.22	.00	.00	.00	.00	.00
PILØTS CNTR BØX	7.00	2.00	7.00	14.00	49.00	.00	.00	.00	.00	.00
CLINØMETERS(2)	1.00	3.50	6.25	3.50	6.25	.00	.00	.00	.00	.00
FIRST AID KIT	1.00	6.20	2.79	6.20	2.79	.00	.00	.00	.00	.00
EMERG BATTERIES (3)	27.00	4.50	6.00	121.50	162.00	.00	.00	.00	.00	.00
ALNAV CLOCK	14.00	5.75	5.50	80.50	77.00	.00	.00	.00	.00	.00

SPHERE ONLY

SUMMARY	NØ. ITEMS	SUM W	S MXW	S MYW	SUM MX	SUM MY	SUM D	S MXPD	S MYPD	SUM MXP	SUM MYP
93		8331.61	4.37	4.73	36374.96	39405.38	10780.82	4.47	4.74	48239.98	51055.38

BG LONGITUDINAL .11

BG VERTICAL .01

OTHER FREEDOM

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MP
SAIL,ETC	221.85	4.64	7.02	1029.38	1557.39	135.00	4.64	7.02	626.40	947.77
SPLASH GUARD	20.00	4.50	8.50	90.00	170.00	12.06	4.50	8.50	54.27	132.15
LITIGN UP BODY SYNT	1904.50	4.64	7.00	8836.88	13331.50	2201.65	4.64	7.00	10215.66	15411.55
3M UPPER FREEBODY	869.00	.38	7.00	327.94	6041.00	1434.60	.38	7.00	10042.30	10042.30
LAYER SYNT RING	1052.00	4.42	3.43	4649.84	3808.36	1212.98	4.42	3.43	5361.37	4153.53
FRT WINDOW CONE	36.00	.75	4.75	27.00	171.00	21.70	.75	4.75	16.27	195.00
MAIN BALLAST WATER	1346.00	4.50	6.00	6057.00	8076.00	1346.00	4.50	6.00	6057.00	8076.00
MAIN BALLAST TANKS	178.00	4.50	6.00	801.00	1068.00	107.50	4.50	6.00	483.75	645.00
VEL9CIMETER	20.00	2.20	9.50	44.00	190.00	10.00	2.20	9.50	22.00	95.00
SAIL CENTRAL BOX	30.00	3.40	12.00	102.00	363.00	20.00	3.40	12.00	68.00	240.00
SAIL J BOX	107.00	7.00	9.00	749.00	963.00	72.00	7.00	9.00	504.00	648.00
FIBERGLASS CLAMP	4.00	2.39	3.46	9.56	13.84	2.22	2.39	3.46	5.31	7.53
SENSOR UNIT	92.00	.50	8.00	46.00	736.00	30.00	.50	8.00	15.00	240.00
MAGNETIC COMPASS	5.07	7.00	10.13	63.49	91.88	8.03	7.00	10.13	84.31	43.23
EXTERIOR LIGHTS	24.00	2.50	5.40	60.00	129.60	8.00	2.50	5.40	20.00	43.23
CURRENT METER,ETC	18.08	3.50	13.20	63.28	238.66	4.00	3.50	13.20	14.00	52.80
PREC DEPTH XDCR	3.50	5.75	10.00	20.13	35.00	1.25	5.75	10.00	7.19	12.50
UGC XDOUCR	27.00	6.50	12.50	175.50	337.50	4.00	6.50	12.50	26.00	50.00
EGG CAMERAS (2)	104.00	.00	7.06	.00	734.24	30.00	.00	7.06	.00	211.80
STR98E PWR UNITS	44.00	7.50	7.25	360.00	343.00	32.00	7.50	7.25	240.00	232.00
FWD STROBE	54.00	.00	6.50	.00	351.00	16.00	.00	6.50	.00	104.00
9AR RADIO TRANS	1.70	7.50	12.00	12.75	204.40	.84	7.50	12.00	6.30	10.00
8AR FLASH LIGHT	1.70	7.50	12.00	12.75	204.40	.84	7.50	12.00	6.30	10.00
TV CAMERA	30.00	-1.50	7.75	-45.00	232.50	6.40	-1.50	7.75	-9.60	49.60
OUTSIDE DEPTH GAGE	5.00	.50	3.25	-2.50	16.25	1.30	.50	3.25	-6.65	4.23
RESCUE SLING,SHCKLS	33.00	4.50	9.00	148.50	297.00	4.20	4.50	9.00	18.50	37.30
SIDE HOOKS FWD	36.00	.75	4.62	27.00	166.32	5.00	.75	4.62	3.75	23.10

OTHER FOREIGN

SUMMARY	NO. ITEMS	SUM W.	S	MXW	S	MYW	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	SUM MXP	SUM MYP
	27	6269.40		3.77		6.27	23665.50	39304.83	6727.87		3.62		6.19	24364.67	4164.81
BG LONGITUDINAL										BG VERTICAL		.08			
										.15					

