
156-IN. -DIA SRM
MASS PROPERTIES REPORT

Contract NAS8-28428
CR-123727

Report 1917-MP1

10 March 1972

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Report 1917-MP1

156-IN. -DIA SRM
MASS PROPERTIES REPORT

Contract NAS8-28428
Data Procurement Document 314
Dat Requirement SE-02

10 March 1972

Prepared For:

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**Details of illustrations in
this document may be better
studied on microfiche**



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Report 1917-MP1

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This report presents mass properties data for 156-in.-dia SRM Booster with two segments. The information contained herein is in accordance with Data Procurement Document 314, Data Requirement SE-20. The SRM baseline Booster is with a fixed 15° canted nozzle and no thrust neutralization system. Summary Mass Properties Data for alternative Booster configurations are included in this report.

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	Weight, lb					
	15° Canted Nozzle		5° Nozzle		10° Nozzle	
	Without TN	With TN	Without TN	With TN	Without TN	With TN
<u>Chamber Assembly</u>	(69,030)	(69,030)	(69,600)	(69,600)	(69,600)	(69,600)
a. Forward Closure	10,913	10,913	10,913	10,913	10,913	10,913
b. Segments (2)	44,148	44,148	44,148	44,148	44,148	44,148
c. Aft Closure	13,575	13,575	14,145	14,145	14,145	14,145
d. Attach. Hardware	394	394	394	394	394	394
<u>Insulation System</u>	(14,620)	(14,620)	(15,726)	(15,726)	(15,726)	(15,726)
a. Forward Closure	5,970	5,970	5,970	5,970	5,970	5,970
b. Segments (2)	4,576	4,576	4,576	4,576	4,576	4,576
c. Aft Closure	4,074	4,074	5,180	5,180	5,180	5,180
<u>Nozzle Assembly</u>	(10,860)	(10,860)	(12,377)	(12,377)	(14,130)	(14,130)
a. Nozzle	8,694	8,694	10,238	10,238	11,734	11,734
b. Nozzle Extension	1,875	1,875	1,875	1,875	1,875	1,875
c. Attach. Hardware	291	291	264	264	264	264
<u>Nozzle Actuation System</u>	(0)	(0)	(600)	(600)	(3,000)	(3,000)
<u>Ignition System</u>	(441)	(441)	(441)	(441)	(441)	(441)
a. Propellants	157	157	157	157	157	157
b. Inert Parts	284	284	284	284	284	284
<u>Thrust Neutralization System</u>	(0)	(2,200)	(0)	(2,200)	(0)	(2,200)
a. Stacks, covers	0	1,054	0	1,054	0	1,054
b. Ordnance	0	486	0	486	0	486
c. Nose Cone Structure	0	660	0	660	0	660
<u>Nose Cone Section</u>	(5,480)	(5,480)	(5,480)	(5,480)	(5,480)	(5,480)
a. Nose Cone	1,397	1,397	1,397	1,397	1,397	1,397
b. Thrust Ring	3,030	3,030	3,030	3,030	3,030	3,030
c. Thrust Ring Fittings	1,053	1,053	1,053	1,053	1,053	1,053
<u>Aft Skirt Support</u>	(57,886)	(7,886)	(7,886)	(7,886)	(7,886)	(7,886)
a. Forward Section	1,798	1,798	1,798	1,798	1,798	1,798
b. Aft Section	6,088	6,088	6,088	6,088	6,088	6,088
<u>Destruct System</u>	(240)	(240)	(240)	(240)	(240)	(240)
a. Command System	20	20	20	20	20	20
b. Destruct Assembly	220	220	220	220	220	220
<u>Instrumentation</u>	(60)	(60)	(300)	(300)	(300)	(300)
<u>Aft Attach. Structure</u>	(1,418)	(1,418)	(1,418)	(1,418)	(1,418)	(1,418)
<u>Misc. Structure and Brackets</u>	(500)	(500)	(500)	(500)	(500)	(500)
TOTAL INERTS	110,535	112,735	114,568	116,768	118,721	120,921
<u>Propellant</u>	(1,000,000)	(1,000,000)	(1,000,000)	(1,000,000)	(1,000,000)	(1,000,000)
a. Forward Closure	145,500	145,500	145,500	145,500	145,500	145,500
b. Segments (2)	674,900	674,900	674,900	674,900	674,900	674,900
c. Aft Closure	179,600	179,600	179,600	179,600	179,600	179,600
TOTAL BOOSTER WEIGHT	1,110,535	1,112,735	1,114,568	1,116,768	1,118,721	1,120,921

Booster Weight Summary

<u>Time, %</u>	<u>Weight, lb</u>	<u>Center of Gravity *</u>			<u>Moment of Inertia **</u>		
		<u>Longitudinal</u> <u>C.G., in.</u>	<u>Lateral</u> <u>C.G., in.</u>	<u>Vertical</u> <u>C.G., in.</u>	<u>Roll,</u> <u>Slug-ft²</u>	<u>Pitch,</u> <u>Slug-ft²</u>	<u>Yaw,</u> <u>Slug-ft²</u>
0	1,110,535	681.0	199.9	200.0	841,840	19,888,386	19,889,653
25	836,945	706.1	199.9	200.0	730,517	13,842,165	13,843,272
50	586,859	714.3	199.9	200.0	585,685	9,282,035	9,282,986
75	344,112	725.5	200.0	200.0	389,283	5,455,824	5,456,618
100	132,204	734.0	200.0	200.0	166,117	3,087,274	3,087,912
Burnout	100,419	735.4	200.1	200.0	125,903	2,745,995	2,746,632

* See component diagram

** $\frac{\text{lb-in.}^2}{4637} = \text{Slug-ft}^2$

Sequence Mass Properties Data
(Booster Weight vs Percent of Web Action Time)