ALVIN WEIGHT AND STABILITY COMPUTATIONS

AFTERBODY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MPX	MPY
FRAME	447.50	9.13	2.77	4108.05	1239.57	169.00	9.13	2.77	1551.42	468.13
VERT FRAME STIF FWD	6.10	8.50	2.50	51.85	15.25	2.31	8.50	2.50	19.63	5.77
VERT FRAME STIF AFT	6.10	12.50	2.50	76.25	15.25	2.31	12.50	2.50	28.87	5.77
NEW SPH RING STIF P	.47	7.50	2.63	3.52	1.24	.18	7.50	2.63	1.35	.47
NEW SPH RING STIF S	.47	7.50	2.63	3.52	1.24	.18	7.50	2.63	1.35	.47
ADDN TO FRAME P	12.00	10.25	1.65	123.00	19.80	4.42	10.25	1.65	45.30	7.23
ADDN TO FRAME S	8.50	10.25	1.65	87.13	14.02	3.13	10.25	1.65	32.08	5.15
ADDN TO FRAME S	.60	6.00	2.75	3.60	1.65	.22	6.00	2.75	1.32	.60
LG BUBY PKG AFT	2310.00	14.16	5.05	32708.60	11665.50	4082.56	14.16	5.05	5789.05	20616.93
PINGER	87.00	14.00	6.75	1218.00	587.25	55.00	14.00	6.75	770.20	371.25
SIDE BUBY PKG (2)	433.00	10.40	6.75	4503.20	2922.75	692.00	10.40	6.75	7196.78	4671.00
CTR BUBY PKG	113.00	10.25	5.83	1203.94	687.94	210.71	10.25	5.83	2159.78	1228.44
TI BUBY SPH UP CTR	224.00	10.25	6.33	2296.00	1417.92	525.93	10.25	6.33	5390.78	3329.14
M/B TANK UP AFTBDY	55.50	10.25	6.83	568.88	379.06	34.81	10.25	6.83	356.80	237.75
M/B WATER UP CTR	300.00	10.18	6.83	3075.00	2049.00	300.00	10.18	6.83	3075.00	2049.00
M/B BUBY PKG UP P	253.00	10.18	6.20	2575.54	1563.60	449.78	10.18	6.20	4578.76	2758.64
M/B BUBY PKG LWR P	203.00	10.13	5.20	2117.44	1081.60	369.70	10.13	5.20	3763.55	1922.44
M/B SPHERES UP P	433.45	10.18	5.70	4412.52	2470.66	525.93	10.18	5.70	3353.97	2397.80
M/B BUBY PKG UP S	250.00	10.18	6.20	2545.00	1550.00	444.44	10.18	6.20	4524.40	2755.53
M/B BUBY PKG LWR S	204.00	10.18	5.20	2076.72	1060.80	362.67	10.18	5.20	3691.98	1885.83
M/B SPHERES UP S	433.45	10.13	5.70	4412.52	2470.66	525.93	10.13	5.70	3353.97	2397.80
M/B SPHERE LOWER P	300.80	6.78	1.42	2039.42	427.14	265.00	6.78	1.42	1796.70	376.30
M/B SPHERE LOWER S	300.80	6.78	1.42	2039.42	427.14	265.00	6.78	1.42	1796.70	376.30
M/B SPHERES PLUMBING	25.00	9.16	4.31	229.00	107.75	3.24	9.16	4.31	29.68	13.95
V/B PUMP	86.00	5.15	1.00	442.90	86.00	14.72	5.15	1.00	73.81	14.72
V/B PUMP MOTOR	150.00	5.15	1.00	772.50	150.00	88.96	5.15	1.00	458.14	88.96
SHUT OFF VALVE	11.70	9.00	1.75	105.30	20.47	2.18	9.00	1.75	19.62	3.81
FLAT SWITCH	18.00	5.15	1.00	92.70	18.00	1.92	5.15	1.00	9.89	1.92
TANK RELIEF VALVE	1.50	9.83	3.38	13.50	2.63	.00	.00	.00	.00	.00
VALVE FRAME, PIPING	20.00	11.33	4.42	196.60	67.60	.00	.00	.00	.00	.00
4-WAY VALVE	5.00	10.17	3.04	56.65	22.10	.00	.00	.00	.00	.00
RY-PASS VALVE	11.70	10.17	3.04	118.99	35.57	2.12	10.17	3.04	22.17	6.53
PR VALVE	5.40	10.13	4.46	54.70	24.08	.00	10.13	4.46	.00	.00
FLOW METER	21.00	10.96	2.88	230.16	60.48	2.56	10.96	2.88	32.44	8.52
PUMP RELIEF VALVE	1.50	10.25	3.96	15.38	5.94	.00	.00	.00	.00	.00
CHECK VALVE	1.90	10.58	4.44	20.10	8.44	.00	.00	.00	.00	.00
HYDR CONTROL BOX	195.00	9.04	4.52	1762.30	881.40	142.22	9.04	4.52	1285.67	642.83
METSR PUMP FRAME	15.00	5.15	1.00	77.25	15.00	.00	.00	.00	.00	.00
HG SPHERES FWD (2)	26.00	1.79	1.90	46.54	49.40	41.70	1.79	1.90	74.64	79.23
HG FRAME FWD	12.00	1.79	1.90	21.48	22.80	41.54	1.79	1.90	8.13	8.63