156-in.-dia SRM 15° Fixed Nozzle without Thrust Neutralization

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DETAILED WEIGHT STATEMENT

MA A SUB P				PART NAME	PART NO.	WEIGHT LB.	CENTER OF GRAVITY INCHES			MOMENT	OF LB-INCHES SQUARED			INERTIA		
							X	Y	Z	WXX	WYY	WZZ	IO X	IO Y	IO Z	
1	CHAMBER ASSY															
1	1	FWD HEAD SEGMENT														
1	1	1	IGNITER BOSS			131.0	171.2	200.0	200.0	.38+07	.52+07	.52+07	.15+05	.77+04	.77+04	
1	1	2	DOME-MEMBRANE			3417.0	209.0	200.0	200.0	.15+09	.14+09	.14+09	.13+08	.88+07	.88+07	
1	1	3	FWD SKIRT&FILLET			847.0	237.9	200.0	200.0	.48+08	.34+08	.34+08	.52+07	.26+07	.26+07	
1	1	4	CYL-MEMBRANE			5663.0	292.0	200.0	200.0	.48+09	.23+09	.23+09	.34+08	.21+08	.21+08	
1	1	5	MATING JOINT			855.0	338.0	200.0	200.0	.93+08	.34+08	.34+08	.52+07	.26+07	.26+07	
1	1	6	PINS+SEAL-AFT			124.0	341.0	200.0	200.0	.14+08	.50+07	.50+07	.77+06	.38+06	.38+06	
1	1		FWD HEAD SLGMENT		*** TOTAL *	11037.0	264.8	200.0	200.0	.80+09	.44+09	.44+09	.58+08	.57+08	.57+08	
1	2	FWD CYL SEGMENT														
1	2	1	CYL-MEMBRANE			20097.0	501.0	200.0	200.0	.50+10	.80+09	.80+09	.12+09	.22+09	.22+09	
1	2	2	FWD JOINT			1122.0	343.0	200.0	200.0	.13+09	.45+08	.45+08	.68+07	.34+07	.34+07	
1	2	3	AFT JOINT			855.0	658.0	200.0	200.0	.37+09	.34+08	.34+08	.52+07	.26+07	.26+07	
1	2	4	PINS+SEAL-AFT			124.0	661.0	200.0	200.0	.54+08	.50+07	.50+07	.77+06	.38+06	.38+06	
1	2		FWD CYL SEGMENT		*** TOTAL *	22198.0	500.0	200.0	200.0	.56+10	.89+09	.89+09	.13+09	.28+09	.28+09	
1	3	AFT CYL SEGMENT														
1	3	1	CYL-MEMBRANE			20097.0	821.0	200.0	200.0	.14+11	.80+09	.80+09	.12+09	.22+09	.22+09	
1	3	2	FWD JOINT			1122.0	663.0	200.0	200.0	.49+09	.45+08	.45+08	.68+07	.34+07	.34+07	
1	3	3	AFT JOINT			855.0	978.0	200.0	200.0	.82+09	.34+08	.34+08	.52+07	.26+07	.26+07	
1	3	4	PINS+SEAL-AFT			124.0	981.0	200.0	200.0	.12+09	.50+07	.50+07	.77+06	.38+06	.38+06	
1	3		AFT CYL SEGMENT		*** TOTAL *	22198.0	820.0	200.0	200.0	.15+11	.89+09	.89+09	.13+09	.28+09	.28+09	
1	4	AFT HEAD SLGMENT														
1	4	1	NOZZLE BOSS			1120.0	1159.4	200.0	200.0	.15+10	.45+08	.45+08	.51+07	.26+07	.26+07	
1	4	2	DOME-MEMBRANE			1595.0	1140.6	200.0	200.0	.21+10	.64+08	.64+08	.85+07	.45+07	.45+07	
1	4	3	AFT SKIRT+FILLET			888.0	1132.0	200.0	200.0	.11+10	.36+08	.36+08	.54+07	.27+07	.27+07	
1	4	4	CYL-MEMBRANE			8850.0	1054.9	200.0	200.0	.98+10	.35+09	.35+09	.54+08	.40+08	.40+08	
1	4	5	MATING JOINT			1122.0	976.3	200.0	200.0	.11+10	.45+08	.45+08	.68+07	.34+07	.34+07	
1	4		AFT HEAD SEGMENT		*** TOTAL *	13575.0	1072.1	200.0	200.0	.16+11	.54+09	.54+09	.80+08	.86+08	.86+08	
1	5	MISCELLANEOUS														
1	5	1	PRIMER			22.0	661.0	200.0	200.0	.96+07	.88+06	.88+06	.13+06	.19+07	.19+07	
1	5		MISCELLANEOUS		*** TOTAL *	22.0	661.0	200.0	200.0	.96+07	.88+06	.88+06	.13+06	.19+07	.19+07	
1			CHAMBER ASSY		*** TOTAL *	69030.0	677.8	200.0	200.0	.37+11	.28+10	.28+10	.41+09	.58+10	.58+10	

156-in.-dia SRM 15° Fixed Nozzle without Thrust Neutralization

DETAILED WEIGHT STATEMENT

MA A SUB P			PART NAME	PART NO.	WEIGHT LB.	CENTER OF GRAVITY INCHES			MOMENT	OF LB-INCHES SQUARED			INERTIA		
						X	Y	Z	WXX	WYY	WZZ	IO X	IO Y	IO Z	
2			INSULATION-INT												
2	1		FWD HEAD SEG												
2	1	1	DOME		2597.0	210.3	200.0	200.0	.11+09	.10+09	.10+09	.81+07	.51+07	.51+07	
2	1	2	CYLINDER		3100.0	271.8	200.0	200.0	.23+09	.12+09	.12+09	.18+08	.11+08	.11+08	
2	1	3	JOINT-AFT		140.0	332.0	200.0	200.0	.16+08	.56+07	.56+07	.81+06	.40+06	.40+06	
2	1	4	LINER		114.9	246.0	200.0	200.0	.69+07	.46+07	.46+07	.40+06	.47+06	.47+06	
2	1	5	ADHESIVE		19.0	246.0	200.0	200.0	.11+07	.76+06	.76+06	.11+06	.10+06	.10+06	
2	1		FWD HEAD SEG	*** TOTAL *	5970.0	246.0	200.0	200.0	.37+09	.24+09	.24+09	.28+08	.24+08	.24+08	
2	2		FWD CYL SEG												
2	2	1	CYLINDER		1248.0	501.0	200.0	200.0	.31+09	.50+08	.50+08	.75+07	.87+07	.87+07	
2	2	2	JOINT-FWD		399.0	359.0	200.0	200.0	.51+08	.16+08	.16+08	.24+07	.13+07	.13+07	
2	2	3	JOINT-AFT		399.0	639.0	200.0	200.0	.16+09	.16+08	.16+08	.24+07	.13+07	.13+07	
2	2	4	LINER		205.0	499.0	200.0	200.0	.51+08	.82+07	.82+07	.12+07	.24+07	.24+07	
2	2	5	ADHESIVE		37.0	499.0	200.0	200.0	.92+07	.15+07	.15+07	.22+06	.43+06	.43+06	
2	2		FWD CYL SEG	*** TOTAL *	2288.0	500.1	200.0	200.0	.59+09	.92+08	.92+08	.14+08	.30+08	.30+08	
2	3		AFT CYL SEG												
2	3	1	CYLINDER		1248.0	821.0	200.0	200.0	.84+09	.50+08	.50+08	.75+07	.87+07	.87+07	
2	3	2	JOINT-FWD		399.0	679.0	200.0	200.0	.18+09	.16+08	.16+08	.24+07	.13+07	.13+07	
2	3	3	JOINT-AFT		399.0	959.0	200.0	200.0	.37+09	.16+08	.16+08	.24+07	.13+07	.13+07	
2	3	4	LINER		205.0	819.0	200.0	200.0	.14+09	.82+07	.82+07	.12+07	.24+07	.24+07	
2	3	5	ADHESIVE		37.0	819.0	200.0	200.0	.25+08	.15+07	.15+07	.22+06	.43+06	.43+06	
2	3		AFT CYL SEG	*** TOTAL *	2288.0	820.1	200.0	200.0	.16+10	.92+08	.92+08	.14+08	.30+08	.30+08	
2	4		AFT HEAD SEG												
2	4	1	DOME		1107.0	1148.7	200.0	200.0	.15+10	.44+08	.44+08	.58+07	.31+07	.31+07	
2	4	2	CYLINDER		1385.0	1017.2	200.0	200.0	.14+10	.55+08	.55+08	.82+07	.62+07	.62+07	
2	4	3	JOINT-FWD		399.0	981.0	200.0	200.0	.38+09	.16+08	.16+08	.24+07	.13+07	.13+07	
2	4	4	LINER		136.0	1075.7	200.0	200.0	.16+09	.54+07	.54+07	.68+06	.71+06	.71+06	
2	4	5	ADHESIVE		22.0	1075.7	200.0	200.0	.25+08	.88+06	.88+06	.13+06	.13+06	.13+06	
2	4	6	JOINT RESTRICT		1025.0	981.0	200.0	200.0	.99+09	.41+08	.41+08	.34+07	.17+07	.17+07	
2	4		AFT HEAD SEG	*** TOTAL *	4074.0	1042.5	200.0	200.0	.44+10	.16+09	.16+09	.21+08	.32+08	.32+08	
2			INSULATION-INT	*** TOTAL *	14620.0	597.6	200.0	200.0	.70+10	.58+09	.58+09	.76+08	.18+10	.18+10	

156-in.-dia SRM 15° Fixed Nozzle without Thrust Neutralization

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DETAILED WEIGHT STATEMENT

MA A SUB P			PART NAME	PART NO.	WEIGHT LB.	CENTER OF GRAVITY INCHES			MOMENT	OF LB-INCHES SQUARED			INERTIA		
						X	Y	Z	WXX	WYY	WZZ	IO X	IO Y	IO Z	
3			NOZZLE-FXD CNTD												
3	1		THROAT ASSY												
3	1	1	THROAT		406.0	1186.1	183.0	200.0	.57+09	.14+08	.16+08	.26+06	.14+06	.14+06	
3	1	2	ENT CAP-UPPER		381.0	1174.5	187.0	200.0	.53+09	.13+08	.15+08	.35+06	.18+06	.18+06	
3	1	3	ENT CAP-LOWER		259.0	1173.0	186.5	200.0	.36+09	.90+07	.10+08	.34+06	.17+06	.17+06	
3	1	4	D6AC HOUSING		1407.0	1182.0	184.0	200.0	.20+10	.48+08	.56+08	.18+07	.92+06	.92+06	
3	1		THROAT ASSY	*** TOTAL *	2453.0	1180.6	184.6	200.0	.34+10	.84+08	.98+08	.27+07	.15+07	.15+07	
3	2		SHELL ASSY												
3	2	1	BOSS		1164.0	1162.5	200.0	200.0	.16+10	.47+08	.47+08	.53+07	.27+07	.27+07	
3	2	2	SHELL		915.0	1169.0	187.5	200.0	.13+10	.32+08	.37+08	.27+07	.14+07	.14+07	
3	2		SHELL ASSY	*** TOTAL *	2079.0	1165.4	194.5	200.0	.28+10	.79+08	.83+08	.81+07	.40+07	.41+07	
3	3		INT INSULATION												
3	3	1	SHELL ASSY		1623.0	1170.1	187.0	200.0	.22+10	.57+08	.65+08	.47+07	.24+07	.24+07	
3	3	2	NOZZLE ASSY		95.0	1180.6	184.5	200.0	.13+09	.32+07	.38+07	.13+06	.65+05	.65+05	
3	3		INT INSULATION	*** TOTAL *	1718.0	1170.7	186.9	200.0	.24+10	.60+08	.69+08	.48+07	.25+07	.25+07	
3	4		EXIT CONE												
3	4	1	BOSS-FWD		224.0	1193.5	181.0	200.0	.32+09	.73+07	.90+07	.20+06	.10+06	.10+06	
3	4	2	BOSS-AFT		320.0	1257.0	164.0	200.0	.51+09	.86+07	.13+08	.77+06	.38+06	.38+06	
3	4	3	EXIT CONE		1900.0	1226.0	172.5	200.0	.29+10	.57+08	.76+08	.29+07	.21+07	.21+07	
3	4		EXIT CONE	*** TOTAL *	2444.0	1227.1	172.2	200.0	.37+10	.72+08	.98+08	.39+07	.32+07	.32+07	
3	5		EXIT CONE EXT												
3	5	1	EXIT CONE		1555.0	1303.9	152.2	200.0	.26+10	.36+08	.62+08	.63+07	.43+07	.43+07	
3	5	2	ATTACH BOSS		320.0	1257.5	164.0	200.0	.51+09	.86+07	.13+08	.77+06	.38+06	.38+06	
3	5		EXIT CONE EXT	*** TOTAL *	1875.0	1296.0	154.2	200.0	.31+10	.45+08	.75+08	.71+07	.53+07	.53+07	
3	6		MISCELLANEOUS												
3	6	1	CASE/NOZ BOLTS		260.0	1161.0	200.0	200.0	.35+09	.10+08	.10+08	.12+07	.60+06	.60+06	
3	6	2	OTHER HWWARE		26.0	1172.6	164.0	200.0	.36+08	.70+06	.10+07	.63+05	.32+05	.32+05	
3	6	3	ADHESIVE		5.0	1180.6	184.5	200.0	.70+07	.17+06	.20+06	.15+05	.74+04	.74+04	
3	6		MISCELLANEOUS	*** TOTAL *	291.0	1162.4	196.5	200.0	.38+09	.11+08	.12+08	.13+07	.65+06	.68+06	
3			NOZZLE-FXD CNTD	*** TOTAL *	10860.0	1206.0	179.1	200.0	.16+11	.35+09	.43+09	.30+08	.41+08	.43+08	
5			IGNITION SYSTEM												
5	1		PRIMARY IGNITER		31.0	171.0	200.0	200.0	.91+06	.12+07	.12+07	.12+03	.58+03	.58+03	
5	2		SECONDARY IGN												
5	2	1	CHAMBER ASSY		172.6	186.1	200.0	200.0	.60+07	.69+07	.69+07	.12+05	.38+05	.38+05	
5	2	2	EXT INSULATION		57.8	191.6	200.0	200.0	.21+07	.23+07	.23+07	.43+04	.12+05	.12+05	
5	2	3	INT INSULATION		17.6	189.4	200.0	200.0	.63+06	.70+06	.70+06	.12+04	.34+04	.34+04	
5	2	5	PROPELLANT		153.0	189.0	200.0	200.0	.55+07	.61+07	.61+07	.71+04	.19+05	.19+05	
5	2		SECONDARY IGN	*** TOTAL *	401.0	188.1	200.0	200.0	.14+08	.16+08	.16+08	.24+05	.74+05	.74+05	
5	3		ATTACH HARDWARE		9.0	182.3	200.0	200.0	.30+06	.36+06	.36+06	.11+04	.53+03	.53+03	
5			IGNITION SYSTEM	*** TOTAL *	441.0	186.8	200.0	200.0	.15+08	.18+08	.19+08	.26+05	.84+05	.84+05	