ALVIN WEIGHT AND STABILITY COMPUTATIONS
(CONTINUED)
AFTERBODY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
HG FRAME SYNT FWD	5.00	1.73	1.90	8.95	9.50	8.00	1.79	1.90	14.32	15.20
HG SPHERES AFT (2)	26.00	17.50	3.92	455.00	191.92	41.70	17.50	3.92	729.75	163.45
HG FRAME AFT	10.00	17.50	3.92	175.00	39.20	3.78	17.50	3.92	66.15	14.82
HG FWD	245.25	1.73	1.90	439.00	465.97	.00	1.79	1.90	.00	.00
HG AFT	245.25	17.50	3.92	4291.38	961.38	.00	17.50	3.92	.00	.00
HG SYSTEM PLUMBING	25.00	11.00	2.00	275.00	50.00	5.00	11.00	2.00	55.00	10.00
SKIDS & BELTS(2 STS)	46.50	8.67	.25	403.15	11.63	17.60	8.67	.25	152.39	4.40
SPHERE REL. GUIDES(2	19.00	4.50	1.20	85.50	22.80	2.50	4.50	1.20	11.25	3.00
SPHERES REL DEGS, ET	33.00	4.50	1.20	148.50	39.60	4.36	4.50	1.20	19.62	5.23
SPHERE PDSILS & PADS	13.50	4.50	2.00	60.75	27.00	5.10	4.50	2.00	22.95	10.20
SPHERE RELEASE SHIMS	2.50	4.50	.50	11.25	1.25	.95	4.50	.50	4.27	.47
PURPULSION BXX & OIL	849.00	13.50	2.30	11461.50	1952.70	510.00	13.50	2.30	6885.00	1173.00
PRAP BXX PTE M90	12.00	13.50	2.30	162.00	27.60	.00	.00	.00	.00	.00
PRAP BXX SUPPRTS	8.00	13.50	2.30	108.00	18.40	2.00	13.50	2.30	27.00	4.60
PRAP BXX FRAME SUPP	3.00	13.50	2.30	40.50	6.90	1.00	13.50	2.30	13.50	2.30
FRAME REAR SPT STP,	35.50	15.75	2.42	559.13	85.91	12.00	15.75	2.42	189.00	29.04
CANN HALVES LOWER	35.00	4.50	2.00	157.50	70.00	14.22	4.50	2.00	63.39	28.44
LIFT PRP UNITS,BXX	382.00	9.00	7.75	3438.00	2960.50	232.00	9.00	7.75	2088.00	1798.00
LIFT PRP BXX OIL	127.00	9.00	7.75	1143.00	984.25	.00	.00	.00	.00	.00
STERN PRP ASSEMBLY	950.00	20.20	4.63	19190.00	4398.50	458.00	20.20	4.63	9251.60	2120.54
STERN PRP OIL	22.68	20.20	4.43	1670.14	382.81	.00	20.20	4.43	.00	.00
BATTERY BXX FWD	78.50	8.68	2.80	681.38	219.80	733.03	8.68	2.80	6362.70	2052.43
BATT BXX COVER,ETC	15.00	8.68	4.38	130.20	65.70	13.71	8.68	4.38	119.00	60.05
BATT BXX EXT FRAME	76.75	8.68	2.80	666.19	214.90	29.00	8.68	2.80	251.72	81.20
BATTERIES(1560#)	900.00	8.68	2.80	7812.00	2520.00	.00	.00	.00	.00	.00
BATT BXX OIL	235.00	8.68	2.80	2039.80	658.00	.00	.00	.00	.00	.00
BATT INT RACKS,ETC	36.00	8.68	2.80	312.48	100.80	.00	.00	.00	.00	.00
BATT FUSES,WIRE,ETC	10.00	8.68	2.80	86.80	28.00	.00	.00	.00	.00	.00
BATT BXX GASKET	2.00	8.68	4.33	17.36	8.66	.00	.00	.00	.00	.00
BATTERY BXX MID	78.50	10.00	2.80	785.00	219.80	.00	.00	.00	.00	.00
BATT BXX COVER,ETC	15.00	10.00	4.38	150.00	65.70	733.03	10.00	4.38	7330.30	2052.43
BATT BXX EXT FRAME	76.75	10.00	2.80	767.50	214.90	13.71	10.00	2.80	137.10	60.05
BATTERIES(1560#)	900.00	10.00	2.80	9000.00	2520.00	29.00	10.00	2.80	290.00	81.20
BATT BXX OIL	235.00	10.00	2.80	2350.00	658.00	.00	.00	.00	.00	.00
BATT INT RACKS,ETC	36.00	10.00	2.80	360.00	100.80	.00	.00	.00	.00	.00
BATT FUSES,WIRE,ETC	10.00	10.00	2.80	100.00	28.00	.00	.00	.00	.00	.00
BATT BXX GASKET	2.00	10.00	4.33	20.00	8.66	.00	.00	.00	.00	.00
BATTERY BXX AFT	78.50	11.40	2.80	894.90	219.80	.00	.00	.00	.00	.00
BATT BXX COVER,ETC	15.00	11.40	4.38	171.00	65.70	733.03	11.40	4.38	8356.54	2052.43
BATT BXX EXT FRAME	76.75	11.40	2.80	874.95	214.90	13.71	11.40	2.80	156.29	60.05
						29.00	11.40	2.80	330.60	81.20

ALVIN WEIGHT AND STABILITY COMPUTATIONS
(CONTINUED)