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156-in.-dia SRM 15° Fixed Nozzle without Thrust Neutralization

DETAILED WEIGHT STATEMENT

MA	A	SUB	P	PART NAME	PART NO.	WEIGHT LB.	CENTER OF GRAVITY INCHES			MOMENT WXX	OF LB-INCHES SQUARED			INERTIA		
							X	Y	Z		WYY	WZZ	IO X	IO Y	IO Z	
7				NOSE CONE ASSY												
7	1			NOSE CONE-FWD												
7	1	1		NOSE CONE		247.0	80.4	200.0	200.0	.16+07	.99+07	.99+07	.33+06	.29+06	.29+06	
7	1	2		BULKHEAD		400.0	110.0	200.0	200.0	.48+07	.16+08	.16+08	.68+06	.34+06	.34+06	
7	1	3		INTERMED STRUCT		750.0	162.9	200.0	200.0	.20+08	.30+08	.30+08	.31+07	.20+07	.20+07	
7	1			NOSE CONE-FWD	*** TOTAL *	1397.0	133.2	200.0	200.0	.26+08	.56+08	.56+08	.41+07	.42+07	.42+07	
7	2			THRUST RING												
7	2	1		BOX		1527.0	197.7	202.3	200.0	.60+08	.62+08	.61+08	.80+07	.44+07	.44+07	
7	2	2		SKIN		1503.0	215.2	200.0	200.0	.70+08	.60+08	.60+08	.91+07	.47+07	.47+07	
7	2			THRUST RING	*** TOTAL *	3030.0	206.4	201.2	200.0	.13+09	.12+09	.12+09	.18+08	.93+07	.93+07	
7	3			FWD ATTACH FTG												
7	3	1		THRUST FITTING		903.0	152.7	256.0	200.0	.21+08	.59+08	.36+08	.82+06	.61+06	.13+07	
7	3	2		SEP PLANE		150.0	113.7	269.0	200.0	.19+07	.11+08	.60+07	.22+06	.14+05	.21+06	
7	3			FWD ATTACH FTG	*** TOTAL *	1053.0	147.1	257.9	200.0	.23+08	.70+08	.42+08	.11+07	.82+06	.17+07	
7				NOSE CONE ASSY	*** TOTAL *	5480.0	176.3	211.8	200.0	.18+09	.25+09	.22+09	.26+08	.21+08	.24+08	
8				AFT SKIRT SUPPRT												
8	1			FWD SECTION												
8	1	1		SKIN		1101.0	1154.9	200.0	200.0	.15+10	.44+08	.44+08	.67+07	.34+07	.34+07	
8	1	2		FWD FLANGE		354.0	1142.0	200.0	200.0	.46+09	.14+08	.14+08	.21+07	.11+07	.11+07	
8	1	3		AFT FLANGE		121.0	1166.8	200.0	200.0	.16+09	.48+07	.48+07	.73+06	.36+06	.36+06	
8	1	4		FWD ATTCH HDW		111.0	1140.9	200.0	200.0	.14+09	.44+07	.44+07	.67+06	.34+06	.34+06	
8	1	5		AFT ATTCH HDW		111.0	1166.1	200.0	200.0	.15+09	.44+07	.44+07	.67+06	.34+06	.34+06	
8	1			FWD SECTION	*** TOTAL *	1798.0	1153.0	200.0	200.0	.24+10	.72+08	.72+08	.11+08	.56+07	.56+07	
8	2			AFT SECTION												
8	2	1		FWD BOX SECTION		2228.0	1167.6	200.0	200.0	.30+10	.89+08	.89+08	.12+08	.61+07	.61+07	
8	2	2		AFT BOX SECTION		2177.0	1235.6	200.0	200.0	.33+10	.87+08	.87+08	.16+08	.82+07	.82+07	
8	2	3		SUPPORT STRUTS		701.0	1202.0	200.0	200.0	.10+10	.28+08	.28+08	.45+07	.25+07	.25+07	
8	2	4		FOOT PADS		654.0	1241.0	200.0	200.0	.10+10	.26+08	.26+08	.49+07	.25+07	.25+07	
8	2	5		SKIN		328.0	1201.6	200.0	200.0	.47+09	.13+08	.13+08	.24+07	.13+07	.13+07	
8	2			AFT SECTION	*** TOTAL *	6088.0	1205.6	200.0	200.0	.89+10	.24+09	.24+09	.40+08	.27+08	.27+08	
8				AFT SKIRT SUPPRT	*** TOTAL *	7886.0	1193.6	200.0	200.0	.11+11	.32+09	.32+09	.51+08	.36+08	.36+08	
9				DESTRUCT SYSTEM												
9	1			COMMAND SECTION		20.0	220.0	124.0	200.0	.97+06	.31+06	.80+06	.48+03	.48+03	.48+03	
9	2			DESTRUCT ASSY		220.0	685.1	122.0	200.0	.10+09	.33+07	.88+07	.26+04	.15+08	.15+08	
9				DESTRUCT SYSTEM	*** TOTAL *	240.0	646.3	122.2	200.0	.10+09	.36+07	.96+07	.32+04	.19+08	.19+08	
10				INSTRUMENTATION		60.0	140.0	200.0	200.0	.12+07	.24+07	.24+07	.58+04	.58+04	.58+04	

156-in.-dia SRM 15° Fixed Nozzle without Thrust Neutralization

DETAILED WEIGHT STATEMENT

MA A SUB P				PART NAME	PART NO.	WEIGHT LB.	CENTER OF GRAVITY INCHES			MOMENT	OF LB-INCHES SQUARED			INERTIA		
							X	Y	Z	WXX	WYY	WZZ	IO X	IO Y	IO Z	
11	AFT ATTCH STRUCT															
11	1	DIAGONAL SEG														
11	1	1	+Z STRUT			159.0	1197.6	290.0	311.0	.23+09	.13+08	.15+08	.11+06	.86+05	.11+06	
11	1	2	-Z STRUT			159.0	1197.6	290.0	89.0	.23+09	.13+08	.13+07	.11+06	.86+05	.11+06	
11	1	3	+Z FITTING			65.0	1231.0	250.0	281.0	.98+08	.41+07	.51+07	.13+04	.92+03	.92+03	
11	1	4	-Z FITTING			65.0	1231.0	250.0	119.0	.98+08	.41+07	.92+06	.13+04	.92+03	.92+03	
11	1	DIAGONAL SEG			*** TOTAL *	448.0	1207.3	278.4	200.0	.65+09	.35+08	.23+08	.51+07	.50+07	.48+06	
11	2	HORIZONTAL SEG														
11	2	1	+Z STRUT			274.0	1167.6	274.0	312.0	.37+09	.21+08	.27+08	.51+06	.86+05	.42+06	
11	2	2	-Z STRUT			274.0	1167.6	274.0	89.0	.37+09	.21+08	.21+07	.51+06	.86+05	.42+06	
11	2	3	+Z FITTING			92.0	1167.6	220.0	281.0	.13+09	.45+07	.73+07	.21+04	.87+03	.22+04	
11	2	4	-Z FITTING			92.0	1167.6	220.0	119.0	.13+09	.45+07	.13+07	.21+04	.87+03	.22+04	
11	2	HORIZONTAL SEG			*** TOTAL *	732.0	1167.6	260.4	200.0	.10+10	.50+08	.37+08	.95+07	.83+07	.13+07	
11	3	CORE FITTINGS														
11	3	1	+Z FITTING			119.0	1171.0	332.0	345.0	.16+09	.13+08	.14+08	.69+04	.67+04	.11+05	
11	3	2	-Z FITTING			119.0	1171.0	332.0	55.0	.16+09	.13+08	.36+06	.69+04	.67+04	.11+05	
11	3	CORE FITTINGS			*** TOTAL *	238.0	1171.0	332.0	200.0	.33+09	.26+08	.15+08	.50+07	.50+07	.22+05	
11	AFT ATTCH STRUCT					*** TOTAL *	1418.0	1180.7	278.1	200.0	.20+10	.11+09	.75+08	.21+08	.19+08	.31+07
12	MISC SUPT STRUCT					500.0	276.5	200.0	200.0	.38+08	.20+08	.20+08	.21+07	.13+07	.13+07	

156-in.-dia SRM 15° Fixed Nozzle without Thrust Neutralization

DETAILED WEIGHT STATEMENT

MA A SUB P	PART NAME	PART NO.	WEIGHT LB.	CENTER OF GRAVITY INCHES			MOMENT WXX	OF LB-INCHES SQUARED			INERTIA		
				X	Y	Z		WYY	WZZ		IO X	IO Y	IO Z
20	PROPELLANT												
20 1	FWD HEAD SEG												
20 1 1	HEAD SECTION		50500.0	219.8	200.0	200.0	.24+10	.20+10	.20+10	.11+09	.74+08	.74+08	
20 1 2	CYL SECTION		75000.0	292.6	200.0	200.0	.81+10	.38+10	.38+10	.29+09	.21+09	.21+09	
20 1	FWD HEAD SEG	*** TOTAL *	145500.0	267.3	200.0	200.0	.11+11	.58+10	.58+10	.40+09	.46+09	.46+09	
20 2	FWD CYL SEG		337450.0	498.8	200.0	200.0	.84+11	.13+11	.13+11	.11+10	.34+10	.34+10	
20 3	AFT CYL SEG		337450.0	818.8	200.0	200.0	.23+12	.13+11	.13+11	.11+10	.34+10	.34+10	
20 4	AFT HEAD SEG												
20 4 1	FWD SECTION		122781.0	1039.3	200.0	200.0	.13+12	.49+10	.49+10	.41+09	.34+09	.34+09	
20 4 2	INTERMED SECT		26195.0	1109.4	200.0	200.0	.32+11	.10+10	.10+10	.96+08	.50+08	.50+08	
20 4 3	AFT SECTION		30624.0	1144.9	200.0	200.0	.40+11	.12+10	.12+10	.11+09	.60+08	.60+08	
20 4	AFT HEAD SEG	*** TOTAL *	179600.0	1067.5	200.0	200.0	.21+12	.72+10	.72+10	.62+09	.78+09	.78+09	
20	PROPELLANT	*** TOTAL *	1000000.0	675.2	200.0	200.0	.53+12	.40+11	.40+11	.33+10	.77+11	.77+11	