AFTERBODY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
BATTERIES (15260#)	900.00	11.40	2.80	10260.00	2520.00	.00	.00	.00	.00	.00
BATT B9X BIL	235.00	11.40	2.80	2679.00	658.00	.00	.00	.00	.00	.00
BATT INT RACKS, ETC	36.00	11.40	2.80	410.40	100.80	.00	.00	.00	.00	.00
BATT FUSES, WIRE, ETC	10.00	11.40	2.80	114.00	28.00	.00	.00	.00	.00	.00
BATT BRX GASKET	2.00	11.40	4.33	22.80	8.66	.00	.00	.00	.00	.00
BATTERY DRAPS (2) FWD	56.00	8.68	3.03	486.08	169.68	7.15	8.68	3.25	62.06	23.24
BATTERY DRAPS (2) MID	56.00	10.00	3.03	560.00	169.68	7.15	10.00	3.25	71.50	23.24
BATTERY DRAPS (2) AFT	56.00	11.40	3.03	638.40	169.68	7.15	11.40	3.25	81.51	23.24
SPHERE SUP SYNTAC (2)	3.00	4.30	2.00	12.30	6.00	4.80	4.30	2.00	20.64	9.60
FRAME SYNTACTIC (9)	17.00	9.00	3.50	153.00	59.50	27.20	9.00	3.50	244.80	2.80
V/R B9X BRKT	1.50	17.50	5.00	26.25	7.50	.56	17.50	5.00	9.80	.51
LWR BASKET HINGE (2)	4.50	4.00	.30	18.00	1.35	1.70	4.00	.30	6.80	.51
WT & BSKT REL BRKT 3	2.00	4.62	2.75	9.24	5.50	.76	4.62	2.75	3.51	2.00
V/R SPHERE BRAC (2)	2.00	6.78	1.42	13.56	2.84	.76	6.78	1.42	3.15	1.00
CTR V/R PKG BRAC 2	4.00	10.50	5.00	42.00	20.00	1.52	10.50	5.00	15.96	7.60
BUGY PKG HRLDOWNS 6	3.00	15.00	5.00	45.00	15.00	1.13	15.00	5.00	16.95	5.60
HAISTING PIN	2.50	12.50	7.44	31.25	13.60	.95	12.50	7.44	11.87	7.37
FRAME SIDE BD SKIN (2)	22.50	7.00	1.50	157.50	33.75	11.90	7.00	1.50	83.30	17.80
TIE DOWNS (2)	11.50	7.00	4.50	80.50	17.25	6.10	7.00	4.50	42.70	3.10
HANDLING PADS (6)	10.00	8.25	1.67	46.70	46.70	3.70	8.25	1.67	30.32	17.20
BATTERY CHG CABLE TR	15.00	8.00	6.50	120.00	97.50	1.98	8.00	6.50	15.84	12.87
BATTERY CHG CABLES	10.00	10.70	7.83	107.00	78.30	3.70	10.70	7.83	39.59	28.97
MARSH MARINE CABLES	14.50	10.70	7.67	155.15	111.21	7.25	10.70	7.67	77.57	53.61
INSTRUMENT CASE	62.50	9.35	4.67	584.37	211.87	31.25	19.35	4.67	22.19	145.94
BATT9M WINDOW CONE	17.00	6.30	.83	107.10	14.11	3.34	6.30	.83	21.04	2.77
FWD WT DRAP, SBL	12.50	3.50	1.00	43.75	12.50	6.95	3.50	1.00	24.32	6.95
PART WT DRAP, SBL FWD	10.50	4.25	3.00	72.63	31.50	3.50	4.25	3.00	15.30	10.20
STRD WT DRAP, SBL FWD	10.10	4.50	3.00	45.45	30.30	3.40	4.50	3.00	15.30	10.20
PART WT DRAP, SBL AFT	10.10	6.00	3.00	60.60	30.30	3.40	6.00	3.00	20.40	10.20
STRD WT DRAP, SBL AFT	10.10	6.00	3.00	60.60	30.30	3.40	6.00	3.00	20.40	10.20
BATTERY RESERV0IR B9	122.00	7.00	1.40	1224.00	254.80	215.10	7.00	1.40	1503.70	321.14
BATTERY RES B9X BAG	32.00	7.00	1.40	224.00	44.80	17.80	7.00	1.40	124.60	24.92
BATTERY RES B9X BRKT	1.40	7.00	1.40	9.80	1.96	.37	7.00	1.40	2.59	.37
RUBBER GASKETS (3)	10.00	4.50	2.60	45.00	26.00	8.33	4.50	2.60	37.48	21.66
MISC PLUMBING	24.00	10.10	3.67	242.40	88.08	3.14	10.10	3.67	31.71	11.32
FATHOMETER	31.50	5.50	2.25	173.25	70.88	15.50	5.50	2.25	85.25	34.83
SYNT FWD SKIDS	22.00	6.50	.25	143.00	5.50	39.00	6.50	.25	253.50	9.70
CNTR CTR B9X	50.40	10.40	3.20	524.16	161.28	370.00	10.40	3.20	3848.00	1184.00
CNTR CTR COVER	14.60	10.40	3.20	151.84	46.72	.00	.00	.00	.00	.00

ALVIN WEIGHT AND STABILITY COMPUTATIONS

(CONTINUED)

AFTER88DY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
CNTR CTR INT PANELS	82.00	10.40	3.20	852.30	262.40	.00	.00	.00	.00	.00
CENTRAL CTR BIL	260.00	10.40	3.20	2704.00	832.00	.00	.00	.00	.00	.00
MISC FITTINGS	25.00	10.40	3.20	260.00	80.00	.00	.00	.00	.00	.00
SMALL BUSH PKGS AFT	103.00	17.28	5.38	1779.24	554.14	183.11	17.28	5.38	3164.14	983.13
SVNT AFT SKIDS	21.93	10.50	.25	230.26	5.48	38.98	10.50	.25	403.29	9.74
AMF XPDR CASE	20.00	9.83	4.12	786.40	329.60	45.00	19.83	4.12	442.35	185.40
AMF XPDR HEAD	8.00	17.12	5.12	136.96	40.96	5.82	17.12	5.12	99.64	29.80
AUX RATT BFX BRKT	23.50	15.87	1.96	372.94	46.04	8.88	15.87	1.96	143.93	17.40
SS INSERTS:BOLTS	4.00	16.03	3.17	64.12	12.68	.50	16.03	3.17	8.01	1.58
RASKET ELECT DISC	15.00	.67	2.00	10.05	30.00	4.87	.67	2.00	3.26	9.74
MIDSHIP BUSH P FWD	25.75	9.11	4.62	234.58	118.96	48.00	9.11	4.62	437.28	221.75
MIDSHIP BUSH S FWD	30.00	9.11	4.62	273.30	138.60	56.45	9.11	4.62	514.26	250.80
MIDSHIP BUSH P AFT	30.00	11.22	4.62	336.60	138.60	56.45	11.22	4.62	633.37	250.80
MIDSHIP BUSH S AFT	29.00	11.19	4.62	324.51	133.98	54.59	11.19	4.62	610.86	231.21
FWD SKIN SUPPORTS	13.25	2.00	1.50	26.50	19.88	8.80	2.00	1.50	17.60	13.20

AFTER88DY

SUMMARY	NO. ITEMS	SUM W	S MXW	S MYW	SUM MX	SUM MY	SUM D	S MXP	S MYP	SUM MXP	SUM MYP
	135	15766.60	11.19	3.97	176365.09	62661.69	14576.05	11.52	4.55	167862.02	66316.97

BG LONGITUDINAL .33

BG VERTICAL .58

ALVIN WEIGHT AND STABILITY COMPUTATIONS

PAGE 1

VARIABLE LOAD(NORMAL)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
MECHANICAL ARM	432.55	-0.30	2.70	-131.56	1184.08	143.00	.00	2.70	.00	386.10
MECH ARM REL	94.50	.80	3.00	77.20	289.50	30.50	.80	3.00	24.40	91.50
MECH ARM CONTR B8X	10.00	1.00	7.00	10.00	70.00	.00	1.00	7.00	.00	.00
ARM OFFSET BRKTS	13.00	1.00	3.00	13.00	39.00	3.00	1.00	3.00	3.00	9.00
SAMPLE TRAY, T88LS	150.00	-2.50	1.40	-375.00	210.00	45.00	-2.50	1.40	-112.50	53.00
PERSANNE (3)	500.00	5.86	4.13	2930.00	2065.00	.00	.00	.00	.00	.00
ASCENT WEIGHT	500.00	4.50	2.60	2250.00	1300.00	45.00	4.50	2.60	202.50	117.00
ADD LEAD OR PAYLOAD	275.00	4.00	3.00	1100.00	825.00	.00	.00	.00	.00	.00