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156-in.-dia SRM 15° Fixed Nozzle without Thrust Neutralization

SUMMARY WEIGHT STATEMENT

MA		WEIGHT LB.	CENTER OF GRAVITY INCHES		
			X	Y	Z
1	CHAMBER ASSY	69030.0	677.8	200.0	200.0
2	INSULATION-INT	14620.0	597.6	200.0	200.0
3	NOZZLE-FXD CNTD	10860.0	1206.0	179.1	200.0
5	IGNITION SYSTEM	441.0	186.8	200.0	200.0
7	NOSE CONE ASSY	5400.0	176.3	211.8	200.0
8	AFT SKIRT SUPPRT	7806.0	1193.6	200.0	200.0
9	DESTRUCT SYSTEM	240.0	646.3	122.2	200.0
10	INSTRUMENTATION	60.0	140.0	200.0	200.0
11	AFT ATTCH STRUCT	1418.0	1180.7	278.1	200.0
12	MISC SUPT STRUCT	500.0	276.5	200.0	200.0
	BASIC MOTOR INERTS	110535.0	733.4	199.4	200.0
	BASIC MOTOR PROPELLANTS	1000000.0	675.2	200.0	200.0
	BASIC MOTOR	1110535.0	681.0	199.9	200.0

THE INERTIA OF THE MOTOR INERTS ABOUT ITS CENTER OF GRAVITY IS

IX = 135351.12 SLUG-FT. SQUARED

IY = 3147593.34 SLUG-FT. SQUARED

IZ = 3148048.56 SLUG-FT. SQUARED

THE INERTIA OF THE BASIC MOTOR ABOUT ITS CENTER OF GRAVITY IS

IX = 841840.40 SLUG-FT. SQUARED

IY = 19898306.25 SLUG-FT. SQUARED

IZ = 19899653.00 SLUG-FT. SQUARED

156-in.-dia SRM 15° Fixed Nozzle with Thrust Neutralization

SUMMARY WEIGHT STATEMENT

MA		WEIGHT	CENTER OF GRAVITY		
		LB.	INCHES		
			X	Y	Z
1	CHAMBER ASSY	69030.0	677.6	200.0	200.0
2	INSULATION-INT	14620.0	597.6	200.0	200.0
3	NOZZLE-FXD CNTD	10860.0	1206.0	179.1	200.0
5	IGNITION SYSTEM	441.0	186.0	200.0	200.0
6	THRUST TERM SYS	2200.0	170.8	200.0	200.0
7	NOSE CONE ASSY	5480.0	176.3	211.8	200.0
8	AFT SKIRT SUPPRT	7800.0	1193.6	200.0	200.0
9	DESTRUCT SYSTEM	240.0	646.3	122.2	200.0
10	INSTRUMENTATION	60.0	140.0	200.0	200.0
11	AFT ATTCH STRUCT	1418.0	1180.7	278.1	200.0
12	MISC SUPT STRUCT	500.0	276.5	200.0	200.0
	BASIC MOTOR INERTS	112735.0	722.4	192.4	200.0
	BASIC MOTOR PROPELLANTS	1000000.0	675.2	200.0	200.0
	BASIC MOTOR	1112735.0	680.0	199.9	200.0

THE INERTIA OF THE MOTOR INERTS ABOUT ITS CENTER OF GRAVITY IS

IX = 137285.87 SLUG-FT. SQUARED

IY = 3295718.69 SLUG-FT. SQUARED

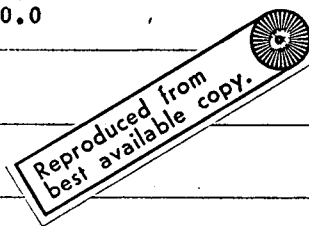
IZ = 3297553.37 SLUG-FT. SQUARED

THE INERTIA OF THE BASIC MOTOR ABOUT ITS CENTER OF GRAVITY IS

IX = 843775.34 SLUG-FT. SQUARED

IY = 20012559.50 SLUG-FT. SQUARED

IZ = 20014402.00 SLUG-FT. SQUARED



156-in.-dia SRM 5° Movable Nozzle without Thrust Neutralization

SUMMARY WEIGHT STATEMENT

MA		WEIGHT LB.	CENTER OF GRAVITY INCHES		
			X	Y	Z
1	CHAMBER ASSY	69600.0	682.3	200.0	200.0
2	INSULATION-INT	15726.0	637.5	200.0	200.0
3	NOZZLE, 5 DEGREE	12377.0	1184.5	200.0	200.0
4	NOZZLE ACT SYS	600.0	1192.0	233.0	167.0
5	IGNITION SYSTEM	441.0	186.8	200.0	200.0
7	NOSE CONE ASSY	5480.0	176.3	211.8	200.0
8	AFT SKIRT SUPPRT	7886.0	1193.6	200.0	200.0
9	DESTRUCT SYSTEM	240.0	646.3	122.2	200.0
10	INSTRUMENTATION	300.0	948.0	252.0	148.0
11	AFT ATTCH STRUCT	1418.0	1180.7	270.1	200.0
12	MISC SUPT STRUCT	500.0	276.5	200.0	200.0
	BASIC MOTOR INERTS	114568.0	747.2	201.7	199.7
	BASIC MOTOR PROPELLANTS	1000000.0	675.2	200.0	200.0
	BASIC MOTOR	1114568.0	682.6	200.2	200.0