VARIABLE LOAD(NORMAL)

SUMMARY	NO. ITEMS	SUM W	S MXW	S MYW	SUM MX	SUM MY	SUM D	S MXP	S MYP	SUM MXP	SUM MYP
8		1983.05	2.96	3.02	5873.63	5982.58	266.50	.44	2.50	117.40	656.60
BG LONGITUDINAL		-2.52			BG VERTICAL	.52					

ALVIN WEIGHT AND STABILITY COMPUTATIONS

RELEASED FOREBODY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
SPHERE ONLY	8331.61	4.37	4.73	36374.96	39405.38	10780.82	4.47	4.74	48239.98	51055.38
OTHER FOREBODY	6269.40	3.77	6.27	23665.50	39304.83	6727.87	3.62	6.19	24364.67	41644.51
PERSNNEL (3)	500.00	5.86	4.13	2930.00	2065.00	.00	.00	.00	.00	.00
MECH ARM CONTR B9X	10.00	1.00	7.00	10.00	70.00	.00	.00	.00	.00	.00

RELEASED FOREBODY

SUMMARY	N6. ITEMS	SUM W	S	MXW	S	MYW	S	MX	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	SUM MXP	SUM MYP
	4	15111.01		4.17		5.35		62980.46		80845.22	17508.69		4.15		5.30	72604.65	92710.19

BG LONGITUDINAL

-02

BG VERTICAL

-05

ALVIN WEIGHT AND STABILITY COMPUTATIONS

ENTIRE VEHICLE(NORMAL)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
SPHERE ONLY	8331.61	4.37	4.73	36374.96	39435.38	10780.82	4.47	4.74	48239.98	51055.38
OTHER FOREBODY	6269.40	3.77	6.27	23665.50	39304.83	6727.87	3.62	6.19	24364.67	41644.81
AFTERBODY	15766.60	11.19	3.97	176365.09	62661.69	14576.05	11.52	4.55	167862.02	66316.97
VARIABLE LOAD(NORMAL)	1983.05	2.96	3.02	5873.63	5982.58	266.50	.44	2.50	117.40	656.60

ENTIRE VEHICLE(NORMAL)

SUMMARY	NO. ITEMS	SUM W	S MXW	S MYW	SUM MX	SUM MY	SUM D	S MXPD	S MYPD	SUM MXP	SUM MYP
	4	32350.66	7.49	4.55	242279.18	147354.49	32351.24	7.44	4.94	240584.07	159693.75

BG LONGITUDINAL .05

BG VERTICAL .38

ALVIN WEIGHT AND STABILITY COMPUTATIONS

PAGE 1

EMERGENCY CONDITIONS (1)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
IN NORMAL CONDITION	32350.66	7.49	4.55	242279.18	147354.49	32351.24	7.44	4.94	240584.07	159693.75
BLOW M/B FBOY	-1346.00	4.50	6.00	-6057.00	-8076.00	.00	.00	.00	.00	.00
BLOW M/B AFTBDY	-300.00	10.25	6.83	-3075.00	-2049.00	.00	.00	.00	.00	.00

EMERGENCY CONDITIONS (1)

SUMMARY	NO. ITEMS	SUM W	S	MXW	S	MYW	S	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	S	SUM MXP	SUM MYP
3		30704.66		7.59		4.47		233147.18	137229.49	32351.24		7.44		4.94		240584.07	159693.75
BG LONGITUDINAL								BG VERTICAL	.47								

ALVIN WEIGHT AND STABILITY COMPUTATIONS

EMERGENCY CONDITIONS (3)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MP	MP
IN NORMAL CONDITION	32350.66	7.49	4.55	242279.18	147354.49	32351.24	7.44	4.94	240584.07	159693.75
DR9P FWD BATTERY	-1356.63	8.68	3.19	-11775.55	-4327.65	-775.74	8.68	3.19	-6733.42	-2474.61
DR9P AFT BATTERY	-1356.63	11.40	3.19	-15465.58	-4327.65	-775.74	11.40	3.19	-8843.44	-2474.61

EMERGENCY CONDITIONS (3)

SUMMARY	NO. ITEMS	SUM W	S MXW	S MYW	SUM MX	SUM MY	SUM D	S MXP	S MYP	SUM MXP	SUM MYP
	3	29637.40	7.26	4.68	215038.05	138699.19	30799.76	7.31	5.02	225007.21	154744.53

BG LONGITUDINAL .05

BG VERTICAL .34

ALVIN WEIGHT AND STABILITY COMPUTATIONS

EMERGENCY CONDITIONS (4)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MP
IN NORMAL CONDITION	32350.66	7.49	4.55	242279.18	147354.49	32351.24	7.44	4.94	159533.75
DR9P FWD BATTERY	-1356.63	8.68	3.19	-11775.55	-4327.65	-775.74	8.68	3.19	-2474.61
DR9P MID BATTERY	-1356.63	10.00	3.19	-13566.30	-4327.65	775.74	10.00	3.19	-2474.61
DR9P AFT BATTERY	-1356.63	11.40	3.19	-15465.58	-4327.65	775.74	11.40	3.19	-2474.61

EMERGENCY CONDITIONS (4)

SUMMARY	NO.	ITEMS	SUM W	S	MXW	S	MYW	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	S	MXP	SUM MYP
		4	28280.77		7.12		4.75	201471.75	134371.54	30024.02		7.24		5.07		217249.81	152269.92
BG LONGITUDINAL			.11					BG VERTICAL	.32								

ALVIN WEIGHT AND STABILITY COMPUTATIONS

EMERGENCY CONDITIONS (5)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
IN NORMAL CONDITION	32350.66	7.49	4.55	242279.18	147354.49	32351.24	7.44	4.94	240584.07	159593.75
DR9P FWD BATTERY	-1356.63	8.68	3.19	-11775.55	-4327.65	-775.74	8.68	3.19	-6733.42	-2474.61
DR9P MID BATTERY	-1356.63	10.00	3.19	-13566.30	-4327.65	-775.74	10.00	3.19	-7757.40	-2474.61
DR9P AFT BATTERY	-1356.63	11.40	3.19	-15465.58	-4327.65	-775.74	11.40	3.19	-8843.44	-2474.61
DR9P ARM	-438.55	-0.30	2.70	131.56	-1184.08	-143.00	.00	2.70	.00	-386.10

EMERGENCY CONDITIONS (5)

SUMMARY	NO. ITEMS	SUM W	S	MXW	S	MYW	S	MX	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	SUM MXP	SUM MYP
5	5	27842.22		7.24		4.78		201603.32		133187.46	29881.02		7.27		5.08	217249.81	151883.82

BG LONGITUDINAL .03

BG VERTICAL .30

ALVIN WEIGHT AND STABILITY COMPUTATIONS

EMERGENCY CONDITIONS (6)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
IN NORMAL CONDITION	32350.66	7.49	4.55	242279.18	147354.49	32351.24	7.44	4.94	242584.07	159593.75
FL99D V/B SPHERES	265.00	9.05	4.27	2398.25	1131.55	.00	.00	.00	.00	.00
DR9P FWD BATTERY	-1356.63	8.65	3.19	-11775.55	-4327.65	-775.74	8.68	3.19	-6733.42	-2474.61
DR9P MID BATTERY	-1356.63	10.00	3.19	-13566.30	-4327.65	-775.74	10.00	3.19	-7757.40	-2474.61
DR9P AFT BATTERY	-1356.63	11.40	3.19	-15465.58	-4327.65	-775.74	11.40	3.19	-8843.44	-2474.61
DR9P ARM	-433.55	-0.30	2.70	131.56	-1184.08	-143.00	.00	2.70	.00	-386.10

EMERGENCY CONDITIONS (6)

SUMMARY	NO. ITEMS	SUM W	S MXW	S MYW	SUM MX	SUM MY	SUM D	S MXP	S MYP	SUM MXP	SUM MYP
	6	28107.22	7.26	4.78	204001.57	134319.01	29881.02	7.27	5.08	217249.81	151883.82

BG LONGITUDINAL .01

BG VERTICAL .30

STEP 0

III. Summary of Results

The most recent previous computations were done in December 1975. The results were reported in a memorandum (Ref. 1) that was issued to update the 1975 weight report (Ref. 2). The principal results of the present computations for the normal submerged submarine are as follows:

Total weight	32,351 lb.
Total displacement	32,351 lb.
BG distance (vertical)	0.38 ft.
BG distance (longitudinal)	-0.05 ft.

The item "additional lead or payload" in the Variable Load section was adjusted to 275 pounds to balance the weight with the displacement.

The present total displacement (32,351 pounds) is very close to the 1975 value of 32,344 pounds (Ref. 1). The vertical BG distance remains unchanged from the 1975 value, while the horizontal component of BG has decreased by 0.02 foot indicating an improvement in basic fore-and-aft trim.

For the released forebody and the other emergency conditions the BG values are the same as, or very close to,

the values of last season. Differences, where they occur, are no more than 0.02 foot.

IV. References

1. ALVIN Weight Report Update for 1975-76 Winter Operating Season, by Arnold G. Sharp, W.H.O.I. Office Memorandum, December 16, 1975.
2. DSRV ALVIN Weight Report, 1975, by Arnold G. Sharp, W.H.O.I. Technical Memorandum No. 5-75, October 1975.

V. Appendix - Computer Program


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1. C *****
2. C ALVIN WEIGHT AND STABILITY PROGRAM
3. C JUNE 1971
4. C PROGRAMMER: ANDREW H. ELIASON
5. C MODIFIED BY W FREUND
6. C AUGUST 1975
7. C TO ELIMINATE THE NEED FOR MULTIPLE RUNS.
8. C PROGRAM CHANGED SO THAT OUTPUT VALUES FROM SOME SECTIONS ARE
9. C STORED INTERNALLY FOR USE AS INPUT TO LATER SECTIONS.
10. C
11. C USE X OPTION FOR CALCULATION WITH PLOT
12. C *****
13. C
14. C NOTE: THE PROGRAM EXPECTS INPUT AS FOLLOWS:
15. C 1 SET OF ALVIN PICTURE DATA FOLLOWED BY AN EOD CARD (OR EOD ALONE)
16. C 5 SETS OF DATA EACH PRECEDED BY A SECTION ID CARD AND
17. C FOLLOWED BY AN EOD CARD.
18. C 1 SECTION ID CARD (ENTIRE VEHICLE-NORMAL) FOLLOWED BY AN EOD CARD.
19. C 1 TO N SETS OF EMERGENCY CONDITION DATA EACH PRECEDED BY A
20. C SECTION ID CARD AND FOLLOWED BY AN EOD CARD.
21. C THE PROGRAM MAY BE HALTED AFTER ANY SECTION BY PUNCHING A 3 IN
22. C COLUMN 64 OF THE LAST DATA CARD OF THE LAST SECTION WANTED.
23. C EXCEPT THAT - SINCE THERE IS NO CARD DATA FOR THE
24. C ENTIRE VEHICLE-NORMAL SECTION, THE 3 SHOULD BE PUNCHED IN
25. C COLUMN 64 OF THE SECTION ID CARD IF THE ENTIRE VEHICLE SECTION
26. C IS THE LAST ONE WANTED.
27. C THE PLOT OPTION (2 IN COL. 64) FOLLOWS THE SAME RULE.
28. C
29. C PROGRAM PERFORMS WEIGHT AND STABILITY CALCULATIONS FOR
30. C ALVIN AND ITS PARTS.
31. C OUTPUT IS IN SECTIONS. DATA IS READ IN FOR ONE SECTION,
32. C CALCULATIONS ARE MADE AND RESULTS PRINTED. THEN THE NEXT SECTION
33. C DATA IS READ, ETC.
34. C
35. C EACH SECTION PRODUCES DETAIL AND SUMMARY RESULTS.
36. C FOR EACH SECTION OF THE OUTPUT THE OUTPUT PAGE NUMBER IS SET = 1
37. C AND THE SECTION ID IS READ IN FROM A CARD.
38. C SECTIONS ARE INDEPENDENT OF ONE ANOTHER EXCEPT THAT
39. C OUTPUT FROM SOME IS INPUT TO OTHERS.
40. C
41. C THE FIRST 4 SECTIONS ARE TITLED:
42. C 1. SPHERE ONLY
43. C 2. OTHER FOREBODY
44. C 3. AFTERBODY
45. C 4. VARIABLE LOAD
46. C
47. C SIX OF THE SUMMARY VALUES FROM EACH OF THE FIRST FOUR SECTIONS
48. C ARE STORED IN ARRAY STORE(6,4) FOR USE BY LATER SECTIONS.
49. C
50. C SECTION 5 IS TITLED RELEASED FOREBODY. INPUT TO THIS SECTION
51. C IS SUMMARY VALUES FROM SPHERE ONLY AND FOREBODY PLUS
52. C NEW INPUT READ JUST BEFORE PROCESSING THIS SECTION.
53. C OUTPUT FROM THIS SECTION IS NOT SAVED.
54. C
55. C SECTION 6 IS TITLED ENTIRE VEHICLE(NORMAL). INPUT TO THIS SECTION
56. C IS THE SUMMARY VALUES OF THE FIRST 4 SECTIONS. NO ADDITIONAL
57. C DATA IS READ IN FOR THIS SECTION.
58. C OUTPUT FROM THIS SECTION IS SAVED FOR INPUT TO THE FOLLOWING
59. C SECTIONS.