THE INERTIA OF THE MOTOR INERTS ABOUT ITS CENTER OF GRAVITY IS

IX = 134487.81 SLUG-FT. SQUARED
 IY = 3272209.53 SLUG-FT. SQUARED
 IZ = 3271905.47 SLUG-FT. SQUARED

THE INERTIA OF THE BASIC MOTOR ABOUT ITS CENTER OF GRAVITY IS

IX = 841033.26 SLUG-FT. SQUARED
 IY = 20055236.75 SLUG-FT. SQUARED
 IZ = 20054992.75 SLUG-FT. SQUARED

156-in.-dia SRM 5° Movable Nozzle with Thrust Neutralization

SUMMARY WEIGHT STATEMENT

MA		WEIGHT LB.	CENTER OF GRAVITY INCHES		
			X	Y	Z
1	CHAMBER ASSY	69600.0	682.3	200.0	200.0
2	INSULATION-INT	15726.0	637.5	200.0	200.0
3	NOZZLE, 5 DEGREE	12377.0	1184.5	200.0	200.0
4	NOZZLE ACT SYS	600.0	1192.0	233.0	167.0
5	IGNITION SYSTEM	441.0	186.8	200.0	200.0
6	THRUST TERM SYS	2200.0	170.8	200.0	200.0
7	NOSE CONE ASSY	5480.0	176.3	211.0	200.0
8	AFT SKIRT SUPPRT	7886.0	1193.6	200.0	200.0
9	DESTRUCT SYSTEM	240.0	646.3	122.2	200.0
10	INSTRUMENTATION	300.0	948.0	252.0	148.0
11	AFT ATTCH STRUCT	1418.0	1180.7	278.1	200.0
12	MISC SUPT STRUCT	500.0	276.5	200.0	200.0
	BASIC MOTOR INERTS	116768.0	736.3	201.6	199.7
	BASIC MOTOR PROPELLANTS	1000000.0	675.2	200.0	200.0
	BASIC MOTOR	1116768.0	681.6	200.2	200.0

THE INERTIA OF THE MOTOR INERTS ABOUT ITS CENTER OF GRAVITY IS

IX = 136423.79 SLUG-FT. SQUARED

IY = 3427767.22 SLUG-FT. SQUARED

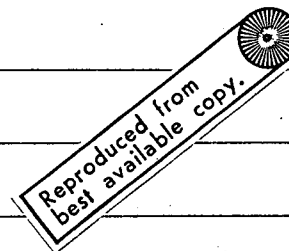
IZ = 3428043.94 SLUG-FT. SQUARED

THE INERTIA OF THE BASIC MOTOR ABOUT ITS CENTER OF GRAVITY IS

IX = 842967.53 SLUG-FT. SQUARED

IY = 20190194.25 SLUG-FT. SQUARED

IZ = 20190530.00 SLUG-FT. SQUARED



156-in.-dia SRM 10° Movable Nozzle without Thrust Neutralization

SUMMARY WEIGHT STATEMENT

MA		WEIGHT LB.	CENTER OF GRAVITY INCHES		
			X	Y	Z
1	CHAMBER ASSY	69600.0	682.3	200.0	200.0
2	INSULATION-INT	15726.0	637.5	200.0	200.0
3	NOZZLE, 10 DEG	14130.0	1173.5	200.0	200.0
4	NOZZLE ACT. SYS	3000.0	1184.5	233.0	167.0
5	IGNITION SYSTEM	441.0	186.8	200.0	200.0
7	NOSE CONE ASSY	5480.0	176.3	211.8	200.0
8	AFT SKIRT SUPPRT	7886.0	1193.6	200.0	200.0
9	DESTRUCT SYSTEM	240.0	646.3	122.2	200.0
10	INSTRUMENTATION	300.0	948.0	252.0	148.0
11	AFT ATTCH STRUCT	1418.0	1180.7	278.1	200.0
12	MISC SUPT STRUCT	500.0	276.5	200.0	200.0
	BASIC MOTOR INERTS	118721.0	761.1	202.3	199.0
	BASIC MOTOR PROPELLANTS	100900.0	675.2	200.0	200.0
	BASIC MOTOR	1119721.0	684.4	200.2	199.9

THE INERTIA OF THE MOTOR INERTS ABOUT ITS CENTER OF GRAVITY IS

IX = 137140.56 SLUG-FT. SQUARED
 IY = 3410541.41 SLUG-FT. SQUARED
 IZ = 3410194.47 SLUG-FT. SQUARED

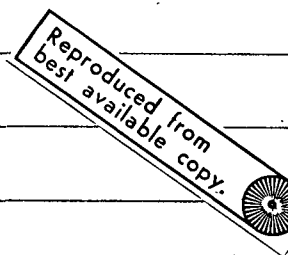
THE INERTIA OF THE BASIC MOTOR ABOUT ITS CENTER OF GRAVITY IS

IX = 843762.30 SLUG-FT. SQUARED
 IY = 20247700.00 SLUG-FT. SQUARED
 IZ = 20247452.75 SLUG-FT. SQUARED

156-in.-dia SRM 10° Movable Nozzle with Thrust Neutralization

SUMMARY WEIGHT STATEMENT

MA		WEIGHT LB.	CENTER OF GRAVITY INCHES		
			X	Y	Z
1	CHAMBER ASSY	69600.0	682.3	200.0	200.0
2	INSULATION-INT	15726.0	637.5	200.0	200.0
3	NOZZLE, 10 DEG	14130.0	1173.5	200.0	200.0
4	NOZZLE ACT SYS	3000.0	1184.5	233.0	167.0
5	IGNITION SYSTEM	441.0	186.8	200.0	200.0
6	THRUST TERM SYS	2200.0	170.8	200.0	200.0
7	NOSE CONE ASSY	5480.0	176.3	211.8	200.0
8	AFT SKIRT SUPPRT	7886.0	1193.6	200.0	200.0
9	DESTRUCT SYSTEM	240.0	646.3	122.2	200.0
10	INSTRUMENTATION	300.0	948.0	252.0	148.0
11	AFT ATTCH STRUCT	1418.0	1180.7	270.1	200.0
12	MISC SUPT STRUCT	500.0	276.5	200.0	200.0
	BASIC MOTOR INERTS	120921.0	750.4	202.2	199.1
	BASIC MOTOR PROPELLANTS	100000.0	675.2	200.0	200.0
	BASIC MOTOR	1120921.0	683.4	200.2	199.9

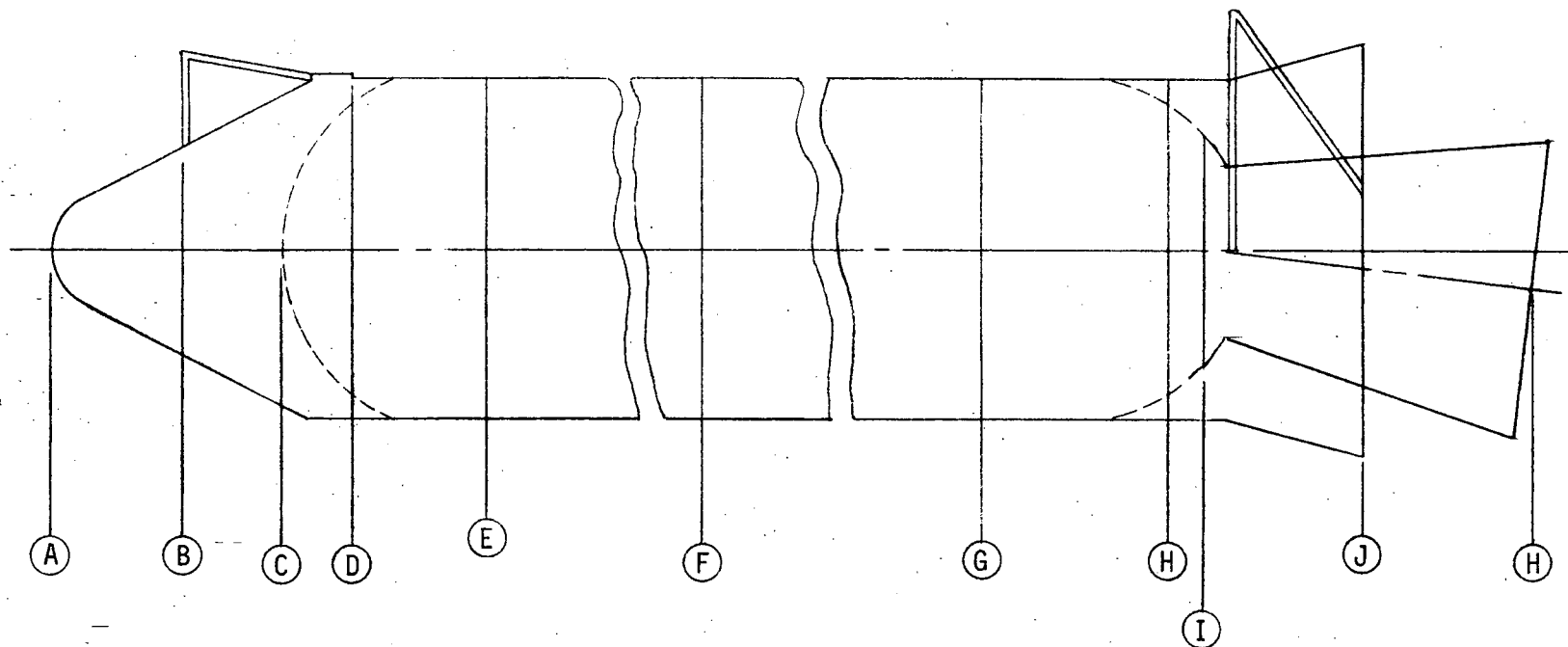


THE INERTIA OF THE MOTOR INERTS ABOUT ITS CENTER OF GRAVITY IS

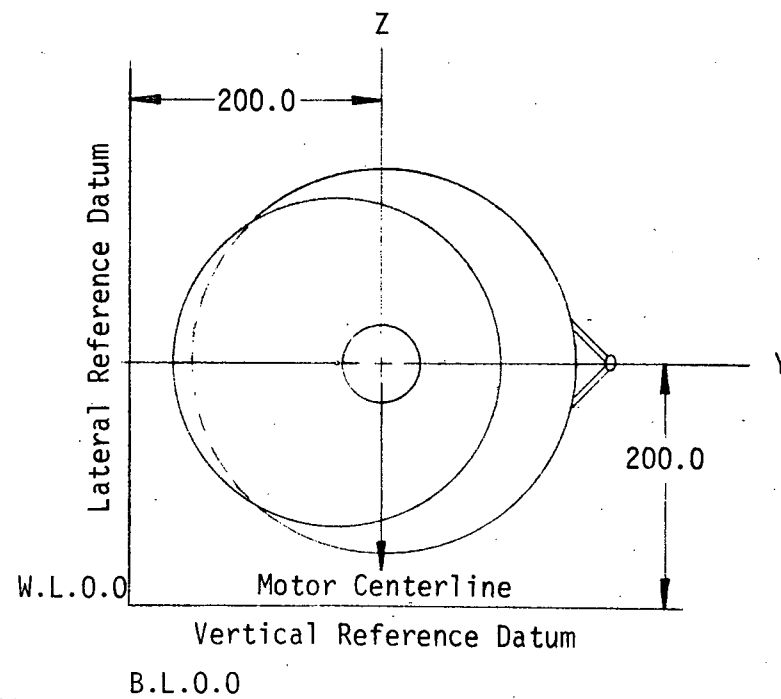
IX = 139070.03 SLUG-FT. SQUARED
 IY = 3573703.41 SLUG-FT. SQUARED
 IZ = 3574018.12 SLUG-FT. SQUARED

THE INERTIA OF THE BASIC MOTOR ABOUT ITS CENTER OF GRAVITY IS

IX = 845696.80 SLUG-FT. SQUARED
 IY = 20373489.75 SLUG-FT. SQUARED
 IZ = 20373820.00 SLUG-FT. SQUARED



Letter Definition	Booster Station, in.
A	31.00
B	113.66
C	170.00
D	230.66
E	341.00
F	661.00
G	981.00
H	1139.62
I	1161.00
J	1236.62
K	1350.14



Component Reference Diagram