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[illegible]


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120. 5      CONTINUE
121. C
122. C *****
123. C OUTPUT SECTION 5 - RELEASED FOREBODY. *****
124. C WE GET FIRST 2 RECORDS FROM CORE THEN START READING INTO
125. C ELEMENT 3 OF INPUT ARRAYS. *****
126. C *****
127. C
128. C      IPAGE = 1
129. C      READ(105,900) ID
130. C      CALL COREID(2)
131. C      CALL COREDATA(2)
132. C      CALL RDATA(3)
133. C      CALL CALCPRI
134. C      CALL PICTURE
135. C      IF(C(N).EQ.3) STOP
136. C
137. C *****
138. C OUTPUT SECTION 6 - ENTIRE VEHICLE NORMAL. *****
139. C ALL 4 RECORDS FOR THIS SECTION COME FROM CORE.
140. C SINCE NO DATA IS READ HERE WE GET PICTURE/STEP CODE FROM ID CARD.
141. C SAVE SUMMARY DATA FROM THIS SECTION. *****
142. C *****
143. C
144. C      IPAGE = 1
145. C      N = 4
146. C      READ(105,901) ID, C(N)
147. C      READ(105,901,END=6)
148. C      CONTINUE
149. C      CALL COREID(4)
150. C      CALL COREDATA(4)
151. C      N = 4
152. C      CALL CALCPRI
153. C      CALL SAVE(1)
154. C      CALL PICTURE
155. C      IF(C(N).EQ.3) STOP
156. C
157. C *****
158. C OUTPUT SECTION 7 TO N - EMERGENCY CONDITIONS. *****
159. C THERE IS NO LIMIT TO THE NUMBER OF THESE SECTIONS.
160. C END RUN WITH 3 IN CBL. 64.
161. C WE GET FIRST INPUT RECORD FROM CORE. THEN WE READ.
162. C START READING INTO ELEMENT 2 OF INPUT ARRAYS. *****
163. C *****
164. C
165. C      ID OF FIRST DETAIL LINE IS THE SAME FOR ALL OF THESE.
166. C      INTEGER EMLINE(5)/IN NORMAL CONDITION 1/
167. C      REPEAT 7, FOR J = (1,5)
168. C      IDEN(1,J) = EMLINE(J)
169. C      CONTINUE
170. C
171. C      INTEGER GA/O/
172. C      REPEAT 10, WHILE GA.EQ.0
173. C      IPAGE = 1
174. C      READ(105,900) ID
175. C      CALL COREDATA(1)
176. C      CALL RDATA(2)
177. C      CALL CALCPRI
178. C      CALL PICTURE
179. C

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190. IF(C(N).EQ.3) STOP
191. CONTINUE
192. C
193. 100 FORMAT(7A4)
194. 901 FORMAT(7A4, T64, I1)
195. C
196. C*****
197. SUBROUTINE RDATA(START)
198. C*****
199. REPEAT 5, FOR N = (START, 300)
200. READ(105,100,END=7)
201. X (IDEN(N,J), J=1,5),
202. X W(N), X(N), Y(N), D(N), XP(N), YP(N), C(N)
203. C*****
204. CONTINUE
205. C
206. 5
207. CONTINUE
208. C
209. 7
210. N = N + 1
211. RETURN
212. C
213. 100 FORMAT(5A4,1X,F8.2,2(1X,F5.2),1X,F8.2,2(1X,F5.2),1X,I1)
214. C*****
215. SUBROUTINE SAVE(SMRY)
216. C*****
217. DOUBLE PRECISION STORE(6,4)
218. INTEGER IDSTORE(4,5)
219. C
220. REPEAT 5, FOR L = (1,5)
221. IDSTORE(SMRY,L) = ID(L)
222. CONTINUE
223. C
224. 5
225. STORE(1,SMRY) = SW
226. STORE(2,SMRY) = SRXW
227. STORE(3,SMRY) = SRYW
228. STORE(4,SMRY) = SD
229. STORE(5,SMRY) = SRXPD
230. STORE(6,SMRY) = SRYPD
231. C
232. RETURN
233. C
234. C*****
235. SUBROUTINE COREID(NUMBER)
236. C*****
237. REPEAT 5, FOR N = (1,NUMBER)
238. REPEAT 3, FOR L = (1,5)
239. IDEN(N,L) = IDSTORE(N,L)
240. CONTINUE
241. 3
242. CONTINUE
243. C
244. 5
245. RETURN
246. C
247. C*****
248. SUBROUTINE COREDATA(NEED)
249. C*****
250. REPEAT 5, FOR N = (1, NEED)
251. C

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240. W(N) = STORE(1,N)
241. X(N) = STORE(2,N)
242. Y(N) = STORE(3,N)
243. D(N) = STORE(4,N)
244. XP(N) = STORE(5,N)
245. YP(N) = STORE(6,N)
246.
247. C 5 CONTINUE
248. RETURN
249.
250. C *****
251. C SUBROUTINE CALCPRI
252. C *****
253. C
254. C WRITE(108,200) IPAGE,WRITE(108,250) ID,WRITE(108,300)
255. C
256. C ITEM = 1
257. C SW=0.0;SRXW=0.0;SRYW=0.0;SRX=0.0;SRY=0.0;SD=0.0;SRXPD=0.0;SRYPD=0.0
258. C SRXP=0.0;SRYP=0.0
259. C
260. C CALCULATE RESULTS
261. C DO 30 I=1,N
262. C PX=W(I)*X(I);RY=W(I)*Y(I)
263. C RXP=D(I)*XP(I);RYP=D(I)*YP(I)
264. C SW=W(I)+SW;SD=D(I)+SD
265. C SRX=SRX+PX;SRY=SRY+RY;SRXP=SRXP+RXP;SRYP=SRYP+RYP
266. C SRXW=SRX/SW;SRYW=SRY/SW
267. C SRXPD= SRXP/SD;SRYPD=SRYP/SD
268. C BGL=SRXPD-SRXW;BGV=SRYPD-SRYW
269. C
270. C WRITE(108,400)((IDEN(I,J),J=1,5),W(I),X(I),Y(I),RX,RY,D(I),XP(I),
271. C 1 YP(I),RXP,RYP
272. C
273. C IF (ITEM.EQ.40.8P,ITEM.EQ.80.8P,ITEM.EQ.120) IPAGE=IPAGE+1;
274. C 1 WRITE(108,200) IPAGE,WRITE(108,260) ID,WRITE(108,300)
275. C
276. C ITEM=ITEM+1
277. C 30 CONTINUE
278. C
279. C PRINT RESULTS
280. C WRITE(108,950) ID
281. C WRITE(108,500)
282. C 1 SRYP,WRITE(108,700) BGL,BGV;
283. C
284. C RETURN
285. C
286. C 200 FORMAT(1H1,
287. C X 46X, 'ALVIN WEIGHT AND STABILITY COMPUTATIONS',
288. C X 35X, 'PAGE ', I1/)
289. C
290. C 250 FORMAT(46X,7A4/)
291. C
292. C 260 FORMAT (46X,7A4, ' (CONTINUED)',/)
293. C
294. C 300 FORMAT(3X, 'IDENTIFICATION', 11X, W, 9X, X, 1X, 8X, Y, 9X, MX, 10X, MY,
295. C 111X, 'D', 9X, 'XP', 7X, 'YP', 8X, 'MXP', 9X, 'MYP',/)
296. C
297. C 400 FORMAT(1X, 5A4, 4X, F8.2, 2(4X, F5.2), 3(3X, F9.2), 2(4X, F5.2), 2(3X, F9.2),
298. C 500 FORMAT(/, ' SUMMARY N6. ITEMS', 6X, 'SUM W', 4X, 'S MXW', 4X, 'S MYW',
299.

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300.      16X,ISUM MX,6X,ISUM MY,7X,ISUM D,5X,IS MYPD,3X,IS MYPD,4X,ISUM
301.      1 MXP,5X,ISUM MYP)
302.
303.
304.      600 FORMAT(14X,I3,8X,F8.2,2(4X,F5.2),3(3X,F9.2),2(4X,F5.2),2(3X,F9.2))
305.      700 FORMAT(/,10X,1BG LONGITUDINAL,5X,F5.2,20X,1BG VERTICAL,5X,F5.2)
306.
307.      800 FORMAT('1')
308.
309.      950 FORMAT(/,1X,7A4)
310.
311.      C*****
312.      X SUBROUTINE PICTURE
313.      C*****
314.      C CALCULATE PICTURE ROTATION DATA
315.      X IF(C(N).LT.2) GO TO 80
316.      X THETA =DATAN2(SRXPDSRXXW,SRYPD.SRYW)
317.      X DO 25 I=1,M
318.      X IF (ARRAY2(I).GT.3000) ARRAY4(I)= 10500; GO TO 25
319.      X X1= ARRAY1(I)
320.      X Y1= ARRAY2(I)
321.      X GAMMA=DATAN2(Y1,X1)
322.      X R =DSORT(X1**2+Y1**2)
323.      X A = GAMMA + THETA
324.      X X1= R*DCOS(A)
325.      X Y1= R*DSIN(A)
326.      X ARRAY3(I)=X1
327.      X ARRAY4(I)=Y1
328.      X 25 CONTINUE
329.      C*****
330.      X PLAT ALVIN PICTURE
331.      X CALL PLAT(10.0,10.0,-3)
332.      X CALL AXDRAW(-6.0,0.0,X,1,16.0,0.0,-6.0,1.0,1.0,-1)
333.      X CALL AXDRAW(0.0,-4.0,Y,1,10.0,90.0,-4.0,1.0,1.0,-1)
334.      X CALL SYMBOL (-7.,-9.,-21,10.0,28)
335.      X DO 75 I=1,M
336.      X IPEN=2
337.      X IF (I.EQ.1.0R.IFLAG.EQ.1) IPEN=3;GO TO 65
338.      X IF (ARRAY4(I).GT.10000)IFLAG=1;GO TO 75
339.      X 65 X2= ARRAY3(I)/SCALE
340.      X Y2= ARRAY4(I)/SCALE
341.      X CALL PLAT(X2,Y2,IPEN)
342.      X IFLAG=0
343.      X 75 CONTINUE
344.      X CALL PLAT (0.0,0.0,999)
345.      X 80 CONTINUE
346.      X RETURN
347.      C
348.      END

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